APPENDIX B

OPTIMIZATION STUDY

NOTE TO READER
APPENDIX B

In April 2015, Treasury Metals submitted an Environmental Impact Statement (EIS) for the proposed Goliath Gold Project (the Project) to the Canadian Environmental Assessment Agency (the Agency) for consideration under the Canadian Environmental Assessment Act (CEAA), 2012. The Agency reviewed the submission and informed Treasury Metals that the requirements of the EIS Guidelines for the Project were met and that the Agency would begin its technical review of the submission. In June 2015, the Agency issued a series of information requests to Treasury Metals regarding the EIS and supporting appendices (referred to herein as the Round 1 information requests). The Round 1 information requests included questions from the Agency, other federal and provincial reviewers, First Nations and other Aboriginal peoples, as well as interested stakeholders. As part of the Round 1 information request process, the Agency requested that Treasury Metals consolidate the responses to the information requests into a revised EIS for the Project.

Appendix B to the revised EIS (Optimization Study) presents a review of the potentially viable gold processing alternatives for the Project. The information provided in this appendix was used in the evaluation of alternatives presented in Section 2 and Appendix X, as well as in the Project description (Section 3) used as the basis for the revised EIS. No changes have been made to this appendix from the original EIS issued in April 2015.

As part of the process to revise the EIS, Treasury Metals has undertaken a review of the status for the various appendices. The status of each appendix to the revised EIS has been classified as one of the following:

- **Unchanged**: The appendix remains unchanged from the original EIS, and has been re-issued as part revised EIS.
- **Modified**: The appendix remains relatively unchanged from the original EIS, and has been re-issued with relevant clarification.
- **Re-written**: The appendix has been substantially changed from the original EIS. A re-written appendix has been issued as part of the revised EIS.
- **Discarded**: The appendix is no longer required to support the EIS. The information in the original appendix has been replaced by information provided in a new appendix prepared to support the revised EIS.
- **New**: This is a new appendix prepared to support the revised EIS.

The following table provides a listing of the appendices to the revised EIS, along with a listing of the status of each appendix and their description.

List of Appendices to the Revised EIS		
Appendix	Status	Description
Appendix A	Modified	Table of Concordance
Appendix B	Unchanged	Optimization Study
Appendix C	Unchanged	Mining Study
Appendix D	Re-written	Tailings Storage Facility
Appendix E	Unchanged	Traffic Study
Appendix F	Re-written	Water Management Plan
Appendix G	Discarded	Environmental Baseline
Appendix H	Unchanged	Acoustic Environment Study
Appendix I	Unchanged	Light Environment Study
Appendix J	Unchanged	Air Quality Study
Appendix K	Unchanged	Geochemistry
Appendix L	Discarded	Geochemical Modelling
Appendix M	Unchanged	Hydrogeology
Appendix N	Unchanged	Surface Hydrology
Appendix O	Discarded	Hydrologic Modeling
Appendix P	Unchanged	Aquatics DST
Appendix Q	Re-written	Fisheries and Habitat
Appendix R	Re-written	Terrestrial
Appendix S	Re-written	Wetlands
Appendix T	Unchanged	Socio-Economic
Appendix U	Unchanged	Heritage Resources
Appendix V	Unchanged	Public Engagement
Appendix W	Unchanged	Screening Level Risk Assessment
Appendix X	Re-written	Alternatives Assessment Matrix
Appendix Y	Unchanged	EIS Guidelines
Appendix Z	Unchanged	TML Corporate Policies
Appendix AA	Modified	List of Mineral Claims
Appendix BB	Unchanged	Preliminary Economic Assessment
Appendix CC	Unchanged	Mining, Dynamic And Dependable For Ontario's Future
Appendix DD	Re-written	Aboriginal Engagement Report
Appendix EE	Unchanged	Country Foods Assessment
Appendix FF	Unchanged	Photo Record Of The Goliath Gold Project
Appendix GG	Modified	TSF Failure Modelling
Appendix HH	Unchanged	Failure Modes And Effects Analysis
Appendix II	Unchanged	Draft Fisheries Compensation Strategy and Plans
Appendix JJ	New	Water Report

TREASURY METALS INC.

GOLIATH GOLD PROJECT
PROCESS OPTIMIZATION STUDY

Lycopodium

5027-REP-001

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REV NO.	DATE	DESCRIPTION OF REVISION	BY	DESIGN APPROVED	PROJECT APPROVED
D	7.10.17	ISSUED FOR INFORMATION	SG		
C	3.06.14	ISSUED FOR INFORMATION	SG		
B	17.04.14	ISSUED FOR INFORMATION	TF		
A	31.03.14	DRAFT ISSUED FOR REVIEW	TF		

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DISCLAIMER

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TABLE OF TERMS AND ACRONYMS

1Q14	first quarter of 2014
µm	microns (10^{-6} m)
Axb	JK SimMet Rock Breakage Parameters
AARL	Anglo American Research Laboratory
ADIS	Automated Digital Imaging System
Ag	silver
Ai	Abrasion Index
ALS	Australian Laboratory Services
ARD	Acid Rock Drainage
Au	gold
BFS	Bankable Feasibility Study
BMAL	Bulk Mineral Analysis with Liberation
BWi	Bond Work Index
CCTV	Closed Circuit Television
Cdn$	Canadian dollars
CGR	Continuous Gravity Recovery
CIL	Carbon-in-Leach
CIP	Carbon-in-Pulp
cps	centipoise
EIS	Environmental Impact Statement
FEL	Front End Loader
g/t	grams per tonne
Gekko	Gekko Systems Pty Ltd
GRG	Gravity Recoverable Gold
HVAC	Heating, Ventilating, and Air Conditioning
ICP	Inductively Coupled Plasma (trace metal analysis technique)
I/O	Input / Output
IL	Intensive Leach
ILR	Intensive Leach Reactor
km	kilometres
kWh	kilowatt-hours
LOM	Life of Mine
m	metres
MCC	Motor Control Centre
MIBC	methyl isobutyl carbinol
MMER	Metal Mining Effluent Regulations
MTO	Material Take Off
NaCN	sodium cyanide
NG	Natural Gas
Owner	Treasury Metals Inc.
PAX	potassium amyl xanthate
PCS	Plant Control System
PDC	Process Design Criteria
PEA	Preliminary Economic Assessment
POX	Pressure Oxidation
ppm	parts per million
QEMSCAN	Quantitative Evaluation of Minerals by Scanning Electron Microscopy
ROM	Run of Mine
SAG	Semi-Autogenous Grinding
SG	Specific Gravity
SMBS	sodium metabisulphite
SO_2	sulphur dioxide
t	tonnes
t/a	tonnes per annum (year)
t/d	tonnes per day
TOC	Total Organic Carbon
TSF	Tailings Storage Facility
UPS	Uninterruptible Power Supply

US$	United States dollars
VESDA	Very Early Smoke Detection and Alarm
WSP	WSP Canada Inc., Engineering consultant for TSF

1.0 EXECUTIVE SUMMARY

1.1 Introduction and Background

Treasury Metals Inc. ("Treasury") plans to develop the Goliath Gold Project, located near the community of Wabigoon and approximately 20 km east of Dryden in northern Ontario, into an operating mine and gold processing facility.

A detailed Project Description (dated 26 November 2012) has been previously prepared, and Treasury are currently working to prepare a detailed Environmental Impact Statement (EIS) for submission to the federal government in the third quarter of 2014. Also in the third quarter of 2014, Treasury intends to initiate a Bankable Feasibility Study (BFS) for the project, by which time the process to be utilized within the plant for gold extraction must be established and agreed by the key project stakeholders.

The purposes of this Optimization Study are to:

- Consider potentially viable gold processing alternatives for the new facility, considering all work performed to date as well as the input of other consultants currently engaged on the project.
- Evaluate the relative merits, opportunities, drawbacks, and risks of the alternatives including comparative conceptual (±35%) capital and operating cost estimates for each alternative.
- Recommend a preferred process option on which to base future project development and to carry forward to the upcoming BFS.
- Provide the level of process development necessary for the recommended alternative to support the EIS submission by Treasury.

1.2 Study Approach

In January 2014, Treasury retained Lycopodium Minerals Canada Ltd (“Lycopodium”) to prepare an Optimization Study for process plant and infrastructure aspects of the project. The aim of this study is to review previous work and develop process and cost scenarios for the project for the purpose of establishing a preferred process for development in a subsequent bankable feasibility study.

Lycopodium's scope of facilities for this study included the process plant, plant site infrastructure (power distribution systems, water systems, plant air, natural gas supply and distribution, plant fuel storage, sewage systems, site roads and drainage except haul roads, plant buildings, including offices, plant maintenance workshop, warehouse, administration, plant control room / MCCs, plant entry security, assay laboratory, and building services such as HVAC, fire protection, lighting).

Treasury separately retained a consulting firm; WSP Canada Inc. of Thunder Bay, Ontario to perform a similar review and optimization of tailings deposition and storage, water reclamation and treatment aspects of the project.

1.3 Metallurgy

Goliath is a free-milling gold deposit primarily composed of quartz-sericite, biotite-muscovite schist and a minor metasedimentary rock component. The dominant non-sulphide gangue materials are quartz (56%), micas (22%), and feldspars (17%). Sulphide minerals, consisting primarily of pyrite and pyrrhotite, account for less than 2% of the deposit. The material contains coarse gold and is readily amenable to conventional processing routes including gravity concentration combined with carbon-in-leach (CIL) or flotation. LOM head grades are presently 2.87 g/t gold, and 9.3 g/t silver. The highest recoveries achieved in testwork were 95.5% gold and 63% silver accomplished using the gravity – cyanide leach flowsheet.

For the three options considered the plant capacity, estimated recovery, and estimated gold production are as follows:

Table 1.1: Plant Capacity, Gold Recovery, and Gold Production

Parameter	Option 1	Option 2	Option 3
Plant ROM Ore Throughput			
Dry (t/d)		2,700	
Recovery (%)	95.5	94.4	93.9
Metal Production			
Au (oz/a)	86,852	85,852	85,397
Total Equivalent Au * (oz/a)	89,648	89,670	88,058

*Equivalent Gold Based on Au/Ag Price Ratio = 66

As seen in the table above, all options were based on a common throughput of 2,700 t/d to simplify the analysis of alternatives; as a separate exercise Lycopodium investigated potential savings associated with the construction of an initially smaller (ie: reduced tonnage) plant. This investigation is described in the Reduced Tonnage Options Study of Appendix 7.

1.4 Process Plant and Infrastructure

Three options for processing of the Goliath ore were identified and considered as part of this Optimization Study. Two of the options produce doré bar as the final product, and one option produces both doré and sulphide concentrate to be sold, as indicated below:

- **Option 1** – Standard Gravity / CIL Circuit with Cyanide Destruction of CIL Tails (doré bar production).

- **Option 2** – Gravity followed by Flotation and subsequent sale of Flotation Concentrate. This is a Zero Cyanide Circuit (concentrate and some doré bar production).

- **Option 3** – Gravity followed by Flotation and Intensive Cyanide Leaching of the Concentrate (doré bar production).

All options include common front end crushing and grinding, while the back ends of the three options differ significantly in processing steps utilized and amount of cyanide required.

For the purpose of this study, and for the balance of the work, Option 1 was considered the base case upon which a full conceptual design was developed and is described in this report.

An evaluation of plant infrastructure requirements was also conducted and is described for the base case facility, including the utilization of existing Treasury-owned buildings near the site for administration and warehousing purposes.

1.5 Capital and Operating Costs

A summary of capital costs for the three options is provided below.

Table 1.2: Capital Cost Summary for Three Process Options (±35%)

	Option 1 (Cdn$)	Option 2 (Cdn$)	Option 3 (Cdn$)
Plant Cost	49,310,000	42,240,000	46,840,000
Infrastructure Cost	16,880,000	16,130,000	16,760,000
TSF Cost (from WSP)	9,330,000	9,330,000	9,330,000
Indirects	15,370,000	14,400,000	15,180,000
TOTAL	**90,890,000**	**82,100,000**	**88,110,000**

A summary of operating costs for the three options is provided below:

Table 1.3: Operating Cost Summary for Three Process Options (±35%)

	Estimate Summary (1Q14, ±35%)		
	Cdn$	**Cdn$/t ore**	**Cdn$/oz Au (Equiv.)**
Option 1	19,121,554	19.40	213.30
Option 2	14,294,792	14.51	159.42

Option 3	16,234,071	16.47	184.36

Lycopodium's investigation of capital and operating cost variations associated with the construction of an initially smaller (ie: reduced throughput) plant is described in the Reduced Tonnage Options Study of Appendix 7.

1.6 Recommended Path Forward

Within the level of detail of this study, there is essentially no difference between Options 1 and 3 in terms of capital costs and perceived value to the project. While Option 3 will have a lower operating cost, it will also deliver approximately 2% lower overall recovery than Option 1. Option 1 will provide the highest overall recovery and significant decreased sensitivity to process upsets. As such, Lycopodium recommends proceeding with Option 1 (Gravity Concentration, CIL Circuit) as the preferred option for future project development. This presents no change from the processing route selected in the PEA.

2.0 METALLURGY

Sufficient metallurgical testing has been conducted on samples of the Goliath deposit to allow for evaluation of the three processing options. The test work has been reviewed and the selected process design criteria (PDC) used for development of the options is presented in this section.

2.1 Metallurgical Testing

As of 15 February 2014, three completed metallurgical test work programs were available for review with one ongoing. Two of the programs were undertaken by G&T Metallurgical Services Ltd.[1,2], and one by Gekko Systems Pty Ltd[3]. These test programs are briefly discussed in chronological order in the following subsections. For more detailed information the reader is referred to the test work reports, some of which are currently available on Treasury's website.

2.1.1 Pre-Feasibility Test Work

G&T Metallurgical Services Ltd. in Kamloops, British Columbia, undertook Pre-Feasibility test work between Feb 2011 and June 2011. A composite sample was prepared and used for the test program. Two processing routes were investigated:

- gravity concentration followed by cyanidation of the gravity circuit tailing, and
- gravity concentration followed by flotation of the gravity tailing and subsequent cyanidation of the flotation concentrate.

The gravity / cyanidation route produced the best overall gold recovery at 95% to 96% at a grind size of P_{80} 105 microns and 48 hours of leaching. The flotation route produced gold recoveries of 90%. The processing flowsheets are depicted in Figure 2.1 (images taken from ALS report KM2906). QEMSCAN and ADIS mineralogical studies as well as a single bond ball mill work index test were also conducted.

Sample

[1] Pre-Feasibility Metallurgical Testing Goliath Gold Project KM2906; G&T Metallurgical Services Ltd, June 2011; Kamloops, BC, Canada.
[2] Feasibility Metallurgical Testing Goliath Gold Project KM3406; G&T Metallurgical Services Ltd, September 2012; Kamloops, BC, Canada.
[3] Test work Report T0892 Treasury Metals Goliath Ver 1.4; Gekko Systems Pty. Ltd.; February 2014; Ballarat, Victoria, Australia.

The composite comprised 30 individual half cores totalling 58.6 kg. The samples used for the composite are numbered in the range of 383564 to 980782. These have not been correlated to drill hole numbers. As such, the spatial origin or representativeness of this sample has not been determined. The head assays of this composite, shown in Table 2.1 reveal grades higher than the expected life of mine for both gold and silver. The specific gravity (SG) of the Knelson and pan tail blend after leaching, and at 105 µm, was measured to be 2.69.

A bond ball mill work index test was performed on the composite sample producing a result of 11.1 kWh/t.

Table 2.1: Replicate Head Assays for Composite 1

Sample	Assays							
	% Cu	**% Pb**	**% Zn**	**% Fe**	**% S**	**Au g/t**	**Ag g/t**	**% C**
Master Composite 1 Head 1	0.017	0.04	0.08	1.33	1.46	-	25	0.02
Master Composite 1 Head 2	0.017	0.04	0.08	1.32	1.33	-	24	0.02
Master Composite 1 Head 3	0.010	0.04	0.07	1.63	1.40	3.5	-	-
Master Composite 1 Head 4	0.013	0.07	0.07	1.58	1.41	3.3	-	-
Average	**0.014**	**0.05**	**0.08**	**1.47**	**1.40**	**3.4**	**24**	**0.02**

Gravity and Leach Test Work

Flowsheets of the two processing routes tested are depicted in Figure 2.3 (images taken from ALS report KM2906). Results of the tests are presented in Table 2.3. The gravity recovery numbers in this report are lower than in the subsequent reports because the gravity concentrate is reported as pan concentrate. Given that the high grade pan tail reports to the leach, the leach recoveries in this report are similar to the whole ore leach results reported in subsequent reports. Leach kinetics of gold were quick with leaching being essentially complete in 24 hours. Silver leaching occurred more slowly and was still ongoing at 48 hours. Leach kinetics are presented in Figure 2.1 and Figure 2.2. Results of the Pre-Feasibility gravity tests are presented in Table 2.2.

