



Technical Report Summary

Ontario Operations

Sudbury District

Canada

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1 EXECUTIVE SUMMARY

1.1 INTRODUCTION

This report was prepared as a Technical Report Summary (TRS) in accordance with the Securities and Exchange Commission (SEC) S-K regulations (Title 17, Part 229, Sections 601 and 1300 until 1305) for Vale S.A. (Vale) on Vale Base Metals Limited¹ (Vale Base Metals or VBM) Ontario Operations.

1.2 TERMS OF REFERENCE

The Report was prepared to be attached as an exhibit to support mineral property disclosure, including mineral resource and mineral reserve estimates, for the Ontario Operations in Vale Form 20-F for the year ending 31 December, 2025.

Mineral resources were estimated for selected zones within the Blezard, Coleman, Copper Cliff, Creighton, Ella–Capre, Stobie, Garson, Totten and Nickel Rim South Extension (formerly Victor) deposits.

Mineral reserves were estimated for the Coleman, Copper Cliff, Creighton, Garson, and Totten Mines using underground mining methods and for the Stobie Pit using open pit mining methods.

Unless otherwise indicated, all financial values are reported in real, unescalated, US dollars (US\$). The local currency is the Canadian dollar (C\$). The metric system is used in the Report unless otherwise noted. Mineral resources and mineral reserves are reported using the definitions in Subpart 229.1300 – Disclosure by Registrants Engaged in Mining Operations in Regulation S–K 1300. The Report uses Canadian English.

1.3 PROPERTY DESCRIPTION

The Ontario Operations are primarily located in the Sudbury district of Ontario. Sudbury is about 330 km north–northeast of Toronto. The centroid for the Ontario Operations is approximately N46°29'29.0, W81°04'05.0, being the geographical co-ordinates of the bulk of the estimated mineral reserves and resources.

The Ontario Operations comprise five operating underground mines — Coleman, Creighton, Copper Cliff, Totten and Garson — and the Stobie open-pit operation which supply polymetallic sulphide ore to the Clarabelle Mill concentrator. The mill produces: (i) nickel concentrates, which are processed through the Copper Cliff Smelter and Refinery to produce high-purity nickel pellets and powders and (ii) copper concentrates which are sold directly to the market. Sudbury also has the capability to process third-party ores and concentrates, and the site can also recycle secondary materials through its smelting complex.

Excess nickel oxide from the smelter is refined at Vale Base Metals' Clydach Refinery in Wales. Precious-metal- residues from Sudbury metallurgical circuits are treated at the Port Colborne Refinery and recover cobalt, gold, and platinum group metal (PGM) intermediates (platinum and palladium).

The Ontario Operations also have non-producing properties including: Blezard, Ella-Capre, and Nickel Rim South Extension (formerly Victor); which are in advanced exploration and host mineral resources. In Sudbury, Ontario Operations also own a series of privately owned buildings, roads, railway, hydroelectric dams and transmission lines, besides legacy areas for closure. VCL owns approximately 80,261 ha of patented mining rights in the Sudbury area and approximately 59,742 ha of patented surface rights which includes a combination of approximately 1,369 ha of mining and surface rights co-owned with other parties. Note that Vale S.A. 20-F includes Ontario properties outside the Sudbury area and the scope of this report; the total in the 20-F is 81,145 ha. Sufficient surface rights are held to support the life-of-mine plans (LOMPs).

¹ Vale Base Metals is defined as Vale Base Metals Limited and its majority-owned subsidiaries.

There are no royalties or other similar payments made on the Ontario Operations mine properties within the Sudbury Basin.

At Ontario Operations, VCL holds several agreements with third parties that pertain to roadways, easements, access agreements, and product export. Main agreements include those with Glencore Canada Limited (Glencore) for reciprocity regarding selected mining and mineral processing activities and ventilation, and with Wheaton Precious Metals Corp for gold streaming on a sub-set of properties.

VCL holds OIC permits (see definition in Chapter 3.2.3) that allow it to export nickel, copper, and precious metals products outside of Canada for further refinement. Each permit is granted for a five-year period, and to date, the permits have been renewed as required. The OIC permit for copper expires in April 2027. The nickel and precious metals OIC permit is current until December, 2030. These permits are necessary for Vale Base Metals to further refine its product to sell demanded products. There is a reasonable expectation that the OIC permits can continue to be renewed for the duration of the life-of-mine (LOM).

1.4 OWNERSHIP

The Ontario Operations are owned and operated by Vale Canada Limited, which is part of the Vale Base Metals group. Vale Base Metals is a diversified Base Metals mining company with operations and projects in Canada, Brazil, UK, Indonesia and Japan primarily producing copper, nickel, cobalt, gold, silver and PGEs. Vale Canada is a wholly owned subsidiary of Vale Base Metals Limited. Vale Base Metals Limited is 90% indirectly owned by Vale, and 10% indirectly owned by Manara Minerals Investment Company (Manara Minerals).

1.5 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

The Ontario Operations are located in the Sudbury Basin, within the boundaries of the greater city of Sudbury, which is 330km north–northeast of Toronto. Well developed transportation routes provide access to the Sudbury area. Access to the various mine sites is through a system of numbered municipal roads. The Greater Sudbury Airport is served by regional carrier lines. Sudbury is also served by rail.

The climate of the Sudbury region typically includes snow from November through to April while the summer months tend to be warm and favourable. Mining operations are conducted year-round. Elevations range from 222 to 445 m above sea level with local relief in the order of 30 to 60 m. The topography of the “rim” of the Sudbury Basin consist of relatively rocky hills with intermittent swamps and marshes, covered to varying degrees with mixed forest along the south range of the basin, and predominately coniferous to mixed forests on the north side of the basin. The central part of the Basin is occupied by low-lying flat agricultural land. The dominant vegetation type is temperate boreal forest.

The Ontario Operations are in an area that has more than a hundred years of mining activity. As a result, local and regional infrastructure, and the supply of goods available to support mining operations is well-established. Personnel with experience in mining-related activities are available in the Sudbury district.

1.6 HISTORY

The Ontario Operations have over 100 years of active mining history under various operators, and exploration activities date back to 1856 when nickel was first discovered. Vale obtained its interest in the Ontario Operations in 2006, with a takeover of Inco, formerly the International Nickel Company of Canada, Limited. On 2024 Vale announced the successful completion of its sale of 10% equity stake in Vale Base Metals to Manara Minerals.

1.7 GEOLOGY AND MINERALIZATION

The Sudbury magmatic copper–nickel sulphide deposits are part of the Paleoproterozoic Sudbury Structure which comprises the Sudbury Igneous Complex (SIC) and associated dykes, and the overlying Paleoproterozoic Whitewater Group rocks. Deposits within the SIC are type examples of nickel–copper mineralization arising from a meteorite impact. Major components of the SIC include the differentiated norite–gabbro–granophyre Main Mass and a group of minor intrusions, collectively termed the Sublayer.

Footwall rocks to the Sudbury Structure are Archean gneisses and granitic and mafic igneous rocks to the north and Paleoproterozoic metavolcanic and metasedimentary rocks of the Huronian Supergroup to the south. The Sudbury Structure is exposed as an elliptical ring with a northeast-trending long axis of ~72 km and a short axis of ~27 km.

Nickel–copper–gold–platinum group element (PGE) deposits in the Sudbury Basin are spatially and genetically related to relatively small discontinuous bodies of inclusion-rich material localized either at the contact between the main mass of the SIC and footwall rocks or within radiating and concentric offset dykes cutting footwall rocks. The Sudbury deposits host three principal styles of mineralization:

- **Contact-style**, associated with the sublayer at the base of the SIC. Sulphide mineralization within the Sublayer is generally zoned from massive sulphide at the footwall to disseminated sulphide towards the hanging wall
- **Footwall-style**, proximal to the sublayer, basal SIC. Footwall-style deposits host highly fractionated mineralization compared to the contact-style mineralization. Two sub-types are also identified as massive sulphide-copper deposits and low-sulphide high-PGE deposits.
- **Offset-style**, which consists of sublayer norite and quartz diorite with a variable footwall breccia component occurring as dyke-like structures radial or concentric to the contact of the SIC. Mineralization consists of zones of disseminated blebby and massive nickel–copper–PGE–gold sulphides.

The three mineralization environments can vary, and/or transitional, with many deposits exhibiting characteristics that overlap multiple mineralization styles.

The sulphide mineral assemblage predominantly consists of pyrrhotite, pentlandite, and chalcopyrite, while variable amounts of millerite, cubanite, and bornite are found in particular deposit types (e.g. footwall deposits).

Vale continues to actively explore within the Ontario Operations area, and the majority of deposits remain open at depth.

1.8 EXPLORATION

The primary geophysical exploration methods applied include University of Toronto Electro Magnetometer (UTEM-4), televiwer, radio imaging method (RIM) and down-hole induced polarization (IP). These methods are used to identify areas of sulphide mineralization. The geophysical information is integrated with the drill hole database to improve deposit model interpretations and to act as vectors for exploration drilling.

As of 2025 year-end, Ontario Operations total exploration and drillhole database includes 93,110 core drill holes. A total of 14,666,348m of core has been drilled in Ontario Operations, with a sub-set of 9,573,582m included and supporting the mineral resources and reserves estimates.

Drill holes are spaced at intervals as required by the type of mineralization and the information required (i.e., exploration or resource definition drilling), with the typical spacing being >100 m for exploration and 10–50 m for resource definition drilling. Current underground drill programs for exploration and operations purposes typically use a core size of BQ (36.4 mm diameter). AQTk (35

mm diameter) core has been used historically. Surface exploration drill programs are typically completed using NQ sized core (47.6 mm diameter).

Standardized logging procedures and software are used to record geological and geotechnical information including lithology, description of mineralization and percentage sulphide content, mineralogy, major structures, rock quality designation (RQD) and rock mass rating (RMR). Core recovery is generally good at all deposits.

On surface, global positioning system (GPS) coordinates are used for collar locations, while underground, drill collar locations are measured from survey control points. Depending on the program, down-hole survey instrumentation could include single shot or multi-shot gyroscopic orientation tools. Earlier programs used acid tube tests. Historical boreholes with acid tube test surveys are occasionally resurveyed using a gyroscopic instrument for trajectory verification.

