APPENDIX D

PROCESS DESIGN CRITERIA

TETRA TECH WARDROP

SEABRIDGE GOLD

Appendix D1

Process Design Criteria and Mass Balance

PROCESS DESIGN CRITERIA - FLOTATION PROCESS PLANT

Project: **KERR-SULPHURETS-MITCHELL PROJECT (PRE-FEASIBILITY 2012)**
Project No.: **12528801**
Client: **SEABRIDGE GOLD INC**
Update Date: **April 26 2012**
Rev.: **A**

Description	Unit	Value	Source
General			
Type of Deposit:		Copper/Gold / MolybdenumPorphyry	
Operating Schedule			
Shifts/Day		2	Client
Hours/Shift	h	12	Engineering Design
Hours/Day	h	24	Engineering Design
Days/Year	d/a	365	Engineering Design
Availability/Utilization			
Overall Plant Availability	%	94	Engineering Design
Annual Processing Rate, Overall	t/a (dry)	47,450,000	Client
Daily Processing Rate	t/d	130,000	Calculations
Processing Rate, Operating	t/h	5,762	Calculations
Ore Characteristics			
Ore Specific Gravity		2.80	Testwork Reports
Ore Bulk Density	t/m^3	1.65	Engineering Design
Ore Moisture Content	%	4.0	Engineering Design
Abrasion Index - Mitchell	g	0.293	Calculations
Abrasion Index - Sulphurets	g	0.233	Testwork Reports
Abrasion Index - Kerr	g	TBD	Testwork Reports
Bond Work Index - Mitchell (Average)	kWh/t	14.6	Testwork Reports
Bond Work Index - Sulphurets (Average)	kWh/t	19.0	Testwork Reports
Bond Work Index - Kerr (Average)	kWh/t	13.4	Testwork Reports
Production			
Head Cu Grade (Average)	%	0.207	Mining Production Schedule
Head Cu Grade (Design)	%	0.311	Highest One Year Average
Head Mo Grade (Average)	%	0.004	Mining Production Schedule
Head Mo Grade (Design)	%	0.007	Highest One Year Average
Head Au Grade (Average)	g/t	0.549	Mining Production Schedule
Head Au Grade (Design)	g/t	1.098	Highest One Year Average
Cu Recovery	%	81.7	Testwork Reports
Mo Recovery	%	29.3	Estimate
Au Recovery (Copper Concentrate)	%	53.9	Testwork Reports
Au Recovery (CIL Circuit)		19.2	Testwork Reports
Au Bearing Concentrate Mass Recovery (to Cyanidation)	%	11.5	Testwork Reports
Cu Concentrate Grade	% Cu	25.0	Testwork Reports
	g/t Au	43.8	Testwork Reports
Mo Concentrate Grade	% Mo	50.0	
Pyrite (Au) Concentrate Grade	% Cu	TBD	Testwork Reports
	g/t Au	1.2	Calculations
Cu Conc Mass Recovery (Average)	%	0.68	Calculations
Cu Concentrate Production (Average)	t/a	320,835	Calculations
Gold-Silver Dore Mass Recovery (Average)	%	0.000058	Calculations
Gold-Silver Dore Production (Average)	kg/a	27,556	Calculations
- including Gold Production (Average)	kg/a	4,912	Calculations
Mo Conc Mass Recovery (Average)	%	0.0026	Calculations
Mo Concentrate Production (Average)	t/a	1,246	Calculations

Crushing at Mine Site			
Primary Crushing - Mitchell Site			
Crusher Type		Gyratory Crusher	Engineering Design
Number of Crushers		2	Engineering Design
Operating Shifts/Day	shift/d	2	Engineering Design
Operating Hours/Shift	h/shift	12	Engineering Design
Crusher Operating Time	%, overall	70	Engineering Design
Processing Rate, Operating	t/h	7,738	Calculations
Processing Rate, Operating (each)	t/h	3,869	Calculations
Feed Top Particle Size	mm	1,500	Engineering Design
Product Particle Size, P80	mm	150	Engineering Design
No of Discharge Feeders (each crusher)		1	Engineering Design
Type of Discharge Feeder		Apron	Engineering Design
Primary Crushing - Kerr Site			
Crusher Type		Gyratory Crusher	Engineering Design
Number of Crushers		1	Engineering Design
Operating Shifts/Day	shift/d	2	Engineering Design
Operating Hours/Shift	h/shift	12	Engineering Design
Crusher Operating Time	%, overall	70	Engineering Design
Processing Rate, Operating	t/h	3,000	Calculations
Feed Top Particle Size	mm	1,500	Engineering Design
Product Particle Size, P80	mm	150	Engineering Design
No of Discharge Feeders		1	Engineering Design
Type of Discharge Feeder		Apron	Engineering Design
Primary Crushing - Sulphurets Site			
Crusher Type		Gyratory Crusher	Engineering Design
Number of Crushers		1	Engineering Design
Operating Shifts/Day	shift/d	2	Engineering Design
Operating Hours/Shift	h/shift	12	Engineering Design
Crusher Operating Time	%, overall	70	Engineering Design
Processing Rate, Operating	t/h	3,000	Calculations
Feed Top Particle Size	mm	1,500	Engineering Design
Product Particle Size, P80	mm	150	Engineering Design
No of Discharge Feeders		1	Engineering Design
Type of Discharge Feeder		Apron	Engineering Design
Coarse Ore Stockpile at Minesite			
Crushed Ore Stockpile (Live Capacity)	t	30,000	Engineering Design
Crushed Ore Bulk Density	t/m^3	1.65	Engineering Design
Angle of Repose	degrees	37	Engineering Design
Angle of Reclaim	degrees	60	Engineering Design
No of Feeders		6 (4 op / 2 st)	Engineering Design
Average Tonnage Rate, Operating	t/h	7738	
Average Tonnage Rate (Each), Operating	t/h	1290	Calculations
Average Tonnage Rate (Each), Design	t/h	1935	
Type of Feeders		Apron	Engineering Design
Feeder Operating Time	%, overall	70	Engineering Design
Ore Transportation from Mine Site to Plant Site			
Ore Transport Method		Conveying	Engineering Design
Process Rate - Nominal	t/h	7738	Engineering Design
Process Rate - Design	t/h	10,000	Engineering Design
Coarse Ore Stockpile at Plant Site			
Crushed Ore Stockpile (Live Capacity)	t	60,000	Engineering Design
Crushed Ore Bulk Density	t/m^3	1.65	Engineering Design
Angle of Repose	degrees	37	Engineering Design
Angle of Reclaim	degrees	60	Engineering Design
No of Feeders		6 (4 op / 2 st)	Engineering Design
Average Tonnage Rate, Operating	t/h	6779	