Table 2.2: Pre-Feasibility Gravity Recovery Test Results

Test	Pan Concentrate	Pan Tail	Knelson Tail

	Recovery %		Recovery %		Recovery %	
	Au	Ag	Au	Ag	Au	Ag
1	26	6	45	24	29	70
4	23	5	40	13	37	82
8	43	8	30	23	27	69

Table 2.3: Pre-Feasibility Test Work Recoveries

Gravity Test #	Leach Test #	Leach Material Description	Grind Size (µm)	NaCN (ppm)	Metal Recovery					
					Pan Conc Recovery (%)		48 hr Leach Recovery (%)		Overall Recovery (%)	
					Au	Ag	Au	Ag	Au	Ag
1	2	Knelson Tail	105	2000	26	6	90	74	92	76
1	3	Knelson and Pan Tail Blend	105	2000	26	6	96	76	97	77
4	5	Knelson and Pan Tail Blend	125	2000	23	5	92	71	94	72
4	6	Knelson and Pan Tail Blend	68	2000	23	5	95	77	96	78
8	9	Knelson and Pan Tail Blend	144	2000	43	8	93	68	96	71
1	11	Knelson and Pan Tail Blend	105	1000	26	6	97	63	97	65
1	12	Knelson and Pan Tail Blend	105	500	26	6	95	67	96	69
10	13	Bulk Rougher Concentrate*	105	2000	36	8	95*	96*	90	88

* Flotation Concentrate Recovered 57% of the head Au, and 84% of the head Ag

Figure 2.1: Pre-Feasibility Test Work Gold Leach Kinetics

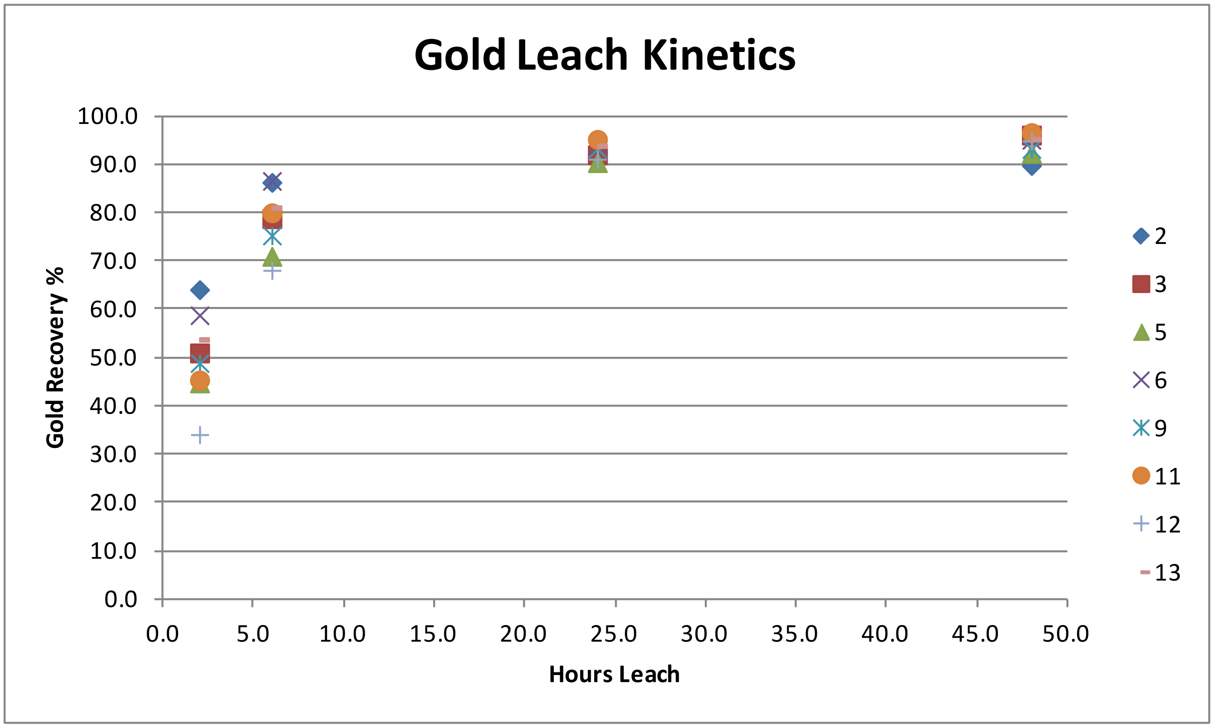


Figure 2.2: Pre-Feasibility Test Work Silver Leach Kinetics

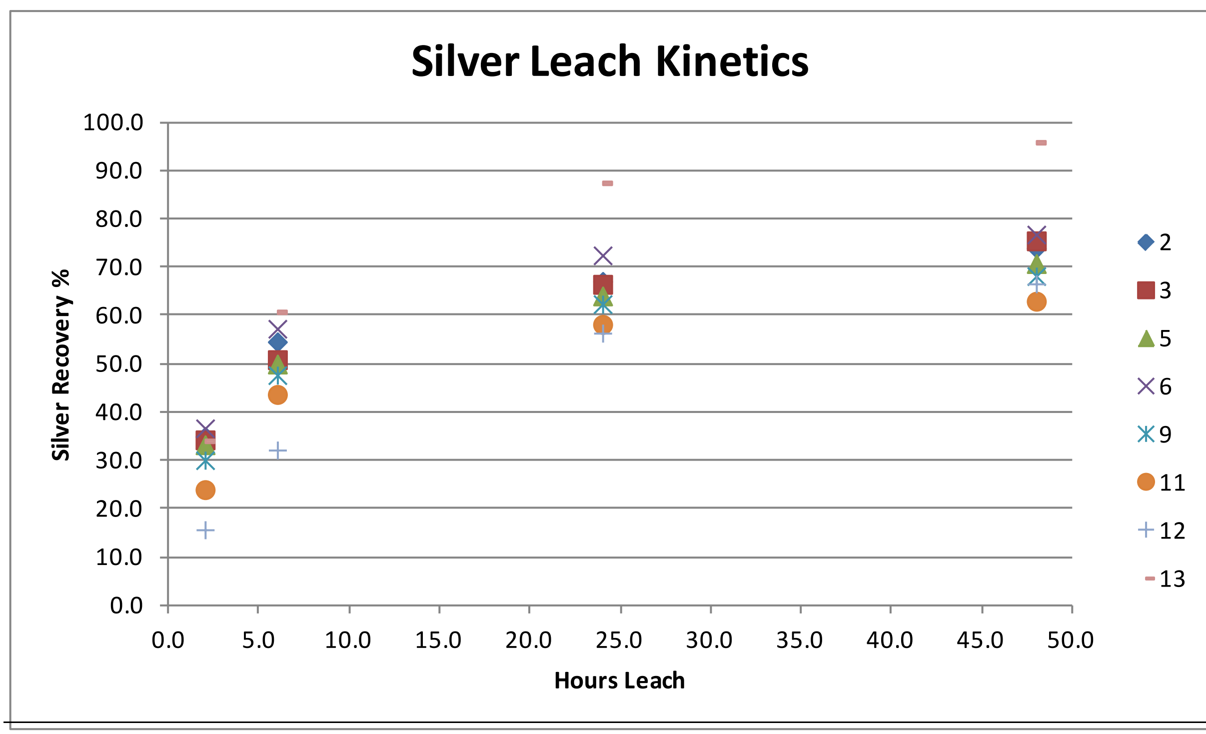
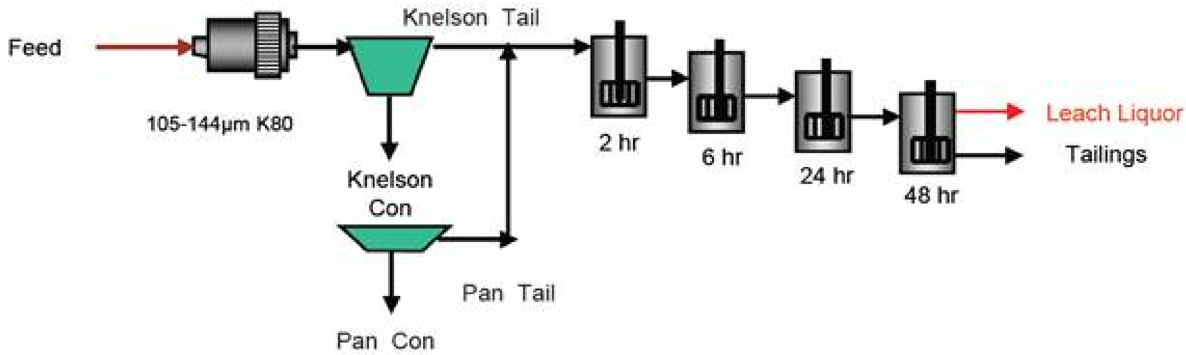
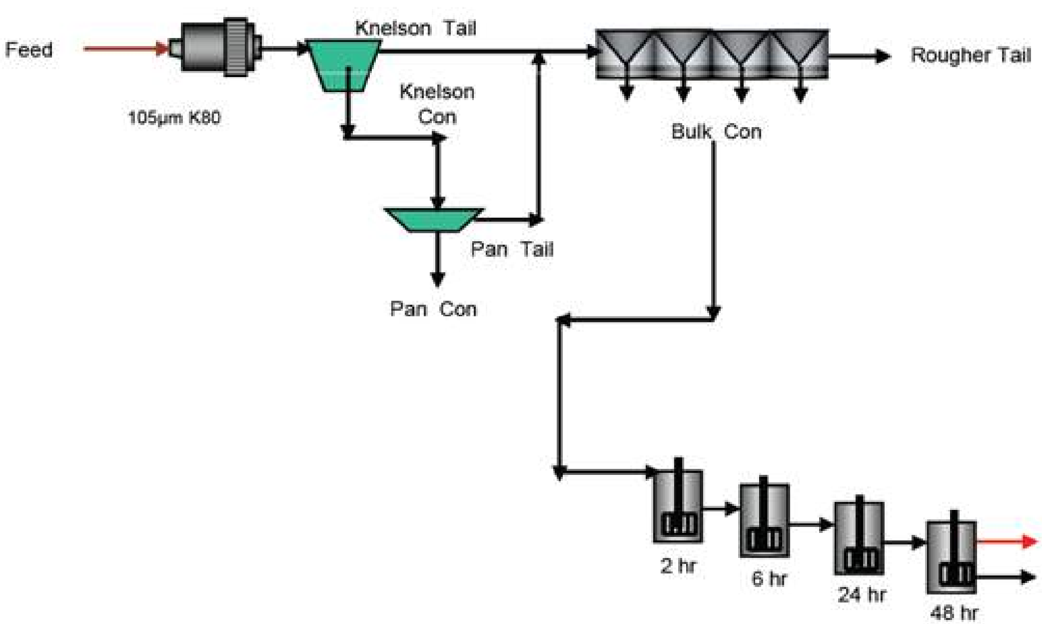


Figure 2.3: Pre-Feasibility Test Work Flowsheets (Images taken from ALS Report KM2906)

Flowsheet 1 – Gravity-Cyanidation (Tests 1-6,8-9,11-12)



Flowsheet 2 – Gravity-Flotation-Cyanidation (Tests 7,10,13)



Mineralogy

The mineral content and preliminary fragmentation data were acquired by completing a QEMSCAN Bulk Mineral Analysis with Liberation (BMAL). Results of the BMAL analysis are presented in Table 2.4. No silver minerals were observed during the mineralogical analysis. It was believed that the concentration of silver in the feed was too low to allow for observation of carrier minerals, and possibly that the silver is tied up in mineral structure like tetrahedrite. Total sulphide content accounted for ~2.1% of the sample mass. About 10% of the sulphide mineral was present as pyrrhotite. The dominant non-sulphide gangue minerals present were quartz 56%, micas 22%, and feldspars 17%. Minor amounts of chlorites and iron oxides were also observed.

Table 2.4: Mineral Composition of Composite 1

Minerals	Weight Percent
Sizing (K80, µm)	105
Copper Sulphides	0.05
Galena	0.04
Sphalerite	0.13
Pyrite	1.65
Pyrrhotite	0.20
Iron Oxides	0.09
Quartz	55.6
Feldspars	16.7
Muscovite	19.9
Biotite / Phlogopite	2.27
Chlorite	0.71
Epidote	0.45
Ti Minerals	0.24
Tourmaline	0.35
Apatite	0.17
Amphibole (Hornblende)	0.16
Calcite	0.07
Others	1.21
Total	100

Note:

1) Copper sulphides includes chalcopyrite, covellite and tetrahedrite

2) Iron oxides includes magnetite, hematite, geothite, and limonite

3) Feldspars includes plagioclase-feldspar, feldspar-albite, alkali feldspar, and K-feldspar

4) Ti minerals includes sphene and rutile / anatase

5) Tourmaline includes kaoline

6) Others includes chromite, garnet, and unsolved minerals

2.1.2 Feasibility Test Work

Feasibility test work was undertaken by G&T Metallurgical Services Ltd. in Kamloops, British Columbia, between April 2012 and September 2012. Two master composite samples were prepared along with ten variability composites.

Two processing routes were investigated using the master composite samples:

- gravity concentration followed by cyanidation of the gravity circuit tailing, and
- whole ore leach.

The variability composite samples were tested using only the gravity followed by cyanidation flowsheet. The test flowsheets are shown in Figure 2.2. Silver recoveries were not measured in this test work program.

Sample

One hundred and sixty three (163) discrete samples from 17 drill holes totalling 398.5 kg were used to generate Master Composite 2. Prior to the reporting of grades, initial comminution and metallurgical tests were conducted on Master Composite 2. When measured, the gold grade was found to be higher than the resource grade, and Master Composite 2 was diluted with TL0802, TL1097 and TL11178 to generate Master Composite 3. All remaining test work was conducted on Master Composite 3. Master Composite 2 was estimated at 5.9 g/t Au and 11 g/t Ag, and Master Composite 3 at 2.2 g/t Au and 8 g/t Ag. Variability composites were also generated. The full test work report (KM3406) provides additional details. Gold grade in the variability composites ranged from 0.4 to 15.4 g/t. The degree of sample representativeness of the deposit was not evaluated in this study. The head assays for the Master Composites are shown below. It is noted that the mercury assays reported are at the limit of detection values. The actual mercury assays are expected to be lower.

Table 2.5: Feasibility Test Work Composite Head Grades

Sample	Assays								
	Au g/t	**Ag g/t**	**% As**	**% S**	**% S (s)**	**% C**	**% TOC**	**% Sb**	**Hg g/t**
Master Composite 2	5.89	11	0.02	1.24	1.22	0.03	0.02	0.003	1*
Master Composite 3	2.15	8	0.004	1.27	1.24	0.02	0.01	0.003	1*
Variability Comp 1	1.98								
Variability Comp 2	0.84								
Variability Comp 3	2.34								
Variability Comp 4	3.59								
Variability Comp 5	2.86								
Variability Comp 6	0.71								
Variability Comp 7	1.82								
Variability Comp 8	5.52								
Variability Comp 9	0.37								
Variability Comp 10	15.4								

Gravity and Leach Test Work

Two flowsheets were tested. The flowsheets are depicted in Figure 2.4. The first flowsheet included gravity separation with intensive cyanide leach of the gravity concentrate and traditional agitated leach of the gravity tail. The second flowsheet involved direct agitation of the whole ore leach.

For Flowsheet 1, the primary grind size varied from 60 to 147 µm K80. The gravity concentrate was subjected to intensive cyanidation. The leach residue was combined with the gravity tail for further cyanidation. Once the primary grind size was established, additional tests were carried out at variable NaCN concentrations from 250 to 2,000 ppm. The pH was maintained at 11.0. At the conclusion of the tests, an additional test was conducted without oxygen sparging using Owner selected conditions.

For Flowsheet 2, the primary grind size was maintained at 94 µm K80. The whole ore sample was subjected to cyanidation at 1,000 ppm NaCN. The pH was maintained at 11.0.

The gravity recoveries reported in the Feasibility test work program are based on intensively leached Knelson concentrate (no pan upgrading). Mass recoveries were not reported. The two initial tests indicated that the gravity recoverable gold content of the feed was between 69% and 72%.