1.9 SAMPLE PREPARATION, ANALYSES, AND SECURITY

All drill core is boxed and secured at the drill site using fibre tape. The core boxes are then transported to both Stobie Geoscience Core Logging Facility or Butler Building for storage, logging and sampling. Both facilities are secured with restricted access and surveillance.

The sampling interval is established by minimum or maximum sampling lengths and geological and/or structural criteria. The minimum sampling length is 15 cm while the maximum is 3 m. The core from underground drilling is typically sampled in its entirety. Surface exploration programs split most mineralized intersections and half of the core is stored, half sent for assay.

Specific gravity (SG) is estimated based on formulae using nickel, copper and sulphur. Where sulphur is not available, a nickel, copper and cobalt formula is used. The estimated SG values are periodically checked by comparing with water immersion SG measurements collected during logging and sampling.

Samples are currently prepared at the ALS Minerals (ALS) facility in Sudbury, Ontario. The ALS analytical facility in Vancouver is the primary analytical laboratory and has been used since 1999. Activation Laboratories Ltd. in Ancaster, Ontario, is currently used as secondary analytical laboratory. Both laboratories are accredited by the Standards Council of Canada.

Each sample is crushed to a minimum of 70% passing 10 mesh, then pulverized to 85% passing 200 mesh.

Analytical methods have varied over time. Currently, analytical methods requested by Vale Base Metals include copper, nickel, cobalt, iron, sulphur, arsenic, lead, and zinc using a sodium peroxide fusion with an ICP-AES finish; lime, magnesia and silica could also be requested by the same method; PGE via lead collection fire assay fusion/ICP-AES finish; and arsenic and lead using an aqua regia digestion followed by an ICP-AES finish.

During Inco operating period (prior 2006) a multi-element X-ray fusion (XRF) method for copper, nickel, cobalt, iron, sulphur and arsenic; fire assay with silver bead being arced on an ARL spark emission spectrometer, direct current plasma and inductively-coupled plasma (ICP) analysis for gold, platinum and palladium, and occasionally for rhodium and silver; a base metal suite using Na_2O_2 fusion followed by ICP analysis; and PGE via fire assay/ICP- atomic emission spectroscopy (AES).

The quality assurance and quality control (QA/QC) protocol includes in-house and certified standard reference materials, coarse preparation blanks, coarse reject duplicates, and check assay programs. QA/QC data are validated on a monthly basis. In addition to these steps the sample preparation laboratory and assay laboratories are audited every year and two to three years, respectively

The sample preparation, analysis, quality control, and security procedures used by the Ontario Operations have changed over time to meet evolving industry practices. Practices at the time the information was collected were industry-standard, and frequently were industry-leading practices. The Qualified Person is of the opinion that the sample preparation, analysis, quality control, and

security procedures are sufficient to provide reliable data to support estimation of mineral resources and mineral reserves.

1.10 DATA VERIFICATION

Vale Base Metals had data collection procedures in place that included several verification steps designed to ensure database integrity. Vale Base Metals staff also conducted regular logging, sampling, laboratory, and database reviews. In addition to these internal checks Vale Base Metals contracted independent consultants to perform laboratory, database, and mine study reviews. The process of active database quality control and internal and external audits generally resulted in high-quality data.

Vale Base Metals currently uses a system of “layered responsibility” to ensure that only appropriately verified data are used for estimation purposes. The concept of a system of “layered responsibility” is that individuals at each level within the organization assume responsibility, through a sign-off or certification process, for the work relating to preparation of mineral resource and mineral reserve estimates that they are most actively involved in.

Vale Base Metals and its predecessor companies commissioned a number of audits and third-party reviews of block models, mineral resources and mineral reserves.

1.11 METALLURGICAL TESTWORK

The mineralogy and metallurgical performance of the sulphide deposits at the Ontario Operations are generally well understood due to the extensive drill hole coverage, mill performance records and mineralogical and metallurgical studies conducted over the operational history.

The anticipated metal recoveries at the Clarabelle Mill are based on an empirical mill process model that uses ore attributes (nickel to pyrrhotite ratio, nickel grade, etc.) which were developed internally by Vale Base Metals staff. The model contains assumptions as to the behaviour of typical ores based on grade and pyrrhotite content. Maximum allowable recovery values are set for higher-grade ores that are known to exceed the model forecast recoveries.

Tests were performed on samples are considered to be representative for the different orebodies/zones and the mineralogy of the various orebodies and zones.

The deleterious elements for smelting are arsenic, lead, zinc, and chromium. With these typical deleterious element concentrations, the mill concentrate feed (nickel concentrate currently) for the smelter routinely meets smelter specifications.

1.12 MINERAL RESOURCE ESTIMATES

1.12.1 ESTIMATION METHODOLOGY

Mineral resources were estimated for selected zones within the Blezard, Coleman, Copper Cliff, Creighton, Ella–Capre, Stobie, Garson, Totten and Nickel Rim South Extension (NRSE) deposits.

Resource estimation follows a similar procedure for all sites in the Ontario Operations. Vale Base Metals has a set of protocols, internal controls, and guidelines in place to support the estimation process. All mineralogical information, exploration boreholes and background information were provided to the estimators by the geological staff at the mines or by exploration staff. Geological modeling and mineral domain interpretation, as well as grade estimation, were completed using commercially available packages (Datamine and Leapfrog).

Estimation and interpolation methods varied by deposit with ordinary kriging (OK) used as primary estimator. Typically, alternate grade interpolations including nearest neighbor (NN) and inverse weighted distance (IDW) were performed for use in model validation to assess reasonableness of the OK estimates. Interpolation was typically performed in four passes. Search neighborhoods were based on variography, mineralization geometry, or on selected drill spacings. Minimum and maximum numbers of informing samples varied by deposit, as did the number of samples allowed to be used from a single drill hole. Unfolding and dynamic anisotropy was used as required to allow

for a localized change in the strike, dip, and plunge orientation of the Mineralization. All block models were flagged to account for mining depletion.

Mineral resource confidence classifications were assigned based on a combination of factors, including geological understanding and confidence, drill hole support, grade estimation confidence relative to planned production rates, and identified risk factors. The assignments were reviewed to assess the impacts of factors such as metallurgical recoveries, geomechanical studies, mine design work, and representative mineability and recovery reconciliation analysis. Where mining has occurred or is currently active, the mined-out volumes were wireframed, classified as either void or fill, and overprinted upon the resource model to account for mining depletion.

For each mineral resource estimate, an initial assessment was undertaken that evaluated likely infrastructure, mining, and process plant requirements; mining methods; process recoveries and throughputs; environmental, permitting, and social considerations relating to mining and processing methods; waste disposal; and technical and economic considerations in support of an assessment of reasonable prospects of economic extraction. All material is assumed to be blended at the Clarabelle Mill, and milling throughput rates will depend on the blending strategy in place at the mill at the time the material is processed.

Commodity prices used in mineral resource estimation are based on long-term analyst and bank forecasts. The forecast prices may vary locally by the individual mines and deposits to reflect the time at which the mineral resources are updated. All forecast commodity prices are expressed in un-escalated real US dollars. This approach is considered reasonable for support of mineral resource estimates, as it is in line with common industry practice.

The mineral resources are reported at varying cut-off values, which are based primarily on the mining method. Process and G&A costs assumed that material will be sent to, and blended at, the Clarabelle Mill.

1.12.2 MINERAL RESOURCE STATEMENT

Mineral resources current as at 31 December, 2025, are reported using the mineral resource definitions set out in S-K 1300, and are reported exclusive of those mineral resources converted to mineral reserves. The reference point for the estimate is in-situ.

Mineral resources are presented both on a 100% basis, based on Vale Base Metals' view, and on a 90% basis, considering only the ownership attributable to Vale, the registrant.

The measured and indicated mineral resource estimates for the Ontario Operations are provided in Table 1-1. The inferred mineral resource estimates are included in Table 1-2. The Qualified Person for the estimate is Mr. Henrique Vigario, MAusIMM, a Vale Base Metals employee.

Table 1-1: Ontario Operations – Measured and Indicated Mineral Resource Statement

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Blezard	Measured		—	—	—	—	—	—	—
	Indicated		7,887	0.68	0.99	0.04	0.26	0.27	0.08
	Sub-total Measured + Indicated		7,887	0.68	0.99	0.04	0.26	0.27	0.08
Coleman	Measured		1,103	1.37	1.23	0.03	0.89	1.13	0.29
	Indicated		762	0.88	1.91	0.05	0.25	0.24	0.04

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
	Sub-total Measured + Indicated		1,865	1.17	1.51	0.04	0.63	0.76	0.19
Copper Cliff	Measured		617	0.78	1.09	0.04	0.56	0.70	0.20
	Indicated		4,572	1.07	1.28	0.04	1.12	1.67	0.39
	Sub-total Measured + Indicated		5,189	1.04	1.26	0.04	1.05	1.55	0.37
Creighton	Measured		1,597	0.80	1.10	0.03	0.85	1.23	0.21
	Indicated		4,416	0.90	1.17	0.04	0.40	0.39	0.12
	Sub-total Measured + Indicated		6,013	0.88	1.15	0.03	0.52	0.62	0.14
Garson	Measured		2,208	0.89	1.47	0.05	0.44	0.25	0.12
	Indicated		4,546	1.07	1.01	0.04	0.66	0.89	0.27
	Sub-total Measured + Indicated		6,754	1.02	1.16	0.05	0.59	0.68	0.22
Copper Cliff Pit	Measured		9,250	0.48	0.95	0.05	0.13	0.20	0.04
	Indicated		3,329	0.56	1.05	0.05	0.14	0.20	0.03
	Sub-total Measured + Indicated		12,579	0.50	0.98	0.05	0.13	0.20	0.04
Stobie Pit	Measured		446	0.40	0.44	0.02	0.16	0.19	0.07
	Indicated		4	0.28	0.43	0.02	0.09	0.09	0.04
	Sub-total Measured + Indicated		450	0.39	0.44	0.02	0.16	0.19	0.07
Totten	Measured		868	1.02	0.86	0.02	0.86	0.79	0.31
	Indicated		421	1.61	0.74	0.02	1.31	1.13	0.43
	Sub-total Measured + Indicated		1,289	1.21	0.82	0.02	1.01	0.90	0.34
Nickel Rim South Extension	Measured		—	—	—	—	—	—	—
	Indicated		14,919	4.09	1.70	0.03	1.38	1.69	0.55
	Sub-total Measured + Indicated		14,919	4.09	1.70	0.03	1.38	1.69	0.55
	Measured		16,091	0.67	1.04	0.04	0.35	0.42	0.10

