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FORTUNE MINERALS LIMITED

TECHNICAL REPORT ON THE FEASIBILITY STUDY FOR THE NICO GOLD-COBALT-BISMUTH-COPPER PROJECT NORTHWEST TERRITORIES, CANADA

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1.0 SUMMARY

1.1 INTRODUCTION

Fortune Minerals Limited (Fortune) is a public company, listed on the Toronto Stock Exchange, with two primary assets: the NICO gold-cobalt-bismuth-copper Project in the Northwest Territories (NWT) and the Arctos anthracite Project in British Columbia. The NICO Project is 100% owned by Fortune.

Micon International Limited (Micon) has been retained by Fortune to compile an independent Feasibility Study on the NICO Project in support of financing. This Technical Report summarizes the results of that study.

The NICO Project is based on mining the NICO deposit in the NWT by a combination of open pit and underground methods, and producing a bulk gold-cobalt-bismuth-copper concentrate in a processing plant located at the Project site. The bulk concentrate will be bagged at the Project site, transported by road to the rail head at Hay River, NWT, and then hauled by rail to a dedicated siding at the Saskatchewan Metals Processing Plant (SMPP), a new hydrometallurgical facility to be built by Fortune at a permitted site approximately 26 kilometres north of Saskatoon, Saskatchewan. The SMPP, the site for which is crossed by a rail line and has a readily available source of grid power, has been designed to produce the following saleable mineral products from the bulk concentrate:

- Gold as doré bars.
- Cobalt, principally as cobalt sulphate heptahydrate, but with the option of producing cobalt carbonate, cobalt oxide, cobalt nitrate and cobalt chloride. The financial model for the Project is based on the production of cobalt sulphate heptahydrate only.
- Bismuth as bismuth ingot, bismuth needles and bismuth oxide. The financial model is based on producing 20% of the bismuth as ingot, 20% as needles and 60% as oxide.
- Copper as copper cement, which will be sold to a copper smelter for conversion to copper metal.

Fortune will be responsible for marketing all of the products.

1.2 PROJECT OVERVIEW

The location of the NICO Project is shown in Figure 1.1.

Figure 1.1
NICO Project – General Location Map

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The principal Project facilities to be constructed on lands controlled by Fortune in the NWT are:

- An open pit mine with a design rate of production of 4,650 tonnes of ore per day, or approximately 1.7 million tonnes per year, which is planned to operate from June, 2017 until 2037.
- A small underground mine, which is planned to extract 1,544 tonnes of high-grade ore per day, from April, 2018 to June, 2019.
- A processing plant with a design throughput capacity of 1.7 million tonnes of ore per year, which is planned to operate from October, 2017 to 2037, and which will utilize conventional crushing, grinding and flotation processes to produce approximately 54,500 tonnes per year of a bulk sulphide concentrate, containing gold, cobalt, bismuth and copper, together with a high content of arsenic.
- A co-disposal facility for the permanent storage of both mine waste rock and process tailings.
- All of the infrastructure and service facilities required to support the productive operations.

Electric power is to be supplied by a power line, approximately 30.5 kilometres long, from the Snare Hydroelectric Complex to the Project site.

The facilities to be constructed at the SMPP comprise a complete hydrometallurgical plant which will produce saleable gold, cobalt, bismuth and copper products from the bulk concentrate produced in the NWT. Solid residues from the SMPP, which will include iron-arsenic precipitates from the cobalt circuit, iron and gypsum residues from the copper releach circuit, and solid residues from the recovery of cobalt and gold, will be disposed of in an engineered permanent residue storage facility located on the SMPP site. Liquid residue, consisting of a saline liquid waste stream and effluent from the cyanide destruction circuit, will be disposed of by deep-well injection, at a depth of approximately 800 metres below surface.

Over its operating life of approximately 20 years, the NICO Project is scheduled to mine and process 33.1 million tonnes of ore, and to produce the following quantities of saleable metals:

- Gold : 814,000 troy ounces.
- Cobalt : 70 million pounds.
- Bismuth : 74 million pounds.
- Copper : 11.2 million pounds.

1.3 PROJECT DEVELOPMENT

Access to the Project site is to be provided by an all-weather road, to be constructed by the NWT and Tłįchǫ (First Nation) governments, linking the existing highway from Edmonton to Yellowknife and Behchokö to the Tłįchǫ community of Whatì, further to the north. This road is scheduled for completion early in 2016. Fortune will be responsible for constructing a spur road, approximately 33 kilometres long, from the end of the all-weather road to the Project site. Fortune is negotiating details of the funding and construction schedule for the all-weather road with the NWT and Tłįchǫ governments.

The schedule of Project construction, summarized below, is contingent upon timely approval of all required permits, timely arranging of Project funding and completion of the all-weather road on schedule.

It is planned to commence construction at the Project site with a program of early works in summer, 2014 and 2015. All of the material and equipment required for this program are to be brought to the Project site over the winter road, which typically remains serviceable until April. The material and equipment required for the modest program planned for 2014 are already at the site.

Full-scale construction programs are then planned for 2016 and 2017, with equipment and materials brought in over the all-weather road. The scheduled date for the commencement of productive processing operations is October, 2017.

The construction schedule for the SMPP has been dovetailed with the schedule for the Project site, in order to achieve start-up of the SMPP in October, 2017.

1.4 SUMMARY OF FINANCIAL EVALUATION

Fortune has evaluated the overall economics of the NICO Project by conventional discounted cash flow techniques, under the presumption that the initial capital expenditure will be financed 30% by equity and 70% by debt. All revenues and costs are expressed in Canadian dollars, typically of fourth quarter 2013 value. Metal prices denominated in US dollars have been converted to Canadian currency at an exchange rate of C$1.00 = US$0.88. This exchange rate has been assumed to remain constant throughout the life of the Project. Micon has confirmed the mathematical integrity of the Fortune financial model, by independently reproducing the results.

A summary of the results of the base case financial analysis is presented in Table 1.1. All production, revenue and cost data are life-of-mine estimates.

Table 1.1
Summary of Base Case Financial Analysis

Item	Units	Value
Mine Life	y	20
Open Pit Ore Mined	thousand t	32,500
Underground Ore Mined	thousand t	577
Concentrate Produced	thousand t	1,062
Gold Produced	thousand oz	814.4
Cobalt Produced (in sulphate)	thousand lb	69,526
Bismuth Produced	thousand lb	73,656
Copper Produced	thousand lb	11,195
Gross Revenue	C$ million	3,842
Transport, Refining, Marketing	C$ million	246
Net Smelter Return	**C$ million**	**3,596**
Mine and Mill Operating Costs	C$ million	746
Other Site Operating Costs	C$ million	359
SMPP Operating Costs	C$ million	599
Operating Profit	**C$ million**	**1,892**
Corporate Administration, Interest, Fees	C$ million	212
Royalties, Income Taxes	C$ million	141
Cash Flow Before Capital Costs	**C$ million**	**1,540**
Initial Capital Costs – Project Site	C$ million	347
Initial Capital Costs – SMPP	C$ million	242
Sustaining Capital Costs, Working Capital	C$ million	60
Reclamation Security Funding	C$ million	53
Net Cash Flow	**C$ million**	**837**
Pre-Tax Present Value (7%/y discount)	C$ million	254
Post-Tax Present Value (7%/y discount)	C$ million	224
Pre-Tax Internal Rate of Return	%/y	15.6
Post-Tax Internal Rate of Return	%/y	15.1

Under the base case input estimates, the NICO Project is expected to yield an after-tax undiscounted life-of-mine cash flow of C$837 million, a net present value of C$224 million at a discount rate of 7% per year and a post-tax internal rate of return of 15.1% per year. The pre-tax economic indices are a net present value C$254 million at a discount rate of 7% per year and an internal rate of return of 15.6% per year.

1.5 TECHNICAL DATA

1.5.1 Geological Setting

The NICO deposit occurs in the southern part of the Proterozoic Bear Structural Province within the Great Bear magmatic zone (GBMZ), a Paleoproterozoic belt of calc-alkaline volcanic and plutonic rocks approximately 800 km long and 100 km wide. Felsic to intermediate rocks of the Faber Group predominate in the southern part of the GBMZ, and consist of rhyodacite ignimbrites and associated flows, tuffs, breccias and volcaniclastics. These rocks are bordered by granodiorite to monzogranite plutons and intruded by coeval granite and feldspar porphyritic plugs.

The NICO deposit is hosted in iron- and potassium-altered, brecciated basement sedimentary rocks of the Treasure Island Group, at and beneath the unconformity with the volcanic Faber Group rocks. The cobalt-gold-bismuth-copper mineralization of the deposit is located within locally altered biotite-amphibole magnetite schist of the Treasure Island Group.

Sulphide mineralization is disseminated and makes up between 3% and 10% of the mineralized rocks. The sulphide minerals are predominantly aligned along the foliation planes. Only small native gold grains have been observed. These are mainly associated with sulphides, but also occur with silicate minerals such as feldspar. The sulphides consist primarily of cobaltite/cobaltian arsenopyrite, bismuthinite and chalcopyrite.

Gold mineralization forms a central 'bulls-eye' to the deposit, within the cobalt-bismuth core of the magnetite mineralization, and is confined largely to the middle and lower zones.

1.5.2 Mineral Resource Estimate

The mineral resource estimate for the NICO deposit was prepared by P&E Mining Consultants Inc. (P&E) and is presented in Table 1.2. Open pit mineral resources are reported against a C$46 per tonne net smelter return (NSR) cut-off, as constrained within an optimized pit shell. Underground mineral resources are reported against a C$80 per tonne NSR cut-off. The effective date of this estimate is November 30, 2011. The mineral resources were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) standards on Mineral Resources and Reserves. No additional drilling has been completed since the effective date of this resource estimate.

Table 1.2
NICO Estimated Mineral Resources

Area	NSR Cut-off (C$/t)	Class	Tonnes x 1,000	Au (g/t)	Bi (%)	Co (%)
Open Pit	46	Measured	18,911	1.05	0.15	0.12
		Indicated	10,983	1.19	0.14	0.12
		M+I total	**29,894**	**1.10**	**0.15**	**0.12**
		Inferred	2	0.30	0.07	0.08
Underground	80	Measured	231	2.29	0.06	0.15
		Indicated	764	1.72	0.07	0.16
		M+I total	**995**	**1.85**	**0.07**	**0.16**
		Inferred	31	0.65	0.11	0.25

Gold grades vary locally more than cobalt and bismuth grades. The local accuracy of estimation for gold grades in each block may not be high, although the model is expected to be globally accurate. The distribution and variability of cobalt and bismuth grades in the model are quite smooth and there is expected to be little issue with local estimation accuracy.

Micon and P&E both conclude that the mineral resource model for the NICO deposit is suitable for use in a Feasibility Study.

1.5.3 Open Pit Mining

The NICO property has a number of mineral occurrences and one ore deposit, referred to as the Bowl Zone. In general, this orebody is comprised of a series of stacked stratabound lenses of ironstone that dip at approximately 50° towards the north-northeast. The mineralized zones to be mined consist of three sub-parallel lenses, approximately 40 m apart. They are referred to as the Upper, Middle and Lower Zones, which are up to 1.5 km in length, 550 m in width (down dip) and 70 m in thickness (across dip).

The Project will utilize conventional open pit mining, supplemented by trackless underground mining methods in the early years of its life. It will then convert to an open pit operation only for the remainder of its productive mine life of approximately 20 years.

The ultimate open pit shell has been selected by applying universally accepted floating cone techniques, combined with reasonable technical and economic input parameters. The overall wall slopes used in the design were recommended by Golder Associates Ltd. (Golder), on the basis of geotechnical testing and analysis.

Production from within the ultimate pit shell has been scheduled to maximize present value, within the limitations of practical mining constraints. The production plan calls for the pit to be developed in phases, as illustrated in Figure 1.2.

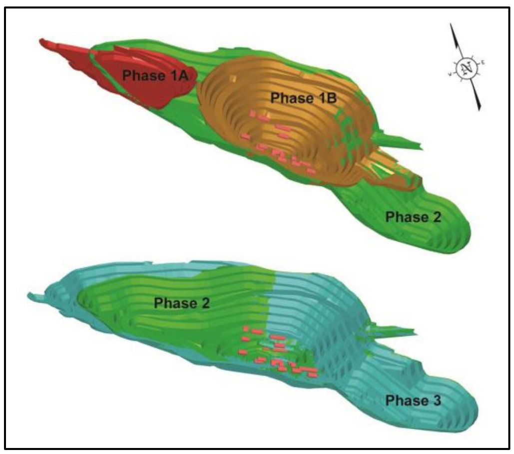
Open pit mining will be conducted by conventional drilling, blasting, loading and hauling techniques, using standard, proven equipment. It is planned to employ a contractor to carry out initial pre-production development work for the open pit. Fortune will then take control of all open pit operations progressively, as its own equipment fleet is mobilized. A contractor will supply all explosives and blasting supplies but Fortune will perform the blasting operations.

1.5.4 Underground Mining

Production from the open pit will be supplemented by high-grade ore mined from underground for a short period early in the Project life, in order to enhance early cash flow.

Access for underground mining will be gained by rehabilitating and deepening the existing exploration decline. It is planned to mine 21 individual stopes, generally on the retreat, using transverse and longitudinal blasthole mining methods. The general location of the underground mining blocks within the open pit shell is shown in Figure 1.2. All underground rehabilitation, development and stoping operations will be undertaken by a contractor.

Figure 1.2
Schematic Representation of the Phase Pit Shells and the Planned Underground Stopes



The underground open stopes will not be backfilled during mining. About mid-way through the life of the Project, the open pit will begin to intersect the underground workings. As they are intersected, the open stopes will be filled with broken ore from the open pit, either through drop raises or directly as they are exposed. The open pit will then progress through the underground workings, recovering the support pillars previously left in place.

The design mine production schedule for both open pit and underground mining of the reserves is provided in Table 1.3.

1.5.5 Mineral Reserves

The mineral reserves for the NICO Project, which were originally estimated by P&E and subsequently updated by Fortune, are summarized in Table 1.4. These reserves were estimated using the CIM standards on Mineral Resources and Reserves, and include allowances for mining losses and dilution.

Table 1.3
NICO Project – Mine Production Schedule

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
MINE PRODUCTION SCHEDULE																									
Open Pit																									
Ore Mined (thousand tonnes)	**32,500**			17	460	1,443	1,488	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Low-Grade Waste Mined (thousand tonnes)	**5,484**			2	127	285	415	359	222	222	143	243	328	264	276	320	312	345	299	271	205	157	476	208	5
Waste Mined (thousand tonnes)	**92,325**			4,915	10,883	5,091	4,047	6,777	3,281	3,858	7,320	7,132	5,964	4,280	3,503	3,445	3,534	2,494	2,555	3,042	2,448	1,421	3,814	2,123	398
Total Waste Mined (thousand tonnes)	**97,810**			4,917	11,009	5,377	4,462	7,136	3,504	4,081	7,463	7,375	6,292	4,543	3,779	3,765	3,846	2,839	2,853	3,313	2,653	1,578	4,291	2,331	403
Total Mined (thousand tonnes)	**130,310**			4,934	11,470	6,820	5,950	8,623	5,165	5,829	9,159	9,070	7,992	6,251	5,470	5,463	5,553	4,552	4,545	4,953	4,312	3,376	5,948	4,034	841
Gold Grade (grams/tonne)	**0.96**			0.24	0.19	0.24	0.21	0.42	0.30	0.52	1.22	1.25	1.76	1.59	0.53	0.55	0.51	0.53	0.68	0.88	1.35	2.67	0.75	1.94	2.01
Cobalt Grade (%)	**0.11**			0.14	0.13	0.12	0.11	0.12	0.13	0.13	0.11	0.11	0.09	0.12	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.11	0.16
Bismuth Grade (%)	**0.14**			0.07	0.11	0.14	0.13	0.11	0.14	0.17	0.19	0.17	0.16	0.12	0.15	0.17	0.18	0.17	0.15	0.14	0.12	0.08	0.13	0.06	0.02
Copper Grade (%)	**0.04**			0.03	0.04	0.01	0.01	0.03	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.06	0.08	0.07	0.04	0.01	0.05	0.03	0.01
Contained Gold (thousand ounces)	**1,008.2**			0.1	2.9	11.0	9.8	20.3	16.3	29.4	66.7	67.9	96.4	87.1	28.9	30.2	28.0	29.0	37.3	46.5	72.1	154.1	39.9	106.1	28.3
Contained Cobalt (thousand pounds)	**81,026**			53	1,292	3,813	3,761	3,872	4,749	4,910	4,269	4,145	3,318	4,593	4,701	4,610	4,416	4,384	4,172	3,877	3,310	3,953	3,231	4,064	1,532
Contained Bismuth (thousand pounds)	**99,923**			27	1,142	4,461	4,255	3,699	5,169	6,613	7,215	6,473	5,876	4,656	5,538	6,539	6,785	6,376	5,481	5,033	4,457	3,192	4,638	2,106	194
Contained Copper (thousand pounds)	**26,946**			12	423	370	410	1,092	1,452	1,968	1,617	1,210	889	731	771	1,087	1,798	2,394	2,825	2,530	1,580	484	1,999	1,182	124
Underground																									
Ore Mined (thousand tonnes)	**577**					273	304																		
Gold Grade (grams/tonne)	**4.96**					4.10	5.74																		
Cobalt Grade (%)	**0.10**					0.14	0.07																		
Bismuth Grade (%)	**0.17**					0.28	0.07																		
Copper Grade (%)	**0.02**					0.03	0.01																		
Contained Gold (thousand ounces)	**92.1**					36.0	56.1																		
Contained Cobalt (thousand pounds)	**1,307**					842	465																		
Contained Bismuth (thousand pounds)	**2,159**					1,711	448																		
Contained Copper (thousand pounds)	**250**					169	81																		
Total Mine Production																									
Ore Mined (thousand tonnes)	**33,077**			17	460	1,717	1,792	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Waste Mined (thousand tonnes)	**97,810**			4,917	11,009	5,377	4,462	7,136	3,504	4,081	7,463	7,375	6,292	4,543	3,779	3,765	3,846	2,839	2,853	3,313	2,653	1,578	4,291	2,331	403
Total Mined (thousand tonnes)	**130,887**			4,934	11,470	7,093	6,254	8,623	5,165	5,829	9,159	9,070	7,992	6,251	5,470	5,463	5,553	4,552	4,545	4,953	4,312	3,376	5,948	4,034	841
Gold Grade (grams/tonne)	**1.03**			0.24	0.19	0.85	1.14	0.42	0.30	0.52	1.22	1.25	1.76	1.59	0.53	0.55	0.51	0.53	0.68	0.88	1.35	2.67	0.75	1.94	2.01
Cobalt Grade (%)	**0.11**			0.14	0.13	0.12	0.11	0.12	0.13	0.13	0.11	0.11	0.09	0.12	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.11	0.16
Bismuth Grade (%)	**0.14**			0.07	0.11	0.16	0.12	0.11	0.14	0.17	0.19	0.17	0.16	0.12	0.15	0.17	0.18	0.17	0.15	0.14	0.12	0.08	0.13	0.06	0.02
Copper Grade (%)	**0.04**			0.03	0.04	0.01	0.01	0.03	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.06	0.08	0.07	0.04	0.01	0.05	0.03	0.01
Contained Gold (thousand ounces)	**1,100.3**			0.1	2.9	47.0	65.9	20.3	16.3	29.4	66.7	67.9	96.4	87.1	28.9	30.2	28.0	29.0	37.3	46.5	72.1	154.1	39.9	106.1	28.3
Contained Cobalt (thousand pounds)	**82,333**			53	1,292	4,655	4,226	3,872	4,749	4,910	4,269	4,145	3,318	4,593	4,701	4,610	4,416	4,384	4,172	3,877	3,310	3,953	3,231	4,064	1,532
Contained Bismuth (thousand pounds)	**102,082**			27	1,142	6,172	4,703	3,699	5,169	6,613	7,215	6,473	5,876	4,656	5,538	6,539	6,785	6,376	5,481	5,033	4,457	3,192	4,638	2,106	194
Contained Copper (thousand pounds)	**27,196**			12	423	539	490	1,092	1,452	1,968	1,617	1,210	889	731	771	1,087	1,798	2,394	2,825	2,530	1,580	484	1,999	1,182	124

Table 1.4
NICO Project – Mineral Reserves

Type	Classification	Tonnes (thousand)	Average Grade			
			Gold (g/t)	Cobalt (%)	Bismuth (%)	Copper (%)
Open Pit	Proven	20,453	0.92	0.11	0.15	0.04
	Probable	12,047	1.03	0.11	0.13	0.04
	Total	**32,500**	**0.96**	**0.11**	**0.14**	**0.04**
Underground	Proven	282	4.93	0.14	0.27	0.03
	Probable	295	5.00	0.07	0.07	0.01
	Total	**577**	**4.96**	**0.10**	**0.17**	**0.02**
Total	Proven	20,735	0.97	0.11	0.15	0.04
	Probable	12,342	1.13	0.11	0.13	0.04
	Total	**33,077**	**1.03**	**0.11**	**0.14**	**0.04**

1.5.6 Metallurgical Testwork

Fortune completed extensive bench scale and pilot plant testwork studies between 1997 and 2012 using samples representative of the mineralization of the NICO deposit. The majority of this flowsheet development work was undertaken at the SGS Mineral Services laboratory, Lakefield, Ontario, Canada.

The purpose of the metallurgical test programs was to develop a process flowsheet and generate process design criteria for the recovery of bismuth, cobalt, copper and gold from the NICO deposit. Initial work in 1997 and 1998 considered the recovery of separate bismuth and cobalt concentrates, as well as a bulk product containing bismuth, cobalt, gold and copper. This process flowsheet was developed and optimized over the following years, with bench scale testwork programs in 2000, 2001, 2004/2005 and 2009, mini-pilot scale hydrometallurgical testwork in 2006, and significant pilot plant mill and flotation test runs in 2007/2008 and 2010.

The metallurgical testwork completed to date included not only flotation parameter optimization and modelling, but also grinding, gravity recovery of gold, concentrate dewatering and hydrometallurgical recovery of cobalt, bismuth, gold and copper, and the validation of a process to produce cobalt and bismuth products.

The hydrometallurgical testwork undertaken to date comprises bismuth flotation optimization tests, cobalt hydrometallurgical circuit development testing, iron and arsenic removal tests, copper recovery tests, cobalt purification and recovery testwork, bismuth recovery testwork, gold recovery tests and cyanide destruction tests.

The results of this comprehensive testwork formed the basis for the Front-End Engineering Design (FEED) studies prepared by Aker Solutions (now Jacobs Minerals Canada Inc.) in September, 2012. The FEED studies developed the flowsheets for both the processing plant at the Project site and the SMPP. The FEED studies also included, among other things, equipment lists, general arrangement drawings and cost estimates for these facilities.

1.5.7 Process Plant at the Project Site

The process design for the Project site was developed for a mineral processing plant with a throughput of approximately 1.7 million tonnes of ore per year. With an operating availability design criterion of 90%, the plant has been designed for processing 215 tonnes of ore per hour. The basic flowsheet, a simplified diagram of which is shown in Figure 1.3, consists of conventional crushing, grinding and flotation, to produce a bulk sulphide concentrate which will be thickened, filtered and bagged, prior to shipment to the SMPP hydrometallurgical processing facility. A gravity circuit is also included in the flowsheet to recover coarse gold, ahead of the flotation circuit.

Crushing will be undertaken in three stages, with the third stage in closed circuit with screens. The crushed ore will be ground in a ball mill and Vertimills, which will operate in closed circuit with cyclones to produce a flotation feed of 80% finer than 53 microns. A bleed from the cyclone overflow will feed the gravity gold circuit. The concentrate from the gravity circuit will go directly to the final concentrate thickener, while the gravity tailing will be returned to the grinding circuit.

Underflow from the grinding circuit cyclones will feed the rougher flotation circuit, the tailing from which will flow by gravity to the tailings thickener and, ultimately, to the co-disposal facility. Concentrate from the rougher flotation circuit will feed a cleaner and cleaner-scavenger circuit, the tailings from which will be reground to a fineness of 80% passing 20 microns, and then subjected to secondary flotation.

The bulk cleaner concentrate, the secondary cleaner concentrate and the gravity concentrate form the feed to the concentrate thickener, the underflow from which will be directed to a recessed plate type pressure filter, to reduce the moisture content of the concentrate to approximately 8%. The filtered concentrate will then be bagged for shipment.

The design production schedule for the processing plant at the Project site is shown in Table 1.5.

1.5.8 Co-disposal Facility

The Project will generate a total of approximately 32 Mt of tailings and 97.8 Mt of mine waste rock, including 5.5 Mt of low-grade material which, potentially, could be processed. Both of these waste streams will be disposed of together in a facility referred to as co-disposal facility (CDF).

Figure 1.3
NICO Process Flowsheet

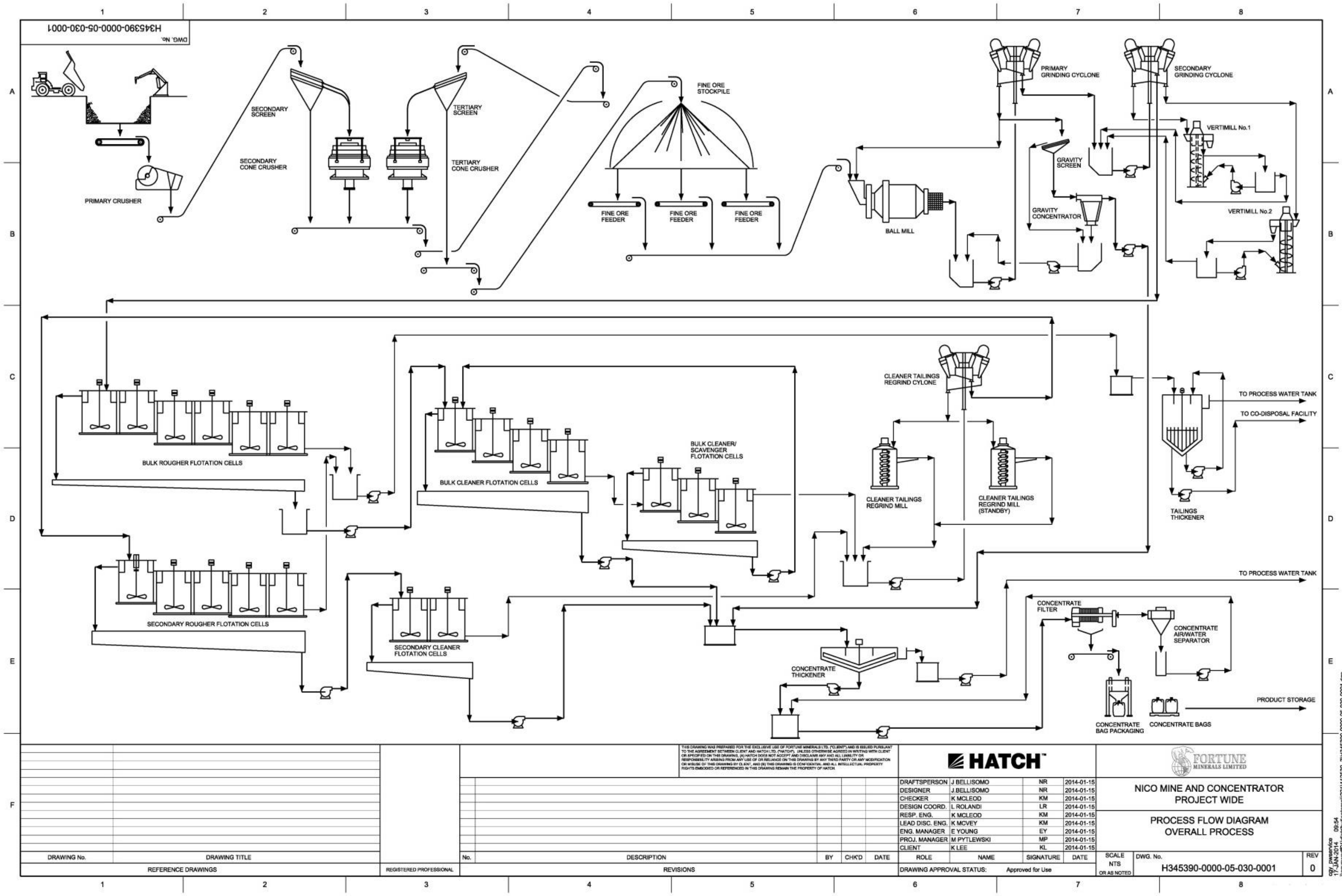


Table 1.5

NICO Project – Process Plant Production Schedule

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
MINE PRODUCTION																									
Total Ore Mined (thousand tonnes)	**33,077**			17	460	1,717	1,792	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Contained Gold (thousand ounces)	**1,100.3**			0.1	2.9	47.0	65.9	20.3	16.3	29.4	66.7	67.9	96.4	87.1	28.9	30.2	28.0	29.0	37.3	46.5	72.1	154.1	39.9	106.1	28.3
Contained Cobalt (thousand pounds)	**82,333**			53	1,292	4,655	4,226	3,872	4,749	4,910	4,269	4,145	3,318	4,593	4,701	4,610	4,416	4,384	4,172	3,877	3,310	3,953	3,231	4,064	1,532
Contained Bismuth (thousand pounds)	**102,082**			27	1,142	6,172	4,703	3,699	5,169	6,613	7,215	6,473	5,876	4,656	5,538	6,539	6,785	6,376	5,481	5,033	4,457	3,192	4,638	2,106	194
Contained Copper (thousand pounds)	**27,196**			12	423	539	490	1,092	1,452	1,968	1,617	1,210	889	731	771	1,087	1,798	2,394	2,825	2,530	1,580	484	1,999	1,182	124
STOCKPILE MOVEMENTS																									
Opening Balance																									
Tonnes (thousand)					17	154	197	290	78	41	91	88	85	87	96	89	89	97	112	105	47	8	107	66	71
Gold Grade (grams/tonne)					0.24	0.20	0.21	0.21	0.21	0.21	0.38	0.38	0.38	0.41	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	2.51	4.05	3.91
Cobalt Grade (%)					0.14	0.13	0.13	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.16	0.16
Bismuth Grade (%)					0.07	0.11	0.12	0.12	0.12	0.12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.09	0.14	0.13
Copper Grade (%)					0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.01	0.02	0.02
Contained Gold (thousand ounces)					0.1	1.0	1.3	1.9	0.5	0.3	1.1	1.1	1.0	1.1	1.6	1.5	1.5	1.6	1.9	1.8	0.8	0.1	8.6	8.6	8.9
Contained Cobalt (thousand pounds)					53	435	550	783	211	111	252	244	234	238	264	244	243	265	303	285	127	21	239	239	249
Contained Bismuth (thousand pounds)					27	367	501	770	208	109	299	290	278	284	310	287	286	320	375	352	157	25	201	201	207
Contained Copper (thousand pounds)					12	138	149	171	46	24	81	78	75	76	80	74	74	83	104	97	43	7	34	34	37
Annual Addition																									
Tonnes (thousand)	**507**			17	157	43	100			50			2	10			9	15				99		5	
Gold Grade (grams/tonne)				0.24	0.19	0.24	0.21			0.52			1.76	1.59			0.51	0.53				2.67		1.94	
Cobalt Grade (%)				0.14	0.13	0.12	0.11			0.13			0.09	0.12			0.12	0.12				0.10		0.11	
Bismuth Grade (%)				0.07	0.11	0.14	0.13			0.17			0.16	0.12			0.18	0.17				0.08		0.06	
Copper Grade (%)				0.03	0.04	0.01	0.01			0.05			0.02	0.02			0.05	0.06				0.01		0.03	
Contained Gold (thousand ounces)	**12.7**			0.1	1.0	0.3	0.7			0.8			0.1	0.5			0.1	0.3				8.5		0	
Contained Cobalt (thousand pounds)	**1,322**			53	442	115	254			141			3	26			22	38				218		11	
Contained Bismuth (thousand pounds)	**1,331**			27	391	134	287			190			6	27			34	55				176		6	
Contained Copper (thousand pounds)	**317**			12	145	11	28			56			1	4			9	21				27		3	
Annual Depletion																									
Tonnes (thousand)	**(507)**				(21)		(7)	(212)	(37)		(3)	(3)			(7)	(0.4)			(7)	(58)	(39)		(40)		(71)
Gold Grade (grams/tonne)					0.20		0.21	0.21	0.21		0.38	0.38			0.53	0.53			0.52	0.52	0.52		2.51		3.91
Cobalt Grade (%)					0.13		0.13	0.12	0.12		0.13	0.13			0.12	0.12			0.12	0.12	0.12		0.10		0.16
Bismuth Grade (%)					0.11		0.12	0.12	0.12		0.15	0.15			0.15	0.15			0.15	0.15	0.15		0.09		0.13
Copper Grade (%)					0.04		0.03	0.03	0.03		0.04	0.04			0.04	0.04			0.04	0.04	0.04		0.01		0.02
Contained Gold (thousand ounces)	**(12.7)**				(0.1)		(0.05)	(1.4)	(0.2)		(0.0)	(0.0)			(0.1)	(0.0)			(0.1)	(1.0)	(0.7)				(8.9)
Contained Cobalt (thousand pounds)	**(1,323)**				(60)		(20)	(572)	(100)		(8)	(10)			(20)	(1)			(18)	(157)	(107)				(250)
Contained Bismuth (thousand pounds)	**(1,332)**				(50)		(19)	(562)	(98)		(9)	(11)			(24)	(1)			(23)	(195)	(132)				(208)
Contained Copper (thousand pounds)	**(317)**				(19)		(6)	(125)	(22)		(2)	(3)			(6)	(0)			(6)	(54)	(36)				(37)
Closing Balance																									
Tonnes (thousand)				17	154	197	290	78	41	91	88	85	87	96	89	89	97	112	105	47	8	107	66	71	0
Gold Grade (grams/tonne)				0.24	0.20	0.21	0.21	0.21	0.21	0.38	0.38	0.38	0.41	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	2.51	4.05	3.91	0
Cobalt Grade (%)				0.14	0.13	0.13	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.16	0.16	0
Bismuth Grade (%)				0.07	0.11	0.12	0.12	0.12	0.12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.09	0.14	0.13	0
Copper Grade (%)				0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.01	0.02	0.02	0
Contained Gold (thousand ounces)				0.1	1.0	1.3	1.9	0.5	0.3	1.1	1.1	1.0	1.1	1.6	1.5	1.5	1.6	1.9	1.8	0.8	0.1	8.6	8.6	8.9	0
Contained Cobalt (thousand pounds)				53	435	550	783	211	111	252	244	234	238	264	244	243	265	303	285	127	21	239	239	249	(1)
Contained Bismuth (thousand pounds)				27	367	501	770	208	109	299	290	278	284	310	287	286	320	375	352	157	25	201	201	207	0
Contained Copper (thousand pounds)				12	138	149	171	46	24	81	78	75	76	80	74	74	83	104	97	43	7	34	34	37	0
MILL PRODUCTION SCHEDULE																									
Ore Milled (thousand tonnes)	**33,078**				324	1,673	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	509
Gold Grade (grams/tonne)	**1.03**				0.20	0.87	1.20	0.40	0.30	0.52	1.22	1.24	1.76	1.59	0.53	0.55	0.51	0.53	0.68	0.87	1.33	2.67	0.73	1.94	2.27
Cobalt Grade (%)	**0.11**				0.13	0.12	0.11	0.12	0.13	0.13	0.11	0.11	0.09	0.12	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.11	0.16
Bismuth Grade (%)	**0.14**				0.11	0.16	0.12	0.11	0.14	0.17	0.19	0.17	0.16	0.12	0.15	0.17	0.18	0.17	0.15	0.14	0.12	0.08	0.12	0.06	0.04
Copper Grade (%)	**0.04**				0.04	0.01	0.01	0.03	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.06	0.08	0.07	0.04	0.01	0.05	0.03	0.01
Contained Gold (thousand ounces)	**1,100.3**				2.0	46.7	65.3	21.7	16.5	28.5	66.7	68.0	96.3	86.6	29.1	30.2	27.8	28.7	37.4	47.5	72.8	145.6	39.9	105.8	37.2
Contained Cobalt (thousand pounds)	**82,334**				910	4,541	3,992	4,444	4,849	4,770	4,277	4,155	3,314	4,567	4,721	4,611	4,394	4,346	4,191	4,035	3,417	3,735	3,231	4,053	1,782
Contained Bismuth (thousand pounds)	**102,083**				801	6,038	4,435	4,261	5,267	6,424	7,224	6,485	5,871	4,629	5,561	6,540	6,750	6,321	5,504	5,228	4,588	3,016	4,638	2,100	402
Contained Copper (thousand pounds)	**27,196**				297	528	468	1,217	1,474	1,911	1,619	1,213	888	726	777	1,087	1,789	2,374	2,831	2,584	1,616	458	1,999	1,179	161
Gold Recovery (%)	**78.2**				67.3	81.6	83.4	68.5	68.0	69.3	77.3	77.4	80.6	79.5	69.3	69.9	69.2	69.3	70.0	74.3	77.8	85.0	74.5	82.3	83.2
Cobalt Recovery (%)	**90.9**				90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9
Bismuth Recovery (%)	**82.1**				82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1
Copper Recovery (%)	**89.1**				89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
Recovered Gold (thousand ounces)	**860.3**				1.4	38.1	54.4	14.8	11.2	19.8	51.5	52.6	77.6	68.9	20.1	21.1	19.3	19.9	26.2	35.3	56.6	123.8	29.7	87.0	30.9
Recovered Cobalt (thousand pounds)	**74,839**				827	4,127	3,629	4,039	4,408	4,335	3,888	3,776	3,013	4,151	4,291	4,191	3,994	3,950	3,809	3,668	3,106	3,395	2,937	3,684	1,620
Recovered Bismuth (thousand pounds)	**83,808**				658	4,957	3,641	3,498	4,324	5,274	5,931	5,324	4,820	3,800	4,566	5,369	5,542	5,190	4,519	4,292	3,767	2,476	3,808	1,724	330
Recovered Copper (thousand pounds)	**24,231**				265	470	417	1,084	1,313	1,703	1,443	1,080	791	647	692	969	1,594	2,115	2,522	2,302	1,440	408	1,781	1,051	143
Concentrate Produced (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Gold Grade of Concentrate (grams/tonne)	**25.19**				4.09	22.06	31.04	8.47	6.41	11.27	29.39	30.00	44.24	39.28	11.49	12.02	10.98	11.35	14.92	20.12	32.29	70.58	16.96	49.62	58.84
Cobalt Grade of Concentrate (%)	**3.20**				3.61	3.48	3.02	3.36	3.67	3.61	3.23	3.14	2.51	3.45	3.57	3.49	3.32	3.29	3.17	3.05	2.58	2.82	2.44	3.06	4.50
Bismuth Grade of Concentrate (%)	**3.58**				2.87	4.18	3.03	2.91	3.60	4.39	4.93	4.43	4.01	3.16	3.80	4.47	4.61	4.32	3.76	3.57	3.13	2.06	3.17	1.43	0.92
Copper Grade of Concentrate (%)	**1.03**				1.15	0.40	0.35	0.90	1.09	1.42	1.20	0.90	0.66	0.54	0.58	0.81	1.33	1.76	2.10	1.91	1.20	0.34	1.48	0.87	0.40
Concentrate Shipped (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3

Fortune retained Golder to carry out the conceptual design of the CDF, as input to the Jacobs FEED study. Golder had previously carried out a trade-off study for the management of tailings and mine waste rock, the result of which was the selection of the CDF system and a pre-feasibility study level design and cost estimate, at an assessed accuracy of plus or minus 25%.

The advantages of the co-disposal of waste are:

- Minimization of the footprint of the waste disposal facilities.
- Minimization of the potential for acid generation and metal leaching.
- Maximization of water conservation.
- Minimization of water treatment requirements.
- The ability to undertake progressive reclamation.

The CDF will be contained by a perimeter dyke comprising a prism of mine rock at least 25 metres thick. The perimeter dyke will be raised periodically in 5-metre lifts, using the upstream construction method. Inside the perimeter dyke, the CDF will comprise alternating layers of mine waste rock and tailings, about 5 metres thick. The perimeter dyke will be free draining but it will retain tailings particles. Five seepage collection ponds (SCP) will be constructed downstream of the CDF at topographically low areas, to intercept any tailings water that may seep through the perimeter dyke. Water collected in the SCPs will be pumped to the process plant for re-use.

The tailings layers will be created by constructing a series of cells. A 5-metre thick layer of waste rock will be pushed over each tailings cell as soon as it is complete. The permanent cover system will be designed to prevent erosion and potential transport of tailings solids, to reduce infiltration and to prevent contact between tailings and surface runoff. The cover system will include a capillary break to reduce metal uptake by vegetation in the cover and, therefore, ingestion of metals from the vegetation by wildlife.

1.5.9 Hydrometallurgical Processing Plant

The bulk gold-cobalt-bismuth-copper concentrate produced at the Project site in the NWT will require further processing at the SMPP, principally by hydrometallurgical techniques, to produce saleable gold, cobalt, bismuth and copper products. The bulk concentrate will be transported by road and rail to a dedicated rail siding on the SMPP property.

At the SMPP, the bulk concentrate will be re-ground to minus 14 microns and subjected to secondary flotation to produce separate auriferous cobalt and bismuth concentrates. The bismuth concentrate will then be treated by a ferric chloride leach. The pregnant solution will be subjected to electrowinning to produce bismuth cathode, which will then be smelted, with a flux, to produce bismuth ingots of 99.995% purity. It is planned also to produce bismuth needles and to convert a high proportion of the bismuth ingots to bismuth oxide.

The bismuth residue will be combined with the cobalt concentrate and subjected to a pressure acid leach in an autoclave. Iron, arsenic and copper will then be precipitated sequentially with lime and sodium carbonate. The copper precipitate will be re-leached, and then re-precipitated as copper cement, which will be sold to a third party smelter for conversion into copper metal.

Cobalt pregnant solution produced by the pressure acid leach, after the precipitation of iron and arsenic, will be processed by solvent extraction, using Cyanex 272, in order to remove metallic impurities by sequential stripping, and leave a pure cobalt sulphate solution. This solution will then be evaporated and subjected to a three-stage crystallization process to produce cobalt sulphate heptahydrate, containing 20.9% cobalt. Cobalt carbonate, cobalt oxide, cobalt nitrate and cobalt chloride can also be produced from the same solution, should market conditions so dictate.

The tailing from the cobalt concentrate will be leached with cyanide, for the recovery of gold, as doré bars.

The design production schedule for the hydrometallurgical processing facility in Saskatchewan is summarized in Table 1.6.

Solid waste residue from the SMPP will consist primarily of two streams:

- Residue from the cyanide leach used to recover gold, which will be produced at a design rate of 9 tonnes per hour.

- Iron-arsenic precipitate, and gypsum residue, from the precipitation circuit following the autoclave, which will be produced at a design rate of 5.7 tonnes per hour. The arsenic will present as scorodite, a relatively stable iron-arsenic compound.

These solid waste streams will be permanently entombed in a dedicated permanent residue storage facility (PRSF), located on the SMPP property. The PRSF will be constructed as a series of dyked cells, above the groundwater table. Each cell will have a dual containment liner and a leak detection system. As soon as possible after each cell is filled with residue, an engineered cover will be placed over it, to limit water and oxygen ingress and to support vegetation. The site selected for the PRSF is underlain by 9 to 18 metres of low conductivity till, providing a high level of secondary containment to prevent any contamination of the Dalmeny Aquifer below.

The principal liquid residue from the SMPP will be a high chloride brine from the bismuth recovery process. This solution will be injected, through a deep well, into the Souris River Formation, at a depth below surface of approximately 800 metres. The design rate of production of this waste solution is 11 cubic metres per hour.

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Table 1.6
Hydrometallurgical Plant Production Schedule

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
MILL PRODUCTION																									
Concentrate Shipped (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Moisture Content of Concentrate (%)	**8.7**				8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Concentrate Shipped (thousand wet tonnes)	**1,154.6**				11.3	58.4	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	17.8
Gold Grade of Concentrate (grams/tonne)	**25.19**				4.09	22.06	31.04	8.47	6.41	11.27	29.39	30.00	44.24	39.28	11.49	12.02	10.98	11.35	14.92	20.12	32.29	70.58	16.96	49.62	58.84
Cobalt Grade of Concentrate (%)	**3.20**				3.61	3.48	3.02	3.36	3.67	3.61	3.23	3.14	2.51	3.45	3.57	3.49	3.32	3.29	3.17	3.05	2.58	2.82	2.44	3.06	4.50
Bismuth Grade of Concentrate (%)	**3.58**				2.87	4.18	3.03	2.91	3.60	4.39	4.93	4.43	4.01	3.16	3.80	4.47	4.61	4.32	3.76	3.57	3.13	2.06	3.17	1.43	0.92
Copper Grade of Concentrate (%)	**1.03**				1.15	0.40	0.35	0.90	1.09	1.42	1.20	0.90	0.66	0.54	0.58	0.81	1.33	1.76	2.10	1.91	1.20	0.34	1.48	0.87	0.40
Gold in Concentrate (thousand ounces)	**860.3**				1.4	38.1	54.4	14.8	11.2	19.8	51.5	52.6	77.6	68.9	20.1	21.1	19.3	19.9	26.2	35.3	56.6	123.8	29.7	87.0	30.9
Cobalt in Concentrate (thousand pounds)	**74,839**				827	4,127	3,629	4,039	4,408	4,335	3,888	3,776	3,013	4,151	4,291	4,191	3,994	3,950	3,809	3,668	3,106	3,395	2,937	3,684	1,620
Bismuth in Concentrate (thousand pounds)	**83,808**				658	4,957	3,642	3,498	4,324	5,274	5,931	5,324	4,820	3,800	4,566	5,369	5,542	5,190	4,519	4,292	3,767	2,476	3,870	1,724	267
Copper in Concentrate (thousand pounds)	**24,231**				265	470	417	1,084	1,313	1,703	1,443	1,080	791	647	692	969	1,594	2,115	2,522	2,302	1,440	408	1,781	1,051	143
HYDROMETALLURGICAL PLANT PRODUCTION																									
Concentrate Treated (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Cobalt Concentrate Produced (thousand dry tonnes)	**979.1**				9.6	49.5	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	15.1
Gold Recovery to Cobalt Concentrate (%)	**21.3**				21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
Cobalt Recovery to Cobalt Concentrate (%)	**97.8**				97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8
Bismuth Recovery to Cobalt Concentrate (%)	**11.1**				11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Copper Recovery to Cobalt Concentrate (%)	**39.5**				39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Gold in Cobalt Concentrate (thousand ounces)	**183.2**				0.3	8.1	11.6	3.2	2.4	4.2	11.0	11.2	16.5	14.7	4.3	4.5	4.1	4.2	5.6	7.5	12.1	26.4	6.3	18.5	6.6
Cobalt in Cobalt Concentrate (thousand pounds)	**73,193**				808.7	4,036.4	3,549.2	3,950.5	4,310.7	4,240.0	3,802.2	3,693.4	2,946.5	4,059.6	4,196.8	4,099.2	3,906.1	3,863.5	3,725.5	3,586.8	3,037.2	3,320.6	2,872.4	3,603.2	1,584.3
Bismuth in Cobalt Concentrate (thousand pounds)	**9,303**				73.0	550.2	404.2	388.2	480.0	585.4	658.3	591.0	535.0	421.8	506.8	596.0	615.1	576.1	501.6	476.4	418.1	274.8	429.6	191.4	29.7
Copper in Cobalt Concentrate (thousand pounds)	**9,583**				104.7	186.0	165.0	428.7	519.3	673.6	570.6	427.3	313.0	256.0	273.8	383.1	630.4	836.4	997.5	910.5	569.6	161.2	704.5	415.5	56.6
Recovery of Gold from Cobalt Concentrate (%)	**94.7**				94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
Recovery of Cobalt from Cobalt Concentrate (%)	**92.9**				92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
Recovery of Bismuth from Cobalt Concentrate (%)	**0**				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recovery of Copper from Cobalt Concentrate (%)	**46.2**				46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2
Recovered Gold in Doré from Cobalt Concentrate (thousand ounces)	**173.5**				0.3	7.7	11.0	3.0	2.3	4.0	10.4	10.6	15.6	13.9	4.1	4.3	3.9	4.0	5.3	7.1	11.4	25.0	6.0	17.5	6.2
Recovered Cobalt from Cobalt Concentrate (thousand pounds)	**67,996**				751.3	3,749.8	3,297.2	3,670.0	4,004.6	3,938.9	3,532.3	3,431.2	2,737.3	3,771.3	3,898.8	3,808.1	3,628.8	3,589.2	3,461.0	3,332.2	2,821.6	3,084.9	2,668.5	3,347.4	1,471.8
Recovered Bismuth from Cobalt Concentrate (thousand pounds)	**0**				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recovered Copper from Cobalt Concentrate (thousand pounds)	**4,427**				48.4	85.9	76.2	198.1	239.9	311.2	263.6	197.4	144.6	118.3	126.5	177.0	291.3	386.4	460.9	420.6	263.2	74.5	325.5	192.0	26.2
Bismuth Concentrate Produced (thousand dry tonnes)	**83.2**				0.8	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	1.3
Gold Recovery to Bismuth Concentrate (%)	**78.7**				78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7
Cobalt Recovery to Bismuth Concentrate (%)	**2.2**				2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Bismuth Recovery to Bismuth Concentrate (%)	**88.9**				88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9
Copper Recovery to Bismuth Concentrate (%)	**60.5**				60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5
Gold in Bismuth Concentrate (thousand ounces)	**676.8**				1.1	30.0	42.8	11.7	8.8	15.5	40.6	41.4	61.0	54.2	15.8	16.6	15.1	15.7	20.6	27.8	44.5	97.4	23.4	68.5	24.3
Cobalt in Bismuth Concentrate (thousand pounds)	**1,646**				18.2	90.8	79.8	88.9	97.0	95.4	85.5	83.1	66.3	91.3	94.4	92.2	87.9	86.9	83.8	80.7	68.3	74.7	64.6	81.1	35.6
Bismuth in Bismuth Concentrate (thousand pounds)	**74,506**				584.8	4,406.6	3,237.3	3,109.3	3,844.1	4,688.4	5,272.4	4,733.0	4,284.9	3,378.6	4,059.0	4,773.2	4,926.7	4,613.7	4,017.2	3,815.9	3,348.8	2,201.2	3,440.3	1,532.7	237.6
Copper in Bismuth Concentrate (thousand pounds)	**14,648**				160.0	284.3	252.3	655.3	793.7	1,029.5	872.1	653.1	478.4	391.2	418.5	585.5	963.6	1,278.4	1,524.7	1,391.6	870.6	246.4	1,076.8	635.0	86.5
Recovery of Gold from Bismuth Concentrate (%)	**94.7**				94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
Recovery of Cobalt from Bismuth Concentrate (%)	**92.9**				92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
Recovery of Bismuth from Bismuth Concentrate (%)	**98.9**				98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9
Recovery of Copper from Bismuth Concentrate (%)	**46.2**				46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2
Recovered Gold in Doré from Bismuth Concentrate (thousand ounces)	**640.9**				1.0	28.4	40.6	11.1	8.4	14.7	38.4	39.2	57.8	51.3	15.0	15.7	14.3	14.8	19.5	26.3	42.2	92.2	22.2	64.8	23.0
Recovered Cobalt from Bismuth Concentrate (thousand pounds)	**1,530**				16.9	84.4	74.2	82.6	90.1	88.6	79.5	77.2	61.6	84.8	87.7	85.7	81.6	80.7	77.9	75.0	63.5	69.4	60.0	75.3	33.1
Recovered Bismuth from Bismuth Concentrate (thousand pounds)	**73,656**				578.2	4,356.4	3,200.4	3,073.9	3,800.3	4,635.0	5,212.3	4,679.1	4,236.0	3,340.0	4,012.8	4,718.8	4,870.5	4,561.1	3,971.4	3,772.4	3,310.7	2,176.1	3,401.1	1,515.2	234.9
Recovered Copper from Bismuth Concentrate (thousand pounds)	**6,767**				73.9	131.3	116.5	302.8	366.7	475.6	402.9	301.7	221.0	180.7	193.4	270.5	445.2	590.6	704.4	642.9	402.2	113.9	497.5	293.4	40.0
Total Recovered Gold (thousand ounces)	**814**				1.3	36.1	51.5	14.1	10.6	18.7	48.8	49.8	73.4	65.2	19.1	20.0	18.2	18.8	24.8	33.4	53.6	117.2	28.2	82.4	29.3
Total Recovered Cobalt (thousand ounces)	**69,526**				768.2	3,834.2	3,371.4	3,752.5	4,094.7	4,027.5	3,611.7	3,508.4	2,798.9	3,856.2	3,986.5	3,893.8	3,710.4	3,669.9	3,538.8	3,407.1	2,885.0	3,154.2	2,728.5	3,422.7	1,504.9
Total Recovered Bismuth (thousand ounces)	**73,656**				578.2	4,356.4	3,200.4	3,073.9	3,800.3	4,635.0	5,212.3	4,679.1	4,236.0	3,340.0	4,012.8	4,718.8	4,870.5	4,561.1	3,971.4	3,772.4	3,310.7	2,176.1	3,401.1	1,515.2	234.9
Total Recovered Copper (thousand ounces)	**11,195**				122.3	217.3	192.8	500.8	606.6	786.8	666.5	499.2	365.6	299.0	319.9	447.5	736.4	977.0	1,165.3	1,063.6	665.4	188.3	823.0	485.3	66.1

1.5.10 Infrastructure

1.5.10.1 Project Site in the NWT

All-weather road access between Edmonton and the NICO Project site is scheduled for completion early in 2016. Grid electrical power will be supplied from the Snare Hydroelectric Complex, with the connection expected to be completed late in 2016. Fortune is presently negotiating the terms of the power supply agreement with Northwest Territories Power Corporation. Temporary power during construction, prior to late 2016, will be supplied by a 1,000 kilowatt generator set. During operations, standby emergency power will be provided by a 2 megawatt diesel generated power plant.

Other infrastructure to be provided at the Project site will include:

- Camp accommodation for up to 300 persons during construction. For operations, this camp will be modified to accommodate 150 persons, and a sports complex will be added.
- Fresh water supply, drawn from Lou Lake and pumped through an insulated, heat-traced line to fresh water storage tanks at the processing plant.
- A firewater system.
- Fuel storage facilities, located within a bermed area.
- Area heating by a closed-circuit diesel fired boiler, which will circulate hot glycol solution to all buildings.
- Communications and information systems.
- Administrative, laboratory, maintenance and warehousing facilities, including a truckshop for maintenance of the mobile open pit mining equipment.
- First aid and firefighting facilities.
- A sewage treatment facility.
- Waste disposal facilities.

1.5.10.2 SMPP

The SMPP is located close to established road and rail networks, and in an area with a technically-competent labour pool. Grid electric power is readily available. A dedicated rail siding will be established on the SMPP property, for the receipt of inbound bulk concentrate from the NWT and for the outbound shipment of saleable products. An oxygen plant will be built on the property, principally to supply oxygen for the autoclave. A two-storey administrative, laboratory and warehouse building is planned.

1.6 ENVIRONMENTAL, SOCIO-ECONOMIC AND PERMITTING CONSIDERATIONS

1.6.1 Project Site in the NWT

The active Project area in the NWT will be approximately 485 hectares, with limited changes made to the natural flow of water. The Project will locally affect water quantity, air, soils, vegetation, and wildlife and fish health. Caribou and water quality have been identified as the most important community concerns related to the environment. It is anticipated, however, that there will be no observable change in the availability of wildlife due to effects of the NICO Project, relative to current natural changes in population size. Changes in water, soils and plants caused by the Project in the small area at and near the site will not affect the health of wildlife, or the health of people that eat wildlife. Approximately 85 hectares of land will be permanently altered by the Project, principally the areas of the open pit and the co-disposal facility.

Caribou may be in the area near the Project during winter. Because of noise during operations, caribou might not use the area within about 15 km of the Project. The possible direct habitat loss associated with the Project, combined with previous, existing and predicted future developments, is expected to be about 0.2% of their winter range. Traffic associated with the proposed all-season Project access road could affect the behaviour and movement of wildlife, including caribou. Changes in water, soils and plants will be limited.

Air emissions are expected from the process plant, vehicle exhausts, road dust and blasting. Emissions will include mainly nitrogen and sulphur oxides, fumes from fuels, and dust. Metal concentrations in surface waters resulting from mine dust settling and runoff were identified as potentially resulting in water quality guideline exceedences in some small lakes and ponds immediately adjacent to the area of the mine and processing plant.

Computer models were used to predict the quality of waters that would flow from the mining, processing and co-disposal areas. Activities in these areas, site water drainage and the filling of the open pit with water after closure were considered in the assessment of site water quality predictions. The results of these predictions were used to evaluate the need for, and the type of, treatment options that might be required to ensure that the water would be safe to discharge into Peanut Lake. These water quality predictions were combined with the effects of dust, to predict the total effects on water quality in Nico Lake, Peanut Lake, Burke Lake and the Marian River, during operations and after closure.

While there may be some changes to the water quality in Nico, Peanut and Burke Lakes during construction and operations, none of these changes is expected to result in significant negative effects to water quality in these lakes after closure. Aquatic health will not be at risk during construction and operations. The Marian River will not be affected during construction, operations, or after closure. It is predicted that the NICO Project will not have a significant negative impact on fish and the condition of their habitats.

Particular concern has been expressed by the Tłįchǫ community for the potential cumulative effects of the NICO Project, combined with those of the closed Rayrock and Colomac mines. Because the condition of the water in Burke Lake and the Marian River will remain similar to the current conditions, the cumulative effect of the Project on any other downstream lakes or waterways is considered negligible.

The NICO Project is a small development compared to other mines in the NWT, but it will contribute to the overall labour, financial, physical, human and social resources of both the NWT and the nearby communities. Employment and small business opportunities will be offered preferentially to Tłįchǫ and Aboriginal personnel, wherever possible.

In general, the NICO Project will increase the amount of money in the area through additional wages and business activities, with secondary benefits such as improved roads and spending. Improved roads in the area will give residents better access to services and goods that previously were difficult to obtain.

In summary, impacts to the economics of the area are expected to be positive and to last at least until the mine is closed. The positive and negative impacts to health, wellness and public safety are expected to be small and similar to existing conditions. Impacts to employment and infrastructure are expected to be positive and to last until after the mine is closed.

The effects from closure and reclamation will be limited. Most of the mine will be closed and reclaimed within two years, leaving only a few items requiring manpower.

The Mackenzie Valley Review Board has recommended to the Minster of Aboriginal Affairs and Northern Development Canada and the Tłįchǫ Government that the Project proceed to the regulatory phase of approvals, subject to 13 conditions or measures outlined in the report of January 25, 2013. In July 2013, the Minister and the Grand Chief of the Tłįchǫ Government approved the Report of Environmental Assessment, with revision to Measure Number 8 regarding mitigation and management of cumulative effects on barren ground caribou.

Fortune is working with the Tłįchǫ Government and the various regulatory agencies on the best means of implementing the measures and suggestions.

1.6.2 The SMPP

An Environmental Impact Statement (EIS) was prepared to summarize the costs and benefits of the SMPP, including potential impacts and mitigation measures. A description of the natural environment of the study area was presented that included the geology and groundwater setting, surface water, biological resources and heritage resources. Based on the work completed, no significant long-term negative environmental impacts are anticipated to result from the construction, operation or closure of the SMPP

Residual impacts at the proposed site of the SMPP are predicted to occur to the terrain, air emissions, soils, vegetation, surface water runoff, land use and socio-economics. Impacts beyond the site boundaries are expected to be minimal. A summary of the predicted environmental effects is provided in EIS, and continual environmental monitoring and adaptive management during the construction, operation and closure will ensure that the appropriate mitigation measures are applied. No cumulative effects are expected.

This SMPP will create both long-term and short-term economic benefits for the local area, as well as the Province of Saskatchewan. The period for public comment on the EIS and the SMPP expired on December 6, 2013 and, on February 11, 2014, the Saskatchewan Minister of Environment issued a decision approving the construction and operation of the SMPP. An application for re-zoning of the SMPP site from agricultural to industrial use is in progress and is expected to be approved later in 2014.

1.7 ECONOMIC DATA

1.7.1 Marketing and Metal Prices

The NICO Project is planned to produce the following products, by the hydrometallurgical processing of the bulk concentrate produced at the Project site in the NWT:

- Gold, as doré which will then be refined into pure metal.
- Cobalt, as cobalt sulphate heptahydrate, containing 20.9% cobalt; other cobalt salts can be produced as required.
- Bismuth, as 99.995% ingot (20%), as 99.995% bismuth needles (20%) and as 89.7% bismuth oxide (60%).
- Copper, as copper cement.

All of these products are readily saleable, although copper cement will need to be sold to a copper smelter and refinery, for conversion to copper cathode. Cobalt contained in cobalt sulphate commands a premium over the price of cobalt metal. That premium has been assessed for various global regions and, as applied in this report, has a volume-weighted average of 19%. The base case metal prices used in the financial model are summarized in Table 1.7. These prices are assumed to remain constant, in real terms, throughout the life of the Project.

Table 1.7
Base Case Metal Prices

Metal	Metal Price (US$)	Exchange Rate (US$/C$)	Metal Price (C$)
Gold (per oz)	1,350	0.88	1,534
Cobalt (per lb)	16.00	0.88	18.18
Cobalt in sulphate (per lb)	19.04	0.88	21.64
Bismuth ingot (per lb)	10.50	0.88	11.93
Bismuth needles (per lb)	11.00	0.88	12.50
Bismuth in oxide (per lb)	14.00	0.88	15.91
Bismuth (per lb, average)	12.64	0.88	14.36
Copper as cathode (per lb)	3.25	0.88	3.69
Copper as cement (per lb)	2.38	0.88	2.70

Fortune will be responsible for the marketing of all products. Fortune's cost of marketing is assessed as 1% of the gross revenue received from the sale of cobalt, bismuth and copper.

The financial model makes provision for the costs of transporting and refining the gold doré. The estimated cost of smelting and refining the copper cement to be produced at the SMPP has been included in the financial model by reducing the net price received from US$3.25 per pound for cathode, to US$2.38 per pound for copper contained in cement. The price of bismuth is a weighted average of US$10.50 per pound for ingot (20%), US$11.00 per pound for needles (20%) and US$14.00 per pound for bismuth contained in oxide, less an allowance of US$0.10 per pound for the additional processing required (60%).

1.7.2 Cost Structure

The estimates of capital expenditure and operating cost for the NICO Project in the NWT have been developed by Procon Mining and Tunnelling Ltd. (Procon), based on the work of Fortune and third party engineering companies, consultants and contractors which were responsible for developing the estimates for the scope of work in their respective areas. The estimates are based on budgetary quotations received from potential vendors for the major items, and factored estimates or database information for other items. The capital expenditure and operating cost estimates for the Project site have an assessed level of accuracy of plus or minus 15%.

The estimates of capital expenditure for the SMPP have also been developed by Procon, to an assessed level of accuracy of plus or minus 15%.

The estimates of operating cost for the SMPP have been based on an addendum to the Jacobs FEED study which incorporated the production of cobalt sulphate, rather than cobalt cathode, as originally envisaged. The Jacobs estimates have been subsequently updated by Fortune. The estimates of operating cost for the SMPP have an assessed level of accuracy of plus or minus 15% for the basic plant, but minus 10%, plus 25% for the cobalt sulphate circuit.

1.7.2.1 Capital Expenditures

The estimated pre-production capital expenditures for the construction of the NICO Project in the NWT are estimated at C$346.5 million, as summarized in Table 1.8.

Table 1.8
Summary of NICO Project Estimated Pre-Production Capital Costs

Cost Component	Estimated Cost (C$ million)
Open pit mining	52.4
Underground mining	-
Process plant and related infrastructure	170.0
Indirect costs	88.3
Engineering, procurement and construction management (EPCM)	39.1
Other costs	(3.3)
Total pre-production capital	**346.5**

An additional C$41.4 million has been provided for sustaining capital expenditures to be incurred throughout the life of the Project.

The pre-production capital expenditures for construction of the SMPP are estimated at C$242.5 million, as summarized in Table 1.9.

Table 1.9
Summary of SMPP Estimated Pre-Production Capital Cost

Cost Component	Estimated Cost (C$ million)
Labour	45.9
Permanent material	31.4
Construction material	5.9
Process equipment	57.9
Equipment purchases and operation	6.7
Sub-contractors and design	17.2
Sub-Total	**165.0**
Indirect costs	77.5
Total	**242.5**

An additional C$16.4 million has been included for subsequent sustaining capital expenditures to be incurred throughout the operating life of the SMPP.

The total estimated pre-production and sustaining capital expenditures for the NICO Project are summarized in Table 1.10. These estimates are expressed in constant Canadian dollars of fourth quarter, 2013 value.

Table 1.10
Total Estimated Capital Expenditures

Location	Pre-Production Capital (C$ million)			Sustaining (C$ million)	Total Capital (C$ million)
	Direct Costs	Indirect Costs	Total		
NWT	222.4	124.1	346.5	41.4	387.9
SMPP	165.0	77.5	242.5	16.4	258.9
Total	**387.4**	**201.6**	**589.0**	**57.8**	**646.8**

1.7.2.2 Operating Costs

The estimated life-of-mine (LOM) operating costs for the NICO Project in the NWT are summarized in Table 1.11. The average estimated cost is C$39.70 per tonne of ore milled. These costs are expressed in constant Canadian dollars of fourth quarter, 2013 value.

Table 1.11
Summary of Project Site Operating Cost Estimate

Cost Centre	Life-of-Mine Cost (C$ million)	Average Annual Cost (C$ million)	Average Unit Cost (C$/t total ore mined)
Open Pit Mining	271.2	13.6	8.20
Underground Mining	52.7	2.6	1.59
Processing (NWT)	422.4	21.1	12.77
Shared Services	355.2	17.8	10.74
Concentrate Transport	212.1	10.6	6.41
Total	**1,313.6**	**65.7**	**39.71**

The estimated LOM operating costs for the SMPP are estimated at C$599 million, or C$564 per tonne of bulk concentrate processed, distributed approximately as summarized in Table 1.12.

Table 1.12
Summary of SMPP Operating Cost Estimate

Item	Life-of-Mine Cost (C$ million)	Average Annual Cost (C$ million)	Average Unit Cost (C$/t concentrate)
Labour	169	8.5	159
Power	73	3.7	69
Reagents	209	10.5	197
Maintenance Supplies	82	4.1	77
Infrastructure	11	0.5	10
Other	55	2.8	52
Total	**599**	**30**	**564**

The total cost of operating the SMPP is equivalent to C$18.11 per tonne of ore milled at the Project site.

Fortune has also performed an analysis of the average cash cost of production per ounce of gold equivalent and per pound of cobalt equivalent, with metal equivalents being calculated on the basis of the revenues estimated to be received for each metal, thereby taking into account both the ratio of the prices of each metal and the differences in metallurgical recovery. A further analysis was undertaken of the cash operating costs of producing gold, cobalt and bismuth, after by-product credits for each of the other metals. The results of these analyses are summarized in Table 1.13.

Table 1.13
Unit Cost of Metal Equivalents and Net of By-Product Credits

Unit Cost Measure	Units	Average Unit Cost
Per equivalent ounce of gold	US$/oz	673.54
Per equivalent pound of cobalt	US$/lb	9.50
Per ounce of gold, net of by-product credits	US$/oz	(702.12)
Per pound of cobalt, net of by-product credits	US$/lb	(5.19)
Per pound of bismuth, net of by-product credits	US$/lb	(10.18)

1.7.3 Financial Evaluation

The overall results of the base case financial evaluation of the NICO Project have been summarized in Table 1.1. The discounted cash flow evaluation has been based on the production schedules, metal prices, capital expenditures and operating costs summarized above and discussed in detail in the body of this report, together with the following additional considerations:

- Provision has been made for the payment of NWT mining royalty, Canadian federal income tax, NWT income tax and Saskatchewan income tax. Fortune reports that it will be exempt from Saskatchewan income tax for five years, once taxable in the Province, based on legislation introduced by the Province to attract industrial investment.

- Provisions have been included for Fortune's corporate overhead costs and for minor changes in working capital.

- An annual allowance has been included for security deposits to fund final reclamation and closure.

- The Project capital expenditure is assumed to be financed 30% by equity and 70% by debt.

Details of the projected annual cash flows are provided Table 1.14.

The overall economics of the NICO Project are more sensitive to changes in the factors that affect revenue, than they are to changes in capital expenditures or operating costs. Sensitivity analyses have been conducted to determine the effect on net present value and internal rate of return of variations from the base level prices of the two principal co-products, gold and cobalt. The results are summarized in Table 1.15. These sensitivity analyses also serve as a proxy for variations in ore grade, metallurgical recovery or metal production, for either gold or cobalt.

Table 1.14
NICO Project Cash Flow

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
PRODUCTION DATA																									
Open Pit Ore Mined (thousand tonnes)	**32,500**			17	460	1,443	1,488	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Open Pit Waste Mined (thousand tonnes)	**97,810**			4,917	11,009	5,377	4,462	7,136	3,504	4,081	7,463	7,375	6,292	4,543	3,779	3,765	3,846	2,839	2,853	3,313	2,653	1,578	4,291	2,331	403
Underground Ore Mined (thousand tonnes)	**577**					273	304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reclaimed from Stockpile (thousand tonnes)	**507**				21	0	7	212	37	0	3	3	0	0	7	0	0	0	7	58	39	0	40	0	71
Ore Milled (thousand tonnes)	**33,078**				324	1,673	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	509
Concentrate Treated (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Concentrate Treated (thousand wet tonnes)	**1,154.6**				11.3	58.4	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	17.8
Gold Sold (thousand ounces)	**814.4**				1.2	35.3	52.5	14.0	10.7	18.6	48.6	49.8	73.3	65.3	19.5	20.0	18.2	18.8	24.7	33.3	53.4	116.7	31.2	82.0	27.4
Cobalt Sold (thousand pounds)	**69,526**				256.1	4,193.7	3,318.6	3,744.6	4,075.2	4,030.3	3,634.4	3,515.8	2,837.0	3,801.3	3,976.7	3,898.9	3,720.0	3,672.9	3,546.2	3,415.3	2,913.4	3,141.3	2,822.0	3,390.5	1,621.5
Bismuth Sold (thousand pounds)	**73,656**					4,623.1	3,216.7	3,106.7	3,741.8	4,564.5	5,161.1	4,718.2	4,273.1	3,413.7	3,965.5	4,660.3	4,852.9	4,584.1	4,019.8	3,792.8	3,347.9	2,268.6	3,311.7	1,657.4	376.5
Copper Sold (thousand pounds)	**11,195**					316.0	191.4	462.1	594.0	764.9	677.7	519.7	383.1	308.6	318.6	433.0	701.7	945.7	1,140.3	1,072.7	711.4	248.0	761.8	517.0	127.3
METAL PRICES																									
Gold Price (US$/ounce)				1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350
Cobalt Price (US$/pound)				16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Price of Cobalt in Sulphate (US$/pound, plus 19%)				19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04
Bismuth Price (US$/pound)				12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64
Copper Price (US$/pound)				2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
Exchange Rate (US$/C$)				0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Gold Price (C$/ounce)				1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534
Cobalt Price (C$/pound)				18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18
Price of Cobalt in Sulphate (C$/pound)				21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64
Bismuth Price (C$/pound)				14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36
Copper Price (C$/pound)				2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
REVENUE AND EXPENDITURE (C$ thousand)																									
Gross Revenue from Gold Sales	**1,249,358**				1,787	54,088	80,474	21,482	16,369	28,599	74,488	76,415	112,403	100,164	29,871	30,626	27,996	28,917	37,924	51,138	81,996	178,992	47,866	125,746	42,018
Gross Revenue from Cobalt Sulphate Sales	**1,504,283**				5,540	90,737	71,803	81,020	88,172	87,202	78,634	76,069	61,383	82,245	86,040	84,357	80,488	79,468	76,728	73,894	63,035	67,966	61,057	73,359	35,084
Gross Revenue from Bismuth Sales	**1,057,972**				0	66,404	46,204	44,623	53,746	65,563	74,132	67,770	61,377	49,033	56,959	66,939	69,705	65,844	57,739	54,478	48,088	32,585	47,568	23,806	5,408
Gross Revenue from Copper Sales	**30,214**				0	853	517	1,247	1,603	2,064	1,829	1,403	1,034	833	860	1,169	1,894	2,552	3,078	2,895	1,920	669	2,056	1,395	344
Gross Sales Revenue	**3,841,828**				**7,327**	**212,082**	**198,997**	**148,373**	**159,889**	**183,428**	**229,085**	**221,658**	**236,197**	**232,276**	**173,730**	**183,091**	**180,083**	**176,782**	**175,468**	**182,405**	**195,039**	**280,213**	**158,547**	**224,306**	**82,854**
Concentrate Transportation	**(212,099)**				(2,067)	(10,729)	(10,895)	(10,887)	(10,887)	(10,898)	(10,895)	(10,887)	(10,887)	(10,895)	(10,887)	(10,887)	(10,898)	(10,895)	(10,887)	(10,887)	(10,895)	(10,887)	(10,898)	(10,887)	(3,264)
Gold Refining	**(7,492)**				(12)	(327)	(476)	(145)	(116)	(184)	(442)	(453)	(655)	(586)	(192)	(196)	(181)	(186)	(237)	(311)	(484)	(1,028)	(293)	(730)	(260)
Marketing Expense	**(25,925)**				(55)	(1,580)	(1,185)	(1,269)	(1,435)	(1,548)	(1,546)	(1,452)	(1,238)	(1,321)	(1,439)	(1,525)	(1,521)	(1,479)	(1,375)	(1,313)	(1,130)	(1,012)	(1,107)	(986)	(408)
Net Smelter Return	**3,596,312**				**5,192**	**199,445**	**186,441**	**136,072**	**147,451**	**170,797**	**216,202**	**208,865**	**223,417**	**219,473**	**161,213**	**170,484**	**167,483**	**164,222**	**162,969**	**169,894**	**182,529**	**267,285**	**146,250**	**211,704**	**78,922**
Open Pit Mining	**(271,154)**				(171)	(11,730)	(12,530)	(12,442)	(14,616)	(14,845)	(11,821)	(11,990)	(12,241)	(15,228)	(14,893)	(14,832)	(14,837)	(15,329)	(15,324)	(14,040)	(13,734)	(14,975)	(16,066)	(12,518)	(6,992)
Underground Mining	**(52,742)**					(24,970)	(27,772)																		
Milling	**(422,454)**				(2,872)	(21,265)	(21,188)	(21,225)	(21,207)	(21,207)	(21,207)	(21,244)	(21,207)	(21,207)	(21,207)	(21,244)	(21,207)	(21,207)	(21,207)	(21,244)	(21,207)	(21,207)	(21,207)	(21,244)	(16,444)
Shared Services and Camp	**(355,176)**			(110)	(3,354)	(18,340)	(18,222)	(18,271)	(18,251)	(18,200)	(17,672)	(17,719)	(17,672)	(17,672)	(17,672)	(17,719)	(17,672)	(17,672)	(17,672)	(17,719)	(17,672)	(17,672)	(17,672)	(17,719)	(12,832)
SMPP Operating Costs	**(599,123)**				(5,864)	(30,307)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,761)	(9,220)
Other Processing Charges	**(4,025)**		(70)	(77)	(147)	(256)	(201)	(201)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)
Total Operating Cost	**(1,704,674)**		**(70)**	**(187)**	**(12,408)**	**(106,868)**	**(110,676)**	**(82,902)**	**(85,018)**	**(85,196)**	**(81,644)**	**(81,897)**	**(82,064)**	**(85,051)**	**(84,716)**	**(84,739)**	**(84,660)**	**(85,152)**	**(85,147)**	**(83,947)**	**(83,557)**	**(84,798)**	**(85,889)**	**(82,423)**	**(45,669)**
Operating Profit	**1,891,638**		**(70)**	**(187)**	**(7,216)**	**92,577**	**75,765**	**53,170**	**62,434**	**85,602**	**134,558**	**126,969**	**141,354**	**134,423**	**76,497**	**85,745**	**82,823**	**79,070**	**77,822**	**85,947**	**98,972**	**182,488**	**60,361**	**129,281**	**33,253**
Corporate Administration	**(34,500)**		(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
Interest Expense	**(174,110)**			(6,224)	(17,486)	(18,952)	(17,718)	(17,311)	(17,455)	(16,913)	(15,791)	(13,341)	(11,061)	(8,376)	(5,697)	(4,246)	(2,552)	(987)	0	0	0	0	0	0	0
Financing Fees	**(3,351)**		(3,351)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Income Tax	**(104,029)**		2	7	437	(210)	283	349	156	(420)	(1,707)	(1,513)	(1,870)	(1,643)	(201)	(432)	(360)	(257)	(12,067)	(12,928)	(13,348)	(15,637)	(16,429)	(17,723)	(8,518)
Territorial Royalty	**(36,221)**		0	0	0	0	0	0	0	0	0	0	0	0	(449)	(4,051)	(3,168)	(4,075)	(4,078)	(3,927)	(3,786)	(4,030)	(4,134)	(3,817)	(706)
Cash Flow Before Capital Expenditure	**1,539,427**		**(4,919)**	**(7,904)**	**(25,765)**	**71,915**	**56,830**	**34,708**	**43,635**	**66,769**	**115,560**	**110,615**	**126,923**	**122,904**	**68,650**	**75,516**	**75,243**	**72,251**	**60,177**	**67,592**	**80,338**	**161,321**	**38,298**	**106,241**	**22,529**
Open Pit Mining Capital	**(52,395)**		(19,283)	(20,155)	(12,957)																				
Mill and Infrastructure Capital	**(170,048)**		(56,933)	(81,533)	(31,582)																				
Indirect Capital Costs	**(88,326)**		(34,511)	(45,475)	(8,340)																				
EPCM Costs	**(39,059)**		(14,485)	(18,674)	(5,900)																				
SMPP Direct Capital Costs	**(164,953)**		(24,918)	(118,316)	(21,719)																				
SMPP Indirect Capital Costs	**(77,498)**		(25,770)	(39,794)	(11,934)																				
Capital Cost Adjustments	**3,273**		8,113	(3,049)	(1,791)																				
Sustaining Capital	**(57,810)**				(302)	(4,783)	(4,559)	(10,952)	(4,492)	(4,410)	(110)	(5,411)	(7,330)	(4,631)	(2,332)	0	(6,893)	(37)	0	(286)	(1,093)	(79)	(110)		
Change in Working Capital	**(2,612)**		(1,878)	63	17	(3,622)	(572)	37	(1,084)	(1,039)	(702)	731	1,074	109	(275)	(631)	(101)	328	667	297	955	418	84	598	1,914
Total Capital Expenditures	**(649,428)**		(169,665)	(326,933)	(94,508)	(8,405)	(5,131)	(10,915)	(5,576)	(5,449)	(812)	(4,680)	(6,256)	(4,522)	(2,607)	(631)	(6,994)	291	667	11	(138)	339	(26)	598	1,914
Project Cash Flow Before Debt Financing	**889,999**		**(174,584)**	**(334,837)**	**(120,273)**	**63,510**	**51,699**	**23,793**	**38,059**	**61,320**	**114,748**	**105,935**	**120,667**	**118,382**	**66,043**	**74,885**	**68,249**	**72,542**	**60,844**	**67,603**	**80,200**	**161,660**	**38,272**	**106,839**	**24,443**
Debt Financing Drawndown	**446,754**			322,956	122,562	1,236																			
Debt Financing Repaid	**(446,754)**					(19,198)	(20,421)	(5,870)	(12,468)	(25,784)	(56,312)	(52,429)	(61,711)	(61,601)	(33,349)	(38,955)	(35,967)	(22,689)							
Reclamation Security Funding	**(53,107)**			(5,000)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)
ANNUAL NET CASH FLOW	**836,892**		**(174,584)**	**(16,881)**	**(1)**	**43,258**	**28,988**	**15,632**	**23,300**	**33,245**	**56,145**	**51,215**	**56,665**	**54,490**	**30,403**	**33,639**	**29,991**	**47,562**	**58,553**	**65,313**	**77,910**	**159,369**	**35,981**	**104,548**	**22,152**

Table 1.15
Sensitivity Analyses

Gold Price (US$/oz)	**1,200**	**1,350**	**1,500**
Pre-tax NPV, 7% (C$ million)	196	**254**	312
Pre-tax IRR (%)	13.9	**15.6**	17.2
Post-tax NPV, 7%(C$ million)	168	**224**	281
Post-tax IRR (%)	13.3	**15.1**	16.7
Cobalt Price (US$/lb)	**13.00**	**16.00**	**19.00**
Pre-tax NPV, 7% (C$ million)	124	**254**	383
Pre-tax IRR (%)	11.4	**15.6**	19.4
Post-tax NPV, 7% (C$ million)	98	**224**	350
Post-tax IRR (%)	10.7	**15.1**	19.0

A separate sensitivity analysis has also been conducted, using the base case production and cost estimates, but with a series of cyclical metal prices fluctuating over the range shown in Table 1.16, and over a recurring six-year cycle.

Table 1.16
Cyclical Metal Prices

Metal	**Price Range**	
	Low	**High**
Gold (US$/oz)	1,200	1,900
Cobalt (US$/lb)	12.00	30.00
Bismuth (US$/lb)	7.00	19.00
Copper (US$/lb)	3.00	4.50

Under this sensitivity analysis, the NICO Project would be expected to yield an after-tax, undiscounted life-of-mine cash flow of C$1.44 billion, an after-tax net present value of C$505 million at a discount rate of 7% per year and an after-tax internal rate of return of 23.2% per year. The equivalent pre-tax indices are a present value of C$543 million and an internal rate of return of 23.6% per year.

1.8 CONCLUSIONS AND RECOMMENDATIONS

The principal conclusions reached on the basis of the discussion contained in this report are that the NICO Project is technically feasible and also that, at the metal prices and exchange rates used in the financial analysis, the Project is economically viable.

The principal components of the proposed Project that are not yet at the Feasibility Study level of definition are:

- The operating cost estimates for the SMPP, which remain based on the original FEED study and have an assessed level of accuracy of minus 10%, plus 25% for the cobalt sulphate production circuit.

- A detailed analysis of the future demand for bismuth oxide, which is projected to constitute 60% of the bismuth produced, or an average of approximately 1,000 tonnes per year of bismuth oxide.

It is recommended that studies be advanced on both of these fronts, as a matter of priority.

The principal matters outstanding before construction at the Project site in the NWT can begin are obtaining the permits necessary to do so and arranging financing for the Project. Since all materials and equipment required for the 2015 early works program must be delivered to site over the winter road, prior to about April, 2015, failure to secure financing by approximately September, 2014 will jeopardize that program and potentially set the Project back by a full year.

The procedure for obtaining permits for the site in the NWT is well advanced and, to a large extent, now in the hands of the regulatory authorities. It is recommended, however, that consultation with all stakeholders continue unabated, since the public may still have the right to comment on the permit applications.

Completion of the all-weather road from Behchokö to Whatì early in 2016 is critical to maintaining the Project construction schedule. Negotiation of a definitive agreement between the NWT and Tłįchǫ governments, and Fortune if necessary, to achieve this schedule is also regarded as a matter of priority. The terms under which electric power will be supplied to the Project site from the Snare Hydroelectric Complex remain to be finalized.

An Impact and Benefits Agreement with the Tłįchǫ government may involve some added cost for the Project. It is recommended that the financial terms of that agreement be negotiated as soon as possible.

2.0 INTRODUCTION

Fortune Minerals Limited (Fortune) is a public company, listed on the Toronto stock exchange, with two primary assets: the NICO gold-cobalt-bismuth-copper Project in the Northwest Territories (NWT) and the Arctos anthracite Project in British Columbia. The NICO Project is 100% owned by Fortune.

Micon International Limited (Micon) has been retained by Fortune to compile an independent Feasibility Study on the NICO Project in support of financing, and to prepare a Technical Report discussing the findings of the study. Throughout this report, reference is made to studies, memoranda and reports prepared by Fortune's advisors and consultants. These documents, which are listed in Section 28.0 of this report, are available for review at Fortune's office, 148 Fullarton Street, Suite 1600, London, Ontario, Canada, N6A 5P3, telephone +519.858.8188.

Micon does not have, nor has it previously had, any material interest in Fortune or related entities. Micon is receiving from Fortune a fee for its services based on time and expenses. That fee is in no way contingent on the results of this report.

This report is intended to be used by Fortune subject to the terms of its agreement with Micon. That agreement permits Fortune to file this Technical Report on SEDAR, pursuant to securities regulations. Any other use of this report, by any third party, is at that party's sole risk.

This report is based on the information available at the effective date of the report. Micon reserves the right, but will not be obliged, to revise this report if additional information becomes known to it subsequently.

This report contains tabulated technical and economic data related to the NICO Project. These tables show sub-totals and totals which may not sum precisely, due to rounding of individual numerical entries.

2.1 TERMS OF REFERENCE

Micon has compiled an independent Feasibility Study report on the NICO Project and has relied upon the following principal sources of information in the preparation of this report:

- Technical Report on the Bankable Feasibility Study for the NICO Cobalt-Gold-Bismuth Deposit, Mazenod Lake Area Northwest Territories, Canada, February, 2007 (Hennessey et al., 2007).

- Technical Report and Updated Mineral Reserve Estimate and Front-End Engineering & Design (FEED) Study on the NICO Gold-Cobalt-Bismuth-Copper Deposit, Mazenod Lake Area, Northwest Territories, Canada, August, 2012. (Puritch et al., 2012).

- FEED Study, NICO Concentrator Report, Jacobs Minerals Canada Inc. (formerly Aker Solutions), September, 2012.
- FEED Study, Saskatchewan Metals Processing Plant, Jacobs Minerals Canada Inc. (formerly Aker Solutions), September 2012.
- Updated capital expenditure and operating cost estimates, Procon Mining & Tunnelling Ltd., February, 2014.
- Draft Feasibility Study report, Fortune Minerals, April, 2013.
- Comprehensive financial model for the NICO Project, prepared by Fortune Minerals and its advisors, and finalized in March, 2014.

The Feasibility Study contributors and areas of responsibility are listed in Table 2.1.

Table 2.1
Feasibility Study Contributors and Areas of Responsibility

Study Area	Contributor
Mineral resources	P&E Mining Consultants Inc., Micon International Limited
Mine design and schedule	P&E Mining Consultants Inc., Fortune Minerals Limited
Mineral reserves	P&E Mining Consultants Inc., Fortune Minerals Limited
Metallurgical testwork	SGS Mineral Services
Process and infrastructure design	Jacobs Minerals Canada Inc.
	Fortune Minerals Limited
	EBA Engineering Consultants Ltd. (access road)
	International Quest Engineering Ltd. (truckshop, mine dry)
Mine access road	EBA Engineering Consultants Ltd.
Waste rock and tailings disposal design	Golder Associates Ltd.
Effluent treatment plant design	Golder Associates Ltd.
SMPP process design	Jacobs Minerals Canada Inc.
	Fortune Minerals Ltd.
Environmental and permitting	Golder Associates Ltd. (Project site) MDH Engineering Solutions Corp. (SMPP)
Capital expenditure and operating cost estimate	P&E Mining Consultants Inc., (mine)
	Jacobs Minerals Canada Inc. (process and infrastructure)
	Golder Associates Ltd. (tails dewatering and pumping, co-disposal area, effluent plant)
	Fortune Minerals Limited
	Procon Mining & Tunnelling Ltd. (process and infrastructure)
Preliminary engineering, Project site	Hatch Associates
Marketing	Fortune Minerals Limited
Economic analysis	Fortune Minerals Limited

Micon has relied upon the technical data and information received from Fortune. Micon has reviewed this technical information and believes that, in general, it adequately supports a feasibility level study. While exercising all reasonable diligence in checking and confirming this information, Micon takes no responsibility for its accuracy.

2.2 QUALIFIED PERSONS

The Qualified Persons responsible for this report, all of whom are independent of Fortune, are:

- Harry Burgess, P.Eng., associate mining engineer with Micon.
- Richard M. Gowans, P.Eng., president and principal metallurgist of Micon.
- B. Terrence Hennessey, P.Geo., vice president and senior geologist of Micon, who visited the NICO Project site from September 5 to 9, 2003.
- Christopher R. Lattanzi, P.Eng., associate mining engineer with Micon.
- Eugene Puritch, P.Eng., mining engineer and president of P&E Mining Consultants Inc., who visited the NICO Project site on July 10 and 11, 2004 and again on April 24, 2012.

2.3 LEGAL FRAMEWORK

The Government of Canada is currently in the process of transferring the responsibility for the management of public land, water and resources in the NWT to the Government of the Northwest Territories (GNWT). The GNWT is in the final stage of devolution negotiations with the Canadian government and expects to complete this process in the spring of 2014.

The transfer of responsibilities to the GNWT is designed to increase the self-sufficiency and accountability of Canada’s regions. The GNWT will share up to 25% of its portion of resource revenues with participating Aboriginal governments, including the Tłı̨chǫ.

2.4 UNITS, CURRENCY AND ABBREVIATIONS

All currency amounts in this report are stated in Canadian or US dollars, as specified, with costs typically expressed in Canadian dollars (C$) and commodity prices in US dollars (US$). Quantities are generally stated in SI units, the Canadian and international practice, including metric tons (tonnes, or t), kilograms (kg) and grams (g) for weight; kilometres (km) or metres (m) for distance; hectares (ha) for area; weight percent (%) for bismuth (Bi), cobalt (Co) and copper (Cu) grades and grams per metric tonne (g/t) for gold grades (g/t Au). Precious metal grades may be expressed in parts per billion (ppb) or parts per million (ppm) and their quantities may also be reported in troy ounces (ounces or oz).

Abbreviations used in this report are listed in Table 2.2.

Table 2.2
List of Abbreviations

Abbreviation	Term
^{o}	Degree(s)
^{o}C	Degree(s) Centigrade
^{o} C-days	Degree Centigrade days
^{o}F	Degree(s) Fahrenheit
<	Less than
>	Greater than
µg/L	Micrograms per litre
µm	Micrometre(s) (micron = 0.001 mm)
%	Percent, percentage
’	Minutes of latitude and longitude
3D	Three dimensional
A	Ampere(s)
AANDC	Aboriginal Affairs and Northern Development Canada
AAS	Atomic absorption spectroscopy
ABA	Acid based accounting
Ag	Silver
Al	Aluminum
ANFO	Ammonium nitrate-fuel oil
As	Arsenic
Au	Gold
B	Billion
Ba	Barium
Bi	Bismuth
Btu	British thermal units
C	Carbon
Ca	Calcium
C$	Canadian dollar(s)
CCR	Central control room
CDA	Canadian Dam Association
CDF	Co-disposal facility
cfm	Cubic feet per minute
cfm/bhp	Cubic feet per minute per brake horse power
CIF	Cost insurance freight
cm	Centimetre(s)
CN	Canadian National Railway
CNF	Cost and freight
Co	Cobalt
Cu	Copper
CV	Coefficient of variation
d	Day(s)
DAR	Developer’s Assessment Report
dB(A)	Decibel(s) (adjusted)
dmt	Dry metric tonne(s)
dtpd	Dry metric tonnes per day
dwt	Dead weight tonnes
EDXRF	Energy dispersive x-ray fluorescence
EPC	Engineering, procurement and construction
F	Fluorine

Abbreviation	Term
Fe	Iron
FEED	Front-end engineering and design
FOB	Free on board
ft	Foot, feet
FW	Footwall
g	Gram(s)
g	Acceleration due to gravity
g/L	Grams per litre
g/t	Grams per tonne
Ga	Billion years (old, ago)
GA	General arrangement
gal	Gallon(s)
GHG	Green House Gas (emissions)
Golder	Golder Associates Ltd.
gpm	Gallons per minute
GPS	Global positioning system
GRG	Gravity-recoverable gold
GWh	Gigawatt-hour
H	Hydrogen
h	Hour(s)
h/d	Hours per day
h/w	Hours per week
ha	Hectare(s)
HAZOP	Hazard and operability study
HDPE	High density polyethylene
HP	horsepower
HQ	Diamond drill core size 63.5 mm (inside diameter of core tube)
HU	Habitat unit
Hz	Hertz
IBA	Impact benefit agreement
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma Mass Spectrometry
in	Inch(es)
INAC	Indian and Northern Affairs Canada
IRR	Internal Rate of Return
J	Joule(s)
K	Potassium
k	Kilo (thousand)
kcfm	Thousand cubic feet per minute
kg	Kilogram(s)
kg/h	Kilograms per hour
kg/m^3	Kilograms per cubic metre
km	Kilometre(s)
km/h	Kilometres per hour
kPa	Kilopascal(s)
kV	Kilovolt(s)
kVA	Kilovolt-ampere(s)
kW	Kilowatt(s)
kWh	Kilowatt hour
kWh/t	Kilowatt hours per tonne
L	Litre(s)

Abbreviation	Term
L/h	Litres per hour
L/s	Litres per second
LAN	Local area network
lb	Pound(s)
LCT	Locked cycle test
LHD	Load-haul-dump
LME	London Metal Exchange
LOI	Loss on ignition
LOM	Life of mine
M	mega (million)
m	Metre(s)
m^3/h	Cubic metres per hour
m/min	Metres per minute
m/s	Metres per second
mA	Milliampere(s)
Ma	Million years (old, ago)
masl	Metres above sea level
MCC	Motor control centre
min	Minute(s)
ML	Million litres
mL	Millilitres
ML/d	Million litres per day
mm	Millimetre(s)
mg/L	Milligrams per litre
Mg	Magnesium
Mo	Molybdenum
mPa.s	Millipascal second
MPa	Megapascal(s)
MW	Megawatt(s)
MVEIRB	Mackenzie Valley Environmental Impact Review Board
MVLWB	Mackenzie Valley Land and Water Board
MVRMA	Mackenzie Valley Resource Management Act
MW	Megawatt(s)
MWh	Megawatt hour(s)
Na	Sodium
NAG	Net acid generating
Ni	Nickel
NI 43-101	Canadian National Instrument 43-101
NO_2	Nitrous oxide
NPV	Net present value
NSR	Net smelter return
NWT	Northwest Territories
oz	Ounce(s), troy ounces
oz/ton	Ounces per ton (short ton, 2,000 pounds)
P&ID	Process and instrumentation diagram
Pa	Pascal(s)
Pa.s	Pascal-second
Pb	Lead
ppb	Parts per billion
ppm	Parts per million
P3	Public private partnerships

Abbreviation	Term
QA	Quality assurance
QA/QC	Quality assurance/quality control
QC	Quality control
RBC	Rotating biological contactor
RMB	Chinese Renminbi
ROM	Run-of-mine
rpm	Revolutions per minute
RQD	Rock quality designation
s	Second(s)
S	Sulphur
SAG	Semi-autogenous grinding
Sb	Antimony
SEM	Scanning electron microscope
SG	Specific gravity
SI	International system of units
Si	Silicon
SMPP	Saskatchewan Metals Processing Plant
SO_2	Sulphur dioxide
t	Tonne(s) (metric = 1,000 kg)
t/h	Tonnes per hour
t/y	Tonnes per year
TOR	Terms of reference
tpd	Tonnes per day
TSP	Total suspended particulates
TSS	Total suspended solids
U	Uranium
UCS	Unconfined compressive strength
US$	United States dollar(s)
V	Volt(s)
WLWB	Wek’èezhii Land and Water Board
XRF	Energy-dispersive x-ray fluorescence
y	Year(s)
yd^3	Cubic yard(s)
Zn	Zinc

3.0 RELIANCE ON OTHER EXPERTS

Micon has not reviewed any of the documents or agreements under which Fortune holds title to the NICO Property in the NWT or the site of the proposed SMPP and Micon offers no opinion as to the validity of the titles claimed. A description of the properties, and ownership thereof, is provided for general purposes only.

Section 19.0 of this report, Market Studies and Contracts, has been provided by Fortune, based on its marketing studies, and has been edited by Micon for consistency with other sections of the report.

4.0 PROPERTY DESCRIPTION AND LOCATION

4.1 LOCATION

The NICO Project is located in the Mazenod Lake area of the NWT, Canada, approximately 160 km northwest of the City of Yellowknife, 22 km west of the Snare Hydroelectric Complex and 85 km north of the community of Behchokö.

The Project is located in the Marian River drainage basin, approximately 10 km east of Hislop Lake, within the Taiga Shield and Taiga Plains Ecoregions. The property is centred approximately at latitude 63^{o} 33' N and longitude 116^{o} 45' W, NTS map sheet 85N/10. The general location of the Project has been shown previously in Figure 1.1 and a more detailed map is provided in Figure 4.1.

The NICO Project is located in the Wek'èezhìi Settlement Area of the NWT, and is surrounded by, but is not on, Tłı̨chǫ lands that were established as part of the self-government and land claim settlement agreement between the Tłı̨chǫ (First Nation) Government and the governments of Canada and NWT in August, 2005. Tłı̨chǫ lands cover approximately 39,000 km^2. The NICO Project mining leases were excluded under this agreement. The Project is located approximately 50 km northeast of Whatì and 70 km south of Gamètì, the nearest communities. Other communities include Behchokö, approximately 85 km southeast of the NICO Project, and Wekweètì, located approximately 140 km to the northeast. All of these communities are within the Tłı̨chǫ lands.

In November, 2011, Fortune and the Tłı̨chǫ Government signed a Co-operative Relationship Agreement for the NICO Project. This agreement, which is similar to a Memorandum of Understanding, establishes the framework and path forward for further negotiations, defines primary liaison officials, and sets out the communication protocol for the two parties. The agreement states that the Tłı̨chǫ Government and Fortune "wish to develop a co-operative relationship through which they will attempt to reach mutually beneficial agreement on matters affecting their respective interests." (Fortune Minerals News Release, November 8, 2011). The Tłı̨chǫ Government and Fortune have also signed an Environmental Assessment Funding Agreement to support the Tłı̨chǫ Government with its review of the Developer's Assessment Report (DAR) for the NICO Project.

In January, 2013, Fortune received a recommendation for approval of the environmental impact assessment for the NICO Project from the Mackenzie Valley Environmental Assessment Review Board. Fortune reports that it has also received approval for the Project to proceed from the federal minister of Aboriginal Affairs and Northern Development and from the Tłı̨cho aboriginal government. Fortune is now in the process of securing its Class A Water Licence and Land Use Permit, as well as the other more minor permits required to construct the mine, processing plant and associated infrastructure.

Figure 4.1
NICO Project - Location and Study Area

Fortune, March, 2013.

In 2009, the population of the local area (primarily the communities of Behchokö, Whatì, Gamètì, Wekweètì, Detah, N'Dilo and Yellowknife, as well as the Métis and the Wek'èezhìi Settlement Area) was 22,923, or 52.8% of the NWT population. The majority are based in Yellowknife (population 20,000). The population of the NWT has been experiencing very little growth and high out-migration. The Tłįcho communities have been growing slightly more rapidly than Yellowknife and the NWT overall. Behchokö is the largest of the Tłįchǫ communities, with just over 2,000 people, or about 69% of the entire Tłįchǫ population.

Diamond mining and other resource-based activities since the late-1990s have increased the demand for labour in the NWT. Through the training efforts of various mining companies, an estimated 250 students in the NWT have graduated from heavy equipment training over the past decade and some heavy equipment operators from the local area have become available as the Ekati and Diavik mines transitioned to underground mining.

Compared to the three diamond mines in the NWT, the NICO Project is relatively small in terms of employment and contractors.

4.2 CLAIMS AND TENURE

The NICO Project is located on 10 contiguous mining leases covering 5,140 ha. The original claims, NICO 1 through NICO 12, were staked in 1992, 1994 and 1995. Fortune completed and filed sufficient assessment work to hold the claims in good standing until their 10-year anniversary date, at which time the claims had to be taken to lease or abandoned. Two of the original claims were taken to lease in 2002 and eight others brought to lease in 2004. Two, NICO 6 and 10, were allowed to expire. In order to bring claims to lease status, they had to be surveyed. Accordingly, the leased claims have been surveyed and monuments have been erected at their corners. The locations of the mining leases are shown in Figure 4.2.

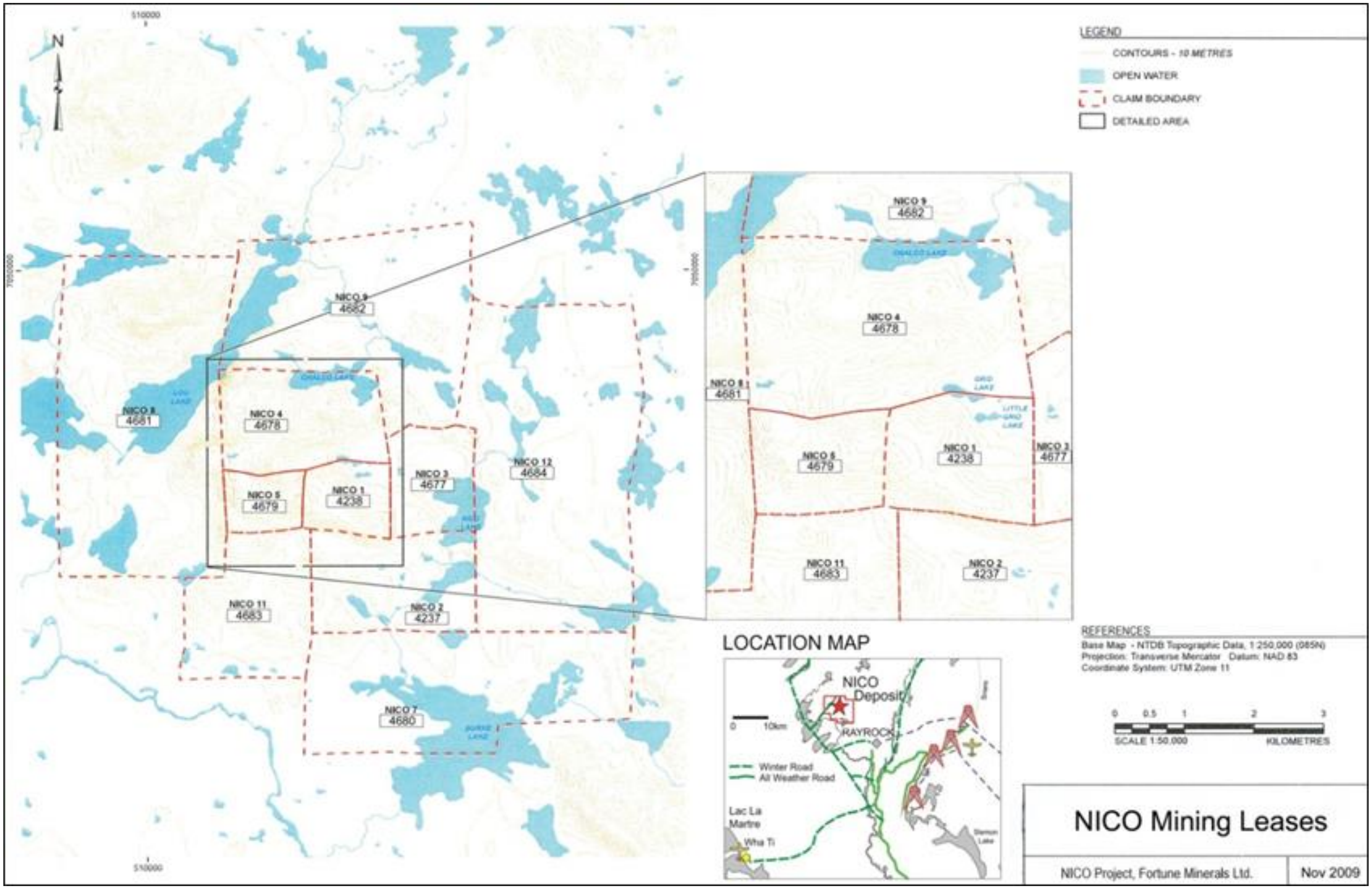
The 10 mining leases that comprise the NICO Project are in good standing and held 100% by Fortune. Annual rental fees are calculated on the basis of C$1.00 per acre (Table 4.1).

Table 4.1
NICO Project - Status of Mining Leases

Mining Lease No.	Claim Name	Area (ha)	Status	Annual Lease Rental Fee (C$)	Issue Date	Lease Expiry Date
4237	NICO 2	334.00	Lease	824	17/07/2002	17/07/2023
4238	NICO 1	102.00	Lease	253	17/07/2002	17/07/2023
4677	NICO 3	181.30	Lease	448	04/10/2004	04/10/2025
4678	NICO 4	323.34	Lease	799	04/10/2004	04/10/2025
4679	NICO 5	104.41	Lease	258	04/10/2004	04/10/2025
4680	NICO 7	698.08	Lease	1,725	04/10/2004	04/10/2025
4681	NICO 8	1,111.67	Lease	2,747	04/10/2004	04/10/2025
4682	NICO 9	827.18	Lease	2,044	04/10/2004	04/10/2025
4683	NICO 11	370.29	Lease	915	04/10/2004	04/10/2025
4684	NICO 12	1,087.39	Lease	2,687	04/10/2004	04/10/2025
Total		**5,139.66**		**12,700**		

Fortune has maintained all of the required permits for exploration and related activities on the NICO property and land use, water use and quarrying permits appropriate to exploration activities have been continually renewed as required.

Figure 4.2
NICO Project - Location of Mining Leases



Fortune, March, 2013.

5.0 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 CLIMATE AND PHYSIOGRAPHY

The climate at the NICO site is continental-subarctic, marked by short summers with average temperatures of 15°C. Winter temperatures typically range from -15 to -30 °C, with periodic lows of -45 °C. The mean freezing index in the region ranges from 3,500 to 4,000 degree Celsius-days (°C-days).

Snowfall is moderate and the overall operating conditions do not present any unusual difficulties that have not been encountered in the many former and ongoing mining operations in northern Canada. Long-term mean precipitation for the NICO Project area is estimated to be 343.5 mm, of which approximately 48.2% is expected to fall as snow. The mean annual snowfall is estimated at 165.5 mm and the mean annual rainfall is estimated at 177.9 mm. The mean annual lake evaporation is estimated at 478.5 mm and the relative humidity varies from 55.9% in June to 82.4% in October.

The NICO Project is located within the zone of discontinuous permafrost. The permafrost zones are quite patchy, depending on the terrain. The annual thaw may reach a depth of 3 m and lenses of permafrost may form or disappear, depending on local short-term influences.

The physiography of the NICO site is moderately rugged, with steep slopes and local relief ranging up to 200 m. Absolute elevation ranges from 150 to 350 masl. Positive land forms are characterized by abundant rock outcrops and sparse vegetation of jack pine and alder, while lowland areas are covered by lakes, muskeg and glacial drift with black spruce, jack pine, poplar, birch, alder, grass, moss and lichen. The NICO deposit is located on the southern slope of a bowl-shaped depression known as the “Bowl Zone”.

5.2 ACCESS AND EXISTING INFRASTRUCTURE

During the summer months, the NICO property is accessed by charter float plane or helicopter from Yellowknife, a journey of approximately one hour. During the winter, access is by charter aircraft on skis or via a 95 km winter road that extends north from Behchokö which lies just north of Highway 3 from Yellowknife. The winter road is maintained by the NWT government. Fortune constructed a short spur from the winter road in 1996 to access the property and its exploration camp at Lou Lake.

Yellowknife is the principal access point to communities in the NWT. Yellowknife is connected to Edmonton by the all-weather highway which passes through Behchokö. Multiple daily commercial flights connect Yellowknife with Edmonton, Calgary, Winnipeg and Ottawa, operated by Canadian North and First Air.

The NICO Project is supported by a semi-permanent camp comprising trailers and a wooden office building located on the east shore of Lou Lake. A permitted fuel depot and steel-sided shop and maintenance building are also located on the property.

Mining has been the economic backbone to the NWT since the first mine went into production in the 1930s. The NWT is currently home to the Ekati, Diavik and Snap Lake diamond mines, making Canada one of the top diamond producers, by value, in the world. Tungsten is also mined near the border with the Yukon Territory.

6.0 HISTORY

The following is based on Technical Reports on the NICO property by Thalenhorst and Farquharson (2002), Hennessey and Puritch (2004), Hennessey et al. (2007) and Puritch et al. (2012).

Early indications of mineralization in the NICO area were obtained by local prospectors in the 1930s and then by New Athona Mines Ltd. (New Athona) which explored the property, then referred to as the CAB claim group, from 1968 to 1970. The CAB claim group was staked to cover two cobalt-bismuth-copper-arsenide showings. Exploration by New Athona included geological mapping, electromagnetic and magnetic geophysical surveys, trenching and approximately 4,636 ft (1,413 m) of diamond drilling in 21 holes. This work led to a "drill-indicated resource" totalling 214,540 tons, averaging "3.24 pounds of bismuth with lesser values in cobalt, copper and gold". Chemical analysis of a bulk sample of massive arsenopyrite yielded 2.36% Co, 0.63% Bi, 22.46% Fe, 16.01% S, 40.84% As, 0.18 oz/ton Ag and 0.14 oz/ton Au (Bryan, 1981, 1982). It appears that New Athona investigated the near-surface mineralization in the volcanic cover rocks of the NICO deposit.

In 1977 and 1978, Eldorado Nuclear Limited conducted exploration for uranium in the area (Thomas and Olson, 1978), and Noranda Exploration followed up the New Athona work from 1978 to 1989, as part of a larger exploration effort that also included work on the Sue-Dianne copper deposit located approximately 25 km north-northwest of the NICO property.

Fortune acquired the NICO Project, comprising 12 staked mineral claims, during 1992-1994. The Bowl Zone, the principal mineralized deposit at NICO, was discovered by Fortune in 1994 as the result of geologic surface work. The program was based on the concept that the general area represented a geological target comparable to the Olympic Dam deposit in Australia. The Bowl Zone was drilled systematically for the first time in 1996, with additional drilling in 1997 and 1998.

Mumin, a consulting geologist retained by Fortune, prepared mineral resource estimates in 1997 and 1998, based on the available drill hole data at each time (Mumin, 1997, 1998a, 1998b). The second estimate (Mumin 1998b) included the results of initial metallurgical testwork at Lakefield Research Limited (Lakefield) (Lakefield, 1997a, 1997b, 1998). These, together with preliminary geotechnical and environmental investigations by Golder Associates Ltd. (Golder) in 1998, were used in a scoping study by Kilborn SNC-Lavalin (Kilborn), which evaluated the economic merits of the Project. The 1998 drilling program was not incorporated into the Kilborn scoping study.

The 1998 Kilborn scoping study evaluated three production rates over a range of cobalt prices from US$5.00/lb to US$30.00/lb and was based on total mineral resources of 88.6 Mt with average grades of 0.07% Co, 0.54 g/t Au and 0.08% Bi. Of this total, 50 Mt with average grades of 0.10% Co, 0.92 g/t Au and 0.11% Bi were determined to be the mineable portion of the resources for an open pit operation with a waste-to-ore stripping ratio of 2.7. The study envisaged on-site flotation of ore to produce a sulphide concentrate, followed by an acid-leach pressure-oxidation process and the recovery of metallic cobalt using solvent extraction-electrowinning.

After the 1998 drilling program, SNC-Lavalin Engineers & Constructors (SNC-Lavalin), the successor company to Kilborn, was retained to validate and verify the drill hole database, including the assay and specific gravity data, and to provide a geologic interpretation of the Bowl Zone and its mineralization. The second SNC-Lavalin study was comprehensive. Using all of the available drill hole data in 1999, SNC-Lavalin also produced an estimate of the mineral resources for the Bowl Zone at a declared pre-feasibility level of accuracy. The unclassified mineral resources were estimated to be 39.6 Mt with average grades of 0.08% Co, 0.41 g/t Au and 0.10% Bi, at a cut-off grade of 0.06% Co (SNC-Lavalin, 1999).

In September, 1999 Fortune retained Strathcona Mineral Services Limited (Strathcona) to update the earlier SNC-Lavalin study and to conduct new mineral resource estimates, based on the geologic model that had been developed by Fortune and validated by SNC-Lavalin. Strathcona's study was also based on additional metallurgical testwork, open pit optimization studies and a preliminary economic evaluation of the Project that excluded on-site processing beyond the flotation concentrate stage.

Strathcona made a number of recommendations, including undertaking additional field programs and studies that were conducted in 2000 and 2001, the results of which were summarized in Thalenhorst and Farquharson (2002). An additional 6,300 m of infill drilling in 33 holes was completed and surface geology was remapped and tied into the drill grid.

An open pit mineral resource was estimated using a cobalt price of US$7.50/lb, resulting in 34 Mt grading 0.08% Co, 0.12% Bi and 0.4 g/t Au, with a waste-to-ore ratio of 1:7.

Electron microprobe analysis of 122 grains revealed that the cobalt is contained in an arsenopyrite (FeAsS)-cobaltite (CoAsS) solid solution series (Lakefield, 2001).

A simple and low-cost flowsheet was further developed in metallurgical testwork at laboratory scale for the production of a bulk sulphide flotation concentrate, followed by separation into cobalt and bismuth concentrates. The cobalt concentrate would have a cobalt content of 2.0% to 7.0%, depending on the local arsenic-to-cobalt ratio of the sulphides in the deposit. Cobalt recovery was predicted at 85% and was not sensitive to ore grade or to the arsenic-to-cobalt ratio.

Flotation testwork was conducted to determine the efficiencies of producing separate bismuth and cobalt concentrates on site, with a view to determining the contribution of bismuth to ore value. A bismuth sulphide concentrate grading 45% Bi and recovering 55% of the bismuth appeared possible but needed further confirmation on a larger scale. It became apparent that both the bismuth and cobalt concentrates carry recoverable and payable amounts of gold that increase with depth in the deposit.

Both the SNC-Lavalin (1999) and Strathcona (Thalenhorst and Farquharson, 2002) mineral resource estimates were based solely on relatively large scale open pit mining methods. In October, 2002, Eugene Puritch, P.Eng., was retained by Fortune to assist in an in-house update of the mineral resource estimate which envisaged a combination of underground and open pit mining methods. In December, 2002, Micon was engaged to provide an independent review of this work and it was realized that additional drilling would be required to fully evaluate the new proposal. In 2003, a 4,720 m program consisting of 33 diamond drill holes was completed that focused on the extremities of the then-proposed East and West pits, as well as two holes drilled to test unexplored geophysical anomalies.

In 2003, Golder conducted geotechnical engineering, hydrogeology, environmental and archaeological surveys for feasibility assessment of the NICO deposit (Golder, 2003a, 2003b, 2004a and 2004b) and to complement the data previously collected by Golder in 1999 to investigate ultimate slope conditions for a proposed single, large open pit, as well as a baseline environmental summary and an aquatics survey (Golder, 1998).

On September 29, 2003, a 1:18,000 scale aerial photographic survey was flown by Eagle Mapping Ltd. over a 7 km by 10 km area of the NICO claims, in order to establish a digital topographic map at 1:2,000 scale with 2 m contour intervals.

Subsequent to the mineral resource estimate described in Hennessey and Puritch (2004), the decision was made to proceed with a Feasibility Study. In conjunction with this, further environmental, geotechnical and metallurgical work was undertaken. None of this affected the block model produced in 2004 but resulted in a mineral reserve estimate being determined from that model.

In late 2006, following completion of the 2004 mineral resource estimate, three more infill diamond holes were drilled, totalling 517.85 m. All three holes were drilled into areas of insufficient hole density and all intersected Au-Co-Bi mineralization.

The exploration program in 2006 and 2007 included the extraction of an underground bulk sample and the compositing of two metallurgical samples, totalling 200 t, for use in the 2007 pilot plant testing program.

Since 2008, the majority of the work done on the property has been focused on development, mainly related to permitting of the NICO mine site and financing. Metallurgical testwork was also conducted, as discussed in Section 13.0 of this report.

