ENDEAVOUR MINING LIMITED CORPORATION

ITY CIL PROJECT OPTIMISATION STUDY

Lycopodium

1955-000-GEREP-0003

September 2017

File Location: 24.02
Rev: E

REV NO.	DATE	DESCRIPTION OF REVISION	BY	DESIGN APPROVED	PROJECT APPROVED
E	4/09/17	ISSUED AS FINAL	SW	SW	RC
D	01.09.17	ISSUED FOR CLIENT REVIEW	SW	SW	RC
C	25.08.17	ISSUED FOR CLIENT REVIEW	SW	SW	pp DG
B	07.08.17	ISSUED FOR CLIENT REVIEW	SW	SW	RC
A	21.07.17	ISSUED FOR REVIEW	AR	DG	

ITY CIL PROJECT

OPTIMISATION STUDY

1955-000-GEREP-0003

Table of Contents

Page

1.0 SUMMARY AND INTRODUCTION 1.1
- 1.1 Executive Summary 1.1
  - 1.1.1 Resource 1.1
  - 1.1.2 Mining 1.2
  - 1.1.3 Metallurgy 1.4
  - 1.1.4 Process Plant 1.5
  - 1.1.5 Infrastructure 1.7
  - 1.1.6 Operating Cost Estimate 1.8
  - 1.1.7 Capital Cost Estimate 1.9
  - 1.1.8 Financial Evaluation 1.9
- 1.2 Introduction 1.10
- 1.3 Current Scope 1.11
- 1.4 Project Background 1.11
- 1.5 Project Location 1.12

2.0 RESOURCE UPDATE SUMMARY 2.1
- 2.1 Geology and Resources 2.1
  - 2.1.1 Regional and Local Geology and Mineralisation 2.1
  - 2.1.2 Informing Data 2.3
  - 2.1.3 Resource Estimation 2.4
  - 2.1.4 Mineral Resource Classification and Reporting 2.6
  - 2.1.5 Comparison with Previous Mineral Resource 2.7

3.0 MINING 3.1
- 3.1 Executive Summary 3.1
- 3.2 Input Parameters 3.2
  - 3.2.1 Gold Price and Royalties 3.2
  - 3.2.2 Resource Model 3.2
  - 3.2.3 Mining Costs 3.3
  - 3.2.4 Processing Costs, Metallurgical Recoveries and Cut-off Grades 3.4
  - 3.2.5 Cut-off Grade Calculation 3.5
  - 3.2.6 Discounting Parameters 3.5
  - 3.2.7 Slope Angles 3.5
- 3.3 Pit Optimisation Results 3.7
  - 3.3.1 Bakatouo Optimisation 3.7
  - 3.3.2 Daapleu Optimisation 3.10
  - 3.3.3 Ity Optimisation 3.13
- 3.4 Pit Designs 3.16
  - 3.4.1 Bakatouo Design 3.16
  - 3.4.2 Daapleu Design 3.18
  - 3.4.3 Ity Design 3.21
  - 3.4.4 Gbeitouo Design 3.23
  - 3.4.5 Walter Design 3.25
  - 3.4.6 ZiaNE Design 3.27
- 3.5 Open Pit Mineral Reserve Estimate 3.30
- 3.6 Life of Mine Schedule 3.32
  - 3.6.1 Tax Concession 3.32

Table of Contents

			Page
	3.6.2	Stockpiling	3.32
	3.6.3	Schedule Setup	3.34
3.7	Schedule Results		3.35
	3.7.1	Scenario 4	3.35
	3.7.2	Scenario 5	3.38
	3.7.3	Scenario 6	3.40
	3.7.4	Scenario 7	3.42
	3.7.5	Scenario 7-1250 Opex 200717	3.44
4.0	**MINING COSTS**		**4.1**
4.1	Introduction		4.1
4.2	Scope, Basis and Exclusions		4.1
	4.2.1	Calsta Scope	4.1
4.3	Calsta Exclusions and Battery Limits		4.2
4.4	Mine Fleet Selection and Optimisation		4.2
	4.4.1	Mine Fleet Selection Criteria	4.2
4.5	Mining Equipment Selection and Pricing		4.3
4.6	Available Time Assumption		4.4
4.7	Mine Equipment Productivity Assumptions		4.4
	4.7.1	Hydraulic Excavator – Ore Loading	4.4
	4.7.2	Off Highway Truck Productivity	4.5
4.8	Mining Equipment Operating Quantities		4.6
4.9	Owner Cost Modelling		4.7
	4.9.1	Personnel and Manning	4.7
	4.9.2	Mining Management and Technical Services (Indirect) Labour	4.8
	4.9.3	Summary of Mining Personnel by Category	4.8
4.10	Fuel		4.9
4.11	Blasting		4.9
	4.11.2	Mine Preparation and Rehabilitation Works	4.10
4.12	Grade Control		4.11
	4.12.1	Mine Operating Overheads	4.11
4.13	Mine Operating Cost Basis Summary		4.12
4.14	Mining Operating Costs		4.13
	4.14.1	Mining Operating Cost Summary	4.13
	4.14.2	Mining Operating Cost Summary by Year	4.14
	4.14.3	Mining Operating Costs by Pit and Rehandle	4.14
	4.14.4	Mining Operating Cost Unit Rates	4.15
4.15	Mining Capital Costs		4.15
	4.15.1	Mining Capital Summary	4.15
	4.15.2	Mining Preproduction Capital Summary by WBS	4.15
5.0	**METALLURGY**		**5.1**
5.1	Metallurgical Testwork Overview		5.1
5.2	Bakatouo Testwork		5.1
	5.2.1	Main Conclusions	5.1
	5.2.2	Sample Selection	5.3
	5.2.3	Comminution Testwork	5.3
	5.2.4	Metallurgical Variability Testwork	5.4

Table of Contents

			Page
	5.2.5	Master Composite Testwork	5.5
	5.2.6	Physical Characterisation Testwork	5.6
	5.2.7	Conclusions	5.6
5.3	Daapleu Refractory Testwork		5.8
	5.3.1	Overview	5.8
	5.3.2	Sample Selection	5.8
	5.3.3	Testwork Programme	5.8
	5.3.4	Key Results	5.9
	5.3.5	Conclusions	5.10
	5.3.6	Detailed Report	5.11
6.0	**PROCESS**		**6.1**
6.1	Process Design		6.1
	6.1.1	Process Development	6.1
	6.1.2	Design Basis	6.1
	6.1.3	Selected Process Flowsheet	6.2
	6.1.4	Changes from 2016 Study	6.3
	6.1.5	Key Process Design Criteria	6.8
6.2	Process and Plant Description		6.9
	6.2.1	Run-of-Mine (ROM) Pad	6.9
	6.2.2	Crushing Circuit	6.9
	6.2.3	Ore Storage and Reclaim	6.9
	6.2.4	Grinding and Classification Circuit	6.10
	6.2.5	Classification and Trash Screening	6.11
	6.2.6	Gravity	6.12
	6.2.7	Mill Area	6.12
	6.2.8	Trash Screening and Pre-leach Thickening	6.12
	6.2.9	Leach and Carbon Adsorption Circuit	6.13
	6.2.10	Stripping Plant and Goldroom Operations	6.13
	6.2.11	Tailings Treatment	6.15
	6.2.12	Tails Disposal	6.16
	6.2.13	Decant Return	6.16
	6.2.14	Reagents	6.16
	6.2.15	Services	6.19
7.0	**ENGINEERING**		**7.1**
7.1	Changes to Design		7.1
	7.1.1	Changes to Mechanical Equipment List	7.1
	7.1.2	Plant Location	7.2
7.2	Revised Plant Design		7.2
	7.2.1	General	7.2
	7.2.2	Primary Crushing	7.3
	7.2.3	Ore Transfer and Stockpile	7.3
	7.2.4	Grinding, Classification and Gravity Circuits	7.3
	7.2.5	Pebble Crushing	7.4
	7.2.6	Gravity Recovery	7.4
	7.2.7	Trash Screening and Pre-leach Thickening	7.5
	7.2.8	Leach and Carbon Adsorption Circuit	7.5
	7.2.9	Elution, Carbon Regeneration and Goldroom	7.6

Table of Contents

			Page
	7.2.10	Tailings Disposal	7.6
	7.2.11	Reagents	7.7
	7.2.12	Air, Oxygen and Water Services	7.8
	7.2.13	Large Volume Spillage Containment	7.9
7.3	Electrical Design		7.10
	7.3.1	Installed Load and Maximum Demand	7.10
	7.3.2	Grid Power Supply	7.10
	7.3.3	11 kV Switchboards	7.10
	7.3.4	Electronic Variable Speed Drives and Soft Starters	7.10
	7.3.5	415 V Motor Control Centre	7.10
	7.3.6	Earth Fault Protection	7.11
	7.3.7	Fire Protection	7.11
	7.3.8	Cable Ladders	7.11
	7.3.9	Cables	7.11
	7.3.10	Lighting	7.12
	7.3.11	Earthing System and Lightning Protection	7.12
7.4	Control System		7.12
	7.4.1	General Overview	7.12
	7.4.2	Drive Controls	7.14
	7.4.3	Valve Control	7.14
	7.4.4	Vendor Packages	7.15
	7.4.5	Operator Interface	7.16
	7.4.6	Emergency Stop Buttons (E Stops) / Safety Devices	7.17
	7.4.7	Cyanide Industry Standards	7.17
	7.4.8	Control System Communications	7.18
	7.4.9	Control System Access	7.18
	7.4.10	Generic Control Description	7.18
	7.4.11	SAG Mill Start-up and Monitoring	7.19
	7.4.12	SAG Mill Process Control	7.19
	7.4.13	Ball Mill Start-up and Monitoring	7.20
	7.4.14	Ball Mill Process Control	7.20
	7.4.15	Mass Flow Rate	7.20
	7.4.16	Density Control	7.21
	7.4.17	Level Control	7.21
	7.4.18	Flow Control	7.21
	7.4.19	Thickener Control	7.21
	7.4.20	Pebble Crusher Control	7.21
7.5	Metallurgical Accounting		7.22
7.6	Infrastructure		7.23
	7.6.1	Changes to Infrastructure	7.23
	7.6.2	Roads	7.23
	7.6.3	Airstrip	7.24
	7.6.4	Power Supply and Distribution	7.25
	7.6.5	Potable Water	7.27
	7.6.6	Sewage	7.27
	7.6.7	Tailing Pipelines	7.27
	7.6.8	Diesel Pipelines	7.28
	7.6.9	Solid and Hydrocarbon Wastes	7.28
	7.6.10	Communication System Infrastructure	7.28

Table of Contents

				Page
		7.6.11	Fuel Supply	7.28
		7.6.12	Explosive Storage and Handling	7.28
		7.6.13	Security and Fencing	7.29
		7.6.14	Site Buildings	7.29
	7.7		Workforce Accommodation	7.30
		7.7.1	Permanent Accommodation Camp	7.30
		7.7.2	Temporary Construction Accommodation	7.31
8.0	**INFRASTRUCTURE**			**8.1**
	8.1		Introduction	8.1
	8.2		Tailings Storage Facility	8.3
	8.3		Surface Water Management Structures	8.6
	8.4		Site Airstrip	8.6
	8.5		Pit Dewatering System	8.7
9.0	**OPERATING COST ESTIMATE**			**9.1**
	9.1		Introduction	9.1
		9.1.1	Major Changes from 2016 FS Study	9.2
	9.2		Power	9.7
	9.3		Operating Consumables	9.8
	9.4		Maintenance	9.10
	9.5		Labour	9.11
	9.6		Laboratory	9.13
	9.7		ROM Rehandle	9.14
	9.8		General and Administration	9.14
	9.9		Services and Utilities	9.15
		9.9.1	Mobile Equipment	9.15
		9.9.2	Water	9.15
	9.10		Operations Pre-Production	9.16
		9.10.2	Pre-Production Labour	9.16
		9.10.3	Pre-Production Administration Expenses	9.16
		9.10.4	First Fill Reagents and Opening Stocks	9.16
		9.10.5	Vendor Representatives	9.17
		9.10.6	Training	9.17
		9.10.7	Working Capital	9.17
10.0	**CAPITAL COST ESTIMATE**			**10.1**
	10.1		Summary Capital Costs	10.1
	10.2		Scope	10.2
	10.3		Plant and Infrastructure Capital Costs	10.3
		10.3.2	General Estimating Methodology	10.5
		10.3.3	Quantity Development	10.5
		10.3.4	Pricing Basis	10.6
		10.3.5	Temporary Construction Facilities	10.7
		10.3.6	Heavy Lift Cranage	10.7
		10.3.7	Contractor Distributables	10.7
		10.3.8	Earthworks	10.7
		10.3.9	Concrete	10.8
		10.3.10	Steelwork10.8	

Table of Contents

			Page
		10.3.11 Platework / Tankage	10.8
		10.3.12 Mechanical Equipment	10.8
		10.3.13 Plant Pipework	10.9
		10.3.14 Overland Pipework	10.9
		10.3.15 Electrical Instrumentation	10.9
		10.3.16 Erection and Installation	10.9
		10.3.17 Architectural / Buildings	10.9
		10.3.18 Transport 10.9	
		10.3.19 EPCM 10.9	
		10.3.20 Vendor Commissioning	10.10
		10.3.21 Qualifications	10.10
		10.3.22 Contingency	10.10
	10.4	Owners Costs	10.11
		10.4.1 Spares	10.11
		10.4.2 First Fill and Opening Stocks of Consumables	10.11
	10.5	Exclusions	10.11
11.0	**FINANCIAL EVALUATION**		**11.1**
	11.1	Introduction	11.1
	11.2	Summary	11.1
	11.3	Principal Assumptions and Inputs	11.2
		11.3.2 Depreciation	11.3
		11.3.3 Company Tax	11.3
		11.3.4 Refining and Transport Costs	11.4
		11.3.5 Silver Credits	11.4
		11.3.6 Royalties	11.4
		11.3.7 Working Capital	11.4
		11.3.8 Closure Costs	11.4
		11.3.9 Other	11.4
	11.4	Sensitivity Analysis	11.5
12.0	**RECOMMENDATIONS**		**12.1**
	12.1	Introduction	12.1
	12.2	Implementation	12.1
	12.3	Risks	12.2
	12.4	Opportunities	12.3

TABLES

Table 1.1.1	Mineral Resources as at Effective Date 01 May 2017	1.1
Table 1.1.2	Historical Mineral Resources as at Effective Date 31 May 2016	1.2
Table 1.1.3	Summary of Updated Mineral Reserve Estimate	1.3
Table 1.1.4	Bakatouo Metallurgical Recovery and Reagent Consumption	1.5
Table 1.1.5	Summary of Key Process Design Criteria	1.6
Table 1.1.6	LOM Mining Operating Costs	1.8
Table 1.1.7	Summary of LOM Process Operating Cost (US$, 2Q17, ±15%)	1.9
Table 1.1.8	Initial Capital Cost Estimate Summary (US$, 2Q17, ±15%)	1.9
Table 1.2.1	List of Consultants	1.10
Table 1.4.1	Comparison of Feasibility Study to Optimisation	1.12

Table of Contents

Page

Table 2.1.1	Drillhole Database No. of Holes and Metres - Effective Data 01 May 2017	2.4
Table 2.1.2	Mineral Resources as at Effective Date 01 May 2017	2.7
Table 2.1.3	Historical Mineral Resources as at Effective Date 31 May 2016	2.7
Table 3.1.1	Summary of Updated Mineral Reserve Estimate	3.1
Table 3.2.1	Revenue and Royalty Rate Assumptions	3.2
Table 3.2.2	Resource Model Summary	3.3
Table 3.2.3	Processing Costs, Recoveries and Cut-off Grade	3.4
Table 3.2.4	Pit Geotechnical Design Parameters	3.6
Table 3.3.1	Bakatouo Pit Optimisation Results Summary	3.8
Table 3.3.2	Daapleu Pit Optimisation Results Summary	3.11
Table 3.3.3	Ity Pit Optimisation Results Summary	3.14
Table 3.4.1	Bakatouo Pit Design Parameters	3.16
Table 3.4.2	Daapleu Pit Design Parameters	3.18
Table 3.4.3	Ity Pit Design Parameters	3.21
Table 3.5.1	Ity Project Mineral Reserves Details	3.31
Table 3.6.1	LOM Schedule Scenarios	3.33
Table 3.6.2	LOM Stockpiling Strategy	3.33
Table 3.6.3	Location Precedence's	3.35
Table 4.4.1	Mine Equipment Selection Criteria	4.3
Table 4.5.1	Mining Equipment Capital Cost	4.4
Table 4.7.1	Hydraulic Excavator – Ore Loading Productivity Assumptions	4.5
Table 4.7.2	Hydraulic Excavator – Waste Loading Productivity Assumptions	4.5
Table 4.8.1	Mining Equipment Operating Schedule	4.6
Table 4.9.1	Direct Labour Numbers	4.8
Table 4.9.2	Mine Management Labour Numbers	4.8
Table 4.9.3	Mining Personnel Summary by Category	4.8
Table 4.13.1	Mine Operating Cost Basis	4.12
Table 4.14.1	Mining Operating Costs (US$ Million)	4.13
Table 4.14.2	Mining Operating Costs for per Year (US$ Million)	4.14
Table 4.14.3	Mining Operating Costs split by Pit and Rehandle (US$ Million)	4.14
Table 4.14.4	Mining Operating Cost Unit Rates	4.15
Table 4.15.1	Mining Capital Costs (US$ Million)	4.15
Table 4.15.2	Mining Capital Costs by WBS (US$ Million)	4.16
Table 5.2.1	Metallurgical Recovery and Reagent Consumption	5.3
Table 5.2.2	Metallurgical Recovery and Reagent Consumption	5.7
Table 5.3.1	Whole-of Ore Leaching vs. Flotation / Regrind Leaching	5.11
Table 6.1.1	Summary of Selected Milling Circuit	6.5
Table 6.1.2	Summary of Key Process Design Criteria	6.8
Table 7.1.1	Major Equipment Changes	7.1
Table 7.3.1	Installed Load and Maximum Demand	7.10
Table 7.6.1	Potable Water Demand	7.27
Table 8.2.1	TSF Design Parameters	8.4
Table 8.4.1	Site Airstrip Design Parameters	8.7
Table 8.5.1	Number of Pit Dewatering Bores	8.8
Table 8.5.2	Scenario 1 - Dewatering Bore Schedule	8.8
Table 8.5.3	Scenario 2 - Dewatering Bore Schedule	8.8
Table 8.5.4	Scenario 3 - Dewatering Bore Schedule	8.9
Table 8.5.5	Pit Dewatering - Annual Capital Costs	8.9

Table of Contents

Page

Table 8.5.6	Staged Construction Quantities	8.10
Table 8.5.7	Diversion Channels DC2 and DC3 - Construction Quantities	8.12
Table 8.5.8	Bridge Crossings - Construction Quantities	8.13
Table 8.5.9	Pit Protection Bunds - Construction Quantities	8.14
Table 9.1.1	Summary Operating Costs by Ore Type at 4 Mtpa Design Throughput	9.3
Table 9.1.2	Fixed / Variable Operating Costs by Ore Type at 4 Mtpa Design Throughput	9.5
Table 9.2.1	Power Consumption and Cost for LOM Blend	9.8
Table 9.3.1	Operating Consumables Consumption and Cost for LOM Blend	9.8
Table 9.4.1	Annual Maintenance Costs	9.10
Table 9.5.1	Manning Numbers and Annual Labour Cost	9.11
Table 9.5.2	Working Rosters	9.11
Table 9.5.3	Labour Rates	9.12
Table 9.6.1	Laboratory Costs and Estimated Samples	9.13
Table 9.8.1	Annual General and Administration Costs	9.14
Table 9.8.2	Camp and Catering Costs	9.15
Table 9.10.1	Plant and Administration Pre-Production Costs	9.16
Table 10.1.1	Initial Capital Cost Estimate Summary (US$, 2Q17, ±15%)	10.2
Table 10.3.1	Capital Cost Estimate Basis	10.4
Table 10.3.2	Derivation of Quantities	10.6
Table 11.2.1	Summary of Financial Analysis Results	11.2
Table 11.3.1	Capital Costs Sensitivity	11.4
Table 11.4.1	Gold Price Sensitivity	11.5
Table.11.4.2	Capital Costs Sensitivity	11.5
Table 11.4.3	Operating Cost Sensitivity	11.5
Table 11.4.4	Condensed Annual Financial Model	11.7

FIGURES

Figure 1.1.1	Mining by Pit Stage	1.3
Figure 1.1.2	Ore Processed By Quarter	1.4
Figure 1.5.1	Location of Ity Project Site	1.14
Figure 2.1.1	Change in Indicated Mineral Resource (‘000 Ounces)	2.8
Figure 2.1.2	Change in Inferred Mineral Resource (‘000 Ounces)	2.9
Figure 2.1.3	Change in Total Mineral Resource (‘000 Ounces)	2.9
Figure 3.3.1	Bakatouo Optimisation Results – Tonnage / Cash Flow Chart	3.9
Figure 3.3.2	Daapleu Optimisation Results – Tonnage / Cash Flow Chart	3.12
Figure 3.3.3	Ity Optimisation Results – Tonnage / Cash Flow Chart	3.15
Figure 3.4.1	Bakatouo Final Design	3.17
Figure 3.4.2	Daapleu Stage 1 Design	3.19
Figure 3.4.3	Daapleu Stage 2 Design	3.20
Figure 3.4.4	Ity Final Design	3.22
Figure 3.4.5	Gbeitouo Final Design	3.24
Figure 3.4.6	Walter Final Design	3.26
Figure 3.4.7	ZiaNE Final Design	3.28
Figure 3.4.8	Zia Site Design	3.29
Figure 3.7.1	Scenario 4 - Total Mining Movements	3.35
Figure 3.7.2	Scenario 4 - Tonnes and Grade Processed in CIL	3.36
Figure 3.7.3	Scenario 4 - Recovered Ounces	3.36

Table of Contents

Page

Figure 3.7.4	Scenario 4 - Stockpiles	3.37
Figure 3.7.5	Scenario 5 - Total Material Movements	3.38
Figure 3.7.6	Scenario 5 - Tonnes and Grade Processed in CIL	3.38
Figure 3.7.7	Scenario 5 - Recovered Ounces	3.39
Figure 3.7.8	Scenario 5 - Stockpiles	3.39
Figure 3.7.9	Scenario 6 - Total Material Movements	3.40
Figure 3.7.10	Scenario 6 – Tonnes and Grade Processed in CIL	3.40
Figure 3.7.11	Scenario 6 - Recovered Ounces Produced	3.41
Figure 3.7.12	Scenario 6 - Stockpiles	3.41
Figure 3.7.13	Scenario 7 - Total Material Movements	3.42
Figure 3.7.14	Scenario 7 - Tonnes and Grade Processed in CIL	3.42
Figure 3.7.15	Scenario 7 - Recovered Ounces Produced	3.43
Figure 3.7.16	Scenario 7 - Stockpiles	3.43
Figure 3.7.17	Scenario 7-1250 Opex 200717 - Total Material Movements	3.44
Figure 3.7.18	Scenario 7-1250 Opex 200717 - Tonnes and Grade Processed in CIL	3.44
Figure 3.7.19	Scenario 7-1250 Opex 200717 - Recovered Ounces Produced	3.45
Figure 3.7.20	Scenario 7-1250 Opex 200717 - Stockpiles	3.45
Figure 4.10.1	Mining Equipment Fuel Usage	4.9
Figure 4.11.1	Bulk Explosive Schedule	4.10
Figure 7.6.1	Project Connection to National Grid	7.26
Figure 8.1.1	Ity Site Layout	8.2
Figure 11.4.1	$NPV_{5\%}$ Sensitivity	11.6
Figure 11.4.2	IRR Sensitivity	11.6

APPENDICES

Appendix 4.1	List of Documents Available in Electronic Format
Appendix 5.1	Bakatouo Testwork Report
Appendix 5.2	Daapleu Refractory Ore Test Report
Appendix 6.1	Process Design Criteria
Appendix 6.2	Flowsheets
Appendix 6.3	Orway Mineral Consultants Report
Appendix 7.1	General Arrangement Drawings
Appendix 7.2	Mechanical Equipment List
Appendix 9.1	Operating Cost Estimate
Appendix 10.1	Capital Cost Estimate Detail

ITY CIL PROJECT

OPTIMISATION STUDY

1955-000-GEREP-0003

Table of Contents

Page

DISCLAIMER

This report has been prepared for Endeavour Mining Limited Corporation (Endeavour) by Lycopodium Minerals Pty Ltd (Lycopodium) as an independent consultant and is based in part on information furnished by Endeavour and in part on information not within the control of either Endeavour or Lycopodium. While it is believed that the information, conclusions and recommendations will be reliable under the conditions and subject to the limitations set forward herein, Lycopodium does not guarantee their accuracy. The use of this report and the information contained herein shall be at the user's sole risk, regardless of any fault or negligence of Lycopodium.

Table of Contents

Page

1.0 SUMMARY AND INTRODUCTION **1.1**
1.1 Executive Summary 1.1
1.1.1 Resource 1.1
1.1.2 Mining 1.2
1.1.3 Metallurgy 1.4
1.1.4 Process Plant 1.5
1.1.5 Infrastructure 1.7
1.1.6 Operating Cost Estimate 1.8
1.1.7 Capital Cost Estimate 1.9
1.1.8 Financial Evaluation 1.9
1.2 Introduction 1.10
1.3 Current Scope 1.11
1.4 Project Background 1.11
1.5 Project Location 1.12

TABLES
Table 1.1.1 Mineral Resources as at Effective Date 01 May 2017 1.1
Table 1.1.2 Historical Mineral Resources as at Effective Date 31 May 2016 1.2
Table 1.1.3 Summary of Updated Mineral Reserve Estimate 1.3
Table 1.1.4 Bakatouo Metallurgical Recovery and Reagent Consumption 1.5
Table 1.1.5 Summary of Key Process Design Criteria 1.6
Table 1.1.6 LOM Mining Operating Costs 1.8
Table 1.1.7 Summary of LOM Process Operating Cost (US$, 2Q17, ±15%) 1.9
Table 1.1.8 Initial Capital Cost Estimate Summary (US$, 2Q17, ±15%) 1.9
Table 1.2.1 List of Consultants 1.10
Table 1.4.1 Comparison of Feasibility Study to Optimisation 1.12

FIGURES
Figure 1.1.1 Mining by Pit Stage 1.3
Figure 1.1.2 Ore Processed By Quarter 1.4
Figure 1.5.1 Location of Ity Project Site 1.14

1.0 SUMMARY AND INTRODUCTION

1.1 Executive Summary

Endeavour Mining is undertaking the development of the Ity CIL Project in Côte d'Ivoire. A Feasibility Study was completed in November 2016 based on a 3 Mtpa CIL processing plant. Since then, further metallurgical studies and resource updates have been completed and this report summarises and updates the findings from the recent work, which has culminated in the process plant now designed for a throughput rate of 4 Mtpa over a 14-year mine life.

1.1.1 Resource

The updated Indicated and Inferred Mineral Resource estimates undertaken by Cube Consulting (Cube), incorporate all validated RC, DC and AC drilling completed at the Ity CIL Project to 01 May 2017. There is a total of nine deposit areas included in the updated Mineral Resource for the Ity CIL Project which include four in situ gold deposits that have been or are currently in production including Mont Ity, Ity Flat, ZiaNE and Walter, plus three near mine in situ deposits including Gbeitouo, Daapleu and Bakatouo and two rock waste dumps Teckraie and Verse Ouest and a discontinued heap leach pad Aires. The nine main prospect areas lie within an area of approximately 5 km (East) by 3 km (North).

Since the previous Mineral Resource statement with an effective date at 31 May 2016, resource definition drilling has been focused on the recently identified Bakatouo deposit and also infill and extension drilling at Verse Ouest, Daapleu and the combined Mont Ity and Ity Flat deposits. These deposits form the basis for the updated Ity CIL Project Mineral Resource.

Table 1.1.1 Mineral Resources as at Effective Date 01 May 2017

Deposit	Cut-off	Indicated			Inferred		
		Tonnes ('000)	Au (g/t)	Au ('000 Oz)	Tonnes ('000)	Au (g/t)	Au ('000 Oz)
Aires	0	5,768	1.09	202			
	0.5				233	0.78	6
Bakatouo	0.5	10,242	2.14	704	606	2.27	44
Daapleu	0.5	28,072	1.50	1,349	748	0.92	22
Gbeitouo	0.5	2,865	1.35	124	270	1.48	13
Mont Ity / Ity Flat	0.5	10,098	2.20	716	9,696	1.40	436
Teckraie	0	2,819	1.07	97			
	0.5				114	0.55	2
Verse Ouest	0	5,883	0.99	187			
	0.5				2,276	0.5	37
Walter	0.5	1,641	1.23	65	601	1.35	26
ZiaNE	0.5	6,678	1.28	274	3,964	1.40	178
Total		**74,066**	**1.56**	**3,718**	**18,508**	**1.28**	**764**

Table 1.1.2 Historical Mineral Resources as at Effective Date 31 May 2016

Deposit	Cut-off	Indicated			Inferred		
		Tonnes ('000)	Au (g/t)	Au ('000 Oz)	Tonnes ('000)	Au (g/t)	Au ('000 Oz)
Aires	0	5,768	1.09	202			
	0.5				233	0.78	6
Daapleu	0.5	19,882	1.51	968	4,329	1.15	160
Gbeitouo	0.5	2,865	1.35	124	270	1.48	13
Mont Ity / Ity Flat	0.5	7,491	2.19	526	11,084	1.92	685
Teckraie	0	2,819	1.07	97			
	0.5				114	0.55	2
Verse Ouest	0	5,896	1.03	195			
	0.5	2,505	0.43	34			
Walter	0.5	2,069	1.21	81	657	1.32	28
ZiaNE	0.5	7,723	1.31	326	4,002	1.39	179
Total		**48,617**	**1.49**	**2,324**	**27,088**	**1.47**	**1,282**

1.1.2 Mining

Cube Consulting was retained by Endeavour to update the Ity life of mine plan based primarily on updated resources at three of the project deposits, namely Daapleu, Mont Ity and Bakatouo and a proposed revised process facility capacity from 3 Mtpa to 4 Mtpa. Broadly, the scope of Cube's work included; open pit optimisation studies and pit designs on the three updated resources, and a range of life of mine scheduling scenarios with various treatment options.

A series of life of mine production schedules were developed by Cube. The mine production schedule selected by Endeavour for use in the optimisation study is presented here for evaluation and strategic decision making.

Furthermore, Cube's work culminated in the estimation of an updated Mineral Reserve for the Ity project. A summary of the estimate is shown in Table 1.1.3.

The mining by pit design and material process summary are shown in Figure 1.1.1 and Figure 1.1.2.

Table 1.1.3 Summary of Updated Mineral Reserve Estimate

Deposit	Probable Mineral Reserves		
	Tonnes (kt)	Gold Grade (g/t)	Gold Metal (koz)
Open Pits			
Bakatouo	8,522	2.28	625
Daapleu	18,961	1.68	1,027
Mont Ity	7,978	2.23	572
Gbeitouo	2,862	1.26	116
Walter	1,611	1.15	59
ZiaNE	8,432	1.04	282
Total Open Pits	48,365	1.72	2,681
Stockpiles and Leach Pad	14,470	1.05	486
Total	62,835	1.57	3,167

This Mineral Reserve estimate is reported as of end April 2017. Changes from the previously reported Mineral Reserves are largely due to revised and updated Mineral Resource estimates on the Daapleu, Ity and Bakatouo deposits and revised operating costs largely associated with revised processing capabilities from a 3 Mtpa facility to a 4 Mtpa treatment facility.

Figure 1.1.1 Mining by Pit Stage

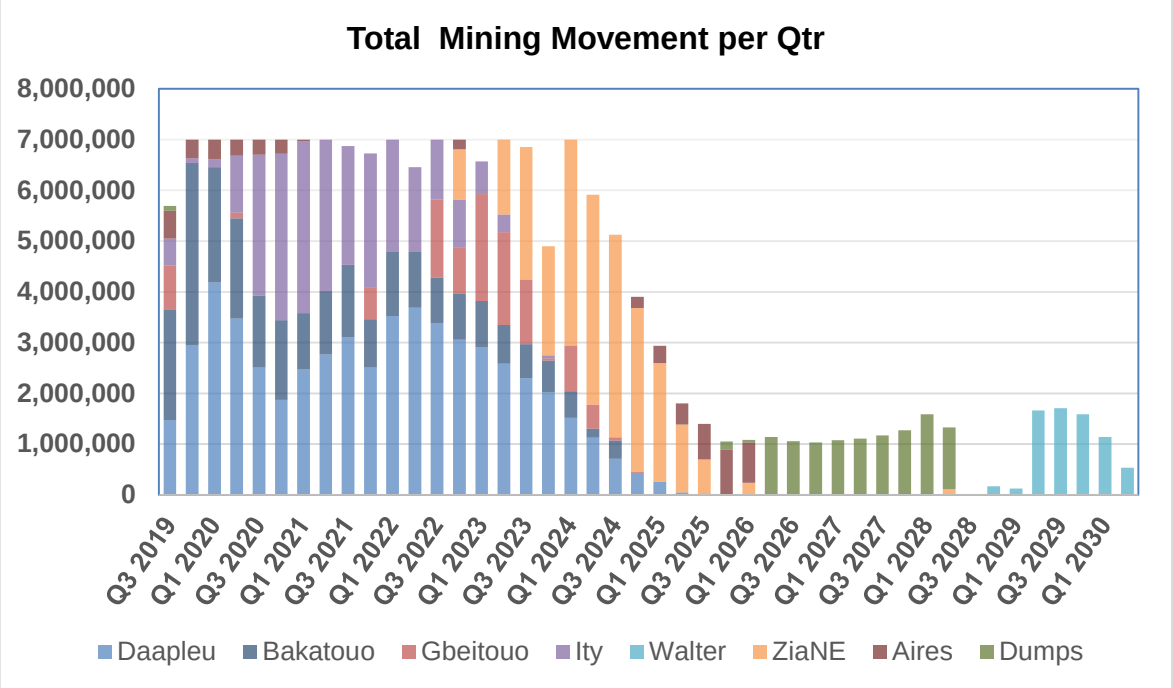
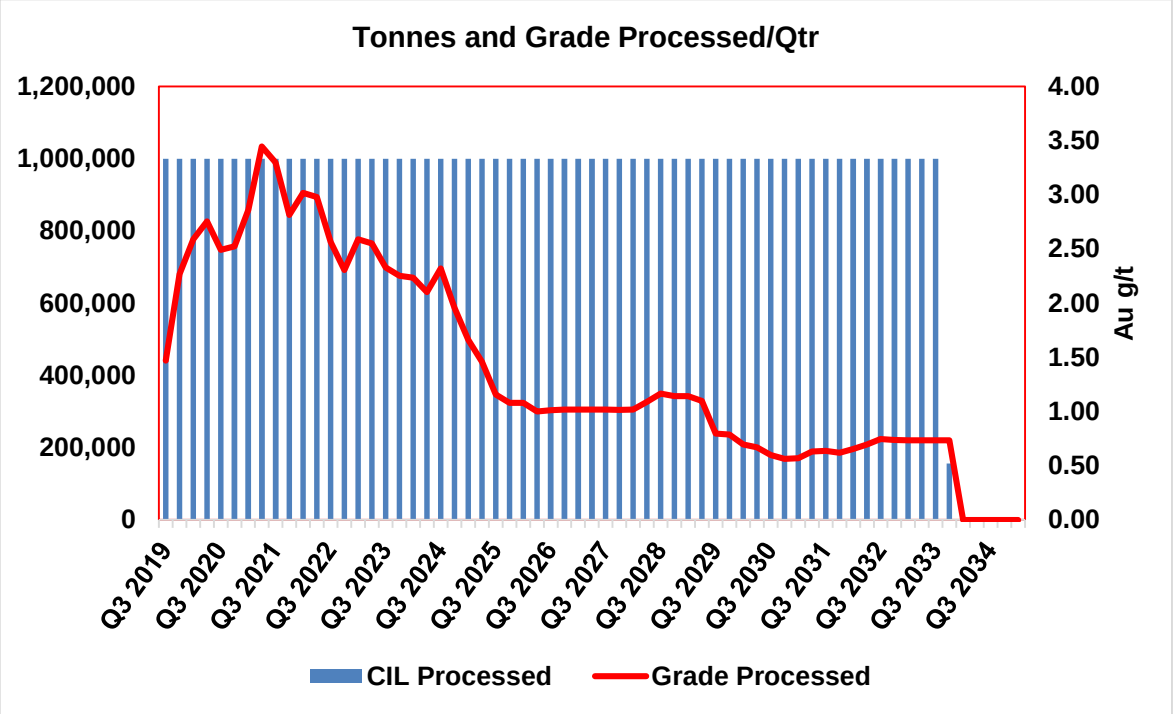


Figure 1.1.2 Ore Processed By Quarter



1.1.3 Metallurgy

Two programmes of testwork have been undertaken since the issue of the Ity FS in 2016:

Daapleu Primary Ore

A follow up investigation was undertaken to determine if the lower gold recovery for Daapleu Primary ore could be improved by a flotation / regrind / leaching process route. Results of this program which included a number of variability samples showed the recovery benefit was only 10 - 12% compared to whole ore leach and was deemed uneconomic by both Endeavour and Lycopodium Minerals Pty Ltd (LMPL).

Bakatouo Deposit

A detailed investigation of the metallurgical response of the Bakatouo deposit was undertaken. Most samples showed high gold extractions but soluble copper levels were also high. A program to evaluate flotation/concentrate leaching was also undertaken but concentrates retained high soluble copper levels (16 to 50%).

Table 1.1.4 Bakatouo Metallurgical Recovery and Reagent Consumption

Composite	Gold Recovery (%)	NaCN Consumption kg/t	Lime[1] Consumption kg/t
Oxide	96	1.8	1.90
Transition	84	5.6	0.85
Fresh	92	2.5	0.28

Note: 1. Lime consumption based on 90% CaO.

Based on these two programs Endeavour elected to proceed on the basis of a CIL project processing all ore types except Bakatouo transition ore which will be stockpiled for future processing.

1.1.4 Process Plant

The Ity design has focused on commonality to Houndé design as much as possible, where practical. Key changes to the process plant from the FS design are as follows:

- Throughput increased from 3 Mtpa to 4 Mtpa.
- Primary crusher increased from C140 (428 dry t/h, P_{80} CSS 160mm) to C160 (571 dry t/h, P_{80} CSS 16 6mm).
- Coarse ore stockpile replaced with a surge bin and dead stockpile.
- SAG and ball mill increased in size to 6 MW each, as per Houndé mills.
- Gravity circuit increased to two centrifugal concentrators and a larger intensive leach reactor.
- Pre-leach thickener increased in size to accommodate increased throughput and poorer settling of oxide minerals
- CIL train increased from 7 to 8 tanks due to increased flow, with tank sizes the same as Houndé.
- Elution circuit increased from 15 to 18 t capacity due to increased metal load.
- Cyanide destruction tanks increased from 550 to 900 m^3 each due to increased flow and increased soluble copper level. Arsenic precipitation circuit increased to two tanks with provision to use one tank for additional cyanide destruction residence time.
- A significantly increased oxygen plant to accommodate the increased soluble copper and therefore CN_{WAD} level to be detoxified.

The key process design criteria listed in Table 1.1.5 form the basis of the detailed process design criteria and mechanical equipment list.

Table 1.1.5 Summary of Key Process Design Criteria

Parameter	Unit	LOM Blend	Source [1,2,3,4,5,6,7]
Ore Blend		51% primary / 49% oxides	Cube
Plant Throughput - Nominal	t/y	4,000,000	Lycopodium
Gold Head Grade - Range	g Au/t	1.0-2.5	Endeavour
Gold Head Grade - Design	g Au/t	2.5	Endeavour
Overall Gold Recovery	%	66-97	Test
Silver Head Grade - Design	g Ag/t	8.5	Endeavour
Design Silver Recovery	%	63	Test
Soluble Copper - Design	ppm	200	Lycopodium
Crushing Plant Utilisation	%	80	Lycopodium
Milling / CIL Plant Utilisation	%	91.3	Lycopodium
ROM Ore Top Size	mm	800	Assumed / OMC
Comminution Circuit – Table 2.4.1		SABC	OMC
Gravity Gold Recovery	%	31	Test / Assumed
Gravity Silver Recovery	%	20	Assumed
Pre-leach Thickener Solids Loading	$t/m^2.h$	0.59	Testwork
Leach / CIL Residence Time	hrs	35	Lycopodium
Leach Slurry Density	% w/w	50	Testwork
Number of CIL Tanks		8	Lycopodium
Cyanide Consumption[5]	kg/t	1.17	Testwork
Quicklime Consumption[6]	kg/t	1.06	Testwork
Elution Circuit Type		Split AARL	Lycopodium
Elution Circuit Capacity	t	18	Lycopodium
Frequency of Elution	strips / week	7	Lycopodium

Notes:

1 Cube refers to advice from the nominated mining subconsultant.
2 'Lycopodium' refers to Lycopodium experience or generally accepted practice.
3 'Testwork' refer to metallurgical testwork conducted.
4 'OMC' refers to advice from Orway Mineral Consultants.
5 Cyanide consumption makes allowance for 100 ppm residual cyanide in the CIL tail solution and soluble copper.
6 Lime consumption based on 90% CaO.
7 Endeavour refers to advice / agreement from Endeavour.

The process plant has been relocated to the hill which currently houses the accommodation camp. This hill will be levelled to RL 330 m. The main reasons for this relocation are as follows:

- The previous location was within the blast zone of the expanded Ity pit.
- The previous arrangement had a coarse ore stockpile which could be approached at an oblique angle. The revised layout incorporates a surge bin and overflow conveyor and needs to be fed perpendicular to the mill feed conveyor to facilitate location of the overflow conveyor and a ramp for loading material from the dead stockpile.

- The previous layout had a long overland conveyor running adjacent to the steep walls of the Aires dump. Run-off from this heap during a rain event would threaten the plant feed conveyor and presented drainage issues around the primary crusher.

- The revised location moves the ROM pad up to the previous plant location and allows the mine services area (MSA) to be situated in the same general area as the process plant allowing sharing of services. The previous location would have also impacted the current heap leach operation during construction

- The cost of the additional earthworks was considered acceptable given the additional benefits outlined.

1.1.5 Infrastructure

The following lists the major changes to infrastructure.

Earthworks

Relocation of the plant has increased earthworks significantly with approximately 3 Mm^3 for the relocated plant. An opportunity exists to significantly reduce this volume with further optimisation during the FEED phase

Airstrip

Additional works plus a refuelling truck.

Water supply

Pit dewatering bores reduced from 42 to 12 on advice from Knight Piésold.

Power Supply

20 MW backup power station added.

Accommodation

Costs updated to reflect Houndé actual costs.

Mining Infrastructure

Bridge over Cavally River revised. Extra bay added to HV workshop. Bulk fuel storage deleted as it is likely it will be financed and amortised with the fuel supplier.

TSF Design

The key modifications to the TSF design are summarised as follows:

- Annual throughput increased to 4 Mtpa (previously 3 Mtpa). The TSF embankments were adjusted to provide a greater TSF basin area to allow a greater drying area for the deposited tailings (and thus improve density) to occur for the greater throughput, within the same general site location as the 2016 FS design.

- The modified embankment alignments resulted in an increased length (and therefore excavation volume) of the TSF Upstream Diversion Channel.

- TSF basin liner system was modified to a full HDPE geomembrane liner (previously unlined without significant basin preparation).

- Total achievable capacity for the TSF is approximately 57Mt.

Surface Water

The key modifications to the water management structures are as follows:

- The Cavally River Crossing (primary haul road and service corridor crossing, of width 40 m) was changed to a concrete bridge structure for ease of construction, based on preliminary discussions with Endeavour.

- Community River Crossing added south of the project site comprising a concrete bridge structure (9 m top width).

- Diversion channels DC2 and DC3 and Pit bund wall added.

1.1.6 Operating Cost Estimate

Mining

The Life of Mine (LOM) mining operating cost is presented in Table 1.1.6 below.

Table 1.1.6 LOM Mining Operating Costs

Mining Operating Costs	US$M	US$/t ore
Pit Loading	38.95	0.62
Pit Hauling	64.73	1.03
Ore Rehandle Load	12.81	0.20
Ore Stock Pile Haul	2.78	0.04
Ancillary	43.12	0.69
Drilling	63.25	1.01
Blasting	50.94	0.81
Personnel (indirect)	38.85	0.62
Mine Preparation and Rehabilitation	4.30	0.07
Grade Control	12.71	0.20
Support Equipment	35.93	0.57
Operating Overheads	6.99	0.11
Total	**375.36**	**5.97**

Process Plant and Infrastructure

Process plant and infrastructure operating costs have been estimated to +/- 15% accuracy. The Life of Mine average operating cost is presented in Table 1.1.7 below.

Table 1.1.7 Summary of LOM Process Operating Cost (US$, 2Q17, ±15%)

Cost Area	LOM Blend US$/t
Power excluding grinding	2.05
Power (grinding)	1.64
Operating Consumables	6.37
Maintenance	0.85
Laboratory	0.18
Process / Maintenance Labour	0.95
Total Processing	**12.03**
Administration Labour	1.08
General and Administration	1.14
Total General and Administration	2.23
Total	**14.25**

1.1.7 Capital Cost Estimate

The project capital cost was estimated at US$ 370.0 million, as summarised in Table 1.1.8 below.

Table 1.1.8 Initial Capital Cost Estimate Summary (US$, 2Q17, ±15%)

Main Area	Initial Capital (US$M)
Treatment Plant	85.0
Reagents and Services	14.1
Infrastructure and Tailings	66.8
Mining	65.5
Construction Distributables	25.3
Subtotal	**256.7**
Management Costs	17.4
Owners Project Costs	59.5
Owners Operations Costs	5.3
Contingency	31.1
Project Total	**370.0**

1.1.8 Financial Evaluation

The results of the financial model show robust results. Applying a long term gold price of $1,250/oz on a flat line basis from the commencement of production, the after-tax $NPV_{5\%}$ is $640.0 million, IRR is 43.3% and project payback period is 1.8 years.

The life of mine average cash cost per ounce is $563, net of silver credits, and with the addition of sustaining capital, the life of mine average AISC/oz is $593. Over the first five years of production, the average AISC/oz is $523.

Project gold production averages 164,407 ounces per year over the life of the project with an average of 250,937 ounces per year over the first five years.

The project shows some sensitivity to capital and operating costs, but is typically sensitive to gold prices. At $1,150/oz gold price the IRR is 36.4%, and the project maintains an IRR of 49.5% at an upside $1,350/oz gold price.

1.2 Introduction

In May 2016 Endeavour Mining Corporation (Endeavour) engaged consultants to undertake scopes of work for a Feasibility Study (FS) for their Ity CIL Project (the Project), located approximately 700 km northwest of Abidjan in southern Côte d'Ivoire.

Table 1.2.1 lists consultants engaged in the FS with a summary of their scope and responsibilities.

Table 1.2.1 List of Consultants

Consultant	Scope / Responsibility
ALS Global	• Metallurgical testwork
Lycopodium Minerals	• Metallurgical testwork supervision • Process plant and related process infrastructure design • Process capital and operating cost estimation • Compilation of overall capital and operating cost estimates • Risk assessment • Project implementation • Overall report compilation
Cube Consulting (Cube) Perth, Australia	• Sampling and verification • Database validation • Review of geological interpretation of geology and mineralisation • Exploratory data analysis • Geological modelling • Mineral Resource documentation
Mining Solutions Consultancy	• Pit optimisation • Mining design and scheduling • Mining cost estimation
Knight Piésold Consulting	• Hydrology modelling and geotechnical investigation • Waste rock geochemistry review • Tailings storage facility (TSF) design • Hydrology design • Haul road design • Airstrip conceptual design • Cavally River diversion
Peter O'Bryan & Associates	• Pit wall geotechnical
Calsta	• Mine fleet selection and optimisation • Preparation of tender documentation and equipment cost sourcing • Technical and commercial evaluation
ECG Engineering	• 90 kV overhead power line (OHPL) design

1.3 Current Scope

The FS Study and a subsequent NI-43101 Technical Document were issued in November 2016. The study concluded that a 3 Mtpa CIL project was feasible. However, it identified a number of opportunities to improve the Project. In particular:

- Further assessment and testing of the Bakatouo deposit to allow it to be included in the Project.
- Updating the resource estimate for all deposits in the study based on recent drilling.
- Testwork on the Daapleu Primary ore to improve the recovery of gold.

Following this, further drilling and resource studies together with additional testwork has been undertaken. This report summarises the results of the additional studies and testwork and describes a revised project scope for a 4 Mtpa CIL facility.

1.4 Project Background

Endeavour currently operate the Ity Heap Leach Operation using open pit mining methods and a heap leach process for gold recovery. A scoping study for the exploitation of the mineral resource using an alternative processing route was conducted in 2013.

In 2014, SNC-Lavalin Inc. (SNC) conducted a Pre-feasibility Study (PFS) on behalf of Société Minière d'Ity (SMI) to evaluate the potential of a CIL plant at a processing rate of 1.5 Mtpa.

The results of the study were positive and in late 2014 through to early 2015, SMI carried out drilling programs at the Daapleu, ZiaNE and Mont Ity deposits designed to upgrade all Inferred Mineral Resource material from the 2014 mineral resource estimate to Indicated Mineral Resources, the Daapleu deposit Indicated Mineral Resource to Measured Mineral Resource, and to delineate each deposit further along strike.

The resulting 2015 mineral resource estimate update yielded a significant increase in measured and indicated mineral resources to 2.9 Moz of gold contained in five deposits, two dumps, decommissioned leach pads and a stockpile. SNC-Lavalin was mandated by SMI to update the PFS for the CIL Project using a processing rate of 2.0 Mtpa.

Coffey Mining (South Africa) Pty Ltd (Coffey) was then requested by Endeavour Mining to compile an independent Technical Report on the project, to comply with disclosure and reporting requirements set forth in the Toronto Stock Exchange Manual, National Instrument 43-101.

The FS report drew on these previously completed studies and published reports, with new contributions from resources within Endeavour and the consulting groups as outlined in Table 1.2.1 above.

Table 1.4.1 summarises the evolution of the project physicals and financials from the FS to Optimisation.

Table 1.4.1 Comparison of Feasibility Study to Optimisation

Physicals and Financial Comparison	Units	Feasibility Study	Optimisation
LOM tonnage ore processed	kt	41,042	57,156
LOM strip ratio	w:o	2.1	1.7
Throughput rate	Mt/a	3.0	4.0
LOM feed grade processed	Au g/t	1.42	1.52
LOM gold recovery	%	83.1%	83.4%
LOM gold production	oz	1,561,902	2,350,872
Production period	Years	13.7	14.5
Upfront capital cost	$M	306.7	370.0
Life of Mine Average			
Gold, average annual production	oz	113,656	164,407
Cash costs per ounce, net Ag credits	$/oz	528	567
AISC per ounce	$/oz	603	593
Project Years 1 to 5 Average			
Gold, average annual production	oz	164,989	250,937
Cash costs per ounce, net Ag credits	$/oz	446	508
AISC per ounce	$/oz	507	523
Project Years 1 to 9 Average			
Gold, average annual production	oz	143,848	209,226
Cash costs per ounce, net Ag credits	$/oz	475	502
AISC per ounce	$/oz	542	527
Using $1,250/oz gold price			
Internal rate of return (after-tax)	%	35.9%	43.3%
Net present value - 0% discount rate (after-tax)	$M	607.2	944.2
Net present value - 5% discount rate (after-tax)	$M	410.9	640.0
Net present value - 10% discount rate (after-tax)	$M	278.3	438.9
Payback period	Years	2.1	1.8

1.5 Project Location

Côte d'Ivoire is located along the coast of Western Africa and is bordered to the east by Ghana, to the north by Burkina Faso and Mali, and to the west by Guinea and Liberia. The Company's mining operations are close to the Liberian border as shown on Figure 1.5.1. Ity is approximately 700 km northwest of Abidjan, which serves as Côte d'Ivoire's economic capital.

The Ity Mine is located in the prefecture of Zouan-Hounien. The project site is accessible via paved road from Abidjan, passing through the capital Yamoussoukro, Daloa and Duekoué. It is also accessible by plane from Abidjan to Man and then from Man to the site by bus operated by SMI. From Duekoué, two roads access the project from both north and south. The north access is through Man and then on to Danané and Zouan-Hounien where a 15 km unsealed road maintained by SMI leads to the village of Ouyatouo. Southern access is through Guiglo and Toulepleu.

Local residents are mainly farmers that make a living from food and cash crops. Cash crops consist of cocoa, kola nut and coffee. The people belong to the Dan ethnic group (Mande language family) in the northern part of the mining concession, and the Wè Sud ethnic group (Kru language family) in the south. The Ity village was located between the Cavally River and the Flotouo-Zia pit. A new village has been built 4 km northeast of the mine near Ouyatouo to provide new homes for the village's inhabitants.

The geomorphology of the Ity area is typical of rain forest areas. The landscape is often referred to as 'half orange type' due to its succession of rounded hills with convex slopes separated by a well-developed drainage system. The weathering profile is thickest on hilltops, whereas variably truncated profiles are found on the slopes. The bedrock sub outcrops near the drainage channels, which are surrounded by floodable flats. Elevations range from approximately 225 m to over 400 m. Vegetation consists of secondary forest found on hilltops, and scrubland and small areas of cultivated farmland on the slopes. Rice farms occupy the lowlands.

Figure 1.5.1 Location of Ity Project Site



Table of Contents

Page

2.0 RESOURCE UPDATE SUMMARY **2.1**
2.1 Geology and Resources 2.1
2.1.1 Regional and Local Geology and Mineralisation 2.1
2.1.2 Informing Data 2.3
2.1.3 Resource Estimation 2.4
2.1.4 Mineral Resource Classification and Reporting 2.6
2.1.5 Comparison with Previous Mineral Resource 2.7

TABLES
Table 2.1.1 Drillhole Database No. of Holes and Metres - Effective Data 01 May 2017 2.4
Table 2.1.2 Mineral Resources as at Effective Date 01 May 2017 2.7
Table 2.1.3 Historical Mineral Resources as at Effective Date 31 May 2016 2.7

FIGURES
Figure 2.1.1 Change in Indicated Mineral Resource (‘000 Ounces) 2.8
Figure 2.1.2 Change in Inferred Mineral Resource (‘000 Ounces) 2.9
Figure 2.1.3 Change in Total Mineral Resource (‘000 Ounces) 2.9

2.0 RESOURCE UPDATE SUMMARY

2.1 Geology and Resources

The updated Indicated and Inferred Mineral Resource estimates incorporate all validated RC, DC and AC drilling completed at the Ity CIL Project to 01 May 2017. There is a total of nine deposit areas included in the updated Mineral Resource for the Ity CIL Project which include four in situ gold deposits that have been or are currently in production including Mont Ity, Ity Flat, ZianNE and Walter, plus three near mine in situ deposits including Gbeitouo, Daapleu and Bakatouo and two rock waste dumps Teckraie and Verse Ouest and a discontinued heap leach pad Aires. The nine main prospect areas lie within an area of approximately 5 km (East) by 3 km (North).

Since the previous Mineral Resource statement with an effective date at 31 May 2016, resource definition drilling has been focused on the recently identified Bakatouo deposit and also infill and extension drilling at Verse Ouest, Daapleu and the combined Mont Ity and Ity Flat deposits. These deposits form the basis for the updated Ity CIL Project Mineral Resource.

2.1.1 Regional and Local Geology and Mineralisation

The Mont Ity deposits are located in the Lower Proterozoic Birimian Formation of the Toulépleu-Ity klippe. The Toulépleu-Ity klippe is a small remnant of the Birimian in the West African Craton which spans ten countries, between Côte d'Ivoire, Senegal, Niger and Ghana.

Milesi et.al, (1989) and the BRGM (1986, 1989) proposed a definition of the Birimian with a lithostratigraphic succession separated into two large groups:

- A Lower Birimian (B1) set essentially flyschoid basin fill. The whole basin is affected by three cycles of deformation including a D1 (2090-2100Ma) phase of major collision and duplication of the lower Proterozoic on the gneissic Archean basement and a break in all B1 sedimentation and intrusion of syn-kinematic granites. D2 and D3 (2090-1970Ma) deformation were responsible for the intrusion of granites mantle between 2080 and 1945Ma (D2 large sinistral offsets, related overlaps and folding: D3 dextral offsets and associated folds).

- The Upper Birimian (B2), volcanic-dominated, with where fluvio-deltaic formations are intercalated in volcano-sedimentary facies.

The Ity area is characterised by a series of granodioritic intrusions into a sedimentary sequence of volcano-sediments and carbonates. The volcanic are tuffaceous deposits chemistry ranges from basic to acidic. All formations have been subjected to regional metamorphism. The main lithologies within the Ity project area include:

- Laterites (Facies 301) - are soils without texture, formed by supergene alteration of iron rich rocks and are generally red in colour. Four lateritic categories have been identified at Ity with all profiles containing millimetre scale fragments of magnetite and quartz.

- Saprolites - are the result of supergene alteration, hydrothermal alteration or a combination of the two. The facies vary in colour as a function of the protolith and degree of oxidation and include:

  - Oxidised saprolites (Facies 201) which are essentially oxides and hydroxides of iron (Fe^{2+} and Fe^{3+}) which are present in a wide range of colours, yellow, orange, brick-red violet etc.

  - Reduced saprolites (Facies 211) are coloured green to white or light grey. They are generally found deeper than that oxidised saprolites and correspond to the water table limit.

- Meta-volcanic sediments (Facies 101) - are dark greyish-brown to grey-green and finely laminated. Minerals are primarily amphibole, chlorites, biotites, traces of magnetite, calcite as veinlets and fracture coatings and quartz veins with tourmaline.

- Carbonate (Facies 401) - typically greenish in colour and microcrystalline with chlorite-epidote alteration, disseminated pyrites and magnetite. The carbonates represent protoskarn facies.

- Granodiorite (Facies 501) - coarse-grained grey felsic intrusive rich in sericite, magnetite and large straw-like crystals of muscovite.

- Daapleu Rhyolite (Facies 601) - granitic intrusive at Daapleu prospect is locally called a rhyolite as it has a fine texture. The rhyolite is leucocratic (grey to white), microgranular, schistose and rich in sericite and contains fine-grained pyrite or magnetite disseminated and in fractures.

- Diorite (Facies 501) - coarse-grained grey-green mafic intrusive composed of amphibole, magnetite and chlorite with fine-grained disseminated pyrite and calcite veins.

- Skarn (Facies 901) - represent metamorphosed carbonate host and are associated with presence of sulphur in the form of varying occurrences of pyrite, pyrrhotite, chalcopyrite and magnetite.

The Ity CIL Project deposits are orogenic gold deposits and generally described as skarn or shear zone styles of mineralisation.

Skarn deposits within the Ity CIL Project include Mont Ity, Ity Flat, ZiaNE, Walter and the recently discovered Bakatouo. The material from which the Aires Verse Ouest and Teckraie dumps have been derived were also sourced from mining of skarn deposits. The skarn corresponds to a sulphur rich skarn (pyrite-pyrrhotite-chalcopyrite, 3-10%) with accessory magnetite. These mineralised zones form discontinuous, sub parallel lenses at the contact with the granodiorite. The mineralised portions of the reduced saprolites correspond to the decarbonation of marble and exoskarn. These are rocks rich in chlorite, tremolite and/or actinolite. The reduced saprolites are the transition zone between the oxidised material and the fresh rock. The oxidised saprolites form the major part of the mineralisation at Mont Ity. The mineralisation was originally a skarn which has undergone severe supergene alteration. The alteration was enhanced by the dissolution of the

sulphides. The alteration was responsible for the generation of karst into which the saprolite material collapsed which provides an explanation for the geometry of the deposit.

The Daapleu and Gbeitouo deposits resemble typical shear zone deposits of the West African granite-greenstone terrane. Both deposits are associated with a major regional shear zone but developed on secondary structures. The lithologies can be any form of sediment, carbonate or igneous rock with the main feature being a shear zone between the two contrasting lithologies. Mineralisation may also be spatially related to the emplacement of intrusives. The gold mineralisation is mesothermal in origin and occurs as free gold in quartz vein stockworks and zones of silicification, associated with arsenopyrite and to a lesser extent pyrite and antimony. Depending on the geological terrane other metals may be associated with the gold and arsenic. The gold mineralisation is found in linear zones in or near the contacts between two different rock types. This contact shows evidence of shearing. Alteration is weak to severe depending on the development of the system.

2.1.2 Informing Data

Prior to 2014, drillhole data was managed on site using bespoke public domain database software. In 2014, SMI introduced AcQuire database software (an industry standard database software) as a replacement to manage all historical and modern drilling data. Since 2014 all historical data has been validated and migrated into the AcQuire database.

As part of the May 2016 FS, Cube was provided with MS Access exports by SMI for each deposit. These were imported into a single MS Access database by Cube which used as the primary data source for the geological interpretations, QAQC analysis and Mineral Resource estimation. Cube has not independently verified any of the data contained in the database except for undertaking routine internal validation checks which identified no material errors in the collar, assay or survey tables. For the May 2017 Mineral Resource update, the deposits with additional drilling included Bakatouo (207 DD holes), Mont Ity / Ity Flat (90 DD holes), Daapleu (84 DD holes) and Verse Ouest (34 AC holes). The drillhole types, number of holes and meters within the database used in the updated Mineral Resource estimate are summarised in Table 2.1.1.

Table 2.1.1 Drillhole Database No. of Holes and Metres - Effective Data 01 May 2017

Deposit	DD	RC	RC-DD	AC
Aires	10 (768)	-	-	159 (6,455)
Bakatouo	207 (26,714)		-	
Daapleu	282 (44,771)	49 (4,242)	-	
Gbeitouo	68 (9,203)	56 (4,309)	7 (863)	
Ity Combined	427 (50,637)	337 (17,4240	-	18 (1,602)
Teckraie	31 (1,079)	2 (28)	-	
Verse Ouest	33 (1,359)	-	-	34 (1,183)
Walter	70 (6,272)	25 (2,253)	6 (613)	
ZiaNE	237 (25,912)	10 (926)	-	

Overall the sample collection and preparation, analytical techniques, security and QA/QC protocols implemented for the Ity CIL Project are consistent with standard industry practice and are suitable for the reporting of exploration results and for use in Mineral Resource estimation. The sampling procedures are adequate for and consistent with the style of gold mineralisation under consideration.

2.1.3 Resource Estimation

For all in situ deposits (Bakatouo, Daapleu, Gbeitouo, Mont Ity, Ity Flat, ZiaNE and Walter), weathering interpretations based on geological logging in the “OX_SUPERGENE” database field were used to define oxide, transitional and fresh weathering domains. Lithological interpretations based on geological logging in the “LITHO” database field were used to create validated three dimensional solids defining the dominant lithological facies types. Robust mineralisation interpretations were based primarily on nominal gold grade cut-offs relevant to each deposit typically between 0.3 and 0.5 ppm which appears to approximate the natural grade cut-off between mineralisation and waste rock. In addition, relevant drill log information and the lithological model were used as guidance for the interpretation.

A unique code for drill intercepts within each of the mineralised domains was used to control the compositing process whilst extracting sample and composite data combinations for statistical analysis and subsequent resource estimation. For all in situ deposits, 1 m or 2 m downhole composites were extracted within the mineralised domains. For the Teckraie, Verse Ouest and Aires deposits, 2.5 m composites were extracted. Appropriate high-grade cuts were applied on an individual domain basis and are typically above the 99th percentile of the assay population. The number of cut samples is generally low and although having a material effect on reducing the coefficient of variation (“CV”), the effect of these top-cuts was not expected to be material on the contained gold estimate.

The primary gold estimation method implemented for all in situ deposits is Localised Uniform Conditioning (LUC). LUC is considered, by Cube as the most appropriate method for the estimation of local recoverable resources for these deposits as it produces representative grade-tonnage functions which are in good accordance with volume-variance relationship principles. It limits the smearing of high grade and the over-smoothing of grade compared to linear estimation methods, into small blocks. The final Mineral Resource is a diluted recoverable resource estimate under the assumption that the process attempts to estimate the recoverable tonnage and grade based on the dimensions of the selective mining unit (SMU) which is regarded as representative of what is practically achievable during actual mining. Estimation is undertaken using relatively large panels and within domains defined by a lower grade cut-off and therefore can be considered as being 'diluted' as they are estimated using all data within these broad mineralised envelopes. The panel size varied between deposit depending on the data spacing however the same SMU (5mE x 5mN x 2.5mRL) was used throughout. A Change of Support is applied to the large diluted panels in order to predict the likely grade tonnage distribution of SMU selectivity. In addition to the imposition of a minimum selective mining dimension, a further change of support correction was applied to the models in the form of an information effect. The information effect is a theoretical 'penalty' adjustment to the SMU grade tonnage distribution to account for the anticipated dilution incurred when making mining selectivity decisions based on likely grade control spaced data. A typical grade control pattern does not represent exhaustive information and some misallocation of material is inevitable when block estimates are based on a non-exhaustive dataset. In a sense, the information effect adjustment is a representation of the impact of inaccuracies anticipated in the practical mining process. Unplanned mining dilution due to mining inaccuracies would still need to be accounted for as a modifying factor.

Background elements including arsenic, sulphur and copper were estimated by Ordinary Kriging or Inverse Distance for all in situ deposits. It is important to note that the estimate for the minor elements are based on a much smaller and biased data sets compared to gold. This is due to multi-element assays not being undertaken for all historic drilling and typically only for drill intervals where gold is greater than 0.5 g/t. Missing assays for the previous grade estimates were ignored however for the recent estimates of Bakatouo and Mont Ity / Ity Flat, regressions based on gold grades were derived to calculate the missing copper assay grades. It is not possible to draw any definitive conclusions from the minor element estimates and they should be used as a guide only.

The primary gold estimation method implemented for the Teckraie and Verse Ouest rock waste dumps and Aires heap leach pad is Ordinary Kriging (OK). OK is considered an appropriate method for estimation given the low coefficients of variation for the cut composite data. No mining selectively would be anticipated during mining and therefore OK will provide a robust global estimate. As such, the global mean of the OK estimate was assigned as the final grade estimate for each deposit.

For the May 2017 updated Mineral Resource, the interpretations and grade estimates were only updated for Bakatouo, Mont It y/ Ity Flat, Daapleu, and Verse Ouest. Bakatouo is a recent discovery and was not previously included in the May 2016 FS. Recent drilling at Mont Ity / Ity Flat and Daapleu confirmed the existing lithological interpretations and generally extended the mineralisation limits.