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Total Ontario Operations Vale Base Metals	Indicated		40,857	2.04	1.33	0.04	0.83	1.03	0.31
	Total Measured + Indicated	100%	56,947	1.65	1.24	0.04	0.69	0.86	0.25
Vale S.A. Equity Interest									
Total Ontario Operations Vale S.A. ⁸ .	Measured		14,482	0.67	1.04	0.04	0.35	0.42	0.10
	Indicated		36,771	2.04	1.33	0.04	0.83	1.03	0.31
	Total Measured + Indicated	90%	51,253	1.65	1.24	0.04	0.69	0.86	0.25

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
Bleazard	Measured		—	—	—	—	—	—
	Indicated		54	78	3	67	68	21
	Sub-total Measured + Indicated		54	78	3	67	68	21
Coleman	Measured		15	14	0	31	40	10
	Indicated		7	15	0	6	6	1
	Sub-total Measured + Indicated		22	28	1	38	46	11
Copper Cliff	Measured		5	7	0	11	14	4
	Indicated		49	59	2	165	245	58
	Sub-total Measured + Indicated		54	65	2	176	259	62
Creighton	Measured		13	18	0	44	63	11
	Indicated		40	52	2	57	56	16
	Sub-total Measured + Indicated		53	69	2	100	119	27
Garson	Measured		20	32	1	31	18	8
	Indicated		49	46	2	96	130	39
	Sub-total Measured + Indicated		69	79	3	127	148	47
Copper Cliff Pit	Measured		44	88	4	39	58	11
	Indicated		19	35	2	15	22	4

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
	Sub-total Measured + Indicated		63	123	6	54	80	15
Stobie Pit	Measured		2	2	0	2	3	1
	Indicated		0	0	0	0	0	0
	Sub-total Measured + Indicated		2	2	0	2	3	1
Totten	Measured		9	7	0	24	22	9
	Indicated		7	3	0	18	15	6
	Sub-total Measured + Indicated		16	11	0	42	37	14
Nickel Rim South Extension	Measured		—	—	—	—	—	—
	Indicated		610	254	4	662	812	266
	Sub-total Measured + Indicated		610	254	4	662	812	266
Total Ontario Operations Vale Base Metals	Measured		108	168	7	182	217	54
	Indicated		834	541	15	1,085	1,354	410
	Total Measured + Indicated	100%	941	709	22	1,267	1,571	464
Vale S.A. Equity Interest								
Total Ontario Operations Vale S.A. ⁸ .	Measured		97	151	6	164	196	48
	Indicated		750	487	13	977	1,218	369
	Total Measured + Indicated	90%	847	638	20	1,141	1,414	418

Table 1-2: Ontario Operations – Inferred Mineral Resource Statement

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Bleazard	Inferred		—	—	—	—	—	—	—
Coleman	Inferred		5,339	0.8	0.4	0.01	1.3	2.1	0.7
Copper Cliff	Inferred		41,684	0.9	0.8	0.03	0.7	0.8	0.3
Creighton	Inferred		13,890	1.1	1.4	0.04	0.5	0.7	0.2
Ella–Capre	Inferred		14,104	1.1	0.7	0.02	1.0	1.2	0.3
Garson	Inferred		4,226	0.9	1.1	0.04	0.5	0.3	0.2
Copper Cliff Pit	Inferred		287	0.6	1.1	0.06	0.2	0.2	0.1
Stobie Pit	Inferred		—	—	—	—	—	—	—
Totten	Inferred		1,040	1.5	0.7	0.02	2.1	1.1	0.6
Nickel Rim South Extension	Inferred		877	2.4	1.0	0.02	0.4	0.6	0.3

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Total Ontario Operations Vale Base Metals	Inferred	100%	81,449	1.0	0.9	0.03	0.8	0.9	0.3
Vale S.A. Equity Interest									
Total Ontario Operations Vale S.A.⁸	Inferred	90%	73,304	1.0	0.9	0.03	0.8	0.9	0.3

Operations/Deposit	Category	Ownership	Metal						
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)	
Bleazard	Inferred		—	—	—	—	—	—	
Coleman	Inferred		44	24	1	222	357	119	
Copper Cliff	Inferred		371	352	12	961	1,132	401	
Creighton	Inferred		148	195	5	236	315	74	
Ella–Capre	Inferred		157	100	3	443	561	134	
Garson	Inferred		36	45	2	72	44	24	
Copper Cliff Pit	Inferred		2	3	1	1	2	0	
Stobie Pit	Inferred		—	—	—	—	—	—	
Totten	Inferred		16	8	0	69	36	18	
Nickel Rim South Extension	Inferred		21	8	0	11	16	7	
Total Ontario Operations Vale Base Metals	Inferred	100%	794	735	23	2,015	2,463	778	
Vale S.A. Equity Interest									
Total Ontario Operations Vale S.A.⁸	Inferred	90%	715	661	21	1,814	2,216	700	

Notes to accompany mineral resources tables:

1. The mineral resource estimate has been prepared using industry accepted practice and complies to the disclosure requirements of S-K1300.
2. The reference point for the mineral resource estimate is in situ.
3. Mineral resources for Vale Base Metals (VBM) are reported on a 100% basis. Vale owns a 90% interest and Manara Minerals the remaining 10% interest
4. The estimate is current as at 31 December, 2025. The Qualified Person for the estimate is Mr. Henrique Vigario, MAusIMM, a Vale Base Metals employee.
5. Mineral resources are reported exclusive of those mineral resources converted to mineral reserves. Mineral resources that are not mineral reserves have not demonstrated economic viability.
6. The estimate uses the following key input parameters: open pit mining methods or underground bulk stoping or narrow vein cut-and-fill mining methods; copper sale price of US\$6,100–9,500/t, nickel sale price of US\$13,376–20,822/t, cobalt sale price of US\$45,000–56,300/t, platinum sale price of US\$1,124–1,350/oz, palladium sale price of US\$925–1,450/oz, gold sale price of US\$1,000–1,950/oz; variable copper recovery by deposit and zone ranging from 91-97% for milling and average 93% for smelter/refinery, variable nickel recovery ranging from 71-89% for milling and average 95% for smelter/refinery; underground mine operating costs ranging from US\$50-180/t mined, open pit mine operating cost US\$13/t mined, process costs ranging from US\$6-27/t milled and US\$78-292/t concentrate. Pricing data are shown as ranges, due to the variability in specific deposit requirements and timing of the associated estimate. Cut-offs used in estimation vary by deposit, ranging from US\$70-182/t for underground mining and US\$33/t for open pit mining. Nickel Rim South Extension mineral resources reported only consider the portion of the project within Vale Base Metals' mineral rights
7. Numbers have been rounded.
8. Ontario mineral resources, reflecting Vale's 90% ownership interest, the registrant, as required by item 1303(B)(3)(iii) of Regulation S-K.

Factors that may affect the mineral resource estimate include: changes to long-term metal price and exchange rate assumptions; changes to geological and grade shape, and geological and grade continuity assumptions; changes to metallurgical recovery assumptions; changes to the input assumptions used to derive the potentially-mineable shapes; changes to the forecast dilution and mining recovery assumptions; changes to the cut-off values applied to the estimates; variations in geotechnical, hydrogeological and mining method assumptions; and changes to environmental, permitting and social license assumptions.

1.13 MINERAL RESERVE ESTIMATES

1.13.1 ESTIMATION METHODOLOGY

Mineral reserves in the Ontario Operations area are estimated for the underground operations of Coleman, Copper Cliff, Creighton, Garson and Totten, and for the open pit operation of Stobie. Only Proven and Probable reserves were used to support the economic analysis.

Mining plans and engineering studies were completed for all mineral reserve estimates. All engineering studies were at a minimum prefeasibility-level studies.

Vale Base Metals uses analyst and bank forecasts when considering long-term commodity price forecasts. The forecast prices may vary locally by the individual mines and deposits to reflect the time at which the mine plans are updated, cash flows are conducted, and the local cut-off grade employed to suit each individual operation based on hoisting capacity, mining method, and geotechnical considerations. The estimated timeframe used for the price forecasts is the 21-year LOM that supports the mineral reserve estimates. All forecast commodity prices are expressed in un-escalated real US dollars.

All run of mine from the Ontario Operations is processed as a blended product at Clarabelle Mill. The mill generates a copper concentrate which is sold to market and a nickel concentrate which is further processed at Vale Base Metals smelting and refining facilities.

Only measured and indicated mineral resources were converted to proven and probable mineral reserves.

1.13.1.1 UNDERGROUND RESERVES

The Ontario Operations currently have a total of five major operating underground mines. Except for Totten, which has a 12-year mining history, the mines have been in operation for decades and, consequently, there is significant history and data available on the geological setting, mining methods, mining conditions, mining recoveries and dilution, production capacity and mining costs. These historical data are used extensively in the mineral reserve estimation process.

The mining methods used in the Ontario Operations include a combination, and variations, of bulk stoping and cut-and-fill approaches.

Cut-off grades at Ontario Operations are determined using a Net Processing Return (NPR) approach. Because mineralization contains multiple payable metals with different prices and recoveries, each block is assigned an NPR value based on long-term metal price and exchange rate assumptions, net of processing and applicable site costs. Material is classified as ore when the NPR value exceeds the mining operating cash cost per short ton; otherwise, it is treated as waste.