In the summer of 2010, Fortune undertook a 38-hole drill program with the objectives of extending the mineral resources and testing for extensions to the known deposit where it was locally open for expansion near the surface, at the deposit ends and also at depth. In particular, the gold-rich central core of the deposit was open for possible extension to depth and, also, between some broad spaced drill hole intersections.

7.0 GEOLOGICAL SETTING AND MINERALIZATION

The information and interpretation in this section of the report have been drawn principally from Technical Reports by Hennessey et al. (2007) and Puritch et al. (2012), and from scientific papers by Goad et al. (2000a, 2003b).

7.1 REGIONAL GEOLOGY

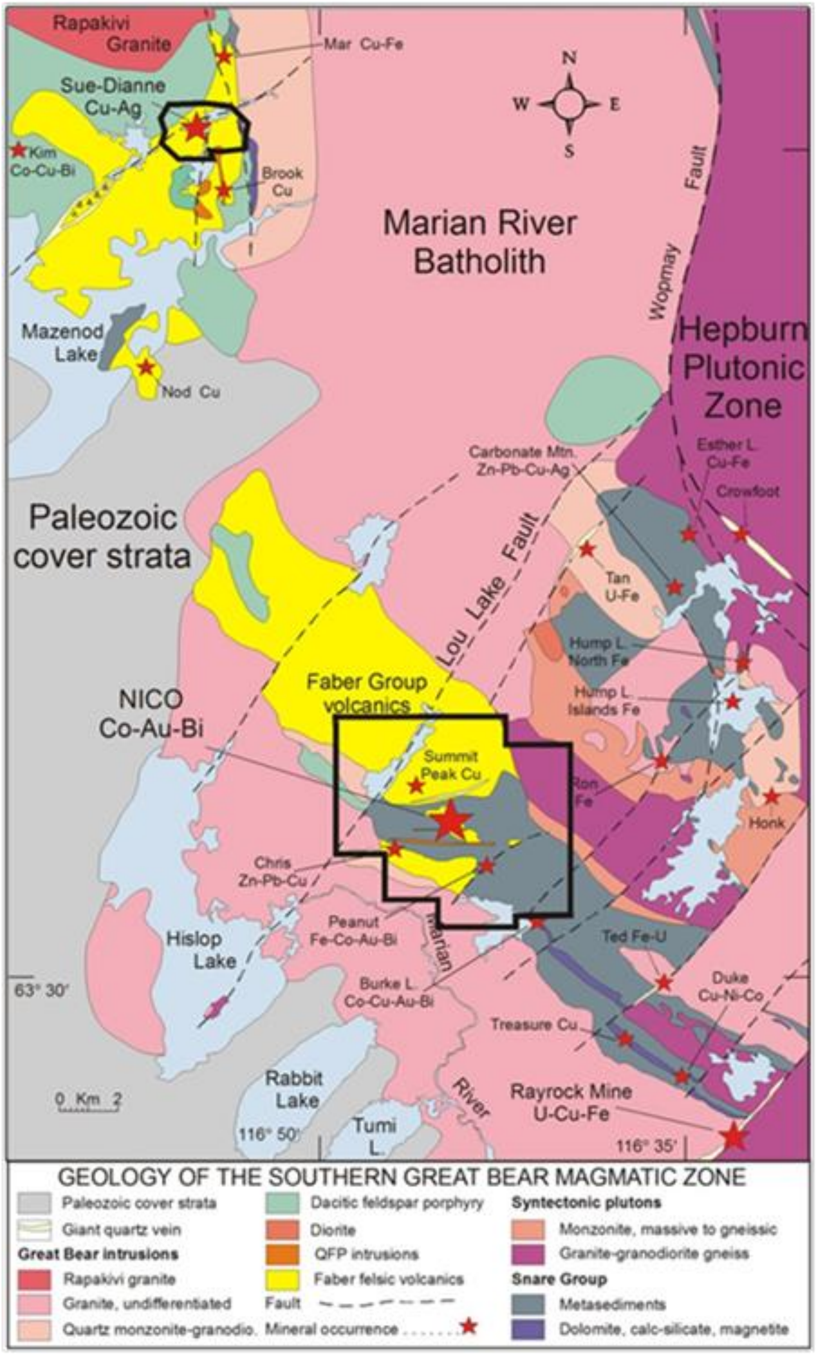
The NICO deposit occurs in the southern part of the Proterozoic Bear Structural Province, which is further subdivided into the Wopmay Orogen and the Amundsen Basin (Fraser et al., 1972). The Great Bear magmatic zone (GBMZ) forms the central tectonic zone of the Wopmay Orogen. The GBMZ consists of a Paleoproterozoic belt of calc-alkaline volcanic and plutonic rocks of 1.88 to 1.84 Ga age, which is exposed from Great Slave Lake in the south to Great Bear Lake in the north. The GBMZ formed during eastward subduction of an oceanic plate beneath the Slave craton and the accreted volcano-plutonic Hottah Terrane. It now occupies the suture zone between them (Hildebrand et al., 1987). The GBMZ and the Hottah Terrane are juxtaposed against peralkaline intrusions and sedimentary rocks of the Coronation Margin along the 10 km wide mylonitic crustal suture, the Wopmay Fault Zone (Goad et al., 2000b). Subaerial volcanics of the GBMZ overlap both the Hottah Terrane and Coronation Margin and are intruded by plutonic rocks of a similar age (Hildebrand et al., 1987). The Wopmay Fault Zone marks the boundary between the Slave craton and the Hottah Terrane and also marks the eastern limit of the GBMZ.

The GBMZ is approximately 800 km long and 100 km wide and consists of low titanium oxide and high alumina calc-alkaline volcano-plutonic rocks. Felsic to intermediate rocks of the 1.87 to 1.84 Ga age Faber Group predominate in the southern part of the GBMZ. These consist of rhyodacite ignimbrites and associated flows, tuffs, breccias and volcaniclastics, which are bordered by granodiorite to monzogranite plutons and intruded by coeval rapakivi (a texture characterized by alkali feldspar phenocrysts that are mantled with plagioclase), granite and feldspar porphyritic plugs (Goad et al., 2000a).

The Coronation Margin is comprised of the Snare, Akaitcho and Epworth Groups which formed as continental margin shelf and slope sediments, as a result of rifting along the margin of the Slave craton (Hoffman, 1973, 1980). The Snare Group consists of arenite, dolomite, siltstone and shale. A tectonic shift to eastward subduction beneath the Hottah Terrane was proposed by Goad et al. (2000a) to account for the formation of the GBMZ and the three stages of deformation and metamorphism recognized in the Coronation Margin. The final deformation postdates plutono-volcanic activity within the GBMZ and gave rise to conjugate transcurrent faults with subordinate normal and reverse faults (Hildebrand and Bowring, 1984).

The regional geology of the southern part of the GBMZ is shown in Figure 7.1.

Figure 7.1
Geology and Mineral Deposits of the Southern Great Bear Magmatic Zone



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Note: The Snare Group rocks, defined in Figure 7.1, have now been reclassified as the Treasure Island Group.

The southernmost Faber Group unconformably overlies metasedimentary basement rocks that were initially considered to be Snare Group, but have been re-classified as the Treasure Island Group by the Geological Survey of Canada. The unconformity at the base of the volcanic rocks is strongly potassium and iron metasomatized and commonly brecciated, whereas contacts between granitic plutons and metasediments are mylonitic. The 'dome and keel' basement and mylonitic detachment faults are indicative of post-collisional extended rift terrains and are domed due to the diapiric rise of late A-type granites (Goad et al., 2000a). Goad et al. (2000a) proposed that iron concentrations may originate from the generation of dry potassic melts in response to crustal thinning and doming during rifting, with iron enrichment derived from melting of iron-rich crust, possibly iron-rich members of the Treasure Island Group.

7.2 Local and Property Geology

The NICO deposit is hosted in iron- and potassium-altered, brecciated basement sedimentary rocks of the Treasure Island Group at and beneath the unconformity with the volcanic Faber Group rocks.

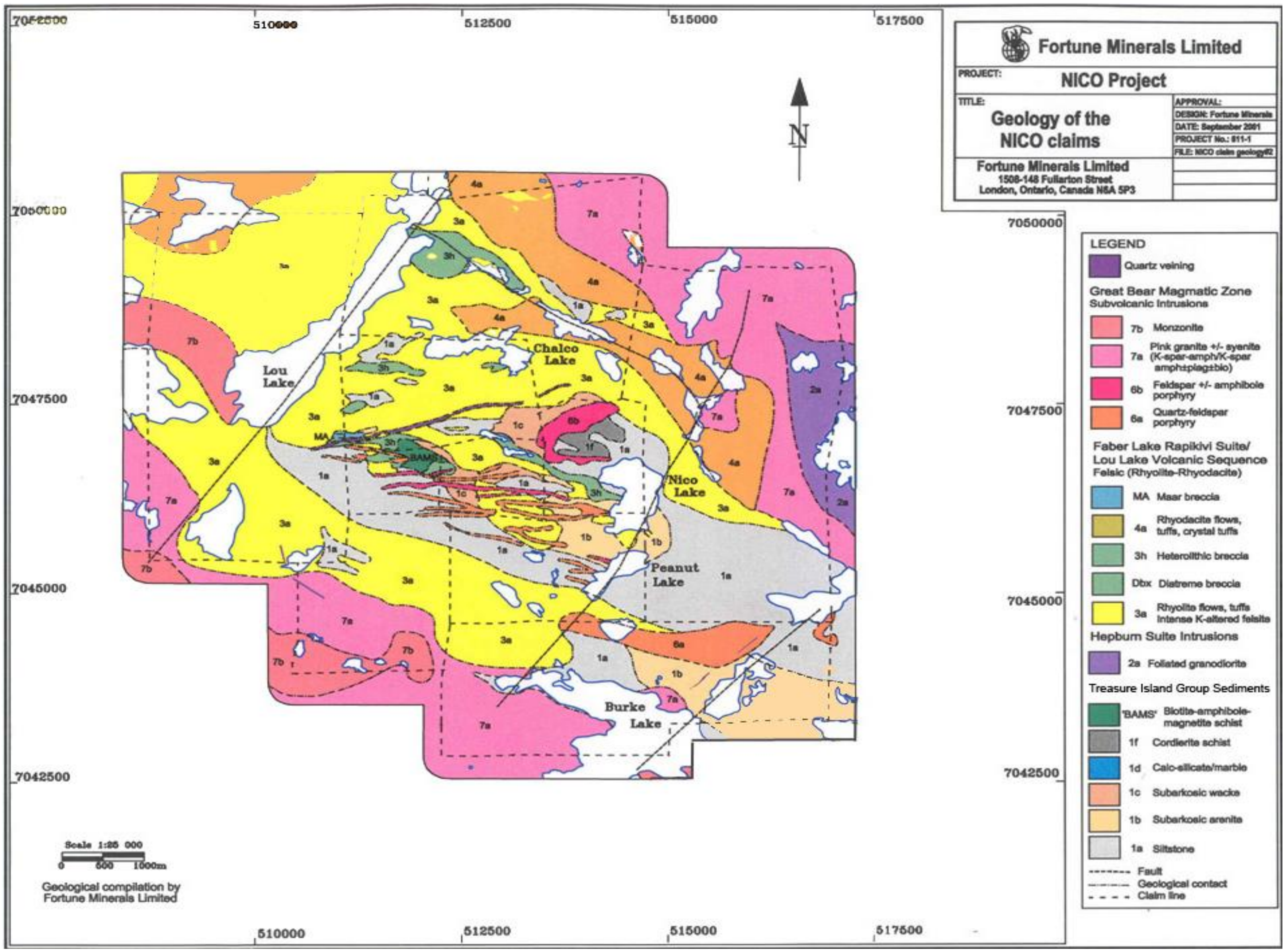
The cobalt-gold-bismuth-copper mineralization of the NICO deposit is located within locally altered biotite-amphibole magnetite schist (BAMS) of the Treasure Island Group. The metasediments of the Treasure Island Group are the oldest rocks in the area and consist of dominantly subarkosic wacke, arenite and minor siltstone and carbonate, and are unconformably overlain by a north-dipping succession of rhyolite to rhyodacite tuffs, flows and minor volcaniclastics of the Faber Group. These rocks are bound between the GBMZ granite to the southwest and monzogranite of the Marian River Batholith to the northeast (Goad et al., 2000a). Treasure Island Group sedimentary rocks are strongly hornfelsed marginal to the GBMZ granites.

Some of the widely developed intermediate to felsic volcanics of the Faber Group are interpreted as high-level sill-type intrusive rocks, rather than extrusive rocks, due to their stratigraphic location below, rather than above, the metasediments (Hennessey et al., 2007). The basal, potassium-feldspar altered rhyolite yields an approximate uranium-lead (U-Pb) date of 1,851 +18/-16 Ma (Gandhi et al., 1996). A felsic intrusive, compositionally identical to the Faber Group volcanic unit except for 10-15% millimetre-sized plagioclase crystals, appears to postdate both the Treasure Island and Faber Groups (Hennessey et al., 2007).

The local geology of the NICO property is shown in Figure 7.2.

Breccias are common, particularly in the Treasure Island Group immediately below the unconformity. The breccias have been interpreted variously as fragmentals and as hydrothermal diatreme breccias formed in a near-surface environment (Goad et al., 2000b). The breccias are spatially related to zones of polymetallic sulphide mineralization, and are capped by massive potassium-feldspar altered rhyolite (felsite) along the unconformity. For the most part, the breccias are composed of clasts of the Treasure Island Group, with lesser felsite clasts in a matrix of iron oxides, biotite, amphibole, chlorite and potassium feldspar (Goad et al., 2000a).

Figure 7.2
NICO Property Geology



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The breccias contain minor sulphide concentrations, despite their proximity to sulphide bearing mineralized lenses with similar hydrothermal alteration. The breccias have been interpreted by Goad et al., (2000a) as maar-facies breccias, suggesting that volcanism was initiated by near surface diatreme activity. The proximity of these breccias to mineralization and the presence of iron oxide and potassium metasomatism suggest that formation of diatreme and maar breccia was coeval with sulphide mineralization (Goad et al., 2000a).

The Treasure Island and Faber Groups are cross-cut by a quartz-feldspar porphyry dyke parallel to the strike of the Treasure Island Group and a younger feldspar-amphibole ± quartz porphyry dyke, emplaced parallel to the strike of the Faber Group at Lou Lake. These dykes, along with dykes discovered in drill core, are considered feeders to the overlying volcanics (Goad et al., 2000a).

Late northeast-striking transverse faults transect the Snare and Faber Groups and adjacent intrusives. These faults merge into the Wopmay Fault and are thought to be related splays (Goad et al., 2000a). Major regional faults trend at 70°. Large-scale quartz veins have been emplaced locally along both fault directions. A thick, sporadically mineralized and persistent quartz vein, similar to the vein hosting the Rayrock uranium deposit to the south of the property, transverses east-northeast through the NICO 4 mining lease.

7.3 MINERALIZATION

Cobalt-gold-bismuth-copper mineralization at NICO is intimately associated with a regional-scale metasomatic event and a later, more restricted, sulphide mineralizing event. Both the Treasure Island Group metasediments and the overlying Faber Group volcanics were subjected to intense regional potassium and iron metasomatism. In the NICO area, the combination of iron and potassium metasomatism has resulted in the creation of an assemblage of amphibole-biotite ± magnetite altered metasedimentary rocks which extend along strike for approximately 2 km. The deposit is hosted within a 200-m thick package of northwest-striking and northeast-dipping amphibole-biotite ± magnetite ironstone and schist and amphibole-biotite altered subarkosic wacke. The latter is considered to be the protolith to the ironstone/schist and becomes increasingly more abundant in the upper part of the hanging wall. The dominant amphiboles are iron-rich.

Sulphide mineralization is disseminated and makes up between 3% and 10% of the mineralized rocks. The sulphide minerals are predominantly aligned along the foliation planes. Only small native gold grains have been observed. These are mainly associated with sulphides, but also occur with silicate minerals such as feldspar (Thalenhorst and Farquharson, 2002). The sulphides consist primarily of cobaltite/cobaltian arsenopyrite, bismuthinite and chalcopyrite.

Walker (1999) suggested the following mineralizing stages based on detailed mineralogical studies:

1. Magnetite is the earliest oxide.

2. Pyrrhotite and pyrite are the earliest sulphides.

3. Introduction of gold-bismuth telluride, chalcopyrite and native bismuth. Bismuthinite is interpreted to occur from stages 3 through to 6.

4. Precipitation of cobaltite.

5. Introduction of colbaltian arsenopyrite.

6. Introduction of massive arsenopyrite (with minor cobalt) clots and veins which appear to overprint all previous sulphides.

7. Formation of hematite.

The occurrence of fracture-filled native gold in both stage 4 cobaltite and stage 6 arsenopyrite is thought to be due to some post-stage 3 crystallization of gold.

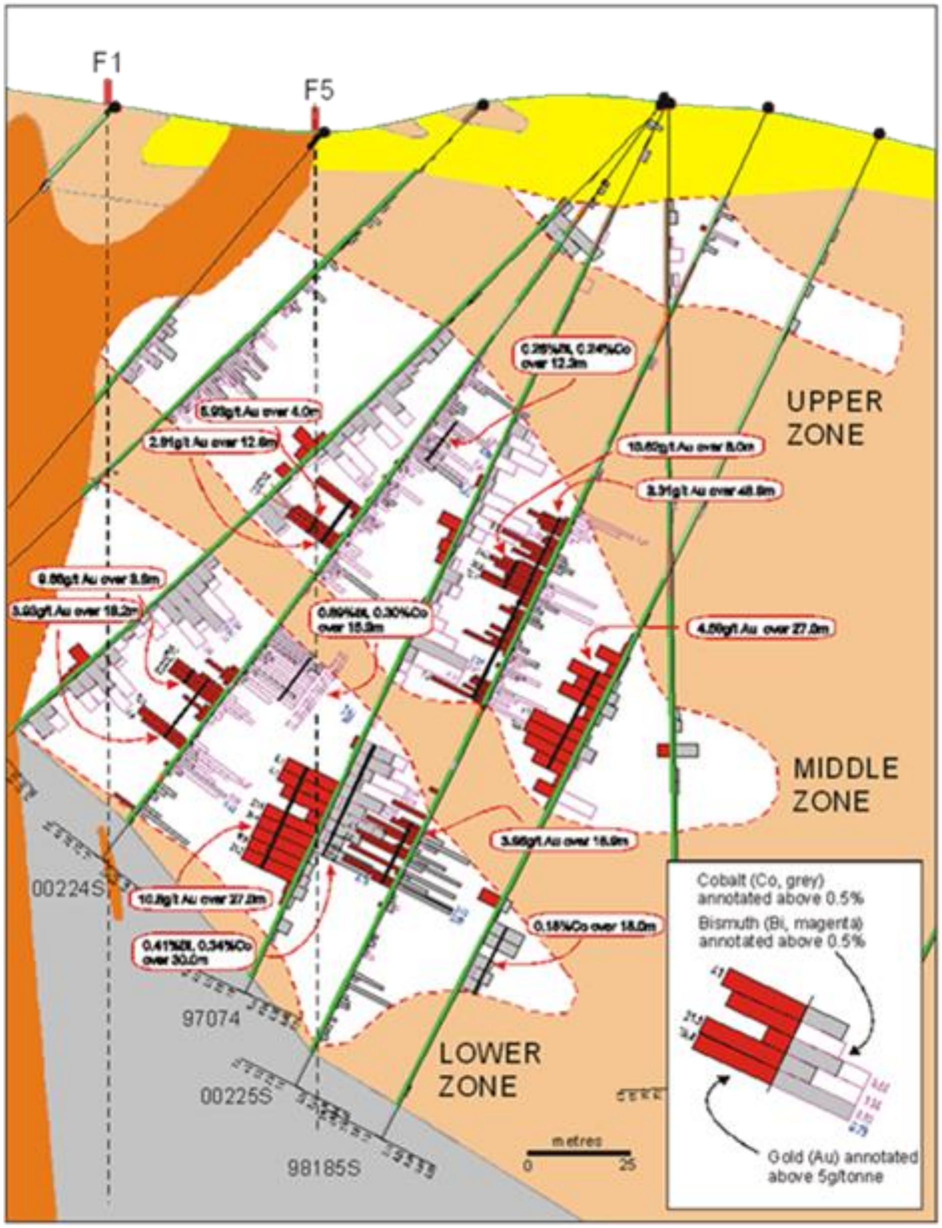
Sulphide mineralization of economic significance is younger than the iron metasomatism and is restricted to certain domains within the BAMS and amphibole-altered wacke. These sulphide-bearing domains are relatively more restricted in volume and together comprise the Bowl Zone. Figure 7.3 is a cross-section through the central part of the Bowl Zone and illustrates the extent of cobalt and bismuth mineralization within the BAMS.

Gold mineralization forms a central ‘bulls-eye’ to the deposit within the cobalt-bismuth core of the magnetite mineralization and is confined largely to the middle and lower zones. Two correlatable horizons of less altered subarkosic wacke partially demarcate the lower/middle and middle/upper zone boundaries (Thalenhorst and Farquharson, 2002). The upper zone is much more restricted in extent and the sulphide and Au-Co-Bi mineralization is weaker.

A minor amount of mineralization occurs in the overlying felsic extrusive/intrusive Faber Group units, and is hosted by east-west striking, sub-vertical, vein-like structures. The arsenopyrite in these near vertical zones was most likely introduced during the stage 6 mineralizing event. Sulphide intersections also occur in the cross-cutting quartz-feldspar and feldspar-amphibole ± quartz porphyry dykes. Many of the late stage felsic intrusions cutting the deposit have removed Co-Bi-Au mineralization and left blocks of relatively unmineralized rock in the centre of the deposit.

Petrographic evidence shows that the majority of cobalt in the Bowl Zone is contained in the arsenopyrite-cobaltite solid solution series, with the rest in cobaltite and minor amounts in the minerals modderite and cobaltian loellingite (Goad et al., 2000b, SGS Lakefield, 2001). The cobalt content is dependent on the relative abundance of both cobaltite and danaite (a variety of arsenopyrite containing cobalt), and on the danaite composition, the latter being the most important factor because of the dominance of danaite in the NICO deposit (Thalenhorst and Farquharson, 2002).

Figure 7.3
Typical Cross-section Through the Bowl Zone at 20+50W



Fortune Minerals.

Walker (1999) reported that the third phase of mineralization started with cobaltite, continuing with cobalt-rich varieties of danaite and ending with cobalt-poor danaite or arsenopyrite. An arsenic/cobalt ratio zonation in the NICO deposit has been recognized with a systematic decrease from high As-Co ratios in the upper part of the deposit to lower ratios at greater depths (Thalenhorst and Farquharson, 2002).

8.0 DEPOSIT TYPES

The NICO deposit can be classified as a hydrothermal iron oxide copper-gold (IOCG) deposit. The NICO deposit and the Sue-Dianne copper-gold deposit, located 25 km to the northwest of NICO, are the only known significant IOCG deposits defined in Canada. The GBMZ hosts the NICO and Sue-Dianne deposits, as well as IOCG prospects, showings, occurrences and alteration zones in or adjacent to Andean-type, 1.85-1.88 Ga, calc-alkaline, basaltic to rhyolitic caldera-fill complexes and stratovolcanoes, diatremes and coeval felsic to intermediate epizonal plutons (Corriveau, 2007).

The IOCG deposit type encompasses a wide spectrum of sulphide-deficient low-Ti magnetite and/or hematite orebodies of hydrothermal origin, in which metals have been interstitially deposited in breccias, veins, disseminations and, locally, massive lenses of primarily polymetallic sulphides +/- gold. These hydrothermal deposits are associated with large-scale continental A- to I-type granitic suites with intermediate and mafic facies, alkaline-carbonatite stocks, crustal-scale fault zones, regional sodic-calcic alteration, focused potassic and iron oxide alteration, and coincident aeromagnetic and gravity highs. The deposits typically have more than 20% iron oxides (Corriveau, 2007).

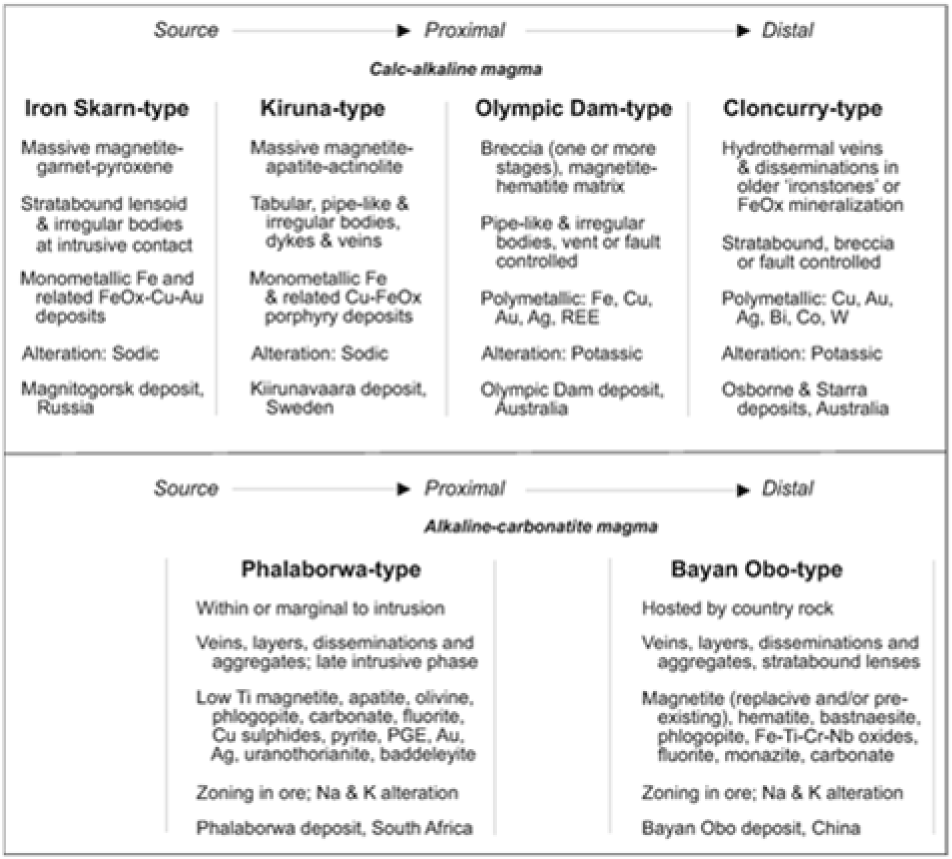
Although Phanerozoic deposits exist, the most important IOCG deposits are Early to Middle Proterozoic in age. The deposits are situated in anorogenic cratonic settings with rifting, and are usually located on major structural lineaments which were likely extensional and/or transcurrent faults related to extensional rifting. Deposits are proximal to and located preferentially in the roof zones of megacrystic syenogranite intrusions, which may display unusual myrmekitic, granophyric and rapakivi textures (Goad et al., 2000a). Rocks that host IOCG deposits formed in regionally oxidized settings through which fluids could flow and/or react.

As a result of the diversity of mineralization, there has been debate as to whether IOCG deposits form a single deposit type or whether they are iron oxide-rich variants of other deposit types. IOCG subtypes have been proposed but, due to the diversity of iron oxide copper-gold, uranium, silver, rare earth element, bismuth and cobalt deposits, there is the possibility of many potential subtypes, as summarized in Figure 8.1.

The NICO deposit has been classified as both a Cloncurry subtype (Goad et al., 2000a) and an Olympic Dam subtype (Gandhi, 2004).

Regionally, cratonic rift basins are characterized commonly by positive Bouguer gravity and total field magnetic trends. The associated granites and related volcanic rocks are usually rich in potassium and uranium and will generate positive radiometric anomalies if exposed at surface. The intersection of regional-scale, structural lineaments related to rifting with plutonism is important in localizing deposits; these lineaments can be detected as linear-magnetic and very-low frequency electromagnetic anomalies. Iron-rich alteration zones dominated by magnetite are characterized by strongly positive magnetic anomalies; those dominated by hematite can be identified by a relatively low-intensity anomaly (Goad et al., 2000a).

Figure 8.1
IOCG Deposit Sub-types



Corriveau, 2007 after Ghandi, 2004.

9.0 EXPLORATION

Extensive exploration work has been conducted on the NICO Property, as summarized in Section 6.0 of this report. In recent years, however, exploration has been conducted principally by drilling. This work, which is described in Section 10.0, included three infill diamond holes drilled in 2006 and a 38-hole drilling program in 2010.

10.0 DRILLING

The most recent drilling campaigns on the NICO Property were conducted in 2003, 2006 and 2010.

10.1 2003 DRILLING CAMPAIGN

The 2003 drilling campaign, which consisted of 33 diamond drill holes, is fully described in the Technical Report by Hennessey et al. (2007) and the results are summarized below.

A total of 13 holes were drilled in the West pit area, principally with the objective of defining relatively shallow mineralization in that area. This drilling, which was generally conducted to a depth of approximately 100 m, was successful in defining the up-plunge and up-dip extents of mineralization in areas which had previously been difficult to access.

Eight holes were drilled in the central part of the NICO deposit, with the main objective of extending the high-grade core of the deposit to depth, and a secondary objective of defining the extent and grade of mineralization between two cross-cutting felsic dykes. These holes were drilled to depths ranging from 154 m to 289 m and all intersected zones of relatively high-grade gold, with generally average cobalt and bismuth grades.

The remaining 12 holes of the 2003 campaign were drilled in the East pit area to test the continuity of mineralization between isolated resource blocks. These holes were drilled to depths of 113 m to 187 m, established the continuity of mineralization and also extended the eastern limits of the known mineralization by approximately 50 m.

10.2 2006 DRILLING CAMPAIGN

In 2006, Fortune drilled three infill holes in portions of the deposit where previous drilling had left local areas without adequate drill coverage. All three holes intersected gold-cobalt-bismuth of generally average grade. The intercept in hole NICO-06-286 extended the higher-grade mineralization an additional 50 m in the central part of the deposit where, previously, it was thought to have terminated.

10.3 2010 DRILLING CAMPAIGN

The 2010 drilling campaign, which consisted of 38 diamond holes, is described in the Technical Report by Puritch et al. (2012). The principal objectives of this drilling were to increase the identified resources and to test for extensions to the known deposit near surface, at the lateral extremities and at depth. A summary of significant intersections from the 2010 drilling is provided in Table 12.1, which is reproduced directly from Puritch et al. (2012). This additional drilling is included in the drill hole database used for estimating the mineral resources discussed in Section 14.0 of this report.

Table 10.1
Highlights of Drill Intercepts from 2010 Drill Program

TABLE 10.1
HIGHLIGHTS OF DRILL INTERCEPTS FROM 2010 DRILL PROGRAM

Borehole ID	Grid East (m)	Grid North (m)	Az	Dip(°)	From (m)	To (m)	Interval (m)	True Width (m)	Au (g/t)	Bi (%)	Co (%)	Cu (%)
NICO 10-300	24+00W	346 N	200	-56	52.00	85.00	33.00	32.41	-	0.28	0.07	0.01
					111.71	163.00	51.29	50.37	2.22	0.04	0.11	0.08
including					121.00	148.00	27.00	26.51	3.99	0.04	0.12	0.08
and					122.00	124.00	2.00	1.96	7.51	0.14	0.15	0.25
and					129.00	131.00	3.00	2.95	15.59	0.05	0.46	0.11
and					135.00	148.00	13.00	12.77	4.93	0.03	0.16	0.06
and					136.00	139.00	3.00	2.95	15.59	0.05	0.46	0.11
NICO 10-299	19+00W	352 N	200	-90	228	232	4.00	2.82	4.68	0.01	-	-
including					228.00	230.00	2.00	1.41	10.60	0.02	-	-
NICO 10-298	19+50W	343 N	200	-90	32.82	33.82	1.00	0.71	0.12	-	0.12	-
NICO 10-297	18+00W	206 N	200	-70	96.00	97.00	1.00	0.91	0.34	0.01	0.11	0.01
					100.00	101.00	1.00	0.91	0.12	0.01	0.11	0.01
NICO 10-296	17+00W	120 N	200	-73	25.44	27.50	2.06	1.82	0.10	-	0.14	-
					32.55	33.55	1.0	0.88	0.89	-	0.29	-
					39.74	43.65	3.91	3.45	0.65	0.01	0.10	0.01
NICO 10-295	17+00W	208 N	200	-65	98.09	99.10	1.01	0.95	0.23	-	0.12	0.01
NICO 10-294	17+50W	205 N	200	-53	64.84	72.98	8.14	8.06	1.53	0.01	0.07	0.01
					65.86	67.88	2.02	1.99	4.50	0.02	0.14	0.01
					117.43	118.43	1.00	0.99	0.50	-	0.69	0.03
NICO 10-293	18+50W	191 N	200	-45	102.24	122.35	20.11	20.11	0.01	0.54	0.31	-
NICO 10-292	25+50W	358 N	200	-45	67.00	71.00	4.00	4.00	0.01	0.34	0.06	0.01
					85.00	91.00	6.00	6.00	-	0.15	0.08	0.02
					95.00	108.00	13.00	13.00	0.01	0.37	0.38	0.01
					137.50	148.00	10.50	10.50	-	0.17	0.11	0.01
NICO 10-291	25+50W	358 N	200	-70	160.18	168.20	8.02	8.02	0.03	0.12	0.04	0.01
NICO 10-301	26+50W	413 N	200	-45	85.03	89.04	4.01	4.01	-	0.09	0.18	0.01
					121.03	126.05	5.02	5.02	0.01	0.08	0.15	-
NICO 10-302	26+50W	367 N	200	-45	91.51	103.56	12.05	12.05	-	0.11	0.12	0.01
NICO 10-303	27+50W	355 N	200	-45	44.00	46.00	2.00	2.00	0.01	0.07	0.25	-
					78.00	82.00	4.00	4.00	-	0.11	0.13	0.01
					95.00	97.00	2.00	2.00	-	0.10	0.15	0.01
NICO 10-305	27+50W	272 N	200	-45	56.00	58.00	2.00	2.00	0.25	0.11	0.10	0.02
NICO 10-309	26+50W	189 N	200	-45	34.64	40.57	5.93	5.93	1.01	0.01	0.19	0.02
NICO 10-312	13+50W	48 N	200	-45	118.47	124.84	6.37	6.37	0.02	0.01	0.13	-
NICO 10-316	16+50W	20 N	200	-45	35.61	37.17	1.56	1.56	0.18	-	0.22	0.02
NICO 10-317	14+50W	131 N	200	-55	84.00	86.00	2.00	1.97	0.27	-	0.14	0.01
					150.54	159.52	8.98	8.84	1.93	0.21	-	-

TABLE 10.1
HIGHLIGHTS OF DRILL INTERCEPTS FROM 2010 DRILL PROGRAM

Borehole ID	Grid East (m)	Grid North (m)	Az	Dip(°)	From (m)	To (m)	Interval (m)	True Width (m)	Au (g/t)	Bi (%)	Co (%)	Cu (%)
including					150.54	157.55	7.01	6.90	2.39	0.18	-	-
NICO 10-318	15+00W	115 N	200	-50	111.00	115.00	4.00	3.98	0.24	-	0.11	-
NICO 10-320	21+50W	135 N	200	-45	56.15	57.00	0.85	0.85	0.01	0.09	0.17	0.01
					98.00	98.94	0.94	0.94	0.97	0.02	0.16	0.01
NICO 10-321	24+50W	137 N	200	-45	17.00	22.00	5.00	5.00	1.27	0.05	0.14	0.01
					32.00	35.00	3.00	3.00	1.24	0.01	0.10	-
					38.00	41.00	3.00	3.00	1.60	0.01	0.08	-
					46.00	49.00	3.00	3.00	0.59	0.01	0.12	0.01
NICO 10-322	25+50W	170 N	200	-45	22.00	24.00	2.00	2.00	0.12	0.05	0.12	-
					45.00	47.00	2.00	2.00	0.77	0.02	0.16	-
NICO 10-323	21+50W	419 N	200	-65	19.00	22.19	3.19	3.00	0.21	0.04	0.15	0.24
					46.74	48.10	1.36	1.28	0.06	0.01	0.21	0.04
					59.27	59.97	0.70	0.66	0.40	0.02	0.16	0.78
					151.00	152.00	1.00	0.94	1.03	-	0.01	0.15
					164.70	165.70	1.00	0.94	0.56	-	0.15	0.01
					168.50	170.50	2.00	1.88	0.20	-	0.12	0.01
					175.20	179.00	3.80	3.57	0.20	-	0.09	-
					225.67	226.50	0.83	0.78	2.72	0.02	-	-
					234.80	236.80	2.00	1.88	0.26	-	0.22	0.01
					260.70	263.62	2.92	2.74	0.02	0.26	0.21	0.02
NICO 10-324	20+00W	443 N	200	-60	23.00	25.00	2.00	1.93	0.19	0.04	0.11	0.31
					71.06	78.93	7.87	7.60	0.14	0.10	0.09	0.11
					146.62	150.00	3.38	3.26	11.59	0.16	0.37	0.14
					222.00	223.00	1.00	0.97	2.65	0.06	0.09	-
					268.00	270.00	2.00	1.93	0.03	0.10	0.13	-
NICO 10-325	21+00W	443 N	200	-65	10.40	11.40	1.00	0.94	2.55	0.40	0.06	0.42
					25.44	26.74	1.30	1.22	0.64	0.03	0.13	0.26
					189.00	197.00	8.00	7.52	4.74	0.16	0.01	-
					226.00	227.00	1.00	0.94	2.75	0.58	-	-
					260.00	274.62	14.62	13.74	0.33	0.01	0.22	-
NICO 10-326	20+50W	433 N	200	-65	141.72	142.80	1.08	1.01	0.21	0.12	0.19	-
					148.00	149.00	1.00	0.94	1.64	0.03	0.01	0.06
NICO 10-327	22+50W	400 N	200	-65	15.00	16.00	1.00	0.94	0.14	0.05	0.10	0.27
					34.00	36.00	2.00	1.88	0.40	0.03	0.15	0.05
					73.08	74.57	1.49	1.40	0.34	0.01	0.29	0.01
					86.00	92.92	2.92	2.74	0.25	0.19	0.20	-
					133.00	138.00	5.00	4.70	1.86	-	0.03	0.03
					166.00	171.00	5.00	4.70	4.84	0.01	0.04	0.01
					192.00	194.00	2.00	1.88	0.25	-	0.37	0.03
					202.00	204.50	2.50	2.35	9.21	0.02	0.01	0.01
					231.30	233.57	2.27	2.13	0.56	0.08	0.17	0.01

10.4 DRILLING PROCEDURES

All drilling completed by Fortune at the NICO Property has been diamond drilling, with recovery of a core sample. The drilling completed from 1996 to 1998 was performed using BQTK-sized rods (40.7-mm diameter core). During the 1998 drilling campaign, the rods were switched to NQ2-sized equipment (50.5-mm diameter core) and, in 2000, Fortune began using stabilized (hexagonal) core barrels with extra stabilizer/reaming shells on the lower three joints in the drill string, or employed extra long stabilizers.

Drill hole set-ups were made under supervision of the geologist who approved the orientation of the rig prior to the commencement of drilling. Drill hole collars were located relative to the local staked grid.

Core was recovered and, along with footage marker blocks for each 3.05-m or 10-ft run (Imperial-sized rods were used in the drilling), was placed in wooden boxes at the drill. The boxes were wired shut and hauled to the Lou Lake camp where a heated, weather-proof core logging facility is located. All holes were stopped under geological control.

All the drill hole collars have been surveyed and all holes have had down-hole dip measurements taken (acid tests prior to 1999 and Sperry Sun survey instruments thereafter). However, during the early drilling programs, no down-hole surveying of the holes was completed because of the significant magnetism in the altered rocks, and the late Sperry Sun data are not considered reliable for azimuth measurements. During the 2000 drilling program, a Gyro down-hole survey instrument and crew were brought in and 60 holes from all of the previous programs were surveyed. A wide range of hole deviations was observed. An analysis of the data by Micon showed that the observed hole deviations seen were in three relatively tightly clustered patterns around the three types of drilling employed, i.e., BQTK, NQ2 unstabilized and NQ2 stabilized. A summary of the results of this analysis is set out in Table 10.2.

Table 10.2
Summary of Analysis of Hole Deviation

Program/Type	Average Deviatio (^{o}/100 m)	
	Az	Dip[1]
1996/97/98 Drilling – All (BQTK)	5.33	-1.52
1998/2000 Drilling – Unstabilized NQ2	2.24	-0.59
2000-03 Drilling – Stabilized NQ2	0.47	-0.69

[1] – minus sign equals drill hole flattening

It can be seen that the changes to the use of NQ2 and stabilized NQ2 drill rods have had a significant effect in reducing drill hole deviation. Actual measured deviations were used for plotting of drill holes when Gyro data were available. When data were not available, the extrapolated surface azimuths of the holes were corrected using the average deviation for the type of equipment used. Dips were taken from actual hole readings.

11.0 SAMPLE PREPARATION, ANALYSES AND SECURITY

A consistent sampling, analytical and security methodology, summarized below, has been employed by Fortune throughout its various drilling programs on the NICO Project.

11.1 CORE LOGGING

Prior to sampling, all core was logged at the Lou Lake camp located on the NICO claims. The following items were checked or recorded by the logging geologists:

- Check blocking of all core.
- Convert feet measurements to metres.
- Consolidate core and line up fractures and joints.
- Note recovery and rock quality designation (RQD).
- Describe rock strength of all lithologies.
- Test all core with a magnet to determine areas of absent, weak, moderate or strong magnetism.
- Describe the principal lithologies present and their locations.
- Lay out sample intervals (generally 1-m samples used but with minor variances allowing for lithological breaks and missing core). Earlier programs had used longer sampling intervals, generally 2 to 3 m and, very occasionally, up to 6-m or more in length for samples that were unlikely to contain significant metal enrichment, but which required analytical verification.
- Measure and describe the weak to strong magnetic areas by sample.
- Describe the sulphides, structure and hematite alteration present in each sample interval.

Since the spring of 2000, all lithologic logs have contained a coded percentage of each principal lithology within each sample interval. Sample intervals were also categorized according to the amount of sulphide mineralization within the interval.

The logging was performed, or in some cases overseen, by Fortune geologists, principally Kathryn Neale, Miroslav Sidor and Derek Mulligan, all of whom were long term consultants to Fortune and familiar with most phases of the Project.

11.2 Core Sampling

Sampling of the drill core was conducted by a technician supervised by the respective logging geologists. All sampling was performed in a separate shed adjacent to the logging facility at the Lou Lake camp.

All drill core samples were split for sampling and one half was assayed. Most of the core was sampled, except for some of the post-mineralization dykes. Samples that were logged as weakly, moderately or strongly mineralized core were split using a diamond blade saw. Trace mineralized core was split with a conventional guillotine type, knife blade splitter, in order to minimize costs.

Once split, samples were placed individually in heavy plastic bags, which were then collected, in numerically ordered groups, into large rice bags for shipment. Samples were shipped to Yellowknife by float plane in summer or pick-up truck in winter, where they were palletized and shipped by transport truck to the assay laboratory.

Intervals which were expected to contain negligible grade (trace mineralization) were shipped as separate 1 m samples with instructions to composite the pulps from groups of consecutive samples for analysis. If gold grades greater than 300 ppb, or cobalt grades greater than 0.05% (500 ppm) were returned, separate pulps for each sample were analyzed. No compositing was performed if any noticeable amount of arsenical sulphide was present.

Once sampled, the core boxes and remaining core were taken to an outdoor core storage area, where they were stacked on large timbers in piles of approximately 10 boxes. The timbers were used to get the boxes well off the ground, in order to promote ventilation and to prevent rot.

11.3 Sample Preparation

All sample preparation and primary assaying of drill core from the 1996 to 2000, 2003, 2006 and 2010 programs were performed by ALS Chemex Canada Limited in North Vancouver (ALS Chemex). ALS Chemex is an ISO accredited laboratory, with a quality assurance system in place at its laboratories complying with the requirements of the international standards ISO 9001:2000 and ISO 17025:1999 (http://www.alsglobal.com/MineralALS Content.aspx?key=66).

Fortune employed ALS Chemex's CRU-31 crushing, SPL-21 splitting and PUL-31 pulverizing protocols (together called the PREP-31 package) for its preparation of samples from NICO. For the PREP-31 protocol, a sample is dried and the entire sample is crushed to better than 70% passing a 2 mm (Tyler 10 mesh) screen. A sub-sample of up to 250 g is taken with a Jones-type riffle splitter and pulverized to better than 85% passing a 75 micron (Tyler 200 mesh) screen, using a puck and bowl pulverizer.

11.4 ANALYSIS

ALS Chemex reports that Fortune regularly receives its analyses by the Au-AA23, As-AA46, Cu-AA62a, Co-AA62 and Bi-AA46 analytical methods for gold, arsenic, copper, cobalt and bismuth, respectively. Over limits for gold are rerun by Au-GRA21. The information on methodology employed in these methods, as presented by ALS Chemex, is summarized in the sections below. The Cu-AA62a method is performed in essentially the same manner as the Cu AA62 method (as outlined in the ME-AA62 description below), but it has a lower detection limit which is achieved through the instrument curve set up for this method.

11.4.1 Method Au-AA23/AU-AA24

Sample Decomposition : Fire Assay Fusion
Analytical Method : Atomic Absorption Spectroscopy (AAS)

A prepared sample pulp is fused with a mixture of lead oxide, sodium carbonate, borax, silica and other reagents as required, inquarted with 6 mg of gold-free silver and then cupelled to yield a precious metal bead.

The bead is digested in 0.5 mL of dilute nitric acid in a microwave oven; 0.5 mL concentrated hydrochloric acid is then added and the bead is further digested in the microwave at a lower power setting. The digested solution is cooled, diluted to a total volume of 4 mL with de-mineralized water, and analyzed by atomic absorption spectroscopy against matrix-matched standards. The Au-AA23/Au-AA24 methods are summarized in Table 11.1.

Table 11.1
ALS Chemex Method AU-AA23/AU-AA24 Summary

ALS Chemex Method Code	Element	Sample Weight (g)	Lower Reporting Limit	Upper Reporting Limit	Units
Au-AA23	Gold	30	0.005	10.0	ppm
Au-AA24	Gold	50	0.005	10.0	ppm

11.4.2 Method Au-GRA21/Au-GRA21

Sample Decomposition : Fire Assay Fusion
Analytical Method : Gravimetric

A prepared sample pulp is fused with a mixture of lead oxide, sodium carbonate, borax, silica and other reagents in order to produce a lead button. The lead button containing the precious metals is cupelled to remove the lead. The remaining gold and silver bead is parted in dilute nitric acid, annealed and weighed as gold. Silver, if requested, is then determined by the difference in weights. The Au-GRA21 and Au-GRA 22 methods are summarized in Table 11.2.

Table 11.2
ALS Chemex Method AU-GRA21/AU-GR22 Summary

ALS Chemex Method Code	Element	Sample Weight (g)	Lower Reporting Limit	Upper Reporting Limit	Units
Ag-GRA21	Silver	30	5	10,000	ppm
Ag-GRA22	Silver	50	5	10,000	ppm
Au-GRA21	Gold	30	0.05	1,000	ppm
Au-GRA22	Gold	50	0.05	1,000	ppm

11.4.3 Method ME-AA46 (includes As-AA46 and Bi-AA46)

Sample Decomposition : Aqua Regia Digestion
Analytical Method : AAS

A prepared sample pulp (0.4 to 2 g) is digested with concentrated nitric acid for one half hour. After cooling, hydrochloric acid is added to produce aqua regia and the mixture is then digested for an additional hour and a half. An ionization suppressant is added if molybdenum is to be measured. The resulting solution is diluted to volume (100 or 250 mL) with demineralized water, mixed and then analyzed by atomic absorption spectrometry against matrix-matched standards. The ME-AA46 method is summarized in Table 11.3.

Table 11.3
ALS Chemex Method ME-AA46 Summary

ALS Chemex Method Code	Element	Detection Limit	Upper Limit	Units
As-AA46	Arsenic	0.01	30	%
Bi-AA46	Bismuth	0.001	30	%
Cd-AA46	Cadmium	0.001	10	%
Co-AA46	Cobalt	0.01	50	%
Cu-AA46	Copper	0.01	50	%
Fe-AA46	Iron	0.01	30	%
Pb-AA46	Lead	0.01	30	%
Mo-AA46	Molybdenum	0.001	10	%
Mn-AA46	Manganese	0.01	50	%
Ni-AA46	Nickel	0.01	50	%
Ag-AA46	Silver	1	1,500	ppm
Zn-AA46	Zinc	0.01	30	%

11.4.4 Method ME-AA62 (includes Cu-AA62a and Co-AA62)

Sample Decomposition : HNO_3-$HClO_4$-HF-HCl digestion
Analytical Method : AAS

A prepared sample pulp (0.2 to 2.0 g) is digested with nitric, perchloric and hydrofluoric acids, and then evaporated to dryness. Hydrochloric acid is added for further digestion, and the sample is again taken to dryness. The residue is dissolved in nitric and hydrochloric acids and transferred to a volumetric flask (100 or 250 mL). The resulting solution is diluted to volume with demineralized water, mixed and then analyzed by atomic absorption spectrometry against matrix-matched standards. The ME-AA62 method is summarized in Table 11.4.

Table 11.4
ALS Chemex Method ME-AA62 Summary

ALS Chemex Method Code	Element	Lower Reporting Limit	Upper Reporting Limit	Units
Ag-AA62	Silver	1	1,000	ppm
Al-AA62	Aluminium[1]	0.01	50	%
Ca-AA62	Calcium[1]	0.05	50	%
Cd-AA62	Cadmium	0.0001	10	%
Co-AA62	Cobalt	0.001	30	%
Cu-AA62	Copper	0.01	50	%
Fe-AA62	Iron	0.01	30	%
K-AA62	Potassium[1]	0.01	30	%
Li-AA62	Lithium	0.01	50	%
Mg-AA62	Magnesium[1]	0.01	50	%
Mn-AA62	Manganese[1]	0.01	50	%
Mo-AA62	Molybdenum	0.001	10	%
Na-AA62	Sodium[1]	0.001	30	%
Ni-AA62	Nickel	0.01	50	%
Pb-AA62	Lead	0.01	30	%
Sr-AA62	Strontium	0.01	20	%
V-AA62	Vanadium	0.01	30	%
Zn-AA62	Zinc	0.01	30	%

[1] Elements reported as oxide.

11.4.5 Other Methods

Fortune reports that arsenic values were only determined from samples collected in 1996, 2000, 2003, 2006 and 2010. For the 1996 sampling, a geochemical method with an upper limit of 10,000 ppm (or 1%) was used, whereas, in 2000, 2003, 2006 and 2010, the arsenic values were determined in the manner described above.

11.4.6 Specific Gravity Measurements

A large number of specific gravity (SG) measurements based on rock type have been taken at the NICO Project and utilized in the mineral resource estimation process.

12.0 DATA VERIFICATION

12.1 SITE VISITS AND INDEPENDENT SAMPLING

12.1.1 Micon Site Visit, 2003

B. Terrence Hennessey, P.Geo., conducted a site visit to the NICO Project site in September, 2003, in preparation for Micon's mineral resource estimate. At that time, Fortune's data collection procedures were reviewed. These included drilling, core logging, sampling and sample shipment procedures, as well as the analytical methods used and the quality assurance/quality control (QA/QC) program employed. A majority of the data and data collection procedures used in the new estimate reported in Puritch et al. (2012) were reviewed at that time.

Micon found no material deficiencies with the exploration data collection at the NICO Project and concluded that the data were suitable for use in a mineral resource estimate.

A review of mineralized intersections conducted by Micon in 2003 in the NICO Project drill core library clearly showed the presence of extensive sulphide mineralization in a hydrothermally altered rock consistent with the mineralization descriptions given above. Pyrite, pyrrhotite and arsenopyrite-cobaltite are clearly visible in drill core. However, visible native gold is rare and the bismuth minerals are difficult to make out against the silver-grey ground mass of arsenical minerals.

Micon collected a small number of duplicate half core samples during its site visit, in order to confirm the presence of copper, gold, cobalt and bismuth mineralization within the rocks and to ensure that it was at grades approximately comparable to, or consistent with, those presented in earlier resource estimates. Six, 25- to 30-cm long samples were collected from a variety of holes and locations representing low, medium and high grade mineralization. Table 12.1 describes the location of the samples collected and gives some brief notes on the Fortune assay results received for the full one-metre samples taken at the same location. The Micon assay results are not directly comparable, as full one-metre samples were not collected.

Table 12.1
Micon Duplicate Sample Descriptions

Sample Number	Hole Number	Box Number	From (m)	To (m)	Length (m)	Notes on Fortune Logs
323922 H	03-255	28	115.91	116.20	0.29	High grade gold
323923 H	03-255	26	103.91	104.16	0.25	High grade gold
323924 H	00-239	14	76.45	76.70	0.25	Low grade bismuth and cobalt
323925 H	00-221	13	69.25	69.51	0.26	Medium grade bismuth and cobalt
323926 H	97-066	17	118.26	118.52	0.26	Low grades
323927 H	97-079	28	192.43	192.74	0.31	High grade gold, medium grade cobalt

Micon collected these samples personally and maintained full chain-of-custody of them until delivery to the laboratory. The samples were prepared and analyzed at ALS Chemex, Mississauga, using the same sample preparation and analytical protocols as employed by Fortune. Table 12.2 presents the results of Micon's analyses for the six check samples.

Table 12.2
Micon Duplicate Sample Assay Results

Sample Number	Au-AA23 (g/t)	Au-GRA21 (g/t)	As-AA46 (%)	Bi-AA46 (%)	Co-AA62 (%)	Cu-AA62 (%)
323922 H	> 10.000	19.90	0.86	0.035	0.562	0.028
323923 H	9.140		0.04	0.009	0.033	0.012
323924 H	0.049		2.62	0.162	0.122	0.002
323925 H	0.068		1.60	0.291	0.304	0.009
323926 H	1.125		0.08	0.011	0.024	0.048
323927 H	> 10.000	50.40	1.33	0.035	0.891	0.028

The check samples collected by Micon have clearly demonstrated the presence of gold, bismuth and cobalt mineralization in approximately similar grade ranges to those predicted by the Fortune drill logs.

12.1.2 P&E Site Visits, 2004 and 2011

Eugene Puritch, P. Eng., of P&E, who is a co-author of the Technical Report Puritch et al. (2012), visited the NICO site on July 10 and 11, 2004 and on April 24, 2012, and conducted a detailed site review, including recording positions of drill hole collars, examination of the core logging facilities and practices, as well as the collection of core samples for independent data verification. A total of six samples from two diamond drill holes were collected and analyzed for bismuth, cobalt, copper and gold, yielding the results shown in Figure 12.1 to Figure 12.3.

Figure 12.1
NICO Deposit Site Visit, Sample Results for Bismuth

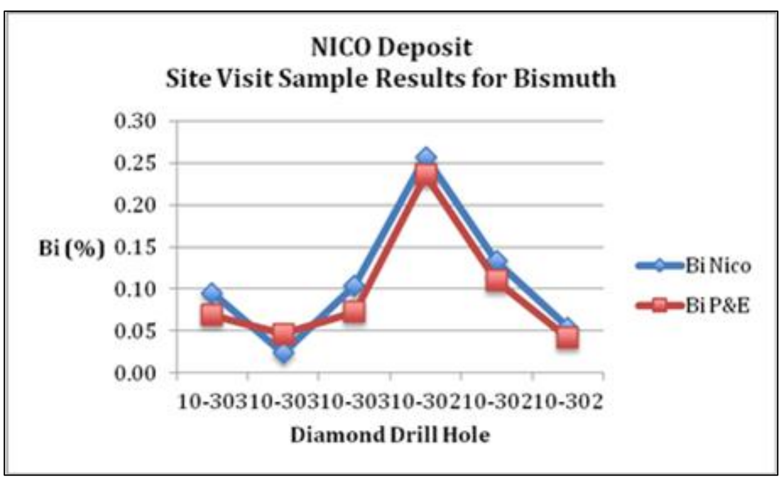


Figure 12.2
NICO Deposit Site Visit, Sample Results for Cobalt

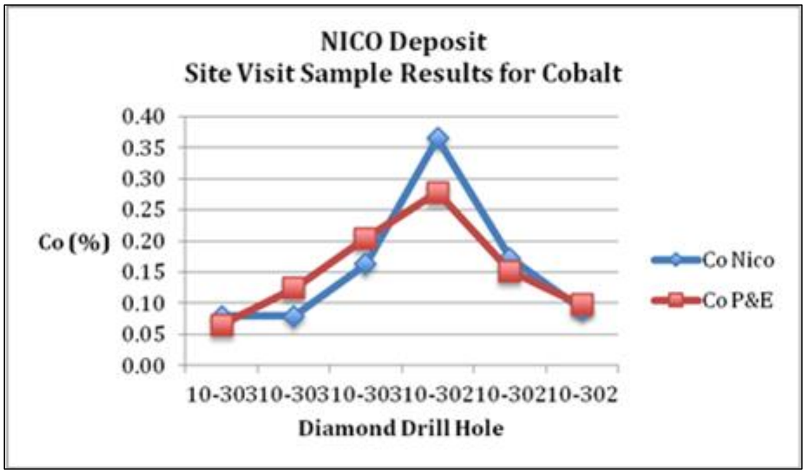
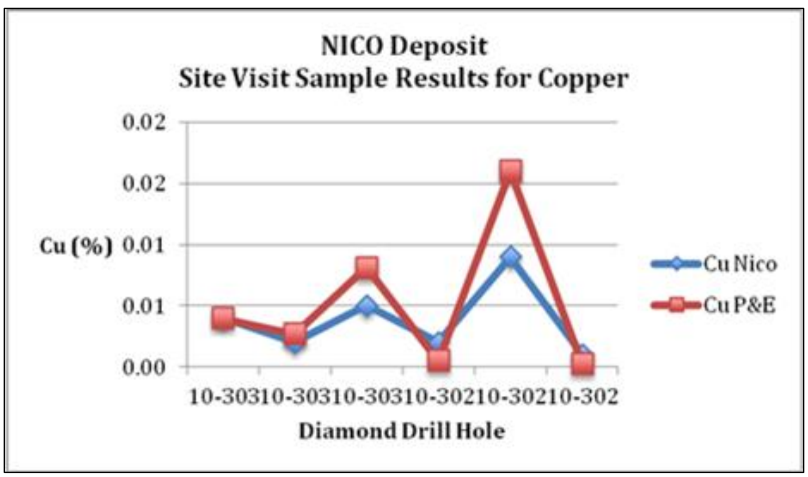


Figure 12.3
NICO Deposit Site Visit, Sample Results for Copper



The check samples were collected by quarter-cutting the remaining half core in the core box. They were given a unique sample number, placed in a bag and, once all samples were collected, were placed into a larger bag and taken by Mr. Puritch to the offices of P&E in Brampton, Ontario. From there, the samples were sent by courier to AGAT Laboratories (AGAT) in Mississauga for analysis.

AGAT has developed and implemented at each of its locations a Quality Management System (QMS) designed to ensure the production of consistently reliable data. The system covers all laboratory activities and takes into consideration the requirements of ISO standards. AGAT maintains ISO registrations and accreditations which provide independent verification that a QMS is in operation at the location in question. Most AGAT laboratories are registered or are pending registration under ISO 9001:2000.

Samples were analyzed for bismuth, cobalt and copper using a 4-acid digest and ICP-ICP/MS finish. Gold was analyzed using fire assay, ICP/MS. Neither the original NICO analyses nor the P&E check analyses returned above detection limits for gold and there is no graphical representation of those results included herein.

The check samples taken by P&E confirm the earlier results obtained by Micon.

12.2 QUALITY ASSURANCE/QUALITY CONTROL

The QA/QC practices for the 2010 NICO infill drilling program consisted of the insertion of alternating blanks and standards approximately every ten samples. In total, two different blanks and four different standards were used. Fortune monitored the QC results on a real-time basis, and P&E independently verified all QC data.

12.2.1 Fortune Au-Co Standards

Three different standards were prepared by SGS Minerals (SGS Lakefield) for previous Fortune drilling programs, using material procured from the NICO site itself. These standards have been named S1 (0.77 ppm Au; 0.066% Co), S2 (0.70 ppm Au; 0.51% Co), and S3 (1.47 ppm Au; 0.19% Co).

For standards S1 and S2, the results generally fell within two standard deviations of the mean. The values that were found slightly beyond two standard deviations did not occur within mineralized zones. One S1 standard assay returned a value significantly different from acceptable values and did not match the value of any other QC sample used. Seven samples surrounding the failed standard were rerun and the new results were used in the master database. All four S3 standard assays were within two standard deviations.

12.2.2 Fortune Blanks

Blank material was also prepared for previous Fortune drilling programs by SGS Lakefield, using material procured from the NICO site. All blanks assayed were within two standard deviations, apart from one sample which did not lie within a mineralized zone.

12.2.3 CDN Resources Laboratories LTD. Au-Cu Standard (CDN-CGS-20)

A gold-copper standard (CDN-CGS-20) was prepared for Fortune by CDN Resource Laboratories, and was named S4 (7.75+0.47 ppm Au; 3.36+0.17% Cu). The results generally fell within two standard deviations of the mean, and those values which were found slightly beyond two standard deviations did not occur within mineralized zones.

12.2.4 CDN Laboratories Blank

A blank (CDN-BL-7) was also prepared for Fortune by CDN Resource Laboratories. While most values fell within two standard deviations, two values were slightly high, and another sample failed. One of the slightly elevated blanks was within a mineralized zone, suggesting slight carry-over contamination. There is no impact to the database. The other slightly elevated blank did not lie within a mineralized zone. Blank sample G225200 was significantly elevated in gold, with a value of 0.06 g/t Au. It did not lie within a mineralized zone and, therefore, no action was taken.

12.2.5 Conclusion

P&E concluded that the assay data were robust and satisfactory for use in a resource estimate. Micon's earlier review had come to the same conclusion.

13.0 MINERAL PROCESSING AND METALLURGICAL TESTING

Fortune completed extensive bench scale and pilot plant testwork studies between 1997 and 2012 using samples representing the mineralization of the NICO deposit. The majority of this flowsheet development work was undertaken at SGS Mineral Services laboratory (SGS-MS), Lakefield, Ontario, Canada.

The purpose of the metallurgical test programs was to develop a process flowsheet and generate process design criteria for the recovery of bismuth, cobalt, copper and gold from the NICO deposit. Initial work in 1997 and 1998 considered the recovery of separate Bi and Co concentrates, as well as a bulk product containing Bi, Co, Au and Cu. This process flowsheet was developed and optimized over the following years, with bench scale testwork programs in 2000, 2001, 2004/2005 and 2009, mini-pilot scale hydrometallurgical testwork in 2006, and significant pilot plant mill and flotation test runs in 2007/2008 and 2010.

The metallurgical testwork completed to date not only included flotation parameter optimization and modelling, but also grinding, gravity recovery of gold, concentrate dewatering and hydrometallurgical recovery of Co, Bi, Au and Cu, and the validation of a process to produce cobalt and bismuth products.

The hydrometallurgical testwork undertaken to date comprises bismuth flotation optimization tests, cobalt hydrometallurgical circuit development testing, iron and arsenic removal tests, copper recovery tests, cobalt purification and recovery testwork, bismuth recovery testwork, gold recovery tests and cyanide destruction tests.

13.1 MINERALOGY

The economically important metals in NICO's mineral resources and reserves are cobalt, gold, bismuth and copper. The average grades of the total measured plus indicted mineral resources and the proven and probable reserves are presented in Table 13.1.

Table 13.1
Mineral Resource and Reserve Grades

Classification	Gold (g/t)	Cobalt (%)	Bismuth (%)	Copper (%)
Measured and Indicated Resources (open pit)	1.10	0.12	0.15	-
Measured and Indicated Resources (underground)	1.85	0.16	0.07	-
Proven and Probable Reserves (open pit)	0.96	0.11	0.14	0.04
Proven and Probable Reserves (underground)	4.96	0.17	0.10	0.02

The mineralogical structure of the NICO deposit determines the metal extraction processes used to recover the metal values in the deposit. Mineralogical analysis of NICO mineralized samples has shown that the mineralization is primarily comprised of iron-rich silicates (ferroanactinolite, ferroan hornblende, annitebiotite and orthopyroxene, feldspar +/- chlorite and carbonate), iron oxide (magnetite and hematite) and a sulphide fraction averaging about five to ten percent. The bulk of NICO opaque minerals are magnetite (Fe_3O_4), hematite

(Fe_2O_3) and goethite (FeO.OH), with sulphides comprising primarily arsenopyrite (FeAsS) with minor to trace amounts of pyrite (FeS_2), chalcopyrite ($CuFeS_2$), sphalerite [(Zn,Fe)S], pyrrhotite (Fe1-xS), native bismuth (Bi), bismuthinite (Bi_2S_3), cobaltite [(Co,Fe)AsS], and a Bi-Cu sulphosalt.

Table 13.2 provides the QEMSCAN mineralogical analyses of the two mineralogical composite samples used for the 2007 pilot plant testwork program. Composites L1 and L2, which represented "underground ore" and "open pit ore", respectively, were prepared from the 175 tonnes of sample received by SGS-MS.

Table 13.2
Mineralogy of the Two 2007 Pilot Plant Composite Feed Samples

Mineral	Composite L1 (wt %)	Composite L2 (wt %)
Chalcopyrite	0.1	0.1
Iron sulphides	1.1	1.1
Cobaltite	0.4	0.3
Arsenopyrite	0.9	0.7
Bismuthinite	0.2	0.2
Other sulphides	0.1	0.1
Non-sulphide gangue	64.4	65.5
Talc	3.2	3.3
Mica/clay	29.5	28.6
Other	0.2	0.2

SGS-MS, Pilot Plant Test Report dated September 11, 2012.

13.1.1 Cobalt

The principal cobalt carriers are arsenopyrite (FeAsS) and cobaltite. An arsenic/cobalt ratio zonation in the NICO deposit has been recognized, with a systematic decrease from high As/Co ratios in the upper part of the deposit to lower ratios at greater depths (Thalenhorst and Farquharson, 2002). Typically, as shown in Figure 13.1, near surface mineralization contains 1.7% Co in arsenopyrite, with about 7% Co at depth.

The arsenopyrite is relatively coarse grained (30 µm to 1 cm) and is effectively liberated at a grind of 80% passing (P_{80}) 72 µm. Cobalt replaces some of the iron in the arsenopyrite mineral lattice. This replacement ranges from one to ten percent and the cobalt content can vary considerably in grains of one sample. Figure 13.2 shows the wide variation of cobalt content in individual grains of one ore sample.

Figure 13.1
Arsenic/Cobalt Ratio as a Function of Depth

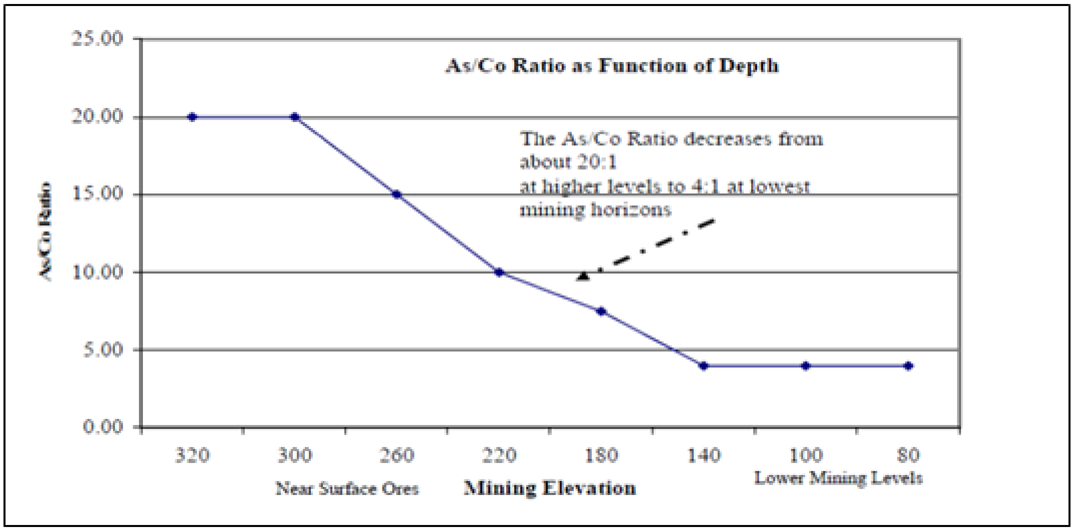
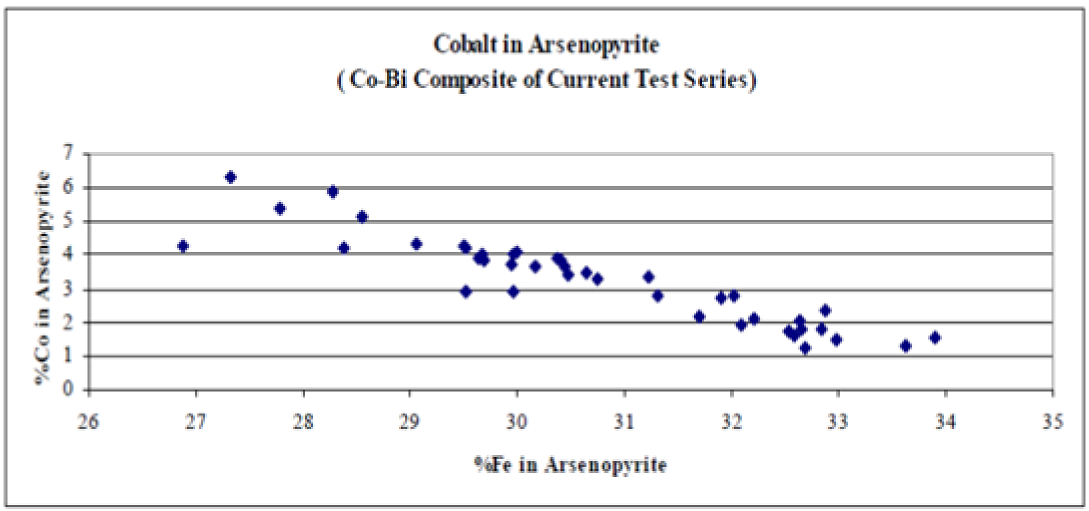


Figure 13.2
Cobalt in Arsenopyrite



13.1.2 Bismuth

The bismuth minerals found in the deposit are native bismuth and bismuthinite. These are generally finer grained (≤ 20 μm to 1 mm) than the arsenopyrite and they tend to form minor middling particles with other sulphides.

13.1.3 Gold

The distribution of gold within the mineral resource varies over a wide range, from a gold grade of about 0.5 g/t for the ores of the upper open pit zones, to around 10 g/t for material in the underground mining area. The gold occurs predominantly as native gold, with lesser amounts of maldonite (Au_2Bi) and a Au-Bi-Te alloy.

The grains range in size from 1 to 15 µm, with a mean calculated diameter of 4.5 µm. At a grind of P_{80} 72 µm, gold grain distribution is roughly 25-40% liberated grains, 10% attachments and inclusions in sulphides and 50-60% attachments and inclusions in silicates. This approximate distribution varies from zone to zone, but a high percentage of gold inclusion in silicates is characteristic for NICO ores at the design grind size.

13.2 CONCENTRATOR METALLURGICAL TESTWORK

Fortune completed extensive bench scale and pilot plant testwork studies between 1997 and 2010 using samples representing the mineralization of the NICO deposit.

The Feasibility Study process design and associated capital and operating costs are based on a FEED study prepared by Aker Metals, a division of Aker Solutions Canada Inc., now Jacobs. The FEED study document was issued to Fortune in September, 2012. Subsequently, Procon has reviewed and updated the capital and operating costs developed by Jacobs, and the Procon estimates are used in this report.

The majority of the design criteria adopted for the FEED study are based on the results from the following relatively recent metallurgical programs:

- Pilot testwork performed at SGS-MS Lakefield in 2007 and 2008.
- Pilot testwork performed at SGS-MS Lakefield in 2010 to 2012.
- Bench scale locked cycle tests and FLEET study by SGS-MS Lakefield in 2009.

Testwork programs completed before the 2007 pilot plant work comprised mainly bench scale flotation tests to produce a bulk concentrate or separate Co and Bi concentrates. Other work included mineralogy investigations and grindability tests.

The testwork conducted on NICO mineralized samples at SGS-MS (previously known as Lakefield Research Ltd.) involved the flotation of finely ground ore samples in order to assess the flotation characteristics of the ore and to produce concentrates for downstream hydrometallurgical testing. Information on sample selection and composite formation for all such testwork can be found in the progress reports issued regularly by Lakefield following each major segment of flotation experimentation.

All of the NICO samples tested up to 2005 were drill core composite samples, initially extracted during drill programs conducted in 1996, 1997, 1998, 2000, and 2003. In addition, a bulk sample program was carried out in 2006/2007 to acquire a large volume of material for the pilot plant scale testing conducted in 2007 and 2008.

13.2.1 Metallurgical Testwork – 1997 to 2005

The following summarizes the bench scale testwork undertaken between 1997 and 2005, under the heading of the corresponding progress report.

13.2.1.1 Lakefield LR5070 Progress Report 1 (PR1), 1997 (Lakefield, 1997a)

Bench flotation tests were conducted on selected samples from the NICO deposit. Bulk rougher and bulk cleaner tests were successful, with high recoveries of cobalt, bismuth, gold and copper. The results of tests to sequentially float cobalt from bismuth in the rougher or cleaner circuits were disappointing. One gravity recoverable gold test and a test to recover tungsten from a rougher tails were also below expectations.

Twelve bags of samples from Chemex Laboratories (Chemex) were used to prepare five composites, representing mineralized intersections from holes 4, 9, 13, 14 and 30 from the 1996 drill program.

13.2.1.2 Lakefield LR5070 Progress Report 3 (PR3), 1998 (Lakefield, 1998)

Bench flotation tests were undertaken to evaluate different grind sizes, as well as tests on bulk flotation reagents, which determined that only frother (MIBC) and a single collector Potassium Amyl Xanthate (PAX) were required. Separation tests floating bismuth from cobalt, using cyanide to depress cobalt flotation, were promising. Cobalt and bismuth recoveries were good with varying grind size; gold recovery was determined to be dependent on grind size.

Three composites were prepared from the same drill core samples used in the PR1 testwork.

13.2.1.3 Lakefield LR5593 Progress Report 5 (PR5), 2000 (Lakefield, 2000)

This test series was primarily designed around producing higher grade cobalt concentrates through multiple stages of cleaning. Environmental tests on flotation water and tailings solids were also completed.

Sample rejects from the 1996, 1997 and 1998 drill programs stored at SGS Lakefield were used to prepare composite samples labelled Middle Zone (MZ) and Lower Zone (LZ). Twelve bags of rejects from the 1998 drilling program were received from Chemex and used to prepare composites MZ-2 and LZ-2. Average grades of the MZ and LZ composites were as follows:

Composite MZ: Bi 0.14%, Co 0.21%, As 0.92% and Au 0.16 g/t.
Composite LZ: Bi 0.17%, Co 0.20%, As 0.84% and Au 1.04 g/t.

13.2.1.4 Lakefield LR10226-001 Progress Report 5 (PR6), 2001 (Lakefield, 2001)

Extensive flotation testing successfully produced separate cobalt and bismuth concentrates with high grades and recoveries. These tests established several circuit parameters, including regrind size and single stage bulk cleaning, and confirmed that only two flotation reagents are required. Ore variability testing established gold feed grade and recovery characteristics. Mineralogical examinations of flotation streams characterized cobalt in arsenopyrite minerals, as well as other minerals. Cobalt as a replacement metal in arsenopyrite explained the inability for cobalt grade to improve with multiple cleaning (see LR5593 PR5).

Three shipments of samples were received in 2001, originating from the 2000 drilling program. These samples were combined to produce one overall mine composite, five gold variability composites, seven Co to As ratio variability composites and two composites representing years 1 to 5 and 6 to 10 of the mine life.

13.2.1.5 AR MacPherson LR10044-103, 2004 (MacPherson, 2004)

A series of grinding tests were completed on composite samples labelled LZ, MZ and DC Comp. An older test from a 1999 composite was also included with the report. The older composite was identified as NICO and described as Upper Zone (UZ). This sample was probably part of the composite used in the LR5070 tests (see PR1 and PR3). Tests completed during this program included the following:

- Wax density tests.
- Modified JK drop weight test (partial test MZ and LZ Comp).
- MacPherson autogenous grindability test (UZ and DC Comp only).
- Bond rod and ball mill grindability tests.
- Bond abrasion test (UZ only).
- JK SimMet simulations and grinding circuit design.

The test results are summarized in Table 13.3.

Table 13.3
2004 Comminution Test Results

Composite Sample	Ore Density	A	b	A x b	AWi		RWi	BWi	Ai
					(kg/h)	(kWh/t)	(kWh/t)	(kWh/t)	(g)
NICO 1999 – Upper	2.98	-	-	-	5.4	17.5	17.8	16.1	0.4173
Lower Ore Zone	3.37	100	0.22	22.0	-	-	-	12.1	-
Middle Ore Zone	3.32	100	0.22	22.0	-	-	-	10.5	-
Composite	-	-	-	-	-	-	17.5	-	-
DC-Comp	3.26	-	-	-	4.4	18.6	20.2	13.6	-

The grindability results showed relatively high autogenous and Bond rod mill indices, medium Bond ball mill indices and a high abrasion index, suggesting that the material is abrasive.

13.2.1.6 Lakefield LR10226-002 Progress Report (PR7), 2004 (Lakefield, 2004)

Work completed during this testing program included:

- Batch and locked cycle flotation testing.
- Grind size variation.
- Bond ball mill work index.
- Gold leach recovery from cleaner tailings using cyanide.

A shipment of samples was prepared from the 2003 drilling program, from which four composites were prepared.

13.2.1.7 Lakefield LR10226-005 Progress Report PR8, 2005 (Lakefield, 2005)

This program examined bulk flotation for producing concentrates for hydrometallurgical testwork. Detailed assays of final concentrates were completed, as well as cyanide leach testing of various concentrates and tailings samples for gold recovery.

The material used for this program of work comprised 2.9 tonnes of reject samples from Chemex and an additional drill core sample. A total of 75% of the reject samples were from the 2000 drilling program, while the remaining 25% were from 2003. A shipment of drill core samples from 2003 was also received and used for grinding and metallurgical testwork. This was identified as the DC sample. The grades of the two composite samples were:

Bulk sample (2000 and 2003 assay rejects)	: Bi 0.16%, Co 0.17%, As 0.92%, and Au 1.91 g/t.
Drill core composite (2003)	: Bi 0.22%, Co 0.15%, As 0.67%, and Au 3.83 g/t.

13.2.1.8 Hydrometallurgical Mini-Pilot Plant, 2006

In 2004 to 2005, a more detailed testwork program was conducted using flotation concentrate samples derived from two bulk samples (see LR10226-005 PR8). This testwork included both a bench scale and a mini-pilot scale component. The purpose of the bench testwork was to verify the earlier leach results and establish solution chemistry and reaction rates in advance of the pilot scale continuous test. A single batch pressure oxidation test and a number of semi-continuous tests were proposed. The extractions were consistent with previous results, with cobalt extraction at 97% and gold extraction ranging from 95.2% to 97.7%.

The cobalt extractions from the two mini-pilot scale pressure oxidation tests were 95% to 96%. A significant difference in gold extraction was noted, with the concentrate sample derived from assay rejects only 88%, while the fresh core sample concentrate produced a gold recovery of about 95%.

The testwork performed during the 2001 to 2006 period became the basis for Micon's Feasibility Study in 2007 (Hennessey et al., 2007). The data and results used in the Micon study were referenced and compared periodically to data in the FEED report.

13.2.2 2007 Pilot Plant

In October, 2007, Fortune provided approximately 176 t of mineralized sample from the NICO deposit to SGS-MS for an extensive laboratory and pilot plant test program. This material originated from underground development specifically targeted to produce a representative bulk sample for pilot plant testing. The bulk sample was primarily taken from three mined areas:

1. The 156 level drifts in October, 2006.
2. A spur off of the 156 level mined in May, 2007.
3. The 118 level mined in August, 2007.

Mineralized samples were bagged, assayed and screened prior to shipping to SGS-MS. A total of 255 supersacks were separated into 12 composite samples, representing both underground ore samples (UG) and open pit ore samples (OP). Composites were blended to form sample P-1, which represented a 2(OP):1(UG) blend of ore that was planned at that time to be representative of the first two years of operation. A second composite was blended to form sample P-2, which represented the remaining years of open pit operation.

The grades of the two composite samples were as follows:

Composite P-1 (UG) Bi 0.18%, Co 0.10%, As 0.47%, and Au 2.72 g/t.
Composite P-2 (OP) Bi 0.25%, Co 0.11%, As 0.46%, and Au 0.90 g/t.

The flotation pilot plant test was carried out in December, 2007. The purpose of the pilot plant was to produce bulk quantities of concentrate for hydrometallurgical testing, to confirm the concentrator flowsheet, to provide engineering design criteria for Micon's Feasibility Study (Hennessey et al., 2007), to test the variability of the ore on plant production, to evaluate the impact of recycled water on plant production and to perform environmental impact testing on all discharge streams. The hydrometallurgical test program extended throughout 2008 and 2009.

This testwork program included:

- Mineralogical characterization.
- Bond rod and ball mill work indices.
- Bench flotation testing.
- Bench rougher kinetics.
- Batch cleaner flotation.
- Bench locked cycle testing.
- Full pilot plant grinding and flotation operation.

- Isamill re-grind testing of bulk cleaner concentrate.
- Solid-liquid separation testing.
- Flocculant testing.
- Conventional thickener sizing.
- High-rate thickener sizing.
- Rheological data summary.

Formal sub-reports from this pilot testing program included:

- Investigation by High Definition Mineralogy into the Mineralogical Characteristics of two Samples, SGS Minerals Services CALR-11747-001, MI5035-NOV07- Report No. 1.

- Flocculant Screening, Gravity Sedimentation and Pulp Rheology for SGS Lakefield Research - Fortune, December, 2007.

13.2.2.1 Grinding Data

The P-1 and P-2 composites were both subjected to rod mill and ball mill grindability tests. The rod mill values were considered relatively high and the ball mill values were average, which corresponded to earlier test results (see AR MacPherson LR10044-103, 2004). The results are summarized Table 13.4.

Table 13.4
2007 Pilot Plant Grinding Test Results

Composite ID	Rod Mill Work Index		Ball Mill Work Index	
	kWh/t	Hardness Percentile	kWh/t	Hardness Percentile
P-1	19.1	88	14.2	47
P-2	20.1	93	14.8	53

13.2.2.2 Flotation Circuit Results

The pilot plant flowsheet consisted of a rod mill/ball mill combination to grind the ore, followed by bulk flotation (rougher, cleaner and cleaner-scavenger), regrind, and bismuth flotation (rougher, rougher-scavenger and three stages of cleaning) to produce a bismuth concentrate and a separate cobalt concentrate. The initial intent was to grind the ore from a crushed product at P_{80} minus 9 mm to a final grind fineness of P_{80} 70 microns. The crushing setting was changed to P_{80} minus 5 mm, because of the limited capacity of the rod mill. From this crushed product size, it was possible to maintain a good throughput rate; but the ball mill was too large, so the final grind was P_{80} minus 57 µm.

The metal recoveries and concentrate grades from the pilot plant were better than laboratory testwork results; this was thought to be due to the finer grind. The regrind fineness, prior to bismuth flotation, was at the laboratory flotation testwork size of P_{80} 14 µm.

The results of the pilot plant flotation circuit for the underground and open pit composites are presented in Table 13.5 and Table 13.6, respectively.

Table 13.5
Summary of Average Head Grades and Circuit Performance of Composite P-1

Product	Grade (%, g/t)			Recovery (%)		
	Bi	Co	Au	Bi	Co	Au
Head	0.18	0.10	2.71	100.0	100.0	100.0
Bulk Concentrate	1.26	0.76	17.15	87.4	94.2	77.5
Bulk Cleaner Concentrate	5.37	3.40	69.16	79.8	90.0	67.1
Bi Concentrate	45.1	0.83	492	71.6	2.3	51
Co Concentrate	0.61	3.70	18.5	8.1	87.6	16

Table 13.6
Summary of Average Head Grades and Circuit Performance of Composite P-2

Product	Grade (%, g/t)			Recovery (%)		
	Bi	Co	Au	Bi	Co	Au
Head	0.26	0.11	0.91	100.0	100.0	100.0
Bulk Concentrate	1.81	0.86	5.03	86.8	94.5	69.1
Bulk Cleaner Concentrate	6.82	3.38	17.33	79.5	90.3	57.8
Bi Concentrate	48.9	0.46	110	72.2	1.6	46.2
Co Concentrate	0.77	3.71	3.91	8.1	89.1	11.7

The flotation reagents used were MIBC, PAX and NaCN. Dosing requirements were optimized for each circuit and are listed below:

- Bulk flotation rougher, >250-g/t PAX (includes PAX added to tertiary grind), 50-g/t MIBC.
- Bulk flotation cleaner and scavenger, 30-g/t PAX.
- Bismuth flotation rougher, 17-g/t NaCN, 7-g/t PAX, 0.5-g/t MIBC.
- Bismuth flotation cleaner scavenger, 10-g/t NaCN, 1-g/t PAX.
- Bismuth flotation 2nd cleaner, 1-g/t NaCN.

13.2.2.3 Solid-Liquid Separation

As part of the pilot plant testing, Pocock Industrial Inc. (Pocock) was retained to perform thickener settling tests on the bismuth and cobalt concentrates. A summary of the design criteria developed by Pocock is shown in Table 13.7. These results were adopted by Jacobs for the FEED study.

Bulk concentrate was not tested for settling rate but, since both the bismuth and cobalt concentrates had the same settling rate of 0.13 m^3/t/d, this rate was used for the bulk concentrate thickening design. For the FEED study design, a high-rate thickener was specified for the bulk flotation tails and conventional thickeners for the bulk concentrate.

Table 13.7
Solid/Liquid Design Criteria from Pocock Thickener Testwork

Thickener Duty	Pocock / SGS Lakefield Results and FEED Design Criteria		
	Specific Loading/Settling Rate	Flocculant Addition Rate	Underflow Solids
Bulk Flotation Tails	3.7 m^3/m^2.h	35 g/t	65-70 wt%
Cleaner Tails	0.17 m^2/t/d	80 g/t	50-55 wt%
Bismuth Concentrate	0.13 m^2/t/d	30 g/t	50-58 wt%
Cobalt Concentrate	0.13 m^2/t/d	50 g/t	60-65 wt%
Bulk Concentrate	0.13 m^2/t/d	80 g/t	60 wt%

13.2.2.4 2007 Pilot Plant Testing Part 2, SGS Lakefield Research 11747-002

In September, 2008, residual samples from the 2007 bulk pilot campaign were recombined into four composites to represent different regions of the NICO deposit and were used for a second continuous pilot plant campaign. The objective was to produce concentrates for further processing and testwork. Grinding and flotation parameters were monitored and reported. The feed composites were compiled to test ore variability and circuit stability under different feed conditions. Composite samples designated as P-3 and P-4 were used for this series. The testwork included:

- Bond rod and ball mill work indices.
- Grinding media type tests.
- Grinding and flotation operating parameters.

13.2.3 Kinetics and FLEET Modelling (2009)

A set of flotation tests were undertaken at SGS-MS in 2009 (SGS Lakefield Research 11747-003), comprising primarily rougher and cleaner kinetic type flotation tests to provide input into a Flotation Economic Evaluation Tool (FLEET) computer model to simulate different flotation cleaning circuit options. The objective of the work was to optimize the bulk flotation circuit and to increase product recoveries, in particular gold, contained in the bulk cleaner tailing stream.

FLEET is a software simulation tool that factors the variability of flotation response across an orebody and takes into account the difficulties that arise from the scaling-up of laboratory tests. SGS-MS considers that the use of FLEET to address flotation problems by using a computer modelling approach improves the design, optimization and planning of flotation plants

The FLEET flotation simulator was used to evaluate the performance of different circuits in terms of their valuable metal recovery and final concentrate product quality, and to determine the best configuration for optimizing the flotation circuit. The scope of the flotation kinetics study included:

- Derivation of flotation kinetic parameters from the results of the standard flotation tests conducted on bulk composite sample P-1.
- Benchmark simulation of the locked cycle tests.
- Evaluation of various flotation cleaner circuit configurations.

The FLEET exercise considered six different flowsheets. The design used for the Jacobs FEED study was based on flowsheet Options 4 and 6 used in the FLEET simulation study. Flowsheet Option 4 comprised a bulk rougher, two stages of cleaning and a cleaner-scavenger stage being fed by the primary cleaner tailings. Flowsheet Option 6 consisted of a bulk rougher and primary cleaner, with a primary cleaner-scavenger and primary cleaner-scavenger tailings regrind to P_{80} 20 µm. Regrind product was fed to a secondary roughing stage, a secondary rougher cleaner and cleaner-scavenger. The concentrate from the secondary cleaner was combined with the bulk second cleaner concentrate to form the bulk concentrate product. The concentrate from the secondary cleaner-scavenger was fed back into the bulk first cleaner stage. The input parameters for Option 4 and 6 are given in Table 13.8.

Table 13.8
Fleet Flowsheet Options 4 and 6 Input Parameters

Process Stream	Flotation Cell Volume (m^3)	No. of Cells	Froth Recovery (%)	Entrainment
Bulk rougher [4,6]	50	7	30	0.40
Bulk cleaner [4,6]	10	4	55	0.56
Bulk cleaner-scavenger [4,6]	10	3	55	0.56
Bulk second cleaner [4]	10	2	55	0.56
Secondary rougher [6]	10	5	45	0.61
Secondary cleaner [6]	5	2	45	0.61
Secondary cleaner-scavenger [6]	5	2	45	0.61

[4] Flowsheet Option 4.
[6] Flowsheet Option 6.

The stage recoveries obtained independently for Options 4 and 6 by using the input parameters presented in Table 13.8 are provided in Table 13.9 and Table 13.10, respectively. It was noted that the FLEET simulation work was based on a small sample of material and bench scale locked cycle tests, and with flotation feed material at a slightly different P_{80} grind size. Therefore, it is possible that the recoveries stated in the FLEET model might not completely reflect the actual achievable recoveries in plant operation.

Table 13.9
FLEET Flowsheet Option 4 Stage Recoveries

Process Stream	Stage Recoveries (%)							
	Mass		Bi		Co		Au	
	Target	Model	Target	Model	Target	Model	Target	Model
Bulk Rougher	12.1	12.1	88.0	87.0	92.0	94.2	78	80.1
Bulk Cleaner	27.6	23.5	-	88.3	-	93.1	-	83.2
Bulk Cleaner-Scavenger	14.3	8.3	-	67.2	-	67.2	-	64.8
Bulk Cleaner + Clnr-Scav.	-	-	97.0	96.8	96.0	99.1	90.0	97.6
Bulk Second Cleaner	-	77.6	-	96.8	-	98.1	-	95.3
Rougher Circuit	-	12.1	-	87.0	-	80.1	-	80.1
Cleaner Circuit	-	20.6	-	95.7	-	97.3	-	93.0
Overall	**3.7**	**2.5**	**85.0**	**83.3**	**89.0**	**91.6**	**70**	**74.5**

Table 13.10
FLEET Flowsheet Option 6 Stage Recoveries

Process Stream	Stage Recoveries (%)							
	Mass		Bi		Co		Au	
	Target	Model	Target	Model	Target	Model	Target	Model
Bulk Rougher	12.1	12.1	88.0	87.0	92.0	94.2	78	80.1
Bulk Cleaner	27.6	24.2	-	90.1	-	94.2	-	85.5
Bulk Cleaner-Scavenger	14.3	9.3	-	69.6	-	65.6	-	67.4
Bulk Cleaner + Clnr-Scav.	-	-	97.0	96.8	96.0	97.9	90	94.7
Secondary Rougher	-	12.6	-	55.2	-	56.4	-	58
Secondary Cleaner	-	15.5	-	76.6	-	75.4	-	80.6
Secondary Clnr-Scav.	-	10.7	-	58.1	-	54.8	-	57.4
Stage 1 Recovery	-	3.1	-	84.2	-	92.2	-	75.9
Stage 1 Cleaner Recovery	-	26.0	-	96.8	-	97.9	-	94.7
Stage 2 Recovery	-	1.9	-	42.3	-	42.5	-	46.7
Stage 2 Cleaner Recovery	-	15.5	-	76.6	-	75.4	-	80.6
Overall	**3.7**	**3.3**	**85.0**	**85.5**	**89.0**	**93.1**	**70**	**78.0**

The addition of Option 6 is not likely to have much impact on the overall recovery of cobalt, as most of it would have already reported to the bulk flotation concentrate. An increase in the overall recovery of bismuth and gold, however, is to be expected.

13.2.4 Flow Property Tests.

Flow property tests were undertaken on a sample of NICO mineralization by Jenike and Johanson Ltd. (J&J). This test program comprised testing of flow properties for storage bin design. The sample was not identified but came from SGS Lakefield in 2008, presumably from the large bulk sample used in the pilot plant.

This testwork indicated that, after 24 hours at rest, for both moisture contents tested (3.4% and 7.5%), the maximum recommended wall angle was 10^{o} from the vertical for flows in chutes and bins.

J&J determined that the minimum chute angles necessary for flow indicated that, with mild steel plate and 7.5% moisture, an angle of 52^{o} from the horizontal was required.

13.2.5 Ore Hardness Variability Testing (2008)

A program of ore hardness variability testing was completed by Starkey and Associates in 2008. These tests were undertaken using ten different drill core samples, including waste samples. Models based on these data were used to determine grinding circuit options. A summary of the results from this test program is presented in Table 13.11.

Table 13.11
Summary of Results from the Ore Hardness Variability Tests (2008)

Sample No.	Description	Calc SAG Pinion Wi[1] (kWh/t)	SG Solids	SAG Dis. Bond Wi (kWh/t)	Calc BM Pinion Wi[2] (kWh/t)	Total Pinion Wi (kWh/t)
1	Year 1 OP[3]	16.6	3.16	13.5	12.5	29.0
2	Years 2 to 4 OP and UG[4]	19.8	3.32	12.7	11.7	31.5
3	Year 1 UG	29.5	3.26	13.3	12.2	41.8
4	Hard ore years 2 to 4	17.3	2.93	15.1	13.9	31.2
5	Middle zone – average	29.6	3.44	12.3	11.3	40.9
6	Deepest UG ore	34.9	3.30	13.7	12.6	47.5
7	Ryolite waste	12.6	2.61	24.1	22.1	34.7
8	Porphry / dike waste	16.4	2.74	18.0	16.5	32.9
9	Year 5, beyond OP	17.1	3.40	12.9	11.8	29.0
10	Pre, bio-amph-schist	29.4	3.19	13.4	12.4	41.8
	Average of 8 ore samples	24.3	3.25	13.4	12.3	36.6

[1] Product size 12 mesh.
[2] Product size 74 µm.
[3] OP = open pit.
[4] UG = underground.

13.2.6 2010 Pilot Plant Testwork

In April, 2010, Fortune selected another 57 t of mineralized sample from the 2006/2007 underground mining campaign. One-tonne capacity bags from that campaign were catalogued and assayed and stored for future use. These samples were assembled to evaluate the wider variability in the ore and the grades of the three composite samples were as follows:

Composite P-3 Bi 0.25%, Co 0.02%, As 0.08%, and Au 2.86 g/t (low Co, high Bi).
Composite P-4 Bi 0.02%, Co 0.11%, As 0.29%, and Au 2.04 g/t (low Bi, high Co).
Composite P-5 Bi 0.14%, Co 0.07%, As 0.18%, and Au 2.45 g/t (residual P3, P4).

This test program was the third continuous grinding and flotation pilot plant operation. The goal was to include the additional cleaning circuits defined by the FLEET modelling. The tests included in this program were:

- Chemical feed analysis.
- Bond ball and rod grindability tests.
- High-Pressure Grinding Rolls (HPGR) investigation.
- Gravity recoverable gold.
- Flotation bench kinetics tests.
- Locked cycle flotation tests.
- Bismuth/cobalt separation tests (with pilot plant pulps).
- Pilot plant operation, grinding and flotation.
- Water analysis.
- Filtration testwork.

The measured Bond rod mill work index and Bond ball mill work index of the P-5 composite were 20.6 kWh/t and 14.3 kWh/t, respectively. These results were consistent with previous test results.

An HPGR trade-off study was completed. Taking into consideration the additional fines in the HPGR product, it was estimated that the HPGR product would require ~6% less power on average, compared to standard feed, to grind from a P_{100} of 6 mesh to a P_{100} of 200 mesh.

A Knelson gravity recoverable gold (GRG) test was conducted on each of the P-3 and P-4 composites, which produced corresponding GRG numbers of 10.7% and 18.3%, respectively.

The pilot plant flowsheet consisted of a rod mill/ball combination to grind the ore, followed by bulk flotation (rougher, cleaner, cleaner-scavenger, second cleaner), regrind, secondary flotation (rougher, cleaner and cleaner-scavenger), bismuth regrind, and bismuth flotation (rougher, rougher-scavenger and three stages of cleaning) to produce a bismuth concentrate and a separate cobalt concentrate. A summary of the average pilot plant flotation results is shown in Table 13.12 and Table 13.13.

Table 13.12
Flowsheet Options 4 and 6 Pilot Plant Results for Composite P-3

Shift ID	Product	Mass (wt %)	Assay (Adjusted) (%, g/t)				Distribution (%)			
			Bi	Co	S	Au	Bi	Co	S	Au
Average PP-08A to PP-08B	PP Feed	100.0	0.23	0.023	0.32	2.40	100.0	100.0	100.0	100.0
	Bulk Ro Conc	19.1	1.00	0.11	1.57	8.48	83.3	88.8	94.0	67.7
	Bulk Conc	3.2	5.45	0.60	8.84	41.5	76.1	84.1	88.6	55.6
	Scav 1st Cl Conc	1.5	0.26	0.017	0.42	4.67	1.8	1.2	2.0	3.0
	Bi Circuit Feed	3.8	4.73	0.51	7.59	37.4	78.8	85.1	90.7	59.7
	Bi Ro Scav Tails (Co Conc)	3.6	0.98	0.53	6.96	13.5	15.2	82.1	77.4	20.0
	Bi Conc	0.3	54.9	0.26	15.9	357	63.7	3.0	13.3	39.7

Table 13.13
Flowsheet Options 4 and 6 Pilot Plant Results for Composite P-5

Shift ID	Product	Mass (wt %)	Assay (Adjusted) (%, g/t)				Distribution (%)			
			Bi	Co	S	Au	Bi	Co	S	Au
Average PP-06A to PP-07B	PP Feed	100.0	0.14	0.076	0.45	2.56	100.0	100.0	100.0	100.0
	Bulk Ro Conc	20.4	0.59	0.33	2.10	9.8	84.9	89.4	94.3	78.1
	Bulk Conc	3.6	3.02	1.73	10.8	49.0	78.3	82.9	86.5	69.8
	Scav 1st Cl Conc	0.8	0.30	0.12	1.23	7.20	1.6	1.2	2.1	2.2
	Bi Circuit Feed	4.4	2.55	1.45	9.1	41.7	79.9	84.1	88.6	71.9
	Bi Ro Scav Tails (Co Conc)	4.1	0.54	1.45	7.67	15.0	15.5	77.7	68.7	23.8
	Bi Conc	0.3	26.0	1.40	26.0	353	64.4	6.4	20.0	48.1

A combined bulk and secondary flotation concentrate sample was sent for pressure filter testing. The lowest moisture recorded was 17.8%.

13.2.7 Compressive Strength Tests

Ore compression and tensile strength tests were undertaken at Queens University in August, 2010. This program was for testing of the 2010 drill core samples to measure unconfined compression, triaxial confined compression and Brazilian indirect tension failure tests.

In 2005, Golder had performed unconfined compressive strength (UCS) tests on six samples. The results varied from 75 Mpa for “ore zone black rock” to 238 MPa for “hanging wall rhyolite”, with an average of 149 MPa.

The 2010 tests at Queen’s University derived values ranging from a low of 55.7 MPa to a high of 212 MPa, and averaging 123 MPa.

13.3 CONCENTRATOR CIRCUIT SELECTION AND ESTIMATED PLANT PERFORMANCE

The overall cobalt, bismuth, gold and copper recoveries estimated by Jacobs for the concentrator FEED study are 90.9%, 82.1%, 72.6% and 89.1% respectively. The stage and total recoveries are summarized in Table 13.14.

Table 13.14
Concentrator FEED Study Plant Recoveries

Description	Stage Recovery (%)				Overall Recovery (%)			
	Co	Bi	Au	Cu	Co	Bi	Au	Cu
Plant Feed	100	100	100	100	100	100	100	100
Gravity Conc.	-	-	10.2	-	-	-	7.8	-
Bulk Flot Conc.	90.5	80.8	68.3	88.2	90.5	80.8	63.0	88.2
Secondary Flot Conc.	8.9	13.7	16.1	13.0	+0.5	+1.3	+1.8	+0.9
Bulk and Secondary Flot Tails					9.1	17.9	27.4	10.9
Overall Recovery					**90.9**	**82.1**	**72.6**	**89.1**

Subsequent to publication of the FEED study, P&E and Fortune reviewed the gold recovery data, particularly with respect to the relationship between gold head grade and gold recovery. As a result of this review, the gold recoveries used in the financial model now vary from period to period, depending on the gold grade of the process plant feed. Base metal recoveries in the financial model are held constant at the levels quoted in Table 13.14.

The average, maximum and process design feed grades, as well as the estimated bulk concentrate grades used in the FEED study, are presented in Table 13.15.

Table 13.15
FEED Design Feed and Concentrate Grades

Description	Co (%)	Bi (%)	Au (g/t)	Cu (%)	As (%)
Average ROM feed grade	0.127	0.165	0.96	0.039	0.845
Maximum ROM feed grade	0.219	0.311	3.82	0.091	1.491
Selected plant design feed grade	0.145	0.190	2.39	0.034	1.002
Plant design concentrate grade	3.66	4.33	44.28	0.84	25.61

A summary and comparison of design data from the 2007 Micon Feasibility Study, the 2007 SGS Lakefield pilot plant work and the 2008 design criteria used for the FEED study are provided in Table 13.16.

Table 13.16
Summary and Comparison of Crushing, Grinding and Flotation Design Parameters

Parameter	Units	2007 Micon Study	2007 Pilot Plant	FEED Design
Crushing (P_{80})	mm	12	9 (target), 5 (actual)	15
Primary Grind (P_{80})	µm	72	70 (target), 57 (actual)	74[2]
Regrind (P_{80})	µm	14	14	15

Parameter	Units	2007 Micon Study	2007 Pilot Plant	FEED Design
SAG Mill Work Index[1]	kWh/t	17.5	-	-
Bond Rod Mill Work Index	kWh/t	17.5	19.1 / 20.1	20.2
Bond Ball Mill Work Index	kWh/t	10.5 – 12.1	14.2 / 14.8	13.6
Regrind Mill Work Index	kWh/t		8	8
Rougher Flotation	minutes	35	45 – 60	45
Bulk Cleaner / Cleaner-Scavenger	minutes	10 total	8 / 6.2	10 / 8
Bismuth Rougher	minutes	8 per stage (4 stages total)	6.9	7
Bismuth Scavenger	minutes	-	6.5	7
Bismuth Cleaner (3 stages)	minutes	-	3.1 / 3.5 / 10.8	3.5 (per stage)

[1] SAG milling was found to be not suitable for the NICO ore, and was not considered in the FEED study.
[2] Finer primary grind to P_{80} of 56-53 μm gives improved gold recovery and has been adopted for current design.

13.4 Hydrometallurgical Circuit Testwork

Since 1997, a significant amount of testwork for the hydrometallurgical circuit has been conducted on NICO mineralization. Preliminary laboratory bench scale work was conducted at SGS through 2003, resulting in the establishment of a basic flowsheet. A more definitive testwork program, known as the ‘mini-pilot’, was conducted at SGS and EHA Engineering (EHA) in 2004 and 2005 for the preparation of the Micon Feasibility Study. An extended pilot plant test program also was performed from 2006 to 2009 at SGS. The results from this pilot plant test program became the basis for the preparation of a FEED study by Jacobs that covers the SMPP. Additional pilot plant work at SGS Lakefield was completed between 2010 and 2012.

The Feasibility Study hydrometallurgical process design is based on the FEED study prepared by Jacobs. The majority of the design criteria for the hydrometallurgical facility were based on information from the bench scale and pilot testwork performed at SGS Lakefield from 2006 to 2012, and supplied by Fortune or its contractors.

13.4.1 SMPP Concentrate Feed Characteristics

Feed to the SMPP facility will be a bulk concentrate containing gold, cobalt, bismuth and copper from the NICO mine and concentrator.

Based on the estimated production head grades and the recovery from the bulk flotation circuit at the NICO concentrator, the average project bulk concentrate head grade and the design grade for the SMPP facility are summarized in Table 13.17.

Table 13.17
FEED Design SMPP Bulk Concentrate Feed Grades

Description	Co (%)	Bi (%)	Au (g/t)	Cu (%)	As (%)	S (%)
Average feed grade	3.23	3.55	25.19	1.03	21.2	-
Selected plant design feed grade	3.66	4.31	51.6	0.87	25.8	17.5

The bulk concentrate is composed primarily of sulphides, namely arsenopyrite (FeAsS), pyrite (FeS_2), cobaltite (CoAsS) and chalcopyrite ($CuFeS_2$).

The measured specific gravity of the dry solids in the bulk concentrate material is approximately 4.3; this includes the 8 wt% entrained moisture in the concentrate.

The bulk concentrate feed to the SMPP will have a particle size of approximately P_{80} 56 µm. IsaMill, Jar and Stirred Media Detritor (SMD) tests were performed on this material to determine the specific energy requirement to grind to a P_{80} of 15 µm.

The IsaMill test determined that the specific energy required to achieve a P_{80} reduction from 56.7 microns to 15 microns is 39.3 kWh/t. For the same material and grind size, the Jar Mill Test resulted in a specific energy of 51.7 kWh/t. Using the conventional Metso Minerals Canada Inc. (Metso) factor of 65% for Vertimill applications, the work index is calculated to be 33.6 kWh/t. The laboratory SMD specific energy for the bulk concentrate is 19.80 kWh/t. With a safety/scale-up factor of 110% as proposed by Metso, the predicted specific energy requirement for SMD is 21.78 kWh/t.

13.4.2 Bismuth Flotation

A number of bench flotation tests have been undertaken for the NICO ore since 1997, and flotation parameters have been determined.

A beneficiation pilot plant test was carried out at SGS Lakefield in December, 2007, to produce bulk quantities of concentrate for hydrometallurgical testing, to confirm the concentrator flowsheet, and to provide engineering design criteria confirmation for the definitive Feasibility Study. The results of the 2007 pilot plant flotation circuit are presented in Table 13.5 and Table 13.6, included previously.

More work was carried out at SGS Lakefield in September, 2009, to optimize the bulk flotation circuit and to increase product recoveries, in particular for gold contained in the bulk cleaner tailing stream. The FLEET flotation simulator was used to evaluate different circuit performance, in terms of valuable metal recovery and final concentrate product quality, and to determine the best circuit configuration for optimizing the flotation circuit.

13.4.3 Cobalt Hydrometallurgical Circuit

13.4.3.1 Bench Scale Testwork

Bench scale testwork was undertaken at SGS Lakefield between 1997 and 2003, to determine operating conditions for pilot tests. A batch pressure oxidation test carried out at 180°C yielded a cobalt extraction of up to 97%. After a solid/liquid separation step, the copper and cobalt in solution were treated in two solvent extraction circuits. Extracted cobalt ultimately was recovered as a high grade cobalt carbonate. Gold was recovered by conventional cyanidation of the autoclave residue.

13.4.3.2 Mini-Pilot Plant Tests (2004 -2005)

In 2004 to 2005, a more detailed testwork program was conducted using concentrate samples produced during the flotation cycle testwork and concentrates derived from two bulk samples. This testwork included both a bench scale and a mini-pilot scale component. The extractions were consistent with previous results, with cobalt extraction at 97% and gold extraction ranging from 95.2% to 97.7%. It was noted that the autoclave residue consists mainly of crystalline scorodite ($FeAsO_4$), which is very stable, and which settles and filters well.

Pregnant solution neutralization for acid, iron and arsenic removal was successful, with the addition of lime or limestone to a pH of 5.0 and oxygen sparging. Part of the copper and cobalt was co-precipitated with the iron and arsenic in the precipitation cake but was recovered in a weak acid leach.

A copper polishing precipitation step using NaHS was proven to be fast and effective.

Two-stage precipitation using soda ash and caustic soda was tested. A pilot first-stage precipitation test yielded a carbonate product with 50.6% Co, while a second-stage caustic precipitation in a batch test successfully lowered the barren solution concentration to 1.2 mg/L Co.

Nickel and zinc remain in solution at high enough concentrations that they adversely affect the final cobalt electrowinning purity. An ion exchange (IX) process was selected for the removal of zinc and nickel.

Electrowinning (EW) of cobalt also was tested to produce sheet cobalt cathode. Marketable product was demonstrated, but nickel, iron, zinc and lead exceeded specifications for the highest grade product. It was concluded that the impurities should be reduced with improved IX performance for Ni and Zn removal.

13.4.3.3 Pilot Plant Testing 2008 to 2010

As it was not possible to pilot the complete hydrometallurgical process at the same time, the continuous pilot plant was operated in the following sequential sections:

- Co pressure oxidation (POX) autoclave, Fe/As precipitation, Cu cementation.
- Co carbonate precipitation.
- Co carbonate re-leach, impurity removal with ion exchange, Co electrowinning.

Cobalt Pressure Oxidation

During the continuous Co POX pilot runs, three different composite feed grades were tested; these were designated “high Au” (PP2), “mid Au” (PP3), and “low Au” (PP4).

The autoclave tests were undertaken at 180°C for 60 minutes and at a free acid concentration of 35 g/L. The Co leach extraction achieved was 93% to 95% and 65% to 76% for Cu.

Fe/As Removal

SGS testwork indicated that good Fe/As removal can be achieved with neutralization to pH 4.6, using 5 hours of retention time. Settling characteristics are reasonable, with 25 wt% solids underflow densities achieved in the thickener. Precipitation extents from the cobalt pregnant leach solution (PLS) were Fe - 99.9%, As - 99.7%, Al - 98.2%, Zn - 36%, Cu - 80% and Co - 2%.

Copper Recovery

The process includes a Co/Cu re-dissolution step to recover these valuable elements from the Fe/As residue. During the pilot plant test, the residue was re-leached with sulphuric acid and then the re-leach solution was treated further with the addition of Fe powder to remove Cu. The FEED design assumes that 60% of the Co will be re-leached, as well as 85% of the Cu. These criteria are conservative compared to the results obtained during the pilot plant testing, and it is considered that copper recovery could be improved and cobalt loss reduced.

It is noted that, after the completion of the pilot plant testwork, the copper cementation circuit was replaced by a copper solvent extraction/electrowinning (SX/EW) circuit. Further analysis, however, demonstrated that the amount of copper available in the concentrates would not support this more costly option, and the current design is to produce copper cement at the SMPP.

The PLS from the Fe/As precipitation is carried forward to copper precipitation to polish and remove residual copper. Two methods were piloted:

- Carbonation by adding sodium carbonate to remove copper and recycling the carbonate precipitate before Fe/As precipitation.

- Removal of copper using ion exchange, followed by a two-stage elution cycle to strip nickel/copper and cobalt separately.

The current cobalt sulphate circuit will include copper precipitation prior to the cobalt recovery process using solvent extraction. This process is not selective against manganese in solution, and a new step has been developed to remove manganese prior to copper precipitation, using SO_2 and air to precipitate manganese oxide. The solution will then flow to the copper precipitation step. The same filter that removes the copper will also remove the suspended manganese oxide solids. The filter cake will be returned to the head of the iron-arsenic removal stage.

Pocock was retained to perform thickening, vacuum and pressure filtration tests on the autoclave discharge material. A pressure filter was selected over a filter press because of its shorter cycle time.

Cobalt Recovery

Two options have been considered for the recovery of cobalt. One is a cobalt cathode and the other, which is now the Feasibility Study base case, is the recovery of cobalt as a cobalt sulphate.

13.4.3.4 Pilot Plant Testing 2011 to 2013

Fortune has conducted extensive marketing of its NICO Project in Asia. This work determined that there is a significant demand for a cobalt sulphate heptahydrate product used to make high performance lithium-ion and nickel metal hydride rechargeable batteries, and that this product typically receives a premium price for the contained cobalt. A testwork campaign was initiated at SGS Lakefield, including pilot plant production of more than 10 kg of cobalt sulphate heptahydrate, in March and April, 2012.

Fortune already had 2,000 L of cobalt pregnant solution that had been processed by acid pressure leach in an earlier autoclave pilot plant test, and this was used to conduct the testwork. Notably, most of the flowsheet that Fortune has already piloted and engineered to produce a 99.8% cobalt cathode product is also used to produce a high purity cobalt sulphate heptahydrate crystal product. After removing metal impurities from the cobalt solution using sequential neutralization, however, solvent extraction is used to reject metal impurities, leaving a pure cobalt sulphate solution which is then evaporated and subjected to a three-stage crystallization process, instead of electrowinning metal. Approximately 10 kg of high quality cobalt sulphate heptahydrate product containing in the range of 19.3 to 20.5% Co was produced in the test, to prove the process flowsheet and product quality. The test data allow for commercial product design to consistently return in excess of 20.5% Co in the heptahydrate product. Production of cobalt sulphate was added as a sensitivity option in the FEED study by Jacobs and was subsequently adopted as the final option for the Feasibility Study.

Producing cobalt sulphate salt through a solvent extraction circuit produces a very clean dissolved cobalt solution from which cobalt will be precipitated as cobalt sulphate heptahydrate. The same solution can also be used to make other cobalt salts, including cobalt carbonate, cobalt oxide, cobalt nitrate and cobalt chloride, which can be precipitated, filtered and dried, or concentrated, crystallized and dried, for sale.

In 2011, continuous and batch pressure oxidation tests were performed on the combined cobalt concentrate and re-pulped Bi leached residue feed. The motivation to test this route was to eliminate the bismuth residue cyanidation and gold electrowinning circuit, and process both the bismuth leached residue and cobalt concentrate through an autoclave and, subsequently, through just one cyanidation step. The pressure oxidation tests produced cobalt, copper and other recoveries consistent with the previous testwork.

13.4.4 Bismuth Circuit

Initial bench scale testwork completed at SGS Lakefield showed that countercurrent ferric chloride leaching of the bismuth flotation concentrate, followed by cementation, was a successful process for the recovery of bismuth into a saleable product.

13.4.4.1 Bismuth Leaching

During the pilot plant test at SGS Lakefield, pressure oxidation and brine leaching of the bismuth concentrate was suggested as an alternative to ferric chloride leaching. Bench testwork showed that, at a pressure oxidative environment of 180°C for 1 hour, followed by a solid-liquid separation and then 2 hours of brine leach, bismuth recovery can reach as high as 99.0%.

One major advantage of pressure oxidation is the possible recovery of cobalt and copper from bismuth concentrate, which are not recoverable through the ferric chloride leaching route. The bismuth autoclave discharge solution containing the cobalt and copper would be bled into the cobalt circuit, by combining with the solution from the cobalt autoclave. Pilot testwork was performed on this proposed flowsheet. The high sulphur content in the bismuth concentrate was proven to be problematic. Significant scaling of elemental sulphur occurred, causing numerous plugging problems and shutdowns of the pilot autoclave. The two-stage countercurrent brine leach testwork was challenging to operate as well. Further, cyanide destruction of the bismuth autoclave discharge residue also proved to be difficult. Due to all the challenges encountered with the bismuth concentrate, the strategy of pressure oxidation and brine leach was abandoned.