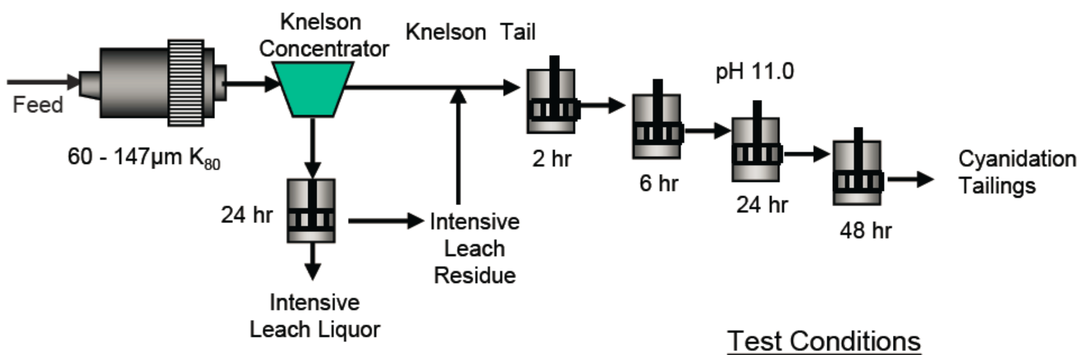
The ore leach recoveries are lower than those reported in the Pre-Feasibility test work because the leach head grade was significantly lower on account of higher gravity recoveries (no pan tails returning to leach). These results indicate that gold recovery is controlled by a constant tails grade and varies with head grade. This can be seen clearly in Figure 2.5. The recoveries achieved in Feasibility gravity / leach test work are summarized in Table 2.6.

The gravity concentrate of sub-samples of Master Composites 2 and 3 was submitted for Automated Digital Imaging System (ADIS) testing. This testing showed that 72% of Master Composite 2 was liberated and 42% of Master Composite 3 was liberated. The majority of the remaining gold mass in Master Composite 2 was associated with pyrite. The majority of remaining gold mass in Master Composite 3 was split evenly between gangue and multi-phase particles. Again, no silver is reported despite the samples containing 11 and 8 g/t respectively.

Similar to the Pre-Feasibility test work, the leach kinetics of the gravity tails are such that leaching is essentially complete in 24 hours. Silver recoveries were not measured in the Feasibility test work program.

Figure 2.4: Feasibility Test Work Flowsheets

Gravity plus Cyanidation Flowsheet 1 (Tests 2 to 4, 7 to 28)

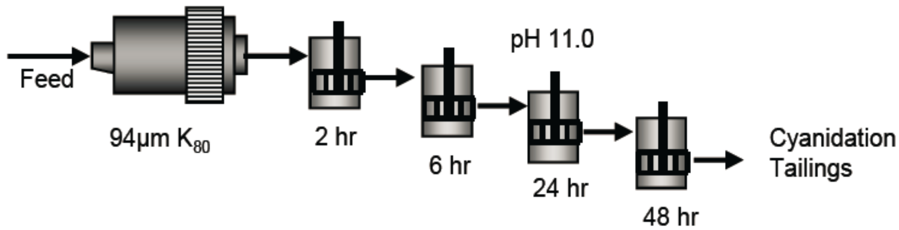


Test Conditions

Gravity Concentrate Leach
24 hours
~10% solids
50g/L NaCN
20g/L LeachAid
pH 12

Gravity Tailing Leach
48 hours
~40% solids
0.025-2.0g/L NaCN
Oxygen/Air
pH 11

Whole-of-Ore Direct Cyanidation Flowsheet 2 (Tests 3 and 5)



Test Conditions

Whole-of-Ore Leach
48 hours
~40% solids
1.0g/L NaCN
Oxygen
pH 11

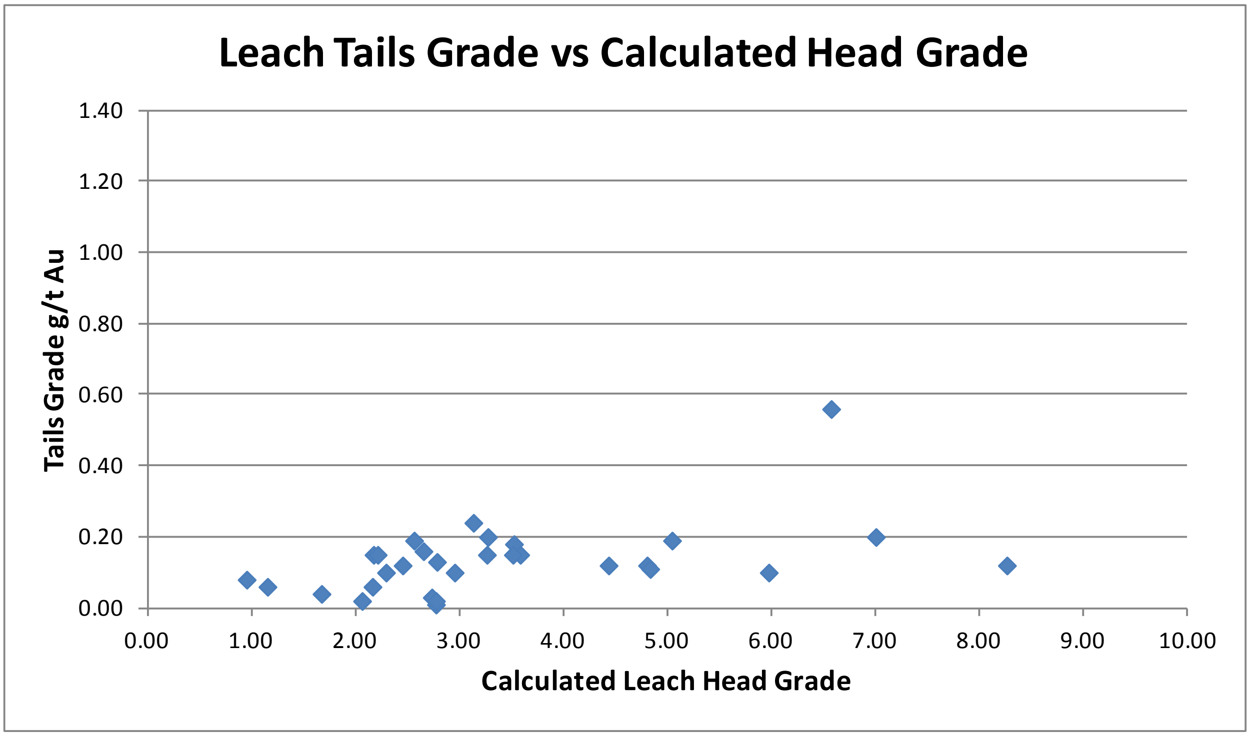
Table 2.6: Feasibility Test Work Composite Recoveries

Sample	Head Grade Au g/t	Grind Size K80 µm	Gold Extraction (oxygen sparge)			Reagent	
			Gravity Leach Solution	48 Hour Bottle Leach	Overall	Consumed kg/t	
			% Au	% Au	% Au	NaCN	Lime
MC2	5.89	114	72	26	98	1.1	0.3
MC2	5.89	114	-	98	98	1	0.3
MC3	2.15	94	69	26	96	0.8	0.2
MC3	2.15	94	-	95	95	0.6	0.2
MC3	2.15	147	70	24	94	0.3	0.3
MC3	2.15	73	74	22	96	0.6	0.4
MC3	2.15	60	73	23	96	1.3	0.4
MC3	2.15	94	61	33	94	0.8	0.3
MC3	2.15	94	63	30	93	0.4	0.3
MC4	2.15	94	68	24	93	0.3	0.3
MC5	2.15	94	71	25	95	0.3	0.3
MC6*	2.15	94	85	13	97	2.1	0.7

* Air Sparge

Sample	Head Grade Au g/t	Grind Size K_{80} µm	Gold Extraction (air sparge)			Reagent	
			Gravity Leach Solution	48 Hour Bottle Leach	Overall	Consumed kg/t	
			% Au	% Au	% Au	NaCN	Lime
Variability Comp 1	1.98	91	76	22	97	1.5	0.2
Variability Comp 2	0.84	102	95	4	99	0.6	0.4
Variability Comp 3	2.34	112	79	18	97	0.5	0.4
Variability Comp 5	2.86	101	84	13	96	0.6	0.4
Variability Comp 6	0.71	103	67	25	92	0.5	0.4
Variability Comp 7	1.82	91	74	20	95	0.5	0.4
Variability Comp 8	5.52	100	66	26	92	0.7	0.4
Variability Comp 9	0.37	93	91	7	98	0.6	0.3
Variability Comp 10	15.4	93	77	22	98	0.4	0.3

Figure 2.5: Agitated Leach Tails Grade vs Head Grade



Additional Test Work

Flocculant screening and dosage testing along with rheology / viscosity measurements were also conducted as part of the Feasibility test work program.

The flocculant and settling test work, performed on Master Composite 3, indicated that a cationic flocculant could achieve a settling velocity of 114 mm per minute at a dosage rate of 20 g/t. Settling rate increased with increasing flocculant dosage.

The viscosity test work performed on Master Composite 3 at 60% solids, produced 164 cps at a shear rate of 119 sec^{-1}, indicating that pumping issues may be encountered when pumping at densities higher than 60 percent solids. When measured at lower shear rates, the slurry viscosity was sufficiently low to be considered acceptable for mixing and screening processes.

Comminution Test Work

SMC tests were performed by G&T on Master Composite 2, results of which are shown in Table 2.7. BWi tests were performed on the Variability Composites ranging from 8.9 to 13.9 kWh/t. The 85^{th} percentile of the variability ball mill work index results is identical to the bond mill work index of Master Composite 1 as reported in the Pre-Feasibility test work.

Table 2.7: SMC Test Results

	A x b			
Sample	**Value**	**Category**	**Rank**	**Percent**
Master Composite 2	50	Medium	2029	54.1

Table 2.8: Bond Ball Mill Work Index Results

Sample	kWh/t
Master Comp 2	10.8
Variability Comp 3	13.9
Variability Comp 4	10.8
Variability Comp 7	10.2
Variability Comp 8	10.4
Variability Comp 9	8.9
Variability Comp 10	9.2

2.1.3 Gekko Test Work

Equipment provider Gekko Systems Pty Ltd. undertook a test work program at their facilities in Australia. The Gekko report reviewed in this study (T0892) was issued 4 February 2014. Subsequent and ongoing test work by Gekko indicates that a grind size of 106 µm can produce similar overall recoveries to a 75 µm grind in Options 2 and 3, if the gravity recovery effort is intensified. In the coarser grind case, two in-line pressure jigs are proposed for rougher duty and one for cleaner duty. As the 106 µm grind size requires additional equipment and circuit complexity to achieve similar recovery, this study considers a 75 µm grind size with a simple Knelson type concentrator gravity circuit. The design of Options 2 and 3 is based on the 75 µm test work results in report T0892.

The purpose of the Gekko test work was to determine amenability of the ore to a flowsheet consisting of vertical shaft impact crushing, gravity and flotation concentration, cyanide leaching, and electrowinning recovery (from gravity concentrate).

Sample

A 167 kg sample of unpublished origin was received by Gekko. Sub samples of ~140 g were assayed for gold and silver by fire assay and ICP. Head grades are presented in Table 2.9. The gold assay discrepancies may indicate the presence of coarse gold, while the silver assays are in close alignment.

Table 2.9: Assayed and Calculated Head Grades of Gekko Composite

Sample	Au Assay (g/t)		Ag Assay (g/t)	
	Assayed	Calculated	Assayed	Calculated
Leachwell on Feed	5.43			
Test work Feed	3.11	3.16	16.15	18.75
CGR Feed	3.46	5.48	20.26	17.95
GRG Feed	4	4.38	15.44	19.96
CGR (Concentrates and Tails)		6.61		17.89
GRG (Concentrates and Tails)		5.15		
Combined CGR Gravity and Flotation		6.67		15.77
Average	**3.52**	**5.09**	**17.28**	**18.06**

Gravity, Leach, and Flotation Test Work

At 80% passing 75 µm, the lab scale Knelson concentrator (GRG test) recovered 75.8% of the gold contained in feed into a 0.4% mass yield. This result aligns with ALS test, which reported similar values of 69% to 72%, and confirms that the ore is highly amenable to gravity concentration by batch centrifugal concentration. The continuous gravity recovery (CRG) test, which simulates Gekko's in-line pressure jig, yielded 76.5% gold recovery and 36% silver recovery into 4.8% of the mass. Again, this indicates high amenability to gravity recovery.

In this test work program, whole ore leaching, batch gravity centrifugal concentration followed by leaching of the gravity tails, and gravity followed by flotation and intensive leach of concentrate processing methods were compared. The results of the tests are presented in Table 2.10. The overall gold recoveries of the CIL alternative are higher than those of the flotation alternatives. The coarse flotation alternative produced the lowest overall gold recovery.

Table 2.10: Gekko Test Work Comparison of Recovery Methods

Test Method & P_{80}	Gold Recovery				Cumulative Recovery
	Gravity	Flotation	Concentrate Leach	Tail Leach	
75 µm - Whole Ore CIL/CIP			96.0%		96.0%
75 µm - BCC Gravity + IL Con	75.8%		98.8%		74.9%
75 µm - BCC Gravity + Float + IL Con	75.8%	88.8%	97.9%		94.6%
75 µm - BCC Gravity + IL Con + CIL/CIP Tail	75.8%		98.8%	92.0%	97.2%
~300 µm - CRG Gravity + IL Con	76.5%		94.3%		72.1%

~300 µm - CRG Gravity + Float + IL Con	76.5%	54.7%	92.2%		82.4%

The Gekko test work confirmed the earlier tests in that it points to gravity followed by CIL leaching of the gravity tails as the best flowsheet option in terms of recovery. In the Gekko test work, silver recovery was lower than the Pre-Feasibility testing (the only other silver information available). This is because the Gekko test work results are based on a 24 hour leach time. In general, the Gekko test work aligns with the other test work in silver recoveries. The cyanidation test results are presented in Table 2.11. The Gekko program utilized intensive cyanidation for leaching of gravity and flotation concentrates, and traditional cyanidation for whole ore and gravity tails leaching. The results show that the composite sample is highly amenable to cyanide leaching with increased recovery and kinetics on finer particles.

The fine grind gravity, flotation, and intensive leach option provides sufficiently high recoveries to justify it as an alternative to gravity / CIL. The flotation option would occupy a smaller footprint and result in less material coming in contact with cyanide possibly providing environmental treatment cost savings.

Table 2.11: Gekko Cyanidation Recoveries of Au and Ag

Test	Cyanide Concentration (%)	8 hr Recovery (%)		24 hr Recovery (%)		Residue Grade (g/t)		NaCN (kg/t)	NaOH (kg/t)
		Au	Ag	Au	Ag	Au	Ag		
(01) Whole Ore	0.05			98	41.2	0.14	11.15	0.2	0.82
(02) GRG Concentrate	2	95.6	59.2	97.8	62.9	19.3	298	0.4	27.92
(03) CGR Concentrate	2	81.9	36.3	94.3	49.5	5.59	106	8.2	16.2
(04) CGR + Float Concentrate	2	90.4	37.7	92.2	45	5.2	108	4.9	
(05) GRG Tails	0.05			72.7	41.2	0.47	10.2	0.2	0.82
(06) Whole Ore	0.05	99	46	96	60.2	0.16	8	0.3	3.45
(07) GRG Tails	0.05	89.9	38.6	92	45.3	0.09	9	0.3	3.91
(08) GRG Concentrate	2	98.3	75.2	98.8	76.6	8.67	145	0.6	2.53

Gekko also assayed the final leach solutions yielding the results presented in Table 2.12. The analysis indicates that the leach solution does not contain sufficiently high concentrations of potentially deleterious elements to be problematic. Mercury levels are low, however no head grade measurement was provided.

Preliminary cyanide destruction test work was being conducted by Gekko at the time this report was being written.

2.1.4 Acid Rock Drainage (ARD) Test Work

Treasury has informed Lycopodium that the test(s) undertaken to ascertain the potential for ARD generation have indicated that the rock is "potentially acid generating". On this basis, the rock has been assumed to be acid generating and the sub-aqueous disposal of tailings is considered as the base case tailings alternative upon which this Optimization Study is based.