An infill drilling campaign at the Verse Ouest stockpile allowed the grade to be re-estimated and confirmed the historical Mineral Resource estimate.

As part of the May 2016 FS, all available bulk density data was supplied by Endeavour and included a total of 3,391 determinations. The determinations that were deemed acceptable were limited to measurements undertaken on diamond drill core which had been measured using a standard water displacement method. This resulted in a total of 2,948 determinations available for inclusion in the total Ity Project. Density determinations were grouped by deposit and lithology type. Outlier samples were removed and the typically mean of each domain population was assigned to the block model based on flagged lithology. In some instances, where the number of density determinations was small, the assigned density was adopted from another deposit with similar geology characteristics.

For the May 2017 updated mineral resource, additional density data was supplied for the deposits to be updated including Bakatouo, Daapleu and Mont Iyt / Ity Flat. Recent drilling at these deposits was exclusively DD and included a significant number of additional density determination measurements. As a result, the number of density data specific to these deposits and used to revise the assigned in situ deposit density included 1,127 for Bakatouo, 2,038 for Daapleu and 1,237 for Mont Ity / Ity Flat.

2.1.4 Mineral Resource Classification and Reporting

For the purpose of public reporting of the in situ Mineral Resources which include Bakatouo, Daapleu, Gbeitouo, Mont Ity / Ity Flat, Walter and ZiaNE have all been reported inside optimised pit shells and above a 0.5g/t Au cut-off. Reporting within an optimised pit shell satisfies the requirement for the Mineral Resource to have reasonable prospects for future economic extraction. The pit optimisation assumes a US$1,500/oz Au price.

For the purpose of public reporting of Mineral Resources for the rock dumps which includes Teckraie and Verse Ouest and also the Aires heap leach pad, these have not been reported inside an optimised pit shell. These deposits have been built up above the existing topography and the associated laterite is shallow and located directly below, therefore satisfying the requirement for the Mineral Resource to have reasonable prospects for future economic extraction. The Teckraie and Verse Ouest rock dump Mineral Resources and Aires leach pad Mineral Resources have been reported above 0g/t Au because there is unlikely to be any grade selectively during mining. The underlying laterite Mineral Resources for each of the deposits has been reported above 0.5g/t Au given the possibility for some mining selectively.

All Mineral Resources are current as at 01 May 2017 and have been reported by cut-off grade and Mineral Resource category which is presented in Table 2.1.2.

Table 2.1.2 Mineral Resources as at Effective Date 01 May 2017

Deposit	Cut-Off	Indicated			Inferred		
		Tonnes ('000)	Au (g/t)	Au ('000 Oz)	Tonnes ('000)	Au (g/t)	Au ('000 Oz)
Aires	0	5,768	1.09	202			
	0.5				233	0.78	6
Bakatouo	0.5	10,242	2.14	704	606	2.27	44
Daapleu	0.5	28,072	1.50	1,349	748	0.92	22
Gbeitouo	0.5	2,865	1.35	124	270	1.48	13
Mont Ity/Ity Flat	0.5	10,098	2.20	716	9,696	1.40	436
Teckraie	0	2,819	1.07	97			
	0.5				114	0.55	2
Verse Ouest	0	5,883	0.99	187			
	0.5				2,276	0.5	37
Walter	0.5	1,641	1.23	65	601	1.35	26
ZiaNE	0.5	6,678	1.28	274	3,964	1.40	178
Total		**74,066**	**1.56**	**3,718**	**18,508**	**1.28**	**764**

2.1.5 Comparison with Previous Mineral Resource

The previous Mineral Resource is presented below in Table 2.1.3.

Table 2.1.3 Historical Mineral Resources as at Effective Date 31 May 2016

Deposit	Cut-Off	Indicated			Inferred		
		Tonnes ('000)	Au (g/t)	Au ('000 Oz)	Tonnes ('000)	Au (g/t)	Au ('000 Oz)
Aires	0	5,768	1.09	202			
	0.5				233	0.78	6
Daapleu	0.5	19,882	1.51	968	4,329	1.15	160
Gbeitouo	0.5	2,865	1.35	124	270	1.48	13
Mont Ity/Ity Flat	0.5	7,491	2.19	526	11,084	1.92	685
Teckraie	0	2,819	1.07	97			
	0.5				114	0.55	2
Verse Ouest	0	5,896	1.03	195			
	0.5	2,505	0.43	34			
Walter	0.5	2,069	1.21	81	657	1.32	28
ZiaNE	0.5	7,723	1.31	326	4,002	1.39	179
Total		**48,617**	**1.49**	**2,324**	**27,088**	**1.47**	**1,282**

Waterfall charts in Figure 2.1.1 to Figure 2.1.3 summarise the changes in Indicated, Inferred and Total gold ounces. The inclusion of the maiden Bakatouo Mineral Resource is the single biggest contribution to the overall increase in the total Ity CIL Project Mineral Resource inventory.

Infill and extensional diamond drilling at Daapleu converted 138,000 oz of Inferred Mineral Resources to Indicated and also increased the total contained metal by approximately 246,000 oz.

Infill diamond drilling at the combined Mont Ity / Ity Flat allowed the conversion of 235,000 oz from Inferred to Indicated. The estimated grade for the converted material was lower and resulted in a slight reduction of 9,000 oz in the total contained metal. Depletion due to mining has resulted in a reduction of approximately 50,000 oz.

The existing Verse Ouest low grade stockpile was drilled with an infill air core drilling program to increase confidence in the grade estimate and allow the conversion of 187,000 oz of Inferred to Indicated.

Mine depletion has decreased Walter and ZiaNE by 18,000 oz and 53,000 oz respectively.

Figure 2.1.1 Change in Indicated Mineral Resource ('000 Ounces)

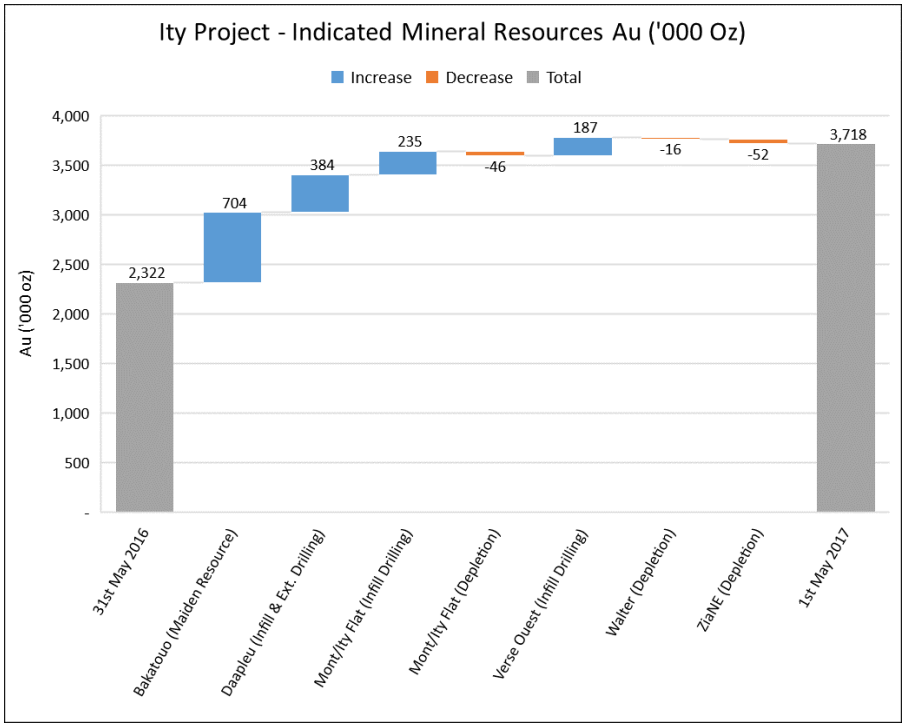


Figure 2.1.2 Change in Inferred Mineral Resource (‘000 Ounces)

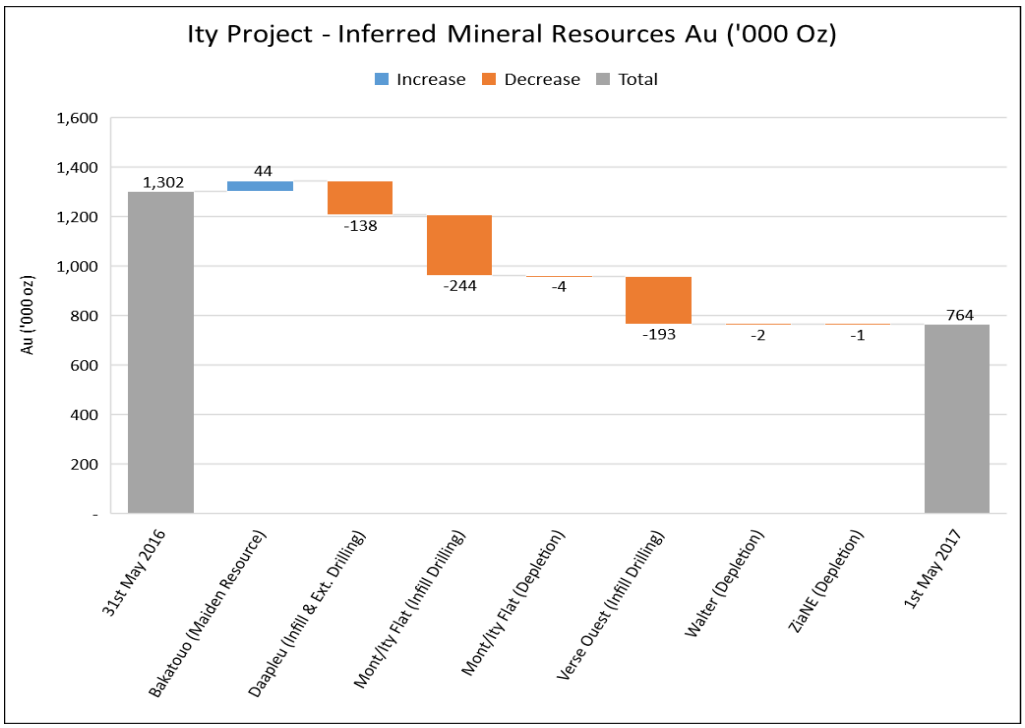
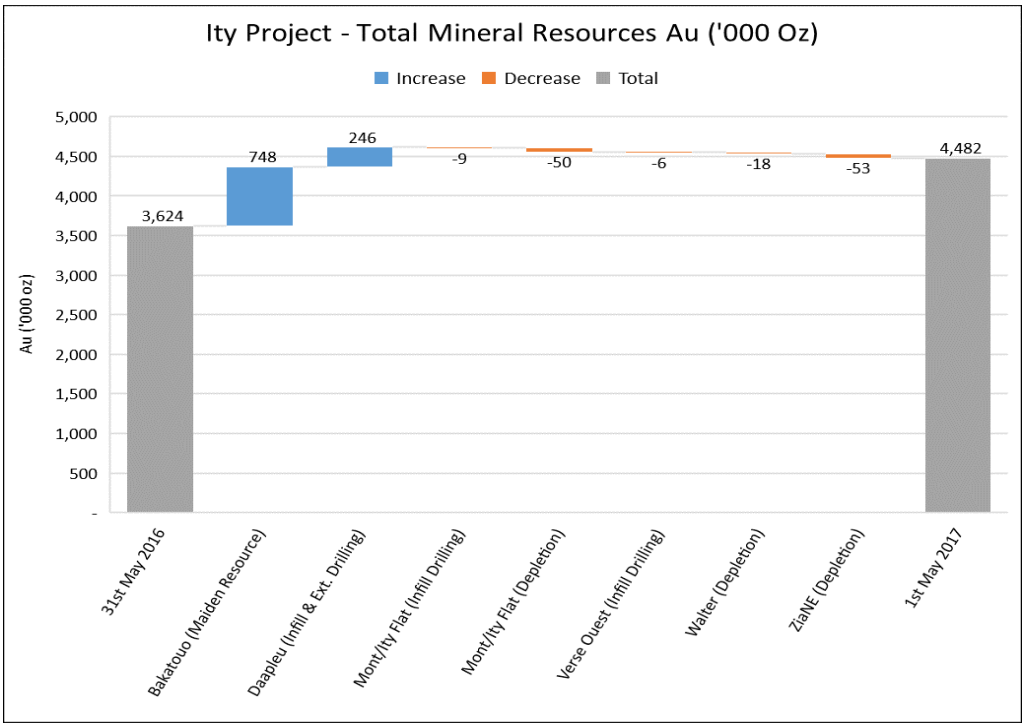


Figure 2.1.3 Change in Total Mineral Resource (‘000 Ounces)



ITY CIL PROJECT

OPTIMISATION STUDY

1955-000-GEREP-0003

Table of Contents

			Page
3.0	**MINING**		**3.1**
	3.1	Executive Summary	3.1
	3.2	Input Parameters	3.2
		3.2.1 Gold Price and Royalties	3.2
		3.2.2 Resource Model	3.2
		3.2.3 Mining Costs	3.3
		3.2.4 Processing Costs, Metallurgical Recoveries and Cut-off Grades	3.4
		3.2.5 Cut-off Grade Calculation	3.5
		3.2.6 Discounting Parameters	3.5
		3.2.7 Slope Angles	3.5
	3.3	Pit Optimisation Results	3.7
		3.3.1 Bakatouo Optimisation	3.7
		3.3.2 Daapleu Optimisation	3.10
		3.3.3 Ity Optimisation	3.13
	3.4	Pit Designs	3.16
		3.4.1 Bakatouo Design	3.16
		3.4.2 Daapleu Design	3.18
		3.4.3 Ity Design	3.21
		3.4.4 Gbeitouo Design	3.23
		3.4.5 Walter Design	3.25
		3.4.6 ZiaNE Design	3.27
	3.5	Open Pit Mineral Reserve Estimate	3.30
	3.6	Life of Mine Schedule	3.32
		3.6.1 Tax Concession	3.32
		3.6.2 Stockpiling	3.32
		3.6.3 Schedule Setup	3.34
	3.7	Schedule Results	3.35
		3.7.1 Scenario 4	3.35
		3.7.2 Scenario 5	3.38
		3.7.3 Scenario 6	3.40
		3.7.4 Scenario 7	3.42
		3.7.5 Scenario 7-1250 Opex 200717	3.44

TABLES

Table 3.1.1	Summary of Updated Mineral Reserve Estimate	3.1
Table 3.2.1	Revenue and Royalty Rate Assumptions	3.2
Table 3.2.2	Resource Model Summary	3.3
Table 3.2.3	Processing Costs, Recoveries and Cut-off Grade	3.4
Table 3.2.4	Pit Geotechnical Design Parameters	3.6
Table 3.3.1	Bakatouo Pit Optimisation Results Summary	3.8
Table 3.3.2	Daapleu Pit Optimisation Results Summary	3.11
Table 3.3.3	Ity Pit Optimisation Results Summary	3.14
Table 3.4.1	Bakatouo Pit Design Parameters	3.16
Table 3.4.2	Daapleu Pit Design Parameters	3.18
Table 3.4.3	Ity Pit Design Parameters	3.21
Table 3.5.1	Ity Project Mineral Reserves Details	3.31
Table 3.6.1	LOM Schedule Scenarios	3.33
Table 3.6.2	LOM Stockpiling Strategy	3.33
Table 3.6.3	Location Precedence's	3.35

Table of Contents (Continued)

Page

FIGURES

Figure 3.3.1	Bakatouo Optimisation Results – Tonnage / Cash Flow Chart	3.9
Figure 3.3.2	Daapleu Optimisation Results – Tonnage / Cash Flow Chart	3.12
Figure 3.3.3	Ity Optimisation Results – Tonnage / Cash Flow Chart	3.15
Figure 3.4.1	Bakatouo Final Design	3.17
Figure 3.4.2	Daapleu Stage 1 Design	3.19
Figure 3.4.3	Daapleu Stage 2 Design	3.20
Figure 3.4.4	Ity Final Design	3.22
Figure 3.4.5	Gbeitouo Final Design	3.24
Figure 3.4.6	Walter Final Design	3.26
Figure 3.4.7	ZiaNE Final Design	3.28
Figure 3.4.8	Zia Site Design	3.29
Figure 3.7.1	Scenario 4 - Total Mining Movements	3.35
Figure 3.7.2	Scenario 4 - Tonnes and Grade Processed in CIL	3.36
Figure 3.7.3	Scenario 4 - Recovered Ounces	3.36
Figure 3.7.4	Scenario 4 - Stockpiles	3.37
Figure 3.7.5	Scenario 5 - Total Material Movements	3.38
Figure 3.7.6	Scenario 5 - Tonnes and Grade Processed in CIL	3.38
Figure 3.7.7	Scenario 5 - Recovered Ounces	3.39
Figure 3.7.8	Scenario 5 - Stockpiles	3.39
Figure 3.7.9	Scenario 6 - Total Material Movements	3.40
Figure 3.7.10	Scenario 6 – Tonnes and Grade Processed in CIL	3.40
Figure 3.7.11	Scenario 6 - Recovered Ounces Produced	3.41
Figure 3.7.12	Scenario 6 - Stockpiles	3.41
Figure 3.7.13	Scenario 7 - Total Material Movements	3.42
Figure 3.7.14	Scenario 7 - Tonnes and Grade Processed in CIL	3.42
Figure 3.7.15	Scenario 7 - Recovered Ounces Produced	3.43
Figure 3.7.16	Scenario 7 - Stockpiles	3.43
Figure 3.7.17	Scenario 7-1250 Opex 200717 - Total Material Movements	3.44
Figure 3.7.18	Scenario 7-1250 Opex 200717 - Tonnes and Grade Processed in CIL	3.44
Figure 3.7.19	Scenario 7-1250 Opex 200717 - Recovered Ounces Produced	3.45
Figure 3.7.20	Scenario 7-1250 Opex 200717 - Stockpiles	3.45

3.0 MINING

3.1 Executive Summary

Cube Consulting was retained by Endeavour to update the Ity life of mine plan based primarily on updated resources at three of the project deposits, namely Daapleu, Mont Ity and Bakatouo and a proposed revised process facility capacity from 3 Mtpa to 4 Mtpa.

Broadly, the scope of Cube's work included; open pit optimisation studies and pit designs on the three updated resources, and a range of life of mine scheduling scenarios with various treatment options.

The results of four of the Life Of Mine (LOM) production schedules were selected by Endeavour and are presented here for evaluation and consideration by Endeavour for further evaluation and strategic decision making.

Furthermore, Cube's work culminated in the estimation of an updated Mineral Reserve for the Ity project. A summary of this preliminary estimate is shown in Table 3.1.1.

Table 3.1.1 Summary of Updated Mineral Reserve Estimate

Deposit	Probable Mineral Reserves		
	Tonnes	Gold Grade	Gold Metal
	(kt)	(g/t)	(koz)
Open Pits			
Bakatouo	8,522	2.28	625
Daapleu	18,961	1.68	1,027
Mont Ity	7,978	2.23	572
Gbeitouo	2,862	1.26	116
Walter	1,611	1.15	59
ZiaNE	8,432	1.04	282
Total Open Pits	48,365	1.72	2,681
Stockpiles and Leach pad	14,470	1.05	486
Total	**62,835**	**1.57**	**3,167**

This Mineral Reserve estimate is reported as of end April 2017. Changes from the previously reported Mineral Reserves are largely due to revised and updated Mineral Resource estimates on the Daapleu, Ity and Bakatouo deposits. In the case of Bakatouo, this is the first inclusion of this deposit in Mineral Reserves. Other changes from previous Mineral Reserves are due to changed operating costs largely associated with revised processing capabilities from a 3 Mtpa treatment facility to a 4 Mtpa treatment facility.

3.2 Input Parameters

Input parameters provided by Endeavour comprised of mining and process operating costs, recoveries and slope parameters. The mining costs were contained in the file *"Ity Mining Cost Model_Sched_v6a 4mtpa_Rev1.5.xlsx"*. The processing costs and recoveries were provided in the file *"Pit Op inputs for Cube 200717.xlsx",* (sheet Rev f Opex). Details of the various input parameters are discussed in the sections below.

3.2.1 Gold Price and Royalties

A base gold price of $1250/oz was used for the open pit optimisation. A 3.5% royalty (Valorem Tax), as well as 99.95% payable gold and a refining and transport cost of $5/oz was applied in the optimisation process.

Table 3.2.1 Revenue and Royalty Rate Assumptions

Item	Unit	Value
Gold Price	$/oz	1,250
Valorem Tax	%	3.50
Payable Gold	%	99.95
Refining and Transport	$/oz	5.00
Net Price	$/oz	1,200.625
Net Price	$/g	38.601

3.2.2 Resource Model

Optimisation and designs were carried out for Bakatouo, Daapleu and Ity models, as the other models had not been modified, previous designs were used. The resource models, estimated by Cube, are Ordinary Kriged (OK) SURPAC models.

Table 3.2.2 Resource Model Summary

Pit	Model		Eastern (X)	Northern (Y)	Elevation (Z)
Bakatouo	*bm_smu_bak_june17.mdl*	*Minimum Coordinates*	*598 700*	*760 800*	*0*
		Maximum Coordinates	*599 600*	*762 000*	*300*
		Parent Block Size	*10*	*10*	*5*
		Sub-Block Size	*5*	*5*	*2.5*
Daapleu	*bm_smu_daapleu_june17.mdl*	Minimum Coordinates	598 900	757 250	-100
		Maximum Coordinates	601 400	759 400	350
		Parent Block Size	5	5	2.5
		Sub-Block Size	5	5	2.5
Ity	*bm_smu_ity_june17.mdl*	*Minimum Coordinates*	*597 500*	*759 400*	*-75*
		Maximum Coordinates	*598 625*	*761 050*	*325*
		Parent Block Size	*5*	*5*	*2.5*
		Sub-Block Size	*5*	*5*	*2.5*

3.2.3 Mining Costs

Endeavour provided mining costs for ore and waste by elevation and by pit. The mining cost model was provided by Calsta in April 2017. These costs included the following items:

- Pit loading.
- Pit haulage.
- Pit ancillary.
- Drill and blast.
- Grade control.
- Overhaul equipment.

The mining costs used were contained in the file *"Ity Mining Cost Model_Sched_v6a 4mtpa_Rev1.5.xlsx"*.

3.2.4 Processing Costs, Metallurgical Recoveries and Cut-off Grades

Endeavour provided the processing costs for the processing of ore in the 4 Mtpa CIL process. The process costs were by pit and by material type.

Table 3.2.3 Processing Costs, Recoveries and Cut-off Grade

Pit	Arsenic	Oxidation	Processing Cost ($/tonne)	Recovery (%)	Cut-Off (g/t)
Daapleu	All	Oxide	11.86	85.20	0.36
		Transitional	14.78	66.00	0.58
		Fresh	14.78	66.00	0.58
Bakatouo	All	Oxide	13.07	94.50	0.36
		Transitional	25.92	84.00	0.80
		Fresh	15.41	97.00	0.41
Ity	All	Oxide	15.43	89.40	0.45
		Transitional	15.43	89.40	0.45
		Fresh	15.43	89.40	0.45
Gbeitouo	All	Oxide	12.83	87.70	0.38
		Transitional	12.83	87.70	0.38
		Fresh	12.83	87.70	0.38
Walter	All	Oxide	12.96	95.60	0.35
		Transitional	12.96	95.60	0.35
		Fresh	12.96	95.60	0.35
Zia NE	All	Oxide	11.32	96.70	0.30
		Transitional	11.32	96.70	0.30
		Fresh	11.32	96.70	0.30
Aires	All	Oxide	14.11	91.63	0.40
		Transitional	14.11	91.63	0.40
		Fresh	14.11	91.63	0.40
Dump	All	Oxide	14.11	91.63	0.40
		Transitional	14.11	91.63	0.40
		Fresh	14.11	91.63	0.40

3.2.5 Cut-off Grade Calculation

Treatment plant breakeven cut-off grades were calculated for the evaluation of the mineable mineral resources. The cut-off grade was determined by:

$$Cut - Off\ Grade\ (Au\ g/t) = \frac{Treatment\ Plant\ Costs}{Final\ Gold\ Price * Recovery}$$

Where: Treatment Plant Costs = Processing costs (by material $/t)

Final Gold Price = $1200.625/oz ($38.60/gm)

Recovery = Metallurgical Recovery (%)

Note: Final gold price takes into account the 3.5% Valorem, 99.95% payable gold and $5/oz refining and transport costs.

3.2.6 Discounting Parameters

For the purposes of creating discounted cash flow scenarios in the optimisations, a discount factor of 10% pa was applied.

3.2.7 Slope Angles

Geotechnical parameters for the design of Daapleu and Ity were based on a geotechnical review of the open pit slope designs as outlined in the report *"1955-000-GREP-0001_C-S4.docx*". Geotechnical parameters for the design of Bakatouo were based on a geotechnical review of the open pit slope designs as outlined in the Geotech report from P O'Bryan and Associates. A summary of the recommendations is shown in Table 3.2.4. The inter-ramp angles were modified to include access ramps to derive an overall slope angle to be used as an input in pit optimisation.

Table 3.2.4 Pit Geotechnical Design Parameters

Pit / Region	Elevation (mRL)	Batter Height	Berm Width	Batter Angle	Inter Ramp Angle
Daapleu	Natural Surface to 5 mbs	5 m	3m	50°	34.8°
Daapleu	15 mbs to 25 mbs	10 m	5 m	50°	36.7°
Daapleu	25 mbs to 45 mbs	20 m	7 m	60°	47.2°
Daapleu	4 5mbs to 205 mbs	10 m	5 m	75°	58.3°
Ity	Natural Surface to base of soil overburden and laterite	4 m	4 m	50°	28.5°
Ity	Natural Surface to BOCO Surface	5 m	3.5 m	50°	33°
Ity	Between BOCO and TOFR	10 m	5.5 m	55°	38.7°
Ity Flat (Western Domain)	Below TOFR	15 m	6 m	70°	52.6°
Ity Flat (Eastern Domain)	Below TOFR	15m	6 m	55°	42.3°
Mont Ity (Western Domain)	Below TOFR	15 m	6 m	70°	52.6°
Mont Ity (Eastern Domain)	Below TOFR	15 m	8 m	65°	45°
Bakatouo	Natural Surface to base of soil overburden and laterite	4 m	4 m	50°	28.5°
Bakatouo	Natural Surface to BOCO Surface	5 m	3.5 m	50°	33°
Bakatouo	Between BOCO and TOFR	10 m	5.5 m	55°	38.7°
Bakatouo	Below TOFR	20 m	7 m	70°	54.5°

3.3 Pit Optimisation Results

Pit optimisations were carried out for the updated models that were received. These were Bakatouo, Daapleu and Ity. The optimisations were carried out using Whittle pit optimisation software and using the parameters discussed above. Bakatouo and Daapleu optimisations were carried out for a range of gold prices from $375/oz to $2500/oz in $25/oz increments, with $1250/oz as the base price. Ity optimisation was carried out for a range of gold prices from $250/oz to $1500/oz in $25/oz increments, with $1250/oz as the base price.

The optimisations were evaluated by reviewing theoretical schedules based on a 'best' case and a 'worst' case schedule and an undiscounted cash flow. The best case scenario simulates the mining of each individual nested shells sequentially. This is usually impractical to achieve operationally as the minimum mining width required to mine a stage is far greater than the actual width between the nested shells. The so-called worst case scenario simulates the mining of an entire bench of a pit before the next bench is mined. In practice, a compromise between the two cases is generally achievable by staging the pit using suitable cutbacks. However, given the relatively small size of the pits and the lack of multiple staging for these deposits, the worst case scenario is considered the best indicator to assist in the selection of the target pit shell for design.

The cash flows as described above exclude capital expenditure or project start-up costs and are used for pit optimisation evaluation as relative values only to assist in the selection of shells on which pit designs can be based. The results of the optimisations were reviewed and put in the context of sensitivities, risks, contained ounces, mine life and total project size to guide shell selections on which open pit designs are based.

Two optimisations were run for each deposit; measured and indicated (Run A) resources only, and then measured, indicated, and inferred resources (Run B). Only the measured and indicated resources optimisations are detailed in this report and used as the basis of pit design/evaluations, Life of Mine (LOM) planning and Mineral Reserves reporting.

3.3.1 Bakatouo Optimisation

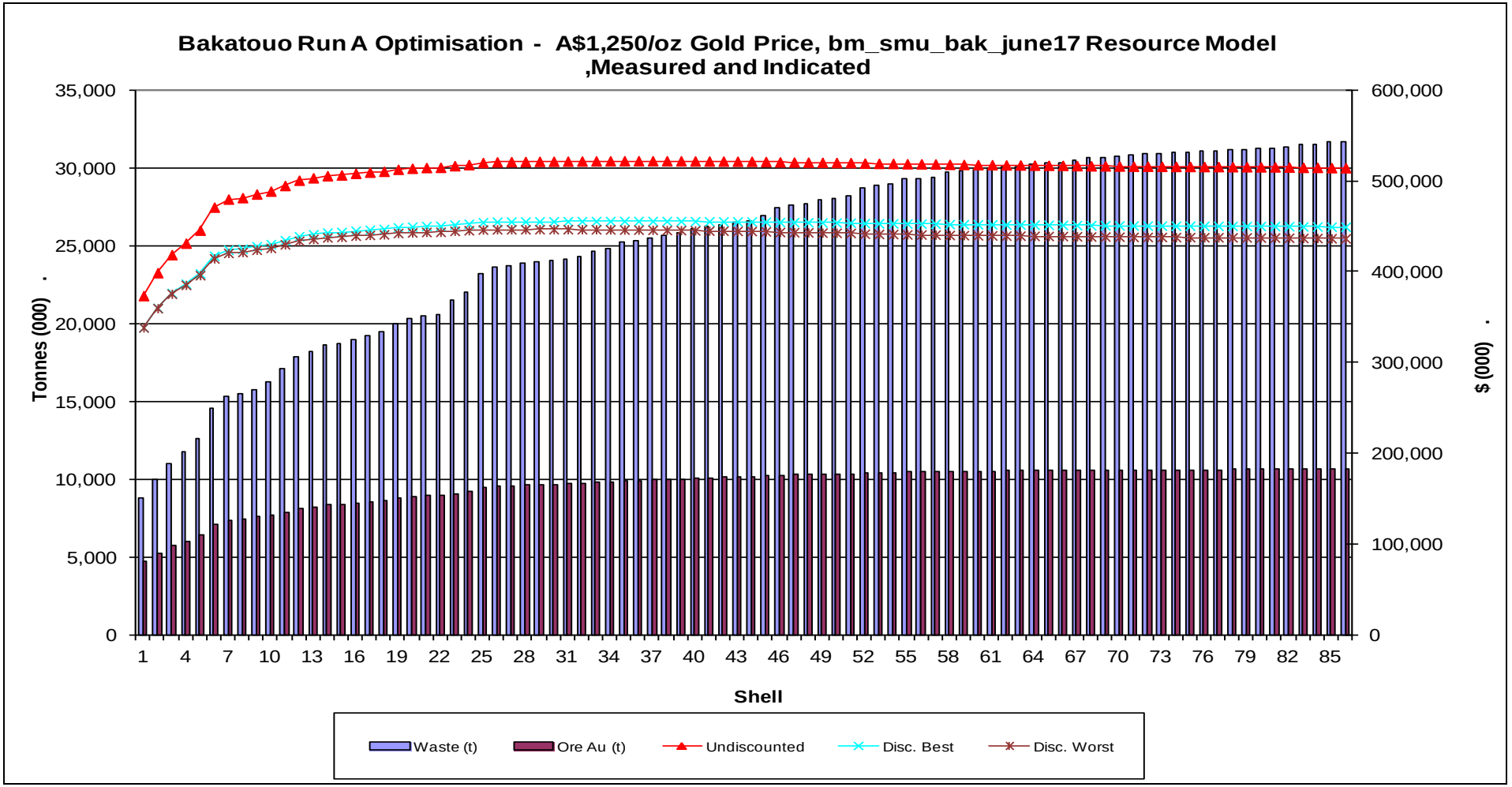
Table 3.3.1 and Figure 3.3.1 show the results of the Bakatouo Run A pit optimisation. This optimisation run forms the basis of all subsequent discussions on pit design and pit inventories. Shell 14 was selected as the guide for the Bakatouo design.

When running the Bakatouo optimisation it was anticipated the transitional material would be processed using a sulphide circuit. This had a processing cost of $23.31/t rather than $25.11/t in the CIL. The recoveries were the same at 84%. After discussion following initial scheduling it was decided to develop the schedule without the Sulphide circuit. This resulted in the Bakatouo material not being processed initially in some scenarios, instead being placed on a stockpile.

Table 3.3.1 Bakatouo Pit Optimisation Results Summary

Shell	Factor	Price	Base RL	Total Tonnes	Waste Tonnes	Strip Ratio	Processed Ore			Mining Cost	Process Cost	Selling Cost Au	Revenue Au	Undiscounted Cash Flow	Discounted Best	Discounted Worst	Cost /Oz	Incr. Cost /Oz
							Tonnes	Au g/t	Rec. Au Oz									
1	0.300	375	140.0	13,459,207	8,748,864	1.9	4,710,343	2.85	403,432	31,044,256	80,205,302	19,919,466	504,290,276	373,121,252	338,143,449	338,143,449	325	325
2	0.320	400	140.0	15,213,858	9,980,444	1.9	5,233,414	2.77	436,014	35,832,170	89,285,727	21,528,210	545,017,984	398,371,877	359,666,268	359,286,376	336	475
3	0.340	425	135.0	16,714,143	11,015,456	1.9	5,698,687	2.69	462,607	39,812,945	97,360,828	22,841,223	578,258,814	418,243,819	376,094,629	375,173,809	346	503
4	0.360	450	135.0	17,793,640	11,774,716	2.0	6,018,924	2.65	480,167	42,722,298	102,875,029	23,708,246	600,208,767	430,903,194	386,303,141	384,975,237	353	529
5	0.380	475	135.0	19,011,516	12,584,198	2.0	6,427,318	2.58	500,753	46,086,050	109,888,044	24,724,687	625,941,451	445,242,670	397,540,054	395,652,921	361	553
6	0.400	500	120.0	21,616,974	14,518,709	2.1	7,098,265	2.51	537,371	53,459,741	121,137,981	26,532,721	671,714,449	470,584,005	417,013,419	414,131,079	374	558
7	0.420	525	120.0	22,687,127	15,332,751	2.1	7,354,376	2.48	550,777	56,275,826	125,560,759	27,194,635	688,471,781	479,440,561	423,589,543	420,137,521	380	589
8	0.440	550	120.0	22,862,479	15,451,233	2.1	7,411,246	2.47	553,248	56,685,027	126,530,949	27,316,609	691,559,714	481,027,129	424,719,667	421,149,835	381	608
9	0.460	575	120.0	23,326,348	15,767,364	2.1	7,558,984	2.45	559,711	57,974,368	129,030,619	27,635,764	699,639,596	484,998,845	427,514,778	423,673,912	383	636
10	0.480	600	120.0	23,892,419	16,224,623	2.1	7,667,796	2.44	565,080	59,379,969	130,849,398	27,900,850	706,350,632	488,220,415	429,806,533	425,687,325	386	650
11	0.500	625	120.0	24,948,012	17,069,315	2.2	7,878,697	2.41	575,623	62,329,255	134,392,063	28,421,386	719,528,762	494,386,057	434,146,783	429,604,600	391	665
12	0.520	650	115.0	25,931,432	17,815,033	2.2	8,116,399	2.39	586,147	65,089,269	138,441,224	28,941,023	732,684,137	500,212,621	438,497,014	433,544,808	397	696
13	0.540	675	110.0	26,438,004	18,209,923	2.2	8,228,081	2.37	591,146	66,545,931	140,342,431	29,187,831	738,932,416	502,856,224	440,661,174	435,590,897	399	721
14	0.560	700	110.0	26,938,051	18,606,139	2.2	8,331,912	2.36	595,612	67,854,599	142,107,521	29,408,362	744,515,495	505,145,014	442,524,309	437,267,504	402	738
15	0.580	725	110.0	27,097,773	18,717,498	2.2	8,380,275	2.35	597,393	68,293,201	142,947,860	29,496,310	746,742,030	506,004,660	443,219,902	437,865,612	403	767
16	0.600	750	110.0	27,468,917	18,986,882	2.2	8,482,035	2.34	601,195	69,379,711	144,647,292	29,684,031	751,494,451	507,783,417	444,653,709	439,159,555	405	782
17	0.620	775	110.0	27,785,629	19,217,062	2.2	8,568,567	2.33	604,210	70,237,719	146,095,405	29,832,890	755,263,044	509,097,030	445,705,234	440,000,423	407	814
18	0.640	800	110.0	28,056,860	19,429,490	2.3	8,627,370	2.32	606,450	70,981,449	147,101,542	29,943,465	758,062,393	510,035,938	446,454,951	440,616,663	409	831
19	0.660	825	110.0	28,742,581	19,964,250	2.3	8,778,331	2.30	612,036	72,949,311	149,629,253	30,219,294	765,045,418	512,247,560	448,208,696	442,082,361	413	854
20	0.680	850	110.0	29,145,471	20,283,907	2.3	8,861,564	2.29	615,092	74,065,246	151,035,958	30,370,186	768,865,458	513,394,068	449,111,171	442,751,273	415	875
21	0.700	875	110.0	29,440,050	20,523,646	2.3	8,916,404	2.28	617,224	74,934,658	151,958,278	30,475,462	771,530,688	514,162,289	449,714,169	443,243,347	417	890
22	0.720	900	110.0	29,512,629	20,571,077	2.3	8,941,552	2.28	617,961	75,145,890	152,391,250	30,511,836	772,451,535	514,402,559	449,899,632	443,372,328	418	924
23	0.740	925	105.0	30,551,403	21,476,491	2.4	9,074,912	2.27	623,742	78,051,634	154,621,566	30,797,257	779,677,396	516,206,938	451,306,470	444,496,923	422	938
24	0.760	950	105.0	31,203,898	22,017,289	2.4	9,186,609	2.25	627,895	79,971,162	156,508,626	31,002,327	784,869,035	517,386,920	452,211,632	445,133,305	426	966
25	0.780	975	105.0	32,611,821	23,152,713	2.5	9,459,108	2.22	636,863	83,868,711	161,082,776	31,445,133	796,079,308	519,682,689	453,933,951	445,893,085	434	994
26	0.800	1000	105.0	33,153,820	23,611,040	2.5	9,542,780	2.21	639,857	85,313,628	162,496,560	31,592,963	799,821,842	520,418,692	454,482,926	446,167,672	437	1,004
27	0.820	1025	105.0	33,306,127	23,732,494	2.5	9,573,633	2.21	640,780	85,691,370	163,020,277	31,638,505	800,974,821	520,624,669	454,632,711	446,188,710	438	1,027
28	0.840	1050	105.0	33,434,662	23,831,416	2.5	9,603,246	2.20	641,639	86,053,088	163,520,535	31,680,912	802,048,402	520,793,867	454,753,587	446,228,633	438	1,053
29	0.860	1075	105.0	33,598,566	23,957,072	2.5	9,641,494	2.20	642,754	86,553,246	164,159,696	31,735,983	803,442,605	520,993,681	454,894,565	446,289,727	439	1,071
30	0.880	1100	105.0	33,668,013	24,004,647	2.5	9,663,366	2.20	643,310	86,766,554	164,530,764	31,763,447	804,137,902	521,077,137	454,950,588	446,298,185	440	1,100
31	0.900	1125	105.0	33,837,189	24,132,496	2.5	9,704,693	2.19	644,421	87,258,349	165,231,111	31,818,300	805,526,582	521,218,823	455,043,571	446,267,364	441	1,122
32	0.920	1150	105.0	34,050,402	24,308,422	2.5	9,741,980	2.18	645,535	87,842,718	165,862,670	31,873,310	806,919,239	521,340,541	455,122,442	446,230,108	442	1,141
33	0.940	1175	105.0	34,455,121	24,660,231	2.5	9,794,890	2.18	647,370	88,991,811	166,759,391	31,963,904	809,212,765	521,497,658	455,221,738	446,172,357	444	1,164
34	0.960	1200	100.0	34,654,359	24,818,503	2.5	9,835,856	2.17	648,475	89,549,001	167,461,856	32,018,469	810,594,154	521,564,828	455,255,328	446,075,113	446	1,189
35	0.980	1225	100.0	35,104,078	25,207,356	2.6	9,896,722	2.17	650,330	90,687,809	168,479,070	32,110,055	812,912,793	521,635,859	455,282,354	445,875,141	448	1,212
36	1.000	1250	100.0	35,243,699	25,322,797	2.6	9,920,902	2.16	651,023	91,102,513	168,888,300	32,144,263	813,778,815	521,643,739	455,277,001	445,806,391	449	1,239
37	1.020	1275	100.0	35,398,432	25,451,777	2.6	9,946,655	2.16	651,726	91,513,356	169,326,088	32,178,980	814,657,708	521,639,284	455,261,162	445,666,481	450	1,256
38	1.040	1300	100.0	35,651,818	25,668,435	2.6	9,983,383	2.16	652,716	92,112,404	169,952,131	32,227,846	815,894,840	521,602,459	455,214,574	445,390,118	451	1,287
39	1.060	1325	100.0	35,835,700	25,825,794	2.6	10,009,906	2.15	653,510	92,668,376	170,397,980	32,267,084	816,888,207	521,554,766	455,164,349	445,261,218	452	1,310
40	1.080	1350	100.0	36,127,640	26,069,628	2.6	10,058,012	2.15	654,810	93,542,889	171,202,037	32,331,253	818,512,730	521,436,551	455,048,440	445,000,538	454	1,341
41	1.100	1375	100.0	36,343,903	26,251,516	2.6	10,092,387	2.14	655,734	94,168,890	171,788,577	32,376,877	819,667,768	521,333,424	454,951,095	444,774,063	455	1,362
42	1.120	1400	100.0	36,476,995	26,364,560	2.6	10,112,435	2.14	656,254	94,521,759	172,130,356	32,402,528	820,317,158	521,262,515	454,885,931	444,628,624	456	1,386
43	1.140	1425	100.0	36,656,416	26,516,848	2.6	10,139,568	2.14	656,930	94,992,021	172,583,200	32,435,919	821,162,510	521,151,370	454,785,910	444,431,778	457	1,414
44	1.160	1450	100.0	36,754,436	26,597,734	2.6	10,156,702	2.13	657,341	95,276,539	172,871,630	32,456,215	821,676,321	521,071,936	454,715,551	444,287,367	457	1,443
45	1.180	1475	100.0	37,103,984	26,903,287	2.6	10,200,697	2.13	658,563	96,259,648	173,622,346	32,516,560	823,204,059	520,805,504	454,486,147	443,903,795	459	1,468
46	1.200	1500	100.0	37,683,692	27,420,439	2.7	10,263,253	2.12	660,340	97,744,298	174,687,061	32,604,280	825,424,799	520,389,159	454,131,381	443,197,286	462	1,484
47	1.220	1525	100.0	37,890,547	27,605,371	2.7	10,285,176	2.12	660,991	98,325,680	175,060,710	32,636,431	826,238,761	520,215,940	453,985,918	442,952,734	463	1,516
48	1.240	1550	100.0	38,017,554	27,715,506	2.7	10,302,048	2.12	661,422	98,686,958	175,345,916	32,657,718	826,777,662	520,087,071	453,877,542	442,784,300	464	1,549
49	1.260	1575	100.0	38,296,050	27,972,773	2.7	10,323,277	2.11	662,130	99,404,463	175,701,753	32,692,680	827,662,784	519,863,887	453,693,575	442,486,755	465	1,565
50	1.280	1600	100.0	38,403,463	28,065,497	2.7	10,337,966	2.11	662,481	99,704,754	175,949,283	32,710,009	828,101,482	519,737,437	453,588,257	442,318,701	465	1,610
51	1.300	1625	100.0	38,526,105	28,171,969	2.7	10,354,136	2.11	662,880	100,066,057	176,220,889	32,729,707	828,600,163	519,583,511	453,460,896	442,126,314	466	1,636

Figure 3.3.1 Bakatouo Optimisation Results – Tonnage / Cash Flow Chart



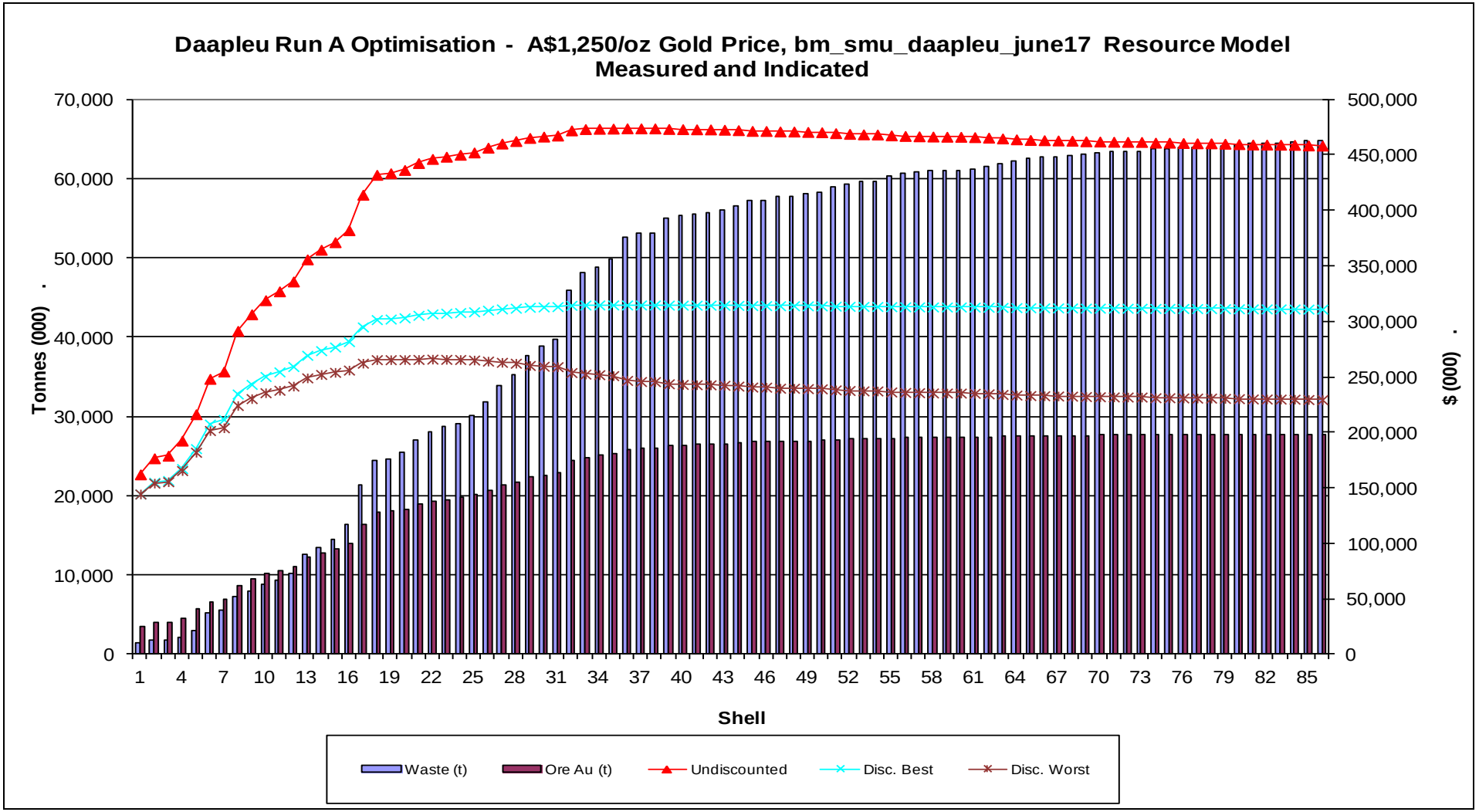
3.3.2 Daapleu Optimisation

Table 3.3.2 and Figure 3.3.2 show the results of the Daapleu Run A pit optimisation. This optimisation run forms the basis of all subsequent discussions on pit design and pit inventories. Shell 22 was selected as the guide for the Daapleu final design, Stage 2, whilst Shell 8 was selected to guide Stage 1.

Table 3.3.2 Daapleu Pit Optimisation Results Summary

Shell	Factor	Price	Base RL	Total Tonnes	Waste Tonnes	Strip Ratio	Total Processed Ore			Mining Cost	Process Cost	Selling Cost Au	Revenue Au	Undiscounted Cash Flow	Discounted Best	Discounted Worst	Cost /Oz	Incr. Cost /Oz
							Tonnes	Au g/t	Rec. Au Oz									
1	0.300	375	145.0	4,886,421	1,399,017	0.4	3,487,404	2.26	186,263	12,145,817	49,264,221	9,196,763	232,829,452	162,222,651	144,564,000	144,564,000	379	379
2	0.320	400	135.0	5,744,045	1,736,847	0.4	4,007,198	2.19	206,732	14,466,443	57,028,300	10,207,373	258,414,492	176,712,375	155,137,106	154,343,723	395	542
3	0.340	425	135.0	5,863,234	1,773,760	0.4	4,089,474	2.18	209,985	14,754,620	58,321,946	10,368,021	262,481,541	179,036,954	156,670,993	155,616,854	397	536
4	0.360	450	135.0	6,814,088	2,214,551	0.5	4,599,537	2.13	229,605	17,190,792	65,850,617	11,336,736	287,005,982	192,627,836	167,458,005	165,654,170	411	557
5	0.380	475	130.0	8,669,218	3,006,532	0.5	5,662,686	2.02	266,049	22,093,995	80,886,162	13,136,172	332,561,315	216,444,985	185,424,470	182,162,255	436	596
6	0.400	500	125.0	11,900,404	5,222,026	0.8	6,678,378	2.02	313,494	31,076,025	97,022,315	15,478,795	391,868,216	248,291,081	207,543,286	201,727,241	458	579
7	0.420	525	120.0	12,483,014	5,528,205	0.8	6,954,809	2.00	324,028	32,661,277	101,460,534	15,998,886	405,035,067	254,914,371	211,706,830	204,225,701	463	621
8	0.440	550	105.0	15,954,444	7,254,265	0.8	8,700,179	1.91	384,306	42,742,042	127,171,245	18,975,105	480,382,399	291,494,007	234,649,163	224,283,442	492	643
9	0.460	575	95.0	17,487,366	8,002,956	0.8	9,484,410	1.88	410,312	47,167,141	138,980,085	20,259,181	512,890,653	306,484,245	243,302,944	230,484,248	503	674
10	0.480	600	85.0	19,012,520	8,893,094	0.9	10,119,426	1.86	432,582	51,605,231	148,608,132	21,358,737	540,727,512	319,155,412	250,407,960	235,802,506	512	681
11	0.500	625	85.0	19,996,386	9,423,822	0.9	10,572,564	1.84	447,171	54,323,353	155,403,314	22,079,080	558,964,029	327,158,283	254,572,269	238,024,310	518	701
12	0.520	650	80.0	21,313,263	10,241,863	0.9	11,071,400	1.83	463,800	58,159,050	162,662,518	22,900,120	579,749,884	336,028,196	259,401,503	241,785,104	525	717
13	0.540	675	65.0	24,806,231	12,580,201	1.0	12,226,030	1.80	503,110	68,418,786	179,674,302	24,841,068	628,887,799	355,953,644	269,517,175	249,180,179	542	743
14	0.560	700	60.0	26,274,951	13,471,865	1.1	12,803,086	1.78	520,888	72,742,338	188,020,656	25,718,845	651,109,999	364,628,160	273,706,180	252,275,134	550	762
15	0.580	725	55.0	27,689,687	14,439,994	1.1	13,249,693	1.77	535,578	76,915,696	194,697,796	26,444,177	669,472,840	371,415,171	276,994,046	254,176,185	557	788
16	0.600	750	50.0	30,284,034	16,350,049	1.2	13,933,985	1.76	559,476	84,376,983	205,135,240	27,624,140	699,345,309	382,208,946	281,842,348	256,208,731	567	798
17	0.620	775	30.0	37,812,149	21,409,888	1.3	16,402,261	1.70	635,058	106,914,546	241,358,381	31,356,014	793,823,140	414,194,199	295,066,179	262,423,005	598	827
18	0.640	800	20.0	42,420,019	24,489,180	1.4	17,930,839	1.67	680,078	120,702,903	263,686,769	33,578,873	850,098,051	432,129,506	301,696,346	265,599,740	615	852
19	0.660	825	20.0	42,740,432	24,662,898	1.4	18,077,534	1.67	683,826	121,640,257	265,826,624	33,763,914	854,782,636	433,551,840	302,182,978	265,578,729	616	870
20	0.680	850	20.0	43,773,043	25,451,849	1.4	18,321,194	1.67	691,824	124,622,046	269,483,492	34,158,812	864,780,036	436,515,687	303,305,193	265,671,730	619	879
21	0.700	875	15.0	45,931,070	26,994,196	1.4	18,936,874	1.66	709,835	130,891,335	278,617,346	35,048,123	887,294,263	442,737,459	305,543,471	265,800,778	626	905
22	0.720	900	10.0	47,332,760	27,991,276	1.5	19,341,484	1.65	721,389	135,140,309	284,526,391	35,618,590	901,736,457	446,451,166	306,809,495	266,067,967	631	929
23	0.740	925	10.0	48,250,965	28,694,112	1.5	19,556,853	1.65	727,943	137,885,942	287,644,367	35,942,194	909,928,961	448,456,457	307,475,666	265,875,831	634	944
24	0.760	950	5.0	48,966,584	29,151,771	1.5	19,814,813	1.64	734,180	140,020,211	291,251,659	36,250,143	917,725,123	450,203,111	308,041,865	265,730,763	637	970
25	0.780	975	5.0	50,190,629	30,107,659	1.5	20,082,970	1.63	742,154	143,578,053	295,175,997	36,643,868	927,692,839	452,294,923	308,729,753	265,260,598	641	988
26	0.800	1000	5.0	52,565,941	31,828,020	1.5	20,737,921	1.62	759,575	150,649,693	304,728,376	37,504,042	949,469,416	456,587,306	310,149,986	264,294,794	649	1,004
27	0.820	1025	0.0	55,175,550	33,825,128	1.6	21,350,422	1.61	776,481	158,430,891	313,546,912	38,338,770	970,601,758	460,285,185	311,302,728	263,196,646	657	1,031
28	0.840	1050	-5.0	57,093,642	35,331,297	1.6	21,762,345	1.61	788,389	164,339,929	319,643,913	38,926,744	985,487,174	462,576,589	311,963,623	262,383,825	663	1,058
29	0.860	1075	-5.0	60,036,979	37,708,660	1.7	22,328,319	1.60	804,864	173,031,385	327,929,020	39,740,180	1,006,080,495	465,379,910	312,782,816	260,361,283	672	1,080
30	0.880	1100	-5.0	61,462,090	38,844,263	1.7	22,617,827	1.60	812,877	177,283,419	332,104,438	40,135,841	1,016,097,218	466,573,520	313,123,969	259,653,708	676	1,101
31	0.900	1125	-5.0	62,689,837	39,737,705	1.7	22,952,132	1.59	820,434	180,895,186	336,626,833	40,508,938	1,025,542,731	467,511,773	313,391,092	259,255,075	680	1,126
32	0.920	1150	-20.0	70,335,716	45,934,789	1.9	24,400,927	1.57	861,515	204,153,508	358,047,518	42,537,303	1,076,893,761	472,155,432	314,547,963	253,962,701	702	1,137
33	0.940	1175	-25.0	72,941,915	48,073,787	1.9	24,868,128	1.57	874,877	212,222,799	364,824,797	43,197,053	1,093,596,277	473,351,628	314,835,015	252,566,913	709	1,160
34	0.960	1200	-25.0	73,944,079	48,883,767	2.0	25,060,312	1.56	879,730	215,150,800	367,475,627	43,436,704	1,099,663,402	473,600,270	314,889,574	252,038,329	712	1,199
35	0.980	1225	-30.0	75,073,662	49,813,950	2.0	25,259,712	1.56	885,222	218,652,757	370,404,569	43,707,871	1,106,528,379	473,763,183	314,909,853	251,207,862	715	1,220
36	1.000	1250	-30.0	78,400,486	52,535,122	2.0	25,865,364	1.55	900,863	228,072,134	379,509,354	44,480,117	1,126,078,924	474,017,319	314,895,158	246,880,926	724	1,234
37	1.020	1275	-30.0	79,146,228	53,139,365	2.0	26,006,863	1.55	904,429	230,271,233	381,632,328	44,656,207	1,130,536,876	473,977,109	314,883,650	245,893,130	726	1,261
38	1.040	1300	-30.0	79,216,946	53,189,514	2.0	26,027,432	1.55	904,818	230,476,286	381,910,413	44,675,422	1,131,023,339	473,961,219	314,879,451	245,836,435	726	1,291
39	1.060	1325	-35.0	81,267,774	54,939,646	2.1	26,328,128	1.55	913,147	236,538,213	386,370,038	45,086,668	1,141,434,628	473,439,710	314,743,990	243,847,953	732	1,313
40	1.080	1350	-35.0	81,710,626	55,287,805	2.1	26,422,821	1.54	915,149	237,758,827	387,717,068	45,185,514	1,143,937,070	473,275,661	314,702,199	243,276,422	733	1,332
41	1.100	1375	-35.0	82,006,870	55,539,521	2.1	26,467,349	1.54	916,330	238,657,434	388,373,917	45,243,811	1,145,412,924	473,137,762	314,667,226	243,016,339	734	1,367
42	1.120	1400	-35.0	82,166,555	55,673,180	2.1	26,493,375	1.54	916,937	239,118,898	388,726,612	45,273,773	1,146,171,454	473,052,172	314,645,502	242,896,634	734	1,391
43	1.140	1425	-35.0	82,637,895	56,063,185	2.1	26,574,710	1.54	918,665	240,423,785	389,787,641	45,359,118	1,148,332,093	472,761,550	314,571,724	242,490,202	735	1,418
44	1.160	1450	-35.0	83,229,055	56,574,990	2.1	26,654,065	1.54	920,751	242,135,250	390,960,278	45,462,086	1,150,938,879	472,381,265	314,476,250	241,764,883	737	1,432
45	1.180	1475	-35.0	84,020,376	57,220,552	2.1	26,799,824	1.54	923,926	244,547,454	393,022,286	45,618,871	1,154,908,148	471,719,538	314,311,243	240,901,101	739	1,458
46	1.200	1500	-35.0	84,114,763	57,303,383	2.1	26,811,380	1.54	924,233	244,819,041	393,192,982	45,634,014	1,155,291,486	471,645,450	314,292,874	240,805,842	740	1,492
47	1.220	1525	-35.0	84,648,640	57,769,201	2.2	26,879,439	1.54	926,001	246,306,831	394,287,382	45,721,337	1,157,502,199	471,186,650	314,180,755	239,866,423	741	1,509
48	1.240	1550	-35.0	84,687,672	57,798,431	2.2	26,889,241	1.54	926,167	246,429,474	394,415,842	45,729,535	1,157,709,735	471,134,884	314,167,881	239,833,007	741	1,562
49	1.260	1575	-35.0	85,015,661	58,077,051	2.2	26,938,610	1.54	927,287	247,435,344	395,114,137	45,784,835	1,159,109,754	470,775,438	314,079,232	239,490,494	742	1,571
50	1.280	1600	-35.0	85,273,042	58,302,457	2.2	26,970,585	1.54	928,109	248,241,716	395,571,967	45,825,396	1,160,136,605	470,497,526	314,010,849	239,278,311	743	1,588
51	1.300	1625	-35.0	85,952,976	58,880,037	2.2	27,072,939	1.53	930,333	250,243,715	397,057,514	45,935,213	1,162,916,787	469,680,345	313,811,653	238,355,690	745	1,617

Figure 3.3.2 Daapleu Optimisation Results – Tonnage / Cash Flow Chart



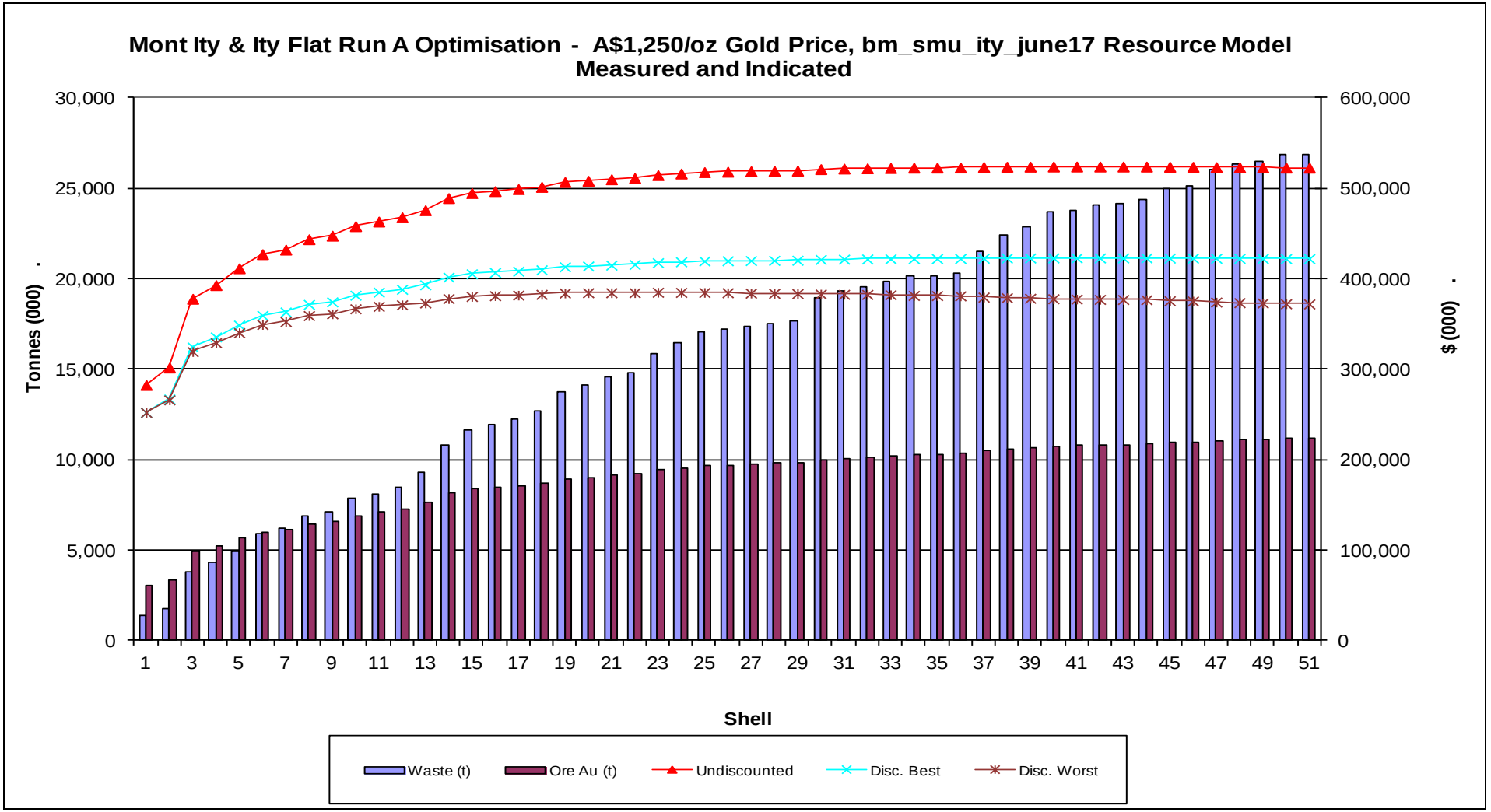
3.3.3 Ity Optimisation

Table 3.3.3 and Figure 3.3.3 show the results of the Ity Run A pit optimisation. This optimisation run forms the basis of all subsequent discussions on pit design and pit inventories. Shell 23 was selected as the guide for the Ity design.