SGS Lakefield conducted conventional thickening and filtration testwork on bismuth leach residue in 2009. Two series of filtration tests were conducted. The first preliminary series was conducted at room temperature and excluded washing. The second series included washing and was conducted at 60°C. Wash efficiency was determined by following iron analyses. It was noted that bismuth tended to precipitate on dilution and the initial wash required both chloride and acid.

13.4.4.2 Bismuth Electrowinning

Bench scale EW tests on pregnant solution prepared by brine leaching and ferric chloride leaching were undertaken to develop basic EW operating conditions and provide proof of concept. Observations, which were oriented toward production of a solid metal cathode product, were used to guide the next phase of testwork. Current efficiency in the testwork was generally satisfactory, with efficiency falling substantially as the solutions became depleted in bismuth.

Leach solutions obtained by single and two-stage leaching of concentrate were subjected to electrowinning at two temperatures. The single-stage leach solution contained residual ferric iron, which resulted in unsatisfactory current efficiency. This confirmed the need for two-stage leaching. Good quality cathode assaying >99% Bi was obtained in both tests. A temperature of 50°C and a target feed concentration of 100 g/L were adopted for further work.

It was clear from the previous testwork that ferric iron could not be tolerated in the catholyte and that separation of catholyte and anolyte with a membrane would allow the iron oxidation reaction to complete the circuit and regenerate ferric iron for re-use in leaching. It was noted that, in the absence of sufficient ferrous iron, the generation of chlorine or oxygen can occur at the anode. Two types of membranes were evaluated, an anionic (quaternary amine) exchange membrane (Ionac® MA-7500) and a low permeability filter cloth. Subsequent testwork evaluated a number of physical membranes of various permeabilities, but none of these latter membranes proved suitable and the essentially impermeable MA-7500 material was adopted for design purposes.

Three anode materials were evaluated and compared on the basis of iron oxidation efficiency. These were titanium, platinized titanium and graphite. No chlorine generation was evident in any test.

13.4.4.3 Chloride Leach and Electro-Recovery (CLER) Process

Later in 2009, an initial series of locked cycle tests to demonstrate the viability of the chloride leach and electro-recovery (CLER) process flowsheet for extracting Bi from the NICO flotation concentrate were carried out. Counter-current leach cycles, initially using synthetic fresh ferric chloride solution, were conducted to generate solution for continuous EW tests. Leaching was conducted at a chloride concentration of 120 g/L NaCl and a temperature of around 95 to 100°C, with slurry density and solution concentrations controlled to yield a 3:1 molar ratio of ferric iron to bismuth in solution in Stage 2 feed.

The two-stage leach in the CLER process is required for control of iron oxidation. The primary purpose of the first stage is not bismuth leaching but to convert all ferric iron to ferrous, using the reducing capacity of the concentrate.

The spent solution from the scavenger EW cell was subjected to iron/arsenic removal testwork using hydrated lime. Minor arsenic leached in Stage 2 yielded a solution containing +/- 100 mg As/L. During Stage 1 leaching, the arsenic concentration in solution was typically reduced to <10 mg/L. The low arsenic concentration of Stage 1 results in an effluent solution from the scavenger cell that is very low in arsenic and no difficulty is expected in reducing the concentration to environmental standards. The solution also contained iron in the ferric state and preliminary tests indicated that no additional oxidant would be required, although some peroxide was added during the latter half of the test.

Additional CLER and continuous EW work was conducted in early 2010 to evaluate alternative electrodes and membrane materials, and the production of a powder bismuth product. Subsequently, melting tests were undertaken on cathode powder product. The primary objective for these tests was to demonstrate satisfactory production of a bismuth powder which would avoid uncertainties regarding the physical character of solid cathode metal. Production of a powder would also simplify the metal recovery operation and allow operation at higher current density with a consequent reduction in the capital cost.

Tests of alternate (physical) membranes were unsuccessful and the original MA-7500 IX membrane was adopted.

Two types of dimensionally stable anodes (DSA) supplied by De Nora Tech were evaluated. DSA anodes consist of titanium substrate with a proprietary mixed metal oxide solution of a precious metal, in this case palladium (Ti-Pd). A total of 10 EW-leach cycles were conducted with variable cathode material, current density and recirculation rates.

Average current efficiency for Bi EW of approximately 95.6% was obtained, which was not affected by current density or the material used as cathode. Based on the highest anodic current density evaluated, a design current density of 200 A/m^2 was selected. Further testwork may allow an increase in this criterion.

The results indicated that the anode metallurgical (i.e. oxidation) efficiency, on average, exceeded the anodic current efficiency, whereas they are expected to be equal. This effect was confirmed in a series of smaller tests and was shown to be related to the DSA anodes used, which appeared to have a catalytic effect on the oxidation of iron.

Following the primary EW testwork, the effect of current density on scavenger cell operation (treating the primary EW bleed stream) was investigated. In all cases, the evolution of H_2 (g) in the cell was high. The constant evolution of H_2 (g) caused floating of the bismuth, ultimately forming a layer covering all the cathodic compartment area. This situation was less problematic during the late stages of Test 2 but still quite significant. A current density of less than 100 A/m^2 was selected for design of the scavenger cells.

The oxidation of iron was in all cases 100%, with the significant excess of power producing chlorine and/or oxygen at the anode.

Melting tests of the resulting powders from both the EW and scavenger cells confirmed that a high purity bismuth ingot containing 99.99% Bi was achievable.

13.4.5 Gold Circuit

The gold recovery circuits were not tested at the continuous pilot plant scale. Rather, batch bottle roll tests were conducted on samples taken from the pilot plant. These initial cyanidation tests were completed on bismuth concentrate samples, as well as on cobalt POX residue combined with bulk flotation cleaner tails.

An early FEED study considered cyanidation of the bismuth residue followed by gold EW. Tests completed in 2011 confirmed that the Bi leached residue can be combined with the Co concentrate in the feed to the autoclave.

13.4.5.1 Bismuth Concentrate Gold Circuit

Initial leach testwork on bismuth concentrate showed inconsistent gold recoveries, which most probably was due to a passivation effect from flotation reagents. A few treatment strategies were tested, such as high shear mixing and pre-treating with iron powder to imitate regrinding with steel media instead of ceramic. The passivation effect eventually was overcome by adding a heat treatment stage, where the concentrate is kept at 60°C for four hours before cyanidation. Cyanidation residence time was 72 hours.

13.4.5.2 Cobalt Residue Gold Circuit

In an earlier study (Hennessey et al., 2007), the autoclave discharge residue was combined with the cleaner tails, at a 50/50 blend ratio, to recover gold from both materials. The overall gold extraction was calculated based on individual recoveries from the two streams.

For the Feasibility Study, bulk flotation cleaner tails will remain at the NICO concentrator and will not be available for gold recovery. Bottle roll tests were completed to verify gold recoveries from the cobalt residue.

13.4.5.3 Merrill Crowe

After the completion of the pilot plant testwork, a trade-off study compared carbon-in-pulp (CIP) and Merrill Crowe for the recovery of gold in cyanide solution. It was decided from the result of the trade-off study that Merrill Crowe should be used. The PLS solution first will be deaerated in a column before being contacted with zinc powder to precipitate gold. A design addition rate of 30:1 Zn to Au molar ratio is used, to reach a gold precipitation recovery of 99.7%. The gold precipitates are recovered from the barren solution by filtration.

13.4.5.4 Combined Residue Gold Circuit

In 2011, it was decided to feed the bismuth leached residue and the cobalt concentrate to the autoclave POX and to treat the autoclave residue product through cyanidation and a Merrill Crowe circuit. The cyanidation testwork on the autoclave residue suggested similar results to the previous testwork on gold recovery from cyanidation of cobalt residue, at around 95%.

This process route is an alternative to the bismuth residue cyanidation and the gold electrowinning circuits and allows the recovery of cobalt and copper from bismuth leach residue, which will otherwise be lost to tails.

13.4.6 Cyanide Destruction

Cyanide destruction tests completed on the Project so far have been based on the INCO SO_2/air process. Small scale continuous testwork was completed on a blend of cyanided residues from cobalt POX, cleaner tails and bismuth in the approximate ratios expected to be seen in the plant (3.1, 12.7, 0.2 kg, respectively).

With the replacement of CIP with Merrill Crowe, the stream requiring cyanide destruction is a barren solution stream, free of solids. The INCO SO_2/air process, which typically is used on a slurry stream, may not be the most suitable process for liquid cyanide destruction. Additional cyanide detoxification testwork was arranged to determine the most effective destruction strategy.

Cyanide detoxification with hydrogen peroxide was allowed for in the FEED study, using standard industrial practices and consumption as the design criteria. Allowance was made to add, in an agitated tank, 2 to 8 g of hydrogen peroxide per gram of cyanide ion (CN^-) to reach a target residual total cyanide level of 1 mg/L at discharge.

13.4.7 Pressure Oxidation Autoclave Corrosion

13.4.7.1 Autoclave Materials Corrosion Tests

The material of construction for the pressure oxidation autoclave was a major focus for the SMPP plant design. The high maintenance associated with a conventional brick lined pressure oxidation autoclave prompted an investigation into alternative materials. SJC Materials Engineering Ltd. was retained in 2008 to perform corrosion testing for a range of alloys to determine the best material for this application. The alloys tested included three super-duplex stainless steel materials (2507, Zeron 100 and Ferrallium), two nickel-based alloys (Hastelloy C22 and Inconel 686), and Titanium Grade 2.

The original solution produced from the pilot plant test program at SGS was used for this corrosion test, but with a spiked acid and chlorides concentration to simulate potential operational upset conditions in the SMPP autoclave. The corrosion testing results showed significant corrosion for all tested materials in both the vapour and the liquid conditions, with the exception of titanium which performed well in both phases.

Based on this corrosion test, three different materials for the autoclave were proposed for economic comparison. These were titanium shell, titanium clad carbon steel shell and acid brick lined carbon steel shell. For the two titanium options, different grades of titanium also were considered for further improvements in crevice corrosion resistance. Grades 2, 12, 16 and 26 were considered for the titanium shell option, while the softer Grades 1, 17 and 27 were considered for the titanium clad option. It was determined from the comparison that the titanium clad autoclave with carbon steel shell is the most economical option.

13.4.7.2 Erosion and Crevice Corrosion Tests on Titanium

Based on the success with titanium in the SMPP autoclave environment, further testwork was performed in 2009 and 2010 at Xstrata Process Support Laboratories (XPS) to determine the effect of erosion and crevice corrosion on various grades of titanium. Six different grades of titanium, namely Grades 2, 3, 7, 12, 16 and 26, were investigated. These grades were chosen because they are more readily available, and are softer, which makes them suitable for fabrication of a titanium clad autoclave.

To determine the effect of crevice corrosion, each of the six titanium coupons was mounted on specially designed autoclave agitator blades, submerged in the original pilot plant solution with spiked acid and chlorides, for four weeks.

To understand the effect of erosion, the test autoclave also was loaded with 15 wt% slurry, which represents the slurry density at the back end of the autoclave. A second round of tests with 30 wt% solids was performed later to simulate the conditions inside the first autoclave compartment. Both sets of test results confirmed negligible general corrosion, and no development of crevice corrosion on all grades of titanium tested. It was concluded that all titanium grades tested were deemed suitable for autoclave cladding.

13.5 HYDROMETALLURGICAL CIRCUIT SELECTION AND ESTIMATED PLANT PERFORMANCE

The hydrometallurgical flowsheet selected for the Feasibility Study comprises regrinding of the bulk flotation concentrate to 14 microns and bismuth flotation to separate the feed into a cobalt concentrate and bismuth concentrate. The bismuth concentrate will be treated in the CLER circuit to produce bismuth ingot product with a target purity of >99% Bi. This circuit will also be capable of producing bismuth needles and, with some minor additions, bismuth oxide.

The CLER circuit bismuth residue and the cobalt concentrate will undergo pressure hydrometallurgical treatment and the cobalt pregnant solution will be processed by solvent extraction to remove metal impurities, followed by a three-stage crystallization process to produce a cobalt sulphate heptahydrate product grading 20.9% cobalt. This circuit will also be capable of producing cobalt carbonate, cobalt oxide, cobalt nitrate and cobalt chloride.

The residue from the pressure treatment, which contains significant amounts of gold, will be leached with cyanide. The gold in the cyanide pregnant leach solution will be recovered as gold doré using a Merrill Crowe circuit.

A copper cement product containing about 88% Cu will be recovered in an iron cementation circuit. This copper recovery circuit will be fed from the Fe/As residue re-leach circuit. The copper cement will be sold to a copper smelter for conversion to copper metal.

The overall cobalt, bismuth, gold and copper recoveries estimated by Jacobs for the hydrometallurgical FEED study are 92.9%, 87.9%, 94.7% and 46.2%, respectively. The stage and total recoveries are summarized in Table 13.18. The overall estimated Project cobalt, bismuth, gold and copper recoveries, including the NICO concentrator and the SMPP are 84.4%, 72.2%, 68.8% and 41.2%, respectively.

Table 13.18
Hydrometallurgical FEED Study Plant Recoveries

Description	Stage Recovery (%)				Overall Recovery (%)			
	Co	Bi	Au	Cu	Co	Bi	Au	Cu
Plant Feed	100	100	100	100	100	100	100	100
Bulk Concentrate	90.9	82.1	72.6	89.1	90.9	82.1	72.6	89.1
Bulk Concentrate Feed (SMPP)	100	100	100	100	100	100	100	100
Bismuth Flotation Concentrate	2.2	88.9	78.7	60.4	2.2	88.9	78.7	60.4
Bismuth Flotation Tails (Co Concentrate)	97.8	11.1	21.3	39.6	100	11.1	21.3	39.6
Co Concentrate, Bi Residue Feed					100		100	71.2
Pressure Oxidation	95.0		100	76.0	95.0		100.0	54.1
Solution Neutralization, Co Precipitation and Cu Cementation	98.5			85.4	93.6			46.2
Purification & Ion Exchange	99.3				92.9			
Co Electrowinning	100				92.9			
Bi Concentrate Feed						88.9		
Bismuth CLER		98.86				87.9		
Gold: Cyanidation Feed							100.0	
Gold Cyanidation			95				95.0	
Merrill Crowe			99.7				94.7	
Gold Refinery			100				94.7	
SMPP Recovery					**92.9**	**87.9**	**94.7**	**46.2**
Overall (NICO + SMPP) Recovery					**84.4**	**72.2**	**68.8**	**41.2**

a. The recoveries represent the results from SGS pilot plant testing between 2007 and 2011. The process facilities were designed using the process conditions demonstrated by the pilot plants. The recoveries in the table represent the performance of the process plant with similar ore feed conditions.

b. The current process design and the METSIM model are based on testwork results up until 2009. In the next phase, the METSIM model should be updated with the recovery values from the testwork conducted in 2010 and 2011. The latest recovery values, although slightly different from METSIM, are not anticipated to affect the design and equipment selection significantly. These are the changes:
   a. Autoclave residue cyanidation gold recovery was revised from 89.5% to 95%.
   b. Au recovery in the autoclave was revised to be based on 100%.
   c. Recoveries of Cu in NICO and SMPP were revised.
   d. Co, Bi, Au and Cu recoveries at NICO were revised from FLEET modelling values to pilot test results.
   e. Co recovery in solution neutralization, precipitation was revised from 96.1% to 98.5%.

c. The table does not represent the anticipated recovery of the orebody. The bulk metals, cobalt and bismuth have somewhat consistent recovery rates over the expected mine life/ore grade profiles and the process facility is designed to accommodate these varying feed grades. Gold, however, does have a noticeable trend with lower feed grades having lower flotation recoveries and conversely higher feed grades will have a higher recovery. Gold recovery for the plant design was based on a blend of ore samples that will not necessarily match the ore fed to the plant. The anticipated gold grade and recovery fluctuations will not affect the plant equipment sizing or costs.

d. Chloride Leach and Electro-Recovery (CLER) circuit for the recovery of Bi is provided by Fortune, based on reports provided by EHA/DMA on Bi processes and recovery.

14.0 MINERAL RESOURCE ESTIMATES

14.1 INTRODUCTION

The mineral resource estimate presented herein was prepared by P&E and is summarized in Puritch et al., 2012. The mineral resources were estimated following the guidelines of the Canadian Securities Administrators' National Instrument 43-101 and Form 43-101F1 and in conformity with Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Estimation of Mineral Resource and Mineral Reserves Best Practice guidelines. Mineral resources have been classified in accordance with the CIM Standards on Mineral Resources and Reserves: Definition and Guidelines.

Mineral resources are not mineral reserves and do not have demonstrated economic viability. There is no guarantee that all or any part of a mineral resource will be converted into a mineral reserve. Confidence in the estimate of inferred mineral resources is insufficient to allow the meaningful application of technical and economic parameters or to enable an evaluation of economic viability worthy of public disclosure.

All mineral resource estimation work reported herein was carried out by Fred H. Brown, CPG, P. Geo., and Eugene Puritch, P.Eng., both of whom are independent Qualified Persons. The mineral resource estimate is based on information and data supplied by Fortune and independently verified by the Qualified Persons.

Mineral resource modelling and estimation were carried out using the GEMS Gemcom v5.23 and Snowden Supervisor v7.10.11 software programs.

14.2 PREVIOUS MINERAL RESOURCE ESTIMATE

A previous mineral resource estimate (see Table 14.1) was released in November, 2004, and subsequently used in a Feasibility Study reported by Micon in 2007. These estimates have now been superseded by the current mineral resource estimate.

Table 14.1
Previous Mineral Resources Estimate Dated November, 2004

Area	NSR Cut-off (C$/t)	Class	Tonnes x 1,000	Au (g/t)	Bi (%)	Co (%)	NSR (C$/t)
Open Pit	$20	Measured	2,718	0.46	0.155	0.120	$32.76
		Indicated	5,513	0.49	0.126	0.137	$35.11
		M+I	**8,231**	**0.48**	**0.136**	**0.131**	**$34.33**
U/G	$50	Measured	1,382	3.97	0.192	0.129	$78.17
		Indicated	3,741	3.25	0.223	0.170	$79.86
		M+I	**5,123**	**3.44**	**0.210**	**0.160**	**$79.40**

Hennessey et al., 2007.

14.3 SAMPLE DATABASE

Sample data were provided in the form of Excel spreadsheets and Access databases (Puritch et al., 2012). The supplied databases contain 25,055 assay records from 325 drill holes (Table 14.2). P&E used 299 drill hole records for its mineral resource estimate, and each drill hole record consisted of collar, survey and assay data. Assay data fields consisted of the drill hole identification numbers, down-hole interval distances, sample number and individual element grades. Sampling data for 22 trenches were also included; however, trench data were used for visual domaining only and not for grade estimation. All data are in metric units, and have been converted to the NAD83 GPS coordinate system.

Table 14.2
NICO Drilling Database Records

Phase	Number	Metres
2009	288	55,541.37
2010	37	6,112.00
Total	**325**	**61,653.37**

Industry standard validation checks were completed on the supplied database, and minor corrections made where necessary. P&E validated the mineral resource database by checking for inconsistencies in naming conventions or analytical units, duplicate entries, interval, length or distance values less than or equal to zero, blank or zero-value assay results, out-of-sequence intervals, intervals or distances greater than the reported drill hole length, inappropriate collar locations, and missing interval and coordinate fields. No significant discrepancies with the supplied data were noted. P&E concluded that the database was suitable for mineral resource estimation.

14.4 DOMAIN MODELLING

Three mineralization domains and five lithological domains were modelled. Domain models were generated from successive polylines oriented perpendicular to the trend of the mineralization and spaced every five metres along the strike of the deposit. Mineralization domains were defined by continuous mineralization and assay intervals equal to or greater than a calculated net smelter return (NSR) value of C$40/t.

Where necessary, a small number of lower value assays were included, in order to preserve continuity. All polyline vertices were snapped directly to drill hole assay intervals, in order to generate a true three-dimensional representation of the extent of the mineralization. A topographic surface of unknown resolution was also supplied by Fortune from LiDAR data, and all domain wireframes were clipped to this surface. The resulting mineralization domains were used as hard boundaries during estimation, and for rock coding, statistical analysis and compositing limits.

A total of 5,966 bulk density measurements were provided by Fortune, with an average bulk density of 3.18 t/m^3 (Table 14.3). Bulk density values were back-tagged to lithological domains and used to determine average bulk density values for mineral resource estimation.

Table 14.3
Bulk Density Measurments

Domain	Rock Code	Average Bulk Density (t/m^3)
Lower Mineralization Domain	10	3.25
Middle Mineralization Domain	20	3.21
Upper Mineralization Domain	30	2.94
QAP Dykes	100	3.05
FAP Dykes	200	3.05
Volcanics	300	3.03
Wackes	400	3.12
Siltstone	500	3.37

14.5 COMPOSITING

Drill hole assay samples display bimodal sampling lengths, averaging 1.00 m and 3.00 m in length, respectively. In order to provide equal sample support, length-weighted 3.00 m composites were calculated for all elements within the defined mineralization domains. A small number of unsampled intervals were assigned a nominal grade of 0.0001 for compositing purposes. The compositing process started at the first point of intersection between the drill hole and the domain intersected, and halted upon exit from the domain wireframe. Composites that were less than 1.00 m in length were discarded so as to not introduce a short sample bias into the estimation process. The wireframes that represent the interpreted mineralization domains were also used to back-tag a rock code field into the composite workspace. The composite data were then exported to Gemcom extraction files for grade estimation, and summary composite statistics were calculated by domain for each element (Table 14.4).

14.6 TREATMENT OF EXTREME VALUES

The presence of high-grade outliers was evaluated from grade-capping curves and by the review of histograms and log-probability graphs of the grouped composite grade data. For gold, estimation was done using indicator kriging, and a capping threshold was derived from the high-grade bin. For bismuth, the capping threshold selected was equivalent to the 99.87 percentile, and the cobalt and copper capping thresholds were set to the same percentile. Composite values were capped to the selected threshold value prior to estimation (Table 14.5).

Table 14.4
NICO Uncapped Composite Statistics by Domain

Statistic	Domain 10	Domain 20	Domain 30	Total
Au Composites				
Statistic	**Domain 10**	**Domain 20**	**Domain 30**	**Total**
Samples	1,837	1,515	523	3,875
Minimum	0.0001	0.0001	0.0001	0.0001
Maximum	43.45	47.17	8.63	47.17
Mean	0.84	0.77	0.15	0.72
Standard Deviation	2.83	2.52	0.47	2.52
CV	3.39	3.29	3.12	3.52
Bi Composites				
Statistic	**Domain 10**	**Domain 20**	**Domain 30**	**Total**
Samples	1,837	1,515	523	3,875
Minimum	0.0001	0.0001	0.0001	0.0001
Maximum	2.73	1.41	1.03	2.73
Mean	0.12	0.11	0.04	0.10
Standard Deviation	0.20	0.15	0.10	0.17
CV	1.65	1.38	2.30	1.63
Co Composites				
Statistic	**Domain 10**	**Domain 20**	**Domain 30**	**Total**
Samples	1,837	1,515	523	3,875
Minimum	0.0001	0.0001	0.0001	0.0001
Maximum	1.02	1.12	0.91	1.12
Mean	0.11	0.08	0.04	0.09
Standard Deviation	0.13	0.09	0.08	0.11
CV	1.16	1.22	1.84	1.28
Cu Composites				
Statistic	**Domain 10**	**Domain 20**	**Domain 30**	**Total**
Samples	1,837	1,515	523	3,875
Minimum	0.0001	0.0001	0.0001	0.0001
Maximum	0.88	0.59	1.17	1.17
Mean	0.03	0.03	0.05	0.03
Standard Deviation	0.07	0.06	0.10	0.07
CV	2.14	1.96	2.13	2.11

Note: CV = Coefficient of Variation.

Table 14.5
NICO Capping and Threshold Values

Commodity	Threshold	Number Capped
Au	24.00 g/t	8 (0.2%)
Bi	1.40 %	5 (0.1%)
Co	0.94 %	4 (0.1%)
Cu	0.71 %	5 (0.1%)

14.7 CONTINUITY ANALYSIS

For bismuth, cobalt and copper, directional experimental semi-variograms were modelled from uncapped composite data, using a normal-scores transformation (Table 14.6). The down-hole variogram was viewed at a 3 m lag spacing (equivalent to the composite length) to assess the nugget variance contribution. Nugget and standardized spherical models were used to construct the experimental semi-variograms in normal-score transformed space. Semi-variogram model ranges were then checked and iteratively refined for each model relative to the overall nugget variance, and back-transformed variance contributions were calculated for grade interpolation. Continuity ellipsoids based on the semi-variogram models were then generated for each variable and used to define the appropriate search strategy.

For gold, directional indicator semi-variograms were modelled from uncapped composite data based on a 1.50 g/t indicator threshold (Table 14.6). Experimental indicator semi-variograms for each of the three principal directions were constructed and, in general, the strike and dip directions were aligned with observed mineralization trends, with the cross-strike direction being variable.

Table 14.6
NICO Experimental Semi-Variograms

Commodity	Strike	Dip	Cross-Strike	Semi-Variogram
Au	80 m	80 m	10 m	0.4 + Sph(0.40, 80)
Bi	120 m	40 m	40 m	0.14 + Sph(0.86, 140)
Co	120 m	40 m	40 m	0.37 + Sph(0.63, 120)
Cu	120 m	40 m	40 m	0.16 + Sph(0.84, 120)

14.8 BLOCK MODELS

A block model was established across the mineralized domains, based on a 5 m by 5 m by 5 m block size (Table 14.7). The block model consists of separate sub-models for estimated grades, indicator kriging probabilities, associated rock codes, percent, density and classification attributes, and a calculated NSR value. A percent block model was used to accurately represent the volumes and tonnages that were contained within the respective mineralization domains.

Table 14.7
NICO Block Model Setup

Axis	Minimum	Maximum	Size (m)	Number
X	510,907.50	513,307.50	5	480
Y	7,046,793.59	7,048,293.59	5	300
Z	-100.00	400.00	5	100
Rotation	-20.112°			

14.9 ESTIMATION AND CLASSIFICATION

The mineral resource estimate was constrained by wireframes that form hard boundaries between the respective composite data files. Individual block grades were used to calculate a NSR block grade model.

Block estimates for gold were calculated using non-linear indicator kriging of capped composite grades. Based on the defined 1.50 g/t indicator semi-variogram, a high-grade probability, high grade estimate and low-grade estimate were calculated for each block and then combined into a single block estimate. Bismuth, cobalt and copper were estimated using linear ordinary kriging of capped composite grades.

A three-pass series of expanding search ellipses with varying minimum sample requirements was used for sample selection, estimation and classification.

During the first pass, five to twelve composite values from two or more drill holes within a search ellipsoid corresponding to 45% of the defined bismuth variogram ranges were required for estimation. All block grades estimated during the first pass were classified as Measured.

During the second pass, blocks not populated during the first pass were estimated. Five to twelve composite values from two or more drill holes within a search ellipsoid corresponding to 100% of the defined bismuth variogram ranges were required for estimation. All block grades estimated during the second pass were classified as Indicated.

During the third pass, blocks not populated during the first or second pass were estimated. Three to twelve composite values from one or more drill holes within a search ellipsoid corresponding to about 300% of the defined range were required for estimation. All block grades estimated during the third pass were classified as Inferred.

14.10 MINERAL RESOURCE ESTIMATE

In order to ensure that the reported mineral resources meet the CIM requirement for reasonable prospects for economic extraction, a conceptual floating-cone optimized pit shell was developed based on all available mineral resources (Measured, Indicated and Inferred), using the economic parameters listed in Table 14.8. The gold price used was based on the 36-month trailing average as of November, 2011. Copper was not included in the mineral resource estimate.

Table 14.8
Economic Parameters

Parameter	Value
Gold Price	US$1,250.00/oz
Bismuth Price	US$10.00/lb
Cobalt Price	US$20.00/lb
Open Pit Mining Cost	C$2.50/t
Underground Mining Cost	C$32.00/t
Processing Cost + G&A	C$46.00/t
Exchange Rate	0.95
Pit Wall Slope Angle	45°

All open pit mineral resources are reported against a C$46 NSR cut-off (Table 14.9), as constrained within the optimized pit shell. Underground mineral resources are reported outside the optimized pit shell against a C$80 NSR cut-off. The estimated mineral resources are summarized in Table 14.10. The effective date of this estimate is November 30, 2011.

Table 14.9
NSR Metal Unit Values

Commodity and Range	Recovery (%)	NSR (C$/t)
0.3 g/t >= Au < 0.5 g/t	56	23.31
0.5 g/t >= Au < 1.5 g/t	60	24.98
1.5 g/t >= Au < 2.5 g/t	70	29.14
2.5 g/t >= Au < 3.5 g/t	74	30.80
3.5 g/t >= Au < 4.5 g/t	79	32.89
Au >= 4.5 g/t	84	34.97
Co %	83	385.22
Bi %	70	162.44

Table 14.10
NICO Estimated Mineral Resources

Area	NSR Cut-off (C$/t)	Class	Tonnes x 1,000	Au (g/t)	Bi (%)	Co (%)
Open Pit	46	Measured	18,911	1.05	0.15	0.12
		Indicated	10,983	1.19	0.14	0.12
		M+I total	**29,894**	**1.10**	**0.15**	**0.12**
		Inferred	2	0.30	0.07	0.08
Underground	80	Measured	231	2.29	0.06	0.15
		Indicated	764	1.72	0.07	0.16
		M+I total	**995**	**1.85**	**0.07**	**0.16**
		Inferred	31	0.65	0.11	0.25

1. Open pit mineral resources are defined within an optimized pit shell that incorporates projected metal recoveries, estimated operating costs and metals price assumptions.
2. Mineral resources which are not mineral reserves do not have demonstrated economic viability. The estimate of mineral resources may be materially affected by environmental, permitting, legal, marketing or other relevant issues. The mineral resources were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum Standards on Mineral Resources and Reserves, Definitions and Guidelines, prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council.
3. The quantity and grade of reported inferred resources are uncertain in nature and there has been insufficient exploration to define these inferred resources as an indicated or measured mineral resource. It is uncertain if further exploration will result in upgrading the inferred resources to an indicated or measured mineral resource category.

14.11 MINERAL RESOURCE VALIDATION

The block model was validated visually by inspection of successive section lines, in order to confirm that it correctly reflects the distribution of high-grade and low-grade samples.

An additional validation check was completed by comparing the model block grade estimates to the average grade of the capped composites used for estimation (Table 14.11). P&E believes the mineral resource estimate to be reasonable and robust.

Table 14.11
Validation Statistics for Capped Composites and Block Estimates

Commodity	Capped Composite Average	Block Estimate
Au g/t	0.693	0.709
Bi %	0.104	0.101
Co %	0.089	0.089
Cu %	0.034	0.034

14.12 CONCLUSIONS

Micon has reviewed the current November, 2011 mineral resource estimate used in the 2012 Technical Report completed by P&E and the Fortune 2013 Feasibility Study update. The estimate was checked for reasonableness and use of appropriate methodologies.

Micon is familiar with Fortune's NICO deposit having completed a mineral resource estimate on it in 2003/2004 and an earlier Feasibility Study in 2007.

14.12.1 Block Model Checks

In August, 2013, after reading the P&E Technical Report (Puritch et al., 2012) and reviewing the 2007 Feasibility Study, Micon met with Fred Brown, the Qualified Person responsible for the November, 2011 mineral resource estimate for the NICO Project. This estimate was used in the 2012 Technical Report and 2013 Feasibility Study update, and is also used in this report.

The mineralization (grade shell) and block models were reviewed on-screen and the geological model was also reviewed. Grade shell models were compared to previous interpretations and for agreement with the new drilling. Block model grades were compared to nearby drill holes for reasonable agreement.

Numerous questions were asked and answered, regarding such matters as the handling of the unmineralized late dykes in the model, the structure of the NSR formula and the grade interpolation methodology used.

The grade shell models were found to be reasonable interpretations of the mineralization displayed on the drill hole traces on-screen. The interpolation methods were judged to be appropriate for the situation. Interpolated block grades for cobalt, bismuth and gold were found to be in reasonable agreement with the nearby informing samples from the drill holes.

All grades were generally higher in the Middle and Lower zones, with gold higher in the down-dip portions of those zones and bismuth generally higher up-dip. Cobalt was transitional between the two.

The overall resource grades for bismuth and cobalt were found to compare reasonably well with the 2007 estimate, although the gold grades were much lower. This can be explained by the use of a US$1,250/oz gold price in the NSR formula, versus the US$375/oz price used in the 2007 study. The lower overall gold grade has slightly affected the average bismuth and cobalt grades.

14.12.2 Summary

Gold grades vary locally more than the cobalt and bismuth grades do. The local accuracy of estimation for gold grades in each block may not be high, given the generally 30- to 50-m spaced drilling and lack of very tight infill drilling. The model, however, is considered to be globally accurate. Construction of a blasthole data block model during mining should quickly identify local variations in grade.

The distribution and variability of cobalt and bismuth grades in the model are quite smooth and there is expected to be little issue with local estimation accuracy.

Micon concludes that the mineral resource model for the NICO deposit is suitable for use in a Feasibility Study. To the best of Micon's knowledge, there are no known environmental, legal, title, technical, taxation, socio-economic, marketing, political or other relevant factors which would materially affect the mineral resource estimate.

15.0 MINERAL RESERVE ESTIMATES

15.1 MINERAL RESERVE CRITERIA

Mineral reserve estimates were prepared by P&E and are summarized in Puritch et al. (2012). The mineral reserves for the open pit and underground mining operation were determined based upon a mine plan, mine dilution, mine extraction and operating costs, for an annual production rate of 1,698,400 t, based on 4,650 t/d, 365.25 d/y. Table 15.1 presents the parameters that were used to determine both the open pit and underground reserves.

Table 15.1
Resource to Reserve Conversion Parameters

Commodity	Price US$ (US$/oz or /lb)	Metallurgical Recovery (%)	Recoverable Value (C$/%/t or C$/g/t)
Gold < 0.5 g/t	1,200	63%	22.74
Gold – 0.5-1.5 g/t	1,200	67%	24.37
Gold – 1.5-2.5 g/t	1,200	72%	28.43
Gold – 2.5-3.5 g/t	1,200	77%	30.05
Gold – 3.5-4.5 g/t	1,200	81%	32.08
Gold > 4.5 g/t	1,200	87%	34.11
Cobalt	17	83%	327.44
Bismuth	9	70%	146.20
Copper	2.36	60%	32.86
	Exchange Rate		
	C$ 1.00 = US$ 0.95		
	Operating Costs		
	U/G Ore Mining	$104.64	per tonne mined
	Processing	$41.82	per tonne processed
	G&A	$6.25	per tonne processed

Fortune Minerals (2013).

15.2 NET SMELTER RETURN (NSR)

Given the polymetallic nature of the NICO deposit, the NSR has been used to determine the value of each mining block within the resource model. Mining cut-off limits have been determined using the NSR values summarized in Table 15.1. Block NSR net values that exceed the cut-off value were classified as resources that could be converted to reserves. The NSR value per tonne for each block in the model was determined on the basis of parameters such as anticipated concentrate recoveries, smelter payables, smelter treatment charges, applicable refining charges, royalties, metal prices and the C$/US$ exchange rate. For currency conversion, an exchange rate of C$1.00/US$0.95 was used. The metal prices used for the estimation of reserves were based on a three-year trailing average that was adjusted downwards for certain metals for the purpose of rounding to reasonable values.

15.3 UNDERGROUND RESERVES

Since the publication of the most recent Technical Report on the NICO Project by Purtich et al., in 2012, Fortune has developed more detailed plans for underground mining. These plans include certain tonnages that were previously considered to be mined by open pit methods, and certain additional tonnages, not considered in Purtich et al., 2012. The current underground mining plan is based on the reserves summarized in Table 15.2.

Table 15.2
Underground Reserves

Classification	Tonnes (Thousand)	Au (g/t)	Co (%)	Bi (%)	Cu (%)
Proven	282	4.93	0.14	0.27	0.03
Probable	295	5.00	0.07	0.07	0.01
Total	**577**	**4.96**	**0.10**	**0.17**	**0.02**

Fortune Minerals (2013).

1. Mine recovery and dilution are included in these quantities.
2. All of the material designated as reserves in the underground portion was derived from measured and indicated resources that have been demonstrated to be economic as result of the current study and are therefore designated as proven and probable reserves using the Canadian Institute of Mining, Metallurgical and Petroleum (CIM) Standards on Mineral Resources and Reserves, Definitions and Guidelines, prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council.

15.4 OPEN PIT RESERVES

The open pit mineral reserve estimate summarized in Table 15.3 has been determined based on selection of blocks that are above the marginal economic NSR cut-off of C$48.07/t. Approximately 100,000 t of open pit reserves included in Purtich et al., 2012, are now planned to be mined by underground methods.

Table 15.3
Open Pit Reserve

Classification	Tonnes (Thousand)	Au (g/t)	Co (%)	Bi (%)	Cu (%)
Proven	20,453	0.92	0.11	0.15	0.04
Probable	12,047	1.03	0.11	0.13	0.04
Total	**32,500**	**0.96**	**0.11**	**0.14**	**0.04**

Fortune Minerals (2013).

1. Mine recovery and dilution are included in these quantities.
2. All of the material designated as reserves in the open pit portion was derived from measured and indicated resources that have been demonstrated to be economic as result of the current study and are therefore designated as proven and probable reserves using the Canadian Institute of Mining, Metallurgical and Petroleum (CIM) Standards on Mineral Resources and Reserves, Definitions and Guidelines, prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council.

15.5 TOTAL MINERAL RESERVES

The total mineral reserves included in the mining plan for the NICO Project are summarized in Table 15.4.

Table 15.4
NICO Project – Total Reserves

Classification	Tonnes (thousand)	Au (g/t)	Co (%)	Bi (%)	Cu (%)
Proven	20,735	0.97	0.11	0.15	0.04
Probable	12,342	1.13	0.11	0.13	0.04
Total	**33,077**	**1.03**	**0.11**	**0.14**	**0.04**
Metal Contained[1]		**1,100 Moz**	**82.3 Mlb**	**102.1 Mlb**	**27.2 Mlb**

Fortune Minerals (2013).
[1]Contained metal quantities are estimated as mined, and do not allow for metallurgical recovery factors.

The ability to mine these estimated reserves is contingent upon receiving the necessary permits to do so. Otherwise, to the best of Micon's knowledge, there are no known environmental, legal, title, technical, taxation, socio-economic, marketing, political or other relevant issues that would materially affect the reserve estimate.

16.0 MINING METHODS

16.1 OVERVIEW

The NICO property has a number of mineral occurrences and one ore deposit, referred to as the Bowl Zone. In general, this orebody is comprised of a series of stacked stratabound lenses of ironstone that dip at approximately 50° towards 030° (north-northeast). The mineralized zones to be mined consist of three sub-parallel lenses, approximately 40 m apart. They are referred to as the Upper, Middle and Lower Zones, which are up to 1.5 km in length, 550 m in width (down dip) and 70 m in thickness (across dip).

The Project will utilize conventional open pit mining, supplemented by trackless underground mining methods in the early years of its life. It will then convert to an open pit operation for the remainder of its productive mine life of approximately 20 years.

The mine production schedule predicts that open pit waste stripping will commence in February, 2016, with continuous open pit ore production starting in June, 2017. Dewatering and rehabilitation of the existing underground workings, and underground ore and waste development, will be undertaken prior to the scheduled commencement of underground stoping in April, 2018. Underground ore production will end in June, 2019. Open pit ore production will continue until 2037. The mine schedule is based on the following:

- The open pit mine will operate from June, 2017 to 2037 and will produce a total of 32.5 Mt grading 0.96 g/t Au, 0.14% Bi, 0.11% Co and 0.04% Cu. Associated life-of-mine waste removal is estimated at 97.8 Mt.

- The underground mine will operate from April, 2018 to June, 2019 and will produce a total of 577,000 t grading 4.96 g/t Au, 0.17% Bi, 0.10% Co and 0.02% Cu.

- Of the total open pit waste, approximately 5.5 Mt of mineralized material will be tracked in the production schedule, in case economic conditions justify processing it. Until then, this material will be treated as waste and hauled to the co-disposal facility. The process plant production schedule makes no provision for the treatment of this material.

- The open pit and underground production schedules are both based on working seven days per week, with two 12-h shifts per day and employees working on a 21 days on-21 days off rotation.

- During the approximately one year of underground production, an average 1,544 t/d of underground ore will be supplemented with an average of 3,106 t/d open pit ore.

- After the completion of the underground mining operation, the open pit is scheduled to produce 4,650 t/d ore, on average. Open pit ore mined in excess of the capacity of the processing plant will be stockpiled for subsequent processing.

- The total life-of-mine underground and open pit reserve to be mined is 33.1 Mt, grading 1.03 g/t Au, 0.14% Bi, 0.11% Co and 0.04% Cu.

The design mine production schedule is presented in Table 16.1 and the mine site layout, including the open pit, portal and ramp are illustrated in Figure 16.1.

16.2 GEOTECHNICAL CONSIDERATIONS

Golder has provided geotechnical support for the open pit and underground designs for the NICO Project since 2003.

During 2010 and continuing into 2013, Fortune and P&E carried out detailed design work to optimize the location, number and size of the proposed underground workings, relative to the ultimate pit shell and its intermediate phases. The updates, included herein, pertain specifically to the geotechnical analyses to support this optimized mine design work. The most recent overall mine plan envisions an underground mine with an approximate mine life of one year, and considers a deeper open pit.

Review of the slope geometries for the open pit indicates that the maximum inter-ramp slope angles conform to the recommendations provided in the Golder 2004 Technical Memorandum on slope design. The maximum inter-ramp slope angle will be 50˚.

The engineering geology investigations include: i) outcrop mapping by Fortune in 1998-2000, ii) geotechnical logging and rock strength testing of exploration core in 1998, iii) geotechnical logging of exploration core in 2003, iv) geotechnical logging and core orientation of geotechnical drill holes in 2003, and v) additional laboratory rock strength testing from definition drilling core obtained in 2010.

The pit slope designs indicate competent rock masses, for which overall stability will not be a control on slope design for the anticipated slope heights. Consequently, pit slope designs were based on kinematic assessments, with achievable bench geometries controlling the inter-ramp angle.

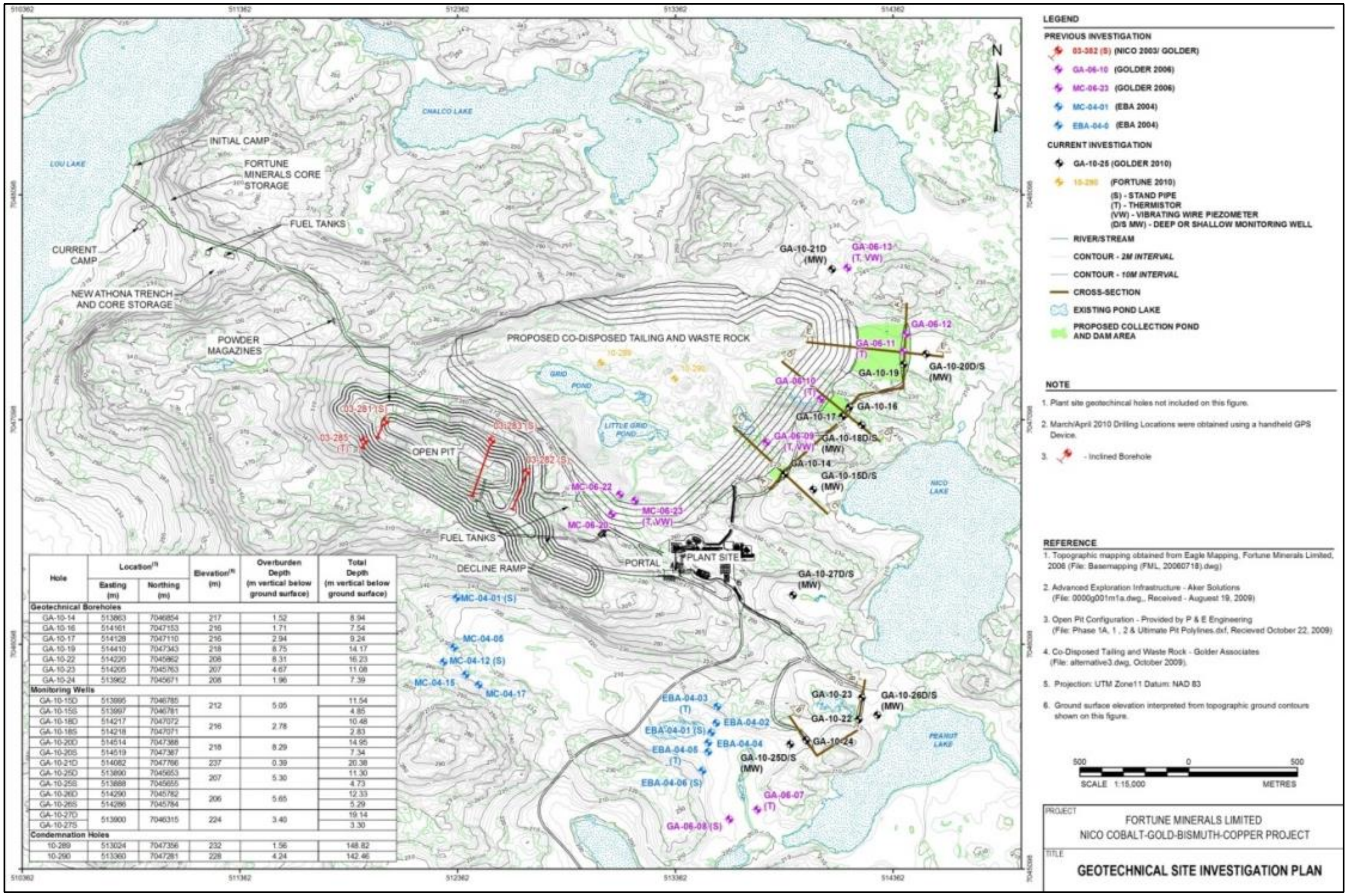
Underground geometries were based on the same engineering geology model. Analyses included semi-empirical stope design and three-dimensional numerical modelling for evaluating the interaction of the open pit and underground openings.

The NICO Project is located in a seismically stable part of Canada, in a region of lowest hazard.

Table 16.1
NICO Project – Mine Production Schedule

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
MINE PRODUCTION SCHEDULE																									
Open Pit																									
Ore Mined (thousand tonnes)	**32,500**			17	460	1,443	1,488	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Low-Grade Waste Mined (thousand tonnes)	**5,484**			2	127	285	415	359	222	222	143	243	328	264	276	320	312	345	299	271	205	157	476	208	5
Waste Mined (thousand tonnes)	**92,325**			4,915	10,883	5,091	4,047	6,777	3,281	3,858	7,320	7,132	5,964	4,280	3,503	3,445	3,534	2,494	2,555	3,042	2,448	1,421	3,814	2,123	398
Total Waste Mined (thousand tonnes)	**97,810**			4,917	11,009	5,377	4,462	7,136	3,504	4,081	7,463	7,375	6,292	4,543	3,779	3,765	3,846	2,839	2,853	3,313	2,653	1,578	4,291	2,331	403
Total Mined (thousand tonnes)	**130,310**			4,934	11,470	6,820	5,950	8,623	5,165	5,829	9,159	9,070	7,992	6,251	5,470	5,463	5,553	4,552	4,545	4,953	4,312	3,376	5,948	4,034	841
Gold Grade (grams/tonne)	**0.96**			0.24	0.19	0.24	0.21	0.42	0.30	0.52	1.22	1.25	1.76	1.59	0.53	0.55	0.51	0.53	0.68	0.88	1.35	2.67	0.75	1.94	2.01
Cobalt Grade (%)	**0.11**			0.14	0.13	0.12	0.11	0.12	0.13	0.13	0.11	0.11	0.09	0.12	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.11	0.16
Bismuth Grade (%)	**0.14**			0.07	0.11	0.14	0.13	0.11	0.14	0.17	0.19	0.17	0.16	0.12	0.15	0.17	0.18	0.17	0.15	0.14	0.12	0.08	0.13	0.06	0.02
Copper Grade (%)	**0.04**			0.03	0.04	0.01	0.01	0.03	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.06	0.08	0.07	0.04	0.01	0.05	0.03	0.01
Contained Gold (thousand ounces)	**1,008.2**			0.1	2.9	11.0	9.8	20.3	16.3	29.4	66.7	67.9	96.4	87.1	28.9	30.2	28.0	29.0	37.3	46.5	72.1	154.1	39.9	106.1	28.3
Contained Cobalt (thousand pounds)	**81,026**			53	1,292	3,813	3,761	3,872	4,749	4,910	4,269	4,145	3,318	4,593	4,701	4,610	4,416	4,384	4,172	3,877	3,310	3,953	3,231	4,064	1,532
Contained Bismuth (thousand pounds)	**99,923**			27	1,142	4,461	4,255	3,699	5,169	6,613	7,215	6,473	5,876	4,656	5,538	6,539	6,785	6,376	5,481	5,033	4,457	3,192	4,638	2,106	194
Contained Copper (thousand pounds)	**26,946**			12	423	370	410	1,092	1,452	1,968	1,617	1,210	889	731	771	1,087	1,798	2,394	2,825	2,530	1,580	484	1,999	1,182	124
Underground																									
Ore Mined (thousand tonnes)	**577**					273	304																		
Gold Grade (grams/tonne)	**4.96**					4.10	5.74																		
Cobalt Grade (%)	**0.10**					0.14	0.07																		
Bismuth Grade (%)	**0.17**					0.28	0.07																		
Copper Grade (%)	**0.02**					0.03	0.01																		
Contained Gold (thousand ounces)	**92.1**					36.0	56.1																		
Contained Cobalt (thousand pounds)	**1,307**					842	465																		
Contained Bismuth (thousand pounds)	**2,159**					1,711	448																		
Contained Copper (thousand pounds)	**250**					169	81																		
Total Mine Production																									
Ore Mined (thousand tonnes)	**33,077**			17	460	1,717	1,792	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Waste Mined (thousand tonnes)	**97,810**			4,917	11,009	5,377	4,462	7,136	3,504	4,081	7,463	7,375	6,292	4,543	3,779	3,765	3,846	2,839	2,853	3,313	2,653	1,578	4,291	2,331	403
Total Mined (thousand tonnes)	**130,887**			4,934	11,470	7,093	6,254	8,623	5,165	5,829	9,159	9,070	7,992	6,251	5,470	5,463	5,553	4,552	4,545	4,953	4,312	3,376	5,948	4,034	841
Gold Grade (grams/tonne)	**1.03**			0.24	0.19	0.85	1.14	0.42	0.30	0.52	1.22	1.25	1.76	1.59	0.53	0.55	0.51	0.53	0.68	0.88	1.35	2.67	0.75	1.94	2.01
Cobalt Grade (%)	**0.11**			0.14	0.13	0.12	0.11	0.12	0.13	0.13	0.11	0.11	0.09	0.12	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.11	0.16
Bismuth Grade (%)	**0.14**			0.07	0.11	0.16	0.12	0.11	0.14	0.17	0.19	0.17	0.16	0.12	0.15	0.17	0.18	0.17	0.15	0.14	0.12	0.08	0.13	0.06	0.02
Copper Grade (%)	**0.04**			0.03	0.04	0.01	0.01	0.03	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.06	0.08	0.07	0.04	0.01	0.05	0.03	0.01
Contained Gold (thousand ounces)	**1,100.3**			0.1	2.9	47.0	65.9	20.3	16.3	29.4	66.7	67.9	96.4	87.1	28.9	30.2	28.0	29.0	37.3	46.5	72.1	154.1	39.9	106.1	28.3
Contained Cobalt (thousand pounds)	**82,333**			53	1,292	4,655	4,226	3,872	4,749	4,910	4,269	4,145	3,318	4,593	4,701	4,610	4,416	4,384	4,172	3,877	3,310	3,953	3,231	4,064	1,532
Contained Bismuth (thousand pounds)	**102,082**			27	1,142	6,172	4,703	3,699	5,169	6,613	7,215	6,473	5,876	4,656	5,538	6,539	6,785	6,376	5,481	5,033	4,457	3,192	4,638	2,106	194
Contained Copper (thousand pounds)	**27,196**			12	423	539	490	1,092	1,452	1,968	1,617	1,210	889	731	771	1,087	1,798	2,394	2,825	2,530	1,580	484	1,999	1,182	124

Figure 16.1
Mine Site Layout



Hole	Location[1] Easting (m)	Location[1] Northing (m)	Elevation[6] (m)	Overburden Depth (m vertical below ground surface)	Total Depth (m vertical below ground surface)
Geotechnical Boreholes					
GA-10-14	513863	7046854	217	1.52	8.94
GA-10-16	514161	7047153	216	1.71	7.54
GA-10-17	514128	7047110	216	2.94	9.24
GA-10-19	514410	7047343	218	8.75	14.17
GA-10-22	514220	7045862	208	8.31	16.23
GA-10-23	514205	7045763	207	4.67	11.08
GA-10-24	513962	7045671	208	1.96	7.39
Monitoring Wells					
GA-10-15D	513995	7046785	212	5.05	11.54
GA-10-15S	513997	7046781			4.85
GA-10-18D	514217	7047072	216	2.78	10.48
GA-10-18S	514218	7047071			2.83
GA-10-20D	514514	7047388	218	8.29	14.95
GA-10-20S	514519	7047387			7.34
GA-10-21D	514082	7047766	237	0.39	20.38
GA-10-25D	513890	7045653	207	5.30	11.30
GA-10-25S	513888	7045655			4.73
GA-10-26D	514290	7045782	206	5.65	12.33
GA-10-26S	514286	7045784			5.29
GA-10-27D	513900	7046315	224	3.40	19.14
GA-10-27S					3.30
Condemnation Holes					
10-289	513024	7047356	232	1.56	148.82
10-290	513360	7047281	228	4.24	142.46

Fortune Minerals (2013).

16.3 Open Pit Operations

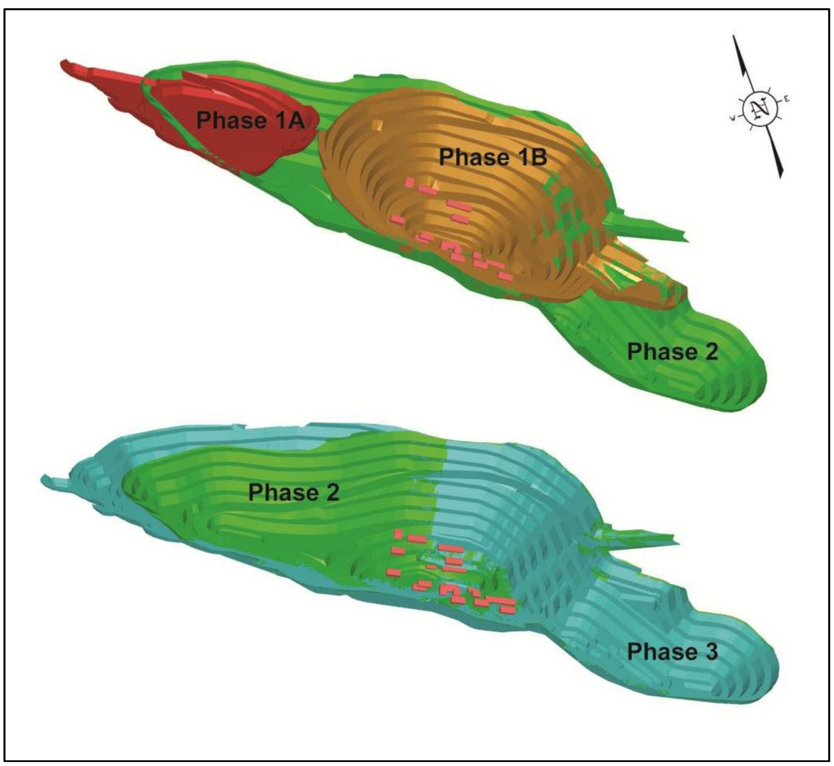
Mining of the NICO deposit will commence by extracting the richer ore zones using underground mining techniques in the early stage of the mine life. High-grade underground ore will be supplemented by open pit ore until the underground ore is exhausted. Thereafter, mining will be by open pit methods only. Starting about mid-way through the mine life, the pit will intersect the previously developed underground workings.

The open pit will be a conventional mining operation, utilizing proven drilling, blasting, loading and haulage equipment, together with conventional technology.

The open pit will be developed in three phases, identified as Phase 1A and 1B, Phase 2 and Phase 3. Phase 1A and 1B will be mined first and excavated in tandem, with the majority of the ore initially coming from Phase 1A. Except for a few small areas, Phase 2 will not begin until Phase 1A is complete. At this time, Phase 1B will continue and Phase 2 will be started. Phases 1B and 2 will be excavated together until 1B is completed, at which time Phase 3 will begin. Phases 2 and 3 will continue together until Phase 2 is completed. Phase 3 will then continue until the end of the mine life in 2037.

Figure 16.2 illustrates the phases of the open pit, while Table 16.2 presents a summary of the scheduled dates of production from each phase.

Figure 16.2
Schematic Representation of the Phase Pit Shells and the Planned Underground Stopes



Puritch et al. (2012).

Figure 16.2 also shows the underground stopes that are planned to be mined, within the open pit shell, using upper blastholes and without backfill. As the open pit advances towards these open stopes, they will be backfilled with broken rock from the pit floor via drop raises, or as they are exposed.

Table 16.2
Open Pit Phases

Phase	Waste (Mt)	Ore (Mt)	Grade				Start	Finish
			Au (g/t)	Co (%)	Bi (%)	Cu (%)		
Pre-production	15.0	0.4	0.26	0.12	0.11	0.04	February, 2016	November, 2017
1A	5.0	2.6	0.22	0.12	0.14	0.01	2018	2020
1B	27.3	10.2	1.10	0.12	0.16	0.04	2017	2026
2	35.4	14.9	0.94	0.11	0.14	0.04	2023	2035
3	15.1	4.4	1.33	0.11	0.08	0.04	2027	2037
Total	**97.8**	**32.5**	**0.96**	**0.11**	**0.14**	**0.04**		

It is planned to use a contractor to perform initial pre-production development work for the open pit. Fortune will then perform all of the productive open pit operations, using its own personnel and equipment. There will be a transition period between the initial contracted pre-production activities and the progressive mobilization and integration of Fortune's equipment fleet into the operations. An explosives contractor will provide the explosives, blasting agents and accessories for the operation, but the blasting itself will be performed by Fortune. A summary of the estimated number of personnel to be employed in the open pit operation is provided in Section 21.0 of this report.

16.3.1 Geotechnical Parameters

Bench geometries were developed assuming that adequate dewatering of the rock slopes will have been achieved due to exposure and blasting. Review of the pit shell Phases 1 to 3 indicates maximum inter-ramp slope angles of 50^{o}. Table 16.3 presents the open pit design slopes recommended by Golder.

Fortune considers that the hanging wall slope design may be aggressive and plans to optimize the design by placing ramps on the footwall, which will then be mined at the flatter angles conforming to the dip of the stratabound mineralization zones.

Potential for toppling failure, particularly on the hanging wall, is not considered a control on bench design, given the moderate to wide spacing of joints. Localized toppling instabilities may still occur. Should toppling failure be problematic, a mid-bench catch-berm may be required.

Potential wedge F1-F3, plunge 50°, will control slope design on southeast-dipping end walls. Northwest-dipping end walls have been assigned the same recommended configuration for consistency.

Table 16.3
NICO Open Pit Slope Design Recommendations

Slope Dip Direction	Rock Type	Maximum Vertical Bench Separation (m)	Bench Face (or Batter) Angle (°)	Minimum Berm Width (m)	Maximum Inter-ramp Angle (°)
020° to 030° Footwall	Meta-sedimentary Rock	15	75	8.5	50° [1, 2]
	Volcanic Cap Rock[3]	15	75	8.5	50°
200° to 210° Hangingwall	Meta-sedimentary Rock	15 20	75 75	8.0 9.0	51° to 54° [4]
	Volcanic Cap Rock[3]	15	75	8.0	51°
Endwalls	All rock types	15 m	75	8.5	50°

Fortune (2013), after Golder, 2004.
Notes:
1. Actual inter-ramp and overall slopes on the footwall will most often be less than 50°, controlled by the local dip of the stratabound mineralization zones and placement of ramps.
2. Bench face angle controlled by potential for planar failures involving set F2, dip 78°; inter-ramp slope angle controlled by set F1 (foliation), mean dip 50°.
3. Some slopes will expose significant amounts of volcanic rocks on the upper benches. While the kinematics indicate that the structural fabric in the volcanic rocks is more favourable and that steeper slopes could be achieved, surface exposures are blocky and broken, and ravelling can be expected on excavated slopes. For this reason a steeper design for slopes in volcanics is not presented. Initial operating experience with volcanic slopes will determine whether ravelling will require modified blasting practices or a shallower inter-ramp angle.
4. Bench face angle on the hanging wall will be controlled by potential for planar failures involving set J2 (dip 79°). Inter-ramp angle on the hanging wall will be controlled by potential for planar instability involving set J4 (dip 55°). Should the F2-J2 wedge be prevalent (plunge 51°), the inter-ramp angle will require flattening from 54° to 51°.

Where the open pit walls are greater than 90 m to 120 m high without being crossed by a ramp or wider berm, Fortune plans that an extra-wide (12 m to 15 m) geotechnical bench will be placed on the slope as a conservative measure. This bench is intended to provide additional catchment against potential rock fall hazards. The width has not been finally designed and the 12 m to 15 m width is recommended based on experience.

16.3.2 Blasthole Drilling and Blasting

The proposed blasthole drilling patterns for ore and waste, and powder factors, are shown in Table 16.4. The 127 mm (5 in) diameter blastholes will be drilled using diesel-powered track-mounted down-the-hole drills.

Table 16.4
Production Drilling Patterns

Item	Ore	Waste
Bench height (m)	10	10
Blasthole diameter (mm)	127	127
Burden (m)	3.5	3.5
Spacing (m)	3.5	4.5
Collar (m)	2.5	2.5
Subdrill (m)	1	1
Explosive type	70/30	70/30
Rock density (t/m^3)	3.227	3.069
Explosive density (g/cm^3)	1.15	1.15
Powder factor (kg/t)	0.31	0.26
Tonnes per metre drilled (t/m)[1]	35.2	43.1

Puritch et al. (2012).
[1] Includes a 2% allowance for blasthole re-drilling and clean-out.

The blastholes will be loaded with a blended emulsion explosive, primed, and stemmed using crushed rock and drilling cuttings. It is expected that the mine will progressively improve and optimize its drilling pattern and blasting program. The explosives, blasting agents and blasting accessories will be supplied by a licenced explosive supplier. The supplier will set-up its explosive and detonator storage magazines and operating facility in secure locations on the mine property.

16.3.3 Loading and Haulage

The blasted ore will be excavated and hauled to the primary crusher, or stockpiled in the vicinity of the crusher. The blasted waste rock will be excavated and hauled to the co-disposal facility. The proposed drilling, loading, haulage and auxiliary equipment required for the open pit is summarized in Table 16.5.

Table 16.5
Open Pit Equipment Requirements

Equipment Type	Number of Units
Sandvik D25KS Blasthole Drill	2
Cat. 330 Excavator	1
Cat. 6018 Hydraulic Shovel	1
Cat. 374 Excavator	1
Cat. IT626 Wheel Loader	1
Cat. 777 Haul Truck	6
Cat. 740 Haul Truck	6
Cat. 769 Water Truck	1
Fuel Truck	1
Cat. D10 Bulldozer	1
Cat. 16M Grader	1
Powder Truck	1
Bus – 34 Passenger	2
Crane – 60 t Rough Terrain	1
Survey Truck	1

Equipment Type	Number of Units
Pick-up Truck	10
Flatbed Truck	1
Sanding Truck	1
Lube Truck	2
Mechanics Truck	3
Compressor – 185 cfm	4
Generator – 30 kW	6
Generator – 100 kW	2
Lighting Plants	12

The grader, water truck and fuel truck included in Table 16.5 will service all Project needs, in addition to the open pit mine.

16.3.4 Open Pit Mine Infrastructure

The principal infrastructure supporting the open pit operations will be fuel storage facilities and a maintenance shop for mobile equipment. Diesel fuel for all Project requirements will be stored in a central facility described in Section 18.1.5. The main consumers will be the mine haul trucks. A fuel truck is included in the open pit equipment fleet to transfer fuel from the central storage to the individual items of mobile equipment operating in the pit.

The mobile equipment maintenance facility will be part of a centralized service building, as shown in Figure 16.3. The maintenance facility will have two bays of sufficient size to service the mine haul trucks, and will be provided with a 20-t overhead crane. A separate wash bay is also included in the design.

16.4 UNDERGROUND OPERATIONS

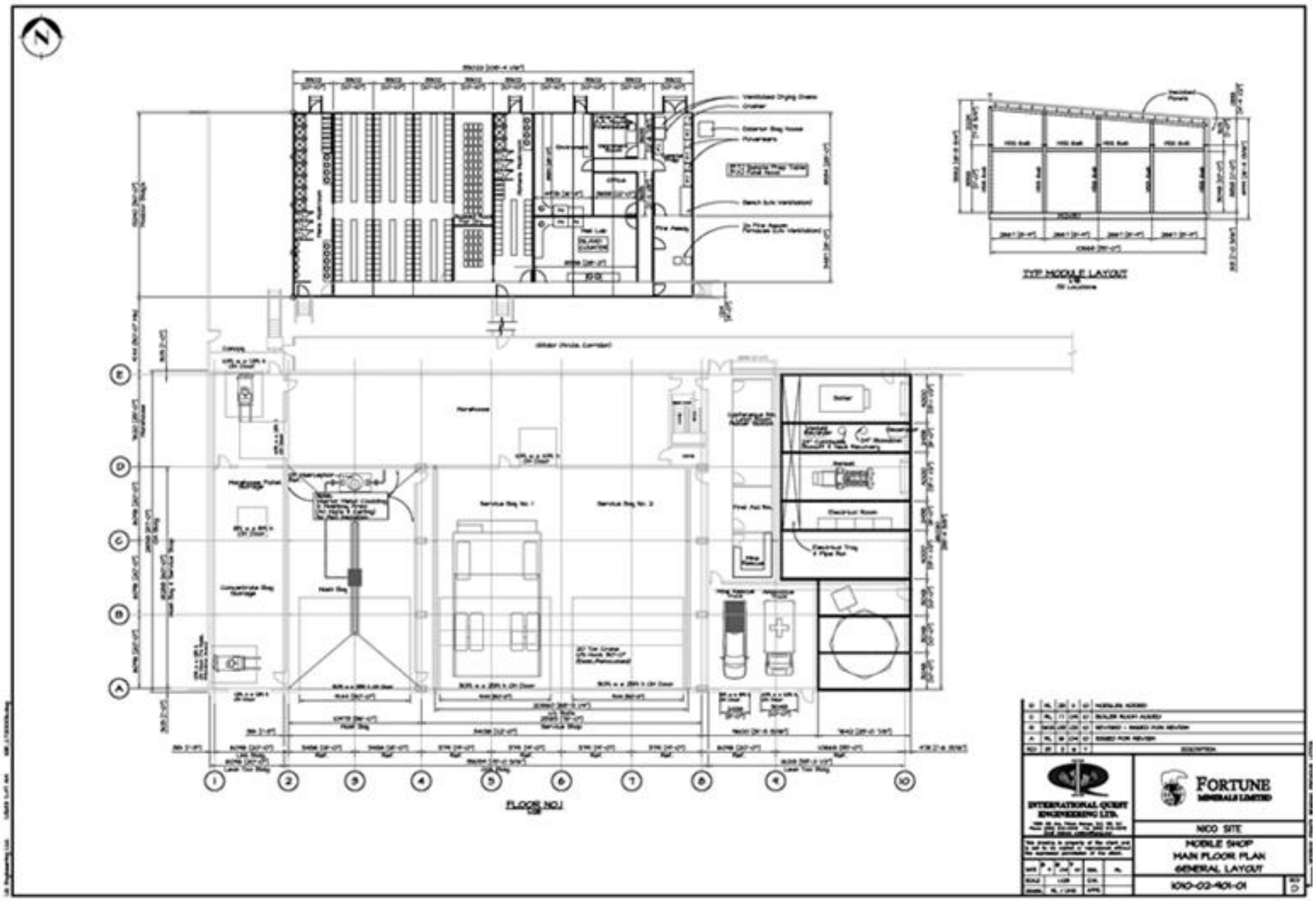
Underground mining operations will be conducted by a contractor, using conventional blasthole stoping methods. The underground mine production schedule calls for sustained ore production to commence in April, 2018. The underground mine plans are based on the following considerations:

- During the underground pre-production period, the underground mine contractor will mobilize and set up its equipment and facilities on surface, in order to dewater and rehabilitate the existing underground workings. The contractor will then continue with underground development activities, prior to the commencement of productive stoping operations.

- Underground mining will be via retreat transverse and longitudinal blasthole open stoping methods, generally mined from the top down, without backfill. The main mining levels will be at 215, 195, 170, 161, 141, 135, 116, 95, 75 and 70 m amsl.

- The underground mining operation will average 1,544 t/d of ore for a period of approximately one year, with total production of 577,000 t grading 4.96 g/t Au, 0.17% Bi, 0.10% Co and 0.02% Cu.

Figure 16.3
Open Pit Maintenance Facility



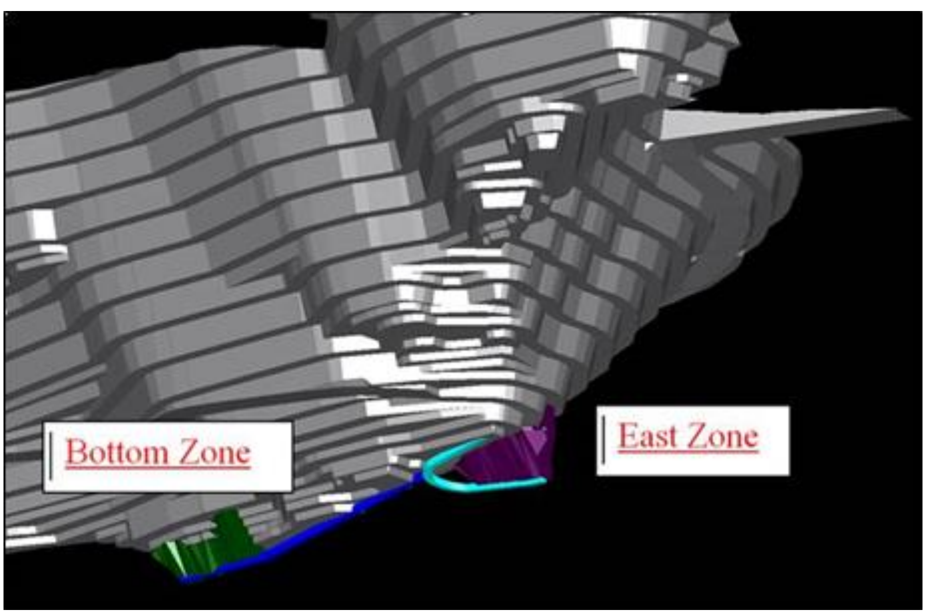
- There will be a total of 21 blasthole stopes. A summary of the stope mining sequence, location and ore production tonnages is presented in Table 16.6. The existing exploration decline, completed in 2006 in order to recover a bulk sample of ore, will be utilized for access to the stope mining areas.

Table 16.6
Underground Stoping Sequence

Levels	Ore (t)	Grade				Start	Finish
		Au (g/t)	Co (%)	Bi (%)	Cu (%)		
195-215	70,700	2.36	0.36	0.23	0.06	April, 2018	September, 2018
170-195	114,000	3.59	0.36	0.15	0.02	April, 2018	December, 2018
161	27,200	4.70	0.01	0.04	0.01	May, 2018	December, 2018
135-141	96,800	6.29	0.14	0.04	0.01	June, 2018	January, 2019
116-95	44,500	8.93	0.23	0.24	0.02	June, 2018	March, 2019
East Zone	147,200	6.06	0.04	0.01	0.01	September, 2018	June, 2019
Bottom Zone	76,600	3.41	0.01	0.11	0.01	October, 2018	June, 2019
Total	**577,000**	**4.96**	**0.17**	**0.10**	**0.02**		

The areas identified in Table 16.6 as the East Zone and the Bottom Zone include additional high-grade reserves that have been identified outside the open pit shell and are now included in the underground mining plan. These reserves were not included in the reserves identified in Purtich et al. (2012), since the open pit shell was used as the limit for reserve estimation at that time. The location of these additional reserves is illustrated in Figure 16.4, which also shows the additional development required to access them.

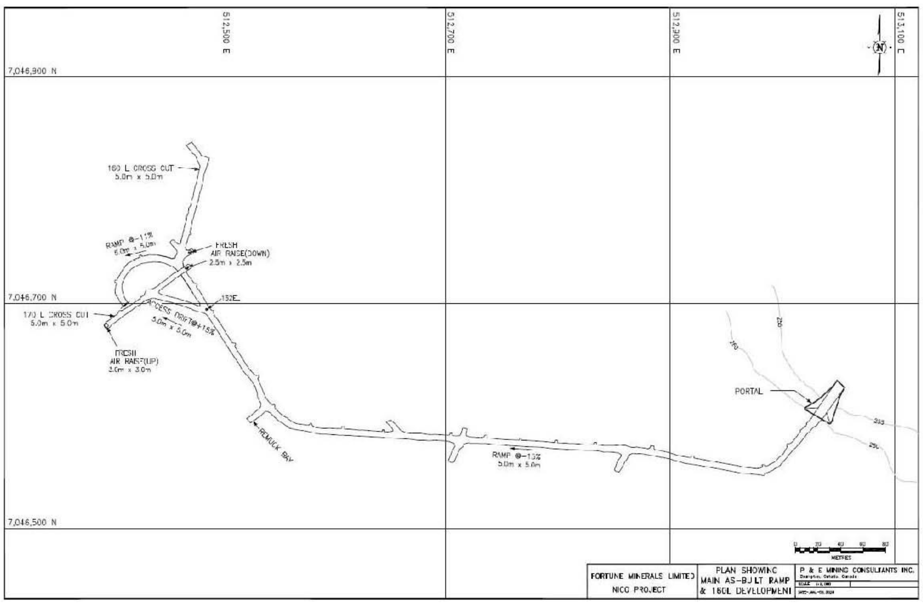
Figure 16.4
Location of Additional Underground Reserves



Fortune Minerals (2013).

Underground development has been undertaken on several levels of the NICO deposit, for exploration and bulk sampling. The existing underground development in the NICO deposit, at the 150 m level is shown on the as-built drawing, Figure 16.5.

Figure 16.5
Existing Underground Development – at the 150 m Level
(As-built drawing)

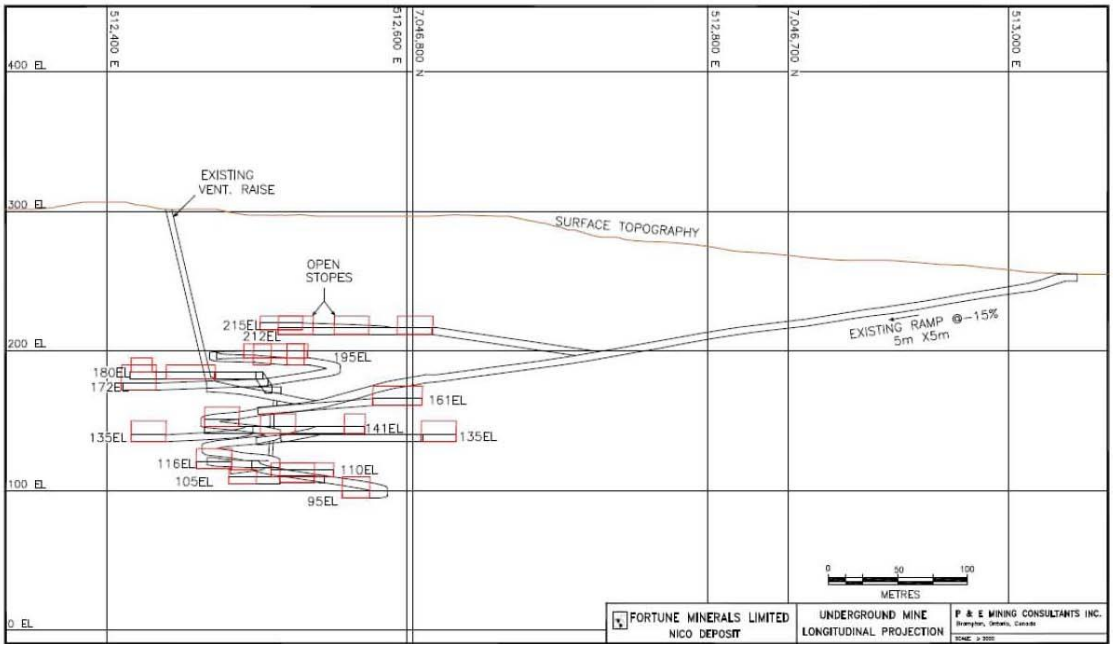


Puritch et al. (2012).

The proposed mine plan is based on an underground development program that includes the extension of the 5 m by 5 m exploration decline, ultimately to the 70 m level. The planned stopes are illustrated in Figure 16.6, which presents a longitudinal projection of the existing and proposed underground workings. Figure 16.6 does not show the Bottom Zone and East Zone stoping areas, nor the development required to access them. These are illustrated in Figure 16.4, included previously.

The underground infrastructure will include an escapeway in the existing fresh air raise between the 95 m level and surface, a portable lunchroom/refuge station, a main sump on the access ramp to the 105 level, a portable electrical substation and safety bays. Secondary sumps, and powder and cap magazines, will be installed in unused muck bays. Most stope access drifts and cross-cuts will be driven in ore. The underground mine equipment maintenance shop will be located on surface.

Figure 16.6
Longitudinal Projection of the Proposed Underground Workings



Puritch et al. (2012).

Stopes will be left unfilled. As the open pit advances towards the underground workings, stopes will be backfilled with broken ore from the pit floor via drop raises, or as they are exposed, and the pit will advance through the orebody, recovering the underground pillars.

16.4.1 Underground Mine Design and Stope Layout

The mine plan is based on minimizing the required development and, where possible, placing it in ore. Access to the stopes will be via 5 m high by 5 m wide level access ramps, generally driven in waste, and by 5 m high by 5 m wide level footwall drifts, 4.5 m high by 4 m wide extraction cross-cuts and 4.5 m high by 12 m wide under-cuts, generally driven in ore. The extraction cross-cuts have been sized to accommodate scoop tram haulage, while the footwall drifts and access ramps are designed for underground haulage trucks.

16.4.1.1 Stope Design

Given that the major mineralized zones consist of sub-parallel lenses, approximately 40 m apart, the current plan is to mine selected longitudinal and transverse stopes in a manner designed to minimize the potential impact on future open pit mining.

Since these stopes will not be backfilled during underground mining, they are designed to be mined with dimensions that will ensure stability while they remain open.

An assessment of safe stope dimensions has been carried out using the Mathews/Potvin method (Mathews et al., 1981; Potvin, 1988) for open stope stability. Input requirements for this method include assessment of rock mass quality for the various walls of the stope and estimation of the stress concentration within the excavated stope.

The interaction of the open pit and underground stopes was evaluated by Golder, with input from P&E. A review of this evaluation is included in the Golder (2005) and Golder (2010a and 2010b) Technical Memoranda.

As a result of the analysis of this stress interaction, the stope designs and planning for the underground mine were modified. The initial mine planning considered the excavation of a series of sub-parallel transverse stopes that would be located near the hanging wall (MZ stopes) and in the footwall (LZ stopes). The stopes were to be separated by sill and rib pillars, to be recovered later during open pit mining. The current plan is to mine selected longitudinal and transverse stopes and minimize their potential impacts on future open pit mining.

16.4.1.2 Stope Stability Assessment

A preliminary stope stability assessment was carried out in 2005 using the Mathews/Potvin stability graph. The results were presented in the Golder (2005a) Technical Memorandum. This initial assessment provided estimates of maximum hydraulic radius (HR) for unsupported stope walls. These estimated values are presented in Table 16.7.

Table 16.7
Preliminary Values of Maximum Hydraulic Radius for Unsupported Walls

Depth (m)	HR Back (m)	HR for the Hanging Wall (m)	HR for the Sidewalls (m)
100	4.3	7.5	6.8
250	3.9	7.5	5.4

Puritch et al. (2012).

The stope HR corresponds to the area divided by the perimeter of the exposed stope surface. The HR value, in conjunction with a stability number N, which is derived from estimates of rock mass quality and adjustment factors based on stress conditions, orientation of structures, and the most likely modes of failure, permits the design of the stope dimensions to render stable openings.

Based on these HR values, and given that the stopes would not be supported, the 2005 scoping study recommended that the stope dimensions be a strike length of 12 m, a height of 25 m and a length (in the transverse direction) of 30 m to 35 m, creating HR values for the back of 4.3 to 4.5 m, HR values for the hanging wall of 4.1 m, and HR values for the sidewalls of 6.8 m to 7.3 m. In addition, 12 m wide sill and rib pillars were recommended to be used between the LZ (footwall) and MZ (hanging wall) series of stopes. The 2005 analyses considered only a single opening and did not evaluate the interaction/redistribution of stresses that would result from multiple stope openings and pit advancement.

In 2010, the 2005 analysis was updated and refined to assess the effects of induced stresses which may be generated as a result of the interaction of the underground and open pit excavations. Three-dimensional numerical modelling was carried out using the boundary element code MAP3D©. Based on the numerical results, the HR values were modified from those developed in 2005.

Values of HR were calculated for the geometries of the stopes designed by P&E. The calculated HR values were then compared to the revised values of maximum HR, as shown in Table 16.8. The stope geometries that exceeded the recommended HR values were re-designed, in order not to exceed the maximum stable unsupported value.

Table 16.8
Revised Values of Maximum Hydraulic Radius for Unsupported Walls

Rock Type	Q'	A	B	C	Calculated N'	Hydraulic Radius[1]	
						Maximum Stable Unsupported (m)	Average Unsupported Transition (m)
Depth < 150 m							
BACK STABILITY							
Metasediments (-1 std.)	9.3	0.90	0.5	2.0	8.4	5.1	6.8
Metasediments Stable (mean)	14.9	0.90	0.5	2.0	13.4	6.1	7.9
Metasediments Stable (+1 std.)	24.0	0.90	0.5	2.0	21.6	7.3	9.2
HW STABILITY							
Metasediments (-1 std.)	9.3	1.00	0.2	4.0	7.45	4.9	6.5
Metasediments Stable (mean)	14.9	1.00	0.2	4.0	11.94	5.9	7.6
Metasediments Stable (+1 std.)	24.0	1.00	0.2	4.0	19.16	7.0	8.9
SIDEWALL STABILITY							
Metasediments (-1 std.)	9.3	0.55	0.5	4.0	10.2	5.5	7.2
Metasediments Stable (mean)	14.9	0.55	0.5	4.0	16.4	6.6	8.4
Metasediments Stable (+1 std.)	24.0	0.55	0.5	4.0	26.3	7.9	9.8
Depth > 150 m							
BACK STABILITY							
Metasediments (-1 std.)	9.3	0.45	0.5	2.0	4.2	4.0	5.4
Metasediments Stable (mean)	14.9	0.45	0.5	2.0	6.7	4.7	6.3
Metasediments Stable (+1 std.)	24.0	0.45	0.5	2.0	10.8	5.6	7.3
HW STABILITY							
Metasediments (-1 std.)	9.3	0.50	0.2	4.0	3.7	3.8	5.2
Metasediments Stable (mean)	14.9	0.50	0.2	4.0	6.0	4.5	6.1
Metasediments Stable (+1 std.)	24.0	0.50	0.2	4.0	9.6	5.4	7.1
SIDEWALL STABILITY							
Metasediments (-1 std.)	9.3	0.30	0.5	4.0	5.6	4.4	5.9
Metasediments Stable (mean)	14.9	0.30	0.5	4.0	9.0	5.3	6.9
Metasediments Stable (+1 std.)	24.0	0.30	0.5	4.0	14.4	6.3	8.1

Puritch et al. (2012).
[1] Recommended range of HR values are highlighted in blue.

16.5 UNDERGROUND DEVELOPMENT AND PRODUCTION

16.5.1 Mine Development

An underground mining contractor will mobilize and set up on site in sufficient time to complete all rehabilitation and development work prior to the commencement of stoping operations in April, 2018. Two trackless development crews are scheduled. Development crew 1 will start with mine development on the 195-215 level area and development crew 2 will start on the 170-195 level area. Initially, the contractor development crews will advance at an estimated rate of 6.5 m per day, single heading. Once established, the contractor will advance at a rate of 8 m per day, double heading. Development crew 1 will progress from the 195-215 level area to the 161 level, and then to the 135-141 level area. Development crew 2 will progress from the 170-195 level area to the 116-95 level area, and then to the 75 and 70 levels.

16.5.2 Stope Development

Once the access and footwall drifts in waste have been completed to the first accessible stopes on the 195-215 and 170-195 levels, the development crews will proceed with stope development to all stopes, as they become accessible. Development crews will excavate undercut cross-cuts, undercut slashes and slot raises, and will complete drilling in these stopes.

16.5.3 Stoping

Stoping includes blasting, followed by mucking and truck haulage to surface. There will be one stope blasting crew, and an average of three scooptram and two to three haulage truck drivers per day.

The underground mining method will be retreat transverse and longitudinal blasthole open stoping, using up-holes, generally mined from the top down, without backfill. There is a total of 21 blasthole stopes. Ore pillars will be left in place between stopes, for ground support. Stoping will include drilling and blasting the slot raises, and production drilling and blasting, utilizing 51 mm diameter drill holes.

16.6 UNDERGROUND MINE VENTILATION

Ventilation flows are designed to sweep the underground workings from the centrally located fresh air raise (FAR) to the extremities of the mine. The ventilation system is designed to operate as follows:

- The ventilation system provides fresh air, via the FAR, to the bottom of the mine; the air then up-casts in the main decline. Auxiliary fans and ducting direct fresh air to active working areas. The air then flows back to the main decline and returns to surface.

- It is planned to use blasthole open stoping that generally retreats from the furthest extremities on the levels to the FAR and decline complex. Adequate ducting and secondary ventilation fans will direct fresh air to the working areas.

- The underground ventilation system is designed for airflow volumes and an airflow distribution that will provide an acceptable atmosphere within the working environment for all underground workers. The ventilation system is designed to control diesel exhaust emission concentrations in the workplace and by default, dust and blasting fumes.

The following specific ventilation design criteria and assumptions were adopted:

- The system will be designed to provide at least 100 cfm/bhp (cubic feet per minute, per brake horsepower) of diesel equipment operating underground. Where it is planned to use combinations of equipment simultaneously in an area, the ventilation volumes will be designed to support the total sum of operating horsepower for major development or production equipment.

- Not all diesel equipment will operate simultaneously underground.

- The FAR (intake complete with fan installation) and ramp are presently completed to the 135 level.

- Fresh air, heated in winter, will downcast in the FAR to the bottom of the existing decline, and will up-cast through the decline to surface.

- During installation, obstructions, restrictions and diameter reductions in the auxiliary ducting will be minimized.

- Diesel equipment will be maintained to control and minimize exhaust emissions to Canadian and NWT mining industry standards.

An equipment distribution list was developed, listing the diesel equipment, the locations in the mine at which the equipment is to operate, and the utilization time on a monthly basis. From the equipment distribution list, minimum required air volumes were determined for diesel exhaust emission control. Table 16.9 provides a summary of the diesel equipment, brake horsepower and utilization factors planned for the underground workings.

The required minimum fresh air volume is based on the provision of 100 cfm/bhp for the total operating diesel horsepower (≈ 228 kcfm), plus an allowance for inactive mining areas and an estimated leakage factor (20%). The minimum volume required is estimated to be approximately 324 kcfm (≈153 m^3/s).

Table 16.9
Ventilation Requirement for Underground Diesel Equipment

Unit	Number	Engine Power (HP)	Installed Power (HP)	Overall Utilization (%)	HP for Ventilation (HP)	Ventilation (cfm)	Ventilation (m^3/s)
Scoop-tram – 8 yd^3	2.5	325	813	87.5	711	71,094	34
U/G Truck 50 t Haul Truck	3.5	575	2,013	60	1,208	120,750	57
Longhole ITH Drill	2	173	346	10	35	3,460	2
Development Jumbo – 2 Boom	2	149	298	10	30	2,980	1
Getman Anfo Loader	1	173	173	20	35	3,460	2
Getman Scissor Lift	2	173	346	25	87	8,650	4
Getman Boom Truck	1	173	173	25	43	4,325	2
Toromont Cat Grader M135H	1	135	135	25	34	3,375	2
Mechanic’s Vehicle	1	128	128	25	32	3,200	2
Electrician’s Vehicle	1	128	128	25	32	3,200	2
Staff Toyota	1	128	128	25	32	3,200	2
Subtotal	**18**	**2,260**	**4,680**		**2,277**	**227,694**	**107**
Allow 42,500 cfm (20 m^3/s) to ventilate approximately four inactive mining areas						42,500	20
Minimum air required (allow for 20% leakage and short-circuiting)						324,233	153
Say						324,300	153

Puritch et al. (2012).

16.7 UNDERGROUND MINE HYDROLOGY

Based on the underground exploration development program that was completed in 2006 by Procon, it is expected that the groundwater inflow will be negligible, at an estimated 50 m^3/d (9.2 USgpm).

16.8 UNDERGROUND OPERATIONS AND MAINTENANCE PERSONNEL

All of the underground labour force will be contractor personnel. The number of workers required is based on the total amount of underground development, construction and production work required, and labour productivities. It is estimated that, during the period of underground ore production from April, 2018 to June, 2019, the number of contractor personnel required will range between approximately 60 and 110, with the lower number required in the early months of operation. Additional details of the total number of persons to be employed in the underground operation are provided in Section 21.0 of this report.

16.9 UNDERGROUND EQUIPMENT

An estimate of the contractor’s principal equipment requirements is presented in Table 16.10.

Table 16.10
Estimated Underground Equipment Requirements

Equipment Type	Number of Units
Drill Jumbo	4
Hydraulic Hammer	6
Jackleg	8
Stoper	8
ANFO Loader – Hand	2
ANFO Loader – 120	2
ANFO Loader – Mobile	1
Scissor Lift	1
Scoop Tram – 3-5 yd^3	1
Scoop Tram – 8 yd^3	3
Truck – Toro 40D	4
Truck – Volvo 6x6	1
Grader	1
Service Tractor	2
Fan – 75 HP	5
Fan – 100 HP	3
Toyota Jeep	2
Crewcab – 4x4	3

Puritch et al. (2012).

16.10 ELECTRICAL POWER

The required electrical power for underground mining will be supplied from a connection to the Snare Hydroelectric Complex, with emergency power provided by an existing diesel generating set, to be located near the portal.

The portal substation is also located close to the underground ramp entrance. Power from portal substation to the underground substations will be fed via two redundant mine power cables. The power to the various underground power centres will be distributed at 4.16kV, via mine power cables. A secondary electrical substation will be located at the 105 level, to serve the main dewatering pumps and portable substation required in this general area.

Three mine underground portable substations, rated at 600 kVA, will be used to feed the area ventilation and working machinery loads.

It is estimated that the power consumption for the underground will be 1.3 MW normal running load, with a peak demand load of 2.3 MW, as shown in Table 16.11.

Table 16.11
Underground Electrical Power Requirements

Description of Load	Normal Running Load (kW)	Peak Demand Load (kW)
Ventilation	623	804
Mine Dewatering	139	315
Mine Equipment	551	1,194
Total	**1,313**	**2,313**

Puritch et al. (2012).

If power from the main substation is not available, emergency power to the essential underground loads will be supplied from the standby diesel generator located at the portal substation. The total underground requirement, on standby, is an estimated 0.8 MW.

17.0 RECOVERY METHODS

The recovery of saleable products from the NICO deposit will take place in two stages. First, a bulk flotation concentrate containing recoverable gold, cobalt, bismuth and copper will be produced at the Project site in the NWT. The bulk concentrate will then be transported by road and rail to the SMPP for further treatment, principally by hydrometallurgical techniques, to produce separate gold, cobalt, bismuth and copper products.

17.1 PROCESSING PLANT AT THE PROJECT SITE

The Feasibility Study design of the processing plant at the Project site is based on a FEED study prepared by Aker Metals, a division of Aker Solutions Canada Inc. (Aker Solutions), now Jacobs Minerals Canada Inc. (Jacobs). The FEED study document was issued to Fortune in September, 2012. Hatch Associates (Hatch) was subsequently retained by Fortune to undertake preliminary engineering for the plant. Aker Solutions also produced a separate FEED study for the SMPP, as described in Section 17.2 of this report.

The process design for the Project site was developed for a 1,695,060 t/y mineral processing plant. With an operating availability design criterion of 90%, the plant has been designed for processing 215 t/h. The majority of the process design criteria are based on the information from the pilot testwork performed at SGS-MS in 2007 and 2010 and the locked cycle and FLEET testwork performed by SGS in 2009.

17.1.1 Aker Solutions (Jacobs) FEED Study

The FEED report for the on-site processing plant comprises ten volumes and includes:

- Process design criteria.
- Process flow diagrams (PFDs).
- METSIM model (mass balance only).
- Equipment lists.
- Piping and instrument diagrams (P&IDs).
- Mechanical and electrical equipment duty specifications.
- Engineering discipline design criteria.
- Site plans.
- General arrangements (GA) drawings.
- Structural steel GA drawings.
- Detailed equipment arrangement drawings based on preliminary vendor information.
- Equipment and material technical bid evaluations.
- Capital cost estimate.
- Operating cost estimate.
- Engineering, procurement and construction management (EPCM) schedule.
- Preliminary project execution plan.

The mechanical equipment list generated for the FEED study is based on the PFDs developed in collaboration with Fortune, SGS-MS, various subconsultants and Aker Solutions. The mass and energy balance used for the sizing of equipment was derived from the METSIM® model simulation developed for the NICO process plant. The equipment list has subsequently been updated by Hatch.

The NICO process flowsheet is provided in Figure 17.1 and the overall layout of the plant is shown in Figure 17.2.

17.1.2 Process Description

The NICO Project mineral processing plant is designed for the treatment of a bismuth-cobalt-gold-copper sulphide ore from the NICO deposit, at an average design throughput rate of 4,645 t/d for 365 days per year. The processing plant at the NICO Project site will produce, on average, 167.4 dry t/d of bulk concentrate containing an average of 3.55% Bi, 3.23% Co, 25.19 g/t Au, 1.03% Cu and 13.52% S. This concentrate will be filtered using a pressure filter to approximately 8% moisture, packaged and shipped to the hydrometallurgical facility in Saskatchewan for further processing. The bulk concentrate will also have a high content of arsenic, estimated at approximately 20% As, on average.

The mineral processing facilities at the Project site are subdivided as follows:

- Ore receiving pad.
- Primary crushing.
- Secondary and tertiary crushing.
- Fine ore storage.
- Grinding.
- Gravity gold recovery.
- Flotation.
- Concentrate dewatering and packaging.
- Tailings dewatering and disposal.
- Reagent preparation.

Process flow diagrams for the various process sections described below can be found in Appendix I of this report. These drawings have been updated by Hatch from those included in Volume 2 of the FEED study.

Figure 17.1
NICO Process Flowsheet

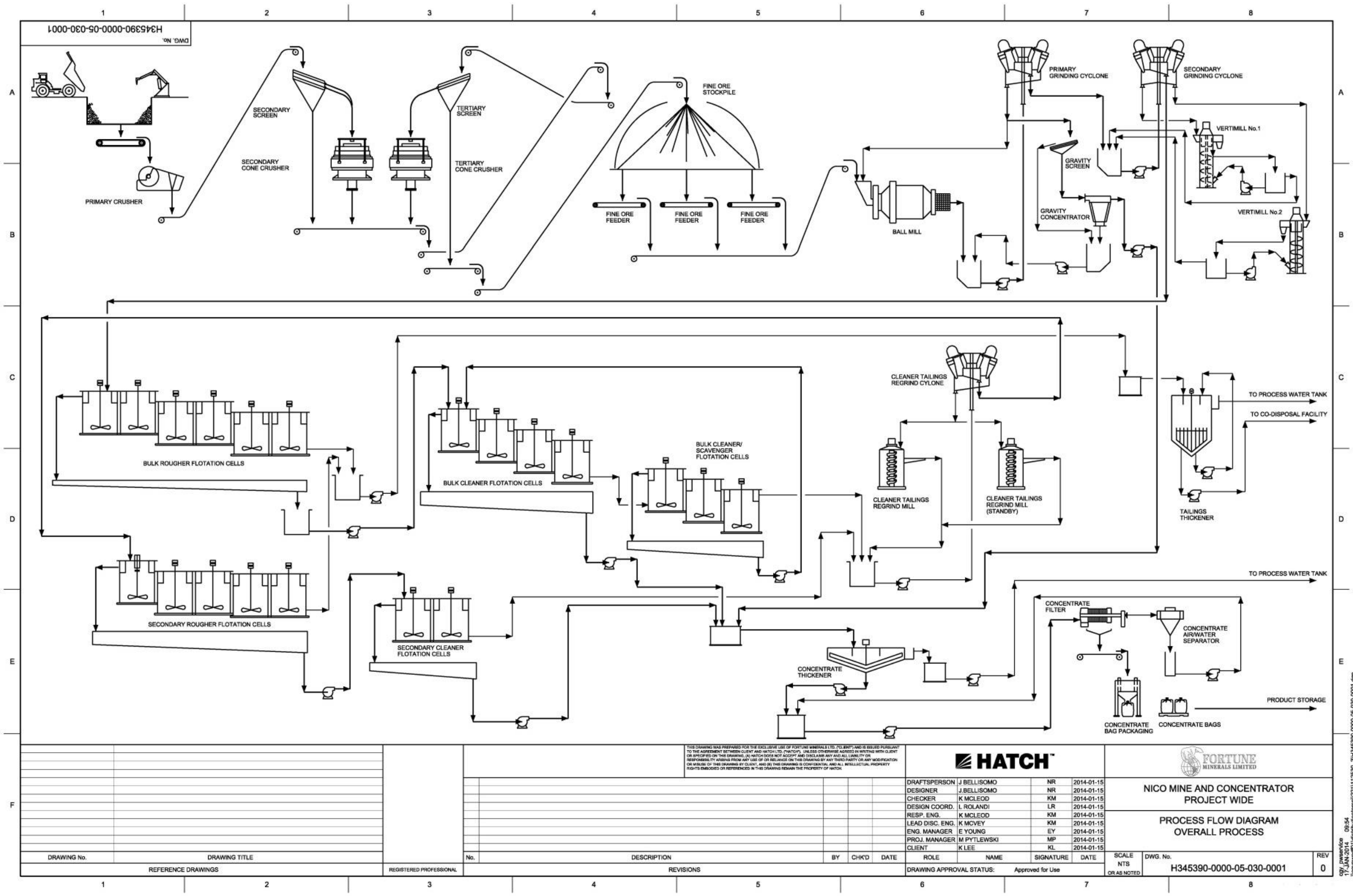
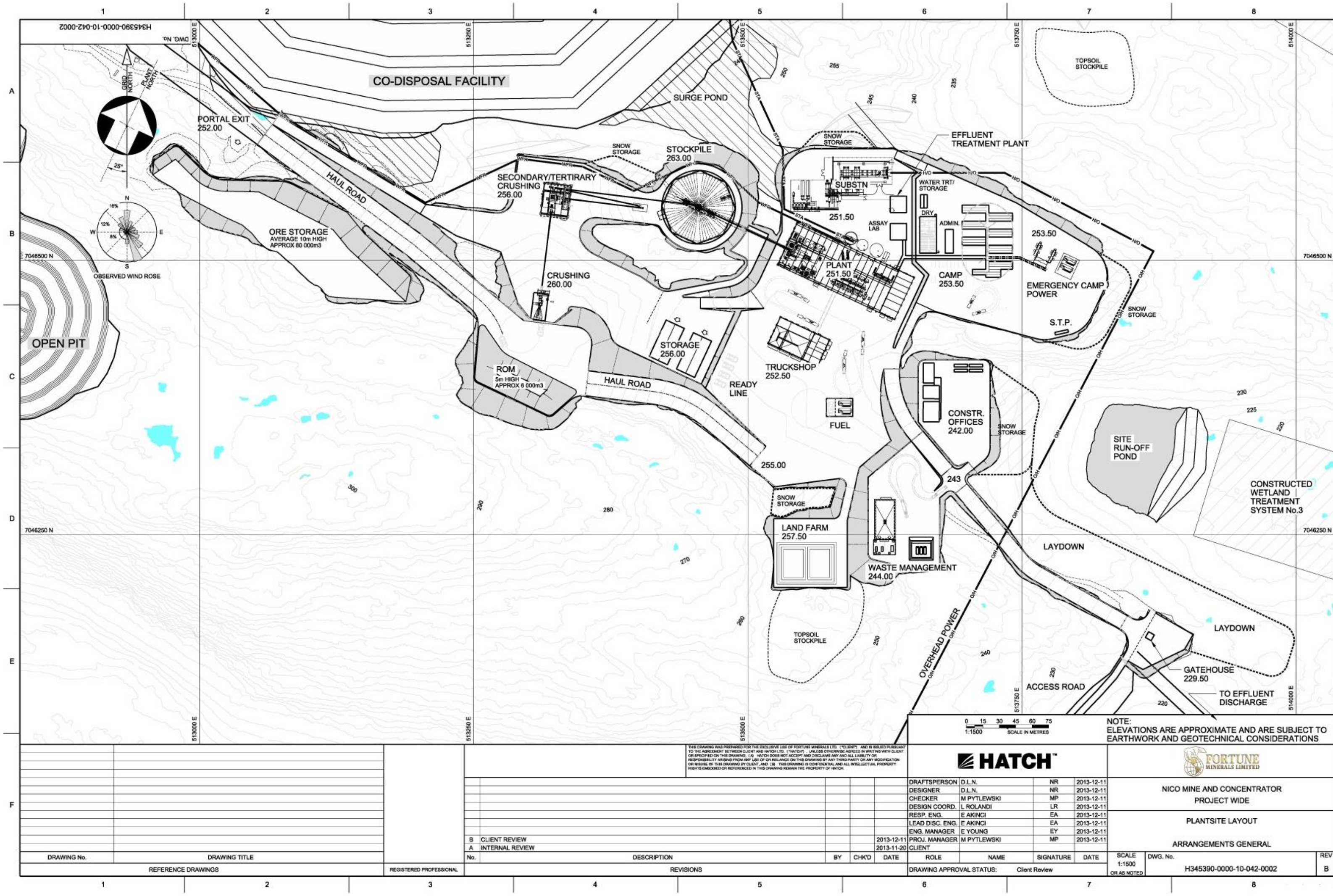


Figure 17.2
Project Site Layout, NWT



17.1.2.1 Ore Receiving Pad

Run-of-mine (ROM) ore will be delivered by haul trucks from the underground and open pit mines. The ore will be dumped on the ore receiving pad for further blending or staged for feeding the primary crusher with a front-end loader. The crusher will also be designed so that trucks can dump directly into the feed hopper. During periods in which the open pit produces ore in excess of the capacity of the processing plant, the surplus ore will be stockpiled and processed subsequently.

17.1.2.2 Primary Crushing

The primary crusher dump hopper is designed with a capacity of 180 t, corresponding to two truckloads, and has only one access side. Truck dumping will be controlled by the crusher operator using a system of traffic lights. A heavy-duty, hydraulic rock-breaker is provided to break up oversize boulders.

ROM ore will discharge from the dump hopper onto a 1.5-m wide and 15-m long apron feeder and feed into a 48 inch by 63 inch jaw crusher. The feeder is equipped with a tramp metal magnet located over the head pulley to remove any magnetic metal emanating from either underground or the open pit.

The primary jaw crusher will operate at a nominal closed-side setting of 150 mm, to produce a product with a P_{80} of approximately 120 mm, at an average throughput rate of 516 t/h. The jaw crusher discharges onto the 1,050-mm wide by 97.2-m long primary crushed ore conveyor, which includes a belt scale and a metal detector.

The primary crusher truck dump hopper is provided with an air-atomized fogging dust suppression unit for control of dust emission during the dumping operations. A control room is located inside a heated enclosure above the truck dump level, which will allow the operator to see into the dump hopper. A heavy-duty 25-t mobile crane will be used for maintenance of the primary crushing station.

17.1.2.3 Secondary and Tertiary Crushing

The primary crushed ore conveyor will discharge onto a 1.8 m wide by 4.8 m long double-deck vibrating screen with openings of 75 mm on the top deck and 38 mm on the bottom.

The screen oversize from both decks will feed a HP 500 size secondary standard Symons cone crusher via a 38-t feed bin. The secondary crusher discharge and the secondary screen undersize will be conveyed to the tertiary 2.4 m wide by 7.3 m long double deck screens. The oversize (+8 mm) from each screen will feed a MP 800 short head cone crusher. The screen undersize feeds the fine ore stockpile conveyor.

17.1.2.4 Fine Ore Storage

The fine ore stockpile will provide crushed ore surge capacity so that the process plant can be supplied with a continuous source of feedstock. The live capacity of the fine ore stockpile is 3,000 t, representing about 14 hours of operation at the design milling rate of 215 t/h. The stockpile will be enclosed in a circular dome.

Fine ore will be fed to the mill building via three variable-speed feeders that will discharge onto the ball mill feed conveyor.

17.1.2.5 Grinding and Gravity Concentration

The 1,050 mm wide by 190 m long ball mill feed conveyor will discharge fine ore into a 16.5 ft diameter by 24 ft long (5.03 m by 7.32 m) ball mill, driven by a 3,200 kW motor. The mill will operate in closed circuit with a cluster of cyclones from which the overflow will feed a secondary grinding circuit, while the majority of the underflow will be recycled to the ball mill. The cyclone cluster consists of nine 381 mm diameter cyclones with eight units operating under nominal flow conditions.

A portion of the cyclone underflow will feed the gold gravity recovery circuit which includes a 828 mm wide by 4,877 mm long scalping screen fitted with a 2 mm aperture screen deck, and a gravity concentrator that will separate and concentrate fine materials with a high specific gravity. Heavy minerals, including gold, will be collected and pumped to the final concentrate thickener for dewatering and packaging with the flotation concentrates. Screen oversize and gravity tailings will gravitate to the mill cyclone feed pump box.

The secondary grinding circuit includes two 750 kW vertical mills in closed circuit with cyclones and cyclone feed pumps. The secondary grind will produce flotation feed at minus 53 μm.

17.1.2.6 Bulk Flotation Circuit

The bulk rougher flotation design consists of a bank of five 70 m^3 capacity circular tank type flotation cells with a total retention time of about 45 minutes. Two flotation reagents, MIBC and PAX, are added at the beginning and midway through the circuit to collect and float the valuable minerals. The remaining ground slurry will flow by gravity from the final cell to the tailings thickener for disposal.

The bulk rougher concentrate froth will be pumped to the first bulk cleaner cell. The bulk cleaner and bulk cleaner-scavenger circuit design comprises a bank of seven 10 m^3 circular tank-type flotation cells. The first four cells will be bulk cleaners and the final three will be bulk cleaner-scavenger cells. The bulk cleaner concentrate will be pumped to the concentrate thickener. The concentrate from the cleaner-scavengers will be recycled to the head of the bulk cleaner circuit.

The bulk second cleaner flotation design is based on the results of the locked cycle and FLEET testwork performed by SGS-MS in 2009. It is based on Flowsheet Option 4 of the SGS-MS Lakefield FLEET report.

Cleaner-scavenger tailings will be reground with two vertical regrind mills in closed circuit with a cyclone cluster comprising five 254 mm diameter cyclones (three operating and two on standby). The cyclone overflow product from the re-grind circuit (80% passing 20 µm) will feed the secondary flotation circuit.

17.1.2.7 Secondary Flotation Circuit

The secondary flotation circuit comprises a bank of five 10 m^3 capacity circular secondary rougher tank-type flotation cells and a bank of four 10 m^3 capacity secondary cleaner (two) and scavenger-cleaner (two) cells.

The secondary cleaner concentrate will be pumped to the concentrate thickener. The secondary rougher tailings report to the final tailings pump box and thickener, while the secondary cleaner tailings will be recycled to the regrind circuit.

17.1.2.8 Concentrate Dewatering

The final bulk concentrate, the secondary cleaner concentrate and the gravity concentrate will feed the 5.8 m diameter bulk concentrate thickener. The thickener design is conventional with a bridge-mounted drive mechanism. Thickener overflow will be pumped to the concentrator process water tank. Thickener underflow will be pumped to a storage tank, prior to feeding the bulk concentrate pressure filter. The underflow storage tank is sized to provide 12 h retention time.

The pressure filter will be a fully-automatic vertical recessed plate type filter. The discharged cake from the pressure filter will contain approximately 8% moisture. The filtrate collected in the filtrate pump box will be pumped to the concentrator process water tank. The filter cake will discharge onto the concentrate loadout conveyor.

17.1.2.9 Concentrate Packaging

The concentrate filter cake from the filter press will feed a concentrate packaging system. The packaging system will collect and bag concentrates for transport. Each bag will be weighed, sampled and tagged for shipment. The filter press will discharge into a hopper, allowing the bagging system to operate independently of the filter press.

17.1.2.10 Tailings Dewatering

Flotation tailings will be fed to a 12 m diameter high-density deep-bed tailings thickener, where they will be dewatered to a design of 75% solids by weight. The thickener underflow will be pumped to the co-disposal area. Thickener overflow will be pumped to the concentrator process water tank.

17.1.2.11 Reagents

PAX and MIBC will be used in the flotation area of the concentrator. PAX is a collector, while MIBC is a frother. The flotation reagent preparation area and the secondary flotation area will share a 1-t overhead crane to facilitate maintenance of pumps and lifting of PAX bags. PAX will be delivered as pellets in bulk 1 t bags and the design includes an agitated mixing tank and a day tank for PAX preparation. Fresh water will be added to the mixing tank to dissolve the pellets and a pump will transfer the solution to the day tank. Metering pumps will deliver PAX to the cyclone feed box and flotation cells.

MIBC will be delivered in drums. A drum pump will transfer MIBC to a distribution tank, from which it will be distributed by metering pumps to the bulk rougher and secondary rougher flotation cells.

Flocculant will be delivered in bulk 1 t bags. The flocculant mixing system has the capacity to service all thickeners in the plant. The system for preparing 0.5% wt. flocculant solution consists of a dosing unit, a wetting unit, mixing tank, storage tank, one operating metering pump and their corresponding in-line mixers. Fresh water will be added to the wetting unit and the mixing tank for solids wetting and dissolution. The in-line mixers are included to further dilute the flocculant solution down to 0.1% wt. with fresh water, before delivery to the respective thickeners.

17.1.3 Plant Utilities

17.1.3.1 Compressed Air

The service building will house four air compressors, with two operating and two on standby, to provide compressed plant air, instrumentation air and air for the pressure filter. Two pairs of flotation air blowers will also be provided in the service building, for supplying air to the flotation circuit.

17.1.3.2 Fresh Water

The fresh water supply for the NICO concentrator and the potable water treatment plant will be from Lou Lake. The fresh water tank will be located in close vicinity to the concentrator and has a design capacity of 70 m^3. Fresh water will be distributed from the tank and be used for the following applications:

- Mine dust suppression and drills.
- Concentrator process water.
- Hose water distribution.
- Gland water distribution.

- Sewage treatment incinerator.
- Reagent preparation.
- Potable water.

Fresh water will be pumped to a boiler package to generate hot water for general uses around the plant. There is one boiler in the NICO plant. Building heat will be supplied by propane direct heaters in some locations, and by propane fired boiler hydronic systems for the camp and office buildings. The additional electrical load of about 7 MW is under review by the local utility.

Fresh water for making potable water will be first treated in a 2.9 m^3/h potable water treatment plant, before being stored in the potable water supply tank. Potable water will be supplied to all end users by potable water supply pumps.

Water from the fresh water tank will be pumped to a gland water cartridge filter to remove any entrained solid fines. Filtered gland water will then be pumped to all gland water users. The hose water requirement on-site will be supplied directly from the fresh water tank to the individual hose stations.

17.1.3.3 Process Water

The concentrator process water comprises the overflows from the tailings thickener and bulk concentrate thickener, bulk concentrate filtrates, as well as pumped reclaim water from the surge pond. The process water will be distributed to the different users in the concentrator.

The design of the process water tank has a firewater reserve of sufficient capacity to pump for 2 h in the event of a fire.

17.1.4 Process Design Criteria

A complete list of detailed process design criteria is included in Volume 2 of the FEED study. A summary of key criteria is provided in Table 17.1.

The crushing plant will operate for one 10-hour shift per day while the grinding, flotation and product de-watering facilities will operate for 24 h/d, 365 d/y. The design concentrator operating utilization is 90%.

Table 17.1
Summary of Key Process Design Criteria

Criterion	Units	Value	Source
Metal Recoveries to Bulk Concentrate			
Cobalt	%	90.9	CL
Gold	%	72.6[1]	CL
Bismuth	%	82.1	
Copper	%	89.1	

Criterion	Units	Value	Source
Average ROM Ore Grades			
Cobalt	%	0.145	FML
Gold	%	2.386	
Bismuth	%	0.190	
Copper	%	0.034	BFS
Sulphide sulphur	%	0.55	AD
Arsenic	%	1.002	FML
Physical Ore Characteristics			
Ore specific gravity		3.30	FML
Crushed fine ore bulk density	t/m^3	1.80	AK
Moisture in ROM feed	wt%	6.5	FML
Real ore density	t/m^3	3.39	AD
Abrasion index (Ai)	g	0.3299	LR
Ball mill bond work index	kWh/t	13.6	LR
Operating Schedule and Throughput Rates			
Days per year 365 days	d/y	365	AD
Shifts per day		2	AD
Hours per shift	h	12	AD
Annual ore tonnage	dry t/y	1,695,000	FML
Nominal daily tonnage,	dry t/d	4,645	FML
Nominal hourly tonnage	dry t/h	194	FML
Crusher plant operation schedule (shifts/day)		2	FML
Crusher plant operating effective time	%	38	FML
Crusher design throughput rate	dry t/h	516	CL
Concentrator operating factor	%	90	BFS
Design daily tonnage	dry t/d	5,161	CL
Design hourly tonnage	dry t/h	215	CL
Concentrator Design			
Number of crushing stages		3	BFS
Primary crusher feed size (F_{80})	mm	300	AK
Primary crusher product size (P_{80})	mm	120	AK
Secondary crusher product size (P_{80})	mm	25.4	SI
Tertiary crusher product size (P_{80})	mm	6	AK
Fine ore storage	t	3,000	FML
Ball mill circulating load	%	300	ME
Grinding circuit product size (P_{80})	µm	53	AK
Gravity concentration mass pull	%	0.03	V
Gravity circuit gold recovery	%	7.8	V
Bulk flotation rougher mass pull	%	12.8	PP
Bulk flotation rougher retention time	min	45	PP/AK
Bulk flotation cleaner mass pull	%	3.42	AD
Bulk flotation cleaner retention time	min	10.4	PP/AK
Bulk flotation cleaner-scavenger mass pull	%	0.88	PP
Bulk flotation cleaner-scavenger retention time	min	8.1	PP/AK
Regrind specific energy consumption	kWh/t	6.0	AD/V
Regrind mill circuit product size (P_{80})	µm	20	FL
Secondary flotation rougher mass pull	%	1.2	FL
Secondary flotation rougher retention time	min	30	CL/FL
Secondary flotation cleaner mass pull	%	0.19	FL
Secondary flotation cleaner retention time	min	20	CL/FL

Criterion	Units	Value	Source
Tailings thickener underflow density	% solids	75	GPT
Specific loading rate for high rate application	$m^3/m^2.h$	3.7	PP
Tails high rate thickener flocculant dosage	g/t solids	35	PP
Bulk concentrate thickener underflow density	% solids	60	AD
Specific loading rate for conventional application	$m^2/t/d$	0.13	AD
Concentrate thickener flocculant dosage	g/t solids	80	AD
Bulk concentrate filter design availability	%	85%	FML
Filter slurry feed solids density	% solids	60	AD
Filter cake moisture	% water	8	V/AD
Effective filtration rate	$kg/m^3.h$	535	V/AD

[1] Gold recovery listed is for the design gold grade. Gold recovery varies with mill feed grade, and this variation is reflected in the financial model.

