

Subject: FW: Clarification on the use of data for Precipitation and Hydrology estimates

Attachments: Followup_PrecipitationData.pdf; highlandvalleycopperweatherinfo.pdf

From: Federico G. Osorio <email address removed>

Sent: Friday, April 30, 2010 7:18 PM

To: Prosperity Review [CEAA]; jcathcart@knightpiesold.com

Cc: Federico G.

Subject: Clarification on the use of data for Precipitation and Hydrology estimates

Hi,

Please see the attached documents.

Thanks,
Federico G. Osorio

P Do you really need to build this mine? Please think of the environment!

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Hi Jaime,

Sorry for the delay on the follow up to our conversation about precipitation estimates and the seemingly erratic selection of weather stations and dismissal of extreme rainfall events. If I remember correctly you mentioned you didn't believe that other stations had recorded the high precipitation events from 1997/1998. I am attaching Table 3.5 from Appendix 4-4-D, to highlight the availability of the precipitation data and

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M:\110100266101\A\Report\2-Baseline_Hydro meteorology\Rev 8\Report_2_Rev_8_Gold-Copper_Revision\ALL Tables - 1_ER_Admin_Revision.xls\Table 3.5 (file precip)

Station	Year	Elevation (m)	Rainfall (mm)												Annual
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Prosperity Site Station M1	1995	1450	0.0	14.0	7.0	4.0	42.0	58.0		59.0	10.0	118.0	47.0		
	1996			0.0	0.0	0.0	21.4	54.5	8.3	41.0	60.7	13.5	0.0	0.0	
	1997		8.0	0.0	7.4	9.9	26.7	43.1	90.8	1.7	32.1			6.0	
	1998		0.0	0.0	0.5	0.0	388.6	634.2	506.0						
Prosperity Site Station M2	1995	1450								65.3	10.3				
	1996									4.0	58.3				
	1997							210.0	258.0	2.4					
	1998						8.1	95.4	0.8						
Prosperity Site Station M4	1996	1660							10.8	51.8	59.8				
	1997						28.0	452.8	192.0	40.0	449.0				
	1998						554.0	633.0	206.0						
Prosperity Site Station M5	2006	1570									1.4	32.0	15.2	4.0	
	2007		0.0	0.0	0.0	2.8	16.8	63.8	11.0	16.8	34.4	21.4			

to further enquiry why only station M1 was considered for the Double-Mass Curves.

I would like to point out that the above Table indicates that for 2007, the year that was considered to represent 'average' conditions, the rainfall for Jan-Mar is 0.0. Also I would like to contrast the above Table, with Table 2-4 of Appendix 4-4-A presented below

Notes

- 1) Monthly total rainfall for station M2 in August 1996 was not collected for the complete month.
- 2) Station M2 was moved to a new location at the beginning of August 1997. The new location is approximately 250 m southeast of M1. The old location was approximately 1 km north of M1.
- 3) The bold values are believed to be erroneous and were not included in any analyses. It is suspected that they are all out by a factor of 10, but this could not be confirmed.
- 4) The rainfall total for station M5 in September 2006 and October 2007 only include data for a partial month.

Table 2-4 Summary of Precipitation within the Project Region Based on Site-specific Climate Monitoring

Station Name	Precipitation (mm)			
	Winter ^a	Spring ^b	Summer ^c	Autumn ^d
Monthly Average Precipitation				
Station M1, Taseko Mines	28.8	36.7	51.0	47.3
Station M2/M5 Combined, Taseko Mines	6.16	5.22	90.8	21.5
Station M4, Taseko Mines	4.70	16.8	100	36.7
Maximum Precipitation				
Station M1, Taseko Mines	97.0	148	139	135
Station M2/M5 Combined, Taseko Mines	32.8	16.3	258	58.3
Station M4, Taseko Mines	19.2	37.6	206	59.8
SOURCE: Taseko Mines (2006).				
NOTES:				
^a	Winter months: December, January, February.			
^b	Spring months: March, April, May.			
^c	Summer months: June, July, August.			
^d	Autumn months: September, October, November.			

I realize that Table 3.5 only accounts for rainfall, so I am including the data from the River Forecast Centre, which you referenced in your presentation.