Table 3.3.3 Ity Pit Optimisation Results Summary

			Base	Total	Waste	Strip	Processed Ore			Mining	Process	Selling Cost	Revenue	Undiscounted	Discounted	Discounted	Cost	Incr.
Shell	Factor	Price	RL	Tonnes	Tonnes	Ratio	Tonnes	Au g/t	Rec. Au Oz	Cost	Cost	Au	Au	Cash Flow	Best	Worst	/Oz	Cost /Oz
1	0.200	250	125.0	4,363,006	1,361,758	0.5	3,001,248	3.26	280,274	12,106,893	41,923,720	13,838,525	350,342,393	282,473,256	252,123,816	252,123,816	242	242
2	0.220	275	115.0	5,140,337	1,778,142	0.5	3,362,195	3.14	302,218	14,178,019	46,901,984	14,922,025	377,772,751	301,770,724	266,934,683	265,990,442	251	371
3	0.240	300	115.0	8,698,665	3,781,972	0.8	4,916,693	2.78	391,636	23,983,739	68,438,001	19,337,019	489,544,757	377,785,998	324,517,180	319,405,048	285	400
4	0.260	325	110.0	9,540,285	4,304,218	0.8	5,236,067	2.73	409,721	26,212,850	72,813,228	20,229,982	512,151,408	392,895,348	335,635,104	329,203,992	291	415
5	0.280	350	110.0	10,613,241	4,942,030	0.9	5,671,211	2.66	432,663	29,171,988	78,788,056	21,362,762	540,829,384	411,506,578	348,720,880	340,322,509	299	439
6	0.300	375	110.0	11,923,345	5,921,779	1.0	6,001,566	2.63	452,199	32,367,262	83,409,770	22,327,319	565,248,547	427,144,195	359,419,376	349,358,397	305	450
7	0.320	400	110.0	12,328,569	6,208,768	1.0	6,119,801	2.61	458,661	33,487,315	85,042,107	22,646,398	573,326,485	432,150,665	363,158,828	352,562,148	308	475
8	0.340	425	105.0	13,285,197	6,842,574	1.1	6,442,623	2.57	474,128	36,068,191	89,527,166	23,410,058	592,659,660	443,654,245	371,562,605	359,213,502	314	506
9	0.360	450	105.0	13,638,131	7,073,316	1.1	6,564,815	2.55	479,560	36,999,737	91,206,282	23,678,297	599,450,526	447,566,209	374,352,572	361,184,871	317	530
10	0.380	475	100.0	14,734,598	7,828,691	1.1	6,905,907	2.50	494,708	39,875,319	95,980,236	24,426,216	618,385,187	458,103,415	381,692,419	366,728,834	324	554
11	0.400	500	100.0	15,175,187	8,069,616	1.1	7,105,571	2.46	502,356	41,137,405	98,804,308	24,803,850	627,945,521	463,199,959	385,113,125	369,408,540	328	584
12	0.420	525	100.0	15,758,955	8,471,886	1.2	7,287,069	2.44	509,619	42,610,316	101,292,389	25,162,453	637,024,077	467,958,920	388,253,742	371,157,095	332	595
13	0.440	550	100.0	16,865,626	9,254,907	1.2	7,610,719	2.39	521,984	45,275,109	105,672,053	25,772,986	652,480,616	475,760,468	393,239,208	373,154,731	339	619
14	0.460	575	100.0	18,900,141	10,762,783	1.3	8,137,358	2.33	543,648	50,759,429	112,854,929	26,842,607	679,559,631	489,102,665	401,701,551	378,005,803	350	634
15	0.480	600	100.0	20,000,671	11,653,544	1.4	8,347,127	2.31	552,860	53,336,552	115,746,432	27,297,487	691,075,571	494,695,100	405,417,580	380,366,011	355	643
16	0.500	625	95.0	20,366,190	11,928,399	1.4	8,437,791	2.30	556,559	54,359,405	117,014,977	27,480,081	695,698,209	496,843,747	406,821,037	381,162,133	357	669
17	0.520	650	95.0	20,809,004	12,264,361	1.4	8,544,643	2.29	560,540	55,482,762	118,467,006	27,676,645	700,674,523	499,048,109	408,241,127	381,834,290	360	696
18	0.540	675	95.0	21,329,172	12,664,071	1.5	8,665,101	2.27	565,140	56,861,957	120,139,708	27,903,802	706,425,324	501,519,858	409,815,661	382,691,402	363	713
19	0.560	700	95.0	22,707,217	13,773,084	1.5	8,934,133	2.25	575,602	60,377,358	123,838,346	28,420,346	719,502,397	506,866,347	413,152,500	384,133,978	369	739
20	0.580	725	95.0	23,090,134	14,086,597	1.6	9,003,537	2.24	578,412	61,397,527	124,811,756	28,559,079	723,014,610	508,246,248	413,999,553	384,485,949	371	759
21	0.600	750	95.0	23,655,750	14,553,134	1.6	9,102,616	2.23	582,008	62,685,982	126,171,106	28,736,655	727,510,214	509,916,471	415,004,591	384,469,659	374	786
22	0.620	775	95.0	24,012,783	14,807,994	1.6	9,204,789	2.22	585,081	63,610,804	127,599,456	28,888,382	731,351,410	511,252,767	415,781,729	384,494,277	376	815
23	0.640	800	95.0	25,270,982	15,860,701	1.7	9,410,281	2.20	592,854	66,850,861	130,416,278	29,272,162	741,067,353	514,528,051	417,695,997	384,979,346	382	829
24	0.660	825	95.0	26,004,559	16,475,748	1.7	9,528,811	2.18	597,209	68,734,330	132,025,239	29,487,179	746,510,816	516,264,069	418,685,091	384,837,606	386	851
25	0.680	850	95.0	26,690,050	17,047,536	1.8	9,642,514	2.17	601,355	70,553,615	133,601,065	29,691,908	751,693,828	517,847,240	419,570,948	384,784,213	389	868
26	0.700	875	95.0	26,880,878	17,191,554	1.8	9,689,324	2.17	602,640	71,008,571	134,241,441	29,755,365	753,300,342	518,294,965	419,804,092	384,450,159	390	902
27	0.720	900	95.0	27,117,541	17,376,411	1.8	9,741,130	2.16	604,126	71,597,239	134,943,445	29,828,710	755,157,178	518,787,784	420,059,088	384,026,743	391	918
28	0.740	925	95.0	27,314,776	17,529,874	1.8	9,784,902	2.16	605,351	72,083,187	135,551,129	29,889,234	756,689,414	519,165,864	420,249,420	383,804,766	392	942
29	0.760	950	95.0	27,475,231	17,653,432	1.8	9,821,799	2.15	606,306	72,445,199	136,059,082	29,936,355	757,882,351	519,441,715	420,382,334	383,529,250	393	961
30	0.780	975	95.0	28,909,694	18,928,383	1.9	9,981,311	2.14	612,647	76,160,378	138,259,926	30,249,441	765,808,586	521,138,841	421,264,367	383,040,422	399	982
31	0.800	1000	95.0	29,377,263	19,312,395	1.9	10,064,868	2.13	615,070	77,334,241	139,410,187	30,369,085	768,837,558	521,724,045	421,605,225	382,709,940	402	1,009
32	0.820	1025	95.0	29,685,646	19,571,080	1.9	10,114,566	2.12	616,612	78,138,808	140,106,053	30,445,232	770,765,320	522,075,226	421,821,008	382,611,160	403	1,022
33	0.840	1050	95.0	29,974,479	19,807,458	2.0	10,167,021	2.12	618,001	78,804,378	140,831,050	30,513,806	772,501,368	522,352,133	421,989,897	382,253,642	405	1,051
34	0.860	1075	95.0	30,376,910	20,120,803	2.0	10,256,107	2.11	620,163	79,813,482	142,039,119	30,620,545	775,203,614	522,730,468	422,218,388	381,463,953	407	1,075
35	0.880	1100	95.0	30,457,552	20,180,845	2.0	10,276,707	2.10	620,638	80,028,027	142,324,273	30,644,023	775,797,996	522,801,674	422,260,970	381,314,039	408	1,100
36	0.900	1125	95.0	30,627,549	20,313,391	2.0	10,314,158	2.10	621,527	80,468,444	142,837,889	30,687,890	776,908,562	522,914,338	422,327,899	380,997,403	409	1,123
37	0.920	1150	95.0	32,024,139	21,513,389	2.1	10,510,750	2.08	627,201	83,960,285	145,565,344	30,968,033	784,000,796	523,507,133	422,676,106	379,626,896	415	1,146
38	0.940	1175	95.0	32,974,173	22,370,182	2.1	10,603,991	2.07	630,512	86,336,448	146,873,848	31,131,517	788,139,610	523,797,798	422,844,682	378,980,089	419	1,162
39	0.960	1200	95.0	33,494,745	22,823,587	2.1	10,671,158	2.07	632,493	87,686,821	147,793,163	31,229,325	790,615,775	523,906,466	422,904,604	378,315,118	422	1,195
40	0.980	1225	90.0	34,427,463	23,679,851	2.2	10,747,612	2.06	635,606	90,212,099	148,868,212	31,383,066	794,507,955	524,044,579	422,980,964	377,829,944	426	1,206
41	**1.000**	**1250**	**90.0**	**34,563,473**	**23,788,117**	**2.2**	**10,775,356**	**2.06**	**636,187**	**90,525,499**	**149,246,027**	**31,411,714**	**795,233,229**	**524,049,988**	**422,981,777**	**377,448,521**	**426**	**1,241**
42	1.020	1275	90.0	34,883,419	24,078,411	2.2	10,805,008	2.05	637,187	91,327,316	149,658,091	31,461,124	796,484,103	524,037,573	422,971,766	377,110,804	428	1,262
43	1.040	1300	90.0	34,926,842	24,112,671	2.2	10,814,171	2.05	637,367	91,422,512	149,785,503	31,469,986	796,708,451	524,030,450	422,966,714	376,993,580	428	1,290
44	1.060	1325	90.0	35,167,786	24,332,131	2.3	10,835,655	2.05	638,124	92,078,683	150,084,657	31,507,368	797,654,831	523,984,124	422,937,210	376,713,071	429	1,311
45	1.080	1350	90.0	35,921,351	24,989,779	2.3	10,931,572	2.04	640,741	94,147,689	151,379,709	31,636,612	800,926,833	523,762,824	422,797,598	375,586,356	433	1,335
46	1.100	1375	90.0	36,036,585	25,088,322	2.3	10,948,263	2.04	641,150	94,456,112	151,606,491	31,656,783	801,437,494	523,718,108	422,769,747	375,315,270	433	1,360
47	1.120	1400	90.0	37,060,656	26,026,276	2.4	11,034,380	2.03	644,056	97,148,039	152,773,617	31,800,285	805,070,462	523,348,521	422,544,650	374,136,109	437	1,377
48	1.140	1425	90.0	37,373,242	26,299,023	2.4	11,074,219	2.03	645,057	97,961,798	153,319,448	31,849,676	806,320,865	523,189,943	422,448,447	373,477,318	439	1,409
49	1.160	1450	90.0	37,613,964	26,507,734	2.4	11,106,230	2.03	645,833	98,588,109	153,766,572	31,887,993	807,290,905	523,048,231	422,362,988	373,117,349	440	1,433
50	1.180	1475	90.0	37,973,503	26,819,113	2.4	11,154,390	2.02	646,992	99,580,630	154,418,375	31,945,212	808,739,500	522,795,282	422,211,544	372,261,017	442	1,468
51	1.200	1500	90.0	38,040,376	26,874,144	2.4	11,166,232	2.02	647,221	99,749,835	154,582,698	31,956,554	809,026,626	522,737,539	422,177,028	372,066,077	442	1,501

Figure 3.3.3 Ity Optimisation Results – Tonnage / Cash Flow Chart



3.4 Pit Designs

Pit designs were completed for the pits that had optimisations run. These included:

- Bakatouo.
- Daapleu.
- Ity.

For the remaining pits the existing designs were used. These included:

- Gbeitouo.
- Walter.
- ZiaNE.

The existing dumps were also included as process feed for the Life of Mine schedule. These included:

- Aires HL.
- Verse Ouest / Teckraie Dump (labelled as Dump in the Schedule).

The region labelled as Dump in the schedule consists of Verse Ouest and Teckraie. It is split into two regions; Dump_S1 and Dump_S2. Dump_S1 is the portion of the dump that is located above the Ity pit and will need to be mined prior to the mining of Ity.

Aires HL is also split into AIRS_S1 and AIRS_S2 for the same reason. AirS_S1 will need to be mined prior to mining Zia NE.

3.4.1 Bakatouo Design

Table 3.4.1 Bakatouo Pit Design Parameters

Pit / Region	Elevation (mRL)	Batter Height	Berm Width	Batter Angle	Inter Ramp Angle
Bakatouo	Natural Surface to base of soil overburden and laterite	4 m	4 m	50°	28.5°
Bakatouo	Natural Surface to BOCO Surface	5 m	3.5 m	50°	33°
Bakatouo	Between BOCO and TOFR	10 m	5.5 m	55°	38.7°
Bakatouo	Below TOFR	20 m	7 m	70°	54.5°

Figure 3.4.1 Bakatouo Final Design



3.4.2 Daapleu Design

Table 3.4.2 Daapleu Pit Design Parameters

Pit / Region	Elevation (mRL)	Batter Height	Berm Width	Batter Angle	Inter Ramp Angle
Daapleu	Natural Surface to 5 mbs	5 m	3 m	50°	34.8°
Daapleu	15 mbs to 25 mbs	10 m	5 m	50°	36.7°
Daapleu	25 mbs to 45 mbs	20 m	7 m	60°	47.2°
Daapleu	45 mbs to 205 mbs	10 m	5 m	75°	58.3°

Figure 3.4.2 Daapleu Stage 1 Design

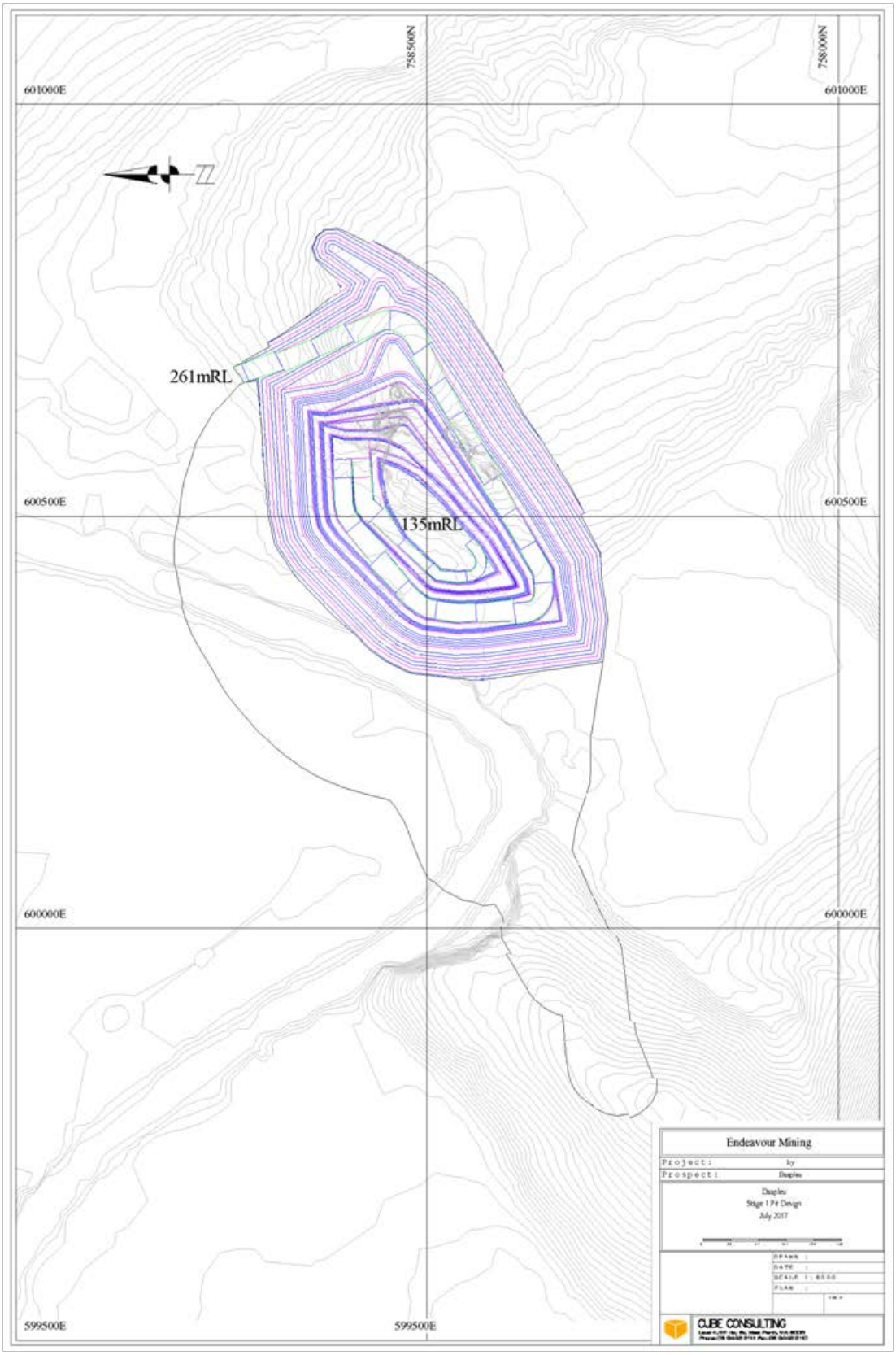
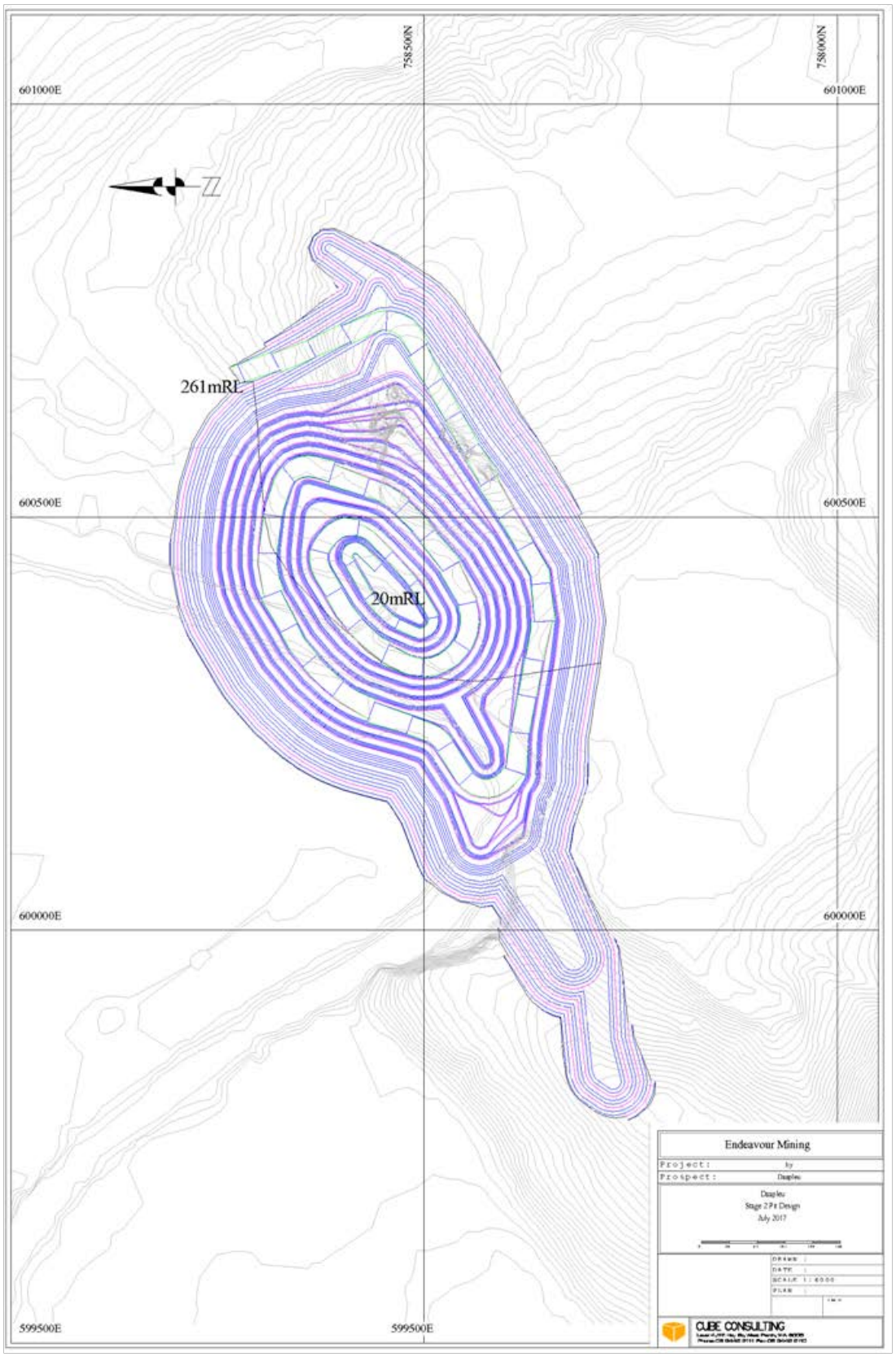


Figure 3.4.3 Daapleu Stage 2 Design

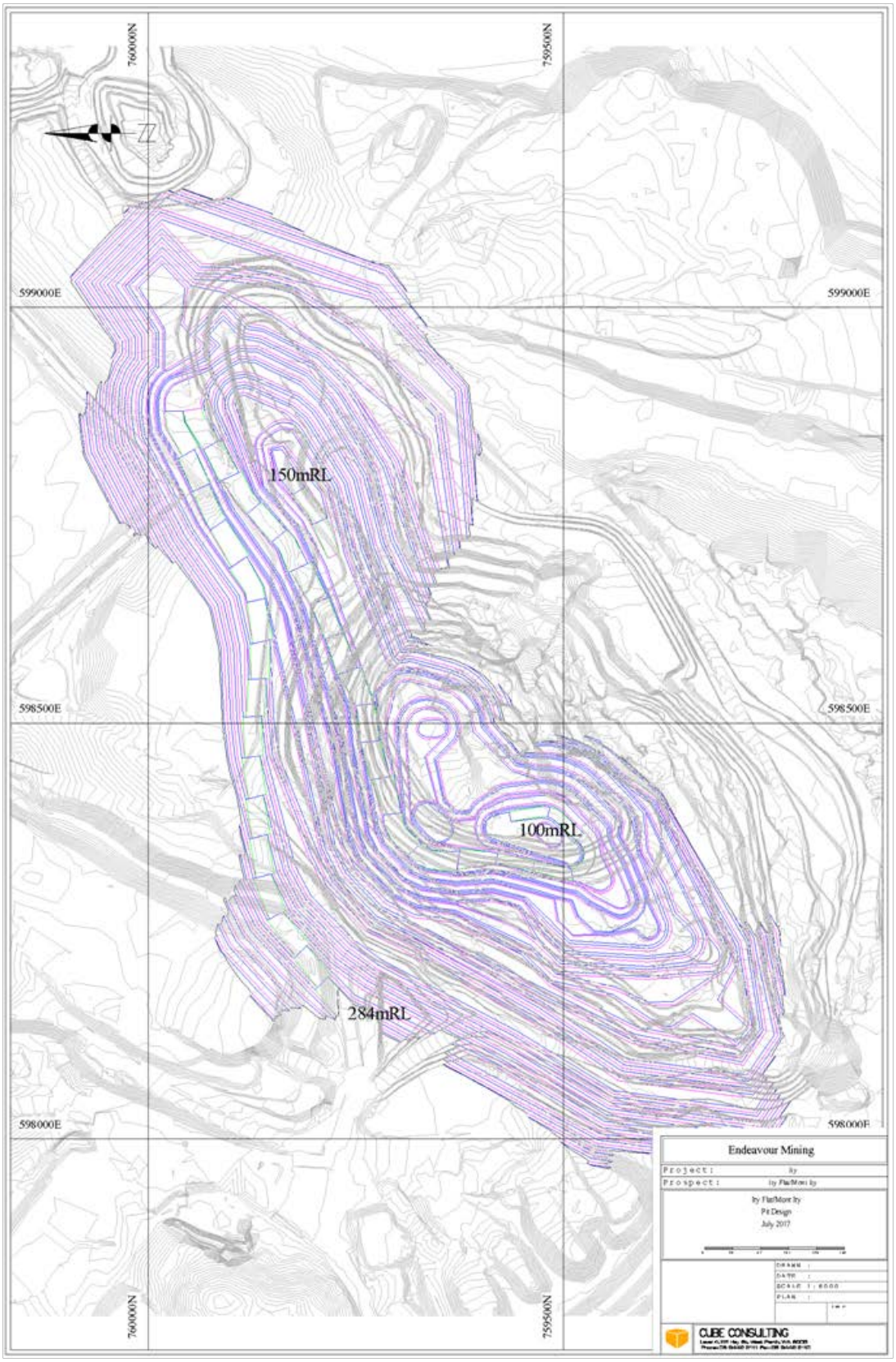


3.4.3 Ity Design

Table 3.4.3 Ity Pit Design Parameters

Pit / Region	Elevation (mRL)	Batter Height	Berm Width	Batter Angle	Inter Ramp Angle
Ity	Natural Surface to base of soil overburden and laterite	4 m	4 m	50°	28.5°
Ity	Natural Surface to BOCO Surface	5 m	3.5 m	50°	33°
Ity	Between BOCO and TOFR	10 m	5.5 m	55°	38.7°
Ity Flat (Western Domain)	Below TOFR	15 m	6 m	70°	52.6°
Ity Flat (Eastern Domain)	Below TOFR	15 m	6 m	55°	42.3°
Mont Ity (Western Domain)	Below TOFR	15 m	6 m	70°	52.6°
Mont Ity (Eastern Domain)	Below TOFR	15 m	8 m	65°	45°

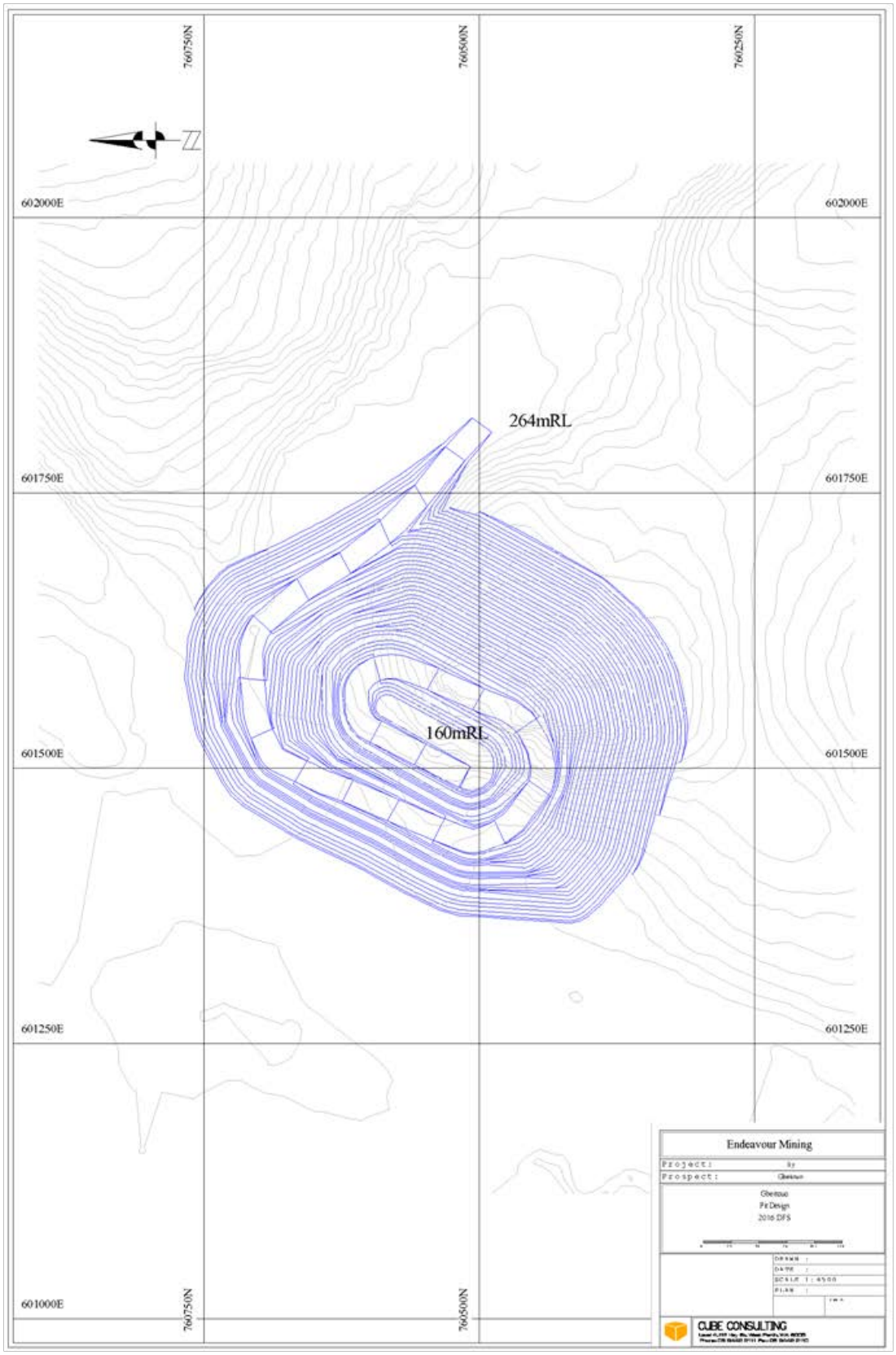
Figure 3.4.4 Ity Final Design



3.4.4 Gbeitouo Design

This design is as supplied by Endeavour and is unchanged from the previous mine schedule and Mineral Reserves work.

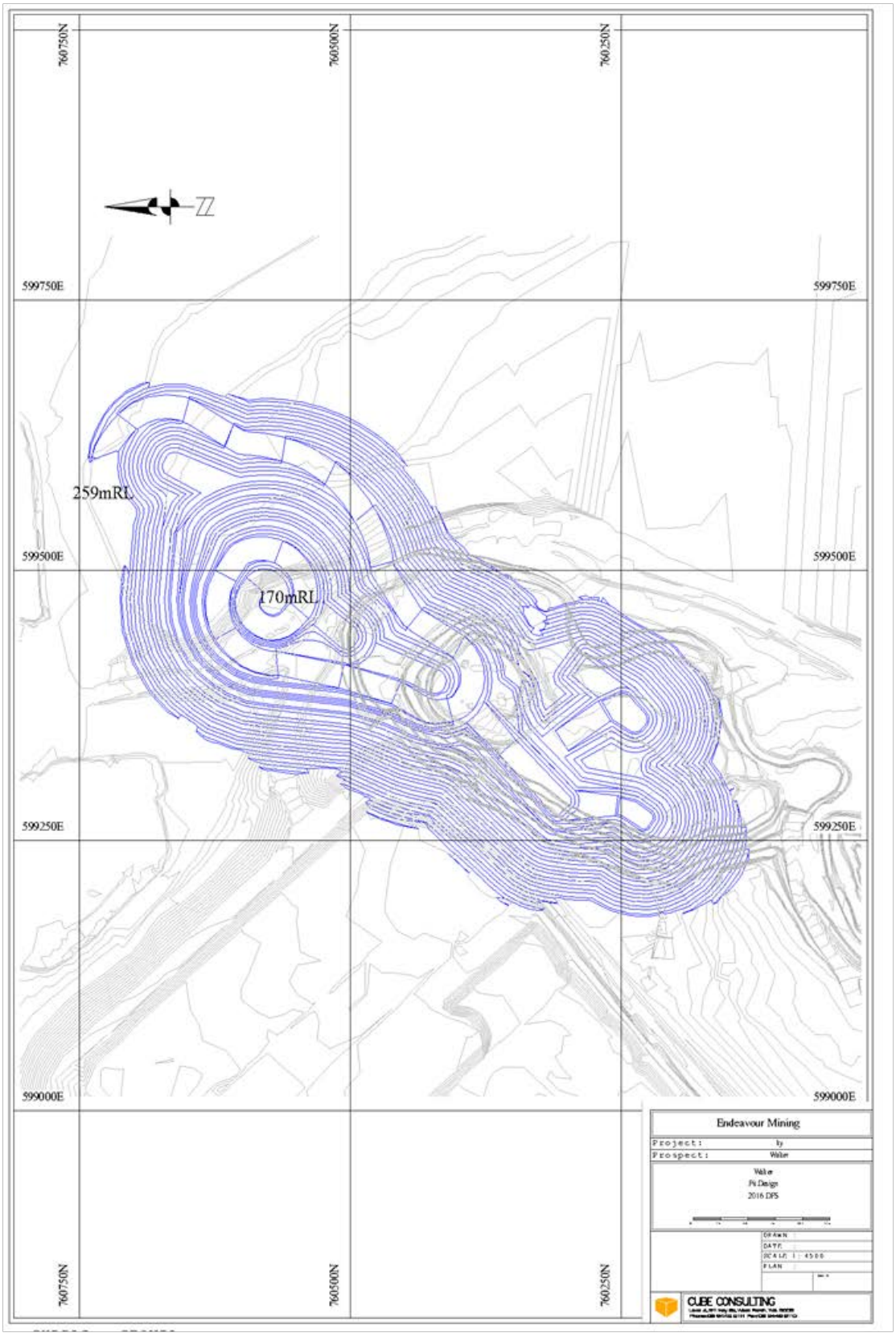
Figure 3.4.5 Gbeitouo Final Design



3.4.5 Walter Design

This design is as supplied by Endeavour and is unchanged from the previous mine schedule and Mineral Reserves work.

Figure 3.4.6 Walter Final Design



3.4.6 ZiaNE Design

This design is as supplied by Endeavour and is unchanged from the previous mine schedule and Mineral Reserves work.

Figure 3.4.7 ZiaNE Final Design

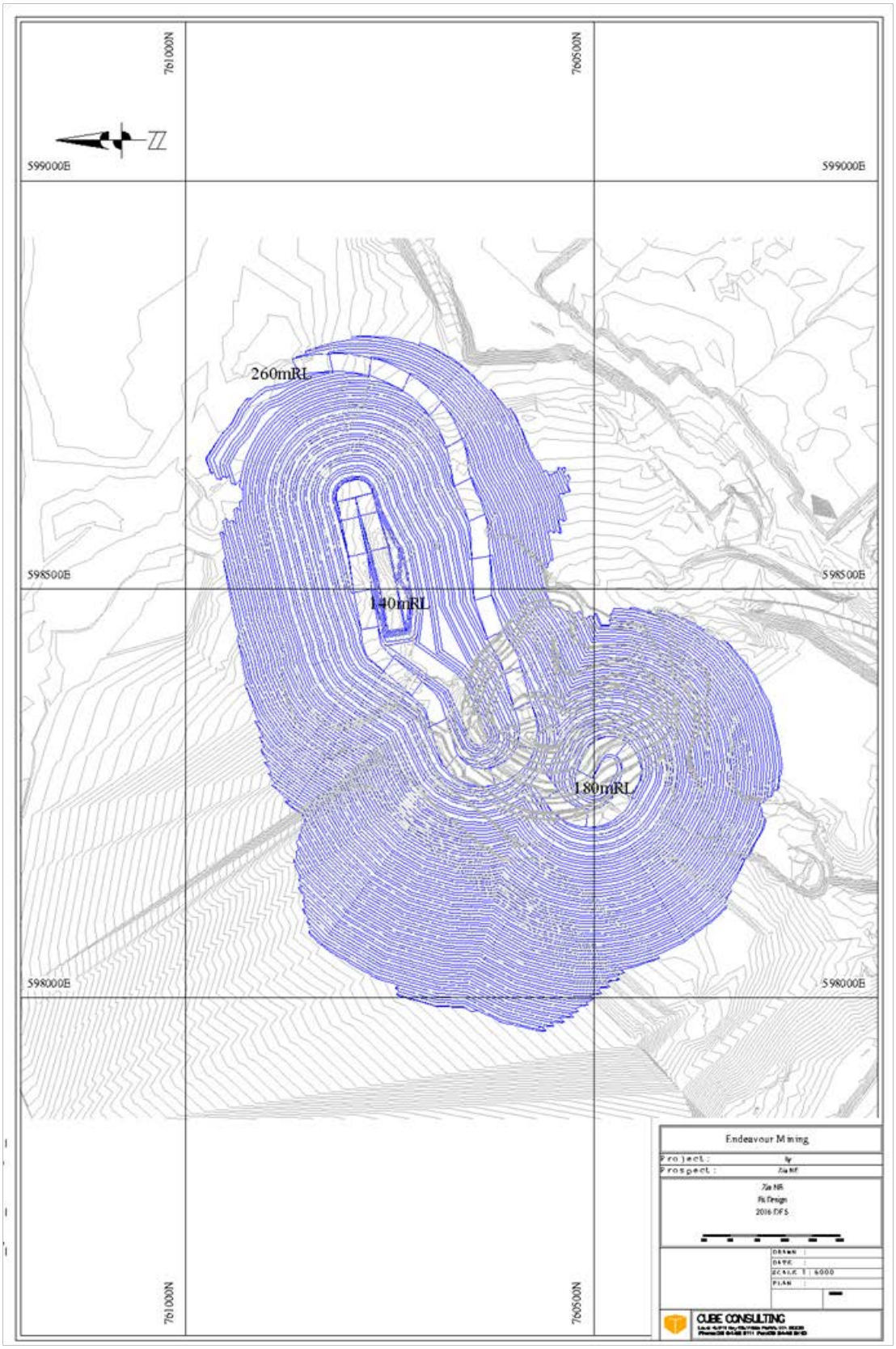
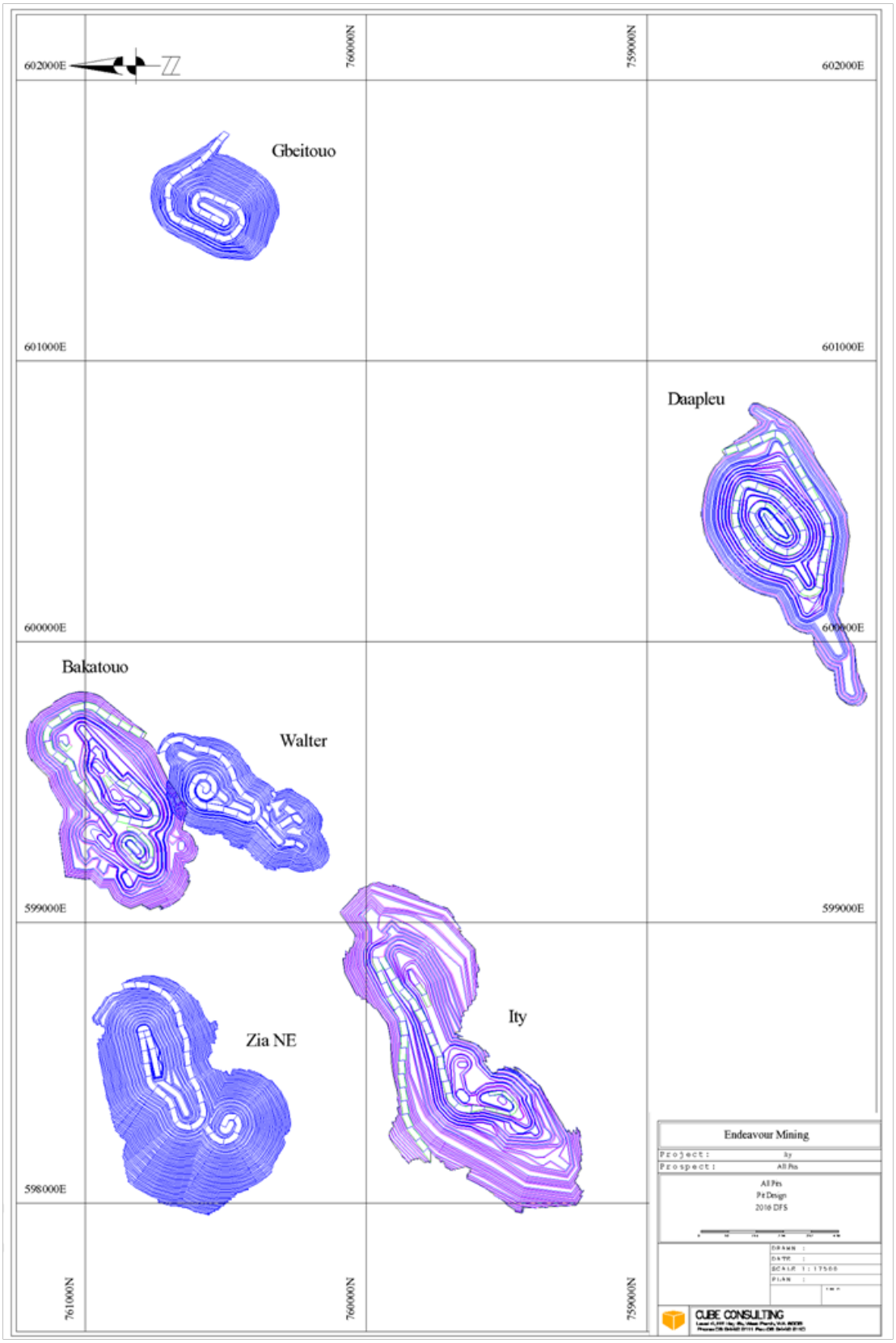


Figure 3.4.8 Zia Site Design



3.5 Open Pit Mineral Reserve Estimate

The following tabulation represents a Mineral Reserve based on the work completed and discussed in this report.

This Mineral Reserve estimate is reported as of end April 2017. Changes from the previously reported Mineral Reserves are largely due to revised and updated Mineral Resource estimates on the Daapleu, Ity and Bakatouo deposits. In the case of Bakatouo, this is the first inclusion of this deposit in Mineral Reserves. Other changes from previous Mineral Reserves are due to changed operating costs largely associated with revised processing capabilities from a 3 Mtpa treatment facility to a 4 Mtpa treatment facility.

The mining engineering work completed, as discussed within this report, included the open pit optimisation and detailed pit designs for the Daapleu, Ity and Bakatouo deposits. All other deposits have made use of the existing designs which implies that they may not be optimal, however their inclusion in a complete life of mine production schedule have confirmed their economic viability as part of the Ity project.

The estimated in-situ Mineral Reserves occur within open pits containing 112.2 Mt of waste material which results in a waste to ore tonnage strip ratio of 2.3:1.

The tabulated Mineral Reserves tonnages and contained ounces have been rounded to reflect precision in the estimation which may result in apparent errors of summation in the totals.

Table 3.5.1 Ity Project Mineral Reserves Details

Ity Project			Proven			Probable			Total Mineral Reserve		
Deposit	**Type**	**Cut-Off (g/t)**	**Tonnes (kt)**	**Gold Grade (g/t)**	**Gold Metal (koz)**	**Tonnes (kt)**	**Gold Grade (g/t)**	**Gold Metal (koz)**	**Tonnes (kt)**	**Gold Grade (g/t)**	**Gold Metal (koz)**
Bakatouo-Oxide	Open Pit	0.36				1,724	1.93	107	1,724	1.93	107
Bakatouo-Transitional	Open Pit	0.80				1,146	3.10	114	1,146	3.10	114
Bakatouo-Fresh	Open Pit	0.41				5,652	2.22	404	5,652	2.22	404
Daapleu- Oxide	Open Pit	0.36				1,609	1.25	65	1,609	1.25	65
Daapleu- Transitional	Open Pit	0.58				914	1.50	44	914	1.50	44
Daapleu- Fresh	Open Pit	0.58				16,438	1.74	918	16,438	1.74	918
Ity-Oxide	Open Pit	0.45				1,391	2.00	89	1,391	2.00	89
Ity-Transitional	Open Pit	0.45				3,278	2.65	279	3,278	2.65	279
Ity-Fresh	Open Pit	0.45				3,308	1.92	204	3,308	1.92	204
Gbeitouo-Oxide	Open Pit	0.38				1,076	1.24	43	1,076	1.24	43
Gbeitouo-Transitional	Open Pit	0.38				76	1.20	3	76	1.20	3
Gbeitouo-Fresh	Open Pit	0.38				1,709	1.27	70	1,709	1.27	70
Walter-Oxide	Open Pit	0.35				277	1.48	13	277	1.48	13
Walter-Transitional	Open Pit	0.35				763	1.09	27	763	1.09	27
Walter-Fresh	Open Pit	0.35				571	1.06	19	571	1.06	19
ZiaNE-Oxide	Open Pit	0.30				5,417	1.06	185	5,417	1.06	185
ZiaNE-Transitional	Open Pit	0.30				2,157	1.00	70	2,157	1.00	70
ZiaNE-Fresh	Open Pit	0.30				858	1.00	27	858	1.00	27
Aires-Oxide	Heap Leach	0				5,768	1.09	202	5,768	1.09	202
Teckraie	Stockpile	0				2,819	1.07	97	2,819	1.07	97
Verse Ouest-Oxide	Stockpile	0				5,883	0.99	187	5,883	0.99	187
Ity Project Total						**62,835**	**1.57**	**3,167**	**62,835**	**1.57**	**3,167**

3.6 Life of Mine Schedule

A range of four separate Life of Mine schedules were generated for the Ity project with a planned processing capacity of 4 Mtpa. The schedules produced considered the variable mining costs of ore and waste, the variable recoveries of different material, processing costs of different materials, and tax concessions for material processed from Daapleu and Gbeitouo in the initial 5 years, gold price, royalties, refining costs and payable gold whilst allowing stockpiling to maximise cash flow.

Initially a range of schedules were produced which included a sulphide process which was used to process the transitional material from Bakatouo and high arsenic material (As > 1000 ppm) from the other deposits. The sulphide process was also set up as an alternative process for the high copper ore material. After discussion with Endeavour it was determined that the sulphide process was no longer to be considered.

After multiple schedules were generated it was decided that four schedules be reported for comparison. The conditions of these schedules are shown in Table 3.6.1.

All the reported scenarios used the input parameters provided by Endeavour which comprised mining and process operating costs and recoveries. The mining costs were contained in the file *"Ity Mining Cost Model_Sched_v6a 4mtpa_Rev1.5.xlsx"*. The processing costs and recoveries for Scenario 4, Scenario 5, Scenario 6 and Scenario 7 were provided in the file *"Pit Op inputs for Cube 030717.xlsx"*. The processing costs and recoveries for Scenario 7_1250 were provided in the file *"Pit Op inputs for Cube 200717.xlsx".* Details of the various input parameters are discussed in Section 3.2 previously.

3.6.1 Tax Concession

There was a tax concession applicable for revenue generated from Daapleu and Gbeitouo in the initial five years. The value of the concession was calculated as 25% of the net operating profit. This was calculated by taking the difference between the Revenue and the Costs and multiplying it by 25%. The costs included the mining cost and the processing costs whilst the revenue was based on the revenue from the recovered ounces, after taking royalty, refining and shipping and payable gold into account.

3.6.2 Stockpiling

The schedule incorporated the material to be stockpiled prior to processing. A large number of stockpiles were defined, but not all of them will be used. Each pit had its own range of stockpiles to enable the scheduler to process them individually. These stockpiles isolated material by weathering, grade and high and low arsenic. As there is no longer the ability to process the high and low grade arsenic material in separate plants these stockpiles are no longer required, but remained as part of the original set up. Each location also had a stockpile for inferred material. This allowed the inferred material to be mined as potential ore, and not treated, hence being regarded as waste. No inferred material was processed in any of the schedule scenarios. The stockpiles for each pit are shown in Table 3.6.2.

Table 3.6.1 LOM Schedule Scenarios

Scenario	Opex	CIL Capacity	Maximum Bakatouo Ore Processed	Maximum Vertical Advance (mpa)	Total Material Moved
Scenario 4	*Pit Op inputs for Cube 030717*.xlsx	4 Mtpa	4 Mtpa	60 m	44 Mtpa
Scenario 5	*Pit Op inputs for Cube 030717*.xlsx	4 Mtpa	800 ktpa	60 m	44 Mtpa
Scenario 6	*Pit Op inputs for Cube 030717*.xlsx	4 Mtpa	800 ktpa	60 m	36 Mtpa
Scenario 7	*Pit Op inputs for Cube 030717*.xlsx	4 Mtpa	800 ktpa	60 m	28 Mtpa
Scenario 7_1250	*Pit Op inputs for Cube 200717*.xlsx	4 Mtpa	800 ktpa	60 m	28 Mtpa

Table 3.6.2 LOM Stockpiling Strategy

Stockpile Name	Weathering State	Classification	Grade Specification	Grade Range (g/t)	Arsenic Value (ppm)
pit_OX_LG_LAS	Oxide	Measured/Indicated	LG	Cut - 0.9	<=1000 ppm
pit_OX_LG_HAS	Oxide	Measured/Indicated	LG	Cut - 0.9	>1000 ppm
pit_OX_MG_LAS	Oxide	Measured/Indicated	MG	0.9 – 1.5	<=1000 ppm
pit_OX_MG_HAS	Oxide	Measured/Indicated	MG	0.9 – 1.5	>1000 ppm
pit_OX_HG_LAS	Oxide	Measured/Indicated	HG	> 1.5	<=1000 ppm
pit_OX_HG_HAS	Oxide	Measured/Indicated	HG	> 1.5	>1000 ppm
pit_TR_LG_LAS	Transitional	Measured/Indicated	LG	Cut - 0.9	<=1000 ppm
pit_TR_LG_HAS	Transitional	Measured/Indicated	LG	Cut - 0.9	>1000 ppm
pit_TR_MG_LAS	Transitional	Measured/Indicated	MG	0.9 – 1.5	<=1000 ppm
pit_TR_MG_HAS	Transitional	Measured/Indicated	MG	0.9 – 1.5	>1000 ppm
pit_TR_HG_LAS	Transitional	Measured/Indicated	HG	> 1.5	<=1000 ppm
pit_TR_HG_HAS	Transitional	Measured/Indicated	HG	> 1.5	>1000 ppm
pit_FR_LG_LAS	Fresh	Measured/Indicated	LG	Cut - 0.9	<=1000 ppm
pit_FR_LG_HAS	Fresh	Measured/Indicated	LG	Cut - 0.9	>1000 ppm
pit_FR_MG_LAS	Fresh	Measured/Indicated	MG	0.9 – 1.5	<=1000 ppm
pit_FR_MG_HAS	Fresh	Measured/Indicated	MG	0.9 – 1.5	>1000 ppm
pit_FR_HG_LAS	Fresh	Measured/Indicated	HG	> 1.5	<=1000 ppm
pit_FR_HG_HAS	Fresh	Measured/Indicated	HG	> 1.5	>1000 ppm
Pit_INF	ALL	Inferred	ALL	ALL	ALL

Stockpiling Cost

The cost used for placing material on the stockpiles was the cost supplied in the mining costs provided by Calsta in the file *"Ity Mining Cost Model_Sched_v6a 4mtpa_Rev1.5.xlsx*".

The cost of material reclaimed from stockpile was $1.47/t. This value was used as it was the same value that was used for reclaiming from the initial stockpiles.

3.6.3 Schedule Setup

Time Periods

It was required that the schedule be reported in quarterly time periods. For the initial four scenarios the schedule started in Quarter 1, 2019 and continued to Quarter 3, 2034, at which point all economic material was processed, excluding that classified as inferred. For the final scenario, Scenario 7_1250 the schedule started in Quarter 3, 2019. To arrive at the starting position of Quarter 1 or Quarter 3, 2019, the current mine schedule was depleted from the end of March 2017 survey file.

Discount Rates

A discount rate of 10%pa was applied quarterly by setting the discount rate to 2.5% per quarter.

Vertical Rate of Advance

The schedule restricted the vertical rate of advance to three benches per quarter. This limited it to 15 m per quarter, which was equivalent to 60 metres vertical advance per year. If a bench contained less than 50,000 tonnes, then it would not attribute to the vertical advance. This takes into account small tonnes on benches that are near the surface, or small tonnage remaining on benches at the commencement of quarters.

Pit Precedence's

To maintain a practical schedule, precedence's were put in place between locations in regard to the mining sequence. These precedence's are outlined in Table 3.6.3.

Table 3.6.3 Location Precedence's

Location	Preceding Location	Description
Daapleu Stage 2	Daapleu Stage 1	Daapleu Stage 1 must progress with or ahead of Daapleu Stage 2 to prevent undermining.
Dump Stage 2	Dump Stage 1	Dump Stage 1 must progress with or ahead of Dump Stage 2 to prevent undermining.
Ity	Dump Stage 1	Dump Stage 1 must be mined prior to commencing Ity. This is the component of the dump that is located on the Ity pit.
Zia NE	Aires Stage 1	Aires Stage 1 must be mined prior to commencing Zia NE. This is the component of the dump that is located on the Zia NE pit.
Aires Stage 2	Aires Stage 1	Aires Stage 1 must progress with or ahead of Aires Stage 2 to prevent undermining.

3.7 Schedule Results

The schedule results for the various scenarios are summarised below.

3.7.1 Scenario 4

Figure 3.7.1 Scenario 4 - Total Mining Movements

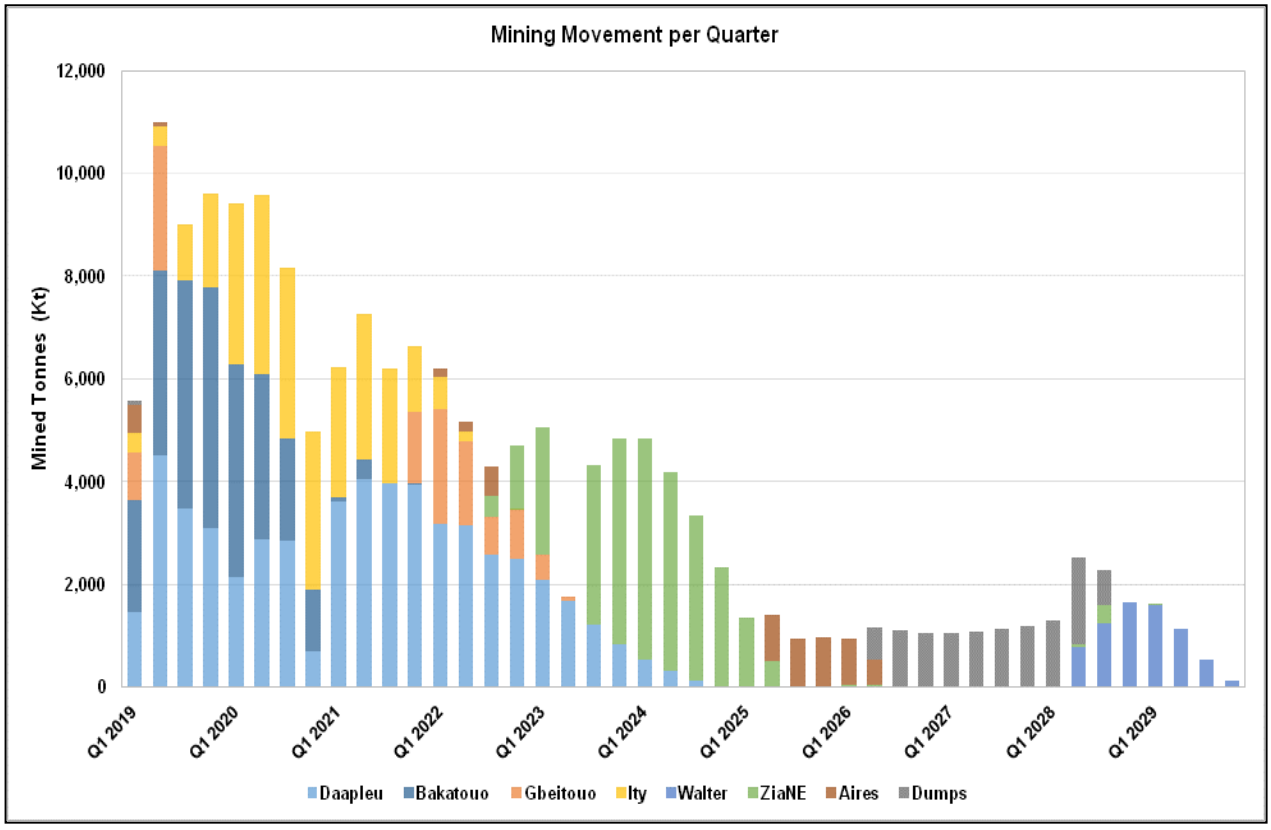


Figure 3.7.2 Scenario 4 - Tonnes and Grade Processed in CIL

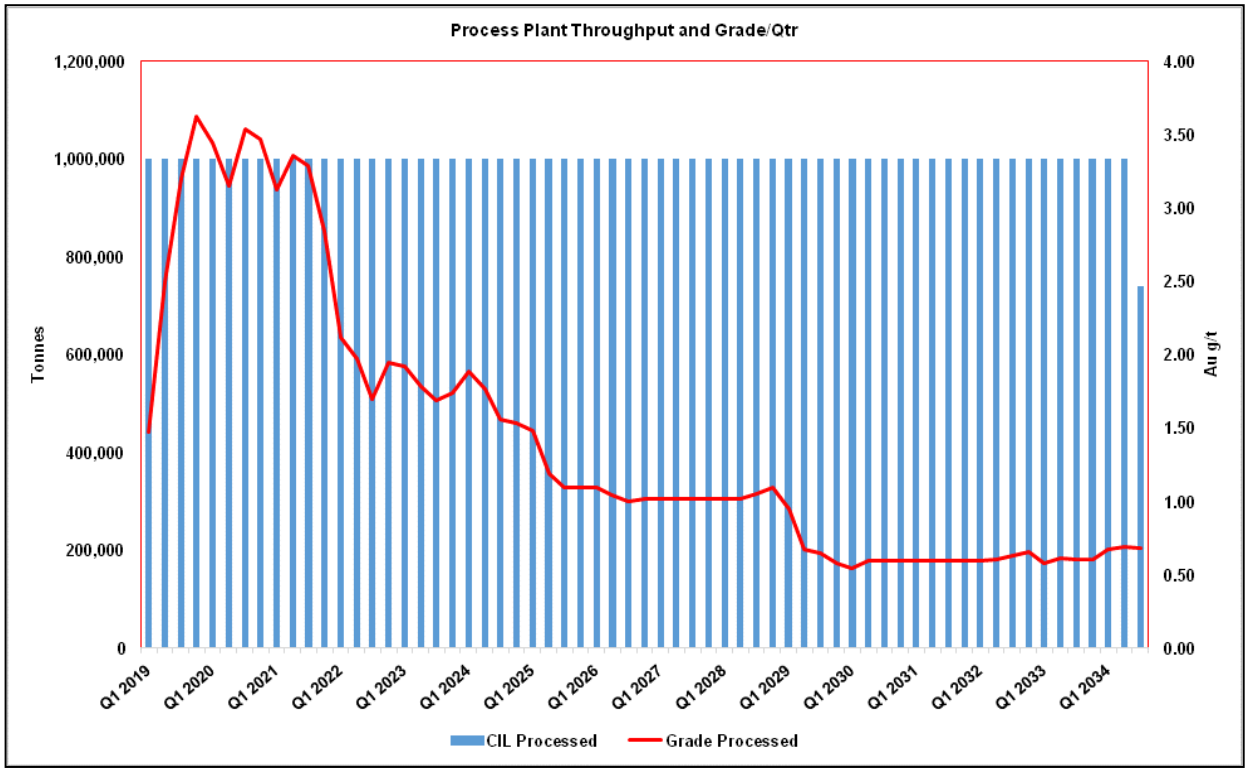


Figure 3.7.3 Scenario 4 - Recovered Ounces

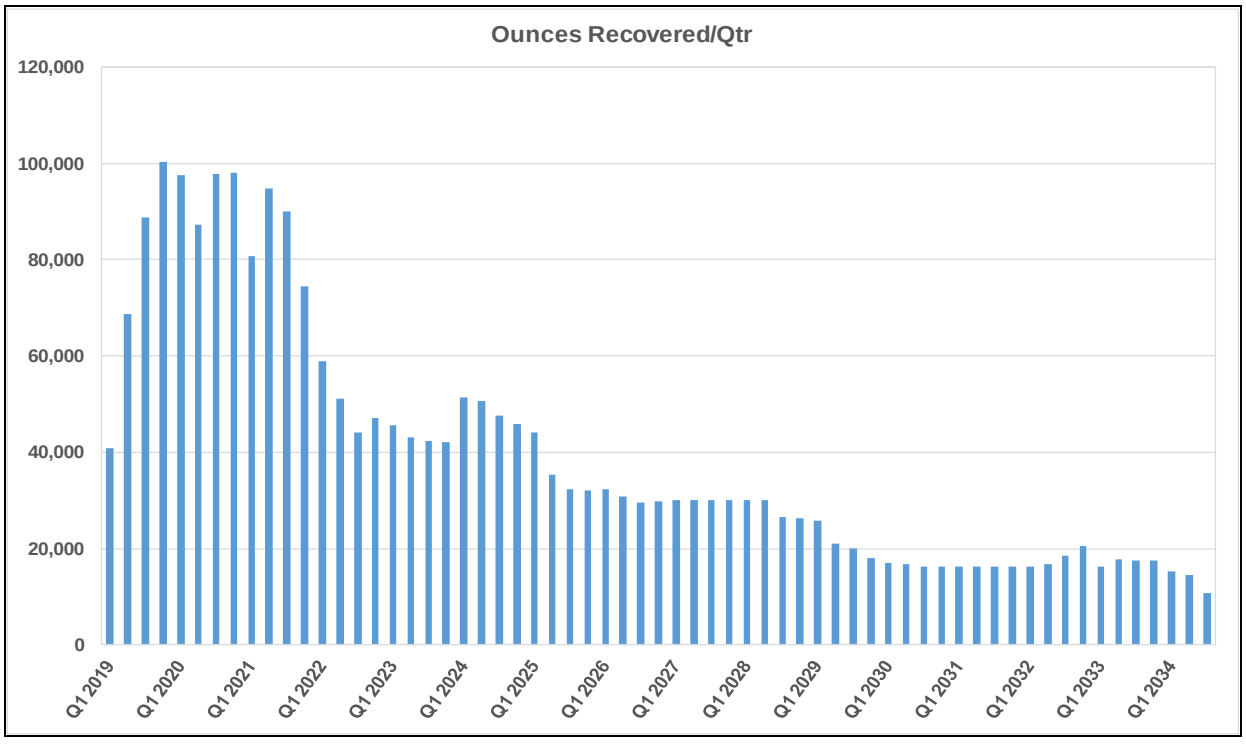
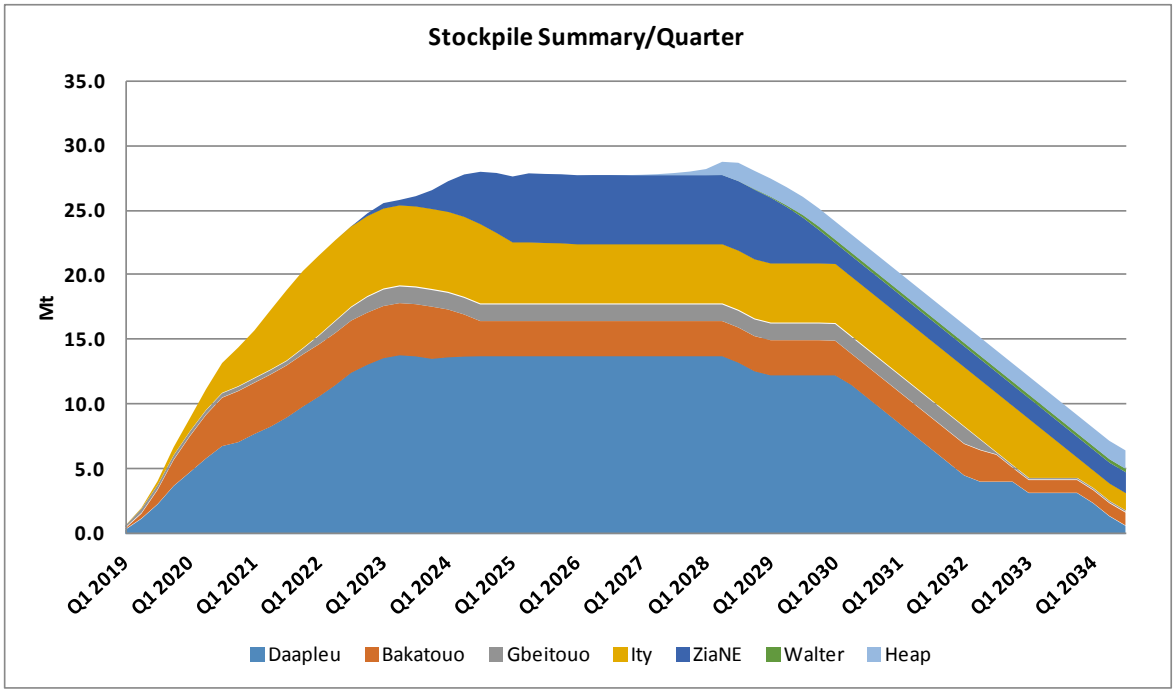


