AVALON
MINERALS LTD

Viscaria Copper Project

Scoping Study April 2016 Update

Summary Paper

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1. Executive summary

Avalon Minerals' vision is to become a European copper producer whose foundation asset is the Viscaria Copper Project. Viscaria is located five kilometres west of the major mining town of Kiruna, Sweden. Kiruna possesses major infrastructure due to the requirements of major iron ore miner and pelletiser LKAB; this includes hydropower energy distribution, electrified heavy gauge rail and sealed highways to major ports.

The project is targeting production in 2019, when consensus pricing forecasting for copper is greater than $3.00 per pound.

> Viscaria offers investors a unique opportunity participate in a low technical risk and low capital intensity opportunity of >28% IRR and production approaching 30,000 tonnes copper in concentrate, where NPV is greater than pre-production capital

The headline case is Target Case A, which satisfies all strategic performance indicators, including >20,000 tonnes per annum of copper production, >25% IRR, Capital Intensity <US$8,000 per average annual tonne of copper production and an NPV which is greater than pre-production capital.

Target Case A will require the definition of additional underground tonnage at depth at D Zone. This is considered very low technical risk as the deposit is open at depth and drilling has demonstrated increasing grade and thickness at depth. Target Case A has not included known opportunities, such as the definition of additional lodes in the open pits at A Zone and B Zone which will reduce strip ratios. These lodes are known to exist, but were never assayed due to the historical Outokumpu underground mining cut-off of 2.0% copper precluding their inclusion to assaying.

Target Case B includes conservative allowances for resource growth in the immediate A Zone and B Zone resources to deliver a production rate in excess of 30,000 tonnes per annum copper

1.1 Business strategy and analysis

Avalon's strategic performance criteria for are listed in Table 1-1 below.

Table 1-1 Strategic performance indicators

Performance Criteria	Target A (2.0Mtpa)	Target B (3.0Mtpa)
Performance criteria achieved at copper price <US$3.00/lb	✓	✓
Payback period approximately three years	~	~
Mine life of nine plus years	✓	✓
Pre-tax IRR >25%	✓	✓
Capital intensity < US$8,000 per tonne copper produced	✓	✓
Copper production >20,000 tonnes per annum	✓	✓
Copper production >30,000 tonnes per annum	✗	✓
C1 cash cost <US$2.00 per pound	✓	✓
AISC < 50% global production AISC (US$2.10)	✓	✓
NPV approximately equal to, or greater than, pre-production capital	✓	✓

✓ Achieved ✗ Not achieved ~ Substantially achieved

1.2 Scorecard

Target Case A, being the 2.0Mtpa case, incorporates individual A and B Zone open pits containing 8.0Mt of ore at a strip ratio of 6:1. D Zone open pit contributes 1.6Mt. The D Zone defined underground mining inventory totals 3.8Mt. The 2.0Mtpa case also assumes an additional 2.4Mt of ore from D Zone Underground North and 2.0Mt of ore from D Zone Underground South based on results of drilling outside the published mineral resources to take total underground mining inventory to 8.25Mt.

Target Case B, being the 3.0Mtpa case, incorporated a combined A Zone and B Zone open pit. This occurred because the substantially lower processing costs and G&A costs justified a major cutback between the two lodes. Under this scenario the combined A Zone and B Zone open pit contains 18.0Mt ore at a strip ratio of 8.6:1. Target Case B included the same 4.4Mt of additional underground material as stated in Target Case A above.

Under the commodity price scenario of $3.00/lb copper the scenarios produce the following metrics:

Table 1-2 Scenario summary at $3.00 copper price

		Target Case A (2.0Mtpa)	Target Case B (3.0Mtpa)
Ore Mined (Open Pit)	t	9,600,000	18,000,000
Ore Mined (Underground)	t	8,250,000	8,250,000
Waste Mined	t	57,920,000	150,960,000
Strip Ratio	t:t	6.0	8.4
Total Tonnes Mined	t	75,770,000	177,210,000
Ore Milled	t	17,850,000	26,250,000
Ore Grade	%	1.20%	1.06%
Recovery	%	92.49%	91.69%
Cu Produced	t	199,358	257,066
Concentrate Produced	dmt	830,659	1,071,109
Development Capex	US$ million	115	145
Underground Capex (LOM)	US$ million	50	50
Sustaining Capex (Plant & TSF)	US$ million	14	18
C1 Cash Costs	US$/lb	1.81	1.90
AISC	US$/lb	1.97	2.03
EBITDA	US$ million	489	581
Net Operating Cashflow	US$ million	310	369
Net Cashflow	US$ million	304	365
NPV 7%	US$ million	150	178
IRR	%	29%	28%
Payback	Years	3.7	3.6
Capital Intensity	US$/t cu	5,192	5,077

1.3 Sensitivities at alternative copper prices

The most significant parameter affecting projected revenues is the future copper price.

Table 1-3 Copper price sensitivity analysis

Copper Price Sensitivity:	$2.75/lb	Target Case A (2.0Mtpa)	Target Case B (3.0Mtpa)
EBITDA	US$/lb	383.9	446.5
Net Operating Cashflow	US$ million	205.2	233.4
Net Cashflow	US$ million	197.5	229.1
NPV 0%	US$ million	197.5	229.1
NPV 7%	US$ million	85.0	93.9
NPV 10%	US$ million	55.8	59.1
IRR	%	20%	19%
Payback	Years	4.7	4.8
Copper Price Sensitivity:	**$3.00/lb**		
EBITDA	US$/lb	488.6	581.6
Net Operating Cashflow	US$ million	309.9	368.5
Net Cashflow	US$ million	303.8	365.0
NPV 0%	US$ million	303.8	365.0
NPV 7%	US$ million	150.0	178.1
NPV 10%	US$ million	109.5	128.8
IRR	%	29%	28%
Payback	Years	3.7	3.6
Copper Price Sensitivity:	**$3.50/lb**		
EBITDA	US$/lb	698.2	851.7
Net Operating Cashflow	US$ million	519.5	638.7
Net Cashflow	US$ million	514.7	636.0
NPV 0%	US$ million	514.7	636.0
NPV 7%	US$ million	280.1	346.2
NPV 10%	US$ million	217.1	268.3
IRR	%	44%	43%
Payback	Years	2.5	2.4

It can be seen from the above analysis that increasing the scale of the project is key in times of lower copper prices.