Year	01-Jan					01-Feb					01-Mar					01-Apr					01-May					15-May					01-Jun					15-Jun									
	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density					
1994	01-Jan			n		01-Feb	43	123		29	28-Feb	69	162		23	28-Mar	60	165		28	01-May	0	0																						
1995	04-Jan	52	120		23	01-Feb			N	23	02-Mar	54	155		29	01-Apr	40	115		29	01-May	0	0																						
1996	04-Jan	42	71		17	01-Feb	37	81		22	25-Feb	24	74		31	31-Mar	0	0																											
1997	03-Jan	28	39		14						24-Feb	25	57		23	27-Mar	26	64		25	04-May	0	0																						
1998	27-Dec	17	26		15	27-Jan	30	60		20	01-Mar	29	60		21	31-Mar	0	0																											

Yrs of Record	01-Jan					01-Feb					01-Mar					01-Apr					01-May					15-May					01-Jun					15-Jun									
	Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density							
4						3					5					5					3					0					0					0					0				
Mean		34	64		17		36	88		23		40	101		25		25	68		16		0	0		0																				
Normal																																													
Max		52	120		23		43	123		29		69	162		31		60	165		29		0	0		0																				
Min		17	26		14		30	60		20		24	57		21		0	0				0	0																						

Fish Lake 2

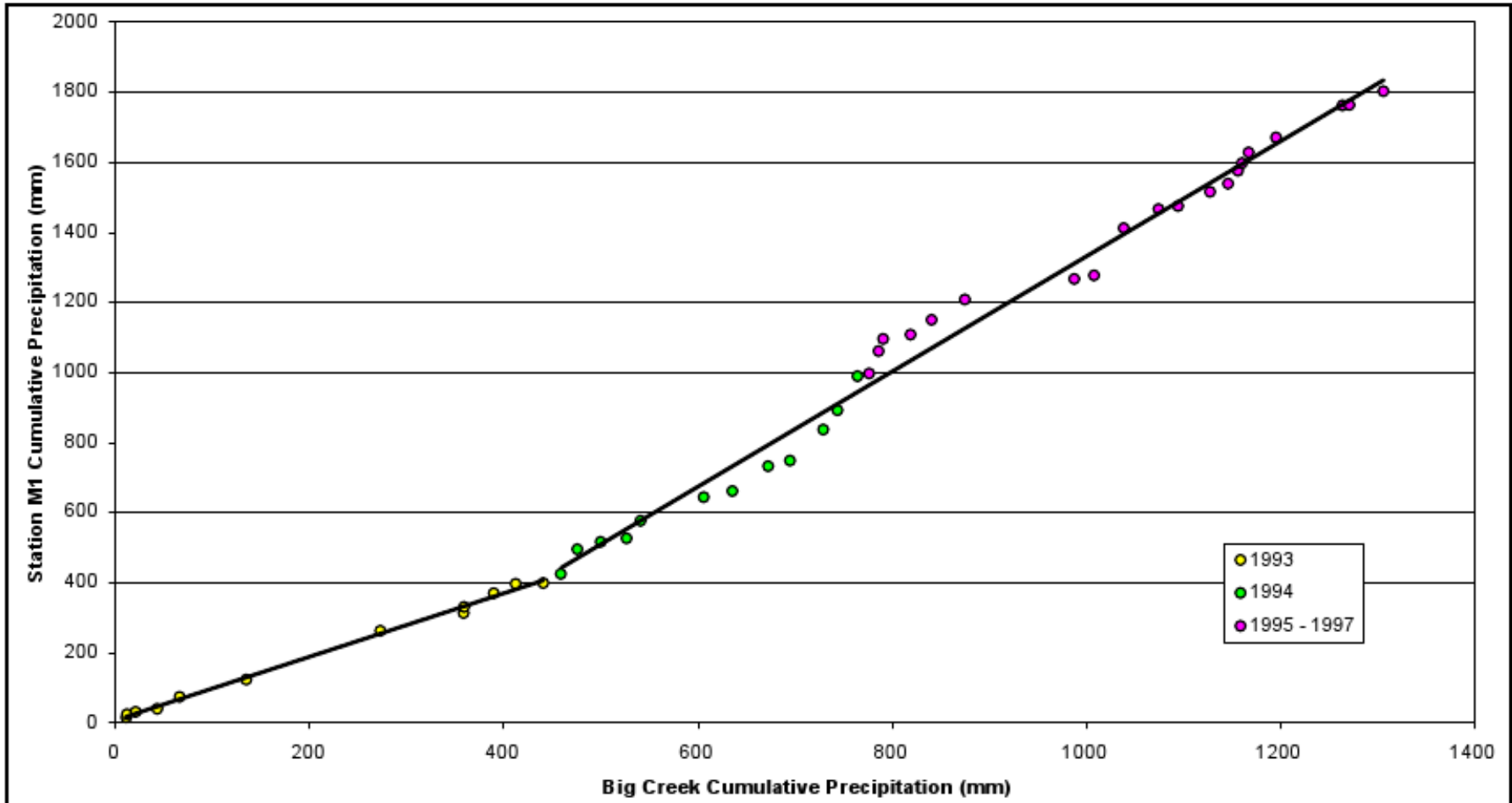
Year	01-Jan					01-Feb					01-Mar					01-Apr					01-May					15-May					01-Jun					15-Jun									
	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density	Date	Snow	Water	Code	Density					
1997	03-Jan	27	38		14						24-Feb	28	46		16	27-Mar	37	80		22	04-May	25	55	E	22																				
1998	27-Dec	18	30		17	27-Jan	33	66		20	01-Mar	33	68		21	31-Mar	31	86		28																									