Figure 3.7.4 Scenario 4 - Stockpiles



3.7.2 Scenario 5

Figure 3.7.5 Scenario 5 - Total Material Movements

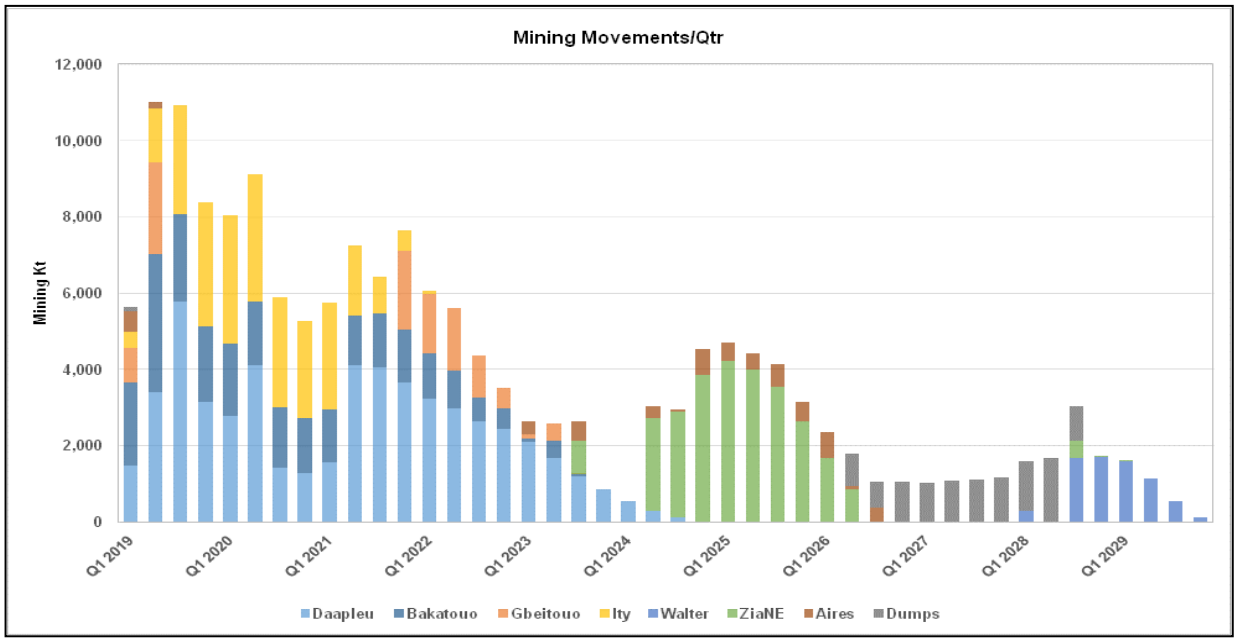


Figure 3.7.6 Scenario 5 - Tonnes and Grade Processed in CIL

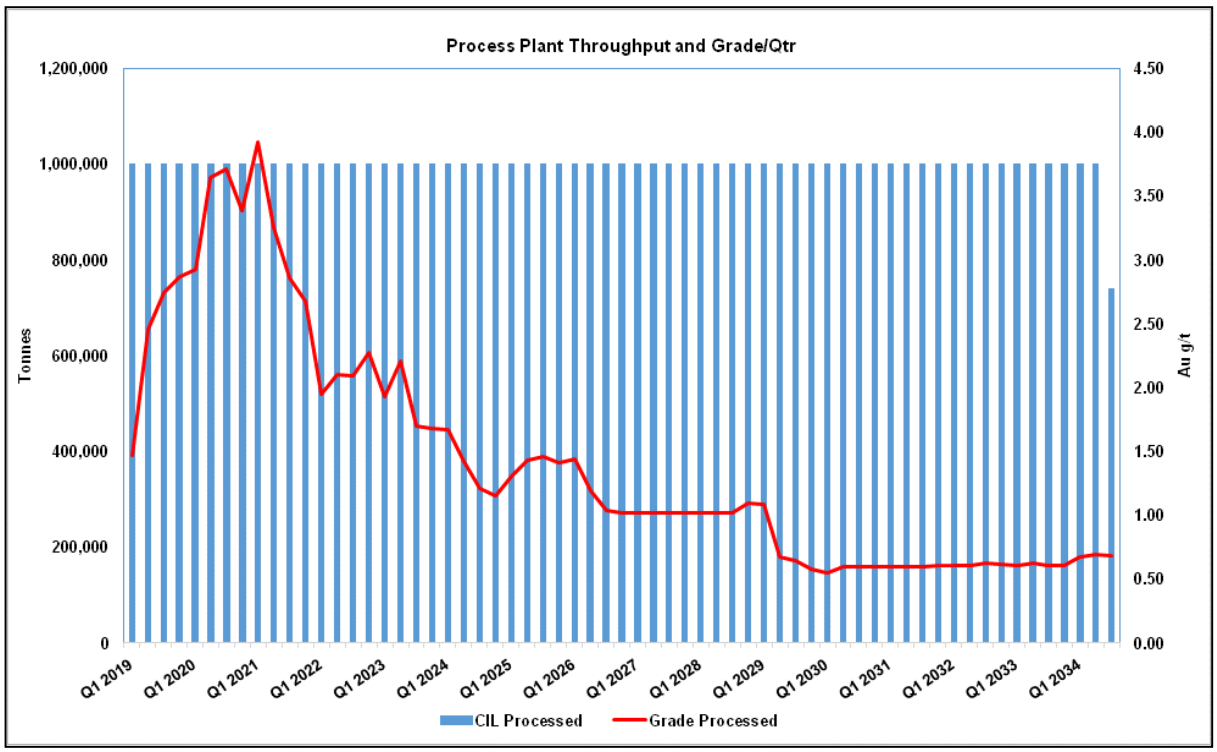


Figure 3.7.7 Scenario 5 - Recovered Ounces

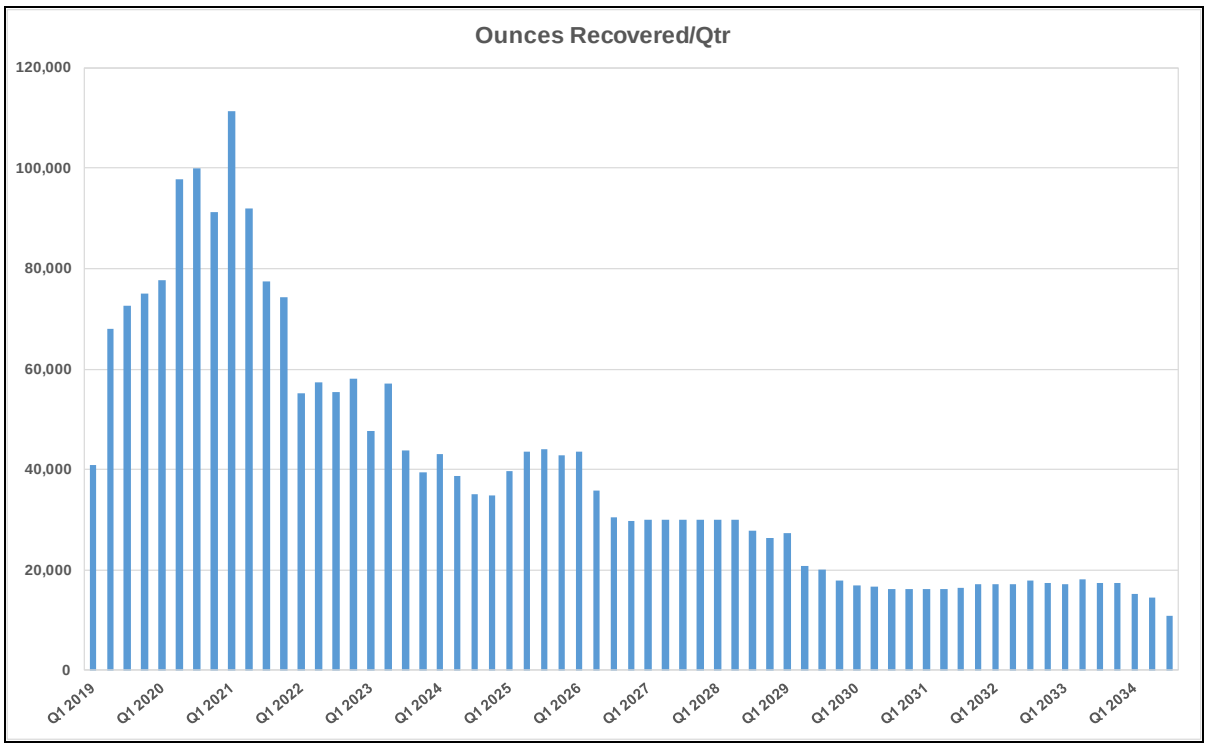
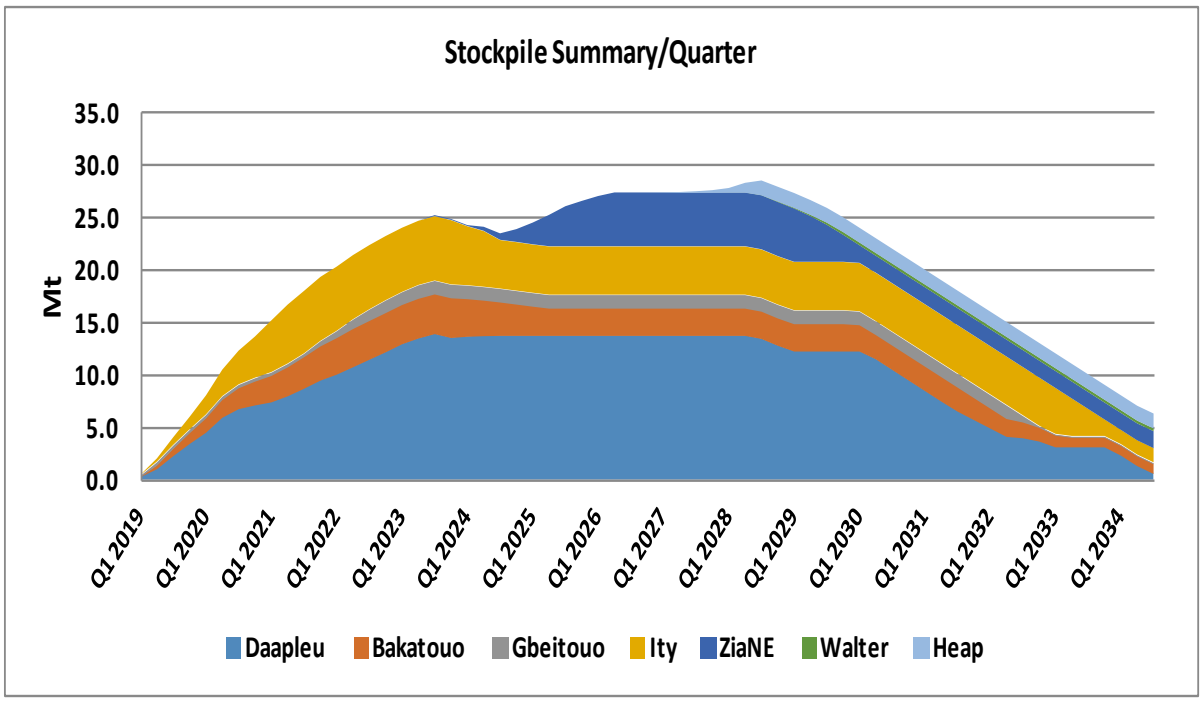


Figure 3.7.8 Scenario 5 - Stockpiles



3.7.3 Scenario 6

Figure 3.7.9 Scenario 6 - Total Material Movements

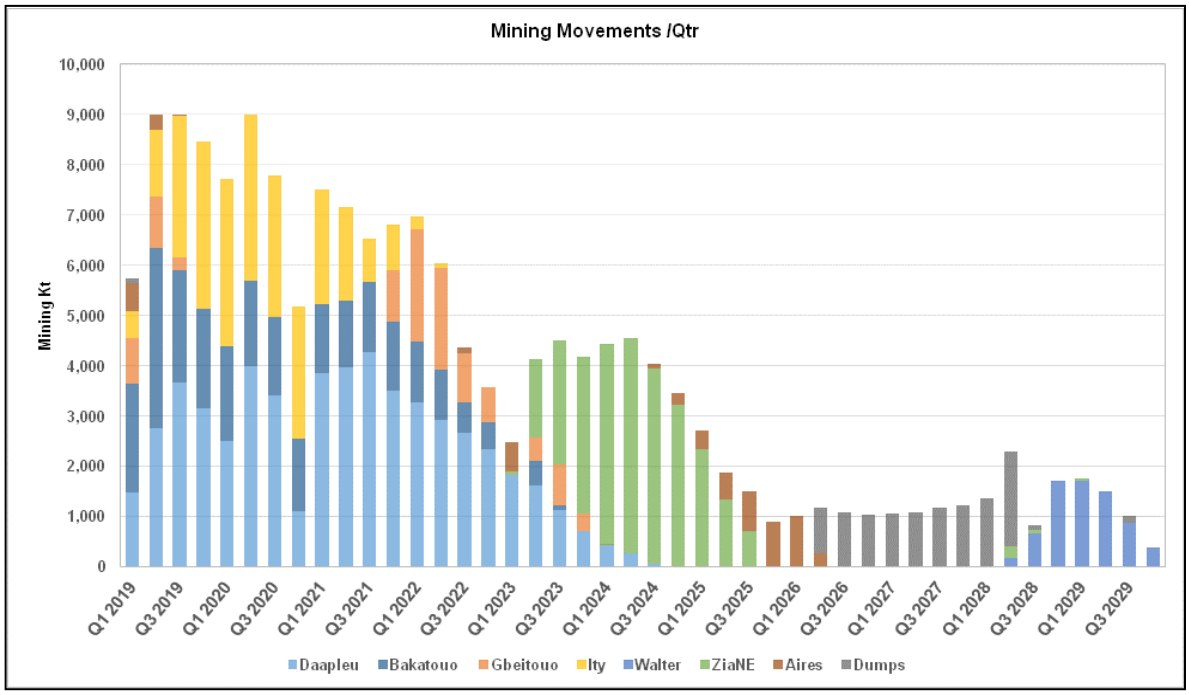


Figure 3.7.10 Scenario 6 – Tonnes and Grade Processed in CIL

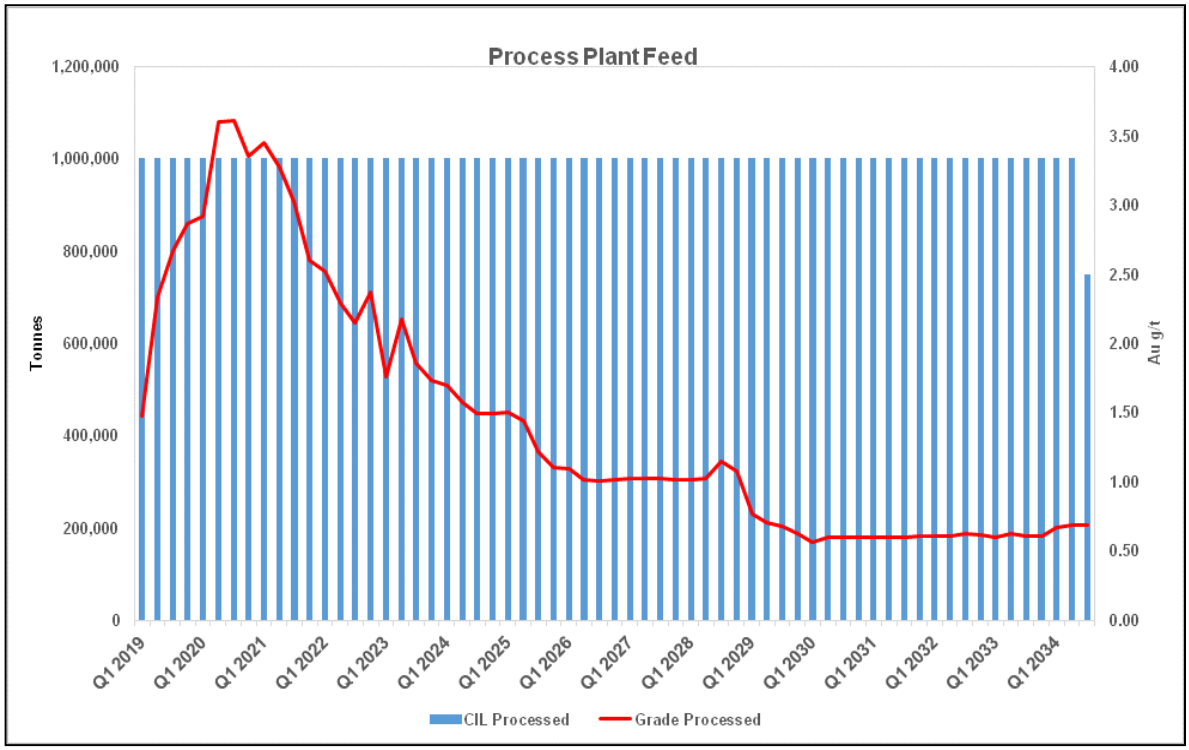


Figure 3.7.11 Scenario 6 - Recovered Ounces Produced

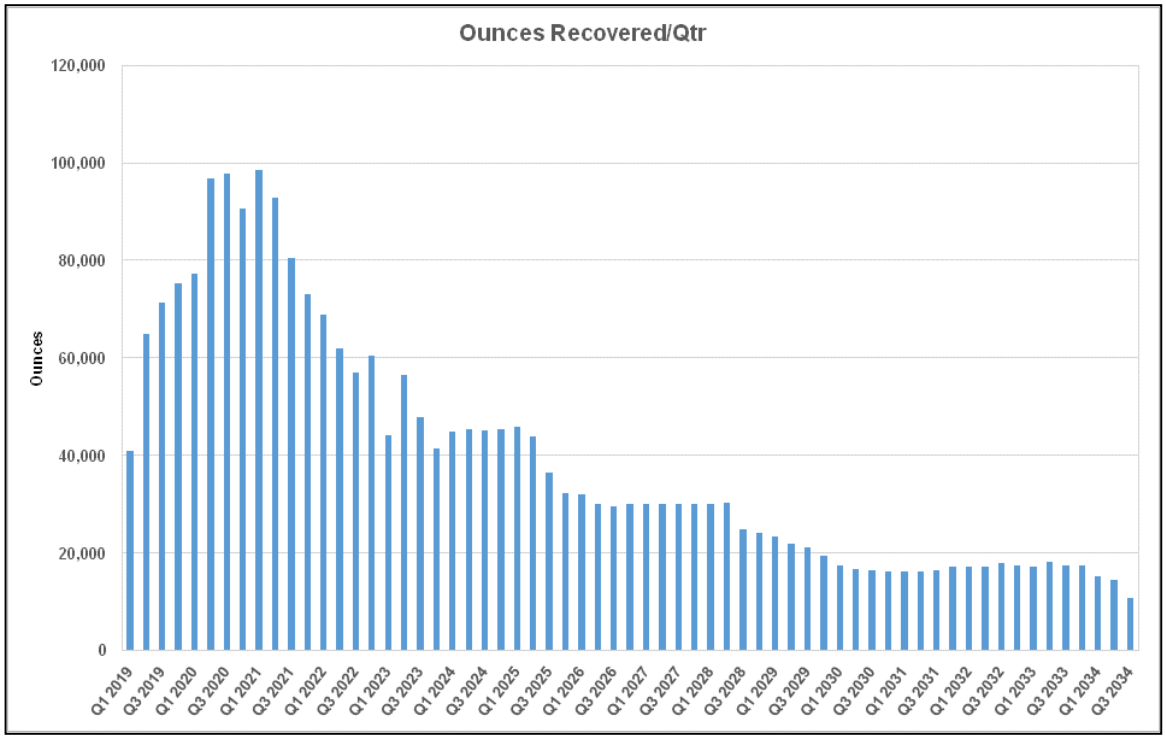
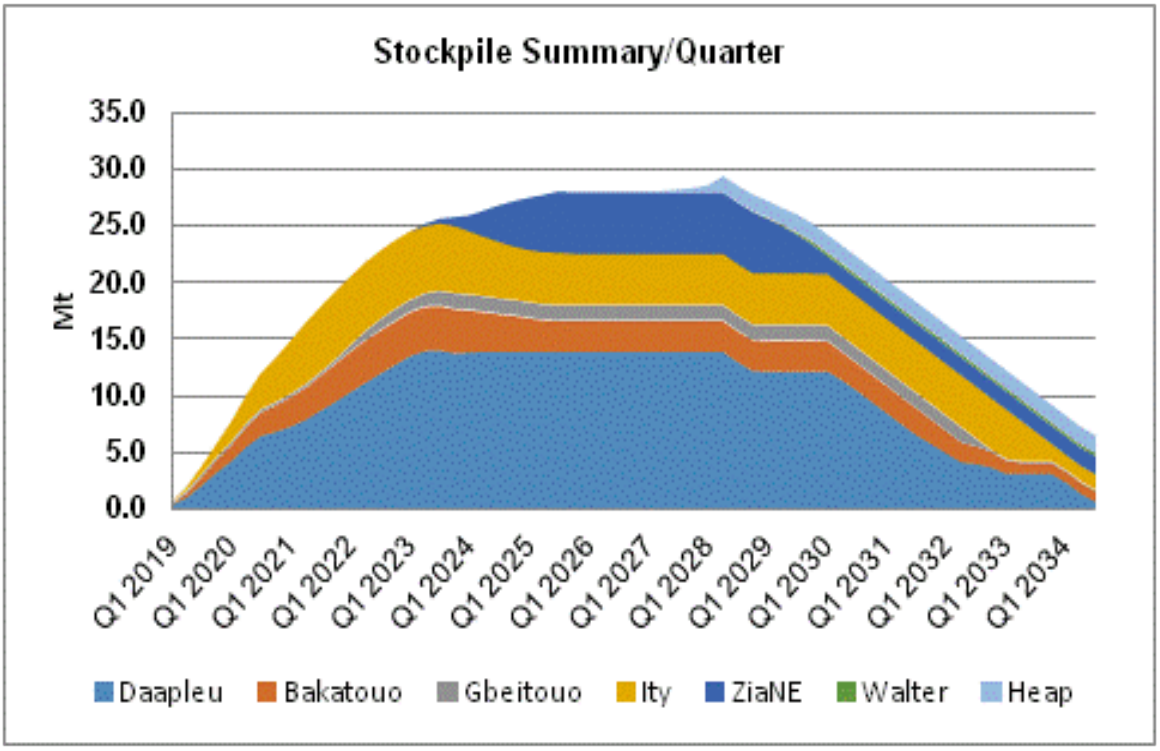


Figure 3.7.12 Scenario 6 - Stockpiles



3.7.4 Scenario 7

Figure 3.7.13 Scenario 7 - Total Material Movements

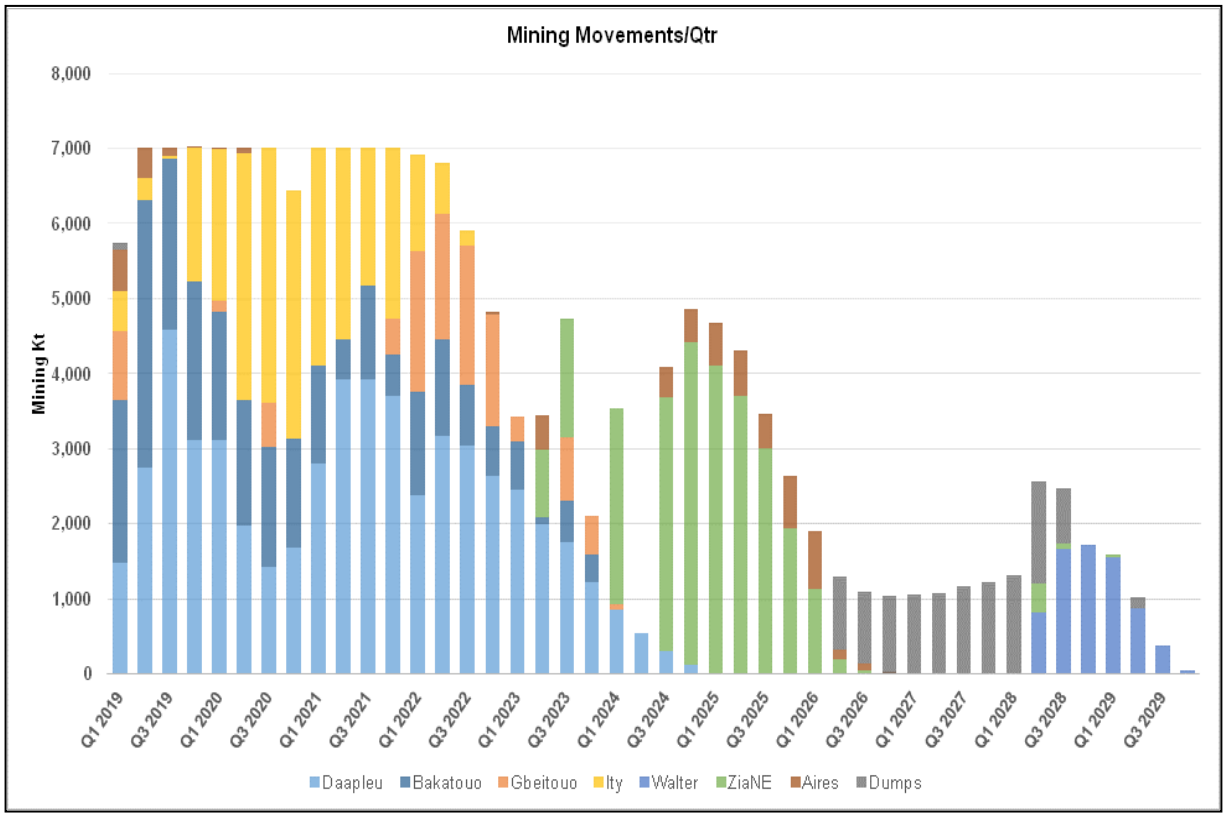


Figure 3.7.14 Scenario 7 - Tonnes and Grade Processed in CIL

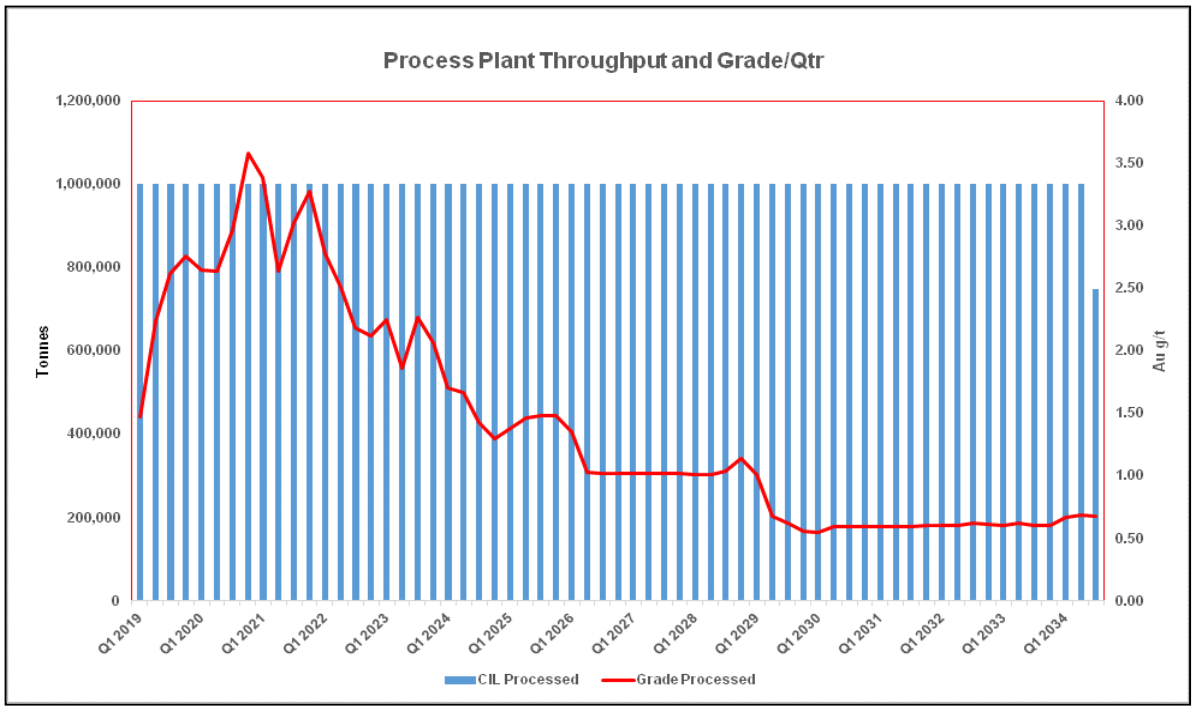


Figure 3.7.15 Scenario 7 - Recovered Ounces Produced

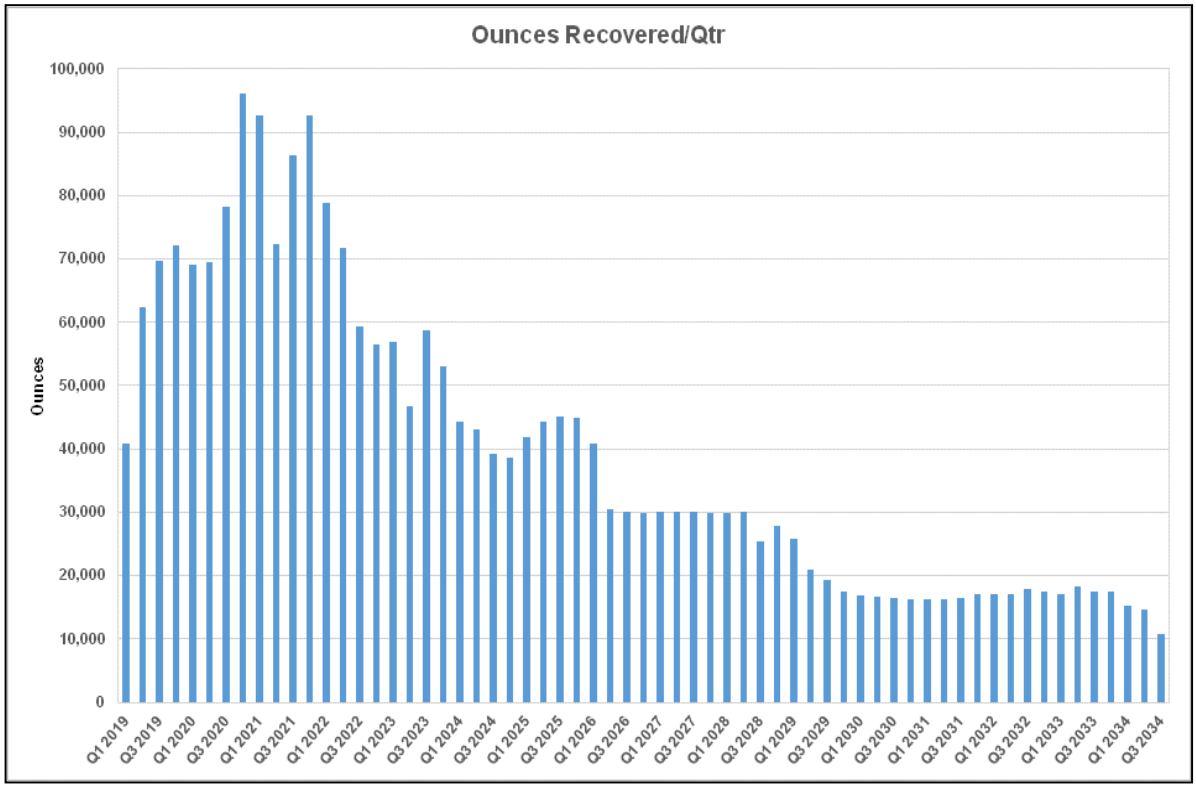
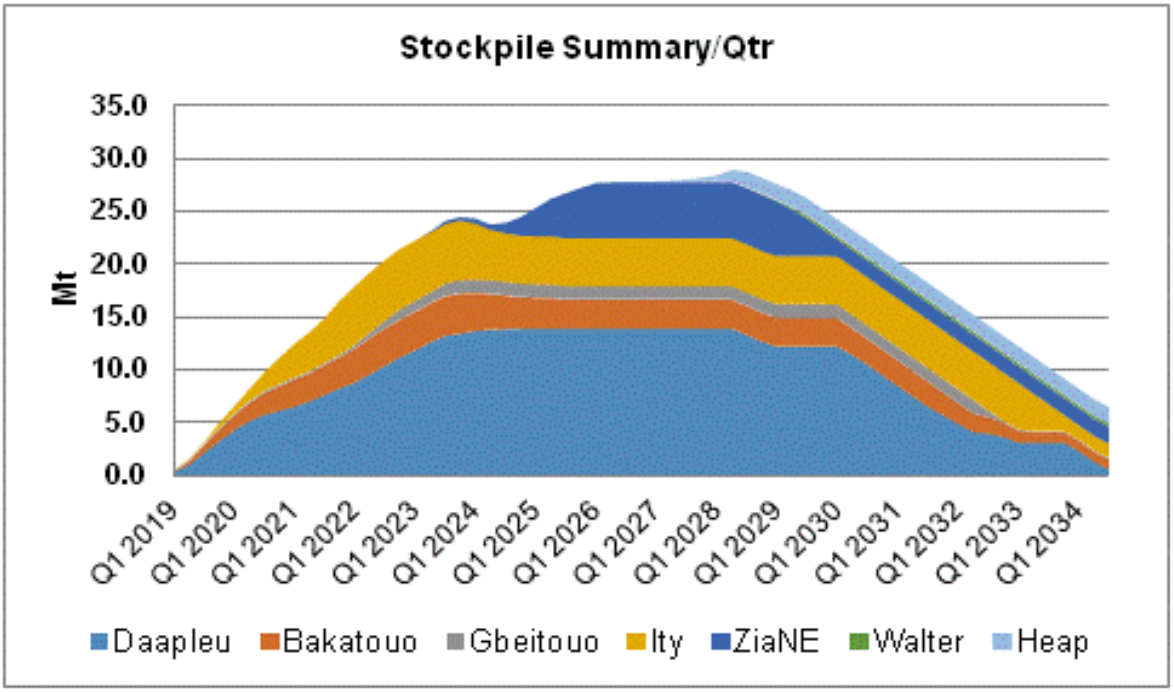


Figure 3.7.16 Scenario 7 - Stockpiles



3.7.5 Scenario 7-1250 Opex 200717

Figure 3.7.17 Scenario 7-1250 Opex 200717 - Total Material Movements

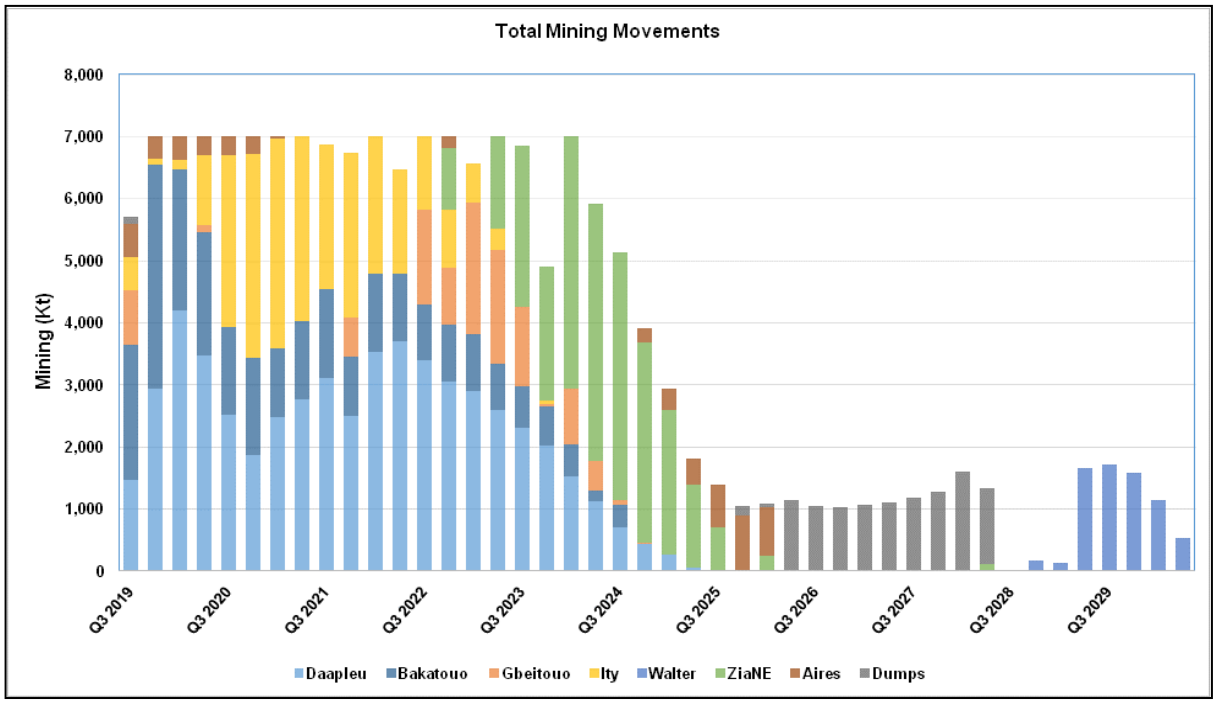


Figure 3.7.18 Scenario 7-1250 Opex 200717 - Tonnes and Grade Processed in CIL

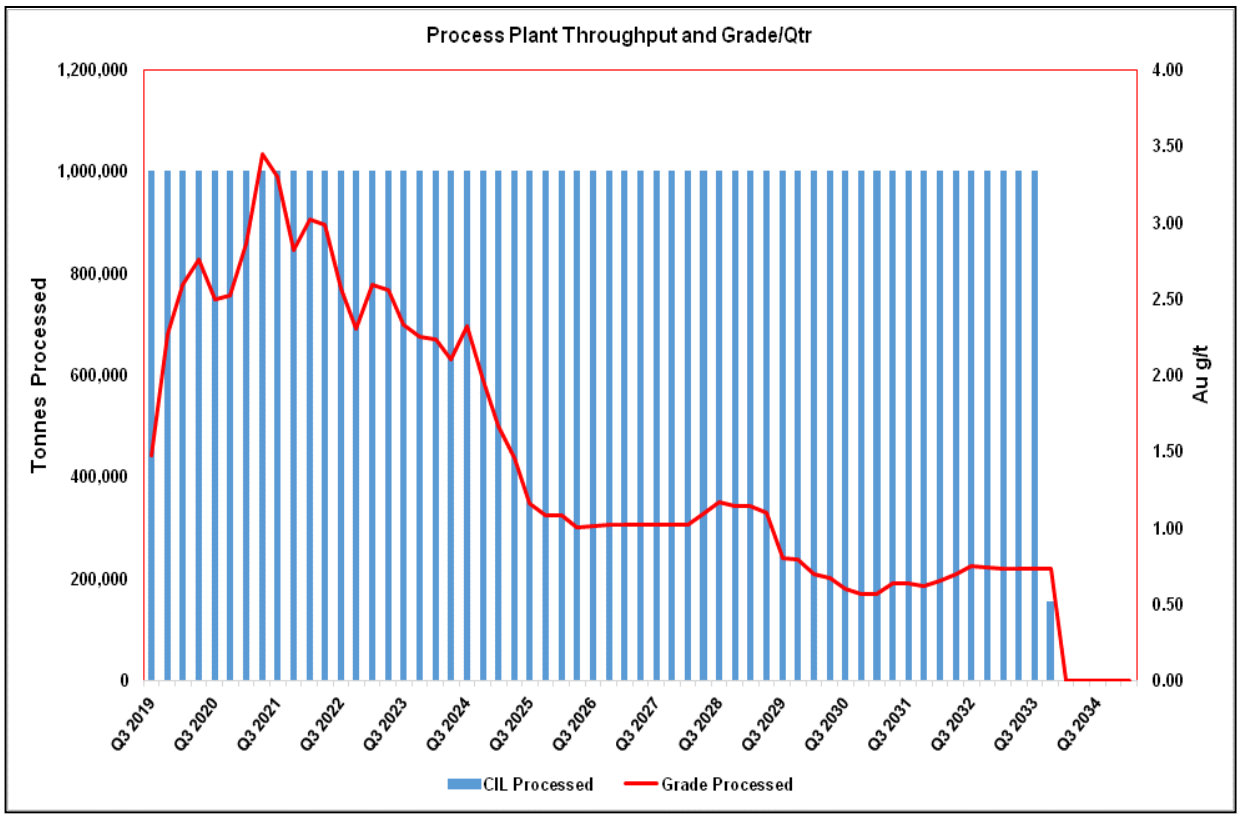


Figure 3.7.19 Scenario 7-1250 Opex 200717 - Recovered Ounces Produced

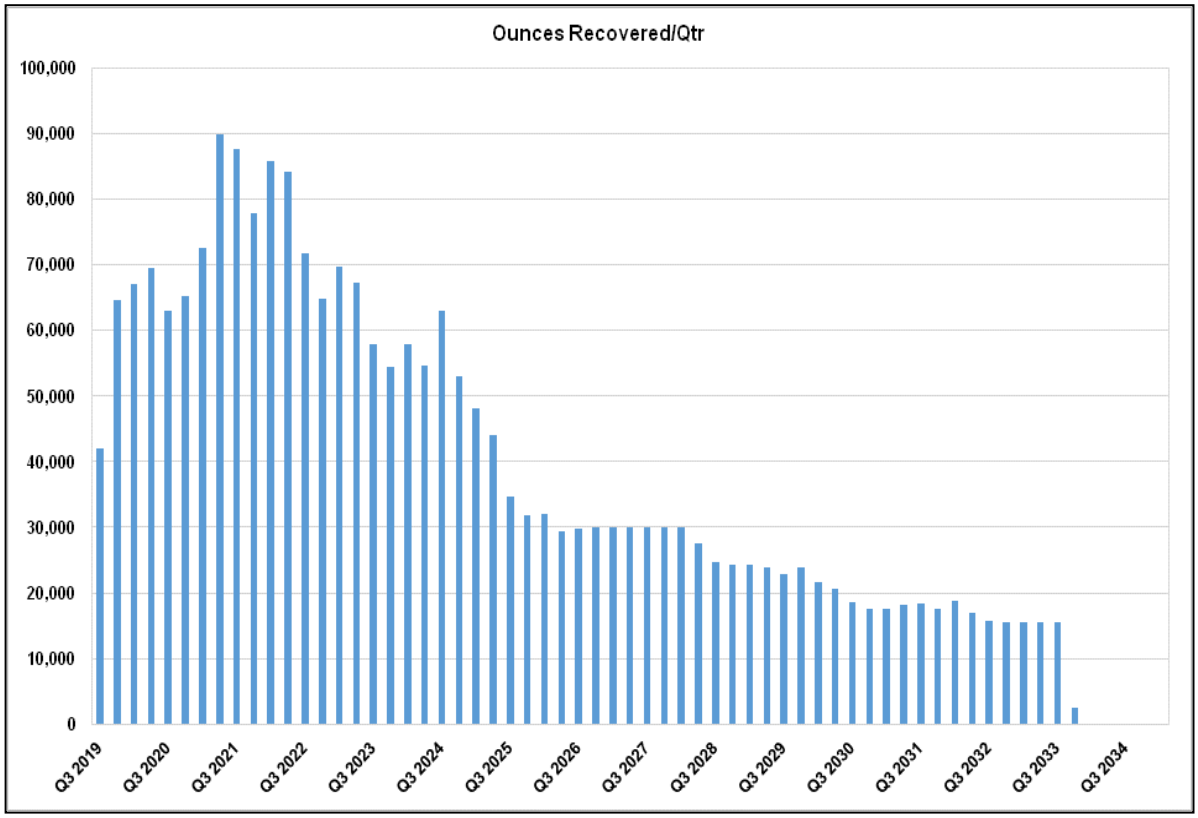


Figure 3.7.20 Scenario 7-1250 Opex 200717 - Stockpiles

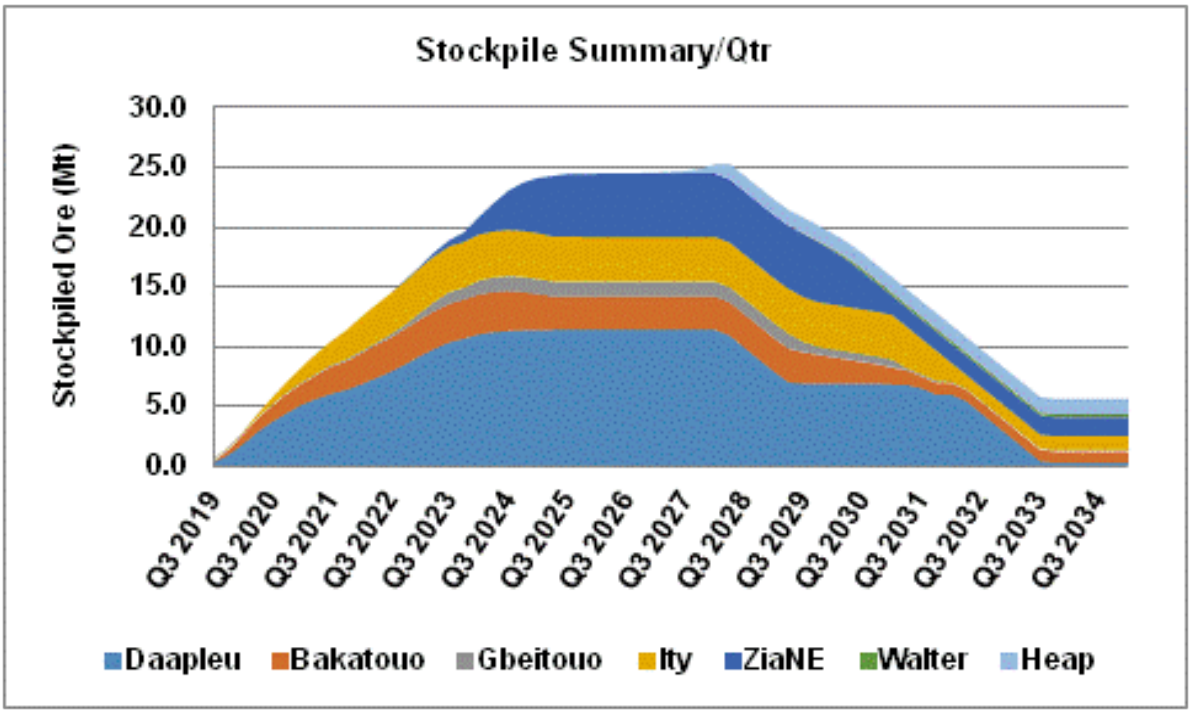


Table of Contents

			Page
4.0	**MINING COSTS**		**4.1**
	4.1	Introduction	4.1
	4.2	Scope, Basis and Exclusions	4.1
		4.2.1 Calsta Scope	4.1
	4.3	Calsta Exclusions and Battery Limits	4.2
	4.4	Mine Fleet Selection and Optimisation	4.2
		4.4.1 Mine Fleet Selection Criteria	4.2
	4.5	Mining Equipment Selection and Pricing	4.3
	4.6	Available Time Assumption	4.4
	4.7	Mine Equipment Productivity Assumptions	4.4
		4.7.1 Hydraulic Excavator – Ore Loading	4.4
		4.7.2 Off Highway Truck Productivity	4.5
	4.8	Mining Equipment Operating Quantities	4.6
	4.9	Owner Cost Modelling	4.7
		4.9.1 Personnel and Manning	4.7
		4.9.2 Mining Management and Technical Services (Indirect) Labour	4.8
		4.9.3 Summary of Mining Personnel by Category	4.8
	4.10	Fuel	4.9
	4.11	Blasting	4.9
		4.11.2 Mine Preparation and Rehabilitation Works	4.10
	4.12	Grade Control	4.11
		4.12.1 Mine Operating Overheads	4.11
	4.13	Mine Operating Cost Basis Summary	4.12
	4.14	Mining Operating Costs	4.13
		4.14.1 Mining Operating Cost Summary	4.13
		4.14.2 Mining Operating Cost Summary by Year	4.14
		4.14.3 Mining Operating Costs by Pit and Rehandle	4.14
		4.14.4 Mining Operating Cost Unit Rates	4.15
	4.15	Mining Capital Costs	4.15
		4.15.1 Mining Capital Summary	4.15
		4.15.2 Mining Preproduction Capital Summary by WBS	4.15

TABLES

Table 4.4.1	Mine Equipment Selection Criteria	4.3
Table 4.5.1	Mining Equipment Capital Cost	4.4
Table 4.7.1	Hydraulic Excavator – Ore Loading Productivity Assumptions	4.5
Table 4.7.2	Hydraulic Excavator – Waste Loading Productivity Assumptions	4.5
Table 4.8.1	Mining Equipment Operating Schedule	4.6
Table 4.9.1	Direct Labour Numbers	4.8
Table 4.9.2	Mine Management Labour Numbers	4.8
Table 4.9.3	Mining Personnel Summary by Category	4.8
Table 4.13.1	Mine Operating Cost Basis	4.12
Table 4.14.1	Mining Operating Costs (US$ Million)	4.13
Table 4.14.2	Mining Operating Costs for per Year (US$ Million)	4.14
Table 4.14.3	Mining Operating Costs split by Pit and Rehandle (US$ Million)	4.14
Table 4.14.4	Mining Operating Cost Unit Rates	4.15
Table 4.15.1	Mining Capital Costs (US$ Million)	4.15
Table 4.15.2	Mining Capital Costs by WBS (US$ Million)	4.16

Table of Contents (Continued)

Page

FIGURES

Figure 4.10.1 Mining Equipment Fuel Usage 4.9
Figure 4.11.1 Bulk Explosive Schedule 4.10

APPENDICES

Appendix 4.1 List of Documents Available in Electronic Format

4.0 MINING COSTS

4.1 Introduction

Endeavour Mining (Endeavour) currently operate the Ity Gold Mine located in Côte d'Ivoire using shallow open pit mining methods with processing via a heap leach approach.

Mining is currently performed on an Owner Mining basis and mining occurs predominantly within oxide material which historically has required minimal blasting.

Resource and cost estimation for this study has been completed on an Owner Mining basis whereby the current mining operation is expanded to further develop currently operating pits together with development of new pits. This study has been completed using a Carbon-in-Leach (CIL) processing methodology in comparison to the current heap leach approach.

4.2 Scope, Basis and Exclusions

4.2.1 Calsta Scope

Calsta Pty Ltd (Calsta) have completed all resourcing, equipment selection and costing related to mining for the Ity CIL Project. As part of this, Calsta developed a detailed cost model which uses first principal calculations incorporating key operating assumptions. As part of this modelling, mining equipment capital and operating costs have been calculated on an estimated life cycle basis rather than whole of life averages in order to best reflect actual estimated cash flows.

The Ity mining related scope covers all open pit, ore reclaim and crusher feed activities. The mining cost estimate covers these areas as well as preproduction and sustaining mine support, setup and rehabilitation activities.

All modelling is based on the mining schedule “Ity Production Schedule v.6a - 4Mtpa with Bakatouo” provided by Mining Solutions. The mining quantities and schedules were then setup by Calsta to allow determination of equipment numbers, general resource requirements and subsequent estimation of mining operating and capital costs.

The report CPL_Ity_CIL_MRC provides full detail as related to the Ity CIL Project mine resourcing and costing estimation as this report is a summary focussing on the basis of estimation.

4.3 Calsta Exclusions and Battery Limits

The following exclusion and battery limit items apply:

- Material properties (specific gravity, swell, moisture content) as advised by Mining Solutions in the FS.
- The mining haul road network, river diversions and surface drainage management which are covered by others.
- Construction and maintenance of roads is limited to the mining works area and excludes all other roads within the project area.
- Given that ore presents early in the mining schedule, haulage of waste for construction of the Tailings Storage Facility (TSF) is not possible. This being the case, TSF construction material will therefore be sourced from existing waste rock stockpiles. As such, TSF embankment build design and costing has been covered by others.
- All fixed infrastructure including offices, maintenance facilities magazines, service facilities, batch plants, refuelling facilities have been designed and costed by others.
- Seeding and other ongoing rehabilitation works associated with the mining waste dumps as well as all other roads, hardstands and associated mining disturbance areas have been designed and costed by others.
- The battery limit for ore handling is to the primary crusher. Mining related costs therefore exclude crusher and processing plant operation.
- Mine related dewatering is limited from the base of each open pit to the natural surface. All other raw water distribution and management has been design and costed by others.
- External pit dewatering via bores has been designed and costed by others.

4.4 Mine Fleet Selection and Optimisation

4.4.1 Mine Fleet Selection Criteria

The selection criteria for mining equipment has been defined by Calsta for the open pit and ore reclaim design and schedule constraints specific to a gold ore operation requiring a high level of material selectivity and flexibility. Table 4.4.1 provides a summary of the selection criteria which formed the basis for equipment enquiries and resourcing requirements.

Table 4.4.1 Mine Equipment Selection Criteria

Activity	Equipment (nominal)	Comment
Pit ore excavating	100 tonne Hydraulic Backhoe Excavator	Provides a good level of ore load selectivity whilst still achieving an acceptable productivity rate.
Pit waste excavating	100 tonne Hydraulic Backhoe Excavator	Larger excavator option (200 t class) not justified when considering rounded equipment numbers. 100 t class provides ore/waste excavating fleet commonality.
Pit material haulage	Rigid chassis dump truck – 90 tonne payload	Suited to pit ramp sizes as designed by Mining Solutions and provides a good match to the selected excavators. This truck type is premised on the assumption that there will be a quality ex pit haul road system which will allow efficient and safe all weather haulage.
Blasthole Drilling	Down The Hole Rig, 102-165mm drill range	Suited to 5 m bench blasting design and the selected drill hole diameter range.
Track Dozers	70 tonne operating weight track type tractor	Sufficient capacity to allow efficient waste dump dozing and pit clean up works.
Wheel Dozers	50 tonne operating weight wheel dozer	Sufficient capacity to allow efficient road cleaning and thereby efficient truck haulage. Also used for excavator and ore rehandle area clean-up.
Water Carts	Rigid chassis dump truck fitted with 50kL capacity water body	Capacity allows flexibility for operating across multiple pits and ore rehandling in any period.
Graders	Motor Grader – 16 foot blade	Suited to the designed pit ramp widths and gradients. Equipment numbers will allow for flexibility operating across multiple pits.
Ore SP Rehandle FEL	50 tonne operating weight front end wheel loader	Suitable for loading 90 t trucks when fitted with high lift package.
Crusher Feed FEL	50 tonne operating weight front end wheel loader	Suitable for load, haul dump of ROM SP ore to the crusher.
General FEL	50 tonne operating weight front end wheel loader	Required for miscellaneous works (clear, grub, windrows etc. and as a backup for the crusher feed and ore rehandle FEL.
Ore SP Haulage	Rigid chassis dump truck – nominal 90 tonne payload	As per the pit haulage trucks for truck commonality.

4.5 Mining Equipment Selection and Pricing

The Komatsu brand has been selected for the mining fleet excluding blast hole drills which are Sandvik brand.

Mining equipment pricing is as contracted for Endeavour Mining's Houndé Gold Project. An exchange rate of USD 1 to YEN 103 has been used. Table 4.5.1 presents the per unit capital cost in millions of USD for the selected mining equipment. The per unit capital costs includes an allowance of 5% (3% for off highway trucks) of the FOB price for spare parts.

Table 4.5.1 Mining Equipment Capital Cost

Description	Class	Selected Equipment	Capital Cost per Unit ($M)
Blasthole Drill	89 mm – 152 mm Down the Hole	Sandvik DI550	$0.68
Diesel Hydraulic Excavator	100 tonne operating weight	Komatsu PC1250SP-8R	$1.16
Rear Dump Off Highway Truck	90 tonne payload	Komatsu HD785-7	$0.86
Track Dozer	70 tonne operating weight	Komatsu D375A-6R	$0.85
Motor Grader	200 kW / 16 foot blade	Komatsu GD825A-2	$0.61
Wheel Loader	400 kW / 50 tonne operating weight	Komatsu WA600-6R	$0.78
Wheel Dozer	400 kW / 50 tonne operating weight	Komatsu WD600-6	$0.72
Water Cart	50,000 litre capacity (65 tonne payload)	Komatsu HD465-7R	$0.91
Tyre Handler	30 tonne operating weight with tyre handler	Komatsu WA500-6	$0.58

4.6 Available Time Assumption

Calsta utilised the following general assumptions to determine the mining equipment operating time per year:

- Mining operates on a 365 day a year on a 24-hour a day basis.
- 28 days a year lost to weather, public holidays and shutdowns.

Detailed assumptions were then applied to each machine type to determine annual equipment engine hours and operating hours specific to fleet types.

4.7 Mine Equipment Productivity Assumptions

Productivity assumptions for the main mining equipment have been used to determine the effective operating rate for primary production machines which in turn allows calculation of the required machine quantities.

An additional efficiency loss has been included, applicable to all machines for training and ramp up over the initial 12 months.

4.7.1 Hydraulic Excavator – Ore Loading

Productivity assumptions for the Komatsu PC1250 hydraulic excavator loading ore material into Komatsu HD785-7 off Highway Trucks are shown in Table 4.7.1.

Table 4.7.1 Hydraulic Excavator – Ore Loading Productivity Assumptions

Productivity Factor	Unit	Oxide	Transition	Fresh
Loading Unit Bucket Size	m^3	6.7	6.7	6.7
Bucket Fill Factor	%	95%	80%	80%
Calculated Max. Bucket Capacity	m^3	6.3	5.8	5.8
Moisture content	%	20%	10%	2%
Loose Wet Density	wmt / m^3	1.55	1.58	1.86
Tray Fill Factor	%	90%	90%	90%
Rated Truck Payload	wmt	91	91	91
Calculated Truck Payload	wmt	81.3	85.1	89.4
Loading unit theoretical prod.	**wmt / Op. hour**	**631**	**530**	**618**
	dmt / Eng. Hr	**464**	**425**	**534**

Productivity assumptions for the Komatsu PC1250 hydraulic excavator loading waste material into Komatsu HD785-7 off Highway Trucks are shown in Table 4.7.2.

Table 4.7.2 Hydraulic Excavator – Waste Loading Productivity Assumptions

Productivity Factor	Unit	Oxide	Transition	Fresh
Loading Unit Bucket Size	m^3	7.5	7.5	7.5
Bucket Fill Factor	%	95%	80%	80%
Calculated Max. Bucket Capacity	m^3	7.1	6.8	6.8
Moisture Content	%	20%	10%	2%
Loose Wet Density	wmt / m^3	1.55	1.58	1.86
Tray Fill Factor	%	100%	95%	95%
Rated Truck Payload	wmt	91	91	91
Calculated Truck Payload	wmt	90.8	87.9	87.9
Loading unit theoretical prod.	**wmt / Op. hour**	**895**	**866**	**988**
	dmt / Eng. Hr	**657**	**694**	**853**

4.7.2 Off Highway Truck Productivity

Productivity assumptions for the Komatsu HD785-7 dump trucks are based on:

- Average loaded speeds and cycle minutes related to each haul profile segment from each pit bench to the nominated truck dump location.
- Average empty speeds and cycle minutes related to each haul profile segment from the nominated truck location back to the allocated pit bench location.
- Static cycle time related to truck load, spot and dump times.

- Total cycle time built up of loaded plus entry plus static time.
- Application of an effective operating factor (47 minutes per hour) to the above.

Truck speeds for different segment lengths and gradients for both loaded and empty truck cycles have been prepared by Calsta using performance data provided by OEMs, with some adjustments made to model known and expected site conditions. The provided haulage segment lengths were increased to allow for rolling resistance. A 3% rolling resistance was used for in-pit haulage whilst a 2% factor was used for all other haul profile segments.

4.8 Mining Equipment Operating Quantities

Based on the allocated productivity levels and available equipment hours, rounded annualised equipment numbers are provided in Table 4.8.1.

Table 4.8.1 Mining Equipment Operating Schedule

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
100 Tonne Excavator		6	6	7	6	7	5	4	4	1			
Ore Rehandle Loader		1	1	1	1	1	1	1	1	1	1	1	1
Pit Trucks		11	15	15	15	17	14	8	9	3			
SP Rehandle Trucks		1	2	2	2	1	2	2	2	2	2	2	2
Track Dozers		6	6	7	6	7	5	4	4	2			
Wheel Dozers		2	2	2	2	2	2	2	2	1	1	1	1
Graders		2	2	2	2	2	2	2	2	2	1	1	1
Water carts		2	2	2	2	2	2	2	2	2	1	1	1
Crusher Feed FEL		1	2	2	2	2	2	2	2	2	2	2	2
Blasthole Drills		1	4	4	4	4	4	0	1	1			
Tyre Handler		1	1	1	1	1	1	1	1	1	1	1	1

4.9 Owner Cost Modelling

4.9.1 Personnel and Manning

Direct Mining Labour

Direct mine labour describes mining equipment operators, blasting personnel, maintenance personnel and general mine services personnel.

Mining equipment operator personnel numbers have been calculated on the following basis:

- Two shifts of 12 hours duration during main mining period based on a 10 days on and five days off roster. Total roster cycle equals 15 days.
- Single shift of 12 hours per day during the open pit mining ramp down period based on a five days on, five days off roster. Total roster cycle equals 10 days.
- Ore rehandle from external stockpiles commences on a single shift basis then moves to a double shift arrangement as the rehandle quantities increase. The two shift roster arrangements described above applies.
- Ore FEL rehandle from the ROM pad to the crusher occurs on a two shift basis on a 10 days on and five days off roster. Total roster cycle equals 15 days.

Blasting personnel numbers have been calculated on the following basis:

- Single shift of 12 hours per day, working a five days on and five days off roster. Total roster cycle equals 10 days.
- Only required in those months where blasting is required.
- One shotfirer per shift as an Endeavour blast management role.
- Three blast crew personnel per shift to allow for stemming works and as a support role to the explosive supplier.

Mining maintenance personnel numbers have been calculated on the following basis:

- Two shifts of 12 hours per day during main mining period, 10 days on and five days off roster. Total roster cycle of 15 days.
- One shift of 12 hours per day during stockpile rehandle only period, five days on and five days off roster. Total roster cycle of 10 days.
- Maintenance labour for standard repair and maintenance tasks has been based on equipment SMU hours per operating period with assumed factors applied for each machine class.

A summary of the annualised (average) direct labour numbers is shown in Table 4.9.1. Maximum numbers occur in Year 2020, being 196.

Table 4.9.1 Direct Labour Numbers

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Equipment Operators	32	109	122	125	125	131	113	80	86	42	21	21	21
Blasting Personnel		3	8	8	8	8	8	2	2	6			
Maintenance Personnel	3	56	66	53	53	54	47	33	32	13	9	9	9
Total	**35**	**167**	**196**	**187**	**187**	**193**	**169**	**115**	**120**	**62**	**30**	**30**	**30**

4.9.2 Mining Management and Technical Services (Indirect) Labour

The cost estimate for Mine Management and Technical Services (Indirect) personnel numbers have been developed by considering the functions performed by each office department in consultation with Endeavour.

Personnel numbers ramp up slowly in line with increases in production and then decrease when mining activities are limited to stockpile rehandle only after year nine. Annual salary costs and associated on-costs were supplied by Endeavour as part of the FS.

Table 4.9.2 provides a summary of the indirect personnel on an annual basis. Maximum Indirect numbers occur in Year 2019, being 54.

Table 4.9.2 Mine Management Labour Numbers

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Mine Management	1	2	2	2	2	2	2	2	2	2	1	1	1
Technical Services	2	13	13	13	13	13	13	13	12	10	8	8	8
Geology	2	12	12	12	12	12	12	12	11	6	5	5	5
Production	8	16	11	10	10	10	10	10	10	7	5	5	5
Maintenance	5	11	9	9	9	9	9	9	9	7	2	2	2
Total	**17**	**54**	**47**	**46**	**46**	**46**	**46**	**46**	**43**	**31**	**21**	**21**	**21**

4.9.3 Summary of Mining Personnel by Category

Table 4.9.3 provides a summary of the total mining personnel on an annual basis, split by principal labour category. Maximum Indirect numbers occur in Year 2018, being 51.

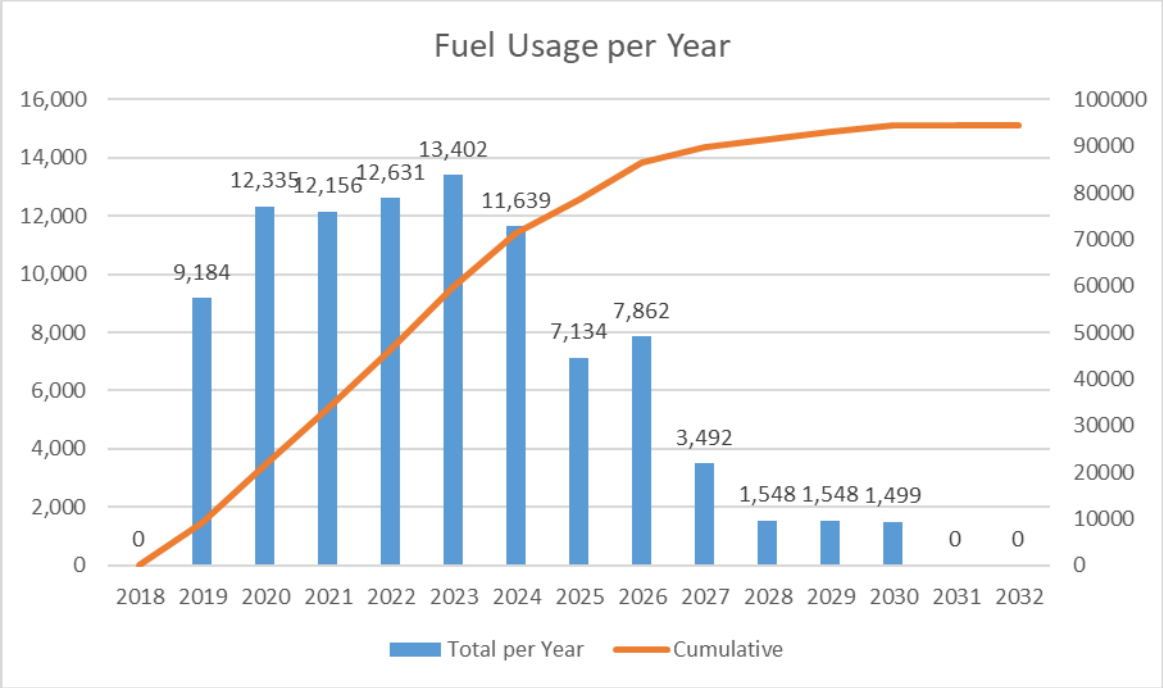
Table 4.9.3 Mining Personnel Summary by Category

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Foreign Expatriate	3	10	10	10	10	10	10	10	10	8	4	4	4
Ivorian FIFO	13	37	30	29	29	29	29	29	27	19	13	13	13
Local Area	36	174	203	194	194	200	176	122	126	66	34	34	34
Total	51	221	243	232	232	238	214	161	163	93	51	51	51

4.10 Fuel

A summary of the fuel usage per year for HME and Light Mining Equipment (LME) is provided in Figure 4.10.1. A total fuel usage for mining equipment of 94.43 ML over the life of mine has been estimated.

Figure 4.10.1 Mining Equipment Fuel Usage



4.11 Blasting

Calsta have assumed explosive supply under a Down-the-Hole service arrangement which will be provided by a reputable explosive supplier. Under this arrangement, the supplier will provide all charge / blast crew personnel, however overall blast management will be Endeavour's responsibility.

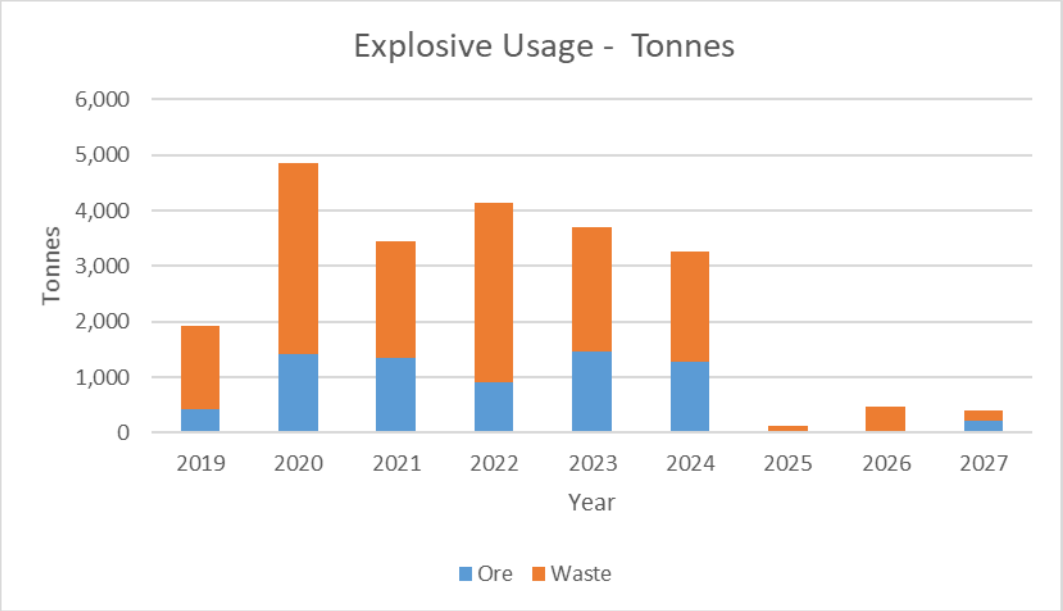
Based on observations made from site visits, it is probable that mining of transition material will periodically result in the creation of a proportion of oversized boulders. This oversize will be managed by a combination of secondary blasting and mechanical rock breaking. Secondary blasting has been included in the cost model as an additional explosives allowance at 5 % of all transitional material.

The project will require establishment of a magazine facility for storage of explosive accessories and miscellaneous explosives. In addition, there will be a requirement for establishment of an emulsion batch plant.

Explosive Schedule

Figure 4.11.1 provides estimated explosive quantity usage based on the assumption that blasting is only required in fresh rock. This assumption results in high usage variability which would be smoothed during actual operations by drill and blasting ahead of load-haul activities.

Figure 4.11.1 Bulk Explosive Schedule



4.11.2 Mine Preparation and Rehabilitation Works

Clearing, grubbing and topsoil removal will be required as both a pre-mining campaign as well as additional campaigns throughout the mine schedule prior to additional pits becoming active.