Source Legend

FML	Data Provided by the Client
SI	Standard Industry Practice
BFS	Design Criteria Provided in Micon Feasibility Study report
AK	Aker Solutions Recommendation
EHA	Data Provided by EHA Engineering
V	Vendor Originated Criteria
GPT	Data Provided by Golder PasteTec
CL	Criteria from Process Calculations
LN	Laboratory Non-representative
EH	Engineering Handbook Data or Literature
LR	Laboratory Representative
AD	Assumed Data
KVK	Data Provided by KVK Consulting Associates Inc
RG	Regulation
PP	Pilot Plant
ME	From Metso Simulation
FL	Log Cycle Test and FLEET model

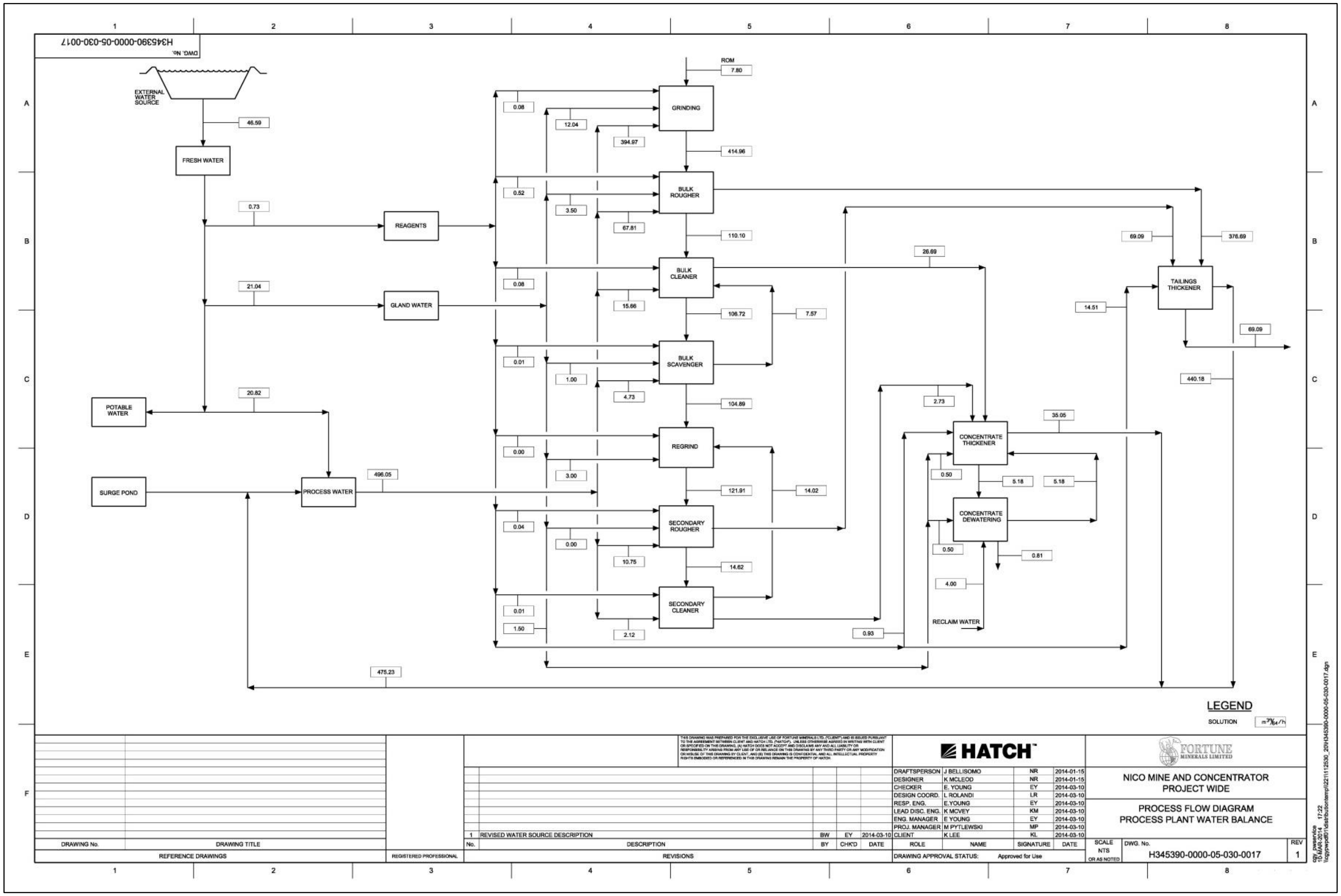
17.1.5 Piping and Instrument Diagrams (P&IDs) and General Arrangement Drawings

The P&IDs for the FEED study were completed to include piping, valves and instrumentation. The process control philosophy was developed in conjunction with the preparation and finalization of the P&IDs. Both the P&IDs and the control philosophy are included in Volume 2 of the FEED study. All P&IDs are being updated by Hatch, in the course of preliminary engineering. General arrangement drawings are included in Volume 2 of the FEED study and are also being updated by Hatch.

17.1.6 Mass and Water Balances

The overall water balance for the NICO concentrator is presented in Figure 17.3. The nominal steady-state fresh water makeup to the plant is 12.8 m^3/h, which will be extracted from Lou Lake. This demand is based on the assumption that 17.4 m^3/h of water are available for reclaim from the tailings feed through thickening and sedimentation in the co-disposal

Figure 17.3
NICO Concentrator Overall Water Balance



facility, and that 34.6 m^3/h of water are available for recycling from the co-disposal facility, through the accumulation of water from precipitation and runoff, minus evaporation and seepage.

If precipitation is not considered, the nominal steady-state fresh water makeup to the plant is approximately 47 m^3/h. This is assuming that 17.4 m^3/h of water are still available for reclaim from the tailings, through thickening and sedimentation in the co-disposal facility.

The maximum fresh water demand would be experienced when reclaimed water is not available while the entire concentrator plant is operating at full capacity, such as during the period of commissioning and plant start-up. The total estimated fresh water intake under these conditions would be 64.8 m^3/h, or approximately 1,555 m^3/d.

The minimum fresh water demand is estimated to be 9.7 m^3/h, in the event of a plant shut down. This water is consumed in the mine area (8.3 m^3/h) and potable water treatment plant (1.4 m^3/h).

The nominal steady-state mass balance for the concentrator was developed in the FEED study from the METSIM® model simulation. The mass balances are being updated by Hatch.

17.1.7 Process Plant Production Schedule

The design production schedule for the processing plant at the NICO Project site is summarized in Table 17.2, which includes the scheduled movements of open pit ore into and out of the ore stockpile. The plant is scheduled to commence treating ore in October, 2017.

Open pit ore produced in excess of the process plant capacity is stockpiled for subsequent processing during periods of lower mine production, and at the end of mine life. Ore delivered to the stockpile is deemed to be at the average grade of open pit ore mined during the relevant period. Ore reclaimed from the stockpile is deemed to be at the average grade of the stockpile at the time. All underground ore is of higher grade than the open pit ore and is fed directly to the processing plant, as it is mined.

17.1.8 Tailings and Waste Rock Storage

17.1.8.1 The Waste Co-disposal Facility

The NICO Project will generate a total of approximately 32 Mt of tailings and 97.8 Mt of waste rock, including 5.5 Mt of low-grade material which, potentially, could be processed. Both these waste streams will be disposed of together in a facility referred to as the co-disposal facility (CDF).

Table 17.2
NICO Project – Process Plant Production Schedule

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
MINE PRODUCTION																									
Total Ore Mined (thousand tonnes)	**33,077**			17	460	1,717	1,792	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Contained Gold (thousand ounces)	**1,100.3**			0.1	2.9	47.0	65.9	20.3	16.3	29.4	66.7	67.9	96.4	87.1	28.9	30.2	28.0	29.0	37.3	46.5	72.1	154.1	39.9	106.1	28.3
Contained Cobalt (thousand pounds)	**82,333**			53	1,292	4,655	4,226	3,872	4,749	4,910	4,269	4,145	3,318	4,593	4,701	4,610	4,416	4,384	4,172	3,877	3,310	3,953	3,231	4,064	1,532
Contained Bismuth (thousand pounds)	**102,082**			27	1,142	6,172	4,703	3,699	5,169	6,613	7,215	6,473	5,876	4,656	5,538	6,539	6,785	6,376	5,481	5,033	4,457	3,192	4,638	2,106	194
Contained Copper (thousand pounds)	**27,196**			12	423	539	490	1,092	1,452	1,968	1,617	1,210	889	731	771	1,087	1,798	2,394	2,825	2,530	1,580	484	1,999	1,182	124
STOCKPILE MOVEMENTS																									
Opening Balance																									
Tonnes (thousand)					17	154	197	290	78	41	91	88	85	87	96	89	89	97	112	105	47	8	107	66	71
Gold Grade (grams/tonne)					0.24	0.20	0.21	0.21	0.21	0.21	0.38	0.38	0.38	0.41	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	2.51	4.05	3.91
Cobalt Grade (%)					0.14	0.13	0.13	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.16	0.16
Bismuth Grade (%)					0.07	0.11	0.12	0.12	0.12	0.12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.09	0.14	0.13
Copper Grade (%)					0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.01	0.02	0.02
Contained Gold (thousand ounces)					0.1	1.0	1.3	1.9	0.5	0.3	1.1	1.1	1.0	1.1	1.6	1.5	1.5	1.6	1.9	1.8	0.8	0.1	8.6	8.6	8.9
Contained Cobalt (thousand pounds)					53	435	550	783	211	111	252	244	234	238	264	244	243	265	303	285	127	21	239	239	249
Contained Bismuth (thousand pounds)					27	367	501	770	208	109	299	290	278	284	310	287	286	320	375	352	157	25	201	201	207
Contained Copper (thousand pounds)					12	138	149	171	46	24	81	78	75	76	80	74	74	83	104	97	43	7	34	34	37
Annual Addition																									
Tonnes (thousand)	**507**			17	157	43	100			50			2	10			9	15				99		5	
Gold Grade (grams/tonne)				0.24	0.19	0.24	0.21			0.52			1.76	1.59			0.51	0.53				2.67		1.94	
Cobalt Grade (%)				0.14	0.13	0.12	0.11			0.13			0.09	0.12			0.12	0.12				0.10		0.11	
Bismuth Grade (%)				0.07	0.11	0.14	0.13			0.17			0.16	0.12			0.18	0.17				0.08		0.06	
Copper Grade (%)				0.03	0.04	0.01	0.01			0.05			0.02	0.02			0.05	0.06				0.01		0.03	
Contained Gold (thousand ounces)	**12.7**			0.1	1.0	0.3	0.7			0.8			0.1	0.5			0.1	0.3				8.5		0	
Contained Cobalt (thousand pounds)	**1,322**			53	442	115	254			141			3	26			22	38				218		11	
Contained Bismuth (thousand pounds)	**1,331**			27	391	134	287			190			6	27			34	55				176		6	
Contained Copper (thousand pounds)	**317**			12	145	11	28			56			1	4			9	21				27		3	
Annual Depletion																									
Tonnes (thousand)	**(507)**				(21)		(7)	(212)	(37)		(3)	(3)			(7)	(0.4)			(7)	(58)	(39)		(40)		(71)
Gold Grade (grams/tonne)					0.20		0.21	0.21	0.21		0.38	0.38			0.53	0.53			0.52	0.52	0.52		2.51		3.91
Cobalt Grade (%)					0.13		0.13	0.12	0.12		0.13	0.13			0.12	0.12			0.12	0.12	0.12		0.10		0.16
Bismuth Grade (%)					0.11		0.12	0.12	0.12		0.15	0.15			0.15	0.15			0.15	0.15	0.15		0.09		0.13
Copper Grade (%)					0.04		0.03	0.03	0.03		0.04	0.04			0.04	0.04			0.04	0.04	0.04		0.01		0.02
Contained Gold (thousand ounces)	**(12.7)**				(0.1)		(0.05)	(1.4)	(0.2)		(0.0)	(0.0)			(0.1)	(0.0)			(0.1)	(1.0)	(0.7)				(8.9)
Contained Cobalt (thousand pounds)	**(1,323)**				(60)		(20)	(572)	(100)		(8)	(10)			(20)	(1)			(18)	(157)	(107)				(250)
Contained Bismuth (thousand pounds)	**(1,332)**				(50)		(19)	(562)	(98)		(9)	(11)			(24)	(1)			(23)	(195)	(132)				(208)
Contained Copper (thousand pounds)	**(317)**				(19)		(6)	(125)	(22)		(2)	(3)			(6)	(0)			(6)	(54)	(36)				(37)
Closing Balance																									
Tonnes (thousand)				17	154	197	290	78	41	91	88	85	87	96	89	89	97	112	105	47	8	107	66	71	0
Gold Grade (grams/tonne)				0.24	0.20	0.21	0.21	0.21	0.21	0.38	0.38	0.38	0.41	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.52	2.51	4.05	3.91	0
Cobalt Grade (%)				0.14	0.13	0.13	0.12	0.12	0.12	0.13	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.10	0.16	0.16	0
Bismuth Grade (%)				0.07	0.11	0.12	0.12	0.12	0.12	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.09	0.14	0.13	0
Copper Grade (%)				0.03	0.04	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.01	0.02	0.02	0
Contained Gold (thousand ounces)				0.1	1.0	1.3	1.9	0.5	0.3	1.1	1.1	1.0	1.1	1.6	1.5	1.5	1.6	1.9	1.8	0.8	0.1	8.6	8.6	8.9	0
Contained Cobalt (thousand pounds)				53	435	550	783	211	111	252	244	234	238	264	244	243	265	303	285	127	21	239	239	249	(1)
Contained Bismuth (thousand pounds)				27	367	501	770	208	109	299	290	278	284	310	287	286	320	375	352	157	25	201	201	207	0
Contained Copper (thousand pounds)				12	138	149	171	46	24	81	78	75	76	80	74	74	83	104	97	43	7	34	34	37	0
MILL PRODUCTION SCHEDULE																									
Ore Milled (thousand tonnes)	**33,078**				324	1,673	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	509
Gold Grade (grams/tonne)	**1.03**				0.20	0.87	1.20	0.40	0.30	0.52	1.22	1.24	1.76	1.59	0.53	0.55	0.51	0.53	0.68	0.87	1.33	2.67	0.73	1.94	2.27
Cobalt Grade (%)	**0.11**				0.13	0.12	0.11	0.12	0.13	0.13	0.11	0.11	0.09	0.12	0.13	0.12	0.12	0.12	0.11	0.11	0.09	0.10	0.09	0.11	0.16
Bismuth Grade (%)	**0.14**				0.11	0.16	0.12	0.11	0.14	0.17	0.19	0.17	0.16	0.12	0.15	0.17	0.18	0.17	0.15	0.14	0.12	0.08	0.12	0.06	0.04
Copper Grade (%)	**0.04**				0.04	0.01	0.01	0.03	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.06	0.08	0.07	0.04	0.01	0.05	0.03	0.01
Contained Gold (thousand ounces)	**1,100.3**				2.0	46.7	65.3	21.7	16.5	28.5	66.7	68.0	96.3	86.6	29.1	30.2	27.8	28.7	37.4	47.5	72.8	145.6	39.9	105.8	37.2
Contained Cobalt (thousand pounds)	**82,334**				910	4,541	3,992	4,444	4,849	4,770	4,277	4,155	3,314	4,567	4,721	4,611	4,394	4,346	4,191	4,035	3,417	3,735	3,231	4,053	1,782
Contained Bismuth (thousand pounds)	**102,083**				801	6,038	4,435	4,261	5,267	6,424	7,224	6,485	5,871	4,629	5,561	6,540	6,750	6,321	5,504	5,228	4,588	3,016	4,638	2,100	402
Contained Copper (thousand pounds)	**27,196**				297	528	468	1,217	1,474	1,911	1,619	1,213	888	726	777	1,087	1,789	2,374	2,831	2,584	1,616	458	1,999	1,179	161
Gold Recovery (%)	**78.2**				67.3	81.6	83.4	68.5	68.0	69.3	77.3	77.4	80.6	79.5	69.3	69.9	69.2	69.3	70.0	74.3	77.8	85.0	74.5	82.3	83.2
Cobalt Recovery (%)	**90.9**				90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9	90.9
Bismuth Recovery (%)	**82.1**				82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1	82.1
Copper Recovery (%)	**89.1**				89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1	89.1
Recovered Gold (thousand ounces)	**860.3**				1.4	38.1	54.4	14.8	11.2	19.8	51.5	52.6	77.6	68.9	20.1	21.1	19.3	19.9	26.2	35.3	56.6	123.8	29.7	87.0	30.9
Recovered Cobalt (thousand pounds)	**74,839**				827	4,127	3,629	4,039	4,408	4,335	3,888	3,776	3,013	4,151	4,291	4,191	3,994	3,950	3,809	3,668	3,106	3,395	2,937	3,684	1,620
Recovered Bismuth (thousand pounds)	**83,808**				658	4,957	3,641	3,498	4,324	5,274	5,931	5,324	4,820	3,800	4,566	5,369	5,542	5,190	4,519	4,292	3,767	2,476	3,808	1,724	330
Recovered Copper (thousand pounds)	**24,231**				265	470	417	1,084	1,313	1,703	1,443	1,080	791	647	692	969	1,594	2,115	2,522	2,302	1,440	408	1,781	1,051	143
Concentrate Produced (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Gold Grade of Concentrate (grams/tonne)	**25.19**				4.09	22.06	31.04	8.47	6.41	11.27	29.39	30.00	44.24	39.28	11.49	12.02	10.98	11.35	14.92	20.12	32.29	70.58	16.96	49.62	58.84
Cobalt Grade of Concentrate (%)	**3.20**				3.61	3.48	3.02	3.36	3.67	3.61	3.23	3.14	2.51	3.45	3.57	3.49	3.32	3.29	3.17	3.05	2.58	2.82	2.44	3.06	4.50
Bismuth Grade of Concentrate (%)	**3.58**				2.87	4.18	3.03	2.91	3.60	4.39	4.93	4.43	4.01	3.16	3.80	4.47	4.61	4.32	3.76	3.57	3.13	2.06	3.17	1.43	0.92
Copper Grade of Concentrate (%)	**1.03**				1.15	0.40	0.35	0.90	1.09	1.42	1.20	0.90	0.66	0.54	0.58	0.81	1.33	1.76	2.10	1.91	1.20	0.34	1.48	0.87	0.40
Concentrate Shipped (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3

Fortune retained Golder and Golder Paste Technology (PasteTec) to carry out the conceptual design of the CDF, as input to the Jacobs FEED study. Golder had previously carried out a trade-off study for the management of tailings and mine waste rock, the result of which was the selection of the CDF system. A pre-feasibility study level design and cost estimate for the CDF was also provided (Golder, 2010a). The cost estimate had an assessed level of accuracy of plus or minus 25%.

Design drivers for the CDF were:

- **Footprint:** The footprint should be minimized and the facility located as close as possible to the open pit and the plant site, in order to minimize haul distances and environmental impact; location of the CDF, pit and plant, all within a single watershed, is preferred.

- **Geochemistry:** Both tailings and mine waste rock are susceptible to metal leaching and a small portion of the mine waste has acid generation potential. The risk of operational and post-closure mass release and mass loadings from the facilities into downstream water bodies must be limited. Oxidation can be limited by reducing ingress of oxygen; loadings from metal leaching can be reduced by limiting water seepage through the CDF.

- **Water conservation:** Water will freeze quickly in the winter months and the volume of water discharged from the plant with the tailings should be minimized, in order to reduce the demand for reclaim water.

- **Water treatment requirements:** Effluent from the site will require treatment throughout operations and, potentially, after closure; treatment requirements should be minimized to the extent possible.

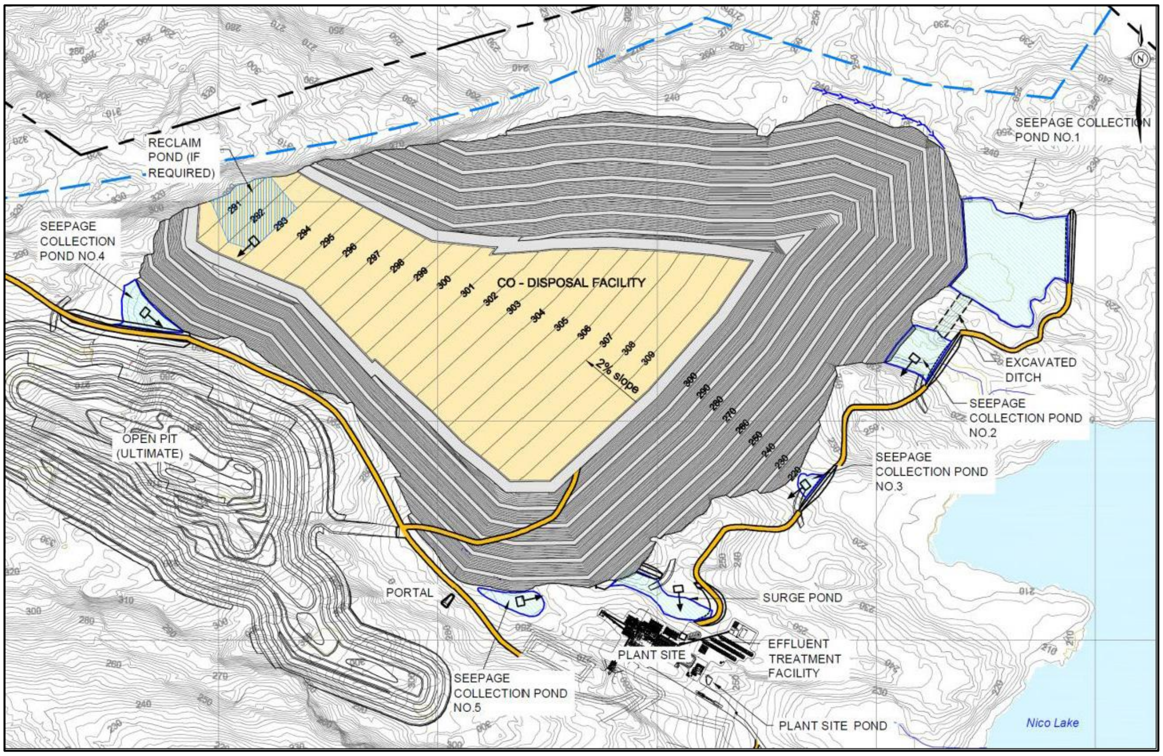
- **Design for closure:** Progressive closure will reduce the area of tailings and mine rock that will be exposed. Covers should be designed to prevent erosion and potential transport of tailings solids, to reduce infiltration and to prevent contact between tailings and surface runoff. The cover system should include a capillary break to reduce metal uptake by vegetation in the cover and, therefore, ingestion of metals from the vegetation by wildlife.

- **Cost:** The facility should be designed with the objective of reducing capital, operating and closure costs.

The CDF will be contained within a perimeter dyke comprising a prism of waste rock at least 25 m thick. Inside the perimeter dyke, the CDF will comprise alternating layers of waste rock and tailings about 5 m thick. The perimeter dyke will be free draining but it will retain tailings particles. Five seepage collection ponds (SCP) will be constructed downstream of the CDF at topographically low areas, to intercept any tailings water that may seep through the perimeter dyke. Water collected in the SCPs will be pumped to the process plant for re-use.

The general arrangement plan of the CDF is shown in Figure 17.4.

Figure 17.4
General Arrangement Plan of the NICO Co-disposal Facility

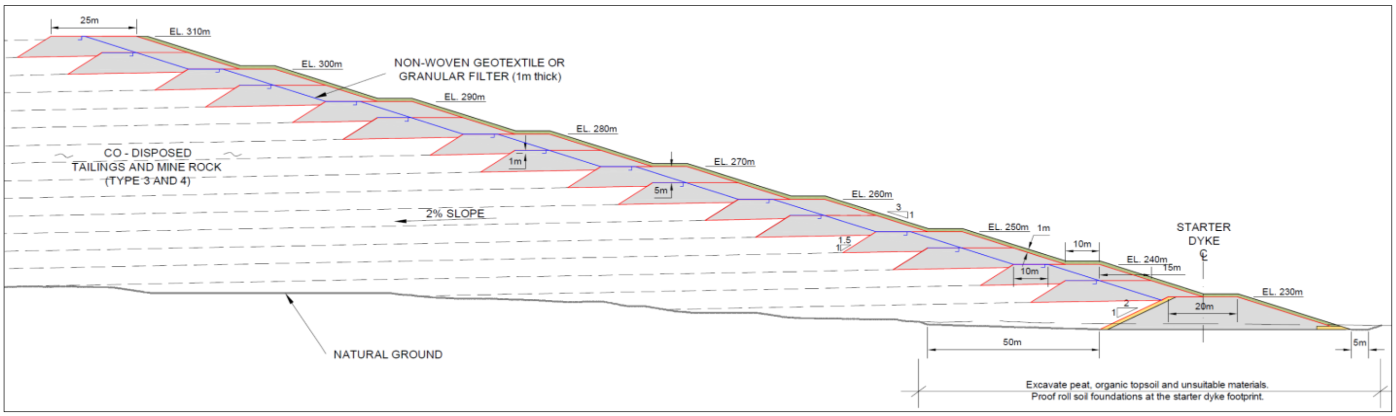


The co-disposal of tailings and waste rock was selected as the preferred waste management system for the following reasons:

- Reduces the footprint area requirement, relative to separate facilities for the storage of tailings and waste rock.
- Maximizes the rate of consolidation of the tailings.
- Improves the stability of the disposal facility.
- Reduces metal leaching and acid mine drainage.
- Minimizes freeze dry and dusting.
- Reduces the mine hauling distance and tailings pumping length.
- Allows progressive reclamation and closure.

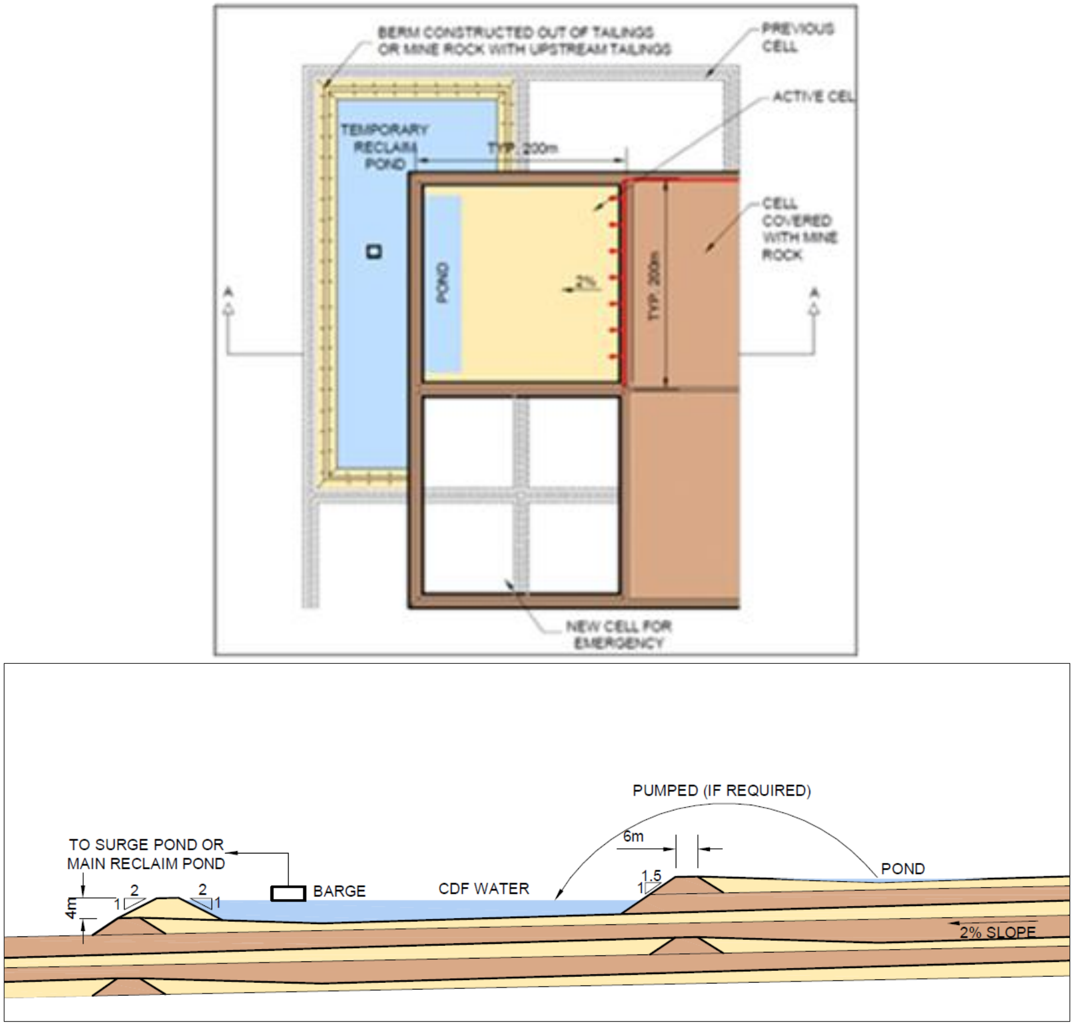
The perimeter dyke will be raised periodically in 5-m lifts, using the upstream construction method illustrated in Figure 17.5, and will be free draining. To retain tailings particles, the perimeter dyke will incorporate a filter comprising either a zone of sand or a non-woven geotextile. The dyke is designed to safely store the probable maximum precipitation (PMP) rainfall event during operational years, and an emergency spillway will be provided for post-closure to safely convey the 1:10,000 year rainfall storm. In addition, the facility is designed to be stable under a 1:2,500 year return period earthquake, at minimum.

Figure 17.5
Typical Cross-section of the Co-disposal Facility Perimeter Dyke



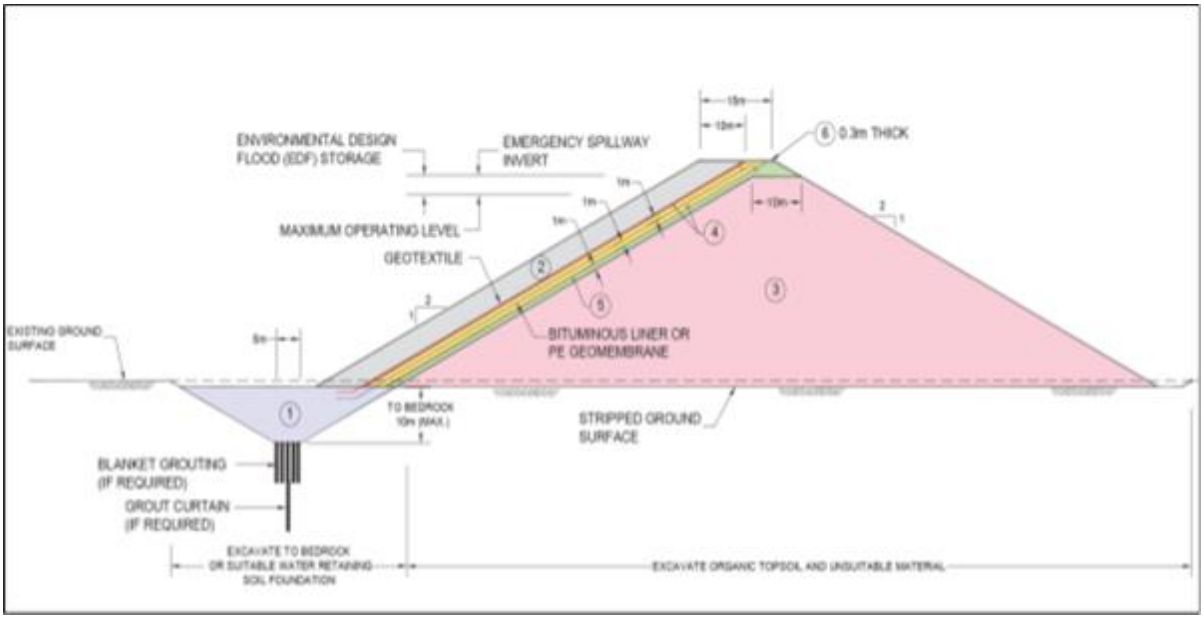
The tailings layers will be created by constructing a series of tailings disposal cells using waste rock, as shown on Figure 17.6. The cell perimeter berms will be constructed by end dumping the waste rock. The berm will have a nominal crest width of 6 m to allow vehicle access. Each tailings disposal cell will be filled with non-segregated thickened tailings, which will be discharged through a series of spigot discharge points from the berms of the cells. A 5 m thick layer of waste rock will be pushed over the tailings disposal cells as soon as they are filled, to maximize mixing of the waste rock and the tailings. The tailings pipeline will have a spill collection system.

Figure 17.6
Typical Layered Co-disposal Scheme



The perimeter berms of the tailings disposal cells will be permeable and the tailings bleed water and runoff will seep through them. A portion of this water will be conveyed to the reclaim pond area within the CDF. Since the CDF and the perimeter dyke are generally free draining, some of the tailings bleed water and runoff water will seep through the facility and report to five topographically low areas downstream of the CDF. A typical cross-section of the SCPs designed to intercept the seepage water is shown on Figure 17.7. The SCPs will be generally shallow and contained by low permeability dams, constructed of rock fill with an internal liner system. Rip-rap will be provided on the upstream face of the dam. Transition and bedding layers will be provided above the rock fill to ensure filter compatibility. The liner will be embedded within the bedding layer. Each of the SCPs will be protected by an emergency spillway to safely convey storm events.

Figure 17.7
Typical Cross-section of Seepage Collection Pond Dams



17.1.8.2 Geotechnical Investigations

Three programs of geotechnical investigation within the footprint areas of the CDF and associated water management facilities have been undertaken, including the drilling of a total of 43 boreholes.

The first site investigation was carried out by EBA Engineering Consultants Ltd. (EBA) in 2004 (EBA, 2005 a, b), during which 11 holes were drilled to the south of the current mine infrastructure locations.

Golder carried out the second round of drilling in 2006 (Golder, 2007), in which 10 holes were drilled. Eight of these were drilled near the toe of the proposed CDF and along the alignment of the dam of SCP 1. Vibrating wire piezometers and thermistors were installed in selected boreholes.

Golder carried out the third program of geotechnical site investigation in 2010 (Golder, 2010b). The program comprised the drilling of 22 boreholes, (seven geotechnical holes, 13 monitoring wells and two condemnation holes). The geotechnical holes were drilled along the alignment of the SCP dams and the polishing pond dams. The monitoring wells were drilled upstream of the CDF and downstream of the SCPs, polishing pond and plant. The condemnation holes were drilled within the footprint of the CDF.

Golder also carried out a geotechnical and hydrogeological investigation in 2003 on the open pit and underground workings (Golder, 2005) and EBA supervised a geotechnical drilling program at the plant site in the fall of 2010. The results are described in Appendix 17.2.

17.1.8.3 Closure

Golder developed a closure plan for the CDF based on the following components:

- Progressive grading of the facility during operations, to promote runoff into the open pit.
- Installation and vegetation of closure cover over the entire surface of the CDF.
- Drainage of runoff water from the surface of the CDF into the open pit, to increase the rate of formation of a pit lake.
- Collection and management of water seepage from the toe of the CDF.

The closure cover will effectively encapsulate the co-disposed tailings and waste rock and was selected to minimize wind and water erosion and to reduce infiltration into the CDF. Where the cover is underlain by co-disposed waste rock and tailings (on the top surface of the CDF), the cover will comprise 0.5 m of glacial till underlain by 0.25 m of sand. Where the cover is underlain by waste rock alone (on the sloped perimeter dyke), the cover will comprise a single layer of glacial till 1.0 m thick, with no underlying sand layer.

The 0.25 m sand layer will serve as a capillary break to minimize the potential for upward flux of tailings pore water and, thereby, reduce the potential for arsenic uptake in vegetation. Mine waste rock will not be a significant source of arsenic.

For past-closure water management, culverts will be installed to direct water flow from SCP 4 under the site road to the open pit.

It has been assumed that water accumulating in SCPs 1, 2, 3 and 5 and the surge pond will be passively treated in constructed wetlands and then released to Nico Lake. The technical feasibility of constructed wetland treatment will be validated during operations.

17.2 SASKATCHEWAN METALS PROCESSING PLANT

The bulk gold-cobalt-bismuth-copper concentrate produced at the Project site in the NWT will be shipped by road and rail to the SMPP for further processing, to produce gold doré, copper cement, and a range of cobalt and bismuth products.

17.2.1 Aker Solutions (Jacobs) FEED Study

The process design for the SMPP is based on a FEED study prepared by Aker Metals, now Jacobs, which was published in September, 2012. Initially, the FEED study considered the production of cobalt as cathode, and an addendum was prepared for the production of cobalt as battery-grade sulphate, at a somewhat lower order of accuracy. The SMPP FEED study, comprises 19 volumes and includes all of the components listed previously in Section 17.1.1 for the processing plant at the Project site.

In the main, the process design criteria are based on the results of the hydrometallurgical testwork described in Section 13.4. The mechanical equipment list generated for the FEED study is based on PFDs developed in conjunction with Fortune and its consultants. The mass and energy balances used for the sizing of equipment were derived from METSIM® model simulations developed for the purpose.

17.2.2 Process Overview

Bulk concentrate produced at the NICO site will be transported by road and rail to a dedicated rail siding on the SMPP property.

At the SMPP, the bulk concentrate will be re-ground to minus 14 µm and subjected to secondary flotation to produce separate auriferous cobalt and bismuth concentrates. The bismuth concentrate will then be treated by a ferric chloride leach. The pregnant solution will be subjected to electrowinning to produce bismuth cathode, which will then be smelted, with a flux, to produce bismuth ingots of 99.995% purity, 99.995% bismuth needles and 89.7% bismuth oxide.

The bismuth leach residue will be combined with the cobalt concentrate and subjected to a pressure acid leach. Impurities, including iron, arsenic, manganese and copper, will then be precipitated sequentially with lime and sodium carbonate. The copper in the precipitates will be re-leached and recovered using an iron cementation process.

Cobalt pregnant solution produced by the pressure acid leach, after the precipitation of iron and arsenic, will be processed by solvent extraction, using Cyanex 272, in order to remove metallic impurities by sequential stripping, and leave a pure cobalt sulphate solution. This solution will then be evaporated and subjected to a three-stage crystallization process to produce cobalt sulphate heptahydrate, containing 20.9% cobalt. Cobalt carbonate, cobalt oxide, cobalt nitrate and cobalt chloride can also be produced from the same cobalt sulphate solution.

The cobalt concentrate residue after the pressure leach will be treated with cyanide, for the recovery of gold as doré bars.

17.2.3 Process Description

The FEED study design for the SMPP is based on treating an average of 217 wet tonnes of bulk concentrate per day, at an overall plant availability of 85%. The processing facilities are subdivided as follows:

- Receipt of bulk concentrate.
- Flotation bismuth minerals from the bulk concentrate.

- Bismuth production circuit.
- Cobalt production circuit.
- Copper production circuit.
- Gold production circuit.
- Residue disposal.
- Reagent preparation.

Process flow diagrams for the processing circuits described below are included in Appendix II of this report.

17.2.3.1 Receipt of Bulk Concentrate

Bagged bulk concentrate from the Project site in the NWT will arrive at the SMPP in rail cars. The bags will be lifted from the rail cars by a crane, placed on pallets and transported by a fork lift to a thermally-controlled thawing shed. Once thawed, the bags will be taken by fork lift to the bulk concentrate handling conveyor system at the east end of the plant. The handling conveyor system ends with a section of live rollers, from which the bags are lifted by a 5-t monorail hoist and delivered to the receiving hopper bag breaker. The concentrate will then pass through a lump breaker and paddle mixer, as it is being re-pulped as feed for the grinding and flotation circuit.

17.2.3.2 Regrinding and Flotation

Prior to flotation, the pulped bulk concentrate will be reground to a P_{80} of 14 µm in two SMD grinding mills, arranged in parallel and each driven by a 355 kW motor. The grinding medium used will be 3 mm Colorado sand. The grinding mills will operate in closed circuit with a cluster of cyclones. Cyclone overflow, at a slurry density of 28% solids by weight, will discharge to the flotation feed pump box.

The purpose of the flotation circuit is to separate the reground concentrate into individual bismuth and cobalt concentrates. Sodium cyanide is added to the flotation feed, in order to depress the cobalt containing minerals cobaltite and arsenopyrite, while floating the bismuth minerals.

The bulk concentrate will be subjected to rougher and cleaner flotation. The bismuth rougher flotation stage contains nine 2.8-m^3 conventional flotation cells, the last three of which are scavengers. PAX collector and sodium cyanide are added to both rougher and scavenger cells, while MIBC frother is added to the rougher cells only.

The bismuth rougher concentrate is pumped to the bismuth first cleaner flotation circuit. The rougher tailing proceeds to the rougher-scavenger cells. The bismuth rougher-scavenger concentrate is returned to the regrinding circuit, while the rougher-scavenger tail, which essentially constitutes the cobalt concentrate, is pumped to the cobalt concentrate thickener.

The bismuth first cleaner flotation circuit consists of seven 1.4-m^3 conventional cells with cascading flow. The first cleaner tail is returned to the regrinding circuit. The concentrate proceeds to the bismuth second cleaner flotation circuit.

The bismuth second cleaner circuit consists of eight 0.7-m^3 conventional cells. The bismuth second cleaner concentrate proceeds to the third cleaner circuit, while the second cleaner tail is returned to the first cleaner circuit.

The bismuth third cleaner circuit consists of two 0.7-m^3 conventional flotation cells with cascading flow. The tails from this circuit are returned to the second bismuth cleaner. The third cleaner concentrate is pumped to the on-stream analyzer system, and then to the bismuth concentrate thickener.

The on-stream analyzer provides real-time assays of bismuth, cobalt, copper, iron and arsenic in several streams in the flotation circuit, including the final bismuth and cobalt concentrates. These assays, combined with on-line calculations of mineral recovery and slurry density, will be used to optimize and maintain the performance of the flotation circuit.

The design recoveries of metals contained in the original bulk concentrate to each of the separate cobalt and bismuth concentrates are summarized in Table 17.3.

Table 17.3
Metal Recoveries to Bismuth and Cobalt Concentrates

Metal	Recovery of Metals from Flotation Feed (%)	
	Bismuth Concentrate	Cobalt Concentrate
Gold	78.7	21.3
Cobalt	2.2	97.8
Bismuth	88.9	11.1
Copper	60.5	39.5

17.2.3.3 Bismuth Recovery

Bismuth is recovered from the bismuth concentrate in a chloride leach and electro-recovery (CLER) circuit.

The underflow from the bismuth concentrate thickener contains approximately 46% bismuth, as bismuth sulphide and elemental bismuth. The slurry is subjected to two-stage leaching, at elevated temperature, in a concentrated ferric-ferrous chloride solution, with solid-liquid separation between the two stages of leaching. The leach residue is filtered and washed, principally to remove chlorides, and then proceeds to the cobalt recovery circuit.

Pregnant solution from the leaching circuit is clarified and partially evaporated for control of the solution balance. The clarified pregnant solution is then subjected to elecrowinning to recover metallic bismuth as a powder. The bismuth powder is filtered, dried and briquetted. The briquettes are then melted and poured as bismuth ingot. Bismuth metal can be moulded or formed into several marketable shapes, as required to meet demand. Bismuth oxide is produced from the pure ingots, on a batch basis, with a small furnace and dust collection system located adjacent to the ingot melting furnace

Chloride Leach

Bismuth concentrates are leached with a concentrated ferric chloride solution to dissolve the bismuth in a two-stage leach process. The two-stage chloride leach is necessary for the control of iron oxidation state. The pregnant solution feeding the electrowinning circuit must have iron in the reduced state, and the first-stage leach primarily converts ferric iron to ferrous. Slurry from the first stage of leaching is thickened, with the pregnant overflow solution being filtered and pumped to the electrowinning circuit. Thickener underflow slurry proceeds to the second stage of leaching in a solution comprising analyte from the electrowinning circuit. Essentially all of the contained bismuth is taken into solution, and the associated sulphide is converted to elemental sulphur. Bismuth extraction in the two stages of leaching is approximately 99%.

Slurry from the second stage of leaching is thickened, with the overflow returning to the first leaching stage, where it is used to re-pulp the bismuth concentrate filter cake, prior to the first-stage leach circuit. Underflow from the second-stage thickener is cooled and filtered. The filter cake is washed in three or four stages to remove soluble bismuth and chlorides, and is then advanced to the cobalt recovery circuit. Filtrate from the residue filter and wash filtrate report to the iron precipitation circuit, to form an iron precipitate for disposal and a residual brine solution for deep-well injection.

Electrowinning

Filtered pregnant solution from the first-stage leach thickener is combined with re-circulated catholyte and fed to the bismuth electrowinning circuit, where it is distributed to a bank of 16 electrowinining cells. Three additional electrowinning cells act as scavengers. Each cell contains 30 copper cathodes and 32 DSA anodes, separated by ion exchange membranes. Metallic bismuth reports to the cathodes as a non-adhering powder, which is continuously withdrawn and recovered by a pressure filter, equipped for washing with a chloride solution.

A bleed stream from the scavenger electrowinning circuit removes excess water and prevents iron from building up in the electrowinning circuit. Iron is precipitated from this stream, and acid neutralized with lime, in a series of tanks. Precipitated iron and gypsum are separated from the solution by thickening and filtration. The filter cake is washed with hot water to remove chlorides and is disposed of in the permanent residue storage facility (PRSF). The thickener overflow, containing primarily sodium chloride, is disposed of by deep-well injection to a saline aquifer, together with filtrate from the bismuth powder filter.

Ingot Production

The bismuth filtered powder product from the electrowinning circuit, grading approximately 99.5% bismuth, is dried in a tunnel oven and briquetted, without binders. The briquettes are melted in an induction furnace, with a caustic cover to prevent oxidation and to collect impurities. The molten bismuth is poured in 12.5 kg ingots, as the final product with a purity of 99.995% bismuth. The bismuth metal can be poured into other shapes, such as needles, beads or custom moulded shapes required for specific market demands.

Bismuth oxide is produced through a separate process in which the pure bismuth ingots are oxidized in a small gas-fired furnace. The bismuth oxide powder is pneumatically transferred to a cyclonic baghouse and dry bagger hopper. The bismuth oxide will be sealed in a plastic liner, within a 25 kg woven bag.

17.2.3.4 Cobalt and Copper Recovery

The tailing from the bismuth flotation circuit is fed to the cobalt concentrate thickener, the underflow from which is combined with the filtered underflow from the bismuth first-stage leach thickener, to form the feed to the cobalt recovery circuit.

The cobalt recovery process involves pressure oxidation (POX) of the whole feed in an autoclave, followed by precipitation of iron, arsenic and copper. The remaining pregnant solution is subjected to solvent extraction to remove impurities. The pure cobalt sulphate solution is then evaporated and crystallized to produce the final cobalt sulphate product, which is dewatered and packaged for shipment to customers. Other cobalt salts can be produced from the same solution, in response to market demand.

Pressure Oxidation

The bismuth leach residue is re-pulped and fed to the agitated autoclave surge tank, where it undergoes pre-acidification for the removal of carbonates, during a 4-hour retention time. The re-pulped bismuth leach residue is then combined with the cobalt concentrate and introduced to the autoclave by a high pressure pump.

The autoclave is 16.6 m long and is divided into five compartments. The design retention time of 60 minutes is sufficient to oxidize up to 95% of the cobalt, 76% of the copper and 87% of the sulphides. The autoclave operates at a temperature of 180^{o}C and a pressure of 2,100 kPa. Oxygen to sustain the oxidation reaction is supplied by an oxygen plant to be built on site, with a design capacity of 120 t/d pure oxygen, at a 93% concentration. Cooling water, to control the autoclave temperature in the face of the exothermic oxidation reaction, is pumped into each compartment. Superheated steam at 180^{o}C is injected into the autoclave for start-up.

Discharge from the autoclave is controlled by a nuclear level gauge and redundant scintillator in the last compartment, a let-down valve and a choke valve. Quench water is pumped into the slurry line before the choke valve, to prevent premature flashing. The slurry is then reduced to a temperature of approximately 115^{o}C and a pressure of 180 kPa in a flash tank, before being directed to the cobalt residue thickener. Autoclave off-gases are also vented to the flash tank and will be passed through heat exchangers, to recover heat for other uses. The gases are then to a scrubber, prior to venting the atmosphere.

Discharge slurry from the flash tank, scrubber discharge and recycled fines from the downstream clarifier are all fed to the cobalt residue thickener, which is rubber-lined. A flocculent dosage of 30 g/t is added to the thickener, to provide an underflow density of 60% solids, by weight. The thickener underflow is fed to a pressure filter, for further dewatering, and then proceeds to the gold recovery circuit.

Iron and Arsenic Precipitation

The pregnant cobalt solution overflow from the thickener is passed through a lamella clarifier, for the recovery of fine solids, and then proceeds to the iron and arsenic precipitation circuit.

The clarified pregnant cobalt solution from the cobalt residue thickener is combined with several recycled streams containing metal precipitates in the solution tank, in which the metal precipitates dissolve as sulphates in the highly acidic pregnant solution. The solution then proceeds to a bank of five precipitation tanks, arranged in series.

Lime is added to the precipitation tanks, in order to raise the pH gradually to 4.6, over a residence time of five hours. Oxygen enriched air is also introduced, to provide the environment necessary to convert ferrous iron to ferric, which then precipitates. Hydrogen peroxide is added to the last precipitation tank, as an additional oxidant. Arsenic precipitates with the iron, as stable scorodite ($FeAsO_4.2H_2O$). A significant amount of gypsum is also formed.

Slurry from the final precipitation tank flows to a thickener, to which flocculent is added at a dosage of 60 g/t solids. A portion of the thickener underflow is recycled back to the first precipitation tank, to act as precipitation seed, and the remaining underflow reports to the downstream copper releach tank. The pregnant thickener overflow proceeds to the copper precipitation circuit.

The thickener underflow reporting to the two agitated copper releach tanks is mixed with acidic eluate solution from the downstream copper ion exchange circuit. Sulphuric acid is added, to adjust the pH to 2. At this pH, and with a residence time of 30 minutes, 85% of the copper and 60% of the cobalt in the slurry are releached back into solution, while most of the iron and arsenic, and gypsum, remain as solids.

Copper Recovery

Copper removal and copper recovery are carried out at two separate locations in the process. The removal step is part of the cobalt solution purification process. After iron and arsenic removal with lime at pH 4.6, the thickener overflow solution is treated for manganese with SO_2 and air, to form MnO_2 solids. The copper is then precipitated with calcium carbonate at a pH between 6.5 and 7.0 to form copper carbonate. Some cobalt will be precipitated as a carbonate as well. The process solution is then pumped through fine filters to recover the solids, leaving a solution free of copper and manganese.

The filter is a batch candle type that can be drained, with the solids dropped into a tank for pumping back to the head end of the iron and arsenic removal stage in the solution collection tank. Precipitated cobalt carbonate will be dissolved and the majority of the copper and most of the manganese dioxide will be settled out with the iron arsenate precipitate.

Copper is recovered from the iron-arsenic precipitate solids. The thickener underflow from the precipitation circuit is filtered and washed to remove and recover cobalt containing solution. The solid precipitate is rinsed in a weak sulphuric acid solution to dissolve copper and any cobalt in the solids, without dissolving the iron and arsenic precipitate. The leached precipitate is conveyed to the PRSF.

The copper solution is cemented with iron powder to form a copper cement. The copper plates out on the iron powder, as an ion equivalent amount of iron is released into solution. The chemistry favours copper cementation over cobalt, so that the cobalt in solution is untouched. The copper is filtered from solution, dried and packaged for transport to the smelter. The solution with the residual cobalt is pumped back to the solution collection tank at the beginning of the iron-arsenic removal process.

Cobalt Solvent Extraction

Cobalt can be selectively removed from the pregnant leach solution using a solvent extraction process with specially designed extractants. Cyanex 272 is a well-known extractant for cobalt, although it will extract preferentially most other metals, such as Fe^{3+}, Al, Zn, Cu and Mn, before cobalt. The partially purified cobalt pregnant solution is fed to a solvent extraction (SX) circuit, utilizing 12% v/v Cyanex 272 organic extractant dissolved in a suitable hydrocarbon diluent (Exxol D80). Some zinc, manganese and magnesium are coextracted, while calcium and nickel are rejected.

The solvent extraction process involves the organic phase, with the Cyanex physically mixing with the cobalt bearing liquid or aqueous solution. The two phases tend to reach an equilibrium with regard to concentrations; the barren organic phase will extract from the higher concentrated cobalt aqueous solution. After mixing, the two liquids are allowed to settle, so that the lighter organic Exxol D80 will separate from the denser leach solution (aqueous). Stripping the organic phase of cobalt follows the same principle, with mixing of a barren aqueous phase solution with a higher concentration (loaded) organic phase and then allowing the two immiscible liquids to settle and separate.

The solvent extraction circuit consists of the following extractions: two scrubbing, three primary cobalt strips and two secondary stages for impurity strip.

The extraction circuit consists of four countercurrent stages. Each stage is comprised of a single mixer and a settler for phase disengagement. For effective extraction of cobalt in the extraction stage, the organic to aqueous ratio (O/A) is about 0.75. At this O/A ratio, a large quantity of organic must be processed through the extraction, as well as the scrubbing stage. To maximize cobalt selectivity, pH is controlled at 5.3 to 4.8 within each stage, by direct addition of sodium carbonate to the mixers. The operating temperature is 55°C.

Raffinate solution treatment is still to be confirmed. One option is to neutralize with sodium carbonate to precipitate nickel. After solid-liquid separation, the effluent will be sent to the water treatment plant and the solid will be placed in the PRSF. Scrubbing is required to remove as much cobalt as possible, loaded with impurities, into the organic extractant. This operation is performed with countercurrent organic and aqueous flow. For scrubbing, the loaded organic composition from the extractant circuit is fed to a two-stage scrubbing circuit, where the organic is scrubbed with the cobalt strip feed, to remove magnesium and calcium. The pH for the selective scrubbing is maintained at 4.4 to 4.6, and the temperature is kept at 55°C. The organic to aqueous ratio for scrubbing is 1.0.

The scrubbed loaded organic composition is then fed to the three-stage stripping section.

Stripping of the cobalt takes place as sulphate, by contacting the scrubbed solvent extractant with the mother liquor from crystallization, adjusting the pH with sulphuric acid to the range of 3.0 to 3.3 and maintaining a temperature of 30ºC to 40°C. The organic extractant is regenerated, followed by separation of the cobalt-loaded stripping solution from the solvent-extractant.

The cobalt stripped organic (barren organic) goes to a two-stage zinc stripping. The stripping aqueous solution is adjusted to a pH in the range of 0.9 to 1.0 with sulphuric acid and the temperature is held at 25ºC to 30°C. The zinc stripped liquor ($ZnSO_4$) is then neutralized with sodium carbonate to a pH of 10. The reacted slurry from the zinc precipitation tank is pumped to a zinc filter. The zinc carbonate is filtered and stored.

Cobalt Crystallization

Cobalt sulphate heptahydrate crystals are produced from the leached solution by evaporating the solution to concentrate the cobalt sulphate and by crystallizing it in three vessels of Continuous Stirred Glass Lined Reactors (CSTR). Solution enters the CSTR cascade crystallizer and is mixed well while maintaining temperature, concentration, velocity, turbulence and other parameters at desired uniform conditions. Supersaturation is generated by evaporation and nuclei form to grow into crystals.

Crystals are separated from the mother liquor in a decanter centrifuge. The mother liquor is recycled back to the scrubbing stage and the cobalt stripping stage. Typically, the smallest crystals are anhydrous and, as more hydrates are added, the crystals get larger. The heptahydrate made from this process is a good fit for crystal size.

The cobalt sulphate is packaged into 50-kg bulk bags in a bulk bag filling system, provided with a platform scale.

17.2.3.5 Gold Recovery

Gold in the bulk concentrate is present as fine free gold and occasionally as a gold bismuth mineral, maldonite. The gold metal will report preferentially to the bismuth concentrate at about 60 to 70%. Gold is not affected by the chloride leach or the sulphuric acid conditions in either of the primary metal dissolution steps. Gold and maldonite in the bismuth concentrate will pass through the ferric chloride leach circuit and join the cobalt concentrate as the feed for the pressure oxidation leach step. Gold entering the autoclave will not dissolve and will remain with the solid residue.

Solids from the autoclave are thickened as described above and the solids are filtered and washed to recover cobalt solutions. The thickened, filtered and washed solids are then conveyed to the cyanide leach circuit.

The residue is re-pulped in the cobalt residue cyanidation feed tank with barren recycle cyanide solution and is pumped to the first of six covered agitated cobalt residue cyanidation tanks, arranged in series. Sodium cyanide and lime are added continuously to the tanks to reach 1 g/L of cyanide in the solution and a pH of approximately 10.5, with a pulp density of 45% solids. Oxygen gas and/or air also are fed to the tanks continuously, to assist the cyanidation reaction.

The discharge from the final cyanidation tank overflows to the cyanidation discharge pump box, where 2.5 g/m^3 of diatomaceous earth body feed is mixed. This slurry then is pumped to a vacuum belt filter. A 1.5 times displacement countercurrent wash, first with gold barren solution and then by process water, is applied to the filter to displace entrained pregnant liquor in the filter cake. The final rinse of the cake with process water ensures that most of the cyanide solution is washed from the cake. The washed filter cake discharges onto the cobalt residue discharge conveyor, which transfers the tailings to the tails residue storage bin, along with the cobalt-copper releach solids tails.

Gold pregnant solution from the autoclave residue cyanidation circuit is pumped to the Merrill Crowe circuit for gold recovery. This circuit will be supplied as a vendor package.

The gold pregnant solution is passed through a clarifying filter to remove any suspended solids. Diatomaceous earth precoat is applied to the filter. The filtered solution flows through a deaeration column to reduce the oxygen content in the solution to less than 0.5 ppm. The filtered and deaerated pregnant solution then is pumped to the first of two conical bottomed precipitation tanks in series. Zinc dust and lead nitrate are added by screw feeders to the first precipitation tank. Zinc addition is based on a zinc-to-gold molar ratio of 30:1. Lead nitrate is added as 10 wt% of the zinc addition.

Gold is precipitated from the cyanide solution by a cementation reaction on the surface of the metallic zinc particles. If present, silver and copper also will cement out.

Body feed is added at 2.5 g/m^3 of precipitated slurry. A sealed centrifugal pump delivers the slurry to a recessed plate type filter. Precoat also can be added to the filter. The filtrate, depleted of gold, is collected in the gold barren solution tank and recycled to various locations within the cyanidation circuit, mainly for cake re-pulp or as filter wash solution. Any excess barren solution is sent to cyanide destruction before discharge to the injection wells. Gold precipitates from the filter are dried in the secured area of the gold refinery.

The gold refinery receives filter cake from the Merrill Crowe circuit. This filter cake is dried in an oven, mixed with weighed amounts of flux and placed into an induction crucible furnace. Molten gold is poured into moulds to form doré bars. Oven and furnace off-gases are processed through a wet scrubber before discharging into the atmosphere. The slag generated from the furnace is collected.

Excess barren solution from the gold recovery circuit is pumped to the agitated cyanide destruction tank, to which hydrogen peroxide is added as an oxidizing agent. Over a residence time of 3 hours, the cyanide in the solution is destroyed, leaving a residual cyanide concentration of approximately 1 ppm. Effluent from the cyanide destruction is combined with other liquid wastes and disposed of by deep-well injection.

17.2.4 Residue Disposal

17.2.4.1 Solid Residue

The solid process residue from the SMPP, all of which will be permanently stored in the PRSF, will consist of three components:

- Acid leach recovery of cobalt and gold residue.
- Copper releach iron and gypsum residue.
- Iron-arsenic precipitates from the cobalt circuit.

It is expected that approximately 158,000 t of residue will be produced each year. The PRSF will be an engineered containment facility, designed to minimize the potential impact to the surrounding environment. The PRSF will be directly north and northeast of the proposed plant site. There is sufficient land to allow for a sizable buffer zone around the PRSF.

The PRSF will be divided into cells to provide containment and storage of the process residue. This cellular design minimizes the active footprint, will allow for liner repairs (if required), and enable active decommissioning throughout the life of the SMPP. Construction of the containment cells will be in pairs, with each cell capable of accommodating between 2 and 2.5 years of process residue. Eighteen years of residue storage capacity is provided by PRSF Cell 1 through Cell 8. An additional seven years of storage capacity, for a total facility life of 25 years, can be obtained from the construction of Cell 9 and Cell 10, if required. The

18-year facility covers 42.8 ha and accommodates 1.51 Mm^3 of residue. The 25-year facility covers 57.9 ha and will contain 2.09 Mm^3 of residue. These additional cells will have an increased capacity to each store 3.5 years of process residue. Cell geometry will vary somewhat, but each cell consists of a 4.65 m deep excavation and 2 m high containment dykes. The containment dykes are planned to be constructed from select material obtained from the cell excavation. The containment dykes will be constructed with a 10 m top width, 3H:1V interior side slopes, and 7H:1V exterior side slopes. The dyke top width and shallow exterior slopes are designed to accommodate use by haul trucks from the plant site.

The environmental considerations associated with the storage and entombment of these residues are discussed in Section 20.2.4.5.

17.2.4.2 Liquid Residue

The saline liquid waste stream from the SMPP and the effluent from the cyanide destruction circuit will be disposed of by deep-well injection into the Souris River Formation, at a depth of approximately 800 m below surface, as discussed in Section 20.2.2.3.

17.2.5 Reagents

A significant number of reagents are used, in various quantities, in the process of producing saleable metal products at the SMPP:

- PAX, as a collector, and MIBC, as a frother, are used in the initial flotation circuit. PAX will be delivered in bags and MIBC will be delivered in drums.

- Sodium cyanide is used in the flotation circuit to depress cobaltite and arsenopyrite, and in the gold recovery circuit. Cyanide will be delivered as a powder in 1-t bags and will be mixed with water and a small amount of sodium hydroxide, to prepare a 10 wt% cyanide solution for distribution to the points of use.

- Argon and nitrogen are used as a blanket in the final stages of bismuth production, to prevent oxidation. It is envisioned that these gases will be provided in bottles, but it may be advantageous to generate them in the oxygen plant.

- Iron powder is used to precipitate copper. The iron powder will be delivered in 1-t bags and will be delivered by screw conveyor to the copper cementation tank.

- Milk of lime is used for pH control at various points in the SMPP flowsheet, including iron-arsenic precipitation, the bismuth CLER circuit and the gold cyanidation circuit. Milk of lime will be prepared in a package slaking plant and will be distributed to the points of use by a lime loop. Barren solution from the second stage of cobalt precipitation will be used for lime slaking.

- Sulphuric acid, which will be delivered at 98% concentration in rail tank cars and stored in a 90-m^3 tank, is used in the copper releach, zinc and nickel ion exchange, cobalt dissolution and bismuth leach circuits, and also during start-up of the cobalt pressure leaching autoclave.

- Lignin sulphonate (Lignosol) is added as a surfactant to the cobalt concentrate slurry, before it is fed to the autoclave, at a design dosage of 6 kg of Lignosol per tonne of autoclave feed.

- Sodium hydroxide is used for pH adjustment, and also in the second stage of cobalt precipitation, the bismuth CLER circuit, the nickel ion exchange circuit, effluent treatment and cyanide preparation.

- Sodium carbonate is used in copper precipitation, the first stage of cobalt precipitation, cobalt electrowinning, and zinc and nickel precipitation.

- Flocculant is used to aid solid-liquid separation in thickeners and clarifiers.

- Hydrogen peroxide is added to the last iron-arsenic precipitation tank, as an additional oxidant in a final polishing step to remove iron and arsenic from solution. Hydrogen peroxide is also used in the cyanide destruction process.

- Hydrochloric acid, at 36 wt% strength, is delivered in drums and used in the reverse-osmosis unit of the water treatment plant.

- Zinc dust, delivered in drums, is used in the Merrill Crowe circuit to precipitate gold.

- Lead nitrate, delivered as a powder in drums, is added to the first precipitation tank of the Merrill Crowe circuit to create preferential reduction sites on the zinc particles.

- Diatomaceous earth, delivered in 25-kg bags, is used to aid solid-liquid separation in filters. Barren gold solution is used to prepare a 30 wt% solution, which is distributed to the points of use.

- Ammonium hydroxide, delivered at 25 wt% in drums, is used in the nickel ion exchange circuit, to strip the resin of any copper.

- Guar gum, delivered in 25-kg bags, is diluted with process water to a 10 wt% solution, and is added to the electrolyte solution as a deposit smoothing and levelling agent.

- Silica, borax, sodium nitrate and sodium carbonate are used as fluxes in the induction crucible furnace.

- Sodium chloride, delivered in tote bags as crystals with a purity of 97% to 99%, is used in the bismuth CLER circuit.

17.2.6 Process Design Criteria, Drawings and Diagrams

A comprehensive list of the process design criteria for the SMPP is included in the FEED study report.

The FEED study report includes process flow diagrams, piping and instrumentation drawings, mass and water balances, a process equipment list and general arrangement drawings. The principal process flow diagrams are provided in Appendix II of this report.

17.2.7 Hydrometallurgical Plant Production Schedule

The design production schedule for the SMPP is summarized in Table 17.4. The plant is scheduled to start processing bulk concentrate in October, 2017.

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Table 17.4
Hydrometallurgical Plant Production Schedule

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
MILL PRODUCTION																									
Concentrate Shipped (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Moisture Content of Concentrate (%)	**8.7**				8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Concentrate Shipped (thousand wet tonnes)	**1,154.6**				11.3	58.4	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	17.8
Gold Grade of Concentrate (grams/tonne)	**25.19**				4.09	22.06	31.04	8.47	6.41	11.27	29.39	30.00	44.24	39.28	11.49	12.02	10.98	11.35	14.92	20.12	32.29	70.58	16.96	49.62	58.84
Cobalt Grade of Concentrate (%)	**3.20**				3.61	3.48	3.02	3.36	3.67	3.61	3.23	3.14	2.51	3.45	3.57	3.49	3.32	3.29	3.17	3.05	2.58	2.82	2.44	3.06	4.50
Bismuth Grade of Concentrate (%)	**3.58**				2.87	4.18	3.03	2.91	3.60	4.39	4.93	4.43	4.01	3.16	3.80	4.47	4.61	4.32	3.76	3.57	3.13	2.06	3.17	1.43	0.92
Copper Grade of Concentrate (%)	**1.03**				1.15	0.40	0.35	0.90	1.09	1.42	1.20	0.90	0.66	0.54	0.58	0.81	1.33	1.76	2.10	1.91	1.20	0.34	1.48	0.87	0.40
Gold in Concentrate (thousand ounces)	**860.3**				1.4	38.1	54.4	14.8	11.2	19.8	51.5	52.6	77.6	68.9	20.1	21.1	19.3	19.9	26.2	35.3	56.6	123.8	29.7	87.0	30.9
Cobalt in Concentrate (thousand pounds)	**74,839**				827	4,127	3,629	4,039	4,408	4,335	3,888	3,776	3,013	4,151	4,291	4,191	3,994	3,950	3,809	3,668	3,106	3,395	2,937	3,684	1,620
Bismuth in Concentrate (thousand pounds)	**83,808**				658	4,957	3,642	3,498	4,324	5,274	5,931	5,324	4,820	3,800	4,566	5,369	5,542	5,190	4,519	4,292	3,767	2,476	3,870	1,724	267
Copper in Concentrate (thousand pounds)	**24,231**				265	470	417	1,084	1,313	1,703	1,443	1,080	791	647	692	969	1,594	2,115	2,522	2,302	1,440	408	1,781	1,051	143
HYDROMETALLURGICAL PLANT PRODUCTION																									
Concentrate Treated (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Cobalt Concentrate Produced (thousand dry tonnes)	**979.1**				9.6	49.5	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	50.3	15.1
Gold Recovery to Cobalt Concentrate (%)	**21.3**				21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3	21.3
Cobalt Recovery to Cobalt Concentrate (%)	**97.8**				97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8	97.8
Bismuth Recovery to Cobalt Concentrate (%)	**11.1**				11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1
Copper Recovery to Cobalt Concentrate (%)	**39.5**				39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5	39.5
Gold in Cobalt Concentrate (thousand ounces)	**183.2**				0.3	8.1	11.6	3.2	2.4	4.2	11.0	11.2	16.5	14.7	4.3	4.5	4.1	4.2	5.6	7.5	12.1	26.4	6.3	18.5	6.6
Cobalt in Cobalt Concentrate (thousand pounds)	**73,193**				808.7	4,036.4	3,549.2	3,950.5	4,310.7	4,240.0	3,802.2	3,693.4	2,946.5	4,059.6	4,196.8	4,099.2	3,906.1	3,863.5	3,725.5	3,586.8	3,037.2	3,320.6	2,872.4	3,603.2	1,584.3
Bismuth in Cobalt Concentrate (thousand pounds)	**9,303**				73.0	550.2	404.2	388.2	480.0	585.4	658.3	591.0	535.0	421.8	506.8	596.0	615.1	576.1	501.6	476.4	418.1	274.8	429.6	191.4	29.7
Copper in Cobalt Concentrate (thousand pounds)	**9,583**				104.7	186.0	165.0	428.7	519.3	673.6	570.6	427.3	313.0	256.0	273.8	383.1	630.4	836.4	997.5	910.5	569.6	161.2	704.5	415.5	56.6
Recovery of Gold from Cobalt Concentrate (%)	**94.7**				94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
Recovery of Cobalt from Cobalt Concentrate (%)	**92.9**				92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
Recovery of Bismuth from Cobalt Concentrate (%)	**0**				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recovery of Copper from Cobalt Concentrate (%)	**46.2**				46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2
Recovered Gold in Doré from Cobalt Concentrate (thousand ounces)	**173.5**				0.3	7.7	11.0	3.0	2.3	4.0	10.4	10.6	15.6	13.9	4.1	4.3	3.9	4.0	5.3	7.1	11.4	25.0	6.0	17.5	6.2
Recovered Cobalt from Cobalt Concentrate (thousand pounds)	**67,996**				751.3	3,749.8	3,297.2	3,670.0	4,004.6	3,938.9	3,532.3	3,431.2	2,737.3	3,771.3	3,898.8	3,808.1	3,628.8	3,589.2	3,461.0	3,332.2	2,821.6	3,084.9	2,668.5	3,347.4	1,471.8
Recovered Bismuth from Cobalt Concentrate (thousand pounds)	**0**				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Recovered Copper from Cobalt Concentrate (thousand pounds)	**4,427**				48.4	85.9	76.2	198.1	239.9	311.2	263.6	197.4	144.6	118.3	126.5	177.0	291.3	386.4	460.9	420.6	263.2	74.5	325.5	192.0	26.2
Bismuth Concentrate Produced (thousand dry tonnes)	**83.2**				0.8	4.2	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	1.3
Gold Recovery to Bismuth Concentrate (%)	**78.7**				78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7	78.7
Cobalt Recovery to Bismuth Concentrate (%)	**2.2**				2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2
Bismuth Recovery to Bismuth Concentrate (%)	**88.9**				88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9	88.9
Copper Recovery to Bismuth Concentrate (%)	**60.5**				60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5	60.5
Gold in Bismuth Concentrate (thousand ounces)	**676.8**				1.1	30.0	42.8	11.7	8.8	15.5	40.6	41.4	61.0	54.2	15.8	16.6	15.1	15.7	20.6	27.8	44.5	97.4	23.4	68.5	24.3
Cobalt in Bismuth Concentrate (thousand pounds)	**1,646**				18.2	90.8	79.8	88.9	97.0	95.4	85.5	83.1	66.3	91.3	94.4	92.2	87.9	86.9	83.8	80.7	68.3	74.7	64.6	81.1	35.6
Bismuth in Bismuth Concentrate (thousand pounds)	**74,506**				584.8	4,406.6	3,237.3	3,109.3	3,844.1	4,688.4	5,272.4	4,733.0	4,284.9	3,378.6	4,059.0	4,773.2	4,926.7	4,613.7	4,017.2	3,815.9	3,348.8	2,201.2	3,440.3	1,532.7	237.6
Copper in Bismuth Concentrate (thousand pounds)	**14,648**				160.0	284.3	252.3	655.3	793.7	1,029.5	872.1	653.1	478.4	391.2	418.5	585.5	963.6	1,278.4	1,524.7	1,391.6	870.6	246.4	1,076.8	635.0	86.5
Recovery of Gold from Bismuth Concentrate (%)	**94.7**				94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7	94.7
Recovery of Cobalt from Bismuth Concentrate (%)	**92.9**				92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9	92.9
Recovery of Bismuth from Bismuth Concentrate (%)	**98.9**				98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9	98.9
Recovery of Copper from Bismuth Concentrate (%)	**46.2**				46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2	46.2
Recovered Gold in Doré from Bismuth Concentrate (thousand ounces)	**640.9**				1.0	28.4	40.6	11.1	8.4	14.7	38.4	39.2	57.8	51.3	15.0	15.7	14.3	14.8	19.5	26.3	42.2	92.2	22.2	64.8	23.0
Recovered Cobalt from Bismuth Concentrate (thousand pounds)	**1,530**				16.9	84.4	74.2	82.6	90.1	88.6	79.5	77.2	61.6	84.8	87.7	85.7	81.6	80.7	77.9	75.0	63.5	69.4	60.0	75.3	33.1
Recovered Bismuth from Bismuth Concentrate (thousand pounds)	**73,656**				578.2	4,356.4	3,200.4	3,073.9	3,800.3	4,635.0	5,212.3	4,679.1	4,236.0	3,340.0	4,012.8	4,718.8	4,870.5	4,561.1	3,971.4	3,772.4	3,310.7	2,176.1	3,401.1	1,515.2	234.9
Recovered Copper from Bismuth Concentrate (thousand pounds)	**6,767**				73.9	131.3	116.5	302.8	366.7	475.6	402.9	301.7	221.0	180.7	193.4	270.5	445.2	590.6	704.4	642.9	402.2	113.9	497.5	293.4	40.0
Total Recovered Gold (thousand ounces)	**814**				1.3	36.1	51.5	14.1	10.6	18.7	48.8	49.8	73.4	65.2	19.1	20.0	18.2	18.8	24.8	33.4	53.6	117.2	28.2	82.4	29.3
Total Recovered Cobalt (thousand ounces)	**69,526**				768.2	3,834.2	3,371.4	3,752.5	4,094.7	4,027.5	3,611.7	3,508.4	2,798.9	3,856.2	3,986.5	3,893.8	3,710.4	3,669.9	3,538.8	3,407.1	2,885.0	3,154.2	2,728.5	3,422.7	1,504.9
Total Recovered Bismuth (thousand ounces)	**73,656**				578.2	4,356.4	3,200.4	3,073.9	3,800.3	4,635.0	5,212.3	4,679.1	4,236.0	3,340.0	4,012.8	4,718.8	4,870.5	4,561.1	3,971.4	3,772.4	3,310.7	2,176.1	3,401.1	1,515.2	234.9
Total Recovered Copper (thousand ounces)	**11,195**				122.3	217.3	192.8	500.8	606.6	786.8	666.5	499.2	365.6	299.0	319.9	447.5	736.4	977.0	1,165.3	1,063.6	665.4	188.3	823.0	485.3	66.1

18.0 PROJECT INFRASTRUCTURE

18.1 NICO PROJECT SITE

The NICO property is presently accessed from Yellowknife by air during the summer and by winter road from Behchokö. An all-weather highway connects Behchokö with Yellowknife and Edmonton, Alberta. Fortune constructed a short spur from the winter road in 1996 to access the property and the exploration camp situated at Lou Lake.

18.1.1 Permanent Road Access

18.1.1.1 All-weather Road – Behchokö to Whatì

Fortune reports that the NWT and Tłįchǫ governments have agreed to fund and construct an all-weather road from Behchokö north to Whatì, with completion planned for early in 2016. This road, the proposed alignment of which is shown in Figure 18.1, will provide all-weather access to Whatì from Highway 3 between Edmonton and Yellowknife.

The all-weather road will extend approximately 20 km north of Whatì. Fortune will then be responsible for the construction of a spur, to provide all-weather access directly to the NICO property. The spur, also shown in Figure 18.1, will be 33 km in length. Fortune may also contribute to the construction of the entire road section from Whatì to the NICO Project, a distance of 51 km, and has already completed engineering and environmental work for this length of road. In the financial model for the Project, the capital cost estimate for this spur is based on a length of 33 km.

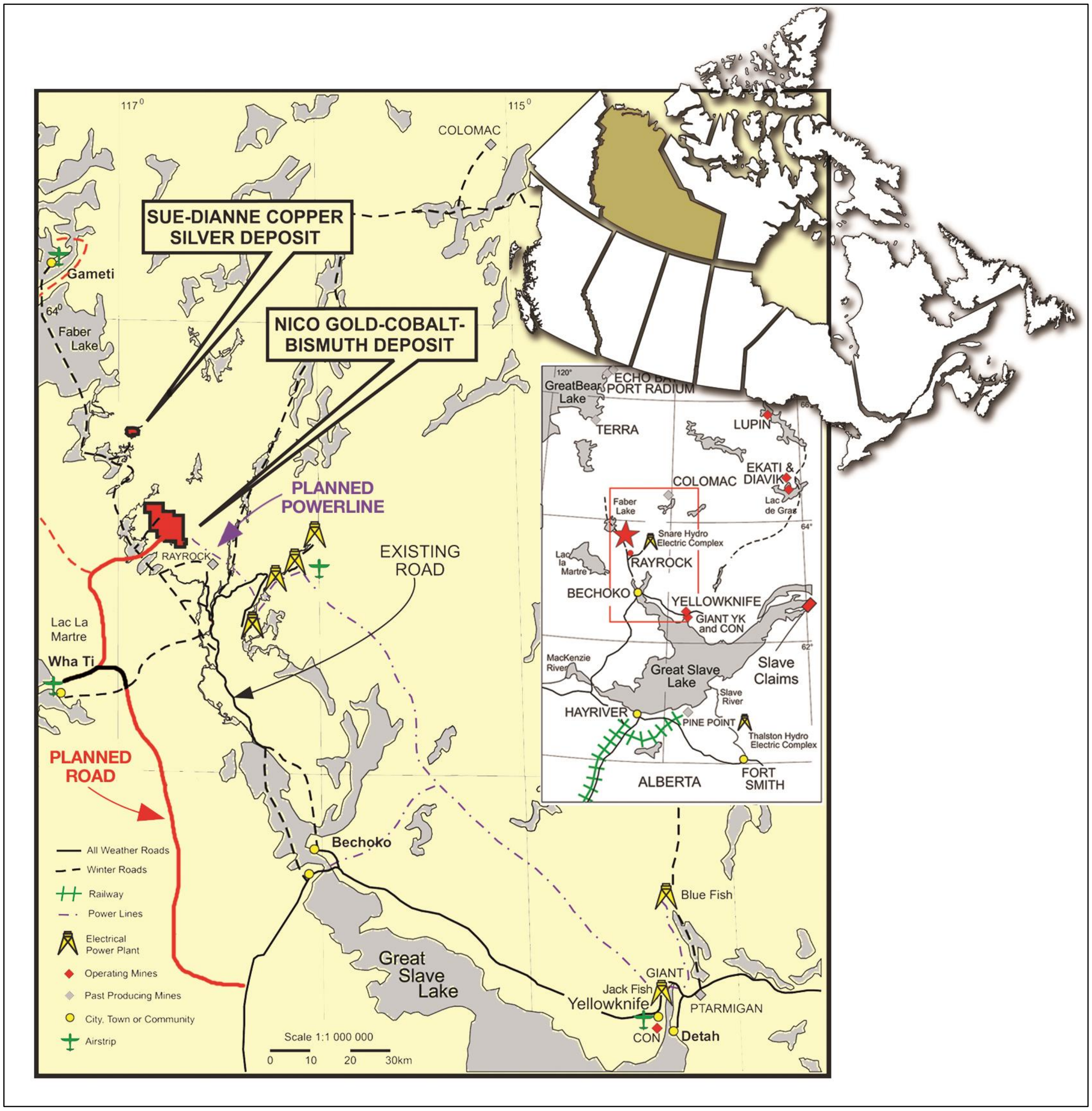
18.1.1.2 NICO Project Access Road

The road spur to be constructed at Fortune's expense, referred to as the NICO Project Access Road (NPAR), will be approximately 33 km long and will run from a point approximately 19 km north of La Martre Crossing (the NICO Intersection) to the Project site. Fortune is discussing with the NWT and Tłįchǫ governments the responsibility for funding the 19-km section of road between the NICO Intersection and La Martre Crossing.

Completion of the NPAR will require a major crossing over the Marian River, approximately 1,000 m from the NICO property boundary. A steel Bailey bridge, capable of carrying 100-t loads, is proposed for this crossing. The bridge will have a 6-m road width and unobstructed height.

The NPAR will pass through swamp and low lying areas which will require culverts for drainage, and rock fill. The route also traverses areas of rock outcrop which will require blasting to maintain the design road gradient and drainage characteristics.

Figure 18.1
All-Weather Road Access



Fortune Minerals.

The alignment of the NPAR was originally selected by EBA in 2004, following foot traverses to clarify terrain types and manual test pitting to obtain soil samples for subgrade classification and the identification of borrow sources. Only minor changes to the alignment have been made since that time.

In 2007, EBA conducted preliminary foundation designs for the Marion River bridge crossing. While the bridge could be supported on concrete abutments, timber crib and granular fill abutments were proposed in order to limit concrete volumes at the remote site.

Subsequently, between 2009 and 2011, EBA refined the alignment and design of the NPAR, assuming a traffic volume of three fuel and supply loads and five loads of concentrate per day. Satellite imagery and LiDAR data permitted minor alignment changes to avoid both low-lying areas and areas with steep gradients.

18.1.2 Site Layout and Roads

The overall Project site layout, shown previously in Figure 17.2, was established on the basis of the following criteria:

- Provide a safe working environment.
- Minimize the environmental impact.
- Minimize the amount of earthworks required.
- Minimize ore and waste haulage distances from the open pit.
- Design a compact plant to minimize heating requirements.
- Provide comfortable camp accommodation and suitable recreation and dining facilities.

All of the site facilities will be connected by a network of engineered access roads. Connecting walkways and utility trays will be in covered utilidors.

Comprehensive geotechnical investigations have been completed in the area to be occupied by the principal site facilities. Thirty-one vertical boreholes have been drilled at the process plant, camp complex, truckshop and associated sites, and three angled holes have been drilled at the site selected for the primary crusher. Three ground temperature cables were also installed.

Subsurface conditions at the locations of all major Project facilities comprise a discontinuous veneer of weathered and frost-shattered rock, a thin mantle of organic material underlain by bedrock, or a blanket of boulder fill, up to 3.5 m thick, in bedrock depressions. The underlying bedrock consists of metagraywacke, with quartz and feldspar, amphibole and rhyolite. Predominantly, the bedrock is of high strength, with poor rock quality material typically confined to the surficial layer. A potential fault, oriented southwest-northeast was interpreted from three borehole intersections. Permafrost was not identified in any of the three holes in which ground temperature cables were installed.

Overburden and fractured bedrock will be removed and all facilities will be founded on solid bedrock.

18.1.3 Power and Energy Systems

Electrical power will be supplied by an approximately 30.5 km long 115 kV power line, from the Snare Hydroelectric Complex to a 15 MVA substation located at the mine site. Back-up power will be supplied by a 2 MW diesel generated power plant, which will provide standby power for critical site functions, in the event of interruption of the grid supply. The electrical substation will be located on the northeast side of the process buildings, with the 5-kV medium voltage switchgear located between the substation and the process building.

The grid connection to the Snare Complex is planned for completion in late 2016. During construction activities prior to that time, a 1,000 kW generator set will be installed at site, to service camp and other needs.

Fortune reports that final engineering and connection studies are complete and that it is negotiating the terms of a power supply agreement with Northwest Territories Power Corporation.

The estimated power demand for the NICO Project is approximately 10 MW, with a running load estimated at 6.9 MW and annual energy consumption approximately 60,000 MWh.

18.1.4 Building Heating System

A built-in, closed-circuit propane fired boiler system will circulate a hot glycol solution for heating the permanent camp and service buildings, and to provide tempered air for the main process buildings. Direct propane space heaters will be used where needed.

The possibility of supplying sufficient power from the Snare Complex to use electric heating remains under investigation.

18.1.5 Fuel Storage and Distribution

Envirotanks will be linked in a bermed area to serve as the fuel storage facility. A manifold will facilitate distribution of diesel from the supply tank feed to a filling station for the fuel truck.

18.1.6 Fresh Water Supply

The fresh water supply will be drawn from the nearby Lou Lake. Water will be pumped through an insulated, heat-traced line to fresh water storage tanks located at the concentrator. Anticipated normal water demand is 12.8 m^3/h and the design will allow for start-up volumes of about 65 m^3/h. The intake screen will meet regulatory standards to protect water-borne species and will be designed with easy access for routine maintenance. The intake will be installed below the anticipated ice thickness on the lake.

18.1.6.1 Firewater System

The firewater pump station will include both electric and diesel pumping systems to ensure full availability to protect the plant.

A fire hydrant grid with an indoor water distribution system will be installed for all site facilities.

18.1.6.2 Water Storage Tanks

Feed and process water tanks will be sized to provide storage and surge capacities.

Firewater will be stored separately.

18.1.6.3 Sewage Treatment Facility

The site sewage system will be a modularized aerobic package plant, complete with rotating biological contactors (RBC). The system will be installed in two modules to meet the needs during the construction phase. One of the units will be surplus to requirements during operations and will be sold. The sewage units will be purchased as a turnkey package.

The construction phase system will accommodate the demand of a workforce of approximately 300. For permanent operations, the system will be designed for a maximum of 150 people.

It is planned that solid discharge from the sewage plant will be directed to the incinerator and that the effluent will be piped to Peanut Lake and discharged through a diffuser.

18.1.7 Solid Waste Disposal Facilities

Management of solid wastes will be guided by considerations of human health and safety, and environmental responsibility. The plan will meet the requirements of legislation and guidelines of the NWT and, as appropriate, the Government of Canada, in the context of the operating licences and permits administered by the WLWB.

On-site disposal of solid non-hazardous waste materials will only be undertaken at locations approved in, and in accordance with the conditions of, the operating licences. To the extent practical, on-site waste disposal will be discouraged. Wastes produced will be handled, stored and transported or disposed in an acceptable and responsible manner.

18.1.7.1 Classification of Waste Types and Sources

Potential waste streams by type of waste produced are described below, excluding waste streams addressed by specific management plans.

To the extent practical and enforceable, domestic refuse will be subject to source separation to facilitate recycling and/or other appropriate handling, as described below for individual waste types. Some domestic waste, however, will proceed to the material sorting facility.

To the extent practical, construction materials will be source-segregated to facilitate both reuse and recycling. Non-hazardous construction materials with no use or value will be placed in the CDF.

Metals will be recovered to the extent possible for recycling purposes. In particular, steel, copper and aluminum will be separated on-site for off-site shipment. Unsegregated metals will also be shipped off-site to a metals sorting facility.

Putrescible materials will be segregated for incineration to prevent attracting wildlife.

Plastics, foams and rubber materials will be sorted for recycling to the extent possible, in accordance with standardized recycling codes.

Incinerator ash will result primarily from the combustion of putrescible materials and sewage sludge, as well as some other combustible materials (e.g., paper, wood, oily rags, plastic films.) Small quantities of other materials disposed with these waste sources will also inevitably find their way into the incinerator. The incinerator ash will not be hazardous and will be disposed of within the CDF.

Electrical or electronic waste materials typically contain a mix of metals and other materials which can be recovered at specialized facilities. These items will be segregated for off-site recycling.

Paper from offices and other sources, and cardboard primarily from packaging, will be source-segregated to the extent possible to facilitate recycling. Soiled paper and cardboard will be incinerated.

Air filters on most engines are designed for single usage. They are classified as non-hazardous and are generally comprised of combustible material acceptable for incineration. If incineration is not possible, these will be added to the waste to be deposited in the CDF.

18.1.7.2 Recycling Program

Fortune will establish a material sorting facility at the NICO Project to centralize and facilitate source-separation and processing of waste streams. In this facility, plastics, metals, glass, electrical/electronic waste and paper products will be segregated and packaged for shipment to receivers for recycling off-site.

To facilitate the separation process at the centralized material sorting facility, separation of waste classes will take place at the source of the waste (working and living areas), through the use of designated containers. Separate containers will be provided in convenient locations in the accommodations complex, service complex, the plant, underground shops and other facilities, for point-of-origin sorting of domestic waste. Large containers will be located at each major facility to separately collect burnable materials, recyclable materials such as scrap metal, timber, tires and unsalvageable equipment.

When sufficient quantities of separated materials are collected, they will be compacted and/or bailed, put on pallets or in crates, and shipped to an appropriate receiver.

18.1.7.3 Treatment of Wastes

Fortune intends to recover energy from used oil and contaminated diesel fuel. Mine and mill maintenance personnel will collect and burn used oil in approved waste heat area heaters, primarily in the heavy equipment maintenance shop but also possibly in the waste sorting building.

Incineration is required to destroy food and other domestic wastes through high temperature combustion. Other wastes that will be incinerated include used absorbents, oily rags, soiled paper and cardboard, non-recyclable hydrocarbon-based plastics and foams.

Solid non-hazardous wastes will be managed in accordance with NWT regulations and good practice and will be disposed of within the CDF. The locations in which solid wastes are deposited in the CDF will be inspected regularly, similar to a conventional landfill. Records of the inspections will be retained.

A soil remediation area will be set up to deal with any contaminated soils.

18.1.8 Communications and Information Management Systems

Site communications systems for the mine will include both voice and data for operations control and for personal communications. The local telecommunications utility has proposed a microwave link for the NICO site. Radio equipment will be supplied for the mine, mill and surface crews.

A leaky feeder system is planned for underground mine communications.

All vehicles will have a radio and personnel will be supplied with hand-held radios, as required. Trucking service companies will establish radio communications with the site using NICO site frequencies.

An information management system, based on a customized software package, will be installed that will link the accounting, human relations, and warehouse and maintenance systems. A dedicated process control network will be installed in the mill for process control and monitoring. Some environmental monitoring data will be collected through the process control network.

18.1.9 Hospital and Medical Facilities

A first aid centre will treat minor medical incidents.

More serious medical emergencies will require evacuation to hospital in Yellowknife, after stabilization on site.

18.1.10 General Site Mobile Equipment

The proposed fleet of mobile surface equipment is shown in Table 18.1. Certain items listed previously in Table 16.5, the open pit mine equipment fleet, will also be used for general purposes throughout the site and are duplicated in Table 18.1.

Table 18.1
Surface Mobile Equipment

Item	Number	Use
Grove Rough Terrain 60-t Crane	1	General
Cat. D8 Bulldozer	1	Road Maintenance
Cat. 826 Wheel Dozer	1	Road Maintenance
Bobcat Skid Steer Loader	1	Packaging
Cat. IT62G Integrated Total Carrier	1	Warehouse Loading and off-loading
Cat. 980 Wheel Loader	1	Road Maintenance
Cat. 990H Wheel Loader	1	Ore Stockpile Management
Cat. 16M Grader	1	Road Maintenance
Fire Truck	1	Safety
Ambulance	1	First Aid
Fuel Truck – 3,000 gal.	1	Fuel Mobile Equipment
Bus – 34 passenger	1	Crew Change Transport
Pick-up	7	General
Flatbed Truck 3t	1	General
Water Truck, Sander	1	Road Maintenance
Rock Truck	1	Road Maintenance
Water Truck	1	Road Maintenance
Lube Truck	1	Mobile Equipment Service
Mechanics Truck	2	Mobile Equipment Maintenance
Air Compressor – 185 cfm	2	General
Genset – 100 kW	4	General

18.1.11 Permanent Camp Complex

During construction, the camp facility will be required to accommodate up to 300 construction personnel. The construction camp will be subsequently modified for long-term permanent use to comfortably accommodate up to 150 employees and to provide high quality dining and recreation facilities.

For mine operations, a sports complex will be added and connected to the main camp complex by enclosed walkways, which will also contain the service utilities utilidor. The sports complex is planned to include a volleyball/recreation court and a small gymnastics area. The 430 m^2 sports complex will be located within a 27 m by 16 m by 8 m structure. The complex will be heated, via hydronic units, with heated glycol/water from the propane boiler heaters.

18.1.12 Railroads and Port Facilities

Concentrates will be bagged at site and trucked to the railhead at Hay River for loading onto rail cars. The rail station is owned and operated by the Canadian National Railway (CNR) and the railway and loading facilities are already in place. Fortune will contract with the carrier for the provision of suitable rail cars, on a schedule to meet the shipping and transportation requirements of the Project. The bagged bulk concentrate will be delivered by rail to the SMPP, north of Saskatoon.

It will not be necessary for Fortune to build any new facilities in order to deliver the concentrates by rail to the hydrometallurgical plant. All required facilities are already in place.

18.2 SASKATCHEWAN METALLURGICAL PROCESSING PLANT

18.2.1 Plant Site and Facility

The SMPP will be constructed on three quarter-sections of land (approximately 194 ha, 480 acres) that have been purchased by Fortune. The infrastructure, including the site buildings, storage ponds, rail spur and residue storage area, will occupy an area of approximately 32 ha (80 acres), allowing for a buffer zone of approximately 161 ha (400 acres). The site is bound by a gravel road (Schultz Road) on the east and summer roads on the west (Range Roads 3071 and 3072, respectively). The site is approximately 800 m north of Highway 305. CNR tracks cut through the southern end of the property in a southeast-northwest direction. The rail line will be used to receive concentrate and reagents for processing and, possibly, for shipment of finished products.

The SMPP site is in proximity to:

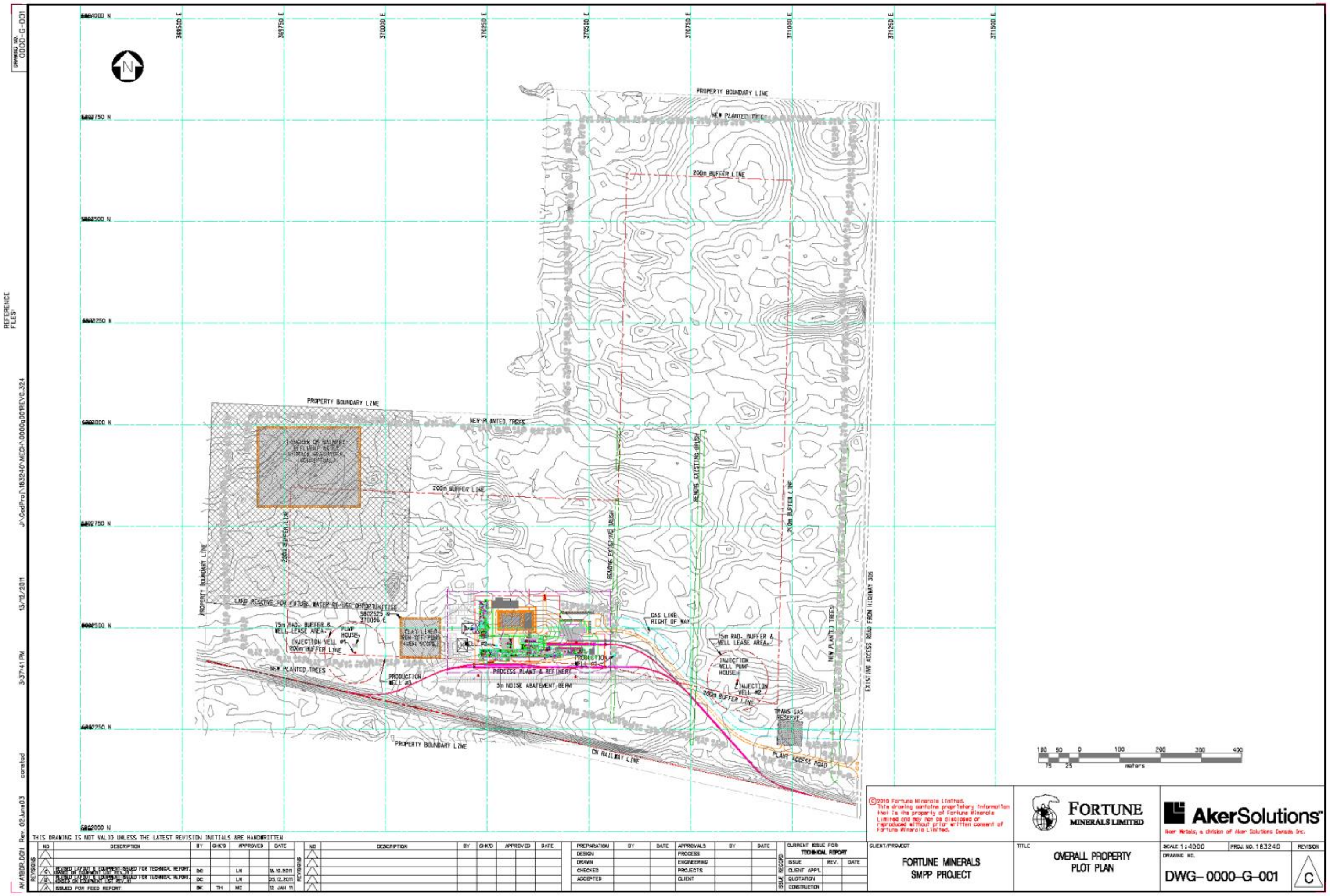
- A technically-competent labour pool.
- Access to transportation networks.
- Connectivity to energy utilities.

The location meets all of the needs of a metallurgical processing facility.

18.2.2 Process Facility

The hydrometallurgical processing plant will be erected on a greenfield site with a buffer zone, a surrounding berm and perimeter rows of trees, to contribute to aesthetics. A residue storage facility is planned for the northern portion of the site. These features are shown on Figure 18.2.

Figure 18.2
Site Layout – Saskatchewan Metallurgical Processing Plant



The plant building will be of structural steel with metal roof and insulated wall panels. The facility will be erected with footings and a concrete floor. The current footprint depicts a linear building in which the mechanical equipment is placed by the order of appearance on the flowsheet, contributing to functionality, material handling characteristics and assurance of product quantity and quality. Figure 18.3 depicts the process building.

18.2.3 Administrative, Laboratory and Warehouse Building

The two-storey administrative, laboratory and warehouse building will be of structural steel with a prefinished metal roof and insulated wall panels. The design will be finished with windows for top floor offices. The administrative building will be the first structure on the approach by road, with the main parking lot being adjacent to it.

Additional outdoor space will provide warehousing needs in a fenced area, with fabric matting for short-term storage and a gravel surface for longer periods.

18.2.4 Access Road

The plant site is accessed from Schultz Road, at the southeast corner of the property. The entrance to the site is located 100 m north of the CNR level crossing and is approximately 4 km from the Yellowhead Highway (Highway 16). The access road, including a truck pullout, will be constructed of compacted gravel throughout, with asphalt surfaces for forklift and pedestrian traffic.

18.2.5 Railway Access

The CNR mainline traverses the southwestern portion of the property. A siding will be constructed to receive railcars carrying concentrate or reagents.

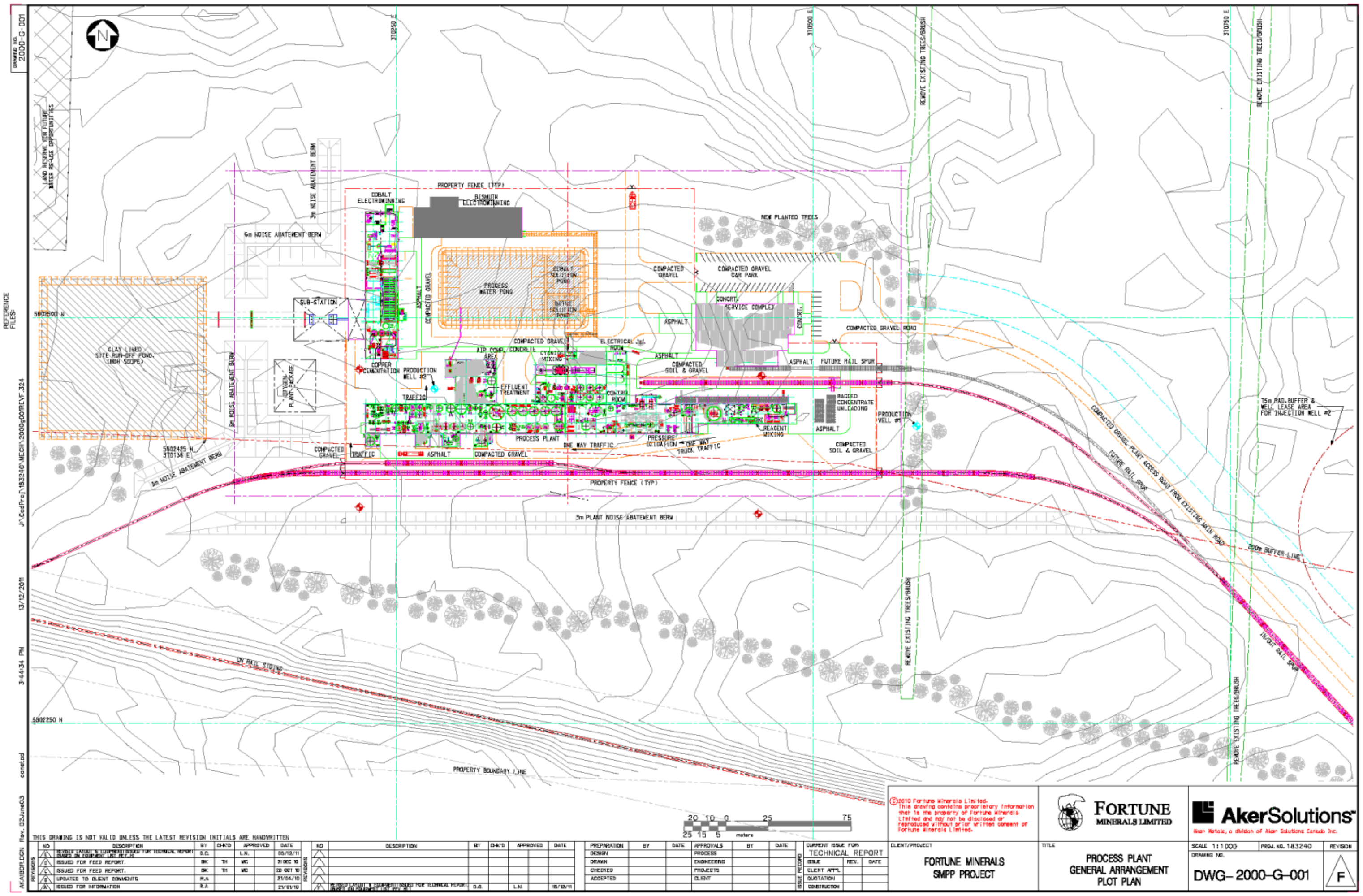
A trackmobile will move the railcars to the process area, according to production scheduling and process needs. The siding will be suitable for weekly receiving and storage of bulk concentrate in gondola cars. There will be room for another spur to be added subsequently, if required for outbound product shipments.

18.2.6 Oxygen Plant

A separate plant will produce the oxygen required for the process. This unit is situated within a bermed area at the west end of the main plant. The oxygen plant is a large power consumer, and will be located close to the incoming electrical feed.

The oxygen plant has a capacity of 120 t/d of oxygen. The system requires a source of very clean air and water; instrumentation air and fresh water will be provided.

Figure 18.3
Plant Layout – Saskatchewan Metallurgical Processing Plant



18.2.7 Electrical

Grid power is available from the utility at 72 kV or 138 kV, depending on anticipated capacity growth for each service which favours one or the other. Essentially, the 72-kV service in the area is reaching its maximum capacity, which warrants SaskPower to install 138 kV to serve the plant and surrounding area. There has been indication of a cost recovery plan to take effect.

Grid power will connect to a substation and switchgear located at the west end of the plant. High current capacity is needed at the bank of rectifiers for use in the electrowinning area. Medium voltage will connect to the main electrical room housed near the centre point of the main plant building. A transformer, rated 15/20 MVA, 138 kV/4.16 kV, will be transferred from the Hemlo inventory.

18.2.8 Communication

18.2.8.1 Telephone

SaskTel provides trunk feed with a high-speed data connection in the area. Data can be shared with the NICO Project site through the web network.

18.2.8.2 Fire Protection and Detection

Approximately 40 Type ABC portable fire extinguishers will be installed throughout the plant, generally at building exits and entrances to all electrical control rooms.

Approximately 300 addressable smoke detectors, located throughout the plant and inside the control and electrical room and at other strategic locations, will activate area alarm horns and flashing lights. The activated sensor location will also be indicated at the fire alarm panel near the control room.

Fire mains located throughout the plant will serve both the 1½-inch diameter fire hose reels provided to cover all areas within the plant, and the wall boxes that will allow for 2½-inch diameter hoses to fight fires from outside the plant. Any piping between buildings will be either heat traced and insulated or buried with sufficient depth and insulated cover to avoid freezing.

18.2.9 Natural Gas

Natural gas service will be installed to within 30 m of the plant structure, approaching from the south. A convenient location for the letdown station will be next to the in-plant road, approximately 72 m from the east end of the building. The gas lines feed the two boiler stations. The process plant buildings and service complex will produce makeup heat from direct fired gas heaters. Heat recovery will be utilized to minimize fuel consumption in the plant, the thaw shed and cross-flow ventilation for the cellhouse during winter months.

18.2.9.1 Heating and Ventilation

Heating and ventilation at the SMPP will be provided by a combination of the following types of units:

- Indoor air handling units for general warm air recirculation. The mixing damper on those units will switch to outside air during the warmer months.
- Outdoor direct gas-fired heating units.
- Fan driven air diffusing units, to recirculate warm air and to minimize stratification of warm air.
- Wall-mounted exhaust fans.

Heat will be recovered from the autoclave discharge, which provides acidic flash steam at around 10 psig to a corrosion-resistant steam-to-water heat exchanger. Flash steam not condensed continues on for discharge and condensation at a Venturi-type scrubber. Full heat recovery is sized at 17,500,000 Btu/h, which is sufficient to heat 700 gpm from 135ºF to 185ºF (159 m^3/h from 57ºC to 85ºC). When water temperatures drop due to a lack of heat recovery, a further steam-to-water heat exchanger will be activated with steam from the boiler plant. Heating of domestic hot water and boiler makeup water should be included also to maximize heat recovery.

18.2.10 Water

Fresh water will be sourced from two of three wells distributed across the grounds, with sufficient open space to permit drill rigs to mobilize for rehabilitation, if dictated by the results of annual inspection testing. The established maximum fresh water makeup rate is approximately 36 m^3/h. Groundwater from the Dalmeny fresh water aquifer will be the prime water source. The design of water pumping stations will comply with the water resource usage and environmental requirements for the Province.

Bottled drinking water will be brought in for consumption by the operating personnel. Eyewash stations will be gravity fed from bottles containing preserved buffered saline solution. Sinks and toilets will be fed from filtered well water.

A fire hydrant branch system will be installed from a header in the plant building. The main fire protection system will pull water from the process water pond.

Raw and process water tanks will provide surge and storage capacities for all the necessary water supply.

18.2.11 Sewage

The sewage storage unit will be purchased from a vendor as a turnkey package. The tank is below ground with the high-level mark situated below the frost line. Waste will be hauled to the local sewage treatment facility.

18.2.12 Site Drainage

Ponds will be provided for:

- Site runoff.
- Process water.
- Process residue storage.

An area will be reserved for a pond dedicated to recyclable water, if such opportunities are available.

The residue reporting to the PRSF is planned to consist of two principal streams:

- Cyanide leach residue is estimated to report to the PRSF at an average rate of 9 t/h.

- Iron-arsenic precipitate, and gypsum residue, is estimated to report to the PRSF at an average rate of 5.7 t/h.

Geochemical characterization of these residue streams, including solid trace metal content, mineralogical composition and leaching potential is ongoing, under the direction of the MDA Advanced Testing Laboratory.

A list of the plant mobile equipment required for the SMPP is provided in Table 18.2.

Table 18.2
Mobile Equipment for the Saskatchewan Metallurgical Processing Plant

Item	Number
Forklift, 5t	1
Small Fork lift, 3 t	2
Boom Truck (freightliner M2-106)	1
Grader (Cat. 120)	1
Dump Truck (Volvo VHD 20 t)	1
Ford Truck (Ford F-250)	4
Portable Welding Machine (Lincoln Vantage 500)	1
Portable Generator (Honda EB6500XA)	1
Portable Pump (Honda WT 40XK2A)	2
Manlift – Scissor Lift (Genie GS-3268)	1
Skid Steer Loader (Bobcat, Cat. 262)	1
Trackmobile Railcar Mover (Viking)	1

19.0 MARKET STUDIES AND CONTRACTS

The following analysis of the markets for gold, cobalt, bismuth and copper has been prepared by Fortune based on its marketing reports and has been edited for consistency with other sections of this report.

19.1 PRODUCT REVENUES

The financial model is based on the following metal prices, which are assumed to remain constant, in real terms, over the life of the Project:

- Gold: US$1,350/oz.

- Cobalt: US$16/lb, with a premium for cobalt contained in cobalt sulphate that varies by geographic region as follows: 20% for North America and Europe, 15% for Asia other than China, with no premium in China, principally because of import duties and value added tax. The 20% and 15% premiums result in effective prices of US$19.20/lb and US$18.40/lb for cobalt contained in sulphate, respectively. The weighted average price used in the financial model is US$19.04/lb of contained cobalt.

- Bismuth: US$10.50/lb as 99.995% ingot, US$11/lb as 99.995% needles and US$14/lb for bismuth contained in 89.7% bismuth oxide. It is planned to produce 60% of the bismuth as oxide, 20% as ingot and 20% as needles. The weighted average price used in the financial model is US$12.64/lb of bismuth.

- Copper cement: An approximately 90% copper product that would receive a net price from the smelter of US$2.38/lb of contained copper.

At the exchange rate of US$0.88 = C$1.00 used in the financial model, the NICO Project is estimated to produce a life-of-mine gross revenue of approximately C$3.85 billion or an average annual gross revenue of approximately C$192 million per year, based on a 20-year life. A summary of the estimated gross revenues for each metal is provided in Table 19.1. Over the life of the Project, the total production of saleable metals is estimated at 814,000 oz of gold in doré, 70 million pounds of cobalt in sulphate, 73 million pounds of bismuth in oxide, ingot and needles, and 11.2 million pounds of copper in copper cement.

Table 19.1
Life-of-Mine Gross Revenue

Metal	Estimated Gross Revenue	
	Life-of-Mine (C$ million)	Annual Average (C$ million)
Gold	1,249	62.5
Cobalt	1,504	75.2
Bismuth	1,058	52.9
Copper	30	1.5
Total	**3,842**	**192.1**

The principal co-products of the NICO Project are cobalt and gold, with bismuth being of somewhat lesser importance and copper contributing only a small portion of total gross revenue.

19.2 PRODUCT SPECIFICATIONS

Gold contained in concentrate will be processed into doré bars. The gold to silver ratio of these bars has not been determined but is anticipated to be high due to the relatively low concentration of silver identified in the deposit.

Cobalt in concentrate will be processed principally into cobalt sulphate heptahydrate ($CoSO_4.7H_2O$) grading 20.9% Co.

Bismuth in concentrate will be processed initially into bismuth ingot or needles, grading 99.995% Bi. Most of the bismuth ingot will be reprocessed to a bismuth oxide powder, containing 89.7% bismuth.

Copper will be recovered from the cobalt stream to produce an approximately 90% copper cement that will be sold to a smelter.

19.3 SUPPLY AND DEMAND FORECASTS

19.3.1 Gold

19.3.1.1 Gold Supply

Gold is widely produced and, in addition to mine production, official sector sales and secondary metal also contribute to total gold supply.

Gold is produced from mines on every continent except Antarctica. Excluding artisanal mining, there are several hundred gold mines operating worldwide, ranging in scale from very small to large multi-million ounce producers. According to the World Gold Council (2014), the overall level of global mine production is relatively stable and has averaged approximately 2,690 tonnes per year over the last five years. Gold production requires a comparatively long lead time, with new mines typically taking 10 years or more to come on stream following the initial discovery. Thus, mine capacity is relatively inelastic and unable to respond quickly to changes in price outlook. Conversely, the recent decline in prices from more than US$1,800/oz to below US$1,200/oz at the end of 2013 has resulted in several large development projects being shelved and a number of smaller higher cost producers being forced to shut down.

While gold mine production is relatively inelastic, the recycling of gold ensures that there is a potential source of readily available supply when required. This helps to satisfy any increase in demand and keeps the gold price more stable. Between 2008 and 2012, recycled gold contributed an average of 39% to annual supply (World Gold Council, 2014).

There was also a net outflow from ETFs of 881 t in 2013, as investors continued to re-evaluate their portfolios in response to market conditions.

19.3.1.2 Gold Demand

Gold demand comprises jewelry fabrication, official coins, bullion and usage in electronics, dentistry and other industrial and decorative applications. According to the World Gold Council (2014), consumers around the world bought gold in record amounts in 2013, led by demand in China and India, with China becoming the world's biggest gold market. In Western markets, consumer demand also remained strong with the United States, in particular, having a robust year in the jewellery, bar and coin sectors.

In 2013, the gold market saw 21% growth in demand from consumers, which contrasted with outflows of 881 t from ETFs. The net result was that global gold demand in 2013 was 15% lower than in 2012, with a full year total of 3,756 t (World Gold Council, 2014).

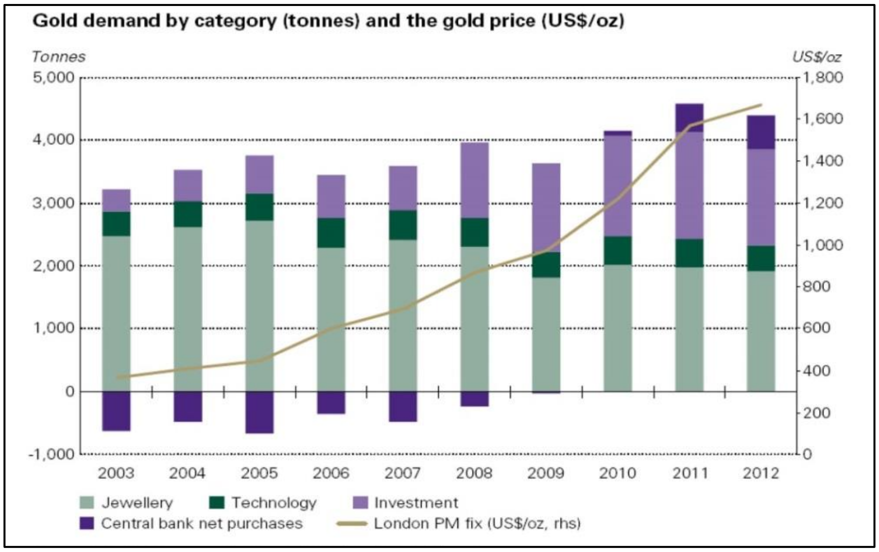
Annual global investment in bars and coins reached 1,654 t, up from 1,289 t in 2012, a rise of 28%. In 2013, Chinese and Indian investment in gold bars and coins was up 38% and 16%, respectively. Although much smaller markets in terms of volume, in the United States, bar and coin demand was up 26% to 68 t and, in Turkey, it was up 113% to 102 t.