Yrs of Record	01-Jan					01-Feb					01-Mar					01-Apr					01-May					15-May					01-Jun					15-Jun				
	Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density			Snow	Water	Density		
2						1					2					2					1					0					0					0				
Mean		22	34		15		33	66		20		30	57		18		34	83		25		25	55		22															
Normal																																								
Max		27	38		17		33	66		20		33	68		21		37	86		28		25	55		22															
Min		18	30		14		33	66		20		28	46		16		31	80		22		25	55		22															

I would like to highlight that perhaps the use of station M1 is not an accurate depiction of how much water there is on site. Furthermore, I would like some further clarification on the following statement, from the April 16, 2010 letter "Re: Precipitation Estimates – Double Mass Curve Analysis" CEAR Doc # 2107 . At paragraph 3, page 1, the last sentence says:

" This approach recognizes that precipitation at two locations can be quite variable and not correlate well linearly, but that the cumulative precipitation will ultimately demonstrate a consistent relation **unless some inconsistency has occurred during the data collection period, such as a change in observation technique or instrumentation, or the relocation of a gauge. Such an inconsistency will be manifested as a break in the slope.**"

I am also including Figure 2 from the same document -which is also the Figure you used during the Topic-Specific presentation- to highlight that such a break in the slope is present and that inconsistencies did occur (as confirmed in the above tables), thus the Double Mass Curve approach is invalid for this data.



NOTES:
 1. VALUES REPRESENT ALL CONCURRENT PRECIPITATION DATA AVAILABLE FOR STATION M1 AND BIG CREEK.

TASEKO MINES LIMITED	
PROSPERITY GOLD-COPPER PROJECT	
BREAK IN DOUBLE MASS CURVE STATION M1 VS. BIG CREEK	
<i>Knight Piésold</i> CONSULTING	P/A NO. VA101-266/15
	REF. NO. VA10-0057
FIGURE 2	
REV	0

REV	DATE	DESCRIPTION	PREP'D	CHK'D	APP'D
0	15 APR '10	ISSUED WITH LETTER	JGC	ER	KJB

As a separate document I am attaching a Highland Valley Copper Document from which I obtained Table 1, presented below.