Average Tonnage Rate (Each), Operating	t/h	1130	Calculations
Average Tonnage Rate (Each), Design	t/h	1695	
Type of Feeders		Apron	Engineering Design
Feeder Operating Time	%, overall	94	Engineering Design
Secondary Crushing			
Configuration		Sizing Prior to Crushing	
Feed Size, F80	mm	150	Engineering Design
Product Size, P80	mm	35-45	Engineering Design
Screen Type		Dry/Vibratory Double Deck	Engineering Design
Screen Apertures	mm	75, 50	Engineering Design
Screen Oversize to Crusher	%, Weight	75	Engineering Design
Crusher Type		Cone Crusher	Engineering Design
Number of Crushers		5 (4 op / 1 st)	Engineering Design
Operating Shifts/Day	shift/d	2	Engineering Design
Operating Hours/Shift	h/shift	12	Engineering Design
Crusher Operating Time	%, overall	85	Engineering Design
Average Tonnage Rate (each)	t/h	1271	Calculations
Fine Ore Stockpile			
Crushed Ore Stockpile (Live Capacity)	t	60,000	Engineering Design
Crushed Ore Bulk Density	t/m^3	1.65	Engineering Design
Angle of Repose	degrees	37	Engineering Design
Angle of Reclaim	degrees	60	Engineering Design
No of Feeders		6 (4 op / 2 st)	Engineering Design
Average Tonnage Rate (Each), Operating	t/h	960	Calculations/Engineering Design
Average Tonnage Rate (Each), Design		1441	Calculations/Engineering Design
Type of Feeders		Apron	Engineering Design
Feeder Operating Time	%, overall	94	Engineering Design
Tertiary Crushing			
Crusher Type		HPGR	Engineering Design
Number of Trains		2	Calculations
Number of Crushers		4	Calculations
Operating Shifts/Day	shift/d	2	Engineering Design
Operating Hours/Shift	h/shift	12	Engineering Design
Crusher Operating Time	%, overall	94	Engineering Design
Average Tonnage Rate (New Feed)	t/h	5,762	Engineering Design
Average Tonnage Rate (New Feed, Each)	t/h	1,441	Calculations
Max. Tonnage Rate	mtph	1,801	Cal/Engineering Design
Circulation Load, Avergae	%	40	Testwork/Engineering Design
Circulation Load, Design	%	45	Engineering Design
Tonnage Rate To HPGR (Average, Each)	t/h	2,017	Calculations
Tonnage Rate To HPGR (Design, Each)	t/h	2,089	Calculations
Feed Size, F80	mm	35-45	Engineering Design
Product Size, P80	µm	2,000	Engineering Design
Screen Type		Vibratory/Wet/Double Deck	Engineering Design
Screen Apertures	mm	15, 6	Engineering Design
Grinding			
Primary Grinding			
Mill Type		Ball Mill	Engineering Design
Number of Trains		2	Engineering Design
Number of Mills		4	Calculations
Mill Size	Dia mm x EGL mm	7,600 x 11,960	TBC by Suppliers
Drive	kW	14,000	TBC by Suppliers
Bond Work Index - Ball Mill (Design)	kWh/t	16.0	Testwork/Engineering Design
Average Tonnage Rate (Each)	t/h	1441	Calculations
max. tonnage rate	mtph	1729	CAL/ENGINEERING DESIGN
Solids/Pulp Density	%	72	Engineering Design
Feed Size, F80	µm	2,000	Engineering Design
Product Size, P80	µm	150	Testwork/Engineering Design