Demand for jewellery increased by 29% from 519 t to 669 t in China, and by 11% from 552 t to 613 t in India, reaching 2,209 t globally.

Technology demand reached 405 t in 2013, virtually unchanged from 407 t in 2012.

Figure 19.1 shows historical gold demand and the trend in gold price from 2003 to 2012. The price of gold softened significantly in 2013.

Figure 19.1
Gold Demand by Category and Gold Price



World Gold Council, 2013.
RHS = right-hand scale.

19.3.1.3 Gold Supply and Demand Outlook

Key findings of the World Gold Council report on gold for the year 2013 are:

- Consumers remain key drivers in the demand for gold.
- China and India both recorded increased demand in 2013.
- Global consumer demand is strengthening.
- Indian demand continues to be strong.
- Technology demand remained stable.
- Central bank purchases in 2013 were down 32% on 2012.

Fortune considers that the gold price should continue its recovery as investors focus on its role as a store of wealth, with physical demand growing particularly in China and India. Central bank purchases are expected to continue, with significant accumulation in China and developing countries. This demand is also expected to be augmented by a return to consumer purchases, particularly in electronics, with recovery of the economies in Europe and the United States.

19.3.2 Cobalt

Material in this section is drawn principally from Skybeco, 2012a, Falso, 2014, Roskill, 2012, Darton Commodities, 2014 and the Cobalt Development Institute newsletters. Given the room for growth in consumption from developing countries such as China, India and Brazil and, particularly, growing demand in rechargeable batteries, Fortune considers that the mid- to long-term outlook for cobalt is buoyant.

19.3.2.1 Cobalt Supply

Cobalt is produced principally as a by-product of nickel and copper mining and refining, and locally by a few primary producers. The supply of cobalt is therefore closely linked to the production of nickel and copper. Growing demand for both nickel and copper has led to the development of several new mining and processing/refining projects. As a result, the supply of by-product cobalt has also increased. However, delays and setbacks have been experienced at several new projects for technical, environmental, financial and political reasons, and several projects have been shelved.

By far the largest source of cobalt mine production is central Africa, particularly the Democratic Republic of the Congo (DRC), which is responsible for 60% of the approximately 85,000 t global supply. Historically, the adjacent country of Zambia produced about 12% of world mine production, but dropped to 2% in 2013 due to production problems that are expected to be resolved in 2014. Zambia produces additional refined cobalt (5% of global supply) from materials sourced in the DRC. The DRC has announced a ban on the sale of unprocessed concentrates and high moisture hydroxide intermediates effective at the end of 2014, a deferral from an earlier announced ban in July, 2013, when higher export duties were levied instead. Both the DRC and Zambia are trying to encourage value-added processing in their respective countries. Both are also constrained by inadequate infrastructure, including critical shortages of electrical power needed to expand mine and refinery production. There is also evidence of potential depletion of near-surface oxide ores that are easily processed by atmospheric leaching and favoured by Chinese processors. These issues have encouraged the development of other potential new mine projects that could produce cobalt raw materials.

Other significant sources of cobalt mine production include nickel sulphide deposits located in Russia, Canada and Australia, as well as nickel-cobalt laterite deposits in Australia, Cuba, the Philippines and Madagascar. Laterite deposits have very high capital and operating costs relative to sulphide deposits and several projects have been unable to repay capital from production. Fortune believes that laterites are unlikely to contribute significant new supply in the foreseeable future. Mine production by producer, country of origin and the primary metal being produced is shown in Table 19.2.

The largest producer of refined cobalt is China, with production of 35,600 t in 2013, up from 29,784 t in 2012 and representing about 43% of world refined cobalt production. Chinese processors import concentrates and intermediate forms of cobalt from the DRC and upgrade these to produce cobalt alloys and chemicals. Early in 2013, OMG Group, the largest single producer of refined cobalt products, sold the Kokkola refinery in Finland to a joint venture of Freeport McMoRan Copper & Gold Inc., Lundin Mining Corporation and Gecamines (La Générale des Carrières et des Mines), joint owners of Tenke Fungrume mine in the DRC. OMG also sold its interests in Groupement pour le Traitement du Terril de Lubumbashi (GTL) and the Big Hill cobalt slag deposit in the DRC, to Groupe Forrest International and

Glencore Xstrata plc, its former joint venture partners. Annual refined cobalt production in 2013 is shown by producer and country in Table 19.3.

Table 19.2
2013 Cobalt Mine Production by Producer, Country and Primary Metal

2013 Mined Cobalt Sources				
Miner/Operator	**Mine/Operation**	**Country**	**Type**	**Tonnes**
Glencore	Mutanda Mining	DRC	Cu	14,000
Freeport McMoRan	Tenke Fungureme	DRC	Cu	12,100
ENRC	BOSS Mining	DRC	Cu	9,100
Norilsk Nickel	Kola MMC	Russia	Ni	5,100
Vale	Sudbury/Voisey's Bay/VNC	Canada	Ni	3,600
Moa JV (Sherritt)	Moa Nickel	Cuba	Ni	3,300
Metorex/Jinchuan	Ruashi Mining	DRC	Cu	3,200
Groupe de Terill Lubumbashi (GTL)	Big Hill (slag operation)	DRC	Cu	3,100
Glencore/Minara	Murrin Murrin	Australia	Ni	2,900
Sumitomo Metal Mining	Coral Bay + Taganito	Philippines	Ni	2,800
Glencore/Katanga Mining	Kamoto/KOV	DRC	Cu	2,600
Shalina Resources/Chemaf	Etoile/Usoke	DRC	Cu	2,200
Ambatovy (Sherritt)	Ambatovy	Madagascar	Ni	2,200
Somika SPRL	Somika	DRC	Cu	2,100
Gecamines	CMSK	DRC	Cu	1,800
Vedanta Resources	Konkola Copper Mines	Zambia	Cu	1,900
MCC/Highlands Pacific	Ramu	Papua New Guinea	Ni	1,400
Cie. De Tifnout Tiranimine (CTT)	Bou Azzer	Morocco	Pr	1,300
Votorantim	Sao Miguel Paulista	Brazil	Ni	1,200
First Quantum	Ravensthorpe	Australia	Ni	1,200
Jinchuan	Lanzhou Jinchuan	China	Ni	1,100
Xstrata	Sudbury, Ragian	Canada	Ni	950
Other below 1,000 t	Various	Various	Ni	3,100
				82,250
		Ni mining	**35%**	
		Cu mining	**63%**	
		DRC based	**61%**	

CDI, 2014; Falso, 2014.

Table 19.3
2013 Refined Cobalt Production by Country

2013 Refined Cobalt Sources		
Producer/Refiner	**Country**	**Tonnes**
Various	China	35,600
Freeport Cobalt	Finland	9,600
Chambishi	Zambia	4,900
Umicore	Belgium	4,500
ICCI/Sherritt	Canada	3,300
Glencore (Xstrata)	Norway	3,200
Minara	Australia	2,900
Sumitomo	Japan	2,800
Katanga Mining	DRC	2,600
Norilsk	Russia	2,400
QNPL	Australia	2,300
Vale	Canada	2,200
Ambatovy	Madagascar	2,100
Tocantins	Brazil	1,650
CTT	Morocco	1,360
Various	South Africa	1,050
Kasese/KCCL	Uganda	400
Various	India	350
Eramet	France	350
		83,560

CDI, 2014; Falso, 2014.

Production of cobalt in 2013 was approximately 83,560 t, up from 77,189 t in 2012, an increase of 8.2%. Cobalt chemicals are now responsible for more than 60% of the global market, up from 50% two years ago, and primarily the result of increased demand in rechargeable batteries. Table 19.4 shows the breakdown of cobalt production in 2013, by product and usage. The additional refined cobalt production is in part due to cobalt from recycling.

Table 19.4
Refined Global Cobalt Production by Product, 2013

Cobalt Usage Overview					
Product	**Tonnes**	**Category**	**within Cat**	**Overall**	**Usage**
Chemicals					
Co Sulphate	13,000		25.0%	15.3%	Batteries, animal feed
Co Oxide	14,000		26.9%	16.5%	Batteries, pigments, colorants
Co Hydroxide	6,000		11.5%	7.1%	Batteries, pigments, driers
Co Nitrate	8,000		15.4%	9.4%	Catalysts, pigments
Co Chloride	5,000		9.6%	5.9%	Catalysts, electroplating
Co Carbonate	6,000		11.5%	7.1%	Catalysts, animal feed, ceramics, pigments
Subtotal	**52,000**	**61.2%**			
Metals					
Co Powder	5,000		15.2%	5.9%	Batteries and metallurgical
Broken Co Cathode	10,000		30.3%	11.8%	Various metallurgical applications, including superalloys, hardmetals, magnets, prosthetics, and other alloys
Cut Co Cathode	10,000		30.3%	11.8%	
Co Briquette	5,000		15.2%	5.9%	
Co Ingots	2,000		6.1%	2.4%	
Co Rounds	1,000		3.0%	1.2%	
Subtotal	**33,000**	**38.8%**			
Total Usage	**85,000**				

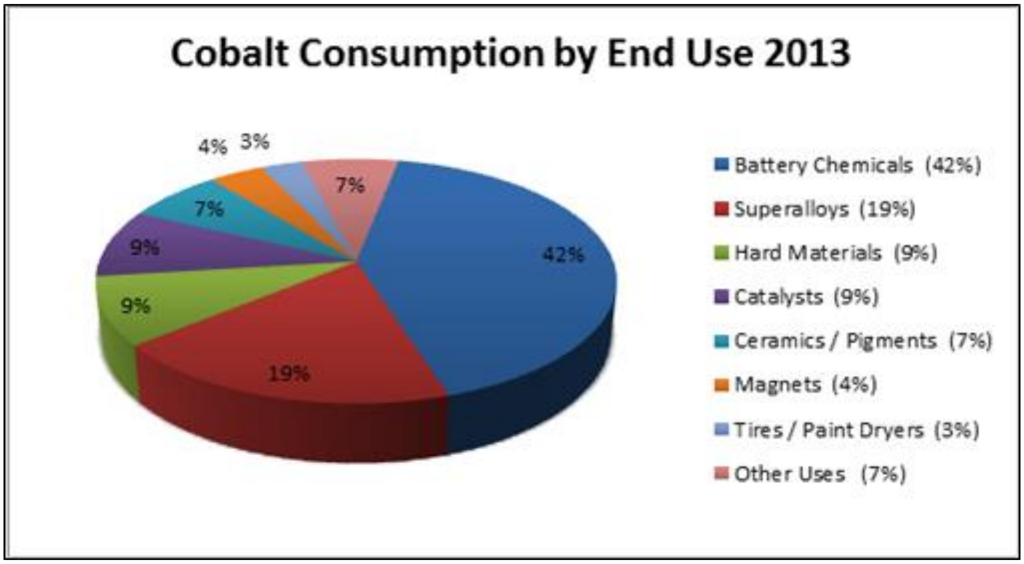
Falso, 2014.

19.3.2.2 Cobalt Demand

Cobalt consumption is divided into metal and chemical end uses. Over the last 10 years, demand for cobalt in chemicals (dominated by battery and catalyst applications) has grown faster than the demand for cobalt as metal (mainly superalloy and hardmetals applications). In 2013, demand for cobalt chemicals represented 61% of the total refined cobalt demand as shown in Figure 19.2.

Cobalt demand in Asia is greater for chemicals, representing about 75% of the market, whereas in North America the demand is the reverse at 75% for metals. Most of the world's cobalt is consumed in Asia (principally China and Japan, but also in South Korea), since the majority of lithium battery production is centred there. China and Japan together account for approximately two thirds of global cobalt chemical consumption.

Figure 19.2
Estimated Cobalt Demand by Product, 2013



The CDI, 2014.

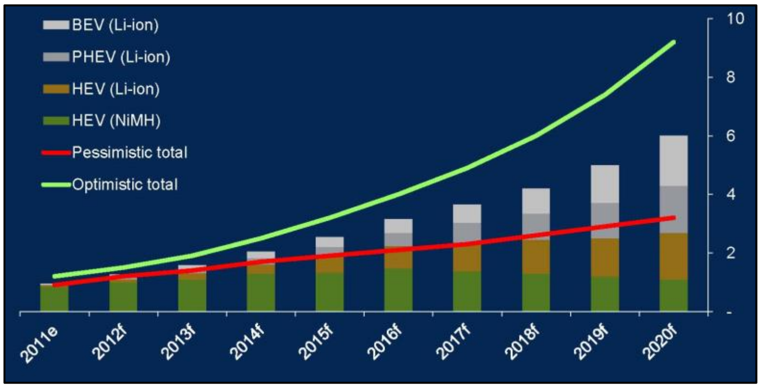
Battery Applications

Cobalt in battery applications has experienced very strong growth from 2000 to the present, with annual growth rates averaging approximately 20%. Battery production is now the greatest single use for cobalt and almost half of the net increase in global demand for cobalt since 2000 stems from battery growth. Cobalt finds use in many rechargeable battery systems: lithium-ion (Li-ion), nickel metal hydride (NiMH) and nickel cadmium (NiCd) batteries. Of these battery technologies, lithium-ion batteries used the most cobalt, up to 87%. In recent years, newer variants of lithium batteries have emerged as manufacturers have attempted to improve performance, reliability and safety, and to lower costs, and not all include cobalt in the formulation. Lithium cobalt oxide, however, remains the dominant technology used in lithium batteries for most electronic devices, including tablets, smartphones and PDAs (personal digital assistants), camcorders and notebook computers. Battery chemistries employed in hybrid electric vehicles (HEV) and electric vehicles (EV) vary by producer. Cobalt content in NiMH batteries is up to 15%, while cobalt in NiCd batteries ranges from 1% to 5%.

Electric vehicles include hybrid electric vehicles, plug-in hybrid electric vehicles and pure electric vehicles. Roskill's projection of global sales of electric vehicles between 2011 and 2020 is shown in Figure 19.3.

There are a number of battery manufacturers gearing up to support electric vehicle growth, particularly in North America, where Fortune, as a Canadian producer, will have a geographic advantage as well as a price advantage under the North America Free Trade Agreement (NAFTA). Notably, Tesla Motors and Panasonic recently announced plans to construct a large new battery plant in North America that could reportedly double world lithium-ion battery production.

Figure 19.3
Recent and Projected Global Sales of Electric Vehicles



Roskill, 2012.

Superalloy Applications

Cobalt is used in superalloys and superalloy demand was strong in 2013, representing approximately 19% of the cobalt market. The outlook for the near future remains equally buoyant, as commercial aircraft and engine manufacturers have strong production schedules through 2014 and order backlogs. The superalloys sector is composed of the following market segments:

- Aerospace : 64%
- Industrial gas turbines : 26%
- Automotive : 6%
- Other : 4%

Alloy producers to the aerospace sector have seen sales volume increases in the order of 40% to 50% for aerospace markets and 15% to 20% for industrial gas turbine (IGT), or land-based markets. IGT applications, while smaller in market size, use more cobalt than aircraft turbines. Skybeco reported that Airbus is projecting that air traffic growth worldwide will more than double over the next 15 years. Its global market forecast for 2011-2030 anticipates the need for 26,900 new passenger jetliners to meet this rising demand. As well, during this time, some 10,500 aircraft from existing fleets will need to be replaced by more eco-efficient models. (Skybeco, 2012a). Specifications for cobalt metals used in aerospace superalloy applications are very tight.

Hardmetals

Cobalt is used in cobalt-chrome-tungsten (Co-Cr-W) alloys to coat other metals, or used directly as Co-Cr-W castings, where erosion resistance and high temperature capabilities are desired. High-speed cutting steels incorporate cobalt, together with chromium, molybdenum, tungsten and vanadium (the latter forming carbides). Cobalt-chrome-molybdenum (Co-Cr-Mo) alloys have application in prosthetics (hip and knee replacements).

Hardmetal applications for cobalt represented about 9% of the cobalt market in 2013. Cobalt growth in hardmetal applications is projected to grow at 2% per year.

Catalysts

The largest application of cobalt in catalysts is the production of polyethylene terephthalic acid (PTA), accounting for approximately 70% of cobalt in catalyst uses. PTA is mainly used in the production of polyester fibres (80%) and polyethylene terephthalate (PET) resins. These markets slowed in 2008, but picked up again in late 2009 and 2010 and current projections call for growth rates of 6% per year. Some 30 t/y of new PTA capacity is expected to come online by 2015.

Gas-to-liquid (GTL) processes use cobalt in the production of Fischer-Tropsch (FT) catalysts to convert natural gas to oil, while hydrodesulphurization processes for the removal of sulphur from oil also use cobalt in a catalyst material.

Catalyst applications accounted for 9% of 2013 cobalt demand and are forecast to grow at 5% per year.

Magnets

Magnets comprise some 4,000 t/y of cobalt usage, primarily in Alnico magnets (aluminum, nickel and cobalt alloyed with iron). Other magnet types include samarium-cobalt (SmCo), iron-chromium-cobalt (FeCrCo) and neodymium-iron-boron (NdFeB). Cobalt used in magnets represents 4% of cobalt demand and is projected to grow at 2% per year.

Other Applications

Other cobalt applications include pigments and ceramics, tires, paint dryers, electroplating and animal feeds. With the exception of electroplating, which uses cobalt in metal form, these all constitute demand for cobalt in various chemical forms (carbonates, sulphates, oxides, acetates, nitrates, etc). Demand growth is projected to be in line with the general level of industrial production.

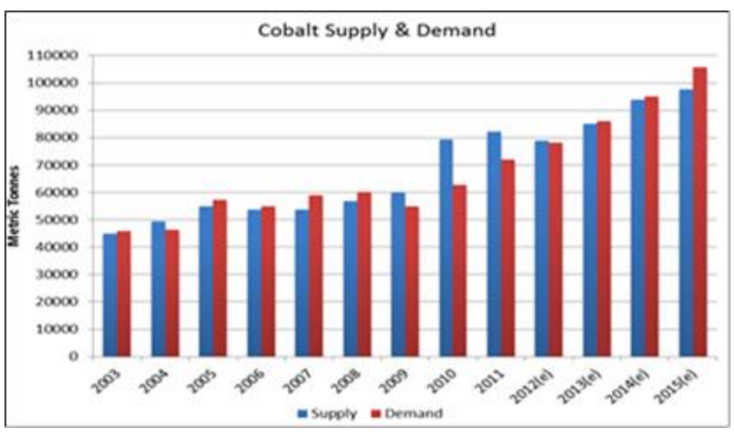
19.3.2.3 Cobalt Supply and Demand Outlook

The majority of new cobalt production projected over the next two to three years will originate in the DRC. Most of this production will be in the form of concentrates and intermediate cobalt products (oxide concentrates, hydroxide and carbonate), with the balance being metal (cathode). Readily available oxide ores from the DRC are being depleted, however, and mines are expected to produce more mixed oxide/sulphide concentrates that will require more expensive downstream process technologies. The largest of the DRC cobalt intermediate producers are expected to be Mutanda Mining, Katanga Mining and Tenke-Fungurume.

Skybeco (2012a) anticipates that refined cobalt output in China will also contract as a result of recent softness in the market and an inability to source sufficient oxide concentrates from the DRC. Marginal producers in Africa may also suspend production until prices improve. The current market environment is also discouraging many new projects from progressing (e.g., Boleo, Formation Capital). In mid-2013, the DRC raised taxes on unprocessed concentrates and partially treated hydroxide products, to encourage downstream processing in the DRC, and is proposing an outright ban on the export of concentrates at the end of 2014.

Skybeco (2012a) anticipates that the small surplus of refined cobalt supply over demand in 2012 will reverse to a small deficit later in 2013. Demand will again exceed supply in 2014 and 2015, though supply will increase as Chinese refiners ramp up production to keep up with battery demand in Asia. See Figure 19.4. Fortune reports that Commodities Research Unit (CRU) is forecasting significant deficits of cobalt production, relative to demand, in 2017. GlencoreXstrata, a large vertically integrated cobalt producer, is forecasting a supply deficit in 2016.

Figure 19.4
Historical and Projected Cobalt Supply and Demand



Skybeco, 2012a.

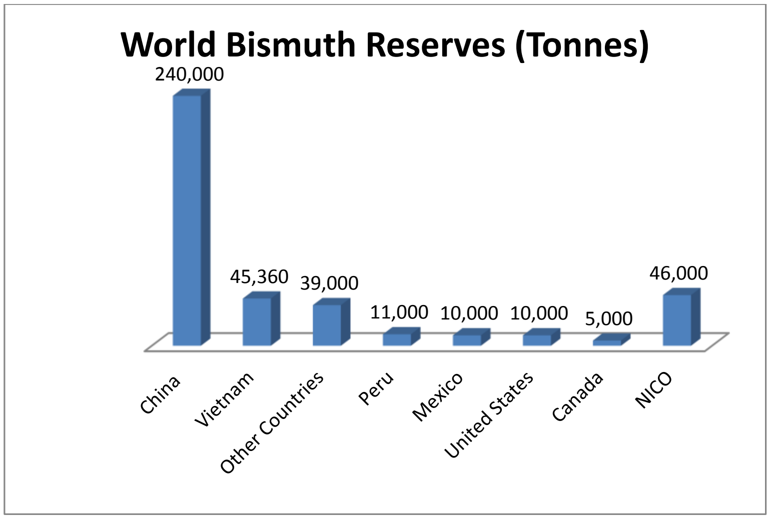
19.3.3 Bismuth

Material in this section is drawn principally from Ian, 2014, Skybeco, 2012b and Metals Bulletin.

19.3.3.1 Bismuth Supply

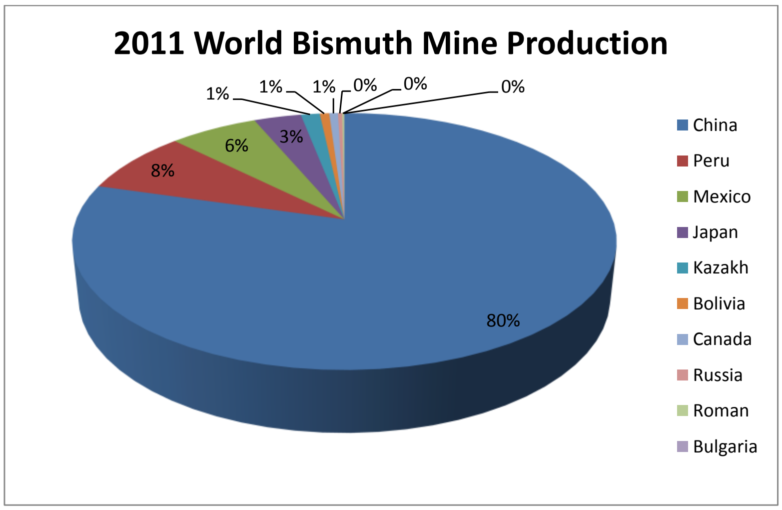
Bismuth is produced primarily in southern China as a by-product of copper, lead and tungsten mining and refining, particularly in the Chenzhou area of Hunan Province. This production is conducted by large state-run entities, as well as a number of smaller private companies. Most of these producers belong to the Hunan Bismuth Group that was formed to have greater influence on the bismuth market. Outside China, most bismuth is produced as a by-product of lead/zinc mining in countries such as Mexico, Peru, Canada and South Korea. A new producer, Masan Group Corporation, recently commenced commercial operations from the Nui Phao tungsten-fluorspar-bismuth-copper-gold deposit in northern Vietnam. World bismuth reserves are shown in Figure 19.5 and estimated world mine production is shown in Figure 19.6.

Figure 19.5
Estimated World Bismuth Mine Reserves by Country



Ian, 2014

Figure 19.6
Estimated World Bismuth Mine Production by Country



Ian, 2014

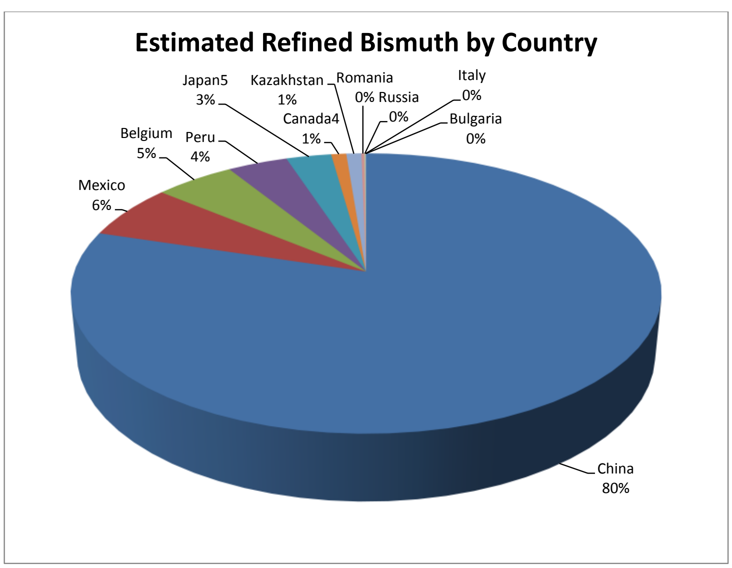
Annual refined bismuth production varies, but is presently about 15,000 to 16,000 t. Most refined bismuth is produced by smelting a bismuth flotation concentrate, using pyro-metallurgical methods to produce an ingot, typically with 99.995% purity (4N) or 99.9995% purity (5N). Some primary refined bismuth production is in the form of needles (stitch), produced by pouring molten metal through a screen into water, instead of casting a bar. Needles have higher unit surface area than ingot and are used by some re-processors to produce other downstream chemicals from metal. Bismuth chemicals are typically produced by re-processing metal, the most common of which is oxide, produced in an oxidation chamber. Other bismuth chemicals include various nitrates, carbonates, aluminates, oxychloride, subsalicylate and other complex compounds, produced by dissolution and precipitation with various reagents.

The dominant producer of refined bismuth is China and the member companies of the Hunan Bismuth Group. Collectively, Chinese producers account for 80% of the refined bismuth supply, as shown in Figure 19.7 (Ian, 2014). The dominant re-processor is 5N Plus, a Canadian company with plants in Canada, the United States, Belgium, Germany and the United Kingdom. 5N Plus acquired MCP Group which, in turn, had amalgamated with Sidech to be the world largest bismuth processing and marketing company.

19.3.3.2 Bismuth Demand

In broad terms, there are two classifications into which bismuth applications can fall: chemical and metal. Virtually all bismuth supply starts as a metal ingot and then is re-processed into various alloys, compounds and chemicals. Chemical applications account for approximately 65% of bismuth use.

Figure 19.7
Estimated World Bismuth Refinery Production by Country



Ian, 2014

Bismuth demand is poised to grow significantly on account of its non-toxic nature, combined with physical properties that allow it to be substituted in place of more harmful metals (e.g., lead) in numerous applications. The harmful effects of lead are well documented, and the amount of legislation and regulation governing its use is expected to increase, paving the way for growing bismuth demand. This has resulted in a structural change to the bismuth market over the past five years that is expected to continue well into the future.

19.3.3.3 Applications for Bismuth

Bismuth's unique properties make it the metal of choice in a myriad of end-use applications and bismuth metal is used in a variety of fusible low melting temperature alloys. The melting point of bismuth is very low, at only 271.4˚C (520.6˚F) and, unlike virtually all metals, bismuth contracts when heated. For this reason, it is used in alloys for such applications as triggering devices in fire-sprinkler systems and holding devices for grinding optical lenses or turbine blades. The growth anticipated for many of these markets, such as turbine blades for increased aircraft building and building construction growth requiring sprinkler systems, will spur more demand for bismuth. The low melting point and thermal conductivity properties of bismuth also allow for its use as a coolant in nuclear power generation applications.

Bismuth has properties similar to lead, and, as such, finds uses in many applications where the use of lead is not practical, desirable or allowable. One of the world's large steelmakers, POSCO Steel of Korea, recently started producing bismuth-based free cutting steels for television component parts in LG products.

Bismuth is used in tin-silver-bismuth solders, where bismuth replaces lead. This has gained momentum in Europe where lead products have been banned in electronics as a result of the European Union's REACH legislation (Registration, Evaluation, Authorization and Restriction of Chemicals). The use of lead is likely to be further restricted globally over the medium term. Bismuth is replacing lead in plumbing solders and plumbing brasses. In California, for example, lead is banned in these applications.

Bismuth is also replacing lead in hot dip galvanizing processes, where its presence increases the fluidity of the molten zinc. Thermo-electric devices use a bismuth telluride alloy to convert electrical energy to heat. This same process can be reversible, in that heat can be converted to electrical energy. This is expected to be a major new development in energy conservation, as waste heat from motors, furnaces or engines may be harnessed to generate electricity with this technology.

Bismuth, particularly bismuth trioxide, is used in paint dryers and flame retardants. In the field of personal care products, bismuth oxychloride is used extensively for its pearlescent effect in lip glosses and eye shadows. In pigments for paints, bismuth oxychloride provides the same effect and is a significant growth market for bismuth in the automotive sector; elsewhere in pigments, bismuth is used in the form of vanadate and oxides for specific colour effects.

Bismuth is a mild anti-bacterial agent and is used extensively in stomach preparations in the form of bismuth subsalicylate; the most high-profile of these is the brand Pepto-Bismol®.

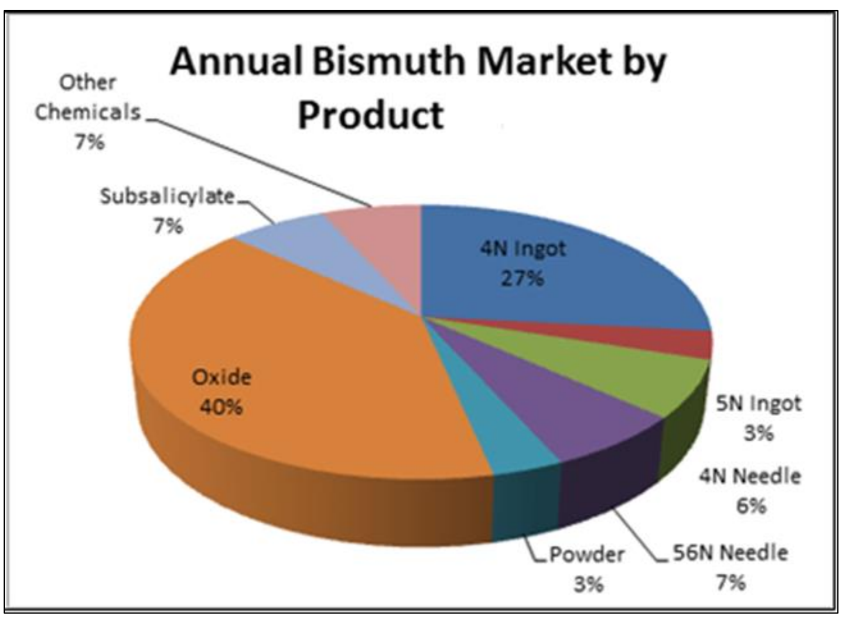
Extreme pressure (EP) greases and lubricants make use of bismuth naphthanate, while brake linings and clutch pads use bismuth sulphide and bismuth octoate as friction modifiers, for consistent brake pad and clutch plate performance.

Bismuth is used in catalysts, including bismuth carboxylate for polyurethane reactions, and bismuth molybdate and bismuth nitrate for oxidation of olefins. Recent research indicates that bismuth telluride alloyed with copper and other metals shows promising prospects in the field of superconductors.

In the automotive sector, bismuth oxide is used as a component frit material in ceramic glass enamels. These form a black opaque barrier, which prevents ultraviolet rays from reaching the adhesive materials used in bonding windshields and window panes to the automobile frame. Other uses include fluorescent lamps, fireworks and ammunition (shot), and fishing sinkers which use bismuth instead of lead for environmental protection of wetlands.

The breakdown between the major metallurgical and chemical products for bismuth is shown in Figure 19.8, recognizing that other bismuth chemicals are typically made from bismuth needles or oxide.

Figure 19.8
Metallurgical and Chemical Demand for Bismuth



Ian, 2014

19.3.3.4 Bismuth Supply and Demand Outlook

During the past two years, supply of bismuth outpaced demand, as some de-stocking took place during the global economic slowdown. This situation corrected itself in the latter part of 2013 and is continuing into 2014 with economic recovery in Europe and North America. Bismuth demand is forecast to show considerable growth due to its role as a non-toxic substitute for lead, especially in such applications as free cutting (machining) steels, copper/brass alloys and in pearlescent paints for the automotive industry. Fortune anticipates that this growth will be in the order of 8-10%/y over the coming three years. Supply is expected to remain stable during 2014, although many of the smaller mines in China may be forced to discontinue operations as a result of environmental restrictions by the government, increasing wage demands in China, and/or the unfavourable economic operating conditions prevailing at this time.

19.3.4 Copper

Copper is widely used in many applications, although it will contribute only a minor proportion of the revenue to be generated by the NICO Project.

19.3.4.1 Copper Supply

Total global refined copper supply in 2012 was 20,127,000 t, of which mine production was 16,740,000 t, with the remainder primarily from secondary processing of recycled materials. Most copper is mined or extracted as copper sulphides from large open pit mines in porphyry copper deposits that contain 0.4% to 1.0% copper, or from higher grade sedimentary copper or massive sulphide deposits. Chile was the top mine producer of copper with at least one-third world share, followed by the United States, Indonesia and Peru.

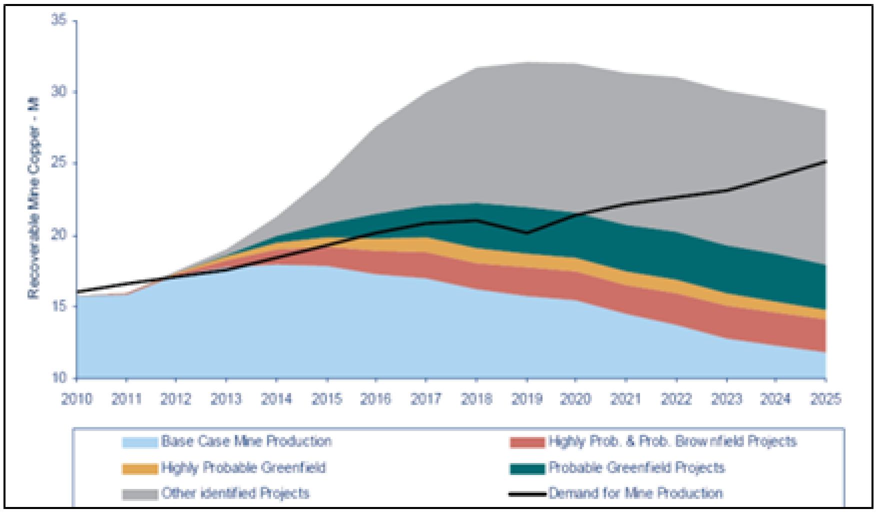
19.3.4.2 Copper Demand

Total global refined copper usage in 2012 was 20,550,000 t. Copper is an excellent conductor of heat and electricity which makes it highly applicable for use in the construction and electrical goods industries. In the construction industry, it is used in the form of cables, wiring, plumbing, heating and ventilation and other building materials. It is also used extensively in the wiring and circuit boards of phones, computers and other electrical goods. The major applications of copper are in electrical wiring (60%), roofing and plumbing (20%) and industrial machinery (15%).

19.3.4.3 Copper Supply and Demand Outlook

Mine production scenarios developed by Brook Hunt and reported by Macquarie Capital are illustrated in Figure 19.9.

Figure 19.9
Copper Mine Productions Scenarios (Base Case and Probable) Versus Demand



Macquarie Capital, February, 2012.

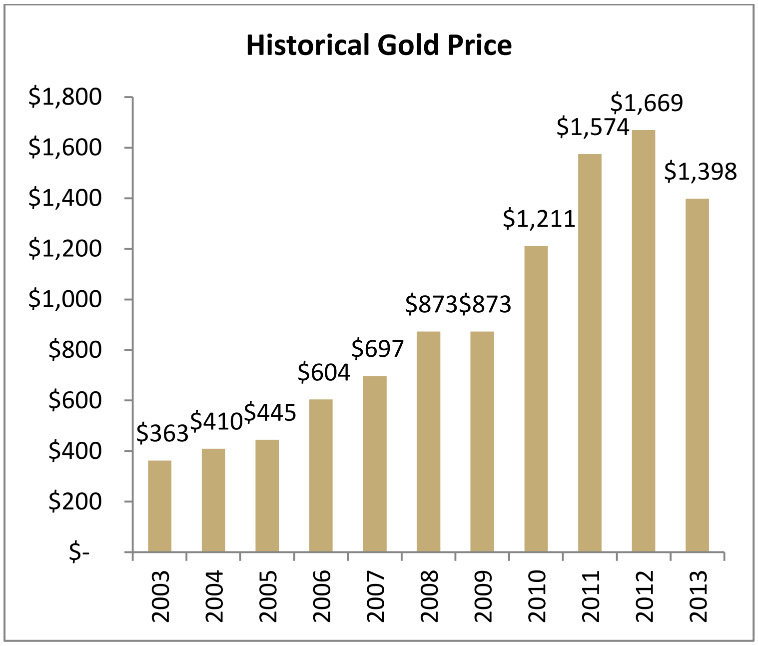
19.4 PRICING STRATEGY AND BASIS

19.4.1 Gold

Gold prices have increased over the last decade as a result of government fiscal policies, central bank purchases, investor purchases and net producer de-hedging. As a result of economic recovery and a stronger U.S. dollar, gold prices retracted in 2013. Gold prices also declined due to large ETF net sales. However, physical demand for gold has been increasing significantly, particularly with the demand for bars, coins and jewellery in China and India. This physical demand is expected to continue, as are purchases from central banks and consumption in electronics. Concurrently, the total cost of gold production has been increasing and Fortune anticipates that this factor will support a gold price close to the marginal cost for a significant proportion of global gold production. Fortune has selected a life-of-mine gold price based on these factors, including the total cost of production for a large number of projects, which is approximately US$1,350/oz in real terms. The cost of production has already resulted in mine shutdowns and some major gold projects, such as Pascua Lama in Chile, have been deferred, suggesting an even higher minimum price over the long-term.

Historical gold prices, to December, 2013, are shown in Figure 19.10, which reflects the lower prices in 2013.

Figure 19.10
Historical Gold Price



19.4.2 Cobalt

19.4.2.1 Cobalt Market Pricing

Cobalt metal is priced principally on the basis of the Metal Bulletin cobalt low grade (minimum 99.3% Co) and high grade (minimum 99.8% Co) quotations, and regular buyers and sellers typically establish contracts linked to the Metal Bulletin monthly average for one of the two grades. These quotations are determined by Metal Bulletin through ongoing contact with producers, consumers and traders, and are published every Wednesday and Friday, with averages at the end of each month. The prices published for low grade and high grade cobalt are given as a range between a “low” and a “high” price, reflecting the fact that individual prices do vary based on commercial factors, such as transactional quantity and specific impurity restrictions.

On February 22, 2010, a cobalt metals futures contract was launched on the London Metals Exchange (LME), followed three months later by a cash contract. The LME represents a terminal market that allows buyers and sellers an alternative to transact on the basis of cash or futures contracts out to 15 months. There are certain requirements to trading cobalt on the LME. Only cobalt metal in the form of cathode (cut or broken), rounds, ingots, granules or briquettes can be transacted; cobalt compounds, chemicals or metal powders are not permitted. The LME contract specifies only a minimum of 99.3% cobalt content, so that buyers and sellers of high grade would accordingly agree on a premium to the quoted LME price. Cobalt must be transacted in lots of 1 t, and packaging must be in drums of 100-500 kg of uniform size and weight. Finally, only LME registered brands can be traded using this platform. There were 14 registered brands approved for trading on the LME in mid-2012.

The LME cobalt contract is still relatively new and occasionally subject to illiquidity. Nevertheless, it does afford a means to employ hedge strategies or to lock in prices for future dates. Trading on the LME is daily, so that market movements are often reflected sooner than on Metal Bulletin, with its twice weekly price announcements.

Cobalt prices peaked in mid-2008 at more than US$50/lb and then dropped sharply and remained below US$20/lb through most of 2009. In 2009 cobalt prices recovered and, in 2010, typically ranged between US$20 and US$23/lb. Following the tsunami in Japan in March, 2011, however, prices drifted lower as markets adopted a wait-and-see approach to how Japanese cobalt consumption would be affected. High grade cobalt prices eventually settled down to US$16.80/lb to US$18.50/lb by late April, before a spate of buying interest from the battery and superalloy sectors sparked a brief rally, resulting a surge back to US$19.00 to US$20.25/lb by mid-May. By end-May, prices started to move downwards again and a gradual decline continued until late 2013, as a result of the global economic slowdown and reduced demand for consumer goods, as well as lower fuel prices which slowed sales of electric vehicles. Cobalt prices in late 2013 and early 2014 have begun a cycle of recovery and high grade cobalt is now trading at about US$15/lb. Fortune expects cobalt prices to return to historical averages of about US$20/lb as the global economy improves. The three-, five-, 10- and 20-year trailing average prices for 99.8% cobalt cathode quoted by Metal Bulletin are US$14.95, US$16.56, US$20.77 and US$19.31 per pound, as shown in Table 19.5. With increasing demand for cobalt in lithium-ion and nickel metal hydride batteries and the threat of supply disruption from the DRC, Fortune expects cobalt to move into a supply deficit that will support a long-term price of at least US$16/lb, with prices eventually returning to the US$20/lb level with further recovery of world markets.

19.4.2.2 Outlook for Cobalt Pricing

The marginal cost of significant cobalt production is in the range of US$15/lb, reflecting the price needed by many Chinese processors of DRC concentrates to sustain profitable operations, the approximate breakeven cost of recycling and the price required by some large producers.

Table 19.5
Three, Five, 10 and 20-Year Trailing Prices for 99.8% Cobalt Cathode
(US$/lb)

Average	Low Price	High Price	Avg Price
3 Year Trailing Average	14.36	15.53	14.95
5 Year Trailing Average	15.91	17.21	16.56
10 Year Trailing Average	20.18	21.36	20.77
20 Year Trailing Average	18.82	19.80	19.31

In the opinion of Skybeco, cobalt prices should see continued support from demand growth, while supply consolidates, primarily in the form of rationalization of excess Chinese refining capacity by late-2013 and uneconomical production of concentrates and intermediates at marginal DRC producers. While fluctuations will always be a part of market prices, longer term pricing beyond 2013 is expected to move within the range of US$15/lb-US$22/lb for 99.8% cobalt cathode metal. Falso (2014) forecasts prices over the next two years to trade in the range of US$14-18/lb, with future prices trending higher as demand for batteries continues to pick up for electric vehicles and supply constraints develop in the DRC. There are likely also to be premiums paid according to product quality and placement ranging from US$1.50-6.00/lb, particularly for cobalt chemicals that require additional processing from low grade metal cathodes. Fortune has been monitoring the prices for cobalt sulphate from producers in China and the United States over several years. Prices being charged for battery grade cobalt sulphate (minimum 20.9% Co) from these sources and monitored from 2011, when compared to the mid-point price of 99.8% metal cathode over the same period, had an average premium of 28%. Fortune expects that premiums on a go-forward basis will range from 10-20% for cobalt sulphate, with premiums realized at the high end of this range in North America and Europe and the lower end of the range in Asia. Fortune expects to have a price advantage in North America, where it will not pay import duties under NAFTA and where manufacturers will wish to have a secure North American source of supply.

19.4.3 Bismuth

19.4.3.1 Bismuth Market Pricing

Until recently, the only source of published bismuth pricing information has been trade publications such as Metals Bulletin, which is based on twice weekly price surveys. Other publications include Metals Week, Asian Metals, Metal Pages and Metals Prices. Bismuth metal is typically priced on the basis of the Metal Bulletin bismuth quotation reflecting a single grade: minimum 99.995% (4N) Bi in ingot form. Prices quoted are given for free market transactions and for domestic transactions in China, the latter given in RMB/t, and are published as a range between “high” and “low”. A monthly average of each of these prices is also published at the end of each month. Regular bismuth consumers typically establish contracts linked to the Metal Bulletin monthly average.

Recently, an electronic platform that trades bismuth, commenced operations in China and is called The Fanya Metal Exchange. With 80% of the world’s bismuth production, China has a significant influence on pricing. China’s bismuth production is being consolidated into fewer stronger companies.

In the early 2000s, bismuth prices ranged between US$3.00/lb and US$4.00/lb. However, in early 2007, prices moved upwards culminating in a high of US$17.50-19.00/lb in that year, caused by rising demand and speculative buying. This was in part attributed to the enactment of European REACH in December, 2006, which caused a structural change in the bismuth market with the banning of lead in a number of applications, including the electronics industry. In addition, China, the historical dominant supplier of bismuth, underwent a significant change in its economy during this period, whereby commodities such as bismuth were no longer dumped on the world market as a source of foreign exchange and China became a net consumer of a number of metals and commodities. A correction followed, however, and prices retreated until early 2008, when power outages and supply disruptions caused by harsh weather in China resulted in another spike by April of that year. Bismuth demand was subsequently hit hard by the worldwide financial crisis in 2008, and prices continued to drift until they bottomed out in August, 2009 at US$5.90/lb-US$7.70/lb. The period from August, 2009 to August, 2011 saw a return to stronger fundamentals, and prices moved upwards to between US$10 and 13/lb. Heavy selling in the latter part of 2011 reversed this trend.

Fortune considers that the supply and demand fundamentals for bismuth have changed significantly as a result of increased consumption, with bismuth being substituted for lead in numerous applications, prompted by environmental concerns. Consequently, the seven-year trailing average, covering the period after the structural change caused by European REACH is considered indicative of the current bismuth market. The three-, five- and seven-year trailing average bismuth prices are shown in Table 19.6.

Table 19.6
Three, Five and Ten-Year Trailing Average Bismuth Prices
(US$/lb)

Average	Average Low Price	Average High Price	Average Price
3 Year Trailing Average	9.14	9.77	9.45
5 Year Trailing Average	9.05	9.97	9.51
7 Year Trailing Average	9.97	10.88	10.42

Metal Bulletin.

19.4.3.2 Outlook for Bismuth Pricing

The bismuth market has undergone a major structural transition with the ban of lead in many markets, such as solders for electronics and piping for potable water. Manufacturers are trying to eliminate the use of toxic metals at source to enhance recycling and reduce potential liabilities from contamination of land fill sites. Fortune has selected the low end of the Skybeco price forecasts and has used US$10.50/lb throughout the life of the Project.

Although bismuth has displayed significant price swings over the past decade, the long-term outlook is generally positive. This is based on the metal’s non-toxic nature and its growing application as a substitute for lead in free machining steels, hot dip galvanizing, plumbing brasses and soldering alloys.

Demand growth for bismuth is projected to average 8-10%/y. The expanded use of bismuth in free machining steels will generate significant additional bismuth demand. Producers in China anticipate that bismuth production growth rates will fall short of such demand growth, and Hunan Jinwang has forecasted that supply from Chinese producers will grow at 5% annually.

Bismuth prices in 2011 saw steady growth from a range of US$9.20-10.20/b at the beginning of January to US$12.80-13.20/lb in mid-August and a high of US$13.50/lb in mid-September. Liquidation of surplus stocks, inherited by 5N Plus from its MCP takeover, occurred, as did higher sales by Chinese producer Shizhuyuan, one of the members of the Hunan Bismuth Industry Co. collaborative group, and this contributed to market prices drifting back to US$9.90-10.90/lb. Since the beginning of 2012, prices have mainly moved sideways posting a small uptick in February, 2012 to US$10.50-11.40/lb, but retreating again by mid-March and averaging US$9.72/lb over the year.

NICO's bismuth products will consist of bismuth ingots (99.995% min), bismuth needles and bismuth oxide. On the market, the NICO bismuth ingot should realize pricing within the Metal Bulletin "high" and "low" quotations. Ian (2014) suggests that a western bismuth producer may be able to extract a premium from the market vis-à-vis the Chinese. A Canadian producer would also be able to access the U.S. market at a price advantage because of protection from tariffs under NAFTA. Given the aforesaid factors and the influence of new entrants into the supply of bismuth to the market, Ian (2014) believes that prices will be stable to higher for the rest of the decade and trade in the range of US$8-12/lb. Bismuth needles and, particularly, bismuth oxide trade at premium prices per pound of contained bismuth.

19.4.4 Copper

Copper represents a relatively small contribution to the economics of the NICO Project. The price has been relatively stable over the past three years, ranging between approximately US$2.80/b and US$4.50/lb. A price of US$3.25/lb is used in the financial model for cathode copper. For the copper cement to be produced at the SMPP, this price has been reduced to US$2.38/lb of contained copper, to account for downstream smelting and refining charges.

19.5 RECOVERY OF METALS

The first step in the hydrometallurgical processing of the bulk concentrate will be the separation of that concentrate into individual cobalt and bismuth concentrates. The estimated recoverable and saleable proportion of each metal contained in each concentrate is summarized in Table 19.7.

Table 19.7
Recovery of Metals Contained in Concentrate

Metal	Recovery of Metal Contained in Concentrate (%)	
	Cobalt Concentrate	Bismuth Concentrate
Gold	94.7	94.7
Cobalt	92.9	92.9
Bismuth	Nil	98.9
Copper	46.2	46.2

19.6 MARKETING RESOURCES AND ORGANIZATION

With hydrometallurgical processing being undertaken in Saskatchewan, the marketing resources and organization are expected to be provided by Fortune. Fortune expects to employ one person to monitor market trends. The financial model provides for a marketing cost, using internal resources, equivalent to 1% of the gross revenue received from the sale of cobalt, bismuth and copper products.

19.7 TREATMENT CHARGES

The gold doré and the copper cement produced at the SMPP will both require further treatment to produce refined saleable products. The charges for this treatment, as reflected in the financial model, are described below.

19.7.1 Gold Refining

The following provisions have been made for the transportation and refining of doré, and the sale of gold:

- A transportation charge of C$1,000 per shipment, with an average of two shipments per month.

- A treatment and refining charge of C$0.17 per ounce of gold contained in doré, plus 0.25% of the value of payable gold.

- A payability factor of 99.75% of the gold contained in doré.

- A selling fee of 0.05% of the gross revenue received from the sale of refined gold.

19.7.2 Refining of Copper Cement

The cost of smelting and refining copper cement has been based on an indicative term sheet provided by a Canadian copper smelter. These charges have been dealt with in the financial model by reducing the net revenue received from US$3.25/lb for copper cathode, to US$2.38/lb for copper contained in cement.

20.0 ENVIRONMENTAL STUDIES, PERMITTING AND SOCIAL OR COMMUNITY IMPACT

20.1 PROJECT SITE

20.1.1 Environmental Studies and Issues

Environmental baseline studies at the NICO Project site in the NWT were initiated in 1998 and continue into 2014, in order fully to understand ambient conditions prior to development. The majority of the baseline studies were completed between 2004 and 2008, before submission of the Developer's Assessment Report (DAR) in 2012. The baseline studies covered a wide range of disciplines, all of which are discussed below.

20.1.1.1 Terrestrial Studies

The collection of terrestrial data began in and around the mine site area in the winter of 1997 (Golder 1998), and along the route of the proposed NICO Project Access Road (NPAR) in the spring of 2004. Terrestrial field studies were planned and conducted to coincide with the seasonal distribution and behaviour patterns of the wildlife, and the growth and reproductive characteristics of rare plants. A vegetation classification of the region surrounding the mine site and NPAR has been conducted, and was used to assess impacts on vegetation and wildlife habitat. Soil profiles and characteristics within the mine site area and along the NPAR were completed in 2005 (Golder 2006).

The NICO deposit is located in an area of rounded, rolling hills of moderate relief. Hilltop elevations are approximately 300 masl, while the valley bottoms and lake surface elevations are at approximately 200 masl. About 50% of the regional study area is covered by black spruce, interspersed with jack pine and white spruce. Lakes cover about 21% of the study area. Mixed woodland covers 12% of the area, with predominantly birch and aspen mixed with black spruce or jack pine. Nine percent of the area is exposed bedrock with sparse vegetation. The remainder is comprised of deciduous trees, treed bogs and fens.

Wildlife species observed in the study area include barren ground caribou, moose, black bear, wolf, wolverine, beaver and muskrat, songbirds raptors (hawks, falcons, eagles, owls), waterfowl (ducks, geese, swans) and shorebirds.

A meteorological station was installed at the NICO site in October, 2004 and the data collected have been used for air dispersion modelling, and water balance calculations. Three passive sampler and dustfall monitoring stations were also installed at site in early June, 2006. These stations have been used to assess background (baseline) conditions and monitor future nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and dustfall during construction and operation of the mine.

20.1.1.2 Hydrology and Aquatic Studies

Hydrological studies within the watershed of the mine site area were initiated during the spring freshet of 2005, and have been used in water balance calculations and site engineering designs, and to assess impacts on the receiving aquatic environment (Golder, 2006). Hydrological monitoring will occur throughout construction and operation of the mine and during closure.

Baseline aquatic studies have collected data on a number of parameters in large and small lakes and streams in the mine site area, and at major stream crossings along the NPAR. Information collected includes surface water quality, sediment quality, benthic invertebrates, lake bathymetry, fish habitat and fish presence. Aquatic work completed in 2004 for the mine site is presented in the Environmental Surveys at Fortune Minerals Ltd. – NICO Deposit Report (Golder, 2004a).

Two major drainages receive runoff from the NICO Project area. Flow from both drainages is southward into the Marian River system. The Lou Lake drainage is situated to the north and west of the proposed mine workings and includes the existing exploration camp. The Burke Lake drainage includes the proposed pit, underground workings, plant site and mine camp.

Fish have been found in all of the lakes within both the Lou Lake and the Burke Lake catchment areas, with the exception of the very shallow basin north of the open pit containing Grid Pond, Little Grid Pond and an un-named wetland area. The water and sediment in these ponds and the wetland are naturally high in arsenic and other metals and contain no fish. Fish found in local lakes include northern pike, walleye, lake trout, lake whitefish, white sucker, lake cisco, nine-spine stickleback and lake chub.

20.1.1.3 Heritage and Archaeology Assessments

Two Heritage Resources Impact Assessments (HRIA) were undertaken in the early stages of the NICO Project. The purpose of these studies was to identify, record and evaluate heritage sites for the purpose of developing appropriate avoidance or mitigation measures.

The first HRIA of proposed mining locations for a bulk sampling program under NWT Class 2 Archaeological Permit 03-942 was undertaken in 2003 (Golder, 2003b). A subsequent assessment on the proposed 50 km long, all-weather access road between the NICO site and the Lac La Martre road (NPAR) under Permit 04-963 was undertaken in 2004 (Golder, 2005). The results of the two previous surveys were verified in 2009 (Golder, 2009).

The Dogrib or Tłı̨chǫ First Nation and North Slave Métis Alliance representatives participated in the HRIAs. They provided advice about the cultural significance of any sites encountered and identified areas of cultural concern or relevant land use patterns.

Two archaeological sites were found in conflict with the proposed NPAR: KjPo-44 and KiPo-4. The Marian River portage site, KjPo-44, has been used from Pre-European contact times through to the present and is given high significance as part of the Dogrib cultural landscape. The trappers' trail, KiPo-4, is situated between Rabbit and Hislop Lakes. No cultural materials were encountered within the intersecting 100 m wide NPAR corridor. There is limited potential for large prehistoric sites within the assessed mining facility locations.

The reports conclude that no further archaeological work is needed but that continued use of the KjPo-44 portage and the KiPo-4 trappers' trail must not be impeded by construction or use of the proposed road. Fortune will be completing a heritage survey with the assistance of the Tłįchǫ Government prior to road construction, to verify the results of the Traditional Knowledge Study prepared during the DAR review.

20.1.2 Environmental Assessment

A number of concerns were raised during the course of the environmental assessment scoping sessions, community meetings and NICO site visits with elders and other Tłįchǫ citizens, including:

- Air quality during operations and closure in relation to dust generation.
- Water usage rates.
- Water quality, with emphasis on water quality post-closure.
- Aesthetics as they relate to Hislop Lake and the Marian River.
- Wildlife habitat loss, especially in relation to caribou habitat.
- Proposed closure techniques and long-term stability.

20.1.2.1 Air Quality

During operations, the results of air quality modelling predicted that SO_2 and carbon monoxide (CO) should be in compliance within the boundaries of the property and that NO_2 concentrations should be in compliance within 250 m of the NICO Project lease boundary. Particulate matter concentrations could exceed the Canadian Regulatory Air Quality Guidelines at as much as 250 m from the lease boundary on occasion throughout the year. Total suspended particulate (TSP) concentrations are predicted to exceed the applicable air quality standards at as much as 500 m from the lease boundary on occasion. These estimates, however, are conservative and there is a high degree of confidence that actual concentrations will be less than the modelled results.

A human health risk assessment was completed. It is anticipated that atmospheric emissions from the NICO Project will result in negligible changes to human health. The assessment also predicted negligible changes to concentrations in caribou and fish tissue, so that negligible changes to human health as a result of ingestion of caribou and fish are predicted.

20.1.2.2 Noise

The recommended maximum value for nighttime noise levels for undeveloped areas is 40 dBA. Modelling results show that noise predictions could slightly exceed this benchmark for mine operations, although noise predictions should be below acceptable benchmarks for the NPAR. The maximum distances for NICO Project-related noise to attenuate to background levels are 3.3 km for mine operations and 0.9 km for vehicles along the NPAR and proposed Tłı̨chǫ Road route.

20.1.2.3 Habitat

The area that will be disturbed during construction and operation is approximately 485 ha (1,200 acres), including 351 ha of uplands, 80 ha of wetlands, 33 ha of burn and 7 ha of aquatic habitat. At closure, 402 ha will be reclaimed. The unreclaimed 83 ha will include the flooded open pit, constructed wetlands, seepage collection ponds, surge pond and excavated ditches.

20.1.2.4 Water

Limited changes will be made to the natural flow of water and the Project will have small effects on water quantity. Caribou and water quality have been identified as the most important concerns related to the environment by the communities. Studies indicate that there could be some changes in the water quality of small lakes closest to the mine, but that changes in water quality caused by the NICO Project in the small area at and near the mine site will not affect the health of wildlife, or the health of people that consume wildlife.

20.1.2.5 Aquatic Environment

Although physical loss of fish habitat will result from the water intake and diffuser structures established in Lou Lake and Peanut Lake, the use of environmental design features will create new fish habitat and provide adequate compensation to offset any harmful alteration, disruption or destruction of existing fish habitat. The gains are expected from the proposed placement of aggregate and rip-rap over the pipes, since gravel, cobble and boulder substrate are key habitat features for many coldwater fish species in lakes.

Windborne dust and air emissions from NICO Project facilities will result in increased deposition of dust in the surrounding area that can settle on or be washed into creeks and lakes. Residual effects of total suspended solids from dust and particulate deposition, however, are expected to be localized in the immediate vicinity of the Project (i.e., Nico and Peanut Lakes) and temporally restricted to the weeks during and after freshet during the construction and operation phases.

A change in trophic status from increases in phosphorus concentrations is not predicted for Nico, Peanut or Burke Lakes, although nutrient predictions for these lakes show increases in nitrogen concentrations from the NICO Project discharge. Although the lakes are not nitrogen-limited, the increase in nitrogen may cause an initial summer increase in phytoplankton biomass in Nico Lake and, to a lesser extent, in Peanut Lake. These initial biomass increases are expected to stabilize after a couple of years once the lakes become completely nitrogen-saturated.

The existing water quality in the local study area includes naturally high levels of arsenic and iron in Nico Lake. With the proposed water treatment system included in the Project design, metal concentrations in water (total and dissolved) are predicted to generally remain below site-specific water quality objectives. Some exceptions include total aluminum and iron concentrations, which are predicted to exceed objectives.

It is predicted that water quality in Burke Lake and the downstream reaches of the Marian River should remain within the range of baseline conditions for TSS, nutrients and metals.

Metal concentrations are expected to be below site-specific water quality objectives post-closure.

Tolerant species (e.g., northern pike and white sucker) characterize the existing fish population assemblages of lakes in the local study area. Increased angler access from the NPAR may affect population sizes of sport fish, although angling opportunities for traditional and non-traditional users should remain within the range of existing conditions for Hislop Lake and the Marian River (i.e., the regional study area).

20.1.2.6 Soil

Most of the impacts on terrain and soil will occur during the construction phase, although activities through the life of the Project will continue to change terrain and soil distribution across the landscape.

Changes to soil quality attributed to NICO Project activities include physical, biological and chemical changes that could occur during soil storage in stockpiles, mixing of soil materials, compaction and soil erosion. The geographic extent of the impact from these activities will be limited to the Project footprint.

20.1.2.7 Vegetation

Direct impacts to vegetation from the NICO Project (including the NPAR) are local in geographic extent. The impacts to vegetation include associated changes to listed plant species, traditional use plants and economic use plants. Overall, the magnitude of impacts to plant populations and communities is expected to be low. An impact of moderate magnitude is predicted for the bedrock open conifer land cover type. Subarctic terrestrial ecosystems are slow to recover following disturbance; the duration of these changes should be long-term and the changes are predicted to be reversible within 50 to 75 years following closure.

20.1.2.8 Wildlife

Bathurst Caribou

The Project is expected to cause indirect changes to the amount of different quality habitats for the Bathurst caribou herd. These changes are expected to result from the combination of noise and other sensory disturbances from the Project, and are regional in geographic extent. Based on the estimated zone of influence from the literature, habitat quality is predicted to decrease within 15 km of the Project site, within 5 km of the NPAR, and within 1 to 5 km for other developments in the winter range. The magnitude of the reduction in good and high quality habitats caused by the NICO Project, including the NPAR, is predicted to be negligible.

The incremental impact on the energy balance of a female caribou from the NICO Project is predicted to result in a negligible magnitude decrease in the fall calf-to-cow ratio, relative to the reference condition. Cumulative impacts to the energy balance of female caribou from encountering 40 disturbance events on the winter range are also predicted to have a low magnitude impact on the fall calf-to-cow ratio, relative to the reference condition. The impact from human disturbance events on calf recruitment is expected to be continuous from one year to the next.

Impacts on the abundance and distribution of the Bathurst caribou population from changes in habitat quality, movement, behaviour, energy balance and calf production from NICO Project activities are expected to be long-term and reversible within two to three life spans for caribou (i.e., five to 10 years after closure).

It is expected that the incremental and cumulative increase in the harvest of caribou associated with improved access from the NPAR and proposed Tłı̨chǫ Road route will be within or approach the upper limits of baseline harvesting values. The duration of impacts to caribou from increased access is predicted to be permanent, as these roads will likely be maintained well beyond the temporal boundary of the assessment.

Based on the analysis of changes to habitat, female energetics, and increased access, the magnitude of changes to the harvesting potential of caribou from the incremental and cumulative impacts of the NICO Project and other developments is expected to be low and moderate, respectively. Overall, the incremental and cumulative changes from the Project and other developments are not predicted to have significant adverse impacts on the persistence of the Bathurst caribou herd.

Other Wildlife

The magnitude of incremental impacts associated with habitat loss and fragmentation from the NICO Project footprint on moose populations is predicted to be negligible. The magnitude of direct habitat impacts from the Project footprint on marten, muskrat, upland breeding birds, waterbirds and raptors is predicted to be low. Cumulative impacts of direct habitat loss and fragmentation from the Project and previous, existing and reasonably foreseeable future developments is expected to be of negligible and low magnitude for moose and other wildlife, respectively.

It is likely that woodland caribou are present in the study area, but infrequently and in low densities. Wildlife baseline studies in the mine and NPAR study areas have been ongoing since 2004, including many aerial and ground surveys in the summer and fall. During these surveys, no evidence of woodland caribou was observed. Woodland caribou tend to be dispersed and in low densities, making them difficult to detect and monitor. Fortune reports that John Mantla (Behchokö, 2003, pers. comm.), Pierre Beaverho (Whatì, 2011, pers comm.), Jimmy Nitsiza (Whatì, 2011, pers comm.) and Jimmy B. Rabesca (Whatì, 2011, pers comm.) indicated that they knew of no traditional hunting of woodland caribou in the area, and believed that they were not commonly present. Traditional knowledge indicates that woodland caribou tend to be more common to the west of the regional study area, beyond the community of Whatì (Dogrib Treaty 11 Council 2001).

It is anticipated that the NICO Project will likely alter the behaviour and movement of a few woodland caribou. However, because of the low frequency of presence and the low number of individuals influenced, the NICO Project is predicted to have a negligible effect on the population size and distribution of the herd.

Development of the NICO Project is expected to cause indirect changes to the amount of different quality habitats for wildlife populations in the region. Based on estimated zones of influence from the literature, habitat quality is predicted to decrease within 1-2 km of the Project site and other developments in the study areas. These changes are expected to result from the combination of noise and other sensory disturbances.

Overall, the NICO Project is predicted to result in negligible to low magnitude impacts on the quality habitat for moose, marten, muskrat, upland breeding birds, waterbirds and short-eared owl. Relative to reference conditions (i.e., no development), cumulative indirect impacts to habitat from the Project and previous, existing and reasonably foreseeable future developments are expected to be of moderate magnitude for moose and marten, and of low magnitude for muskrat, upland breeding birds, waterbirds, short-eared owl and other raptors.

Wildlife Health Risk Assessment

A wildlife health risk assessment was completed to evaluate the potential adverse effect to individual animal health associated with exposure to chemicals from the NICO Project. Sources of chemicals considered in the assessment include fugitive dust, air emissions, treated effluent, and surface water runoff and seepage. The potential for effects to the health of wildlife evaluated for the Project included changes in air, water, soil and vegetation quality.

Based on the calculated exposure ratios, it is anticipated that atmospheric depositions and surface water discharges from the NICO Project will result in negligible health risks to caribou and other wildlife.

Chemicals of potential concern (COPC) are anticipated to be present at low concentrations during construction and operation, and these pathways were determined to have no linkage to effects on the persistence of caribou and other wildlife populations, or continued opportunity for traditional and non-traditional use of wildlife. Caribou may be exposed to similar COPCs at other mining sites, such as historic remediated and non-remediated sites, including the Rayrock and Colomac mines in northern Canada, because they migrate. Even with the conservative assumptions made in the exposure assessment and toxicity assessment that may ultimately over-estimate risk, the potential for cumulative health effects from the NICO Project on caribou are considered negligible.

20.1.3 Socio-economic Impact Assessment

Residual impacts from the NICO Project on the economy of the NWT are predicted to be positive and significant, although the impacts on local employment, family disposable income, education and training, while positive, are expected to be less significant. Negative and non-significant residual impacts are predicted for changes to in-migration, family cohesion, use of traditional language and cultural areas. No archaeological impacts are predicted.

The NICO Project will have a positive impact on employment and business levels, as well as labour income. It will increase local and regional employment, including up to 300 annual full-time equivalent (FTE) jobs during construction, up to 270 annual FTEs during the first two years of operations, and up to 190 annual FTEs for the rest of the operations. Many of these positions will be filled by trained workers from other mines, but first preference for hiring will go to the Tłı̨chǫ communities and other Aboriginal communities.

Overall, the NICO Project will have mainly a positive impact on public infrastructure and services. Some of the improvements to public infrastructure, such as the NPAR, may continue post-closure. After the closure phase, the NPAR will no longer be required for the Project and Fortune will offer the NPAR to the Tłı̨chǫ Government. If not required, the NPAR will be closed and reclaimed by Fortune.

Fortune has decided to reduce the Project footprint and environmental impact by using the existing Whatì airport, in lieu of developing and maintaining an airstrip at the mine site. Serviceability at the Whatì airport will be improved by construction of a multi-purpose facility that can accommodate all users to load, unload and hanger aircraft, as well as facilitate the movement of Tłı̨chǫ workers to the community for job opportunities.

The Tłı̨chǫ communities have limited accommodation for non-Tłı̨chǫ peoples and it is unlikely that non-Tłı̨chǫ people will take up residence in these communities. The camp at the NICO Project worksite is also intended to reduce the possibility of in-migration.

For people working at the NICO Project, there will be a reduction in time spent with family and carrying out traditional activities. The use of traditional language may also decrease but mitigation, such as encouraging the use of traditional languages at the worksite, when safe to do so, is expected to limit this impact.

One of the recommendations from the environmental assessment for the NICO Project was that Fortune "support, during the construction and operations phases of the mine, an on-the-land culture camp in the Hislop Lake area, (k'iàgoti). The culture camp would be used by harvesters, families and the Tłįchǫ Government for ongoing traditional knowledge research, education and traditional land use activities." Fortune will work with the Tłįchǫ Government on the details of the culture camp.

20.1.4 Environmental Management

20.1.4.1 Introduction

Fortune has re-designed the Project components through the environmental assessment and consultation process to prevent, minimize and mitigate the potential perceived and real negative impacts that could be caused. A list of the commitments that Fortune has made is provided in the Report of Environmental Assessment and Reasons for Decision, dated January 25, 2013.

20.1.4.2 Tailings and Waste Rock Management

The mining process will generate a total of approximately 32 Mt of tailings and 97.8 Mt of mine waste rock. Both of these waste streams will be disposed together in the CDF. The CDF is located immediately north of the open pit mine and underground portal, in close proximity to the processing plant. The CDF will be developed on gently sloping ground (less than 1% gradient) in a sub-watershed of Nico Lake, incorporating Grid Pond, Little Grid Pond and an un-named wetland area. The design of the CDF, and the benefits of this concept of waste disposal, have been described in Section 17.1.8.

The CDF was designed to be lower than the surrounding hills to mitigate potential visual impacts from Hislop Lake. Its location was altered to avoid fish habitat. The facility will contain and limit the exposure of acid generating mine waste rock to the environment.

20.1.4.3 Solid Waste Management

The NICO Project will have a waste management and storage facility for collecting and sorting wastes, as described in Section 18.1.7.

20.1.4.4 Water Management

Fresh water for the NICO Project will be obtained from Lou Lake and treated effluent will be discharged to Peanut Lake. The water management system has been optimized in terms of internal recycling of water within the processing plant, by thickening of the tailings and by a high level of reclaim water from the CDF back to the plant. This design has resulted in water withdrawal that is about 10 times less than initially predicted in the Class A Water Licence Application, which has also resulted in reduced discharge volumes.

Waste water from sewage and grey water from the construction and operation phases of the Project will be treated using a pair of rotary biologic contactors installed in parallel, as described in Section 18.1.6.3. Except for sewage, other site water flows during construction and operation will be impounded in a reclaim pond until start-up, when they will either be pumped to the process water tank or treated in the effluent treatment facility (ETF).

During operation and possibly closure, a reverse osmosis (RO) system with a chemical precipitation ETF will be installed and operated to reduce concentrations of aluminum, ammonia, antimony, arsenic, cadmium, cobalt, iron, lead, selenium and uranium.

Fortune has prepared a draft Aquatics Effects Monitoring program to assess water quality during the construction and operation phases of the Project. Fortune has established two additional water quality monitoring stations in Hislop Lake and will add another in Behchokö, to satisfy concerns over water quality in those locations during the operation of the NICO Project.

20.1.4.5 Water Balance

The overall Project water balance has been described in Section 17.1.6. During operation, the water balance indicates that the average flow discharged into Peanut Lake will be a relatively small amount of approximately 290,000 m^3/y (9 L/h).

20.1.4.6 Intake and Discharge Pipe Management

Prior to the installation of the fresh water intake structure at Lou Lake, a Type II or Type III turbidity curtain will be installed around the construction area. Fish will be salvaged from within the perimeter of the turbidity curtain. The worksite entrances will be stabilized and on-shore silt fences will be installed to limit the introduction of sediment from the access area into Lou Lake. The intake itself will be screened according to Department of Fisheries and Oceans (DFO) Guidelines (DFO 1995). Work will be conducted outside fisheries timing windows.

The overall anticipated change in habitat units for all fish species combined, upon installation of the fresh water intake pipe, is a habitat unit (HU) gain of about 345.4 HU. The gains are expected given the proposed placement of aggregate and rip-rap over the intake pipe. The baseline studies did not find spawning and rearing habitats at the proposed intake location, but on the east side of the lake. Other areas near the outflow of the lake are more suitable for spawning and rearing fish. Thus, this intake is expected to have negligible residual effects to fish habitat and the persistence of fish populations.

The protected area of concern will form a continuous semi-circle, encompassing any trenching required for pipes and the diffuser installation. Construction work will be done during relatively dry conditions and outside restricted activity timing windows, which have been identified for NWT lakes, rivers and streams to protect fish during spawning and incubation periods.

The overall anticipated gain in habitat in Peanut Lake will be about 67.8 HU.

20.1.4.7 Watercourse Crossing Management

Some erosion control measures will be specific to individual watercourse crossings. In general, work will be done during relatively dry conditions and during an in-stream work window in late July and early August, to maximize favourable weather and minimize potential effects on fish and fish habitat. On-shore silt fences will be installed and maintained during the construction of watercourse crossings. The construction area will be isolated using cofferdams, and dewatered. Clean water from upstream will be diverted or pumped around the construction zone. Where needed, the watercourse crossings themselves will be armoured with rip-rap to limit erosion of the channel bottom. Where large bodied fish occur, cross-drainage structures will be designed so that flow volumes do not become a barrier to fish passage.

20.1.4.8 Soil Management

Best soil management practices for erosion and sediment control will be employed through the design, construction and operation phases. Actions will be taken to limit sedimentation and erosion based on water flow rates, soil characteristics, topography, climate and season of construction.

20.1.4.9 Dust and Air Quality Management

Periodic road watering will be carried out to minimize dust around the NICO site and the NPAR. In addition, the CDF will be visually monitored and the discharge pipe moved to prevent areas from drying out and producing dust.

Fortune is proposing a monitoring program for assessing impacts of dust emissions from the NICO Project on local air quality. Air quality monitoring is proposed to include sampling for TSP, particulate matter, sulphur dioxide and nitrogen dioxide. In addition, a dustfall monitoring program is proposed on the Project lease boundary, the NPAR and off-site at significant material handling locations.

20.1.5 Permitting Requirements

20.1.5.1 Regulatory Framework

The NICO Project is regulated by the Wek'èezhìi Land and Water Board (WLWB) under the Mackenzie Valley Resource Management Act (MVRMA). The MVRMA implements provisions of land claim agreements and establishes co-management boards as institutions of public government. The Tłįchǫ Government and the WLWB regulate the use of settlement and Crown land and water in their respective settlement areas.

Fortune submitted applications for a Type A Land Use Permit (W2008D0016) and a Type A Water Licence (W2008L2-0004) to the WLWB on November 5, 2008. The permit applications were referred to an environmental assessment due to the potential significant effects from the Project. The Federal Government has overall jurisdiction for the NICO Project through its management of the environmental assessment (EA) process in the NWT. Through the Mackenzie Valley Environmental Impact Review Board (MVEIRB) process, the following federal organizations are stakeholders: Natural Resources Canada, Environment Canada, Fisheries and Oceans Canada, and Aboriginal Affairs and Northern Development Canada. The Tłįchǫ Government is the First Nation government stakeholder. In addition, Industry, Tourism and Investment and the Finance Department are the territorial government stakeholders in the process.

Devolution, or the change of authority from the Canadian to the NWT government, is currently occurring. The devolution agreement was signed on June 25, 2013 and the transfer of authority is targeted for April 1, 2014. With the implementation of devolution, the Government of the NWT (GNWT) will take over decision-making power over its lands and resources, and will receive most of its revenues from hydrocarbon and mineral production. Since the NICO Project has already completed the EA process, this change will not impact Fortune's progress towards obtaining the required permits for operations.

A framework of cooperation is being developed through the proposed negotiation and execution of a Socio-Economic Agreement (SEA) between Fortune and the GNWT. The GNWT is highly supportive of the NICO Project, as it would provide employment opportunities and contribute taxes to the economy of the NWT.

20.1.5.2 Permitting Status and Compliance

The DAR was submitted in May, 2012 and, after a review process by stakeholders, the MVRB recommended to the governments that the Project should proceed to the regulatory phase of approvals, licences and permits. The Report of Environmental Assessment and Reasons for Decision was published on January 25, 2013 and details all of the conditions and commitments of Fortune. In July, 2013, the Minister of AANDC and the Grand Chief of the Tłįchǫ Government approved the Report of Environmental Assessment, with revision to Measure Number 8 regarding mitigation and management of cumulative effects on barren ground caribou, and Fortune's response to changes to Measure Number 8.

Updated Type A water licence and Type A land use permit applications were submitted to the WLWB on October 11, 2013. The Type A water licence and Type A land use permit are the two principal licences required to operate in the NWT. The public hearings for the water licence were held in February, 2014. Fortune is currently providing comments on the draft water licence. The terms and conditions of the water licence and land use permit will be determined by a number of inputs. In support of its application for these permits, Fortune has submitted a series of management plans and other documentation.

Fortune will also require a number of other permits to operate the mine. Table 20.1 and Table 20.2 provide a list of potential licences and permits that will likely be required during the life of the mine.

Table 20.1
Potential Licences, Permits, Authorizations and Approvals for Pre-Development

Authorization, Permit, Licence, Approval	Legislation	Agency	Activity
Archaeological Research Permit	NWT Archaeological Resource Act	Prince of Wales Northern Heritage Centre, Department of Education, Culture and Employment, GNWT	Annually as needed for archaeological research during any phase that research is deemed necessary
Wildlife Research Permit	NWT Wildlife Act	Department of Environment and Natural Resources, GNWT	Permit will be needed annually and long-term for each phase of the Project's life for a wildlife monitoring plan
Scientific Research Permit	NWT Research Act	Aurora Research Institute	As needed annually for aquatic and wildlife effects monitoring plans
Fisheries Research Licence	Fisheries Act	Fisheries and Oceans, Canada	As needed annually for aquatic monitoring plans

Table 20.2
Potential Licences, Permits, Authorizations and Approvals for Construction, Operation and Closure

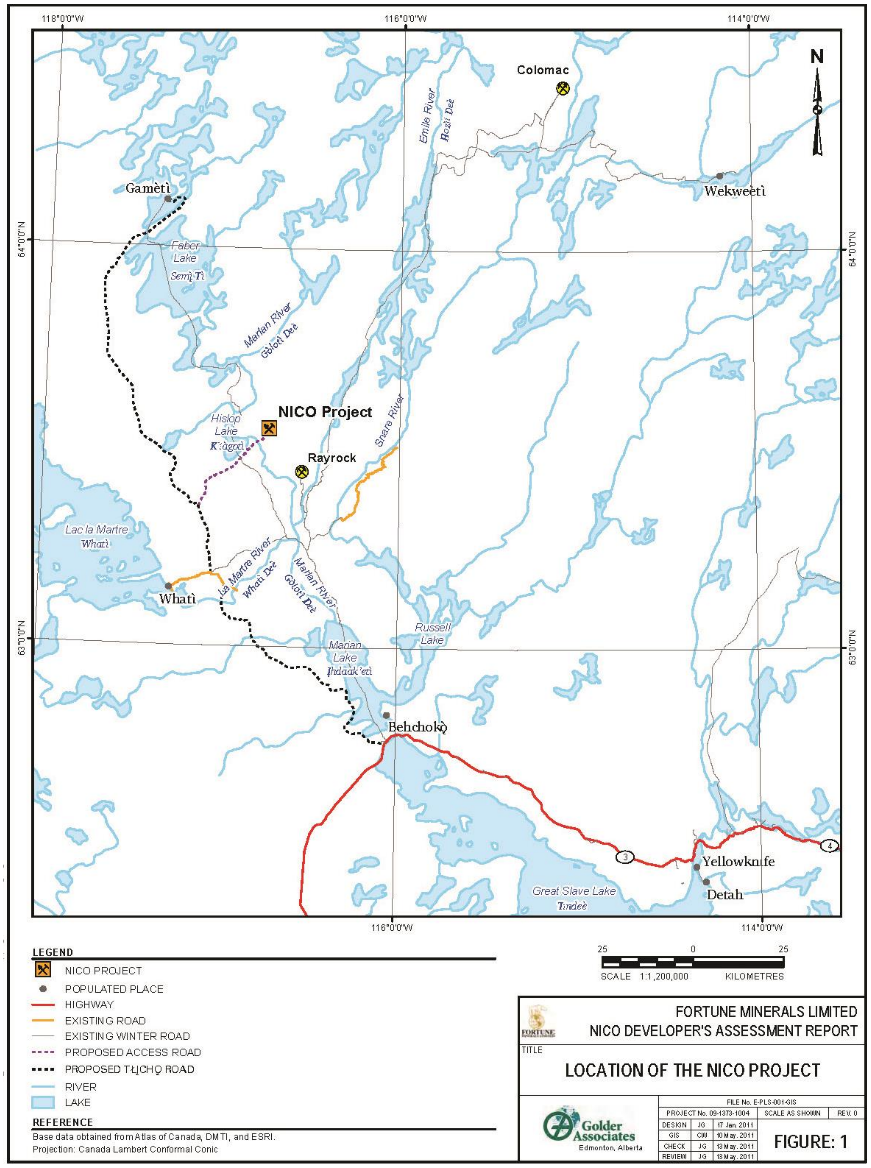
Authorization, Permit, Licence, Approval	Legislation	Agency	Activity
Land Lease Licence of Occupation	Territorial Lands Act and Regulations, Real Property Act	Indian and Northern Affairs Canada	Long-term land lease needed for all phases of the Project
Mineral Lease	Territorial Lands Act Canada Mining Regulations	Mineral and Petroleum Resources Directorate, Indian and Northern Affairs Canada	Long-term mine lease needed for all phases of the Project Initially issued for 21 years; renewable for a further 21 years
Type A Water Licence	Mackenzie Valley Resource Management Act NWT Waters Act and Regulations	Wek'eezhii Land and Water Board	Long-term licence needed for all phases of the Project for water use and discharge
Type A Land Use Permit	Mackenzie Valley Resource Management Act Mackenzie Valley Land Use Regulations	Wek'eezhii Land and Water Board	Land-based infrastructure and mine for all phases of the Project
Operations and Safety Plan Approval	Territorial Mine Health Safety Act and Regulations	Chief Inspector of Mines, Worker's Safety and Compensation Commission, GNWT	Long-term approval needed for construction and operation phases of the Project

Authorization, Permit, Licence, Approval	Legislation	Agency	Activity
Water Intake Authorization	Fisheries Act	Fisheries and Oceans Canada, Fish Habitat Management	Long-term authorization for water use needed for all phases of the Project until closure is complete
Electrical Permit	Electrical Protection Act	GNWT Public Works and Services	Electrical or electronic installations
Timber Permit	NWT Forest Management Act Mackenzie Valley Resource Management Act	GNWT Environment and Natural Resources Wek'eezhii Land and Water Board	Permit to cut timber
Quarry Permit	Mackenzie Valley Resource Management Act	Indian and Northern Affairs Canada	Long-term permit needed for all phases of mining, issued annually
Registration of fuel storage tanks	Canadian Environmental Protection Act	Environment Canada with cooperation from Indian and Northern Affairs Canada	Authorization needed for on-site fuel tank storage facility
Fisheries Authorization or Letter of Advice	Fisheries Act	Fisheries and Oceans Canada, Fish Habitat Management	At each stage of renewal of Water licence or Land Use Permit if fish habitat is harmfully altered, disrupted, destroyed or deleterious substances deposited
Approval for constructing works over waterways	Navigable Waters Protection Act	Transport Canada	Long-term authorization needed for all phases of the Project for structures across or over navigable waters
Explosive Storage and Explosive Handling Permits Detonator Storage Permits	Explosives Act and Regulations Territorial Mine Health and Safety Regulations	Department of Natural Resources Canada Chief Inspector of Mines, Worker's Safety and Compensation Commission, GNWT	Storage and use of explosives at laydown and work areas needed for all phases of the Project where explosives will be used on-site
Approval to Transport Dangerous Goods	Transportation of Dangerous Goods Act	Transport Canada	Transportation of dangerous goods by highway, barge or air subject to the TDG Regulations for all phases of the Project

20.1.6 Social and Community Aspects, Stakeholder Consultation

Fortune has a long-standing positive relationship with the Tłįchǫ Government and its people. This relationship is being formalized in an Impacts and Benefits Agreement (IBA) which has been in negotiations since March, 2013. Figure 20.1 shows the location of Tłįchǫ communities with respect to the NICO Project.

Figure 20.1
Tłı̨chǫ Community Locations



Note: The alignment to the proposed Tłı̨chǫ road shown in Figure 20.1 has been changed since this map was produced. The new alignment is shown on Figure 18.1, included previously.

20.1.6.1 Socio-economic Commitment

Fortune’s socio-economic commitment is provided as follows:

> “Fortune is committed to making a positive difference in the communities in which it operates, where its staff live, and recognizes that generating shareholder value must, at the same time, consider principles of sustainable development.”

> "Fortune's community investment mission is to promote the health, sustainability and well-being of individuals and communities where they do business. Social investments treat all people and resources with integrity and respect. To decide on how sponsorship dollars are allocated, requests for funding are reviewed on a regular and consistent basis. Decisions are based on the application's alignment with Fortune's values and commitments and an assessment of existing funding. The majority of social investment dollars are spent on education, community and the environment."

> "As Fortune moves into the operations phase of the NICO Project, there will be a need to build human resource capacity. This will involve recruiting trainers, apprenticeship support, and participating with the Mine Training Society and other partners to ensure that northern residents have access to training opportunities."

> "Fortune will take all reasonable steps to verify that its contractors and subcontractors during the construction and operation phases adopt hiring policies consistent with Fortune's commitment to hiring Northern Residents."

> "Where opportunities exist, large contracts can be unbundled to create opportunities for local contractors, subcontractors and suppliers. One of the evaluation criteria for contractor bids will be on the basis of whether appropriate commitments to hire Northern Residents are included."

20.1.6.2 Health and Safety Commitment

Fortune's commitment to health and safety is provided as follows:

> "The management of Fortune is committed to preserving the health and safety of employees, client's employees and any other personnel that interact with operations. Fortune will foster a culture conducive to reporting of unsafe acts or conditions in order that we may identify and negate those conditions before injuries occur. The Company will develop and maintain site-specific, comprehensive safety programs for the NICO Project. Fortune will emphasize proper implementation of programs and expects participation by all employees."

20.1.6.3 Stakeholder Consultations

During the community scoping sessions, meetings were held in Yellowknife (April 20, 2009), Whatì (April 27, 2009), Behchokö (May 4, 2009), Gamètì (May 7, 2009) and Wekweetì (November 2 and 3, 2009). The final Terms of Reference was issued based on the information gathered, public interest demonstrated at the community scoping sessions, and from comments provided by regulators, community governments and stakeholders. The EA review process consisted of two rounds of information requests and technical meetings held February 7 to 9, 2012.

Two sessions of additional public hearings were held in three communities in August and October, 2012.

Fortune's approach to engagement for the NICO Project was, and continues to be, based on informing potentially affected communities and land users about the Project, engaging community members in a dialogue about the Project itself and their concerns, and informing them of the potential effects, mitigation and opportunities. Fortune maintains an expressed openness to any community or meeting at any time, with the Tłįchǫ Government's consent. Fortune values the input of the elders and land users and is committed to developing the NICO Project in the most environmentally logical manner possible, taking into account the traditional and future uses of the land by the people on the land.

Fortune plans that the environmental monitoring of the NICO Project will be undertaken by either a Tłįchǫ-owned company or government agency, funded by Fortune and mandated by the WLWB.

20.1.6.4 Education, Training and Employment

The Mine Training Society (MTS) is the main organization working to upgrade the skills of Aboriginals in the NWT. The MTS has successfully trained and placed Aboriginal people into jobs, such as underground miners, mineral process workers, camp cooks, diamond drillers and mine administrators. The NICO Project presents many career opportunities. Fortune's goal is to ensure that Aboriginal people have the background and skills they need to take advantage of these opportunities, while also helping to meet the Project's business needs for personnel. Supporting MTS and other education and training programs to build workforce capacity in Aboriginal communities has been in place for several years.

Fortune will implement the following:

- Hiring preferences will be given to local northern and Aboriginal residents as part of Fortune's commitment to provide employment and business opportunities to Northerners.

- Priority will be given to the residents of Tłįchǫ communities.

- With an attractive shift roster and the proximity of the site to the homes of community members, Fortune may be able to attract already skilled and experienced Tłįchǫ workers and may also be able to recruit those who have not been able to take on rotational work due to concerns about the corresponding effects on families.

- A Tłįchǫ Human Resources Manager will be hired to lead the recruitment process from an office in Behchokö, to facilitate the ability to recruit people from the area.

- All job postings will be given to the Tłįchǫ Career Development Coordinators to give them first opportunity to source an appropriate candidate from their communities.

20.1.7 Social Management

20.1.7.1 Employment and Contracting

Fortune has adopted strategies to assist in maximizing direct employment, contracting, advancement and retention of Wek'èezhìi Settlement Area residents and other Aboriginal and northern people. General mitigation measures are:

- Fortune will be flexible with the entry requirements, where possible, and make every effort to support employees or community residents in upgrading their skills.

- Rosters may vary, influenced by the nature of the work, the level of responsibility, and the place of residence of the employee.

- A flexible shift roster, as well as the relatively close proximity of the mine, may be attractive to Tłı̨chǫ residents and potential new entrants to the labour market.

- Employees will be provided with free scheduled round-trip, work-related ground transportation from Yellowknife, Behchokö, Whatì and Gamètì. Wekweètì will be fly-in only for any employees who reside there.

Equivalent skills and qualifications will be considered when recruiting and hiring. As long as safety can be maintained, and in accordance with specific position requirements, Fortune will try to hire workers at all levels of proficiency, including pre-literate workers. Fortune will attempt to overcome these challenges by incorporating essential skills into safety training, technical training and production planning.

All contractors and employees will be expected to participate in a Cultural Awareness Training Workshop. This introductory course provides employees who participate in the program with basic awareness and skills to work in the northern environment with Aboriginal peoples and with peoples from a variety of cultures.

An Employee and Family Assistance Program will be offered to support all employees when working at the mine site, in order to provide assistance with the issues of shift rotations and the difficulties of home life.

20.1.7.2 Training

Fortune is currently making plans and preparations to begin pre-employment training. Fortune will implement the following steps for training:

- Partner with the Mine Training Society to train an Aboriginal workforce for employment at an open pit mine. Fortune also expects to develop an apprenticeship program where there are available journeyman and eligible apprentices.

- Support potential employees from the Tłı̨chǫ communities to attend Class 1 Driver Training in Fort Smith. Training will be focused on specific job skills development.

- Offer workplace orientation sessions in the community for new workforce entrants. Mine orientation will also include money management and adapting to mine lifestyle and work habits.

An Impact and Benefits Agreement (IBA) is being negotiated and will likely include measures to protect social and cultural values, as well as addressing training, employment and business opportunities.

A Tłı̨chǫ Human Resources Manager will be hired to lead Fortune's recruitment program. Opportunities will be sought for new work entrants to be further developed for more advanced or diverse roles through on-the-job training and support for educational upgrading.

Fortune will also take steps to maximize contractor employment of Aboriginal and northern residents in the NWT.

20.1.8 Reclamation and Mine Closure Requirements

20.1.8.1 Closure Plan

The overall objective of the reclamation plan is to minimize any lasting environmental impacts of operations to the extent practicable and to allow disturbed areas to return to productive fish and wildlife habitat as quickly as possible.

The conceptual closure plan will be updated during operations of the proposed mine to verify its alignment with the local cultural and traditional values and other relevant closure guidelines (such as Wek'eezhii Land and Water Board Draft closure guidelines). Fortune has already commissioned a Traditional Knowledge Study to ensure the involvement of the Tłı̨chǫ Government and Tłı̨chǫ people in the development of a closure and reclamation plan that protects indigenous values and incorporates traditional knowledge. Lessons learned from other mines in the NWT will also be incorporated in the updated conceptual closure plan.

Mine Site Closure Plan

After mining has ceased, closure and reclamation of the plant site will begin. Mobile mining equipment will be shipped off-site. Some of the construction equipment will remain on-site for up to 10 years to assist with closure of the property and the construction of the Constructed Wetland Treatment System (CWTS), but after that, it too will eventually be shipped off-site. The open pit will be actively filled with water during this 10-year period.

Where it is economic to do so, processing equipment, generators, camp trailers, pumps, valves, etc. will be decommissioned and shipped off-site for salvage. Materials with scrap value (e.g., stainless steel, copper, and possibly also structural steel) will be removed from site and sold as scrap. Buildings will be demolished and the debris will be hauled to an industrial non-hazardous waste landfill, to be established in the CDF. Equipment that cannot be salvaged or sold as scrap will also be placed in this landfill. The landfill will be covered after it is no longer required. Building foundations and slabs on grade will be left in place, punctured to allow drainage and covered with till or gravel to provide a medium for subsequent surface revegetation.

The ETF, including the pumps and pipelines and the Peanut Lake diffuser, will be decommissioned and mothballed. This system, however, will remain in place until final closure, as a contingency, in case it becomes necessary to treat any site water prior to release into Peanut Lake. Should active treatment of open pit overflow water become necessary after overflow occurs, an additional CWTS will be constructed to treat this discharge.

Co-Disposal Facility Closure Plan

Fortune intends to progressively reclaim the CDF throughout the operating life of the mine. The perimeter dyke of the CDF will be raised progressively in 5 m lifts using the upstream construction method. On every second lift, a 10-m wide bench will be provided on the exterior slopes of the perimeter dyke. After the bench is created, the previous 10- height will be reclaimed by placing a cover of soil over the slope and allowing the surface to re-vegetate. By the time the mine operation is completed, all but the final 10-m height of the perimeter dyke will have been reclaimed. This represents about 84 ha out of a total slope area of about 132 ha. Portions of the top surface of the CDF will be re-graded, covered and reclaimed after they reach their final grade. It is expected that about 50% of the total top surface area of about 40 ha will be reclaimed prior to the end of operations.

Closure of the CDF is designed to limit wind and water erosion, and effectively shed water and reduce infiltration. The selected cover design for the top surface of the CDF will comprise two layers of soil. The top portion will be a 0.5 m layer of overburden. The lower stratum will be a 0.25 m layer of sand. The lower layer will act as a capillary break, which will prevent the vegetation on the surface from taking up arsenic and other metals from the underlying tailings.

Constructed Wetland Treatment System

Seepage/runoff from the CDF will require treatment prior to release into Nico Lake. A series of CWTSs will be built to passively treat this water (approximately 50,000 to 100,000 m^3/y). The goal is to preserve the water quality of Marian River, which is the ultimate receiving system, downstream of the NICO mine site. Fortune prefers to treat the water in a passive manner with CWTSs, with no long-term operations or maintenance required after the treatment wetland has become established.

Contango Strategies Limited (CSL) of Saskatoon, Saskatchewan, in conjunction with its partners at Ducks Unlimited Canada (DUC), and Drs. John Rodgers and James Castle (of Clemson, South Carolina) has submitted a work plan to Fortune to design and undertake a series of feasibility studies to confirm the performance of a CWTS for removal of COPCs from the CDF water. CSL has reviewed the post-closure water quality predictions for both the CDF and the open pit and, based on CSL's experience in dealing with similar situations, is confident that a CWTS can be designed and implemented for treatment of water post-closure at the NICO site. Pilot studies and testing are ongoing to determine removal rates, optimal design factors, and overall footprint and cost of the potential full scale CWTS.

An indoor pilot CWTS will be built initially to identify the ideal combination of conditions, using locally sourced plants and a Northern climate, to create a water treatment system that results in the maximum removal of COPCs and best outflow water quality. Outdoor and demonstration CWTSs will then be built, prior to constructing a full-scale CWTS at the Project at the earliest feasible time.

CSL's team is confident that the Site-specific Water Quality Objectives (SSWQO) documented in the DHK can be achieved in a passive wetland treatment system.

Open Pit Closure Plan

Fortune will maintain a presence at the site while the open pit is being actively filled with water. A water intake with approved screens, pumps, power supply and pipeline will be constructed from the Marian River to pump water to the open pit. The most logical location for the water pipeline from the river to the open pit is along the NPAR access road.

It is calculated that between 10 and 14 years of active pumping (during the summer) would be required to achieve overflow. Assuming a 12-year pumping period, pumping will occur for about 10 summers and then pause, to allow time for the water to settle and to test the water quality profile in the open pit to determine if in-pit treatment should be undertaken. Experience has shown that snowmelt waters are typically very low in total dissolved solids (i.e., low salinity and low density) and generally do not mix with underlying pit lake waters. The result of this limited mixing is that freshet waters ride over the surface of the pit lake waters and are generally of good quality.

Once full, water from the flooded open pit will be allowed to flow to a settling pond before being released to the environment. Overflow from the open pit is estimated at approximately 169,000 m^3/year. Fortune regards this estimate as being conservative, on the high side. If the discharge quality of water from the settling pond is unacceptable, in-pit treatment or an additional passive CWTS may be required.

20.1.8.2 Post-closure Plan

After the closure phase (approximately 10 years after mine operations have ceased), the NPAR will no longer be required for the NICO Project. Fortune will offer the NPAR to the Tłı̨chǫ Government. If it is not wanted, the NPAR will be closed and reclaimed by Fortune.

Site roads not required for post-closure maintenance and monitoring will be decommissioned and reclaimed at the end of the closure phase.

The open pit will be allowed to fill naturally during the last two years prior to predicted overflow, to allow for settling and in-pit treatment options. The decision to build an additional CWTS specifically to treat overflow water would be made during this time period, if required.

20.1.8.3 Closure Costs and Financial Assurance

A Conceptual Closure and Reclamation Plan (CCRP) will be agreed to by Fortune and government regulators, according to the requirements of the Federal Aboriginal Affairs and Northern Development Canada (AANDC) and the WLWB. The CCRP will include an estimate of closure costs and a financial assurance or security bond will be posted, based on this estimate. The amount and form of this financial assurance will be subject to negotiations between Fortune and AANDC. The financial assurance will be to cover the projected costs of closure and reclamation of the NICO Project. The financial assurance or bond will be held by the Federal government through AANDC.

Total closure costs are currently estimated at C$48 million for this Feasibility Study.

20.2 SASKATCHEWAN METALS PROCESSING PLANT

The following environmental and socio-economic description, impact assessment and mitigation plans are based on the Environmental Impact Statement (EIS) document for the SMPP prepared by MDH Engineered Solutions Corp. (MDH), on behalf of Fortune. On February 11, 2014, the Saskatchewan Minister of Environment issued a decision approving the construction and operation of the SMPP.

20.2.1 Environmental Studies

20.2.1.1 Hydrology Assessment

The proposed SMPP is situated within a non-contributing drainage area, Rice Lake watershed, in a semi-arid region of the Canadian prairies. The Rice Lake watershed is a sub-basin of the North Saskatchewan River watershed. Delineation of regional and local drainage basins was completed using Digital Elevation Models (DEMs) for the SMPP location. Based on the drainage basins, regional and local study areas with an approximate 40 km and 4 km radius from the SMPP site were identified. The North Saskatchewan River, the South Saskatchewan River and Rice Lake are the dominant hydrological features within the regional study area. The dominant surface drainage direction of the area within and around the proposed SMPP site is in a southern/southwestern direction towards Rice Lake. Intermittent streams and wetlands are also present.

Data from the Saskatoon climate station (approximately 24 km southeast of the SMPP site) was used to represent climatic conditions for the study area (Environment Canada, 2010). The average annual precipitation in the study area is approximately 350 mm, with 27% occurring as snowfall. Based on Intensity-Duration-Frequency (IDF) curves at the Saskatoon climate station, the potential extreme runoff contribution varies from 16 mm to 93.6 mm for 1 hour and 24 hour duration rainstorms, with corresponding rainstorm return periods ranging from 2 years to 100 years. Annual potential evaporation is approximately 900 mm within the regional study area.

Significant runoff events occur in the spring (as snowmelt) and early summer, during high intensity rainfall events. To assess the runoff contribution of the watersheds in the study area, stream flow data of the nearby major hydrologic features, rainstorm data, land use and soil characteristics were examined. Land use around the SMPP area is a mixture of annual cropping, hayland and wetlands. In addition, the regional soils have poor infiltration capabilities. Runoff estimation was carried out using the SCS-CN method. The runoff contribution varies from 0 mm to 31.4 mm for 1 hour and 24 hour duration rainstorms, with corresponding rainstorm return periods ranging from 2 years to 100 years.

An estimated gross drainage area of 22.2 ha was identified north, east and west of the proposed SMPP site. This drainage area flows towards the proposed perimeter ditches of the process residue storage facility (PRSF), under post-development conditions.

Although intermittent streams and wetlands are present within and around the regional study area, the proposed development location is at a significant distance from any major hydrological feature. No continuous and defined watercourses were identified in the study area. Most of the area located within and around the proposed SMPP site does not contribute to the regional runoff of Rice Lake or the North Saskatchewan River; rather the runoff flows into local wetlands.

20.2.1.2 Air Quality Assessment

Dustfall monitoring was conducted around the proposed SMPP site to collect ambient dustfall levels for analysis of deposition rates of settleable particulate matter. These baseline data can be used for comparison once the SMPP is operational. Monitoring was conducted in the spring, summer and fall of 2010 and in the winter of 2011 to measure the quantities of dust deposited at seven locations near the SMPP site. The locations were selected according to dominant wind directions, proximity to an adjacent rail line and the desire to minimize disruption to agricultural activities.

The results of the dustfall analysis were compared to the recreational objective (30 day average, 53 mg/100 cm^2) from the Alberta Ambient Air Quality Objectives and Guidelines (2010). This objective was used as a reference since there is no comparable objective in the Province of Saskatchewan. The results indicate that the majority of the measurements are below the recreational objective and all of them are well below the industrial objective of 158 mg/100 cm^2 (30-day average).

20.2.1.3 Noise Assessment

A noise impact assessment (NIA) was completed to assess the noise effects associated with the operation of the proposed SMPP. The Alberta Noise Control Directive (AUB, 2007) was used as a guideline for the completion of the NIA, as Saskatchewan does not currently have guidelines to conduct a noise impact assessment.

The noise assessment included baseline sound monitoring at four locations surrounding the SMPP site, determination of the expected noise emission sources from the SMPP, noise modelling to predict the sound propagation from those sources and the resultant sound levels at the receptors, and a comparison of those levels to the Permissible Sound Levels (PSLs), according to the AUB guidelines. Monitoring was conducted in the spring, summer, fall and winter to collect baseline data to characterize the existing noise environment around the site. The captured data were analyzed to determine the baseline daytime and nighttime Comprehensive Sound Levels (CSLs). Wind speed and direction were monitored simultaneously and the resultant wind roses were developed.

20.2.1.4 Soil

The SMPP Project area is located in the Waldheim Plain, a physiographic subsection of the Saskatchewan Rivers Plain, the “second prairie steppe”. It is comprised of undulating to gently rolling, shallow, sandy and silty glaciolacustrine plains and glacial till plains. The Waldheim Plain has no external drainage, with some drainage flowing to large internal lakes.

The Oxbow Association is the dominant soil type in the SMPP area, with the Meota Association also present. Soils of the Oxbow Association have developed on medium to moderately fine textured, moderately to strongly calcareous, unsorted glacial till. Soils of the Meota Association have developed on coarse to moderately coarse textured, slightly to moderately calcareous, sandy glacio-fluvial and lacustrine deposits. Both soil associations consist of a group of Chernozemic Black soils formed under grassland vegetation.

In the SMPP location, the Oxbow Association is dominantly Orthic Black soils, with significant Calcareous Black Chernozemic soils. Most Oxbow soils are considered to have a Class 3 agricultural capability, because of moderately severe growing limitations due to low moisture holding capacity. The limitations of Class 3 soils restrict the range of crops or require special conservation practices.

The soils of the Meota Association in the area are Orthic Black Chernozemic soils, underlain within 1 m to 2 m of glacial till, with a sandy loam texture. They are the most suitable agricultural soils of the Meota Association, in land capability Class 3, with moderately severe limitations.

20.2.1.5 Terrestrial and Aquatic Resources

The proposed SMPP is located in the Aspen Parkland Ecoregion of the Prairie Ecozone. Regionally, wheatgrasses and speargrasses are the dominant grass species, intermixed with blue grama grass on the upper slopes and rough fescue and Hooker's oat grass on the lower slopes. Trembling aspen is the dominant tree species and is typically found around wetlands. Aspen bluffs generally have an undergrowth of western snowberry, prairie rose, Canada violet, smooth aster and showy aster.

Upland habitat supports a variety of wildlife, including white-tailed deer, mule deer, moose, coyote, red fox, striped skunk, white-tailed jackrabbit, porcupine and Richardson's ground squirrel.

Bird species in the upland habitats include savannah sparrow, horned lark, western meadowlark, American robin, song sparrow, house wren, mourning dove, black-billed magpie, American crow, great-horn owl and red-tailed hawk.

Wetland habitat in the region is dominated by shorebird and waterfowl species, including redwinged blackbird, yellow-headed blackbird, Canada goose, mallard, blue-winged teal, northern shoveler, green-winged teal and gadwall. These birds use the wetlands in the region for breeding and staging areas.

20.2.1.6 Biological Assessment

The assessment of biological resources for the SMPP site was conducted in June, August and September, 2010 (MDH, 2011, Volume II - Appendix O). It comprised a mix of wetland and cropped areas, previously seeded rail and roadside rights-of-way, an abandoned homestead, aspen groves and shelter belts.

The protocols recommended by the Saskatchewan Conservation Data Centre (SKCDC) for rare flora surveys were followed. The survey was conducted by a qualified biologist with a background in plant taxonomy, experience as a field botanist, and knowledge of local flora and regulations regarding rare species in the area. The survey identified all species within the study area.

A total of 115 plant and 20 wildlife species were identified within the study area, which extended beyond the location of the SMPP and included biophysical features in the surrounding landscape. The SMPP site will comprise of approximately 80 ha of the 194 ha examined in the study area. No patches of native grassland vegetation were observed within the proposed SMPP footprint.

No rare or uncommon plant species or federally or provincially tracked animals were observed in the study area.

There were temporary and seasonal wetlands within the SMPP area. The wetland type is based on the community structure of the zones of vegetation surrounding the wetland, which are closely related to water permanence. All wetlands within the study area were shallow (<2 m) and had no surficial drainage or inputs to larger water bodies. The wetlands appear to only have a local surficial connection to each other within the topographical confines of the landscape; therefore, there is very little to no potential for fisheries habitat.

20.2.1.7 Heritage Resources

The location of the SMPP was screened by Western Heritage to identify the existence of historic records and the potential for heritage features at the site. This screening also determined the need for, and scope of, a heritage resource impact assessment (HRIA).

A heritage screening report for the SMPP area was completed (MDH, 2011, Volume II, Appendix Q).

A historical overview of the area indicates no evident historical features. Township maps from 1885 and 1903 show that there are no trails, telegraph lines or other historic features to indicate prior use of the area. A historic trails map also served as a source of historical data. The Encyclopaedia of Saskatchewan was examined for the location of First Nations Residential Schools in the region. There are no known residential schools in the Langham and surrounding area.

The TPCS Developer’s Online Tool indicates that any of the quarter sections planned to be used by Fortune are not considered to be heritage-sensitive. The results from Online Tool indicate that it is not necessary to submit the site to the Heritage Resources Branch for further screening. Furthermore, the screening of the SMPP area by Western Heritage did not indicate the presence of known cemeteries. There are three homestead records in the three quarter sections of the SMPP. There are no recorded archaeological sites in direct conflict with the proposed SMPP.

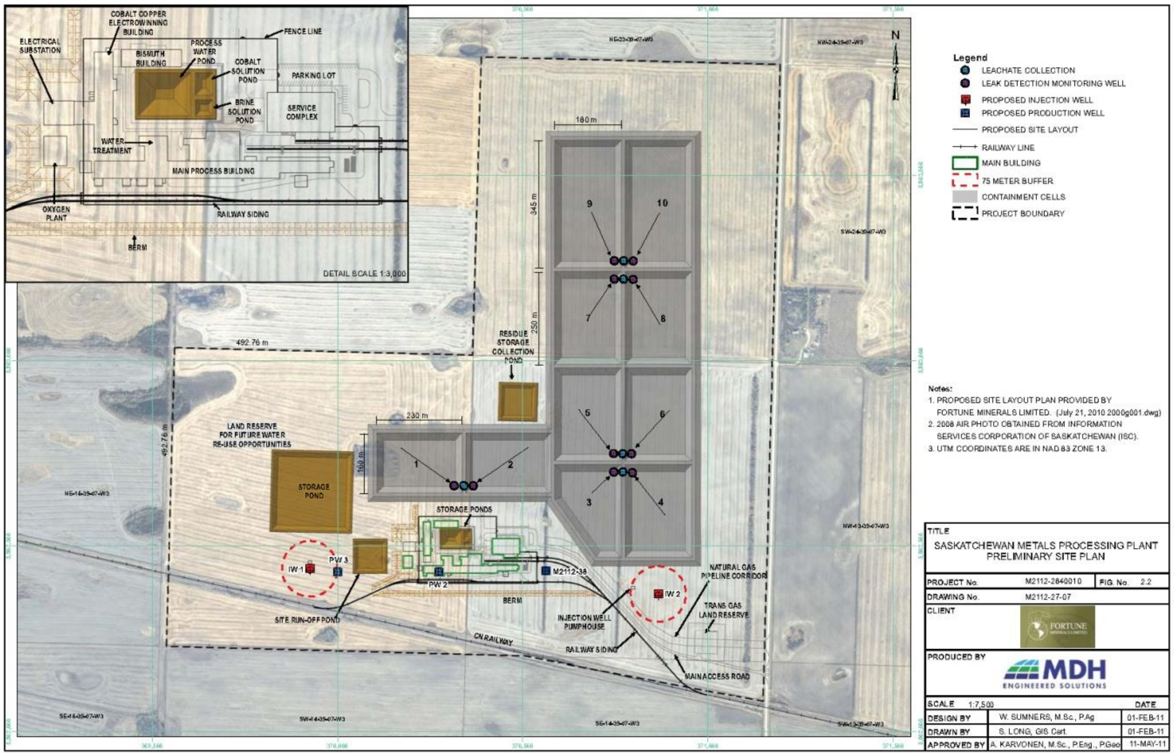
20.2.2 Environmental Assessment

A significant amount of work has been completed by, and on behalf of, Fortune to study the surface and subsurface environment, develop conceptual containment designs, and create environmental impact mitigation plans for the SMPP, the site layout for which is shown in Figure 20.2.

20.2.2.1 Groundwater

Effects on groundwater due to the SMPP have been assessed according to baseline data collection, analysis and detailed modelling studies. Hydrogeologic drilling, instrumentation and testing programs were combined with numerical modelling to determine impacts to the groundwater in the major aquifers beneath the proposed facility.

Figure 20.2
SMPP Site Plan



Three-dimensional groundwater flow modelling was completed to determine the long-term effect of pumping of the Upper Floral Aquifer (e.g. the Dalmeny Aquifer) on surrounding users. The anticipated water requirements of the facility were 50 m^3/h for long-term pumping and 80 m^3/h during the initial 24 hours. Due to changes to the water management strategy and other refinements assessed after the pilot plant studies were completed in April, 2012, Fortune has been able to reduce the fresh water intake requirement for the SMPP to 36 m^3/h (MDH, 2013). This is a 35% reduction and is at a level where changes to the aquifer will be very localized, if they occur at all.

A numerical model simulated historic and assumed future water production by Langham (287 m^3/d) and proposed water production from the original Fortune estimate (1,200 m^3/d). The summary and conclusions of the modelling are as follows:

- Under both scenarios (two-wells or three wells at the SMPP site), unconfined conditions remained within the site boundary and in the vicinity of the pumped wells. Unconfined conditions are present at the Langham site before production of water by the SMPP.

- After 18 years of continuous pumping from the Upper Floral Aquifer, the maximum drawdown simulated at the closest third party well (No. 52078) was <4 m.

- Using a two-well array appears to be slightly better than using a three-well array, based on the proximity of the westernmost Fortune well to No. 52078. The easternmost Fortune wells should be used, with the westernmost well used as a back-up.

- Continued production at Langham results in continued drawdown and a simulated expansion of unconfined conditions in the aquifer.

- The aquifer recovers to within 2.2 m to 2.3 m at the SMPP site under both scenarios. Recovery at the site is muted by continued water production by Langham.

- It is noted that variability in aquifer yield and pumping rates with time will affect the amount of drawdown and degree of interference between active wells over time.

The results of the modelling indicate that use of the Upper Floral Aquifer as a water source for the facility will have minimal impact. Given the available confined head in the Upper Floral Aquifer (approximately 8 m) in the vicinity of the SMPP site, coupled with a maximum predicted drawdown of <4 m at the closest third party water well after 18 years of continuous pumping from the SMPP well field, any impact to third party users of this resource by the SMPP can likely be mitigated by lowering the respective pump assemblies.

20.2.2.2 Solute Migration from the Process Residue Storage Facility

A two-dimensional coupled groundwater flow and solute transport simulation was conducted to evaluate the engineered containment system proposed for the PRSF, over a period of 500 years.

The purpose of this analysis was to identify relative breakthrough times through the leak detection layer and underlying tills, under both normal and high water table conditions. SNC-Lavalin (MDH) has been contracted to evaluate the impact of leakage from the residue storage cells, through the composite liner, on the natural hydrogeological system. Previous modelling (MDH, 2012) was completed for a potentiometric surface within the aquifer at 11 metres below ground level (mbgl). EAB requested that Fortune complete additional modelling using a potentiometric surface within the aquifer at 2 mbgl.

A two-dimensional flow model was used to evaluate the composite liner performance when the hydrostatic level with the aquifer (receptor) is above the water level in the equivalent residue storage cell. The Geo-Studio 2007 codes SEEP/W and CTRAN/W were used to complete a transient finite element fluid flow model, combined with multiple single-species finite element transport models.

The transport models account for advection, dispersion and adsorption for chemicals of possible concern (COPC). Initial steady-stage simulations were conducted to determine the location of the potentiometric surface. Transient numerical simulations were conducted to estimate the spatial extent of source migration and the breakthrough time to the Upper Floral

Aquifer, which is located approximately 19 m below the base of the residue storage cells. All simulations assume that the leachate collection system is not in operation; that is, no leachate is removed when concentrations exceed MAC at the leak detection layer.

The additional modelling was completed using the same water and transport properties as the previous modelling (MDH, 2012), but used a potentiometric surface within the aquifer located 2 mbgl. Comparison of the results to the previous modelling shows no appreciable difference in the movement of As, Mo, Ni, Sb and Se. This study provides evidence on the benefits of using a geomembrane liner, with respect to leachate species migration from the PRSF. The results indicate that the composite liner reduces infiltration from the residue storage cells into the environment, thus influencing the impact of the SMPP on the Upper Floral Aquifer over a 500-years of simulation. The maximum distance travelled by these COPC is less than 5 m below the base of the liner. Activation of the leachate collection system, not considered in the modelling, would probably intercept most of this source within the composite liner.

20.2.2.3 Deep-Well Injection

The Saskatchewan Ministry of Environment (MOE) specified that the EIS should include a deep-well injection model to assess the capacity for disposal. An analytical model was used to investigate the capacity of the Mannville Group disposal horizon, during the operation of the facility. The modelling work established that the disposal horizon is capable of accepting the predicted brine volume of 26.8 m^3/h from one injection well for the operational period of the SMPP (18 years). Due to potential changes to the design and other refinements assessed after the pilot plant studies were completed in April, 2012, Fortune has been able to reduce the injection rate for the deep well for the SMPP to 11 m^3/h (MDH, 2013). This is a 60% reduction in the rate of injection.

Following discussions between Fortune and the Saskatchewan Ministry of Economy (ECON), the Souris River Formation is now the proposed disposal horizon for the brine solution, due to concern expressed by ECON over the use of the Mannville Group.

There is no borehole information available for the Souris River Formation in the vicinity of the SMPP site. The general lithology of the Souris River Formation suggests a potential range of hydraulic conductivity between 10^{-6} and 10^{-13} m/s. Regionally extensive areas of the Souris River Formation with hydraulic conductivities in the range of 10^{-6} to 10^{-7} m/s would be suitable for the design disposal rate from the SMPP of 296 m^3/d, but the conductivities at the formation in the vicinity of the SMPP have yet to be confirmed by drilling.