Table 1 **Monthly climate data for Highland Valley Lornex based on 1961-90 climate normals (Environment Canada, 1993).**

Month	Mean Daily Temperature (°C)	Rainfall (mm)	Snowfall Water Equivalent (mm)
January	-6.6	4.7	36.4
February	-3.9	1.1	24.7
March	-1.1	3.0	18.3
April	3.0	9.4	14.4
May	7.1	30.6	6.9
June	11.4	38.1	1.0
July	14.1	35.1	0.3
August	13.9	36.4	0.0
September	9.8	28.9	0.9
October	4.3	15.7	11.5
November	-2.7	6.7	30.2
December	-6.6	1.1	38.7
Total		210.8	183.3
Total Precipitation			394.1

As you may note, the average yearly temperature is 3.55 Degrees and the Mean Annual Precipitation is 394.1. Will you consider revising your data accordingly? As mentioned during our conversation, based on the above information, I don't believe using Highland Valley Coppers evaporation estimates is adequate. Furthermore, as you indicated in your presentation Highland Valley Copper is in an area that is 'wetter' than Fish Lake. I am not surprised by the inconsistency in the data, but I do urge you to further revise your estimates so that the range of variability is adequately portrayed.

I am attaching an excerpt from Taseko's follow up to undertakings 1a and 1b:

My question/comment (CEAR# 1362):

"Volume 4 page 4-73 states that: potential precipitation in each year of mine operations was assumed to follow a Log-Logistic type of distribution. For each year, the distribution parameters and the proportional amount of precipitation falling as rain or snow were assumed to be the same in each year for the full period of mine operations. The assumption of a Log-Logistic type of distribution must be clarified or explained through numerical values, ince it is a key component in assessing the validity of the model."

Taseko's Response:

" Please see: Document #1311 (Response to EC's questions concerning the water balance model). Appendix A particularly has information that is being requested here."

Document 1311 doesn't mention the term Log-Logistic at all. There is some talk about a Gamma distribution, should I assume that they stopped assuming a Log-Logistic distribution and used the same distribution that for runoff? Am I missing something here?

I would like to thank you for clarifying during your presentation that the probability statements indicate that there is a 95% or 5% probability that the numerical values fall within the predicted range. Its quite different from saying that there is a 95% or 5% probability that there will be a surplus or deficit, I hope the Panel members understood this clarification.

Thanks for your time and attention.

Federico G. Osorio

HIGHLAND VALLEY COPPER REFINERY

PROJECT DESCRIPTION

Proponent Information

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Corporate Information:

Highland Valley Copper is a partnership between Teck Cominco and certain of its wholly-owned subsidiaries (95%) and Highmont Mining Company (5%). Teck Cominco has a 50% interest in Highmont, for an effective 97.5% interest in Highland Valley Copper.

Teck Cominco shares trade on the Toronto Stock Exchange under the symbols **TEK.A** and **TEK.B**.

General Background Information

Highland Valley Copper is currently examining the feasibility of developing a hydrometallurgical copper refinery on its mine site, 19 kilometres west of Logan Lake, BC.

The facility would have capacity to treat 350,000 tonnes per year of copper and molybdenum concentrates and produce up to 132,000 tonnes per year of finished copper cathode metal. Depending on the annual production of Highland Valley concentrates, additional material from outside sources could be processed at the facility. Following completion of mining at the site the refinery facility would be fully available to treat outside concentrates.

Highland Valley Copper is Canada's largest base metal mine and one of the largest copper producers in the world. Mining activity in the Highland Valley began in the early 1960's. Today, over 6,000 hectares of land have been disturbed by mining activities. HVC believes the mine site provides an ideal environmental location for such a facility.

PROJECT DESCRIPTION – HIGHLAND VALLEY COPPER REFINERY

Based on the current mine plan, the operation will close permanently in 2013. Ongoing engineering studies with respect to the extraction of additional mineral reserves indicate that depending on metal prices, the life of the mine could be extended to 2017 or beyond. If the 2017 mine plan is determined to be feasible, the construction of a hydrometallurgical refinery at the site may become economically viable.

The construction of the refinery would enable Teck Cominco to confirm the technical feasibility of the process and may enable the economic development of additional resources in the Highland Valley. Any unutilized capacity could be used to treat off-site concentrates. This would both help to minimize the economic impact of the mine's eventual closure on the surrounding communities of interest and provide a revenue source for the mine to help offset post-closure costs.

Concentrates received from off-site sources would potentially originate from existing copper mines as well as future operations currently in the exploration or feasibility stage.

The refinery structure and shipping yard would be situated at a location close to the existing concentrator in the general plant site area. This would allow convenient transfer of the concentrates from the mill to the refinery. The plant site area is shown in Figure 1 below with the shaded area indicating the location currently being considered for the refinery.