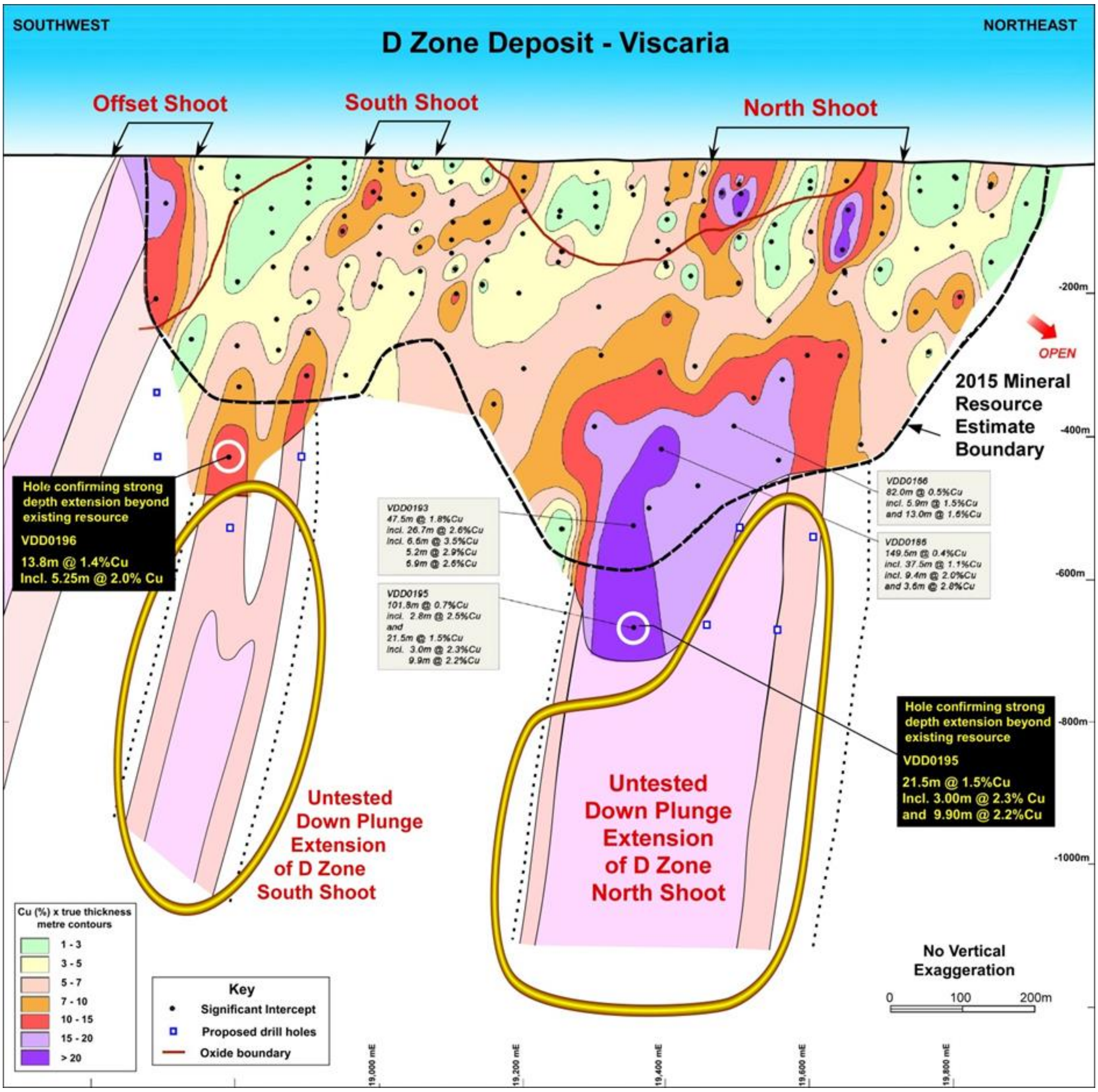
2. Exploration target at D Zone

Drilling to date at the D Zone deposit at Viscaria has defined a copper mineral resource that is mostly shallower than 400 metres depth, and which is also defined locally between 400m and 600m depth.

The majority of the resource that was defined in the 2015 Mineral Resource Estimate lies in the vicinity of the D Zone North Shoot. At depths below around 250 metres, the contours define a less poddy and more.

Collectively, there is high potential for very significant resource expansion at the D Zone deposit at Viscaria from multiple mineralised shoots.

Figure 2-1 D Zone Exploration Targets



Drill hole VDD0195 is the deepest test to date of the North Shoot at D Zone. It intersected a very zone of high-grade copper mineralisation (21.5m @ 1.5% Cu including 9.9m @ 2.2% Cu plus 3.0m @ 2.3% Cu) encapsulated within a very wide mineralised halo (101.8m grading 0.7% Cu) that appears to be widening with depth. Hole

VDD0195 lies near the southwest margin of the North Shoot, and so there is excellent potential for widening of this high-grade mineralised zone a further 200m towards the northeast at depths of 500 to 700 metres.

Furthermore, drill hole VDD0195 lies approximately 100 metres below the base of the 2015 updated resource. Thus this hole is confirmation of excellent continuity of mineralisation below the current Offset Shoot

Opportunity to reduce mining strip ratios by defining additional lodes at A and B Zones

Key drilling targets include additional lodes adjacent to A Zone and B Zone which will have the effect of reducing the overall strip ratio. These lodes are known to exist as they were partly defined by Outokumpu during the previous mining phase, and confirmed by one diamond drill hole completed by Avalon in December 2014 (VDD 182). However, Outokumpu operated an underground only mine and targeted lodes of greater than 2.0% copper. Visual estimates of drilled core intercepts by Outokumpu of these lodes indicate a grade range of 0.7% to 0.9% copper. It is considered likely that an additional 1.0Mt to 2.0Mt of additional mining inventory could be defined by these lodes.

3. Project location

The Viscaria Copper Project is located in Kiruna Municipality in Norrbotten County, the northern-most county in Sweden (Figure 3-1). The Viscaria Copper Project area is located approximately five kilometres west of the town of Kiruna. The Project is located close to major infrastructure which includes the E10 highway and the Kiruna-Narvik and Kiruna-Luleå railway lines.

Figure 3-1 Project location map

The world's largest underground iron ore mine, Kirunavaara, lies on the outskirts of the Kiruna town and was established in 1890The iron ore is processed to produce hematite pellets and sinter fines which are transported by rail to the ports at Narvik and Luleå for export, and to the steel mill at Luleå (SSAB).

The Viscaria Copper Project is situated in a region with highly developed infrastructure including multiple options for airports, railroads, roads and ports.

4. Geology and mineral resource

The A Zone and B Zone deposits at Viscaria are interpreted to be Besshi-type VMS deposits. One model for the D Zone deposit at Viscaria is that it is also a Besshi-type VMS deposit, with the exception that the D Zone lens represents sub-surface replacement of a dolomitic parent horizon, with substantial deformation-related modification/remobilisation of sulphide. The unusually high magnetite content of the D Zone deposit compared to the stratigraphically higher A Zone and B Zone lens's which have lower magnetite contents, leaves open the possibility that the D Zone deposit has affinities to iron-oxide-copper ("IOC") deposits which are a sub-class of iron-oxide-copper-gold ("IOCG") deposits.

Resource estimation

The most recent resource estimate on the A Zone and B Zone deposits was announced on 1 July 2014.

The most recent resource estimate on the D Zone deposit was announced on 30 November 2015.

Table 4-1 lists the current, total combined resource figure for A Zone, B Zone and D Zone.