Ball Mill Recycle Load	%	250	Engineering Design
Mill Speed	% CS	76	Engineering Design
Mill Ball Charge	%	30-35	Engineering Design
Classification		Cyclones	Engineering Design
Make Up Ball Size	mm	75/50	Engineering Design
Grinding Ball Storage Capacity	t	TBD	Engineering Design
Copper and Gold Flotation			
Rougher / Scavenger Flotation			
Rougher / Scavenger Flotation Train Number		4	Engineering Design
Cell Type		Tank Cell	Engineering Design
Number of Cells		20	Calculations
Number of Cells (Each Line)		5	Calculations
Individual Cell Volume	ft^3	7,062	Suppliers
Individual Cell Volume	m^3	200	Suppliers
Solids/Pulp Density	%	37	Mass Balance/Engineering Design
Solid Flow Rate	t/h	5,765	Mass Balance
Solid Flow Rate (Each Line)	t/h	1441	Mass Balance
Pulp Flow Rate	m^3/h	11,876	Mass Balance
Pulp Flow Rate (Each Line)		2,969	Mass Balance
Batch Retention Time	min	7.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	14.7	Calculations
Pulp pH		10.0	Engineering Design/Reports
Cu Regrind Circuit			
Regrinding Circuit Configuration		Closed	Engineering Design
Mill Type		Tower Mills	Engineering Design
Number of Mills		6	Calculations
Tonnage Rate	t/h	346	Mass Balance
Bond Work Index, Design	kWh/t	14.0	Engineering Design
Solids/Pulp Density	%	65	Engineering Design
Feed Size, F80	µm	135	Engineering Design
Product Size, P80	µm	20	Testwork/Engineering Design
Mill Ball Charge	%	TBD	Engineering Design
Recirculating Load	%	150	Engineering Design
Classification		Cyclones	Engineering Design
1st Cu Cleaner Flotation			
Cell Type		Tank Cell	Engineering Design
Number of Cells		6	Calculations
Individual Cell Volume	ft^3	3531	Supplies/Engineering Design
Individual Cell Volume	m^3	100	Supplies/Engineering Design
Solids/Pulp Density	%	19.1	Mass Balance/Engineering Design
Solid Flow Rate	t/h	452	Mass Balance
Pulp Flow Rate	m^3/h	2,057	Mass Balance
Batch Retention Time	min	5.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	10.5	Calculations
Pulp pH		11.0	Testwork Reports
1st Cu Cleaner Scavenger Flotation			
Cell Type		Tank Cell	Engineering Design
Number of Cells		2	Calculations
Individual Cell Volume	ft^3	3531	Supplies/Engineering Design
Individual Cell Volume	m^3	100	Supplies/Engineering Design
Solids/Pulp Density	%	17.0	Mass Balance/Engineering Design
Solid Flow Rate	mtph	336	Mass Balance
Pulp Flow Rate	m^3/h	1752	Mass Balance
Batch Retention Time	min	2.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	4.2	Calculations
Pulp pH		11.0	Testwork Reports

2nd Cu Cleaner Flotation			
Cell Type		Tank Cell	Engineering Design
Number of Cells		3	Calculations
Individual Cell Volume	ft^3	1766	Supplies/Engineering Design
Individual Cell Volume	m^3	50	Supplies/Engineering Design
Solids/Pulp Density	%	18.8	Mass Balance/Engineering Design
Solid Flow Rate	t/h	127.7	Mass Balance
Pulp Flow Rate	m^3/h	591.2	Mass Balance
Batch Retention Time	min	5.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	10.5	Calculations
Pulp pH		11.2	Testwork Reports
3rd Cu Cleaner Flotation			
Cell Type		Tank Cell	Engineering Design
Number of Cells		2	Calculations
Individual Cell Volume	ft^3	1766	Supplies/Engineering Design
Individual Cell Volume	m^3	50	Supplies/Engineering Design
Solids/Pulp Density	%	17.0	Mass Balance/Engineering Design
Solid Flow Rate	t/h	50.0	Mass Balance
Pulp Flow Rate	m^3/h	259.4	Mass Balance
Batch Retention Time	min	4.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	8.4	Calculations
Pulp pH		11.2	Testwork Reports
Molybdenum Recovery			
Cu/Mo Bulk Concentrate Thickening			
Thickener Type		High Rate	Engineering Design
Number of Thickeners		1.0	Engineering Design
Solids Feed Rate	t/h	39.2	Mass Balance
Solids Feed Rate	t/d	#REF!	Mass Balance
Slurry Feed Flowrate	m3/h	125.8	Mass Balance
Thickener U/F Solid	%	60.0	Engineering Design
Thickener Unit Area	m2/(t/d)	0.125	Conventional/Pocock 2009
Mill Feed Grade Fluctuation Factor		1.5	Engineering Design
Thickener Diameter	m	#REF!	Calculations
Conditioning			
Number of Conditioning Tank		1	Engineering Design
Conditioning Tank Dimension	mm x mm	3000 x 3000	Engineering Design
Conditioning Time	min	5.0	Engineering Design
Mo Rougher Flotation			
Cell Type		Tank Cell	Engineering Design
Number of Cells		4.0	Calculations
Individual Cell Volume	ft^3	1059	Supplies/Engineering Design
Individual Cell Volume	m^3	30.0	Supplies/Engineering Design
Solids/Pulp Density	%	30.0	Mass Balance/Engineering Design
Solid Flow Rate	t/h	40.4	Mass Balance
Pulp Flow Rate	m3/h	105.7	Mass Balance
Batch Retention Time	min	13.0	Testwork Reports
Scale-up Factor		2.5	Engineering Design
Plant Retention Time	min	32.5	Calculations
Pulp pH		>11	Testwork Reports
Mo Rougher Scan. Flotation			
Cell Type		Tank Cell	Engineering Design
Number of Cells		2.0	Calculations
Individual Cell Volume	ft^3	1059	Supplies/Engineering Design
Individual Cell Volume	m^3	30.0	Supplies/Engineering Design
Solids/Pulp Density	%	30.0	Mass Balance/Engineering Design
Solid Flow Rate	t/h	39.5	Mass Balance
Pulp Flow Rate	m3/h	103.6	Mass Balance