In the Saskatoon area, the Souris River Formation is approximately 180 m thick, and is located at a depth of approximately 720 metres below ground level (mbgl). Waters of the Souris River Formation are typically of the sodium chloride type, with TDS concentrations ranging from 5,000 mg/L to more than 200,000 mg/L. In the Saskatoon area, the TDS are estimated to be between 200,000 and 300,000 mg/L, well above the expected TDS of the liquid waste stream from the SMPP.

Injection wells are designed with multiple barriers of protection to prevent brine inflows to fresh water aquifers, such as the Dalmeny Aquifer, and the stratigraphic units overlying the Souris River Formation. Protection of the shallow formations is achieved using multiple cemented outer casings with internal concentric tubing, which carries the injected fluid. For corrosive injection fluids, the annulus between the casing and the tubing can be filled with a slightly pressurized inhibiter fluid, which both acts as a leak-detection mechanism and protects the outer casing from corrosion.

Continuous monitoring and annual testing assures that the integrity of the well is maintained.

20.2.2.4 Surface Water

No impact of surface water outside the property boundaries is anticipated as a result of the SMPP development. The proposed development does not intersect any watercourses; therefore, a surface water diversion structure is not expected to be required. No regional flood plains were identified that may cause flooding within the site area.

The SMPP is also not anticipated to have an impact on the flow or water quality of the North Saskatchewan River, Rice Lake or other creeks and rivers in the area. No surface contaminants are expected to be released into the surrounding natural drainage basins. The use of an engineered storm water collection system and proven spill containment procedures will ensure that there is no contaminant release. Any gas and diesel fuel, oils and oil-filled transformer stations at the SMPP site will be stored within separate secondary containment areas.

20.2.2.5 Biological Resources

The cropland, treed, homestead and right-of-way habitats have previously been impacted by agricultural uses and/or land clearing; therefore, no mitigation is recommended for these habitats.

As a result of increased precipitation throughout the province in 2010, several wetlands that are normally dry in the fall continued to have surface water. This may instigate the transition of wetland types at the SMPP site, such that additional wetlands are found there. This was observed at the site during the fall surveying. A pre-construction survey of the wetlands at the site may be required to provide the most accurate wetland extent. This survey would involve the complete characterization of wetlands, including their class, areal extent, depth, vegetation and surrounding upland vegetation.

The impacts to the North Saskatchewan River are negligible, as the wetlands within the study area have no direct surface connection to the river. The potential for fisheries habitat in wetlands within the study area is also negligible. Reduced water depths, a lack of a direct connection to fish bearing waters and barriers to migration have diminished the potential for fisheries habitat.

20.2.2.6 Heritage Assessment

No heritage resources were identified at the SMPP site, as understood under the Heritage Property Act (1980) of Saskatchewan. The screening results indicated that the SMPP is not heritage sensitive and, according to the TPCS Online Tool, it is not necessary to submit the development of the SMPP to the Heritage Conservation Branch for screening and no mitigation for heritage resources at the site is required.

20.2.2.7 Air Quality

An air dispersion modelling (ADM) to estimate pollutant concentrations (or ground level Point of Impingement (POI) concentrations) for air emissions from the SMPP has been completed. The estimated POI concentrations, beyond the property boundary, were added to background air quality data and compared with Regulatory Ambient Air Objectives (RAAOs), to determine if the proposed development requires any additional mitigative measures.

Alberta ADM guidelines (AENV, 2009a) were used, as Saskatchewan has no specific ADM guidelines for industrial developments. No monitored background data were available for the SMPP location, and background air quality data from air monitoring stations in nearby Saskatoon were acquired from NAPS (2010) and WISSA (2006).

The air dispersion modelling results are summarized below:

- The estimated concentrations of $PM_{2.5}$ and Co (combined with background data) beyond the property boundary are lower than regulatory ambient air objectives.

- As the proposed development is located in a rural area and the available background air quality data were taken from the largest city in the province (Saskatoon), background air quality at the SMPP site will have lower total concentrations of air pollutants.

- RAAOs for one hour and annual averages for the pollutants $PM_{2.5}$ and Co were not available, but the estimated concentrations for the facility emissions are not expected to be significantly high.

- Dominant greenhouse gases (GHG) from the proposed facility include CO_2, water vapour and NOx. The GHG emission rates and the corresponding concentrations from the facility are not expected to have significant impact on regional/global GHG levels.

- Sulphur dioxide (SO_2) emissions from the proposed facilities will be minimal and are not expected to cause any significant impacts on the environment or human health.

The Project air emission control measures include baghouses, demisters and scrubbers with single and double stages.

An Emergency Response Plan (ERP) will be developed with mitigative measures for potential emissions that occur accidently and may cause significant impact to the environment and human health.

20.2.2.8 Dust

The dust emissions from the activities at the SMPP will result in the deposition of some airborne dust out of the atmosphere. The main dust generation sources will likely be from wind erosion and the movement of vehicles and large equipment on site. There could also be some fugitive dust emissions from the transport of the process residue to the PRSF and the placement of the residue in the containment cells. Due to the larger particle size and high gravitational settling velocity, however, dustfall will be deposited near the source and, therefore, it is not expected to be dispersed far from the SMPP site.

Dust control mechanisms will be implemented as needed. For any gravel roads, dust suppression will be carried out if necessary.

20.2.2.9 Noise

Permissible Sound Levels (PSLs) determined for each receptor location were compared to the ambient sound levels, plus the expected development sound level from the SMPP, to determine the potential noise impact.

The results of the noise impact assessment indicate that the daytime limit is below AUB guidelines at each of the receptor locations, and that the PSL for nighttime is exceeded slightly at two sites. Since actual noise levels are expected to be lower than those predicted in this study, due to the worst case modelling inputs, further noise monitoring will not be completed at this time.

Given the existing noise emissions within the SMPP area from agricultural, rail and road maintenance activities, wildlife is expected to have become habituated or tolerant to increased noise and activity levels.

20.2.2.10 Roadways

Based on the SMHI Design Manual and limited traffic information, it is expected that a left-turn lane will be required for eastbound traffic on Highway 305 to access the proposed plant site. A flared intersection at the intersection of Highway 305 and Schultz Road will be constructed.

As no impacts to Highway 16 are expected, no mitigation for Highway 16 is recommended, at this time.

20.2.2.11 Cyanide Usage and Transportation

Fortune is committed to the responsible management of cyanide and will be using The International Cyanide Management Code (ICME, 2011). This code is a voluntary initiative administered by The International Cyanide Management Institute to enhance the protection of human health and reduce the potential for environmental impacts.

The code is comprised of nine broad principles which cover all aspects of cyanide production, transportation, storage handling and use. These principles are followed by standards of practice to identify performance goals and objectives to comply with each principle. Principles and practices applicable to cyanide production and transportation are included in separate verification protocols and, in order to receive certification under the code, facilities must ensure that suppliers and transporters adhere to them.

Even though there is no precedent for a catastrophic release of cyanide, procedures will be in place to contain and clean up any release to the environment.

20.2.2.12 Climate Change

Climate change research related to Saskatchewan generally refers to the prairies as a region. Due to the uncertainty of climate predictions, it is not possible to predict accurately how climate change will impact the region surrounding the SMPP site.

Changes in the climate of Saskatchewan could potentially impact the hydrology of the area surrounding the SMPP site. Decreasing runoff as the result of lower precipitation and increased temperatures could impact surface water supplies and groundwater recharge. Extreme weather events, as well as increased fluctuations and changes in the temporal distribution of precipitation, would also have an impact on the local hydrology. It is unlikely, however, that the effects of climatic change could have any significant impact on the SMPP throughout its operating life of approximately 20 years.

20.2.2.13 Regional/Cumulative Assessment

The cumulative effects of the proposed SMPP are positive, when considering the benefits of the development. The SMPP will process metal concentrates from the NICO mine and be part of an operation that permanently employs 85 people in Saskatchewan and up to 250 employees in NWT.

The design of containment facilities and the implementation of proven spill clean-up procedures will limit potential environmental impacts. Waste residue materials will have long-term storage within a dual lined containment facility, with a leak detection and leachate collection system. The proposed development is not expected to release any surface contaminants into the surrounding natural drainage basins and, therefore, to have no impact to surface water outside the boundaries. Extensive environmental monitoring will be in place to identify any potential impacts to nearby surface water features and subsurface contamination at the SMPP site. Procedures from transportation companies are in place to reduce the potential for accidental spills associated with transporting the metal concentrate and chemical reagents to the SMPP facility and to provide effective clean-up, if necessary.

The residual impacts of the proposed development are considered to be low or minor.

20.2.3 Socio-economic Impact Assessment

20.2.3.1 Characteristics of the Area

The predominant land use in the area is agricultural (limited crops, cattle grazing and poultry), with widely spaced farm dwellings. There are 90 third party domestic groundwater wells within 4.5 km radius of the SMPP, including 20 wells within the town limits of Langham. An additional 19 wells were identified during the site visits, for a total of 109 domestic wells in the area (MDH, Appendix K, 2011).

The town of Langham is the closest community to the proposed SMPP and is located northwest of Saskatoon on Highway 16. The town has a population of just over 1,100 and is located approximately 2.5 km west of the SMPP site. The town of Dalmeny is located on Highway 305, approximately 9 km southeast of the site and has a population of approximately 1,500.

Given the site's proximity to Saskatoon, Highway 16 will not experience any significant traffic increase due to the employees and contractors coming to the site. According to SMHI (2008), the average annual daily traffic on Highway 16 from Saskatoon to Langham is 6,960 vehicles. It is expected that approximately 25 to 30 cars will travel to the plant at shift change and that reagents will be delivered to the plant by railcar.

20.2.3.2 Employment and Suppliers

The SMPP is expected to employ 100 people over a 20-year period, based on the anticipated life of the NICO deposit. The SMPP will generate significant taxes annually for the provincial and local governments. The potential for custom processing and metals recycling could extend the life of the facility and provide increased revenues and employment over a longer timeframe. Capital investment in the plant is estimated to be in excess of C$200 million and construction is anticipated to commence upon receipt of the NICO mine permits and financing for the overall NICO Project. Sourcing of construction and operational supplies and servicing will be preferentially reserved for local and/or provincial suppliers, except when speciality materials or services require interprovincial, national or international suppliers. It is estimated that the SMPP Project will require a maximum of 400 workers for approximately 18 months of construction for the site facilities.

The communities surrounding the SMPP will experience growth to support the new families moving to the area for employment, and local businesses (particularly hotels and restaurants) will benefit from contractors working in the area during construction of the SMPP.

20.2.3.3 Local Community

Fortune is committed to ensuring positive relations with the surrounding community. The company has conducted noise, dustfall, and aquifer drawdown testing to determine any necessary mitigative measures. Fortune has also conducted a baseline study of all third party wells within a 4.5 km radius of the site. As part of the study, staff from Fortune visited and interviewed all the well owners and submitted water samples to an accredited laboratory for testing. Aside from the deep-well injection of waste water into the Souris River Formation and possibly surface runoff from capped PRSF cells, no other water is planned to be released to the environment. Fortune has held town meetings regarding the SMPP and hosted open houses in both Langham and Dalmeny, with a presentation about the proposed development.

20.2.4 Environmental Management

20.2.4.1 Process Residues

Waste residues from the recovery of metals will be deposited in an engineered facility with primary and secondary containment, the PRSF. All solid waste residue streams will be filtered to maximize water recycling. There will be three residues which will require long term storage on site:

- Washed residue from the acid leach recovery of cobalt and gold cyanidation.
- Copper re-leach iron/gypsum residue from the recovery of copper.
- Iron-arsenic precipitate solids from the bismuth CLER circuit.

20.2.4.2 Water Recycling and Treatment Processes

Fortune will employ several methods to maximize the amount of aqueous solution that can be recycled at the SMPP. Within each unit operation, solid-liquid separation is used extensively to recycle water for reuse. The water treatment system will be comprised of media and cartridge filters for removal of suspended solids, and an RO unit. The RO treatment will remove chlorides from the water for reuse in the autoclave plant and will minimize corrosion. The permeate from the RO unit will be pumped directly back to the process water tank.

Sodium hydroxide will be used to precipitate any soluble metals in the RO effluent in two brine treatment tanks. The tank discharge will be pumped to a sediment thickener for separation of any precipitated solids. The precipitated solids will be recycled back to the SMPP. Thickener overflow will be combined with the cyanide destruction tank discharge and the high chloride brine from the bismuth CLER process. The combined brine streams will then be disposed of by underground injection into the Souris River Formation. This injection stream will be the only liquid effluent produced by the SMPP requiring deep-well disposal.

20.2.4.3 Building Containment

Each building at the SMPP will be constructed to contain any and all spilled materials. Each tank will have a sump pump located nearby and any spilled material will be washed into the sump and deposited back into the tank. Spill cleanup kits will be located throughout each building and will be used to contain any larger spills. A fire extinguishing system will be installed in each building, with water being supplied by the process water pond. Hand-held fire extinguishers will also be located in the buildings according to fire protection codes.

20.2.4.4 Process Emissions

The proposed SMPP facility will have air emissions from 25 stack sources, vehicles used during construction and operation, and an emergency diesel generator.

20.2.4.5 Process Residue Storage Facility

The PRSF will be used to permanently store process residues generated from the SMPP. It is expected that approximately 158,000 t of residue will be produced each year. The PRSF will be an engineered containment facility, designed to minimize the potential impact to the surrounding environment. The PSRF will be directly north and northeast of the proposed plant site. There is sufficient land to allow for a sizable buffer zone around the PRSF.

A "dry tomb" approach was selected for containment and long-term storage of the SMPP residue, such that each cell is constructed above the groundwater table and capped with a "store and release" engineered cover system after being filled with residue. A 0.5 m freeboard allowance in the containment cells will be in place prior to construction of the cover system. This cover system will control dust, limit water and oxygen ingress, and support vegetation. "Store and release" covers may consist of single or multiple soil layers with a vegetated cover. The cover soil acts to store moisture that is released back to the environment through evaporation and/or transpiration (evapotranspiration) processes. Storage and evapotranspiration then limit the net percolation of moisture into the subsurface. Additionally, water stored in the cover soil will limit the amount of oxygen ingress through the saturated cover system which could react with the stored waste. The cover will significantly reduce air emissions and dustfall from this facility.

Each PRSF cell will have a dual containment liner and a leak detection system. The primary liner will be a composite consisting of a geomembrane placed directly over approximately 0.45 m of compacted soil. Leak detection is provided by a geocomposite material installed beneath the primary liner. Secondary containment is provided by approximately 0.2 m of a compacted soil liner under the geocomposite material. The primary environmental receptor for the downward migration of contaminants from the PRSF is the Dalmeny Aquifer (comprised of the Upper and Lower Floral Aquifers). There is approximately 9 m to 18 m of low conductivity till between the base of the PSRF and the Dalmeny Aquifer, providing a high level of secondary containment for the process residue.

A leachate collection system is also provided for each cell to collect any fluid (i.e. leachate, precipitation, snowmelt, etc.) that accumulates when the cell is open. This system sits directly over the primary liner and consists of a perforated drainage pipe in a herring bone pattern, with a granular cover. The base of the cells will be graded towards a granular sump, where access to the leachate collection system will be provided through a perforated pipe.

Perimeter ditches around the PRSF facility and a runoff collection pond dedicated to the PSRF will collect any runoff once the cells are capped, prior to the establishment of vegetation. This collected runoff may be directed to the process water storage pond, for use in the facility, or monitoring may indicate its suitability to be released to the environment. The surface runoff from the capped PRSF cell will not be exposed to the process residue beneath and may eventually be eliminated as the vegetation on the capped mounds will intercept runoff.

Process Residue Characteristics

The process residue will consist of three components:

- Acid leach recovery of cobalt and gold residue.
- Copper re-leach iron (Fe) and gypsum residue.
- Iron and arsenic precipitates from the cobalt circuit.

The three process residue components will be coarsely mixed during transportation to, and placement in, the PRSF. Therefore, the final process residue will consist primarily of the residue reporting from the pressure acid leach oxidation and cyanidation circuits. Geochemical analyses of these two main components indicate elevated levels of several elements, including arsenic (As). Previous leach testing conducted on the process residue indicated maximum leachable As concentrations of approximately 34 mg/L (Golder, 2009).

Mineralogical quantification of the residue from the leach recovery of cobalt and gold indicates that scorodite ($Fe^{3+}AsO_4.2H_2O$) is the main phase within the process residue. Iron-arsenate phases have been shown to remain relatively stable in alkaline storage facilities.

The PRSF cover system will minimize the infiltration of water into the process residue, mitigating leaching, while the liner system will reduce the infiltration rate to the surrounding environment of any minor amounts of leachate generated.

A two-dimensional coupled groundwater flow and contaminant transport simulation was conducted to evaluate the engineered containment system proposed for the PRSF. Geo-Studio 2007 SEEP/W and CTRAN/W code were used to perform these coupled simulations for a 500-year period. The results of the groundwater flow and containment transport modelling indicate a negligible release of leachate to the environment from the designed PRSF.

Residue Deposition

The process residue generated at the SMPP is a filter cake with approximately 31% moisture content. Initial plans were to transport the residue to the PRSF using 20-t articulated haul trucks. The haul trucks would travel along the crest of the containment dykes to access the operating cells. Construction equipment (i.e. small dozers or tracked skid steers) would then be used to move/spread the residue in the containment cells into lifts with a uniform thickness. As a result of concerns from local residents during the town meetings for the SMPP, Fortune is working on a design and trade-off study for the transportation and placement of process residue. This study will focus on using a small conveyor system with a radial stacker to transport and place the process residue. This is being considered to reduce the potential for dust generated by truck traffic at the PRSF and to reduce the noise and light issues associated with truck haulage. No final decision has been made on the method of transportation of process residue to the PRSF.

It is expected that the containment cells will be constructed in pairs on an as-needed basis. It is suggested that residue will be placed in both active cells simultaneously, to facilitate consolidation of the residue and add flexibility to the operation. Placing residue in two cells simultaneously will also result in thinner lifts to be placed, which will enhance drying. It may also be beneficial to add a cover layer of sand or other suitable material (i.e. ballast) on the geocomposite liner. Water collected in the open cells (i.e. precipitation, snowmelt, etc.) may be retrieved from the leachate collection system and transported to the SMPP for use in the process.

Leachate Collection and Disposal

The design of the sump allows for any leachate to be collected with a sump pump or vacuum truck. A piping system could also be installed which would automatically collect and transport the leachate to the storage ponds. The containment dykes are designed with a 10 m wide crest to allow the manoeuvrability of leachate collection equipment or to provide room for a piping system to be installed. The leachate collection points will be located in a centralized location for multiple cells.

20.2.4.6 Storage Ponds

The operation of the SMPP requires the construction of five storage ponds for site runoff, process water, brine solution, cobalt solution and runoff from the PRSF. An additional effluent water re-use pond is included in the design in the event that Fortune is able to implement additional water re-use programs in the future. Preliminary sizing of these storage ponds has been completed and final designs are pending.

Each of the five ponds will be enclosed by a perimeter dyke with a design height of 1.0 m. The exterior dyke slopes are planned to be 3H:1V for construction and 1H:1V for post-construction. These dykes are designed to be 1 m high. The interior dyke slopes and excavation slopes vary depending on the storage pond. Containment dykes will provide the ponds with freeboard allowance, while limiting excavation depths and providing a barrier around the ponds for safety purposes.

The process water, cobalt solution and brine solution ponds were designed to accommodate the following storage volumes:

- Process water pond – 5,000 m^3.
- Cobalt solution pond – 300 m^3.
- Brine solution pond – 125 m^3.

These ponds were combined into one facility, with three cells, which will be located within the plant site. The ponds will be constructed using a composite liner consisting of geomembrane and compacted soil, similar to the PRSF containment cells.

The site runoff pond was designed to accommodate the runoff from a 1 in 50 year precipitation event over the plant site area, including the buildings, parking lot and rail areas. Additional storage was provided in the site runoff pond to accommodate supplementary runoff from snowmelt.

An additional runoff pond will be required to collect any water which comes from the PRSF. This residue storage collection pond will collect all water from the area during construction, residue placement, and once the cells have been covered. The pond is also sized to accommodate a 1 in 50 year precipitation event.

The provisional design for the water re-use pond, located in the land reserved for future water re-use opportunities to the west of the plant site, includes a 0.45 m thick compacted soil liner. This pond has a storage volume of 110,000 m^3.

20.2.4.7 Groundwater Supply

Fortune plans to use groundwater from the Upper Floral Aquifer to supply water to the facility. This aquifer is regionally extensive and well-studied. A 24-hour constant rate pumping test and three-dimensional saturated-unsaturated (confined-unconfined, respectively) finite-element groundwater flow modelling were used to evaluate water production at the SMPP. Analysis of the pumping test data indicated that the theoretical long-term yield from the primary production well (M2112-38) is 792 m^3/d (121 IGPM). Therefore, the 183 IGPM of water required for facility operations will need to be obtained from multiple wells. MDH recommended two wells (with a third back-up well), spaced at least 250 m apart.

The decision to produce battery-grade cobalt sulphate has resulted in a reduction of the fresh water intake requirement for the SMPP from 55.8 m^3/h to 36 m^3/h. This is a 35% reduction and is at a level where changes to the aquifer will be very localized, if they occur at all.

20.2.4.8 Roads and Traffic

The primary access to the proposed SMPP will be from Highway 16, Highway 305 and an existing gravel road (Range Road 3071 or Schultz Road). Highway 16 is a primary highway and Highway 305 is a secondary highway within 15 km of the plant site. Fortune will be able to haul primary weights on Highway 305, as long as the distance is less than 15 km from Highway 16. Primary weights range from 5,500 kg to 62,500 kg (depending on the truck and season) and all haul trucks transporting materials to and from the plant site will be within this weight range. Schultz Road is a main farm access road that is maintained and operated by the rural municipality (RM) of Corman Park. It is currently built as an all-weather gravel road. The segment of Schultz Road to access the plant facility from Highway 305 is approximately 800 m long. Primary weights are only allowed on the municipal road system if a permit is obtained from the RM. Studies have been done to surface Schultz Road, as well as to determine the adequate turning lanes required on provincial roads.

The planned method of delivery of concentrate and reagents, as well as for the shipment of products leaving the site, will be via CNR. Some truck traffic may be required from time to time but the present road system is adequate for the anticipated traffic.

The railway siding will be built to CNR standards. Maintenance of the railway siding will likely be shared between Fortune and CNR. No environmental assessment for the proposed railway siding is expected, as the Canadian Environmental Assessment Agency (CEAA) has completed an environmental screening and has stated that no comprehensive study is required. Required permits to operate and construct the rail infrastructure will be obtained by CNR, according to its normal operating procedures.

20.2.4.9 Hazardous Substances and Waste Dangerous Goods

Hazardous substances and waste dangerous goods that will be stored at the proposed SMPP are listed in Table 20.3. This list is a preliminary estimate of the quantities of reagents anticipated to be used at the SMPP. Tank numbers and volumes will be determined during detailed design. Storage of these substances will be reported to and approved by applicable provincial regulators annually. All reagents delivered in bulk will be unloaded to contained storage units (i.e. tanks, bins, etc.). All other reagents will be stored inside buildings or outside on covered asphalt pads.

Table 20.3
Hazardous Substances and Waste Dangerous Goods Stored at the SMPP

Reagent Name/Substance	On-site Storage	Units
Ammonium Hydroxide	200	L
Anti-Scalant (RO unit)	1.5	t
Argon (compressed cylinders)	140	m^3 (15 cylinders)
Colorado Sand	-	TBD
Cyanide	20	t
Diesel Fuel	70,000	L
Glycol	-	TBD

Reagent Name/Substance	On-site Storage	Units
Hydrochloric Acid	1,800	L
Hydrogen Peroxide	400	L
Kerosene	48	t
Ketoxime (LIX)	8	t
Lead Nitrate	200	L
Lignosol	10	t
Lime	200	t
Manganese Sulphate	800	L
Methyl Isobutyl Carbinol	200	L
Nitrogen	12	Cylinders
Oxygen	*	
Sodium Carbonate	183,000	L
Sodium Chloride	45	t
Sodium Hydroxide	90,000	L
Sodium Hypochlorite	-	TBD
Sodium Metabisulphite	-	TBD
Sodium Nitrate	-	TBD
Sulphuric Acid	80,000	L
Xanthate	1	t
Zinc Dust	200	L

Note : * - Will be produced on-site (no additional storage vessels required)
TBD - To Be Determined

20.2.4.10 Environmental Monitoring

Fortune's environmental monitoring programs are conducted to comply with the requirements of Saskatchewan's Environmental Management and Protection Act and Regulations (2002) and The Clean Air Act and Regulations (2003). Results of environmental monitoring will be reported annually to MOE, in accordance with the approval to operate. The results of monitoring conducted throughout the year will be compiled in an annual environmental report, submitted to MOE. Data will be collected in a manner that complies with industrial, federal and provincial standards, to ensure that data collection is consistent and information is representative of the conditions that exist at the site.

Groundwater Monitoring

Fortune will measure groundwater levels and conduct geochemical analyses on the existing piezometers at the SMPP site. Some of the existing piezometers at the site may need to be decommissioned as the construction of site infrastructure may occupy their sites. New instrumentation will be installed as required.

Monitoring the leak detection system installed in the PRSF will provide the first indication of leakage through the constructed liner system. This will occur by monitoring the leak detection wells. Chemical analysis of the groundwater will ensure that any changes to the water chemistry or water table will be noticed, so that the proper actions can be taken in a timely manner. After construction of the cell cover, the leachate collection system can be used to monitor net percolation. Monitoring wells may also be installed in the covered deposits to determine chemistry and fluid levels in the residue. These monitoring wells can also ensure that the leachate collection system is functional. If leachate collects within the leak detection monitoring well, it will be pumped and re-used in the SMPP, or removed by a vacuum truck for disposal at an approved facility.

Each fall for the first five years of operations, groundwater samples will be collected and analyzed for routine analysis and trace metals. Based on the results of this sampling, the frequency of sampling beyond five years of operations may be reduced.

Water level data will be acquired seasonally from all instrumentation, and pressure transducers will be installed within all piezometers within the Dalmeny Aquifer, to enable detailed monitoring of depressurization due to groundwater production.

Surface Water Monitoring

Baseline surface water sampling points have been established around the proposed facility. Continued monitoring will be completed in the spring and fall at four locations within the immediate vicinity of the SMPP. Annual fall monitoring is proposed for the remainder of the baseline locations surrounding the SMPP.

Water samples will be analyzed for routine chemical testing, trace metals (total and dissolved) and possibly cyanide, to alleviate potential public concerns. These samples will be collected every year for the first five years of operations. The frequency of sampling beyond five years of operations may be reduced based on the results of the initial sampling.

Runoff from the PRSF will also be collected and monitored prior to its release to ensure that no contaminants are discharged from the facility. This monitoring will also examine routine chemical testing, trace metals (total and dissolved) and possibly cyanide.

Air Emissions

Air emissions will be visually monitored on a daily basis. Major air emission control circuits may need to have their operating parameters electronically monitored in real time, with high and low level alarms set for the various parameters. On an annual basis, a third party contractor will be commissioned to conduct stack sampling.

Containment Dykes

A visual inspection of the PRSF dykes will be completed daily by site personnel. A more detailed inspection of the dykes will be completed monthly. Monthly observations will be recorded and filed, with any required work being completed as soon as possible. On an annual basis, an independent Professional Engineer will be commissioned to conduct a comprehensive visual dyke inspection. The annual visual dyke inspection report will be forwarded to MOE.

Contingency Plan

Fortune will annually update emergency plans, if necessary, for general spill reporting, PRSF contingency plans, berm/dyke failure and other emergency situations at the site. The procedures will be amended as required to reflect the addition of any new processes or activities at the SMPP.

A preliminary Emergency Response Plan (ERP) has been created for the proposed SMPP and will be finalized prior to the commencement of construction. The preliminary ERP is intended to provide general guidance for emergency response and spill contingency planning at the SMPP site, during the construction and operational phases. This plan will be finalized and updated with consultation from provincial regulators to incorporate requirements addressed during the environmental assessment processes and conditions outlined within the operating licence. Provincial requirements for the SMPP decommissioning and closure, as they arise, will also be incorporated into all updated ERPs.

20.2.4.11 Occupational Health and Safety

Fortune is committed to preventing the accidental loss of any of its resources, including employees and physical assets. In fulfilling this commitment to protect both people and property, management will insist on and maintain a safe and healthy work environment, in accordance with industry standards and in compliance with legislative requirements, and will strive to eliminate any foreseeable hazards which may result in property damage, accidents, or personal injury or illness.

All management activities will comply with Fortune's safety requirements as they relate to the planning, operation and maintenance of facilities and equipment. All employees will be trained to perform their jobs properly in accordance with established procedures and safe work practices. The SMPP facility will have a comprehensive orientation and training program to ensure that workers are properly trained in their duties. Monthly safety meetings will provide opportunities for refresher training. Safety incidents will be investigated and corrective actions will be taken, if necessary. Staff and hourly employees will be required to participate in regular documented safety observations to promote safe work practices and to ensure that safe workplace conditions are maintained. The facility will provide orientation for contractor workers who work on-site, to ensure that they are aware of site specific safety requirements and emergency procedures.

Occupational Hygiene

To achieve the highest standard in occupational hygiene, Fortune will hire professional and competent personnel to continually assess occupational hygiene standards to ensure the safety and well-being of all workers at the SMPP. A health, safety and environment (HSE) coordinator will keep contractors and labour groups informed of federal, provincial and local health guidelines and requirements. The coordinator will prepare hazard communication sheets and computer programs to ensure that workers understand the dangers of the chemicals and equipment they use. The occupational hygienist may also coordinate Fortune staff to clean and maintain ventilation systems, lighting, thermal conditions, toilet facilities, personal washing, clothing, change and shower facilities, eating and smoking areas to minimize or eliminate exposure to infectious materials and organisms.

20.2.5 Permitting Requirements

20.2.5.1 Environmental Assessment

The proposed SMPP is subject to the provincial Environmental Assessment Act in order to proceed to development. The process is a harmonized review following the Canada-Saskatchewan Agreement on Environmental Assessment Cooperation (2005).

Fortune submitted its Environmental Project Proposal in July, 2010 and the environmental assessment process was formally announced by the Saskatchewan MOE on January 22, 2011. The environmental impact statement was prepared and submitted according to the site-specific guidelines. The Saskatchewan MOE, Environmental Assessment Branch (EAB), released its Technical Review Comments on the Environmental Impact Statement in September 2013. The public release of the Technical Review Comments on October 5, 2013 also opened a public comment period that closed on December 6, 2013. On February 11, 2014, the Minister of Environment approved Fortune's environmental assessment for the SMPP.

20.2.5.2 Land Purchase and Rezoning

The legal land description of the SMPP is the southeast quarter of Section 23 in Township 39, Range 07, West of the 3rd Meridian (SE¼ 23-39-07-W3) and N½ 14-39-07-W3. Fortune has purchased these lands and a rezoning process will be initiated once the Comprehensive Development Review Report (CDR) has been finalized.

The SMPP is located in the Rural Municipality of Corman Park (RM 344). The access roads to the site are owned and maintained by the RM and the provincial government.

The rezoning process begins with discussions with the township council, prior to formal application. The formal application for zoning, in the form of the CDR, is made to Corman Park. Corman Park reviews the application and then there is a first reading to Council, which typically includes a formal presentation by the applicant. A Council meeting is held with a public hearing and usually includes a second and third reading on the same day. Council approval for rezoning allows a formal response to the Saskatchewan environmental assessment process.

20.2.6 Social and Community Aspects, Stakeholder Consultation

Fortune strives to maintain good public relations in the communities in which it operates. There have been several forums and opportunities for feedback from the public on the proposed SMPP. Direct notification was provided to the municipal government and local landowners in the immediate vicinity of the SMPP site. Fortune published advertisements in community newspapers and handed out pamphlets (door-to-door) in Dalmeny and Langham regarding open houses on February 7 and 8, 2011, respectively. Neighbouring landowners and the general public were invited to review and provide feedback regarding the proposed development. Public notice of the EIS was provided in local papers by MOE and on the internet (MDH, Appendix S, 2011).

20.2.6.1 Public Consultation Activities

Fortune personnel have worked closely with Enterprise Saskatchewan, Saskatchewan Regional Economic Development Association (SREDA) and representatives from the towns of Langham and Dalmeny, to keep government agencies and the public informed about the proposed SMPP. Various meetings and interviews have taken place from April, 2009 to the present day, with landowners and residents of Langham and Dalmeny, RM representatives and various media outlets, to keep people aware of Fortune's plans to develop the SMPP. Meetings at the homes of seven surrounding landowners occurred in November, 2009, to introduce the development and discuss their concerns. These concerns and feedback became part of Fortune's continuous improvement for the SMPP. Representatives from the Rural Municipality of Corman Park met with Fortune personnel on June 24, 2009 and June 10, 2010, to discuss the SMPP and any updates on the proposed development. The meeting provided a chance for the RM to voice its comments, concerns and questions to Fortune. The SMPP was received favourably by the RM.

In August, 2010, Fortune published a "frequently asked questions" pamphlet which was distributed to Enterprise Saskatchewan and landowners, and was posted on the company website. Several meetings also occurred in April, 2010 with surrounding residents with water wells within 4.5 km of the SMPP. Personnel from Fortune informed people of the SMPP development and obtained well usage information and permission to collect samples to obtain baseline water chemistry. Appointments were offered to well owners to accommodate their personal schedules.

20.2.6.2 Open Houses

Open house public meetings were held on February 7, 2011 (Dalmeny) and February 8, 2011 (Langham) to inform the public about the SMPP and collect feedback. Direct notification of the public meeting was provided to the RM, nearby municipal governments and local land owners. Fortune also published advertisements in community newspapers regarding the open house public meeting. All community members were invited to attend.

Posters, a presentation and handouts were used to present information regarding the SMPP and company in general. Fortune and MDH personnel were available to speak with attendees and answer any questions. Attendees were invited to provide their feedback regarding the SMPP and to request further information. Reporters from the local newspapers were present to ask questions and document the event. Approximately 71 and 115 members of the public attended the Dalmeny and Langham open houses, respectively.

A questionnaire was provided so that attendees could comment on the planned development and make requests for additional information (MDH, Appendix S (Volume II), 2011).

20.2.6.3 Public Feedback and Response

The RM of Corman Park heard concerns about the proposed SMPP from nearby residents at a regular council meeting in April, 2011. Concerns about the transportation of chemicals, the storage of residue and impacts to the quality and quantity of water in the Dalmeny Aquifer were raised during this meeting. Several newspaper articles, along with a flyer, have also expressed the concerns of a group of residents that oppose the SMPP (MDH, Appendix S, Volume II, 2011).

The open house meetings conducted in February, 2011, addressed each concern above, providing the public with an opportunity to ask questions and understand the planned activities for the proposed SMPP. Personnel from Fortune have given various interviews to local media to provide additional information on how potential impacts will be avoided and/or minimized. Fortune’s Director of Regulatory and Environmental Affairs (Rick Schyer) and the President and CEO (Robin Goad) also attended an on-camera meeting with the RM of Corman Park Council on May 6, 2011. Two presentations were given at this meeting and each concern brought forward by the public, to Fortune’s knowledge, was addressed. It is Fortune’s intention to attend additional RM meetings and/or meet one-on-one with concerned residents, now that the EIS has been approved.

20.2.7 Social Management

Once the SMPP is operational, Fortune plans to distribute a newsletter twice a year to update the local residents on any changes regarding the facility. Fortune may also hold yearly town meetings to address any concerns or questions about the facility and to provide updates. Fortune will have an open door policy when it comes to dealing with any questions or concerns from the public. A public relations officer will be designated to answer any questions on a daily basis. Contact information for this person will be widely distributed. Fortune may also sponsor local events (i.e. charity events, ball or hockey tournaments, community fundraisers), although the exact level of sponsorship cannot be detailed at this time.

20.2.8 Reclamation and Plant Decommissioning

Fortune acknowledges responsibility for all aspects of its operation and is committed to working with the Province of Saskatchewan to address and resolve environmental issues. In keeping with this commitment, a detailed decommissioning plan that restores the SMPP location to an environmentally stable condition will be developed. It is expected that this plan will be subject to a five year revision cycle, in which Fortune will be required to incorporate information regarding new technologies for decommissioning and any changes to operations at the proposed SMPP.

It is Fortune’s decommissioning objective to restore the location to conditions similar to those that existed prior to the development. It is anticipated that the site would be very similar to existing conditions, except for the mounds created by capping the PRSF.

20.2.8.1 Conceptual Decommissioning Plan

At the time of facility closure, all buildings not required for decommissioning services will be demolished. All salvageable material (i.e. equipment and motors) will be reused, sold or recycled. The remaining materials will be removed from site and disposed in an approved facility. On-site utilities will be isolated, rendered safe and left in place. Roads not required will be removed and the ground will be contoured to restore natural drainage.

Surface structures, such as the storage ponds, will be decommissioned at the end of facility life. The process water pond, cobalt solution pond and brine solution pond will be drained, filled to grade with suitable backfill and capped with fresh soil. All fluids removed from the ponds will be tested and assessed against applicable criteria and disposed of appropriately.

The PRSF will be built in a modular fashion, resulting in incremental construction, decommissioning and reclamation over the life of the facility. Each containment cell within the PRSF will be capped with an engineered cover system, once filled. The construction of a cover over the containment cells will greatly reduce the potential for dust generation at the site.

20.2.8.2 Projected Impacts of the Decommissioning Plan

No lasting impact is expected on the surface environment at the proposed plant site, since the ditches and runoff and storage ponds used for containing runoff and drainage from the SMPP will be filled and contoured to match existing terrain and drainage patterns. It is expected that vegetation will begin to re-establish at the site soon after decommissioning. The low profile of the PRSF (2 m high containment dykes) may facilitate return of the site to agricultural or recreational use. Rezoning the land from an industrial site may be required to use the decommissioned facility for other purposes. Continued monitoring of the storage cells will be required to ensure that no contaminants are escaping from the facility.

20.2.8.3 Reclamation

Reclamation will occur at the SMPP site on an ongoing basis, as the portions of the PRSF will be capped and vegetated while the facility is in operation.

Once the SMPP facility ceases operations, reclamation will generally consist of re-contouring, replacing topsoil and re-vegetating to restore the land surface as nearly as possible to the original conditions. Surface drainage conditions will be restored, similar to conditions before site construction. All ditches will be filled in and contoured to blend with the pre-development terrain and drainage patterns. Salvageable topsoil from site decommissioning and, possibly, facility construction will be used to re-contour the landscape, where applicable. Plant species selected to provide a vegetative cover on each cap will be compatible with the surrounding vegetation.

20.2.8.4 Post-Decommissioning Monitoring

Long-term monitoring of the site, including the cover systems and monitoring wells, will occur following the closure of the plant and the capping of the containment cells. This monitoring will consider surface and groundwater chemistry, dyke stabilities and permanent cover of vegetation. A detailed plan to monitor the site after decommissioning will be developed in consultation with the provincial government. It may be necessary to install further monitoring wells over time, to comply with MOE environmental regulations.

The PRSF at the SMPP will remain in place, along with associated leak detection monitoring wells. This will require monitoring to occur for a period of time, after the site is decommissioned.

21.0 CAPITAL AND OPERATING COSTS

21.1 CAPITAL EXPENDITURES

The pre-production capital expenditure required to construct the overall NICO Project and the subsequent capital expenditure required to sustain the Project in operation have been estimated separately for the Project site in the NWT and for the SMPP. The total estimated capital expenditures are summarized in Table 21.1.

Table 21.1
Total Estimated Capital Expenditures

Location	Pre-Production Capital (C$ million)			Sustaining (C$ million)	Total Capital (C$ million)
	Direct Costs	Indirect Costs	Total		
NWT	222.4	124.1	346.5	41.4	387.9
SMPP	165.0	77.5	242.5	16.4	258.9
Total	**387.4**	**201.6**	**589.0**	**57.8**	**646.8**

The indirect capital costs for the Project site in the NWT make provision for a net credit of C$3.3 million, as described subsequently in Section 21.1.3.

21.1.1 NICO Project Site, NWT

The estimated capital costs for the mine, processing plant and infrastructure at the NICO Project site have been grouped by initial capital and sustaining capital for the purposes of the financial analysis. The estimates were developed by Procon Mining and Tunnelling Ltd. (Procon) and Fortune, based on the work of third party engineering companies, consultants and contractors which were responsible for developing the estimates for the scope of work in their respective areas of expertise. The primary contributors listed in Table 21.2 were responsible for the preparation of area capital costs for the FEED study, which was the starting point for the estimates prepared by Procon.

Table 21.2
Capital Cost Estimate, Primary Contributors

Contributors Name	Scope of Work
Jacobs Minerals Canada Inc., formerly Aker Solutions	Front-End Engineering and Design (FEED) and cost estimate study completed on the process plant and related infrastructure. (included in Jacob's FEED study capital cost)
P&E Mining Consultants Inc.	Mining - open pit and underground
Golder Associates Ltd.	Tailings thickener and underflow pumps Tailings management facilities (TMF) Effluent treatment facility Co-disposal facility
International Quest Engineering Ltd	Service building / truck shop / mine dry (included in Jacob's FEED study capital cost)
EBA Engineering Consultants Ltd.	Main access road (included in Jacob's FEED study capital cost)
Fortune Minerals Limited	Owner's costs, working capital, consolidation of cost estimates into financial model

21.1.1.1 Pre-Production Capital Costs

A summary of the estimated initial capital cost for the NICO Project site is provided in Table 21.3. The estimate scope includes the construction, pre-development and commissioning period. The total initial pre-production capital required for the NICO Project site is estimated to be C$222.4 million. The estimates include direct costs, indirect costs and contingency. No capital expenditure is included for underground mining. This operation will be conducted by a contractor and all costs are included in operating costs.

Table 21.3
Summary of NICO Estimated Pre-Production Capital Costs

Cost Component	Estimated Cost (C$ million)
Open pit mining	52.4
Underground mining	-
Process plant and related infrastructure	170.0
Indirect costs	88.3
Engineering, procurement and construction management (EPCM)	39.1
Contingency, net opportunities	(3.3)
Total pre-production capital	**346.5**

The accuracy range of the capital cost is considered to be plus or minus 15%. The accuracy prediction for the NICO Project takes into account the current state of engineering and procurement. Approximately 25% of engineering had been completed at the date of the FEED Study by Jacobs. For the FEED study, budgetary quotations were obtained for all the commodities and labour, and 99% of the process mechanical equipment. Procon has obtained updated budgetary quotations and the current estimate is expressed in Canadian dollars of fourth quarter, 2013 value.

21.1.1.2 Sustaining Capital Costs

Sustaining capital relates to capital expenditures incurred subsequent to the commissioning of the mine, mill and related infrastructure and through to the end of the mine life. The NICO Project estimated sustaining capital costs are summarized in Table 21.4. Total sustaining capital expenditures are estimated at C$41.4 million.

Table 21.4
NICO Project Estimated Sustaining Costs

Description	Estimated Cost (C$ million)
Mine sustaining capital	38.9
Process and other sustaining capital	2.5
Total sustaining capital	**41.4**

The total NICO Project life-of-mine estimated capital cost, including pre-production and sustaining capital, is estimated at C$387.9 million.

21.1.1.3 Open Pit Mining

Open pit capital costs were originally estimated by P&E and subsequently updated by Procon and Fortune.

It is planned that initial pre-production work will be undertaken by a contractor. Thereafter, Fortune will carry out the open pit operations with its own personnel and equipment, as these are progressively integrated into the operations. Fortune has obtained from an equipment manufacturer indicative terms for leasing much of the open pit equipment fleet and the capital expenditure estimate includes the down payment to be made on this equipment. The subsequent annual leasing costs are included in the sustaining capital estimates.

The total pre-production capital cost of developing and equipping the open pit mine is summarized in Table 21.5. The principal component of this expenditure is the cost of pre-production waste removal from the pit, in order to develop sufficient working faces in ore to supply the processing plant. The quantity of pre-production stripping is based on the open pit mining plan, and cost is based on unit cost budgetary quotations and estimates received from a contractor, Procon.

Table 21.5
Direct Capital Cost Estimate – Mining

Cost Component	Estimated Cost (C$ million)
Labour	15.1
Permanent material	0.3
Construction material	8.4
Equipment	6.8
Equipment operation	21.8
Total	**52.4**

21.1.1.4 Mill and Related Infrastructure

The estimated pre-production capital cost for the NICO mill and related infrastructure is C$170 million. This estimate is based on Jacobs's FEED study estimate, which has been updated and adjusted by Procon and Fortune.

The mill and related infrastructure cost estimates were originally based on second quarter 2010 values, but these were updated by Procon in 2013 on the basis of new budgetary quotations. The overall accuracy of the estimate is judged to be plus or minus 15%. Procon's updated estimate includes a contingency allowance of C$9.5 million to address specific areas of potential risk for cost overrun.

The capital cost estimate assumes that the winter road will be used to mobilize the equipment and materials required for the early works planned for 2014 and 2015, and that the all-weather road to the NICO site will have been completed before the commencement of full-scale construction activities in 2016. The estimate covers the period from the decision to proceed with the construction until the first day of production, including all direct and indirect costs for the construction and commissioning of the mill and related infrastructure.

In 2006, as a capital cost offsetting measure, Fortune purchased the Golden Giant mill in Hemlo, Ontario, to utilize the equipment for the NICO Project. This facility was dismantled during 2008 and 2009. The usable equipment has been stored and will be refurbished as required and used at the NICO operation. It is anticipated that the NICO operation will utilize certain of the former Hemlo underground ventilation fans and heaters, mobile generators, mobile equipment, and other miscellaneous parts and equipment.

A summary of the mill and related infrastructure direct capital cost estimate is provided in Table 21.6.

Table 21.6
Capital Cost Estimate – Mill and Related Infrastructure

Cost Component	Estimated Cost (C$ million)
Labour	29.5
Permanent material	19.1
Construction materials	20.2
Equipment	40.3
Equipment operation	14.1
Sub-contractors	46.8
Total	**170.0**

The estimate includes the cost of the following facilities:

- Access spur road to the site, site development and site roads.
- Crushing plant.
- Fine ore storage.
- Grinding circuit.
- Flotation circuit.
- Concentrate thickening, filtration and loadout.
- Tailings thickener.
- Mill building.
- Main control system.
- Water and compressed air supply.
- Reagent preparation area.
- Co-disposal facility.
- Electric power substation and distribution network.
- Permanent accommodation complex.
- Plant mobile equipment.
- Fuel storage facility.
- Sewage treatment plant.

- Incinerator.
- Gate house.

21.1.1.5 Indirect Costs

Indirect capital expenditures related to construction at the Project site are estimated at C$88.3 million, as summarized in Table 21.7. These costs were originally estimated by Jacobs, in the FEED study, and were subsequently updated by Procon and Fortune.

Table 21.7
Indirect Capital Expenditures

Cost Component	Estimated Cost (C$ million)
Labour	31.0
Permanent material	1.4
Construction material	33.6
Equipment and operation	13.1
Sub-contractors	9.2
Total	**88.3**

Indirect capital expenditures include items other than the direct cost of equipment and facilities, such as:

- Owner's oversight of construction activities.
- Costs associated with insurance and permitting.
- Construction camp and catering costs.
- Equipment freight to the Project site.
- Costs of operating construction warehouses and temporary facilities.
- Costs of providing electric power and other utilities during construction.
- Costs of site safety and security during construction.
- Customs duties and taxes.
- The cost of vendors' representatives, first fills and initial inventory.

21.1.1.6 Engineering, Procurement and Construction Management (EPCM)

The total estimated cost of EPCM services of C$39.1 million has been divided into two components:

- EPCM services of C$16.4 million.
- EPCM fees of C$22.7 million.

EPCM services include all costs incurred for:

- Detailed engineering.
- Preparation of tender documents and bid packages.

- Analysis of vendor bids and selection of vendors and contractors.
- Preparation of drawings to be issued for construction.
- Supervision of construction and contractors on site.

21.1.1.7 Contingency

A risk analysis was performed by Procon and Fortune, in conjunction with updating the capital cost estimate, in which risk was considered within the updated direct and indirect cost estimates, rather than applying a contingency allowance on a percentage basis. Specific risk items not included in the estimates were then identified and considered for a specific contingency amount. The specific contingency included in the financial model is C$9.5 million, based on the individual areas of risk identified. This contingency includes fuel supply escalation; allowances for additional costs related to painting, grounding and protective concrete walls; allowances for a small vehicle and millwright shop, a construction incinerator, site road widening for emergency airstrip, and related labour and catering charges for these activities.

21.1.1.8 Basis of Estimate – FEED Study

The FEED study capital cost estimate, which was the starting point for Procon's updated estimate, was developed based on the following parameters:

- Procurement of new equipment.
- Refurbishing of certain existing Hemlo equipment.
- Initial contract development of the open pit, followed by Owner mining.
- Contract mining of all underground operations.
- Procurement, fabrication and installation of bulk materials.
- Installation labour and supplementary resources for equipment and bulk material installation on site.
- New buildings, structures and associated utility services for most areas.
- The following engineering documents to support the quantity take-offs:
    - Process flow diagrams.
    - Process equipment list.
    - Site plot plans.
    - GA drawings.
    - Electrical load analysis.

    - Electrical single-line diagrams.
    - Electrical equipment list.
    - Piping and instrumentation diagrams.
    - Design sketches.

- Local unit pricing for bulk commodities.

- Local construction labour rates and competitive local contractor rates.

- Freight rates for the transportation of goods to the NICO Project site.

- CDF design, quantity take-offs and costing by Golder, using unit rates from Golder's in-house records for similar projects and adjusted to the anticipated site conditions.

The estimation methodology which was used for the FEED study consisted of the procedures described below.

Budget Pricing for Commodities

Budget pricing for commodities (excavation, backfill, concrete, structural steel, cladding and platework), unit labour rates for commodities and construction labour rates were obtained from local contractors. From the received cost data, unit man-hour rates, construction crew rates and commodity unit pricing were established for the capital cost estimate.

Earthworks, Concrete, Structural Steel and Architectural Elements

Based on the current plant design, material take-offs were completed by the respective discipline engineers. The quantities for site preparation, concrete, structural steel, miscellaneous steel and architectural elements were priced based on the local contractor's unit costs and prices provided.

Mechanical Equipment

The process equipment list formed the base of the estimate. The process equipment list was packaged, data specifications were prepared, and budget quotations were obtained, reviewed and the recommended supplier pricing was applied to the estimate. Requests for quotation were solicited from at least three vendors for all the major equipment with a value in excess of C$250,000. The bids were analyzed based on technical compliance, commercial suitability and delivery schedule.

Several items on the process equipment list were identified as equipment already owned by Fortune as a result of the purchase of equipment from the former Golden Giant mill in Hemlo, Ontario. In some instances, the equipment refurbishment cost was quoted. In other cases, the actual cost to refurbish equipment was not available, and an allowance of 25% of the budgetary price for new equipment was assumed as the refurbishment cost. Shipping costs to refurbishment locations and return from refurbishment locations were assumed to be sunk costs.

Electrical

Requests for quotation were sent out to two to three vendors, based on the equipment list and specification data developed from the single-line electrical diagrams. Budget quotations were received for the electrical equipment and cables. Quotations were analyzed for technical compliance and commercial suitability, and the best vendor package was recommended. Material quantity take-offs were developed and unit pricing was applied.

Instrumentation

Material quantity take-offs were developed and unit pricing was applied.

Piping

Material unit pricing quotations were obtained for large bore process piping and fittings 50 mm (2 inches) and above, similarly for utility pipes of 75 mm (3 inches and above). Material quantity take-offs were developed for piping and unit pricing was applied. Small bore (less than 50 mm for process and less than 75 mm for utility) piping cost was established as an allowance and applied as a percentage of the large bore piping for each area.

Project Indirects

Supply and installation of temporary facilities, temporary utility services, construction site support and operations, construction fuel, catering and workforce transportation were estimated by Jacobs, in collaboration with Fortune, based on the criteria developed for the NICO Project. These estimates were then updated by Procon, also in collaboration with Fortune.

Vendor Representatives

Costs for vendor representatives were prepared from quoted rates provided by the equipment suppliers.

Spare Parts

Costs for spare parts were developed from the recommended spares list provided by equipment suppliers.

Initial Fills and Inventory

Cost of initial fills and inventory were estimated from process requirements, tonnages for grinding media and volumes for reagents.

Freight

Freight costs were developed from the logistics provided by CN World Wide North America, a division of the Canadian National Railway. The transport costs for Hemlo equipment to locations for refurbishing and to Edmonton were included with Owner's costs. Freight costs were subdivided into the following segments:

- Freight from Edmonton, Alberta to Hay River, NWT.
- Freight from Hay River, NWT to the NICO Project site.

For each of the above segments, the freight rates were further subdivided into bulk materials and 20-ft containers.

A separate freight rate was established for oversized loads, which require special procedures, permitting and police escort to the NICO Project site.

Engineering, Procurement and Construction (EPC)

The cost for EPC was derived by estimating engineering and procurement man-hours based on the engineering deliverables, and construction based on the site manpower schedule. The EPC man-hours were multiplied by corresponding rates to establish the total EPC cost. Certain procurement activities were assumed to be performed by Fortune and were included in Owner's costs.

Commissioning and Start-up Assistance

The cost of this function was based on developing a staffing level and corresponding man-hours multiplied by the applicable charge-out rate.

Fuel and Power Costs

The cost of diesel fuel, as updated by Procon, was based on a regression analysis between diesel price and historical world oil price. A C$1.00/L diesel price for the NWT (transportation included) was assumed, based on a US$97.25 per barrel world oil price. This price was used to estimate fuel costs for mobile equipment and power. Fuel consumption for the diesel generators used to supply electric power during the construction period was based on manufacturer specifications.

Co-disposal Facility

The co-disposal facility assumes that suitable mine rock for construction of dams and perimeter dykes will be delivered to the point of use. This has been included within the shared services equipment and labour requirements. Unit prices are based on precedent data from Golder's in-house records for similar projects and adjusted to the anticipated site conditions. Local construction material unit costs cover crushing and screening where required, loading, hauling, dumping, grading and compaction. The estimates assume that local construction materials (sand and till) are readily available on site in the quantities required, at no royalty cost to the contractor. Costs related to obtaining a quarry permit and an estimate for royalties as a result of a quarry permit have been included in Owner's costs.

Owner's Costs

Owner's costs were excluded from the plant initial capital cost and were estimated during the construction and commissioning period, based on the following:

- Insurance: Based on preliminary rate estimates from an insurance broker in the mining industry.

- Value-added taxes, import/duties and property taxes: estimated based on legislation in place in 2012.

- Owner's labour costs: Based on 2012 labour rates with 10% escalation to convert to a 2014 estimate, and fully loaded. The estimate includes all Fortune personnel anticipated to be involved with the Project, including the portion of procurement activities that were excluded from Jacob's EPC estimate.

- Telecommunications: Based on previous vendor quotes for portions not already included in Jacob's estimate.

- Legal and professional services: Based on anticipated level of usage to assist during the construction and commissioning period with contracts and other matters.

- Transportation of Hemlo equipment to Edmonton: Based on a 2012 quote from a transportation vendor for costs of moving all Hemlo equipment from the current staging locations to Edmonton. Jacobs' estimated freight costs from Edmonton onward.

- Other Owner's costs: Based on estimates from operational experience of Fortune team members and third party consultants.

In the updated capital cost estimate prepared by Procon, Owner's costs are included within the indirect category and are not reported as a separate item.

Sources of Data

Ninety-nine percent of the process equipment cost estimates for the NICO mill and related infrastructure in the FEED study were based on budgetary prices of plus or minus 15% accuracy, limited for a specified period in time. The remaining equipment was estimated from data supplied by local vendors. Request for quotations were sourced from at least three vendors for any equipment with a value over C$250,000. The bids were then analyzed, based on technical compliance and commercial suitability, and the best in both categories was recommended taking account delivery schedule.

Labour Productivity for Construction

The base FEED study estimate for the NICO Project site was prepared utilizing US Gulf Coast labour productivity installation man-hours. Based on in-house research, input from the local sources and considering the extended work week Project execution arrangement, the productivity adjustment factors summarized in Table 21.8 were applied.

With the exception of piping, electrical instrumentation and insulation/painting, all productivity factors listed in Table 21.8 were subsequently updated by Procon. The productivity of local labour skills and availability, extended work week, complexity and remoteness of the jobsite, local weather and the expected turnover of workers have been considered in the productivity rates used by Procon.

Table 21.8
Productivity Factors

Item	Factor
Earthworks	1.23
Civil	1.17
Structural	1.18
Architectural	1.11
Equipment	1.18
Piping	1.23
Electrical/instrumentation	1.11
Insulation/painting	1.20

Labour Crew Rates for Construction

The construction labour rates used by Procon have been updated from those used in the FEED study. The rates used by Procon represent a Construction Workers Union (CLAC) workforce and are based on information from CLAC, escalated for 2015 rates. These rates include employee benefits and payroll burdens only.

The average hourly rates are based on a 7-day week, 11-hour work day (77 h work week) and include the cost of premium overtime at 1.5 of the base rate for hours beyond 40 hours per week. A list of the construction labour rates is, as updated by Procon, included in Table 21.9.

Table 21.9
List of Construction Labour Rates

Composite Crew	Rate (C$/h)
Civil - site clearing and grubbing	50.71
Earthworks - building and underground services	52.20
Earthworks - rock excavation	50.71
Concrete, rebar and formwork	55.33
Architectural	51.12
Structural steel	61.52
Mechanical	61.50
Piping	66.50
Electrical and Instrumentation	66.82
Insulation	subcontract

21.1.1.9 Basis of Updated Estimate – Procon

The updated capital cost estimate developed by Procon for the Project site in the NWT commenced with a review of the FEED study estimate and then adopted the procedures described below.

Quantities

Given the level of design included in the FEED study, Procon considered it reasonable to accept the quantities of material estimated in the FEED study for the following disciplines:

- Electrical.
- Instrumentation.
- Structural steel.
- Process and other piping.
- Process equipment.
- Structural concrete.
- Metalwork.

For other disciplines, Procon either performed quantity take-offs or did independent checks to confirm the reasonableness of the FEED study quantities. Earthwork quantities were re-evaluated by Procon, by digitizing drawings and performing independent take-offs. Spot checks were conducted for all other disciplines and the FEED study quantities were adjusted, where appropriate.

Pricing

The FEED study pricing was accepted for the following disciplines:

- Electrical.
- Instrumentation.

- Metalwork.

Process equipment pricing from the FEED study was also generally accepted, although Procon conducted a small sampling survey which indicated a general downward trend in the cost of new process equipment.

Budgetary quotations, with updated pricing, were solicited and received by Procon for the following:

- Bulk cement.
- Fabric buildings.
- Concentrator building steel and cladding.
- Temporary and permanent camps.
- Catering.
- Construction equipment.
- Mining equipment.
- Fuel supply.
- Fuel tanks and storage.
- Tires for mining equipment.
- Explosives.
- Geotextiles.
- Process piping.
- Corrugated metal pipe.
- Structural steel.

Productivity

The FEED study estimates of labour productivity were used for the electrical and instrumentation disciplines. For all other disciplines, Procon used estimates of labour productivity based on its experience with similar projects.

21.1.2 Saskatchewan Metals Processing Plant

The capital cost of constructing the SMPP to produce cobalt sulphate was originally estimated by Jacobs in an addendum to the SMPP FEED study. The estimate was judged to have an accuracy of minus 10% to plus 25%, or a lower order of accuracy than the estimate for construction of the facilities at the Project site in the NWT. The Jacobs estimate of initial capital expenditure for the SMPP, however, has subsequently been reviewed and updated by Procon, with input from Fortune.

The Procon estimate of the initial capital cost of constructing the SMPP is expressed in Canadian dollars of fourth quarter 2013 value and has an assessed level of accuracy of plus or minus 15%. This estimate, however, is based on producing 100% of the bismuth in the form of ingots, whereas the present plan is to produce only 20% of the bismuth as ingot, with

60% being produced as bismuth oxide and 20% as bismuth needles. Fortune has estimated, in preliminary fashion, that the capital cost of purchasing and installing the additional equipment required to produce bismuth oxide and needles will be approximately C$750,000. While this estimate has, at best, a scoping study level of accuracy, any upward variation in the cost of this equipment will not have a material effect on the total capital cost of the SMPP.

Procon's estimate of the initial capital cost of constructing the SMPP, including the additional C$750,000 estimated by Fortune, is C$242.5 million, as summarized in Table 21.10. Subsequent sustaining capital expenditures are estimated C$16.4 million, resulting in an estimated life-of-Project capital expenditure of C$258.9 million.

Table 21.10
Summary of SMPP Life-of-Project Capital Cost

Cost Component	Estimated Cost (C$ million)
Direct Pre-Production Capital	165.0
Indirect Pre-Production Capital	77.5
Total Initial Capital	**242.5**
Sustaining Capital	16.4
Total Life-of-Project Capital	**258.9**

21.1.2.1 Direct Pre-Production Capital

The principal categories of direct pre-production capital expenditure for construction of the SMPP are summarized in Table 21.11. The basis for the estimate, and the cost estimation procedures employed, were essentially the same as those described in Section 13.1.10, in relation to the capital cost estimate for the NICO Project site. The scope of the estimate includes all items involved in constructing the SMPP on what is currently an undeveloped greenfield site. As is to be expected, the most significant items in the estimate are process equipment, construction labour and permanent materials, including concrete, structural steel and other steelwork.

Table 21.11
Summary of SMPP Direct Pre-Production Capital

Cost Component	Estimated Cost (C$ million)
Labour	45.9
Permanent Material	31.4
Construction Material	5.9
Process Equipment	57.9
Equipment Purchases and Operation	6.7
Sub-Contractors and Design	17.2
Total	**165.0**

21.1.2.2 Indirect Pre-Production Capital

The principal categories of indirect pre-production capital expenditure for construction of the SMPP are summarized in Table 21.12.

Table 21.12
Summary of SMPP Indirect Pre-Production Capital

Cost Component	Estimated Cost (C$ million)
Labour, Material, Equipment and Sub-Contractors	44.0
Engineering, Procurement and Construction Management (EPCM)	14.0
EPCM Fees	19.5
Total	**77.5**

The estimates summarized in Table 21.12 were prepared using the same basis and the same estimation procedures as those described previously in connection with the capital expenditure estimates for the NICO Project site.

21.1.2.3 Contingency

As was the case for the Project site in the NWT, risk was considered in the updated estimates of direct and indirect capital costs for the SMPP, so that contingency has already been included in the capital cost estimates shown in Table 21.11 and Table 21.12. There were no specific items not included in the estimates that were identified as requiring a separate additional contingency allowance.

21.1.2.4 Basis for the Estimate

Procon's capital cost estimate for the SMPP is based upon the premise that the work will be performed by a single general contractor, with certain specialty work being sub-contracted, including:

- Electrical – terminations only.
- Instrumentation.
- Earthworks, mass excavation to grade, structural excavation, backfill, ponds.
- Building enclosures.
- Masonry.
- Rail.
- Geotextile liners.

The starting point for Procon's capital cost estimate for the SMPP was the FEED study. Procon updated that estimate essentially in the manner described in Section 13.1.10 for the Project site in the NWT.

21.1.3 Adjustments to Capital Expenditure Estimates

Fortune has applied four adjustments to the estimates of initial capital expenditure prepared by Procon, as summarized in Table 21.13.

Table 21.13
Adjustments to Capital Expenditure Estimates

Cost Component	Adjustment (C$ million)
NICO Project Access Road	(10.0)
Mill and Infrastructure Contingency	9.5
Site Layout and Footprint Saving Opportunities	(4.4)
Additional Pre-Stripping Costs of Open Pit	1.6
Total	**(3.3)**

The capital expenditure estimate prepared by Procon for the NICO Project site makes provision for the full cost of the NICO Project Access Road. Fortune anticipates that, between them, the NWT and Tłı̨chǫ governments will contribute a total of C$10 million to the cost of this road.

The mill and infrastructure contingency of C$9.5 million for the Project site in the NWT has been described in Section 21.1.1.8. It consists of the items shown in Table 21.14.

Table 21.14
Contingency Items for Project Site in the NWT

Item	Contingency (C$ million)
Allowance for increase in fuel cost	2.1
Allowance for painting of steel and piping	1.0
Allowance for grounding	0.5
Small vehicle and millwright shop	0.3
Protective concrete wall around concentrator	0.5
Construction incinerator	0.3
Allowance to widen road as emergency airstrip	0.5
Labour for above work	3.8
Catering for above work	0.8
Total	**9.3**
Rounded to	**9.5**

The current design layout for the Project site in the NWT shows that:

- The mine access road has a section requiring a very deep cut.
- The camp, service building, mine dry, primary and secondary crusher, fine ore storage and concentrator building are all at the same elevation.

Under this design, excavation for the site area amounts to about 565,000 m^3. Procon believes that, with realignment of the layout during detailed engineering, the quantity of excavation can be reduced by approximately 150,000 m^3, resulting in a saving of C$4.4 million.

The additional C$1.6 million for pre-stripping of the open pit relates to freight charges during the pre-production period that had been included in operating costs, but have now been transferred by Fortune to initial capital expenditure.

21.2 OPERATING COSTS

The costs of operating the facilities at the NICO Project and those at the SMPP have been estimated separately. The total estimated life-of-Project operating costs are summarized in Table 21.15.

Table 21.15
Estimated Life-of-Project Operating Costs

Location	Life-of-Project Cost (C$ million)	Average Annual Cost (C$ million)	Average Unit Cost (C$/t ore milled)
NWT	1,313.6	65.7	39.71
SMPP	599.1	30.0	18.11
Total	**1,912.7**	**95.7**	**57.82**

The average annual costs shown in Table 21.15, and all average annual costs quoted subsequently herein, are based on a Project life of 20 years. The operating cost shown in Table 21.15 for the NWT includes the cost of transporting the bulk concentrate from the Project site to the SMPP.

21.2.1 NICO Project Site, NWT

The estimated operating costs for the NICO Project site have been categorized in the financial model under the headings of open pit mining operations, underground mining operations, mill operations, shared services and camp costs, and bulk concentrate transport from the Project site to the SMPP. The operating cost estimates were developed by Procon and Fortune based on the work of various third party engineering companies, consultants and contractors which were responsible for developing the estimates for the scope of work in their respective areas of expertise. Shared services, such as camp, maintenance, general and administration and other supporting infrastructure services were categorized to avoid duplication and to ensure that all required support services for the various Project areas were included.

The primary contributors listed in Table 21.16 were responsible for preparation of the original cost estimates for the FEED study, which was the starting point for the estimates prepared by Procon.

Table 21.16
Operating Cost Estimate, Primary Contributors

Contributors Name	Scope of Work
Jacobs Minerals Canada Inc., formerly Aker Solutions	Front-End Engineering and Design (FEED) and cost estimate study completed on the NICO concentrator and related infrastructure, and the SMPP.
P&E Mining Consultants Inc.	Mining - open pit and underground
Golder Associates Ltd.	Tailings thickener and underflow pumps Tailings management facilities Effluent treatment facility Co-disposal facility
International Quest Engineering Ltd	Service building/truck shop/mine dry (included in Jacob's FEED study capital cost)
EBA Engineering Consultants Ltd.	Main access road (included in Jacob's FEED study capital cost)

A summary of the estimated life-of-mine operating costs for the Project site in the NWT is provided in Table 21.17.

Table 21.17
Summary of Estimated Life-of-Mine Operating Costs at the Project Site

Cost Centre	Life-of-Mine Cost (C$ million)	Average Annual Cost (C$ million)	Average Unit Cost (C$/t total ore mined)
Open Pit Mining	271.2	13.6	8.20
Underground Mining	52.7	2.6	1.59
Processing (NWT)	422.4	21.1	12.77
Shared Services	355.2	17.8	10.74
Concentrate Transport	212.1	10.6	6.41
Total	**1,313.6**	**65.7**	**39.71**

These estimates are expressed in Canadian dollars of fourth quarter, 2013 value and have an assessed level of accuracy of plus or minus 15%.

21.2.1.1 Open Pit Mine Operating Costs

The original basis of the open pit mine operating costs is the mine plan developed by P&E. The open pit will be a conventional mining operation utilizing proven drilling, blasting, loading and hauling technologies. The operating cost estimate is based on Fortune conducting all open pit operations, with its own personnel and equipment, following an initial period in which a contractor will perform initial pre-production development stripping. Fortune's equipment fleet will then be phased in progressively. A specialist contractor employed by Fortune will be responsible for the supply of all explosives and blasting accessories. Fortune intends to lease most of the major open pit mining equipment and the ongoing leasing and equipment operating costs are included within the sustaining capital and operating cost estimates, respectively.

Procon developed the detailed operating costs using categories of equipment usage (fuel, lubricants, parts, maintenance, tires and other consumables), materials (open pit, drilling and blasting), direct and indirect labour and contractor costs. The financial model used for the economic analysis summarizes these cost estimates by categories of labour, parts, drilling, blasting and explosives, and other costs. Certain shared labour and equipment, assumed to be available to support the mining operations, have been accounted for in shared services costs.

LOM open pit mining costs are estimated at C$271.2 million, as shown in Table 21.18.

Table 21.18
Total Open Pit Mining Costs for Life-of-Mine

Open Pit Mining	Total Cost (C$ million)	Unit Cost (C$/t mined)	Unit Cost (C$/t total ore)
Labour costs	104.9	3.23	3.17
Parts costs	111.5	3.43	3.37
Blasting/explosives cost	51.8	1.59	1.57
Other costs	23.5	0.72	0.71
Sub-Total	**291.8**	**8.97**	**8.82**
Freight transferred to capital	(1.6)	(0.05)	(0.05)
Pre-stripping transferred to sustaining capital	(19.0)	(0.58)	(0.57)
Total Open Pit	**271.2**	**8.34**	**8.20**

Detailed staffing levels for the open pit are included in the Procon mine plan and schedule. The proposed shift cycle, for all hourly workers, is a 12-hour shift schedule, based on 21 days on and 21 days off. The open pit will operate for 24 hours per day, 360 days per year.

Annual salary and hourly wages, benefits, allowances and burden rates, for the various job classifications, are based on data collection of local labour rates by Procon and Fortune. The typical open pit manpower complement estimated by Procon is provided in Table 21.19.

Table 21.19
Open Pit Mining Operations Labour Complement

Description		Day Shift	Night Shift	Employees to be Hired
Drilling				
	Operator, drill	2	2	8
Blasting				
	Blaster	1	1	4
	Helper	2	2	8
Loading				
	Operator, hydraulic shovel	1	1	4
	Operator, 992 loader	1	1	4
	Operator, dozer D10	1	1	4
Hauling				
	Operator, haul truck	6	6	24
CDF Operations				
	Labourer	1	0	2
	Operator, dozer D10	1	1	4
	Operator, excavator	1	0	2
Supervision and support				
	General superintendent	1	0	2
	Safety co-ordinator/mine rescue	1	0	2

Description		Day Shift	Night Shift	Employees to be Hired
	Operator, foreman	1	1	4
	Maintenance planner	1	0	2
	Blast technician	1	1	4
	Surveyor, rodman	1	0	2
	Surveyor	1	0	2
	Mechanic	4	2	12
	Tire technician	1	1	4
TOTAL		**29**	**20**	**98**

21.2.1.2 Underground Mine Operating Costs

All underground mining will be performed by a contractor and the contract mining cost estimates are based on quoted rates from Procon. Supporting labour, equipment and power are included in the shared services operating cost estimate.

Underground mine operating costs have been estimated by Procon, based on the underground mining plan developed by P&E and subsequently modified by Fortune. The estimated costs take into account the Fortune October 22, 2012 Technical Memorandum, Case Scenario 2, which concludes that the East Zone and the Bottom West Zone should also be included in the underground mining program. The underground mine operating costs include the labour, equipment and materials required to extract 577,000 tonnes of ore by underground mining methods over a 16-month production period.

Total underground mining costs are estimated at C$52.7 million, comprising direct contract costs of C$47.1 million and contractor's fee of C$5.6 million. The total cost is equivalent to approximately C$91.40/t of underground ore mined.

Staffing levels to support the underground mining are based on the P&E mine plan and manpower requirements. A standardized, 12-hour shift schedule, based on 21 days on, 21 days off, is assumed, including allowance for operations and maintenance support. The underground mine will operate on a 24-hours per day, 365-days per year basis. The clerical support is assumed to only be required 40 hours per week.

Annual salary and hourly wages, benefits, allowances and burden rates for the various job classifications are based on research performed by Procon for local labour rates. The typical underground operations manpower complement estimated by Procon is provided in Table 21.20.

Table 21.20
Underground Mining Labour Complement

Description		Day Shift	Night Shift	Employees to be Hired
Mining				
	Miner	10	10	40
	Longhole driller	1	1	4
	Longhole blaster	0	1	2

Description		Day Shift	Night Shift	Employees to be Hired
	Operator, scoop tram	1	1	4
	Operator, truck	2	2	8
	Operator, surface	1	0	2
Supervision and Support				
	General superintendent	1	0	2
	Mine engineer	1	0	2
	Geologist	1	1	4
	Safety supervisor	1	0	2
	Clerk / expeditor	1	0	2
	Blasting supervisor	1	0	2
	Shift boss	2	2	8
	Surveyor	1	1	4
	Lead mechanic	1	0	2
	Mechanic	5	4	18
	Electrician	1	1	4
Total		**31**	**24**	**110**

21.2.1.3 Mill and Related Infrastructure

The operating costs for the mill and related infrastructure at the NICO Project site are based on the estimated direct costs for processing a nominal annual throughput of 1.695 Mt of run-of-mine ore, as per the production schedule developed by P&E, Procon and Fortune. The concentrator availability has been assumed at 90% (7,884 h/y), which incorporates both scheduled and unscheduled shutdowns. The process operating costs were estimated by Procon.

The mill operating costs comprise the labour workforce to operate the mill, reagents, consumables and power required for the process, mechanical and electrical supplies to maintain the operation, and freight FOB Edmonton to deliver material and consumables to the NICO Project site.

A thorough review and update of the operating cost estimate was performed by Procon, using the Aker Solutions (Jacobs) FEED study report, as well as the associated NICO financial model provided by Fortune that was based on the FEED study and the Technical Report by Puritch et al., 2012. Secondly, a review of the FEED process operating costs was performed by Worley Parsons. The Worley Parsons review examined the operating consumables (quantities and pricing), evaluated the general estimating procedure, conducted spot comparison on high cost items and compiled comparative cost rates, but did not include a check of the associated design or source information.

The NICO mill and related infrastructure operating costs over the life of the mine are C$422.4 million and are summarized in Table 21.21.

Table 21.21
Estimated LOM Mill Operations Operating Costs

Category	Costs Life of Mine (C$ million)	Unit Costs Life of Mine (C$/t milled)
Labour	129.0	3.90
Power	158.8	4.80
Reagents and consumables	105.8	3.20
Mechanical and electrical supplies	28.8	0.87
Total Mill Costs	**422.4**	**12.77**

Diesel fuel costs are based on equipment usage rates and a unit cost of C$1.00/L, as supplied by Procon. The delivery cost to the NICO site is included. A cost of US$97.25/barrel of oil was used as a basis from which to estimate the delivered cost of diesel fuel. Diesel fuel will be required for the mine mobile equipment, for the standby diesel-driven electric generators and other miscellaneous uses. Electric power will be supplied directly from the Snare Hydroelectric Complex, at an estimated cost of C$0.17/kWh.

Plant Labour

The process plant operating schedule is based on a four-shift rotation of 12-h shifts, using a 3-week on, 3-week off cycle. Non-shift labour is based on a 40-h work week. Transportation will be provided from the mine site to Yellowknife and local settlements, as required. It is assumed that labour for the entire complex will be locally based.

A master labour list (see Table 21.22) and labour rates were supplied by Procon, and were used as the basis for estimating the process manpower costs. The labour rates were updated by Procon to fourth quarter, 2013.

Table 21.22
Processing Plant Labour Complement

Description		Day Shift	Night Shift	Employees to be Hired
Process Plant				
	Concentrator superintendent	1	0	1
	Metallurgist	1	0	2
	Plant shift foreman	1	1	4
	Crushing operator	1	1	4
	Grinding operator	1	1	4
	Flotation operator	1	1	4
	Product dewatering operator	1	1	4
	Tailings operator	1	1	4
	Plant helper	1	1	4
Analytical Group				
	Chief laboratory analyst	1	0	1
	Senior assay technician	1	0	2
	Assay technician	1	0	2
	Sample preparation operator	1	1	4
Power and Maintenance Group				
	Maintenance superintendent	1	0	1

Description		Day Shift	Night Shift	Employees to be Hired
	Plant maintenance lead hand	1	0	2
	Maintenance planner	1	0	1
	Reliability engineer	1	0	1
	Plant millwright	2	1	6
	Plant welder/pipefitter	1	0	2
	Electricians	1	1	4
	Electrical apprentice	1	0	2
	Instrumentation technician	1	0	2
Total		**23**	**10**	**61**

Procon OPEX Due Diligence, February 19, 2014.

Power

Power consumption estimates have been adopted from an electrical load analysis developed in the FEED study by Jacobs. The annual power consumption was estimated by multiplying the estimated drawn load from the load analysis by 24 hours and 365 d/y. The power consumptions and costs were estimated for each individual site area.

Power costs are based on an average continuous power demand which has been calculated from the total installed power by applying various process utilization and mechanical efficiency factors. The predicted ball mill specific power requirement was obtained from interpretation of grinding data by sub-consultants who are leading experts in ball mill design.

The power demands for the process plant and other site areas are given in Table 21.23.

Table 21.23
NICO Site Average Power Demand

Area	Drawn Load (kW)	Annual Utilization Factor	Average Operating Load (kW)	Annual Power Consumption (MWh)
Concentrator - Crushing and Fine Ore Storage	733	0.375	275	2,409
Concentrator - Grinding, Flotation, Thickening, Load-out	4,402	0.900	3,962	34,708
Tails Handling	744	0.900	669	5,863
Utilities and Reagents	495	0.900	446	3,906
Assay Labratory	22	1.000	22	192
Service Area and Miscellaneous	521	1.000	521	4,560
Total, Excluding Underground	**6,917**		**5,895**	**51,638**
Underground	1,313	0.950	1,248	10,929

The average estimated power consumption for the NICO site, excluding the underground mine, is 31.0 kWh/t milled.

Reagents and Consumables

Commodity usage rates were developed from testwork and mass balance calculations. Unit pricing for commodities was obtained through direct quotations from vendors, between the third quarter of 2009 and the fourth quarter of 2011. These rates were updated by Procon for the fourth quarter, 2013 estimate.

The types and consumptions of supplies and consumables were estimated in the FEED study, based on testwork by SGS-MS, the process design criteria, process calculations, vendor information and previous experience on similar projects by Jacobs.

Annual consumptions of the reagents and consumables are summarized in Table 21.24. The annual reagent and consumables costs are estimated C$5.3 million, including the cost of transportation to site. This results in a life-of-mine reagents and consumables cost of C$105.8 million.

Table 21.24
Estimated Annual Reagents and Process Consumables Consumption

Reagents and Consumables	Consumption (t/y)
PAX	542
MIBC	98
Flocculant - concentrate thickener	4.9
Flocculant - tailings thickener	51
Grinding balls	769
Colorado sand	190
Crusher linings	61
Ball mill lining sets	20 sets
Regrind mill lining sets	2.7 sets

The unit prices for supplies and consumables used in the operating cost estimates are summarized in Table 21.25. The unit prices were provided by various vendors and Procon. Prices are FOB Edmonton and do not include transportation costs, with the exception of the reagents and consumables associated with tailings.

Table 21.25
Reagents and Process Consumables Unit Costs

Reagents and Consumables	Cost[1] (C$/t)
PAX	3,133
MIBC	3,857
Flocculant - concentrate thickener	3,975
Flocculant - tailings thickener	3,975
Grinding balls	1,304
Colorado sand	603
Primary crusher linings	4,622
Ball mill linings	511,298 (C$/set)
Regrind mill linings	53,677 (C$/set)
Fuel	1.00 (C$/L)[3]
Lubricant	3.38 (C$/L)

Table 21.26 summarizes the costs used for transportation of material from Edmonton to site, as used in the FEED study. The cost of transporting bulk liquor was based on a quoted cost of C$10,000 from Edmonton to Behchokö to the NICO site for a 62.5-t capacity tanker. The bulk solids cost was based on a quoted cost of C$7,000 in a 43-t capacity B-train. The calculated fuel surcharge cost, based on the distance from Edmonton to site, and the cost for bridge tolls, which was obtained by Fortune, were based on rates quoted at the time of the FEED study.

Table 21.26
Reagents and Process Transportation Costs – FEED Study

Transportation Cost	Cost[1] (C$/t)
Bulk Liquor	160
Bulk Solids (drums, bags)	163
Fuel Surcharge for Bulk Solids	35
Bridge Toll	4.3[2]

[1] Unit costs are supplied by Jacobs except where noted.
[2] Cost supplied by Fortune but converted to a per tonne basis by Jacobs.

Freight costs were updated by Procon to fourth quarter, 2013 estimates. The transportation of material to site was estimated and categorized as shown in Table 21.27.

Table 21.27
Transportation Cost – Procon

Area	Estimated Freight Cost (C$ million)	
	Life-of-Project	Annual Average
Open Pit Mine	18.0	0.90
Mill	17.0	0.85
Shared Services	10.8	0.54
Catering	2.4	0.12
Total	**48.2**	**2.41**

The freight costs shown in Table 21.27 were estimated as follows:

- Open pit mine : C$1,500/d
- Mill : 200 loads per year at C$8,500 per load.
- Shared services : C$1,500/d.
- Catering : 345,000 lb/y at C$0.35/lb.

Maintenance

The annual mechanical and electrical maintenance supplies cost was established by Procon and Fortune, based on experience, industrial standards and established maintenance values from operating concentrator plants similar to the NICO facility. Maintenance supplies for the mill are estimated at C$1.45 million per year, resulting in life-of-mine operating costs of C$28.8 million or $0.87/t milled.

21.2.1.4 Shared Services

Operating costs for shared services include items not otherwise captured in the estimates for the NICO mill and related infrastructure, underground mining, open pit mining and concentrate transportation, that are required in order to operate the mine and mill. As such, shared services are utilized within multiple areas of the Project. Shared services costs over the life of the mine are estimated at C$355.2 million and are summarized in Table 21.28.

The shared services and camp costs estimated by Procon and Fortune include management and administration personnel, catering and travel expenses for all site personnel, allowances for small tools and equipment, safety and unscheduled downtime, shared equipment, maintenance personnel, sustaining freight, insurance and property taxes, as well as the specific shared tasks of haulage and access road maintenance and crusher stockpile management.

The permanent camp complex will be available at the start of operations to accommodate the anticipated manpower required to operate the NICO facility.

Table 21.28
Summary of LOM Estimated Shared Services Costs

Shared Services	LOM Cost (C$ thousand)	Unit Cost (C$/t)
Road Maintenance		
Haul Road Labour	7,372	0.22
Haul Road Equipment	6,683	0.20
All Weather Road Winter	15,351	0.46
All Weather Road Summer	8,370	0.25
Subtotal	**37,776**	**1.14**
Manage Stockpile at Plant		
Labour	4,909	0.15
Equipment	7,289	0.22
Sub-total	**12,198**	**0.37**
Equipment		
Service Equipment	2,160	0.07
Repair Equipment	27,220	0.82
Shared Equipment	3,783	0.11
Shared Equipment Sustaining Capital	2,502	0.08
Shared Equipment Ownership	2,899	0.09
Sub-total	**38,564**	**1.17**
Small Tools and Equipment and Safety (STE&S)		
Small Tools	8,203	0.25
Safety	6,899	0.21
Sub-total	**15,102**	**0.46**
Mine Management and Administration (M&A)		
M&A labour	72,965	2.21
Office Supplies and Software	3,013	0.09

Shared Services	LOM Cost (C$ thousand)	Unit Cost (C$/t)
Communication Charges	2,360	0.07
Sub-total	**78,338**	**2.37**
Catering and Travel		
Catering	49,055	1.48
Travel	44,174	1.34
Sub-total	**93,229**	**2.82**
Insurance and Property Taxes		
Insurance	15,216	0.46
Property tax	37,824	1.14
Sub-total	**53,040**	**1.60**
Total	**328,247**	**9.92**
Shared Sustaining Freight	10,800	0.33
Catering Freight	2,415	0.07
Sustaining Capital - Shared Equipment	(2,502)	(0.08)
Large Equipment Assembly classified as Shared Services	38	0.00
Power allocated to Shared Services	16,174	0.49
Total	**355,172**	**10.74**

Shared Services Labour

The labour costs of shared services are derived from the labour complement listed in Table 21.29.

Table 21.29
General and Administration Labour for the Mill and Shared Services

Description		Day Shift	Night Shift	Employees to be Hired
Administration and Accounting				
	Mine Manager	1	0	1
	Executive Assistant	1	0	1
	Accounting Clerk	2	0	4
Human Resources and Community Relations				
	HR Coordinator	1	0	1
Environmental Services				
	Environmental Superintendent	1	0	1
	Environmental Technologist	1	0	2
Health and Safety				
	Safety Coordinator/Mine Rescue	1	0	2
	Security/first aid	1	1	4
Warehouseman and Purchasing				
	Warehouseman	1	0	2
	Stores and Logistics Clerk	1	0	2
	Whati Town Runner	1	1	4
	Dryman / Janitorial	1	1	4
Open Pit Mine Engineering				
	Mine Engineer	1	0	2
	Geologist	1	0	2
	Technician	1	1	4
	Engineering Clerk	1	0	2

Description		Day Shift	Night Shift	Employees to be Hired
Shared Operations				
	Operator, Haul and Site Roads	2	0	4
	Operator, All-Weather Road	3	0	6
	Operator, Loader (stockpile)	1	0	2
	Mechanic (maintenance shop)	6	2	16
Subcontractors				
	Bulk concentrate truckers	4	0	0
	Camp personnel	10	0	0
Guests				
	Vendors, Senior Staff, etc.	10	0	0
Total		**53**	**6**	**66**

Note: Subcontractors and guests require lodging but are not included as employees to be hired.

Infrastructure and other administrative operating costs were updated from the FEED study by Procon with input from Fortune, based on experience at comparable operations. The infrastructure items comprise all general site activities, including building and office maintenance, surface vehicle maintenance, incinerator maintenance, equipment maintenance, heating and ventilation, domestic waste storage and treatment, potable water treatment, garbage disposal, recycling storage and disposal, and other general site needs. Other general and administration items and allowances were included to address costs not otherwise estimated. These include insurance and property taxes.

Insurance costs were estimated based on a preliminary scope and rate estimates provided by an insurance broker in the industry. Property tax costs were estimated based on current legislated NWT property tax rates, applied to an estimate of the taxable property. Total life-of-mine insurance costs and property taxes are estimated at C$53 million, or approximately C$2.65 million per year.

21.2.1.5 Transportation of Concentrate

The cost of transporting the bulk concentrate produced at the NICO Project site to the SMPP for further processing is estimated at approximately C$200 per dry tonne of concentrate, based on the FEED study estimate. This estimate includes the following components:

- Packaging of bulk concentrate at site: approximately C$3.20 per dry tonne concentrate.
- Trucking from site to Hay River: approximately C$86.50 per dry tonne concentrate.
- Transloading to rail at Hay River: approximately C$8.00 per dry tonne concentrate.
- Rail haulage, Hay River to SMPP: approximately C$102.10 per dry tonne concentrate.

The total life-of-mine provision included in the financial model for transportation of concentrate is C$212.1 million, equivalent to approximately C$10.6 million per year.

21.2.2 Processing Concentrate at the SMPP

Life-of-mine operating costs for the SMPP are estimated to be C$599 million or C$564/t of concentrate treated.

The operating cost estimates for the SMPP are based on the Jacobs FEED study and the addendum thereto. Two operating costs are presented by Jacobs. One option, for the production of cobalt cathodes by electrowinning, was prepared at an accuracy plus or minus 15%, whereas the alternative to produce cobalt sulphate heptahydrate was prepared at a prefeasibility level, with an overall accuracy of minus 10%, plus 25%. This Feasibility Study is based on producing cobalt sulphate and a summary of the estimated average annual unit costs for that alternative is provided in Table 21.30.

The FEED study was also based on the production of bismuth as ingot, whereas it has now decided to convert most of the ingot into bismuth oxide, based on the current market analysis. Fortune has estimated, grossly, that the incremental cost of producing the oxide will be C$0.10/lb of contained bismuth. This additional cost has been accounted for by a reduction of C$0.10/lb in the price to be received for bismuth in oxide.

Table 21.30
Summary of Jacobs SMPP Operating Cost Estimates

Description	LOM Cost (C$ million)	Cobalt Sulphate Option (C$/t Concentrate)
Labour	164,115	154.50
Power	65,811	61.95
Reagents	203,135	191.23
Maintenance supplies	91,282	85.93
Infrastructure	63,694	59.96
Equipment	11,083	10.43
Total	**599,120**	**564**

The operating costs for the SMPP were updated by Fortune but originally developed by Jacobs, using the following criteria:

- Labour costs assume 24 h/d operations and are based on a four-shift rotation of 12-h shifts using a 4-days-on, 4-days-off cycle. Non-shift labour is based on a 40-h work week.
- A master labour list and labour rates were supplied to Jacobs by Fortune, and were used as the basis for estimating the manpower costs. A total of 93 people will be required for the process plant.

- Commodity usage rates were developed from testwork and mass balance calculations. Unit pricing for commodities was obtained through direct quotations from various vendors, between the last quarter of 2009 and the second quarter of 2010.

- Electrical power costs used C$0.0583/kWh as the power rate, based on the relevant SaskPower rates (E23 rate code).

- Natural gas costs were estimated on equipment usage rates and a unit cost of C$6.218/GJ, based on SaskEnergy rates.

- Annual maintenance costs for the SMPP facility were estimated using a percentage of the installed mechanical and electrical equipment cost by operating area, as well as mobile equipment cost. The allocated percentages, ranging from 3.0% to 5.5% of the installed costs, were selected using both Aker Solutions and Fortune's past experience with similar projects.

- Miscellaneous SMPP costs were taken from Jacobs' data bank and include costs incurred by the process plant, such as personal protective equipment, et cetera.

- Costs for the Bismuth CLER circuit were provided by Dan Mackie & Associates, hydrometallurgical consultant.

All cost data presented in the SMPP FEED study were based on first quarter 2010 Canadian dollars.

21.2.2.1 Basis of the SMPP FEED Study Operating Cost Estimate

The operating costs for the SMPP were based on the estimated direct costs for processing a nominal annual throughput of 67,188 wet t/y of bulk concentrate (at 8 wt% moisture) or the equivalent of 1.695 Mt of ROM ore. The processing facility availability was assumed at 85% (7,446 h/y), which incorporates both scheduled and unscheduled shutdowns.

The actual final study design annual production rate is 54,500 dry t/y of concentrate or 59,300 wet t/y.

21.2.2.2 SMPP Labour

The estimated labour costs and the manpower requirements on an annualized basis are presented in Table 21.31, based on the FEED study, with minor reductions in personnel due to optimization of the labour force for the production of cobalt sulphate.

Table 21.31
SMPP Labour List and Costs

Position	Number	Annual Cost ($ thousand)
Plant superintendent	1	143
Metallurgist	2	238
Plant shift foreman	4	446
Chief laboratory analyst	1	110
Maintenance superintendent	1	118
Reliability engineer	1	106
Metallurgical technologist	2	161
Trainer	1	92
Control room operator	4	412
Feed handling operator	4	295
Regrind and flotation operator	4	323
Bismuth CLER operator	6	533
Gold recovery operator	4	355
Autoclave/boiler operator	4	540
Copper cementation operator	4	323
Co solvent extraction operator	4	355
Tailings handling operator	4	295
Plant helper	4	267
Assay technician	4	323
Senior assay technician	1	92
Plant millwright	6	670
Plant welder	2	192
Plant pipefitter	2	223
Electrician	4	412
Instrument mechanic	2	206
Water treatment technician	1	81
Total	**77**	**7,311**

21.2.2.3 SMPP Power Costs

Power consumption estimates are based on the FEED study electrical load analysis conducted by Jacobs. The annual power consumption, in megawatt-hours (MWh), was estimated by multiplying the installed power and applying various process utilization and mechanical efficiency factors. The power consumptions and costs were estimated for the individual plant areas.

The unit energy cost was estimated using the then current SaskPower E23 rate code of C$0.0583/kWh. This rate incorporates the basic charges of C$5,534/month, demand charges of C$5.251/kVA/month and energy charges of C$0.04553/kWh. Estimated annual power costs are summarized in Table 21.32.

Table 21.32
SMPP Estimated Annual Power Costs

Area	Connected Load (kW)	Annual Energy Consumption (MWh)	Annual Power Cost ($ thousand)
SMPP flotation circuit	1,283	5,942	341
Bismuth CLER circuit	1,885	13,584	754
Cobalt circuit	3,332	13,384	772
Gold circuit and tailings	1,305	4,655	276
Utilities and reagents	5,287	21,074	1,206
SaskPower monthly charges	-	-	66
Total			**3,415**
C$/t dry concentrate			**61.95**

21.2.2.4 SMPP Maintenance Costs

The annual maintenance costs in the FEED study were estimated using industry standard factors applied to the direct capital costs of all installed mechanical equipment, piping, electrical equipment and instrumentation. A percentage of 5.5% was allowed for the autoclave area, 5.0% for water treatment plants and pressure filter areas, 4.0% for filter press and mill areas and 3.0% for areas only requiring piping, such as the natural gas and oxygen area. The rest of the plant was given a baseline of 3.5%.

The average unit maintenance cost over the life of the Project was estimated at C$85.93/t of dry concentrate treated.

21.2.2.5 Reagents and Consumables

The bases for the selected supplies and consumables, and consumption rates, include testwork conducted at SGS, the process design criteria, process calculations, METSIM® modelling, vendor information, and Jacobs' experience with similar projects. Consumption calculations were based on the average bulk concentrate composition over the life of the Project.

The unit prices used in the FEED study were obtained from various vendors, between the last quarter of 2009 to the second quarter of 2010. Prices were FOB Saskatoon, Saskatchewan and do not include transportation costs to site.

The total average FEED study unit cost for consumables and reagents was C$199.93/t of dry concentrate. Subsequent adjustments by Fortune have reduced this estimate to C$191.23/dry tonne. The major cost items include sodium carbonate (C$36.42/t), lime ($34.42/t), sulphuric acid (C$15.93/t), sodium hydroxide (C$10.33/t) and nickel IX resin (C$9.62/t).

21.2.2.6 SMPP Equipment Costs

The plant mobile equipment costs include those costs incurred for fuel, parts and maintenance. This cost was estimated to be C$48,000/y.

21.2.2.7 SMPP General and Administration (G&A) Costs

The SMPP G&A operating costs are the expenses of cost centres that are not directly linked to the process disciplines These costs include infrastructure, general administration and insurance costs and were estimated using either first principles or experience at other similar operations. A summary of the G&A operating cost is shown in Table 21.33.

Table 21.33
Summary of Estimated G&A SMPP Annual Costs

Area	Life-of-Mine Cost (C$ million)
Infrastructure	8.5
General, administration, other	32.9
Insurance	22.3
Total	**63.7**
C$/t dry concentrate	**60.0**

21.2.2.8 Contingency

There was no overall contingency applied to any of the Project site or SMPP operating cost estimates.

22.0 ECONOMIC ANALYSIS

22.1 METHODOLOGY

Fortune has evaluated the overall economics of the NICO Project by conventional discounted cash flow techniques, under the presumption that the initial capital expenditure will be financed 30% by equity and 70% by debt. The financial model consists of a comprehensive series of linked spreadsheets which, together, provide detailed estimates of all elements of production, revenue and cost associated with the construction and operation of the Project. All revenues and costs are expressed in Canadian dollars, typically of fourth quarter, 2013 value. Metal prices denominated in US dollars have been converted to Canadian currency at an exchange rate of C$1.00 = US$0.88. This exchange rate has been assumed to remain constant throughout the life of the Project.

The Fortune financial model has a base date of January 1, 2015 and estimates production, revenue and cost on a monthly basis for the first four years of the Project life (2015 to 2018), on a quarterly basis for the following two years (2019 and 2020) and annually thereafter, until the forecast end of production in 2037.

Micon has confirmed the mathematical integrity of the Fortune financial model by independently reproducing the results on an annual basis, within very close limits. The summary cash flow tabulation presented in this report has been compiled by Micon. It differs marginally from the Fortune model in certain areas, as a result of minor rounding and timing differences. None of the differences is in any way material to the overall result.

22.2 SUMMARY OF RESULTS

A summary of the results of the base case financial analysis is presented in Table 22.1. All production, revenue and cost data are life-of-Project estimates.

Under the base case input estimates, the NICO Project is expected to yield an after-tax undiscounted life-of-Project cash flow of C$837 million, a net present value of C$224 million at a discount rate of 7% per year, and an after-tax internal rate of return of 15.1% per year. The equivalent pre-tax economic indices are a net present value of C$254 million at a discount rate of 7% per year, and an internal rate of return of 15.6% per year.

Table 22.1
Summary of Base Case Financial Analysis

Item	Units	Value
Mine Life	y	20
Open Pit Ore Mined	thousand t	32,500
Underground Ore Mined	thousand t	577
Concentrate Produced	thousand t	1,062
Gold Produced	thousand oz	814.4
Cobalt Produced (in sulphate)	thousand lb	69,526

Item	Units	Value
Bismuth Produced	thousand lb	73,656
Copper Produced	thousand lb	11,195
Gross Revenue	C$ million	3,842
Transport, Refining, Marketing	C$ million	246
Net Smelter Return	**C$ million**	**3,596**
Mine and Mill Operating Costs	C$ million	746
Other Site Operating Costs	C$ million	359
SMPP Operating Costs	C$ million	599
Operating Profit	**C$ million**	**1,892**
Corporate Administration, Interest, Fees	C$ million	212
Royalties, Income Taxes	C$ million	141
Cash Flow Before Capital Costs	**C$ million**	**1,540**
Initial Capital Costs – Project Site	C$ million	347
Initial Capital Costs – SMPP	C$ million	242
Sustaining Capital Costs, Working Capital	C$ million	60
Reclamation Security Funding	C$ million	53
Net Cash Flow	**C$ million**	**837**
Pre-Tax Present Value (7%/y discount)	C$ million	254
Post-Tax Present Value (7%/y discount)	C$ million	224
Pre-Tax Internal Rate of Return	%/y	15.6
Post-Tax Internal Rate of Return	%/y	15.1

The base case projections of annual production, revenue and cost are shown in Table 22.2, while further details of the input estimates to the base case financial model are provided in the following sections of this report.

22.3 REVENUE

The projected annual production of saleable gold, cobalt, bismuth and copper has been shown previously in Table 8.3, the hydrometallurgical plant production schedule, which, in turn, has been derived from the mine and mill production schedules contained in Table 16.1 and Table 17.2, respectively. The annual quantities of payable metals have been converted to gross annual revenues using the base case metal prices summarized in Table 22.3. Cobalt is to be produced and sold as cobalt sulphate, and the price of cobalt in sulphate is estimated at 119% of the price of cobalt metal. Bismuth is to be produced and sold 20% as bismuth ingot, 20% as bismuth needles and 60% as bismuth oxide. The prices used in the financial analysis are US$10.50/lb for ingot, US$11.00/lb for needles and net US$13.90/lb of contained bismuth for oxide, resulting in a weighted average price of US$12.64/lb. The price of bismuth contained in oxide is based on a market price of US$14/lb, less an allowance of US$0.10/lb for the additional processing required. Copper is to be produced as cement. The price of copper contained in cement has been calculated as the base price of US$3.25/lb, minus the costs of transportation, smelting and refining.

Table 22.2
NICO Project Cash Flow

	Total	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
PRODUCTION DATA																									
Open Pit Ore Mined (thousand tonnes)	**32,500**			17	460	1,443	1,488	1,487	1,661	1,749	1,696	1,695	1,700	1,708	1,691	1,698	1,707	1,713	1,692	1,640	1,659	1,798	1,658	1,703	438
Open Pit Waste Mined (thousand tonnes)	**97,810**			4,917	11,009	5,377	4,462	7,136	3,504	4,081	7,463	7,375	6,292	4,543	3,779	3,765	3,846	2,839	2,853	3,313	2,653	1,578	4,291	2,331	403
Underground Ore Mined (thousand tonnes)	**577**					273	304	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Reclaimed from Stockpile (thousand tonnes)	**507**				21	0	7	212	37	0	3	3	0	0	7	0	0	0	7	58	39	0	40	0	71
Ore Milled (thousand tonnes)	**33,078**				324	1,673	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	1,698	509
Concentrate Treated (thousand dry tonnes)	**1,062.3**				10.4	53.7	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	54.5	16.3
Concentrate Treated (thousand wet tonnes)	**1,154.6**				11.3	58.4	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	59.3	17.8
Gold Sold (thousand ounces)	**814.4**				1.2	35.3	52.5	14.0	10.7	18.6	48.6	49.8	73.3	65.3	19.5	20.0	18.2	18.8	24.7	33.3	53.4	116.7	31.2	82.0	27.4
Cobalt Sold (thousand pounds)	**69,526**				256.1	4,193.7	3,318.6	3,744.6	4,075.2	4,030.3	3,634.4	3,515.8	2,837.0	3,801.3	3,976.7	3,898.9	3,720.0	3,672.9	3,546.2	3,415.3	2,913.4	3,141.3	2,822.0	3,390.5	1,621.5
Bismuth Sold (thousand pounds)	**73,656**					4,623.1	3,216.7	3,106.7	3,741.8	4,564.5	5,161.1	4,718.2	4,273.1	3,413.7	3,965.5	4,660.3	4,852.9	4,584.1	4,019.8	3,792.8	3,347.9	2,268.6	3,311.7	1,657.4	376.5
Copper Sold (thousand pounds)	**11,195**					316.0	191.4	462.1	594.0	764.9	677.7	519.7	383.1	308.6	318.6	433.0	701.7	945.7	1,140.3	1,072.7	711.4	248.0	761.8	517.0	127.3
METAL PRICES																									
Gold Price (US$/ounce)				1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350	1,350
Cobalt Price (US$/pound)				16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
Price of Cobalt in Sulphate (US$/pound, plus 19%)				19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04	19.04
Bismuth Price (US$/pound)				12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64	12.64
Copper Price (US$/pound)				2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38	2.38
Exchange Rate (US$/C$)				0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
Gold Price (C$/ounce)				1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534	1,534
Cobalt Price (C$/pound)				18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18	18.18
Price of Cobalt in Sulphate (C$/pound)				21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64	21.64
Bismuth Price (C$/pound)				14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36	14.36
Copper Price (C$/pound)				2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70	2.70
REVENUE AND EXPENDITURE (C$ thousand)																									
Gross Revenue from Gold Sales	**1,249,358**				1,787	54,088	80,474	21,482	16,369	28,599	74,488	76,415	112,403	100,164	29,871	30,626	27,996	28,917	37,924	51,138	81,996	178,992	47,866	125,746	42,018
Gross Revenue from Cobalt Sulphate Sales	**1,504,283**				5,540	90,737	71,803	81,020	88,172	87,202	78,634	76,069	61,383	82,245	86,040	84,357	80,488	79,468	76,728	73,894	63,035	67,966	61,057	73,359	35,084
Gross Revenue from Bismuth Sales	**1,057,972**				0	66,404	46,204	44,623	53,746	65,563	74,132	67,770	61,377	49,033	56,959	66,939	69,705	65,844	57,739	54,478	48,088	32,585	47,568	23,806	5,408
Gross Revenue from Copper Sales	**30,214**				0	853	517	1,247	1,603	2,064	1,829	1,403	1,034	833	860	1,169	1,894	2,552	3,078	2,895	1,920	669	2,056	1,395	344
Gross Sales Revenue	**3,841,828**				**7,327**	**212,082**	**198,997**	**148,373**	**159,889**	**183,428**	**229,085**	**221,658**	**236,197**	**232,276**	**173,730**	**183,091**	**180,083**	**176,782**	**175,468**	**182,405**	**195,039**	**280,213**	**158,547**	**224,306**	**82,854**
Concentrate Transportation	**(212,099)**				(2,067)	(10,729)	(10,895)	(10,887)	(10,887)	(10,898)	(10,895)	(10,887)	(10,887)	(10,895)	(10,887)	(10,887)	(10,898)	(10,895)	(10,887)	(10,887)	(10,895)	(10,887)	(10,898)	(10,887)	(3,264)
Gold Refining	**(7,492)**				(12)	(327)	(476)	(145)	(116)	(184)	(442)	(453)	(655)	(586)	(192)	(196)	(181)	(186)	(237)	(311)	(484)	(1,028)	(293)	(730)	(260)
Marketing Expense	**(25,925)**				(55)	(1,580)	(1,185)	(1,269)	(1,435)	(1,548)	(1,546)	(1,452)	(1,238)	(1,321)	(1,439)	(1,525)	(1,521)	(1,479)	(1,375)	(1,313)	(1,130)	(1,012)	(1,107)	(986)	(408)
Net Smelter Return	**3,596,312**				**5,192**	**199,445**	**186,441**	**136,072**	**147,451**	**170,797**	**216,202**	**208,865**	**223,417**	**219,473**	**161,213**	**170,484**	**167,483**	**164,222**	**162,969**	**169,894**	**182,529**	**267,285**	**146,250**	**211,704**	**78,922**
Open Pit Mining	**(271,154)**				(171)	(11,730)	(12,530)	(12,442)	(14,616)	(14,845)	(11,821)	(11,990)	(12,241)	(15,228)	(14,893)	(14,832)	(14,837)	(15,329)	(15,324)	(14,040)	(13,734)	(14,975)	(16,066)	(12,518)	(6,992)
Underground Mining	**(52,742)**					(24,970)	(27,772)																		
Milling	**(422,454)**				(2,872)	(21,265)	(21,188)	(21,225)	(21,207)	(21,207)	(21,207)	(21,244)	(21,207)	(21,207)	(21,207)	(21,244)	(21,207)	(21,207)	(21,207)	(21,244)	(21,207)	(21,207)	(21,207)	(21,244)	(16,444)
Shared Services and Camp	**(355,176)**			(110)	(3,354)	(18,340)	(18,222)	(18,271)	(18,251)	(18,200)	(17,672)	(17,719)	(17,672)	(17,672)	(17,672)	(17,719)	(17,672)	(17,672)	(17,672)	(17,719)	(17,672)	(17,672)	(17,672)	(17,719)	(12,832)
SMPP Operating Costs	**(599,123)**				(5,864)	(30,307)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,763)	(30,761)	(9,220)
Other Processing Charges	**(4,025)**		(70)	(77)	(147)	(256)	(201)	(201)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)	(181)
Total Operating Cost	**(1,704,674)**		**(70)**	**(187)**	**(12,408)**	**(106,868)**	**(110,676)**	**(82,902)**	**(85,018)**	**(85,196)**	**(81,644)**	**(81,897)**	**(82,064)**	**(85,051)**	**(84,716)**	**(84,739)**	**(84,660)**	**(85,152)**	**(85,147)**	**(83,947)**	**(83,557)**	**(84,798)**	**(85,889)**	**(82,423)**	**(45,669)**
Operating Profit	**1,891,638**		**(70)**	**(187)**	**(7,216)**	**92,577**	**75,765**	**53,170**	**62,434**	**85,602**	**134,558**	**126,969**	**141,354**	**134,423**	**76,497**	**85,745**	**82,823**	**79,070**	**77,822**	**85,947**	**98,972**	**182,488**	**60,361**	**129,281**	**33,253**
Corporate Administration	**(34,500)**		(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)	(1,500)
Interest Expense	**(174,110)**			(6,224)	(17,486)	(18,952)	(17,718)	(17,311)	(17,455)	(16,913)	(15,791)	(13,341)	(11,061)	(8,376)	(5,697)	(4,246)	(2,552)	(987)	0	0	0	0	0	0	0
Financing Fees	**(3,351)**		(3,351)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Income Tax	**(104,029)**		2	7	437	(210)	283	349	156	(420)	(1,707)	(1,513)	(1,870)	(1,643)	(201)	(432)	(360)	(257)	(12,067)	(12,928)	(13,348)	(15,637)	(16,429)	(17,723)	(8,518)
Territorial Royalty	**(36,221)**		0	0	0	0	0	0	0	0	0	0	0	0	(449)	(4,051)	(3,168)	(4,075)	(4,078)	(3,927)	(3,786)	(4,030)	(4,134)	(3,817)	(706)
Cash Flow Before Capital Expenditure	**1,539,427**		**(4,919)**	**(7,904)**	**(25,765)**	**71,915**	**56,830**	**34,708**	**43,635**	**66,769**	**115,560**	**110,615**	**126,923**	**122,904**	**68,650**	**75,516**	**75,243**	**72,251**	**60,177**	**67,592**	**80,338**	**161,321**	**38,298**	**106,241**	**22,529**
Open Pit Mining Capital	**(52,395)**		(19,283)	(20,155)	(12,957)																				
Mill and Infrastructure Capital	**(170,048)**		(56,933)	(81,533)	(31,582)																				
Indirect Capital Costs	**(88,326)**		(34,511)	(45,475)	(8,340)																				
EPCM Costs	**(39,059)**		(14,485)	(18,674)	(5,900)																				
SMPP Direct Capital Costs	**(164,953)**		(24,918)	(118,316)	(21,719)																				
SMPP Indirect Capital Costs	**(77,498)**		(25,770)	(39,794)	(11,934)																				
Capital Cost Adjustments	**3,273**		8,113	(3,049)	(1,791)																				
Sustaining Capital	**(57,810)**				(302)	(4,783)	(4,559)	(10,952)	(4,492)	(4,410)	(110)	(5,411)	(7,330)	(4,631)	(2,332)	0	(6,893)	(37)	0	(286)	(1,093)	(79)	(110)		
Change in Working Capital	**(2,612)**		(1,878)	63	17	(3,622)	(572)	37	(1,084)	(1,039)	(702)	731	1,074	109	(275)	(631)	(101)	328	667	297	955	418	84	598	1,914
Total Capital Expenditures	**(649,428)**		(169,665)	(326,933)	(94,508)	(8,405)	(5,131)	(10,915)	(5,576)	(5,449)	(812)	(4,680)	(6,256)	(4,522)	(2,607)	(631)	(6,994)	291	667	11	(138)	339	(26)	598	1,914
Project Cash Flow Before Debt Financing	**889,999**		**(174,584)**	**(334,837)**	**(120,273)**	**63,510**	**51,699**	**23,793**	**38,059**	**61,320**	**114,748**	**105,935**	**120,667**	**118,382**	**66,043**	**74,885**	**68,249**	**72,542**	**60,844**	**67,603**	**80,200**	**161,660**	**38,272**	**106,839**	**24,443**
Debt Financing Drawdown	**446,754**			322,956	122,562	1,236																			
Debt Financing Repaid	**(446,754)**					(19,198)	(20,421)	(5,870)	(12,468)	(25,784)	(56,312)	(52,429)	(61,711)	(61,601)	(33,349)	(38,955)	(35,967)	(22,689)							
Reclamation Security Funding	**(53,107)**			(5,000)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)	(2,291)
ANNUAL NET CASH FLOW	**836,892**		**(174,584)**	**(16,881)**	**(1)**	**43,258**	**28,988**	**15,632**	**23,300**	**33,245**	**56,145**	**51,215**	**56,665**	**54,490**	**30,403**	**33,639**	**29,991**	**47,562**	**58,553**	**65,313**	**77,910**	**159,369**	**35,981**	**104,548**	**22,152**

Table 22.3
Base Case Metal Prices

Metal	Metal Price (US$)	Exchange Rate (US$/C$)	Metal Price (C$)
Gold (per oz)	1,350	0.88	1,534
Cobalt (per lb)	16.00	0.88	18.18
Cobalt in Sulphate (per lb)	19.04	0.88	21.64
Bismuth (per lb, average)	12.64	0.88	14.36
Copper as cathode (per lb)	3.25	0.88	3.69
Copper as cement (per lb)	2.38	0.88	2.70

Under the base case projections of production and metal price, cobalt sulphate contributes approximately 39% of life-of-mine gross revenue, before deducting marketing fees, gold contributes 33%, bismuth contributes 27% and copper approximately 1%.

22.4 TRANSPORTATION, TREATMENT AND MARKETING CHARGES

The following provisions for the transportation of bulk concentrate to the SMPP, treatment of the concentrate and marketing of the metal products are included in the base case financial evaluation:

- A charge of C$200/dry tonne for the packaging, road and rail transport of bulk concentrate from the Project site to the SMPP.
- An operating cost of C$564/dry tonne of concentrate for hydrometallurgical processing at the SMPP.
- A cost equivalent to 1% of the gross sales value of cobalt, bismuth and copper, to reflect the marketing cost to be borne by Fortune.
- A net value of copper contained in cement of US$2.38/lb, calculated by deducting the estimated transportation, smelting and refining charges from the base price of US$3.25/lb for copper as cathode.

22.5 CAPITAL EXPENDITURES AND OPERATING COSTS

22.5.1 Capital Expenditures

The capital expenditures included in the base case financial evaluation are those discussed previously in Section 21.1 of this report. Additional minor provisions for annual changes in working capital, amounting to a cash outflow of C$2.6 million over the life of the Project, have also been included in the cash flow forecast.

The construction schedule for facilities at the Project site in the NWT envisages that early works will be conducted during the summers of 2014 and 2015, with full-scale construction in 2016 and 2017, leading to the commencement of production in the fourth quarter of 2017. Fortune reports that the equipment and material required for the modest program of early works scheduled for the summer of 2014 are already at site. For convenience the minor expenditures to be incurred for this program have been included in the financial model in January, 2015. Since all equipment and material required for the early works program in 2015 will need to be delivered to site over the winter road prior to April, 2015, timely completion of the entire construction schedule is contingent on financing being obtained by approximately September, 2014.

The ability to complete the full-scale construction programs planned for 2016 and 2017 is contingent on completion of the all-weather access road to the NICO Project site by spring, 2016. The capital expenditure estimates make provision for Fortune to fund 33 km of spur road connection to the Project site. It remains possible, however, that Fortune will agree to contribute to the cost of an additional 18 km of road.

The construction schedule for the SMPP has been dovetailed with the construction schedule for the Project site.

The total initial Project capital expenditure of C$589 million is scheduled to be spent over the period 2015 to 2017, as summarized in Table 22.4.

Table 22.4
Timing of Initial Capital Expenditure

Location	Scheduled Capital Expenditure (C$ million)			
	2015	**2016**	**2017**	**Total**
NWT	117.1	168.8	60.6	346.5
SMPP	50.7	158.2	33.6	242.5
Total	**167.8**	**327.0**	**94.2**	**589.0**

The allocation of C$117 million of capital expenditure in the NWT in 2015 includes the cost of the early works program and payments on long-lead items of equipment required for the 2016 construction program.

Reclamation security funding of C$53.1 million has been included in the financial analysis as a cash outflow, based on estimates of C$43.1 million for closure and reclamation of the Project site in the NWT and C$10 million for the SMPP. The funding mechanism for reclamation security is still to be determined and alternatives are being reviewed by Fortune. The approach adopted herein of funding all reclamation security in cash is considered to be conservative.

22.5.2 Operating Costs

The on-site operating costs included in the base case financial evaluation for open pit and underground mining, milling, shared services and camp facilities at the Project site, and for the SMPP, are those discussed previously in Section 21.2. An additional provision of approximately C$1.5 million per year has been included for off-site corporate administration.