Table 4-1 Total combined resource figure for A Zone, B Zone and D Zone at Viscaria

Resource Area	Classification	Tonnes (Mt)	Cu Grade (%)	Contained Cu (kt)
A Zone	Measured	14.44	1.7	240.0
	Indicated	4.69	1.2	57.2
	Inferred	2.48	1	25.5
	Subtotal	**21.61**	**1.5**	**322.7**
B Zone	Measured	0.12	1.3	1.6
	Indicated	4.12	0.7	29.7
	Inferred	15.41	0.8	118.7
	Subtotal	**19.65**	**0.8**	**149.0**
D Zone	Indicated	3.11	0.81	25.2
	Inferred	0.01	0.32	0.02
	Subtotal	**3.11**	**0.81**	**25.2**
	Indicated	7.26	1.37	99.8
	Inferred	0.78	1.57	12.2
	Subtotal	**8.03**	**1.39**	**111.9**
Overall Cu	**Total**	**52.4**	**1.2**	**608.9**

5. Mining

The Viscaria open-pit and underground mining operations are scheduled to work 360 days in a year, assuming that up to five days production in a year will be lost due to unscheduled delays such as extreme weather events.

At this stage, it is expected that both operations will be performed by mining contractors with management oversight and technical services provision from Avalon personnel.

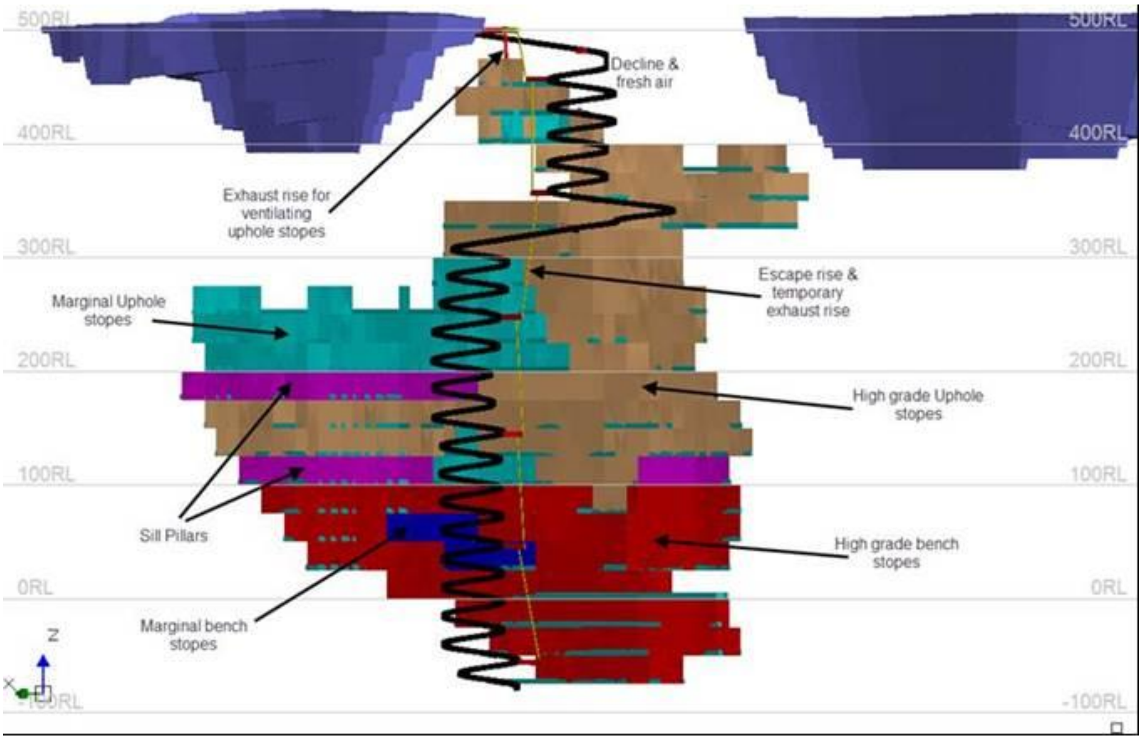
Underground mining

The underground mine is scheduled to produce at a maximum of between 800ktpa and 1.2Mtpa in the Target Cases. Uphole retreat benching with island pillars; and downhole benching with waste fill. Two declines will be required to access the lodes further along strike and to achieve the required production rate

Uphole retreat benching is utilised in the upper levels of the mine where the grade is lower and is principally aimed at providing economic material for mill feed during the progression to the deeper level, higher grade areas. Downhole benching with waste fill is utilised in the lower levels of the mine where the grade is higher such that the loss of economic material to pillars is minimised.

A diagram showing underground capital development, downhole benching stopes and uphole benching stopes is presented in Figure 5-1 below.

Figure 5-1 Viscaria underground design looking east



The underground mining contractor will provide the following capital items on mobilisation:

- Contractor mine offices serviced by water, power and communications
- Muster and crib room
- Explosives magazine and delivery truck
- Workshop and store
- Refuelling and lubrication bay

- Vehicle washdown bay
- Ablution block and change house, including underground toilets
- Underground communications
- Underground power system including permanent 11kV
- Second egress and refuge chambers

The following permanent mine infrastructure will be provided by Avalon:

- First aid and emergency response room including underground ambulance
- Surface primary fans and heating system
- Mine main dewatering system
- Fresh water supply
- Power supply

Open pit mining

The Viscaria open pit operations will involve conventional open pits employing selective mining techniques to exploit the ore. Backhoe excavators and rigid frame off-highway rear dump trucks will be used to mine and haul ore and waste. The mining equipment considered suitable for the project would include 120 to 180 tonne backhoe configured hydraulic excavators and off-highway diesel haul trucks with a payload capacity of around 90 tonnes. Ore will be delivered to the ROM ore stockpile for blending and rehandling by a front-end loader ("FEL") into the crusher

Low-grade material will be selectively stockpiled for possible processing later in the mine life. Waste material will be required during preproduction for TSF embankment construction, the establishment of haul roads from the pits to the ROM pad and waste landform areas, ROM pad construction work and sound bunding. The waste landform will be progressed by tipping from a higher level against a windrow and progressively pushing the waste out with a dozer. Rock-lined drains shall be constructed, where required, to ensure excess run-off is controlled and directed down to sediment traps.

The final pit designed mining inventories are listed in Table 5-1 (Target Case A) and Table 5-2 (Target Case B) below.

Table 5-1 Mining Inventory Open Pit (Target Case A)

	Unit	A&B Zone	D Zone
Mill feed	Mt	8.0	1.6
Waste tonnage	Mt	48.0	9.9
Grade	% Cu	0.90	0.94

Table 5-2 Mining Inventory Open Pit (Target Case B)

	Unit	A&B Zone	D Zone
Mill feed	Mt	15.4	1.6
Waste tonnage	Mt	88.6	9.9
Grade	% Cu	0.83	0.94