Figure 1 Highland Valley Copper plant site location



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A refinery operation can begin in 2010 and would have no negative effects on with existing mining and milling operations. At completion, the refinery and associated facilities would occupy less than five hectares on land that has already been disturbed by mining activities.

Project Overview

The project involves the construction and operation of a hydrometallurgical refinery consisting of various processing components to facilitate hydrometallurgical production of copper cathode plates suitable for shipment.

The onsite components of the project would include one or more buildings to house the process components, yards and associated works to receive concentrate from the mill and to store the copper cathodes before shipment off-site, and the pumping/piping infrastructure to discharge the tailings streams as required for proper disposal. Electrical works will be situated to feed the refinery, as will tanks and associated works to store raw materials needed in the operation of the facility. A separate parking area, a scale, and vehicular access routes are also planned. No offsite components would be required.

Climate

The climate at HVC is characteristic of interior BC. Lying in the rain shadow of the Coast Mountains, the area is characterized by warm, dry summers and cool winters, with an annual range of temperatures of about 25°C and low to moderate snowfall in winter. The climatic conditions near HVC (as represented by the Highland Valley Lornex station) are strongly influenced by elevation, aspect and proximity to the Thompson River Valley. Temperatures near the proposed refinery site are generally cool throughout the year, with mean January and July temperatures of –6.6°C and 14.1°C respectively (see Table 1 for monthly climate data at the Highland Valley Lornex station). As a result of the cooler temperatures, snow accounts for approximately 46% of the total annual precipitation near HVC.

Table 1 *Monthly climate data for Highland Valley Lornex based on 1961-90 climate normals (Environment Canada, 1993).*

Month	Mean Daily Temperature (°C)	Rainfall (mm)	Snowfall Water Equivalent (mm)
January	-6.6	4.7	36.4
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Process Development

The concept for the Project is based on a new process developed by Cominco Engineering Services Limited (CESL), a subsidiary of Teck Cominco. The work was initiated with the express purpose of developing an economically attractive hydrometallurgical alternative to the smelting of copper sulphide concentrates.

Initial testwork on the new process began in 1992. Following a year of bench testwork to develop a preliminary flowsheet, the

design and construction of an integrated pilot plant for the process was initiated. The pilot plant has a capacity of 36 kg of cathode copper per day.



Figure 2 Copper cathode plate product

A larger demonstration facility was constructed in 1997 and is used to test commercial equipment in order to obtain accurate engineering data for use in the design of full-scale plants. Five different concentrates have been processed through the demonstration plant to produce over 300 tonnes of refined copper cathode.

All of the facilities are located at the CESL headquarters in Richmond, B.C.

Environmental Benefits of the CESL Hydrometallurgical Process

More than half of the world's copper is produced from sulphide ores. After milling and flotation, the resultant concentrate is usually smelted and refined to make pure metal. One major disadvantage of smelting is the production of large amounts of sulphur dioxide which must be recovered and converted to sulphuric acid. Using even the best technology, significant quantities of sulphur dioxide gas are generally released into the environment. For every tonne of copper metal, about three tonnes of sulphuric acid are produced. This acid, typically 500,000 – 1,000,000 tonnes per year for a commercial smelter, must be disposed of as it is made. Although market conditions vary, for many years in the recent past there has been a surplus of acid on world markets, making acid disposal a costly liability in some situations. Since freight is a major component of acid costs, it also dictates that smelters be located close to their prospective customers, thus preventing the smelter from locating at the mine site in most circumstances. It also adds the cost of shipping concentrate to the smelter as a cost of doing business.

The CESL process does not produce sulphuric acid, instead converting the sulphur contained in the concentrates to a stable elemental form. On-site treatment of concentrates eliminates the environmental impact associated with transportation of concentrates to smelters and acid from the smelters.

Process Details

The refining process being considered for this project consists of eight unit operations: Grinding, Pressure Oxidation, Molybdenum Oxidation, Evaporation, Enhanced Atmospheric Leach, Neutralization, Solvent Extraction and Electrowinning (Figure 3).

Grinding

The concentrates are first reground to increase the surface area of the minerals, thereby improving the reaction kinetics in Pressure Oxidation. The ground concentrates are thickened to 65% solids and pumped to the Pressure Oxidation circuit.