Table 2.12: ICP Analysis of Gekko Leach Solutions (ppm) (table taken from Report T0864R2)

	LGOL (01) Final Solution	LGOL (02) Final Solution	LGOL (03) Final Solution	LGOL (04) Final Solution	LGOL (05) Final Solution	LGOL (06) Final Solution	LGOL (07) Final Solution	LGOL (08) Final Solution
Au	4.28	81.18	18.02	11.95	0.82	1.93	0.51	75.16
Ag	5.25	47.2	20.7	18.1	4.33	5.6	10.9	45.6
Al	10.7	<0.1	5.5	1.9	7.2	7	6	
As	0.1	0.8	<0.1	0.1	<0.1	<1	2	
B	2	2	1	<1	1	<10	10	
Ba	0.1	0.1	0.1	0.1	0.1	<1	<1	
Be	<0.1	<0.1	<0.1	<0.1	<0.1	<1	<1	
Bi	<2	<2	<2	<2	<2	<20	<20	
Ca	6	19	14	13	13	90	100	
Cd	<0.1	<0.1	<0.1	0.1	0.1	<1	<1	
Co	<0.1	<0.1	0.2	<0.1	<0.1	1	1	
Cr	<0.1	<0.1	<0.1	<0.1	0.1	<1	<1	
Cu	3.6	5.6	7.7	27.6	3.9	28	19	
Fe	6.8	6.6	42.6	43.7	<0.1	11	10	
Hg	<0.2	0.3	0.3	0.3	<0.2	<2	<2	
K	58	17	14	22	15	250	210	
Mg	3	2	3	<1	3	370	380	
Mn	<0.1	0.5	0.8	0.7	<0.1	<1	<1	
Mo	<0.1	<0.1	<0.1	<0.1	<0.1	1	1	
Na	340	8370	7940	7960	351	720	760	
Ni	<0.1	<0.1	<0.1	<0.1	<0.1	2	<1	
P	<5	<5	<5	<5	<5	<50	<50	
Pb	0.2	14.4	8.4	0.4	0.3	5	5	
S	77	91	148	96	43	50	50	
Sb	1.4	<0.4	4	6.4	1.1	<4	<4	
Si	25	5	<1	<1	27	380	390	
Sn	<1	<1	<1	<1	<1	<10	<10	
Sr	0.2	<0.1	<0.1	<0.1	<0.1	<1	<1	
Ti	0.3	0.1	0.3	0.1	0.2	<1	<1	
Tl	<1	<1	<1	<1	<1	<10	<10	
U	<2	<2	<2	<2	<2	<20	<20	
V	0.1	0.1	<0.1	<0.1	0.1	<1	<1	
W	<5	<5	<5	<5	<5	<50	<50	
Zn	4.5	3.4	7.6	17.6	9.5	10	14	
Zr	<1	<1	<1	<1	<1	<10	<10	

2.1.5 Test Work Conclusions

- The gravity / CIL flowsheet appears to be a very viable one given these test results. It has the benefit of being widely used and understood. Across all of the test programs, the gravity / CIL flowsheet was shown to provide the best overall gold recoveries.

- Between 66% and 95% of the gold in the variability composites was extracted by laboratory gravity concentration. This is significant and underscores the importance of including a gravity circuit despite the good overall leach recoveries and kinetics of whole ore leaching.

- Leach kinetics of the gold indicate that 24 hours of leaching time is the optimal trade-off between recovery and increased residence time. While longer residence times will increase silver recovery, the additional silver revenue does not justify the increased leaching circuit residence time. Doubling the residence time to 48 hours results in a ~6.8% increase in silver recovery at the expense of additional operating and capital costs.

- Leaching of the variability composites was conducted using air sparging, and leaching of the master composites was conducted with oxygen sparging. The recoveries clearly indicate no advantage is gained by oxygen sparging.

- The ore is of medium competency and has a medium bond ball work index indicating that comminution can be accomplished by a simple primary crush followed by single stage SAG mill flowsheet.

- Leaching recoveries do not appear to be overly sensitive to grind size and a P_{80} of 106 µm provides optimal recovery for the CIL circuit. In the flotation circuits, a grind size of P_{80} of 75 µm resulted in optimal recoveries versus gravity circuit concentration effort intensity.

- The gravity followed by flotation test work produced lower overall gold recoveries than gravity followed by leaching, regardless of grind size.

- Although flotation recovered approximately 81% of the silver in flotation feed, the leach recovery of silver in the concentrate remained at 69%. Regardless of the processing flowsheet, overall silver recovery remains at approximately 60%. Option 2 could provide significantly higher silver recovery (~80%) if the concentrate buyer can recover significantly more of the silver contained in the concentrate (i.e. utilizes a POX circuit or smelter).

- ICP analysis of the post cyanide destruction test material will provide further direction as to the magnitude and type of solution treatment required. The test work is evaluating the INCO SO_2 / Air process which routinely reduces total cyanide to <1 mg/L. Copper, iron, zinc, and nickel can also be reduced to low levels.

- Agitated leach recoveries are dependent on the head grade. A portion of the gold is not recoverable by agitated leach and the tail grade remains effectively constant at an average of 0.13 g/t over the expected range of resource head grades.

2.2 Selected Metallurgical Design Criteria

The Optimization Study is based on an ore throughput of 2700 t/d (~985,500 t/a). Metallurgical results have been selected from all three test reports available to generate the criteria used for the design of the three options. The salient metallurgical design parameters are presented in Table 2.10.

Based on the available test work, three processing options were considered for evaluation. The options were selected to provide cyanide and cyanide-free processing plants as well as a lowest capital option whereby concentrate is shipped from site for sale to market. In all three options, primary crushing followed by single stage SAG milling was selected as the most desirable comminution circuit because it minimizes footprint, capital expense, and maintenance, while reducing operational complexity.

The three options thus investigated are summarized as follows:

- **Option 1** - standard gravity / CIL circuit with cyanide destruction of CIL tails.
- **Option 2 -** gravity followed by flotation and subsequent sale of flotation concentrate. This is a zero cyanide circuit and also lowest capital cost.
- **Option 3 -** gravity followed by flotation and intensive cyanide leaching of the concentrate resulting in a smaller amount of ore contacting cyanide.

The three processing options are discussed in more detail in Section 3.1, and are presented in graphical overview format in Figure 2.6: Goliath Processing Options.

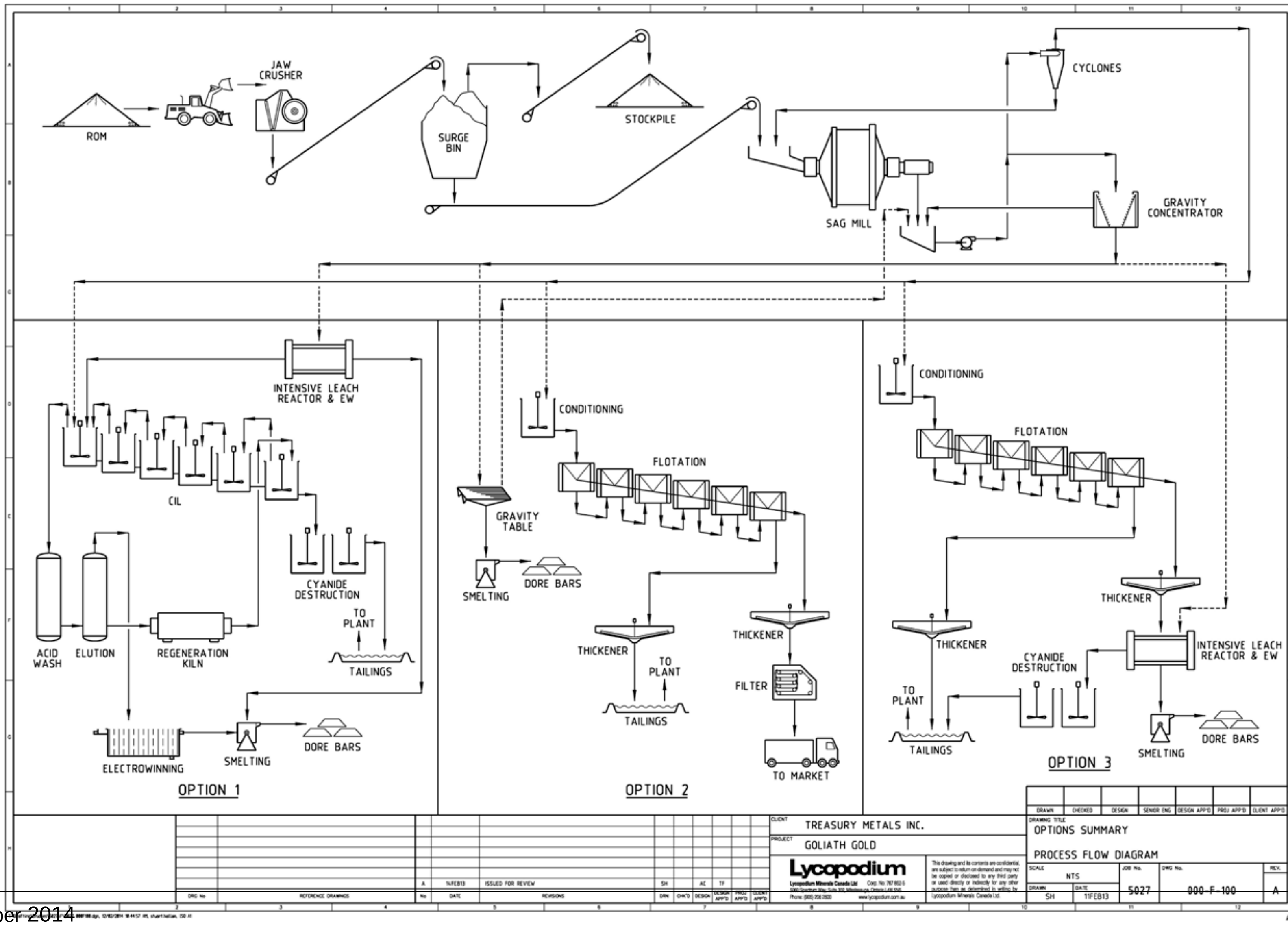
For the purpose of this study, Option 1 is considered the base case because it provides the best overall recovery and highest degree of design confidence as it is the most standard flowsheet for gold recovery. Although test work has indicated that the Goliath ore is not preg robbing, a CIL circuit has been selected over CIP due to its typically lower capital cost, simplicity, and smaller footprint. Carbon-based recovery from solution is more robust both mechanically and chemically, and generally significantly lower in both capital cost and in operating cost as compared to the Merrill Crowe process. Because the Goliath ore leaches quickly, the additional carbon inventory in CIL vs. CIP is only expected to be 10% to 15%.

Options 2 and 3 are comparatively assessed where they differ from the base case.

Table 2.13: Selected Metallurgical Design Parameters

Parameter		Value	Units	Source
Throughput		2700	t/d	Treasury
LOM Head Grade	Au	2.87	g/t	PEA - A.C.A. Howe Table Report 964 "22-1 Summary Net Cash Flow Model and Economic Analysis"
	Ag	9.3	g/t	PEA - A.C.A. Howe Table Report 964 "22-1 Summary Net Cash Flow Model and Economic Analysis"
Crushing Availability		85	%	Lycopodium
Grinding Availability		91.3	%	Lycopodium
SAG Mill Design	Axb	50		SMC Test Report by JKTech No:12021/P10 appended to ALS Metallurgy Report KM3406
	Bwi	11.1	kWh/t	85th percentile of BWi tests on variability composites reported in ALS Metallurgy Report KM3406
Target Grind Size		106 / 75	µm	Lycopodium
Ore SG		2.72		SMC Test Report by JKTech No:12021/P10 appended to ALS Report KM3406
Gravity Recovery	Au	75.3	%	Average of ALS Feasibility/Variability Tests KM3406 and Gekko Tests T0892 Ver 1.4
	Ag	36	%	Gekko CRG Test Result T0892 Ver 1.4
Combined Concentrate ILR Recovery	Au	98.2	%	Average of Gekko ILR Tests of 75µm Concentrate Test Results From T0892 Ver 1.4
	Ag	69	%	Gekko GRG and CRG + Float Test Results T0893
Leach Recovery	Au	95	%	Average of ALS Leach Tests
	Ag	60	%	Average of Gekko Whole Ore Leach Tests LGOL(06)/(01) and ALS Tests KM2906-02 Through 12
Cyanide Destruction Target (total cyanide)		1	ppm	Lycopodium
Flotation Recovery	Au	88.7	%	Gekko Test (Extra Test) Single Stage BCC Tail in Report T0892 Ver 1.4
	Ag	80.8	%	Gekko Test (Extra Test) Single Stage BCC Tail in Report T0892 Ver 1.4
Flotation Concentrate Mass Pull		4.89	%	Gekko Test (Extra Test) Single Stage BCC Tail in Report T0892 Ver 1.4
Leach Residence Time		24	h	Leach curves from all three test work programs.

Figure 2.6: Goliath Processing Options – Summary PFD



3.0 PROCESS PLANT

Three process plant options are assessed in this report and detailed in the following subsections. Option 1 is considered the base case and Options 2 and 3 are compared to Option 1.

Each option has the same comminution circuit concept, which will consist of a jaw crusher and a single stage SAG mill. However, the grind size is reduced from P_{80} 106 µm in Option 1 to P_{80} 75 µm in Options 2 and 3. This will result in a longer SAG mill and a larger motor because of the increased power required to achieve the finer grind size.

Crushing, Ore Storage and Mill Feed

The crushing circuit will consist of a static grizzly over a ROM bin, apron feeder, primary jaw crusher and crusher discharge conveyor. The ore storage circuit will consist of a crushed ore surge bin, apron feeder, stockpile feed conveyor, crushed ore emergency stockpile and a front-end loader (FEL) ramp for the reclaim of stockpiled ore. The mill feed circuit will comprise of a SAG mill feed conveyor, lime silo, lime feeder and weightometer.

Run of mine (ROM) ore will be stockpiled on the ROM pad and reclaimed by an FEL. The FEL will dump onto a static grizzly situated on top of a ROM bin. Ore will be withdrawn from the bin by an apron feeder and fed to the primary jaw crusher. Crushed ore discharged onto the primary crusher product conveyor, will feed a 30-minute capacity surge bin. Ore will be withdrawn from the surge bin at a controlled rate by an apron feeder onto the SAG mill feed conveyor. Overflow from the surge bin will be conveyed to an emergency stockpile and stored for future reclaim by FEL during periods of crusher downtime to maximise mill availability. Dry lime will be added to the SAG mill feed conveyor for pH control of the leach circuit. Dust collectors will be utilized at transfer points and at the primary crusher to keep fugitive dust emissions to a minimum. Conveyors will be covered.

Milling

The milling circuit will consist of a SAG mill with discharge trommel, mill discharge hopper, cyclone feed pumps, cyclone cluster, drive-in sump and sump pump. The gravity gold recovery circuit is discussed separately.

The single stage SAG mill will operate in closed circuit with hydro-cyclones and will be fed new ore, process water, and cyclone underflow. The SAG mill will discharge through a trommel for scats separation with the undersize flowing into the discharge hopper where the slurry will be combined with gravity tails, additional process water, and leach residue from the intensive cyanide leach reactor. The cyclone feed pumps (one standby one operational) will supply the cyclone pack and the gravity circuit with slurry from the discharge hopper. The cyclone pack and feed pump are designed to operate at higher pressures to achieve the target grind size at a higher solids fraction, thereby eliminating the need for a pre-leach thickener.

A single stage SAG mill with hydro-cyclones was selected as the optimum milling configuration. Having only one crusher and one mill minimizes capital and maintenance, and will reduce operational complexity. The closed circuit SAG mill provides simple operation and minimizes footprint when compared to 2 or 3-stage crushing, or a SAB circuit. This configuration is ideal for an indoor, cold weather, small gold plant. The single stage mill provides inherent flexibility in terms of throughput and product grind size, and a proven high availability. As this milling circuit is wet, noise will be the only emission.

A surge bin and dead stockpile configuration has been selected to minimize capital cost.

3.1 Option 1 – Gravity and CIL

Option 1 is a standard carbon-in-leach (CIL) circuit and is considered the base case for the Optimization Study. The ore will be primary crushed with a jaw crusher and then ground to the target leaching P_{80} using a single stage SAG mill and classifying cyclones. The cyclones will be selected to produce a cyclone overflow density suitable for the leach circuit and eliminate the need for a leach feed thickener. A gravity circuit consisting of a scalping screen and centrifugal concentrator will be fed from the cyclone feed distributor. The gravity concentrate will be batch treated in an intensive leach reactor (ILR) with the pregnant solution treated by electrowinning. Cyclone overflow will pass through a trash screen prior to entering the carbon in leach (CIL) circuit. In CIL, the ore slurry will be held in agitated leach reactors for 24 hours along with cyanide and carbon. The cyanide will leach gold and silver into solution, while the activated carbon will move counter current to the slurry and adsorb gold and silver. The loaded carbon will be acid washed and then gold and silver will be stripped from the carbon into solution using the AARL method. The stripped carbon will be re-activated in a kiln and returned to the CIL circuit, while the eluate containing gold and silver will be passed through electrowinning cells to recover the metals. The electrowon metal sludge will be smelted to produce doré. Leached slurry from the CIL circuit is processed in a cyanide destruction circuit prior to disposal in the tailings storage facility (TSF).