Stopes were created using Stope Optimizer commercially available software at the required stope height, length and cut-off criteria based on the mine area. There can be considerable variation in stope sizing from mine to mine and within each mine, depending on geology, geometry, logistical and geotechnical considerations, and historical data. Stopes can range from about 4,500 to >50,000 t.

Dilution and mining recovery for each stope are estimated after consideration of the planned mining method and stope design and are applied as a modifying factor in the form of a percentage allowance of the in-situ estimated tonnage of the stope.

The throughput rate for each mine is based on a detailed mining plan that includes consideration of current and planned mining methods, geotechnical constraints and risks, materials handling system, mining equipment fleet, labour resourcing, infrastructure such as power supply and reticulation, dewatering, backfilling, and ventilation. Life-of-mine plans, as well as more detailed five-year plans, are developed for each mine.

Mine plans are adjusted by mine planners to minimize the risk of ground failures and seismicity through the establishment of an optimal mining block size and shape, and mine sequencing. All of the underground mines are relatively dry, with only small groundwater inflows.

1.13.1.2 OPEN PIT RESERVES

Stobie Pit, now in production, is the only open-pit reserves declared for Ontario Operations. The Stobie Pit is an expansion of mining the historical open pit on site and will extract the mineral reserve between the surface and the remnants of underground mine below, which is no longer in operation. The optimization work involved pit-shells analysis with Lerchs-Grossman (LG) algorithm available in standard software packages applying net smelter return (NSR) as grade descriptor and geomechanical constraints.

An operational schedule was developed in order to determine the optimal pit shell for each deposit; schedule inputs include the minimum mining width, and vertical rate of advance, mining rate and mining sequence. A marginal cut-off grade of US\$33/t for the Stobie Pit was used as the discriminator between ore and waste at the pit rim in design and schedules.

A dilution rate of 8% was selected for the Stobie Pit based on hanging wall and footwall contact with the orebody in the block model. Additional dilution for contacts between the underground workings and ore body was not added to avoid double counting because this dilution rate is already built into the block model. The assumed mining recovery for the Stobie Pit was 95%.

1.13.2 MINERAL RESERVE STATEMENT

Mineral reserves were classified and reported using the mineral reserve definitions set out in S-K 1300. The reference point for the mineral reserve estimate is the tonnage and grades at point of delivery to the process plant (Clarabelle Mill).

Mineral reserves are presented both on a 100% basis, based on Vale Base Metals' view, and on a 90% basis, considering only the ownership attributable to Vale, the registrant.

Mineral reserves that are reported in Table 1-3 are current as at 31 December, 2025. The Qualified Person for the estimate is Mr. Jody Todd, FAusIMM, a Vale Base Metals employee.

Table 1-3: Ontario Operations – Proven and Probable Mineral Reserve Statement

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Coleman	Proven		6,932	1.95	0.78	0.02	1.70	2.10	0.80
	Probable		1,771	2.99	0.59	0.01	1.25	2.10	0.71
	Sub-total Proven + Probable		8,703	2.16	0.74	0.02	1.61	2.10	0.79
Copper Cliff	Proven		7,981	1.4	1.02	0.03	1.29	1.04	0.51
	Probable		23,353	1.19	1.14	0.03	1.12	1.55	0.40
	Sub-total Proven + Probable		31,334	1.25	1.11	0.03	1.16	1.42	0.43

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Creighton	Proven		7,115	2.55	2.78	0.05	0.93	1.06	0.30
	Probable		11,222	1.79	2.36	0.05	0.68	0.75	0.20
	Sub-total Proven + Probable		18,338	2.09	2.52	0.05	0.78	0.87	0.24
Garson	Proven		2,480	1.23	1.43	0.04	0.54	0.33	0.20
	Probable		1,393	1.11	1.16	0.04	0.50	0.32	0.17
	Sub-total Proven + Probable		3,873	1.19	1.33	0.04	0.53	0.32	0.19
Stobie Pit	Proven		740	0.37	0.41	0.02	0.17	0.17	0.07
	Probable		2,874	0.39	0.43	0.02	0.17	0.18	0.07
	Sub-total Proven + Probable		3,614	0.39	0.43	0.02	0.17	0.17	0.07
Totten	Proven		3,699	1.39	1.10	0.03	1.36	0.76	0.44
	Probable		857	1.23	0.58	0.01	1.47	0.97	0.48
	Sub-total Proven + Probable		4,556	1.36	1.00	0.02	1.38	0.80	0.45
Total Ontario Operations Vale Base Metals	Proven		28,948	1.77	1.42	0.03	1.21	1.18	0.48
	Probable		41,471	1.37	1.39	0.04	0.93	1.21	0.33
	Sub-total Proven + Probable	100%	70,419	1.54	1.40	0.03	1.04	1.20	0.39
Vale S.A. Equity Interest									
Total Ontario Operations Vale S.A. ⁶	Proven		26,053	1.77	1.42	0.03	1.21	1.18	0.48
	Probable		37,324	1.37	1.39	0.04	0.93	1.21	0.33
	Sub-total Proven + Probable	90%	63,377	1.54	1.40	0.03	1.04	1.20	0.39

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
Coleman	Proven		135	54	1	378	468	179
	Probable		53	10	0	71	120	41
	Sub-total Proven + Probable		188	64	1	450	588	220
Copper Cliff	Proven		112	81	2	330	267	132
	Probable		279	267	7	839	1,166	298
	Sub-total		391	348	10	1,169	1,432	430

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
	Proven + Probable							
Creighton	Proven		182	198	4	213	242	69
	Probable		201	265	6	245	270	72
	Sub-total Proven + Probable		383	462	10	458	512	141
Garson	Proven		30	35	1	43	26	16
	Probable		16	16	1	22	14	7
	Sub-total Proven + Probable		46	52	2	66	40	23
Stobie Pit	Proven		3	3	0	4	4	2
	Probable		11	12	1	16	16	7
	Sub-total Proven + Probable		14	15	1	20	20	8
Totten	Proven		51	41	1	161	90	53
	Probable		11	5	0	40	27	13
	Sub-total Proven + Probable		62	46	1	202	117	66
Total Ontario Operations Vale Base Metals	Proven		513	412	9	1,130	1,097	450
	Probable		570	575	15	1,233	1,613	438
	Sub-total Proven + Probable	100%	1,083	988	24	2,363	2,710	888
Vale S.A. Equity Interest								
Total Ontario Operations Vale S.A.⁶	Proven		462	371	8	1,017	987	405
	Probable		513	518	13	1,110	1,451	394
	Sub-total Proven + Probable	90%	975	889	22	2,127	2,439	799

Notes to accompany mineral reserves table:

1. Mineral reserves are reported using the mineral reserve definitions set out in S-K 1300. The reference point for the mineral reserve estimate is the point of delivery to the process plant.
2. Mineral reserves for Vale Base Metals (VBM) are reported on a 100% basis. Vale owns a 90% interest and Manara Minerals the remaining 10% interest
3. The estimate is current as at December 31, 2025. The Qualified Person for the estimate is Jody Todd, FAusIMM, a Vale Base Metals employee.
4. The estimates use the following key input parameters: open pit, bulk stoping or narrow vein cut-and-fill mining methods; copper sale price of US\$6,100–7,500/t, nickel sale price of US\$13,376–18,800/t, cobalt sale price of US\$45,000–50,000/t, platinum sale price of US\$1,200–1,225/oz, palladium sale price of US\$925–1,400/oz, gold sale price of US\$1,300–1,450/oz; variable copper recoveries ranging from 91-97% for mill and average 93% for smelter/refinery, variable nickel recoveries ranging from 71–89% for mill and average 95% for smelter/refinery; mine operating costs ranging from US\$50-168/t mined for underground and US\$12/t mined for open pit; mill costs ranging from US\$6-27/t milled; smelter/refinery operating cost of US\$78-292/t concentrate; mining recovery ranging from 70–100%, and unplanned dilution ranging from 0–33%. Costs, metallurgical recovery, and pricing data are shown as ranges, due to the variability in specific deposit requirements and timing of the associated estimate.
5. Numbers have been rounded.

6. Ontario mineral reserves, reflecting Vale's 90% ownership interest, the registrant, as required by item 1303(B)(3)(iii) of Regulation S-K.

Factors that may affect the mineral reserves estimate include: long-term commodity price and exchange rate assumptions; long-term consumables price assumptions; changes to mineral resources input parameters; changes to constraining stope designs; changes to cut-off grade and NPR assumptions; changes to geotechnical and hydrogeological factors; changes to metallurgical and mining recovery assumptions; the ability to control unplanned dilution; and assumptions as to the continued ability to access the site, retain mineral and surface rights titles, maintain environment and other regulatory permits, and maintain the social license to operate.

1.14 MINING METHODS

The most common underground mining method at Ontario Operations is variations of conventional bulk stoping and mechanized cut-and-fill mining methods, selected based on the geological and geotechnical setting of each mine. All underground mines are owner-operated and use standard mining equipment.

The ore and waste handling system varies at each mine. Ore can be transported using load-haul-dump vehicles to a central loading area or ore pass, and then trucked to an underground crusher, from where it is hoisted to surface; or, if the mine has decline access, it is trucked to surface. Most of the waste rock is used underground as fill, although some hoisting of waste rock can occur.

All underground operations uses either sand or mill rock tailings as hydraulic backfill. High-density (paste) backfill is also used at Garson Mine.

For each domain, ground support designs are specified that consider geotechnical conditions, excavation service life and geometry, proximity to present and future openings, personnel exposure, local historical experiences, and local regulations. Geotechnical recommendations for vertical development, lateral development, and mining stopes, are provided. Legacy workings and drill holes are reviewed in alignment with mine plans to ensure associated hazards are effectively mitigated.

Conventional open pit mining is carried out specifically at Stobie Pit. The Stobie Pit is operated by Thiess under a lease agreement with Vale Base Metals. The open-pit mining cycle includes drilling and blasting of ore and waste, ore loading and hauling to the process plant for processing or to stockpiles for process plant feed later in the mine life, and waste rock loading and hauling to a designated waste rock storage facility.