Pressure Oxidation

The ground concentrate slurry is fed to an autoclave, (a sealed vessel capable of withstanding high pressures and temperatures). Inside the autoclave the slurry is sparged with oxygen and mixed with process liquor containing sulphate and chloride. The copper sulphide minerals are oxidized to basic copper sulphate, an acid-soluble solid. By-products of the reaction are hematite and elemental sulphur. The autoclave is continuously discharged to a conditioning tank.

Settling of the autoclave discharge slurry in a conventional thickener is the first step in the separation of the residue solids from the liquor. The solids are filtered and the liquor sent to the Solvent Extraction circuit. The filtered solids are next processed through the Enhanced Atmospheric Leach circuit.

Molybdenum Oxidation

The molybdenum flotation concentrate is combined with process liquor and pumped to a smaller autoclave. The oxidation process leaches the copper sulphide minerals in the feed, but does not leach the molybdenum sulphide.

Evaporator

A number of the process liquor streams are combined and processed through the Evaporator. The Evaporator removes a portion of the water from the blended feed solution, and produces the autoclave acid feed liquor. The water that is removed is condensed, recovered, and used as reagent make-up and residue wash water.

Enhanced Atmospheric Leach

The filtered solids from the Pressure Oxidation circuit are further leached with process liquor to recover any residual basic copper sulphate. Copper is recovered from the leachate via solvent extraction. The remaining solids residue is sent to the tailings pond for disposal.

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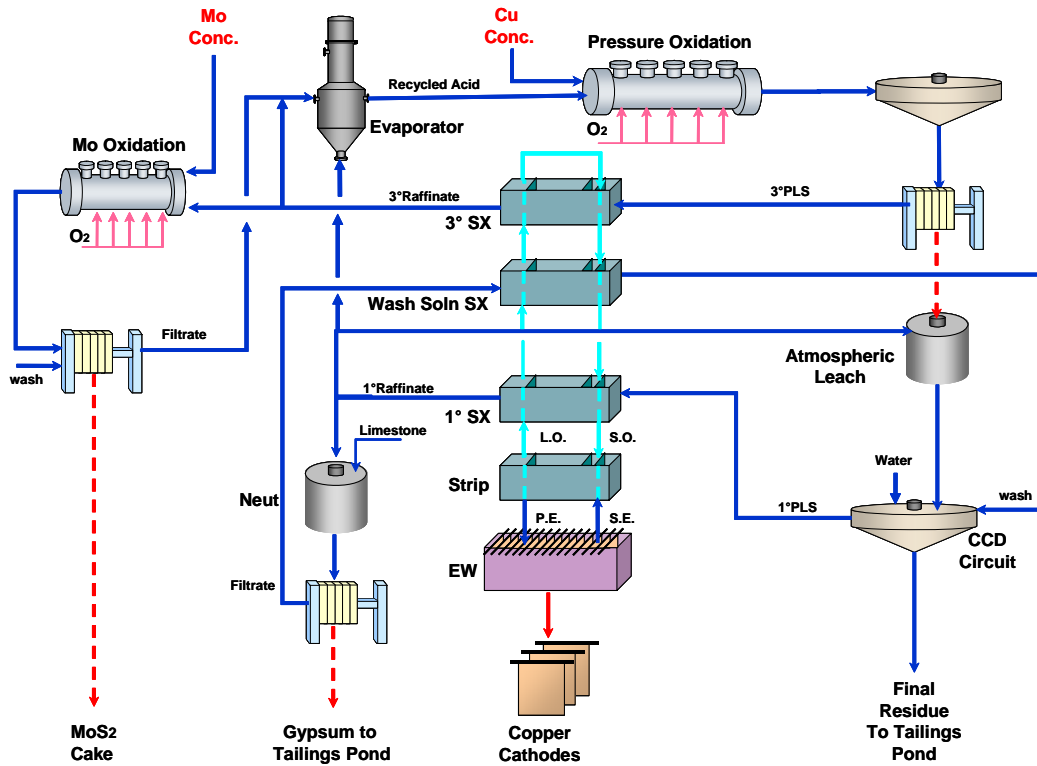


Figure 3 HVC Process Flowsheet

Neutralization

Sulphate (SO_4) builds up in the process liquor through sulphur oxidation in the autoclave and through sulphuric acid addition in Electrowinning. To maintain a plant sulphate balance, an equivalent quantity of sulphate must be removed. This is accomplished in the Neutralization circuit where limestone is added to a portion of the process liquor. Calcium in the limestone reacts with the sulphate to form essentially insoluble gypsum ($CaSO_4$).