Table 5-3 Target Case A production schedule

		1	2	3	4	5	6	7	8	9	10	11	12	Totals
Open Pit A and B Zone														
Ore Mined (Open Pit)	Mt	-	-	0.8	1.2	1.2	1.2	1.2	0.7	0.7	0.7	0.3	-	**8.0**
Waste Mined	Mt	-	-	4.8	7.2	7.2	7.2	7.2	4.2	4.2	4.2	1.8	-	**48.0**
Total tonnes Mined	**Mt**	**-**	**-**	**5.6**	**8.4**	**8.4**	**8.4**	**8.4**	**4.9**	**4.9**	**4.9**	**2.1**	**-**	**56.0**
Ore Grade	%			0.90%	0.90%	0.90%	0.90%	0.90%	0.90%	0.90%	0.90%	0.90%		
Open Pit D														
Ore Mined (Open Pit)	Mt	-	-	-	-	-	-	-	0.5	0.3	0.3	0.5	-	**1.6**
Waste Mined	Mt	-	-	-	-	-	-	-	3.1	1.9	1.9	3.1	-	**10.0**
Total tonnes Mined	**Mt**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.6**	**2.2**	**2.2**	**3.6**	**-**	**11.6**
Ore Grade	%								0.94%	0.94%	0.94%	0.94%		
Underground D Zone Main Lode (North)														
Ore Mined	Mt	-	-	-	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	-	**3.6**
Ore Grade	%				1.71%	1.71%	1.71%	1.71%	1.71%	1.71%	1.71%	1.71%		
Underground D Zone Pillars (North)														
Ore Mined	Mt	-	-	-	-	-	-	-	-	0.2	0.2	0.2	-	**0.6**
Ore Grade	%									1.23%	1.23%	1.23%		
Underground D Zone Marginal (North)														
Ore Mined	Mt	-	-	0.7	-	-	-	0.15	0.2	0.2	0.15	-	-	**1.4**
Ore Grade	%			1.45%				1.45%	1.45%	1.45%	1.45%			
Underground D Zone Development (North)														
Ore Mined	Mt	-	-	-	0.2	0.2	0.2	0.05	-	-	-	-	-	**0.7**
Ore Grade	%				1.33%	1.33%	1.33%	1.33%						

		1	2	3	4	5	6	7	8	9	10	11	12	Totals
Underground D Zone Main Lode (South)														
Ore Mined	Mt	-	-	-	-	-	-	-	-		0.05	0.2	0.2	**0.5**
Ore Grade	%										1.71%	1.71%	1.71%	
Underground D Zone Pillars (South)														
Ore Mined	Mt	-	-	-	-	-	-	-	-	-	-	0.35	0.15	**0.5**
Ore Grade	%											1.30%	1.30%	
Underground D Zone Marginal (South)														
Ore Mined	Mt	-	-	-	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-	-	**0.7**
Ore Grade	%				1.45%	1.45%	1.45%	1.45%	1.45%	1.45%	1.45%			
Underground D Zone Development (South)														
Ore Mined	Mt	-	-	-	-	-	-	-	-	-		0.3	-	**0.3**
Ore Grade	%											1.33%		

TOTALS		1	2	3	4	5	6	7	8	9	10	11	12	Total
Ore Mined (Open Pit)	Mt	-	-	0.8	1.2	1.2	1.2	1.2	1.2	1.0	1.0	0.8	-	**9.6**
Ore Mined (Underground)	Mt	-	-	0.7	0.8	0.8	0.8	0.8	0.8	1.0	1.0	1.2	0.4	**8.3**
Waste Mined	Mt	-	-	4.8	7.2	7.2	7.2	7.2	7.3	6.1	6.1	4.9	-	**57.9**
Strip Ratio		-	-	6.0	6.0	6.0	6.0	6.0	6.1	6.1	6.1	6.1	-	**6.0**
Total tonnes Mined	Mt	-	-	6.3	9.2	9.2	9.2	9.2	9.3	8.1	8.1	6.9	0.4	**75.8**
Ore Milled	Mt	-	-	1.5	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.4	**17.9**
Ore Grade		-	-	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.2%	1.5%	**1.20%**
Recovery		-	-	92.3%	92.0%	92.0%	92.0%	92.0%	92.5%	92.8%	92.8%	93.5%	95.0%	**92.5%**
Cu Produced	t	-	-	16,123	21,747	21,747	21,747	21,918	22,249	22,856	22,980	22,890	5,102	**199,358**
Concentrate Produced	t	-	-	67,177	90,613	90,613	90,613	91,325	92,704	95,235	95,750	95,374	21,256	**830,659**

6. Metallurgy and processing

The main activities in the metallurgical test work programmes were analyses of head samples, comminution characterisation and responses to flotation unit processes. The samples were selected from 16 diamond drill holes in the three zones, totalling about 310 metres interval length. This included about 90 metres of low grade copper material and wall rock, both of which are lower than the cut-off copper grade.

Comminution

A summary of the comminution test results is shown in Table 6-1. Bond work index values are averages. Tests for ball mill work indices used a 106 micron aperture closing screen. A Zone and B Zone ores are considered moderately to highly competent and very hard. D Zone ores are considered low to average competency and low to moderate hardness.

Table 6-1 Comminution characteristics for fresh and transition ores at Viscaria

Comminution test (methodology)		A Zone (fresh)	B Zone (fresh)	D Zone (fresh)	D Zone (transition)
Competency (JK Tech)	Axb	no test	35	51	n.a.
Work index-rod (Bond)	kWh/t	21	25	10	11
Work index-ball (Bond)	kWh/t	17	20	8	10
Abrasion index	--	0.15	0.22	0.12	0.06

Flotation

Rougher, cleaner and regrind/cleaner tests were carried out on ore types from the three zones. The standard primary grind sized used for the tests was 80% passing 106 microns. Very few grind size versus recovery relationships by ore type were tested and these were only at sizes towards the outer limits of rougher flotation range, 160 microns and 45 microns. The rougher concentrate regrind size was 80% passing 53 microns, although a few tests were performed at 45 microns with no significant difference in response. Rougher and cleaner flotation results are summarised in Table 6-2. Regrind/cleaner results are shown for A and B zones; regrind provided no benefit for D Zone ores.

Table 6-2 Summary of flotation results for fresh and transition ores at Viscaria

Flotation		A Zone (fresh)	B Zone (fresh)	D Zone (fresh)	D Zone (transition)	D Zone (oxide)
Feed to float, grade	% Cu	1.64	0.83	1.04	1.54	1.22
Rougher conc, mass	% weight	11	14	8	17	17
Rougher conc, recovery	ave Cu, %	94	95	98	76	38
Rougher tail, grade	% Cu	0.12	0.04	0.02	0.49	0.86
Cleaner conc, grade	% Cu	23	23	26	24	14
	% S-sul	26	31	29	9	1
Cleaner conc, recovery	Cu, %	80	80	94	68	26
	S-sul, %	67	28	93	83	51

Flotation characteristics for the ore types:

- D Zone fresh ore is highly amenable; 25% Cu grade at ≈ 94% copper recovery.
- D Zone transition ore is moderately amenable; nominal 25% Cu grade at mid-60s% copper recovery.
- D Zone oxide ore is not amenable to flotation (and is not included in any mining inventory)
- A Zone fresh ore is amenable to flotation with 80% copper recovery at 23% Cu grade; high copper grade in rougher tail and moderate cleaner grade/recovery performance of copper is most likely caused by chalcopyrite associations with sphalerite. Cleaner optimisation testwork will improve this recovery.
- B Zone fresh ore is amenable to flotation with 80% copper recovery at 23% Cu grade; high rougher tail sulphur grade and poor sulphur recovery in cleaner is due to pyrrhotite; moderate cleaner grade/recovery performance of copper is most likely caused by association with pyrrhotite. Cleaner optimisation testwork will improve this recovery.