3.1.1 Gravity Recovery Circuit

The test work has shown a high portion of gravity recoverable gold in the Goliath ore. The gravity circuit is designed to process the equivalent of the new feed to the grinding circuit. The gravity circuit will comprise a vibrating screen and a centrifugal concentrator. The vibrating screen oversize will be returned to the mill discharge hopper along with the gravity concentrator tail. The gravity concentrate will be leached in an intensive cyanide leach reactor and gold will be directly electrowon from the leach solution. The leached tails will report to the CIL circuit via the grinding circuit. Gold sludge from the dedicated electrowinning cell will report to the retort oven along with the gold sludge from the elution circuit's electrowinning cells. Alternatively, the pregnant leach solution could be combined with the pregnant solution from the elution circuit.

3.1.2 Leaching Circuit

The leaching circuit will consist of a trash screen, feed distributor, six CIL tanks with agitators and air spargers, air blowers, two sump pumps, carbon advance airlifts, inter-tank screens, a loaded carbon pump, carbon recovery screen, carbon safety screen, and a cyanide analyser.

Cyclone overflow from the milling circuit will flow to the trash screen, which will remove unwanted (trash) material from the slurry to prevent downstream carbon screening problems. Undersize from the screen will report to the CIL feed distributor while trash will be directed to the tailings pump hopper for disposal with the CIL tailings stream. The feed distributor will allow bypass of CIL tank 1 if offline, and provide a single point for reagent addition. Barren solution from the elution circuit, gravity leach residue, loaded carbon screen undersize slurry, and cyanide will all be added at the distributor. The leaching circuit will consist of 6 stirred reactor tanks in series with maintenance bypasses around each tank. The leach reactor tanks will allow for 24 hours of slurry residence time. The leaching slurry will flow through the series of tanks by gravity, while the activated carbon will flow counter-current by means of submersible carbon advance pumps. Metals in the ore will be leached into solution using cyanide and oxygen, and then be adsorbed onto activated carbon. The oxygen required for leaching will be provided by air sparging. Slurry containing loaded carbon will be pumped from the first CIL tank to the loaded carbon screen to remove slurry from the carbon. From the loaded carbon screen, the carbon (screen oversize) will report to the acid wash column. Carbon that has been stripped and reactivated will be added to the last CIL tank to replace the carbon removed from the first tank. From the final leach tank, the leached ore slurry will be passed over a carbon safety screen to capture any carbon that would otherwise report to the tailings. Detectors and alarms will be installed to alert workers to leave the CIL tank area if hazardous levels of HCN gas are detected. Any spillage in the leaching area will be contained inside dedicated lined containment areas and returned immediately to the process.

3.1.3 Cyanide Detoxification

The cyanide detoxification circuit will consist of two stirred reactors with air sparging as well as copper sulphate, sodium metabisulphite, and lime addition. Piping arrangements will allow the reactors to be operated in a series or parallel configuration or either reactor to be bypassed. The detoxification circuit will receive CIL tails and discharge treated slurry to the tailings hopper. Movement of slurry through the detoxification circuit will be by gravity. The cyanide detoxification circuit will be designed to destroy cyanide to 1 mg/L total cyanide, which is the current MMER limit for maximum authorized monthly mean concentration. Further natural cyanide degradation will take place in the tailings facility prior to discharge to the environment.

3.1.4 Tails Disposal

The tails hopper will collect various waste streams from the processing plant including tails and spillage. All acidic streams will be directly neutralized prior to entering the tailings hopper. The combined tails slurry will be pumped (at the density it is received) to the tailings pond. The maximum amount of reclaim process water will be pumped from the TSF back to the process plant to minimize the quantity of water to be treated and discharged to the environment.

3.1.5 Elution, Electrowinning, and Gold Room

Loaded carbon in the first CIL tank will be pass over the carbon recovery screen for slurry removal and then discharge to the acid wash vessel. Carbon is acid washed with dilute hydrochloric to remove inorganic foulants, such as precipitated salts, which detrimentally affect gold adsorption. The acid washed carbon will then be transferred to the elution column for stripping of gold and silver using the AARL process. Heated barren solution containing cyanide and caustic will pass through the loaded carbon removing the gold from the carbon into solution. This now pregnant solution will be stored in a tank and circulated through electrowinning cells where gold sludge will be removed from the solution and deposited onto cathodes. The barren solution will be returned to the elution circuit. From time to time, barren solution will be bled from the eluate circuit back to the CIL and made up with fresh treated water. The gold / silver sludge from the elution and gravity circuit electrowinning cells will be filtered then dried in a mercury retort and smelted in a furnace to produce doré bars. Emissions from the gold room equipment are controlled through extraction hoods integral to the electrowinning cells, over the flux mixing and smelting furnace areas and through the mercury retort. All extracted streams are cleaned through bag houses or wet scrubbers.

3.1.6 Reagent Mixing and Storage

Reagents required for leaching, acid wash, elution and detoxification include lime, cyanide, sodium hydroxide, copper sulphate and sodium metabisulphite.

Generally, the reagents will be delivered to the process plant site in concentrated liquid or dry powder form and diluted or dissolved with fresh water in a mixing tank, transferred to a day tank and metered into the process plant using flowmeters and control valves.

Three to five days of reagent supply will be housed in the reagent mixing area of the processing plant and additional storage will be provided in the Tree Nursery warehouse.

3.1.7 Air and Water Services

Air services will consist of air compressors for plant and instrument air supply, leach aeration and carbon transfer airlifts. Water services will consist of raw / fire, potable, and process water storage tanks and distribution pumps and include additional reticulation for domestic consumption, safety showers, gland water, dust suppression and cooling water systems.

Water services, where distribution lines are outside of climate controlled buildings or enclosures, will be insulated and heat traced for protection from freezing.

3.2 Option 2 – Gravity and Flotation with Off-site Concentrate Processing

Option 2 is proposed as a cyanide-free processing flowsheet. In this option, the CIL circuit is replaced with a flotation circuit. The gravity concentrate will be upgraded using gravity techniques and direct smelted, as opposed to being leached in the intensive cyanide leach reactor. The flotation concentrate will be sold or toll treated (treatment by a third party, typically a smelter, who charges for the treatment of the material and either returns the refined material back to the owner or sells the refined material and reimburses the owner).

The overall flowsheet for this option is much simpler than Option 1, and the flotation circuit is expected to be similar to CIL in terms of operational complexity. The flotation circuit will achieve a lower gold recovery as compared to the CIL circuit, although silver recovery may increase over Option 1. By direct smelting the upgraded gravity concentrate, approximately 50% of the gold and 24% of the silver are recovered economically and sold as doré bar. The remainder of the gold and silver is recovered in the flotation concentrate which will be dewatered to below the transportable moisture limit (TML), and sold or toll treated off-site. Either way, there will be a significant reduction in revenue resulting from selling concentrate as compared to doré, and uncertainties will arise when trying to negotiate the value of the concentrate based on assays, transport and toll treatment costs. The primary advantage of Option 2 lies in the absence of cyanide and all cyanide associated issues (cyanide destruction, cyanide code compliance, operator training, and environmental risks). The TSF environmental compliance will be simplified with the absence of cyanide and leached metals in solution. Another notable benefit of Option 2 is that the tailings will be non-acid-generating because the sulphides will be recovered as part of the flotation concentrate and removed from the plant facility.

3.2.1 Grinding and Classification

The single stage SAG mill for this option requires a longer mill shell by 0.7 m, which is required to achieve a P_{80} of 75 micron. This will also require a larger main mill drive of 3 MW compared to 2.6 MW for gravity / CIL. All other aspects of the grinding and classification circuit should remain unchanged.

3.2.2 Gravity

The gravity concentrator used in Option 2 is assumed to be the same as that used in Option 1, with additional concentrate upgrading equipment. The gravity concentrate will be upgraded using a gravity table to allow direct smelting to produce doré bar without the use of an intense cyanide leach reactor. The gravity table tails will be recycled to the mill discharge hopper and ultimately to the flotation circuit. For simplification of comparison in this study, an identical smelting furnace is used in all options as the majority of gold is recovered in the gravity circuit. For this circuit, gravity recovery will require optimization to ensure maximum gold and silver quantities are available for sale as doré.

3.2.3 Flotation

The grinding circuit cyclone overflow will be fed to the flotation conditioning tank via a trash removal screen. Flotation reagents including the collector, potassium amyl xanthate (PAX), and the activator, copper sulphate (as pentahydrate), will be added to the conditioning tank. The agitated conditioning tank will also act as a storage buffer between the grinding circuit and the flotation circuit. A frothing agent, methyl isobutyl carbinol (MIBC), will be added at the discharge of the conditioning tank. Lime addition will not be required for flotation as the natural pH reported in the test work appears to be sufficient.

The flotation circuit will consist of six tank cells in series with the first four tanks acting as roughers and the latter two tanks as scavengers. The sulphide minerals will be floated, along with gold, to produce a gold rich concentrate.

3.2.4 Concentrate Dewatering, Storage and Handling

The flotation concentrate will be pumped to a conventional thickener and the thickener underflow will be pumped via high pressure filter feed pumps to a pressure filter located above a concrete load out facility suitable for direct loading of transport trucks. A concentrate sampler provides representative sample collection. These samples are critical to providing metallurgical data for negotiating the sale or toll treatment of the gold-silver rich concentrate. A truck weighbridge is provided for and the plant site roadways will be rated for concentrate truck traffic.

A concentrate thickener overflow tank will collect and recycle excess process water and ultrafine concentrate solids to the milling circuit. The concentrate thickener will require froth breaking equipment including a froth return pump.

3.2.5 Tailings Disposal

The flotation tails will require thickening due to the lower density in the flotation circuit compared to a CIL. The thickener underflow pumps will be the tailings disposal pumps and pump directly to the TSF. Overflow water from the tailings thickener will discharge to the process water tank.

3.2.6 Reagent Mixing and Storage

Reagents will be required for flotation and thickening and include PAX, copper sulphate, MIBC, lime and flocculants. Different flocculants may be required for flotation concentrate and tailings thickening.

Although these reagents are different to that required for gravity / CIL, the quantity and size of the reagents and the mixing and storage facilities will be similar for the purposes of capital cost comparison.

3.2.7 Air and Water Services

Additional compressed air and air receivers will be added for the concentrate filter air blow required to achieve moisture content suitable for shipping. The additional compressed air equipment will be partially offset by the removal of the compressed air demand associated with leach aeration in Option 1; however, for the purposes of the capital cost estimate, Option 2 will be a higher cost.

3.3 Option 3 – Gravity, Flotation and ILR

Option 3 provides a flotation circuit similar to Option 2. However, in Option 3, the flotation concentrate and gravity concentrates will be intensively leached using cyanide. Gold will be recovered from solution using a Merrill Crowe circuit and smelted on-site to produce doré. The result is that a significantly smaller amount of material (~5% of the plant feed) will be exposed to cyanide as compared to Option 1.

3.3.1 Grinding and Classification

The larger mill and mill drive as described in Option 2 is also applicable to Option 3.

3.3.2 Gravity

The gravity circuit is assumed to be the same as in Option 1. An alternative circuit utilizing three in-line pressure jigs allowing for a coarser grind size was proposed by Gekko, however, the finer grind size and simpler gravity circuit will provide simplicity, decreased capital and will achieve the same recovery as indicated by the testwork.

3.3.3 Flotation

The flotation circuit is the same as for Option 2.

3.3.4 Concentrate Dewatering

The flotation concentrate will be pumped to a conventional thickener and the thickener underflow pumped to an agitated surge tank sized to match the batch size and frequency of the intensive leach reactor (ILR).

3.3.5 Intensive Leach

Gravity concentrate will be combined with flotation concentrate will be fed to two intensive leach reactors (ILRs) operating in series. The ILR product will be pressure filtered and the filtrate collected in a pregnant liquor tank for transfer to the Merrill Crowe circuit. The ILR leach residue will be transferred to the detox plant for cyanide destruction.

The cyanide detoxification circuit will receive the leached concentrate residue and will consist of two stirred reactors with air sparging, copper sulphate, and sodium metabisulphite reagent addition. Piping arrangements will allow the reactors to be operated in a series or parallel configuration or one reactor bypassed. The detoxification circuit will discharge the treated slurry to the tailings hopper. Movement of slurry through the detoxification circuit will be by gravity. The cyanide detoxification circuit will be designed to destroy cyanide to 1 mg/L total cyanide. This is the current MMER (Mining Metal Effluent Regulations) limit for maximum authorized monthly mean concentration. Further degradation of cyanide will take place in the tailings facility prior to discharge to the environment.

3.3.6 Tailings Disposal

The tailings disposal system will be similar to Option 2 however a separate tailings disposal hopper and pumps is required to combine the detoxified ILR residue and the flotation tailings thickener underflow. The tailings hopper will also collect various waste streams from the process plant. All acidic streams will be directly neutralized in the acid neutralization vessel prior to entering the tailings hopper. The maximum amount of reclaim process water will be pumped from the TSF back to the process plant to minimize the quantity of excess water to be treated and discharged back to the environment.

3.3.7 Merrill Crowe Gold Room

The pregnant solution will be transferred to a precipitation reactor where zinc dust is added to precipitate the gold and silver. This precipitate slurry will then be filtered to recover gold and silver precipitate in one stream and barren solution in the filtrate stream. The barren solution will be recycled back to the leach reactor. From time to time, barren solution will be bled from the circuit and made up with fresh water. The gold / silver precipitate from the flotation concentrate and gravity circuits will be filtered then dried in a mercury retort and smelted in a furnace to produce doré bars. Emissions from the gold room equipment will be controlled through extraction hoods over the zinc dust, flux mixing and smelting furnace areas, and through the mercury retort. All ducted streams will be cleaned through bag houses or wet scrubbers. The gold room will be provided with heating and ventilation to maintain a healthy working environment for the gold room operators.

3.3.8 Reagent Mixing and Storage

Reagents will be required for flotation, thickening, intensive leaching and detoxification and will include PAX, copper sulphate, MIBC, lime, cyanide, caustic soda, sodium metabisulphite and flocculants. Different flocculants may be required for flotation concentrate and tailings thickening.

These reagents are a combination of those required for Options 1 and 2. The capital cost of the Option 3 reagents area will be higher than that of the other options.

3.3.9 Air and Water Services

This will be similar to Option 2.

4.0 PLANT INFRASTRUCTURE

4.1 General

The conceptual site plan and process area layouts are included in Appendix 3. The following sections describe the foreseen plant infrastructure which has been allowed for in the Optimization Study capital cost estimate.

Except where specifically noted, the plant infrastructure items are not expected to be substantially different for the different process plant options.

4.2 Site Layout

The location of the mining pits is established from previous work and is identified on the site layout as previously shown in the PEA.

The process plant site will be located to the east of the mining pits, and just east of the existing Tree Nursery Road. This road currently runs north-south in between the location of the pits and the selected process plant location; the road will be diverted to the east side of the process plant. The plant security gate and car park will be from this new section of Tree Nursery Road. The process plant will be situated on property owned by Treasury. The process plant and ancillary buildings will be located outside a 500 m radius blast zone from the edge of the open pit. The crushing facility will have a tentative clearance of 300 m from the edge of the pit.

Items requiring confirmation in advance of the Feasibility Study include:

- adequacy of the clearance from the edge of the current and future pit outlines (confirmation by qualified mining engineer familiar with the pit design for the project),
- geotechnical conditions at the selected plant site for performing bulk earthworks and laying foundations.

The buildings will be arranged so as to optimize proximity at the mine site, while maintaining required clearances from the mine and HV power line corridor.

Site roads and a parking area with cold weather plug ins will be allowed for in the design. Service roads to the TSF adjacent the tailings disposal pipeline corridor and adjacent the effluent line to Wabigoon Lake where existing roads do not provide sufficient access for inspection. A mine haul road will be allowed for to bring ore from the pits to the primary crusher ROM stockpiles.

The process plant area will include a mine dry (shower and change facilities), lunch room, and maintenance shop.

Simple fencing and signage will be allowed for around the outer property boundary, to prevent incursion by wildlife and unwanted or unintended visitors to the site. In addition, security fencing and gate access around the process plant area buildings (including the crusher) will also be provided.

The existing Tree Nursery buildings roughly 1.5 km to the north of the process plant area will be utilized for site administrative offices and warehousing of spare parts and bulk delivery reagents.

4.3 Power Supply

A Power Supply Study (including preliminary single line diagram) was prepared for the purpose of defining the main requirements of the Goliath Gold plant. The following details are addressed:

- Power supply details (incoming power supply, offtake location, emergency supply).
- Plant demand (load characteristics, maximum demand, SAG mill starting load).
- Method of HV distribution to remote power centres.
- Schedule.
- Energy tariff.
- Implementation plan.