Solvent Extraction

Production of a high quality copper cathode from Electrowinning is only possible from a relatively pure electrolyte (the solution containing the dissolved copper). A process called solvent extraction is used to control the concentration of other metals and other impurities in the electrolyte.

A commercially available organic extractant specific for copper is used. Copper adsorbs onto the organic molecule in a low acid solution. The loaded organic molecules are then separated from this solution and the copper is stripped into a high purity acid electrolyte.

Electrowinning

The electrolyte from Solvent Extraction is fed to Electrowinning for copper plating to cathode. An electric current is used to cause the copper to move out of solution and onto a solid plate of metal which becomes the final product from the process.

Residue Management

There are virtually no liquid effluents produced by the CESL Process, nor any gaseous emissions except a small amount of steam. The only significant by-products of the CESL Process are an environmentally stable leach residue and gypsum. Both of these tailings streams are planned to be directed to the mine's existing tailings impoundment north of the Valley pit.

Archaeological Impacts

As virtually all of the plant site and ancillary services will be constructed on land already disturbed by mining, there will be minimal, if any, new archaeological impacts.

Socio-Economic

Logan Lake was developed in the late 1960's to house employees of the mines in the Highland Valley. Over the years the town has diversified to some degree as a service hub for tourists in the areas and more recently as a retirement community. Currently the District population is approximately 2,300 people.

Closure of the mine will have a significant economic and social impact on the town. A detailed socio-economic study commissioned by HVC concluded that closure of the mine will result in a loss of 900 direct jobs and 800 spin-off jobs in the region, including over 400 jobs in Logan Lake. As well, closure of the mine will reduce municipal taxation revenues which are currently \$850,000.

This project would potentially enable the development of other resources in the Highland Valley prolonging the life of the operation. As well, the refinery could continue to operate after mining is completed provided a suitable concentrate supply was identified.

Land Use Setting

The Project would be sited on Crown land entirely within the current HVC mine site. The area surrounding the mine site has multiple uses including cattle grazing, logging, hunting and fishing. None of the activities in the surrounding area would be impacted by this project.

Concentrates are currently trucked to Ashcroft and shipped by rail. Copper cathode plates produced by the proposed refinery would require similar modes of transportation, likely also to Ashcroft, but at only 35% of the current volume.

First Nations Setting

Highland Valley Copper will be working with the British Columbia Environmental Assessment Office to identify the appropriate First Nations to consult in respect of the Project.

Consultation Activities

Future Consultation Plans

Future consultation is planned in a number of areas.

Government

Presentations on the Project will be made to the different interested local and regional governments in the area. These will include: Logan Lake, Ashcroft, Merritt, Kamloops and the Thompson Nicola Regional District.

Public

Public information sessions are planned for Logan Lake, Merritt and Ashcroft. These will involve presentations on the Project and the distribution of material concerning the Project.

First Nations

Consultation will be undertaken with interested First Nations in the area.

Proposed Development Schedule

A feasibility study is currently underway to develop the project capital costs and economics. This study is scheduled for completion in the third quarter of this year. Based on the results of the study, a project decision is expected early in 2007.

If the decision is made to proceed with the Project, Highland Valley Copper anticipates submitting a Project Application in the spring of 2007 with the goal of beginning construction in early 2008.

Production of cathode copper would begin in mid 2010.

Required Permits

In addition to the Project Approval Certificate that would be issued at the end of a successful environmental assessment, there are a number of other regulatory steps that would be required.

Appropriate permitting would need to be obtained from various provincial ministries including the Ministry of Energy and Mines and Petroleum Resources and the Ministry of Environment. Amendments to the current M-11 Reclamation Permit, the PE-376 Waste Disposal Permit and the PA-1557 Air Emissions Permit are likely to be required.

It is not anticipated that rezoning by the District of Logan Lake would be necessary.