Each mine has a production schedule that incorporates production and cost information for each producing area within the mine, based on mineral reserve estimates. Production schedules were limited by process and infrastructure constraints such as ventilation, drift development, materials handling, backfilling, and muck circuit/storage. The assemblage process activities were used to derive costs based on a combination of historical and budgeted rates. These plans were collated into an overall production schedule for the Ontario Operations. Based on this schedule, the forecast mine life is 21 years.

Five of the mining operations are classified as seismically active. While those operations have a Seismic Management Plan in place, designed to identify, assess and manage seismic hazards, there remains potential for unexpected seismic disturbance. Seismic events have the potential to change geotechnical and hydrological assumptions, sterilize portions of the mine plan, result in an increase in capital costs to repair damaged equipment and infrastructure, increase operating costs due to mitigation measures, and impact the economic analysis that supports the mineral reserve estimates

1.15 RECOVERY METHODS

The process plant design was based on a combination of metallurgical testwork and familiarity gained during historical processing.

Clarabelle Mill was originally built in 1971 and subsequently underwent several major modifications. The current yearly throughput based on SAG-only operation is approximately 5.5 Mt. In 2026, the crushing plant and rod mill circuit will be brought back online with a target production of 6.2 Mt.

At the concentrator, the ore is received from multiple sources including Vale Base Metals owned mines and external feed; then crushed and ground and fed to the froth-flotation cells. The multi-staged froth flotation separates the sulphide minerals into a nickel concentrate and a copper concentrate. The tailings are separated into two distinct streams (rock tails and pyrrhotite tails) and are disposed of in their respective tailings ponds or used for backfill at the Creighton and Copper Cliff Mines. The nickel concentrate typically averages 14% Ni and 3% Cu. The copper concentrate typically averages 31.6% Cu and 0.5% Ni. Over the Life-of-Mine, the expected range metallurgical recovery at Clarabelle Mill is 91.3-97.3% for copper and 71.3-88.9% for nickel. The combined smelter and Refinery average recovery over the Life-of-Mine is 92.8% for copper and 94.6% for nickel.

The copper concentrate is filtered and shipped to market buyers. The nickel–copper bulk concentrate is dewatered at the Vale Base Metals Copper Cliff Smelter and upgraded to Bessemer matte by processing through fluid-bed roasters, electric furnaces, and Pierce–Smith converters. The magnetic metallics (containing nickel, copper, and precious metals) are sent to the Vale Base Metals Copper Cliff Nickel Refinery (CCNR). The nickel sulphides are roasted in a fluid-bed roaster to produce nickel oxides which are then sent to CCNR, or to the Vale Base Metals Clydach Refinery in Wales. The current annual capacity of the Copper Cliff Smelter is 792,000 dry smelter charge tonnes. The Clydach Refinery annual capacity is 44,125 nickel tonnes.

The CCNR complex includes three areas: nickel refinery converter (NRC), Inco pressure carbonyl (IPC) and electrowinning (EW). Nickel sulphides and oxides from the smelter complex and other feeds are blended and fed to top blown rotary converters, which produce a high-grade nickel matte. This matte is granulated and fed into one of three carbonylation reactors in the IPC area, where nickel and trace iron are extracted by reaction with carbon monoxide. The mixture is separated into a pure nickel carbonyl stream and an iron/nickel carbonyl stream. Material from both streams is decomposed at high temperature to produce pure nickel pellets, pure nickel powders and ferro-nickel pellets, which are sold directly to market. The residue left in the reactor, high in copper, cobalt, and precious metals, is ground and pumped to the EW plant as a slurry. The Copper Cliff Nickel Refinery annual capacity is 65,000 nickel tonnes and 9,000 copper cathode tonnes from electrowinning.

In the EW process, copper is removed from IPC residue. Copper cathodes are plated from solution and sold to market. Three other products are made at the EW stage: a nickel–cobalt carbonate slurry, a slurry-rich in precious metals containing platinum-group metals, silver and gold and a slurry enriched in platinum-group metals and selenium–tellurium. These are sent to the Vale Base Metals Port Colborne Refinery for further processing. The Port Colborne Refinery annual capacity is 1,500 tonnes of cobalt rounds. The process also produces gold, silver, and platinum group metal concentrate products for external customers. In addition, tellurium dioxide, selenium, bismuth, and lead carbonate are produced as by-products that are sold to market.

The processing facilities receive feed from both Vale Base Metals Ontario Operations sources and external feed.

1.16 INFRASTRUCTURE

All major infrastructure to support the Ontario Operations mining activities envisaged in the LOM plan is in place.

There are no onsite accommodation camps; personnel reside in Sudbury or nearby communities.

Major infrastructure for the underground mine sites includes head frames; open, cold, and heated warehouses; mechanical and electrical shops; hoist room buildings; fan houses; sand plants; paste fill plants; backfill plants; first aid/security stations; training rooms; offices and change/shower facilities; management and technical services offices; sewage treatment plants; process water storage tanks and pump houses; fuel storage facilities; mine water treatment systems; surface repair facilities; slick line systems; dewatering pipelines; and fresh and return air ventilation systems.

Ontario Operations infrastructure also includes a tailings impoundment area, a slag disposal area, and an oxygen plant.

The processing facilities in Sudbury include a concentrator, a combined nickel and copper smelter, matte processing facilities, a carbonyl nickel refinery, a copper anode casting plant, a sulphuric acid plant and a sulphur dioxide liquefaction plant. Processing facilities at Clydach consist of a carbonyl nickel refinery. Processing facilities at the Port Colborne Refinery include an electro-cobalt refinery and precious metals upgrading facility.

The Copper Cliff tailings impoundment or Central Tailings Area became operational in 1936 and has become the primary management site for tailings generated from the Ontario Operations. The facility spans approximately 2,500 ha and is divided into several areas according to eras of tailings disposal.

Vale Base Metals meets the requirements of the Ontario Northern Development, Mines, Natural Resources and Forestry Lakes and Rivers Improvement Act, uses safety guidance provided by the Canadian Dam Association, Global Industry Standard on Tailings Management (GISTM), and internal risk management frameworks to ensure dam safety. Vale Base Metals has undertaken numerous studies on the Central Tailings Area to update various aspects of the facility to meet current dam engineering practices. A detailed Operations Manual was developed and is regularly updated.

The smelter operation produces approximately 0.5 million tonnes of slag annually. The slag is transported to one of three designated locations on the Copper Cliff property, where it is emptied and left to cool. Once cooled, it is broken up and moved to one of two storage areas—located in the central and northeastern sections of the smelter—specifically designated for cooled slag storage.

The general water management strategy for facilities surrounding the Central Tailings Area focuses on the collection and treatment of impacted runoff. This approach is consistently applied across multiple sites, including the Copper Cliff, Creighton, and Stobie Pit; Clarabelle Mill; the Central Tailings Area; UPA; the Copper Cliff Smelter Complex; the Copper Cliff Nickel Refinery; and the Copper Cliff and Nolin Creek wastewater treatment plants. Surface water in areas potentially affected by acid rock drainage is managed through two dedicated systems: the Copper Cliff and Nolin Creek water management systems

Electrical power for the Ontario Operations is primarily sourced from grid supply (approximately 80%). Power is transmitted on the Hydro One transmission system and is connected to two locations in Sudbury and one in Port Colborne. In Sudbury, all incoming grid-connected power and hydroelectric generation is distributed to mines and processing plants through Vale Base Metals Base Metal's electrical distribution network, consisting of 69 kV distribution power lines, substations, transformers, breakers, disconnects and other electrical equipment. This distribution system is owned, operated, and maintained by Vale Base Metals. A portion of the demand (about 20%) is met by VBM owned hydroelectric power facilities. Vale Base Metals consumes 100% of its self-produced hydro generation behind-the-meter.

1.17 MARKET STUDIES

Vale Base Metals has established contracts and buyers for the products from the Ontario Operations. VBM has an internal marketing group which monitors markets for its key products. Together with public documents and analyst forecasts, these data support that there is a reasonable basis to assume that for the LOM plan, that the key products will be saleable at the assumed commodity pricing.

Vale Base Metals uses long-term analyst and bank forecasts when considering long-term commodity prices.

None of the products from the Ontario Operations are subject to product specification requirements from end users to be saleable.

The terms contained within the refined nickel sales contracts are typical and consistent with standard industry practice and are similar to contracts for the supply of nickel throughout the world. Depending

on the specific contract, the terms for the refined nickel sales are predominantly negotiated annually, or in the case of spot agreements, based on market terms negotiated at the time of sale. There are some instances where a longer contract duration may be negotiated, but this is typically the exception. The differences between the individual contracts are generally in relative quantity of refined nickel that is covered under the sale.

Vale Base Metals has agreements at typical copper concentrate industry benchmark terms for metal payables, treatment charges and refining charges for concentrates produced. Treatment costs and refining costs vary depending on the concentrate type and the destination smelter. The terms contained within the concentrate sales contracts are typical and consistent with standard industry practice and are similar to contracts for the supply of copper concentrate throughout the world. Depending on the specific contract, the terms for the copper concentrate sale are either annually negotiated, benchmark-based treatment and refining charges, or in the case of spot agreements are based on fixed treatment and refining charges based on market terms negotiated at the time of sale. The differences between the individual contracts are generally in relative quantity of concentrates that are covered under annually negotiated treatment and refining charges.

The majority of the cobalt production is sold under annual or multi-year contracts. These contracts are based on market pricing using a negotiated formula based on the Fastmarkets cobalt price plus a premium or discount. The remaining production is sold on a spot basis. These sales are based on the current market pricing at the time of sale, using similar pricing methodology as described previously, or at a spot or fixed current market price. Any finished cobalt sales to affiliated parties are sold at market pricing similar to external parties.

PGE concentrate and gold sands are typically sold using spot pricing terms with end-users based on prevailing market conditions. As metals contained in copper products, the terms for gold and PGEs are determined through a payable mechanism on metal content based on typical market terms. As typical for concentrates, the product is generally contracted under a medium-term contract. A portion of Sudbury gold production is sold under a multi-year streaming agreement.