Processing

The concentrator will utilise the following principal process areas for the recovery of the copper into copper concentrates:

- Three stage crushing, ore storage and reclaim
- Closed circuit single stage Ball milling and classification
- Copper rougher and rougher scavenger flotation
- Rougher-scavenger concentrate regrind
- Copper cleaner, re-cleaner and cleaner scavenger flotation
- Copper concentrate thickening, filtration, storage and container load-out
- Tailings thickening, disposal and decant water return
- Process and raw water storage and distribution
- Reagent make-up and distribution
- High and low pressure air distribution

The copper flotation circuit design consists of rougher flotation, rougher scavenger flotation and two stages of cleaning in closed circuit with a cleaner scavenger.

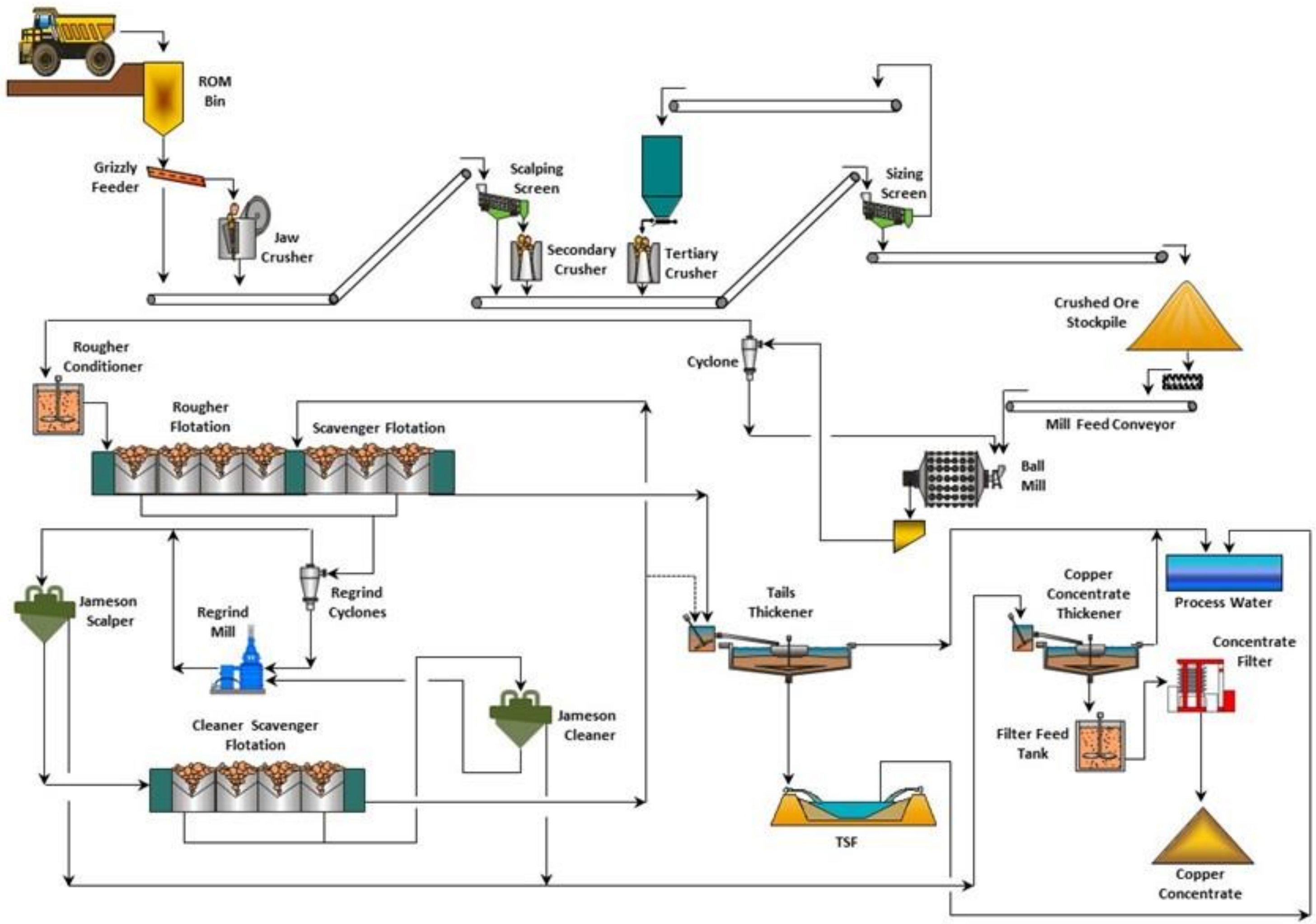
Concentrate will be thickened, filtered and loaded by front end loader into shipping containers. The containers are loaded onto trucks, for transport to port. The concentrate trucks will be washed prior to departing from the concentrate load out shed. Spray water, filtrate and concentrate thickener overflow will be returned to the plant process water circuit. Benchmark settling and filtration rates were utilised in the sizing and selection of the concentrate thickener and filters.

Flotation tails will be thickened, prior to being pumped to the tailings storage facility. Tails thickener overflow will be returned to the plant process water circuit. Water recovered from the TSF will be returned to the plant process water circuit. Benchmark settling rates were utilised in the sizing and selection of the tails thickener.

The Viscaria flow sheet incorporates currently available equipment that has been proven in similar operations. Unit processes in the flowsheet are benchmarked against design data from similar plants globally.

A simplified version of the proposed Viscaria flow sheet is presented in Figure 6-1 below.

Figure 6-1 Viscaria schematic flowsheet



7. Site infrastructure and services

Site development will comprise facilities including:

- Site preparatory work
- Site access and site roads
- Treatment plant including site buildings and services
- Tailings storage facility
- Mine waste landform
- Mine service area
- Power line construction
- Water supply and management.

Site access

Site access is restricted by the construction in 2014 of a new railway line which effectively cut-off a previously existing road serving the purpose. A new bridge will be required to cross the new railway line for operations..

Process plant

The process plant will be located to the east of the A Zone pits, near the site of the previous Outokumpu facility.

Administration and plant buildings

All site administration staff will be accommodated in a main administration building. There are several options available for locating this building, including to consider the lease of an existing commercial building in Kiruna town centre and to limit on-site building requirements to front-line supervision of mining and processing only.

The fixed plant workshop and warehouse will include a crib room, ablutions and training facilities and will be located as close as possible to the treatment plant.

The treatment plant will have two main switch rooms (primary crushing and wet plant), and a compressor building. The site laboratory building will house the assay facilities (mill samples only will be assayed on site). Mine samples will be assayed offsite at a contract laboratory.

Mining facilities

Under the terms of the two mining contracts, all maintenance facilities and associated services will be provided by the open-pit mining contractor and underground contractor as part of their scopes. This includes all buildings and their infrastructure and their connection to the site heating, electrical and water services.

The cost of establishment of the site infrastructure has been included in the mining contractor site establishment costs.

The recommended maintenance facilities for each contractor include the following items:

- Mobile equipment workshop, including a tool store, offices, amenities and work bays, serviced by an overhead travelling crane;
- Warehouse and lay down area;
- A tyre fitting area;
- A light vehicle workshop;
- A wash down area with waste oil traps and sumps;
- A lubrication bay with facilities for bulk lubricant delivery and waste oil removal; and
- A fuel farm with separate re-fuelling points for light and heavy vehicles.