Batch Retention Time	min	5.0	Testwork Reports
Scale-up Factor		2.5	Engineering Design
Plant Retention Time	min	12.5	Calculations
Pulp pH		>11	Testwork Reports
Mo Rougher Concentrate Regrinding			
Regrinding Circuit Configuration		Open	Engineering Design
Mill Type		Stirred Mills	Engineering Design
Number of Mills		1	Engineering Design/Calculations
Tonnage Rate	t/h	1	Mass Balance
Bond Work Index	kWh/t	12.0	Engineering Design
Solids/Pulp Density	%	55	Engineering Design
Feed Size, F80	µm	20	Engineering Design
Product Size, P80	µm	15	Engineering Design
Mill Type	kg/kwh	Stirred Mill	Engineering Design
Mill Ball Charge	%	TBD	Engineering Design
Recirculating Load	%	n/a	Engineering Design
Classification		Cyclones	Engineering Design
1st Mo Cleaner Flotation			
Cell Type		Column	Engineering Design
Number of Cells		1	Calculations
Individual Cell Volume	ft^3	281	Supplies/Engineering Design
Individual Cell Volume	m^3	7.9	Supplies/Engineering Design
Solids/Pulp Density	%	8.8	Mass Balance/Engineering Design
Solid Flow Rate	mtph	1.0	Mass Balance
Pulp Flow Rate	m^3/h	10.6	Mass Balance
Batch Retention Time	min	6.0	Test Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	12.6	Calculations
Pulp pH		>11	Testwork Reports
2nd Mo Cleaner Flotation			
Cell Type		Column	Engineering Design
Number of Cells		1	Calculations
Individual Cell Volume	ft^3	134	Supplies/Engineering Design
Individual Cell Volume	m^3	3.8	Supplies/Engineering Design
Solids/Pulp Density	%	8.7	Mass Balance/Engineering Design
Solid Flow Rate	t/h	0.5	Mass Balance
Pulp Flow Rate	m^3/h	4.9	Mass Balance
Batch Retention Time	min	5.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	10.5	Calculations
Pulp pH		>11	Testwork Reports
3rd Mo Cleaner Flotation			
Cell Type		Column	Engineering Design
Number of Cells		1	Calculations
Individual Cell Volume	ft^3	111	Supplies/Engineering Design
Individual Cell Volume	m^3	3.1	Supplies/Engineering Design
Solids/Pulp Density	%	8.7	Mass Balance/Engineering Design
Solid Flow Rate	t/h	0.3	Mass Balance
Pulp Flow Rate	m^3/h	3.1	Mass Balance
Batch Retention Time	min	4.0	Testwork Reports
Scale-up Factor		2.5	Engineering Design
Plant Retention Time	min	10.0	Calculations
Pulp pH		>11	Testwork Reports
4th Mo Cleaner Flotation			
Cell Type		Column	Engineering Design
Number of Cells		1	Calculations
Individual Cell Volume	ft^3	111	Supplies/Engineering Design
Individual Cell Volume	m^3	3.1	Supplies/Engineering Design
Solids/Pulp Density	%	11.9	Mass Balance/Engineering Design

Solid Flow Rate	t/h	0.2	Mass Balance
Pulp Flow Rate	m^3/h	1.7	Mass Balance
Batch Retention Time	min	4.0	Testwork Reports
Scale-up Factor		2.5	Engineering Design
Plant Retention Time	min	10.0	Calculations
Pulp pH		>11	Testwork Reports
Pyrite Rougher / Scavenger Flotation			
Pyrite Rougher / Scavenger Flotation Train Number		4	Engineering Design
Cell Type		Tank Cell	Engineering Design
Number of Cells		20	Calculations
Number of Cells (Each Line)		5	Calculations
Individual Cell Volume	ft^3	7,062	Suppliers
Individual Cell Volume	m^3	200	Suppliers
Solids/Pulp Density	%	37	Testwork/Engineering Design
Solid Flow Rate	t/h	5,419	Mass Balance
Solid Flow Rate (Each Line)	t/h	2,710	Mass Balance
Pulp Flow Rate	m^3/h	11,155	Mass Balance
Pulp Flow Rate (Each Line)		5,578	Mass Balance
Batch Retention Time	min	8.0	Testwork Reports
Scale-up Factor		2.1	Engineering Design
Plant Retention Time	min	17	Calculations
Pulp pH		9.5-10	Engineering Design/Reports
Pyrite Concentrate Regrind Circuit			
Mill Type		Tower Mills	Engineering Design
Number of Mills		6.0	Calculations
Tonnage Rate	t/h	363	Mass Balance
Bond Work Index, Design	kWh/t	14.0	Engineering Design
Solids/Pulp Density	%	65.0	Engineering Design
Feed Size, F80	µm	113	Engineering Design
Product Size, P80	µm	20	Testwork/Engineering Design
Mill Ball Charge	%	TBD	Engineering Design
Recirculating Load	%	150	Engineering Design
Classification		Cyclones	Engineering Design
Copper Concentrate Dewatering			
Thickening			
Thickener Type		High Rate	Engineering Design
Number of Thickeners		1	Calc/Engineering Design
Solids Feed Rate	t/h	39	Mass Balance
Slurry Feed Flowrate	m^3/h	128	Mass Balance
Thickener U/F Solid	%	60	Engineering Design
Concentrate Production, Norminal	t/d	879	Mass Balance
Thickener Unit Area	$m^2/(t/d)$	0.125	Test Results
Design Factor		1.5	Engineering Design
Thickener Diameter	m	14	Calculations
Concentrate Stock Tank Retention Time	h	8.0	Engineering Design
Concentrate Stock Tank	m^3	297	Calculations
Filtration			
Filter Type		Pressure	Engineering Design
Number of Filters		2	Calc/Engineering Design
Solids Feed Rate	t/h	39	Calculations
Design Factor		1.5	Engineering Design
Solids Feed Rate, Design		73	Engineering Design
Slurry Feed Flowrate	m^3/h	56	Mass Balance
Filter Availability	%	80	Engineering Design
Filtration Rate	$t/(h.m^2)$	0.22	Test Result/Engineering Design
Filter Area	m^2	332	Calculations
Filter Cake Moisture	%	9	Engineering Design
Copper Concentrate Stocking			