Intercompany agreements between Vale Base Metals affiliates are negotiated under the arm's length principle based on market terms and rates that would be achieved had the contract been negotiated with an unaffiliated third party.

1.18 ENVIRONMENTAL, PERMITTING AND SOCIAL CONSIDERATIONS

1.18.1 ENVIRONMENTAL STUDIES AND MONITORING

Ontario Operations are one of the largest integrated mining complexes in the world, including both mines and processing operations, some dating back to the early- and mid-1900s. Environmental regulations and awareness have progressed significantly from the beginning of the Ontario Operations, and Vale Base Metals has engaged in baseline studies, various improvement and legacy reclamation initiatives and other activities to ensure compliance as the regulatory regime changes.

All pertinent baseline information as per standard of the day is available in the closure plans for the mine sites and surface plants, including land use, topography, regional geology, local geology and mineralogy, soil, climate and hydrology, hydrogeology, terrestrial plant and animal life and aquatic plant and animal life, with relevant updates provided in the subsequent closure plan amendments.

As the mines and plant sites have continued to expand, supporting environmental studies have been completed to assess site environmental conditions, and to support permit applications and decision-making processes.

Characterization studies were completed for environmental media including soil, water, waste, air, noise and closure. Plans were developed and implemented for all Ontario Operation mine sites to address waste management, spill prevention and contingency planning, water management and fugitive dust management.

1.18.2 CLOSURE AND RECLAMATION CONSIDERATIONS

Vale Base Metals has 16 closure plans for aspects of the Ontario Operations, covering active and inactive sites.

Closure Plans were submitted to the relevant regulatory authority in 2001 in accordance with Part VII of the Ontario *Mining Act*. As required by regulation and internal guidelines, these documents are updated in five-yearly intervals to ensure they accurately depict onsite liabilities, as well as whenever there is a significant change made to a site.

Vale Base Metals developed closure cost estimates associated with the chosen rehabilitation strategy for each property. The estimate also includes an expected schedule for closure-related expenditures. Closure costs are included in the mine site financial models as cash costs, on an annual basis for all sites. The closure cost estimate for the Ontario Operations is approximately US\$2,279 million.

Financial assurance in the form of bonds, letters of credit, and financial tests are filed with the Ministry of Energy and Mines to ensure that the rehabilitation work outlined in a closure plan is successfully performed. The total financial assurance for Ontario Operations is C\$1,315,123,440 (US\$1,012 million). Financial assurance must be included with the submission of a closure plan.

1.18.3 PERMITTING

All known and anticipated environmental permits and approvals are in place to support mining and processing operations, as well as for shorter term works, undertakings or activities carried out on mine or plant site footprints. Where permits have specific terms, renewal applications are made to the relevant regulatory authority as required, prior to the end of the permit term.

1.18.4 SOCIAL CONSIDERATIONS, PLANS, NEGOTIATIONS AND AGREEMENTS

Vale Base Metals routinely engages with five Indigenous communities in the Sudbury Basin including Atikameksheng Anishnawbek First Nation, Wahnapiatae First Nation, Sagamok Anishnawbek First Nation, Whitefish River First Nation and the Métis Nation of Ontario – Region 5. Vale Base Metals has signed agreements with Atikameksheng Anishnawbek First Nation, Sagamok Anishnawbek First Nation and the Métis Nation of Ontario – Region 5.

There are currently no known consultation obligations which would materially impact the mineral reserve estimates. However, consultation obligations may need to be satisfied before new areas that currently only have mineral resource estimates can be developed.

Vale Base Metals does not currently have agreements or established relationships with Indigenous communities near the Port Colborne Refinery. This is largely due to the fact that the Crown has not identified any impact from the Port Colborne Refinery to Indigenous traditional territories in the region. However, Vale Base Metals has established a positive relationship with Mississauga of the Credit First Nation.

Due to the proximity of Vale Base Metals Operations to local communities, the company continues to engage the local communities of interest that may be impacted by future development. There are a variety of communication channels for community engagement including Annual Reports to the Community, annual Open Houses, a Community Liaison Committee, a company website, local media relations and advertising. Vale Base Metals has also established a grievance mechanism known as the Community Concerns Line to receive community concerns, complaints, and other matters; there are also a number of email communication channels to register grievances. These grievances are recorded in a grievance database and tracked for mitigation and conclusion.

The workforce at the Vale Base Metals Ontario Operations is largely unionized. A significant portion of employees across the mining, milling, smelting, and refining operations in the Sudbury area are represented by labour unions and are covered by collective bargaining agreements. These

agreements govern terms and conditions of employment, including wages, benefits, work rules, and health and safety provisions.

1.19 CAPITAL COST ESTIMATES

All capital cost estimates are at a minimum at a pre-feasibility level of confidence, having an accuracy level of $\pm 25\%$ and a contingency range not exceeding 15%.

Capital costs are based on recent prices or operating data. Sustaining capital cost forecasts are based on forecast mine development and construction needs, mobile equipment re-build/replacement schedules and fixed asset replacement and refurbishment schedules.

The overall capital cost estimate for the LOM (2026–2046) is US\$6,051 million as shown in Table 1-4.

Table 1-4: LOM Total Capital Cost Estimate (Real US\$)

Area	Capital Cost Type	Unit	Value
Mining	Annual capital development	US\$ M	1,036
	Mobile equipment	US\$ M	499
	Asset integrity (facilities/buildings)	US\$ M	1,840
	Asset integrity (fixed equipment)	US\$ M	596
Milling	Sustaining	US\$ M	530
Smelting and refining	Sustaining	US\$ M	503
Other	Sustaining	US\$ M	1,047
Total		US\$ M	6,051

Note: All numbers have been rounded. "Other" costs include provision for elements such as the power department (electrical power generation and distribution), the divisional shops (custom parts repair and manufacturing), the transportation department, the environment department, and the central engineering department.

The capital cost estimates presented in this technical report are to support demonstration of the economic viability of the mineral reserves. This information may differ from other capital cost estimates Vale Base Metals publishes on an annual detailed basis.

1.20 OPERATING COST ESTIMATES

All operating cost estimates are at a minimum at a pre-feasibility level of confidence, having an accuracy level of $\pm 25\%$ and a contingency range not exceeding 15%. Operating costs are based on actual costs from operations and are projected through the LOM plan.

Historical costs are used as the basis for operating cost forecasts for supplies and services unless there are current contract terms for these items. Labour and energy costs are based on budgeted rates applied to headcounts and energy consumption estimates. The long-term mine operating cost model accounts for the impact of varying production rates on the direct variable costs.

Operating costs total US\$18,751 million over the LOM (2026–2046; Table 1-5).

The operating cost estimates presented in this Report demonstrate the economic viability of the mineral reserve on its own. The mineral reserves throughput for the processing plant decreases relative to the strategic plan that includes externally purchased feeds and transfers of feed from other Vale Base Metals operations over the LOM plan. The information presented may differ from other operating cost estimates Vale Base Metals publishes on an annual detailed basis.

Table 1-5: LOM Operating Cost Estimate (Real US\$)

Area	Total LOM Cost	
	Unit	Value
Mining	US\$ M	8,510
Milling+Tailings	US\$ M	1,391
Smelting	US\$ M	2,181
Refining	US\$ M	2,088
General and administrative/corporate overhead	US\$ M	4,099
Logistics and distribution costs	US\$ M	482
Total	US\$ M	18,751

Note: All numbers have been rounded.

1.21 ECONOMIC ANALYSIS

The aim of the economic evaluation presented in this report is to demonstrate the economic viability of the mineral reserve. Therefore, the planned production, costs, taxes and other information presented may differ from other information published by the company. The planned mine production may vary due to continuous mineral exploration and technical studies, and / or inclusion of externally sourced materials processed at Ontario Operations downstream facilities (e.g., external ore to Clarabelle Mill or external concentrate to Copper Cliff Smelter).

The financial model that supports the mineral reserve declaration is a standalone model that calculates annual cash flows based on scheduled ore production, processing recoveries, metal sale prices, a C\$/US\$ exchange rate, projected operating and capital costs and estimated taxes. All costs and prices are in “real” dollars, therefore, without escalation. Revenue is calculated from the recoverable metals and long-term metal price. Confidential premiums that Vale Base Metals receives are not included in external disclosure but are considered in the evaluation of mineral resources and mineral reserves and the resulting economic analysis.

The financial analysis is based on an after-tax discount rate of 6.3% following a mid-year convention and a long-term C\$/US\$ exchange rate of 1.30. The currency used to document the cash flow is US\$.

Ontario Operations is subject to income and mining taxes, which are both profit-based taxes. The financial estimates are based on a combined federal and provincial income statutory tax rate of 25% and a provincial mining tax rate of 10%, before processing allowance.

The LOM plan assumes that active mining operation ceases in 2046, and closure costs are estimated from 2047–2151.

Absent from the reserve-only cash flow are Ontario mineral resources, external feeds acquired by Ontario Operations to be treated by its processing assets. As such this plan does not fill the capacity of the mill which would otherwise be planned to run at capacity.

The post-tax NPV 6.3% is US\$1,951 million (Table 1-6). As the cash flows are based on existing operations where all costs are considered sunk to 1 January 2026, considerations of payback and internal rate of return are not relevant.

Table 1-6: Economic Analysis Summary Table (Real \$US)

Item	Sub-item	Units	Total/Average
Production	Tonnes Ore Processed	Mt	69

Item	Sub-item	Units	Total/Average
	Copper	%	1.55
	Nickel	%	1.42
	Cobalt	%	0.03
	Platinum	g/t	1.02
	Palladium	g/t	1.13
	Gold	g/t	0.39
Metal recovery	Copper	kt	967
	Nickel	kt	770
	Cobalt	kt	7
	Platinum	k oz	1,730
	Palladium	k oz	2,025
	Gold	k oz	616
Economic results	Total revenue	US\$ M	29,432
	Total operating costs	US\$ M	(18,751)
	Total capital costs	US\$ M	(6,051)
	Tax	US\$ M	(1)
	Closure	US\$ M	(1,268)
	Working capital	US\$M	301
	Free cash flow post-tax	US\$ M	3,662
	NPV @ 6.3%	US\$ M	1,951

Note: Totals may not sum due to rounding. All tonnages in metric tonnes. Economic analysis reported on a 100% Vale Base Metals basis; Vale owns a 90% interest and Manara Minerals the remaining 10% interest. Please refer to the note regarding forward-looking information at the front of the Report. Taxes are largely offset by input tax credits. The closure costs total US\$2.3 billion – financial model runs to 2060; the value in table above is discounted at 6.3% for 2061-2151. Figures shown do not deduct the stream amounts. For a description of the streaming arrangement with Wheaton Precious Metals, see Chapter 3.8

A sensitivity analysis was performed on metal prices, metal recovered, capital costs and operating costs using a range of 25% above and below base case values. The Ontario Operations are most sensitive to the following, arranged in order from most to least sensitive, nickel price, nickel grade, operating costs, capital costs, copper price, and copper grade.