Water supply and management

Bottled drinking water will be sourced from Kiruna town on an as needs basis.

Potable water for the site operations will be sourced from the treated water pond located on-site and will be mainly used for ablutions.

Process water sourced primarily from the dewatering of the open-pit and underground mining operations will supply the plant and operations. The latter will include site access road and mining area dust suppression, underground drilling equipment and underground dust suppression.

Tailings storage facility

The tailings storage facility (TSF) site selection study covered the full extent of the available topography not currently under a third party land use agreement and located within Avalon Mineral's granted exploration and exploitation licences. The study examined an option for thickened tailings disposal within the confines of the site avoiding the strike of the ore zones, Natura 2000 nature reserves, reindeer herding corridors, national roads and railway alignments. The study also avoided areas which, based on aerial imagery, indicated the presence of extensive peat bogs where the founding conditions are likely to be challenging.

This TSF siting study included the assessment of optimum embankment alignments, pre-commissioning and life-of-mine (LOM) embankment configurations and optimum deposition strategies with possible decant options.

In addition to the thickened tailings option, an alternative technology was considered to dispose of the tailings as a filtered "dry" material within a waste landform. This has potential benefits in cold climates by eliminating the requirement to manage tailings slurry and water during the winter period when freezing will be a significant issue, and may also reduce the construction requirement which will have to be performed in a very short construction season. Additionally, co-disposal will allow more tailings to be stored on a smaller footprint. As such, Tailings Co-Disposal was also included in this study as a disposal option.

Thickened Tailings Option

The area south of the A Zone pit was identified as the potential TSF site for the Thickened Tailings Option. The area northeast of the A Zone, B Zone and D Zone pits, where some of the current waste dumps are located, was identified as suitable for the waste landform for this option.

It was assumed that tailings will be discharged into the facility by sub-aerial method of deposition utilising banks of spigots located at regular intervals during summer, predominantly from all perimeter embankments with the aim of maintaining the supernatant pond away from the perimeter embankments. During the winter, point discharge will be required to reduce issues with freezing. The decant pond will be accessed via a causeway constructed from the midpoint of the southwest wall which will be constructed towards the ridge line with the aim of minimising the fill volumes required for the decant causeway.

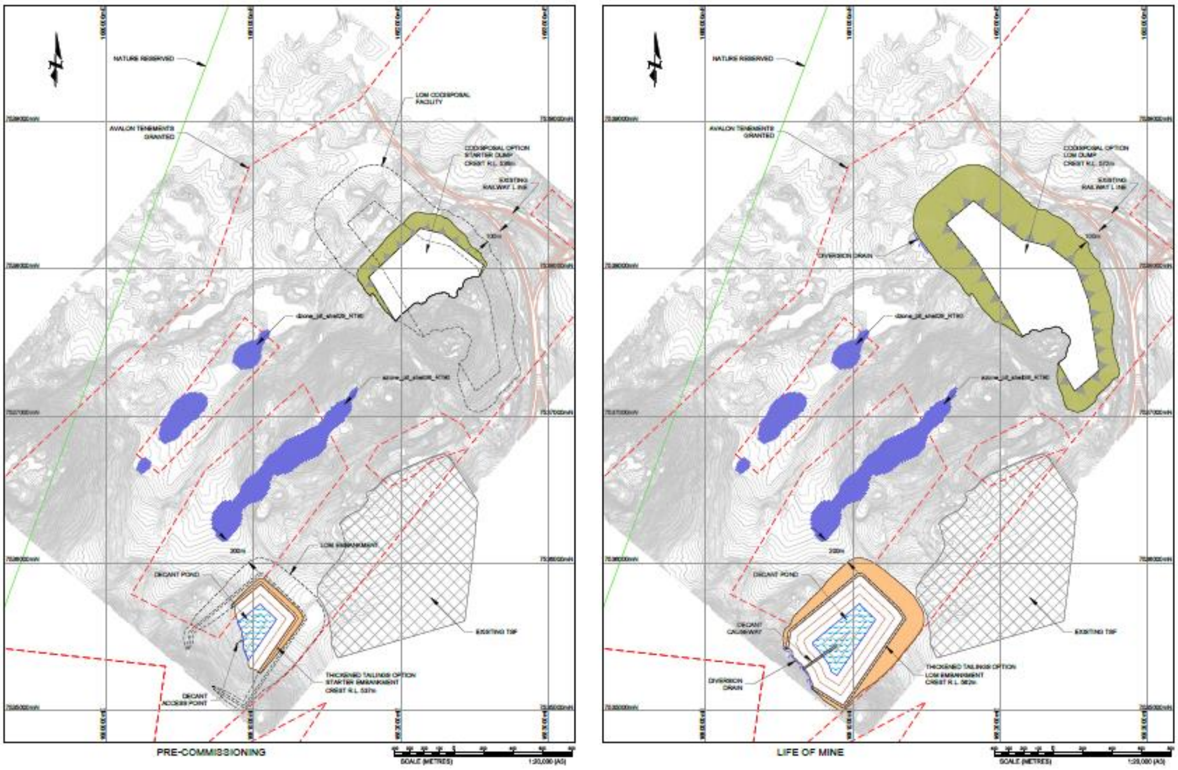
Tailings Co-Disposal

The area northeast of the pits was identified as the potential Co-Disposal site. A perimeter bund will be constructed of waste rock with an infill of combined tailings and waste rock. In order to prevent loss of tailings into the waste rock fill, a layer of geofabric will be installed at the interface of the perimeter bund and infill.

The maximum stacking height was defined as 10 metres with a 10 metre step-in between each stage of stacking.

No significant surface water diversions works will be required for this option.

Figure 7-1 Diagram of two alternative tailings disposal options for a) pre-commissioning and b) life-of-mine – Thickened Tailings and Co-Disposal



.TSF conclusions

The main reason for the limited industry adoption of filtered or co-Disposed tailings to date is economic. Comparisons of capital and operating costs, as conducted here, invariably favour conventional thickened methods, however, this takes a limited view. Cost estimates for conventional tailings dams do not include the risk costs, either direct or indirect, associated with failure potential.

For the purpose of the Scoping Study, the Thickened Tailings option has been selected for costing purposes.

Power

Electricity will be supplied from the State grid via a tap-off connecting the Viscaria project site with the 133kV high voltage lines crossing the project area. The tap-off can occur directly at the power line intersect, requiring a 33kV line to the process plant located approximately 1,000 metres away.

Heating

Kiruna town has a waste-to-energy plant, Värmeverk, which produces 77 MW of heat, and supplies 90 percent of all properties in Kiruna – including a third of all houses – with district heating. It is anticipated that the project will leverage of this infrastructure for heating requirements.

Accommodation facilities

There is no plan to construct a mine village due to the proximity to Kiruna town.

8. Project execution and capital cost

Given the relatively small size of the processing plant and current market conditions, the implementation of the construction of the process plant and associated infrastructure sections of the plant facility is less dependent on the supply of long lead items, such as the mill, and more dependent on execution timing within the harsh winter period where temperatures are significantly sub-zero.