The Power Supply Study provides the basic information required to advance discussions with the provincial electrical energy supplier (Hydro One).

The Power Supply Study is included in this document as Appendix 5.

Lighting required for illumination of the process plant area and within buildings is also allowed for.

4.4 Water Supply

Raw water will be drawn from the local pond on site adjacent to the Tree Nursery buildings. Confirmation will be required in the Feasibility Study that the pond has sufficient capacity and inflow to meet the plant operational, startup and first fill requirements.

4.5 Communication Systems

External communication systems are not considered. An integrated voice and data network infrastructure will be provided in the process plant. Telephone and voice mail system will provide voice functionality via this network. This system will be linked to the main telephone switchboard for connection to outside lines. Radio sets will be provided for operations personnel.

4.6 Heating, Ventilating, and Air Conditioning (HVAC) Systems

An allowance per square metre of building area has been applied in the capital cost estimate to allow for HVAC systems. The process plant and ancillary buildings will require varying degrees of ventilation and air conditioning. Ventilation will be provided by thermostatically controlled exhaust fans and dampers. Heating the process plant and ancillary buildings for the winter months will be provided by natural gas heaters located around the buildings. Ventilation and air conditioning for the control room and electrical room will be provided by packaged air conditioning units. Rooms including offices will be maintained under positive pressure to prevent dust infiltration. Exhaust fans will be used to provide ventilation of the washroom areas.

4.7 Building Fire Protection Systems

An allowance per square metre of building area has been applied to the capital cost estimate for building fire protection systems.

Systems to be provided for personnel and property protection include: smoke / heat detectors and manual pull stations, fire extinguishers, fire hydrant coverage of all process plant areas and internal fire hose coverage for all enclosed building areas.

Fire hose cabinets and external fire hydrants will be located so that all interior areas of the buildings are within reach of a fire hose stream.

A sprinkler system will be provided for the gold room, along with fire hose coverage throughout the facility, supplemented by hand held fire extinguishers.

Sprinkler systems will be provided for crusher and mill lubrication units with hand held fire extinguishers as backup.

For electrical rooms, ionization type very early smoke detection and alarm (VESDA) will be provided with hand held fire extinguishers as backup.

A wet sprinkler system will be provided for the control room, with hand held fire extinguishers.

Sprinkler coverage will be provided for enclosed conveyors. Sprinkler systems will be alarmed and interlocked with the conveyor drive to stop the belt when fire protection system or alarms are activated. Open transfer conveyors will be protected by hose reels and area hydrants.

A separate stand pipe system will be installed to provide fire hose coverage throughout the reagent area, with hand held fire extinguishers.

Fire hose coverage for the crusher will be provided by site fire hydrants supplemented by hand held fire extinguishers and ionization type smoke detectors in enclosed areas.

4.8 Plumbing and Sanitary Drainage Systems

An allowance has been applied in the capital cost estimate for plumbing and sanitary drainage.

Hot and cold plumbing will be provided to each fixture. Domestic hot water will be stored in insulated hot water tanks, with the tank volume based on the number of fixtures and daily requirements for shift change shower demand.

The domestic sanitary sewer piping system will be designed to collect all non-process waste from sanitary fixture units and non-process building floor drains.

Emergency shower and eyewash stations will be located in areas where workers could be exposed to toxic liquids and chemicals due to spillage, mishandling or other accidental causes. Each will have local audible and visual alarms.

4.9 Main Control System

Plant operations will be controlled by a plant control system (PCS). Equipment interlocking will also be incorporated.

Operator control stations will be provided in the crusher control room, elution area and in the main control room in the mill building. All plant variables and motor status will be accessible from any operator station. The crusher station will be capable of operating independently from the main system in case of a communication system link failure.

For process control, signals from / to the field instruments will be wired to the centralized input / output (I/O) panels located in the electrical room.

Fibre optic communication links will be used to connect remote areas to the control room, namely controls and CCTV signals from the crusher building and the recycle water station at the tailings area.

The PCS will provide production reports, process computations, alarm logs, process trending and graphic displays.

4.10 Security System and CCTV Monitoring

Process plant area access will be controlled and monitored 24 hours per day. The refinery located in the process plant will not be continuously manned by security personnel but motion, vibration and/or temperature sensors will be provided to detect unauthorized intrusion. Security cameras will be located in the goldroom, on the roof of the process plant building, and at the process plant gate house.

In addition to the security system, an independent CCTV system will monitor the crusher feed chute and crushed ore feeder discharge, with the monitors located in the main control room. A video recorder will capture all relevant entry / exit details in high security areas and log all security alarms in chronological order. Security signals will be transmitted via secure dedicated cables with the system backed up by dedicated UPS.

4.11 Process Plant and Ancillary Buildings - Layout

In general, all process areas will be housed in a building covered with pre-finished, insulated metal roof and wall cladding. Internal partition walls will be concrete block or drywall over metal stud.

Overall dimensions of buildings will be as provided on the process plant layout drawings in Appendix 3.

Interior operating areas will be interconnected such that it is not necessary to go outside in moving from one area to another, including connection of the surge bin via an enclosed conveyor gallery. Other conveyors will be covered but not fully enclosed, as they will carry material but will not serve as a walking route for plant personnel.

The emergency stockpile will not be covered, and the primary crushing plant will be enclosed below the ROM bin.

The CIL tanks will be located outside, with a protective shelter and crane gallery over top of the tanks. The gallery will allow for indoor maintenance and servicing of agitator gearboxes, intertank screens, carbon transfer pumps and the carbon sizing screen. The crane drop down bay will be at the mill building end, with forklift access to the adjacent workshop. The gallery enclosure will have ridge ventilation for fume exhaust. The CIL tank 1 will be the northernmost tank, and will be pump fed. A space allowance for up to two additional CIL tanks is provided. Containment of CIL area spillage will be achieved via a concrete containment bund that will drain to the event pond.

The largest building on the site will be the mill building. The entire building will sit under an overhead crane rated to lift the mill drive equipment as the heaviest lift to a drop down bay that will allow mobile access into the adjacent workshop. Detoxification tanks will sit outside but adjacent to the mill building and will be integrated with the CIL containment area.

The control room will be at an elevated location within the mill building.

The acid wash and elution columns will sit adjacent to CIL tanks 1 and 3. The carbon recovery screen above the columns will sit at the top-of-CIL tank level in a covered building annex. This annex will provide a covered route for operators moving between the CIL and the elution / reagents / water services area. The main pipe rack will be located inside the building, which will significantly reduce pipe heating and insulation requirements.

The air and water services area will include air compressors, dryers and receivers, water treatment plant and water pumps. All piping and cables will feed directly off the main pipe rack.

The gold room will be located against the wall of the workshop, and will be considered a separate and secure area. The gold room will include a small overhead crane for lifting and moving anodes / cathodes.

The workshop / plant offices sit adjacent to the feed end of the mill building, and will include: overhead crane, machinery bays, central aisle as working area, and plant and maintenance offices and services against one long wall. A parts store area will be attached however the main warehouse will be located within the existing Tree Nursery facilities.

There will be one main electrical room for the process plant, to be located adjacent to the main pipe / cable rack and positioned close to the centre of the plant to minimize cable runs to all plant areas.

4.12 Pipelines

Effluent water from the plant area will be transported via pipeline and discharged into Wabigoon Lake. The pipeline will extend into the lake to a suitable location and suitable depth to enhance mixing of the effluent within the lake.

Plant tailings will be transported via pipeline to the TSF, and distributed at the TSF via piping and discharge spigots.

Reclaim water from the TSF will be returned to the process plant for reuse in the process.

All overland water and slurry pipelines will be insulated for freeze protection.

A natural gas (NG) pipeline will bring NG from a main pipeline running adjacent to the Trans Canada Highway up to the plant area. Discussions are in progress with the NG utility supplier regarding the process for having a pipeline tapped from the main and run to the process plant site. Pricing and configuration of the NG pipeline will be established in consultations between Treasury and the supplier.

5.0 CAPITAL COST ESTIMATE

5.1 Introduction

In general the costs for the process plant and infrastructure were estimated from quantities and rates determined for recent similar projects and studies undertaken by Lycopodium.

Unit rates for concrete, steelwork, plate work and equipment were based on recent quotations from other studies as well as correspondence with vendors and contractors in certain cases. The rates selected reflect current local market conditions around the area of Dryden.

In some cases indicative equipment pricing was obtained from vendors for large pieces of equipment, such as the SAG mill, jaw crusher, and CIL circuit. In other cases quotations and actual equipment costs from other recent similar Lycopodium projects were utilized and are considered representative for the Goliath Project.

No engineering work was completed except for preliminary process engineering, plant layout, conceptual mechanical engineering design, and conceptual electrical engineering design. The database quantities used for compiling the estimate were based on similar projects.

Capital costs for the mine are not included in this study, and are considered an addition to the Owner's cost.

Capital costs for the TSF were estimated by WSP based in Thunder Bay, Ontario, and are included in the overall capital cost estimate contained herein. Further details and a breakdown of the TSF cost are contained in a separate report prepared by WSP. Cost items which were included in the estimates of both Lycopodium and WSP have been removed from the WSP estimate.

The capital costs are presented in Canadian dollars as at the first quarter of 2014 to an estimated accuracy of ±35%.

5.2 Capital Cost Estimate Summary

Table 5.1 summarizes the capital cost estimate for the Goliath Project, including a project contingency. A more detailed breakdown of the estimate by plant area and discipline is included in Appendix 6.

Table 5.2 provides a comparative capital cost estimate for the Goliath Project, of Options 1, 2, and 3.

All cost estimates in Tables 5.1 and 5.2 are provided in Canadian dollars.

Table 5.1: Goliath Project Capital Cost Estimate Summary for Base Case (±35%)

Discipline	Supply	Installation	Freight	Subtotal	Contingency	Totals *
A General	337,000	344,000	27,000	708,000	125,000	833,000
B Earthworks	-	4,000,000	-	4,000,000	-	4,000,000
C Concrete	2,005,000	3,305,000	135,000	5,445,000	817,000	6,262,000
D Steelwork	3,423,000	3,862,000	274,000	7,559,000	1,134,000	8,693,000
E Platework	2,196,000	1,364,000	176,000	3,736,000	615,000	4,351,000
F Mechanical	12,284,000	4,408,000	1,023,000	17,714,000	2,368,000	20,082,000
G Piping	1,885,000	2,109,000	160,000	4,154,000	998,000	5,152,000
H Elec & Instrumentation	2,344,000	1,761,000	188,000	4,293,000	1,033,000	5,326,000
M Buildings & Architectural	6,344,000	4,017,000	508,000	10,869,000	1,450,000	12,319,000
O Owner's Costs	1,413,000	2,840,000	4,000	4,258,000	639,000	4,897,000
P EPCM	8,382,000	-	-	8,382,000	1,257,000	9,639,000
Totals *	**40,613,000**	**28,010,000**	**2,495,000**	**71,118,000**	**10,436,000**	**81,554,000**

* Total cost excludes TSF cost of $9,330,000 (and applicable contingencies) as provided by WSP

Table 5.2: Goliath Project Comparative Capital Estimate Summary for Three Options (±35%)

Description	Base Case	Option 2	Option 3
Plant Cost	**49,310,000**	**42,240,000**	**46,840,000**
B Earthworks	4,000,000	4,000,000	4,000,000
C Concrete	6,260,000	5,290,000	5,920,000
D Steelwork	8,690,000	7,340,000	8,220,000
E Platework	4,350,000	3,670,000	4,120,000
F Mechanical	19,490,000	16,440,000	18,420,000
G Piping	2,250,000	1,900,000	2,130,000
H Electrical and Instrumentation	4,270,000	3,600,000	4,030,000
Infrastructure	**27,000,000**	**26,250,000**	**26,880,000**
Buildings, HVAC & Fire Protection Systems	12,320.000	11,570,000	12,200,000
Power Supply from Grid	460,000	460,000	460,000
Process Water Piping	920,000	920,000	920,000
Natural Gas Supply	460,000	460,000	460,000
Creek Diversion	300,000	300,000	300,000
Diversion of Road	460,000	460,000	460,000
Communications	140,000	140,000	140,000
Tailings Piping	1,480,000	1,480,000	1,480,000
Sewage Treatment	300,000	300,000	300,000
Potable Water Treatment	40,000	40,000	40,000
Tailings (per WSP minus duplicated costs)	9,330,000	9,330,000	9,330,000
Indirects	**15,370,000**	**14,400,000**	**15,180,000**
Owner's Cost	4,900,000	4,780,000	4,900,000
EPCM	9,640,000	8,790,000	9,450,000
General	830,000	830,000	830,000
Total	**90,890,000**	**82,100,000**	**88,110,000**

5.3 Estimate Qualifications, Assumptions, and Exclusions

- Due to the limited engineering design work performed, estimates were factored from previous similar projects and include indicative quotations from vendors for major equipment items.
- The capital estimate is based on the implementation of an EPCM contracting strategy.
- The capital estimate reflects prevailing Canadian market conditions.

- A lump sum for earthworks has been considered to reflect the nature of the local topography.

- Fresh water supplies were assumed (but not confirmed) to be readily available in the required amount at the nearby Tree Nursery ponds. It is also assumed that this pond water is available year round and that there is no risk of the pond completely freezing in the winter.

- The TSF is assumed to be in relatively close proximity (within 500 m) of the process plant site, with pipelines allowed for in the estimate to transfer a tailings slurry to the TSF and to return reclaim water from the TSF back to the plant. A design and capital cost estimate for the TSF was undertaken by WSP and is provided in a separate report. A TSF total capital cost is included in this report via transference from the separate WSP report with duplicated items deleted.

- The decant water system (pumps, barges) which returns water from the TSF back to the process plant is included in the estimate by WSP, and is not duplicated or separately estimated by Lycopodium.

- It is assumed that power will be provided to the project via a tapped connection into the existing Hydro One electrical power overhead lines which cross through project site. A budgetary estimate of Cdn$460,000 has been assumed for all electrical equipment downstream of the main tap, however the cost of making the connection to the existing line will be established in discussion between Treasury and Hydro One, and is not included in this estimate.

- Owner's costs have been assumed, details of which are included in Appendix 6.

- It is assumed that natural gas will be provided to the project via a pipeline tapped from the existing supply main which runs parallel to the Trans Canada Highway in the area of the site which will be installed and run up to the process plant area. A budgetary estimate of Cdn$460,000 has been assumed.

- It is assumed that construction and permanent camps will not be required, and that the construction work force will either come from the local communities, or will come from further away but will reside in the local communities for the duration of the construction.

- The plant site will be located on reasonably flat terrain and where soil conditions are suitably compacted such that major foundation will not require replacement of unsuitable materials.

- Borrow pits containing materials suitable for the hardstand and crushed aggregate materials used for reinforced concrete are located within 10 km radius of the project site.

- Prices of materials and equipment with an imported content are converted to Canadian dollars at the prevailing exchange rates.

- Operator training is assumed to be included in the operational readiness budget by the Owner, and is thus not included in this estimate.

- An allowance is made for meals and board for construction crew and included in the construction indirect costs.

The following additional items are excluded from the estimate:

- Mining costs (pits, underground, truck fleet, truck shops and maintenance).

- All mining-related works, including mobile fleet and services, bore fields etc.

- Sunken costs, including Pre-Feasibility and Feasibility costs.

- Exchange rate variations.

- Any environmental requirement not identified in the scope for the estimate.

- Discussions with any governmental agency or authority.

- Raising of finance and / or supply of associated documentation.

- Permits, licences and approvals.

- Land acquisition costs and fees.

- Cost of handling and disposal of any contaminated product.

- Financial modelling.

- Geotechnical investigations.

- Hydrogeological surveys.

- Borefield development.

- Owner’s plant and administrative pre-production costs (labour, training, etc.).

- Metallurgical test work.

- Project insurance.
- Escalation.
- Financing costs or interest costs during construction.
- Working capital for initial production period, as well as sustaining capital.
- All duties, tariffs, and taxes.
- Other Owner's costs unknown to or not divulged to Lycopodium.

5.4 Capital Cost Estimate Basis

The capital cost estimate was prepared from first principles, and then checked against other similar projects actually estimated and subsequently constructed by Lycopodium. The following items form the basis of the estimate as presented:

- The estimate is prepared by discipline for major areas of the plant.
- The estimate is prepared by individual assessment of the work content, ie: buildings and architecture, earthworks, concrete, structural steel, platework, etc.
- Preliminary estimates for concrete, steelwork, plate work, piping and electrical benchmarked from previous similar Lycopodium projects.
- Vendor budget quotations and previous project benchmarking for major equipment; previous project benchmarking for other equipment items.
- Percentages for Feasibility Study and EPCM costs based on similar projects.
- Rates for concrete works, structural and platework fabrication, site labour and electrical works are all based on recent budgetary quotation requests from local contractors and subsequently benchmarked against similar Lycopodium projects.