Topsoil removal has been calculated on a 300 mm depth assumption. Grubbing as well as topsoil material will be placed in several stockpiles for later rehabilitation use following completion of the open pit mining phase.

The requirement to build a ROM pad waste rock base is part of the mining cost estimation scope. Given that ore presents together with waste in the first month of the open pit mining schedule, waste rock material from the planned pits to construct the ROM pad will not be possible. This being the case, this material will be reclaimed from an existing stockpile.

Lycopodium have estimated a ROM build volume of 1.34M m^3. Calsta have scheduled this activity to be completed four months prior to commencement of ore processing, assuming an average haul length of 500 m for reclaim of current waste to the ROM pad build. A key assumption for the activity is that available stockpiled waste rock is competent for the required ROM pad LOM duty.

All haul roads, culverts, bridges and associated drainage has been excluded from the Calsta mining scope and have been covered elsewhere within this Study.

The mining cost scope includes a provision for battering waste dumps to a nominal 18 degrees. Battering will utilise dozers, which will be followed by placement of topsoil and vegetation as previously stockpiled using front end loaders and dump trucks in preparation for rehabilitation seeding. Mining rehabilitation within the mining scope excludes rehabilitation of roads, buildings and other hardstands which are covered elsewhere within this Study.

4.12 Grade Control

Grade control modelling of the expected ore boundaries will be managed in the first instance by RC drilling and subsequent assay sampling and analysis. The following grade control parameters have been assumed:

- Drill area = LG + HG ore zone plus 20% overlap.
- A redrilling allowance of 5%.
- A drill pattern of 5 m x 10 m @ 60 degrees for all material types.
- Samples at 1.0 m intervals.

RC Drilling will be carried out using a specialist contractor.

4.12.1 Mine Operating Overheads

The following mine operating cost overheads were allowed for on a dynamic basis following the mining schedule:

- Mining consultants operating provision.
- PPE and safety equipment.
- General open pit operating consumables.
- Geology and survey specific consumables.
- Mining administration overheads.

4.13 Mine Operating Cost Basis Summary

Table 4.13.1 Mine Operating Cost Basis

Cost Area	Usage	Cost Basis
Direct Labour	Operator and maintenance personnel based on the equipment numbers related to assigned shifts as previously discussed.	Base salaries and on-costs determined by Endeavour. Additional allowances for operating consumables per category.
Indirect Labour	Quantities as previously discussed.	Base salaries and on-costs determined by Endeavour. Additional allowances for operating consumables per category.
Equipment Maintenance Parts and OEM Labour	Based on life cycle accumulative hours matched to hours achieved in the schedule.	Life cycle rates for all major components and consumables as provided by OEM's. Additional provisions have been included for accident damage and unplanned maintenance in the life cycle cost calculation.
Direct Tip into Primary Crushers	90 tonne rear dump OHT are able to direct tip into the primary crusher.	A direct tip factor of 15% is assumed. An average ROM front end loader tram distance to crusher equals 120 metres.
Fuel	Quantity based on estimated fuel burn rates for respective mobile equipment types and duties.	Allocated $/L fuel rate (US$1.00 / L).
Tyres	Based on estimated tyre life for respective mobile equipment types and duties.	Respective unit tyre costs as provided by tyre suppliers. Increased tyre life may be possible by implementing a robust tyre management strategy which could provide upside to the FS.
Ground Engaging Tools	Ground Engaging Tools (GET) based on expected life, material abrasiveness and level of blasting.	GET component unit costs provided by suppliers.
Drill Consumables	Consumables suited to the selected blasthole rigs, allocated typical useful lives.	Drill consumable unit costs as provided by Sandvik.
Excavator / Track Dozer Undercarriage	Based on information provided by the OEM's and site visits, considering material abrasiveness, excavator walking and mining operator techniques for competency.	Undercarriage component costs provided by OEM's.
Blasthole Parameters	Drill parameters assume a target powder factor of 0.61 kg/ m^3, blasting in fresh material only.	Cost drivers as covered (drill consumables, labour, maintenance and fuel).
Presplit Drilling	Pit wall Presplit drilling limited to the Daapleu pit fresh rock material.	Cost drivers as covered (drill consumables, labour, maintenance and fuel).
Blasting	Emulsion product used throughout. Quantities of explosives as well as accessories based on the blasthole parameters driven by the mining schedule.	A Down-the-hole service arrangement is assumed based on RFQ pricing. Scope includes explosive product supply and hole charging.

Cost Area	Usage	Cost Basis
Secondary Blasting	Transition material may periodically result in the creation of oversized boulders. Oversize will be managed by a combination of secondary blasting and mechanical rock breaking.	Secondary blasting has been included in as an additional explosives allowance at 5% of all Transitional material.
Pit Dewatering	In pit dewatering of ground water and dust suppression water which finds its way to the pit base.	Capital costs for supply of dewatering equipment has been provided by suppliers. Operating costs are based on an hourly operating fuel and maintenance rate.
Mine Preparation and Rehabilitation	Clearing, grubbing and topsoil removal will be required as both a pre-mining campaign as well as additional campaigns throughout the mine schedule prior to additional pits becoming active	Contractor rates have been applied to volume of area required. Topsoil removal has been calculated using 300mm depth assumption.
Grade Control	Quantities as previously discussed	Both drill and sample unit costs based on current Houndé Gold Operation contract rates.
Mine Operating Overheads	As previously discussed	A derivative of material movement based on the schedule.

4.14 Mining Operating Costs

All costs are quoted in USD.

4.14.1 Mining Operating Cost Summary

Table 4.14.1 presents the Life of Mine operating costs split by cost area.

Table 4.14.1 Mining Operating Costs (US$ Million)

Mining Operating Costs	$M
Pit Loading	38.95
Pit Hauling	64.73
Ore Rehandle Load	12.81
Ore Stock Pile Haul	2.78
Ancillary	43.12
Drilling	63.25
Blasting	50.94
Personnel (indirect)	38.85
Mine Preparation and Rehabilitation	4.30
Grade Control	12.71
Support Equipment	35.93
Operating Overheads	6.99
Total	**375.36**

4.14.2 Mining Operating Cost Summary by Year

Table 4.14.2 presents the operating costs split by cost area per year.

Table 4.14.2 Mining Operating Costs for per Year (US$ Million)

Mining Operating Costs	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Pit Loading	0.02	3.09	3.88	4.53	4.16	3.81	4.18	7.37	7.13	0.76				
Pit Hauling	0.04	4.35	7.03	6.95	8.51	14.82	7.99	3.62	7.89	3.52				
Ore Rehandle Load		0.35	0.59	0.76	1.52	0.66	0.77	1.19	1.76	1.11	1.01	1.24	1.76	0.09
Ore Stock Pile Haul		0.06	0.06	0.06	0.17	0.11	0.11	0.38	0.33	0.24	0.38	0.40	0.43	0.05
Ancillary	0.05	3.69	4.39	3.98	5.13	6.20	5.42	5.01	3.65	3.41	0.50	0.58	1.03	0.08
Drilling		3.61	14.26	8.13	12.96	10.24	10.59	1.32		2.15				
Blasting		2.66	10.53	6.14	9.81	8.42	9.01	1.65		2.72				
Personnel (indirect)	0.30	4.56	3.93	3.13	3.75	3.75	3.75	3.75	3.75	3.13	1.55	1.55	1.55	0.39
Mine Prep. and Rehab	1.97	0.28		0.60	1.10	0.35								
Grade Control	0.17	1.61	1.38	1.15	1.34	2.33	1.40	0.73	2.13	0.47				
Support Equipment		2.89	3.60	3.04	3.66	3.65	3.64	3.50	3.38	3.49	1.57	1.57	1.57	0.39
Operating Overheads	0.12	0.76	0.83	0.84	0.89	0.92	0.92	0.53	0.51	0.37	0.09	0.09	0.09	0.02
Total	**2.67**	**27.91**	**50.48**	**39.31**	**52.98**	**55.27**	**47.80**	**29.04**	**30.53**	**21.37**	**5.10**	**5.43**	**6.43**	**1.02**

4.14.3 Mining Operating Costs by Pit and Rehandle

Table 4.14.3 presents the operating costs split by pit and stockpile rehandle.

Table 4.14.3 Mining Operating Costs split by Pit and Rehandle (US$ Million)

Mining Operating Costs	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Daapleu 1	0.14	4.64	16.60	17.72	4.12									
Daapleu 2			0.00	4.90	29.15	28.45	23.08	2.97						
Ity Flat			1.59	6.97	5.93									
Mont Ity			0.00	2.88	8.28	13.32	3.38							
Gbeitouo					2.72	7.87	11.27	0.71						
Walter						4.52	8.68	4.70						
Zia NE							0.51	19.10	28.45	20.02				
Bakatouo	0.03	21.12	31.64	5.41										
Ore Rehandle	0.46	1.60	0.65	0.82	1.69	0.77	0.88	1.57	2.09	1.35	5.10	5.43	6.43	1.02
Common Costs	2.04	0.55	0.00	0.60	1.10	0.35	0.00	0.00	0.00	0.00				
Total	**2.67**	**27.91**	**50.48**	**39.31**	**52.98**	**55.27**	**47.80**	**29.04**	**30.53**	**21.37**	**5.10**	**5.43**	**6.43**	**1.02**

4.14.4 Mining Operating Cost Unit Rates

Table 4.14.4 presents total costs for mining, total material movement and unit rates for the preproduction and sustaining periods. Unit rates are exclusive of equipment capital costs.

Table 4.14.4 Mining Operating Cost Unit Rates

Mining Operating Costs	Preproduction	Sustaining	Total
Total Cost (US$ M)			
Open Pit Mining – Ore	1.25	122.40	123.65
Open Pit Mining - Waste	9.64	212.20	221.84
Ore Rehandle	1.73	28.14	29.87
Total Material Movement (Mt)			
Ore Tonnes Mined	0.78	36.81	37.60
Waste Tonnes Mined	6.76	105.62	112.37
Rehandle Ore	0.18	63.69	63.88
Unit Rates ($/t)			
Open Pit Mining	1.44	2.35	2.30
Ore Rehandle & Crusher Feed	9.54	0.44	0.47

4.15 Mining Capital Costs

4.15.1 Mining Capital Summary

Table 4.15.1 presents Life of Mine capital costs split by both heavy mining equipment and light mining equipment.

Table 4.15.1 Mining Capital Costs (US$ Million)

Mining Operating Costs	$ M
Heavy Mining Equipment	46.23
Light Mining Equipment	19.44
Total	**65.67**

4.15.2 Mining Preproduction Capital Summary by WBS

Preproduction has been defined as all costs up to and including the first month of ore processing. All costs past month one of ore processing are therefore allocated as sustaining costs.

Mining has been allocated the 400 WBS series for project reporting. Table 4.15.2 provides Preproduction costs related to equipment capital purchases and operational mining costs.

Table 4.15.2 Mining Capital Costs by WBS (US$ Million)

	400	2018	2018	2018	2018	2018	2018	2018	2019	2019	2019	2019	2019
	Area / Facility Codes	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
420	**Mine Establishment**												
421	Haul Roads												
422	Pre Stripping												
423	ROM Pad	0.10	0.10	0.10									
424	Dewatering												
425	Waste Dumps												
426	Settlement Ponds												
427	River / Creek Diversions												
430	**Mining Preproduction**												
431	Mining Labour - Indirect					0.15	0.15	0.42	0.42	0.42	0.42	0.42	0.40
432	Mining Labour - Direct					0.06	0.06	0.14	0.17	0.15	0.15	0.15	0.17
432	Maintenance Parts					0.00			0.16	0.45	0.44	0.39	0.56
433	Fuel									0.69	0.75	0.75	0.79
434	Drill Consumables												
435	Blasting consumables												
436	Grade control					0.06	0.12	0.18	0.23	0.22	0.23	0.22	0.07
437	Mine Preparation		0.55	0.57	0.56								
438	Mining Overheads					0.01	0.01	0.01	0.02	0.05	0.06	0.06	0.06
440	**Mining Consultants**												
441	Consultant Mining Engineer					0.03	0.03	0.03					
442	Geological						0.03	0.03					
443	Geotechnical							0.03					
444	Hydrology							0.03					
460	**Mine Mobile Equipment - HME**												
461	Excavators							5.81					
462	Front End Loaders										2.35		
463	Trucks							10.32	0.86		1.72		
464	Track Dozers							2.55					
465	Wheel Dozers							1.44					
466	Graders							1.21					
467	Water Carts							1.81					
468	Blasthole Drills												0.68
469	Tyre Handler							0.58					
470	**Mine Mobile Equipment - LME**												
471	General Mine Mobile Equipment			3.28									0.80
472	Mine Operating Equipment			1.86									
473	Mining First Fills & Spares												
474	Comms & System Controls			1.02									
475	Light Vehicles & Busses			1.63									
476	Maintenance Equipment Setup			0.50									
	Total	**0.10**	**0.65**	**8.96**	**0.56**	**0.31**	**0.40**	**24.60**	**1.85**	**1.97**	**6.12**	**1.99**	**3.53**

APPENDIX 4.1

LIST OF DOCUMENTS AVAILABLE IN ELECTRONIC FORMAT

File Name	Source	Description
CPL_Ity_CIL_MRC_R1.pdf	Calsta	Full Mining Resourcing and Costing Consultant Report, Rev1
Ity Mining Cost Model_Sched_v6a 4mtpa_Rev1.5.xlsx	Calsta	Full mining cost model for build-up of resources and cost estimation based on 4mpta throughput mining schedule.
Ity Production Schedule v.6a - 4Mtpa with Bakatouo	Mining Solutions	Corresponding to the designed pits and removal of the Verse Quest ore stockpile
RFBP Pack	Calsta	Covering letter, Acknowledgement form, Instruction to Suppliers, Conditions of RFBP.
Technical Bid Evaluation	Calsta	Provides an evaluation of the equipment suppliers, being: • Atlas Copco. • Bia Overseas. • JA Delmas. • Premium Equip Liebherr. • Sandvik.

Table of Contents

Page

5.0 METALLURGY **5.1**
5.1 Metallurgical Testwork Overview 5.1
5.2 Bakatouo Testwork 5.1
5.2.1 Main Conclusions 5.1
5.2.2 Sample Selection 5.3
5.2.3 Comminution Testwork 5.3
5.2.4 Metallurgical Variability Testwork 5.4
5.2.5 Master Composite Testwork 5.5
5.2.6 Physical Characterisation Testwork 5.6
5.2.7 Conclusions 5.6
5.3 Daapleu Refractory Testwork 5.8
5.3.1 Overview 5.8
5.3.2 Sample Selection 5.8
5.3.3 Testwork Programme 5.8
5.3.4 Key Results 5.9
5.3.5 Conclusions 5.10
5.3.6 Detailed Report 5.11

TABLES
Table 5.2.1 Metallurgical Recovery and Reagent Consumption 5.3
Table 5.2.2 Metallurgical Recovery and Reagent Consumption 5.7
Table 5.3.1 Whole-of Ore Leaching vs. Flotation / Regrind Leaching 5.11

APPENDICES
Appendix 5.1 Bakatouo Testwork Report
Appendix 5.2 Daapleu Refractory Ore Test Report

5.0 METALLURGY

5.1 Metallurgical Testwork Overview

Two programmes of testwork have been undertaken since the issue of the FS in 2016:

- A detailed investigation of the metallurgical response of the Bakatouo deposit.
- A follow up investigation to determine if the gold recovery for Daapleu primary ore can be improved by a flotation / regrind / leaching process route.

5.2 Bakatouo Testwork

5.2.1 Main Conclusions

Comminution Testing

- Comminution testing indicated the mineralised zones are moderately competent. A grind target of 75 microns was used similar to the other Ity deposits. Results showed abrasion index of 0.155, Bond ball work index of 11.2 kWh/t and SMC modelling parameter (Axb) of 52.

Variability Testing

- Variability testing on 35 intercept samples spread across the orebody included gravity followed by direct cyanidation.
- All tests demonstrated over 90% gold extraction after 24 hour except for six samples (mainly transition) with an average of 95% gold extraction for the samples excluding the six poor performers. Leach kinetics were typically fast with maximum extraction from the gravity tail being reached within eight hours apart from a few notably poor performers.
- Gravity gold recovery averaged 30% with highs of over 50%.
- Cyanide consumption averaged 2 - 2.5 kg/t for the tests, peaking at 7.4 kg/t for the poor recovery samples.
- Copper extraction of approximately 50% was experienced for most samples and the poor gold extraction results are clearly associated with high copper in solution grades (>1,000 ppm). Higher copper solution grades also result in notably slower gold leach kinetics.

The degree of cyanide soluble copper in these ores was highlighted as a significant issue for the ore processing despite the high gold recoveries.

- Coarse intermittent bottle rolls (IBR) were used to investigate leaching at a coarse size to simulate heap leaching since Ity has an operating heap leach. Gold leach extractions after 120 hours averaged 71% compared to gold extractions for the equivalent variability sample groupings with an average of 94%. Heap leaching is not recommended for Bakatouo ores given the high copper content and cyanide demand.

- Gold diagnostic leach results clearly show that with sufficient cyanide, almost all the gold in all the weathered states is leachable. This result demonstrates that the soluble copper and its associated cyanide consumption is the only problematic aspect for treatment of this ore.

Master Composite Testing

- Oxide, Transition and Fresh composites were made up from the variability intercepts.

- For the oxide composite, an acid pre-leach on the gravity tail was conducted to remove the bulk of the soluble copper ahead of cyanidation. The bulk of the soluble copper was removed and gold leaching achieved 97.3% extraction. Cyanide usage was reduced to 0.57 kg/t with 18 ppm of copper in the final leach solution. However adding the acid leach step was not considered practical so the project will assume blending of the oxide ores with other feedstocks to reduce the copper in solution.

- For the transition composite, a number of process routes including an acid pre-leach and flotation were tested. The difficulty experienced with treating the transition ores and potential flowsheet complexity suggest that it may be better to stockpile this material for a period to allow oxidation to proceed with potential for reduced copper and increased gold extraction at a later date.

- Flotation of the fresh ore was very successful with high copper recovery (approximately 97%) to the rougher concentrate in 4% of the feed mass although the rougher concentrate could be cleaned to only 2% mass recovery with low copper loss to tails. Significant gold (47%) was recovered to the float concentrate. Flotation tails leaching from the sighter tests achieved lower residue grades than the variability tests with relatively low cyanide usage. This offers a potential process route however the level of soluble copper in the leach solution may need separate treatment by resin.

Physical Testing

- This testwork included oxygen uptake tests, standard carbon loading (kinetic) tests, cyanide detoxification tests, slurry rheology and thickening tests. No abnormal behaviour was observed apart from the oxide ores displaying very viscous behaviour at densities above 40% solids. Leaching of the oxide at 35% solids is recommended.

Metallurgical Recoveries

The variability leach testing results have proven to be reliable and repeatable so recovery estimates based on this testwork should be fairly robust. If it is assumed that the ores will be directly cyanide leached, the gold recovery based on the variability test average results after accounting for soluble loss and process inefficiencies for the Bakatouo ores is estimated to be as follows.

Table 5.2.1 Metallurgical Recovery and Reagent Consumption

Composite	Gold Recovery (%)	NaCN Consumption kg/t	Lime[1] Consumption kg/t
Oxide	96	1.8	1.90
Transition	84	5.6	0.85
Fresh	92	2.5	0.28

Note: 1. Lime consumption based on 90% CaO.

Significant copper extraction varying from 16 to 50% is also expected.

5.2.2 Sample Selection

Representative core samples from the various Bakatouo ore lithologies, weathered states and mineralisation styles were selected based on site geological advice and downhole assay data. This deposit has only recently been drilled and this is the first metallurgical programme that has been conducted on Bakatouo drill core samples. The metallurgical testwork was undertaken by ALS Metallurgy in Perth between February and June 2017.

The gold mineralisation in Bakatouo typically occurs along the contact between the intrusive footwall (granodiorite) and the skarnified carbonate sedimentary rocks which have been classified as a highly altered exoskarn and a calc-silicate endoskarn that is less mineralised. Relatively high copper grades associated with much of the gold mineralisation were identified early as a potential problem for processing of these ores.

5.2.3 Comminution Testwork

SMC testing and Bond work indices for a number of lithologies indicated that the mineralised zones are moderately competent with the more altered, higher grade exoskarn typically being quite fractured while the lower grade, adjoining intrusives and endoskarn are more competent. A grind target P_{80} of 75 µm was selected for testing; this grind yielded good metallurgical recoveries and the ore competency did not dictate the grinding circuit design, so no grind optimisation testing was conducted.

Process design criteria determined for the fresh ore feed were:

- Abrasion index, Ai = 0.155.
- Bond ball work index, BWi = 11.2 kWh/t.
- SMC modelling parameters, A x b = 52.

Estimated throughputs based on the selected mills for the Ity CIL Project, range from 3.75 to 4.5 Mtpa for the fresh ore. Mill throughput for the softer ores will be ball mill limited, but will generally exceed the plant hydraulic capacity.

5.2.4 Metallurgical Variability Testwork

Variability testwork was conducted on 35 contiguous intercept samples representing a geographical spread across the orebody and each of the weathered states, oxide, transition and fresh. A standard test with a gravity recovery stage followed by direct cyanidation was conducted for each sample.

- All tests demonstrated over 90% gold extraction after 24 hour except for six samples (mainly transition) with an average of 95% gold extraction for the samples excluding the six poor performers. Leach kinetics were typically fast with maximum extraction from the gravity tail being reached within eight hours apart from a few notably poor performers.
- Gravity gold recovery averaged 30% with highs of over 50%.
- Cyanide consumption averaged 2 - 2.5 kg/t for the tests, peaking at 7.4 kg/t for the poor recovery samples.
- Copper extraction of approximately 50% was experienced for most samples and the poor gold extraction results are clearly associated with high copper in solution grades (>1,000 ppm). Higher copper solution grades also result in notably slower gold leach kinetics.
- There appears to be little gold - arsenic association in the samples with contained arsenic.

The degree of cyanide soluble copper in these ores was highlighted as a significant issue for the ore processing despite the high gold recoveries and the copper in solution will have to be addressed to prevent a build-up over time with recycled solution such that all leaching is adversely affected by the copper concentrations.

Heap Leach Amenability

Coarse intermittent bottle rolls (IBR) were used to investigate leaching at a coarse size to simulate heap leaching since Ity has an operating heap leach. Gold leach extractions after 120 hours averaged 71% compared to gold extractions for the equivalent variability sample groupings with an average of 94%.

Heap leaching is not recommended for Bakatouo ores given the high copper content and cyanide demand.

Diagnostic Testwork Programme

Gold diagnostic leach results clearly show that with sufficient cyanide, almost all the gold in all the weathered states is leachable. This result demonstrates that the soluble copper and its associated cyanide consumption is the only problematic aspect for treatment of this ore.

Copper diagnostic leaches indicated a moderate to high degree of acid and cyanide solubility for all the variability samples. A mineralogical investigation indicated that bornite and chalcopyrite host most of the elemental copper in the fresh composites. In the transition composite malachite / azurite and native Cu / tenorite host 65% of the elemental copper. The copper minerals are classified as 'well liberated' (90%).

Of the gold grains observed in the fresh composites, several occurred as liberated particles (10 to 150 µm in size). The remaining gold grains were smaller than 15 µm and occurred mainly in bornite, chalcopyrite, pyrite, and less commonly in silicates.

5.2.5 Master Composite Testwork

Equal masses from each variability composite were combined to make up the master composites. With generally high gold extractions, the major problem to be addressed for processing Bakatouo ores was how to selectively remove the soluble copper to reduce cyanide consumption, adsorption issues and detoxification costs.

Oxide Composite Testwork

An acid pre-leach on the gravity tail was conducted to remove the bulk of the soluble copper ahead of cyanidation. The bulk of the soluble copper was removed and gold leaching achieved 97.3% extraction. Cyanide usage was reduced to 0.57 kg/t with 18 ppm of copper in the final leach solution.

The baseline direct leach and gravity gold extraction was 98.7% for the oxide ore composite with 0.88 kg/t NaCN and 190 ppm Cu in solution.

Adding the acid leach step was not considered practical so the project will assume blending of the oxide ores with other feedstocks to reduce the copper in solution.

Transition Composite Testwork

Treatment of the transition composite followed a similar route to the oxide composite with acid leaching of the gravity tails stream ahead of the cyanidation step. Gold extraction from the acid leach residue was significantly higher than the average of the variability transition composites, but with the high Cu starting grade, copper in solution was still 540 ppm.

An alternate route was trialled with the acid wash residue being floated post neutralisation. Mass recovery to rougher concentrate was 20% for this test containing 58% of the residual copper. Leaching of the flotation tail and assuming high gold recovery from the flotation concentrate increased the overall gold extraction to 98% with low tails leach cyanide usage and copper in solution reduced to 114 ppm. Leaching of the high copper flotation concentrate was put on hold pending selection of a suitable route for treatment of the fresh ore flotation concentrate.

The difficulty experienced with treating the transition ores and potential flowsheet complexity suggest that it may be better to stockpile this material for a period to allow oxidation to proceed with potential for reduced copper and increased gold extraction at a later date, given the relatively low resource tonnages.

Fresh Ore Composite Testwork

Flotation of the fresh ore was very successful with high copper recovery (approximately 97%) to the rougher concentrate in 4% of the feed mass although the rougher concentrate could be cleaned to only 2% mass recovery with low copper loss to tails. Significant gold (47%) was recovered to the float concentrate. Flotation tails leaching from the sighter tests achieved lower residue grades than the variability tests with relatively low cyanide usage.

The baseline direct leach and gravity gold extraction was 93.8% for the fresh ore composite.

The best overall extraction for the combined flotation concentrate and tails leaches was 92.3% with similar total cyanide consumption, but only 40 ppm Cu in the tails solution. Selective ion exchange resin recovery of the gold from the concentrate leach solution was successful, leaving a copper rich tail which could be separately treated for cyanide recovery while precipitating out the copper.

5.2.6 Physical Characterisation Testwork

This phase of testing was required to define the physical characteristics of the slurry and the engineering design parameters required for implementation of the process selected. This testwork included oxygen uptake tests, standard carbon loading (kinetic) tests, cyanide detoxification tests, slurry rheology and thickening tests.

No abnormal behaviour was observed apart from the oxide ores displaying very viscous behaviour at densities above 40% solids. Leaching of the oxide at 35% solids is recommended.

5.2.7 Conclusions

Development of a simple test to determine the cyanide solubility of the copper rich ores is essential for grade control to allow selective mining and treatment of Bakatouo ores as this will allow early identification of difficult to treat ores.

Because the testwork programme focussed on measures to selectively address the contained copper such that gold leaching could proceed in the relative absence of copper, repeat testing in a number of areas is recommended if it is proposed to process these ores following a direct leaching approach. Specifically, review of the testwork to determine metallurgical design parameters will be required, e.g. sequential CIP, oxygen uptake rates and detoxification testwork. Tailings geochemical testing would also need to be revisited.

There is scope for optimisation of the test results in some areas. Cyanide recovery processes should be reviewed and if an economically attractive approach can be defined, specific testing would be required.

Metallurgical Recoveries

The variability leach testing results have proven to be reliable and repeatable so recovery estimates based on this testwork should be fairly robust. If it is assumed that the ores will be directly cyanide leached, the gold recovery based on the variability test average results after accounting for soluble loss and process inefficiencies for the Bakatouo ores is estimated to be:

- 96% for oxide.
- 84% for transitional ore.
- 92% for fresh ore.

Associated with the gold recovery will be a minimum copper extraction of:

- 16% for oxide (equivalent to approximately 175 ppm in solution).
- 50% for transitional ore (equivalent to approximately 2,980 ppm in solution).
- 42% for fresh ore (equivalent to approximately 675 ppm in solution).

Reagent Consumption

A summary of the testwork sodium cyanide and lime consumption for direct leaching is provided in Table 5.2.2. Detoxification reagents required will be based on an excess relative to the CN_{WAD} in the CIL tails solution.

Table 5.2.2 Metallurgical Recovery and Reagent Consumption

Composite	Gold Recovery (%)	NaCN Consumption kg/t	Lime[1] Consumption kg/t
Oxide	96	1.8	1.90
Transition	84	5.6	0.85
Fresh	92	2.5	0.28

Note: 1. Lime consumption based on 90% available CaO.

Detailed Report

A detailed report can be found in Appendix 5.1.

5.3 Daapleu Refractory Testwork

5.3.1 Overview

A programme of metallurgical testwork was completed by ALS Perth in December 2016 as part of the Ity Gold Project FS. Part of this programme included a preliminary investigation into a number of different processing options for the refractory Daapleu sulphide ore. Based on the results, flotation followed by fine grinding and cyanidation of the concentrate yielded appeared to be the preferred option for treatment of the Daapleu refractory ore. Results indicated a potential benefit of 15 - 20% gold recovery by flotation, regrind of concentrate to 10 microns and separate leaching of concentrate and tails.

An additional programme of metallurgical testwork was subsequently undertaken by ALS, under the supervision of Lycopodium, to establish sufficient definitive data to enable design of a future flotation and concentrate regrind circuit to process the refractory Daapleu ore. This additional testwork programme was conducted on two bulk composites to establish optimum flotation and regrind conditions, followed by a series of variability tests under optimised conditions.

5.3.2 Sample Selection

Based on the available Daapleu core samples, two master composites (Composite #8 and Composite #9), representing low (~1%) and high (~2.2%) sulphur respectively, were prepared for the Daapleu refractory ore testwork programme. The samples were selected on the basis of spatial distribution throughout the Daapleu pit and to cover a range of depths within the pit. An additional eight composites (Composite #9 to Composite #17) were prepared from the remaining Daapleu drill core for the variability testwork. Head assays for the composites were in the range 0.5 to 1.6 g Au/t with the exception of composite 17 at 15.3 g Au/t.

5.3.3 Testwork Programme

The key elements of the testwork programme were:

- Whole ore cyanidation at a grind of 75 microns.
- Flotation testwork at 75 microns to optimise pulp density and reagent suite.
- Bulk flotation at optimised conditions to generate bulk concentrate and tails.
- Concentrate leach tests on as-received and reground concentrates (10 and 25 micron).
- Leach tests on flotation tails.
- Ancillary testing including carbon contact (CIL design), oxygen uptake and diagnostic leach.

- Dispatch of a sample to Outotec for regrind specific power determination.

- Testing of variability composites including whole ore leach, flotation at optimised conditions, regrind of concentrate to the optimised size and subsequent leaching of concentrate and tails.

5.3.4 Key Results

- Whole ore leaching of the composites gave gold extractions ranging from 41.5 to 85.2%.

- Optimised flotation conditions were based on 35% solids slurry density and a reagent regime comprising 50 g/t PAX and 10 g/t MX900 with MIBC as frother and a laboratory float time of 14 minutes.

- Bulk flotation tests on master composites gave gold recovery of 88 to 91.4%. Flotation of variability composites gave gold recovery of 83 to 95%.

- Leaching of flotation tails on master composites gave gold recovery of 77 to 83%. Leaching of flotation tails on variability composites gave gold recovery of 57 to 89%.

- Regrind / leach testwork on master composites showed gold recovery improved from 56% at 75 microns to 66% at 10 microns for Composite #8. Gold recovery improved from 66% at 75 microns to 74% at 10 microns for Composite #9. Based on indicative pricing for the regrind mill the finer 10 micron size was selected for regrind testwork on the variability composites.

- A direct leach of concentrate at standard (0.1% NaCN) conditions gave significantly lower (5 - 10%) extraction than an intense leach. This indicates simply treating the concentrate and tails through the main CIL circuit will result in significantly lower extraction. Intensive leach conditions were therefore applied.

- Leaching of flotation concentrates from the variability samples gave gold extraction of between 61% and 97%.

- Combining concentrate leach at 10 microns with float tails leach at 75 microns gave gold extraction of between 51% and 96% across all composites. The improvement in gold extraction over whole ore leaching ranged from 5 to 15%.

- Regrind specific energy testwork at Outotec indicated a specific energy requirement of 90 kWh/t to achieve a P_{80} size of 10 microns.

- Ancillary testing showed:

  - Fleming k and n values were within normal range for float tails and lower than expected for float concentrate.

  - Oxygen demand for concentrate leaching was high as expected for finely milled sulphides.

- Rheology testing on concentrates showed high viscosity requiring a lower (30% solids) leach density.

- Cyanide detoxification on concentrates showed CN_{WAD} can be reduced to below 20 ppm using 240% stoichiometric addition of SMBS in the SO_2 / air system. However, two hours' residence time is required due to the high concentration of CN_{WAD} in feed.

- Arsenic precipitation testwork showed the high arsenic level (1,800 - 2,500 ppm) in the feed slurry could be reduced to 4 - 7 ppm with the addition of ferrous sulphate in an acid environment.

5.3.5 Conclusions

The results of the flotation tails leach tests, combined with the concentrate leach results at the optimised regrind particle size, enabled a direct comparison of gold (and silver) extraction between each of the variability composites as well as with that obtained from the whole-of-ore leach tests for each composite. A summary of the overall gold, silver, arsenic, and copper recoveries is presented in Table 5.3.1.

Table 5.3.1 Whole-of Ore Leaching vs. Flotation / Regrind Leaching

Variability Sample	Circuit Configuration	Overall Recovery (%)				Consumption (g/t)	
		Au	Ag	As	Cu	NaCN	Lime
Composite #10	Whole-of-Ore Leach (75 µm)	57.6	85.4	3.4	20.7	0.25	0.40
	Flotation (75 µm) / Regrind (10 µm) Leach	64.2	92.3	0.6	47.2	1.64	0.36
Composite #11	Whole-of-Ore Leach (75 µm)	75.4	72.9	0.8	17.6	0.22	0.30
	Flotation (75 µm) / Regrind (10 µm) Leach	83.7	91.2	2.1	74.5	1.27	0.29
Composite #12	Whole-of-Ore Leach (75 µm)	77.2	83.9	1.5	15.3	0.14	0.30
	Flotation (75 µm) / Regrind (10 µm) Leach	86.5	88.0	1.5	44.1	1.99	0.28
Composite #13	Whole-of-Ore Leach (75 µm)	45.3	52.0	1.8	22.0	0.17	0.30
	Flotation (75 µm) / Regrind (10 µm) Leach	61.2	94.1	1.3	65.0	1.27	0.31
Composite #14	Whole-of-Ore Leach (75 µm)	81.8	82.2	3.2	28.3	0.25	0.40
	Flotation (75 µm) / Regrind (10 µm) Leach	96.0	95.5	0.5	72.4	1.26	0.34
Composite #15	Whole-of-Ore Leach (75 µm)	79.6	61.7	0.2	17.7	0.46	0.70
	Flotation (75 µm) / Regrind (10 µm) Leach	92.2	26.3	0.0	28.1	3.51	0.49
Composite #16	Whole-of-Ore Leach (75 µm)	85.2	75.7	1.2	23.3	0.18	0.35
	Flotation (75 µm) / Regrind (10 µm) Leach	93.9	82.7	2.0	50.4	1.14	0.31
Composite #17	Whole-of-Ore Leach (75 µm)	41.5	59.1	0.4	35.8	0.50	0.40
	Flotation (75 µm) / Regrind (10 µm) Leach	51.2	96.3	0.3	89.9	5.85	0.93

The results indicate a consistently higher overall gold and silver recovery for the flotation / concentrate regrind circuit configuration compared to the whole-of-ore leach – average gold and silver recoveries increased by 10.7% and 11.7%, respectively. Cyanide consumption, however, is consistently higher for the flotation / regrind circuit (average ~700% increase in cyanide consumption) while there is little discernible difference in the overall lime consumption between the two circuit configurations.

5.3.6 Detailed Report

A detailed report can be found in Appendix 5.2.

APPENDIX 5.1

BAKATOUO TESTWORK REPORT

APPENDIX 5.2

DAAPLEU REFRACTORY ORE TEST REPORT

Table of Contents

			Page
6.0	**PROCESS**		**6.1**
	6.1	Process Design	6.1
		6.1.1 Process Development	6.1
		6.1.2 Design Basis	6.1
		6.1.3 Selected Process Flowsheet	6.2
		6.1.4 Changes from 2016 Study	6.3
		6.1.5 Key Process Design Criteria	6.8
	6.2	Process and Plant Description	6.9
		6.2.1 Run-of-Mine (ROM) Pad	6.9
		6.2.2 Crushing Circuit	6.9
		6.2.3 Ore Storage and Reclaim	6.9
		6.2.4 Grinding and Classification Circuit	6.10
		6.2.5 Classification and Trash Screening	6.11
		6.2.6 Gravity	6.12
		6.2.7 Mill Area	6.12
		6.2.8 Trash Screening and Pre-leach Thickening	6.12
		6.2.9 Leach and Carbon Adsorption Circuit	6.13
		6.2.10 Stripping Plant and Goldroom Operations	6.13
		6.2.11 Tailings Treatment	6.15
		6.2.12 Tails Disposal	6.16
		6.2.13 Decant Return	6.16
		6.2.14 Reagents	6.16
		6.2.15 Services	6.19

TABLES

Table 6.1.1	Summary of Selected Milling Circuit	6.5
Table 6.1.2	Summary of Key Process Design Criteria	6.8

APPENDICES

Appendix 6.1	Process Design Criteria
Appendix 6.2	Flowsheets
Appendix 6.3	Orway Mineral Consultants Report

6.0 PROCESS

6.1 Process Design

6.1.1 Process Development

Initial testwork on Bakatouo ores indicated that while gold extractions were high, soluble copper may become an issue. Flotation testing indicated an alternative process route which could be combined with the Daapleu primary ore process.

A preliminary cost / benefit analysis of the flotation / regrind / leach flowsheet for Daapleu primary ore was conducted. The results from the Daapleu testwork indicated a lower overall benefit from the flotation/regrind/leach flowsheet than was expected. In particular:

- Average benefit reduced 16% to 11%. This was based on an improvement in whole ore leach rather than a drop in the results of the flotation / regrind flowsheet. The benefit was therefore reduced.
- The circuit was more complex with the requirement for an intensive leach and separate carbon handling circuit due to the significant differences in carbon loading.
- Parallel processing of the Bakatouo primary ore through the circuit would require a soluble copper mitigation strategy possibly involving the use of a separate resin circuit to separate gold from copper.
- Preliminary capital cost estimates indicated the sulphide treatment route would add up to USD60 million to the project cost.

After discussion with Endeavour the decision was made to treat all ores through a single CIL circuit and blend down the high copper levels in Bakatouo and the high arsenic levels in Daapleu.

6.1.2 Design Basis

The revised process plant design for the Ity CIL Project is based on a robust metallurgical flowsheet designed for optimum recovery with minimum operating costs. The flowsheet is constructed from unit operations used at other Endeavour Mining Corporation Operations that are well proven in the West African Region.

The key criteria for equipment selection are the suitability for duty and the projected mine life of the operation without unnecessarily compromising reliability and ease of maintenance. The plant layout provides ease of access to all equipment for operating and maintenance requirements while maintaining a compact footprint to minimise construction costs.

The Ity CIL plant will process a range of ore types (oxide, transition and fresh) with variable ore characteristics, gold grades and metallurgical treatment requirements. The primary ores are significantly more competent than the oxide ores.

Following updated resource and reserve estimates, the key change to the design basis is an increase in throughput from 3 Mtpa feed to 4 Mtpa feed.

The Ity ores contain significant silver which has influenced the design of the elution circuit and goldroom. Soluble copper is also present in the Ity ores and this has been considered in the plant design.

The key project and ore specific design criteria that the plant design must meet are as follows:

- 4 Mtpa of blended ore; 51% primary and 49% oxide (LOM).
- Crushing plant mechanical availability of 80%.
- Mechanical availability for the remainder of the plant of 91.3% supported by crushed ore storage and stand-by equipment in critical areas.
- Sufficient automated plant control to minimise the need for continuous operator intervention and allow manual override and control if and when required.

A process design criteria (1955-000-PRPDC-0002) document has been prepared incorporating the engineering and key metallurgical design criteria derived from the results of metallurgical testwork and comminution circuit modelling. The design document is included in Appendix 6.1 and forms the basis for the design of the processing plant and required site services.

The selected milling circuit has been sized to accommodate the 85th percentile in terms of competence of the ores to be treated.

6.1.3 Selected Process Flowsheet

The treatment plant design incorporates the following unit process operations:

- Single stage primary crushing to produce a crushed product size of 100% passing (P_{100}) 326 mm (P_{80} of 166 mm).
- Crusher discharge feeding a surge bin and dead stockpile (12 hours live). Ore reclaim via an apron feeder.
- Two stage SAG / Ball milling in closed circuit with hydrocyclones to produce a P_{80} grind size of 75 µm and including crushing of pebbles from the SAG mill.
- Gravity concentration and removal of coarse gold from the milling circuit recirculating load and treatment of gravity concentrate by intensive cyanidation and electrowinning to recover gold to doré.
- Pre-leach thickener to increase the slurry density to the carbon in leach (CIL) circuit to minimise CIL tankage, improve slurry mixing characteristics and reduce overall reagent consumption.

- A CIL circuit incorporating eight CIL tanks containing carbon for gold and silver adsorption with oxygen sparged from an oxygen plant.
- Eighteen tonne split Anglo (AARL) elution circuit, electrowinning and gold smelting to recover gold and silver from the loaded carbon to produce doré and incorporating a cold cyanide wash for management of soluble copper.
- A 60 tpd capacity oxygen plant to service requirements of CIL tank sparging and detoxification circuit
- Tailings treatment incorporating cyanide destruction using sodium metabisulphite / air, followed by arsenic precipitation and stabilisation.
- Tailings pumping to the tailings storage facility (TSF).

A simplified flow diagram depicting the unit operations incorporated in the selected process flowsheet is shown in flowsheet 000-PRPFD-0002 included in Appendix 6.2.

6.1.4 Changes from 2016 Study

The key changes to the process plant equipment and flowsheet are as follows.

Throughput

The plant design has been based on a nominal capacity of 4.0 Mtpa of blended ore. A design margin of 20% for conveyors, pumps and piping will be allowed to account for surges. Design feed grade is 2.5 gAu/t.

Crushing

The ROM pad will be an important part of the mine operation with ore being sourced from up to three pits at one time. It will be used to provide a buffer between the pits and the plant. The ROM stockpile will allow blending of feed stocks and ensure a consistent feed type and rate to the plant. A mobile rock breaker will be used to break any oversize rocks on the ROM pad. The crushing circuit will incorporate a C160 jaw crusher and a short sacrificial conveyor. As significant tramp material is anticipated, a picking station and tramp magnet have been included.

Surge Bin and Reclaim

The FS study incorporated a coarse ore stockpile and reclaim feeders. This has been modified to a surge bin overflowing to a dead stockpile. This arrangement is similar to the Houndé design and allows the stockpile to be reclaimed via front end loader into the surge bin.

Comminution Circuit Selection

The comminution circuit design from the FS was based on an evaluation of 2016 testwork with historical comminution testwork reviewed, but not used in detail, because of the lack of data on the origins of the samples tested. The original selection was an SABC circuit comprising a 7.3 m dia x 3.79 m EGL SAG mill complete with 4,000 kW motor and a 5.8 m dia x 9.2 m EGL ball mill complete with 5,300 kW motor suited to a 3 Mtpa throughput.

The opportunity to use an existing design from Houndé incorporating a 6 MW SAG mill and 6 MW ball mill was evaluated by Orway Mineral Consultants (OMC). The report is presented in Appendix 6.3.

The report evaluated three cases:

- Case 1 - Capacity using 6 MW SAG and 6 MW ball mill, both mills powered by independent VVVF drives.
- Case 2 - Capacity of 6 MW SAG with appropriate sized ball mill.
- Case 3 - Base conditions for 3 Mtpa operation.

Cases 2 and 3 are not considered for this study. A summary of the equipment selection at a throughput of 4 Mtpa is provided in Table 6.1.1.

Milling and Classification

Based on this evaluation, the milling circuit will utilise the same mills as those selected for Houndé. The SAG mill will be equipped with a variable speed drive and will be capable of operating between 60% and 80% of critical speed. The ball mill will also be fitted with a variable speed drive. The variability in ore competence can therefore be addressed by varying the speed of the SAG and ball mills. The softer ores will require a higher ball charge and slower speed. The harder ores will require a higher mill speed.

A facility to directly feed spent heap material to the ball mill when the SAG mill is offline for maintenance has also been included. Maximum use of the existing Houndé milling circuit design will be made to reduce design time and therefore lead time for the schedule.

Gravity Concentration

Gravity testwork indicated that 11 - 49% of the gold in feed can be recovered by gravity gold methods. The FS study included a single Knelson concentrator fed from cyclone underflow. This has been modified to a pump fed dual circuit which is identical to Houndé. This will allow for the increased throughput at lower gravity recovery expected at Ity compared to Houndé.

Table 6.1.1 Summary of Selected Milling Circuit

Parameters	Condition	Units	Design Blend
Throughput		tph	500
CWi		kWh/t	15.0
BWi		kWh/t	13.1
Axb		-	49.3
Milling Feed F_{80}		mm	166
Milling Product P_{80}		µm	75
Mill Specific Energy	@ P_{80} 75 µm	kWh/t	19.0
SAG Mill			
Mill Diameter		m	8.53
Mill EGL		m	4.35
L:D Ratio			0.51
Ball Charge	Duty	%	10
	Max	%	15
Total load	Duty	%	25
	Max	%	35
Mill Speed		%	75
Drive Type			Variable Speed
Mill Pinion Power	Nominal	kW	4,494
	Max	kW	5,233
Installed Power		kW	6,000
Discharge Arrangement			Grate
Open Area		%	8
Grinding Media		mm	125
Ball Mill			
Mill Diameter		m	6.10
Mill EGL		m	9.05
L:D Ratio			1.48
Ball Charge	Duty	%	32
	Max	%	37
Mill Speed		%Nc	75
Drive Type			Variable Speed
Mill Pinion Power	Nominal	kW	5,161
	Max	kW	5,680
Installed Power		kW	6,000
Discharge Arrangement			Overflow
Grinding Media		mm	50

Pre-leach Thickening

A pre-leach thickener with bypass has been included. This thickener has been sized to allow for the poorer settling properties of Zia and Ity materials.

Leach and Adsorption Circuit

The leach / adsorption circuit has been modified to include eight CIL tanks to achieve the required residence time, acceptable stage efficiency and target solution tails grades. The tanks will be identical in size with cyanide added to the CIL tanks as required. The CIL circuit has been designed for a residence time of 35 hours at 500 t/h solids at 50% w/w density. This is based on the slower leaching behaviour of some specific ores. Oxygen will be added to all tanks to oxygenate the slurry and oxidise any cyanicides and to maintain an adequate dissolved oxygen level for leaching in the CIL tanks.

If more viscous ore types are encountered the CIL circuit will have a residence time of 25 hours at 40% w/w density. This assumes the cyclone overflow density will be adjusted from 35 to 40% w/w solids if the need to bypass the thickener is encountered.

Some of the ore types (Ity Flat and Mont Ity) contain significant soluble copper. Some of this copper is likely to adsorb onto carbon and dilute the doré. To reduce this effect, the circuit will be operated at elevated cyanide levels to minimise the level of copper adsorption.

Elution and Goldroom

The average daily movement of carbon has been calculated based on the design feed grade and maximum CIL gold and silver extraction (assuming no gravity gold recovery). On this basis, an eighteen tonne capacity split Anglo elution circuit has been selected requiring just over seven strips per week. The Anglo circuit has been selected as it offers the flexibility to run more than one elution in a day.

The key driver for the capacity of the elution circuit is the high silver level with an overall loaded carbon grade of 5,400 g/t of gold and silver. This flows on to the goldroom which requires three large electrowinning cells to recover the high precious metals load.

A cold cyanide wash step has been included in the flowsheet that can be used when treating the high soluble copper ores. The wash step occurs in the elution column prior to commencement of elution and produces a cyanide and copper rich stream which will be directed to cyanide destruction.

Tailings Treatment

Testwork results from both leaching and cyanide destruction have dictated the design of the cyanide destruction circuit.

- Resource modelling has provided data on the expected copper head grade for each ore source.
- Leach testwork has provided levels of soluble copper in the leach solution for each ore type.
- Combining these has allowed a calculation of the expected level of soluble copper in the mill feed.

- This soluble copper will combine with cyanide to form the bulk of the CN_{WAD} feeding the cyanide detoxification plant.

- Testwork has indicated that the target discharge of below 50 ppm CN_{WAD} can be achieved in one hour. However, to allow for surges in copper and therefore CN_{WAD} levels, the design of the plant has two tanks with a total residence time of 2.2 hours including air holdup.

High levels of arsenic are found in Daapleu oxide, transition and primary ores. Testwork has indicated that the residual level of arsenic can be brought down to below 1 ppm by the addition of ferrous sulphate in an acid environment. This process is rapid and has been included in the design.

The design of the arsenic precipitation circuit has two agitated tanks the same size as the cyanide destruction tanks. This provides an additional 2.2 hours residence time. One of these tanks will be designed for use as either a cyanide destruction or arsenic precipitation tank to provide additional cyanide destruction capacity if required and bring the total cyanide destruction residence time to 3.3 hours.

Oxygen Plant

The high level of soluble copper in the feed to the Ity plant, resulting largely from Ity and Bakatouo ores, will result in significant CN_{WAD} levels. The SO_2 / Air process requires large amounts of oxygen and this has led to an increase in the oxygen plant. The plant will have a capacity of 60 tonnes per day and will be configured with a number of modules to ensure there is always capacity available.

Reagents

The increased capacity of the cyanide destruction and arsenic precipitation circuits has led to an increase in the capacity of the sodium metabisulphite and caustic soda mix / storage facilities. In addition, an allowance for a sulphuric acid storage and dosing facility has been made to accommodate the pH modification required for the arsenic precipitation circuit. Testwork is ongoing to optimise the storage and dosing requirement.

6.1.5 Key Process Design Criteria

The key process design criteria listed in Table 6.1.2 form the basis of the detailed process design criteria and mechanical equipment list.

Table 6.1.2 Summary of Key Process Design Criteria

		LOM Blend	Source [1,2,3,4,5,6,7]
Ore Blend		51% primary / 49% oxides	Cube
Plant Throughput - Nominal	t/y	4,000,000	Lycopodium
Gold Head Grade - Range	g Au/t	1.0-2.5	Endeavour
Gold Head Grade - Design	g Au/t	2.5	Endeavour
Overall Gold Recovery	%	66-97	Test
Silver Head Grade - Design	g Ag/t	8.5	Endeavour
Design Silver Recovery	%	63	Test
Soluble Copper - Design	ppm	200	Lycopodium
Crushing Plant Utilisation	%	80	Lycopodium
Milling / CIL Plant Utilisation	%	91.3	Lycopodium
ROM Ore Top Size	mm	800	Assumed / OMC
Comminution Circuit – Table 2.4.1		SABC	OMC
Gravity Gold Recovery	%	31	Test / Assumed
Gravity Silver Recovery	%	20	Assumed
Pre-leach Thickener Solids Loading	$t/m^2.h$	0.59	Testwork
Leach / CIL Residence Time	hrs	35	Lycopodium
Leach Slurry Density	% w/w	50	Testwork
Number of CIL Tanks		8	Lycopodium
Cyanide Consumption[5]	kg/t	1.17	Testwork
Quicklime Consumption[6]	kg/t	1.06	Testwork
Elution Circuit Type		Split AARL	Lycopodium
Elution Circuit Capacity	t	18	Lycopodium
Frequency of Elution	strips / week	7	Lycopodium

Notes:

1 Cube refers to advice from the nominated mining subconsultant.

2 'Lycopodium' refers to Lycopodium experience or generally accepted practice.

3 'Testwork' refer to metallurgical testwork conducted.

4 'OMC' refers to advice from Orway Mineral Consultants.

5 Cyanide consumption makes allowance for 100 ppm residual cyanide in the CIL tail solution and soluble copper.

6 Lime consumption based on 90% CaO.

7 Endeavour refers to advice / agreement from Endeavour.

6.2 Process and Plant Description

The process and plant description should be read in conjunction with the process plant flowsheets provided in Appendix 6.2 and the process plant general arrangement drawings provided in Appendix 7.1. The mechanical equipment list is also appended in Appendix 7.2.

6.2.1 Run-of-Mine (ROM) Pad

Haul trucks operating directly from the pits will deliver run-of-mine (ROM) ore to the ROM pad where it will be dumped in blending stockpiles arranged by ore grade and lithology. A front end loader (FEL) will be used to reclaim and tram ore from the various stockpiles to the ROM bin. Where possible, ore will be direct tipped into the ROM Bin. Ore will be blended under the guidance of mine geologists and process personnel to maintain a relatively constant feed grade and ore hardness to the process plant.

6.2.2 Crushing Circuit

ROM ore will be loaded into the crushing circuit feed bin (ROM bin) by FEL from the ROM pad stockpiles or direct tipping. A grizzly will be fitted to the ROM bin to protect the downstream equipment from oversize material. A mobile rock breaker will be utilised to break oversize rocks.

ROM ore will be drawn from the ROM bin at a controlled rate by an apron feeder which will discharge over a vibrating grizzly. The grizzly oversize will report to the jaw crusher. The grizzly undersize and jaw crusher discharge will gravitate to the primary crushing discharge conveyor. A picking station will be provided to remove organic matter.

The crusher product conveyor will discharge onto a 350 m long surge bin feed conveyor. A suspended tramp metal magnet will be located at the transfer point between the crusher product conveyor and the surge bin feed conveyor and will remove any coarse metal to protect the conveyor. A weightometer on the surge bin feed conveyor will measure crusher product.

Coarse spillage in the crusher area will be cleaned up by FEL and transported to the ROM pad for drying or fed directly to the primary crusher. Water sprays will be installed for dust suppression as required. A 10 tonne hoist will be provided over the jaw crusher to facilitate regular maintenance.

The crushing circuit will be controlled locally. The FEL driver will ensure feed is maintained to the crushing circuit and will communicate with the crushing operator using a two-way radio to supply information on crusher feed operation. The speed of the primary feeder will be controlled to a target set-point and measured using the crushing weightometer.

6.2.3 Ore Storage and Reclaim

The surge bin feed conveyor will discharge into a 250 tonne capacity surge bin. Excess ore from crushing will overflow this bin onto a conveyor feeding a dead stockpile. This surge bin will provide 30 minutes feed to the milling circuit in the event of a crusher breakdown. This will allow time for a FEL to relocate and commence feeding the bin from the dead stockpile. Water sprays will be installed for dust suppression as required.

Primary ore will be reclaimed from the surge bin via a single variable speed apron feeder.

Quicklime, used for pH control in the leach circuit, will be added directly onto the mill feed conveyor. Quicklime will be stored in a lime silo and will be metered onto the belt using a variable speed rotary feeder. The speed of the rotary feeder will be varied according to the mill feed tonnage. The silo will be loaded pneumatically from bulk lime trucks. The silo will be fitted with a dust collector.

A conveyor weightometer will be installed on the SAG mill feed conveyor to provide accurate total instantaneous and accumulated mass flow feed into the plant. SAG mill grinding media will be loaded onto the SAG mill feed conveyor from the SAG grinding media storage bunker using a FEL.

The reclaim circuit will be controlled from the main control room. Area shift operators will also monitor the circuit.

6.2.4 Grinding and Classification Circuit

The grinding circuit will consist of an SABC circuit with hydrocyclones.

SAG Mill

A 8.50 m dia x 4.35 m EGL SAG mill complete with a 6,000 kW variable speed drive will operate at up to a maximum 15% volumetric ball loading. Variable speed control of the mill, accomplished through a VVVF system, will provide flexibility for processing of the various ore types. A speed range of 60% to 80% critical speed will be available.

SAG mill grinding media, typically 100 - 125 mm diameter balls, will be stored adjacent to the bulk ball mill grinding media bunker. SAG mill grinding media will be removed from the bulk storage bunker using a FEL and transferred to SAG mill feed conveyor.

SAG mill liners and grates will be handled by a mill liner handler capable of managing the new liners.

Pebble Crushing

The SAG mill discharge will be transferred to a vibrating single deck heavy duty pebble dewatering screen fitted with a nominal 15 mm aperture rubber screen deck. Undersize from the screen will feed the mill discharge hopper. The oversize pebbles (nominally +15 mm) will be conveyed to a pebble crusher feed bin ahead of a single 250 kW pebble crusher.

One stage of tramp metal removal via a self cleaning belt magnet across the pebble transfer conveyor will be used to remove mill balls and any other magnetic steel debris discharged from the SAG mill. Tramp metal ejected will be deposited in a bunker area with concrete walls on three sides which will provide access for metal removal and protection to personnel in the area. Metal detection will provide a final level of protection against metal entering the pebble crusher. Upon detection of metal, the flop gate at the head of the transfer conveyor will be activated and the ore stream will bypass the pebble crusher surge bin for a predetermined period and will be deposited directly on the SAG mill feed conveyor.

The pebble crusher surge bin will hold approximately 25 minutes capacity to improve steady state operation of the pebble crusher. The nominal design allows for use of a single pebble crusher to meet the expected pebble load as the competence of the ore is moderate.

A variable speed pebble crusher vibrating feeder will transfer the pebbles at a controlled rate from the surge bin into the pebble crusher. Pebbles will be crushed from a nominal top size of 75 mm to a P_{80} of approximately 12 mm. The pebble crusher will operate at a closed side setting of 11 mm, depending on the ore competency, moisture content and crusher power draw. Product from the pebble crusher will be transferred to the SAG mill feed conveyor. An overhead hoist will be provided to facilitate crusher maintenance.

Ball Mill

A 6.10 m dia x 9.05 m EGL overflow ball mill complete with a 6,000 kW variable speed drive will operate at up to 35% volumetric ball loading. Product size from the closed ball mill grinding circuit will be 80% passing 75 µm on 100% primary ore. A provision has been made to allow direct feed from the surge bin to the ball mill via a transfer conveyor. This will be used when the SAG mill is offline to feed spent heap material. The ball mill will be variable speed normally operating at 75% critical speed.

Ball mill grinding media will be 50 mm diameter balls and will be stored adjacent to the bulk SAG mill grinding media bunker. Ball mill grinding media will be removed from the bulk storage bunker and transferred to a kibble. Grinding media will be loaded into the ball mill via the ball mill ball charging hoist. The ball charging hoist will be used to manoeuvre the ball charging kibble onto the ball mill feed box from where the grinding media will enter the ball mill.

6.2.5 Classification and Trash Screening

The discharge from the SAG and ball mills will be combined in a common mill discharge hopper and diluted with process water prior to classification. The combined mill discharge slurry will be pumped using duty / stand-by pumps, to the classifying cyclones. The cyclone cluster will comprise 15 x 380 mm diameter hydrocyclones operating at 100 kPa. The number of operating cyclones will depend on the ore type being treated.

Cyclone overflow, at 35% w/w solids, will flow by gravity to one of two trash screens in a duty/standby configuration. Trash screen oversize will gravitate to a trash collection bin. The trash screen has been located to allow the underflow to gravitate to the 38 m diameter pre-leach thickener feed box or to bypass the thickener and feed the CIL circuit directly. The underflow from the cyclone cluster will feed a distribution box. This box will allow part of the cyclone underflow to be returned to the SAG mill if required to balance power draw with the main flow returning to ball mill feed.

6.2.6 Gravity

Feed for the gravity circuit will be pumped direct from the mill discharge hopper by a separate set of slurry pumps. The gravity circuit consists of two parallel circuits each containing a screen and concentrator. The feed stream will gravitate to one of two vibrating 'degritting' screens to remove coarse (+2 mm) material and fragments of broken mill balls. This oversize will return to ball mill feed. The screen undersize stream from the screens will gravitate to one of two 48 inch centrifugal concentrators. The tails slurry from the centrifugal concentrators will gravitate to the mill discharge hopper. The concentrators will be operated on a semi-batch basis with periodic discharge of the coarse, high SG material (gravity concentrate) to the concentrate storage hopper as part of the intensive leach reactor.

The intensive leach reactor (ILR) will process the concentrate once per day in a rotating drum leach vessel. Cyanide and caustic will be introduced into the slurry and the drum will be rotated for up to 20 hours to leach out gold and silver. At the end of this time the pregnant liquor will be separated from the solids and pumped to the dedicated pregnant liquor tank. Reactor tails will be pumped back to the mill discharge hopper for additional milling to recover any remaining entrained gold and silver.

A dedicated pregnant liquor pump will feed the gravity electrowinning cell in the goldroom with gold recovered onto stainless steel cathodes and barren liquor returned to the pregnant liquor tank. The cathodes from the gravity electrowinning cell will be treated separately to assist in metallurgical accounting. Spent electrolyte will be recycled to the head of the CIL circuit.

6.2.7 Mill Area

A davit crane will be provided over the cyclones for maintenance. A seven axis liner handler will be provided for mill liner change outs.

The mill floor slab will be sloped towards a large drive in collection sump at the discharge end of the mills where submersible pumps will return spillage to the mill discharge hopper or tails tank.

The slab below the SAG mill feed chute will be sloped to either feed a sump pump or will gravitate to the discharge end drive-in sump. Scats from the ball mill will be collected in a drive in scats bunker to facilitate bulk scats removal via a front end loader for disposal. The scats bunker will drain into the mill area drive in collection sump.

6.2.8 Trash Screening and Pre-leach Thickening

Trash screen underflow from the grinding circuit will be thickened in a high rate thickener to the nominal leach feed density of 50% w/w solids. Thickener underflow will be pumped to the CIL circuit and thickener overflow will gravitate to the mill water tank.

Materials with poor settling characteristics or higher slurry viscosity will gravitate directly as trash screen underflow to the CIL circuit.

6.2.9 Leach and Carbon Adsorption Circuit

Pre-leach thickener underflow stream will be pumped to the CIL circuit. The circuit will consist of eight tanks interconnected with launders and slurry will flow by gravity through the tank train.

Each tank will be fitted with a dual impeller mechanical agitator to ensure uniform mixing and a mechanically swept woven wire intertank screen to retain the carbon. All tanks will be fitted with bypass facilities to allow any tank to be removed from service for agitator or screen maintenance.

Quicklime added directly to the mill feed conveyor will ensure that the slurry pH is suitable for cyanidation. Sodium cyanide solution will be metered into CIL feed box and tanks from a ring main system. Oxygen gas from the pressure swing adsorption (PSA) plant will be distributed to all tanks and sparged down the agitator shafts to oxidise any cyanicides and to provide oxygen to the leach.

Fresh / regenerated carbon will be returned to the circuit at CIL Tank 8 and will be advanced counter current to the slurry flow by pumping slurry with a recessed impeller slurry pump and carbon from CIL Tank 8 to CIL Tank 7 and so on. The intertank screen in CIL Tank 7 will retain the carbon whilst allowing the slurry to flow by gravity back to CIL Tank 8. This counter-current process will be repeated until the carbon eventually reaches CIL Tank 1. A recessed impeller pump will be used to transfer slurry to the loaded carbon recovery screen mounted above the acid wash column in the elution circuit. The carbon will be washed and dewatered on the recovery screen prior to reporting to the acid wash column. The associated slurry and wash water will return to CIL Tank 1.

Slurry from the last CIL tank (CIL tails) will gravitate to the carbon safety screen to recover any carbon leaking from worn screens or overflowing tanks. Screen underflow will gravitate to the detoxification circuit. Screen oversize (recovered carbon) will be collected in the fine carbon bin for potential return to the circuit.

Barren carbon returning to the adsorption circuit from the carbon regeneration kiln will be screened on the carbon sizing screen to remove fine carbon and quench water. The sized and regenerated carbon will report directly to CIL Tank 8.

6.2.10 Stripping Plant and Goldroom Operations

The following operations will be carried out in the stripping and goldroom areas:

- Acid washing of carbon.
- Cold cyanide washing of carbon as required.
- Stripping of gold from loaded carbon using the split AARL method.
- Electrowinning of gold from pregnant solution.
- Smelting of electrowinning products.

The split AARL stripping circuit will be automated and will contain a separate acid wash and an elution column.

The total carbon movement around the elution circuit on a daily basis will be approximately 18 tonnes, with a solution flow rate in the elution circuit of 2 BV/h (77 m^3/h).

Acid Wash

Loaded carbon will be received into the 18 tonne capacity acid wash column. During acid washing, a dilute solution of hydrochloric acid will be pumped into the bottom of the column to remove contaminants, predominantly carbonates, from the carbon. After the soak period of 30 minutes has elapsed, the loaded carbon will be rinsed with water. Dilute acid and rinse water will be pumped to the tailings hopper for disposal. Washed carbon from the acid wash column will be pressure transferred from the acid wash column to the elution column and the water will be drained out.

Cold Cyanide Wash

A cold cyanide solution (2% caustic, 2% NaCN) will be made up in the cold cyanide wash tank sufficient for two bed volumes of the elution column. The cyanide solution will be circulated through the column and back to the tank for 60 minutes to remove any soluble copper. The solution will then be pushed through the column and into the cold wash product tank with fresh water. This copper cyanide rich solution will then be pumped slowly over the course of 20 hours to the cyanide destruction tanks for treatment. This slow return avoids a surge of copper being delivered to the destruction tanks.

Pre-soak and Elution

The split AARL elution process will be used to recover gold adsorbed onto carbon recovered from the CIL circuit. Initially lean eluate from the lean eluate tank will be heated to approximately 95°C and pumped into the base of the elution column using the strip solution pump. Sodium hydroxide (NaOH) and sodium cyanide (NaCN) will be pumped from the respective storage tanks and injected into the suction line of the strip solution pump. The loaded carbon will be pre-soaked in the cyanide / caustic solution for 30 minutes to elute gold.

The pregnant eluate will then be rinsed from the carbon by up to ten bed volumes of solution heated to approximately 140°C. The first five bed volumes of the elution will be drawn from the lean eluate tank and directed to the pregnant solution tank for recovery of gold by electrowinning. The last five bed volumes of the elution will be drawn from the treated water tank and will be directed to the lean eluate tank for re-use during the next elution cycle.

Strip solutions will be heated indirectly by diesel fired oil heaters and a heat input heat exchanger. Heat recovered from solution exiting the elution column will be used to pre-heat solution prior to the heat input circuit.

Solution samplers will be provided to collect pregnant and stripped eluant for assay.

Electrowinning and Goldroom

Once the elution cycle is completed, recovery of gold and silver by electrowinning will proceed. Direct current will be passed through stainless steel anodes and stainless steel mesh cathodes within the electrowinning cells and electrolytic action will cause the gold and silver in solution to plate out on the cathodes. Three electrowinning cells arranged in parallel will be required. Electrowinning will take approximately 8 to 12 hours. An overhead crane (2 t capacity) will be provided to assist with handling of cathodes and anodes. The cathodes will be washed with high pressure spray water and the gold / silver sludge will be recovered in a vacuum pan filter. The gold / silver sludge filter cake will be dried in ovens and direct smelted with fluxes in an electric induction furnace to produce doré bars.