The project schedule for engineering and construction to practical completion is estimated to be 18 months, due largely to the execution constraints during the winter period.

Modularisation of key components of the process plant will be investigated, such that entire areas of the process plant could be delivered to site pre-assembled. This may include items such as flotation tanks and filter plants.

At this stage, it is assumed that the engineering and development of the process plant and site facilities will be awarded, either by tender or by negotiation, to a suitably qualified engineering contractor on a reimbursable EPCM. It is recognised that other forms of negotiated contract bases (including Design and Construct) could be implemented and will be assessed in later stages of the feasibility study process.

Key Dates for the construction of the process plant and associated infrastructure are listed below:

- Project Approval by Avalon Board of Directors – Day 0
- Award EPCM Contract – Day 30
- Start Detail Design – Day 30
- Start Procurement – Day 30
- Start Construction of the Process Plant – Day 120
- Practical Completion – Day 520
- Commission Plant – Day 545
- First Copper Production – Day 550

These dates will be revised to accord with actual project approval timing.

Mine development

The life-of-mine plan has determined that both open pit and underground operations need to occur concurrently and from the beginning of mine life. It is assumed that both open pit and underground operations will be executed by two separate mining contractors and not as owner operator. It is recognised that this may change as the feasibility study process continues.

A reasonable amount of site preparation work commences one year before ore mining is required. It is expected this could be conducted by the open-pit mining contractor. Works will comprise construction of access roads and haul roads, settling ponds, drainage systems, waste storage facility establishment and construction of the TSF starter embankment.

The open-pit mining contractor will mobilise open-pit mining equipment and personnel ready to start mining three months before the treatment plant commences operation.

Construction of the TSF will continue throughout the life of the project.

The underground mine development schedule comprises a twelve month pre-production period. The better grade for the underground orebody is at depth, and project economics are driven by early extraction of this ore source.

The waste generated by the decline development may also be utilised for TSF embankment purposes.

Portal establishment and early decline development must occur in a summer period.

Capital cost

The estimated capital for the Viscaria Copper Project Target Case (2.0Mtpa) is summarised in

Table 8-1. The capital requirements include capital cost estimates, owners costs and contingencies.

The Scoping Study estimate is largely a factored estimate. However, budget pricing has been obtained for a significant percentage (~44%) of the equipment list. Additionally, budget pricing has been obtained from an experienced Scandinavian mining contractor for relevant mining costs.

The estimate includes a 15% contingency on directs and indirects applied to the process plant and other infrastructure. The estimate accuracy is Scoping Study level or ±30% accuracy as at Quarter 3, 2015.

Table 8-1 Capital cost estimate by area for Target Case A 2.0Mtpa plant

		USD
Grand Total		**115.1**
113	Site Drainage and culverts, creek diversion	1.6
120	Crushing and storage	15.0
130	Milling	10.0
151	Flotation Roughers	11.6
152	Flotation Cleaners	6.4
153	Regrinding	2.6
160	Concentrate Thickening and Filtration	3.0
170	Tails Thickening and Disposal	2.5
210	Reagents	3.0
220	Water Services	1.6
230	Plant Services.	0.4
240	Air Services	2.3
270	HVAC	2.0
.0312	Site access road and bridge	1.5
313	Carparks & Hardstand, weighbridge, fencing	0.7
316	Communications	0.1
317	Port	0.5
331	Raw Water Supply and settlement ponds	0.3
333	Water Treatment & Disposal	1.0
342	HV Tap-Off & Switchyard / Substation	2.0
344	Site Power Distribution	0.3
346	Emergency / Standby Power	0.3
348	Buildings – Admin & Plant	5.5
351	Tailings Storage Facility	2.3
352	Tailings Pipeline and decline	1.0
413	Survey Equipment	0.1
415	Mining Contractor Mob/Demob	5.0
416	Underground ventilation / compressors / electrical	3.0
417	Mine Planning	0.1
421	Haul Roads	0.8
423	ROM Pad	0.3
425	Waste Storage Facility	0.3
452	Other mining facilities	0.3
510	EPCM	8.0
550	Other Owners Costs	3.5
910	Project Contingency	16.2

9. Operating costs

The site operating cost estimate is described according to four main operating areas:

- Open pit mining
- Underground mining
- Processing
- General and Administration

Underground mining

As part of the operating cost analysis, numerous benchmarking exercises were performed and are summarised below.

Table 9-1 List of benchmarked operations

	Operation	Owner	Location	Mining rate (Mtpa)	Haulage depth (m)	Orebody width (m)
0	Viscaria	Avalon	Kiruna, Sweden	2.0	600	4 to 20
1	Tritton	Straits	NSW, Australia	1.6	900	8 to 40
2	Cosmo Howley	Newmarket	NT, Australia	0.4	600	5 to 8
3	Bjorkdal	Mandalay	Sweden	0.8	800	1 to 5
4	Kylylahti	Boliden	Finland	0.4	800	4 to 12

A summary of these benchmarks are provided in Table 9-2 below.

Table 9-2 Operating cost benchmarks, United States dollars

Activity	Unit	Viscaria	Tritton	Cosmo Howley	Bjorkdal	Kylylahti
Processing rate	Mtpa	2.0	1.6	0.3	1.3	0.66
Mining rate – Open pit	Mtpa	1.2	n/a	n/a	0.8	n/a
Strip ratio – Open pit	w:o	6.0	n/a	n/a	9.5	n/a
Mining rate - Underground	Mtpa	0.8	1.6	0.3	0.5	0.66
Grade – Open pit		0.91%	n/a	n/a	1.25g/t Au	n/a
Grade - Underground		1.48%	1.91% Cu	3.79g/t Au	3.26g/t Au	1.66% Cu, 0.70g/t Au
Processing recovery	%	90	94	93	88	92 / 75
Underground Mining	$/t	35.00	34	41	32	35.51
Ore Trucking	$/t	n/a	n/a	5	n/a	6.71
Open Pit Mining	$/t	2.40	n/a	n/a	2.32	n/a
Processing	$/t	12.10	10	21	7.32	22.21
General and Admin Costs	$/t	2.50	8	5	3.80	3.47

Offsite	$/t	9.05	15	n/a	n/a	11.50
Open Pit Mining	$/lb	0.43	n/a	n/a	n/a	n/a
Underground Mining	$/lb	0.55	0.94	n/a	n/a	1.13
Ore Trucking	$/lb	n/a	n/a	n/a	n/a	0.22
Processing	$/lb	0.51	0.28	n/a	n/a	0.63
General and Admin Costs	$/lb	0.11	0.22	n/a	n/a	0.12
Offsite	**$/lb**	**0.39**	**0.41**	**n/a**	**n/a**	**0.39**
By-product credits	$/lb	0	(0.04)	n/a	n/a	(0.78)
C1 Costs (copper)	$/lb	1.86	1.81	n/a	n/a	1.71
AISC Costs (copper)	$/lb	2.10	2.10	n/a	n/a	2.59

Open pit mining operating cost

The mining cost summary breakdown is provided in Table 9-3 below. The summary is based on a calculation of both unit rate costs and fixed costs applied to the total mining schedule tonnage.

The mining cost is broken down according to industry standard activity types.