1.22 CONCLUSIONS

Under the assumptions presented in this Report, the Ontario Operations have a positive cash flow, and mineral reserve estimates can be supported.

1.23 RECOMMENDATIONS

The QPs make the following recommendations for Ontario Operations:

- Complete, in conjunction with Glencore, an updated feasibility study to support conversion of Nickel Rim South Extension to reserves. The study should consist of developing the 24N, BL28, and NR14 zones, located at 1,500–2,800 m below surface at the Nickel Rim South Extension property. The study should focus on using existing Nickel Rim South mine infrastructure for the development evaluation. The estimated cost to complete the study is approximately US\$ 11 million.
- Complete a pre-feasibility study to support the addition of mineral resources at the Ella-Capre and Murray deposits. The estimated cost to complete the study is approximately US\$ 50 million.

2 INTRODUCTION

2.1 REGISTRANT

This report was prepared as a Technical Report Summary (TRS) in accordance with the Securities and Exchange Commission (SEC) S-K regulations (Title 17, Part 229, Sections 601 and 1300 until 1305) for Vale S.A. (Vale) on Vale Base Metals Limited (VBM) Ontario Operations.

The Ontario Operations are owned and operated by Vale Canada Limited, which is part of the Vale Base Metals group. Vale Base Metals is a diversified Base Metals mining company with operations and projects in Canada, Brazil, UK, Indonesia and Japan primarily producing copper, nickel, cobalt, gold, silver and PGEs. Vale Canada is a wholly owned subsidiary of Vale Base Metals Limited. Vale Base Metals Limited is 90% indirectly owned by Vale, and 10% indirectly owned by Manara Minerals Investment Company (Manara Minerals).

2.2 TERMS OF REFERENCE

2.2.1 REPORT PURPOSE

The Report was prepared to be attached as an exhibit to support mineral property disclosure, including mineral resource and mineral reserve estimates, for the Ontario Operations in Vale Form 20-F for the year ending 31 December, 2025.

Mineral resources were estimated for selected zones within the Blezard, Coleman, Copper Cliff, Creighton, Ella–Capre, Stobie, Garson (McConnell is included with Garson), Totten and Nickel Rim South Extension (formerly Victor) deposits.

Mineral reserves were estimated for the Coleman, Copper Cliff, Creighton, Garson, and Totten Mines using underground mining methods and for the Stobie Pit using open pit mining methods.

2.2.2 TERMS OF REFERENCE

Unless otherwise indicated, all financial values are reported in real, unescalated, United States (US) currency (US\$) including all operating costs, capital costs, cash flows, taxes, revenues, expenses, and overhead distributions. The Canadian currency is the Canadian dollar (C\$).

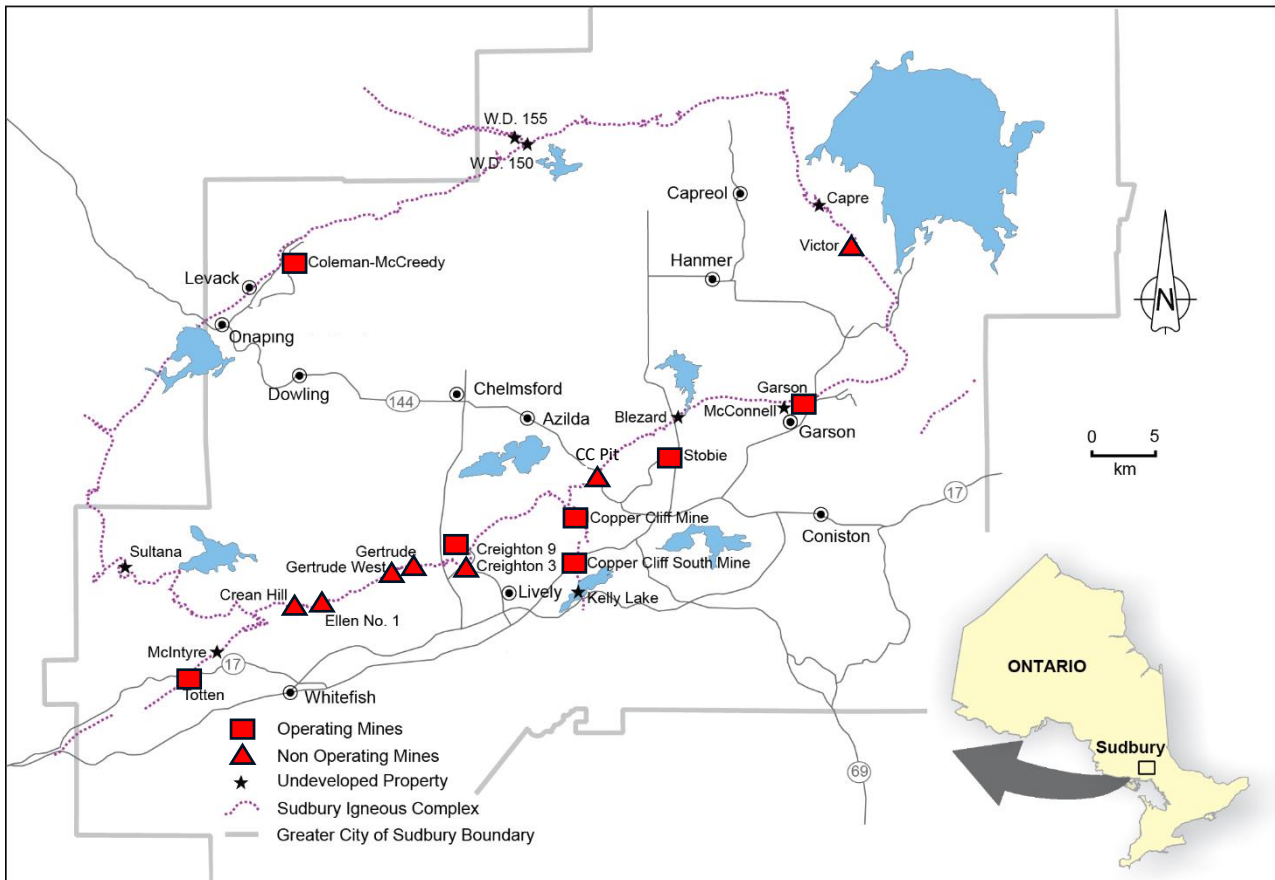
Ontario Operation's day to day work and database records are in the U.S. Customary system of units, which are used to refer to mining equipment capacities, skip, hoist, and ore pass capacities, back fill rates, development rates and mine level designations as well as some analytical results and formulae.

Unless otherwise indicated, the metric system is used in this Report.

Mineral resources and mineral reserves are reported using the definitions in Subpart 229.1300 – Disclosure by Registrants Engaged in Mining Operations in Regulation S–K 1300.

The Report uses Canadian English.

Figure 2-1: Ontario Operations Location Plan



Note: Figure prepared by Vale Base Metals, 2025.

2.3 QUALIFIED PERSONS

The following Vale Base Metals employees serve as Qualified Persons (QPs):

- Mr. Jody Todd, FAusIMM, Head of Strategic Mine Planning, Vale Base Metals Base Metals;
- Mr. Henrique Vigario, MAusIMM, Global Head Geology, Vale Base Metals;
- Mr. Damodara Chinnasane, P. Eng., Interim Practice Lead Geotech, Vale Base Metals;
- Mr. Greg Puro, P. Eng, Practice Lead Tailings, Vale Base Metals;
- Mr. Adam MacMillan, P. Eng, Director Copper Processing, Research and Innovation, Vale Base Metals.

Report chapter responsibilities are summarized in Table 2-1.

2.4 SITE VISITS AND SCOPE OF PERSONAL INSPECTION

Mr. Jody Todd:

- Sudbury Operations Center: Meetings with Leadership teams - Life of Asset Planning/Governance (Jun24-Jun25, Jul 15-Jul 19, Sep 10 - Sep13 (2024), Jan 13-Jan16, Feb 24-Feb 27, Apr 7-Apr11, May 26-May 30, Jun 23-Jun 27, Jul 7 - Jul10, Oct 30-Oct 31)

Mr. Henrique Vigario:

- Sudbury Operations Center: Meetings with Leadership teams - Life of Asset Planning/Governance (2025)
- Coleman Mine – Site operations review and underground leadership field tour (2025)

Mr. Damodara Chinnasane:

- Coleman, Copper Cliff, Totten: Operations checks as part of assurance function. Various times in 2024 and 2025
- Garson: Investigation into seismic event (June 23-26 2025)

Mr. Greg Puro:

- Ontario Operations: Review and discuss operational practices for dams (Multiple visits in 2025)

Mr. Adam MacMillan:

- Ontario Operations: Site visits, planning and leadership reviews (2025)

Table 2-1: Qualified Person Chapter Responsibilities

Qualified Person	Chapter Responsibilities
Mr. Henrique Vigario	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.12, 1.22, 1.23; 2; 3; 4; 5; 6; 7; 8; 9.1, 9.2, 9.3.1, 9.4; 11; 20; 22.1, 22.2, 22.4, 22.12, 22.13; 23; 24; 25.
Mr. Jody Todd	1.1, 1.2, 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19, 1.20, 1.21, 1.22, 1.23; 2; 12; 13; 14; 15; 16; 17; 18; 19; 21; 22.5, 22.6, 22.7, 22.8, 22.9, 22.10, 22.11, 22.12, 22.13; 23, 24, 25
Mr. Damodara Chinnasane	1.1, 1.2, 1.8, 1.14, 1.22, 7.4, 13.2, 22.1, 22.6, 22.13
Mr. Greg Puro	1.1, 1.2, 1.16, 1.22, 15.4, 22.8, 22.13
Mr. Adam MacMillan	1.1, 1.2, 1.11, 1.22, 10, 22.3, 22.13

2.5 REPORT DATE

Information in the Report is current as at December 31, 2025.