Fume extraction systems will be provided to remove fumes and dust from the electrowinning cells, calcine ovens, barring furnace and flux mixing area. In addition to this, fresh air fans will be provided to ensure there is adequate ventilation inside the goldroom.

Site Security

The gold room design is based on full security surveillance by a security guard and a second level of surveillance by remote control CCTV cameras with remote viewing and recording facilities. Additional security methods and practices will be used; however, description of these is intentionally excluded from this report and is generally implemented very late in the construction period.

Additional cameras will be located at key locations to maintain surveillance particularly in regard to gravity gold processing and to assist with operational monitoring.

Carbon Regeneration

After completion of the elution process, the barren carbon will be transferred to a horizontal diesel-fired regeneration kiln circuit. The carbon will be hydraulically transferred to a dewatering screen prior to entering the feed hopper of the regeneration kiln. In the feed hopper any residual and interstitial water will be drained from the carbon before it enters the kiln.

The carbon will be heated to 650 - 750°C and held at this temperature for 15 minutes to allow effective regeneration to occur. Regenerated carbon from the kiln will discharge to a quench tank. The quenched carbon will be pumped, using a recessed impeller pump, to the carbon sizing screen. Carbon sizing screen oversize will enter the CIL tanks and screen undersize will join the CIL tailings flow which will pass over the carbon safety screens.

6.2.11 Tailings Treatment

Cyanide Destruction

The Project is committed to meeting or exceeding the ICMC requirements. An SO_2 / air cyanide destruction circuit will be utilised to meet this requirement. The SO_2 / air destruction circuit will reduce the weak acid dissociable cyanide (CN_{WAD}) in the slurry discharged from the CIL circuit to less than 50 mg/L prior to pumping to the TSF.

The cyanide destruction circuit will consist of two tanks providing 2.2 hours residence time with provision to swing a third tank to this duty. The tanks will be interconnected with launders to allow the circuit to be run in parallel or series.

Underflow from the CIL circuit carbon safety screen and the cold cyanide copper wash from elution will gravitate to the cyanide destruction circuit. Copper sulphate (if required) and sodium metabisulphite (SMBS) solutions will be added to provide the required copper and sulphur dioxide for the cyanide destruction process. Because of the high level of CN_{WAD}, it is anticipated that oxygen from the PSA plant will be injected via in-tank sparges under the cyanide destruction agitators to provide oxygen to the slurry. This will be evaluated further with the vendors. Provision will be made for caustic solution to be added to maintain a slurry pH 8.0 to 9.0.

Arsenic Precipitation

Some ores contain soluble arsenic which will be treated and stabilised before discharge to the TSF. The arsenic precipitation and stabilisation reaction involves the use of ferrous sulphate. The reaction is rapid however two tanks of 1.1 hours residence time each will be provided. Discharge from the cyanide destruction circuit will gravitate to the arsenic precipitation circuit. Ferrous sulphate and sulphuric acid will be added in the presence of oxygen. The arsenic in solution will precipitated as ferric arsenate in the tails slurry.

6.2.12 Tails Disposal

Arsenic precipitation tails and other miscellaneous waste streams from the process plant will be combined in the tails hopper and pumped to the TSF.

Tailings will be deposited into the TSF using a peripheral discharge and decant method. Cyclic spigot deposition at various locations will be used to allow consolidation and drying of deposited material into beaches to direct supernatant water to a pond around the decant tower.

6.2.13 Decant Return

Supernatant water will be recovered from the TSF and returned as process water for the plant.

6.2.14 Reagents

Quicklime

Quicklime will be delivered to site in bulk tankers and pneumatically transferred into the silo. Quicklime will be metered via a rotary valve directly onto the mill feed conveyor for circuit pH control. Emergency lime storage for bulk bags will be provided. A dust collector will minimise dust emissions during loading of quicklime into the storage silo.

Cyanide

Cyanide will be delivered to site in one tonne boxes containing bulka bags of cyanide briquettes. The briquettes will be added to the cyanide mixing tank using an electric hoist and enclosed bag breaker and dissolved in process water to achieve the required solution strength.

The cyanide solution will be transferred to the storage tank for use in the process. Cyanide will be reticulated to the CIL circuit via a ring main and dosed to the CIL tanks as required. A dedicated pump will provide cyanide solution to the elution circuit and intensive leach reactor as required.

Caustic Soda

Caustic soda (sodium hydroxide) will be delivered to site in bulk bags of 'pearl' pellets. Caustic bags will be added to the mixing tank by electric hoist via a bag breaker and screw feeder on the receiving hopper and dissolved in raw water to the required solution strength.

The caustic solution will be pumped to the elution circuit and intensive leach reactor as required, with separate dedicated pumps for the cyanide destruction and arsenic precipitation facilities.

Hydrochloric Acid

Concentrated hydrochloric acid (32% w/w) will be delivered to site in 1,000 L isotainers. The concentrated hydrochloric acid will be pumped into the acid mixing / storage tank where it will be diluted with the correct quantity of raw water to achieve the required acid wash concentration.

The dilute acid solution will be pumped to the elution circuit as required.

Activated Carbon

Activated carbon will be delivered to site in 500 kg bulk bags. Carbon will be added to the carbon quench tank as required for carbon make-up to the CIL inventory. Carbon will be added directly to the last adsorption tank, as required, for carbon make-up or via the regeneration kiln to allow fines removal on the sizing screen.

Grinding Media

Grinding balls will be delivered to site in bulk. Balls will be charged to the SAG and ball mill as required to achieve the target power draw.

Grinding balls will be charged to the SAG mill via the SAG mill feed conveyor. Grinding balls will be charged to the ball mill by loading the balls using a fork lift with a hydraulic drum tipper attachment into ball charging kibbles and lifting the kibble via a hoist into the ball mill feed chute.

Flocculant

Flocculant will be delivered to site in 750 kg bulk bags. Flocculant will be added to the flocculant plant storage hopper using an electric hoist and bag breaker. The vendor supplied package flocculant mixing plant will automatically mix batches of flocculant with filtered water and transfer the mixed flocculant to a separate storage tank after each mixing cycle is complete.

The flocculant solution will be pumped to the pre-leach thickener and intensive leach reactor as required.

Sodium Metabisulphite

SMBS powder will be delivered in bulk bags. SMBS bags will be added to one of two mixing tanks by electric hoist via a two systems of bag breaker / screw feeder / receiving hopper.

The SMBS solution will be transferred to the storage tank for use in the process. SMBS solution will be metered to the cyanide destruction circuit by dosing pumps as required to meet ICMC requirements.

Copper Sulphate

Copper sulphate will be delivered in 25 kg bags and will be mixed with filtered water. Copper sulphate solution will be metered to the cyanide destruction circuit by dosing pumps as required to meet ICMC requirements.

Ferrous Sulphate

Ferrous sulphate will be delivered in 1,000 kg bags and will be mixed with filtered water. Ferrous sulphate solution will be metered to the arsenic precipitation circuit by dosing pumps as required.

Sulphuric Acid

Concentrated sulphuric acid (98% w/w) will be delivered to site in 1,000 L IBCs and transferred to a bulk storage tank. The concentrated sulphuric acid will be pumped into the arsenic precipitation tank as required.

Fluxes

Sodium borate (borax), silica flour, sodium nitrate (nitre) and sodium carbonate (soda ash) will be used as fluxes for gold smelting. The fluxes will be delivered in 25 kg bags and mixed in small quantities with the gold sludge prior to smelting.

Diesel

Diesel will be delivered to site by bulk tankers and transferred to one of the two bulk storage tanks. The diesel will be used in the mine, the process plant, for backup generators and to refuel site vehicles.

Diesel may be pumped from the storage tanks to the plant day tank for use in the strip solution heater and carbon regeneration kiln.

Reagents Storage

Reagents will be received on site either in bulk (grinding media) or in shipping containers, with a minimum of one months' capacity stored on site, to ensure that supply interruptions due to port, transport or weather delays do not restrict production. Reagent containers will be offloaded from the delivery truck by the site crane and stacked in a lay-down area until required. Empty containers will be returned with the next delivery.

6.2.15 Services

Raw Water

Water will be pumped from the pit dewatering bores to the plant raw water tank. The raw water tank will have sufficient capacity to minimise the impact of short term supply interruptions. Duty / stand-by water pumps will be provided for the raw water distribution to the plant.

Fire Water

Fire water for the process plant will be drawn from the raw water tank. Suctions for other water services fed from the raw water tank will be at an elevated level to ensure a fire water reserve always remains in the raw water tank.

The fire water pumping system will contain:

- an electric jockey pump to maintain fire ring main pressure
- an electric fire water delivery pump to supply fire water at the required pressure and flowrate
- a diesel driven fire water pump that will automatically start in the event that power is not available for the electric fire water pump or that the electric pump fails to maintain pressure in the fire water system.

Fire hydrants and hose reels will be placed throughout the process plant, fuel storage and plant offices at intervals that ensure complete coverage in areas where flammable materials are present.

Filtered Water

Filtered water for the process plant will be produced by treating raw water in the filtered water treatment plant. The treatment plant will consist of clarification through flocculant addition, sand filtration, carbon filtration and biocide dosing. Filtered water will be report to the filtered water storage tank and will be distributed to the plant as required using duty / stand-by filtered water pumps.

Gland Water

Water from the filtered water storage tank will be distributed as gland service water using duty / stand-by gland water pumps.

Mill Water

Overflow from the pre-leach thickener will feed the mill water tank. This water will be used for grinding circuit dilution and will be topped up with process water as required.

Process Water

Water will be pumped from the TSF decant to the plant process water tank. The plant process water will consist of TSF decant return water and raw water tank overflow. The process water tank will be located so that the raw water tank overflows to the process water tank allowing the process water tank to be kept full at all times.

Duty / stand-by process water pumps will be provided for the plant process water supply. A separate water pump will be provided for fluidisation water supply to the gravity concentrator.

Antiscalant will be added as required to condition the water and reduce fouling of pipelines, spray nozzles and screen decks.

Bore Water

Excess bore water from pit dewatering operations will be pumped from the bores to the bore water tank. This will feed a water treatment facility designed to produce water quality sufficient to be discharged into the Cavally River. The bore water tank will have sufficient capacity to minimise the impact of short term supply interruptions. Duty / stand-by bore water pumps will be provided for the bore water feed to the plant.

Potable Water

Filtered water will be supplied to the plant potable water treatment plant. The water treatment facility will include micro filtration, ultra-violet sterilisation and chlorination. Potable water will be stored in the plant potable water tank and will be reticulated to the site ablutions, safety showers and other potable water outlets. Transfer pumps will also feed water to a separate camp potable water tank for reticulation and to the mine services area. Additional ultra-violet sterilisation units will be installed on outgoing potable water distribution headers.

Plant and Instrument Air Supply

Plant and instrument air will be supplied from duty / stand-by air compressors. The air will be filtered and dried before distribution with separate air receivers. A check valve on the instrument air supply will ensure the integrity of instrument air supply such that air from the plant air system serves as a back-up for instrument air, but plant air cannot draw down the instrument air system.

Oxygen

A Pressure Swing Adsorption (PSA) oxygen plant will be installed adjacent to the CIL tanks. The oxygen rich stream (90% O_2) will discharge to the oxygen receiver and then be distributed to the CIL tanks, ILR, cyanide destruction and arsenic precipitation tanks. The oxygen plant will be supplied with clean air from dedicated screw compressors. The compressed air will have water and oil removed prior to the PSA unit.

APPENDIX 6.1

PROCESS DESIGN CRITERIA

APPENDIX 6.2

FLOWSHEETS

APPENDIX 6.3

ORWAY MINERAL CONSULTANTS REPORT

Table of Contents

			Page
7.0	**ENGINEERING**		**7.1**
	7.1	Changes to Design	7.1
		7.1.1 Changes to Mechanical Equipment List	7.1
		7.1.2 Plant Location	7.2
	7.2	Revised Plant Design	7.2
		7.2.1 General	7.2
		7.2.2 Primary Crushing	7.3
		7.2.3 Ore Transfer and Stockpile	7.3
		7.2.4 Grinding, Classification and Gravity Circuits	7.3
		7.2.5 Pebble Crushing	7.4
		7.2.6 Gravity Recovery	7.4
		7.2.7 Trash Screening and Pre-leach Thickening	7.5
		7.2.8 Leach and Carbon Adsorption Circuit	7.5
		7.2.9 Elution, Carbon Regeneration and Goldroom	7.6
		7.2.10 Tailings Disposal	7.6
		7.2.11 Reagents	7.7
		7.2.12 Air, Oxygen and Water Services	7.8
		7.2.13 Large Volume Spillage Containment	7.9
	7.3	Electrical Design	7.10
		7.3.1 Installed Load and Maximum Demand	7.10
		7.3.2 Grid Power Supply	7.10
		7.3.3 11 kV Switchboards	7.10
		7.3.4 Electronic Variable Speed Drives and Soft Starters	7.10
		7.3.5 415 V Motor Control Centre	7.10
		7.3.6 Earth Fault Protection	7.11
		7.3.7 Fire Protection	7.11
		7.3.8 Cable Ladders	7.11
		7.3.9 Cables	7.11
		7.3.10 Lighting	7.12
		7.3.11 Earthing System and Lightning Protection	7.12
	7.4	Control System	7.12
		7.4.1 General Overview	7.12
		7.4.2 Drive Controls	7.14
		7.4.3 Valve Control	7.14
		7.4.4 Vendor Packages	7.15
		7.4.5 Operator Interface	7.16
		7.4.6 Emergency Stop Buttons (E Stops) / Safety Devices	7.17
		7.4.7 Cyanide Industry Standards	7.17
		7.4.8 Control System Communications	7.18
		7.4.9 Control System Access	7.18
		7.4.10 Generic Control Description	7.18
		7.4.11 SAG Mill Start-up and Monitoring	7.19
		7.4.12 SAG Mill Process Control	7.19
		7.4.13 Ball Mill Start-up and Monitoring	7.20
		7.4.14 Ball Mill Process Control	7.20
		7.4.15 Mass Flow Rate	7.20
		7.4.16 Density Control	7.21
		7.4.17 Level Control	7.21
		7.4.18 Flow Control	7.21
		7.4.19 Thickener Control	7.21

Table of Contents (Continued)

			Page
	7.4.20	Pebble Crusher Control	7.21
7.5	Metallurgical Accounting		7.22
7.6	Infrastructure		7.23
	7.6.1	Changes to Infrastructure	7.23
	7.6.2	Roads	7.23
	7.6.3	Airstrip	7.24
	7.6.4	Power Supply and Distribution	7.25
	7.6.5	Potable Water	7.27
	7.6.6	Sewage	7.27
	7.6.7	Tailing Pipelines	7.27
	7.6.8	Diesel Pipelines	7.28
	7.6.9	Solid and Hydrocarbon Wastes	7.28
	7.6.10	Communication System Infrastructure	7.28
	7.6.11	Fuel Supply	7.28
	7.6.12	Explosive Storage and Handling	7.28
	7.6.13	Security and Fencing	7.29
	7.6.14	Site Buildings	7.29
7.7	Workforce Accommodation		7.30
	7.7.1	Permanent Accommodation Camp	7.30
	7.7.2	Temporary Construction Accommodation	7.31

TABLES

Table 7.1.1	Major Equipment Changes	7.1
Table 7.3.1	Installed Load and Maximum Demand	7.10
Table 7.6.1	Potable Water Demand	7.27

FIGURES

Figure 7.6.1	Project Connection to National Grid	7.26

APPENDICES

Appendix 7.1	General Arrangement Drawings
Appendix 7.2	Mechanical Equipment List

7.0 ENGINEERING

7.1 Changes to Design

The most significant changes to the process plant design have resulted from the increased throughput from 3 Mtpa in the FS to 4 Mtpa in this study. In addition, the inclusion of Bakatouo feed and the significant soluble copper levels identified have necessitated changes to the equipment list. The following section should be read in conjunction with plant layout drawings in Appendix 7.1 and mechanical equipment list in Appendix 7.2.

7.1.1 Changes to Mechanical Equipment List

Major changes are presented in Table 7.1.1 below:

Table 7.1.1 Major Equipment Changes

Unit	3 Mtpa FS	4 Mtpa Study	Comment
Throuhgput	3,000,000 tpa	4,000,000 tpa	Upgraded resource
Primary Crusher	C 140	C160	Meet capacity when grizzly blocked
Ore Storage	Coarse Stockpile	Surge Bin	Lower cost
Lime Storage	Silo plus emergency	Silo only	Lower cost
SAG Mill	7.3 m x 3.8 m, 4MW	8.5 m x 4.4 m, 6MW	Houndé mill
Ball Mill	5.8 m x 9.2 m, 5.3MW	6.1 m x 9.1 m, 6MW	Houndé mill
Gravity Concentrator	1 x Knelson 48 inch	2 x Knelson 48 inch	Increased gold / silver load
Intensive Leach Reactor	1 x 3000kg unit	1 x 5000kg unit	Increased gold / silver load
Mill Feed	SAG mill only	SAG and Ball mill	Flexibility on reline shuts
Trash Screens	1 off 3 m x 6 m	2 off 3 m x 6 m	Standby for expected high trash load
Pre-Leach Thickener	1 x 30 m diam	1 x 38 m diam	Increased feed, poorer settling
CIL Tanks	7 x 2900m^3	8 x 2900m^3	Increased feed
Elution Circuit	15t split Anglo	18t split Anglo	Increased feed
Carbon Regen Kiln	1 x 750 kg/hr	1 x 900 kg/hr	Increased carbon load
Electrowinning	3 x 22 cathode, 4500A	3 x 33 cathode, 6000A	Increased gold/silver load
Drying Ovens	1 x 18.5 kW	2 x 18.5 kW	Increased gold / silver load
Induction Furnace	1 x 100 kW	1 x 150 kW	Increased gold / silver load
Cyanide Destruction Tanks	2 x 550 m^3	2 x 900 m^3	Increase soluble copper and CN_{WAD}
Arsenic Precip Tanks	1 x 550 m^3	2 x 900 m^3	Increased feed and residence time
Reagents - Caustic	1 x 20m^3	1 x 90m^3	Arsenic precip demand
Reagents - SMBS	1 x 43 m^3 /1 x 85m^3	2 x 20 m^3 /1 x 230m^3	Increase soluble copper and CN_{WAD}
Services Oxygen	1 x 10tpd PSA	1 x 60tpd PSA	Increase soluble copper and CN_{WAD}
Installed Power	20 MW	26 MW	Larger mills and oxygen plant

7.1.2 Plant Location

The process plant has been relocated to the hill which currently houses the accommodation camp. This hill will be levelled to RL 330 m. The main reasons for this relocation are as follows:

- The previous plant location was within the blast zone of the expanded Ity pit.
- The previous arrangement had a coarse ore stockpile which could be approached at an oblique angle. The revised layout incorporates a surge bin and overflow conveyor and needs to be fed perpendicular to the mill feed conveyor to facilitate location of the overflow conveyor and a ramp for loading material from the dead stockpile.
- The previous layout had a long overland conveyor running adjacent to the steep walls of the Aires dump. Run-off from this heap during a rain event would threaten the plant feed conveyor and presented drainage issues around the primary crusher.
- The revised location moves the ROM pad up to the previous plant location and allows the mine services area (MSA) to be situated in the same general area as the process plant allowing sharing of services.
- The cost of the additional earthworks was considered acceptable given the additional benefits outlined.

7.2 Revised Plant Design

7.2.1 General

The civil, mechanical and electrical design of the plant facilities is based on industry standard practice and Lycopodium's extensive experience in gold plant design and project implementation in West Africa and elsewhere. Where possible, commonality with Endeavour's Houndé project has been implemented.

The main process plant has been laid out to optimise use of a constrained site in which the plant is positioned and to minimise footprint. It is relatively square and a number of process blocks from Houndé have been re-positioned to accommodate the site topography, the access and the drainage. This configuration has resulted in a very compact layout which suits the available site dimensions.

The mechanical design of all process tanks will be in accordance with API 650 with due consideration of the seismicity applicable to the plant location, with appropriate materials selection and corrosion allowances.

Materials handling, containment and bunding in all plant areas has been designed to minimise the possibility of spillages to the environment and to meet legislative requirements.

Due consideration will be given to the nature of the various types of process slurries and reagents being pumped around the plant in terms of settling, wear and scaling.

7.2.2 Primary Crushing

The ROM pad will be located due west of the proposed ZiaNE pit boundary and north of the existing Ity pit outside the blast exclusion zone.

The primary crushing facility will be built into the ROM pad and will consist of a covered steel ROM bin fitted with a static grizzly mounted in a concrete vault. The primary apron feeder mounted below the bin will discharge onto the vibrating grizzly with oversize feeding the jaw crusher. The jaw crusher will be supported on a concrete platform over the crusher discharge conveyor. The concrete vault will be wider than planned for the FS to accommodate the larger crusher selected.

A crusher maintenance hoist will be provided. Replaceable abrasion resistant linings will be provided in all chutes and conveyor skirtboards at all wear points. A concrete sump suitable and sump pump will be supplied to pump out rainfall and spillage that has been hosed to the sump.

A pulsed jet insertable dust collector will return dust to the discharge conveyor. Dust suppression sprays will also be used to control fugitive dust emissions.

7.2.3 Ore Transfer and Stockpile

The process plant is located approximately 350 m north-north-west of the primary crusher. A short 1,200 mm wide crusher discharge conveyor will exit the crusher vault to a transfer point. As the process plant will be fed from a number of pits with old workings it is anticipated that there will be significant tramp metal and organics. A picking station has been allowed to remove branches and tree stumps. A tramp magnet will be suspended over this transfer to pick up any steel from the crushed ore belt. The main ore transfer conveyor will be a 1,200 mm wide conveyor approximately 350 m long which will run north-north-west and will feed a 250 t surge bin. All conveyors will be covered and will be fitted with pullwires and drift switches to ensure safe operation.

The surge bin will have 0.5 hours storage and will feed a single variable speed reclaim apron feeder which will be mounted above the SAG mill feed conveyor. Excess crushed ore will overflow onto a 1,200 mm wide stockpile feed conveyor discharging onto a dead stockpile. The bin will be the means of charging the SAG mill with balls. A lime silo will be provided on the mill feed conveyor. This will be filled pneumatically from bulk tankers.

A sump pump will be located at the reclaim area and will pick up spillage and rainfall from the lime area and pebble crushing area.

7.2.4 Grinding, Classification and Gravity Circuits

The grinding, classification and gravity separation circuits will be combined in a concrete and steel structure. Mill operations and maintenance will be catered for from a suspended concrete slab. The mills will be fitted with steel liners so a seven axis mill liner handler will be provided for mill relining.

Access to the main mill level platform will be via two stairways from ground level, one of these will also provide access up to the gravity circuit floor and screen / cyclone floor. Intermediate operating levels including the mill feed conveyor head platform and cyclone / trash screen platform may also be reached via a stairway from the ball mill discharge level. Secondary access will also be possible via the SAG mill feed conveyor walkway. A secondary feed conveyor will be installed to facilitate transferring crushed ore to the ball mill in the event the SAG mill is offline for maintenance. This conveyor will include access on one side. Ball mill ball charging will be performed using a dedicated electric hoist and kibble discharging into the mill feed chute. An additional sub-floor will provide access to the mill feed transfer conveyor.

Servicing of the two mill drives, the mill discharge screen and cyclone feed pumps will rely on mobile craneage for all lifting requirements, road access for which will be available adjacent to the structure. The cyclone / trash screen / gravity screen platform will be serviced by a one tonne davit crane. Spillage handling will be provided by two sumps, one directly under the SAG mill feed chute and one at the SAG mill discharge. The SAG mill feed end will be sloped down to the sump pump. The SAG mill discharge will use a front end loader in a drive-in sump. A sump pump will collect floor spillage in the vicinity of the discharge end of the mill, bunker drainage water and pump scuttling slurry and solids from the duty / stand-by cyclone feed pumps.

7.2.5 Pebble Crushing

Oversize from the pebble screen will discharge onto a single pebble transfer conveyor. In the event that this conveyor trips, an overflow chute will discharge pebbles into the SAG mill discharge drive-in sump where they will be reclaimed by FEL. A self-cleaning tramp metal magnet will be mounted over the conveyor and will remove tramp steel from the pebble belt. An operating platform will be provided for this magnet.

Pebble crushing will be housed in a separate building mounted over the SAG mill feed belt. The pneumatically operated deflector gate will allow pebbles to feed a surge bin or, in the event of fugitive steel being detected by the metal detector, will divert pebble feed to a bypass chute. The bypass chute will be fitted with wear liners and will feature a number of rock boxes to minimise impact before discharging directly onto the SAG mill feed belt.

The pebble surge bin will also have a wear lining and will discharge via a variable speed vibrating feeder into the pebble crusher. The pebble crusher will be mounted on a concrete foundation and will include rubber mounts to minimise transmission of vibration. The crusher will include its own ground-mounted lubrication skid. In addition, a hydraulic pump system will allow raising and lowering of the bowl and automatic tramp relief.

7.2.6 Gravity Recovery

Two gravity feed pumps (duty / stand-by) will feed the twin parallel gravity circuits. A splitter box will direct feed to two separate gravity scalping screens mounted on the same floor as the trash screen. The undersize from these screens will feed separate centrifugal concentrators. The centrifugal concentrators will be located inside a secure area complete with mesh screening and a lockable door. Product from the concentrators will gravitate via a fully welded steel pipe to the intensive leach reactor, located on the ground floor in a secure meshed area with a lockable door. A sump pump will service the leach reactor.

7.2.7 Trash Screening and Pre-leach Thickening

The trash screens (duty / stand-by) will be located on the milling building upper level to facilitate feeding both the pre-leach thickener and the CIL circuit. Trash screen oversize material will be diverted to a bunker at ground level for disposal by FEL. Screen undersize will flow by gravity into a splitter box which will feed the pre-leach thickener feed box or directly into the CIL feed box if the thickener is offline.

The 38 m diameter above-ground pre-leach thickener will be located in a bunded area with mill water tank adjacent to grinding and classification. The thickener underflow pumps will serve as leach feed pumps and will be located outside the thickener wall for ease of maintenance and mobile crane access.

Two methods of access will be provided. The first, directly from the milling area and the second via a stairwell on the southern side of the thickener which will allow access from ground level to the thickener bridge via the flocculant mixing plant. The concrete slab will be drained to a floor area sump pump for spillage collection. In the case of a thickener emergency dump, the bund will fill and overflow to the main plant drain running north / south and into the tailings storage facility.

7.2.8 Leach and Carbon Adsorption Circuit

The CIL plant will consist of eight 2,900 m^3 agitated tanks. A CIL feed box and launder diverter gates will be located at top of tank platform level. The carbon recovery screen and will also be located at top of tank level.

There will be three means of access to the top of tanks; directly from the mill building, stairway from ground level at the eastern end and a stairway through the elution area.

The top of tank equipment will be serviced by the CIL gantry crane. A 16 tonne crane will be provided for this and other maintenance duties. The intertank screens, carbon transfer pumps and launder gates will be located below the platform steel to reduce potential trip-hazards on the platform area above the tanks. Removable grating panels will provide safe access to platform levels below the main floor to inspect equipment and temporary handrails will make the CIL platform area safe.

The CIL tanks will be bunded for spillage and splash, but not for containment of a tank volume. Accidental or deliberate dumping of the contents of a CIL tank will cause the bund to overflow to the main plant drain and into the TSF compliant with ICMC guidelines. Four floor area sump pumps will be located in the bund at accessible positions adjacent the bund wall to collect and return spillage to the circuit. The CIL bund floor will slope to each of these sump positions.

7.2.9 Elution, Carbon Regeneration and Goldroom

The circuit will be housed in a building supported directly off the ground and will include the loaded carbon screen and diesel tank on the top floor and the acid wash and elution columns running to the ground. A stairwell will run up this building with access at the bottom of the columns, the column manholes, the top of column valves and filters and the loaded carbon screen. The loaded carbon screen floor will lead directly onto the CIL top of tank floor. The column manhole floor will also provide access to the regeneration kiln.

The top floor will be under roof and wall cladding to protect the carbon screen. The regeneration kiln will also be protected to shield the shell from differential temperature changes and to keep instrumentation and control panels sheltered.

The carbon regeneration kiln and quench tank will be fitted with an overhead monorail hoist used regularly for new carbon addition but will also be available for maintenance of the kiln drive, shell and rollers. Additional lifting facilities will not be required in this area as maintenance of other equipment will be performed in situ.

The acid wash column will have a partitioned area of the area bund, separated such that any acid spillage cannot mix with cyanide solutions and will be separately disposed of by a dedicated sump pump.

The goldroom building and eluate tanks will be located inside a secure area for restricted access by authorised personnel and vehicles only. The secure area will have separate personnel and vehicle access gates. The strongroom will be enclosed by additional secure walls and roof to provide additional security. The building will be ventilated with fresh air, separate extraction of dust, fumes and heat from the smelting furnace and electrowinning cells. There will be stairway access to the upper level as well as an alternative emergency egress.

The electrowinning cells and anode support frame will be located on the upper level and serviced by an overhead gantry crane. The pregnant solution tank and strip solution tank will be located within a concrete containment bund.

7.2.10 Tailings Disposal

The carbon safety screen will be located on a steel structure adjacent to the main north / south piperack to allow for gravity feed to the screen. Access to the screen will be via a stairway from the top of CIL or ground level. The cyanide destruction tanks will be located next to the screen. Screen undersize will gravity flow to the cyanide destruction feed launder whereas oversize will be diverted into the fine carbon bin situated at the base of the structure. The cyanide destruction tanks and arsenic precipitation tanks are all located in the same area to allow gravity flow and to allow any of the tanks to be bypassed. The tails hopper has been located between the four tanks to allow bypass to tails in the event of a breakdown. A concrete slab and bund will contain any spillage and direct overflow to the main plant drain and TSF.

The tailings pumps will transport the tailings slurry via an HDPE pipe to the discharge point of the tailings storage facility located to the south of the plant.

All equipment will be readily accessible by mobile crane to conduct maintenance.

7.2.11 Reagents

Reagent mixing areas have been consolidated into one area adjacent to the CIL tanks. The reagent storage / mixing area for CIL and elution will be located on the south eastern side of the CIL tanks. Hydrochloric acid, caustic and the flocculant mixing plant will be grouped on one common bunded area with appropriate partitioning for floor spillage, whilst a second separate bunded area will be used for sodium cyanide.

The reagent storage / mixing area for cyanide destruction and arsenic precipitation will be located on the south western side of the CIL tanks across the piperack from the destruction tanks and will be separately bunded.

Cyanide

Sodium cyanide briquettes in one tonne bulka bags will be laid down next to the cyanide mixing plant. A steel structure with access stairs from ground level will house the enclosed bag breaker, a mixing tank and a bag lifting hoist. The structure will be fitted with a roof to provide protection to the bag breaking operation from the weather. Mixed cyanide will be pumped to the cyanide storage tank.

Spillage in the area will be pumped via a sump pump into the leach feed box.

Caustic Soda

Caustic soda in bulk bags will be loaded into a bag breaker and feeder located on the top of the mixing and storage tank. The cyanide hoist will be used for loading caustic. A common platform for access to cyanide, caustic and hydrochloric acid tanks will be provided.

Hydrochloric Acid

The hydrochloric acid facility will be located within a partitioned area of the reagents bund and will have a dedicated sump pump which will dispose of any spillage to the tailings thickener.

Delivery of acid will be via 1,000 L isotainers and unloaded into the mixing and storage tank using a floor-mounted drum pump.

Flocculant

Dry flocculant bags will be transported by forklift from the reagents store to the flocculant mixing area adjacent to the pre-leach thickener. The bags will be loaded into a bag breaker located on the top of a small mixing and storage tank. Stair access to the top of tank will be provided.

The bag breaker and dry hopper structure will be partially clad for rain and wind protection.

Sodium Metabisulphite

Sodium Metabisulphite (SMBS) powder in one tonne bulka bags will be laid down next to the mixing plant. A steel structure with access stairs from ground level will house twin enclosed bag breakers, feed hoppers, mixing tanks and a bag lifting hoist. The structure will be fitted with a roof to provide protection to the bag breaking operation from the weather. Mixed SMBS will be pumped to the SMBS storage tank.

Spillage in the area will be pumped via a sump pump into the cyanide destruction tanks.

Copper Sulphate

Copper sulphate in 25 kg bags will be loaded manually into a bag breaker located on the top of the mixing tank. The telehandler will locate a pallet of the reagent bags next to the bag breaker. A needle tank will provide temporary feed to the cyanide destruction tanks while a new batch of copper sulphate is being mixed. A common platform for access to SMBS, copper sulphate and ferrous sulphate tanks will be provided.

Ferrous Sulphate

Ferrous sulphate in 1,000 kg bags will be loaded into a bag breaker located on the top of the mixing tank. A needle tank will provide temporary feed to the arsenic precipitation tank while a new batch of ferrous sulphate is being mixed.

7.2.12 Air, Oxygen and Water Services

Air Services

All compressed air services will be housed in a compressor station at the western end of the east / west piperack consisting of a fully clad steel structure and concrete slab floor. The building will have one permanently open panel for forklift access should any of the package unit compressors need to be removed for major overhaul. Normal maintenance will be expected to be carried out with the units in situ.

Oxygen Plant

A packaged PSA oxygen plant will be located adjacent to the compressor station. Weather protection is not needed for these vendor packages.

Water Services

Water services include raw water, process water, fire water, potable water, bore water and filtered (non-potable quality). All tanks, pumps and the potable water treatment plant will be located on the western side of the process plant and will be serviced via a common pipe rack.

Filtered / Gland / Potable Water

The potable water treatment plant will be located on the western side of the process plant and will also serve the camp. No weather protection or permanent lifting facilities have been allowed for water services, although the potable water treatment plant will be containerised. Gland water will be pumped from the filtered (non-potable) water tank.

Raw Water

Raw water will be supplied to the raw water tank from the pit dewatering pumps via a storage tank located near the Daapleu pit. Transfer pumps will feed the plant on demand with excess bore water being treated through a containerised water treatment facility if required prior to release into the Cavally River.

Fire Water

The raw water tank will also hold a volume of 288 m^3 of water reserved for firewater use. The fire protection skid of electric with backup diesel pumps and jockey pump will draw from the base of the raw water tank. The raw water distribution pump set will draw from higher up in the tank to prevent depletion of the fire water supply reserve.

Mill / Process Water

Mill water consists predominantly of pre-leach thickener overflow with top up from the process water system and is stored in a tank adjacent to the pre-leach thickener. Process water consists of TSF decant return and raw water tank overflow and is used for pressurised sprays, service points and reagent mixing.

Pipe Racks

The following pipe racks have been allowed:

- A west-east pipe rack running from air services and the main MCC past and joining the north / south piperack.
- A south-north pipe rack running between the goldroom in the north and the detoxification / tailings area in the south.
- A west-east piperack running between the reagents area and CIL.

7.2.13 Large Volume Spillage Containment

The drain under the central north / south pipe rack will act as the low point for plant spillage. In the event of a large spillage event the grinding area and cyanide destruction area will drain north to south and into a double-lined trench which will drain from the plant into the tailings storage facility. Similarly, the elution and CIL areas will drain east to west and into the same lined trench. No separate event pond will be provided due to space constraints.

7.3 Electrical Design

7.3.1 Installed Load and Maximum Demand

The plant site-wide electrical power requirements for infrastructure, mining and processing were calculated on the basis of preliminary equipment sizing. The installed load and maximum demand for the Project is estimated below (to be confirmed by ECG).

Table 7.3.1 Installed Load and Maximum Demand

Installed Load		Maximum Demand		Average Demand	
(MW)	**(MVA @ 0.85pf)**	**(MW)**	**(MVA @ 0.85pf)**	**(MW)**	**(MVA @ 0.85pf)**
26.7	31.4	21.8	25.6	16.3	19.1

The maximum demand is based on an average load factor of 80% for all areas except the mill drive, which was given a load factor of 95%. The 6,000 kW SAG mill and 6,000 kW ball mill represents approximately 54% of the average load.

7.3.2 Grid Power Supply

Power for the facilities will be sourced from the grid by an extension to the Danané substation and construction of 58 km of 90 kV overhead power line. The Ity substation, owned by CIE, will include a 90/11 kV transformer with an 11 kV feeder taken to the main plant switchboard.

7.3.3 11 kV Switchboards

One 11 kV switchboard has been allowed for in the plant and one will be supplied with the grid supply switchyard onsite power plant. The 11 kV switchboards will be fully withdrawable design complete with protection, metering and earthing facilities.

Protection will be provided by microprocessor based protection relays.

7.3.4 Electronic Variable Speed Drives and Soft Starters

LV variable speed drive (VSD) units and soft starter (SS) ratings range from 0.18 kW up to 315 kW. These are floor or wall mounted (dependent upon size) along the internal wall of the LV substation.

7.3.5 415 V Motor Control Centre

Two LV switchrooms will be included. The main switchroom will be located adjacent to the grinding areas to minimise cable length to the HV drives. This switchroom will be separated into an HV area for the 11 kV switchboard and an LV area for the 415 V MCCs. The second switchroom will be adjacent to the primary crusher area.

The MCCs will be double-sided (back to back) and housed in the LV switchrooms. Construction of all MCCs will have Form 4 segregation, Type 2 coordination. Starters in MCCs will be of demountable design and main incoming circuit breakers will be of withdraw-able design complete with protection. All motor starters will be equipped with smart overload relays as per Lycopodium engineering standard. The LV MCCs will supply power to the low voltage motors, low voltage variable speed drives and low voltage distribution boards.

7.3.6 Earth Fault Protection

Earth leakage protection will be applied to circuits with GPOs (General Purpose Outlets, i.e. power points) and for lighting circuits.

7.3.7 Fire Protection

The HV switchroom, LV switchroom and the plant control room will be provided with fire detection systems. Signals from the fire detection system will be wired to the respective fire indication panel (FIP) in the switchrooms and all signals will be monitored by a master fire detection panel (MFIP) in the security / emergency services control room. Each FIP will also be wired to a local siren with beacon to warn staff of the fire detection. The same fire and smoke activation alarm signals detected by the fire detection system will also be monitored in the plant control room. The diesel power station will have a water mist suppression system (as per that included in the Houndé system).

7.3.8 Cable Ladders

Cable ladders will generally be laid horizontally, with vertical ladders used in areas where spillage may occur. Hot dip galvanised / epoxy painted type cable ladder will be used. However, stainless steel cable ladders will be used in areas exposed to corrosive particles / fumes / mists.

Cables of different voltage groups will be installed on separate ladders. If they need to be installed on the same ladder, then complete segregation of the ladders will be provided. Ladder routes will follow the mechanical pipe racks.

7.3.9 Cables

Direct buried cables will be provided with armouring.

Cables up to 16 mm^2 will be PVC insulated and bigger cables will be XLPE insulated.

VSD cables will be multiple core 3 x phase and 3 x earth cables symmetrically laid out within an overall shielded cable.

Cables within the plant area will be installed above ground, on cable ladders and follow the mechanical pipe racks wherever possible.

7.3.10 Lighting

All lighting around the process plant will be design in a fit for purpose manner to suit the operational requirement for each area.

7.3.11 Earthing System and Lightning Protection

The earthing system within the plant will be designed in accordance with relevant Australian Standards (i.e. AS 3000, AS 3007 and Australian Communications Authority (ACA)). The following method of system earthing will be implemented at various voltage levels:

- 11 kV Earthed via earthing transformers
- 415 V Solidly earthed system / Multiple Earthed Neutral (MEN) / T-N-C-S

  Note: T – Terre (French for earth)

  N – Neutral

  C – Combined

  S - Separate

Lightning protection will be provided for all plant building structures. Plant substations / switchrooms and structural high points will be fitted with lightning masts of sufficient height and quantity to ensure that all exposed points will be covered as per 'Rolling Sphere Method' of AS 1768. Lightning protection systems will have their own independent earthing electrodes and will be interconnected with the power earthing system.

7.4 Control System

7.4.1 General Overview

The general control philosophy for the plant will be one with an adequate level of automation and remote control facilities. Instrumentation will be provided within the plant to measure and control key process parameters and to provide a safe work environment.

The main control room, which will be located in the plant administration office, will house two PC based operator interface terminals (OIT). Both of the OITs will act as the control system SCADA servers as well as configuration / operator stations. The control room is intended to provide a central area from where the plant is operated and monitored and from which the regulatory control loops can be monitored and adjusted. An additional OIT will be provided in the crusher cubicle.

All key process and maintenance parameters will be available for trending and alarming on the process control system (PCS).

The PCS that will be used for this plant is a PLC-based SCADA system. The PCS will control the process interlocks and PID control loops for non-packaged equipment. Control loop set-point changes for non-packaged equipment will be made at the OIT.

There will be two modes for loop controlled Control Variables available in the PCS. These are 'Auto Mode' and 'Manual Mode'. In Auto Mode, the Control Variable will be predominantly controlled by the applicable PID loop based on the Process Variable set-point. Auto Mode control may include cascade control loops where the Process Variable set-point is provided by another control loop rather than being directly specified. In Manual Mode, the Control Variable may be entered manually on the SCADA OIT. Both Process Variable set-point and Control Variable set-point can be entered from the control loop pop up on the OIT.

In general, the plant process drives will, as a minimum, report their Ready, Run and Fault status to the PCS system and will be displayed on the OIT. Local control stations will be located in the field in proximity to the relevant drives. These will as a minimum, contain start and latch-off-stop (LOS) pushbuttons which will be hard-wired to the drive starter.

The OIT will allow drives / valves to be selected to Auto or Remote or Local modes via the drive / valve control popup on the OIT. Statutory interlocks such as emergency stops and overload protection are hardwired and will apply in all modes of operation.

- **Remote mode**: 'Remote' selection allows drives and valves to be controlled remotely from the OIT. This mode allows operators to start / stop or open / close a drive or valve manually by clicking on the relevant pushbutton on the OIT ('Manual mode') or controlled by an automatic sequence or control loop ('Auto mode'). If not in Remote mode, the drive or valve can only be controlled from local pushbuttons in the field ('Local mode').

- **Auto mode**: When all associated drives or valves are selected to 'Auto', this mode allows for the starting of automatic sequences for some systems, e.g. in the elution circuit, where the system may be group started when all associated drives or valves are selected to 'Auto'.

- **Local mode**: 'Local' selection allows each drive / valve to be operated in the field via a local pushbutton, which is connected to the PLC. All process interlocks will apply.

The control of most of the vendor packages will be done via the local control panel with no control or set-point changes from the PCS system. General equipment fault alarms from each vendor package will be monitored by the PCS system and displayed on the OIT. Fault diagnostics and troubleshooting of vendor packages will be performed locally. Digital output can be transmitted from the PCS to the vendor packages where required. The function of these outputs is to enable the start permissive for the packages or to start these packages remotely. For some specific packages (elution heater, compressors) a remote set-point can be entered.

7.4.2 Drive Controls

In general, drives will be powered from starters installed in a Motor Control Centre (MCC) located in the low voltage switchrooms. The starter for a DOL drive will be controlled and monitored by a PLC using drive starters and marshalling panels. No 'smart MCCs' will be employed. Field inputs will be wired directly to the PLC and an output will be wired to the start relay of a DOL drive. Each DOL drive will have 'Running', 'Ready' and 'Fault' status displayed on the OIT as a minimum. A start / stop command can be sent from the OIT drive popup to the drive starter via the PLC.

There will be local start / E-stop pushbuttons for each DOL drive, which will be hard-wired to the drive starter circuit. There will be local start / stop / E-stop pushbuttons for each VSD drive, which will also be hardwired to the drive starter circuit. Start and stop pushbuttons will be momentary type and E-stop pushbuttons will be latched mushroom head type.

Variable Speed Drive (VSD) units will be of a Variable Voltage Variable Frequency (VVVF) type utilising Pulse Width Modulated (PWM) technology and mounted within the low voltage switchroom. VSD speed can be controlled via the PCS, in the case of process closed loop circuits, or the VSD faceplate where only manual speed control is required. There will be no provision made for speed control local to the drive.

Exceptions to this drive control philosophy will be drives which form part of vendor packages that are controlled from a vendor supplied local control panel.

Interlocks will be provided to prevent large loads from starting simultaneously. This will be implemented in the PLC program.

The starting of conveyors and other major rotating equipment, such as the mills, will be preceded by a start siren.

The PCS will provide run-time monitoring (run hours) on all equipment (including all equipment with drives larger than 55 kW and the carbon forwarding pumps).

7.4.3 Valve Control

Automatic valves will be controlled via the OIT. There will be no local control stations, except for the cyclone feed pumps, pre-leach thickener underflow pumps, tails pumps and elution. Isolation valves and manual control valves will be operated locally with no remote position indication available.

Local control stations will be provided for the valves on the large slurry pumps (the cyclone feed pumps, the pre-leach thickener underflow pumps and the tails pumps) to allow both auto and field selection of Dump / Start / Stop.

There will be a number of local control stations located in the acid wash and elution area to allow for the field control of the elution circuit valves.

Automatic control valves will be controlled by PID loops within the PLC. Manual operation of the valves, as required for maintenance purposes, will be from the OIT and there will be no provision made for local position control. Feedback of automatic control valve position will be available remotely.

Actuated valves for the cyclones will be able to be operated from the control room or locally from the vendor control panel.

7.4.4 Vendor Packages

The following equipment will be supplied with dedicated instrumentation and control:

- Primary crusher gap setting adjustment and LRS soft starter.
- SAG mill control including interlock protection, lubrication package, VVVF speed control and inching drive. An Ethernet connection to the PCS will provide mill weight, mill speed, mill power, mill motor vibration monitoring, bearing temperatures, gearbox temperatures, lubrication system fault status and grease system fault status. Trending will be provided for these parameters. Mill start-up will be from the field control panel.
- Ball mill including interlock protection, lubrication package, VVVF speed control and inching drive. An Ethernet connection to the PCS will provide mill power, mill motor vibration monitoring, bearing temperatures, gearbox temperatures, lubrication system fault status and grease system fault status. Trending will be provided for these parameters. Mill start-up will be from the field control panel.
- Pebble crusher gap setting / bowl clamping.
- Self cleaning metal magnet.
- Centrifugal gravity concentrator operation and interlock control. The gravity concentrators will be controlled from a central control station. Interlocking with the ILR vendor package will prevent the gravity concentrators from dumping if the ILR is not ready or the concentrate feed hopper is full via a control permissive.
- Inline leach reactor (ILR) operation and interlock control. The ILR will be controlled from a local control station. The ILR control system will prevent the gravity concentrator from dumping if the ILR is not available or if the concentrate feed hopper is full by setting a control permissive.
- Pre-leach thickener rake drive and torque control.
- Flocculant mixing system.
- Plant and instrument air compressors including instrument air dryers. Remote access to pressure set-point will be provided via Ethernet.
- Stand-alone control of the oxygen PSA plant.

- Carbon regeneration kiln. Trending of the kiln temperatures will be provided on OIT.
- Induction furnace.
- Cell sludge pan filter vacuum system, including the vacuum pump. The cell sludge vacuum pump will be controlled from a local panel. The vacuum system is manually operated.
- Strip solution heater package. Remote access to temperature set-point will be provided via Ethernet.
- Electrowinning cell rectifiers – including local and remote display of voltage and current, and local and remote control of voltage.
- Fire water pump system including electric jockey pump, electric fire water pump and diesel fire water pump.
- Water filtration system.
- Potable water.
- Pit dewatering treatment.
- Sewage pumping stations.
- Sewage treatment system.

The above equipment will have its own sequencing and control provided by a local, stand-alone vendor supplied control system. A general system running and fault status will be reported to the PCS system. Any fault diagnosis will be done locally, except as specified (e.g. the mills).

7.4.5 Operator Interface

The main control room will contain two OITs each of which can run the SCADA, along with an OIT station in the crusher cubicle. Depending on access assignments, the OIT in the crusher cubicle will also be able to start and stop equipment in the crushing area. One of the OITs in the main control room will generally be configured for use as an engineering terminal for PCS configuration. Both OITs will be located in the control room in the plant administration building.

The SCADA OIT for the Ity CIL Project will include the following:

- Animated process mimics.
- Drive and valve status display.
- Drive and valve mode selection and start / stop or open / close control.
- Current active alarm display.

- Popup to display analogue ranges and set-points for analogue alarms. Analogue process values on the OIT are displayed using appropriate engineering units.

- Perform trending of all analogue values. The trend displays will enable the display of data from the past 30 days. The operator will be able to change the time scale and magnitude axis for each trend.

- Control loop pop-ups.

7.4.6 Emergency Stop Buttons (E Stops) / Safety Devices

Emergency Stop Buttons (E-Stops) will be hardwired into all the drive starter circuits. Every drive will have emergency stop buttons located in proximity to the drive. Emergency stop buttons will be of a latched mushroom head style.

In addition, there will be a number of emergency stop buttons in the plant to stop specific equipment:

- SAG mill – Four E-Stops in the field.

- Ball mill – Four E-Stops in the field.

- Pebble crusher – One E-stop vendor supplied.

- Centrifugal concentrator – One E-Stop vendor supplied.

- ILR – One E-Stop vendor supplied.

- Thickener rake drive control – One E-Stop supplied.

- Carbon regeneration kiln – One E-Stop vendor supplied.

- Feeders and conveyors will be equipped with lanyard type emergency stop pull wires.

- VSDs will be equipped with Soft Stop and Latch Off Stops.

In addition, all conveyors will have belt drift switches and under-speed sensors that will alarm on the OIT. The under-speed will shutdown the conveyor.

7.4.7 Cyanide Industry Standards

A number of alarms and interlocks have been included to meet cyanide industry standards.

- The cyanide mixing tank has dual independent level measurement tied to a shutdown of the fill device (water valve or transfer pump). This prevents overflowing of the tank.

- The process water tank has level indication which will alarm if the level rises above a preset point.

7.4.8 Control System Communications

Fibre optics will be used for communication between the switchrooms and the control room. Ethernet switches will be used at the plant LV switchrooms and the control room. Ethernet will be used as the communication backbone between PLC racks; and SCADA hardware. Fibre optics will be used to allow communication with the raw water harvesting, raw water storage and tails dam equipment.

7.4.9 Control System Access

The control system SCADA defaults to 'view only' access when no user is logged in. Each operator or engineer will be assigned with usernames and passwords in order to operate the plant via the SCADA. Access privileges will be assigned to usernames. For example, the operator user group will have access to drive controls but not to loop tuning. There are four levels of access privilege:

- **Viewers** will have view-only access with no access to drive / valve controls.
- **Operators** will have access to the day-to-day operation functions of the plant.
- **Engineering** users will have access to maintenance and/or diagnostic functions, e.g. loop tuning.
- **Administrators** will have access to all functions and can add additional / remove existing users.

7.4.10 Generic Control Description

Where instrument measurements are said to be only displayed locally, there will be no transmission of the signal from the field to the PCS system.

Where instrument measurements are said to be displayed on the OIT, they will first be transmitted to the PLC and then displayed on the OIT. Instrument measurements displayed on the OIT may also be displayed locally on the instrument or local transmitter depending on access.

Where the PCS system is said to control a device, e.g. VSD speed control, based on an instrument measurement, e.g. hopper level, there will be a PID controller programmed in the PLC. The instrument measurement will be displayed on the OIT and a process variable set-point can be entered by the operator on the OIT.

7.4.11 SAG Mill Start-up and Monitoring

The SAG mill will be supplied with a standalone control panel. The SAG mill will be controlled from this panel, including all protective interlocks and all control interlocks for start-up and shutdown. All SAG mill status and alarm conditions will be available to the plant PCS via a fibre optic Ethernet connection. The SAG mill will also include the following:

- Mill load measurement calculated from mill bearing lube system hydraulic pressure (output to plant PCS).
- Mill power draw from the HV starter metering module (output to plant PCS).
- Mill feed rate from the SAG mill feed weightometer (output to SCADA).
- An LRS to limit starting torque.
- A variable voltage, variable frequency drive with full speed adjustment (0 – 80% critical speed, output to SCADA). Mill speed display will be available on the SCADA.
- Bearing temperature measurement. Bearing temperatures will be available on the SCADA.
- Mill motor vibration monitoring. Mill vibration measurements will be available on the SCADA.
- Mill run hours.
- Locked charge timer.

7.4.12 SAG Mill Process Control

The PCS will allow remote control of SAG mill feed rate to a predetermined set-point via the surge bin apron feeders. No allowance for an automatic loop control of feed rate based on mill power or load has been made. A facility for remote adjustment of SAG mill speed from the control room will be provided.

SAG mill density will be controlled by addition of SAG mill feed water, which is proportional to SAG mill feed rate. SAG mill load will be monitored and SAG mill media will be charged manually by a FEL into the surge bin to maintain a target mill load. Mill power will be monitored and operations staff will need to adjust speed, charge and/or feed rate to maintain the target power.

7.4.13 Ball Mill Start-up and Monitoring

The ball mill will be supplied with a standalone control panel. The ball mill will be controlled from this panel including all protective interlocks and all control interlocks for start-up and shutdown. All ball mill status and alarm conditions will be available to the plant PCS via a fibre optic Ethernet connection. The mill will also include the following:

- Mill power draw from the HV starter metering module (output to plant PCS).
- An LRS for limiting start-up torque.
- A variable voltage, variable frequency drive with full speed adjustment (0 – 80% critical speed, output to SCADA). Mill speed display will be available on the SCADA.
- Bearing temperature measurement. Bearing temperatures will be available on the SCADA.
- Mill motor vibration monitoring. Mill vibration measurements will be available on the SCADA.
- Mill run hours.
- Locked charge timer.

7.4.14 Ball Mill Process Control

Ball mill operation will aim to maintain a ball charge that fully utilises the available motor power. If the ball mill is under-utilised because the feed is fine or soft, the ball mill speed can be reduced to reduce power draw. Generally, grinding variability will be addressed through the SAG mill speed control, as this is more flexible.

Ball mill ball charging will be manual with a kibble for charging media into the ball mill feed chute. A light will indicate to the hoist operator that the kibble is in the correct position for media charging into the ball mill feed chute.

Under normal circumstances, water will not be added to the ball mill feed. Ball mill feed density will be dictated by the cyclone underflow density, however provision to add mill water to the ball mill feed stream will be made, to cater for instances where a high slurry viscosity in the mill could cause the ball charge to 'float'. The ball mill feed water addition is manually adjusted.

7.4.15 Mass Flow Rate

Conveyed solids will be measured by weightometer to monitor the crushing and milling rates. Mass flow will be displayed on the OIT. Weightometers will have a 4 - 20 mA output for flow rate and a digital pulsed output for totalised flow.

Volume flow and slurry density will be measured on key streams to monitor the transport of material through the circuit.

The flow and density measurements will be displayed on the OIT. The mass flow rate of key streams will be calculated in the PLC using the measured flow rate and density. This value will also be displayed on the OIT.

7.4.16 Density Control

Cyclone feed density will be measured using a nucleonic density gauge and transmitter and displayed on the OIT.

Control of milling water addition will be by a PID loop in the PLC based either on cyclone feed density measurement or on the total milling circuit water addition. The total water addition to the cyclone feed hopper will be calculated in the PLC as the difference between the milling circuit water addition and the SAG mill feed water addition.

Pre-leach thickener underflow density will be measured using a nucleonic density gauge and transmitter and displayed on the OIT.

Tails density will be measured using a nucleonic density gauge and transmitter and displayed on the OIT.

7.4.17 Level Control

Level measurement of key hoppers and tanks will be made using ultrasonic level transmitters or differential pressure transmitters (for solutions) and displayed on the OIT. During normal operation PID loops in the PLC will control the level in these hoppers by regulating the discharge pump speed.

7.4.18 Flow Control

Flow control of key liquid streams will be monitored by the PLC using flow indicators and controlled by flow control valves or pump speed.

7.4.19 Thickener Control

A vendor supplied bed level indicator will be provided on the pre-leach thickener for measurement of the solid / liquid interface. Control of the bed level in the thickener will be by a PID loop in the PLC which will regulate the speed of the flocculant dosing pump.

A vendor supplied pressure indicator will be provided on the pre-leach thickener for measurement of the bed mass. Control of the bed pressure in the thickener will be by a PID loop in the PLC which will regulate the speed of the duty thickener underflow pump.

7.4.20 Pebble Crusher Control

The pebble cone crusher will be choke fed where possible to maximise size reduction and minimise overall crusher wear by ensuring choke conditions are maintained. A level detector in the feed canister of the pebble crusher will provide the feedback on the pebble load in the pebble crusher feed canister. Crusher current will also be monitored.

Hydraulic adjustment of the pebble crusher closed side setting will be provided.

The pebble crusher will be protected from tramp metal by one stage of magnetic metal removal using a self cleaning belt magnet on the pebble conveyor followed by a metal detector and feed bypass facility via a flop gate on the discharge of the pebble conveyor feeding the pebble surge bin.

7.5 Metallurgical Accounting

Weightometers will be located on the following conveyors throughout the plant:

- Crushed ore transfer conveyor will measure primary crushed ore tonnage.
- SAG mill feed conveyor will measure mill feed tonnes.
- Pebble conveyor will measure the pebbles being recirculated to the SAG mill feed.
- The tonnage of crushed ore reporting to the stockpile can be estimated from the difference between the crushed ore tonnage and the mill feed tonnes.

Manual sampling of the leach feed stream and the final plant tailings will allow composite shift samples for leach head grade and tails solution and residue grades.

Density and flow meters on the leach feed and tailings lines will allow the dry tonnage of solids pumped to the leach circuit and TSF to be determined as a cross check on the mill feed tonnage determined from the mill feed weightometer. In conjunction with the leach feed and plant tails samples, the mass flow measurements will allow the gold recovered in the leach / CIL to be calculated.

A dedicated electrowinning cell will be provided for recovery of the gold leached by intensive cyanidation of gravity concentrate and the recovered gravity gold sludge can be smelted separately. The plant head grade can be back-calculated from the gravity and leach head grade.

Regular gold 'in circuit' surveys will allow reconciliation of precious metals in feed compared to doré production.

Water supplied and used in the various areas will be continuously monitored.

Reconciliation of the amount of reagents used over relatively long periods will be achieved by delivery receipts and stock takes. On an instantaneous basis, reagent usage rates of cyanide, elution and detoxification reagents and diesel flow rates to unit operations will be measured (L/min) and accumulated (m^3) using flow meters.

7.6 Infrastructure

7.6.1 Changes to Infrastructure

The following lists the major changes to infrastructure.

Earthworks

Relocation of the plant has increased earthworks significantly with approximately 3 Mm^3 for the relocated plant.

Airstrip

Additional works plus a refuelling truck.

Water Supply

Pit dewatering bores reduced from 42 to 12 on advice from Knight Piésold.

Power Supply

20 MW backup powerstation added.

TSF

A larger footprint and increased quantities.

Accommodation

Costs updated to reflect Houndé actual costs.

Mining Infrastructure

Bridge over Cavally River revised. Extra bay added to HV workshop. Bulk fuel storage deleted as it will be financed by the fuel supplier.

7.6.2 Roads

The main access road will continue from the Ity village, with entrance gate along the northern site perimeter fence for a further 3 km up to the process plant. The road will be sealed from the village to the entrance gate, and unsealed from this point.

Plant Roads

Plant internal roads will provide access between the administration area, plant site facilities, fuel storage and mine services area. These roads will generally be 9 m wide and will be constructed flush with the bulk earthworks pad to ensure that storm water sheet flow is achieved across the site, thereby avoiding the need for deep surface drains and culvert crossings within the plant area.

Access to the accommodation camp, located approximately 1 km northwest of the process plant, will be by a 9 m wide gravel road.

Access Tracks

A number of new tracks will be constructed to access infrastructure such as the tailings storage facility, sediment control structures and water bore pumps remote from the plant site. The access tracks will be cleared and graded natural earth tracks. These tracks will be construction to carry mining and large earthmoving trucks. Exact routes will be determined during construction of the Project to best fit local terrain and vegetation density.

Site Access Roads

Site access roads were designed to facilitate the following routes:

- Existing public roads to camp.
- Existing public roads to plant site.
- Plant site to TSF.
- Site haul roads to emulsions plant.
- Plant site to mining area.

The site access roads will consist of two 4.5 m wide running lanes, for a total formation width of 9 m. A 200 mm laterite wearing course will be placed over the sub-grade / general fill. Turnouts and level spreaders will be located as required along the road alignments to manage rainfall runoff and sediment control.

All culvert crossings for the site access roads were designed for a 1 in 20-year recurrence interval storm event, and will comprise corrugated steel pipe culverts or reinforced concrete box culverts for significant culvert crossings. The culvert inlets and outlets will comprise stone pitched headwalls.

7.6.3 Airstrip

Currently, expatriate and Abidjan based national employees travel from Abidjan to Man, then commute from the Man airport to site via bus. The national airline Air Côte d'Ivoire currently operates flights from Abidjan to Man on Thursday and Sunday only. While the flight time is approximately 1 hour, the final bus trip from Man to site is limited by at times poor road conditions, with the commute to site a minimum of 2.5 hours.

The option of constructing an airstrip in the project area, if cost effective, will reduce the transit time to site and allow the engagement of a charter operator for direct flights on days and commute times that better suit operational requirements. Direct charter flights will improve security of personnel during the commute, as well as improving site safety and security for personnel evacuation from site if required.

A conceptual design for a site airstrip was completed by Knight Piésold. The detailed design of the site airstrip should be completed once a suitable location is confirmed. The airstrip was designed using Australian Civil Aviation Safety Authority (CASA) guidelines as a guide (Ref 1), and has been approved by Authorite Nationale De L'Aviation Civile de Cote d'Ivoire (ANAC). The prevailing wind direction of the Ity project site is NW to SE (Ref 2). The airstrip will be orientated similarly to ensure optimal operability. In addition, site investigation of the proposed airstrip should be completed during the detailed design phase (once a suitable location is confirmed).

The conceptual airstrip design is summarised as follows:

- The runway running surface is 1,500 m long and 23 m wide. The surrounding runway strip is 90 m wide.
- The airstrip design was completed using a Beechcraft 1900D and King Air 350 as the design aircraft.
- It is likely that cut and fill operations will be required to achieve a design compliant with the CASA guidelines, in particular to achieve required longitudinal profiles.
- Localised widening at the ends of the runway running surface were included in the design, as the design aircrafts cannot turn around within the design runway width.
- The aircraft trafficked pavement design (runway, taxiway and apron) comprises two pavement layers constructed over a prepared sub-grade. In order of foundation to surface.
- External to the trafficked areas, the in situ material will be graded to line and level, and proof rolled.

References

Civil Aviation Safety Authority (Australian Government) (November, 2013), Manual of Standards Part 139 – Aerodromes Version 1.11, November 2013.

SNC Lavalin (July, 2015), Feasibility Study Site Hydrology Design Bases and Design Criteria Report, Report Ref. 628121-0000-4HER-0001.

7.6.4 Power Supply and Distribution

Power Supply

ECG Engineering (ECG) has been engaged by Endeavour to investigate power supply options for the CIL Project. While a grid connected 6.6 kV power supply currently connects the existing site HL operations to the grid, this will not be adequate to supply the CIL plant power requirements of 26 MW.

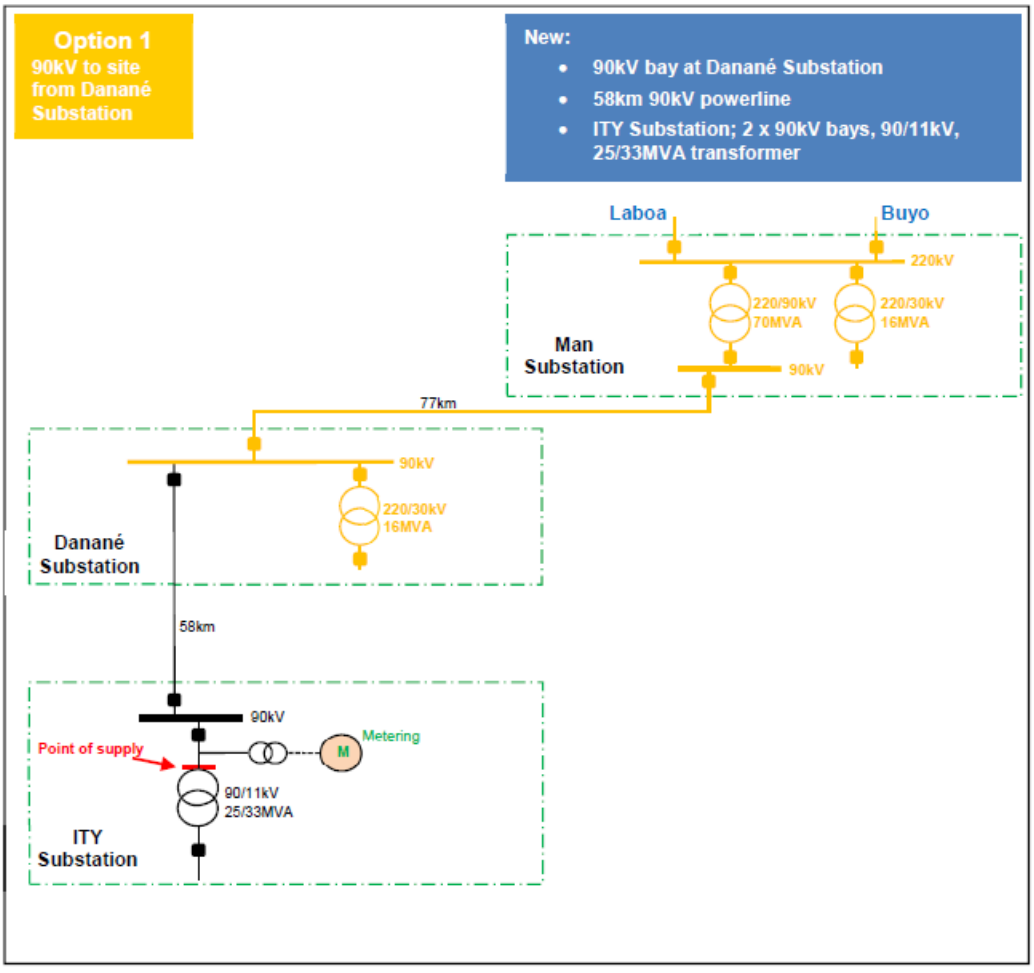
Power for the CIL Project will be supplied via a connection to the national grid at Danané, approximately 58 km from the Project site. La Société des Energies de Côte d'Ivoire (CI-ENERGIES) owns the National Interconnected Transmission System (ITS) in Côte d'Ivoire, and Compagnie Ivoiriennne d'Electricite (CIE) manages the electricity generation and transmission network for the Government.