In-Plant Stockpile Capacity	t	9,229	Engineering Design
Copper Concentrate Bulk Density	t/m3	2.1	
	m^3	4,395	Calculations
Maximum Storage Day	day	7	Engineering Design
Molybdenum Concentrate Dewatering			
Thickening			
Thickener Type		High Rate	Engineering Design
Number of Thickeners		1	Calc/Engineering Design
Solids Feed Rate	t/h	0.2	Mass Balance
Slurry Feed Flowrate	m^3/h	1.7	Mass Balance
Thickener U/F Solid	%	60.0	Engineering Design
Concentrate Production	t/d	4.7	Mass Balance
Thickener Unit Area	$m^2/(t/d)$	0.20	Engineering Design
Design Factor		1.5	Engineering Design
Thickener Diameter	m	1.3	Calculations
Concentrate Stock Tank Retention Time	h	8.0	Engineering Design
Concentrate Stock Tank	m^3	1.5	Calculations
Filtration			
Filter Type		Pressure	Engineering Design
Number of Filters		1	Calc/Engineering Design
Solids Feed Rate, Nominal	t/h	0.2	Calculations
Design Factor		1.2	Engineering Design
Solids Feed Rate, Design	t/h	0.3	Engineering Design
Slurry Feed Flowrate	m^3/h	0.2	Mass Balance
Filter Availability	%	75	Engineering Design
Filtration Rate	$t/(h.m^2)$	0.15	Engineering Design
Filter Area	m^2	2	Calculations
Filter Cake Moisture	%	9	Engineering Design
Drying			
Dryer Type		Direct Heating	
Number of Dryer		1	Calc/Engineering Design
Solids Feed Rate, Nominal	t/h	0.2	Calculations
Design Factor		1.2	Engineering Design
Solids Feed Rate, Design		0.56	Calculations
Dryer Availability	%	42	Engineering Design
Dried Concentrate Moisture	%	5	Engineering Design
Packing Method		Bagged	Engineering Design
Molybdenum Concentrate Stocking			
In-Plant Stockpile Capacity	t	39	Engineering Design
Molybdenum Concentrate Bulk Density	t/m3	1.2	
	m^3	33	Calculations
Maximum Storage Day	day	7	Engineering Design
Tailings			
Disposal Methods		Tailings Dam Impoundment	Engineering Design
Solid Flow Rate	t/h	5,726	Mass Balance
Pulp Flow Rate	m^3/h	11,157	Mass Balance
Reagents			
Lime		Quicklime	
Consumption (Hydrated) - Flotation	g/t	950	Testwork/Estimate
	t/d	134	Calculation
Solids Specific Gravity		2.2	Suppliers/Engineering Design
Lime Silo Storage Capacity	t	940	Engineering Design
Lime Slake System Type		Tower Mill	Engineering Design
Lime Slaking Rate	t/h	#REF!	Engineering Design
Lime Slurry Density	% Solid	15	Engineering Design

Number of Storage Tank		1	Engineering Design
Lime Stocktank Capacity	h	12	Engineering Design
Lime Stocktank Capacity	m^3	854	Engineering Design
Potassium Amyl Xanthate (PAX)			
Consumption	g/t	40	Testwork/Estimate
Solids Specific Gravity		1.2	Suppliers/Engineering Design
PAX Solution Strength	%	10	Engineering Design
PAX Mix Tank Capacity	h	12	Engineering Design
PAX Mix Tank Capacity	m^3	8	Engineering Design
PAX Holding Tank Capacity	h	12	Engineering Design
PAX Holding Tank Capacity	m^3	8	Engineering Design
3418A			
Consumption	g/t	8	Testwork/Estimate
Specific Gravity		1.1	Suppliers/Engineering Design
3418A Solution Strength	%	100	Engineering Design
3418A Holding Tank Capacity	h	12	Engineering Design
3418A Holding Tank Size	m^3	1	Engineering Design
A208			
Consumption	g/t	48	Testwork/Estimate
Specific Gravity		1.1	Suppliers/Engineering Design
A208 Solution Strength	%	100	Engineering Design
A208 Holding Tank Capacity	h	12	Engineering Design
A208 Holding Tank Size	m^3	1	Engineering Design
Fuel Oil (Diesel)			
Consumption	g/t	15	Testwork/Estimate
Specific Gravity		0.9	Suppliers/Engineering Design
Strength	%	100	Engineering Design
Fuel Oil Holding Tank Capacity	h	12	Engineering Design
Fuel Oil Holding Tank Size	m^3	1.5	Engineering Design
Sodium Sulphide (Na2S)			
Consumption	g/t	69	Testwork/Estimate
Solids Specific Gravity		1.9	Suppliers/Engineering Design
Na2S Purity	%	59 to 62	Suppliers
Solution Strength	%	25	Engineering Design
Na2S Mix Tank Capacity	h	12	Engineering Design
Na2S Holding Tank Capacity	h	12	Engineering Design
Sodium Cyanide (NaCN)			
Consumption	g/t	3	Testwork/Estimate
Solids Specific Gravity		1.6	Suppliers/Engineering Design
Solution Strength	%	10	Engineering Design
NaCN Mix Tank Capacity	h	12	Engineering Design
NaCN Holding Tank Capacity	h	12	Engineering Design
MIBC			
Consumption	g/t	35	Testwork/Estimate
Specific Gravity		0.8	Suppliers/Engineering Design
MIBC Solution Strength	%	100	Engineering Design
MIBC Holding Tank Capacity	h	12	Engineering Design
Antiscalant			
Consumption	g/t	4	Testwork/Estimate
Specific Gravity		1.0	Suppliers/Engineering Design
Antiscalant Purity	%	100	Suppliers
Flocculant - Concentrates			
Consumption	g/t	10.3	Testwork/Estimate
Solids Specific Gravity		0.8	Suppliers/Engineering Design
Flocculant Solution Strength	%	0.5	Engineering Design
Flocculant Mix Tank Capacity		Flocculant Package	Engineering Design
Flocculant Holding Tank Capacity	h	12	Engineering Design