Table 9-3 Mining cost breakdown

	Cost (US$/t)	Application method	Basis
Loading	$0.31	Unit rate	Equipment type and numbers specified
Hauling	$0.60	Unit rate	Assumed single haulage profile, equipment numbers specified
Mine support fleet	$0.38	Assuming 6:1 strip ratio average	Equipment type and numbers specified
Drill and blast	$0.38	Assuming 6:1 strip ratio average	Assumed drill and blast design
Presplit	$0.04	Assuming 6:1 strip ratio average	Assumed pre-split design
Workshop	$0.05	Assuming 6:1 strip ratio average	Assumption on fixed cost for workshop tooling, power, etc.
Grade control	$0.10	Assuming 6:1 strip ratio average	Assumed grade control design
Light vehicles	$0.02	Assuming 6:1 strip ratio average	Equipment type and numbers specified
Consumables	$0.02	Assuming 6:1 strip ratio average	Allowance
Mine administration	$0.35	Assuming 6:1 strip ratio average	Organisation structure designed
Dewater and dayworks	$0.05	Assuming 6:1 strip ratio average	Allowance
Rehandle crusher	$0.10	Assuming 6:1 strip ratio average	Assumption on single FEL on the ROM
Total	**$2.20**		

The mining contractor will be responsible for all loading, hauling and dumping of ore and waste excavated from the pit. The contractor will excavate and load ore in accordance with the marked ore and waste blocks and ensure minimum contamination and maximum recovery of ore. The contractor will haul ore and waste from the pit to the designated destinations as directed by the Avalon site representative and use the haul routes with the lowest unit rate between the pit, waste landforms and ROM pad.

Costs associated with ancillary equipment are included in the contractor's rates. This includes the cost of the remaining support earthmoving equipment including bulldozers, graders, water carts and other miscellaneous ancillary equipment for use in such duties as batter trimming, dozing and floor clean-up, active mining road construction/maintenance, dust suppression, rock-breaking and waste stockpile maintenance.

In addition to undertaking all mining operations, the contractor is to mobilise all plant, equipment and associated personnel as necessary to undertake the mining works. The contractor would also be responsible for establishing and maintaining all access roads in the immediate vicinity of Viscaria for the works stipulated.

Process operating cost

The process operating cost estimate includes all areas, from the ROM crushing circuit through to the disposal of tailings to the tailings storage facility.

The overall accuracy of the OPEX estimate is +/- 35% and no accuracy limits are applied. Contingency has been allowed for in the miscellaneous cost.

The process operating costs have been determined for seven discrete cost centres and have been compiled from a variety of sources. Operating costs have been developed using the ore specific plant parameters specified in the process design criteria. The overall process operating costs for the 2.0Mtpa throughput scenario are summarised in Table 9-4.

Table 9-4 Process operating cost breakdown (Target Case A – 2.0Mtpa)

Cost Centre	Total Annual Cost (US$)	US$/t	% of Total
Utilities (Power and Water)	4.6M	2.3	23%
Labour and Administration	5.7M	2.85	28%
Reagents	4.2M	2.1	21%
Consumables	3.1M	1.55	15%
Maintenance	1.1M	0.55	5%
Laboratory	0.6M	0.3	3%
Miscellaneous	0.8M	0.4	4%
Total	20.1M	10.05	23%

The process operating cost estimate has been developed from a number of sources. Cost determinations have been based on fixed and variable components relating to ore throughput and ore characteristics. The sources of data are detailed in Table 9-5.

Table 9-5 Plant operating cost source data

Cost Centre	Source Data
Power	Consumption from mechanical equipment list load estimate.
Water	Consumption from project water balance (raw water) and treatment cost from benchmarking of similar operations (RO).
Labour	Manning schedules based upon labour list.
Reagents	Consumptions from ALS test work and unit prices from prices supplied by international suppliers or available from benchmarking.
Consumables	Consumptions predicted from comminution test work and unit prices from prices supplied by international suppliers.
Maintenance	Predicted based upon a factored percentage of the capital cost estimate.
Laboratory	Predicted based upon unit costs for similar scale operations.
Mobile Vehicles	Predicted from annual usage and unit costs for similar scale operations.

General and administration costs

General and administration costs (Table 9-6) are broken down into a number of areas, including:

- Labour costs, including on-costs associated with management and commercial functions
- Insurances
- Site operating costs for medical and OH&S requirements, finance, security, human resources and training, community relations and environment

Table 9-6 General and administration costs

Item	US$ / yr
Labour	1.20M
Insurance	1.10M
IT systems and maintenance	0.45M
General legal	0.30M
Auditing	0.10M
Tax advice	0.10M
HR advice / recruitment	0.20M
Other professional advisors	0.20M
Office equipment / stationery / supplies / cleaning	0.08M
Communications (phone/internet/postage etc)	0.08M
Community Fund	0.05M
Travel	0.03M
Training / memberships / functions / promotions	0.1M
Miscellaneous	0.1M
Total	**4.0M**

10. Project risk

The Viscaria risk register has been developed in line with the Avalon enterprise risk management policy which requires formalised risk assessments to be completed at each stage of a project life cycle from acquisition, evaluation and assessment, development and construction, throughout operations and closure.

Avalon recognises that risk is inherent in all activities. Avalon is not risk averse, but actively assesses and manages investment and financial risks in the context of potential returns and through an internal enterprise risk management system. Each project is required to have a detailed risk profile understanding at any given time, including the current status of each material risk and a priority ranking. This allows for proactive consideration of risks and the identification of opportunities.

Risk mitigation plans have been developed for all medium and high level risks (and "special") remaining at the completion of the studies phase. Responsibility for the treatment of each risk is identified in the risk register. The treatment plans developed considered the hierarchy of controls and used the ALARP (as low as reasonably practicable) principles.

Table 10-1 Risk Mitigation Plan

Risk Issue	Mitigation Plan	Target Date
Delay to project implementation due to access rights not finalised (Unmitigated Risk Level = M)	Early engagement with County Administrative Board for construction access rights and Trafikverket for "time-on-track" relating to any bridge construction. First formal request for Project Development Area applied for in December 2015. Definitive action plan with Trafikverket for bridge construction required by PFS.	Completion of PFS
Delay to project implementation due to concentrate logistics solution not finalised (Unmitigated Risk Level = M)	Ensure that multiple logistics solutions are always available to the project through all study phases and in the EIS. Review point required at completion of PFS and EIA application.	Completion of EIA application
Delays to project implementation due to tailings embankment issues during construction (Unmitigated Risk Level = "special")	Ensure filtered tailings is strongly considered in PFS stage and EIA application. Ensure independent review panel is strongly considered during design, construction, operations and closure phases.	Completion of PFS
Cost over-run to project implementation due to lack of consideration of local conditions (Unmitigated Risk Level = M)	Engagement of local Scandanavian engineering firm during PFS stage for development of execution strategy that clearly articulates arctic conditions execution strategy. Consideration of modularisation opportunities in PFS to reduce execution risk.	Completion of PFS
Delay to project execution due to early works program not executed (Unmitigated Risk Level = M)	Full consideration of early works program required in PFS, which also addresses likely funding strategy. Early works could include mine dewatering and establishment of HVAC services.	Completion of PFS