The project will require the following:

- Extension of the Danané Substation by extending the existing 90 kV bus and addition of a 90 kV transmission line feeder.
- Construction of 58 km of 90 kV single circuit lattice tower transmission line.
- Construction of a substation at ITY site which will be owned and operated by CIE.
- The Project would take a 90 kV tariff metered feeder, install a 90 / 11 kV transformer in the CIE substation and provide an 11 kV feeder to the Plant Main 11 kV Switchboard.

The grid connection diagram is shown in Figure 7.6.1.

Figure 7.6.1 Project Connection to National Grid



7.6.5 Potable Water

The overall site water balance is described in Knight Piésold Report (PE17-00579).

The potable water demand for the Project has been calculated on a per capita usage basis and is summarised in Table 7.6.1 below.

Table 7.6.1 Potable Water Demand

Area	No. of Personnel	Usage (L/person/day)	Demand (m^3/day)
Accommodation Camp	200	300	60
Plant	243	70	17
Other	187	70	13
Total			**90**

Raw water will be sourced from dewatering bores around the site and pumped to a raw water storage tank located adjacent to the potable water treatment facility at the process plant.

A vendor package modular potable water treatment plant including filtration, ultra-violet sterilisation and chlorination will be installed. Potable water will be stored in the plant potable water tank and will be reticulated to the plant buildings, site ablutions, safety showers and other potable water outlets.

Potable water for the accommodation camp will be pumped from the water treatment plant at the plant site to a water storage tank at the camp. The tank will provide two-day reserve storage in the event of supply line disruptions. Water will be delivered into the camp reticulation system using a constant pressure variable flow pump system. The pump skid will include a UV disinfection unit to provide additional security against contamination.

7.6.6 Sewage

Effluent from all water fixtures in the process plant, mine services area and accommodation camp will drain to gravity sewerage systems. The gravity sewerage system for each area will drain to a sewer pump station from where it will discharge via a pressure main to a vendor package sewage treatment plant system located at the process plant.

Treated effluent will be discharged into leach drains or the plant tails hopper. Treatment plant sludge will be suitable for direct landfill burial in unlined pits.

7.6.7 Tailing Pipelines

The overland HDPE tailings pipelines to and from the TSF will be placed in a lined trench. On sections where these pipes cross under the roads, they will be encased within larger pipes.

7.6.8 Diesel Pipelines

All diesel pipelines will be laid on a sand base and wrapped in denso wrap type material for corrosion protection, sealing and water proofing of the pipelines.

7.6.9 Solid and Hydrocarbon Wastes

Wastes will be sorted and reused or recycled as far as the limited access to recycling facilities allows.

Waste lubricating oils will be returned to the supplier for recycling.

General solid wastes will be deposited into a landfill at the toe of the mine waste dump and promptly covered to deter vermin and scavengers.

Materials such as cyanide packaging will be decontaminated and buried, under supervision, on site beneath mine waste to prevent unauthorised use.

7.6.10 Communication System Infrastructure

Internal communications and IT services will be via a site wide fibre optic network.

One of the local mobile phone providers will be contracted to install facilities on site and provide a link into the local, national and international telecommunication network.

A radio network will be established with dedicated operational, security and emergency channels to cover the line, process plant and infrastructure services.

A local ground station will be installed to provide global satellite voice and data connection.

7.6.11 Fuel Supply

To minimise site works, fuel storage will comprise a vendor supplied package of two 12,000 m^3 double skinned self-bunded fuel storage tanks and pump skids to be located at the MSA. This provides sufficient fuel for the needs of the mining fleet and emergency power for three months if there is any disruption of fuel supply. The requirement to store fuel for the mining fleet is, however, dependent on the final contractual arrangements with the mining contractor.

7.6.12 Explosive Storage and Handling

An emulsion plant for mixing and storage of ANFO (ammonium nitrate / fuel oil) will be established by contract with a reputable supplier. This cost has been included in the explosive supply cost in the operating cost estimate. The facility will be located south of the mine services area and accessed by an unsealed road. The facility will be fully fenced and will include monitored electronic security.

A high explosive magazine will be built and located separately. This will store high explosives and detonators and will include a blast berm and will be fully fenced.

7.6.13 Security and Fencing

Site security is based on concentric lines of fencing / control.

The main point of entry will be where the main access road enters the site. This point of entry will be provided with a gate and manned security post.

Main facilities within the site will be enclosed by a further line of patrolled fencing with manned access control points. Entry into the administration accommodation and similar areas will require a mine identity card and/or proof of legitimate business beyond that point.

The process plant itself will be enclosed by a double line of security fencing monitored by closed circuit cameras. Entry will be via a single monitored security post and will be strictly controlled. Exit from the plant area will be subject to a search of vehicles, toolboxes and 'pat down' and/or metal detector search of all persons.

Access to the goldroom within the plant will be restricted and strictly controlled. Extensive camera surveillance will be installed and all personnel allowed into the area will be accompanied and monitored by members of the security team. Persons leaving the area will be subject to a comprehensive search of themselves and any tools or equipment leaving the building.

7.6.14 Site Buildings

Site buildings will be 'fit for purpose' industrial type structures. The workshop and warehouse will be constructed of a concrete slab on ground with structural steel frame and metal cladding. Offices and amenity buildings will be prefabricated structures.

The following facilities will be located in fenced areas outside the secure process plant area:

- Gatehouse with turnstile and entry boom gate control.
- Main administration building.
- First aid / medical clinic.
- Administration junior staff mess.
- Warehouse and stores.
- Contract laboratory.
- Emergency power generators.
- Transformer / switchyard.
- Fuel storage facility.
- Mine services area.

- Emulsion plant.

The following buildings will be located inside the process plant high security area:

- Security access building and change room including laundry.
- Plant offices, training room, junior staff mess and ablutions.
- Plant workshop including small store, welding bay and overhead crane.
- Engineering offices and ablutions.
- Reagent storage area.
- Goldroom.

7.7 Workforce Accommodation

7.7.1 Permanent Accommodation Camp

The 200 bed accommodation camp will be located approximately 300 m north of the main administration building and will provide accommodation for salaried and security staff not originating from the local area.

The camp buildings will be constructed from blockwork and will consist of the following:

- Eight management units – two blocks of four units.
- 152 accommodation units – nineteen blocks of eight units.
- 40 man fully furnished containerised units – relocated from construction camp.
- Dry mess with food storage and preparation, kitchen and dining facilities and camp administration office.
- Wet mess with a bar, TV area and store room.
- Combined laundry building / gymnasium incorporating ablution facilities for camp staff.

Costing has been based on the already built camp facilities at Endeavour's Houndé site.

7.7.2 Temporary Construction Accommodation

The existing operations camp supplemented with containerised accommodation units will be used for pioneer accommodation pending early completion of the new permanent camp. These containerised units will be moved to the permanent camp once is it operational.

The permanent camp will then be used for Endeavour and EPCM contractor staff with any surplus capacity made available to senior contractor personnel if available.

Contractors will be required to provide their own accommodation for their construction workforce. An area will be set aside for temporary contractor camps adjacent to the construction site. Alternatively, some contractors may choose to source temporary accommodation in nearby towns and villages.

APPENDIX 7.1

GENERAL ARRANGEMENT DRAWINGS

APPENDIX 7.2

MECHANICAL EQUIPMENT LIST

Table of Contents

			Page
8.0	**INFRASTRUCTURE**		**8.1**
	8.1	Introduction	8.1
	8.2	Tailings Storage Facility	8.3
	8.3	Surface Water Management Structures	8.6
	8.4	Site Airstrip	8.6
	8.5	Pit Dewatering System	8.7

TABLES

Table 8.2.1	TSF Design Parameters	8.4
Table 8.4.1	Site Airstrip Design Parameters	8.7
Table 8.5.1	Number of Pit Dewatering Bores	8.8
Table 8.5.2	Scenario 1 - Dewatering Bore Schedule	8.8
Table 8.5.3	Scenario 2 - Dewatering Bore Schedule	8.8
Table 8.5.4	Scenario 3 - Dewatering Bore Schedule	8.9
Table 8.5.5	Pit Dewatering - Annual Capital Costs	8.9
Table 8.5.6	Staged Construction Quantities	8.10
Table 8.5.7	Diversion Channels DC2 and DC3 - Construction Quantities	8.12
Table 8.5.8	Bridge Crossings - Construction Quantities	8.13
Table 8.5.9	Pit Protection Bunds - Construction Quantities	8.14

FIGURES

Figure 8.1.1	Ity Site Layout	8.2

8.0 INFRASTRUCTURE

8.1 Introduction

This section summarises the design modifications from the Feasibility Study (FS), KP Report Ref. PE301-00505/02 (Rev B, November 2016), incorporated into the recent capital cost estimate.

The following infrastructure design has been modified from the FS:

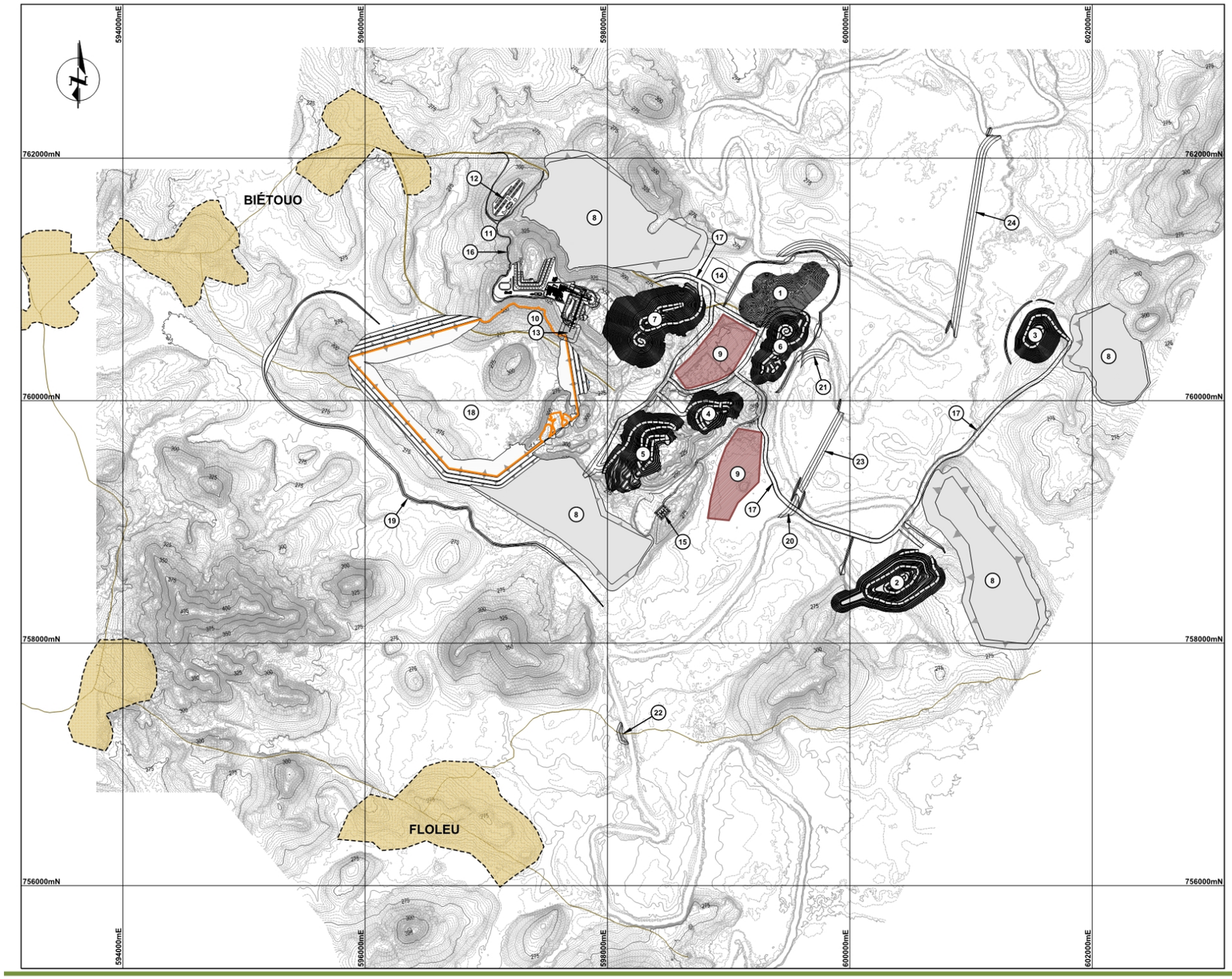
- Tailings Storage Facility (TSF).
- Site surface water management structures.
- Site airstrip.
- Pit dewatering system.

The following infrastructure (within the KP design scope) has not been modified for this exercise as any changes were agreed with Endeavour to have only minor cost implications:

- Site haul roads.
- Site access roads.

The design modifications are outlined in the following sections. The updated site layout is shown on Figure 8.1.1.

Figure 8.1.1 Ity Site Layout



NOTES:

1. 1m CONTOUR INTERVAL SHOWN TOPOGRAPHY DATA PROVIDED BY ENDEAVOUR, JANUARY 2016,
2. FINAL TAILINGS STORAGE FACILITY EMBANKMENTS SHOWN.
3. CIL PIT LAYOUTS SHOWN. RECEIVED MAY, 2017.
4. WASTE DUMPS PROVIDED BY MINING SOLUTIONS, SEPTEMBER 2016.
5. PLANT SITE, ROM PAD AND SITE ROAD LAYOUT PROVIDED BY LYCOPODIUM, AUGUST 2017.
6. EXISTING ROADS AND VILLAGE EXTENTS ESTIMATED BY KNIGHT PIESOLD BASED ON AERIAL TOPOGRAPHY.
7. LOCATION OF AIRSTRIP TO BE ADVISED.

KEY:

1. BAKATOUO PIT
2. DAAPLEU PIT
3. GBEITOU PIT
4. ITY FLAT PIT
5. MONT ITY PIT
6. WALTER PIT
7. ZIA PIT
8. WASTE DUMP
9. STOCKPILE
10. PLANT SITE
11. ADMINISTRATION BUILDINGS
12. CAMP
13. ROM PAD
14. MINE SERVICES & FUEL STORAGE AREA
15. EMULSIONS COMPOUND
16. SITE ACCESS ROAD
17. HAUL ROAD
18. TAILINGS STORAGE FACILITY
19. TSF DIVERSION CHANNEL
20. DAAPLEU RIVER DIVERSION
21. WALTER RIVER DIVERSION
22. COMMUNITY RIVER CROSSING
23. DIVERSION CHANNEL DC2
24. DIVERSION CHANNEL DC3
25. AIRSTRIP LOCATION (SEE NOTE 7)

600 400 200 0 400 800 1200
SCALE (METRES) 1:30,000 (A3)

Knight Piésold CONSULTING

ITY GOLD PROJECT
SITE LAYOUT UPDATE
GENERAL ARRANGEMENT PLAN

Ref: PE301-00505 2017-08-31
Figure 1

8.2 Tailings Storage Facility

The key modifications to the TSF design are summarised as follows:

- Annual throughput increased to 4 Mtpa (previously 3 Mtpa). The TSF embankments were adjusted to provide a greater TSF basin area to allow a greater drying area for the deposited tailings (and thus improve density) to occur for the greater throughput, within the same general site location as the FS design.

- The modified embankment alignments resulted in an increased length (and therefore excavation volume) of the TSF Upstream Diversion Channel.

- TSF basin liner system was modified to a full HDPE geomembrane liner (previously unlined without significant basin preparation). The basin works required to achieve a full basin HDPE liner are summarised below:

  - The full TSF basin area will be cleared, grubbed and topsoil stripped.

  - All organic and saturated material will be removed from the TSF basin to provide a suitable subgrade for HDPE liner installation. This is anticipated to be a significant excavation volume within the low-lying areas of the TSF basin (existing river plain). The estimated average depth of material removal over the river plain is 1 m, based on previous project experience with similar climatic conditions in West Africa.

  - A compacted soil liner will be prepared to act as a HDPE subgrade material. Where suitable, this will comprise scarified (depth 300 mm), moisture conditioned and compacted basin material. Where unsuitable (due to the presence of gravelly or abrasive materials), a 300 mm layer of Zone A fill will be imported to form the HDPE subgrade.

  - The HDPE (1.5 mm smooth) geomembrane liner will be installed over the compacted soil liner.

  - The TSF embankment upstream faces were modified to 3H:1V to facilitate safe installation of HDPE geomembrane liner on the embankment face.

  - A leakage collection and recovery system (LCRS) was added to the TSF design, comprising a network of drains (in the natural drainage courses within the TSF basin) and collection sump beneath the basin HDPE liner. This also aids groundwater management during construction and HDPE liner installation.

Revised TSF design parameters are provided in Table 8.2.1. Parameters modified from the FS are shown in bold red text.

Table 8.2.1 TSF Design Parameters

TSF Design	
Throughput	**4.0 Mtpa**
Storage Capacity	
- Stage 1	**6.67 Mt (20 months)**
- Final	57.0 Mt (15 years)
Embankment Freeboard	Greater of: (i) 0.5 m above maximum tailings elevation, or (ii) 1.0 m above maximum design stormwater elevation
Stormwater Capacity	
- Short duration	1 in 100 year recurrence interval, 72 hour duration storm event superimposed over average conditions operating pond volume
- Long duration	1 in 100 year recurrence interval, wet annual rainfall sequence
Spillway	
- Intermediate Stages	1 in 100 year recurrence interval storm event, (critical duration) occurring when supernatant pond is at spillway inlet level.
- Final Stage (closure)	Probable Maximum Flood (PMF) storm event.
Earthquake Loading	
- Operating	Operating Basis Earthquake (OBE)
- Final	Maximum Design Earthquake (MDE)
Factors of Safety (target values)	
- Static (Operation)	1.3
- Seismic (OBE)	1.1
- Static (Closure)	1.5
- Seismic (MDE)	1.1
TSF Construction	
TSF Embankment	
- Crest Width	6 m
- Upstream Slope	**3.0 H:1V**
- Downstream Slope (Intermediate)	2.75H:1V
- Downstream Slope (Closure)	3.5H:1V (overall)
Construction Description	
- Cut-off Trench	Upstream toe cut-off through residual/transported material.
- Embankment	Multi-zoned earth fill embankment, upstream low permeability zone.
- Embankment raises	Downstream raise construction methods.
- TSF basin	**Full basin cleared, grubbed and topsoil stripped, all unsuitable material removed from basin.**

Table 8.2.1 TSF Design Parameters (continued)

TSF Construction	
Construction Description **- Basin Liner** - Underdrainage **- LCRS** - Decant	 **Compacted soil liner, overlain by HDPE geomembrane liner over entire TSF basin area (including embankment face).** System of finger and collector drains within low lying areas of the TSF basin. **Leakage collection and recovery system (LCRS) installed beneath basin liner.** Slotted concrete tower sections, surrounded by clean, coarse rockfill. Series of towers to accommodate pond migration throughout operation.
TSF Operation	
Slurry Characteristics	50% solids by weight. Stage 1 in situ density = 1.10 t/m^3 Final in situ density = 1.30 t/m^3 Tailings beach slope = 100H:1V
Fluid Management	Basin underdrainage system gravity feeds into collection sump(s). Return to supernatant pond via submersible pump*1. Decant tower system for removal of supernatant solution. Return to the plant via submersible pump*1.
General	Upstream spigot deposition of tailings from embankment crest and TSF southern perimeter. The supernatant pond is to be maintained at the decant tower location, remote (where possible) from the embankments.
TSF Rehabilitation	
Final Embankment Slopes	External to waste dump - 3.5H:1V (overall), with 5 m horizontal benches at 10 m height increments.
Cover Profile	Generally shaped to achieve dry closure with no ponding (water shedding).
Capping	Low permeability mine waste (nominal 0.3 m thickness), covered with topsoil (0.2 m), re-vegetation.
Closure Spillway	Probable Maximum Flood (PMF) storm event.

*1 – Design by others.

The revised TSF staged construction quantities are provided in Table 8.5.6.

8.3 Surface Water Management Structures

The revised site water management structures are shown on Figure 1 (refer site general arrangement). The modifications to the site water management structures are summarised as follows:

- The Cavally River Crossing (primary haul road and service corridor crossing, of width 20 m) was changed to a concrete bridge structure for ease of construction, based on preliminary discussions with Endeavour.

- The Community River Crossing was added south of the project site (as shown on Figure 1), comprising a concrete bridge structure (5 m top width). The Community River Crossing was designed to the same flood criteria as the Cavally River crossing, the 1 in 100 year recurrence interval flood elevation plus freeboard. The bridge span and channel width was maintained from the Cavally River crossing.

- Diversion Channel DC2 was added to the project infrastructure, with a view to increasing the clearance between the project area and the Cavally River in times of low flow. It should be noted that the diversion channel was designed as a low flow channel only, in that it's dimension matches the defined river channel only and does not contain the larger flood plain. Full containment of flood flows would require construction of a flood levee on at least one side of the diversion channel, and bridge crossing elevations would need to be reviewed.

- Diversion Channel DC3 was added to the project infrastructure, with a view to diverting the Cavally River to avoid the future Bakatouo pit. It should be noted that the diversion channel was designed as a low flow channel only, in that it's dimension matches the defined river channel only and does not contain the larger flood plain. Full containment of flood flows would require construction of a flood levee on at least one side of the diversion channel, and bridge crossing elevations would need to be reviewed.

- Pit protection bund (alignments shown on Figure 1) crest elevations were updated based on the revised flood modelling.

The revised surface water management construction quantities are provided in Table 8.5.6, Table 8.5.7 and Table 8.5.8.

8.4 Site Airstrip

The Site Airstrip design was reviewed based on the site location nominated by Endeavour. The site airstrip conceptual design is documented in Memorandum Ref. PE17-00705 (15 August 2017), with the final location to be selected. As the detailed airstrip design is not yet completed, the capital cost estimate from the FS was maintained for the current estimate.

Key design parameters for the site airstrip are provided in Table 8.4.1. The required runway running surface for a Type 1B aircraft is 800 m long and 18 m wide, however Endeavour may elect to maintain a 1,500 m long by 23 m wide runway to ensure operational flexibility.

Table 8.4.1 Site Airstrip Design Parameters

Design Parameter	Value
Design Aircraft	King Air 350 and Beechcraft 1900D
Runway Length	≥ 1500 m
Runway Width	≥ 23 m
Runway Longitudinal Slope	≤ 2.0%
Runway Traverse Slope	1.5 - 2.5%
Runway Strip Width	≥ 90 m
Runway Strip Traverse Slope	≤ 3.0%
Clearway Length	≥ 80 m
Taxiway Width	≥ 10.5 m
Taxiway Strip Width	≥ 43 m
Taxiway Longitudinal Slope	≤ 3.0%
Wheel Distance to Runway Edge (taxiing)	≥ 2.25 m
Turning Radius (turnaround)	≥ 10.26 m
Turning Radius (≤ 24 km/h)	≥ 35.0 m

8.5 Pit Dewatering System

The pit dewatering requirements were reviewed based on the initial investigation findings. The groundwater modelling and recommendations are documented in Memorandum Ref. PE17-00519 (30 June 2017).

The objectives of the groundwater modelling were to:

- Update the existing numerical groundwater model with local scale geology.
- Recalibrate the model with abstraction and monitoring data from 1 January 2013 to August 2016.
- Incorporate the latest pumping test analyses from BBH3, BBH4 and IBH3.
- Incorporate the latest pit shells including cutbacks in Ity and Daapleu pits.
- Predict inflows to each pit based on the latest mine schedule.
- Predict the number of dewatering bores required to achieve drier mining condition for the life of the mine.
- Propose potential dewatering bore locations.

The complexities of the fractured flow systems meant that the number of dewatering bores required cannot be accurately determined, as it depends on the actual bore yield when drilled. As an indication of the number of bores an estimate based on historical abstraction rates was used. Bore yield of 500 kL/day was assumed for all bores except Mont Ity bores where the fractured rock has shown to have higher yield. A bore yield of 1,000kL/day was assumed for Mont Ity bores.

Three scenarios were evaluated:

- Scenario 1 Current diversion arrangement
- Scenario 2 S1 plus additional diversion adjacent to Walter Pit (DC2).
- Scenario 3 S2 plus major diversion adjacent to Bakatouo Pit (DC3).

The maximum number of bores in each pit for each scenario is provided in Table 8.5.1, and the number of bores required for each year is provided in Table 8.5.2 to Table 8.5.4.

Table 8.5.1 Number of Pit Dewatering Bores

Scenario	Bakatouo (500kL/d)	Daapleu (500kL/d)	Ity Flat (500kL/d)	Mont Ity (1,00kL/d)	Gbeitouo (500kL/d)	Walter (500kL/d)	Zie NE (500kL/d)
1	15	12	0	6	4	15	11
2	11	3	0	6	4	4	10
3	5	3	0	5	4	2	7

Table 8.5.2 Scenario 1 - Dewatering Bore Schedule

Year	Bakatouo (500kL/d)	Daapleu (500kL/d)	Ity Flat (500kL/d)	Mont Ity (1,00kL/d)	Gbeitouo (500kL/d)	Walter (500kL/d)	Zie NE (500kL/d)	Total
2018	10	2	0	0	0	0	0	12
2019	15	4	0	0	0	0	0	19
2020	15	9	0	3	0	0	0	27
2021	15	10	0	3	1	0	0	29
2022		11	0	5	2	10	0	28
2023		12	0	6	4	15	0	37
2024		12	0		4	15	0	31
2025			0				4	4
2026			0				11	11
2027			0				19	19

Table 8.5.3 Scenario 2 - Dewatering Bore Schedule

Year	Bakatouo (500kL/d)	Daapleu (500kL/d)	Ity Flat (500kL/d)	Mont Ity (1,00kL/d)	Gbeitouo (500kL/d)	Walter (500kL/d)	Zie NE (500kL/d)	Total
2018	7	1	0	0	0	0	0	8
2019	10	2	0	0	0	0	0	12
2020	11	3	0	3	0	0	0	17
2021	10	3	0	3	1	0	0	17
2022		2	0	5	2	0	0	9
2023		3	0	6	4	2	0	15
2024		3	0		3	4	0	10
2025			0				4	4
2026			0				10	10
2027			0				9	9

Table 8.5.4 Scenario 3 - Dewatering Bore Schedule

Year	Bakatouo (500kL/d)	Daapleu (500kL/d)	Ity Flat (500kL/d)	Mont Ity (1,00kL/d)	Gbeitouo (500kL/d)	Walter (500kL/d)	Zie NE (500kL/d)	Total
2018	2	1	0	0	0	0	0	3
2019	4	2	0	0	0	0	0	6
2020	5	3	0	3	0	0	0	11
2021	4	3	0	3	1	0	0	11
2022		2	0	5	2	0	0	9
2023		3	0	5	4	0	0	12
2024		3	0		4	2	0	9
2025			0				0	0
2026			0				7	7
2027			0				6	6

Based on the sequence of construction the annual capital costs for the boreholes are summarised in Table 8.5.5. It should be noted that these capital estimates are for construction of the boreholes only (i.e. pumps, pipes, power and civil infrastructure are excluded).

Table 8.5.5 Pit Dewatering - Annual Capital Costs

Year	Scenario 1	Scenario 2	Scenario 3
2018	450,000	300,000	113,000
2019	263,000	150,000	113,000
2020	300,000	188,000	188,000
2021	75,000	38,000	38,000
2022	525,000	113,000	113,000
2023	338,000	188,000	75,000
2024	-	75,000	75,000
2025	150,000	150,000	-
2026	263,000	225,000	263,000
2027	-	-	-
Total	2,364,000	1,427,000	978,000

The key issue is to select the timing of the additional diversion works. Based on these cost summaries the additional diversion works should be constructed upfront. If the additional diversion works cannot be constructed upfront then a suggested sequence is highlighted in Table 8.5.5 and summarised below:

- Scenario 1 2018
- Scenario 2 2019
- Scenario 3 2023 onwards

Table 8.5.6 Staged Construction Quantities

Item	Description	Unit	Rate	Stage 1 - RL271.6 m	Stage 2 - RL275.1 m	Stage 3 - RL278.1 m	Stage 4 - RL280.8 m	Stage 5 - RL283.3 m	Stage 6 - RL285.7 m	Stage 7 - RL288.0 m	Stage 8 - RL290.2 m	Stage 9 - RL292.4 m	Stage 10 - RL294.5 m	Stage 11 - RL296.9 m	CLOSURE
				Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity
0	**MATERIAL SUPPLY**														
	Material Supply														
0.1	Supply suitable Zone E erosion protection material to stockpile	m3		13,000	200	200	200	200	200	200	200	200	200	200	1,300
0.2	Supply suitable Zone F erosion protection material to stockpile	m3		9,500	100	100	100	100	100	100	100	100	100	100	0
0.3	Supply suitable Zone G erosion protection material to stockpile	m3		2,200	2,300	1,000	2,100	2,500	1,000	1,700	1,500	1,000	1,000	1,000	0
0.4	Supply Bidim A24 Geotextile	m2		90,700	300	300	300	200	200	200	200	200	200	200	0
0.5	Supply 160 mm draincoil (with filter sock)	m		7,420	50	50	50	40	40	40	40	40	40	30	0
0.6	Supply 100 mm draincoil (with filter sock)	m		6,200	0	0	0	0	0	0	0	0	0	0	0
0.7	Supply 63 mm draincoil (with filter sock)	m		6,200	0	0	0	0	0	0	0	0	0	0	0
0.8	Supply 1.5 mm (60 mil) smooth HDPE geomembrane	m2		1,007,000	166,000	135,000	121,000	100,000	84,000	78,000	69,000	64,000	68,000	74,000	0
	Sub Total														
1	**SITE PREPARATION**														
	Site Preparation														
1.1	Clear and grub embankment footprints, haul vegetation to designated stockpile	m2		55,000	25,000	29,000	33,000	35,000	35,000	36,000	35,000	39,000	33,000	95,000	0
1.2	Clear and grub area of TSF basin, haul vegetation to designated stockpile	m2		893,000	130,000	108,000	81,000	65,000	44,000	42,000	36,000	35,000	28,000	42,000	0
1.3	Clear and grub TSF emergency spillway footprint, haul to designated stockpile	m2		2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	0
1.4	Strip topsoil from embankment footprints, haul to designated stockpile	m3		9,000	4,000	5,000	5,000	6,000	6,000	6,000	6,000	6,000	5,000	15,000	0
1.5	Strip topsoil from TSF basin area, haul to designated stockpile	m3		134,000	20,000	17,000	13,000	10,000	7,000	7,000	6,000	6,000	5,000	7,000	0
1.6	Strip topsoil (200 mm) from TSF emergency spillway footprint, haul to designated stockpile	m3		400	400	400	400	400	400	400	400	400	400	400	0
1.7	Excavate unsuitable material from the TSF embankment footprints and basin, haul to designated stockpile (nominal allowance)	m3		558,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	14,000	28,000	0
	Stockpiles & Borrow Areas														
1.8	Clear and grub designated stockpiles, push material to perimeter (2m high)	m2		367,000	23,000	21,000	25,000	20,000	18,000	19,000	19,000	19,000	18,000	37,000	0
1.9	Clear and grub designated borrow areas, push material to perimeter (1.5m deep)	m2		31,000	18,000	20,000	74,000	28,000	32,000	36,000	40,000	42,000	46,000	102,000	20,000
1.10	Strip topsoil from borrow areas, haul to designated stockpiles	m3		7,000	4,000	4,000	15,000	6,000	7,000	8,000	8,000	9,000	10,000	21,000	4,000
	Sub Total														
2	**TSF EMBANKMENT CONSTRUCTION**														
2.1	Excavate embankment cut off trench, haul and place in Zone C material of embankment or designated stockpile	m3		29,000	4,000	6,000	6,000	5,000	2,000	2,000	2,000	2,000	1,000	1,000	0
2.2	Scarify, condition and compact in-situ subgrade in cutoff trench (to 300 mm) prior to fill placement	m2		5,600	1,300	1,900	2,000	1,700	500	500	600	500	200	300	0
2.3	Extra over for breaking hard rock material (nominal allowance)	m3		900	200	300	300	300	100	100	100	100	100	100	0
2.4	Win from borrow, load, haul, place, spread, condition and compact Zone A material in cutoff trench	m3		35,500	5,500	8,200	8,300	7,000	2,600	2,600	2,700	2,600	1,300	1,400	0
2.5	Scarify, condition and compact suitable insitu subgrade (200 mm depth) within embankment footprint area	m2		44,000	23,000	26,000	30,000	32,000	35,000	36,000	34,000	39,000	33,000	95,000	0
2.6	Win from borrow, load, haul, place, spread, condition and compact Zone A material in embankments	m3		70,000	45,000	37,000	165,000	44,000	46,000	46,000	45,000	46,000	45,000	53,000	0
2.7	Win from borrow, load, haul, place, spread, condition and compact Zone C material in embankments	m3		196,000	203,000	245,000	924,000	351,000	417,000	480,000	534,000	561,000	621,000	1,463,000	0
2.8	Install 1.5 mm (60 mil) smooth HDPE geomembrane to upstream embankment slope (including anchor trench backfill and excavation)	m2		21,000	19,000	14,000	27,000	24,000	30,000	27,000	25,000	22,000	32,000	24,000	0
2.9	Remove wearing course and safety bund from previous crest, place, spread, condition and compact in Zone C embankment	m3		0	1,900	2,200	2,800	3,500	4,100	4,300	4,400	4,600	4,600	4,700	0
2.10	Win from borrow, load, haul, place, spread, condition and compact wearing course on embankment crest	m3		1,300	1,500	1,900	2,400	2,800	2,900	3,000	3,100	3,100	3,200	3,200	0
2.11	Win from borrow, load, haul, place, spread and shape Zone D safety bund on embankment crest	m3		600	700	900	1,100	1,300	1,400	1,400	1,500	1,500	1,500	1,500	0
	Sub Total														
3	**UNDERDRAINAGE RETURN SYSTEM**														
	Soil Liner Construction														
3.1	Scarify, condition and compact suitable insitu subgrade (300 mm depth) as low permeability soil liner	m2		413,000	117,000	98,000	73,000	59,000	40,000	38,000	33,000	32,000	26,000	38,000	0
3.2	Install 1.5 mm (60 mil) smooth HDPE geomembrane to TSF basin (including anchor trench backfill and excavation)	m2		893,000	130,000	108,000	81,000	65,000	44,000	42,000	36,000	35,000	28,000	42,000	0
3.30	Win from borrow, load, haul, place, spread, condition and compact Zone A material (300mm depth) as low permeability soil liner	m3		144,000	3,900	3,300	2,500	2,000	1,400	1,300	1,100	1,100	900	1,300	0
	Upstream Toe Drain														
3.4	Install 160mm draincoil with all tees, bends and joints complete in toe drain	lin m		1,220	50	50	50	40	40	40	40	40	40	30	0
3.5	Install A24 Bidim geotextile in toe drain	m2		4,450	200	200	200	160	160	160	160	160	160	120	0
3.6	Win from supplied stockpile, load, haul, place and spread Zone F drainage material in toe drain	m3		350	20	20	20	20	20	20	20	20	20	10	0
	Finger Drains														
3.7	Excavate and shape trench for finger drains, shape and compact as protection bund	m3		1,400	0	0	0	0	0	0	0	0	0	0	0
3.8	Install A24 Bidim geotextile in finger drain	m2		21,500	0	0	0	0	0	0	0	0	0	0	0
3.9	Install 63mm draincoil with all tees, bends and joints complete in finger drains	lin m		6,200	0	0	0	0	0	0	0	0	0	0	0
3.10	Win from supplied stockpile, load, haul, place and spread Zone F drainage material in finger drains	m3		1,400	0	0	0	0	0	0	0	0	0	0	0
	Main Collector Drain & Channel														
3.11	Excavate and shape trench for collector drains including LCRS drains, spread and compact to cap finger and collector drains	m3		17,900	0	0	0	0	0	0	0	0	0	0	0
3.12	Install A24 Bidim geotextile in LCRS drains	m2		23,000	0	0	0	0	0	0	0	0	0	0	0
3.13	Install 100mm draincoil groundwater drain, with all tees, bends and joints complete, in LCRS drains	lin m		6,200	0	0	0	0	0	0	0	0	0	0	0
3.15	Win from supplied stockpile, load, haul, place and spread Zone F drainage medium in LCRS drains	m3		4,400	0	0	0	0	0	0	0	0	0	0	0
3.16	Install A24 Bidim geotextile in collector drains	m2		32,500	0	0	0	0	0	0	0	0	0	0	0
3.17	Install 160mm draincoil with all tees, bends and joints complete and geotextile wrapped, in collector drains	lin m		6,200	0	0	0	0	0	0	0	0	0	0	0
3.18	Win from supplied stockpile, load, haul, place and spread Zone F drainage material in collector drain	m3		2,900	0	0	0	0	0	0	0	0	0	0	0
	Underdrainage Collection Sump														
3.19	Excavate and shape underdrainage collection sump, haul to designated stockpile	m3		190	0	0	0	0	0	0	0	0	0	0	0
3.20	Install A24 Bidim geotextile in underdrainage sump	m2		470	0	0	0	0	0	0	0	0	0	0	0
3.21	Win from supplied stockpile, load, haul, place and spread Zone F drainage material in sump	m3		190	0	0	0	0	0	0	0	0	0	0	0
	Underdrainage Riser Pipe														
3.22	Excavate and shape underdrainage riser channel, haul to designated stockpile	m3		18	5	4	4	4	4	3	3	3	3	4	0
3.23	Install 1.5 mm (60 mil) smooth HDPE geomembrane to riser channel as wearsheet	m2		30	7	6	5	5	5	5	4	4	4	5	0
3.24	Supply and install 450mm diameter HDPE underdrainage riser pipe (slotted), including all fittings	lin m		3	0	0	0	0	0	0	0	0	0	0	0
3.25	Supply and install 450mm diameter HDPE underdrainage riser pipe (solid), including all fittings	lin m		32	8	7	6	6	5	5	5	5	5	5	0
3.26	Supply and install cement stabilised backfill surrounding underdrainage riser pipe	m3		30	6	5	5	5	4	4	4	4	4	4	0
3.27	Supply and install submersible underdrainage pump (and associated infrastructure)	Item		1	1	1	1	1	1	1	1	1	1	1	0

Table 8.5.6 TSF – Staged Construction Quantities (continued)

Item	Description	Unit	Rate	Stage 1 - RL271.6 m	Stage 2 - RL275.1 m	Stage 3 - RL278.1 m	Stage 4 - RL280.8 m	Stage 5 - RL283.3 m	Stage 6 - RL285.7 m	Stage 7 - RL288.0 m	Stage 8 - RL290.2 m	Stage 9 - RL292.4 m	Stage 10 - RL294.5 m	Stage 11 - RL296.9 m	CLOSURE
				Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity	Quantity
	LCRS Collection Sump														
3.28	Excavate and shape ground water collection sump, haul to designated stockpile	m3		190	0	0	0	0	0	0	0	0	0	0	0
3.29	Win from borrow, load, haul, place, spread, condition and compact Zone A material (300 mm depth) in sump	m3		100	0	0	0	0	0	0	0	0	0	0	0
3.30	Install A24 Bidim geotextile in LCRS collection sump	m2		470	0	0	0	0	0	0	0	0	0	0	0
3.31	Win from supplied stockpile, load, haul, place and spread Zone F drainage material in sump	m3		190	0	0	0	0	0	0	0	0	0	0	0
	LCRS Riser Pipe														
3.32	Excavate and shape LCRS riser channel, haul to designated stockpile	m3		18	5	4	4	4	4	3	3	3	3	4	0
3.33	Install A24 Bidim geotextile in LCRS riser channel	m3		30	7	6	5	5	5	5	4	4	4	5	0
3.34	Supply and install 450mm diameter HDPE ground water riser pipe (slotted), including all fittings	lin m		3	0	0	0	0	0	0	0	0	0	0	0
3.35	Supply and install 450mm diameter HDPE ground water riser pipe (solid), including all fittings	lin m		32	8	7	6	6	5	5	5	5	5	5	0
3.36	Supply and install cement stabilised backfill surrounding ground water riser pipe	m3		30	6	5	5	5	4	4	4	4	4	4	0
3.37	Supply and install submersible ground water pump (and associated infrastructure)	Item		1	1	1	1	1	1	1	1	1	1	1	0
	Sub Total														
4	**DECANT RETURN SYSTEM**														
4.1	Excavate decant trench and sump bases, load, haul, place, spread, condition and compact in Zone C embankment	m3		13,700	0	0	0	0	0	0	0	0	0	0	0
4.2	Supply and install 25MPa reinforced concrete tower base for decant tower including foundation compaction, formwork and reinforcement	Item		2	1	0	1	0	0	1	0	0	0	0	0
4.3	Supply and install 1800 mm diameter slotted reinforced concrete pipe for decant tower	lin m		12	9	2	5	6	3	5	5	3	2	3	0
4.4	Win from supplied stockpile, load, haul and place Zone G material for surrounding decant tower	m3		2,200	2,300	1,000	2,100	2,500	1,000	1,700	1,500	1,000	1,000	1,000	0
4.5	Win from borrow, load, haul, place, spread, condition and compact Zone C in decant access causeway	m3		4,000	4,500	3,000	4,500	5,000	2,500	4,000	4,000	2,500	2,500	2,500	0
4.6	Win from borrow, load, haul, place, spread, condition and compact wearing course on decant access causeway	m3		180	90	90	90	90	90	90	90	90	90	90	0
4.7	Win from borrow, load, haul and place safety bund (Zone D) on decant access causeway	m3		90	50	50	50	50	50	50	50	50	50	50	0
4.8	Supply and install submersible decant pump (and associated infrastructure)	Item		2	1	0	1	0	0	1	0	0	0	0	0
4.9	Relocate and install decant pump associated infrastructure to subsequent stage's crest	Item		0	1	0	1	0	0	1	0	0	0	0	0
	Sub Total														
5	**EMERGENCY SPILLWAY**														
5.1	Excavate and shape emergency spillway, haul, spread, condition and compact as Zone C material in embankments	m3		1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	0
5.2	Scarify, condition and compact base of spillway channel (200 mm depth)	m2		720	720	720	720	720	720	720	720	720	720	720	0
5.3	Install Zone E erosion protection material to spillway channel base	m3		108	108	108	108	108	108	108	108	108	108	108	0
	Sub Total														
6	**MONITORING & INSTRUMENTATION**														
6.1	Install survey pins complete in TSF embankments	Item		5	6	8	9	11	11	11	12	12	12	12	0
6.2	Decommission standpipe piezometers in previous stage crest	Item		0	5	6	8	9	11	11	11	12	12	12	0
6.3	Install standpipe piezometers complete in TSF embankments	Item		5	6	8	9	11	11	11	12	12	12	12	0
6.4	Install monitoring bores complete (10 m average depth)	Item		2	0	0	0	0	0	0	0	0	0	0	0
6.5	Install monitoring bores complete (60 m average depth)	Item		2	0	0	0	0	0	0	0	0	0	0	0
	Sub Total														
7	**DEPOSITION**														
7.1	Supply and install reducing tees for spigot droppers	Item		100	11	19	20	17	5	4	4	2	3	4	0
7.2	Supply and install 150 mm water delivery hose for spigot droppers	lin m		100	11	19	20	17	5	4	4	2	3	4	0
7.3	Supply and install T-bolt clamp for spigot droppers	Item		100	11	19	20	17	5	4	4	2	3	4	0
7.4	Supply and install 225 mm diameter slotted uPVC pipe for spigot droppers	lin m		660	510	240	710	520	730	620	520	430	790	450	0
7.5	Supply and install spigot clamps	Item		100	11	19	20	17	5	4	4	2	3	4	0
7.6	Supply and install geomembrane wearsheet to embankment face at spigot offtake locations	m2		1,320	1,020	480	1,420	1,040	1,460	1,240	1,040	860	1,580	900	0
7.7	Supply and install decant water return pipeline	lin m		1,670	0	0	0	0	0	0	0	0	0	0	0
7.8	Supply and install tailings delivery pipeline	lin m		3,190	0	0	0	0	0	0	0	0	0	0	0
7.9	Supply and install tailings distribution pipeline	lin m		2,500	280	470	510	430	130	100	100	40	70	90	0
	Sub Total														
8	**TSF DIVERSION CHANNEL**														
	Diversion Channel														
8.1	Clear and grub diversion channel footprint, haul to designated stockpile	m2		142,000	0	0	0	0	0	0	0	0	0	0	0
8.2	Strip topsoil (200 mm) from diversion channel footprint, haul to designated stockpile	m3		28,400	0	0	0	0	0	0	0	0	0	0	0
8.3	Excavate and shape diversion channel, haul to stockpile	m3		604,000	0	0	0	0	0	0	0	0	0	0	0
8.4	Scarify, condition and compact base of diversion channel (200 mm depth)	m2		25,600	0	0	0	0	0	0	0	0	0	0	0
8.5	Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer in diversion channel	m3		12,800	0	0	0	0	0	0	0	0	0	0	0
	Sub Total														
9	**TSF REHABILITATION**														
	TSF Rehabilitation														
9.1	Win from borrow, load, haul, place, spread, condition and compact Zone A low permeability fill over tailings surface (300mm)	m3		0	0	0	0	0	0	0	0	0	0	0	290,100
9.2	Win from stockpile, load, haul, place and spread topsoil over tailings surface (200mm)	m3		0	0	0	0	0	0	0	0	0	0	0	58,020
9.3	Revegetate tailings surface (including hydroseeding, hand seeding, labour, etc)	m2		0	0	0	0	0	0	0	0	0	0	0	1,504,000
9.4	Win from stockpile, load, haul, place and spread topsoil over embankment downstream face (200mm)	m3		0	0	0	0	0	0	0	0	0	0	0	37,000
9.5	Revegetate embankment downstream surface (including hydroseeding, hand seeding, labour, etc)	m2		0	0	0	0	0	0	0	0	0	0	0	185,000
	TSF Closure Spillway														
9.6	Excavate and shape spillway, haul to designated stockpile	m3		0	0	0	0	0	0	0	0	0	0	0	5,700
9.7	Scarify, condition and compact base of spillway channel (200 mm)	m2		0	0	0	0	0	0	0	0	0	0	0	2,900
9.8	Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer in spillway	m3		0	0	0	0	0	0	0	0	0	0	0	1,300
9.9	Remove from existing emergency spillway inlet, load, haul, place and spread Zone E erosion protection layer in spillway inlet	m3		0	0	0	0	0	0	0	0	0	0	0	20
	Sub Total														

Table 8.5.7 Diversion Channels DC2 and DC3 - Construction Quantities

Item	Description	Unit	Rate	Qty
1	**SITE PREPARATION**			
1.1	**Site Preparation**			
1.1.1	Clear and grub channel footprints, haul to designated stockpile	m2		163,000
1.1.2	Clear and grub bund footprints, haul to designated stockpile	m2		11,400
1.1.3	Strip topsoil (200 mm) from channel footprints, haul to designated stockpile	m3		32,600
1.2	**Stockpiles & Borrow Areas**			
1.2.1	Clear designated stockpile areas, push material to perimeter	m2		245,000
1.2.2	Clear and grub designated borrow areas, push material to perimeter	m2		9,800
1.2.3	Strip topsoil from borrow areas, haul to designated stockpile (200mm)	m3		1,960
	Total Site Preparation			
2	**RIVER DIVERSION CONSTRUCTION**			
2.1	**Diversion Channel No. 2**			
2.1.1	Excavate channel, load and haul to stockpile	m3		255,000
2.1.2	Scarify, moisture condition and compact base of channel (200 mm depth)	m3		18,200
2.1.3	Win from borrow, load, haul, place, spread, moisture condition and compact general fill in Channel Diversion Bunds	m3		22,600
2.2	**Diversion Channel No. 3**			
2.2.1	Excavate channel, load and haul to stockpile	m3		692,000
2.2.2	Scarify, moisture condition and compact base of channel (200 mm depth)	m2		42,400
2.2.3	Win from borrow, load, haul, place, spread, moisture condition and compact general fill in Channel Diversion Bunds	m3		26,100
	Total River Diversion Construction			

Table 8.5.8 Bridge Crossings - Construction Quantities

Item	Description	Unit	Rate	Year 0	Year 4	Total
				Qty	Qty	Qty
0	**MATERIAL SUPPLY**					
0.1	**Material Supply**					
0.1.1	Supply Zone E material to stockpile	m3		3,100	13,780	16,880
0.1.2	Supply Reno mattress to stockpile	m3		440	0	440
0.1.3	Supply concrete including all reinforcement	m3		2,680	0	2,680
	Total Material Supply					
1	**SITE PREPARATION**					
1.1	**Site Preparation**					
1.1.1	Clear and grub footprint, haul to designated stockpile	m2		16,200	52,700	68,900
1.1.2	Strip topsoil (200 mm) from footprint, haul to designated stockpile	m3		3,250	10,540	13,790
1.1.3	Excavate unsuitable material in footprint, haul to designated stockpile (allowance)	m3		0	0	0
1.2	**Stockpiles & Borrow Areas**					
1.2.1	Clear designated stockpile areas, push material to perimeter	m2		11,000	11,000	22,000
	Total Site Preparation					
2	**RIVER DIVERSION CONSTRUCTION**					
2.1	**Walter Pit Diversion Construction**					
2.1.1	Excavate channel, load and haul to stockpile	m3		0	77,000	77,000
2.1.2	Scarify, moisture condition and compact base of channel (200 mm depth)	m3		0	6,160	6,160
2.1.3	Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer in channel	m3		0	3,180	3,180
2.2	**Daapleu Pit Diversion Construction**					
2.2.1	Excavate channel, load and haul to stockpile	m3		69,400	0	69,400
2.2.2	Scarify, moisture condition and compact base of channel (200 mm depth)	m2		5,280	0	5,280
2.2.3	Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer in channel	m3		3,100	0	3,100
2.2.4	Win from suppled stockpile, haul and place reno mattress in channel	m3		440	0	440
2.3	**Bakatouo Pit Diversion Construction**					
2.3.1	Excavate channel, load and haul to stockpile	m3		0	199,000	199,000
2.3.2	Scarify, moisture condition and compact base of channel (200 mm depth)	m2		0	18,000	18,000
2.3.3	Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer in channel	m3		0	10,600	10,600
	Total River Diversion Construction					
3	**BRIDGE CROSSING CONSTRUCTION**					
3.1	**Bridge Crossing Construction**					
3.1.1	Excavate to cantilevered retaining wall and pillar foundations, haul to fill areas, moisture condition and compact suitable material as general fill	m3		1,050	0	1,050
3.1.2	Excavate to cantilevered retaining wall and pillar foundations, haul to stockpile	m3		0	0	0
3.1.3	Construct piles, including hammering/boring, reinforcement, concrete and cap	lin m		240	0	240
3.1.4	Construct reinforced concrete cantilevered retaining wall structures as bridge abutments, including all formwork and falsework	m3		1,700	0	1,700
3.1.5	Construct reinforced concrete pillars and beams as bridge supports, including all formwork and falsework	m3		100	0	100
3.1.6	Win from borrow, load, haul, place, spread, moisture condition and compact suitable material as general fill	m3		8,620	0	8,620
3.1.7	Construct bridge structure	m2		1,000	0	1,000
3.2	**Village Bridge Crossing Construction**					
3.2.1	Excavate to cantilevered retaining wall and pillar foundations, haul to fill areas, moisture condition and compact suitable material as general fill	m3		800	0	800
3.2.2	Excavate to cantilevered retaining wall and pillar foundations, haul to stockpile	m3		0	0	0
3.2.3	Construct piles, including hammering/boring, reinforcement, concrete and cap	lin m		50	0	50
3.2.4	Construct reinforced concrete cantilevered retaining wall structures as bridge abutments, including all formwork and falsework	m3		600	0	600
3.2.5	Construct reinforced concrete pillars and beams as bridge supports, including all formwork and falsework	m3		50	0	50
3.2.6	Win from borrow, load, haul, place, spread, moisture condition and compact suitable material as general fill	m3		4,300	0	4,300
3.2.7	Construct bridge structure	m2		200	0	200
	Total River Diversion Construction					

Table 8.5.9 Pit Protection Bunds - Construction Quantities

Description	Unit	Rate	Year 0	Year 3	Year 4	Year 5	Total
			Qty	Qty	Qty	Qty	Qty
MATERIAL SUPPLY							
Material Supply							
Supply Zone E material to stockpile	m3		3,580	1,100	4,240	7,000	15,920
Total Material Supply							
SITE PREPARATION							
Site Preparation							
Clear and grub footprint, haul to designated stockpile	m2		20,800	11,200	33,700	35,500	101,200
Strip topsoil (200 mm) from footprint, haul to designated stockpile	m3		4,200	2,300	6,800	7,100	20,400
Excavate unsuitable material in footprint, haul to designated stockpile (allowance)	m3		2,100	1,200	3,400	3,600	10,300
Stockpiles & Borrow Areas							
Clear designated stockpile areas, push material to perimeter	m2		2,400	1,000	3,300	4,000	10,700
Clear and grub designated borrow areas, push material to perimeter	m2		7,400	1,900	10,000	9,500	28,800
Strip topsoil from borrow areas, haul to designated stockpile (200mm)	m3		1,500	400	2,000	1,900	5,800
Total Site Preparation							
PIT PROTECTION BUND CONSTRUCTION							
Walter Pit Protection Bund Construction							
Scarify, moisture condition and compact footprint (200 mm depth) prior to fill placement	m2		0	0	33,700	0	33,700
Win from borrow, load, haul, place, spread, condition and compact Zone A material as bund	m3		0	0	98,000	0	98,000
Win from stockpile, load, haul, place and spread topsoil (200 mm thick) on bund downstream slope face	m3		0	0	2,590	0	2,590
Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer on bund upstream slope face	m3		0	0	4,240	0	4,240
Win from borrow, load, haul, place, spread, moisture condition and compact wearing course	m3		0	0	860	0	860
Win from borrow, load, haul and place safety bunds	m3		0	0	720	0	720
Bakatouo Pit Protection Bund Construction							
Scarify, moisture condition and compact footprint (200 mm depth) prior to fill placement	m2		0	0	35,500	0	35,500
Win from borrow, load, haul, place, spread, condition and compact Zone A material as bund	m3		0	0	93,000	0	93,000
Win from stockpile, load, haul, place and spread topsoil (200 mm thick) on bund downstream slope face	m3		0	0	2,700	0	2,700
Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer on bund upstream slope face	m3		0	0	4,200	0	4,200
Win from borrow, load, haul, place, spread, moisture condition and compact wearing course	m3		0	0	1,000	0	1,000
Win from borrow, load, haul and place safety bunds	m3		0	0	840	0	840
Daapleu Pit Protection Bund Construction							
Scarify, moisture condition and compact footprint (200 mm depth) prior to fill placement	m2		20,800	0	0	0	20,800
Win from borrow, load, haul, place, spread, condition and compact Zone A material as bund	m3		73,000	0	0	0	73,000
Win from stockpile, load, haul, place and spread topsoil (200 mm thick) on bund downstream slope face	m3		1,760	0	0	0	1,760
Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer on bund upstream slope face	m3		2,630	0	0	0	2,630
Win from borrow, load, haul, place, spread, moisture condition and compact wearing course	m3		460	0	0	0	460
Win from borrow, load, haul and place safety bunds	m3		380	0	0	0	380
Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer on haul road upstream slope face	m3		950	0	0	0	950
Gbeitouo Pit Protection Bund Construction							
Scarify, moisture condition and compact footprint (200 mm depth) prior to fill placement	m2		0	11,200	0	0	11,200
Win from borrow, load, haul, place, spread, condition and compact Zone A material as bund	m3		0	18,000	0	0	18,000
Win from stockpile, load, haul, place and spread topsoil (200 mm thick) on bund downstream slope face	m3		0	700	0	0	700
Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer on bund upstream slope face	m3		0	1,100	0	0	1,100
Win from borrow, load, haul, place, spread, moisture condition and compact wearing course	m3		0	470	0	0	470
Win from borrow, load, haul and place safety bunds	m3		0	390	0	0	390
Zia NE Pit Protection Bund Construction							
Win from suppled stockpile, load, haul, place and spread Zone E erosion protection layer on haul road upstream slope face	m3		0	0	0	2,800	2,800
Total Pit Protection Bund Construction							

Table of Contents

Page

9.0 OPERATING COST ESTIMATE 9.1
9.1 Introduction 9.1
9.1.1 Major Changes from 2016 FS Study 9.2
9.2 Power 9.7
9.3 Operating Consumables 9.8
9.4 Maintenance 9.10
9.5 Labour 9.11
9.6 Laboratory 9.13
9.7 ROM Rehandle 9.14
9.8 General and Administration 9.14
9.9 Services and Utilities 9.15
9.9.1 Mobile Equipment 9.15
9.9.2 Water 9.15
9.10 Operations Pre-Production 9.16
9.10.2 Pre-Production Labour 9.16
9.10.3 Pre-Production Administration Expenses 9.16
9.10.4 First Fill Reagents and Opening Stocks 9.16
9.10.5 Vendor Representatives 9.17
9.10.6 Training 9.17
9.10.7 Working Capital 9.17

TABLES
Table 9.1.1 Summary Operating Costs by Ore Type at 4 Mtpa Design Throughput 9.3
Table 9.1.2 Fixed / Variable Operating Costs by Ore Type at 4 Mtpa Design Throughput 9.5
Table 9.2.1 Power Consumption and Cost for LOM Blend 9.8
Table 9.3.1 Operating Consumables Consumption and Cost for LOM Blend 9.8
Table 9.4.1 Annual Maintenance Costs 9.10
Table 9.5.1 Manning Numbers and Annual Labour Cost 9.11
Table 9.5.2 Working Rosters 9.11
Table 9.5.3 Labour Rates 9.12
Table 9.6.1 Laboratory Costs and Estimated Samples 9.13
Table 9.8.1 Annual General and Administration Costs 9.14
Table 9.8.2 Camp and Catering Costs 9.15
Table 9.10.1 Plant and Administration Pre-Production Costs 9.16

APPENDICES
Appendix 9.1 Operating Cost Estimate

9.0 OPERATING COST ESTIMATE

9.1 Introduction

The Ity CIL Project operating cost estimate presented here is for the process plant and infrastructure alone. Mining cost modelling has been completed by Calsta and is reported separately in Section 4.

Process plant and administration operating costs have been estimated for the eight Ity ore sources and the life of mine (LOM) blend based on the pit schedule developed by Cube and described as *pit schedule v7, Scn 10, CIL only 12/7/17*. The operating costs have been determined for a plant with a 'design' annual throughput of 4,000,000 tpa and the parameters specified in the Process Design Criteria.

The process plant operating cost estimate has been compiled from information sourced by Endeavour and Lycopodium:

- Manning levels, salaries and current contracted reagent costs, as noted, based on advice from Endeavour.
- Consumable prices from supplier budget quotations, Endeavour advice from Ity or the Lycopodium database.
- Modelling by Orway Mineral Consultants (OMC) for crushing and grinding energy and consumables, using ore characteristics measured during the testwork.
- Reagent consumption and gold extractions based on laboratory testwork results.
- General and administration (G & A) costs based on advice from Endeavour and typical allowances.
- First principle estimates based on typical operating data / standard industry practice.

The operating cost estimate is summarised in Table 9.1.1 with operating cost detail included in Appendix 9.1. The estimate is considered to have an accuracy of ±15%, is presented in US dollars (US$) and is based on prices obtained during the second quarter of 2017 (2Q17).

All costs associated with mining are excluded from this estimate except mining personnel camp and catering costs and grade control laboratory costs, which are included in the general and administration cost and laboratory cost.

The General and Administration costs in Table 9.1.1 exclude all head office and off site costs.

The process operating costs were split into fixed and variable components to enable them to be used to derive annual costs for changing ore blends and/or throughput with further development of the mine plan. The split of fixed and variable costs by ore type are presented in Table 9.1.2.

The operating cost estimate includes all direct costs to allow production of gold bullion. The battery limits for the process plant operating costs are as follows:

- Ore delivered to the ROM bin (ROM pad FEL costs are included in the Mining costs).
- Tailings discharge from the tails pipeline to the tailings storage facility (TSF).
- Gold bullion in plant goldroom safe.

9.1.1 Major Changes from 2016 FS Study

The major changes to the 2016 FS study can be summarised as follows:

- Throughput has increased from 3 Mtpa to 4 Mtpa.
- Bakatouo Oxide and Fresh ore has been included in the feed.
- Major process changes have included:
  - Relocated ROM pad and larger crusher.
  - Coarse ore stockpile replaced with surge bin and dead stockpile.
  - Larger milling and gravity circuit.
  - Larger thickener.
  - Eight rather than six CIL tanks.
  - Larger elution circuit.
  - Larger detoxification circuit.
  - Larger arsenic precipitation circuit.
  - Larger reagent mixing and dosing system.
  - Larger oxygen plant.
  - TSF capacity has increased to 57 Mt.

Table 9.1.1 Summary Operating Costs by Ore Type at 4 Mtpa Design Throughput

Cost Area	Daapleu Oxide		Gbeitouo		Ity Flat (1)		Mont Ity (1)	
	US$/annum	US$/t	US$/annum	US$/t	US$/annum	US$/t	US$/annum	US$/t
Power (exc grinding)	8,199,240	2.05	8,199,240	2.05	8,199,240	2.05	8,199,240	2.05
Power (grinding)	4,320,999	1.08	6,236,263	1.56	5,736,847	1.43	5,587,144	1.40
Operating Consumables	18,126,297	4.53	20,085,260	5.02	25,712,927	6.43	36,347,242	9.09
Maintenance	3,395,999	0.85	3,395,999	0.85	3,395,999	0.85	3,395,999	0.85
Laboratory	726,567	0.18	726,567	0.18	726,567	0.18	726,567	0.18
Process & Maintenance Labour	3,782,046	0.95	3,782,046	0.95	3,782,046	0.95	3,782,046	0.95
Total Processing Cost	**38,551,149**	**9.64**	**42,425,376**	**10.61**	**47,553,626**	**11.89**	**58,038,238**	**14.51**
Administration Labour	4,336,975	1.08	4,336,975	1.08	4,336,975	1.08	4,336,975	1.08
General & Administration Costs	4,566,581	1.14	4,566,581	1.14	4,566,581	1.14	4,566,581	1.14
Total General & Administration	8,903,556	2.23	8,903,556	2.23	8,903,556	2.23	8,903,556	2.23
Total Cost including G&A	**47,454,705**	**11.86**	**51,328,932**	**12.83**	**56,457,182**	**14.11**	**66,941,794**	**16.74**

	Walter		ZiaNE		Daapleu Primary		Heaps/Dumps (2)	
	US$/annum	US$/t	US$/annum	US$/t	US$/annum	US$/t	US$/annum	US$/t
Power (exc grinding)	8,199,240	2.05	8,199,240	2.05	8,199,240	2.05	8,199,240	2.05
Power (grinding)	4,721,967	1.18	4,161,260	1.04	8,149,108	2.04	5,736,847	1.43
Operating Consumables	22,122,254	5.53	16,111,133	4.03	25,953,159	6.49	25,712,927	6.43
Maintenance	3,395,999	0.85	3,395,999	0.85	3,395,999	0.85	3,395,999	0.85
Laboratory	726,567	0.18	726,567	0.18	726,567	0.18	726,567	0.18
Process & Maintenance Labour	3,782,046	0.95	3,782,046	0.95	3,782,046	0.95	3,782,046	0.95
Total Processing Cost	**42,948,074**	**10.74**	**36,376,246**	**9.09**	**50,206,120**	**12.55**	**47,553,626**	**11.89**
Administration Labour	4,336,975	1.08	4,336,975	1.08	4,336,975	1.08	4,336,975	1.08
General & Administration Costs	4,566,581	1.14	4,566,581	1.14	4,566,581	1.14	4,566,581	1.14
Total General & Administration	8,903,556	2.23	8,903,556	2.23	8,903,556	2.23	8,903,556	2.23
Total Cost including G&A	**51,851,630**	**12.96**	**45,279,802**	**11.32**	**59,109,676**	**14.78**	**56,457,182**	**14.11**

Note 1: - Mont Ity:Ity Flat split 70:30 in tonnes. Note 2 - Heaps based on Ity Flat costs

Table 9.1.1 Summary Operating Costs by Ore Type at 4 Mtpa Design Throughput (continued)

Cost Area	Bakatouo Oxide		Bakatouo Transition		Bakatouo Primary		LOM Average (3)
	US$/annum	US$/t	US$/annum	US$/t	US$/annum	US$/t	US$/t
Power (exc grinding)	8,199,240	2.05	8,199,240	2.05	8,199,240	2.05	2.05
Power (grinding)	4,320,999	1.08	6,236,263	1.56	8,149,108	2.04	1.64
Operating Consumables	22,935,789	5.73	72,424,900	18.11	28,467,003	7.12	6.37
Maintenance	3,395,999	0.85	3,395,999	0.85	3,395,999	0.85	0.85
Laboratory	726,567	0.18	726,567	0.18	726,567	0.18	0.18
Process & Maintenance Labour	3,782,046	0.95	3,782,046	0.95	3,782,046	0.95	0.95
Total Processing Cost	**43,360,641**	**10.84**	**94,765,016**	**23.69**	**52,719,964**	**13.18**	**12.03**
Administration Labour	4,336,975	1.08	4,336,975	1.08	4,336,975	1.08	1.08
General & Administration Costs	4,566,581	1.14	4,566,581	1.14	4,566,581	1.14	1.14
Total General & Administration	8,903,556	2.23	8,903,556	2.23	8,903,556	2.23	2.23
Total Cost including G&A	**52,264,197**	**13.07**	**103,668,572**	**25.92**	**61,623,520**	**15.41**	**14.25**

Note 3 - Calculated from summary schedule from Cube.