Fortune has performed an analysis of the average cash cost of production per ounce of gold equivalent and per pound of cobalt equivalent, with metal equivalents being calculated on the basis of the revenues estimated to be received for each metal, thereby taking into account both the ratio of the prices of each metal and the differences in metallurgical recovery. A further analysis was undertaken of the cash operating costs of producing gold, cobalt and bismuth, after by-product credits for each of the other metals. The results of these analyses are summarized in Table 16.5.

Table 22.5
Unit Cost of Metal Equivalents and Net of By-Product Credits

Unit Cost Measure	Units	Average Unit Cost
Per equivalent ounce of gold	US$/oz	673.54
Per equivalent pound of cobalt	US$/lb	9.50
Per ounce of gold, net of by-product credits	US$/oz	(702.12)
Per pound of cobalt, net of by-product credits	US$/lb	(5.19)
Per pound of bismuth, net of by-product credits	US$/lb	(10.18)

22.6 ROYALTIES AND INCOME TAXES

Annual profits from the NICO Project will be subject to at least four forms of government levy: NWT mining royalty, federal income tax, NWT income tax and Saskatchewan income tax. The calculation of Territorial and Provincial income tax requires an allocation of Project profits between the NWT and Saskatchewan. Fortune reports that it will be exempt from Saskatchewan income tax for five years, once taxable in the Province, based on legislation introduced by the Province to attract industrial investment.

The NWT royalty is payable on an annual profit equal to the cash operating profit of the operation, less a depreciation deduction and a processing allowance. Cash operating profit is determined by deducting from gross revenue all cash costs incurred in producing and marketing saleable mineral commodities. Corporate overhead charges, interest expenditures and financing fees are not deductible. Depreciation of qualifying expenditures may be claimed at a maximum rate of 100% of the balance of such expenditures. The annual processing allowance is 8% of the capital cost of processing assets, subject to a maximum of 65% of the profit remaining after claiming the depreciation deduction.

The rate of royalty payable on the annual profit is the lesser of 13% of that profit or the amount calculated on a graduated scale, which commences at 5% on profits up to C$5 million and increases progressively to 14% on profits in excess of C$45 million. The full amount of NWT royalty paid is deductible for both federal and NWT income tax purposes.

Federal, NWT and Saskatchewan income taxes are essentially all levied on the same taxable income, calculated as the annual cash operating profit of the operation, generally as defined for the NWT royalty calculation, less the following deductions:

- Corporate overhead costs, interest charges and financing fees.

- Capital cost allowance, which is the tax equivalent of depreciation and which can be claimed at different rates, depending on the nature of the assets acquired.

- The cost of assets acquired to construct a new mine (Class 41(a)) can be deducted from taxable income at a maximum rate of 100% of the available balance.

- The cost of other capital assets, including sustaining capital expenditures (Class 41(b)), can be deducted on a declining-balance basis at a maximum rate of 25%.

- For convenience, the minor costs incurred for all other assets have been grouped together in the financial evaluation and are deducted on a declining-balance basis at a maximum rate of 10%.

- Canadian exploration expenses include all exploration costs and mine development costs incurred prior to the commencement of commercial production from a mine. These expenses can be deducted at a maximum rate of 100% of the available balance.

- Canadian development expenses include the cost of acquiring a resource property and costs incurred for mine development after the commencement of commercial production. These expenditures can be deducted on a declining-balance basis at a maximum rate of 30%.

The rates of income tax payable are 11.5% in the NWT, 15% federally and 12% in Saskatchewan. The federal government then allows the deduction of investment tax credits directly from income tax payable. These investment tax credits amount to 10% of qualifying Canadian exploration expenses, and the deductible balance of Canadian exploration expenses must be reduced by the amount of the investment tax earned.

Fortune presently has outstanding balances of unclaimed Class 41 (a) capital cost allowances, Canadian exploration expenses, Canadian development expenses and investment tax credits, in addition to accumulated losses from prior years which, within limits, can be deducted from future taxable income. All of these existing tax pools have been utilized in calculating future income tax liabilities.

Under Fortune’s corporate structure, a portion of the profits generated from metal sales is assumed to be taxed in a Bermudian metal marketing company.

The 2013 federal budget proposed changes to the income tax deductions available to companies developing new mining projects in Canada. These changes, which will be introduced progressively, affect the allocation of pre-production mine development costs between Canadian exploration expenses and Canadian development expenses, and also phase-out the accelerated capital cost allowance currently applicable to Class 41(a) expenditures. These provisions, however, do not apply to expenditures incurred on new mines for which engineering and design work for construction had commenced prior to the announcement of the new measures. It is understood that the NICO Project satisfies this grandfathering provision and all income tax calculations have been performed under the pre-existing regime for deductions.

22.7 PROJECT FINANCING

The financial evaluation of the NICO Project is based on the presumption that all expenditures incurred prior to the attainment of commercial production, including financing fees and interest during construction, will be financed 30% by equity and 70% by debt, with the debt being subject to the following terms:

- An arrangement fee, payable on closing, of 0.75% of the total amount of the facility.
- No commitment fee on the undrawn balance of the facility.
- An interest rate of 4.35%/y on the outstanding amount drawn down.
- A debt repayment schedule, commencing in 2018 and continuing for a maximum of 12 years, with periodic repayments based principally on a cash flow sweep.

22.8 SENSITIVITY ANALYSIS

The overall economics of the NICO Project are more sensitive to changes in the factors that affect revenue, than they are to changes in capital expenditures or operating costs. Sensitivity analyses have been conducted to determine the effect on net present value and internal rate of return of variations from the base level prices of the two principal co-products, gold and cobalt. The results are summarized in Table 22.6. These sensitivity analyses also serve as a proxy for variations in ore grade, metallurgical recovery or metal production, for either gold or cobalt.

A separate sensitivity analysis has also been conducted, using the base case production and cost estimates, but with a series of cyclical metal prices. This analysis was conducted with metal prices fluctuating over the range shown in Table 22.7, and over a recurring six-year cycle.

Table 22.6
Sensitivity Analyses

Gold Price (US$/oz)	**1,200**	**1,350**	**1,500**
Pre-tax NPV, 7% (C$ million)	196	**254**	312
Pre-tax IRR (%)	13.9	**15.6**	17.2
Post-tax NPV, 7%(C$ million)	168	**224**	281
Post-tax IRR (%)	13.3	**15.1**	16.7
Cobalt Price (US$/lb)	**13.00**	**16.00**	**19.00**
Pre-tax NPV, 7% (C$ million)	124	**254**	383
Pre-tax IRR (%)	11.4	**15.6**	19.4
Post-tax NPV, 7% (C$ million)	98	**224**	350
Post-tax IRR (%)	10.7	**15.1**	19.0

Table 22.7
Cyclical Metal Prices

Metal	**Price Range**	
	Low	**High**
Gold (US$/oz)	1,200	1,900
Cobalt (US$/lb)	12.00	30.00
Bismuth (US$/lb)	7.00	19.00
Copper (US$/lb)	3.00	4.50

Under this sensitivity analysis, the NICO Project would be expected to yield an after-tax, undiscounted life-of-mine cash flow of C$1.44 billion, an after-tax net present value of C$505 million at a discount rate of 7% per year, and an after-tax internal rate of return of 23.2% per year. The equivalent pre-tax indices are a present value of C$543 million and an internal rate of return of 23.6% per year.

23.0 ADJACENT PROPERTIES

To the best of Micon's knowledge, there are no properties adjacent to the NICO Project which influence the findings of this report. Fortune owns 100% of the Sue-Dianne property, which is located approximately 25 km north of the NICO Project and which contains a small copper-silver-gold IOCG deposit. The mining and processing of mineralization from this deposit, however, is not part of the proposed NICO Project.

24.0 OTHER RELEVANT DATA AND INFORMATION

All data and information relevant to the Feasibility Study of the NICO Project have been included in other sections of this report, except for Project implementation and risk management, which are discussed below.

24.1 PROJECT IMPLEMENTATION

The distance between the Project site in the NWT and the SMPP in Saskatchewan requires that two separate, but coordinated, plans and schedules be developed for construction of the facilities, one for each location. The site in the NWT is remote and the new facilities to be built there include significant infrastructure. The SMPP, on the other hand, is close to the city of Saskatoon and the infrastructure in the area is already fully developed. Construction at the Project site, therefore, will take longer to complete and ample time is available for construction of the SMPP.

The construction schedule discussed below is designed to achieve start-up of the processing facilities at both sites in October, 2017. Completion of the facilities at the Project site by that date is contingent upon securing permitting and financing for the Project by approximately September, 2014 and completion of the all-weather road to the site by early, 2016.

24.1.1 Project Site in the NWT

24.1.1.1 Overview

For the purpose of the implementation plan, construction at the Project site in the NWT has been divided into five basic elements of work scope:

- Project access road.
- Temporary and permanent camps.
- Permanent power supply.
- Open pit and underground mines.
- Concentrator and related process buildings and services.

Project Access Road

The proposed all-weather road linking the Project site to Whatì and Behchokö has been described in Section 18.1.1. The road alignment has been finalized, Fortune has completed detailed engineering on the sections of road for which it is or may become responsible, and bids have been received from several construction contractors. The final permit for construction of the road has yet to be received and negotiations are still in progress between Fortune and the NWT and Tłįchǫ governments with respect to financing of the road. The Project implementation plan requires that the road be completed by early 2016, in order to service the full-scale construction program planned for the summer of that year.

Material and equipment required for the program of preliminary early works planned for 2014 are already on site. Equipment and materials for the more extensive program of early works planned for 2015 will be delivered to site over the existing winter road. Financing will need to be in place by approximately September, 2014, in order to commence procurement activities to support the 2015 program at site.

Temporary and Permanent Camps

Central to the overall Project development strategy is the early provision of camp accommodation at the site. The camp strategy is directly related to the scale of work to be performed at the site and consists of three camp configurations:

- Pioneer camp – a 28-bed camp that currently exists at the site and will support the 2014 preliminary early works program.

- Temporary camp – a 150-bed camp that will be established early in 2015 and will remain in use throughout the construction period.

- Permanent camp – a 180-bed high quality camp that will be established early in 2016. Initially, this camp will support the major construction activities scheduled for 2016 and 2017. Thereafter, it will be used to accommodate operating personnel throughout the entire life of the Project.

The temporary camp will be located close to the existing Pioneer camp, approximately 2 km from the plant site. The permanent camp will be located in the same footprint as the plant site, and will require that significant site preparation work be completed in 2015. Timely completion of the camp strategy is on the critical path to achieving the overall Project construction schedule. The camp strategy has been designed to ensure that sufficient accommodation is available at all times to meet construction requirements. Camp amenities have been designed to ensure that fully qualified personnel will be attracted to and retained at the Project site.

Permanent Power Supply

As described in Section 18.1.3, permanent electric power is to be supplied to the Project site by a transmission line from the Snare Hydroelectric Complex. Fortune is in the process of negotiating a power supply agreement with Northwest Territories Power Corporation. It is anticipated that the cost of the power line will be financed by the utility and that this cost will be reimbursed by Fortune, over time, through the negotiated rate structure for the supply of power.

It is anticipated that permanent power will be available at the site late in 2016. Power required for construction activities prior to that date will be supplied by diesel generators.

Open Pit and Underground Mines

As described in Section 16.0, mining of the NICO orebody will be undertaken primarily by open pit, supplemented by high-grade ore from an underground mine for a short period early in the life of the Project. Initial pre-production development of the open pit will be performed by a contractor, commencing early in 2016. Fortune will then take control of open pit operations progressively, as its equipment fleet is mobilized. All pre-production development and subsequent productive underground mining operations will be carried out by a contractor.

Concentrator and Related Process Buildings and Services

The concentrator and related process buildings and services include the site infrastructure required to support the processing operation that produces a bulk concentrate which is then shipped to the SMPP for further processing into saleable mineral commodities. The basic components of this scope of work, all of which have been described previously in this report, are:

- Concentrator building.
- Service building and truck shop.
- Ore handling, including three stages of crushing.
- Fine ore storage and distribution, including grinding.
- Flotation, concentrate dewatering and concentrate handling.
- Co-disposal facility, including tailings transportation and storage.
- Mine dry building.
- Waste water treatment.
- Incinerator.
- Waste management, including handling, storage and disposal.
- Storm water runoff pond.
- Fire water storage and distribution.
- Fuel storage.
- Electrical substation, switchgear, transformers and distribution.
- Gate house, security and communications network.

24.1.1.2 Project Implementation Approach and Strategy

The overall approach adopted for the Project implementation plan provides the most cost effective and efficient means of accomplishing the required scope of work, within the constraints of financing variables, availability of the winter road and the impact of climatic conditions at the Project site. The strategy centres on a phased approach to identifying the components of the works to be accomplished and establishing realistic timeframes for the completion of those works. The Project milestones that result from the overall implementation schedule for the Project site in the NWT are summarized in Table 24.1.

Table 24.1
Project Milestones, NWT

NICO PROJECT MILESTONE LISTING PROJECTMILESTONES			
MINE / CONCENTRATOR MILESTONES		START	FINISH
Z0025	**NICO P/MILESTONE - (PHASE 1) INITIAL EPC / JV CONTRACT SIGNED**	**27-Sep-13 A**	
Z0030	**NICO P/MILESTONE - INITIAL PROJECT FUNDING (COMMITMENT) RECEIVED**	**26-Jul-13 A**	
Z0070	NICO P/MILESTONE - INTERMEDIATE (PARTIAL) FINANCING RECEIVED		20-May-14
Z0160	NICO P/MILESTONE - FULL PROJECT FINANCING RECEIVED		01-Sep-14
Z0040	NICO P/MILESTONE - START LONG LEAD EQUIPMENT RFP's	27-Oct-14	
Z0045	NICO P/MILESTONE - E/W & SITE DEVELOPMENT DRAWINGS ISSUED AFC		28-Nov-14
Z0100	NICO P/MILESTONE - START SITE PREPARATION WORKS	16-Feb-15	
Z0050	NICO P/MILESTONE - DETAILED DESIGN COMPLETED		29-Oct-15
Z0060	NICO P/MILESTONE - CONSTRUCTION DOCUMENTS ISSUED		17-Dec-15
Z0110	NICO P/MILESTONE - START A/G CONSTRUCTION WORKS	01-Jun-16	
Z7000	NICO P/MILESTONE - MECHANICAL COMPLETION		06-May-17
Z0120	NICO P/MILESTONE - START COMMISSIONING	25-Jul-17	
Z9000	NICO P/MILESTONE - START OF PRODUCTION RAMP-UP		01-Oct-17
Z9999	NICO P/MILESTONE - PRODUCTION AT FULL CAPACITY		15-Dec-17
Z8000	NICO P/MILESTONE - BEGIN U/G MINING OPERATIONS	01-Apr-18	
Z8500	NICO P/MILESTONE - U/G MINING AT FULL CAPACITY		01-Jul-18
NPAR ALL-WEATHER ACCESS ROAD MILESTONES			
Z0080	**NPAR P/MILESTONE - DETAILED ENGINEERING CONTRACT AWARDED**		**03-Apr-13 A**
Z0085	NPAR P/MILESTONE - (ASSUMED) START CONSTRUCTION (BEHCHOKO to WHATI / GAMETI)		01-Aug-14*
Z0075	NPAR P/MILESTONE - AWARD CONSTRUCTION CONTRACT (FML SECTIONS)		01-Sep-14
Z0090	NPAR P/MILESTONE - ALL WEATHER ROAD TO NICO COMPLETE		25-Jan-16
CONSTRUCTION COMPLETION MILESTONES			
Z7720	NICO P/MILESTONE - CONCRETE WORKS COMPLETED		12-Aug-16
Z7730	NICO P/MILESTONE - MECHANICAL & PIPING WORKS COMPLETE		19-Dec-16
Z7740	NICO P/MILESTONE - HANDOVER TO COMMISSIONING COMPLETE		15-May-17
Z2310	NICO P/MILESTONE - CDF READY FOR USE		10-Aug-17

Achievement of the milestones listed in Table 24.1, and of the overall schedule, are contingent upon approval of final Project financing by approximately September 1, 2014. That date provides sufficient time to formalize commitments and to organize equipment, material and camp units for delivery to site over the winter road early in 2015. Any significant delay in obtaining financing would jeopardize the 2015 early works program and potentially result in a delay of one full year in the overall implementation program.

Preliminary Early Works

Certain early works have already been completed at the Project site and the remainder are scheduled for the summer of 2014 and 2015. The works already completed and those scheduled for 2014 are summarized in Table 24.2.

Table 24.2
Preliminary Early Works Activities – 2013 and 2014

"PRE-EARLY" SITEWORK SCOPE & EXECUTION STRATEGY / STATUS			
Work Element	**Scope of Deliverable**	**Timeframe**	**Status and Other Considerations**
Site Survey **Survey of Pioneer Camp**	**Full review of camp (rooms, etc) and list of required works to make it fully operational. Camp also needs to be serviceable for partial operations.**	**May / June 2013**	**COMPLETED in 2013**
Survey camp utility services	**Full review of camp utility services and list of required works to repair / upgrade as required for full operations.**		**COMPLETED in 2013**

"PRE-EARLY" SITEWORK SCOPE & EXECUTION STRATEGY / STATUS			
Work Element	**Scope of Deliverable**	**Timeframe**	**Status and Other Considerations**
Survey of overall site	**Survey of site (roads, buildings, laydown, etc.) and generation of drawings that show current "as built" situation. List of improvements / upgrades required to make site as efficient (with space) as possible, as well as identification of potential laydown areas.**		
Survey of "foot print" for permanent camp and potential area for temporary construction camp.	**Survey and determine scope of works required to prepare foot print of permanent camp for receiving utilities, etc. and the permanent camp units. Establish best location of the temporary construction camp.**		
Survey of site equipment	**Inspection of all site equipment and list of recommended actions to repair / refurbish each to full working order.**		**COMPLETED in 2013**
<u>Remediation Works</u> Procure equipment / materials	**Procurement of all items required to execute work lists from above.**	**June / July 2013**	**COMPLETED in 2013**
Execute refurb / repair works identified (for camp and equipment) from survey.	**Refurb / repair / upgrade camp and equipment to fully operational condition.**	**July / Aug 2013**	**COMPLETED in 2013**
Sewage Lagoon assessment & upgrade / expansion	Investigate current sewage lagoon for max capabilities and prepare area for use at max capacity. Need the current lagoon to be able to support at least 50 people for a 1-2 month period (during early 2015).	Summer 2014	Current lagoon sized for current camp only, but moderate expansion is possible and needs to be implemented. Early 2015 site workers (~50 – 60) need to be accommodated until new system can be installed.
<u>Clearing Works</u>	Establish adequate laydown areas by clearing the area adjacent to the fuel tanks (drawing prepared) and adjacent to Lou Lake. Remove core boxes and clear area across the road from the Pioneer camp (drawing prepared). This is a potential area for new temp camp.	Summer 2014	Works are known and basic drawings prepared for the clearing scope. Need these areas cleared so initial 2015 operations (ice road deliveries and installation of temp camp) can be accomplished as early as possible.
<u>Aggregate Survey</u>	Sampling of areas in which excavation is planned in 2015, in the plant and site road areas, to determine the classification of the rock.	Summer 2014	Type 1 or 1a is expected. These areas are to be cut-and-fill and should not require mine waste rock.

The preliminary early works program planned for 2014 is modest in scope and is designed to ensure that the Project site is made ready for the more extensive program planned for 2015. This work can be accomplished with equipment already at the site and is authorized under the Interim Site Permit issued late in 2013.

Early Works

The engineering work required to support the more extensive early works program scheduled for 2015, and the works themselves, are summarized in Table 24.3.

Table 24.3
Early Works Activities – 2015 Program

"EARLY WORKS" SCOPE & EXECUTION STRATEGY / STATUS			
Work Element	**Scope of Deliverable**	**Timeframe**	**Status and Other Considerations**
Engineering **NPAR Detailed Engineering**	**Detailed Engineering for the north sections (from Whati to site) of the all-weather access road.** **Work awarded to EBA in early 2013.**	**March – Dec 2013**	**COMPLETED in 2013**
NPAR Construction RFP	**Prepare and issue RFP for construction of the NPAR road north of Whatì. RFP issued and bids received in late 2013.** **Bid review completed and short-list established.**	**Dec 2013 – Jan 2014**	**COMPLETED in early 2014**
Award NPAR Construction contract	Award construction contract for NPAR road.	Sep 2014	Award delayed by project financing and/or gov't funds being available to begin works.
EPC – Phase 1 (Preliminary Engineering of Plant)	**Confirmation of initial FS design parameters, site layout, process flow sheets, general design specs and equipment list(s), as well as establish the basic plant design criteria to be executed in the Phase 2 – Detailed Engineering phase.** **Work awarded in fall of 2013.**	**Sep 2013 – Jan 2014**	**COMPLETED in early 2014**
EPC – Phase 2 (Detailed Engineering of Plant)	Based on design parameters established in Phase 1, provide full detailed design of the entire plant site and all support elements.	Sep 2014 – March 2016	Work also awarded to Hatch – Vancouver, but put on hold until financing in place.
Procurement Procurement (in-house scope)	Services from the Fortune Procurement Team to develop and issue RFPs for required goods and services, as well as awarding PO's for same. Critical items for 2015 (Site Prep) works include fuel, equipment, and temp camp (and possibly perm camp) units. Lead times required for the critical items noted are in the 3-6 month range and need to be delivered to ice road staging area as early as possible, so many commitments will need to be made as soon as financing is achieved.	Various times during 2014	Much of the upfront works in the procurement cycle have been completed. Some rebidding will be required. Plan is to have updated bids available at the time financing is achieved in early Sept. 2014 so awards can be made as required.
Procurement Services	Services required to coordinate the procurement of plant equipment, especially the items with long lead manufacturing / delivery timeframes. The current engineering contractor has provided a proposal that includes management of all (or part) of the procurement requirements that come out of the detailed engineering works.	Late 2014 / Early 2015	Scope of this work and who will do it is still under discussion. Will need a decision and at least a partial award (if not staying in-house) by late 2014 / early 2015.

Hatch Associates (Hatch) has been retained to undertake preliminary engineering for the facilities required at the Project site, and the basic design elements have already been established. As soon as Project financing is obtained, Fortune will release detailed engineering and procurement. Fortune and Hatch have prepared a work schedule, listing of deliverables, progress measurement system and reporting guidelines for the detailed engineering and procurement phase of the Project. Initial procurement activities, which will need to be undertaken later in 2014, include:

- Ordering and expediting the equipment, materials, fuel and camp units required for the 2015 early works program, so that all of these items can be delivered to the forward staging area in Edmonton in time for them to be hauled to site over the winter road.

- Ordering of those items of major equipment with long lead times that will be required for the 2016 construction program.

The early works planned for 2015 include four critical components:

- Establishment of the temporary 150-bed construction camp in spring, 2015, in order to accommodate the required workforce.
- Completion of all site preparation works by the end of the 2015 season, so that concrete work can commence early in 2016.
- Erection of the permanent 180-bed camp, in order to accommodate the peak construction manpower requirements in mid-2016.
- Commencement of construction of the all-weather access road from the site to the Marian River.

The detailed activities planned for 2015 are:

- Receive, catalogue and store all equipment and material arriving at site over the winter road.
- Install the temporary construction camp, with all facilities and appurtenances.
- Install the aggregate crushing and concrete batch plants.
- Complete blasting, excavation and site preparation for all plant areas.
- Construct or upgrade all plant roads.
- Complete site preparation for the permanent camp.
- Commence concrete foundation work for the concentrator building.
- Commence concrete work for support service areas.
- Commence construction of the site access road.

The prerequisite for timely completion of the 2015 program is the successful organization and management of the delivery, across the winter road, of the required materials and equipment. Establishing the temporary camp at an early date will be critical, since the availability of accommodation is one of the most important aspects of the construction program.

Full-Scale Construction, 2016 and 2017

The key to successful completion of the construction program planned for 2016 will be the availability of the all-weather access road early in the year. The initial work planned for 2016 includes completion of concrete foundations in all areas and installation of the permanent camp, with all the necessary amenities and services. The peak construction workforce of approximately 300 will be reached in the fall of 2016.

The most critical works to be completed during 2016 and 2017 are those associated with multi-disciplinary activities within the concentrator building. Coordination of those activities, in a well-phased and efficient installation process, will be key to maintaining the overall construction schedule. The bulk of the construction program is scheduled for completion in the first quarter of 2017. This will be followed by completion of punch-listed items, hand-over to the commissioning team and commissioning, prior to the planned commencement of processing operations in October, 2017. Fortune intends to hire key operating and maintenance personnel early in the construction program, so that they can become familiar with the installed equipment and facilities, and can participate fully in the hand-over and commissioning process.

24.1.1.3 Work Breakdown Structure

The work breakdown structure (WBS) for the Project site in the NWT has been designed to conform with the elements of the implementation plan described above. The WBS also provides the basis for comprehensive monitoring of planned and actual progress throughout the entire construction program.

The WBS is designed in levels of progressively greater detail. Level 1, shown in Table 24.4, provides the highest level summary of the most important elements of the implementation plan.

Table 24.4
Work Breakdown Structure – Level 1

WBS Code	WBS Name	Total Activities	Start	Finish
NICOL.6	**NICO PROJECT - CAPEX SCOPE**	**607**	**22-Oct-12 A**	**15-Dec-17**
NICOL.6.A	NICO PROJECT MILESTONES	36	03-Apr-13 A	15-Dec-17
NICOL.6.3	PERMITTING & PRE-EARLY WORKS	112	22-Oct-12 A	01-Sep-14
NICOL.6.B	EARLY WORKS	256	14-Jan-13 A	21-Oct-16
NICOL.6.7	2015 (SITE PREP) CONSTRUCTION	70	21-Oct-13	07-Jul-17
NICOL.6.2	2016/17 WORKS (CONCRETE & A/G CONSTRUCTION)	111	06-Sep-15	10-May-17
NICOL.6.11	2017 WORKS (H/O, PRE-COMMISSIONING & COMMISSIONING)	22	29-Mar-17	15-Dec-17
NICOL.5	**PLANT & MINING OPERATIONS (OPEX SCOPE)**	**8**	**31-Dec-16**	**01-Jul-18**
NICOL.5.2	OPEN PIT MINING OPERATIONS	2	31-Dec-16	17-Jan-18
NICOL.5.1	PLANT PRODUCTION RAMP-UP	2	01-Oct-17	15-Dec-17
NICOL.5.4	U/G MINING OPERATIONS	4	01-Apr-18	01-Jul-18

Level 2 of the WBS, shown in Table 24.5, provides a further level of detail and generally represents the categories of work to be carried out.

Table 24.5
Work Breakdown Structure – Level 2

WBS Code	WBS Name	Total Activities	Start	Finish
NICOL.6	**NICO PROJECT - CAPEX SCOPE**	**607**	**22-Oct-12 A**	**15-Dec-17**
NICOL.6.A	**NICO PROJECT MILESTONES**	**36**	**03-Apr-13 A**	**15-Dec-17**
NICOL.6.A.1	MINE / CONCENTRATOR MILESTONES	19	26-Jul-13 A	15-Dec-17
NICOL.6.A.2	ACCESS ROAD (NPAR) MILESTONES	4	03-Apr-13 A	25-Jan-16
NICOL.6.A.5	PERMITTING MILESTONES	2	11-May-14	12-May-14
NICOL.6.A.4	CONSTRUCTION COMPLETION MILESTONES	7	23-May-16	10-May-17
NICOL.6.A.3	WINTER ICE ROAD OPERATIONS	4	1-Mar-15	15-Mar-16
NICOL.6.3	**PERMITTING & PRE-EARLY WORKS**	**112**	**22-Oct-12 A**	**1-Sep-14**
NICOL.6.3.2	PROJECT FUNDING	11	13-Feb-13 A	1-Sep-14
NICOL.6.3.4	PERMITTING	80	22-Oct-12 A	2-Jul-14
NICOL.6.3.1	PRE-EARLY WORKS	21	15-May-13 A	30-Sep-13 A
NICOL.6.B	**EARLY WORKS**	**256**	**14-Jan-13 A**	**21-Oct-16**
NICOL.6.B.3	ENGINEERING & STUDIES	201	14-Jan-13 A	21-Oct-16
NICOL.6.B.1	PERMITS	41	21-Oct-13	12-May-14
NICOL.6.B.6	WINTER ROAD OPERATIONS	8	2-Mar-15	1-Apr-15
NICOL.6.B.5	PROCURE TEMPORARY CONSTRUCTION CAMP	6	01-Jun-13 A	13-Nov-14
NICOL.6.7	**2015 (SITE PREP) CONSTRUCTION**	**70**	**21-Oct-13**	**7-Jul-17**
NICOL.6.7.8	PLANT AREA SITE PREP (CLEARING / BLASTING / EXCAVATING)	70	21-Oct-13	7-Jul-17
NICOL.6.2	**2016 / 2017 WORKS (CONCRETE & A/G CONSTRUCTION)**	**111**	**6-Sep-15**	**10-Aug-17**
NICOL.6.2.8	PERMANENT CAMP	8	29-Dec-15	29-Jun-16
NICOL.6.2.1	POTENTIAL WORKS ON SUPPORT SERVICE AREA	5	6-Sep-15	14-Dec-15
NICOL.6.2.2	CIVIL / CONCRETE WORKS	8	21-Jan-16	22-May-16
NICOL.6.2.3	CONSTRUCTION CONTRACTOR MOBILIZATION	3	16-Jan-16	31-Mar-16
NICOL.6.2.4	GENERAL FIELD REQUIRED DATES (FRD)	9	26-Jan-16	18-Jul-16
NICOL.6.2.5	MAJOR PLANT A/G CONSTRUCTION	70	14-Feb-16	20-Dec-16
NICOL.6.2.7	TAILINGS PIPELINE	1	6-Oct-16	10-Jan-17
NICOL.6.2.6	CDF	5	12-Mar-16	10-Aug-17
NICOL.6.2.10	OPEN PIT MINE	2	14-Feb-16	19-Oct-16
NICOL.6.11	**2017 WORKS (H/O, PRE-COMMISSIONING & COMMISSIONING)**	**22**	**29-Jun-16**	**1-Aug-17**
NICOL.6.11.9	PUNCHOUT & HANDOVER	9	29-Jun-16	25-Jan-17
NICOL.6.11.4	PRE-COMMISSIONING & COMMISSIONING	10	20-Jul-16	25-May-17
NICOL.6.11.2	COMMISSIONING	3	25-May-17	1-Aug-17
NICOL.5	**PLANT & MINING OPERATIONS (OPEX SCOPE)**	**8**	**19-Oct-16**	**01-Jul-18**
NICOL.5.2	**OPEN PIT MINING OPERATIONS**	**2**	**31-Dec-16**	**17-Jan-18**
NICOL.5.2.2	INITIAL MINING OPERATIONS	1	31-Dec-16	6-Mar-17
NICOL.5.2.3	PRODUCTION MINING OPERATIONS	1	7-Mar-17	11-Nov-17
NICOL.5.1	**PLANT PRODUCTION RAMP-UP**	**2**	**01-Oct - 17**	**15-Dec-17**
NICOL.5.4	**U/G MINING OPERATIONS**	**4**	**01-Apr-18**	**01-Jul 18**
NICOL.5.4.1	PRELIMINARY REMEDIATION & SET-UP	2	14-Jun-17	01-Oct-17
NICOL.5.4.2	PRODUCTION RAMP-UP	2	01-Apr-18	01-Jul-18

Level 3 of the WBS, not included in this report, provides a further degree of detail, and will provide the reporting structure to be used throughout the engineering, procurement and construction program.

Certain elements of the Project scope are broken down into additional levels of detail, in order to show specific sub-areas or individual disciplines.

24.1.1.4 Engineering

Engineering work for the project site in the NWT is being performed in two phases:

- Phase 1 – preliminary engineering.
- Phase 2 – detailed engineering.

Hatch has completed preliminary engineering for the facilities at the Project site and has set the overall parameters for the design. Detailed engineering is scheduled to commence as soon as Project financing has been arranged. While Hatch has provided a proposal to undertake both detailed engineering and procurement, Fortune anticipates receiving other proposals for this work and a final decision will be made when financing is resolved.

During the preliminary engineering phase, Hatch has developed a fully detailed estimate, schedule, deliverables list and performance measurement system for detailed engineering that is ready for immediate implementation when that phase of work commences. The link between detailed engineering, procurement and construction has also been defined.

24.1.1.5 Procurement and Contracts

The procurement and contracting functions are most likely to be executed by an engineering contractor, under the supervision of Fortune's Project management team. The overall procurement and contracting strategy has already been developed. The overriding concepts are to have competitive bidding on all significant purchase orders and contracts, within Fortune's strong commitment to encourage First Nations content and participation to the maximum possible extent. The short term procurement strategy will focus on the equipment and material required for the early works program scheduled for 2015, the scope of which has been described previously.

24.1.1.6 Construction

The construction strategy has been developed to take full account of the three variables that have the most influence on the timing and content of the work that can effectively be performed at the Project site:

- Access to the site.
- Climatic conditions and limited hours of daylight during the winter months.
- Availability and quality of camp accommodation.

The early works scheduled for 2015 have been planned so that all of the required equipment and materials can be delivered to site over the winter road, prior to the commencement of actual site work. Success of this program is contingent on having financing in place by approximately September, 2014, so that equipment and materials can be ordered and delivered to the staging area in Edmonton by early in 2015. Success of the full-scale construction programs scheduled for 2016 and 2017 is contingent on the all-weather road to site being complete and ready for use early in 2016.

Winter weather and restricted hours of daylight can have an adverse impact on construction activities, particularly concrete placement. The construction schedule has been designed so that very little concrete work will occur during the winter months. To the extent possible, steel erection is planned for the summer months, during which extended hours of daylight permit this work to be undertaken on two shifts per day. In addition, most mechanical, piping, electrical and instrumentation work has been scheduled to take place after building enclosures are completed.

The remote location of the Project site requires that accommodation be provided for all construction personnel. The construction schedule has been developed to fit with the phased approach, described previously, of progressive increases in camp capacity. The quality of camp accommodation and amenities is important in attracting and retaining fully qualified personnel. Camp design has been based on the principles of comfortable accommodation, superior dining facilities and appropriate recreational amenities.

24.1.1.7 Construction Hand-Over, Pre-Commissioning and Commissioning

The process from hand-over of equipment and facilities to the operator, through pre-commissioning and commissioning, has been developed in accordance with the following strategy:

- The construction contractor is responsible for all work, including paperwork and documentation, until 100% mechanical completion is achieved.
- The construction contractor will be required to do work of high quality, and will also be required to review all work and rectify all deficiencies prior to hand-over.
- The construction contractor will provide power and test points between each item of equipment and the control system.
- Hand-overs for pre-commissioning will be by individual items of equipment, rather than complete systems.
- Complete systems will be handed-over for commissioning once all individual components have been accepted.
- Complete cooperation will be required between the engineering contractor and the operator's team throughout the hand-over and commissioning process.

24.1.1.8 Ramp-Up to Full Production

The commissioning phase ends when the entire plant has operated at a prescribed level for a period of time. The construction schedule allows approximately six months to complete the hand-over, pre-commissioning and commissioning of all facilities at the Project site. Start-up of productive operations is scheduled for October, 2017 and, thereafter, a period of two months is allowed, within which to achieve full design capacity.

24.1.2 The SMPP

The construction schedule for the SMPP has been developed using the same principles as those described above for the Project site in the NWT. The two construction schedules have been coordinated, so that the SMPP will be available to commence operation in October, 2017.

The SMPP consists principally of the plant facilities located on the SMPP property. Electric power, natural gas and rail services will be provided from existing networks. The SMPP has been permitted but still requires to be re-zoned from agricultural to industrial use. Fortune anticipates that this process will be completed by approximately mid-2014, well in advance of the scheduled commencement of any construction work at the site.

24.1.2.1 Implementation Approach and Strategy

As is the case for the Project site in the NWT, the implementation strategy for the SMPP centres on a phased approach to identifying the components of the works to be accomplished and establishing realistic time frames for the completion of those works. The Project milestones that result from the overall SMPP implementation schedule are summarized in Table 24.6.

Table 24.6
Project Milestones – SMPP

SMPP PROJECT MILESTONE LISTING			
PROJECT MILESTONES CONCENTRATOR MILESTONES		START	FINISH
Z1000	**SMPP P/MILESTONE – FINAL EA ARROVAL RECEIVED**	**13-FEB-14 A**	
Z1300	SMPP P/MILESTONE – SUBMIT BANKABLE FEASIBILITY STUDY	21-MAR-14	
Z1500	SMPP P/MILESTONE – PRELIMINARY ENGINEERING COMPLETED		04-JUL-14
Z1100	SMPP P/MILESTONE – REZONING REQUEST APPROVED		28-JUL-14
Z1400	SMPP P/MILESTONE – FULL PROJECT FUNDING RECEIVED		01-SEP-14
Z1600	SMPP P/MILESTONE – START OF SITE PREP WORKS	17-MAY-15	
Z1220	SMPP P/MILESTONE – SITE PREP COMPLETED / BUILDINGS ENCLOSED		27-NOV-15
Z1230	SMPP P/MILESTONE – START MAIN CONSTRUCTION WORKS	07-JAN-16	
Z1210	SMPP P/MILESTONE – DETAILED ENGINEERING COMPLETED		31-MAR-16
Z1240	SMPP P/MILESTONE – BULK CONSTRUCTION WORKS COMPLETED		26-MAR-17
Z1280	SMPP P/MILESTONE – RAIL FACILITIES READY FOR 1st CONCENTRATE DELIVERY (FROM NICO)		06-JUN-17
Z1275	SMPP P/MILESTONE – 1ST CONCENTRATE DELIVERY REQUIRED FOR COMMISSIONING	30-OCT-17	
Z1250	SMPP P/MILESTONE – COMMISSIONING COMPLETE		30-DEC-17
Z1280	SMPP P/MILESTONE – RAMP-UP COMPLETE / START OF NORMAL OPERATIONS		30-DEC-17

24.1.2.2 Work Breakdown Structure

Levels 1 and 2 of the WBS for the SMPP are shown in Tables 24.7 and 24.8, respectively.

Table 24.7
SMPP Work Breakdown Structure - Level 1

WBS Code	WBS Name	Total Activities	Start	Finish
SMPPL	**SMPP – SASKATCHEWAN PROCESSING PLANT**	**492**	**01-JAN-14**	**12-OCT-17**
SMPPL.1	PROJECT MILESTONES	14	18-Feb-14	12-Oct-17
SMPPL.2	PERMITTING, RE-ZONING & UTILITY SERVICE CONNECTIONS	17	06-Jan-14	25-May-15
SMPPL.3	FEASIBILITY STUDY / DUE DILLIGENCE / PROJECT FUNDING	11	06-Jan-14	01-Sep-14
SMPPL.4	PRELIMINARY ENGINEERING	28	06-Jan-14	04-Jul-14
SMPPL.5	DETAILED ENGINEERING	274	21-Jul-14	31-Mar-16
SMPPL.6	EQUIPMENT MANUFACTURE, SHIP & DELIVERY	31	01-Jan-14	27-May-16
SMPPL.7	SITE CONSTRUCTION	99	08-May-15	30-Sep-17
SMPPL.8	PUNCHOUT / RECTIFICATION	15	15-Feb-17	23-May-17
SMPPL 9	PRE COMMISSIONING	5	20-May-17	04-Sep-17
SMPPL.9	COMMISSIONING & STARTUP	3	05-Sept-17	30-Dec-17

Table 24.8
SMPP Work Breakdown Structure - Level 2

WBS Code	WBS Name	Total Activities	Start	Finish
SMPPL	**SMPP - SASKATCHEWAN PROCESSING PLANT**	**492**	**01-Jan-14**	**30-Oct-17**
SMPPL.1	**PROJECT MILESTONES**	**14**	**18-Feb-14**	**12-Oct-17**
SMPPL.2	**PERMITTING, RE-ZONING & UTILITY SERVICE CONNECTIONS**	**17**	**06-Jan-14**	**25-May-15**
SMPPL.2.1	PERMITTING	5	06-Jan-14	18-Feb-14
SMPPL.2.2	RE-ZONING OF PROPERTY FOR INDUSTRIAL	4	04-Feb-14	28-Jul-14
SMPPL.2.3	SASK POWER CONNECTION	8	25-Aug-14	25-May-15
SMPPL.3	**FEASIBILITY STUDY / DUE DILLIGENCE / PROJECT FUNDING**	**11**	**06-Jan-14**	**01-Sep-14**
SMPPL.3.1	UPDATE FEASIBILITY STUDY	1	06-Jan-14	24-Jan-14
SMPPL.3.2	PREPARE SCHEDULE, ESTIMATE, EXECUTION PLAN & FINANCIAL MODEL	4	06-Jan-14	28-Feb-14
SMPPL.3.3	DUE DILLIGENCE REVIEW & FINALIZATION	2	03-Mar-14	21-Mar-14
SMPPL.3.4	FUNDING PROCESS	4	21-Mar-14	01-Sep-14
SMPPL.4	**PRELIMINARY ENGINEERING**	**28**	**06-Jan-14**	**04-Jul-14**
SMPPL.4.1	REQUEST PROPOSAL & AUTHORIZE WORKS	3	06-Jan-14	17-Jan-14
SMPPL.4.6	GENERAL REVIEW & GAP ANALYSIS	2	20-Jan-14	14-Feb-14
SMPPL.4.2	DISCIPLINE DESIGN CRITERIOR	6	17-Feb-14	27-Jun-14
SMPPL.4.5	PROCESS CONFIGURATION DEVELOPMENT	9	17-Feb-14	13-Jun-14
SMPPL.4.4	3D MODELING OF PROCESS BUILDINGS	7	21-Apr-14	04-Jul-14
SMPPL.5	**DETAILED ENGINEERING**	**274**	**21-Jul-14**	**31-Mar-16**
SMPPL.5.10	CONTRACTING	5	21-Jul-14	01-Sep-14
SMPPL.5.11	PHASE 1 - SITE PREP & BUILDING STRUCTURES ENGINEERING	46	01-Sep-14	01-May-15
SMPPL.5.8	PHASE 2 - PLANT & FACILITIES ENGINEERING WORKS	174	01-Apr-15	31-Mar-16
SMPPL.5.12	PROCUREMENT OF EQUIPMENT & MATERIALS	49	25-Sep-14	17-Nov-15
SMPPL.6	**EQUIPMENT MANUFACTURE, SHIP & DELIVERY**	**31**	**01-Jan-14**	**27-May-16**
SMPPL.6.1	MANUFACTURING	11	31-Oct-14	16-Mar-16
SMPPL.6.2	SHIPPING	9	15-May-15	27-May-16
SMPPL.6.3	DELIVERY TO SITE	11	01-Jan-14	27-May-16
SMPPL.7	**SITE CONSTRUCTION**	**99**	**08-May-15**	**30-Sep-17**
SMPPL.7.13	CONSTRUCTION MILESTONES	4	30-Sep-15	08-Jul-17
SMPPL.7.5	SITE PREPARATION / FOUNDATIONS & BUILDING ENCLOSURES	24	08-May-15	27-Nov-15
SMPPL.7.6	PLANT & FACILITIES CONSTRUCTION	71	02-Dec-15	30-Sep-17
SMPPL.8	**CONSTRUCTION PUNCHOUT, RECTIFICATION & PRECOMMISSIONING**	**15**	**04-Apr-16**	**06-Jun-17**
SMPPL.8.1	PUNCHOUT & RECTIFICATION	5	15-Feb-17	23-May-17
SMPPL.8.2	PRECOMMISSIONING	5	20-May-17	04-Sep-17
SMPPL.9	**COMMISSIONING & STARTUP**	**3**	**05-Sep-17**	**30-Dec-17**
SMPPL.9.1	COMMISSIONING	2	05-Sep-17	03-Dec-17
SMPPL.9.2	FULL PRODUCTION	1	04-Dec-17	30-Dec-17

24.1.2.3 Engineering and Procurement

Preliminary Engineering

It is anticipated that preliminary engineering for the SMPP will be completed by Fortune's existing engineering contractor prior to the finalization of Project financing arrangements. Preliminary engineering will include a detailed schedule, deliverable list and a control and monitoring system that will be used during detailed engineering. Detailed engineering, the commencement of which is contingent upon the receipt of Project financing, will proceed in two phases.

Detailed Engineering

The preliminary engineering phase will establish the design parameters for the SMPP, which will form the basis for detailed engineering. The first phase of detailed engineering will then focus on the site works scheduled for 2015. These include the detailed design of site and building layouts, basic underground services and earthworks, main building foundations and building structures. The purpose of these engineering activities will be to coordinate and complete the design and procurement of all elements of the structures, so that all building envelopes can be erected before the onset of winter of 2015. This will permit the work planned for that winter, which includes equipment foundations, to be undertaken in a protected environment.

The second phase of detailed engineering, much of which could proceed concurrently with the first phase, will be devoted to the design and procurement of equipment, piping, electrical distribution, instrumentation and other service components that are to be installed within the buildings or elsewhere on site. It is anticipated that the required oxygen plant will be procured on a turnkey basis.

Procurement

The procurement strategy for the SMPP is yet to be finalized. It is likely that the engineering contractor will be responsible for the preparation of tender documents, the receipt of bids and the preparation of a bid analysis, with recommendations, for Fortune's consideration. Alternatively, it is possible that one or more preferred suppliers will be selected to provide most of the equipment.

24.1.2.4 Construction

The construction plan for the SMPP is most conveniently divided into the following components:

- Site preparation and building enclosures.
- Main plant and facilities.
- Hand-over, commissioning and start-up.

The underlying strategy of the SMPP construction plan is to complete all site preparation works and building enclosures in 2015, prior to the onset of winter. The site is well suited to the efficient execution of earthworks and it is planned to limit underground piping and services to the extent possible. The principal earthworks will comprise excavation of the footprint of each building to the bottom of the foundation, so that the foundations can then be constructed without impediment. Once the foundations are complete, the building can be erected during the summer and fall of 2015.

Construction of the main plant and facilities is planned to start in the late fall of 2015 or the early spring of 2016. The initial component of this work will be the construction of equipment foundations, backfilling and the pouring of floor slabs, where possible. The next component of work will be the placement of the main process equipment on the prepared foundations. This equipment has been sequenced for arrival at the site during the spring and summer of 2016. The follow-on work of installing platforms, mechanical items, piping, instrumentation and electrical cables is phased in, area-by-area, to provide the most efficient production schedule.

The peak of construction activity occurs in mid-2016, when multi-disciplinary work is occurring in all buildings. The schedule is designed to minimize parallel work in each individual building, so as to limit disruption and provide flexibility for all disciplines.

The bulk of the construction work at the SMPP is scheduled for completion in the spring of 2017, leaving adequate time for the hand-over and commissioning process to be completed prior to the scheduled start-up date of October, 2017. The hand-over and pre-commissioning principles and procedures will be similar to those described previously for the Project site in the NWT. The commissioning start-up sequence will involve bringing the various circuits and systems into operational mode in a sequenced manner. All hydrometallurgical circuits will be tested first with water only and then with process fluids and solids, as required. A period of approximately six months has been allowed for the hand-over and commissioning of the facilities, prior to the planned start-up of production operations in October, 2017. Thereafter, a period of two months is scheduled, within which to achieve full design capacity.

24.1.3 Monitoring and Control

24.1.3.1 Cost Management

A cost management system, using Coreworx project management software, will be maintained throughout the construction period at both sites. The structure will be consistent with the WBS and will provide the necessary linkage to progress measurement and cost parameters. The system will collect actual data at a level that can realistically be achieved and will provide a comprehensive comparison to the base estimates. Monthly monitoring and analysis of trends will provide full knowledge of the progress and cost of construction and will identify the most important cost drives that require management attention.

The cost system will provide charts and graphs that show the status of planned and actual expenditures, unit rates, and labour and material costs, in addition to forecasting costs that are outside planned parameters. This information will be used as the basis for appropriate action to mitigate potential adverse impacts, if required.

24.1.3.2 Planning, Scheduling and Progress Measurement

The functions of planning, scheduling and progress measurement are vital to implementing and maintaining a successful construction management system, and these functions are also components of the Coreworx software. The Coreworx system integrates planning, scheduling, progress measurement and the monitoring and forecasting of costs into a single database, to ensure that all of these elements of Project management are consistent and that comprehensive input is provided to the decision making process.

A master Project schedule has been developed and actual progress will be monitored and measured against the scope, timing, construction effort and manpower levels set out in that schedule. Each element of work awarded to a new contractor will be based on achieving the results required by the master schedule, and the performance of each contractor will be closely monitored by the construction management team.

The master schedule has been developed using Primavera software. Once the engineering, procurement and construction program begins, the master schedule will be retained, but a separate current schedule will also be established, and updated periodically, to reflect the actual status of work. The timing and duration of all future activities will be recalculated in the current schedule, so that the effect of any current slippage or acceleration of work on future activities can be evaluated, and remedial actions taken, if required.

During the engineering and procurement phases of the program, progress will be updated bi-weekly and fully reported on a monthly basis. During construction, progress will be updated and reported on a weekly basis. The measurement of construction progress will focus on direct construction works.

A system of measurement based on Project deliverables and quantities will also be employed, based on the deliverable matrix summarized in Table 24.9. All specific deliverables will be included in a database that assigns a man-hour or cost weighting to each line item.

Table 24.9
Deliverable Matrix

Engineering	Procurement	Construction
Each Specification	Each Bid Package (proposal and bid effort)	Commodity installation quantities, i.e., earthworks, concrete, steel, piping, equipment, cable / cable tray, instruments, etc. (by drawing take-off)
Each Study or Investigation	Each Manufacturing / Delivery Status for equipment and materials.	
Each Criterion / Scope Definition		
Each Bid Package (development)		
Each Drawing / Design Sketch		Installation of "package" equipment

Each deliverable will be assigned achievement milestones, based on the defined sequence of work required, and progress will be monitored against these milestones.

The analysis of scope creep or float, and trend analysis, will be key functions of the progress management system. As new items are identified that are outside the planned scope, estimate or performance requirements, they will be included in the schedule, to ensure that there is always an accurate assessment of actual progress against the master Project schedule.

24.2 RISK MANAGEMENT

Fortune has developed an approach to risk management based on assessment of a range of business, environmental, regulatory and project management risks.

Risks associated with metal prices, market demand, exchange rates and other elements of the world economy that are outside the control of the Project team are not included in the following assessment. Other external factors include risks associated with the location of the

Project, such as severe weather, as well as political change and tax increases. These risks are considered to be low and well understood by Fortune and are not discussed in this report.

The focus of the Project risk management assessment is on the risks that are within the control of the Project team, for which mitigation strategies can be developed and/or controls put in place. A comprehensive list of these controllable risks has been developed from a number of studies prepared by Fortune, with the assistance of external experts and consultants involved in delivering specific work packages.

Table 24.10 presents a summary of the risk likelihood and consequence categories.

Table 24.10
Summary of Risk Likelihood and Consequence Categories

Likelihood Category	Description
L	Less than 25% probability of occurrence. Likely to occur once every five years.
M	25-50% probability of occurrence. Likely to occur once per year.
H	Greater than 50% probability of occurrence. Likely to occur once per month.
Consequence Category	**Description**
L	Minimal short-term impact to one individual or stakeholder.
M	Moderate impact to individual or stakeholder. Impacts annual plan or objective.
H	Lasting impact to individual or stakeholder. Failure to achieve long-term plan or objective.

The severity ranking of the risks is typically assessed as low, medium or high and their priorities are assessed according to consequences, as presented in Table 24.11.

Table 24.11
Risk Ranking Results

Risk Ranking	Risk Category	Description
L	Acceptable as is.	Not prioritized for additional mitigation at this time.
M	Acceptable with controls.	Should be verified that procedures or controls are in place.
H	Undesirable.	Should be mitigated with engineering and/or administrative controls to a risk ranking of M or less within a specified time period, based on actions proposed by the team.

The resulting risk ranking matrix is shown in Figure 24.1.

Figure 24.1
Risk Ranking Matrix

Consequence Rating			
Likelihood Rating	L	M	H
H	M	H	H
M	L	M	H
L	L	M	M

24.2.1 Business Risks

Identified business risks, mitigation action, mitigation status and ranking are shown in Table 24.12.

Table 24.12
Business Risks

Description	Consequence	Cause	Existing Controls	Actions	Likelihood and Consequence		
Tłı̨chǫ Access road unavailable for project use	Unable to construct and operate project with sufficient rate of return.	Road decision and construction not realized in required timeframe Lack of Government support (financial primarily)	Continue to seek government support for project road. Continue to work with Tłı̨chǫ, GNWT, CanNor (federal government) on securing the road funding. Community consultation efforts. Build on support from Tłı̨chǫ government.	Schedule completed involving winter road for early construction. Continue to work with Tłı̨chǫ and NWT on route and road standards. Translate Tłı̨chǫ support into funding and execution plan. Continue to work with NWT on road studies and standards.	H	H	H
Financing for project execution not yet available	Schedule delays. Loss of reputation. Loss of staff. Additional costs to suspend and restart the project.	Budget for planned work exceeds funds available. Inability to attract a strategic partner .	Engage Deloitte to secure a strategic partner. Project optimized to achieve an attractive rate of return. Continue to work with Procon/CAMCE to secure full financing.	Limit scope of work to company's financial capacity. Enter into deal with Camce/Procon to finance ongoing activities.	H	H	H
Insufficient rate of return to attract bank financing	Unable to finance the project.	Uncertainty in metal price forecast. Project capital and operating cost combined with metal prices not attractive enough for bank financing.	Seeking strategic partners to distribute risk and optimize rate of return. Optimizing capital costs. Optimizing operating costs. Marketing strategy includes value added products and favourable jurisdictions.	Review capital costs and determine opportunities for savings. Review operating costs and determine opportunities for savings. Coordination and accumulation of market data and analysis to optimize product mix and sales jurisdiction to maximize revenue.	M	M	M
Financing unavailable to meet current start-up date	Start-up delayed. Financial stress.	Financing unavailable in current market conditions. Project cannot attract strategic partners	Hired Deloitte to identify and seek strategic partners. Open to re-configuring project to attract strategic partners.	Continue to follow up with interested potential partners and complete due diligence activities as required. Stay flexible in terms of project configuration. Change start-up date and schedule to match financing.	H	M	M
Tłı̨chǫ IBA expectations too high	Reduction in project returns depending on agreement reached.	Diamond mines have set high expectations of project returns.	IBA negotiation teams have been formed and initial meetings have occurred. Fortune's IBA negotiations team is continuing to build appropriate expectations with Tłı̨chǫ negotiations team Fortune is sharing project economic	Continue to share project economic details with Tłı̨chǫ. Present IBA solutions that do not strain project economics and allow participation in project upside. Continue IBA negotiations with Tłı̨chǫ.	M	M	M

Description	Consequence	Cause	Existing Controls	Actions	Likelihood and Consequence		
			information with Tłı̨chǫ on ongoing basis.				
IBA with North Slave Metis Alliance	Litigation or delays in project financing due to lack of agreement.	NSMA not satisfied with IBA offer.	Preliminary discussions with Bill Enge (president of NSMA) on IBA expectations.	Sign MOU with NSMA as promised in public hearings. Initiate negotiations only when IBA with Tłı̨chǫ has been signed.	M	M	M

The primary business risks associated with the NICO Project are related to finalizing joint venture strategic partnerships with a company that has the financial resources to help Fortune fund the construction and development of the Project.

Fortune has engaged the services of Deloitte & Touche Corporate Finance Canada Inc. (Deloitte) to identify potential strategic partners and help evaluate and conclude a transaction. A Project data room has been set up to actively share relevant information about the NICO Project with potential future partners.

Low capital and operating costs and continual access to the market for its products are keys for the NICO Project. The all-weather access road to the Project site is a critical element. The operational plan requires regularly scheduled daily shipments to maximize the availability of concentrate to be forwarded to the SMPP. Unrestricted site access is also connected to Project optimization efforts and cost savings opportunities, reducing the required capital cost and lowering operating costs.

To mitigate impacts of continual access to site, Fortune is working with the Canadian Federal, NWT and Tłı̨chǫ governments on a partnership to construct the Tłı̨chǫ Road, including the extension of this road to the mine. Key stakeholders in the proposed all-weather road include Fortune and the three levels of government noted above. Fortune is in negotiations with all parties and it is understood that an agreement has been reached to construct the road. To support efforts with the Federal Government, Fortune has engaged the firm of FlieshmanHillard to lead efforts to lobby Federal support. Fortune is also in negotiation with the Tłı̨chǫ government over an Impact and Benefits Agreement.

24.2.2 Environmental and Regulatory Risks

Table 24.13 summarizes the environmental and regulatory risks associated with development of the NICO Project.

Table 24.13
Environmental and Regulatory Risks

Description	Consequence	Cause	Existing Controls	Actions	Likelihood and Impact		
Co-disposal tests have yet to achieve stable metal levels	Additional long term testing required to validate co-disposal option	Time required to achieve stable results from co-disposal test program. Current test samples have not yet reached stable levels.	On-going testing and monitoring of samples. Verification of test samples and protocols. Containment ponds and water recycle planned for the facilities.	Continue long term testing and effluent monitoring (in-progress). Establish a plan to allow for treatment of water should it contain unacceptable metal levels.	M	M	M
Closure bonding conditions	-Unable to finance closure requirements from AANDC Current financial request from AANDC unacceptable	Uncertainty in Fortune's ability to meet closure objectives for water quality.	Contango Strategies Ltd. developing indoor pilot wetland treatment system to demonstrate technology is viable. Will complete more extensive geochemical tests early in life of CDF to confirm predictions.	Complete and review costing spreadsheet to validate costs. Once decision on financial instrument complete, finalize negotiations with AANDC and WLWB on closure bonding requirements. Risk consultant retained to assess funding options. Ensure technical requirements are appropriate.	M	M	M
Re-zoning of lands for SMPP	Unable to re-zone land in desired location Project delay until plant location secured	Stakeholder resistance. Lack of understanding of project and its impacts.	Use experienced resources to complete re-zoning work. Continue dialogue with local stakeholders. EA approved by the government and conditions accepted.	Issue documents to start re-zoning process once public communications in proper state Meet with Langham, Dalmeny and Corman Park and councils to discuss project. Conduct open houses and information sessions as required.	L	H	M
Safety incident during early construction phase (applicable to NICO and SMPP)	Schedule delays as a result of re-focusing safety efforts	Lack of early preparation of processes and procedures. Standards not established prior to procurement or work commencement.	Past safety practices from test mining.	Complete when required a comprehensive safety, health and indoctrination package for construction and operations. Hire and train resources with a focus on safety. Establish and communicate clear standards.	M	M	M
Delay in receiving Mine Water license and Land Use Permit	Critical permit to allow for Land Use and project approval	Stakeholder resistance. Incomplete documentation. Regulatory delays as a result of measures not being fully accepted as written.	Continued engagement with government authorities. Continue working with Tłįchǫ to maintain support for the project. All management plans completed and ready for submission. Interim permit achieved.	Continue efforts with stakeholders to secure approval. Answer all questions and inquiries promptly with authorities. Engage key stakeholders to ensure timely approval.	M	L	L
SMPP residue does not meet regulatory requirements for long-term storage	Unable to cost effectively store residue due to differing regulatory requirements	Residue storage system does not produce expected results.	PRSF designed for long term operation and control .	Establish monitoring plan as part of ongoing operations.	M	L	L

Fortune has adopted a pro-active approach its commitment to environmental and regulatory requirements. With the support of Golder, extensive testing, modelling and baseline studies have been completed. All environmental impacts have been clearly addressed in the Developers Assessment Report (DAR). The end results were measures that generated actions modifying the construction, operation and closure plans, with adverse environmental effects engineered out of the Project. Impacts will be closely monitored through management plans or actively reviewed by advisory committees. The efforts to pro-actively address all concerns were recognized officially by the MVRB and all the participating government and aboriginal organizations during the review board process, and validated by a timely approval and recommendation for Ministerial review.

Due to devolution and the settled land claim of the Tłįchǫ Government, there is some uncertainty within the regulatory process. Fortune is engaged in open dialogue with the Federal and NWT governments to advise and provide guidance. Fortune's environmental and regulatory legal counsel provided relevant briefing notes to the government to support the process.

24.2.3 Project Management Risks

Project implementation and management risks are presented in Table 24.14.

Table 24.14
Project Implementation and Management Risks

Description	Consequence	Cause	Existing Controls	Actions	Likelihood and Impact		
Current schedule not achievable	Loss of project returns. Increased financing requirements. Loss of stakeholder confidence. Delay in production.	Schedule does not have weather or other delays accounted for. Construction camp too small. Inadequate risk assessment and management program. All weather road not available.	FEED engineering completed. Use developed winter road strategy. Early works program. Schedule completed and due diligence has validated approach and durations. Completed Phase 1 engineering to settle layout and related issues.	Implement a risk management program. Work with governments to establish all-weather road. Execute developed plan according to the schedule. Update the schedule for the most recent configuration.	M	M	M
Insufficient preparation for execution once financing and permits in place.	Increased costs and schedule delays.	Lack of detailed planning for execution.	FEED engineering completed. Extensive engineering and preparation work. Completed Phase 1 detailed engineering and updates to schedule based on financing.	Complete detailed project planning and execution plan. Seek financing to meet the developed plan. Complete early works to reduce risk and increase certainty in cost and schedule.	M	M	M
Uncertainty in capital cost estimate	Loss of project returns. Increased financing requirements. Loss of stakeholder confidence.	Inaccurate estimates or not current. Factored estimates. Missing scope items. Inadequate oversight of consultants.	Independent estimate developed as part of due diligence. Phase 1 detailed engineering completed with a focus on identified risk elements.	Update costs to ensure information is as current as possible. Complete review of China buy opportunity. Establish a procurement plan that reduces capital costs through bulk purchases and preferred relationships.	M	M	M
Uncertainty in operating cost estimate	Loss of project returns. Loss of stakeholder confidence.	Operating cost estimate not current or inaccurate. Change in configuration requires a review of certain operating cost centres.	FEED engineering completed. Independent estimate developed as part of due diligence.	Update costs to ensure information is as current as possible.	M	M	M
Engineering schedule not linked to procurement requirements.	Schedule delays. Loss of project returns. Increased financing requirements. Loss of stakeholder confidence.	Incomplete planning of project execution activities.	Project execution plan and schedule develop ed as part of due diligence. Early engineering completed.	Complete project planning to increase certainty.	M	M	M

Individuals for key positions have been recruited to plan and drive Project execution. As a result, resources have been mobilized to address regulatory and permitting issues, procurement, bids for long-lead items, site planning and construction contracting, thereby reducing identified Project management risks.

24.2.4 Path Forward

Fortune strives to be pro-active by assessing all potential risks and implementing mitigation strategies, whenever possible. All studies are carried out to ensure that the extent and degree of significance is well understood. Strict adherence to company policies and procedures is required, including management approval at each stage of the Project.

As part of Project planning and execution, Fortune will continue to complete risk assessments appropriate for the stage of the Project. During detailed engineering, hazard and operability (HAZOP) studies will be completed on all systems. In addition, prior to starting construction activities, a comprehensive risk analysis will be completed and plans will be put in place to ensure timely and cost effective completion of each construction package.

Achieving certainty in the regulatory process, planning and execution, and Project funding, are key objectives. Action points in these areas have been identified and are being actively managed. Working relationships have been developed with the communities, agencies, regulatory bodies and all levels of government, and these are critical to Project success.

25.0 INTERPRETATION AND CONCLUSIONS

This report describes the findings of a comprehensive Feasibility Study which has evaluated the technical feasibility and economic viability of producing saleable gold, cobalt, bismuth and copper by mining and processing of the mineral reserves located on the NICO Project site in the NWT.

The principal conclusions reached on the basis of the discussion contained in this report are that the NICO Project is technically feasible and also that, at the metal prices and exchange rate used in the financial analysis, the Project is economically viable.

Technical feasibility has been demonstrated by:

- A sufficient level of exploration and drilling to support a reliable estimate of the resources contained in the NICO deposit.

- Designs and production schedules for the open pit and underground mines that have been prepared in detail and in accordance with generally accepted engineering procedures.

- Comprehensive metallurgical testwork of sufficient scope to identify the most appropriate unit operations for extracting saleable metal products from the NICO ore.

- The development of metallurgical flowsheets from the results of testwork, and the selection and sizing of the processing equipment at a level appropriate for a Feasibility Study.

- The design and selection of infrastructure, and of facilities for the storage of mine and process wastes, also at a level appropriate for a Feasibility Study.

- Comprehensive environmental baseline studies, followed by the development of concrete plans for the mitigation of environmental impacts, sufficient to support an application to the appropriate regulatory authorities for the permits required to commence construction at the Project site in the NWT. Approval to construct and operate the SMPP has already been granted.

- A logical program and schedule for Project construction.

Economic viability has been demonstrated through a detailed and comprehensive financial model, which includes:

- Estimates of revenue made on the basis of detailed production schedules, combined with a series of projected metal prices.

- Estimates of capital expenditure and operating cost which, in the main, are considered accurate to within plus or minus 15%, as appropriate for use in a Feasibility Study.

- Estimates of all applicable taxes to be levied on the profits of the Project.

- A debt financing scheme that has yet to be approved by potential lenders.

In common with all mining projects, the economics of the NICO Project are most sensitive to changes in the prices of the principal mineral commodities produced. The economic viability of the Project remains vulnerable to any persistent decrease in the prices of cobalt, gold and bismuth below those projected herein.

26.0 RECOMMENDATIONS

The principal components of the proposed Project that are not yet at the Feasibility Study level of definition are:

- The operating cost estimates for the SMPP, which remain based on the original FEED study and have an assessed level of accuracy of minus 10%, plus 25% for the cobalt sulphate production circuit.

- A detailed analysis of the future demand for bismuth oxide, which is projected to constitute 60% of the bismuth produced, or an average of approximately 1,000 tonnes per year of bismuth oxide.

It is recommended that studies be advanced on both of these fronts, as a matter of priority.

The principal matters outstanding before construction at the Project site in the NWT can begin are obtaining the permits necessary to do so and arranging financing for the Project. Since all materials and equipment required for the 2015 early works program must be delivered to site over the winter road, prior to about April, 2015, failure to secure financing by approximately September, 2014 will jeopardize that program and potentially set the Project back by a full year.

The procedure for obtaining permits for the site in the NWT is well advanced and, to a large extent, now in the hands of the regulatory authorities. It is recommended, however, that consultation with all stakeholders continue unabated, since the public may still have the right to comment on the permit applications.

Completion of the all-weather road from Behchokö to Whatì early in 2016 is critical to maintaining the Project construction schedule. Negotiation of a definitive agreement between the NWT and Tłįchǫ governments, and Fortune if necessary, to achieve this schedule is also regarded as a matter of priority. The terms under which electric power will be supplied to the Project site from the Snare Hydroelectric Complex remain to be finalized.

An Impact and Benefits Agreement with the Tłįchǫ government may involve some added cost for the Project. It is recommended that the financial terms of that agreement be negotiated as soon as possible.

27.0 DATE AND SIGNATURE PAGE

The effective date of this report is April 2, 2014 and signing date is May 5, 2014.

"Harry Burgess, P.Eng,"

Harry Burgess, P.Eng.
Associate Consultant, Micon International Limited

"Christopher R. Lattanzi, P.Eng.

Christopher R. Lattanzi, P.Eng.
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B. Terrence Hennessey, P.Geo.
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28.0 REFERENCES

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29.0 CERTIFICATES

CERTIFICATE OF AUTHOR
HARRY BURGESS, P. Eng.

As a co-author of the report entitled “Technical Report on the Feasibility Study for the NICO Gold-Cobalt-Bismuth-Copper Project, Northwest Territories, Canada”, effective date April 2, 2014, I, Harry Burgess do hereby certify that:

1. I am an Associate of, and carried out this assignment for, Micon International Limited, Suite 900, 390 Bay Street, Toronto, Ontario, M5H 2Y2, telephone (416) 362-5135, fax (416) 362-5763, e-mail hburgess@micon-international.com.

2. I hold the following academic qualifications:

B.Sc. (Mechanical Engineering)	London University	1966
B.Sc. (Mining Engineering)	London University	1968
M.Sc. (Engineering)	University of Witwatersrand	1980

3. I am a registered Professional Engineer with the Association of Professional Engineers of Ontario (membership number 6092506); as well, I am a member in good standing of several other technical associations and societies, including:

   The Australasian Institute of Mining and Metallurgy (Fellow)
   The Institution of Mining and Metallurgy (Fellow)
   The Canadian Institute of Mining, Metallurgy and Petroleum (Member)

4. I have worked as a mining engineer in the minerals industry for more than 40 years;

5. I am familiar with NI 43-101 and, by reason of education, experience and professional registration, I fulfill the requirements of a Qualified Person as defined in NI 43-101. My work experience includes 13 years as a mining engineer working in mine planning and production operations in underground copper and gold mining and over 30 years as a consulting mining engineer working in open pit and underground operations involving many minerals and all aspects of mining from mine design to financial evaluation.;

6. Those sections of the Technical Report for which I am responsible have been compiled in compliance with NI 43-101.

7. I am responsible for the preparation of Sections 15 and 16 of the Technical Report.

8. I have not visited the NICO Project.

9. I have had no prior involvement with the NICO Project.

10. As of the date of this certificate to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make this report not misleading.

11. I am independent of Fortune Minerals Limited, as defined by NI 43-101.

Dated this 5th day of May, 2014.

“Harry Burgess” {signed and sealed}

Harry Burgess, P. Eng.

CERTIFICATE OF AUTHOR
RICHARD M. GOWANS, P. Eng.

As a co-author of the report entitled "Technical Report on the Feasibility Study for the NICO Gold-Cobalt-Bismuth-Copper Project, Northwest Territories, Canada", effective date April 2, 2014, I, Richard Gowans do hereby certify that:

1. I am employed by, and carried out this assignment for, Micon International Limited, Suite 900, 390 Bay Street, Toronto, Ontario M5H 2Y2, tel. (416) 362-5135, fax (416) 362-5763, e-mail rgowans@micon-international.com.

2. I hold the following academic qualifications:

   B.Sc. (Hons) Minerals Engineering, University of Birmingham, U.K., 1980.

3. I am a registered Professional Engineer of Ontario (membership number 90529389); as well, I am a member in good standing of the Canadian Institute of Mining, Metallurgy and Petroleum.

4. I have worked as a process metallurgist in the minerals industry for more than 30 years.

5. I have read NI 43-101 and, by reason of education, experience and professional registration, I fulfill the requirements of a Qualified Person as defined in NI 43-101. My work experience includes the management of technical studies and design of numerous metallurgical testwork programs and metallurgical processing plants.

6. Those sections of this Technical Report for which I am responsible have been compiled in compliance with NI 43-101.

7. I am responsible for the preparation of Sections 13 and 17 (except 17.1.8) of the Technical Report.

8. I have not visited the NICO Project.

9. I have had no prior involvement with the NICO Project.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make this report not misleading.

11. I am independent of Fortune Minerals Limited, as defined by NI 43-101.

Dated this 5th day of May, 2014.

"Richard Gowans" {signed and sealed}

Richard Gowans, P. Eng.

CERTIFICATE OF AUTHOR
B. TERRENCE HENNESSEY, P.Geo.

As a co-author of the report entitled "Technical Report on the Feasibility Study for the NICO Gold-Cobalt-Bismuth-Copper Project, Northwest Territories, Canada", effective date April 2, 2014, I, B. Terrence Hennessey do hereby certify that:

1. I am employed by, and carried out this assignment for Micon International Limited, Suite 900, 390 Bay Street, Toronto, Ontario, M5H 2Y2, tel. (416) 362-5135, fax (416) 362-5763, e-mail thennessey@micon-international.com.

2. I hold the following academic qualifications:

   B.Sc. (Geology), McMaster University, 1978

3. I am a registered Professional Geoscientist with the Association of Professional Geoscientists of Ontario (membership # 0038); as well, I am a member in good standing of several other technical associations and societies, including:

   The Australasian Institute of Mining and Metallurgy (Member)
   The Canadian Institute of Mining, Metallurgy and Petroleum (Member)

4. I have worked as a geologist in the minerals industry for 28 years.

5. I do, by reason of education, experience and professional registration, fulfill the requirements of a Qualified Person as defined in NI 43-101. My work experience includes 7 years as an exploration geologist looking for iron ore, gold, base metal and tin deposits, more than 11 years as a mine geologist in both open pit and underground mines and 17 years as a consulting geologist working in precious, ferrous and base metals and industrial minerals. I have previous experience with resource estimation and review of layered mafic intrusive deposits.

6. Those sections of this report for which I am responsible have been compiled in accordance with NI 43-101.

7. I am responsible for the preparation of Sections 4 to 9, 10.1, 10.2, 10.4, 12.1.1, 14.2 and 14.12 of the Technical Report.

8. I visited the NICO Project site during the period September 5 to 9, 2003.

9. I was a co-author of the report entitled "Technical Report on the Bankable Feasibility Study for the NICO Cobalt-Gold-Bismuth Deposit, Mazenod Lake Area, Northwest Territories, Canada", dated February, 2007.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make this report not misleading.

11. I am independent of Fortune Minerals Limited, as defined by NI 43-101.

   Dated this 5th day of May, 2014

   "B. Terrence Hennessey" (Sealed)

   B. Terrence Hennessey, P. Geo.

CERTIFICATE OF AUTHOR
CHRISTOPHER R. LATTANZI, P. Eng.

As a co-author of the report entitled "Technical Report on the Feasibility Study for the NICO Gold-Cobalt-Bismuth-Copper Project, Northwest Territories, Canada", effective date April 2, 2014, I, Christopher R. Lattanzi, do hereby certify that:

1. I am an Associate of, and carried out this assignment for, Micon International Limited, Suite 900, 390 Bay Street, Toronto, Ontario, M5H 2Y2, tel. (416) 362-5135, fax (416) 362-5763, e-mail clattanzi@micon-international.com.

2. I hold the following academic qualifications:

   B. Eng. (Mining), University of Melbourne, Australia, 1959.

3. I am a registered Professional Engineer with the Association of Professional Engineers of Ontario (membership number 25705013); as well, I am a member in good standing of the Canadian Institute of Mining, Metallurgy and Petroleum.

4. I have worked as a mining engineer in the minerals industry for more than 50 years.

5. I have read NI 43-101 and, by reason of education, experience and professional registration, I fulfill the requirements of a Qualified Person as defined in NI 43-101. My experience includes the planning and direct supervision of open pit mines and more than 40 years as a consultant in the mineral industry.

6. Those sections of this Technical Report for which I am responsible have been compiled in accordance with NI 43-101.

7. I am responsible for the preparation of Sections 1 to 3, 17.1.8, 18 and 20 to 26 of the Technical Report.

8. I have not visited the NICO Project.

9. I have had no prior involvement with the NICO Project.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make this report not misleading.

11. I am independent Fortune Minerals Limited, as defined by NI 43-101.

Dated this 5th day of May, 2014.

"Christopher R. Lattanzi" {signed and sealed}

Christopher R. Lattanzi, P. Eng.

CERTIFICATE OF AUTHOR
EUGENE PURITCH, P. Eng.

As a co-author of the report entitled "Technical Report on the Feasibility Study for the NICO Gold-Cobalt-Bismuth-Copper Project, Northwest Territories, Canada", effective date April 2, 2014, I, Eugene Puritch do hereby certify that:

1. I am President of, and carried out this assignment for P&E Mining Consultants Inc., 2 County Court Boulevard, Brampton, Ontario, Canada, L6W 3W8, tel. (905) 595-0575, e-mail gene@peconsulting.ca

2. I am a graduate of The Haileybury School of Mines, with a Technologist Diploma in Mining, as well as obtaining an additional year of undergraduate education in Mine Engineering at Queen's University. In addition I have also met the Professional Engineers of Ontario Academic Requirement Committee's Examination requirement for Bachelor's Degree in Engineering Equivalency.

   Mining Technologist Diploma, Haileybury School of Mines, 1977

3. I am a mining consultant currently licensed by the Professional Engineers of Ontario (License No. 100014010) and registered with the Ontario Association of Certified Engineering Technicians and Technologists as a Senior Engineering Technologist. I am also a member of the National and Toronto CIM.

4. I have practiced my profession continuously since 1978.

5. I do, by reason of education, experience and professional registration, fulfill the requirements of a Qualified Person as defined in NI 43-101. My career experience is summarized below:

Mining Technologist - H.B.M.&S. and Inco Ltd.	1978 - 1980
Open Pit Mine Engineer - Cassiar Asbestos/Brinco Ltd.	1981 - 1983
Pit Engineer/Drill & Blast Supervisor - Detour Lake Mine	1984 - 1986
Self-Employed Mining Consultant - Timmins Area	1987 - 1988
Mine Designer/Resource Estimator - Dynatec/CMD/Bharti	1989 - 1995
Self-Employed Mining Consultant/Resource-Reserve Estimator	1995 - 2004
President, P&E Mining Consultants Inc.	2004 - Present

6. Those sections of this report for which I am responsible have been compiled in accordance with NI 43-101.

7. I am responsible for the preparation of Sections 10.3, 11, 12.1.2, 12.2, 14.1 and 14.3 to 14.11 of the Technical Report.

8. I visited the NICO Project site during the period July 10 to 11, 2004 and also on April 24, 2012.

9. I was a co-author of the reports entitled "Technical Report on the Bankable Feasibility Study for the NICO Cobalt-Gold-Bismuth Deposit, Mazenod Lake Area, Northwest Territories, Canada", dated February, 2007, and "Technical Report and Updated Reserve Estimate and Front-End Engineering and Design (FEED) Study on the NICO Gold-Cobalt-Bismuth-Copper Deposit, Mazenod Area, Northwest Territories, Canada", effective date July 2, 2012.

10. As of the date of this certificate, to the best of my knowledge, information and belief, the Technical Report contains all scientific and technical information that is required to be disclosed to make this report not misleading.

11. I am independent of Fortune Minerals Limited, as defined by NI 43-101.

    Dated this 5th day of May, 2014

    "Eugene Puritch" (sealed)

    Eugene Puritch, P. Eng.

APPENDIX I

PROCESS FLOW DIAGRAMS FOR THE

PROCESSING PLANT AT THE PROJECT SITE

HATCH™

FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	J.BELLISOMO	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
OVERALL PROCESS

SCALE	DWG. No.	REV
NTS OR AS NOTED	H345390-0000-05-030-0001	0

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

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No.	DESCRIPTION	BY	CHK'D	DATE
REVISIONS				

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STREAM No.	UNITS	101	110	111	112	120	121	122
MASS - SOLIDS	tph	464.50	464.50	349.54	114.96	862.71	398.21	464.50
MASS - SOLUTION	tph	16.85	16.85	12.68	4.17	31.29	14.44	16.85
MASS - SLURRY	tph	481.35	481.35	362.21	119.13	894.00	412.65	481.35
SPECIFIC GRAVITY - SOLIDS	S.G.	3.30	3.30	3.30	3.30	3.30	3.30	3.30
PERCENT SOLIDS (wt/wt)	%	96.50	96.50	96.50	96.50	96.50	96.50	96.50
SPECIFIC GRAVITY - SLURRY	S.G.	3.05	3.05	3.05	3.05	3.05	3.05	3.05
VOLUME - SOLIDS	m3/h	140.76	140.76	105.92	34.84	261.43	120.67	140.76
VOLUME - SOLUTION	m3/h	16.85	16.85	12.68	4.17	31.29	14.44	16.85
VOLUME - SLURRY	m3/h	157.60	157.60	118.60	39.01	292.72	135.11	157.60

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

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REGISTERED PROFESSIONAL

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FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
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CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
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ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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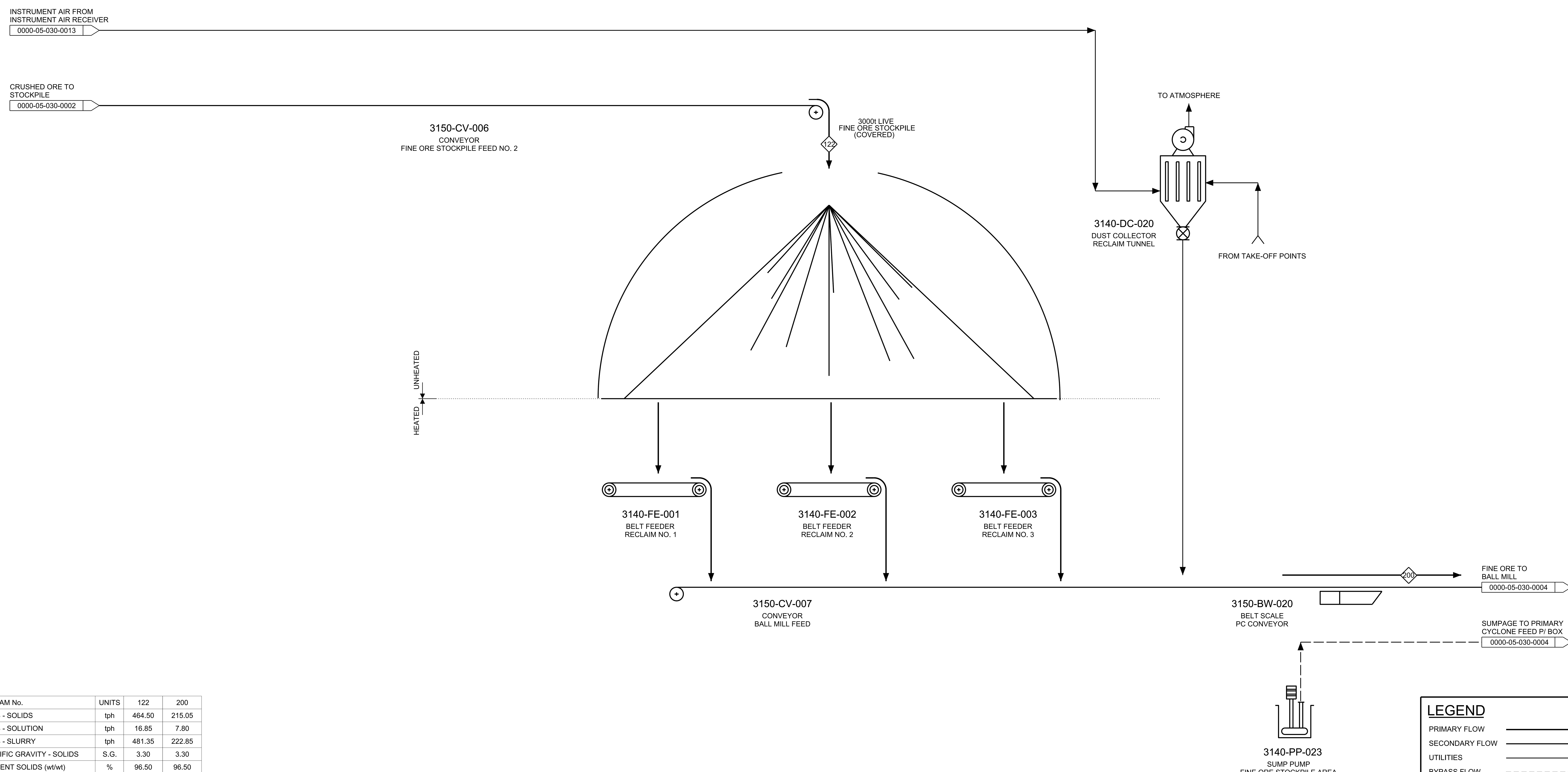
NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
PRIMARY, SECONDARY AND TERTIARY CRUSHING

SCALE	DWG. No.	REV
NTS OR AS NOTED	H345390-0000-05-030-0002	0

DWG. No. H345390-0000-05-030-0003



STREAM No.	UNITS	122	200
MASS - SOLIDS	tph	464.50	215.05
MASS - SOLUTION	tph	16.85	7.80
MASS - SLURRY	tph	481.35	222.85
SPECIFIC GRAVITY - SOLIDS	S.G.	3.30	3.30
PERCENT SOLIDS (wt/wt)	%	96.50	96.50
SPECIFIC GRAVITY - SLURRY	S.G.	3.05	3.05
VOLUME - SOLIDS	m3/h	140.76	65.17
VOLUME - SOLUTION	m3/h	16.85	7.80
VOLUME - SLURRY	m3/h	157.60	72.97

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

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ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
FINE ORE STORAGE

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STREAM No.	UNITS	200	202	203	204	205	206	207	209	210	211	212	700	701	702	703	704	705	801	803	
MASS - SOLIDS	tph	215.05	633.19	752.66	537.62	119.47	418.15	11.95	107.48	215.05	119.43	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
MASS - SOLUTION	tph	7.80	409.99	615.81	264.80	58.84	205.95	4.69	88.15	351.02	94.84	0.04	98.12	10.00	195.10	0.04	4.00	30.00	4.00	2.00	
MASS - SLURRY	tph	222.85	1043.18	1368.48	802.41	178.31	624.10	16.64	161.63	566.06	214.27	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SPECIFIC GRAVITY - SOLIDS	S.G.	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
PERCENT SOLIDS (wt/wt)	%	96.50	60.70	55.00	67.00	67.00	67.00	71.80	66.50	37.99	55.74	50.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
SPECIFIC GRAVITY - SLURRY	S.G.	3.05	1.73	1.62	1.88	1.88	1.88	2.00	1.34	1.36	1.64	1.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
VOLUME - SOLIDS	m3/h	65.17	191.88	228.08	162.91	36.20	126.71	3.62	32.57	65.17	36.19	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
VOLUME - SOLUTION	m3/h	7.80	409.99	615.81	264.80	58.84	205.95	4.69	88.15	351.02	94.84	0.04	98.12	10.00	195.10	0.04	4.00	30.00	4.00	2.00	
VOLUME - SLURRY	m3/h	72.97	601.87	843.89	427.71	95.05	332.66	8.31	120.72	416.18	131.03	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

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DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
PRIMARY GRINDING AND GRAVITY CONCENTRATE

SCALE NTS OR AS NOTED

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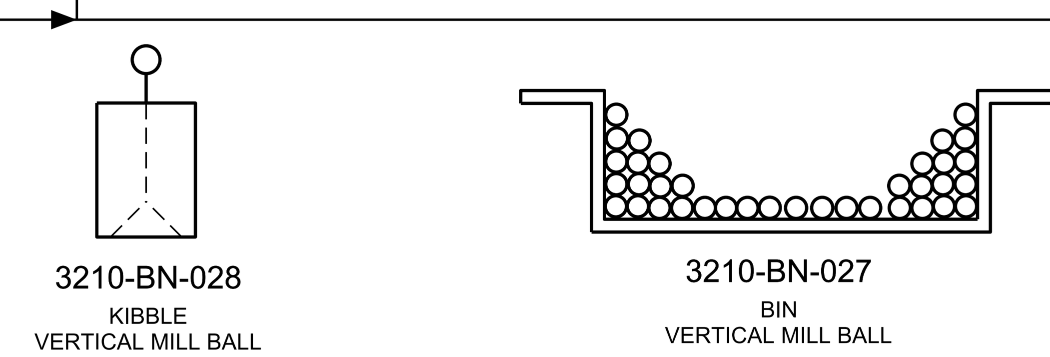

STREAM No.	UNITS	210	221	223	224	225	708	805	806	807	900
MASS - SOLIDS	tph	215.05	591.38	215.05	188.17	188.17	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	351.02	722.79	414.96	153.95	153.95	57.79	4.00	1.00	1.00	0.08
MASS - SLURRY	tph	566.06	1314.17	630.01	342.12	342.12	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	3.30	3.30	3.30	3.30	3.30	0.00	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	37.99	45.00	34.13	55.00	55.00	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.36	1.46	1.31	1.62	1.62	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	65.17	179.21	65.17	57.02	57.02	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	351.02	722.79	414.96	153.95	153.95	57.79	4.00	1.00	1.00	0.08
VOLUME - SLURRY	m3/h	416.18	902.00	480.13	210.97	210.97	0.00	0.00	0.00	0.00	0.00

LEGEND

PRIMARY FLOW	
SECONDARY FLOW	
UTILITIES	
BYPASS FLOW	
INTERMITTENT FLOW	
VENDOR PACKAGE	
FUTURE	

HATCH™

FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
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ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
SECONDARY GRINDING

SCALE NTS OR AS NOTED

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STREAM No.	UNITS	223	302	303	335	500	711	810	811	910	911
MASS - SOLIDS	tph	215.05	27.53	187.52	19.76	207.28	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	414.96	110.10	374.19	118.08	494.77	67.81	1.00	2.50	0.01	0.51
MASS - SLURRY	tph	630.01	137.63	561.71	137.84	702.05	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	3.30	4.10	3.20	3.90	3.20	0.00	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	34.13	20.00	33.38	14.34	29.53	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.31	1.18	1.30	1.12	1.25	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	65.17	6.71	58.60	5.07	64.78	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	414.96	110.10	374.19	118.08	494.77	67.81	1.00	2.50	0.01	0.51
VOLUME - SLURRY	m3/h	480.13	116.82	432.79	123.15	559.54	0.00	0.00	0.00	0.00	0.00

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE
REVISIONS				

HATCH™

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
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ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
BULK ROUGHER FLOTATION

SCALE	DWG. No.	REV
NTS OR AS NOTED	H345390-0000-05-030-0006	0

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STREAM No.	UNITS	302	313	314	316	317	720	721	920	921
MASS - SOLIDS	tph	27.53	7.35	22.06	1.89	20.17	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	110.10	26.69	106.73	7.57	104.89	15.66	4.73	0.08	0.01
MASS - SLURRY	tph	137.63	34.05	128.79	9.46	125.06	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	4.10	4.50	4.00	4.40	3.90	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	20.00	21.60	17.13	20.00	16.13	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.18	1.20	1.15	1.18	1.14	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	6.71	1.63	5.52	0.43	5.17	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	110.10	26.69	106.73	7.57	104.89	15.66	4.73	0.08	0.01
VOLUME - SLURRY	m3/h	116.82	28.33	112.24	8.00	110.06	0.00	0.00	0.00	0.00

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

HATCH™

FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
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CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
BULK CLEANER FLOTATION

SCALE NTS OR AS NOTED

DWG. No. H345390-0000-05-030-0007

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DWG. No. H345390-0000-05-030-0008

STREAM No.	UNITS	317	321	322	324	344	830
MASS - SOLIDS	tph	20.17	67.03	44.69	22.34	2.17	0.00
MASS - SOLUTION	tph	104.89	166.60	44.69	121.91	14.02	1.00
MASS - SLURRY	tph	125.06	233.63	89.37	144.26	16.19	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	3.90	3.90	3.90	3.90	4.10	0.00
PERCENT SOLIDS (wt/wt)	%	16.13	28.69	50.00	15.49	13.41	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.14	1.25	1.59	1.12	1.11	0.00
VOLUME - SOLIDS	m3/h	5.17	20.31	11.46	6.77	0.53	0.00
VOLUME - SOLUTION	m3/h	104.89	166.60	44.69	121.91	14.02	1.00
VOLUME - SLURRY	m3/h	110.06	186.91	56.14	128.68	14.55	0.00

LEGEND

PRIMARY FLOW
SECONDARY FLOW
UTILITIES
BYPASS FLOW
INTERMITTENT FLOW
VENDOR PACKAGE
FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

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PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
BULK CLEANER SCAVENGER TAILINGS REGRIND

SCALE NTS OR AS NOTED | DWG. No. H345390-0000-05-030-0008 | REV 0

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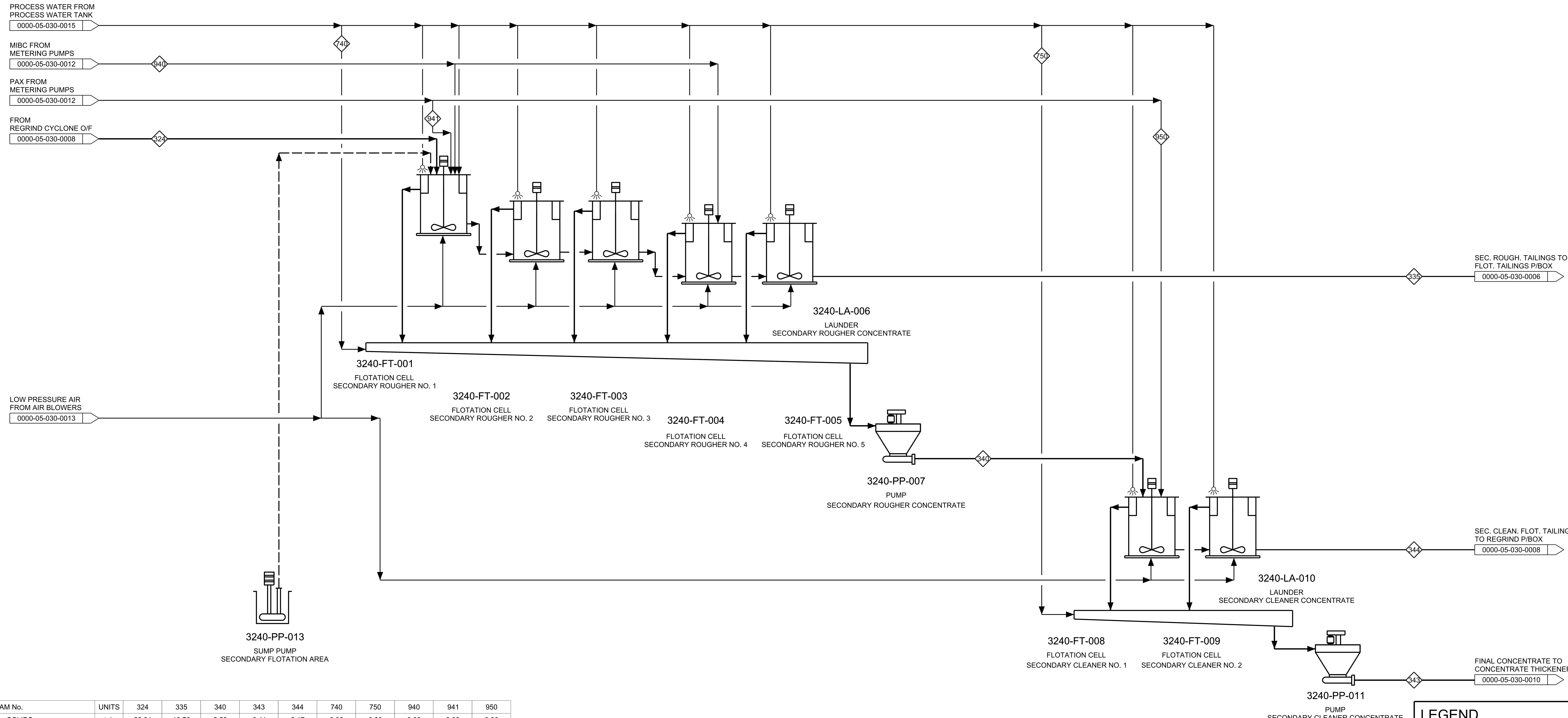
DWG. No. H345390-0000-05-030-0009



STREAM No.	UNITS	324	335	340	343	344	740	750	940	941	950
MASS - SOLIDS	tph	22.34	19.76	2.58	0.41	2.17	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	121.91	118.08	14.62	2.73	14.02	10.75	2.12	0.01	0.03	0.01
MASS - SLURRY	tph	144.26	137.84	17.20	3.14	16.19	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	3.90	3.90	4.20	4.50	4.10	0.00	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	15.49	14.34	15.00	13.00	13.41	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.12	1.12	1.13	1.11	1.11	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	6.77	5.07	0.61	0.09	0.53	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	121.91	118.08	14.62	2.73	14.02	10.75	2.12	0.01	0.03	0.01
VOLUME - SLURRY	m3/h	128.68	123.15	15.24	2.83	14.55	0.00	0.00	0.00	0.00	0.00

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

HATCH™

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
SECONDARY FLOTATION

SCALE: NTS OR AS NOTED

DWG. No. H345390-0000-05-030-0009

REV 0

STREAM No.	UNITS	208	313	343	401	402	403	405	406	409	861	863	864	865	960
MASS - SOLIDS	tph	0.04	7.35	0.41	7.76	0.00	7.76	0.00	7.76	7.76	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	0.003	26.69	2.73	39.72	35.05	5.18	9.36	5.18	0.81	0.50	0.50	0.50	4.00	0.93
MASS - SLURRY	tph	0.05	34.05	3.14	47.48	0.00	12.94	0.00	12.94	8.58	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	3.30	4.50	4.50	4.50	0.00	4.50	0.00	4.50	4.50	0.00	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	93.00	21.60	13.00	16.35	0.00	60.00	0.00	60.00	90.50	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	2.84	1.20	1.11	1.15	0.00	1.88	0.00	1.88	3.38	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	0.01	1.63	0.09	1.73	0.00	1.73	0.00	1.73	1.73	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	0.003	26.69	2.73	39.72	35.05	5.18	9.36	5.18	0.81	0.50	0.50	0.50	4.00	0.93
VOLUME - SLURRY	m3/h	0.02	28.33	2.83	41.45	0.00	6.90	0.00	6.90	2.54	0.00	0.00	0.00	0.00	0.00

LEGEND

PRIMARY FLOW
SECONDARY FLOW
UTILITIES
BYPASS FLOW
INTERMITTENT FLOW
VENDOR PACKAGE
FUTURE

HATCH™

FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
CONCENTRATE THICKENING AND STORAGE

DRAWING No.	DRAWING TITLE
REFERENCE DRAWINGS	

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE
REVISIONS				

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HOLD
H0001

DWG. No. H345390-0000-05-030-0011

STREAM No.	UNITS	500	502	503	920
MASS - SOLIDS	tph	207.28	0.00	207.28	0.00
MASS - SOLUTION	tph	494.77	440.18	69.09	0.08
MASS - SLURRY	tph	702.05	0.00	276.38	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	3.20	0.00	3.20	0.00
PERCENT SOLIDS (wt/wt)	%	29.53	0.00	75.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.25	0.00	2.06	0.00
VOLUME - SOLIDS	m3/h	64.78	0.00	64.78	0.00
VOLUME - SOLUTION	m3/h	494.77	440.18	69.09	0.08
VOLUME - SLURRY	m3/h	559.54	0.00	133.87	0.00

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

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FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

DRAWING APPROVAL STATUS: Approved for Use

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
TAILINGS AREA

SCALE NTS OR AS NOTED

DWG. No. H345390-0000-05-030-0011

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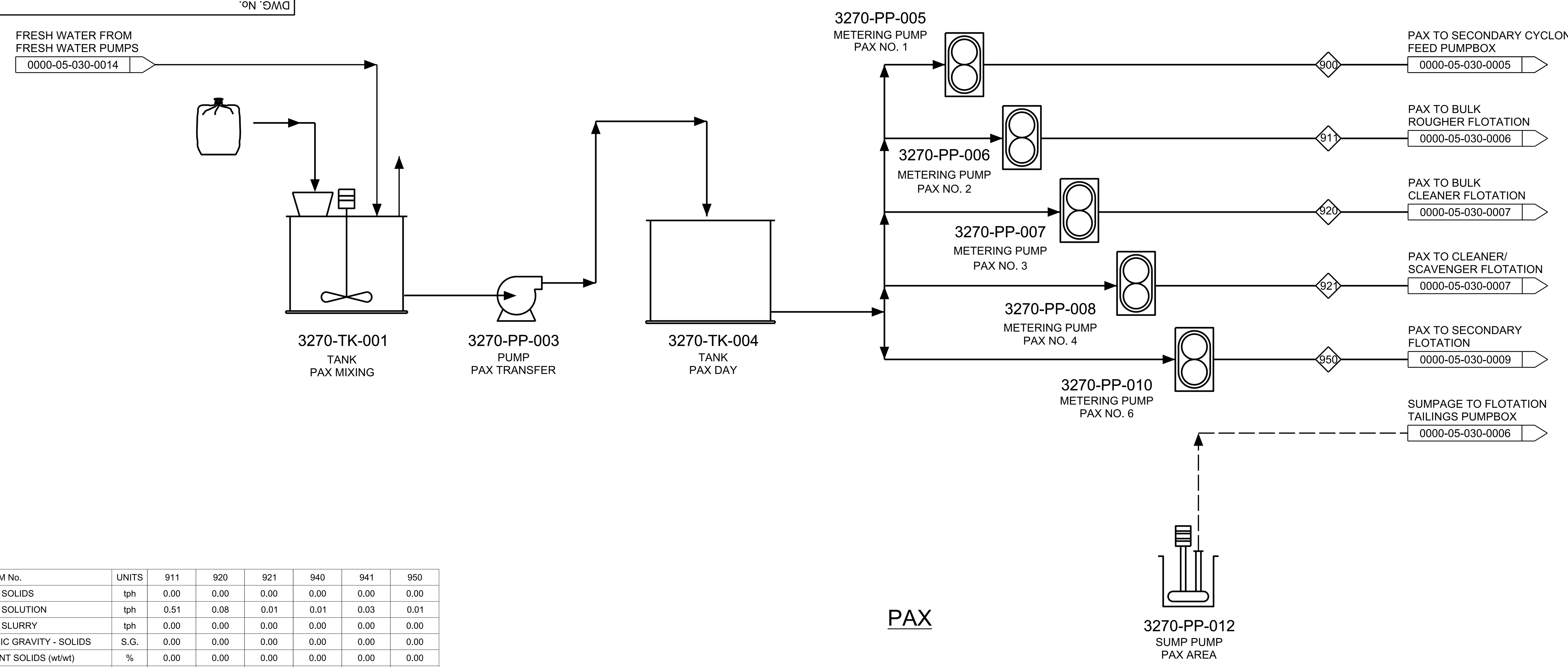

STREAM No.	UNITS	911	920	921	940	941	950
MASS - SOLIDS	tph	0.00	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	0.51	0.08	0.01	0.01	0.03	0.01
MASS - SLURRY	tph	0.00	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	0.00	0.00	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	0.00	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	0.00	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	0.00	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	0.51	0.08	0.01	0.01	0.03	0.01
VOLUME - SLURRY	m3/h	0.00	0.00	0.00	0.00	0.00	0.00

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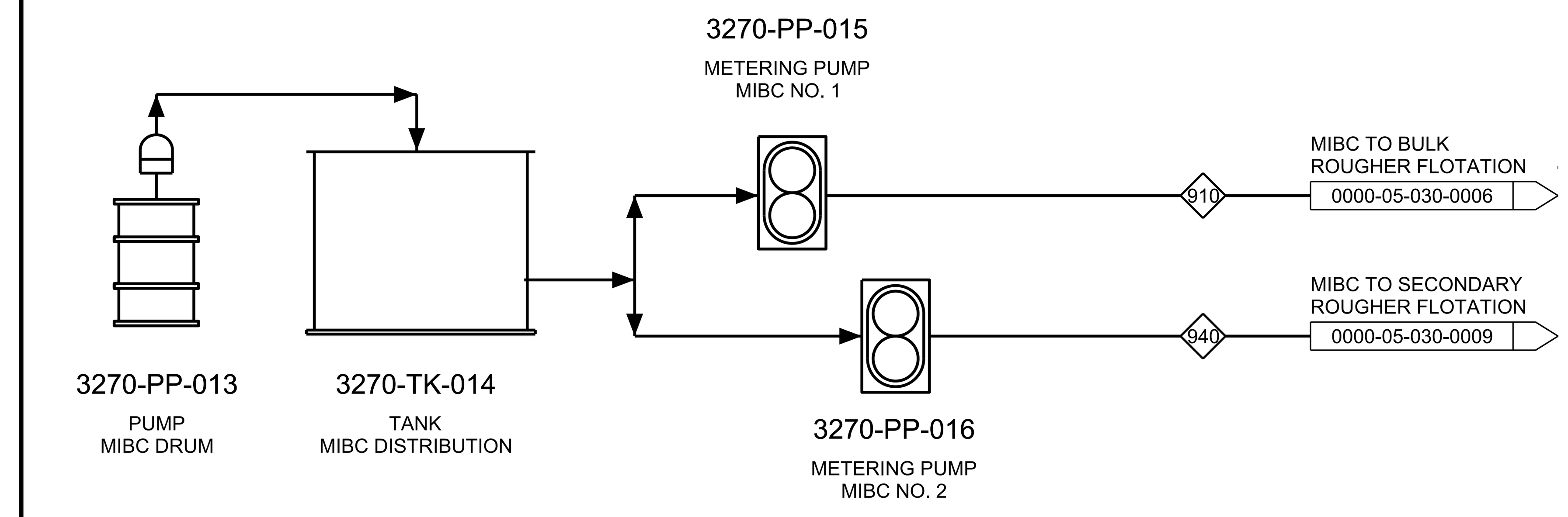

STREAM No.	UNITS	960	970
MASS - SOLIDS	tph	0.00	0.00
MASS - SOLUTION	tph	0.93	14.51
MASS - SLURRY	tph	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	0.00	0.00
VOLUME - SOLIDS	m3/h	0.00	0.00
VOLUME - SOLUTION	m3/h	0.93	14.51
VOLUME - SLURRY	m3/h	0.00	0.00

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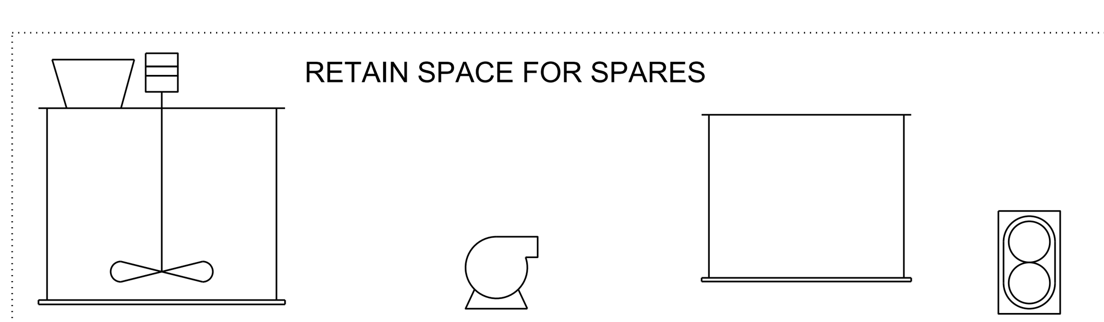

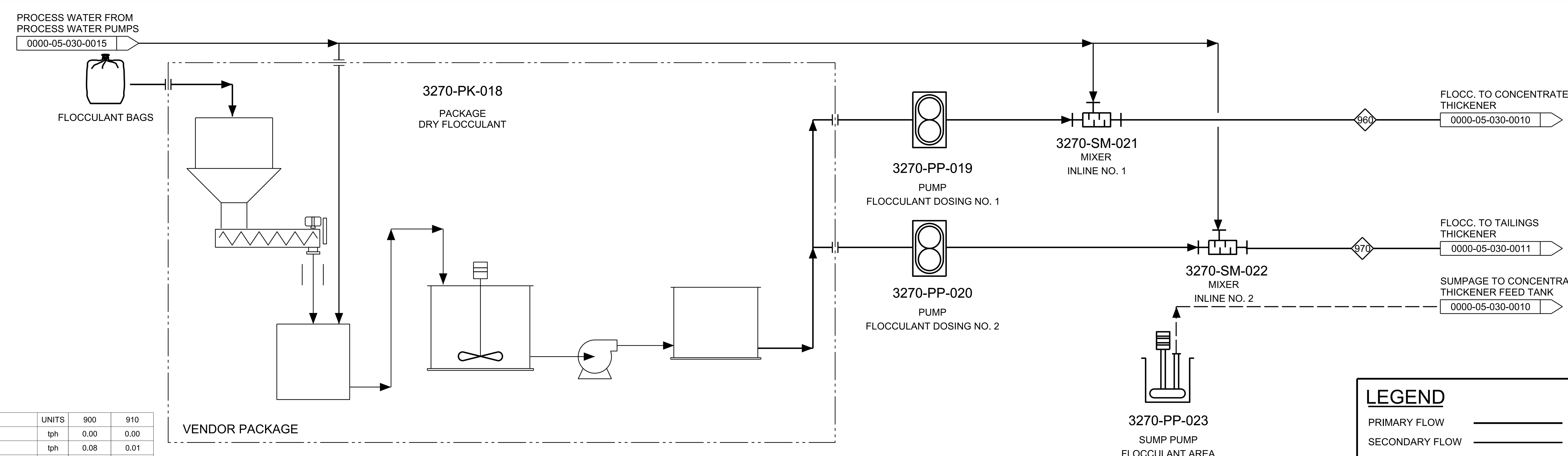

STREAM No.	UNITS	900	910
MASS - SOLIDS	tph	0.00	0.00
MASS - SOLUTION	tph	0.08	0.01
MASS - SLURRY	tph	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	0.00	0.00
VOLUME - SOLIDS	m3/h	0.00	0.00
VOLUME - SOLUTION	m3/h	0.08	0.01
VOLUME - SLURRY	m3/h	0.00	0.00

FLOCCULANT

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

HATCH™

FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
REAGENTS

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

SCALE: AS NOTED | DWG. No. H345390-0000-05-030-0012 | REV 0

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REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

HATCH™

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
LOW PRESSURE, PLANT AND INSTRUMENT AIR

SCALE	DWG. No.	REV
NTS OR AS NOTED	H345390-0000-05-030-0013	0

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DWG. No. H345390-0000-05-030-0014

STREAM No.	UNITS	600	601	602	604
MASS - SOLIDS	tph	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	46.59	0.00	21.06	0.73
MASS - SLURRY	tph	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	46.59	0.00	21.06	0.73
VOLUME - SLURRY	m3/h	0.00	0.00	0.00	0.00

LEGEND

- PRIMARY FLOW
- SECONDARY FLOW
- UTILITIES
- BYPASS FLOW
- INTERMITTENT FLOW
- VENDOR PACKAGE
- FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

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ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
FRESH WATER, FIRE WATER AND
EFFLUENT TREATMENT FACILITY

SCALE	DWG. No.	REV
NTS OR AS NOTED	H345390-0000-05-030-0014	0

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DWG. No. H345390-0000-05-030-0015

STREAM No.	UNITS	402	502	605	606	865
MASS - SOLIDS	tph	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	tph	35.05	440.18	496.03	0.00	4.00
MASS - SLURRY	tph	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SOLIDS	S.G.	0.00	0.00	0.00	0.00	0.00
PERCENT SOLIDS (wt/wt)	%	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLIDS	m3/h	0.00	0.00	0.00	0.00	0.00
VOLUME - SOLUTION	m3/h	35.05	440.18	496.03	0.00	4.00
VOLUME - SLURRY	m3/h	0.00	0.00	0.00	0.00	0.00

LEGEND

PRIMARY FLOW
SECONDARY FLOW
UTILITIES
BYPASS FLOW
INTERMITTENT FLOW
VENDOR PACKAGE
FUTURE

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
PROCESS, POTABLE AND GLAND WATER

SCALE NTS OR AS NOTED

DWG. No. H345390-0000-05-030-0015

REV 0

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REFERENCE DRAWINGS

REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

HATCH™

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
DESIGN COORD.	L ROLANDI	LR	2014-01-15
RESP. ENG.	K MCLEOD	KM	2014-01-15
LEAD DISC. ENG.	K MCVEY	KM	2014-01-15
ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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FORTUNE MINERALS LIMITED

NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
SEWAGE TREATMENT, MATERIAL RECOVERY AND FUEL OIL

SCALE NTS OR AS NOTED

DWG. No. H345390-0000-05-030-0016

REV 0

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FORTUNE MINERALS LIMITED

ROLE	NAME	SIGNATURE	DATE
DRAFTSPERSON	J BELLISOMO	NR	2014-01-15
DESIGNER	K MCLEOD	NR	2014-01-15
CHECKER	K MCLEOD	KM	2014-01-15
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RESP. ENG.	K MCLEOD	KM	2014-01-15
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ENG. MANAGER	E YOUNG	EY	2014-01-15
PROJ. MANAGER	M PYTLEWSKI	MP	2014-01-15
CLIENT	K LEE	KL	2014-01-15

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NICO MINE AND CONCENTRATOR
PROJECT WIDE