PROCESS DESIGN CRITERIA - CYANIDE LEACH PROCESS PLANT

Project: KERR-SULPHURETS-MITCHELL PROJECT (PRE-FEASIBILITY 2012)
Project No.: 12528801
Client: SEABRIDGE GOLD INC
Update Date: April 26 2012
Rev.: A

Gold Leaching Plant			
Description	**Unit**	**Value**	**Source**
General			
Feed Tonnage - Pyrite Conc	t/a	2,990,845	Engineering Design
	days/a	365	Engineering Design
	t/day	8,194	Engineering Design
	t/h	363	Mass Balance
Plant Running Time/Availability	%	94.0	Engineering Design
Feed Tonnage - Design	t/h	400	Calculations/Test Work
	t/day	9,014	Calculations/Test Work
Cyanidation Circuit Feed Specific Gravity		3.2	Experience
Feed Tonnage - Cleaner Tailing	t/a	2,525,392	Calculations
	days/a	365	Engineering Design
	t/day	6,919	Calculations
	t/h	307	Mass Balance
Plant Running Time/Availability	%	94.0	Engineering Design
Feed Tonnage - Design	t/h	337	Mass Balance
	t/day	7,611	Mass Balance
Cyanidation Circuit Feed Specific Gravity		3.2	Experience
Feed Tonnage - Pyrite Conc+Cleaner Tail	t/a	5,516,237	0.0
	days/a	365	Engineering Design
	t/day	15,113	0.00
	t/h	670	Calculations
CIL Feed Grade - Gold	g/t Au	1.2	Calculations/Test Work
CIL Feed Grade - Copper	%	0.12	Test Work/Enginneering Design
Average Gold Recovery - CIL Feed	%	72.0	Test Work Reports
Average Gold Recovery - Mill Feed	%	19.2	Calculations
Metal Production: Gold	kg/a	5,002	Calculations
	kg/day	13.7	Calculations
Copper Dissolution	%	TBD	
CIL Feed Thickening			
Thickening - Pyrite Conc			
Thickener Type		High Rate	Engineering Design/Client
Number of Thickeners		1	Calculations
Solids Feed Rate	t/h	363	Mass Balance
Solids Feed Rate (design)	t/h	400	Calculations
Solids Feed Rate (design)	t/d	9,014	Calculations
Slurry Feed Flowrate	m^3/h	309	Mass Balance
Thickener U/F Solids Density, by weight	% solids	65	Engineering Design
Thickener Unit Area	$m^2/(t/d)$	0.12	Test Work Reports
Thickener Diameter	m	37.1	Calculations
Thickening - Cleaner Tailing			
Thickener Type		High Rate	Engineering Design/Client
Number of Thickeners		1	Calculations
Solids Feed Rate	t/h	307	Mass Balance
Solids Feed Rate (design)	t/h	337	Calculations
Solids Feed Rate (design)	t/d	7,611	Calculations
Slurry Feed Flowrate	m^3/h	264	Mass Balance
Thickener U/F Solids Density, by weight	% solids	65	Engineering Design
Thickener Unit Area	$m^2/(t/d)$	0.12	Test Work Reports
Thickener Diameter	m	34.1	Calculations