Table 9.1.2 Fixed / Variable Operating Costs by Ore Type at 4 Mtpa Design Throughput

Cost Area	DAA Oxide		Gbeitouo		Ity Flat		Mont Ity	
	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t
Power (exc grinding)	8,199,240	0.00	8,199,240	0.00	8,199,240	0.00	8,199,240	0.00
Power (grinding)	0	1.08	0	1.56	0	1.43	0	1.40
Operating Consumables	0	4.53	0	5.02	0	6.43	0	9.09
Maintenance	2,828,000	0.14	2,828,000	0.14	2,828,000	0.14	2,828,000	0.14
Laboratory	581,254	0.04	581,254	0.04	581,254	0.04	581,254	0.04
Process & Maintenance Labour	3,782,046	0.00	3,782,046	0.00	3,782,046	0.00	3,782,046	0.00
Total Processing Cost	**15,390,540**	**5.79**	**15,390,540**	**6.76**	**15,390,540**	**8.04**	**15,390,540**	**10.66**
Administration Labour	4,336,975	0.00	4,336,975	0.00	4,336,975	0.00	4,336,975	0.00
General & Administration Costs	4,566,581	0.00	4,566,581	0.00	4,566,581	0.00	4,566,581	0.00
Total General & Administration	8,903,556	0.00	8,903,556	0.00	8,903,556	0.00	8,903,556	0.00
Total Cost including G&A	**24,294,096**	**5.79**	**24,294,096**	**6.76**	**24,294,096**	**8.04**	**24,294,096**	**10.66**

Cost Area	Walter		Zia NE		DAA Prim		Heaps/Dumps	
	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t
Power (exc grinding)	8,199,240	0.00	8,199,240	0.00	8,199,240	0.00	8,199,240	0.00
Power (grinding)	0	1.18	0	1.04	0	2.04	0	1.43
Operating Consumables	0	5.53	0	4.03	0	6.49	0	6.43
Maintenance	2,828,000	0.14	2,828,000	0.14	2,828,000	0.14	2,828,000	0.14
Laboratory	581,254	0.04	581,254	0.04	581,254	0.04	581,254	0.04
Process & Maintenance Labour	3,782,046	0.00	3,782,046	0.00	3,782,046	0.00	3,782,046	0.00
Total Processing Cost	**15,390,540**	**6.89**	**15,390,540**	**5.25**	**15,390,540**	**8.70**	**15,390,540**	**8.04**
Administration Labour	4,336,975	0.00	4,336,975	0.00	4,336,975	0.00	4,336,975	0.00
General & Administration Costs	4,566,581	0.00	4,566,581	0.00	4,566,581	0.00	4,566,581	0.00
Total General & Administration	8,903,556	0.00	8,903,556	0.00	8,903,556	0.00	8,903,556	0.00
Total Cost including G&A	**24,294,096**	**6.89**	**24,294,096**	**5.25**	**24,294,096**	**8.70**	**24,294,096**	**8.04**

Table 9.2.1 Fixed / Variable Operating Costs by Ore Type at 4 Mtpa Design Throughput (continued)

Cost Area	Bakatouo Oxide		Bakatouo Transition		Bakatouo Primary		LOM	
	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t	Fixed US$/annum	Variable US$/t
Power (exc grinding)	8,199,240	0.00	8,199,240	0.00	8,199,240	0.00	8,199,240	0.00
Power (grinding)	0	1.08	0	1.56	0	2.04	0	1.64
Operating Consumables	0	5.73	0	18.11	0	7.12	0	6.37
Maintenance	2,828,000	0.14	2,828,000	0.14	2,828,000	0.14	2,828,000	0.14
Laboratory	581,254	0.04	581,254	0.04	581,254	0.04	581,254	0.04
Process & Maintenance Labour	3,782,046	0.00	3,782,046	0.00	3,782,046	0.00	3,782,046	0.00
Total Processing Cost	**15,390,540**	**6.99**	**15,390,540**	**19.84**	**15,390,540**	**9.33**	**15,390,540**	**8.18**
Administration Labour	4,336,975	0.00	4,336,975	0.00	4,336,975	0.00	4,336,975	0.00
General & Administration Costs	4,566,581	0.00	4,566,581	0.00	4,566,581	0.00	4,566,581	0.00
Total General & Administration	8,903,556	0.00	8,903,556	0.00	8,903,556	0.00	8,903,556	0.00
Total Cost including G&A	**24,294,096**	**6.99**	**24,294,096**	**19.84**	**24,294,096**	**9.33**	**24,294,096**	**8.18**

Qualifications

The operating cost estimate excludes the following:

- Mining costs and other areas not specifically mentioned in the detailed estimate.
- All ore handling costs.
- All head office (off-shore) costs, including head office labour.
- Any impact of foreign exchange rate fluctuations.
- Any escalation from the date of the estimate.
- Any contingency allowance.
- All withholding taxes and other taxes (Import duties on consumables allowed).
- Tailings storage facility future lifts and site rehabilitation.
- Government monitoring / compliance costs except where noted.
- Gold refining and bullion transport and in-transit security of gold from site.
- Ongoing land / community compensation costs.

The operating cost estimate includes the following:

- Import duties on consumable unit costs (in the consumables cost).
- Costs for the preparation and assaying of 100 mine grade control samples per day and routine laboratory tests on the site water samples (in the laboratory cost).

9.2 Power

The project will run from a grid power supply. This will necessitate expanding the Danané substation and running a new 90 kV overhead power line. ECG conducted a study which has indicated an electricity supply cost of US$0.1243/kWh.

The power consumption for the SAG and ball mills has been calculated from the average comminution characteristics for each of the ore types. Power consumption for the remainder of the plant has been estimated from installed power estimates for the process plant from the mechanical equipment list and allowances for the plant infrastructure and village from the FS load list. Typical drive efficiency and utilisation factors were applied to the installed power to estimate the plant average continuous power draw. Major change here is the increase in power for the oxygen plant.

The annual power cost for the LOM blend is summarised by plant area in Table 9.2.1 with further detail for the individual ore types included in Appendix 9.1.

Table 9.2.1 Power Consumption and Cost for LOM Blend

Area	Installed Power kW	Average kW	Power Cost US$/annum
Primary Crushing / Stockpile	595	357	389,087
Milling / Reclaim (exc grind)	3,132	1,365	1,486,336
Grinding Energy	12,000	8,805	9,587,483
Gravity / Leaching / Refining	3,546	1,882	2,049,457
Tailings / Detox	1,267	772	840,919
Reagents / Services	4,447	2,086	2,270,923
TSF / Water Treatment	782	386	419,910
Mine Services	149	62	67,967
Camp and Lighting / Small Power	817	620	674,640
Total	**26,734**	**16,335**	**17,786,723** US$4.45/t ore

Note: Grinding energy based on LOM average. Varies with ore type.

9.3 Operating Consumables

Costs for operating consumables, including reagents, liners, fuels and process supplies have been estimated and are summarised for the LOM blend in Table 9.3.1 with further detail for the individual ore types included in Appendix 9.1.

Table 9.3.1 Operating Consumables Consumption and Cost for LOM Blend

	Consumption	Units	Cost US$/annum	Cost US$/t
Jaw Crusher Liners	3.6	Sets/y	125,376	0.031
SAG Mill Liners	0.6	Sets/y	389,008	0.097
Ball Mill Liners	1.2	Sets/y	807,267	0.202
Pebble Crush Liners	5.0	Sets/y	27,838	0.007
SAG Mill Media	0.23	kg/t	725,866	0.181
Ball Mill Media	0.46	kg/t	1,483,236	0.371
Cyanide	0.89	kg/t	5,811,574	1.453
Lime	1.56	kg/t	1,921,458	0.480
Carbon	35	g/t	294,000	0.074
Flocculant	15	g/t	202,753	0.051
Hydrochloric Acid	0.23	kg/t	304,566	0.076
Sodium Hydroxide	0.74	kg/t	1,195,630	0.299
Sodium Metabisulphite	1.94	kg/t	3,995,877	0.999
Copper Sulphate	0.03	kg/t	213,581	0.053
Ferrous Sulphate	0.05	kg/t	77,868	0.019
Sulphuric Acid	3.20	kg/t	4,030,885	1.008
Fuel	0.91	L/t	3,657,777	0.914
Other			195,846	0.049
Total			**25,460,404**	**6.37**

Note: Consumption based on LOM average. Additional cyanide for copper.

Where the supplier did not include transport and freight to site and port clearance charges these costs have been included. For freight ex-works to Abidjan port, 15% of the supply cost was added. For clearance and freight from Abidjan port to Ity site, a cost of US$75/t was allowed based on advice from Endeavour.

The consumption of reagents has been calculated from laboratory testwork or has been estimated from typical usage rates. No additional allowance for process upset conditions and wastage of reagents has been allowed. Major changes here relate to the presence of soluble copper and its impact on cyanide consumption and detoxification costs.

Liner wear rates and grinding media consumption for the ore types have been calculated by OMC from the comminution testwork data.

The wear life for the primary and pebble crusher liners by ore type was calculated based on standard manganese steel liners, in terms of operating hours to replacement. The number of liner sets per year was then calculated based on the design crushing hours.

The wear life for the mill liners by ore type was calculated by OMC based on abrasion data and power draw and used to calculate the number of liner changes required at standard operating conditions. Additional contract labour has been included in the maintenance cost to provide for mill liner changes.

Mill grinding media consumption was calculated for each individual comminution sample using empirical formulae based on power draw and abrasion index. The grinding media consumption rate was calculated for each ore type.

The cyanide consumption for the CIL circuit has been calculated from the optimisation testwork results for the ore type composites with allowance for residual free cyanide. The cyanide consumption for the cold cyanide wash and elution has been calculated based on first principles.

The lime consumption for the CIL circuit has been calculated from the optimisation testwork results for ore types. The consumption rate was adjusted to account for the difference between the hydrated lime (60% CaO) used in the testwork and the quoted plant lime supply (90% CaO).

The activated carbon consumption for the CIL circuit was based on Lycopodium's database of similar projects. The flocculant consumption rates for the pre-leach thickener have been assumed as the thickening testwork was incomplete at the time of writing. Consumption rates for elution and goldroom reagents have been calculated from first principles based on estimated operating schedules.

A delivered diesel price of US$1.00/litre has been used as advised by Endeavour based on local pricing. Diesel will be used in plant mobile equipment and for carbon elution and regeneration. The diesel consumption for plant mobile equipment is based on industry standard vehicle consumption rates and estimated equipment utilisation. The diesel usage for carbon treatment has been advised by vendors and checked from first principles.

Allowances have been made for mill lubricants, water treatment reagents and operator supplies.

9.4 Maintenance

The maintenance cost allowance has been factored from the capital supply cost using factors from the Lycopodium database and is summarised in Table 9.4.1 with further detail included in Appendix 9.1.

Table 9.4.1 Annual Maintenance Costs

	Total US$/annum	Total US$/tonne	Fixed (US$/annum)
Feed Preparation / Milling	1,405,559	0.351	1,124,000
Gravity / Leaching / Elution	447,434	0.112	358,000
Tails and Detox	47,706	0.012	38,000
Reagents	19,590	0.005	16,000
Plant Services	221,897	0.055	178,000
Infrastructure	86,920	0.022	87,000
MSA	33,924	0.008	34,000
HV Switchyard	178,260	0.045	178,000
Mobile Equipment	498,710	0.125	399,000
Contract Maintenance	200,000	0.050	160,000
Maintenance General	256,000	0.064	256,000
Total	**3,395,999**	**0.85**	**2,828,000**

The maintenance cost covers mechanical spares and wear parts, but excludes crushing and grinding wear components, media and general consumables (covered in the consumables cost estimate). The maintenance cost excludes all payroll maintenance labour (covered in the labour cost estimate) but includes an allowance for contract maintenance.

The maintenance cost for mobile equipment was estimated based on unit costs for maintenance of the vehicles and other mobile or portable equipment (refer to Section 9.8).

The contract maintenance cost allows for contract labour relating to the replacement of mill wear liners and plant shutdowns. Crusher liner and screen deck change-outs will be carried out by the site maintenance labour personnel.

The maintenance cost estimate includes maintenance on infrastructure and buildings.

Provision has been made for general maintenance expenses, such as specialist maintenance planning software, maintenance manuals and control system licence fees as well as vendor site visits.

9.5 Labour

The labour rates, manning levels and rosters used to determine the labour operating cost estimate were agreed with Endeavour based on benchmarking within Cote d'Ivoire and similar operations. Some adjustments have been made since the FS was completed. The shift manning levels are based on a three panel; 12-hour shift roster plus leave cover.

Manning numbers and annual labour costs are summarised in Table 9.5.1. More detail of the labour structure and costs is included in Appendix 9.1.

Working roster details are provided in Table 9.5.2.

Table 9.5.1 Manning Numbers and Annual Labour Cost

Area	Labour Cost	Number of Personnel			
	US$/year	Expatriate	National	Local	Total
Process Operations	1,730,334	5	11	65	81
Maintenance	2,051,712	7	6	54	67
Total Processing	**3,782,046**	**12**	**17**	**119**	**148**
Administration	4,139,176	8	35	52	95
Total - Processing and Administration	**7,141,424**	**20**	**52**	**171**	**243**
Mining Personnel (1)		11	42	134	187
Total Personnel including Mining (1)		31	94	305	430

Note: (1) Indicative data only for Mining personnel, full details in Mining Cost section.

Table 9.5.2 Working Rosters

Employee Type	Roster	Cycle Duration	Cycles per Year	Working Hours per Day	Working Weeks per Year
Expatriate	7 weeks on, 3 weeks off	10 weeks	4.8	10 - 12 hours	33.6
Ivorian Nationals	3 weeks on, 1 week off	4 weeks	12	10 - 12 hours	36
Local Nationals, Shiftwork	3 panel roster; 8 days, 4 days off	12 days	16	12 hours	32
Local Nationals, Daywork	5 days, 2 days off	7 days	48	10 hours	48

Assume 4 weeks leave per annum.

Labour includes all personnel required for the Ity project, excluding offshore head office personnel. This includes plant administration, operations, maintenance and mining owner and contract personnel.

The labour cost includes all direct hire administration and plant operations and maintenance personnel, but excludes the cost of service provider personnel, and all mining personnel, including direct hire mining staff, who are included in the mining costs. Contract service providers include laboratory, security, medical clinic services and camp and catering services.

The General and Administration cost estimate below includes labour associated cost allowances for first aid and medical costs, medical examinations, visas and passports (expatriates), safety clothing and entertainment, recruitment, relocation costs and personnel replacement due to staff turnover.

Local bus transport between the camp and plant site has been allowed for Endeavour personnel in the labour and mobile equipment costs.

Labour rates and overheads for Expatriate, Ivorian National and Local National staff are summarised in Table 9.5.3.

Table 9.5.3 Labour Rates

	Annual Cost US$/annum		
	Base Salary Range	**Overhead Cost**	**Labour Cost Total**
Overseas Expatriate			
Managers	146,000 - 320,000	65,000 – 84,000	211,000 – 479,000
Senior Staff	76,000 - 100,000	42,000 – 50,000	118,000 – 150,000
Ivorian National			
Managers / Supervisors	39,000 – 59,000	21,000 – 28,000	61,000 – 87,000
Technical Staff	17,000 - 39,000	12,000 – 20,000	29,000 – 58,000
Local National			
Operations / Maintenance	8,000 – 16,000	5,000 – 10,000	12,000 – 25,000
Labourers (Unskilled)	6,000 – 7,000	3,500 – 4,000	10,000 – 11,000

Expatriate

Expatriate overhead costs include allowances for medical insurance, government charges, training levy, travel costs, visa and work permit costs and Côte d'Ivoire income tax as well as a bonus scheme.

The travel overhead cost provides, per work cycle, return flights between the country of hire and Abidjan. Expatriate personnel will be housed in the camp when on site and catering and accommodation costs have been provided for in the administration cost.

Ivorian National

Ivorian National overhead costs include allowances for medical costs, government charges, training levy and travel costs as well as a bonus scheme.

The travel overhead cost provides, per work cycle, domestic return flights between Abidjan and site. Senior National personnel will be housed in the camp when on site and catering and accommodation costs have been provided for in the administration cost.

Local National

Local National overhead costs include allowances for medical costs, government charges, training levy and daily travel costs as well as a bonus scheme.

9.6 Laboratory

A contract laboratory will provide sample preparation and assay services for plant and environmental samples and one hundred mine grade control samples per day.

SGS Minerals Services has provided a quotation for the supply of the laboratory equipment, mobilisation and all ongoing costs (laboratory labour, equipment and consumables) comprising a fixed monthly cost and a variable cost related to the number of samples being processed. The laboratory building has been captured in the capital cost estimate.

The laboratory costs and the estimated samples are summarised in Table 9.6.1.

Table 9.6.1 Laboratory Costs and Estimated Samples

Item		Samples/ Month	US$/ Month	US$/ Year
Fixed Fee			44,520	534,242
Variable Fee (Based on the following samples)			16,027	192,325
Mine Exploration and Grade Control		3,000		
Plant Solids (Assay, Moisture, Sizing)	Dry	30		
	Slurry	342		
	Total	**372**		
Plant Solutions (Assay)		402		
Plant Carbon (Assay)		120		
Bullion (Au & Ag)		22		
Environmental (CN, WAD, Total CN)		24		
Environmental (pH, TSS,TDS,E Coli, Assay)		0		
Total			**60,547**	**726,567**

9.7 ROM Rehandle

The cost associated with rehandling the ROM ore for blending and plant feed is captured in the mining cost estimate.

9.8 General and Administration

The general and administration costs were estimated by Endeavour and Lycopodium based on costs from existing Endeavour operations, supplier quotations and appropriate benchmarking. The General and administration cost is summarised in Table 9.8.1 with more detail provided in Appendix 9.1.

Note the administration labour cost, shown in Table 9.8.1 is also shown and discussed in Section 9.5.

Table 9.8.1 Annual General and Administration Costs

	Annual Cost US$
Site Office	677,400
Insurance	900,000
Financial	121,000
Government Charges	20,500
HR Administration	498,720
Contracts	1,589,621
Community Relations	102,000
Other	480,000
Total G&A	**4,389,241**
G&A Labour	**4,139,176**
Total G&A, incl labour	**8,528,418**
Total G&A, incl labour ($/t)	**2.84**

The basis of costs for the accommodation contract is shown in Table 9.8.2.

Table 9.8.2 Camp and Catering Costs

Employee Type	Basis	Number of Personnel	Rate (US$/ person/day)	Weeks/year on Site	Annual Cost (US$/year)
Process & Admin Expatriates	Camp	20	18	33.6	84,905
Mining Expatriates (1)	Camp	11	18	33.6	46,698
Process & Admin Ivorian Nationals	Camp	49	18	36	222,875
Mining Ivorian Nationals (1)	Camp	42	18	36	191,035
Process & Admin Locals	Local	174	9	32	351,748
Mining Locals (1)	Local	134	9	32	270,886
Accommodation and Meals		430			1,168,146
Total Annual Cost incl 10% contingency for visitors					**1,284,961**

Note: (1) Indicative data only for Mining personnel.

9.9 Services and Utilities

9.9.1 Mobile Equipment

Mobile equipment costs provide for the fuel and maintenance of the mobile equipment fleet (excluding the mining fleet and mining light vehicles). The purchase cost of this equipment has been included in the capital cost estimate.

Detail of the mobile equipment and fuel and maintenance costs are included in Appendix 9.1.

An FEL for loading (rehandling) crushed ore from the stockpile is included in the mobile equipment list. The costs associated with ore rehandling on the ROM pad are included in mining costs.

9.9.2 Water

Water supply costs are based on operation and maintenance of pit dewatering bores around Daapleu based on advice from Knight Piésold. The cost also allows for treatment of excess water prior to discharge to the river.

Water supply costs have not been estimated separately as they have been included in the other cost centres:

- Water supply pumping power is included in the power cost.
- Maintenance costs associated with water supply are included in the maintenance cost.
- Water treatment costs are included in the operating consumables costs.
- Labour required for water supply has been included in the labour cost.

The consumables cost estimate includes allowances for the treatment of elution water and potable water and for the addition of anti-scalant to both the decant return and the elution water.

9.10 Operations Pre-Production

The costs incurred by the operations during the latter stages of construction and commissioning are included in the capital cost estimate under Owner's Costs, but are derived in the operating cost estimate. The pre-production process and administration cost estimate is summarised in Table 9.10.1 and is based on a nominal annual throughput of 4,000,000 tpa of blended feed from the first year of operation.

Table 9.10.1 Plant and Administration Pre-Production Costs

Cost Centre		US$
Mining	Labour	Excluded
	Expenses	Excluded
	Subtotal	-
Administration	Labour	1,036,421
	Working Capital	1,027,333
	Subtotal	2,063,755
Process Plant	Labour	647,946
	First Fill - consumables	799,276
	Opening Stocks - consumables	2,913,962
	Vendor Representatives - commissioning	397,500
	Training (ops and maintenance)	200,000
	Working Capital - Processing	4,992,846
	Subtotal	9,951,529
Total		**12,015,284**

9.10.2 Pre-Production Labour

Pre-production labour costs reflect the need to recruit key operating personnel in time for them to set up and establish operating procedures and undergo training as required. It is envisaged that manning will commence to build-up eight months preceding plant start-up. The pre-production labour cost estimate is presented in Appendix 9.1

9.10.3 Pre-Production Administration Expenses

The administration expenses associated with establishment of operations during the period preceding start-up have been excluded as these are included in the Owners cost allowances.

9.10.4 First Fill Reagents and Opening Stocks

Costs have been allowed to purchase the consumables and reagents required to fill the reagent tanks, charge the mill with media and provide the initial stocks of materials to sustain the operations for the first one to two months until regular ordering of supplies can be established.

Quantities allowed have been based on either a month's consumption or minimum shipping quantities, considering package size. The first fill and opening stock estimates are provided in Appendix 12.1.

The initial set of wear liners for the crusher and mills have been included in the capital equipment supply costs. An additional set of liners for the crushers, SAG and ball mill have been allowed as part of the opening stocks inventory. First fill SAG mill grinding media cost has been calculated based on processing an average blend which requires a 10% ball charge.

It has been assumed that diesel inventory will be held on site on a consignment basis by the supplier, with limited provision for first fill and no allowance for opening stocks.

9.10.5 Vendor Representatives

These costs allow for specialist vendor representatives to oversee commissioning of their equipment, and include allowances for labour, airfares and expenses. The cost allowances for vendor representatives total US$397,500 and are summarised in Appendix 9.1.

9.10.6 Training

The training allowance covers the cost of providing pre-production training for operations and maintenance staff, and an allowance for expatriate assistance with start up operations for four months. The training cost of US$200,000 is based on allowances summarised in Appendix 12.1.

9.10.7 Working Capital

The basis of the process working capital calculation is six weeks of plant operations using the weighted average plant operating cost for the first year of operation based on the pit schedule provided. This has assumed the process plant is operating at 100% throughput of 4,000,000 tpa from Day 1 which is a conservative assumption.

APPENDIX 9.1

OPERATING COST ESTIMATE

Table of Contents

			Page
10.0	**CAPITAL COST ESTIMATE**		**10.1**
	10.1	Summary Capital Costs	10.1
	10.2	Scope	10.2
	10.3	Plant and Infrastructure Capital Costs	10.3
		10.3.2 General Estimating Methodology	10.5
		10.3.3 Quantity Development	10.5
		10.3.4 Pricing Basis	10.6
		10.3.5 Temporary Construction Facilities	10.7
		10.3.6 Heavy Lift Cranage	10.7
		10.3.7 Contractor Distributables	10.7
		10.3.8 Earthworks	10.7
		10.3.9 Concrete	10.8
		10.3.10 Steelwork	10.8
		10.3.11 Platework / Tankage	10.8
		10.3.12 Mechanical Equipment	10.8
		10.3.13 Plant Pipework	10.9
		10.3.14 Overland Pipework	10.9
		10.3.15 Electrical Instrumentation	10.9
		10.3.16 Erection and Installation	10.9
		10.3.17 Architectural / Buildings	10.9
		10.3.18 Transport	10.9
		10.3.19 EPCM	10.9
		10.3.20 Vendor Commissioning	10.10
		10.3.21 Qualifications	10.10
		10.3.22 Contingency	10.10
	10.4	Owners Costs	10.11
		10.4.1 Spares	10.11
		10.4.2 First Fill and Opening Stocks of Consumables	10.11
	10.5	Exclusions	10.11

TABLES

Table 10.1.1	Initial Capital Cost Estimate Summary (US$, 2Q17, ±15%)	10.2
Table 10.3.1	Capital Cost Estimate Basis	10.4
Table 10.3.2	Derivation of Quantities	10.6

APPENDICES

Appendix 10.1	Capital Cost Estimate Detail

10.0 CAPITAL COST ESTIMATE

The Project FS study that was published in 2Q16 has been updated to 2Q17 and incorporates an increased throughput change from 3.0 Mtpa to 4.0 Mtpa and a number of process changes to facilitate the same which are identified in Sections 2 and 3 of this report.

The overall study capital cost estimate was updated and compiled by Lycopodium and is presented here in summary format. The capital cost estimate reflects the Project scope as described in the FS study and updated in this study report. Additional estimate details for items costed by Lycopodium are provided in Appendix 10.1.

Summary mine capital costs (developed by Calsta and Endeavour) are included in the estimate tables below with detail provided in separate reports.

Knight Piésold provided quantities for the tailings storage facility, haul roads, site access roads, river diversions and pit protection bunds with rates applied by Lycopodium to derive the capital estimate.

All costs are expressed in US dollars ($) unless otherwise stated and based on 2Q17 pricing. The estimate is deemed to have an accuracy of ±15%.

Where costs used in the estimate were provided in other than US dollars the following exchange rates were used:

- US$1.00 = A$1.300 (Australian Dollar).
- US$1.00 = 593 XAF (CFA Franc).
- US$1.00 = 13.62 ZAR (South African Rand).
- US$1.00 = 0.891 € (Euro).

The various elements of the Project estimate have been subject to internal peer review by Lycopodium and have been reviewed with Endeavour for scope and accuracy.

10.1 Summary Capital Costs

The updated project capital cost was estimated at US$ 370.0 million. The capital estimate is summarised in Table 10.1.1.

Table 10.1.1 Initial Capital Cost Estimate Summary (US$, 2Q17, ±15%)

Main Area	Initial Capital (US$M)
Treatment Plant	85.4
Reagents and Services	14.1
Infrastructure and Tailings	66.3
Mining	66.4
Construction Distributables	25.2
Subtotal	257.4
Management Costs	17.4
Owners Project Costs	59.5
Owners Operations Costs	5.3
Contingency	30.4
Project Total	**370.0**

10.2 Scope

The overall capital cost estimate includes the following scopes of work:

- Mine contractor mobilisation and pre-commissioning mining costs as advised by Endeavour.
- Process facility and infrastructure as described in Sections 6 and 7 and tailings storage facility as described in Section 8.
- Installation costs, EPCM costs and contractor distributable costs.
- Owners costs including first fill and opening stocks of reagents and consumables as well as operating and insurance spares.
- Site earthworks, tailings storage facility, haul roads, site access roads, river diversions and pit protection bunds.
- Mobile equipment.

Exclusions include the following:

- Project sunk costs.
- Import duties and taxes on the assumption that the Project will be exempt.
- Escalation.

10.3 Plant and Infrastructure Capital Costs

The project capital cost estimate summarised by Area, Facility and Primary Discipline is included in Appendix 10.1. The capital cost estimate was prepared in accordance with Lycopodium's standard estimating procedures and practices. The basis and methodology are summarised in Table 10.3.1 below.

Table 10.3.1 Capital Cost Estimate Basis

Description	Basis
Site	
Geographical Location	Actual site
Maps and Surveys	Good topographical data available
Geotechnical Data	Preliminary
Process Definition	
Process Selection	Fixed
Design Criteria	Fixed
Flowsheets / Plant Capacity	Fixed
P&IDs	Not Required as suitable 'go-by' costs available from Lycopodium's database
Mass Balances	Fixed
Equipment List	Fixed
Process Facilities Design	
Equipment Selection	Selection based on duty and budget pricing provided by vendors.
General Arrangement Drawings	Fixed
3D model	Preliminary to a level of detail suitable for FS
Piping Drawings	Not required
Electrical Drawings	HV SLD. LV drawings not required.
Specifications / Data Sheets	Preliminary for BQRs
Infrastructure Definition	
Existing Services	Not relevant other than use of exploration camp for 'pioneer' accommodation.
Design Basis	Fixed
Layout	Fixed
Bulk Earthworks – Plant-site, Mine Services & Camp	Volume estimated from 3D Models.
Tailings storage facility, haul roads, site access roads, river diversions and pit protection bunds	Bulk Quantities provided by Knight Piésold
Detailed Earthworks	Allowances for under pad excavation and backfill to prepare site for concrete works.
Concrete Installation	Estimated from the layout and similar projects of comparable scale. Concrete (wet) supply rates and installation rates applied from project specific BQRs.
Structural Steel	Quantities estimated from the layout and similar projects of comparable scale. Supply and install rates applied from project specific BQRs.
Platework & Small Tanks	Quantities provided in the mechanical equipment list. Large item quantities estimated from reference projects. Smaller items compared to database. Supply and install rates applied from project specific BQRs.
Tankage Field Erect	Quantities provided in the mechanical equipment list. Supply and install rates applied from project specific BQRs.
Mechanical Equipment	Quantities provided in the mechanical equipment list. Costs from responses to BQRs from reputable suppliers for all equipment packages with a value nominally >$50,000. Costs for low value items taken from the Lycopodium database.
Mining Fleet	Refer mining cost estimate.
Power Supply	Estimate provided by ECG.
Conveyors	Concrete and structural estimated from reference projects and layout. Mechanicals supply pricing from current database and installation rates applied from responses to BQRs.
Plant Piping General	Factored off mechanical costs derived by completed project actuals.
Overland Piping	Size and specification based on engineering selection. Quantity based on site layout. Rates based on recent market inquiries.
Electrical General	Quantities derived from engineering design and site layout. Materials pricing and installation costs from a combination of recent database information and responses to BQRs.
Electrical HV	Quantities derived from engineering design and site layout. Materials pricing and installation costs from a combination of recent database information and responses to BQRs.
Commodity Rates – General	Appropriate rates from responses to project specific BQRs.
Installation Rates – General	Appropriate rates from responses to project specific BQRs based on preliminary contracting strategy.
Heavy Cranes	Requirements estimated based on largest lifts and likely duration.
Freight General	Combination of rates per freight ton and factors.
Contractor Mobilisation / Demobilisation	Appropriate rates from responses to project specific BQRs, adjusted to suit the final project scope.
Fencing	Costed based on measured length and rate.
EPCM	Scope and deliverables based estimate.
Vendor Representatives	Estimated.
Owner's Costs	
Site Establishment	Requirements estimated using base rates.
Construction Facilities	Allowance based on projects of a similar size.
Opening Stocks, First Fill Reagents and Consumables	Estimated from consumption rates and costs in operating cost estimate.
Working Capital	Estimated from costs in operating cost estimate and likely commissioning and ramp up schedule.
Spares	Historical data from similar sized plants.
Owner's Project Team	Client estimate.
Project Insurances and Permits	Client estimate.
Sterilisation Drilling	Assumed in sunk costs.
Land Compensation	Client estimate.
Community Relations	Client estimate.
Plant preproduction expenses	Estimated from operating cost estimate and likely commissioning / ramp up schedule.
Training	Estimated from operating cost estimate manning schedule
Owners Team Expenses	Client estimate.
Duties and Taxes	Excluded on the assumption the Project will be exempt.
Escalation	Excluded.

10.3.2 General Estimating Methodology

The process plant was broken down into unit operation areas with quantity take-offs benchmarked against similar facilities from previous projects to provide the additional scope and level of confidence needed to confirm a FS level of estimate.

Overall plant layout and equipment sizing was prepared with sufficient detail to permit an assessment of the engineering quantities for the majority of the facilities for earthworks, concrete, steelwork, and mechanical items. The layouts enabled preliminary estimates of quantities to be taken for all areas and for interconnecting items such as piperacks.

Unit rates for labour and materials were derived from responses to BQRs sent to fabricators and contractors experienced in the scale and type of work in the region.

Budget pricing for equipment was obtained from reputable suppliers with the exception of low value items which were costed from Lycopodium's database of recent project costs.

For the accommodation camp, offices, workshops and similar items appropriate budget pricing was obtained from reputable suppliers of similar prefabricated designs with erection / installation costs derived from solicited contractor rates.

For the tailings storage facility, haul roads, site access roads, river diversions and pit protection bunds, bills of quantities were provided by Knight Piésold based on their preliminary designs.

All earthworks and concrete works have been costed on an Owners self perform basis with applicable rates and distributables included to support the work.

10.3.3 Quantity Development

Overall estimated quantities of key commodities are shown in Table 10.3.2.

The derivation of quantities within these categories by percentage is provided in the table weighted by value of the direct permanent works (i.e. excluding temporary works, construction services, commissioning assistance, EPCM, escalation and contingency).

Preliminary Engineering refers to quantities taken from data and layouts prepared specifically for the Project. Concept Engineering refers to quantities derived from similar project designs factored and/or modified to suit.

Table 10.3.2 Derivation of Quantities

Classification	Quantity	Unit	Preliminary Engineering %	Concept Engineering %	Estimated %
Concrete (excluding blinding)	13,625	m^3	80%	15%	5%
Structural Steel	1,937	t	90%	5%	5%
Chutes / Hoppers / Bins / Tanks	391	t	95%	5%	-
Field Erected Tanks	1,415	t	80%	20%	-

10.3.4 Pricing Basis

Estimate pricing has been derived from a combination of the following sources:

- Budget pricing or recent project actuals for all equipment and material packages valued over nominally $50,000.
- Recent historical pricing from low value equipment and materials.
- Quoted rates.
- Allowances.

Pricing has been identified by the following cost elements, as applicable, for the development of each estimate item.

Plant Equipment

This component represents prefabricated, pre-assembled, off-the-shelf types of mechanical or electrical equipment, either fixed or mobile. Pricing is inclusive of all costs necessary to purchase the goods ex-works, generally excluding delivery to site (unless otherwise stated) but including operating and maintenance manuals. Vendor representation and commissioning spares have been allowed for separately in the estimate.

Bulk Materials

This component covers all other materials, normally purchased in bulk form, for installation on the Project. Costs include the purchase price ex-works, any off-site fabrication, transport to site (unless otherwise stated), and over-supply for anticipated wastage.

Installation

This component represents the cost to install the plant equipment and bulk materials on site or to perform site activities. Installation costs are further divided between direct labour, equipment and contractors' distributables.

The labour component reflects the cost of the direct workforce required to construct the Project scope. The labour cost is the product of the estimated work hours spent on site multiplied by the cost of labour to the contractor inclusive of overtime premiums, statutory overheads, payroll burden and contractor margin.

The equipment component reflects the cost of the construction equipment and running costs required to construct the Project. The equipment cost also includes cranes, vehicles, small tools, consumables, PPE and the applicable contractor's margin.

Contractors' indirect costs encompass the remaining cost of installation and include items such as offsite management, onsite staff and supervision above trade level, crane drivers, mobilisation and demobilisation, R&Rs, meals and accommodation costs, and the applicable contractors' margin.

10.3.5 Temporary Construction Facilities

Facilities will be capable of servicing the owners and EPCM teams.

Included in the estimate for construction facilities are the following:

- Construction offices.
- Computers and computing servers, telephones, printers, etc. and office furniture.
- Provision of services.

10.3.6 Heavy Lift Cranage

A heavy lift crane of 250 t capacity has been allowed for in the estimate for the duration of the installation of the mills.

10.3.7 Contractor Distributables

Mobilisation / Demobilisation

Costs for mobilisation / demobilisation of labour and equipment to / from the Project site were, where practical, adopted from budget quotation enquiries to contractors or adjusted from current tenders / contracts to reflect the Project location.

10.3.8 Earthworks

Quantities for plant site bulk earthworks have been estimated from the layout. Rates were provided by EDV based on an Owner self perform strategy and benchmarked against similar projects.

Quantities for the ROM pad (at the process plant) are limited to the engineered fill and drainage and site earthworks required around the ROM retaining wall. The cost of the balance of the ROM pad is included in the mining estimate.

10.3.9 Concrete

Quantities for concrete works were established using the following:

- Material take-offs from layouts prepared for the FS and actual quantities from reference projects of like process facilities.
- Benchmarking against detailed drawings for similar sized projects completed by Lycopodium.

Rates for this estimate were based on an Owner self perform strategy, benchmarked against similar projects.

Rates and quantities were prepared on a composite per cubic metre basis. Mobilisation, demobilisation and indirect costs were separated to reflect contract methodology.

10.3.10 Steelwork

Quantities for structural steel were established using the following:

- The layout and equipment elevation drawings / sketches prepared for the FS and actual quantities from reference projects of like process facilities.
- Benchmarking against detailed drawings for similar sized projects completed by Lycopodium.

Rates for this estimate were based on responses to BQRs from fabricators with experience on this kind of work and capacity to perform the works.

Site installation hours were based upon responses to BQRs from regional contractors with experience on this kind of work and capacity to perform the works.

10.3.11 Platework / Tankage

Platework and tankage quantities were determined using the sizing provided in the mechanical equipment list prepared for the FS update as the basis.

Rates for this estimate were based on responses to BQRs from regional subcontractors with experience on this kind of work and capacity to perform the works.

10.3.12 Mechanical Equipment

The mechanical equipment list prepared for the FS update provided the quantities and sizing for the cost estimate.

Budget pricing was obtained from reputable suppliers for the major mechanical equipment, based on equipment data sheets prepared for the FS along with recent project actual cost data for minor equipment.

Equipment installation hours were estimated based on responses to BQRs solicited from contractors and installation hours estimated by Lycopodium. For each individual item of equipment due allowances were made for retrieval from the storage location, handling, placing, installing and commissioning the equipment.

10.3.13 Plant Pipework

The supply and installation estimate for in-plant piping was derived using factors derived from previously built projects. These factors are a percentage of the mechanical equipment supply and installation costs, and are calculated per individual plant area. The plant piping costs allow for the supply and installation of pipe, fittings, mountings and manual valves.

10.3.14 Overland Pipework

The overland piping, i.e. tailings discharge line and decant water return line was estimated from first principle engineering. Quantities were based on material take-offs.

10.3.15 Electrical Instrumentation

The supply and installation estimate for electrical and instrumentation was estimated in detail and compiled using electrical equipment lists, loads lists, GA drawings and supplier pricing for the FS. This was updated and the electrical and instrumentation estimate has been added into the master estimate at WBS Level 3 subtotals.

10.3.16 Erection and Installation

Included in the discipline by discipline assessment of erection / installation costs detailed above, allowances were made for major construction cranage and equipment and construction costs such as site establishment, construction personnel meals, accommodation, flights and fuel usage, etc.

10.3.17 Architectural / Buildings

Budget pricing for prefabricated and steel frame buildings were sourced from reputable suppliers based on preliminary layout drawings.

10.3.18 Transport

The transport costs included in the estimate are a combination of rates per freight ton and factors on supply costs.

10.3.19 EPCM

The Engineering, Procurement and Construction Management (EPCM) estimate was based on a first principle build-up of costs based on the assessed scope of work managed by the EPCM Engineer for the Project.

Expenses such as catering and accommodation for the Engineer's site personnel, as well as site telecommunications costs are included in the estimate.

10.3.20 Vendor Commissioning

The estimate was based on Lycopodium's experience for similar plant and equipment.

10.3.21 Qualifications

The estimate is subject to the following qualifications:

- All labour rates, materials and equipment supply costs are current at 2Q17. Contingency has been allowed based on the quality of the information however no allowance for escalation has been included.
- Construction contractor rates include mobile equipment, vehicles, fuel, construction power and consumables for the duration of construction. Potable water and raw water supply will be provided by the Client and available at site for the use by contractors.
- Accommodation, meals and mobilisation / demobilisation / R&R flights of construction contractor personnel are incorporated in the contractor indirect labour rates on the basis of individual contractors making their own accommodation arrangements.
- Meals and accommodation for the owner and EPCM teams have been allowed in the estimate.
- Project spares have been based on other projects of similar size.
- A commissioning assistance crew is allowed for in the EPCM allowance.
- PLC programming for the process plant has been allowed for in the EPCM allowance.
- Site supply of power and raw water (for operations and construction), sewage removal and treatment, communications network for construction facilities are included in the infrastructure costs.

10.3.22 Contingency

The purpose of contingency is to make specific provision for uncertain elements of cost within the Project scope. Contingencies do not include allowances for scope changes, escalation or exchange rate fluctuations.

Contingency is an integral part of an estimate and has been applied (after careful analysis) to all parts of the estimate, i.e. direct costs, indirect costs, services costs, etc.

10.4 Owners Costs

The following items are included in the Owner's costs:

- Owner's project management team.
- Owner's team costs including project insurances.
- Operating and capital spares holdings.
- First fill and opening stocks of reagents and consumables.
- Cost of preproduction labour, training and operational readiness.

10.4.1 Spares

Spares have been taken as an allowance of the capital costs and benchmarked against the spares expenditure on projects of a comparable scale. A minimalist approach has been assumed, with spares stocks progressively expanded during operations.

10.4.2 First Fill and Opening Stocks of Consumables

Quantities for opening stocks and first fill consumables have been assembled from basic principles and using the Project design criteria. Unit rates are based on budget quotations solicited from suitable suppliers.

10.5 Exclusions

The following is excluded from the overall project capital costs:

- Duties / taxes / fees.
- Project sunk costs (allowance made in the Cash Flow Model).
- Project escalation.

APPENDIX 10.1

CAPITAL COST ESTIMATE DETAIL

Table of Contents

Page

11.0 FINANCIAL EVALUATION **11.1**
11.1 Introduction 11.1
11.2 Summary 11.1
11.3 Principal Assumptions and Inputs 11.2
11.3.2 Depreciation 11.3
11.3.3 Company Tax 11.3
11.3.4 Refining and Transport Costs 11.4
11.3.5 Silver Credits 11.4
11.3.6 Royalties 11.4
11.3.7 Working Capital 11.4
11.3.8 Closure Costs 11.4
11.3.9 Other 11.4
11.4 Sensitivity Analysis 11.5

TABLES
Table 11.2.1 Summary of Financial Analysis Results 11.2
Table 11.3.1 Capital Costs Sensitivity 11.4
Table 11.4.1 Gold Price Sensitivity 11.5
Table.11.4.2 Capital Costs Sensitivity 11.5
Table 11.4.3 Operating Cost Sensitivity 11.5
Table 11.4.4 Condensed Annual Financial Model 11.7

FIGURES
Figure 11.4.1 $NPV_{5\%}$ Sensitivity 11.6
Figure 11.4.2 IRR Sensitivity 11.6

11.0 FINANCIAL EVALUATION

11.1 Introduction

A simple financial model has been used to collate the study results in order to estimate and evaluate project cash flows and economic viability. The evaluation method takes into account milled tonnages and grades for the ore and the associated recoveries, gold price (revenue), operating costs, bullion transport and refining charges, government royalties and capital expenditures (both initial and sustaining). The project has been evaluated on a 100% ownership basis, with no debt financing.

The financial evaluation presents results for Net Present Value ('NPV'), Internal Rate of Return ('IRR'), and payback period. The financial model allows for sensitivity evaluations for changes in gold price, operating costs, and capital costs to determine their relative importance in evaluating the investment decisions. The financial assessment has been prepared with the input from Endeavour, Cube Consultancy Pty Ltd (mining and processing schedules), Calsta Pty Ltd (mining costs), Lycopodium (processing plant, site G&A and infrastructure), and Knight Piésold (tailings management facility and water storage).

11.2 Summary

The results of the financial model show robust results. Applying a long term gold price of $1,250/oz on a flat line basis from the commencement of production, the after-tax $NPV_{5\%}$ is $640.0 million, IRR is 43.3% and project payback period is 1.8 years. The life of mine average cash cost per ounce is $567, net of silver credits, and with the addition of sustaining capital, the life of mine average AISC/oz is $593. Over the first five years of production, the average AISC/oz is $523.

Project gold production averages 164,407 ounces per year over the life of the project with an average of 250,937 ounces per year over the first five years.

The project shows some sensitivity to capital and operating costs, but is typically sensitive to gold price fluctuations. At $1150/oz gold price the IRR is 36.4%, and the project maintains an IRR of 49.5% at an upside $1,350/oz gold price.

The summary of the cash flow model (Condensed Annual Cash Flow) is included in Table 11.4.4 at the end of this section.

Table 11.2.1 presents a summary of the production information on which the cash flow model is based and the key project financial measures.

Table 11.2.1 Summary of Financial Analysis Results

Financial Summary	Units	FS	Optimisation	% Change
LOM tonnage ore processed	kt	41,042	57,156	39.3
LOM strip ratio	w:o	2.1	1.7	-20.7
LOM feed grade processed	Au g/t	1.42	1.52	6.5
LOM gold recovery	%	83.1	83.4%	0.4
LOM gold production	oz	1,561,902	2,350,872	50.5
Production period	Years	13.7	14.5	5.5
Upfront capital cost	$M	306.7	370.0	20.7
Life of Mine Average				
Gold, average annual production	oz	113,656	164,407	44.7
Cash costs per ounce, net Ag credits	$/oz	528	567	7.4
AISC per ounce	$/oz	603	593	-1.6
Project Years 1 to 5 Average				
Gold, average annual production	oz	164,989	250,937	52.1
Cash costs per ounce, net Ag credits	$/oz	446	508	13.9
AISC per ounce	$/oz	507	523	3.3
Project Years 1 to 9 Average				
Gold, average annual production	oz	143,848	209,226	45.4
Cash costs per ounce, net Ag credits	$/oz	475	502	13.9
AISC per ounce	$/oz	542	527	3.3
Using $1,250/oz Gold Price				
Internal rate of return (after-tax)	%	35.9	43.3%	18.6
Net present value - 0% discount rate (after-tax)	$M	607.2	944.1	53.2
Net present value - 5% discount rate (after-tax)	$M	410.9	640.0	53.1
Net present value - 10% discount rate (after-tax)	$M	278.3	438.8	54.5
Payback period	Years	2.1	1.8	-1.7

11.3 Principal Assumptions and Inputs

The financial evaluation of the Ity CIL Project was based upon:

- Capital cost estimates prepared by Lycopodium, Calsta, Knight Piésold, and actual costs from Endeavour's Houndé Gold Project. The Houndé Project is located in Burkina Faso and is currently in construction.
- Mine schedule and mining operating cost estimates based on an owner-operated mining fleet, prepared by Cube Consulting and Calsta, respectively.
- Process operating and general and administration (G&A) cost estimates prepared by Lycopodium.
- Metallurgical performance characterised by testwork conducted on composite samples from the Ity deposits.

- Sustaining capital costs have been factored using the estimates developed during the FS as a basis.
- Owners capital cost estimates prepared by Endeavour using recent project data.
- Royalty, tax, discount rates and other model inputs provided by Endeavour. The cash flow analysis excludes any effects due to inflation and all dollars are expressed as real.
- A gold price of $1,250/oz, with +/-20% gold price sensitivity analysis ($1,150 to $1,350/oz).
- Construction is completed over an 18 month Pre-Production period and operations commence in Project Year 1.
- The financial assessment has been undertaken in United States Dollars (US$).

11.3.1 Basis of Estimate

- Quarterly tonnage, strip ratio and head grade have been based on the mining schedule as discussed in Section 3.
- The mining, processing and administration costs are based on the operating cost estimates discussed in Section 4 and Section 9.
- The overall recovery figures are based on testwork. Metallurgical recovery is discussed in Section 5.
- The capital cost estimate used as basis for the cash flow model is discussed in Section 10.
- The treatment of depreciation and company taxes are based on the understanding of current Côte d'Ivoire tax law.

11.3.2 Depreciation

Provision has been made for depreciation using a straight line method for a period of 10 years for initial construction capital only.

11.3.3 Company Tax

Corporate tax rate of 25% of gross profit has been used.

11.3.4 Refining and Transport Costs

- A refinery gold payable rate of 99.9% is assumed.
- The refining charge of $5.00 per ounce of gold is based on Endeavour experience and actual costs incurred from current operating mines in Côte d'Ivoire, and includes the cost of transport and insurance of the gold from site to the refinery

11.3.5 Silver Credits

- Silver to gold ratios typically range from 3.5 to 1 to as little as 2 to 1. For the financial model, payable silver in the doré ingots has been estimated on a ratio of 2 to 1. Silver credits have been calculated using a flat, long-term silver price of $15 per ounce.

11.3.6 Royalties

- The State of Côte d'Ivoire is entitled to production royalties as follows.

Table 11.3.1 Capital Costs Sensitivity

Royalty	Gold Price
3%	Up to $1,000
3.5%	$1,000 –$1,300
4%	$1,300 –$1,600
5%	$1,600 and Over

11.3.7 Working Capital

- Working capital, first fills and spare parts have been included in the upfront capital cost.

11.3.8 Closure Costs

- In the financial model, demolition and closure activities occur in Year 15 after mining and processing activities have ceased, with an estimated cost of $5.0 million.

11.3.9 Other

- The cash flow model is based on 100% project ownership.
- No provision has been made for interest or cost of capital.
- No provision has been made for escalation or inflation.
- No provision has been made for additional taxation or costs related to the repatriation of funds from Côte d'Ivoire.

- Allowance has been made in the capital costs for Import Duties with an amount of $1.97 million.

- The cash flow calculations have been prepared on a quarterly basis, and have been totalised to annual amounts based on Project years in the Condensed Annual Cash Flow included in Table 11.4.4.

11.4 Sensitivity Analysis

A sensitivity analysis was performed on the after-tax cash flows by varying key variables (gold price, Capex, Opex) to +/- 20% of the base case cash flow and each sensitivity was performed independently. The results are summarised in Table 11.4.1, Table.11.4.2 and Table 11.4.3 and Figure 11.4.1 and Figure 11.4.2 show the sensitivity analysis on the after-tax $NPV_{5\%}$ and IRR financial indicators.

Table 11.4.1 Gold Price Sensitivity

Gold Price ($US/oz)	NPV ($M) (after-tax)			IRR (after-tax)
	0%	5%	10%	
$1,150/oz	763	507	338	36.4%
$1,200/oz	854	574	388	39.9%
$1,250/oz	944	640	439	43.3%
$1,300/oz	1,023	697	483	46.2%
$1,350/oz	1,113	763	533	49.5%

Table.11.4.2 Capital Costs Sensitivity

Capex Change (%)	NPV ($M) (after-tax)			IR (after-tax)
	0%	5%	10%	
-20%	1,002	697	493	55.0%
-10%	973	668	466	48.6%
+0%	945	640	439	43.3%
+10%	916	612	412	38.9%
+20%	887	584	385	35.1%

Table 11.4.3 Operating Cost Sensitivity

Capex Change (%)	NPV ($M) (after-tax)			IRR (after-tax)
	0%	5%	10%	
-20%	1,155	790	551	50.4%
-10%	1,049	715	495	46.9%
+0%	944	640	439	43.3%
+10%	838	565	383	39.7%
+20%	730	488	326	35.9%

Figure 11.4.1 NPV$_{5\%}$ Sensitivity

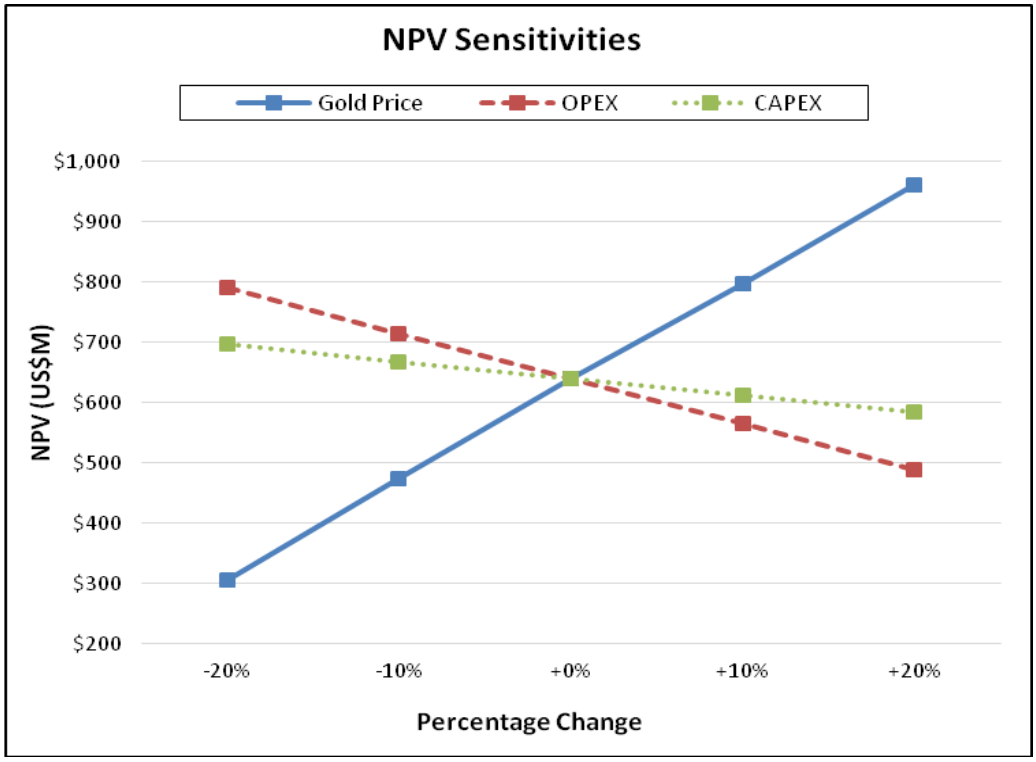


Figure 11.4.2 IRR Sensitivity

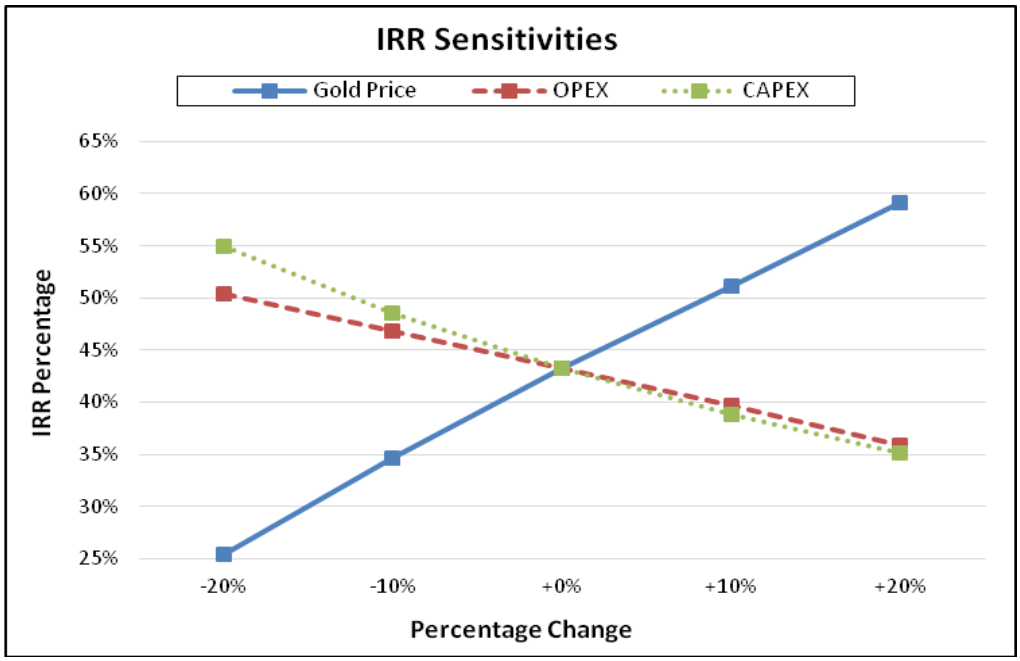


Table 11.4.4 Condensed Annual Financial Model

Item	Unit	LOM Total / Average	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Mining Schedule																			
Total Material Moved	kt	169,094		12,696	28,000	27,602	27,459	25,321	21,938	7,186	4,306	4,623	3,087	5,077	1,799	0	0	0	0
Total Waste Moved	kt	106,246		9,199	18,425	19,298	19,202	17,306	13,774	2,442	271	291	652	4,242	1,145	0	0	0	0
Total Ore Mined	kt	62,848		3,497	9,575	8,304	8,257	8,015	8,164	4,743	4,035	4,332	2,435	836	654	0	0	0	0
Stripping Ratio	w:o	1.7		2.6	1.9	2.3	2.3	2.2	1.7	0.5	0.1	0.1	0.3	5.1	1.7	0	0	0	0
Au Grade - Ore Mined	g/t	1.52		1.55	1.73	1.98	1.78	1.61	1.4	1.2	1.02	0.99	0.88	1	1.09	0	0	0	0
Contained Gold - Ore Mined	oz	3,066,293		174,317	534,064	529,462	472,505	415,109	368,158	183,540	132,707	137,984	68,790	26,830	22,827	0	0	0	0
Processing Schedule																			
Total Ore Processed	kt	57,156		2,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	3,156	0
Au Grade - Ore Processed	g/t	1.53		1.87	2.59	3.11	2.72	2.43	2.15	1.34	1.03	1.02	1.1	0.96	0.63	0.61	0.71	0.73	0
Contained Gold - Ore Processed	oz	2,817,723		120,169	333,107	399,369	349,498	312,724	277,045	172,137	132,041	130,945	141,897	122,978	81,228	78,994	91,082	74,509	0
Au Recovery	%	83.40%		88.70%	79.40%	82.10%	87.70%	79.70%	82.50%	92.10%	91.80%	91.60%	75.00%	77.10%	96.50%	90.70%	73.80%	66.00%	0
Recovered Gold	oz	2,350,871		106,589	264,653	327,747	306,416	249,281	228,509	158,613	121,240	119,985	106,453	94,861	78,410	71,678	67,260	49,176	0
Payable Gold	oz	2,349,695		106,536	264,521	327,583	306,263	249,157	228,394	158,534	121,179	119,925	106,399	94,814	78,370	71,643	67,226	49,151	0
Operating Cost Summary																			
Mining	US$/t Mined	2.62		2.62	1.78	2.69	3.00	3.10	2.96	2.41	2.15	0.60	0.55	1.83	3.08	5.46	0.00	0.00	0.00
Processing	US$/t Ore Processed	11.97		11.97	11.19	12.34	12.82	12.87	12.32	11.27	11.44	11.78	11.88	12.25	11.77	10.10	11.97	12.73	12.55
General & Administrative	US$/t Ore Processed	2.23		2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23	2.23
Cash Operating Costs (Net of Credits)	US$/oz Gold Sold	516.6		516.6	438.4	479.6	411.4	449.9	508.6	442.3	416.8	458.2	466.6	571.9	730.2	729.6	840.7	950.0	1,040.4
Total Cash Costs	US$/oz Gold Sold	566.6		566.6	488.4	529.6	461.4	499.9	558.6	492.3	466.8	508.2	516.6	621.9	780.2	779.6	890.7	1,000.0	1,090.4
All-In-Sustaining Costs	US$/oz Gold Sold	593.4		593.4	504.5	540.0	477.0	513.7	582.1	526.0	490.8	545.1	560.5	697.1	840.4	832.3	948.6	1,000.0	1,090.4
Cash Flow Summary																			
Gold Revenue	$M	2,936		133.1	330.5	409.3	382.6	311.3	285.4	198.1	151.4	149.8	132.9	118.5	97.9	89.5	84.0	61.4	0.0
Less: Royalties, Credits, Transportation & Refining	$M	-57		-2.6	-6.4	-8.0	-7.4	-6.1	-5.5	-3.9	-2.9	-2.9	-2.6	-2.3	-1.9	-1.7	-1.6	-1.2	0.0
Less: Cash Operating Costs	$M	-1,274		-49.4	-133.6	-143.1	-145.6	-133.1	-106.8	-70.1	-58.6	-59.0	-63.6	-71.6	-59.2	-62.0	-65.6	-52.4	0.0
Mining	$M	-445		-22.6	-75.3	-82.9	-85.2	-74.9	-52.8	-15.5	-2.6	-2.6	-5.6	-15.7	-9.8	0.0	0.0	0.0	0.0
Processing	$M	-684		-22.4	-49.4	-51.3	-51.5	-49.3	-45.1	-45.7	-47.1	-47.5	-49.0	-47.1	-40.4	-47.9	-50.9	-39.6	0.0
General & Administrative	$M	-127		-4.5	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-8.9	-7.0	0.0
Mine EBITDA	$M	1,605		81.1	190.5	258.2	229.6	172.2	173.0	124.1	89.9	87.9	66.8	44.5	36.8	25.7	16.8	7.8	0.0
Less: Sustaining Capital	$M	-63		-1.7	-2.7	-5.1	-4.2	-5.8	-7.7	-3.8	-4.5	-5.3	-8.0	-5.7	-4.1	-4.1	0.0	0.0	0.0
All-In-Sustaining Costs	$M	-1,394		-53.7	-142.8	-156.2	-157.2	-145.0	-120.1	-77.8	-66.0	-67.2	-74.1	-79.6	-65.2	-67.9	-67.2	-53.6	0.0
Sustaining Margin	$M	1,542		79.4	187.7	253.1	225.4	166.3	165.3	120.3	85.4	82.6	58.8	38.8	32.7	21.6	16.8	7.8	0.0
Less: Working Capital Movement	$M	0		-11.6	-0.7	-2.1	1.9	2.1	0.8	3.8	0.2	0.0	0.6	-0.2	1.5	-0.4	0.3	3.1	0.7
Less: Taxes	$M	-217		0.0	0.0	-8.7	-35.3	-54.0	-14.0	-34.7	-18.2	-8.8	-8.9	-12.2	-9.0	-2.9	-3.6	-3.5	-2.8
Less: Customs Duties & VAT	$M	0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FCF Before Non-Sustaining Capital	$M	1,325		67.7	187.0	242.3	192.0	114.5	152.1	89.4	67.3	73.9	50.5	26.4	25.2	18.3	13.5	7.5	-2.1
Less: Non-Sustaining Capital	$M	-345	-210.4	-134.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Equipment Financing	$M	-32	-3.2	-6.4	-6.4	-6.4	-6.4	-3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Reclamation and Salvage Costs	$M	-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-4.7	0.0

Table 11.4.4 Condensed Annual Financial Model (continued)

Item	Unit	LOM Total / Average	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Exploration	$M	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mine Free Cash Flow	$M	944	-213.6	-72.8	180.6	235.9	185.6	111.2	152.1	89.4	67.3	73.9	50.5	26.4	25.2	18.3	13.5	2.9	-2.1
Cumulative Mine Free Cash Flow	$M		-213.6	-286.4	-105.8	130.1	315.6	426.9	579.0	668.3	735.7	809.5	860.0	886.4	911.6	929.9	943.4	946.3	944.2

Project IRR and NPV (after-tax)		
Internal Rate of Return	%	43.3%
Net Present Value - 0% Discount Rate	$M	944.2
Net Present Value - 5% Discount Rate	$M	640.0
Net Present Value - 10% Discount Rate	$M	438.9
Payback Period	Years	2.1

Table of Contents

			Page
12.0	**RECOMMENDATIONS**		**12.1**
	12.1	Introduction	12.1
	12.2	Implementation	12.1
	12.3	Risks	12.2
	12.4	Opportunities	12.3

12.0 RECOMMENDATIONS

12.1 Introduction

This section briefly outlines the path forward and the current risks and opportunities identified.

12.2 Implementation

The approach to project implementation is to engage a suitable Engineering, Procurement and Construction Management (EPCM) contactor for design and construction management of the process plant and infrastructure, which will then be handed over to the Owner's operating team. The construction of the mining operations will be self-performed by the Endeavour operations team. This approach was used as the basis for the build up of the capital cost estimates.

The first stage of the implementation is to commence Front End Engineering Design (FEED), which is now underway, focussing initially on completing sufficient engineering detail for the procurement of long lead items. FEED will produce key deliverables including the following:

- Process design and flowsheets.
- Mechanical and electrical equipment lists and design bases.
- Standard specifications.
- Long lead equipment specifications (crushers, feeders, agitators, CIL tanks, intertank screens buildings).
- Tender adjudications and recommendations.
- Procurement packages for structural steel, platework, reo bar, cast-ins, bulk pipe, steel framed buildings.
- Process plant layouts.
- Drawing standards.
- Bulk earthworks scope of work and drawings.
- Below ground concrete design for key structures (primary crushing, milling, CIL).

Duration of this activity is six weeks. Subsequent to this detailed design will commence.

12.3 Risks

Risk Reviews

No formal risk reviews have been undertaken either during the FS or during this optimisation study. With a compressed timeline and concurrent activities, these reviews have been deferred to post FS, and either prior to or during detailed design. It is recommended that the following occur:

- Hazop / Hazid – During detailed design with design and layout revised from FS.
- Design and Constructability – Initial post FS, detailed during detailed design phase.
- Project Risk Review – Post FS and prior to detailed design.

Site Geotechnical

- While a detailed geotechnical program was completed for the process plant site as nominated in the 2016 Feasibility Study, a follow up program is required. This program is currently being planned based on the final plant site location.

Site Layout

- Site layout requires further optimisation.

Metallurgical Testwork

- The metallurgical testwork program conducted during and after the FS has identified the key issues of soluble copper and arsenic and developed methods for treatment. The plant has been designed for a maximum soluble copper level of 200 ppm based on the mine schedule. Careful grade control will be required to avoid exceeding that level.

Power

- Power supplies in Africa can pose risks for reliability, which has forced operating mines to install additional diesel generation to maintain plant availability. CIE Energies in Côte d'Ivoire considers their power supply to be reliable. An alternative 225 kV OHPL from Man, should be considered as an alternative to the currently selected 90 kV from Danane during the detailed design phase. This option is potentially more reliable, with significantly more load capability. The additional cost of this option is considered low at this point.

Environmental and Community

- A number of changes have occurred during both the FS and Optimisation Study that conflict with information in previous ESIA submissions. This includes relocation of TSF and process plant, ROM pad, Cavally River diversion, additional river diversion required to accommodate Walter pit and new site access road. A revised ESIA will be developed to consider the impacts of these changes and will require submission to Government. This is a potential schedule impact for any required re-permitting.

Project Execution

- Execution of CIL project construction activities will have potential impacts on current HL operations. This requires careful consideration and planning to reduce risks associated from interaction of these activities from both a cost, schedule and safety perspective.

12.4 Opportunities

Earthworks

- Terracing of the main process plant pad may reduce earthworks volumes, and it is expected that post study work in the FEED phase of the project will realise significant reductions in earthworks volumes

Metallurgy and Process Development

- Treatment for soluble copper and arsenic consumes significant reagents and a further program of optimisation to reduce sulphuric acid in the arsenic precipitation is warranted.

Water Treatment

- Available water analysis data for the FS was limited and provisions for dewatering bore treatment pre release were included. Recent analysis has indicated the dewatering bore is low in arsenic and may be suitable for release. This may allow deferral or removal of this water treatment facility. Water should be tested for basic physio-chemical parameters, nutrients and metals.