PROCESS FLOW DIAGRAM
PROCESS PLANT WATER BALANCE

SCALE	DWG. No.	REV
NTS OR AS NOTED	H345390-0000-05-030-0017	0

DRAWING No.	DRAWING TITLE

REFERENCE DRAWINGS

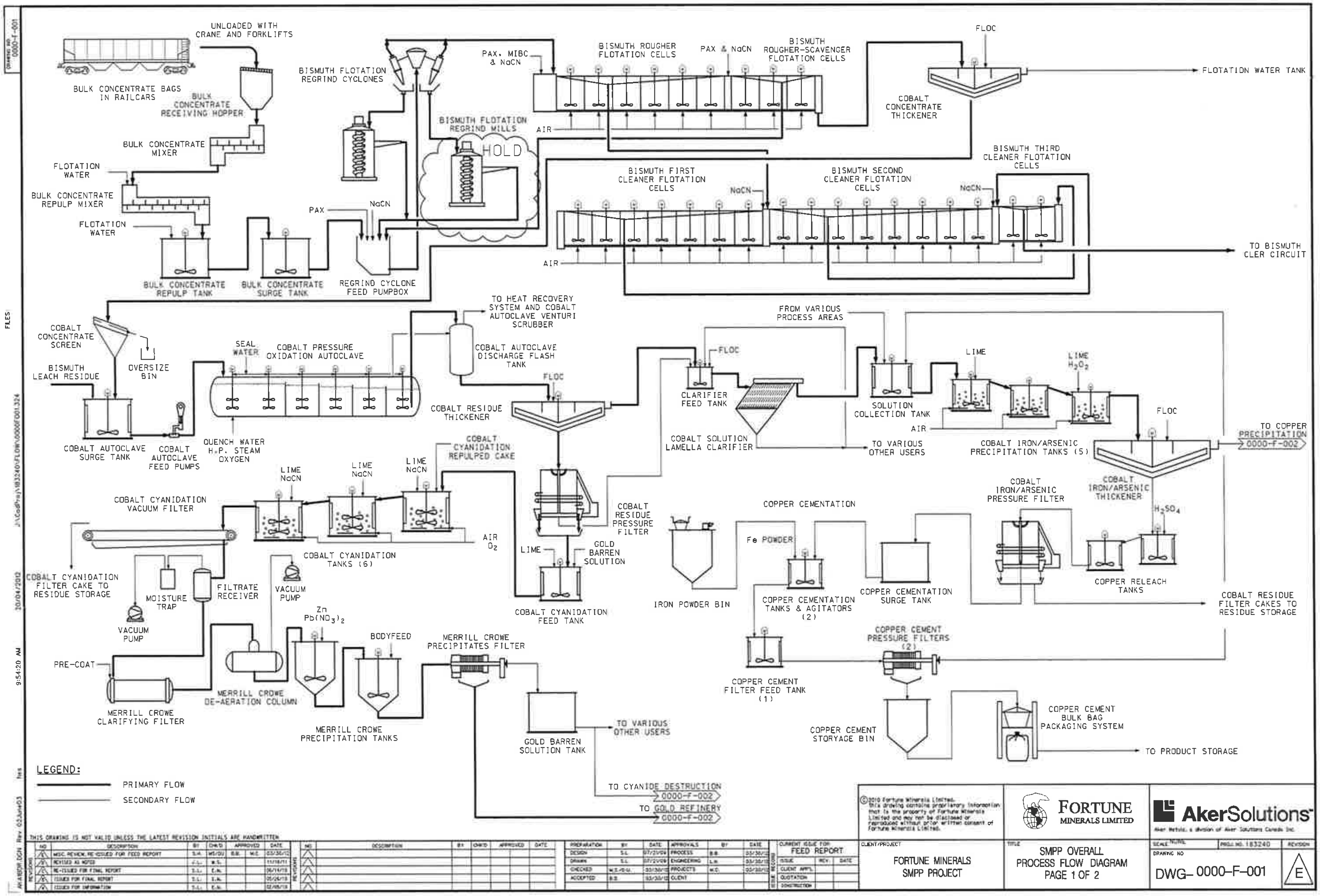
REGISTERED PROFESSIONAL

No.	DESCRIPTION	BY	CHK'D	DATE

REVISIONS

APPENDIX II

PROCESS FLOW DIAGRAMS FOR THE SMPP


UNLOADED WITH CRANE AND FORKLIFTS
BULK CONCENTRATE BAGS IN RAILCARS
BULK CONCENTRATE RECEIVING HOPPER
BULK CONCENTRATE MIXER
FLOTATION WATER
BULK CONCENTRATE REPULP MIXER
FLOTATION WATER
BULK CONCENTRATE REPULP TANK
BULK CONCENTRATE SURGE TANK
PAX
NaCN
REGRIND CYCLONE FEED PUMPBOX
BISMUTH FLOTATION REGRIND CYCLONES
BISMUTH FLOTATION REGRIND MILLS
HOLD
PAX, MIBC & NaCN
BISMUTH ROUGHER FLOTATION CELLS
PAX & NaCN
BISMUTH ROUGHER-SCAVENGER FLOTATION CELLS
AIR
FLOC
COBALT CONCENTRATE THICKENER
FLOTATION WATER TANK
BISMUTH FIRST CLEANER FLOTATION CELLS
NaCN
BISMUTH SECOND CLEANER FLOTATION CELLS
NaCN
BISMUTH THIRD CLEANER FLOTATION CELLS
AIR
TO BISMUTH CLER CIRCUIT
COBALT CONCENTRATE SCREEN
OVERSIZE BIN
BISMUTH LEACH RESIDUE
COBALT AUTOCLAVE SURGE TANK
COBALT AUTOCLAVE FEED PUMPS
SEAL WATER
COBALT PRESSURE OXIDATION AUTOCLAVE
QUENCH WATER H.P. STEAM OXYGEN
TO HEAT RECOVERY SYSTEM AND COBALT AUTOCLAVE VENTURI SCRUBBER
COBALT AUTOCLAVE DISCHARGE FLASH TANK
FLOC
COBALT RESIDUE THICKENER
COBALT RESIDUE PRESSURE FILTER
LIME
GOLD BARREN SOLUTION
COBALT CYANIDATION FEED TANK
FLOC
CLARIFIER FEED TANK
COBALT SOLUTION LAMELLA CLARIFIER
FROM VARIOUS PROCESS AREAS
SOLUTION COLLECTION TANK
TO VARIOUS OTHER USERS
LIME
LIME H_2O_2
AIR
COBALT IRON/ARSENIC PRECIPITATION TANKS (5)
FLOC
TO COPPER PRECIPITATION 0000-F-002
COBALT IRON/ARSENIC THICKENER
COBALT IRON/ARSENIC PRESSURE FILTER
H_2SO_4
COPPER RELEACH TANKS
COBALT RESIDUE FILTER CAKES TO RESIDUE STORAGE
COBALT CYANIDATION REPULPED CAKE
LIME NaCN
LIME NaCN
LIME NaCN
COBALT CYANIDATION VACUUM FILTER
COBALT CYANIDATION TANKS (6)
AIR O_2
COBALT CYANIDATION FILTER CAKE TO RESIDUE STORAGE
MOISTURE TRAP
FILTRATE RECEIVER
VACUUM PUMP
VACUUM PUMP
PRE-COAT
MERRILL CROWE CLARIFYING FILTER
MERRILL CROWE DE-AERATION COLUMN
Zn $Pb(NO_3)_2$
BODYFEED
MERRILL CROWE PRECIPITATION TANKS
MERRILL CROWE PRECIPITATES FILTER
GOLD BARREN SOLUTION TANK
TO VARIOUS OTHER USERS
TO CYANIDE DESTRUCTION 0000-F-002
TO GOLD REFINERY 0000-F-002
COPPER CEMENTATION
Fe POWDER
IRON POWDER BIN
COPPER CEMENTATION TANKS & AGITATORS (2)
COPPER CEMENTATION SURGE TANK
COPPER CEMENT FILTER FEED TANK (1)
COPPER CEMENT PRESSURE FILTERS (2)
COPPER CEMENT STORYAGE BIN
COPPER CEMENT BULK BAG PACKAGING SYSTEM
TO PRODUCT STORAGE
LEGEND:
PRIMARY FLOW
SECONDARY FLOW
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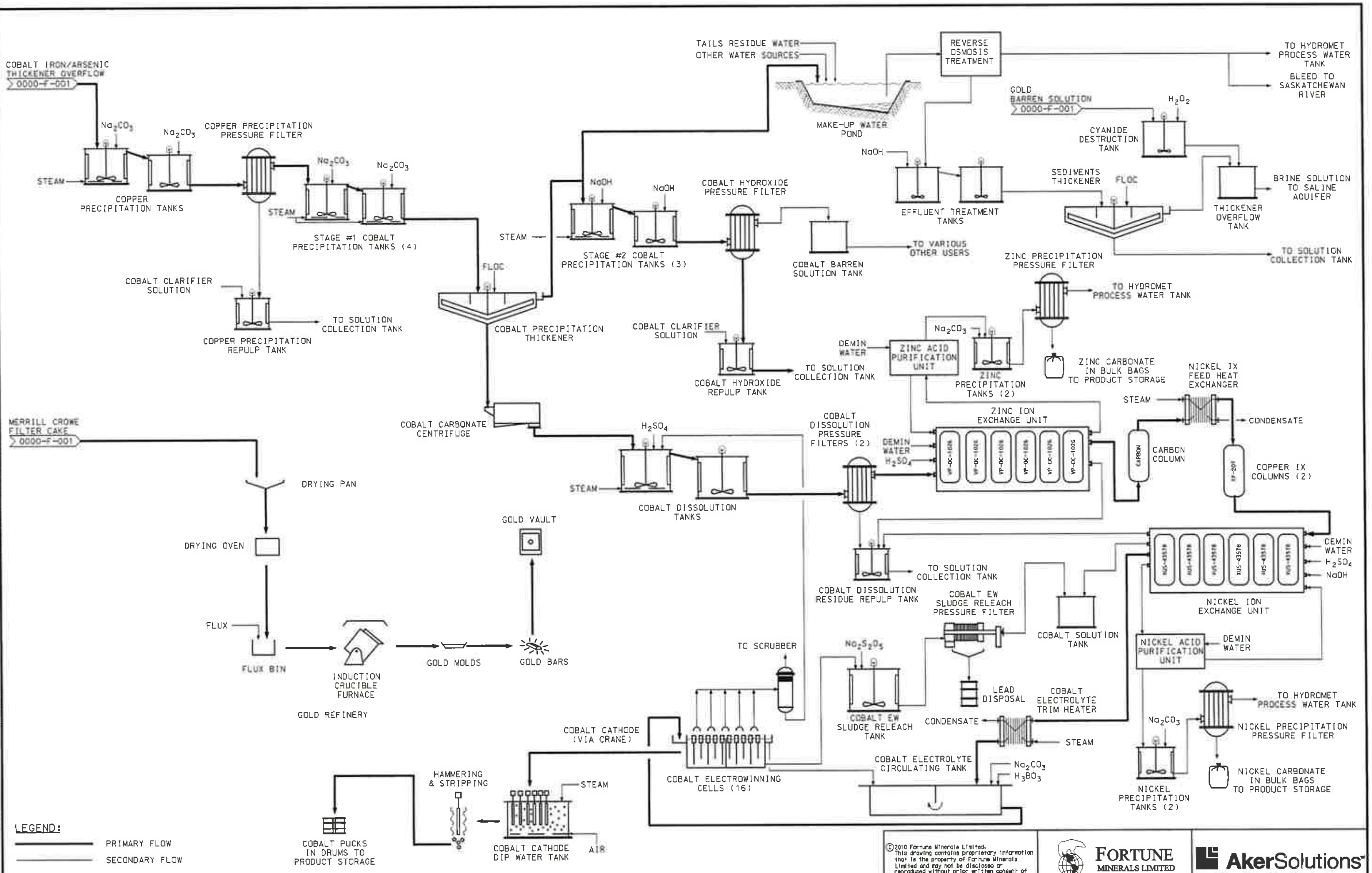
FORTUNE MINERALS LIMITED
AkerSolutions
FEED REPORT
FORTUNE MINERALS SMPP PROJECT
SMPP OVERALL PROCESS FLOW DIAGRAM PAGE 1 OF 2
PROJ. NO. 183240
DWG- 0000-F-001
E



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NO	DESCRIPTION	BY	CHK'D	APPROVED		DATE
E	MISC REVIEW, RE-ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B.	M.C.	03/30/12
D	REVISED AS NOTED	J.G.	M.S.			11/18/11
C	RE-ISSUED FOR FINAL REPORT	S.L.	E.A.			06/14/10
B	ISSUED FOR FINAL REPORT	S.L.	E.A.			04/26/10
A	ISSUED FOR INFORMATION	S.L.	E.A.			02/05/10

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	S.L.	07/21/09	PROCESS	B.B.	03/30/12
DRAWN	S.L.	07/21/09	ENGINEERING	L.N.	03/30/12
CHECKED	M.S./D.U.	03/30/12	PROJECTS	M.C.	03/30/12
ACCEPTED	B.B.	03/30/12	CLIENT		

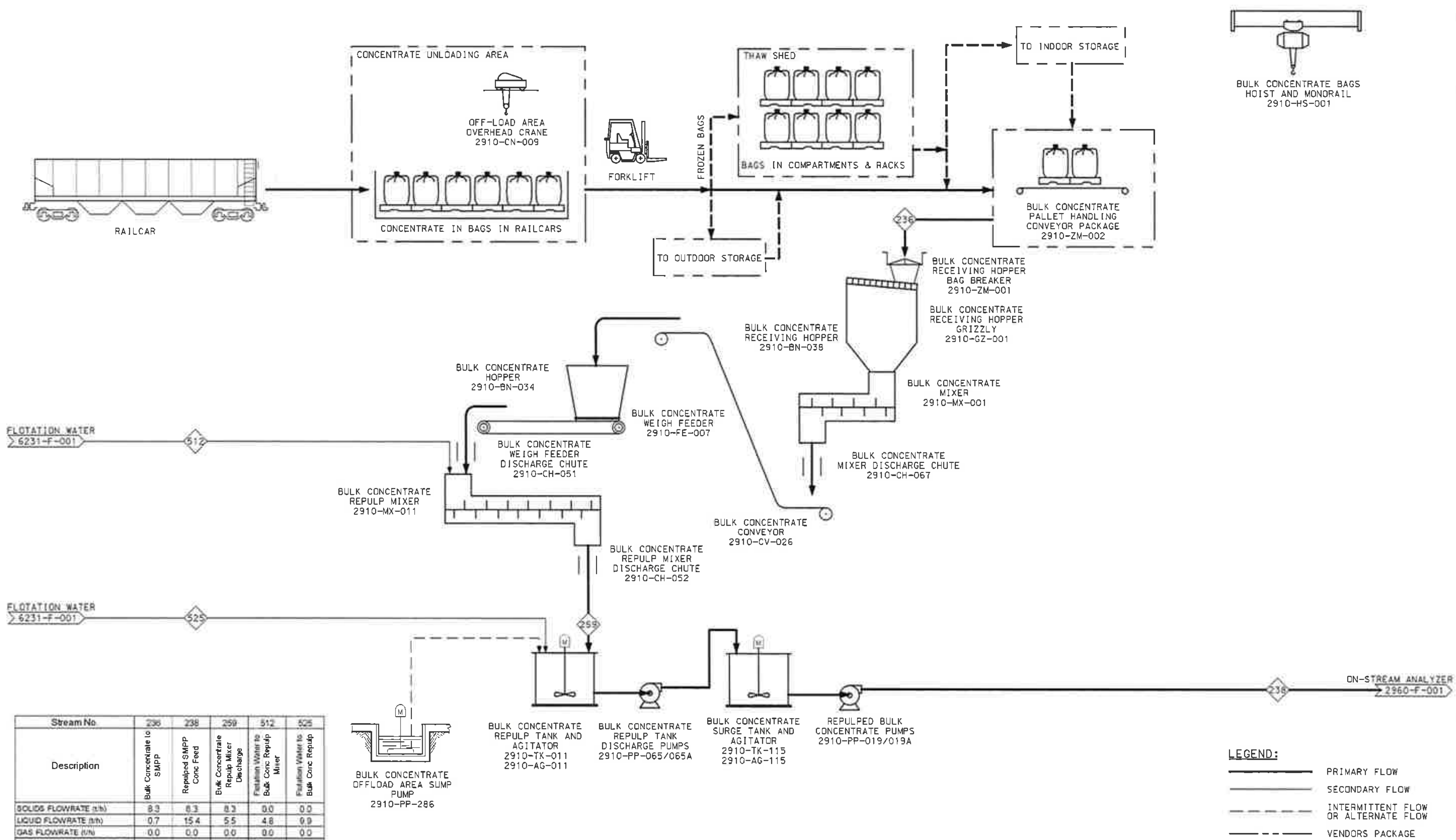
CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: SMPP OVERALL PROCESS FLOW DIAGRAM PAGE 2 OF 2

SCALE: NONE | PROJ. NO. 183240 | REVISION

DRAWING NO. DWG-0000-F-002 | E



Stream No.	236	238	259	512	525
Description	Bulk Concentrate to SMPP	Repulped SMPP Conc Feed	Bulk Concentrate Repulp Mixer Discharge	Flotation Water to Bulk Conc Repulp Mixer	Flotation Water to Bulk Conc Repulp
SOLIDS FLOWRATE (t/h)	8.3	8.3	8.3	0.0	0.0
LIQUID FLOWRATE (t/h)	0.7	15.4	5.5	4.8	9.9
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	-	17.8	-	-	-
PERCENT SOLIDS (% wt)	92	35	60	0	0
SOLIDS S.G.	3.4	3.4	3.4	3.4	3.4
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0
STREAM S.G.	2.9	1.3	1.7	1.0	1.0
TEMPERATURE (°C)	22.1	15.6	16.8	14.7	14.7
INSTANTANEOUS FLOW (m3/h)	12.5	0.0	31.8	19.2	39.5

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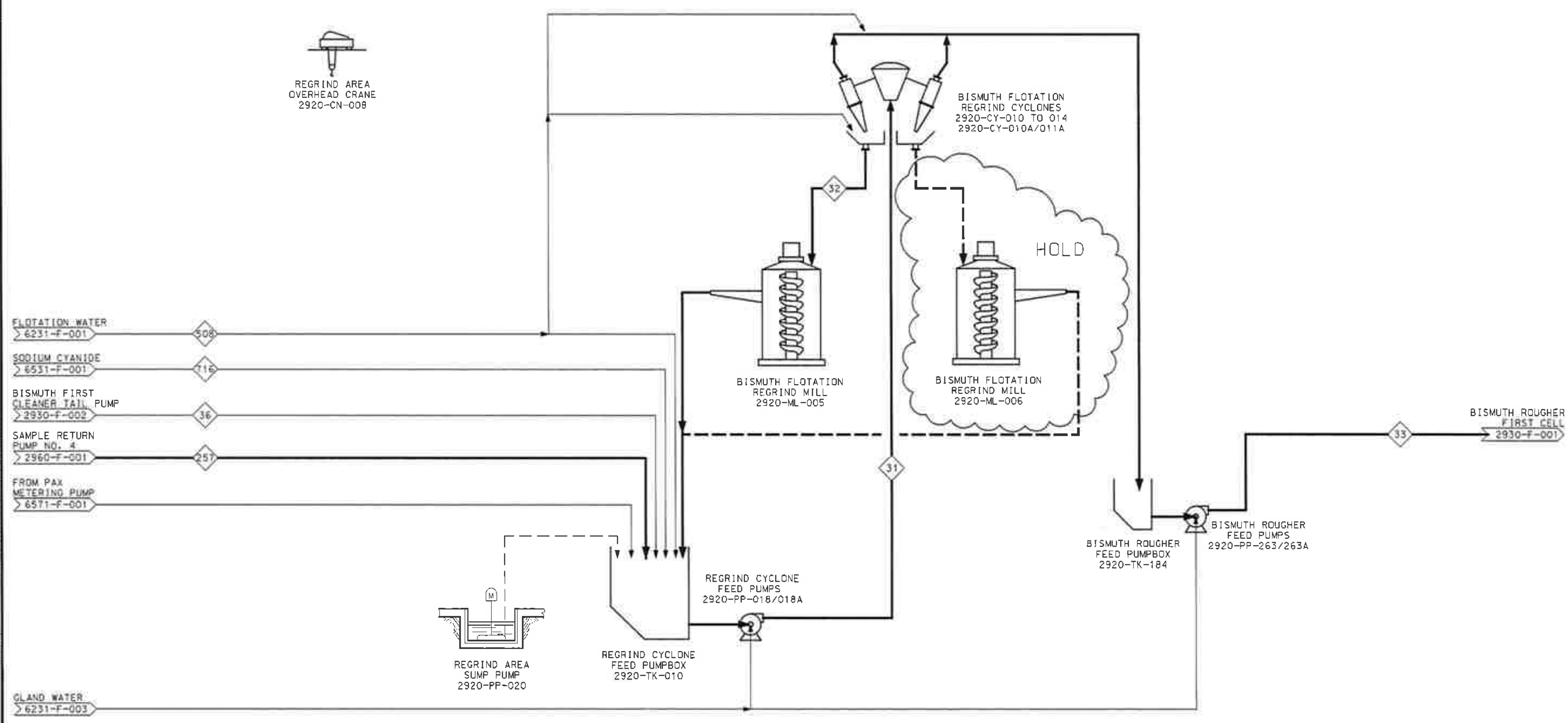
CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: SMPP UNLOADING & FEED PREPARATION AREA PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240

DRAWING NO: DWG-2910-F-001 | REVISION: G



Stream No.	31	32	33	36	257	508	716
Description	Feed to Regrind Cyclone	Regrind Cyclone UF	Regrind Cyclone OF	1st Bi Cleaner Tails	Regrind SMPP Conc feed, Bi Ro Scav Conc Recycle	Flotation Water To Regrind Cyclone Feed	Cyanide to regrind cyclone feed
SOLIDS FLOWRATE (t/h)	121.1	48.4	24.2	14.6	9.6	0.0	0.0
LIQUID FLOWRATE (t/h)	308.1	79.0	150.0	111.9	24.8	13.3	0.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	342.8	93.0	156.8	116.0	27.5	13.2	0.0
PERCENT SOLIDS (% wt)	28	38	14	12	28	0	10
SOLIDS S.G.	3.4	3.4	3.4	3.4	3.4	3.4	1.6
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0
STREAM S.G.	1.3	1.4	1.1	1.1	1.2	1.0	1.1
PRESSURE (kPa abs)	101.3	101.3	101.3	101.3	101.3	101.3	101.3
TEMPERATURE (C)	15.0	15.0	15.0	15.0	15.0	14.7	20.0
INSTANTANEOUS FLOW (m3/h)	342.8	93.0	156.8	116.0	27.5	13.2	0.0

LEGEND:

- PRIMARY FLOW
- SECONDARY FLOW
- INTERMITTENT FLOW OR ALTERNATE FLOW
- SPACE FOR FUTURE USAGE
- DISTINCT PHYSICAL BUILDING
- VENDORS PACKAGE

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NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
E	RE-ISSUED FOR FINAL REPORT	S.L.	E.N.		06/14/10
D	ISSUED FOR FINAL REPORT	S.L.	E.N.		04/21/10
C	ISSUED FOR ENGINEERING	S.L.	E.N.		01/15/10
B	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.N.		12/23/09
A	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.N.		11/25/09
G	MDC REVIEW, RE-ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B. M.C.	03/30/12
F	RE-ISSUED FOR FINAL REPORT	S.L.	M.S.		02/27/12

CURRENT ISSUE FOR: FEED REPORT

FORTUNE MINERALS LIMITED

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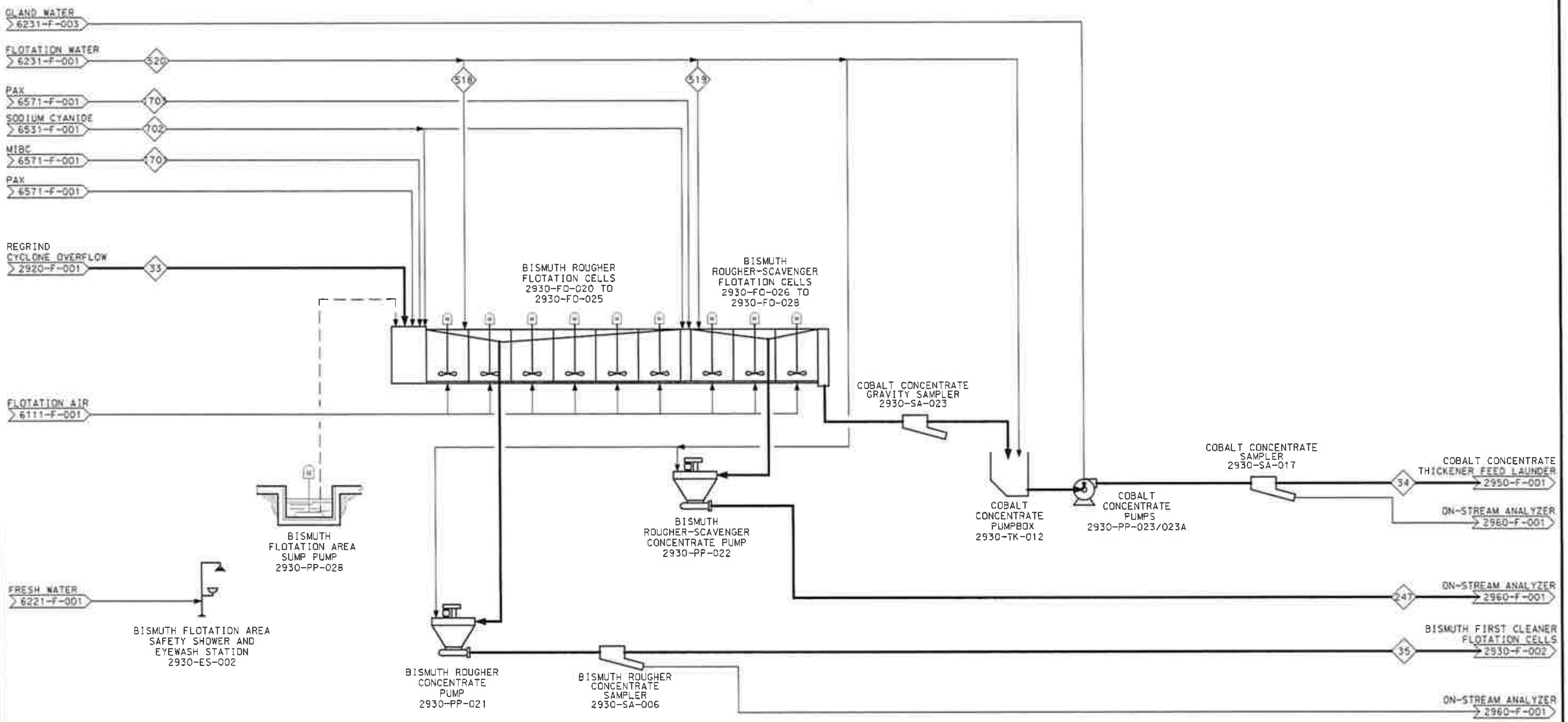
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: BISMUTH FLOTATION REGRIND PROCESS FLOW DIAGRAM

PROJ. NO. 183240

DRAWING NO. DWG-2920-F-001

REVISION: G



Stream No.	33	34	35	247	518	519	520	702	1700	1701	1703
Description	Regrind Cyclone OF	Bi Ro-Scavenger Tails	Bi Rougher Conc	Bi Ro-Scav Conc Recycle	Launder Water	Launder Water	Flotation Water to Bismuth Ro Flot	Cyanide To Bi Flotation	PAX to Bi Rougher Flotation Cells	MIBC to Bi Rougher Flotation Cells	PAX to Bi Rougher Scavenger Flotation Cells
SOLIDS FLOWRATE (t/h)	24.2	7.6	15.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID FLOWRATE (t/h)	150.0	48.8	101.9	9.3	8.0	2.0	10.0	0.1	0.0	0.0	0.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	156.8	51.0	106.1	9.7	8.0	2.0	10.0	0.1	0.0	0.0	0.0
PERCENT SOLIDS (% wt)	14	14	13	12	0	0	0	0	10	0	10
SOLIDS S.G	3.4	3.4	3.5	3.3	3.4	3.4	3.4	2.8	1.0	0.0	1.0
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0	1.0	1.0
STREAM S.G	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.1	1.0	1.0	1.0
TEMPERATURE (C)	15.0	15.0	15.0	15.0	14.7	14.7	14.7	19.6	20.0	20.0	20.0
INSTANTANEOUS FLOW (m3/h)	156.8	51.0	106.1	9.7	8.0	2.0	10.0	0.1	0.0	0.0	0.0

LEGEND:

PRIMARY FLOW
SECONDARY FLOW
INTERMITTENT FLOW OR ALTERNATE FLOW
VENDORS PACKAGE

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NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
	RE-ISSUED FOR FINAL REPORT	S.L.	E.A.		
	ISSUED FOR FINAL REPORT	S.L.	E.A.		
	ISSUED FOR ENGINEERING	S.L.	E.A.		
	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.A.		12/23/09
	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.A.		11/25/09
	MSC REVIEW, RE-ISSUED FOR FEED REPORT	S.H.	WS/DU	B.B. M.C.	03/30/12
	RE-ISSUED FOR FEED REPORT	D.C.	S.A.		02/14/12

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	S.L.	07/21/09	PROCESS	B.B.	03/30/12
DRAWN	S.L.	07/21/09	ENGINEERING	L.H.	03/30/12
CHECKED	W.S./D.U.	03/30/12	PROJECTS	M.C.	03/30/12
ACCEPTED	B.B.	03/30/12	CLIENT		

CURRENT ISSUE FOR: FEED REPORT

FORTUNE MINERALS LIMITED

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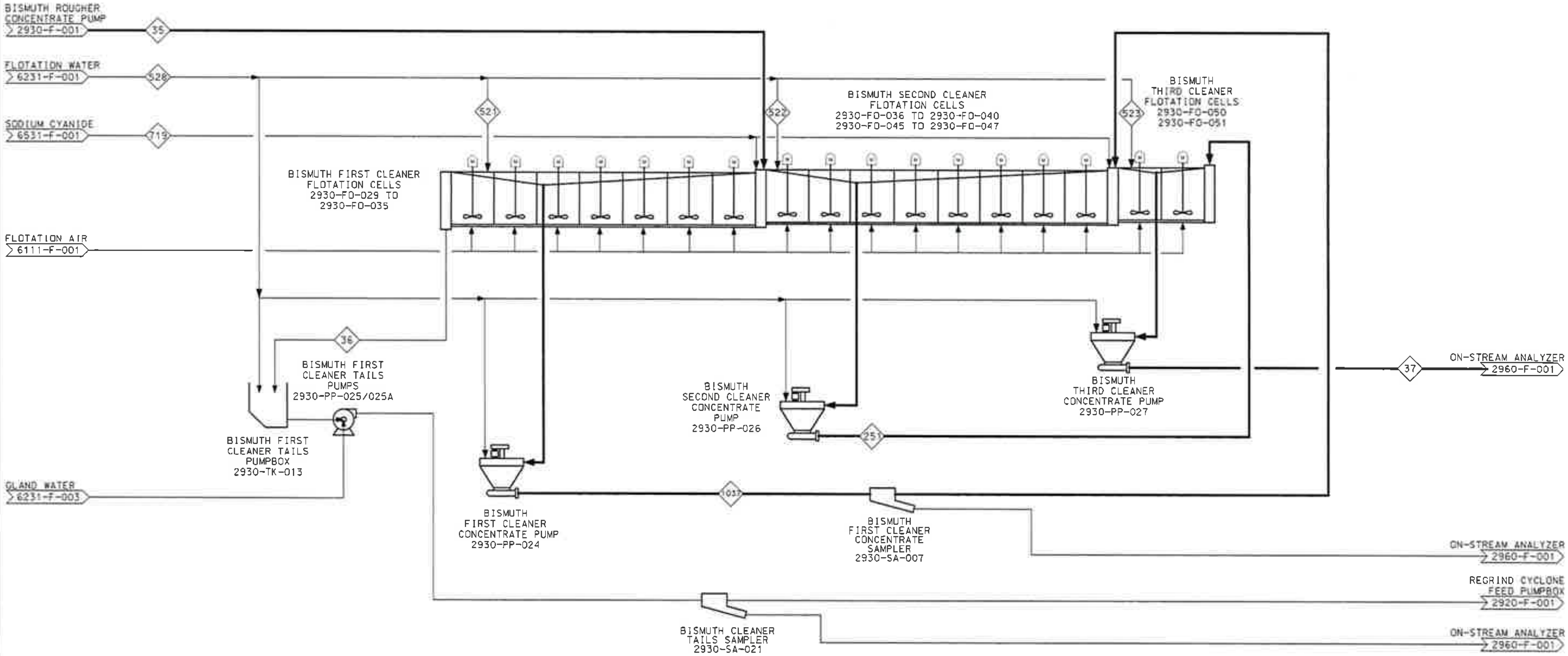
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: BISMUTH ROUGHER FLOTATION PROCESS FLOW DIAGRAM

SCALE NONE | PROJ. NO. 183240

DRAWING NO. DWG- 2930-F-001

REVISION G



Stream No.	35	36	37	251	521	522	523	528	1037	719
Description	Bi Rougher Conc	1st Bi Cleaner Tails	Bi Concentrate	2nd Bi Conc	Launder Water	Launder Water	Launder Water	Flotation Water to Bismuth Cleaner Flot	1st Bi Conc	Cyanide to Bi cleaner flotation
SOLIDS FLOWRATE (t/h)	15.3	14.6	0.7	2.1	0.0	0.0	0.0	0.0	9.7	0.0
LIQUID FLOWRATE (t/h)	101.9	111.9	3.8	15.6	8.3	4.4	1.0	13.7	67.6	0.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	106.1	116.0	3.9	16.1	8.3	4.4	1.0	13.7	70.1	0.0
PERCENT SOLIDS (% wt)	13	12	16	12	0	0	0	0	12	0
SOLIDS S.G.	3.5	3.4	4.4	3.9	3.4	3.4	3.4	3.4	3.7	1.6
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
STREAM S.G.	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.1	1.1
TEMPERATURE (°C)	15.0	15.0	14.8	14.9	14.7	14.7	14.7	14.7	14.9	20.0
INSTANTANEOUS FLOW (m3/h)	106.1	116.0	3.9	16.1	8.3	4.4	1.0	13.7	70.1	0.0

LEGEND:

PRIMARY FLOW
SECONDARY FLOW
INTERMITTENT FLOW OR ALTERNATE FLOW
VENDORS PACKAGE

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REVISIONS: RE-ISSUED FOR FINAL REPORT; ISSUED FOR FINAL REPORT; ISSUED FOR ENGINEERING; UPDATED AND RELEASED TO ENGINEERING; PRELIMINARY RELEASE FOR ENGINEERING; MISC REVIEW, RE-ISSUED FOR FEED REPORT

CURRENT ISSUE FOR: FEED REPORT

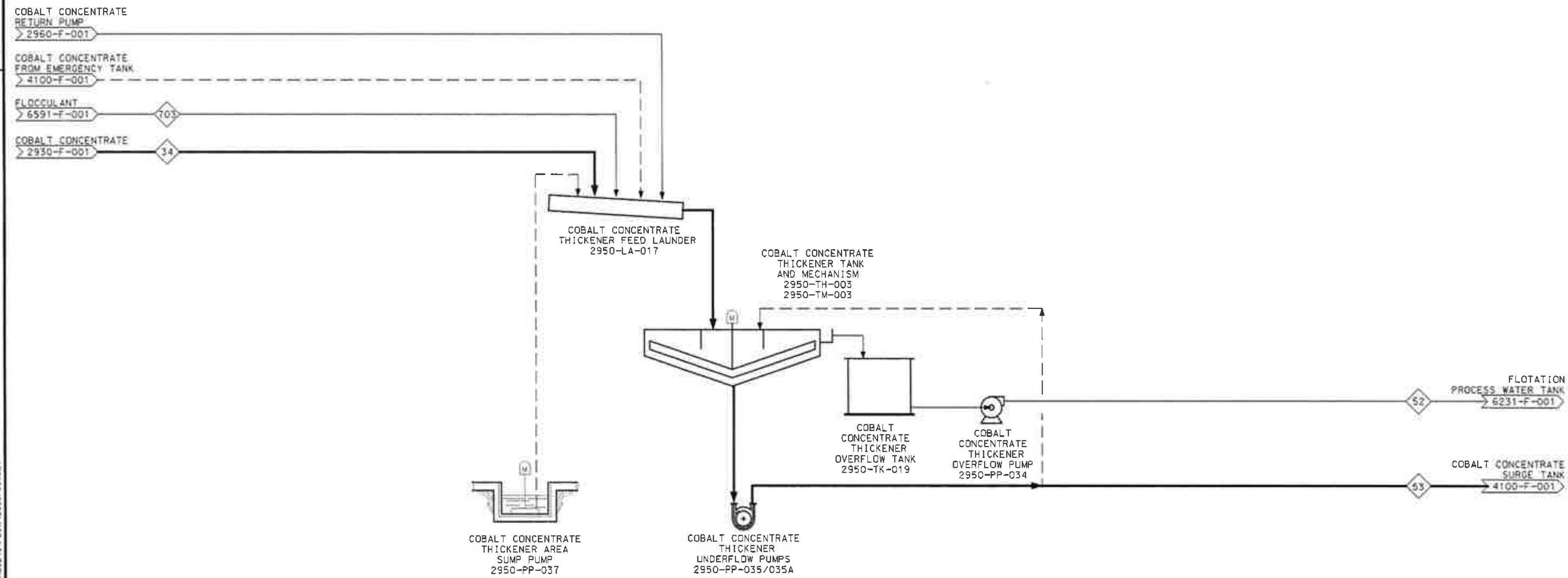
FORTUNE MINERALS LIMITED

AkerSolutions

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: BISMUTH CLEANER FLOTATION PROCESS FLOW DIAGRAM

SCALE: NONE
PROJ. NO. 183240
DRAWING NO. DWG-2930-F-002
REVISION F



Stream No.	34	52	53	703
Description	Bi Ro-Scavenger Tails	Co conc thkne OF	Co Concentrate	Flocc to Co Conc Thckr
SOLIDS FLOWRATE (t/h)	7.6	0.0	7.6	0.0
LIQUID FLOWRATE (t/h)	48.8	43.7	5.1	0.1
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	51.0	43.7	6.7	0.1
PERCENT SOLIDS (% wt)	14	0	60	1
SOLIDS S.G.	3.4	3.4	4.7	0.0
LIQUID S.G.	1.0	1.0	1.0	1.0
STREAM S.G.	1.1	1.0	1.9	1.0
TEMPERATURE (C)	15.0	14.2	20.0	20.0
INSTANTANEOUS FLOW (m3/h)	51.0	43.7	6.7	0.1

LEGEND:

PRIMARY FLOW

SECONDARY FLOW

INTERMITTENT FLOW OR ALTERNATE FLOW

VENDORS PACKAGE

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REVISIONS

NO.	DESCRIPTION	BY	CHK'D	APPROVED		DATE
E	RE-ISSUED FOR FINAL REPORT	S.L.	E.N.			06/14/10
D	ISSUED FOR FINAL REPORT	S.L.	E.N.			04/21/10
C	ISSUED FOR ENGINEERING	S.L.	E.N.			01/15/10
B	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.N.			12/23/09
A	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.N.			11/25/09

REVISIONS

NO.	DESCRIPTION	BY	CHK'D	APPROVED		DATE
F	MSD REVIEW RE-ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B.	M.C.	03/30/12

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	S.L.	07/21/09	PROCESS	B.B.	03/30/12
DRAWN	S.L.	07/21/09	ENGINEERING	S.H.	03/30/12
CHECKED	M.S./D.U.	03/30/12	PROJECTS	M.C.	03/30/12
ACCEPTED	B.B.	03/30/12	CLIENT		

ISSUE RECORD

CURRENT ISSUE FOR
FEED REPORT

ISSUE	REV.	DATE
CLIENT APP'L		
QUOTATION		
CONSTRUCTION		

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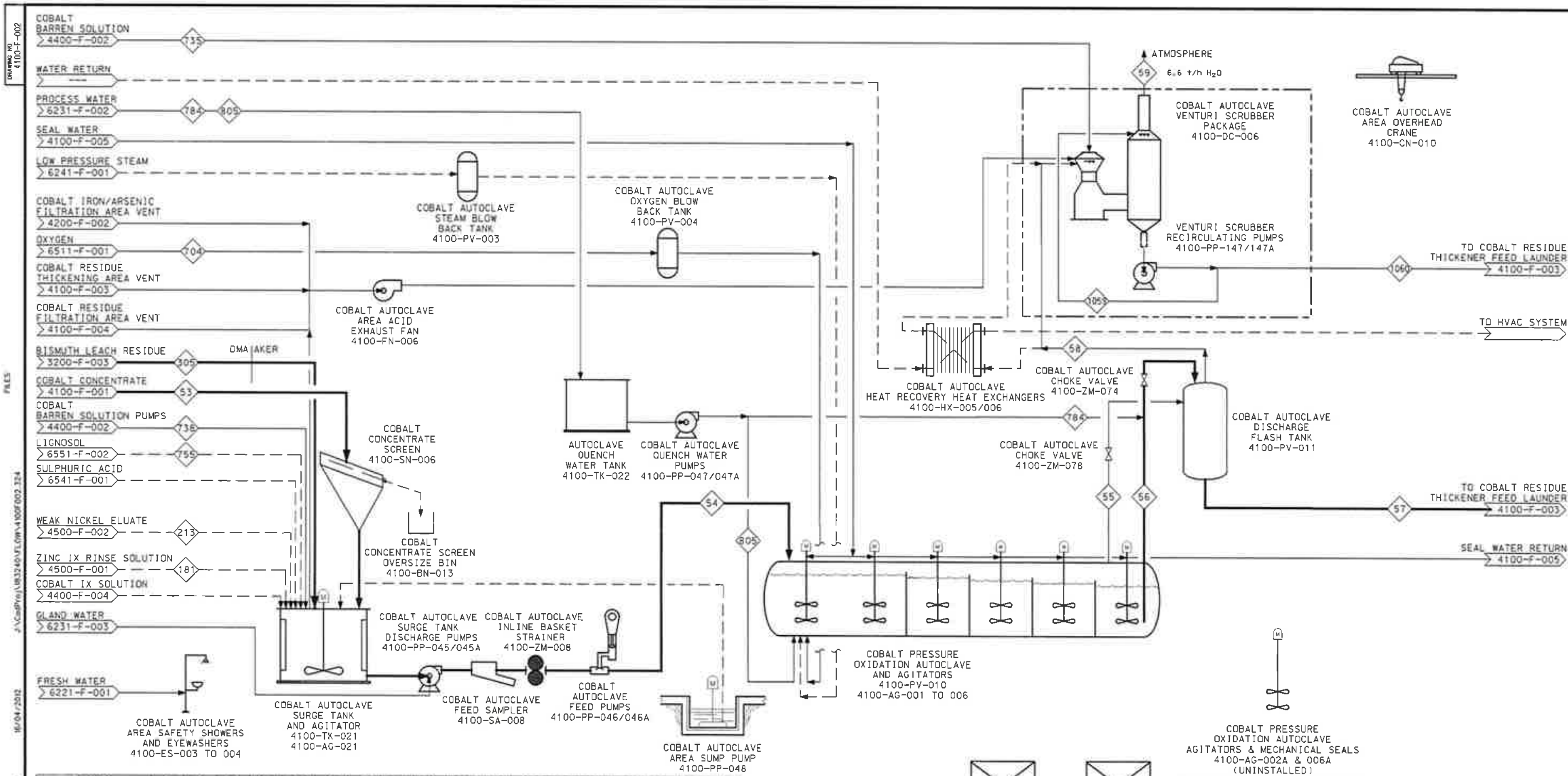
CLIENT/PROJECT
FORTUNE MINERALS
SMPP PROJECT

TITLE
COBALT CONCENTRATE
THICKENING
PROCESS FLOW DIAGRAM

SCALE NONE
PROJ. NO. 183240
REVISION
DRAWING NO.
DWG- 2950-F-001
F



COBALT PRESSURE OXIDATION AUTOCLAVE AGITATORS & MECHANICAL SEALS 4100-AG-002A & 006A (UNINSTALLED) 4100-ZM-068 TO 073, 069A/073A

FLASH TANK DIP TUBE AND INSERT PACKAGE 4100-ZP-002

COBALT AUTOCLAVE DIP TUBE AND INSERT PACKAGE 4100-ZP-001

LEGEND:

- PRIMARY FLOW
- SECONDARY FLOW
- INTERMITTENT FLOW OR ALTERNATE FLOW
- VENDORS PACKAGE

Stream No	53	54	55	56	57	58	59	181	213	305	704	735	738	755	784	805	1059	1060
Description	Co Concentrate	Co POX Feed	Co POX Vent	Co POX Discharge	Co AC Flash Discharge	Co AC Flash Vent	Co Scrubbed Gas to Atm	Zn IX Slow Rinse Discharge	Ni Weak Eluate (Ca rich solution)	Repulped Ferric Chloride Leached Filter Cake	Oxygen to Co POX	Cobalt Barren Solution to AC Gas Scrubber	Cobalt Barren Solution to Co Conc Repulp	Lignosol to Autoclave	Choke Solution to Autoclave Choke Valve	Co POX Cooling Water	AC Scrubber Recycle	Co Scrubber Discharge
SOLIDS FLOWRATE (t/h)	7.6	8.0	0.0	9.1	8.9	0.2	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
LIQUID FLOWRATE (t/h)	5.1	18.7	0.0	67.9	62.9	1.3	0.0	0.04	5.7	0.4	0.0	4.2	7.5	0.05	3.0	46.9	3.6	6.0
GAS FLOWRATE (t/h)	0.0	0.0	1.9	0.0	0.0	8.4	7.9	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	6.7	20.1	137.4	74.3	64.8	7066.5	12379.3	0.03	5.6	0.5	164.2	4.1	7.3	-	3.0	46.5	3.7	6.1
PERCENT SOLIDS (% wt)	60	30	0	12	12	2	0	0	0	50	0	0	0	0	0	0	3	3
SOLIDS S.G	4.7	4.7	0.0	3.2	3.2	3.2	0.0	0.0	0.0	4.6	0.0	2.5	2.5	0.0	3.7	3.7	3.2	3.2
LIQUID S.G	1.0	1.0	0.0	0.9	1.0	1.0	0.0	1.1	1.0	1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
STREAM S.G	1.9	1.3	0.0	1.0	1.1	0.0	0.0	1.1	1.0	1.6	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
PRESSURE (kPa abs)	101.3	2300	2100	2100	180	180	101.3	101.3	101.3	101.3	2300	101.3	101.3	101.3	2300	101.3	101.3	101.3
TEMPERATURE (°C)	20.0	36.8	180.0	180.0	114.6	114.6	97.3	20.0	50.9	20.5	20.0	41.2	41.2	20.0	20.0	20.0	97.5	97.3
pH	7.0	1.0	7.0	0.2	0.1	0.1	7.0	0.5	0.5	7.0	-	5.3	5.3	7.0	7.9	7.9	0.8	0.8
INSTANTANEOUS FLOW (m3/h)	6.7	20.1	137.4	74.3	64.8	7066.5	12379.3	31.4	19.7	0.5	164.2	4.1	7.3	0.2	3.0	46.5	3.7	6.1

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	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.N.		12/23/09
	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.N.		11/25/09

NO.	DESCRIPTION	BY	CHK'D	APPROVED		DATE
	MISC. REVIEW, RE-ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B.	M.C.	03/30/12
	RE-ISSUED FOR FEED REPORT	D.C.	L.M.			02/14/12

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ACCEPTED	B.B.	03/30/12	CLIENT		

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ISSUE | REV. | DATE
CLIENT APPR.
QUOTATION
CONSTRUCTION

FORTUNE MINERALS LIMITED

AkerSolutions

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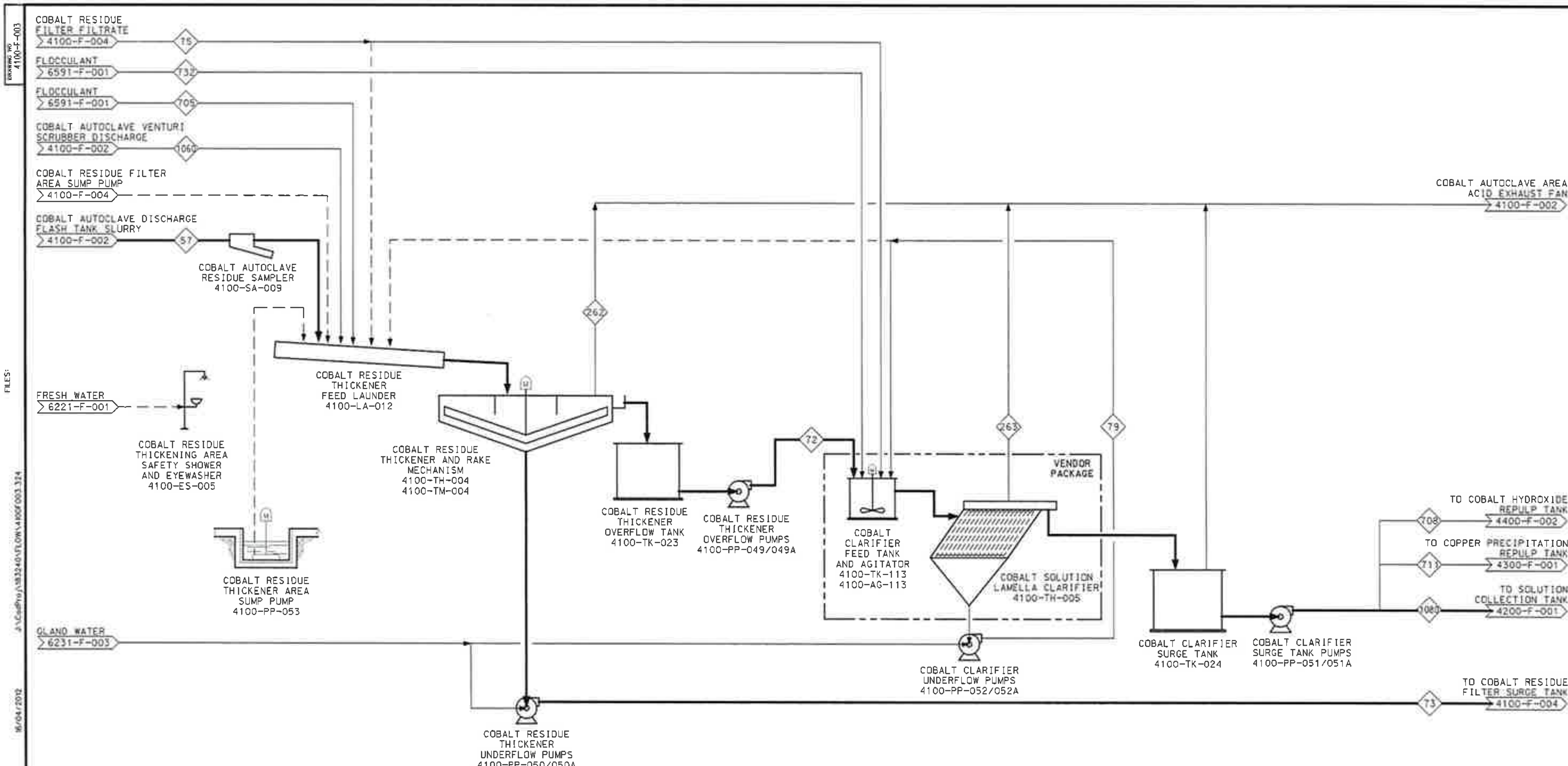
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COBALT PRESSURE OXIDATION PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240 | REVISION

DRAWING NO. DWG-4100-F-002 | G



Stream No.	57	72	73	75	79	262	263	705	708	711	732	1060	1080
Description	Co AC Flash Discharge	Co Residue Thickener OF	Co Residue Thickener UF	Co Residue Filtrates	Clarifier UF	Co Residue Thickener Vent	Clarifier Vent	Flocc to Co Residue Thickener	ACD Solution to Co Repulp Tank	ACD Solution to Repulp Cu Precip Cake	Flocc to Clarifier	Co Scrubber Discharge	ACD Solution to Fe/As Precipitation
SOLIDS FLOWRATE (t/h)	8.9	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
LIQUID FLOWRATE (t/h)	62.9	62.2	6.1	13.4	0.2	0.0	0.0	0.1	0.2	0.2	0.0	6.0	74.8
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.9	0.2	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	64.8	60.7	8.7	-	0.2	1601.8	345.4	0.1	0.2	0.2	0.0	6.1	72.7
PERCENT SOLIDS (% wt)	12	0	60	0	15	0	0	1	0	0	1	3	0
SOLIDS S.G.	3.2	3.2	3.2	3.2	3.2	0.0	0.0	0.0	3.2	3.2	0.0	3.2	3.2
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
STREAM S.G.	1.1	1.0	1.7	1.0	1.1	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
TEMPERATURE (°C)	114.6	99.4	99.4	64.7	91.3	99.4	91.3	20.0	88.0	88.0	20.0	97.3	88.0
INSTANTANEOUS FLOW (m3/h)	64.8	60.7	8.7	69.7	0.2	1601.8	345.4	0.1	0.2	0.2	0.0	6.1	72.7

LEGEND:

PRIMARY FLOW

SECONDARY FLOW

INTERMITTENT FLOW OR ALTERNATE FLOW

VENDORS PACKAGE

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FORTUNE MINERALS LIMITED

AkerSolutions

Aker Metals, a division of Aker Solutions Canada Inc.

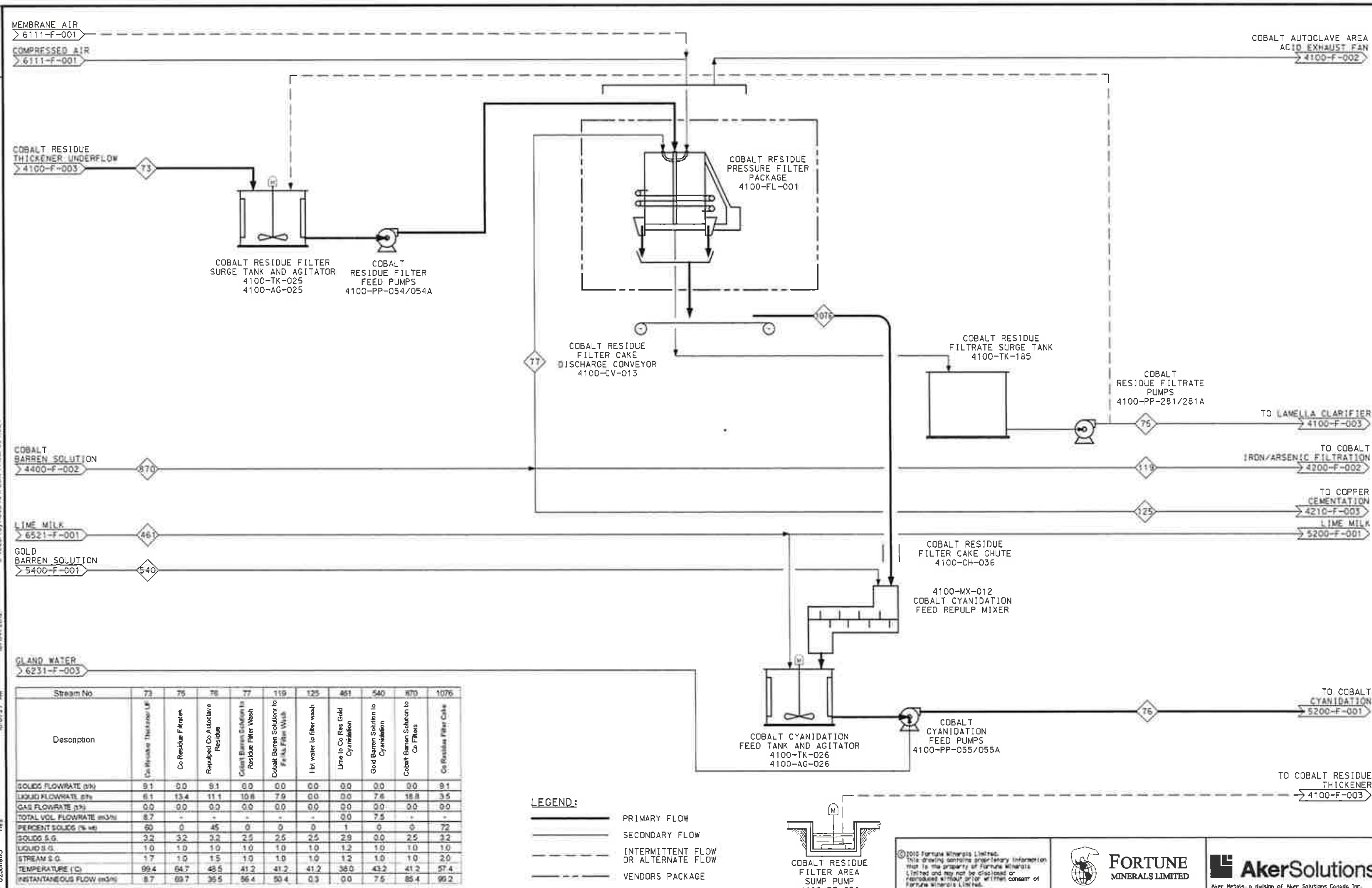
CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COBALT RESIDUE THICKENING & CLARIFICATION PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ NO 183240 | REVISION

DRAWING NO: DWG- 4100-F-003 | G



Stream No	73	75	76	77	119	125	461	540	870	1076
Description	Co Residue Thickener UF	Co Residue Filtrates	Repulped Co Autoclave Residue	Cobalt Barren Solution to Residue Filter Wash	Cobalt Barren Solution to Fe/As Filter Wash	Hot water to filter wash	Lime to Co Res Gold Cyanidation	Gold Barren Solution to Cyanidation	Cobalt Barren Solution to Co Filters	Co Residue Filter Cake
SOLIDS FLOWRATE (t/h)	9.1	0.0	9.1	0.0	0.0	0.0	0.0	0.0	0.0	9.1
LIQUID FLOWRATE (t/h)	6.1	13.4	11.1	10.6	7.9	0.0	0.0	7.6	18.8	3.5
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	8.7	-	-	-	-	-	0.0	7.5	-	-
PERCENT SOLIDS (% wt)	60	0	45	0	0	0	1	0	0	72
SOLIDS S.G.	3.2	3.2	3.2	2.5	2.5	2.5	2.9	0.0	2.5	3.2
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.0	1.0	1.0
STREAM S.G.	1.7	1.0	1.5	1.0	1.0	1.0	1.2	1.0	1.0	2.0
TEMPERATURE (°C)	99.4	64.7	48.5	41.2	41.2	41.2	38.0	43.2	41.2	57.4
INSTANTANEOUS FLOW (m3/h)	8.7	69.7	35.5	56.4	50.4	0.3	0.0	7.5	85.4	99.2

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FORTUNE MINERALS LIMITED

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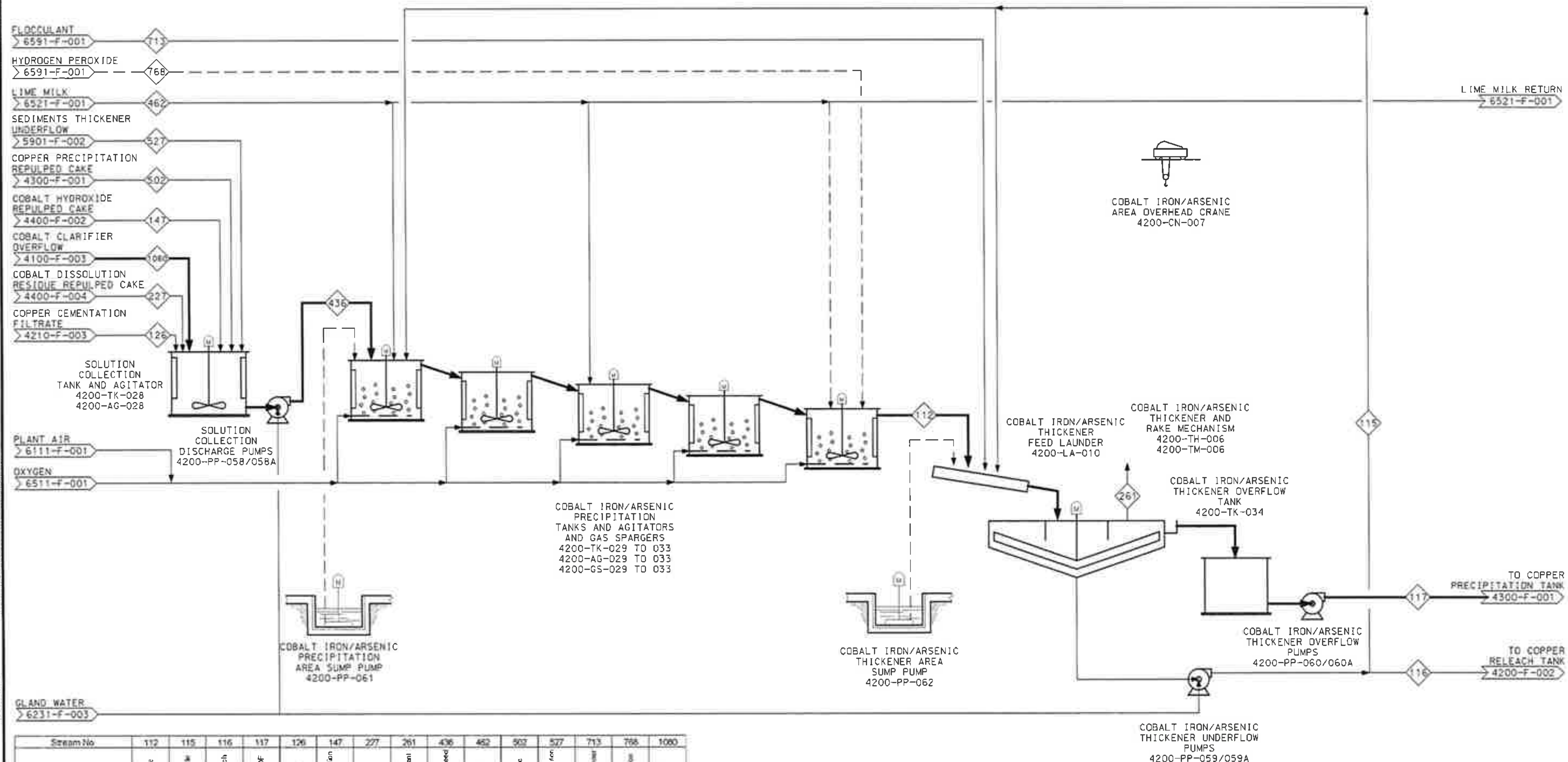
CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COBALT RESIDUE FILTRATION PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240

DRAWING NO: DWG- 4100-F-004 | REVISION: G



Stream No	112	115	116	117	126	147	277	261	436	462	502	527	713	768	1060
Description	Fe/As Precip 5 Discharge	Fe/As Precip Seed Recycle	Fe/As Precip UF to Releach	Fe/As Precip Thickener OF	Cu cementation filtrate	Repulped 2nd Co Precipitation Cake	Co Dissolution Repulp Discharge	Fe/As Precip Thickener Vent	Total Fe/As Precipitation Feed	Lime to Fe/As Precip	Repulped Cu Precip Cake	Effluent Treatment Sludge to Solution Collection Tank	Flocculant to Fe/As Thickener	H2O2 to Fe/As Precipitation	ACD Solution to Fe/As Precipitation
SOLIDS FLOWRATE (t/h)	12.4	6.2	6.2	0.0	0.0	0.1	0.2	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0
LIQUID FLOWRATE (t/h)	134.6	18.5	18.5	97.5	29.1	0.5	2.0	0.0	107.1	14.8	0.3	0.2	0.1	0.02	74.8
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	137.3	20.7	20.7	95.8	28.1	-	-	320.0	103.5	12.8	-	-	0.1	0.01	72.7
PERCENT SOLIDS (% wt)	8	25	25	0	0	15	10	0	0	1	30	20	1	0	0
SOLIDS S.G.	2.5	2.5	2.5	2.5	7.8	2.5	2.8	0.0	2.4	2.9	3.6	2.5	0.0	0.0	3.2
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	1.0	1.2	1.0	1.1	1.0	1.5	1.0
STREAM S.G.	1.1	1.2	1.2	1.0	1.0	1.1	1.1	0.0	1.0	1.2	1.3	1.2	1.0	1.5	1.0
TEMPERATURE (C)	65.5	64.3	64.3	64.3	55.9	65.8	24.9	64.3	75.9	38.0	78.7	16.9	20.0	20.0	88.0
pH	4.6	4.6	4.6	4.6	2.2	0.5	2.6	7.0	0.4	14.6	0.3	9.3	7.0	7.0	0.2
INSTANTANEOUS FLOW (m3/h)	137.3	20.7	20.7	95.8	28.1	1.5	6.1	320.0	103.5	12.8	0.9	0.2	0.1	0.01	72.7

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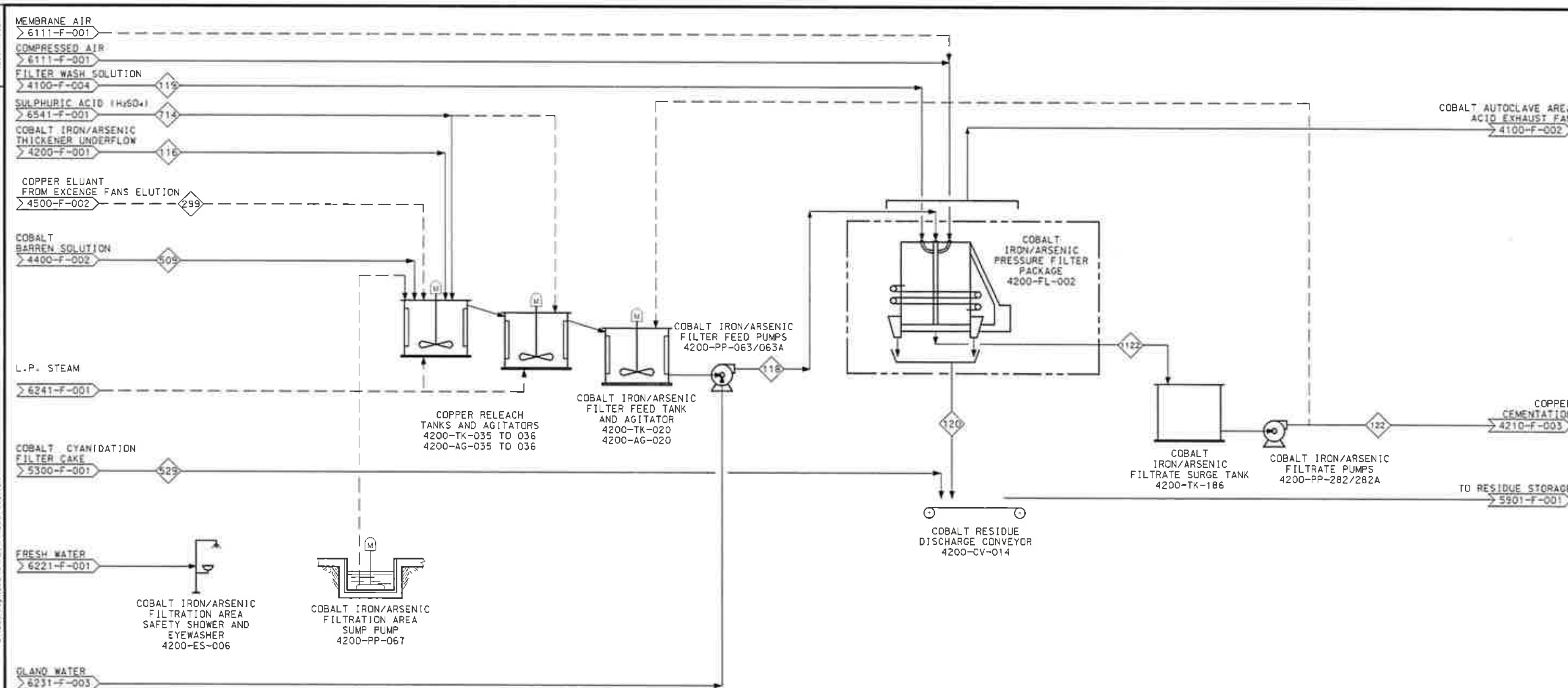
CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COBALT IRON /ARSENIC PRECIPITATION PROCESS FLOW DIAGRAM

SCALE NONE | PROJ NO 183240

DWG- 4200-F-001 | REVISION H



Stream No	116	118	119	120	122	299	509	529	714	1122
Description	Fe/As Precip UF to Releach	Releach Discharge	Cobalt Barren Solution to Fe/As Filter Wash	Fe/As Filter Cake	Fe/As Filtrates	Cu Eluate to Copper Releach	Cobalt Barren Solution to Releach Tank	Co Residue Cyanidation 1 Filter Cake	H2SO4 to Releach	Fe/As Filtrates
SOLIDS FLOWRATE (t/h)	6.2	5.9	0.0	5.9	0.03	0.0	0.0	9.1	0.0	0.0
LIQUID FLOWRATE (t/h)	18.5	25.0	7.9	4.0	29.0	0.0	5.8	2.3	0.4	29.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	20.7	26.5	-	-	27.9	-	5.7	5.0	0.2	-
PERCENT SOLIDS (% wt)	25	19	0	60	0	0	0	80	0	0.1
SOLIDS S.G.	2.5	2.5	2.5	2.5	2.5	0.0	2.5	3.2	0.0	2.5
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.9	1.0
STREAM S.G.	1.2	1.2	1.0	1.6	1.0	1.0	1.0	2.2	1.9	1.0
TEMPERATURE (C)	64.3	60.8	41.2	47.9	55.9	23.5	41.2	31.2	20.0	55.9
pH	4.6	2.0	9.3	5.6	2.1	< 0.1	9.3	9.4	< 0.1	2.1
INSTANTANEOUS FLOW (m3/h)	20.7	26.5	50.4	122.3	27.9	13.1	5.7	5.0	0.2	103.3

LEGEND:

- PRIMARY FLOW
- SECONDARY FLOW
- INTERMITTENT FLOW OR ALTERNATE FLOW
- VENDORS PACKAGE

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CURRENT ISSUE FOR: FEED REPORT

FORTUNE MINERALS LIMITED

AkerSolutions

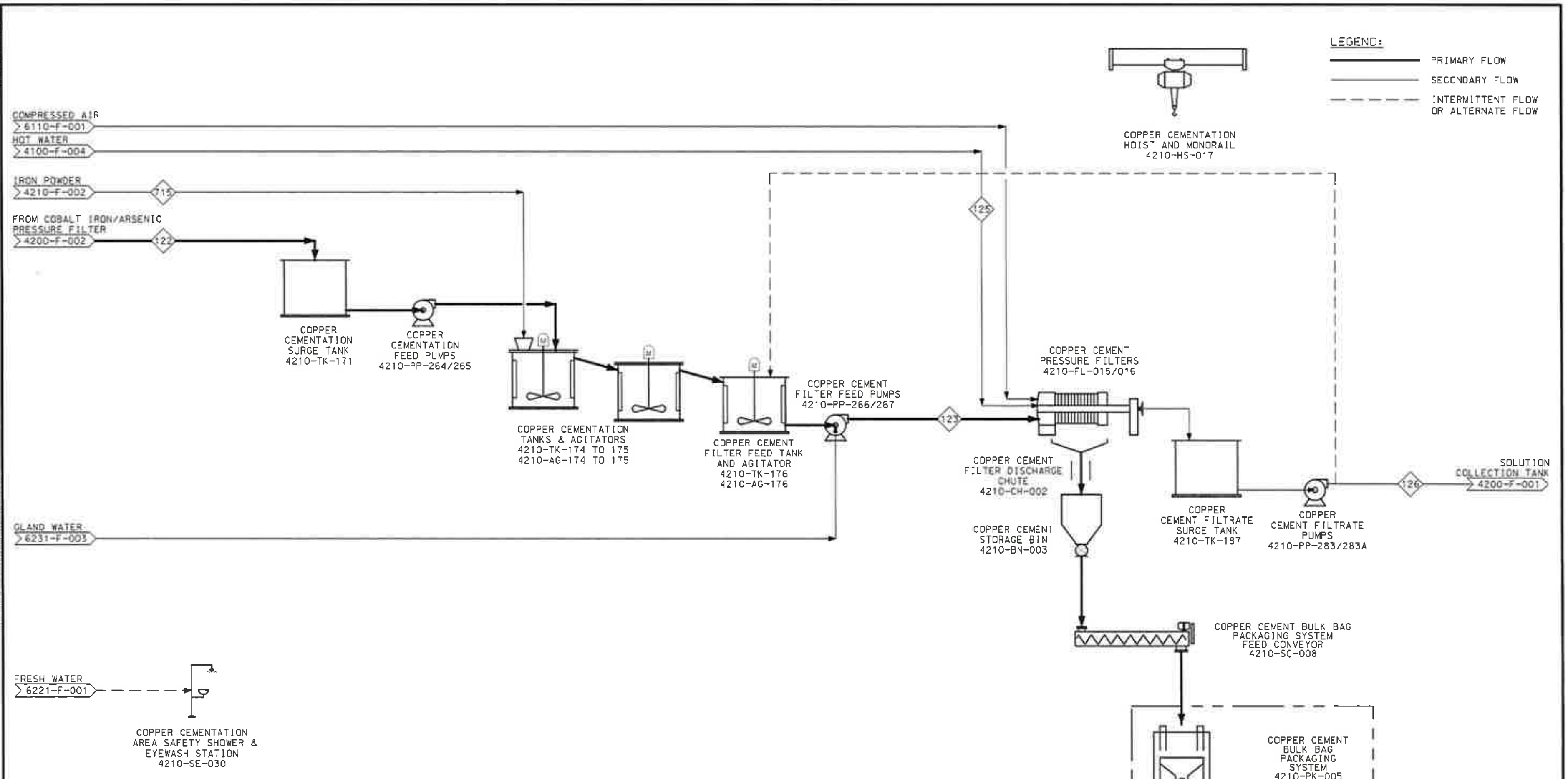
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COPPER RELEACH AND COBALT IRON /ARSENIC FILTRATION PROCESS FLOW DIAGRAM

PROJ. NO. 183240

DWG- 4200-F-002

REVISION: H



Stream No.	122	123	125	126	128	715
Description	Fe/As Filtrates	Cu cementation discharge	Hot water to filter wash	Cu cementation filtrate	Cu cement	Iron powder to Cu cementation
SOLIDS FLOWRATE (t/h)	0.0	0.1	0.0	0.0	0.06	0.0
LIQUID FLOWRATE (t/h)	29.0	29.0	0.0	29.1	0.01	0.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	27.9	28.0	0.0	28.1	0.02	0.0
PERCENT SOLIDS (% wt)	0	0	0	0	85	100
SOLIDS S.G.	2.5	7.8	2.5	7.8	7.8	7.9
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	0.0
STREAM S.G.	1.0	1.0	1.0	1.0	3.9	7.9
TEMPERATURE (°C)	55.9	57.0	41.2	55.9	48.2	20.0
pH	2.1	2.1	9.3	2.2	4.4	7.0
INSTANTANEOUS FLOW (m3/h)	27.9	28.0	0.3	28.1	0.02	0.0

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NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
A	ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B.	M.C. 03/30/12

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	M.S.	03/15/12	PROCESS	B.B.	03/30/12
DRAWN	S.H.	03/15/12	ENGINEERING	L.H.	03/30/12
CHECKED	M.S./D.U.	03/30/12	PROJECTS	M.C.	03/30/12
ACCEPTED	B.B.	03/30/12	CLIENT		

CURRENT ISSUE FOR: FEED REPORT

FORTUNE MINERALS LIMITED

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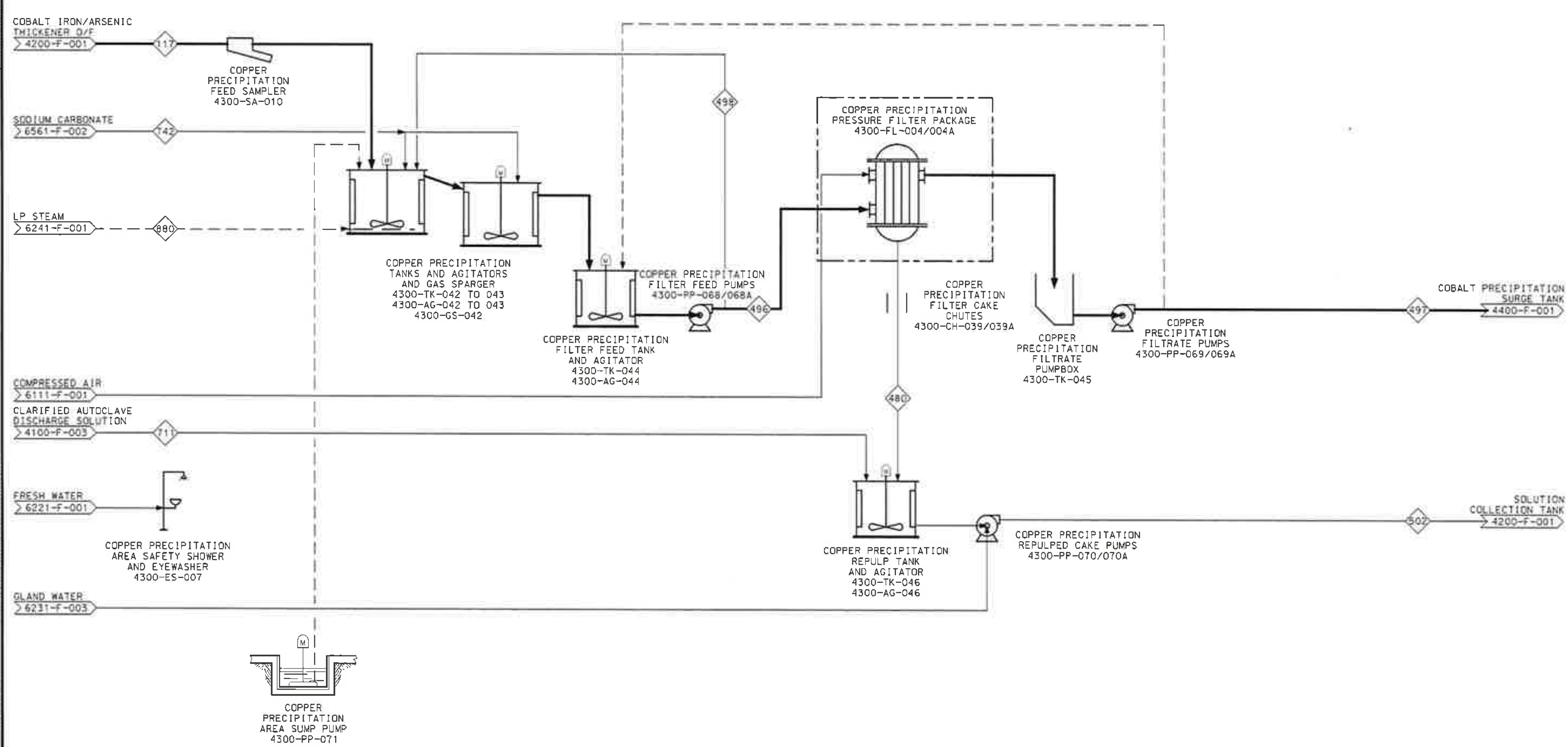
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COPPER CEMENTATION FILTRATION FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240 | REVISION A

DRAWING NO: DWG-4210-F-003



Stream No	117	480	496	497	498	502	711	742	880
Description	Fe/As Precip Thickener OF	Cu Precip Filter Cake	Cu Precip 3 Discharge	Cu Precipitation Filtrates to Co Precip	Copper Precipitation Recycle	Repulped Cu Precip Cake	ACD Solution to Repulp Cu Precip Cake	Na2CO3 To Cu Precipitation	LP steam to Cu Precip
SOLIDS FLOWRATE (t/h)	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0
LIQUID FLOWRATE (t/h)	97.5	0.1	98.0	97.9	9.8	0.3	0.2	0.6	0.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	95.8	-	-	95.9	9.6	-	-	0.6	0.0
PERCENT SOLIDS (% wt)	0	65	0	0	0	30	0	0	0
SOLIDS S.G.	2.5	3.6	3.6	0.0	3.6	3.6	3.2	2.8	0.0
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	0.0
STREAM S.G.	1.0	1.9	1.0	1.0	1.0	1.3	1.0	1.1	0.0
TEMPERATURE (C)	64.3	56.2	59.7	56.2	59.7	78.7	88.0	20.4	180.0
pH	4.6	6.5	6.5	6.5	6.5	0.3	0.2	7.0	7.0
INSTANTANEOUS FLOW (m3/h)	95.8	2.2	98.1	95.9	9.6	0.9	0.4	0.6	0.0

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NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
	RE-ISSUED FOR FINAL REPORT	S.L.	E.K.		06/14/10
	ISSUED FOR FINAL REPORT	S.L.	E.K.		04/21/10
	ISSUED FOR ENGINEERING	S.L.	E.K.		01/15/10
	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.K.		12/23/09
	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.K.		11/25/09

NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
	MISC. REVIEW RE-ISSUED FOR FEED REPORT	S.M.	MS/GU	B.B. M.C.	03/30/12
	RE-ISSUED FOR FEED REPORT	S.D.	S.M.		02/14/12

CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: COPPER PRECIPITATION PROCESS FLOW DIAGRAM

FORTUNE MINERALS LIMITED

AkerSolutions

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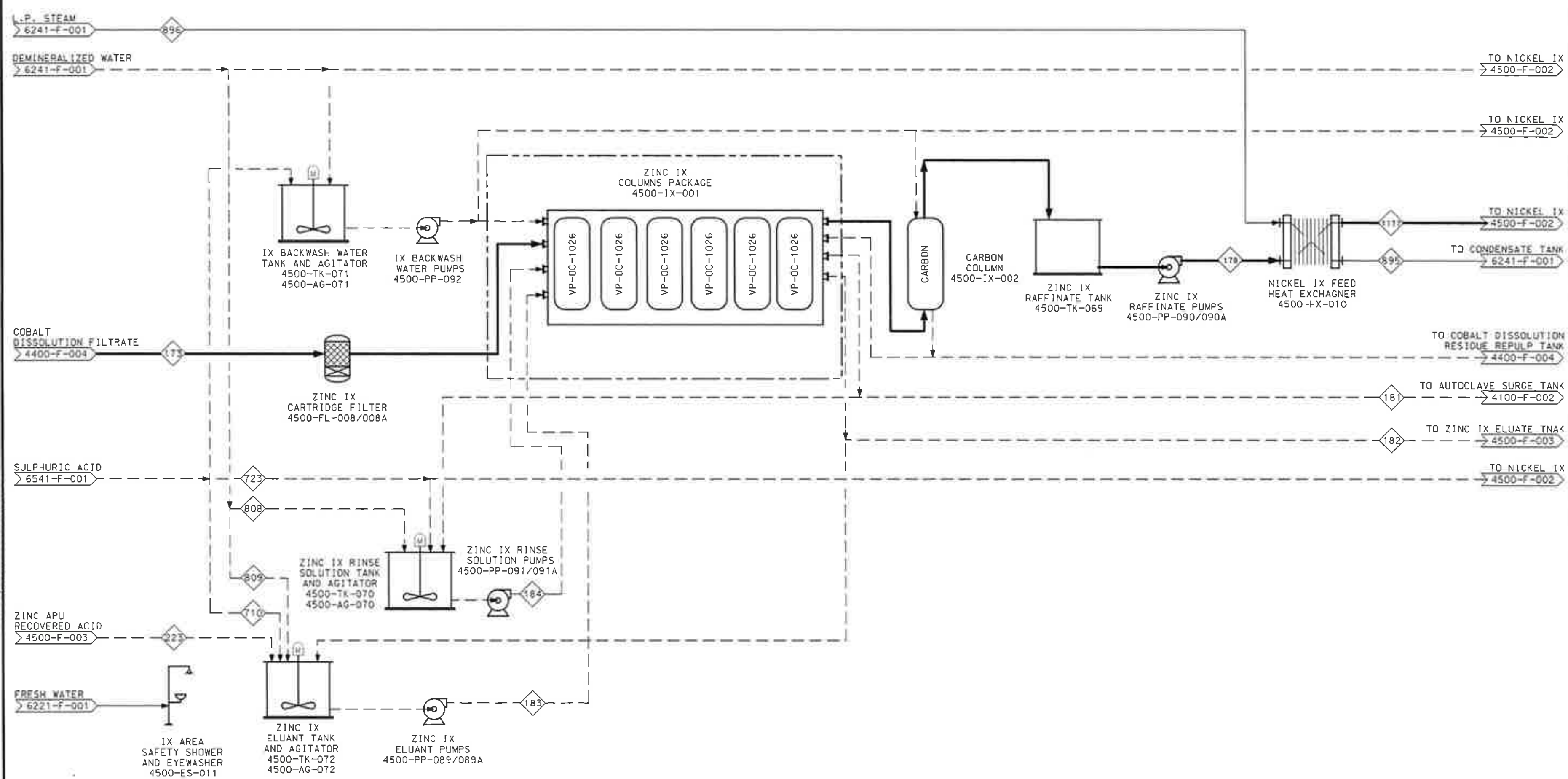
SCALE NONE | PROJ NO 183240 | REVISION G

DRAWING NO DWG- 4300-F-001



Stream No.	173	178	181	182	183	184	223	710	723	808	809	895	896	1177
Description	Zn IX Feed	Zn IX Raffinate	Zn IX Slow Rinse Discharge	Zn Eluate	Zn IX Eluant	[illegible]	Zn APU Recovered Acid	H2SO4 to Zn IX Elution	H2SO4 to Zn IX Rinse	Demin Water to Zn IX Rinse	Demin Water to Zn IX Elution	Ni HX Condensate	LP Steam to Ni HX	Heated Ni IX Feed
SOLIDS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID FLOWRATE (t/h)	7.1	7.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	5.5	5.5	-	-	-	-	-	-	-	-	-	0.0	0.0	5.5
PERCENT SOLIDS (% wt)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLIDS S.G.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID S.G.	1.3	1.3	1.1	1.1	1.1	1.0	1.1	1.9	1.9	1.0	1.0	0.9	0.0	1.3
STREAM S.G.	1.3	1.3	1.1	1.1	1.1	1.0	1.1	1.9	1.9	1.0	1.0	0.9	0.0	1.3
TEMPERATURE (°C)	78.7	74.2	20.0	20.0	20.0	24.4	20.0	20.0	20.0	20.0	20.0	122.0	180.0	64.3
COBALT CONCENTRATION (gpl)	107.8	107.8	36.0	14.5	4.3	0.0	4.4	0.0	0.0	0.0	0.0	0.0	0.0	107.8
ZINC CONCENTRATION (gpl)	0.0	0.0	0.0	3.6	1.1	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H2SO4 CONCENTRATION (gpl)	0.0	0.1	14.9	132.3	152.8	25.0	< 0.1	1851.3	1851.3	0.0	0.0	0.0	0.0	0.1
INSTANTANEOUS FLOW (m3/h)	5.5	5.5	31.4	10.5	10.5	31.4	10.5	0.01	0.00	8.0	7.0	0.0	0.0	5.5

LEGEND:

PRIMARY FLOW
SECONDARY FLOW
INTERMITTENT FLOW OR ALTERNATE FLOW
VENDORS PACKAGE

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REVISIONS

NO	DESCRIPTION	BY	CHK'D	APPROVED		DATE
[illegible]	RE-ISSUED FOR FINAL REPORT	S.L.	E.N.			06/14/10
[illegible]	ISSUED FOR FINAL REPORT	S.L.	E.N.			04/21/10
[illegible]	ISSUED FOR ENGINEERING	S.L.	E.N.			01/15/10
[illegible]	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.N.			12/23/09
[illegible]	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.N.			12/17/09

NO	DESCRIPTION	BY	CHK'D	APPROVED		DATE
[illegible]	MDC REVIEW, RE-ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B.	M.C.	03/30/12
[illegible]	RE-ISSUED FOR FEED REPORT	E.C.	S.L.			02/14/12

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	S.L.	06/26/09	PROCESS	B.B.	03/30/12
DRAWN	S.L.	06/26/09	ENGINEERING	L.N.	03/30/12
CHECKED	M.S./D.U.	03/30/12	PROJECTS	M.C.	03/30/12
ACCEPTED	B.B.	03/30/12	CLIENT		

ISSUE RECORD

CURRENT ISSUE FOR: FEED REPORT

ISSUE	REV	DATE
CLIENT APP'L		
QUOTATION		
CONSTRUCTION		

FORTUNE MINERALS LIMITED

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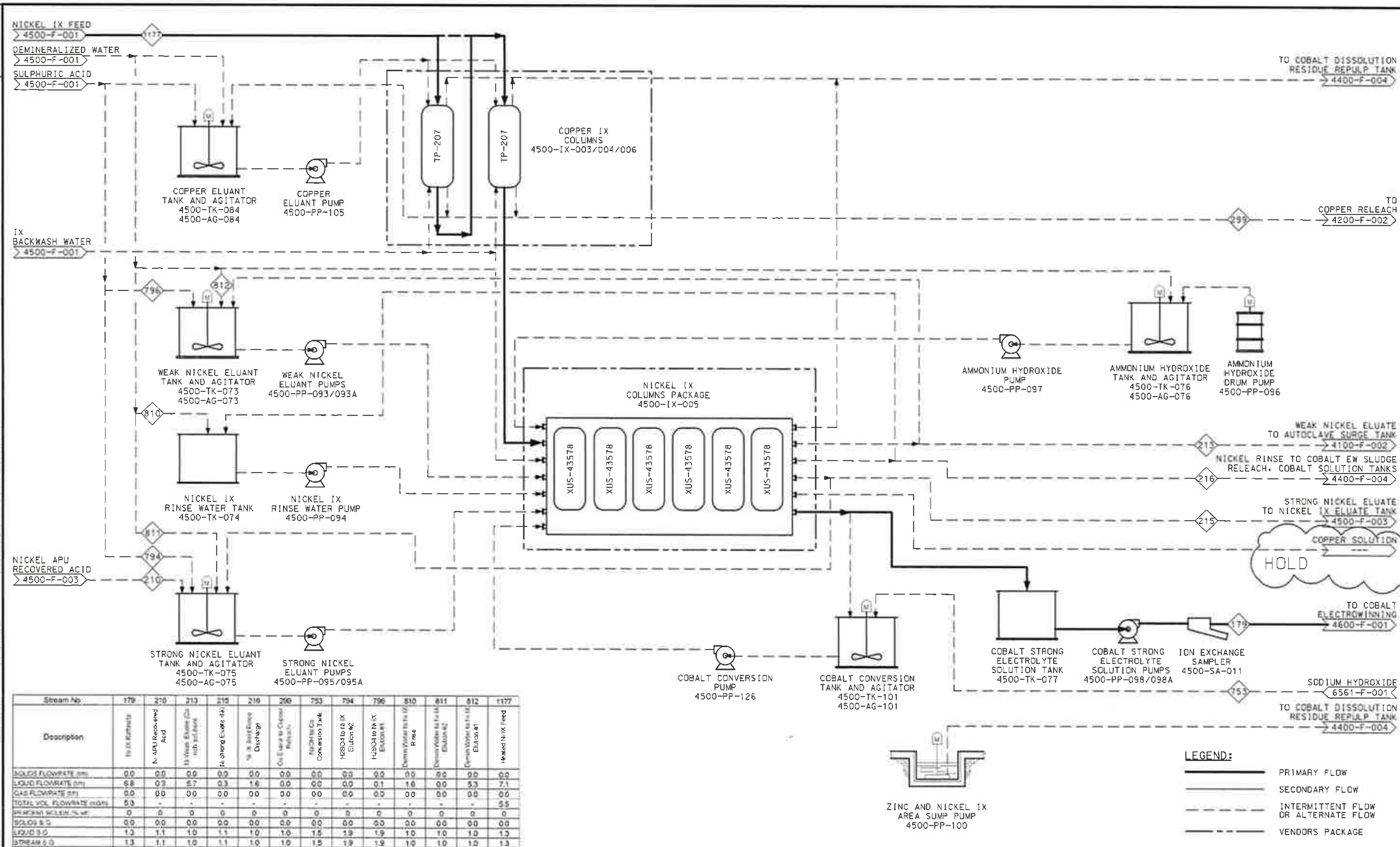
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: ION EXCHANGE AND ELUTION PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240 | REVISION

DRAWING NO: DWG- 4500-F-001

G



Stream No.	179	210	213	215	216	299	753	794	796	810	811	812	1177
Description	Ni IX Raffinate	Ni APU Recovered Acid	Ni Weak Eluate (Co rich solution)	Ni Strong Eluate (Ni)	Ni IX Acid Rinse Discharge	Cu Eluate to Copper Releach	NaOH to Co Conversion Tank	H2SO4 to Ni IX Elution #2	H2SO4 to Ni IX Elution #1	Demin Water to Ni IX Rinse	Demin Water to Ni IX Elution #2	Demin Water to Ni IX Elution #1	Heated Ni IX Feed
SOLIDS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID FLOWRATE (t/h)	6.8	0.3	5.7	0.3	1.6	0.0	0.0	0.0	0.1	1.6	0.0	5.3	7.1
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	5.3	-	-	-	-	-	-	-	-	-	-	-	5.5
PERCENT SOLIDS (% wt)	0	0	0	0	0	0	0	0	0	0	0	0	0
SOLIDS S.G.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID S.G.	1.3	1.1	1.0	1.1	1.0	1.0	1.5	1.9	1.9	1.0	1.0	1.0	1.3
STREAM S.G.	1.3	1.1	1.0	1.1	1.0	1.0	1.5	1.9	1.9	1.0	1.0	1.0	1.3
TEMPERATURE (°C)	52.5	20.0	50.9	20.0	21.0	23.5	23.7	20.0	20.0	20.0	20.0	20.0	64.3
COBALT CONCENTRATION (g/L)	107.0	1.8	4.2	5.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	107.6
NICKEL CONCENTRATION (g/L)	0.1	8.5	0.7	26.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9
H2SO4 CONCENTRATION (g/L)	2.8	< 0.1	18.1	91.0	0.2	95.0	0.0	1851.3	1851.3	0.0	0.0	0.0	0.1
INSTANTANEOUS FLOW (m3/h)	5.3	19.7	19.7	19.7	19.7	13.1	0.1	0.1	0.6	7.0	7.0	16.0	5.5

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NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
	RE-ISSUED FOR FINAL REPORT	S.L.	E.A.		06/14/10
	ISSUED FOR FINAL REPORT	S.L.	E.A.		06/01/10
	ISSUED FOR ENGINEERING	S.L.	E.A.		01/15/10
	UPDATED AND RELEASED TO ENGINEERING	S.L.	E.A.		12/23/09
	PRELIMINARY RELEASE FOR ENGINEERING	S.L.	E.A.		12/17/09

NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
	MISC REVIEW RE-ISSUED FOR FEED REPORT	S.H.	MS/DU	B.B. / M.C.	03/30/12
	RE-ISSUED FOR FEED REPORT	J.C.	S.M.		02/14/11

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	S.L.	09/28/09	PROCESS	B.B.	03/30/12
DRAWN	S.L.	09/28/09	ENGINEERING	L.N.	03/30/12
CHECKED	M.S./D.U.	03/30/12	PROJECTS	M.C.	03/30/12
ACCEPTED	B.B.	03/30/12	CLIENT		

CURRENT ISSUE FOR: FEED REPORT
ISSUE | REV. | DATE
CLIENT APP'L
QUOTATION
CONSTRUCTION

FORTUNE MINERALS LIMITED

AkerSolutions
Aker Metals, a division of Aker Solutions Canada Inc.

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: ION EXCHANGE AND ELUTION PROCESS FLOW DIAGRAM

SCALE NONE | PROJ. NO 183240 | REVISION

DRAWING NO: DWG- 4500-F-002 | G

DRAWING NO. 4500-F-002

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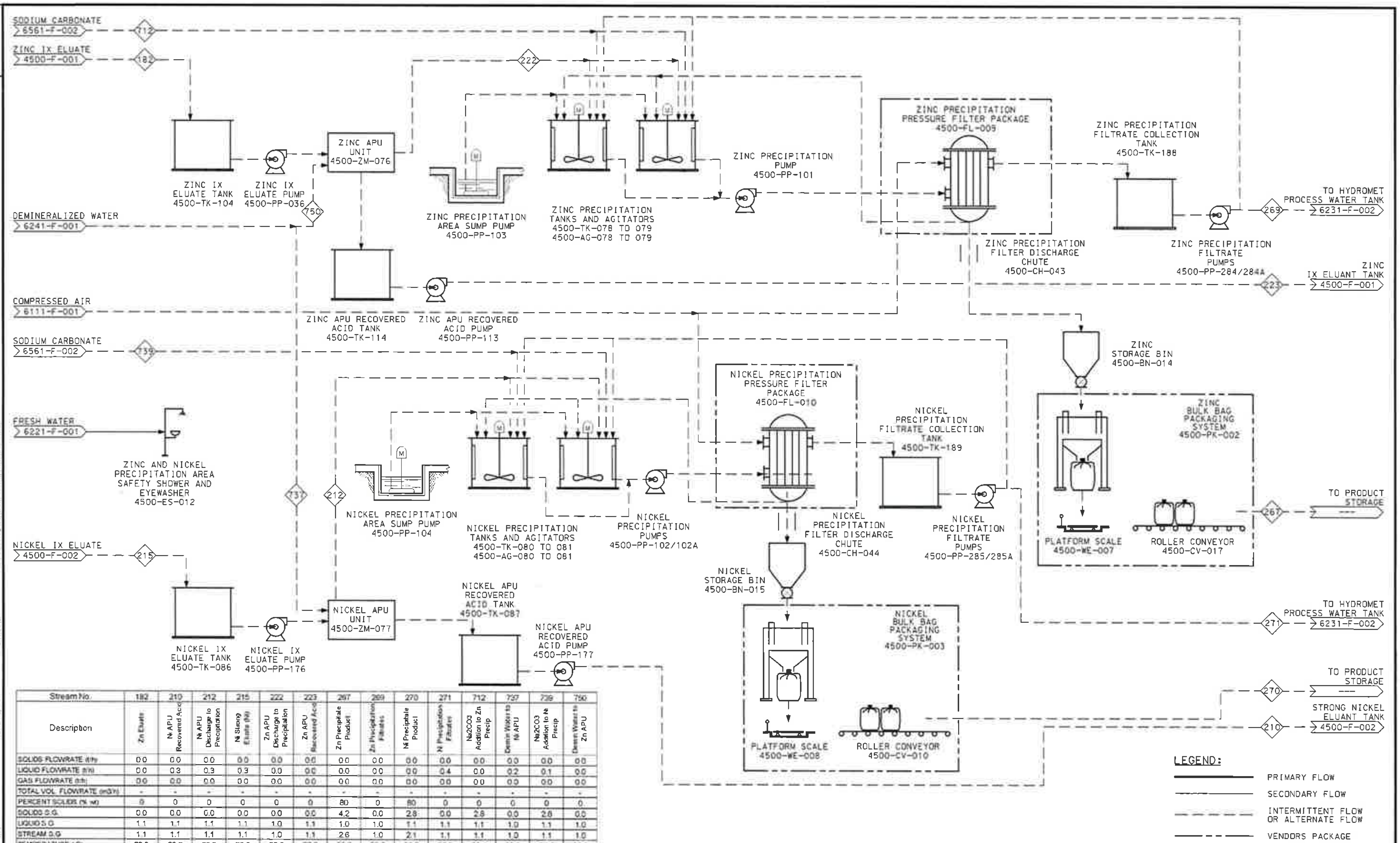

Stream No.	182	210	212	215	222	223	267	269	270	271	712	737	739	750
Description	Zn Eluate	Ni APU Recovered Acid	Ni APU Discharge to Precipitation	Ni Strong Eluate (Ni)	Zn APU Discharge to Precipitation	Zn APU Recovered Acid	Zn Precipitate Product	Zn Precipitation Filtrates	Ni Precipitate Product	Ni Precipitation Filtrates	Na2CO3 Addition to Zn Precip	Demin Water to Ni APU	Na2CO3 Addition to Ni Precip	Demin Water to Zn APU
SOLIDS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LIQUID FLOWRATE (t/h)	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.2	0.1	0.0
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PERCENT SOLIDS (% wt)	0	0	0	0	0	0	80	0	80	0	0	0	0	0
SOLIDS S.G.	0.0	0.0	0.0	0.0	0.0	0.0	4.2	0.0	2.8	0.0	2.8	0.0	2.8	0.0
LIQUID S.G.	1.1	1.1	1.1	1.1	1.0	1.1	1.0	1.0	1.1	1.1	1.1	1.0	1.1	1.0
STREAM S.G.	1.1	1.1	1.1	1.1	1.0	1.1	2.6	1.0	2.1	1.1	1.1	1.0	1.1	1.0
TEMPERATURE (C)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.4	20.0	20.4	20.0
NICKEL CONCENTRATION (gpl)	0.0	8.5	20.4	26.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ZINC CONCENTRATION (gpl)	3.6	0.0	0.0	0.0	2.7	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
pH	< 0.1	< 0.1	0.6	< 0.1	0.5	< 0.1	9.5	9.5	9.5	9.5	7.0	7.0	7.0	7.0
INSTANTANEOUS FLOW (m3/h)	10.5	19.7	19.7	19.7	10.5	10.5	0.0	0.1	0.1	0.7	0.0	19.7	0.3	10.5

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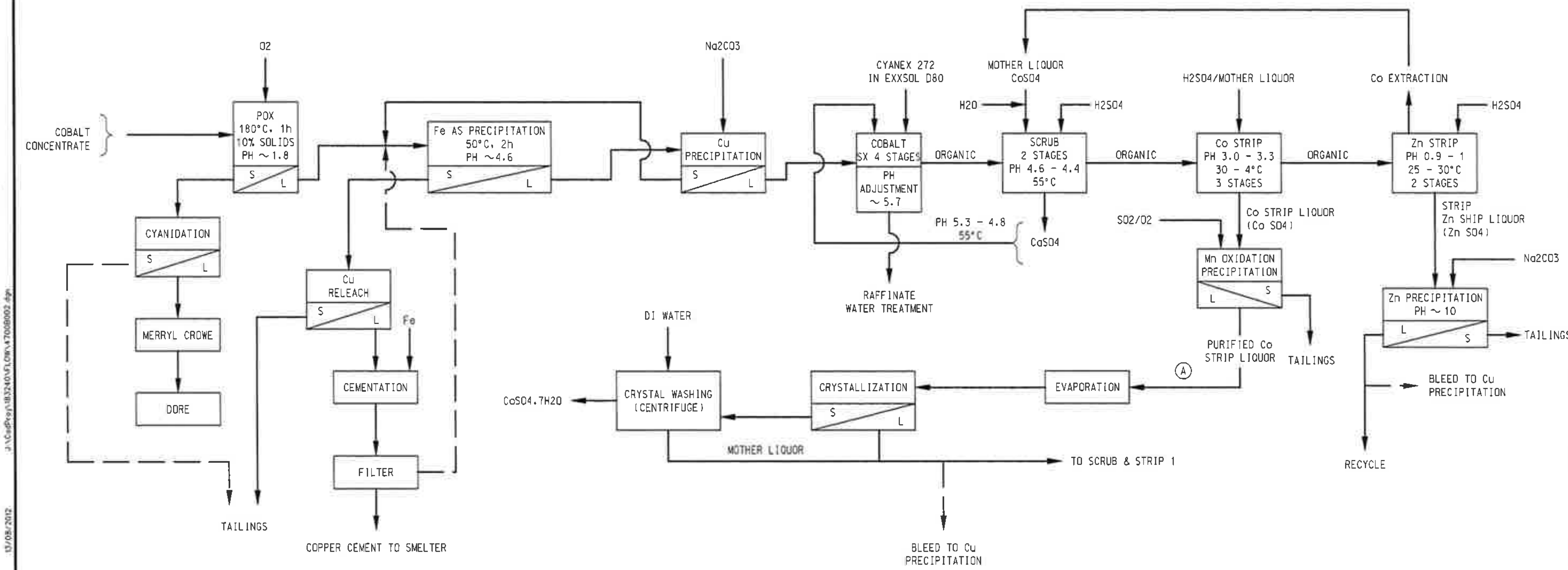
CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: ZINC AND NICKEL PRECIPITATION PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240

DRAWING NO: DWG- 4500-F-003 | REVISION: G



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NO	DESCRIPTION	BY	CHK'D	APPROVED		DATE
A	ISSUED FOR COMMENTS & REVIEW	S.H.	D.U.			27/04/12
B	ISSUED FOR COMMENTS & REVIEW	S.H.	D.U.			13/08/12

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	D.U.	22/02/12	PROCESS		
DRAWN	S.H.	22/02/12	ENGINEERING		
CHECKED			PROJECTS		
ACCEPTED			CLIENT		

CURRENT ISSUE FOR: CLIENT REVIEW

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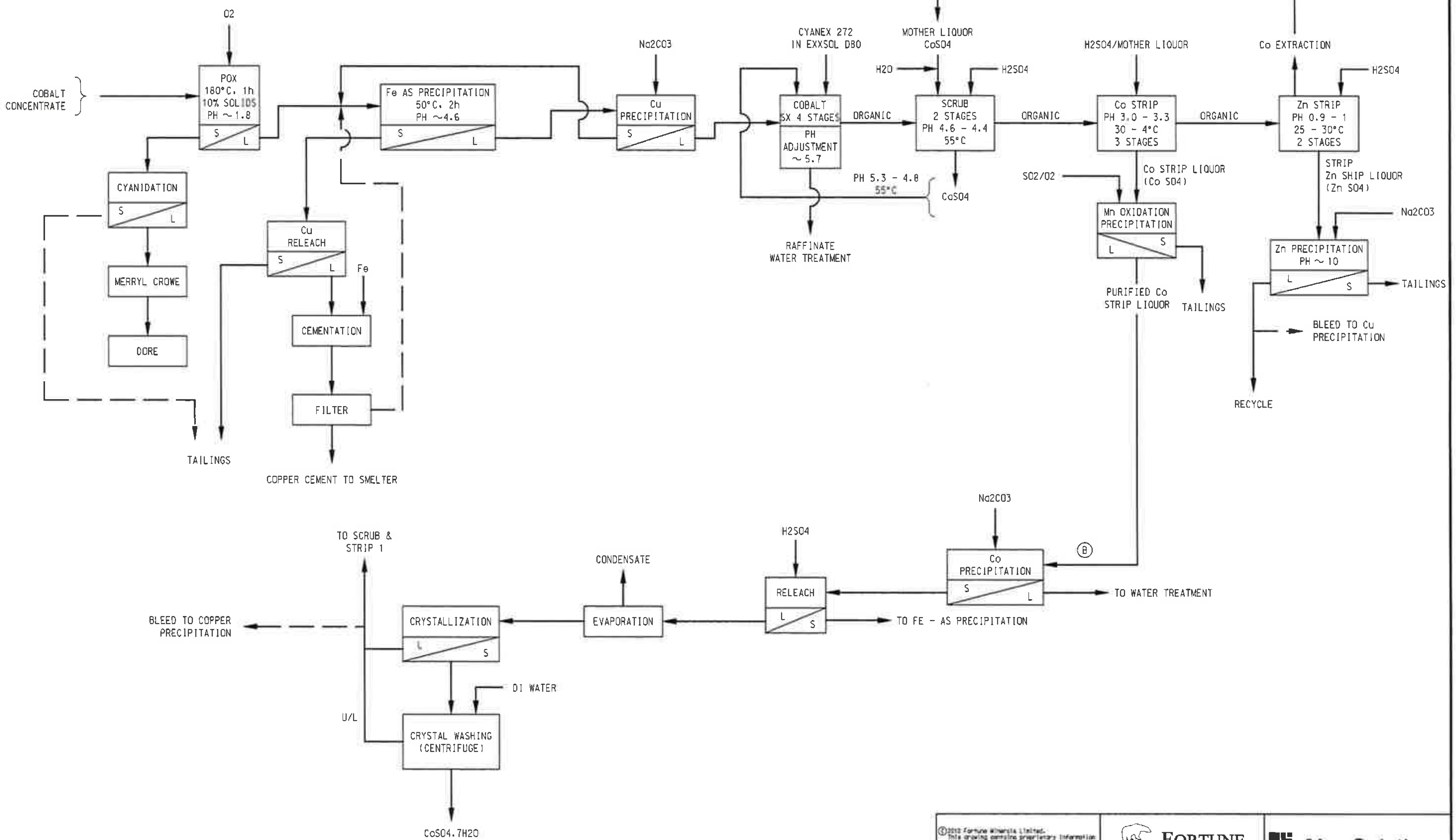
CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: CRYSTALLIZATION BLOCK FLOW DIAGRAM (OPTION A)

SCALE: NONE | PROJ. NO. 183240 | REVISION: B

DRAWING NO: DWG- 4700-B-002



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NO	DESCRIPTION	BY	CHK'D	APPROVED	DATE
A	ISSUED FOR COMMENTS & REVIEW	S.H.	D.U.		27/04/12
B	ISSUED FOR COMMENTS & REVIEW	S.H.	D.U.		13/06/12

PREPARATION	BY	DATE	APPROVALS	BY	DATE
DESIGN	D.U.	22/02/12	PROCESS		
DRAWN	S.H.	22/02/12	ENGINEERING		
CHECKED			PROJECTS		
ACCEPTED			CLIENT		

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CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

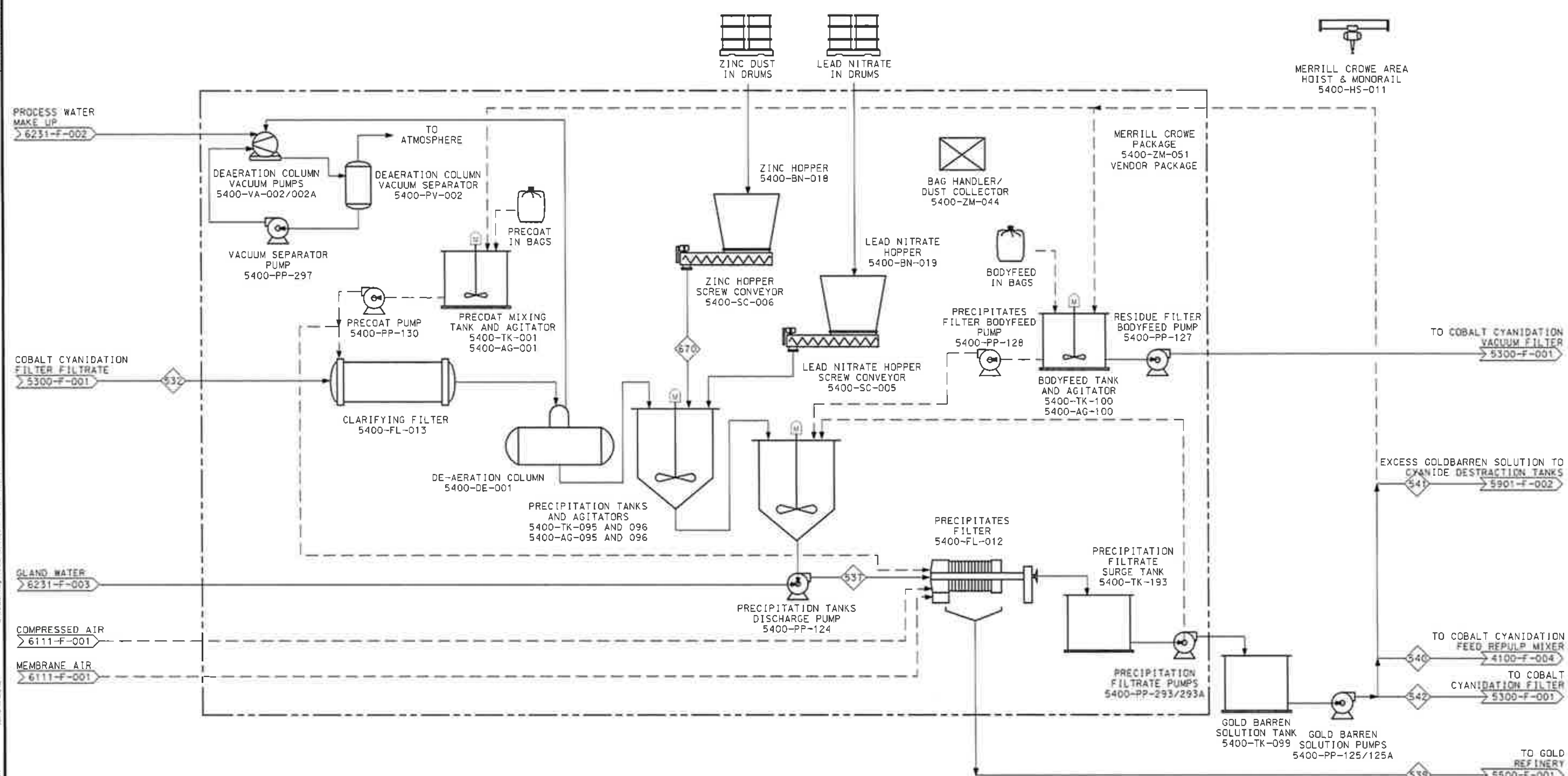
TITLE: CRYSTALLIZATION BLOCK FLOW DIAGRAM (OPTION B)

SCALE: NONE

PROJ. NO. 183240

DRAWING NO. DWG- 4700-B-001

REVISION: B



Stream No.	532	537	539	540	541	542	670
Description	Cobalt Residue Cyanidation Filtrate	Merril Crowe Discharge	Filtered Gold Sludge from Co Gold	Gold Barren Solution to Cyanidation	Excess Gold Barren Solution	Gold Barren Solution to Filter Wash	Zinc Dust
SOLIDS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.00	0.0	0.00
LIQUID FLOWRATE (t/h)	15.8	15.8	0.0	7.6	4.72	3.4	0.00
GAS FLOWRATE (t/h)	0.0	0.0	0.0	0.0	0.00	0.0	0.00
TOTAL VOL. FLOWRATE (m3/h)	15.4	15.5	0.0	7.5	4.63	3.3	0.00
PERCENT SOLIDS (% wt)	0	0	60	0	0	0	75
SOLIDS S.G.	0.0	7.6	7.6	0.0	0.0	0.0	7.1
LIQUID S.G.	1.0	1.0	1.0	1.0	1.0	1.0	1.0
STREAM S.G.	1.0	1.0	2.1	1.0	1.0	1.0	2.8
TEMPERATURE (C)	43.2	43.2	43.2	43.2	43.2	43.2	20.0
INSTANTANEOUS FLOW (m3/h)	15.4	15.5	0.003	7.5	4.63	3.3	0.0018

LEGEND:

- PRIMARY FLOW
- SECONDARY FLOW
- INTERMITTENT FLOW OR ALTERNATE FLOW
- VENDORS PACKAGE

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CURRENT ISSUE FOR: FEED REPORT

CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: MERRILL CROWE PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240

DRAWING NO. DWG- 5400-F-001 | REVISION F

5400-F-001

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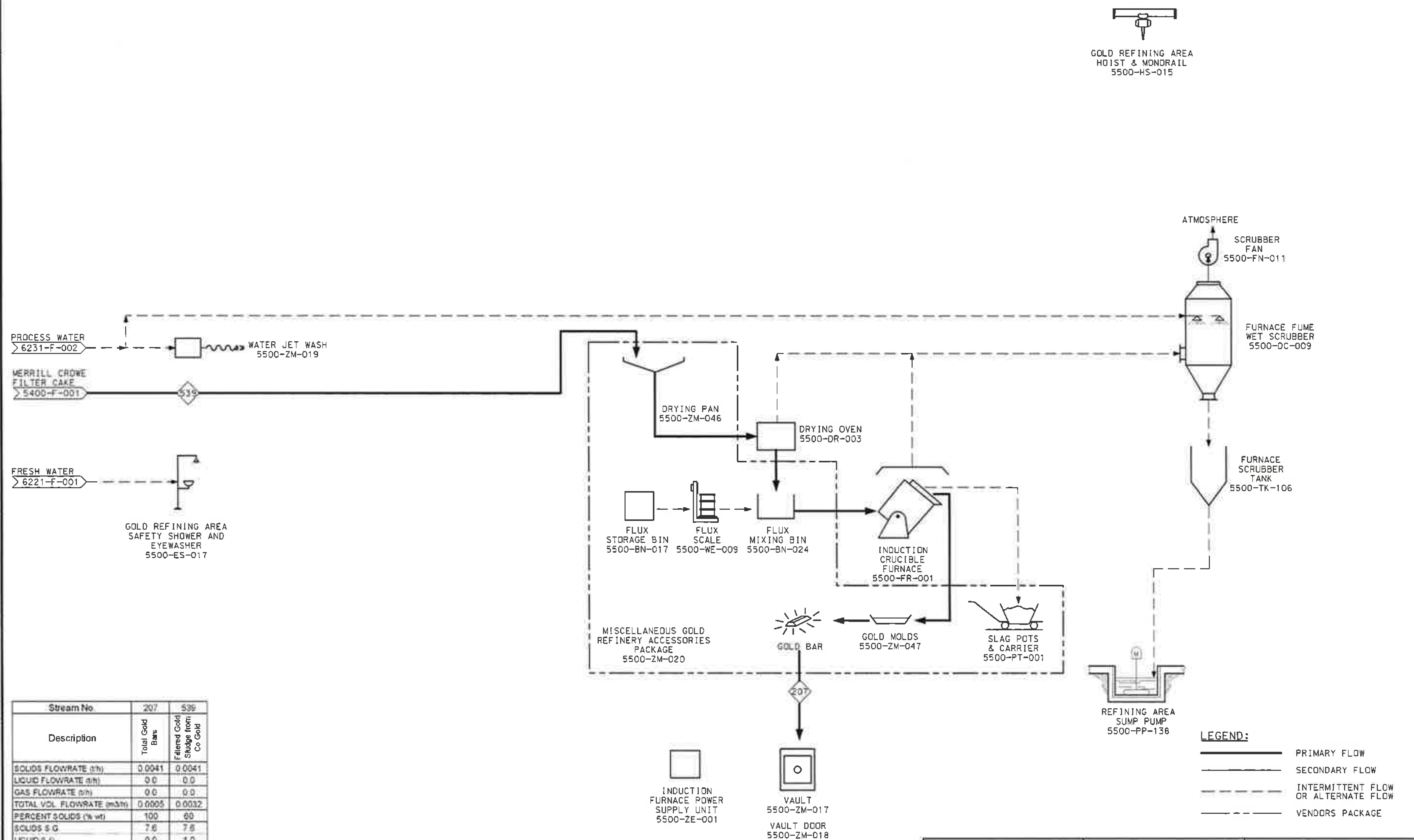

Stream No.	207	539
Description	Total Gold Bars	Filtered Gold Sludge from Co Gold
SOLIDS FLOWRATE (t/h)	0.0041	0.0041
LIQUID FLOWRATE (t/h)	0.0	0.0
GAS FLOWRATE (t/h)	0.0	0.0
TOTAL VOL. FLOWRATE (m3/h)	0.0005	0.0032
PERCENT SOLIDS (% wt)	100	60
SOLIDS S.G.	7.6	7.6
LIQUID S.G.	0.0	1.0
STREAM S.G.	7.6	2.1
TEMPERATURE (C)	43.2	43.2
INSTANTANEOUS FLOW (m3/h)	0.0005	0.003

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CLIENT/PROJECT: FORTUNE MINERALS SMPP PROJECT

TITLE: GOLD REFINING PROCESS FLOW DIAGRAM

SCALE: NONE | PROJ. NO. 183240

DRAWING NO. DWG- 5500-F-001 | REVISION G