Cyanidation			
Cyanidation Method	-	Carbon in Leach (CIL)	Engineering Design/Test Work
Pre-Aeration/NaCN Leach - Pyrite Conc			
Slurry Solids Density, by weight	%, solids	45	Engineering Design
Pre-Aeration Retention Time	h	2.0	Engineering Design/Test Work
Number of the Areartion Tanks	-	2	Calculations
Air Requirement	$Nm^3/h/m^3$	0.24	Engineering Design
Cyanide Concentration	g/L solution	0.00	Engineering Design/Test Work
AreationTank Diameter	mm	9,000	Engineering Design
Aeration Tank Height	mm	10,000	Engineering Design
Slurry pH	-	10.5 -11.0	Engineering Design
CIL Leach Circuit - Pyrite Conc			
Slurry Solids Density, by weight	%, solids	45	Engineering Design
Leach Retention Time	h	23	Engineering Design/Test Work
Number of Leach Tanks	-	5	Calculations
Air Requirement	$Nm^3/h/m^3$	0.24	Engineering Design
Cyanide Concentration	g/L solution	1.50	Engineering Design/Test Work
Carbon Concentration	g/L slurry	15	Engineering Design
Carbon Transfer Screen Aperture	mm	0.85	Engineering Design
Carbon Transfer Screen Load	$m^3/h/m^2$	100	Engineering Design
Slurry Solids Density, by weight	%, solids	45	Engineering Design
Leach Tank Diameter	mm	15,000	Engineering Design
Leach Tank Height	mm	15,000	Engineering Design
Slurry pH	-	10.5 -11.0	Engineering Design/Test Work
Pre-Aeration/NaCN Leach - Cleaner Tailing			
Slurry Solids Density, by weight	%, solids	45	Engineering Design
Pre-Aeration Retention Time	h	2.0	Engineering Design/Test Work
Number of the Areartion Tanks	-	2	Engineering Design
Air Requirement	$Nm^3/h/m^3$	0.24	Engineering Design
Cyanide Concentration	g/L solution	0.00	Engineering Design/Test Work
AreationTank Diameter	mm	9,000	Engineering Design
Aeration Tank Height	mm	10,000	Engineering Design
Slurry pH	-	10.5 -11.0	Engineering Design
CIL Leach Circuit - Cleaner Tailing			
Slurry Solids Density, by weight	%, solids	45	Engineering Design
Leach Retention Time	h	27	Engineering Design/Test Work
Number of Leach Tanks	-	5	Engineering Design
Air Requirement	$Nm^3/h/m^3$	0.24	Engineering Design
Cyanide Concentration	g/L solution	1.50	Engineering Design/Test Work
Carbon Concentration	g/L slurry	15	Engineering Design
Carbon Transfer Screen Aperture	mm	0.85	Engineering Design
Carbon Transfer Screen Load	$m^3/h/m^2$	100	Engineering Design
Slurry Solids Density, by weight	%, solids	45	Engineering Design
Leach Tank Diameter	mm	15,000	Engineering Design
Leach Tank Height	mm	15,000	Engineering Design
Slurry pH	-	10.5 -11.0	Engineering Design/Test Work
Fresh Carbon Characteristics			
Carbon Dimension	mm	3.35 x 1.00	Suppliers
Specific Gravity of Carbon	g/cm^3	1.44	Suppliers
Bulk Density of Activated Carbon, dry	t/m^3	0.47	Engineering Design
Bulk Density of Activated Carbon, wet	t/m^3	0.78	Engineering Design
Safety Screen			
Safety Screen Aperture	mm	0.6	Engineering Design
Safety Screen Duty Load	$(m^3/h)/m^2$	85	Engineering Design
Spray Water	$(m^3/h)/m^2$	2.0	Engineering Design
Carbon Stripping			
Carbon Stripping Method	-	Zadra	Engineering Design

Loaded Carbon			
Daily Carbon Advance Required	t/day	5.5	Calculations
Daily Carbon Advance Designed	t/day	6.6	Calculations/Engineering Design
Loaded Carbon	g Au /t	2,500	Engineering Design
Number of Elutions per Column per Day		1	Engineering Design
Elution Capacity	t/d	6.6	Calculations/Engineering Design
Eluition Column Number		2.0	Engineering Design
Eluition Column Capacity, each	t/d	3.3	Calculations
Eluted Carbon	g Au/t	100	Engineering Design
Acid Washing			
Wash Media		Hydrochloric Acid	Engineering Design
Caustic (100%) Consumption	kg/t carbon	10	Engineering Design
Acid/Caustic Washing Rate		2.0	Engineering Design
Hydrochloric Acid (100%) Consumption	kg/t carbon	50	Engineering Design
Carbon Stripping			
Temperature	^{o}C	~140	Engineering Design
Pressure	kPa	450	Engineering Design
Strip Batch	batch/day	1.0	Engineering Design
Caustic (100%) Consumption	kg/t carbon	40	Engineering Design
Pre-Heater Heat Source	-	Pregant Solution	Engineering Design
Trim Heater Heat Source	-	Electricity	Engineering Design
Carbon Regeneration			
Regeneration Method		Thermal Reactivation	Engineering Design
Carbon Regeneration Capacity	t/day	6.6	Calculations
Reactivation Temperature	^{o}C	700	Engineering Design
Regeneration Furnace	-	Horizontal Kiln	Engineering Design
Heat Source	-	Electricity	Engineering Design
Number of Regeneration Furnace		1	
Number of Regeneration Furnace			
Electrowinning			
Availability	%	90	Engineering Design
Cell Volumn	m^3/cell	4	Engineering Design
Cell Potential	V	3-4	Engineering Design
Cell Current	A	Variable	Engineering Design
Cell Temperature	^{o}C	85	Engineering Design
Cathode	-	Stainless Steel Plate	Engineering Design
Anode	-	Stainless Steel	Engineering Design
Overall Electrowinning Efficiency	%	99	Engineering Design
Gold Smelting			
Smelting Furnace	-	Induction	Engineering Design
Residue Management			
Residue			
Solid Tonnage	t/h	363	Mass Balance
Solid Percent	% w/w	45	Calculations
Au Concentration in CIL Tailings Solution	Au g/t	0.005	Test Work Reports
Residue Washing			
Wash Method		Counter-Current Decantation	Engineering Design
Thickener Type		High Rate	Engineering Design
Wash Stage		2	Engineering Design
Number of Thickeners (each stage)		1	Engineering Design
Solids Feed Rate (design)	t/h	670	Mass Balance
Solids Feed Rate (design)	t/d	14,792	Mass Balance
Slurry Feed Flowrate	m^3/h	2413	Mass Balance
Thickener U/F Solid	%	52	Engineering Design
Thickener Unit Area	m^2/(t/d)	0.12	Experience
Thickener Diameter	m	52	Calculations
Wash Water	m^3/h	1,340	Engineering Design
1st Washing Thickener O/F	m^3/h	1,655	Mass Balance