Capital costs for each area were assembled using the following basic methods of calculation:

- Budget pricing for equipment and facilities were obtained from suitably experienced suppliers, which have been reviewed and deemed to reflect the current market conditions.
- Allowances for compaction, waste, rolling margin and the like are included in the build-up of unit rate costs.

- Quantity information (concrete, steelwork, mechanical, piping) has been derived from a combination of sources and categorized to reflect the maturity of design information as follows:

  - Estimated MTOs from engineered conceptual designs, eg, engineering sketches or descriptions.

  - Historical data for similar sized facilities.

  - Estimates from plot plans, general arrangements or previous experience.

  - Order of magnitude allowance.

  - Budget quotations for mechanical equipment from vendors as well as recent projects and studies.

  - Recent history for contract pricing.

  - Estimated or built-up rates.

5.5 Contingency

The contingency allowance is shown as a separate amount in the capital cost estimate and has been applied on a line by line basis in accordance with Lycopodium's estimating guidelines.

Contingency is not intended to cover additional scope items; rather it is intended to cover uncertainty in certain aspects of the estimate based on assumptions made, level of project development, and use of cost data from vendors and other sources which are not firm.

A 14.7% contingency has been applied to the project estimate.

6.0 OPERATING COST ESTIMATE

6.1 Introduction

The operating costs have been developed according to typical industry standards and norms applicable to a gold processing plant producing gold doré. This section presents operating cost estimates for the three processing options.

6.2 Plant Design Parameters

The Project design is based on the ROM throughput of 985,500 t/a or 2,700 t/d. Operating cost estimates have been prepared for the three process plant options, each with variable metal recovery and production rates. Table 6.1 summarizes the design capacity and metal production for each option.

Table 6.1: Plant Capacity and Metal Production

Parameter	Option 1	Option 2	Option 3
Throughput ROM Plant			
Dry t/a		985,500	
Dry t/d		2,700	
Overall Recovery (%)			
Au	95.5	94.4	93.9
Ag	62.6	85.5	59.6
Annual Metal Production (oz)			
Au	86,852	85,852	85,397
Ag	184,482	251,968	175,641
Total (Au + Ag)	271,334	337,820	261,038
Total Equivalent* Au	89,648	89,670	88,058

*Equivalent Gold Based on Au/Ag Price Ratio = 66

6.3 Cost Categories

The process plant operating cost estimate includes five major categories, as defined below:

1. Labour.

2. Operating Consumables.

3. Power.

4. Maintenance.

5. General and Administration.

Quantities and cost data from each category were compiled from a variety of sources including:

- Metallurgical testwork.
- Supplier quotations.
- Advice from Treasury Metals Inc.
- Lycopodium data.
- First principle estimates.

6.4 Qualifications and Exclusions

The operating cost estimates include all direct costs associated with the Project to allow production of gold doré. Each cost estimate is presented with the following exclusions:

- Plant operating costs commence at the ROM bin ahead of the primary crushing circuit. All costs associated with areas beyond the battery limits of the study are excluded.
- All mining and geology costs.
- Land or other compensation costs.
- All import duties.
- All taxes.
- Impact of foreign exchange rate fluctuations, other than Cdn$ to US$.
- Any escalation from the date of the estimate.
- All head office costs.
- All sunk costs.
- First fill costs.
- Tailings storage, rehabilitation or closure costs.

- Government monitoring and compliance costs.
- Product costs (transportation, marketing, insurance).
- Licence fees or royalties.
- Contingency allowance.

A breakdown of the costs associated with each cost centre is provided in the following sections.

6.5 Exchange Rates, Estimate Date and Escalation

Costs are presented in Canadian dollars and are estimated on a pricing basis as of the first quarter of 2014.

For imported goods, prices have been converted using the following exchange rate:

Cdn$ 1.00	=	US$ 0.975
US$ 1.00	=	Cdn$ 1.026

The exchange rate was taken from the Bank of Canada's 20 month average, covering the span of July 2012 to February 2014.

Escalation of operating costs from the time of the estimate is not considered for the Project.

6.6 Operating Cost Accuracy

The expected order of accuracy for the operating cost analysis is in the range of ±35%, as required by the estimate class, and it is deemed appropriate for the study.

6.7 Labour

The labour element in this document refers to the plant administration department and the process plant labour.

The plant administration department consists of the following areas: management; safety, health and environment; human resources, security, finance and administration, information technology and communications relations. This category includes mostly day work for the administration staff; with the exception of security staff who perform shift work.

The process plant labour is divided into the following areas: management, operations, metallurgy and maintenance. The process plant labour includes a combination of day and shift work.

6.7.1 Wages and Salaries

Wages and salaries used for the administration department have been assumed by Lycopodium, based on similar operations and consideration of general practices in Canada. Wages and salaries for the process plant personnel were taken from the 2013 Manufacturing Salaries - HAYS Compensation, Benefits, Recruitment and Retention Time Guide. For the latter, Lycopodium used an assumed +10% premium to adjust the wages to Northern Ontario rates. A summary of the salary for each position is provided in Table 6.2. These salaries were provided inclusive of overheads costs. Staff are divided into three classes: Management (M), Salary Day (SD) and Salary Shift (SS).

Table 6.2: Employee Compensation

Administration Department**	Class*	Rate
Management		
Site Manager	M	$ 198,800
Office Manager	M	$ 124,250
Secretary	SD	$ 49,300
Safety, Health & Environment		
SHE Manager	M	$ 111,825
OH&S Officer	SD	$ 86,275
Environmental Monitoring Officer	SD	$ 73,950
Environmental Technicians	SD	$ 49,300
First Aid Officer	SD	$ 61,625
Human Resources		
HR Manager	SD	$ 104,763
Senior HR Officer	SD	$ 67,788
HR Officer	SD	$ 67,788
Training Superintendent	SD	$ 80,113
Security		
Manager Security	SD	$ 104,763
Security Supervisors	SS	$ 79,950
Security Staff	SS	$ 59,963
Finance & Administration		
Administration Manager	M	$ 124,250
Senior Accountant	SD	$ 104,763
Accountant	SD	$ 86,275
Accounts Clerk	SD	$ 61,625
Payroll Clerk	SD	$ 61,625
Purchasing Officer	SD	$ 67,788
Warehouse Manager	SD	$ 73,950
Warehouse Officer	SD	$ 67,788
Warehouse Labour	SD	$ 61,625
Expediter Clerk	SD	$ 61,625
IT		
IT Technician	SD	$ 73,950
Community Relations		
Community Relations Manager	SD	$ 86,275

Process Plant***	Class*	Rate
Process Plant Manager	M	$ 177,678
Secretary	SD	$ 49,300
Operations		
Plant Superintendent	M	$ 170,844
General Foreman / Trainer	M	$ 136,675
Shift Supervisors	SS	$ 135,582
Control Room Operators	SS	$ 91,609
Crushing Operators	SS	$ 91,609
Milling Operators	SS	$ 91,609
CIL Operators	SS	$ 91,609
Flotation Operators	SS	$ 91,609
Relief/Daycrew Operators	SS	$ 91,609
Goldroom Supervisors	SD	$ 108,460
Goldroom Operators	SD	$ 84,734
Metallurgy		
Senior Metallurgist	SD	$ 101,681
Plant Metallurgist	SD	$ 91,513
Lab Analyst	SD	$ 86,275
Lab Technicians	SD	$ 61,625
Met Technician	SD	$ 61,625
Maintenance		
Maintenance Manager	M	$ 143,509
Maintenance Supervisor	SD	$ 108,460
Maintenance Planner/Trainer	SD	$ 81,345
Mechanical Engineer	SD	$ 101,681
Electrical Engineer	SD	$ 108,460
Mechanical Supervisor	SD	$ 101,681
Electrical Supervisor	SD	$ 108,460
Boilermakers	SD	$ 84,734
Millwright	SD	$ 84,734
Trades Assistants	SD	$ 77,956
Electricians	SD	$ 104,393
Instrument Technicians	SD	$ 70,499

*Class: M = Management; SD = Salary Day; SS = Salary Shift

**Lycopodium Salary Assumption

***2013 Manufacturing Salaries – HAYS Compensation, Benefits, Recruitment and Retention Time Guide, with +10% salary adjustment for Northern Ontario. Salaries above are inclusive of overhead / loading costs (varies from 23% to 33%)

6.7.2 Process Plant Operations

The daily operation of the mill will be under the control of the General Foreman, who will also act as the Process Trainer. There will be a total of four shift crews staffed by local labour, to cover back-to-back 12 hour shifts.

Each shift crew will include:

- One Shift Supervisor who will direct the day to day plant operation.
- One Crusher Operator, who will also oversee the stockpile reclaim area.
- One Milling Operator, who will also oversee the gravity circuit.
- One Gold room Supervisor and One Gold room Operator.
- One Operator will provide relief for annual leave or illness.

Option 1 will include one additional Leach Operator, who will be responsible for maintaining the CIL, cyanide destruction circuit, intense leach reactor, carbon regeneration kiln and reagent preparation.

Option 2 will include one additional Flotation Operator, who will responsible for maintaining the flotation circuit and thickeners.

Option 3 will also include two additional Flotation Operators, who will share duties and responsibilities for the flotation circuit, thickeners, intense leach circuit and cyanide destruction.

6.7.3 Laboratory

Laboratory costs have been allocated on a per sample basis. These costs are included in the General and Administration cost category. Laboratory staff is to include one Analyst and two Technicians. Costs for the laboratory have been included in the General and Administration cost centre. Unit costs of sample analysis have been supplied by Lycopodium based on gold plants of similar size and complexity.

6.7.4 Metallurgy

The daily metallurgical performance of the plant will be monitored by both a Senior Metallurgist and a Plant Metallurgist, who will also have responsibility for metallurgical accounting. The Metallurgist will work closely with Geologists and Mining Engineers to ensure that the plant operates at maximum productivity.

6.7.5 Maintenance

The Maintenance Supervisor will control all aspects of plant, building and services maintenance.

The Maintenance Planner will be recruited early in the project to ensure early capture of all critical equipment data and preventative maintenance requirements to Treasury's Maintenance Planning system.

The maintenance team will include a trainer, mechanical supervisor, electrical supervisor, electricians, boiler makers, millwrights, and helpers. The maintenance team will be supplemented by appropriately skilled contract labour to undertake major tasks such as relining the crusher.

6.7.6 Labour Summary

Table 6.3 provides the total number of employees and total annual labour cost summary for each plant process alternative. Administration and maintenance labour costs are the same for all three options.

Table 6.3: Labour Summary

Area	Employees	Staff Classification			Total Annual Salary
		M	SD	SS	
Option 1 Total	**72**	**6**	**36**	**30**	**$ 6,543,281**
Administration	29	3	14	12	$ 2,300,488
Process Plant Operations	27	2	7	18	$ 2,769,294
Process Plant Maintenance	16	1	15	0	$ 1,473,500
Option 2 Total	**72**	**6**	**36**	**30**	**$ 6,543,281**
Administration	29	3	14	12	$ 2,300,488
Process Plant Operations	27	2	7	18	$ 2,769,294
Process Plant Maintenance	16	1	15	0	$ 1,473,500
Option 3 Total	**76**	**6**	**36**	**34**	**$ 6,909,718**
Administration	29	3	14	12	$ 2,300,488
Process Plant Operations	31	2	7	22	$ 3,135,731
Process Plant Maintenance	16	1	15	0	$ 1,473,500

6.8 Consumables

The consumables category covers all the wear parts and consumable material in the process plant. The consumables include liners for equipment such as crushers and mills, grinding media, screen decks, and other relevant items, chemical reagents as well as fuel (diesel and natural gas).

Consumables costs have been estimated based on vendor supplied information. Consumption rates and pricing have been based on the following:

- Crusher liner, SAG mill liner as well as steel ball consumption rates have been based Lycopodium calculations. The grinding steel ball consumption rate has been calculated by using the Abrasion Index (Ai). Costs have been based on vendor quotations.

- Laboratory testwork results have been used, wherever possible establishment of reagent consumption rates. In the absence of testwork data, reagent consumption rates were assumed based on Lycopodium experience and generally accepted practice within the industry. To date, reagent consumption rates have not been optimized.

- The consumption rates for sodium cyanide and copper sulphate have been based on testwork and Lycopodium experience.

- Sodium metabisulphite (SMBS) consumption is based on Lycopodium experience and pricing has been supplied by vendors. It has been assumed that SMBS is delivered in bulk bag format. Going forward, the cost and availability of SMBS should be evaluated against the cost of building a rail spur and purchasing SO_2, or burning sulphur to produce SO_2.

- Activated carbon consumption has been based on Lycopodium experience and the price has been supplied by a vendor.

- Elution and gold room reagent consumption rates have been based on first principles calculation and Lycopodium experience and the price has been supplied by vendors.

- The consumption rates for flotation reagents, namely PAX, MIBC and copper sulphate, have been based on preliminary testwork data and the prices are based on vendor quotations.

- Diesel fuel and natural gas consumption rates have been based on first principles calculations and Lycopodium experience and the prices have been supplied by Treasury Metals Inc.

- Antiscalant consumption rates have been based on Lycopodium experience and the price has been based on vendor quotation.

- Water treatment plant consumables have been based Lycopodium experience.

6.9 Power

Power will be provided from the Ontario Hydro grid via a substation owned by Treasury. The power unit cost of $ 0.07 / kWh has been provided by Treasury for the Study.

The plant power consumption has been determined from the installed power in the Electrical Load List, excluding the standby equipment. Electrical load factors and utilisation factors were applied to the installed power to arrive at the annual average power draw, which was then multiplied by total hours operated per annum and the electricity price to obtain the plant power cost.

6.10 Maintenance

Maintenance materials' costs have been estimated by applying factors to the installed mechanical equipment cost. This is done to cover the cost of all maintenance materials and contract labour requirements, with the exception of crusher and SAG mill wear parts, which have been included in the consumables allowance.

The factors applied are based on Lycopodium's database and experience, and are average costs over the life of the mine. As such, actual spares costs may be lower during the initial years but rise later. A factor of 3% has been used in all areas.

6.10.1 Mobile Equipment

The operating costs for mobile equipment have been estimated and include diesel fuel, tires and maintenance parts. The fuel costs have been included in the consumables cost centre whilst the other operating costs have been included in the overall maintenance materials cost centre.

6.11 General and Administration Costs

This element covers the administration cost required for running the operation. The labour portion of the cost has been covered in the Labour category, whereas this element covers the administrative consumables, training sessions, legal fees, consultants and other administrative costs. The General and Administration costs have been entirely based on Lycopodium experience.

6.11.1 Consultants and Contractors

An allowance has been made for the costs of specialist consultants, vendors and contractors. This includes additional personnel for maintenance shutdowns. This also covers costs for environmental compliance testing.

6.11.2 Personnel

First aid and medical, safety clothing, recruitment and training costs have been estimated based on the number of personnel.

6.11.3 Security and Cleaning Contracts

Costs of cleaning office buildings and providing security to the plant site have been estimated by Lycopodium.

6.12 Water

Raw water will be drawn from the former Tree Nursery irrigation ponds. These ponds will provide raw water to the plant by means of an overland pipeline.

A potable water treatment plant will be used to produce drinking and potable water for human consumption.

6.13 Operating Cost Estimate Option 1

The Option 1 operating cost estimate includes all the cost items relevant to processing the ore by crushing and grinding, gravity and ILR, CIL, electrowinning and smelting to produce gold doré. The operating costs listed by major category are presented in Table 6.4.

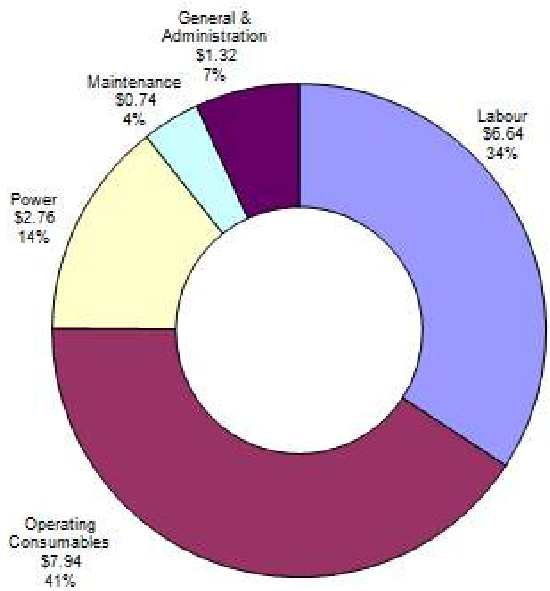
The total annual operating costs for Option 1 was determined to be Cdn$19.1 million, which equates to $19.40 per tonne of ore processed or $213.30 per oz of equivalent gold produced. The major contributors to the overall operating costs are labour (34%), power (14%) and consumables (41%).

Table 6.4: Summary of Option 1 Process Operating Cost Estimate (Cdn$, 1Q14, ±35%)

Cost Category	Total Cost			Distribution
	Cdn$/year	Cdn$/t ore	Cdn$/oz Au (Equiv)	
Labour	6,543,281	6.64	72.99	34%
Operating Consumables	7,824,613	7.94	87.28	41%
Power	2,722,157	2.76	30.37	14%
Maintenance	731,424	0.74	8.16	4%
General & Administration	1,300,079	1.32	14.50	7%
Total	**19,121,554**	**19.40**	**213.30**	**100%**

ROM Throughput = 985,500 t/a; Metal Prod. = 86,852 oz Au and 89,647 oz Au Equiv. Based on Au/Ag Price Ratio = 66

Figure 6.1: Option 1 Operating Cost Distribution



6.14 Operating Cost Estimate Option 2

The Option 2 operating cost estimate includes all the cost items relevant to processing the ore by crushing and grinding, gravity, flotation, smelting gravity concentrate to produce gold doré, and sale of flotation concentrate. The operating costs listed by major category are presented in Table 6.5.

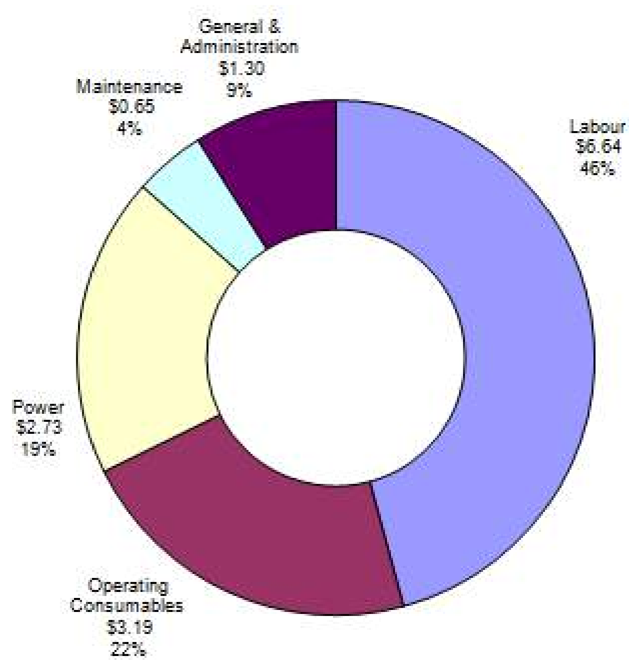
The total annual operating costs for Option 2 was determined to be Cdn$14.3 million which equates to $14.51 per tonne of ore processed or $159.42 per oz of equivalent gold produced. The major contributors to the overall operating costs are labour (46%), power (19%) and consumables (22%).

Table 6.5: Summary of Option 2 Process Operating Cost Estimate (Cdn$, 1Q14, ±35%)

Cost Category	Total Cost			Distribution
	Cdn$/year	Cdn$/t ore	Cdn$/oz Au (Equiv.)	
Labour	6,543,281	6.64	72.97	46%
Operating Consumables	3,141,298	3.19	35.03	22%
Power	2,685,870	2.73	29.95	19%
Maintenance	640,224	0.65	7.14	4%
General & Administration	1,284,119	1.30	14.32	9%
Total	**14,294,792**	**14.51**	**159.42**	**100%**

ROM Throughput = 985,500 t/a; Metal Prod. = 85,852 oz Au and 89,670 oz Au Equiv. Based on Au/Ag Price Ratio = 66

Figure 6.2: Option 2 Operating Cost Distribution



6.15 Operating Cost Estimate Option 3

The Option 3 operating cost estimate includes all the cost items relevant to processing the ore by crushing and grinding, gravity, flotation, ILR and smelting to produce gold doré. The operating costs listed by major category are presented in Table 6.6.

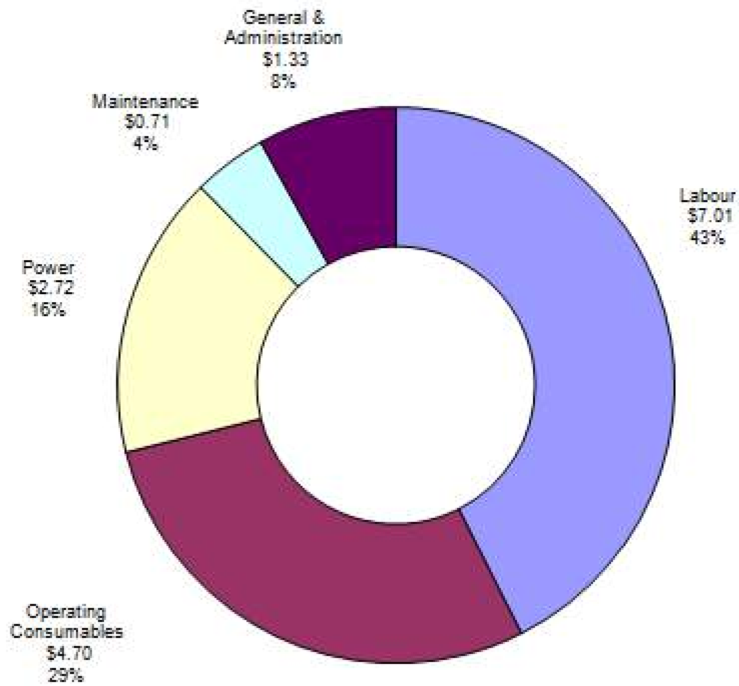
The total annual operating costs for Option 3 was determined to be Cdn$16.2 million, which equates to $16.47 per tonne of ore processed or $184.36 per oz of equivalent gold produced. The major contributors to the overall operating costs are labour (43%), power (17%) and consumables (29%).

Table 6.6: Summary of Option 3 Process Operating Cost Estimate (Cdn$, 1Q14, ±35%)

Cost Category	Total Cost			Distribution
	Cdn$/year	Cdn$/t ore	Cdn$/oz Au (Equiv.)	
Labour	6,909,718	7.01	78.47	43%
Operating Consumables	4,634,423	4.70	52.63	29%
Power	2,682,211	2.72	30.46	17%
Maintenance	699,571	0.71	7.94	4%
General & Administration	1,308,148	1.33	14.86	8%
Total	**16,234,071**	**16.47**	**184.36**	**100%**

ROM Throughput = 985,500 t; Metal Prod. = 85,397 oz Au and 88,258 oz Au Equiv. Based on Au/Ag Price Ratio = 66

Figure 6.3: Option 3 Operating Cost Distribution



6.16 Operating Cost Summary

Operating costs have been developed using the plant parameters specified in the process design criteria and are presented in Table 6.7. Costs are presented in Canadian Dollars (Cdn$) to an accuracy of ±35% as at the first quarter, 2014. Additional details of the estimate are provided in Appendix 7.

The total operating costs per tonne of ore processed are: $19.40 (Option 1), $14.51 (Option 2) and $16.47 (Option 3). The total operating costs per ounce of equivalent gold produced are: $213.30 (Option 1), $159.42 (Option 2) and $184.36 (Option 3).

In general, the major contributors to the overall operating costs are labour, power and consumables. Labour costs ranged from $6.64/t (Options 1 & 2) to $7.01/t (Option 3). Power costs were consistent for all three options at approximately $2.74/t, as were the general and administration costs at approximately $1.33/t. Maintenance costs ranged from $0.65/t (Option 2) to $0.74/t (Option 1). Maintenance costs changed in proportion to the total installed mechanical equipment costs. Consumable costs ranged from $3.19/t (Option 2) to $7.94/t (Option 1). Reagent consumption represents the biggest risk in variance to project operating costs.

For Option 1, the operating consumables constitute $7.94/t, or 41% of the overall operating costs. The crushing, grinding and screening consumables amount to approximately $1.25/t, fuel and general consumables constitute $0.69/t and the remainder of the operating consumables pertains to chemical reagent consumption. For the latter, the reagents SMBS and sodium cyanide represent the two largest contributors for the Option 1 reagent consumable costs. Confirming these usage rates along with the other reagents should be a key part of the Feasibility Study (FS) testwork program. This is recommended to improve accuracy of the operating cost estimate.

The reduction in Option 2 overall operating costs is primarily due to the consumable costs decreasing by approximately 60% to $3.19/t. The major change in operating consumables is attributed to the removal of lime, cyanide, hydrogen peroxide, sodium hydroxide and hydrochloric acid from the suite of reagents used in the process plant.

In comparison to Option 1, the reduction in Option 3 overall operating costs is primarily due to the moderate decrease in consumable costs by approximately 41% to $4.70/t. Option 1 and Option 3 use similar reagent addition schemes, however the reagent consumption rates for the latter are decreased based on the selected processing technology.

The process plant alternatives with highest and lowest total operating costs are Options 1 and 2 respectively. Option 3 offers a balance with respect to operating costs for chemical reagent consumption and overall metal recovery.

Table 6.7: Summary of Process Operating Costs (Cdn$, 1Q14, ±35%)

	Option 1		Option 2		Option 3	
Total Cost	**$19,121,554**		**$14,294,792**		**$16,234,071**	
Cost Category	**Cdn$/t ore**	**Cdn$/oz Au (Equiv.)**	**Cdn$/t ore**	**Cdn$/oz Au (Equiv.)**	**Cdn$/t ore**	**Cdn$/oz Au (Equiv.)**
Labour	6.64	72.99	6.64	72.97	7.01	78.47
Operating Consumables	7.94	87.28	3.19	35.03	4.70	52.63
Power	2.76	30.37	2.73	29.95	2.72	30.46
Maintenance	0.74	8.16	0.65	7.14	0.71	7.94
General & Administration	1.32	14.50	1.30	14.32	1.33	14.86
Total	**19.40**	**213.30**	**14.51**	**159.42**	**16.47**	**184.36**

ROM Throughput = 985,500 t/a; Equiv. Gold Based on Au/Ag Price Ratio = 66

7.0 OPPORTUNITIES, ANALYSIS, AND RECOMMENDATION

7.1 Opportunities

The following opportunities were identified during the work, which may offer potential for further design optimization and/or capital cost reduction, and are recommended for consideration either prior to or during the upcoming Feasibility Study phase:

- For Option 1, include a tailings thickener for cyanide recovery. This will have a double reduction effect in operating consumables costs by reducing cyanide consumption by 40% and consequently reducing the demand for the cyanide detoxification reagent SMBS. This will reduce the operating cost of Option 1 to $18.26 per tonne of ore.

- Relocate process plant south of the pit. This will avoid potential interference with the future pit outline, will negate the requirement for a diversion of Tree Nursery Rd, and will locate the plant on Treasury property and in closer proximity to Wabigoon Lake for water supply and/or discharge but further from the preferred TSF site and HV power corridor The Tree Nursery mine administration and warehouse facilities will also be further away from the plant.

- Reduced throughput scenarios may offer a more favourable initial capital investment countered by a reduced production.

Items requiring confirmation in advance of the Feasibility Study include:

- Adequacy of process plant and crusher location relative to the edge of the pit (confirmation by qualified mining engineer).

- Geotechnical conditions at the site.

- Adequacy and sufficiency of Tree Nursery ponds as the raw water source for the project. This water source has been assumed for this study but has yet to be verified.

7.2 Analysis

The three options were comparatively evaluated using evaluation criteria considered critical to the success of the project. The evaluation criteria, weightings and scoring system are summarized in Table 7.1 and described in the following subsections.

It is seen from the table below (with lower scores being considered more favourable) that Option 1 is preferred when the scores for criteria considered of primary importance, as well as overall scores, are totalled.

Table 7.1: Evaluation of Alternatives Using Critical Criteria (lower scores more favourable)

Evaluation Item	Importance	Relative Ranking *		
		Option 1	Option 2	Option 3
Marketable Final Product	primary	1	3	1
Gold Recovery (%)		1	3	2
Plant Availability		1	2	2
Initial Capital Cost		2	1	2
Annual Operating Cost		2	1	2
SUB-TOTAL SCORE – PRIMARY IMPORTANCE ITEMS		**7**	**10**	**9**
Plant Simplicity – number of unit operations	secondary	2	1	2
Plant Maintainability - equipment and spares inventory		2	1	2
Gold Security		1	3	1
Tailings / Waste Footprint		2	1	2
Use of Cyanide in Process		3	1	2
Metallurgical Accounting of Product		1	2	2
SUB-TOTAL SCORE – SECONDARY IMPORTANCE ITEMS		**11**	**9**	**11**
TOTAL		**18**	**19**	**20**

Ranking: 1 = most favourable, 3 = least favourable

7.2.1 Marketable Final Product

Options 1 and 3 produce a gold / silver doré which is directly saleable. Option 2 produces a lesser amount of gold / silver doré as well as a gold-rich concentrate which requires significant further downstream processing to be equally marketable. Processing of concentrate, and refining of doré charges will be deducted from the gold / silver value.

7.2.2 Gold Recovery (%)

Based on metallurgical testwork, Option 1 provides the highest gold recovery at 95.5%. The CIL circuit downstream of a gravity circuit provides the lowest risk plant as CIL circuit residence time will compensate for any fluctuations in throughput or reduced recovery in the gravity circuit.

7.2.3 Plant Availability

To achieve high availability, the plant must be designed with standby equipment and provisions for short term bypass to keep the plant running while equipment breakdowns are attended to. Although all three options have the same high-availability dry end with surge bin and emergency stockpile reclaim, only the CIL plant has bypass provisions for every tank and the capacity to maintain a high recovery operation if the gravity circuit is shut down.

Option 1 has 24 hours of slurry storage capacity built into the CIL circuit while Options 2 and 3 have 30 minutes each built into the flotation circuits. If there is a significant flow surge or interruption in feed, it is unlikely that the Option 1 plant performance will be affected.

7.2.4 Initial Capital Cost

Option 2 provides the lowest capital cost, but it is noted that the final product of this option is substantially different from Options 1 and 3. Options 1 and 3 are of similar capital cost.

7.2.5 Annual Operating Cost

Option 2 provides the lowest operating cost but this cost does not include the trucking and off-site processing costs associated with the concentrate. Options 1 and 3 are of similar operating costs but only if the tailings cyanide-wash thickener is included in Option 1. Option 3 provides the lowest operating cost.

7.2.6 Plant Simplicity

Option 2 provides a simple, easy to operate plant with the lowest number of unit operations. Options 1 and 3 are also relatively simple and easy to operate, but not to the extent of Option 2.

7.2.7 Plant Maintainability

Plant maintainability is directly related to the number of equipment items and the spares inventory necessary to keep the plant running. Option 2 has the least number of items of equipment, while Options 1 and 3 are comparable.

7.2.8 Gold Security

Option 2 has poor gold security due to the gold lockup in a relatively voluminous flotation concentrate. This concentrate is trucked and processed off-site. Options 1 and 2 have similar levels of gold security.

7.2.9 Tailings / Waste Footprint

Option 2 has the best opportunity for using a dry-stack tailings deposition method which will reduce the TSF footprint.

7.2.10 Use of Cyanide in Process

Option 2 avoids the use of cyanide and Option 3 minimizes the amount of material that is exposed to cyanide. The size of cyanide destruction equipment is reduced and the environmental risk is potentially minimized.

7.2.11 Metallurgical Accounting of Product

Metallurgical accounting can be difficult with low volume, high value streams. It is significantly more difficult when the gold / silver-rich stream is locked up in a flotation concentrate and removed from site (Option 2).

7.3 Recommendation

On the basis of the analysis above and the other investigations performed in this Optimization Study, it is recommended that Option 1 (Gravity Concentration, CIL Circuit) continue to be carried forward as the base case for future project development.

Options 2 and 3, while still technically viable alternatives, have certain inherent disadvantages as compared to Option 1, which are summarized in Table 7.1 above and further described in the sub-sections which follow the table.

APPENDIX 1

PROCESS FLOW DIAGRAM

APPENDIX 2

PROCESS DESIGN CRITERIA

APPENDIX 3

PROCESS PLANT SITE DRAWINGS

APPENDIX 4

MECHANICAL EQUIPMENT LIST

APPENDIX 5

POWER SUPPLY STUDY

APPENDIX 6

CAPITAL COST ESTIMATE

APPENDIX 7

OPERATING COST ESTIMATE

APPENDIX 8

REDUCED TONNAGE OPTIONS STUDY