Cyanide Recovery From Residue Washing Solution			
Cyanide Recovery Method	-	SART/AVR	Engineering Design
Volume into the Cyanide Recovery Circuit	m3/h	1237	Mass Balance
Degree of Vaccum in the AVR System		TBD	Engineering Design
Acidification pH		3	Engineering Design
HCN Reneutralization		NaOH	Engineering Design
Cyanide Destruction			
Cyanide Destruction Method		SO2+Air Oxidation	Engineering Design
CN_{WAD} Concentration in the Cyanide Treated Residues	mg/L	< 2	Engineering Design
Cyanide Destruction Reagent Addition			
SO2	$SO2/CN_{WAD}$	5 g / 1 g	Test Work Reports
CuSO4	Cu/CN_{WAD}	0.14 g / 1 g	Test Work Reports
Cyanide Destruction Stages		2	
Cyanide Destruction Stage One			
Cyanide Destruction Feed	m^3/h	762	Mass Balance
Cyanide Destruction Retention Time - Bench Test	min	60	Test Work Reports
Scale-up Factor		2.0	Engineering Design
Cyanide Destruction Retention Time - Plant	min	120	Calculations
Cyanide Destruction Tank Number		2	Engineering Design
Cyanide Destruction Tank No.1 : Dimensions	diameter, m	11	Calculations
	height, m	12	Calculations
Cyanide Destruction Stage Two			
Cyanide Destruction Retention Time - Plant	min	60	Calculations
Cyanide Destruction Feed	m^3/h	762	Mass Balance
Cyanide Destruction Tank Number		1	Engineering Design
Cyanide Destruction Tank: Dimensions	diameter, m	11	Calculations
	height, m	12	Calculations
Residue Storage			
Storage Methods		Impoundment in Tailings Dam	Engineering Design
Storage Under Water	yes/no	Yes	Engineering Design
Solid Flow Rate	t/h	670	Mass Balance
Pulp Flow Rate	m^3/h	769	Mass Balance
Reagents			
Lime		Quicklime	
Consumption (Hydrated) - Leaching/Cyanide Destruction & Recovery	g/t	92	Testwork/Engineering Design
Solids Specific Gravity		2.2	Suppliers/Engineering Design
Sodium Cyanide (NaCN)			
Consumption	g/t	176	Testwork/Estimate
Solution Strength	%	10	Engineering Design
Solids Specific Gravity		1.6	Suppliers/Engineering Design
NaCN Mix Tank Capacity	h	12	Engineering Design
NaCN Holding Tank Capacity	h	12	Engineering Design
Sodium Meta-Bisulfite- MBS ($Na_2S_2O_5$)			
Consumption	g/t	125	Testwork/Estimate
MBS Purity	%	95	Suppliers
Solids Specific Gravity		1.5	Suppliers/Engineering Design
MBS Solution Strength	%	20	Engineering Design
MBS Mix Tank Capacity	h	12	Engineering Design
MBS Holding Tank Capacity	h	12	Engineering Design
Copper Sulphate(CuSO4.5H2O)			
Consumption	g/t	10	Testwork/Estimate
Solids Specific Gravity		2.3	Suppliers/Engineering Design
Copper Sulphate Solution Strength	%	10	Engineering Design
Copper Sulphate Mix Tank Capacity	h	12	Engineering Design
Copper Sulphate Holding Tank Capacity	h	12	Engineering Design
Sulphur Acid (H2SO4)			
Consumption	g/t	455	Testwork/Estimate
Specific Gravity		1.8	Suppliers/Engineering Design
H2SO4 Purity	%	98	Suppliers
Sodium Hydroxide (NaOH)			
Consumption	g/t	123	Testwork/Estimate
Solids Specific Gravity		2.1	Suppliers/Engineering Design
NaOH Purity	%	98	Suppliers

Antiscalant			
Consumption	g/t	4	Testwork/Estimate
Specific Gravity		1.0	Suppliers/Engineering Design
Antiscalant Purity	%	90	Estimate
Hydrochloric Acid (HCl)			
Consumption	g/t	8	Testwork/Estimate
Specific Gravity		1.2	Suppliers/Engineering Design
HCl Purity	%	37	Suppliers
Flocculant - CIL Feed Thickening			
Consumption	g/t	2.5	Reports/Engineering Design
Solids Specific Gravity		0.8	Suppliers/Engineering Design
Flocculant Solution Strength	%	1	Engineering Design
Flocculant Mix Tank Capacity	h	12	Engineering Design
Flocculant Holding Tank Capacity	h	12	Engineering Design
Flocculant - Residues CCD			
Consumption	g/t	5.0	Reports/Engineering Design
Solids Specific Gravity		0.8	Suppliers/Engineering Design
Flocculant Solution Strength	%	0.5	Engineering Design
Flocculant Mix Tank Capacity	h	12	Engineering Design
Flocculant Holding Tank Capacity	h	12	Engineering Design