2.6 INFORMATION SOURCES

The reports and documents listed in Chapter 24 and Chapter 25 of this Report were used to support Report preparation.

2.7 PREVIOUS TECHNICAL REPORT SUMMARIES

Vale has filed the following technical report summaries on the Ontario Operations:

- Gauld, C., Gardner, N.A., Hossack, A., and Puro, G., 2021: Technical Report Summary, Sudbury Property, Ontario Operations, Canada: report current as at 31 December, 2021, prepared for Vale S.A., dated April 7, 2022, 232 p.
- Hodder, D., Dube, T., Buck, C., Yao, X., Lanteigne, L., and Ansah-Sam, M., 2023: Technical Report Summary, Sudbury Property, Ontario Operations, Canada: report current as at 31 December, 2022, prepared for Vale S.A., dated 23 March 2023, 259 p.

This Report is an update to reports previously filed.

3 PROPERTY DESCRIPTION

3.1 PROPERTY LOCATION

The Ontario Operations are primarily located in the Sudbury district of Ontario. Sudbury is approximately 330 km north–northeast of Toronto.

The centroid for the Ontario Operations is approximately N46°29'29.0, W81°04'05.0, being the geographical co-ordinates of the bulk of the estimated mineral reserves and resources.

The Ontario Operations comprise five operating underground mines — Coleman, Creighton, Copper Cliff, Totten and Garson — and the Stobie open-pit operation which supply polymetallic sulphide ore to the Clarabelle Mill concentrator. The mill produces: (i) nickel concentrates, which are processed through the Copper Cliff Smelter and Refinery to produce high-purity nickel pellets and powders and (ii) copper concentrates which are sold directly to the market. Sudbury also has the capability to process third-party ores and concentrates, and the site can also recycle secondary materials through its smelting complex.

Excess nickel oxide from the smelter is refined at Vale Base Metals' Clydach Refinery in Wales. Precious-metal- residues from Sudbury metallurgical circuits are treated at the Port Colborne Refinery and recover cobalt, gold, and PGM intermediates (platinum and palladium).

The Ontario Operations also include non-producing properties including: Blezard, Ella-Capre, and Nickel Rim South Extension; which are in advanced exploration and host mineral resources. In Sudbury, Ontario Operations also own a series of privately owned buildings, roads, railway, hydroelectric dams and transmission lines, besides legacy areas for closure.

The geographical co-ordinates for the deposits with mineral resource estimates and the main districts in which they are located within the Ontario Operations area are summarized in Table 3-1.

Geographical co-ordinates for the mine sites are provided in Table 3-2 and the locations of the smelting and refining sites are included as Table 3-3.

Table 3-1: District Locations

Property	Latitude (north)	Longitude (west)	Area (ha)	General Location of Mining Rights (Townships)
Copper Cliff	46°30'7"	-81°5'24"	2,295	Snider and McKim
Kelly Lake	46°26'39"	-81°04'03"	620	McKim, Snider, Waters and Broder
Creighton	46°28'23"	-81°11'06"	1,147	Snider and Creighton-Davies
Stobie	46°32'22"	-80°59'28"	711	Blezard and McKim
Garson	46°33'41"	-80°51'39"	820	Garson
Coleman	46°40'1"	-81°21'1"	368	Levack
Totten	46°22'59"	-81°26'55"	444	Drury
Ellen	46°25'41"	-81°19'23"	66	Denison
Capre	46°41'49"	-80°50'18"	414	Capreol and MacLennan
Copper Cliff Pit	46°31'05"	-81°03'33"	706	Snider and McKim
Nickel Rim South Extension	46°40'31"	-80°48'50"	353	Capreol and MacLennan
Crean Hill *	46°25'55"	-81°20'34"	278	Denison
Cryderman	46°35'01"	-80°46'19"	304	Falconbridge
Blezard	46°33'30"	-80°58'43"	278	Blezard

Note: * in process of transfer to Magna.

Table 3-2: Mine Locations

Mine	Latitude (north)	Longitude (west)
Coleman	46°40'37"	-81°20'21"
Copper Cliff	46°29'29"	-81°04'05"
Creighton	46°28'23"	-81°11'06"
Garson	46°34'02"	-80°51'26"
Stobie	46°32'22"	-80°59'28"
Totten	46°22'55"	-81°27'09"

Table 3-3: Smelter/Refinery Locations

Process Facility	Latitude (north)	Longitude (west)
Clarabelle Mill	46°29'46"	-81°03'19"
Copper Cliff Smelter	46°28'35"	-81°03'26"
Copper Cliff Nickel Refinery	46°27'30"	-81°04'30"
Port Colborne Refinery	42°53'00"	-79°14'28"
Clydach Refinery	51°41'44"	-3°53'21"

3.2 PROPERTY AND TITLE IN ONTARIO

3.2.1 INTRODUCTION

Until 1913, surface rights and mineral rights were acquired with land purchase. At that time, the Ontario government enacted legislation reserving land mineral rights to the Crown and granting leases to individuals or companies seeking to extract minerals. Where mineral rights are privately owned due to granting prior to 1913, they can be sold independently of surface rights, so that surface and mineral rights on the same property can be held by different owners.

The Ministry of Energy and Mines is the main regulatory body for the administration of mineral property title and mining in the Province of Ontario. The Canadian Federal Government may also be involved in the mining process where Indigenous matters arise, or where the subject lands are federally regulated, such as when the lands are classified as navigable water bodies.

3.2.2 MINERAL TITLE

There are four main types of mineral title: mining claim, mining lease, patented claim, and mining licence of occupation. Vale Base Metals Ontario Operations' landholdings include each of these title types. Descriptions of each are as follows:

- Mining claim: a mining claim in Ontario is a cell or group of cells from the provincial Mineral Tenure Grid, which divides Crown land into over 5.2 million cells. Prospectors stake these online, with up to 25 cells per claim. To keep a claim active, holders must complete and report C\$200–C\$400 of work per cell each year or the claim is forfeited.
- Mining lease: A mining claim can be converted to a lease once approved assessment work is completed and a letter of intent is submitted. The claim area must then be surveyed, and surface rights must be secured or an agreement reached with the landowner. A mining lease grants mineral rights and removes the requirement for annual assessment work but cannot

be transferred or mortgaged without Ministry approval. Lessees must pay annual rent. Leases last 10 or 21 years, with renewals allowed if required expenditures or applications are submitted.

- Patented claim: Freehold land owners in Ontario hold full fee simple title. Historically, mining claim holders could apply for a mining patent, which grants ownership of surface and/or mineral rights and conveys all Crown title to the land or minerals, subject to any reservations. Patented lands can be transferred or mortgaged without regulatory approval. Holders of patented claims must pay annual Ontario mining tax and, if surface rights are included, applicable mineral land and municipal property taxes.
- Mining license of occupation: these allow the holder to use the land in the manner specified in each license, including the right to dig, excavate and remove ores and minerals from and under the land. The Province of Ontario has the right to revoke licenses of occupation on 30 days prior notice.

3.2.3 ORDER IN COUNCIL

In Canada, an Order-in-Council (OIC) is an executive instrument which, following formal approval by the Lieutenant Governor, functions as the official recorded Order of the Lieutenant Governor in Council. The instrument originates as a Recommendation to Council signed by a Minister or Premier, and is presented to Executive Council for consideration and subsequent approval by the Lieutenant Governor.

Subsection 91(1) of the *Mining Act*, R.S.O. 1990, c. M.14 provides that “all lands, claims or mining rights patented, leased or otherwise disposed of under this or any other Act or by any authority whatsoever, are subject to the condition that all ores or minerals raised or removed therefrom shall be treated and refined in Canada so as to yield refined metal or other product suitable for direct use in the arts without further treatment”. Given Vale Base Metals refining processes includes operations outside of Canada, Vale Base Metals regularly obtains exemptions from the operation of subsection 91(1) under OICs for the export of a portion of its production (see Chapter 3.5.5).

3.2.4 SURFACE RIGHTS

Surface rights refer to any right in land that is not a mining right. The process of acquiring surface rights for mining purposes depends on the owner of the rights:

- No action is required if the surface rights are owned by the claim holder;
- Ownership of the surface rights will be granted to the claim holder during a lease application process if the Crown owns the surface rights;
- If the surface rights are privately owned by an individual or company, then an agreement to allow the claim holder to use the land must be made with the surface rights holder. The agreement should include the compensation given if the land covered by the surface rights sustains any damages. Confirmation of an agreement with the surface rights owner is required for grant of a mining lease, or, upon application by the claim holder, the issuance of an order of the Mining Lands Commissioner indicating that surface rights compensation, if any, has been paid, secured, or settled. Under the Ontario Mining Act, a claim holder may apply to the Mining Lands Commissioner for expropriation of surface rights necessary for mine production from a surface rights holder in exchange for fair market value

3.3 OWNERSHIP

The Ontario Operations are owned and operated by Vale Canada Limited, which is part of the Vale Base Metals group. Vale Base Metals is a diversified Base Metals mining company with operations and projects in Canada, Brazil, UK, Indonesia and Japan primarily producing copper, nickel, cobalt, gold, silver and PGEs. Vale Canada is a wholly owned subsidiary of Vale Base Metals Limited. Vale Base Metals Limited is 90% indirectly owned by Vale, and 10% indirectly owned by Manara Minerals Investment Company (Manara Minerals).

3.4 MINERAL TITLE

3.4.1 OVERVIEW

In each township, VCL is the registered owner of mining rights and surface rights or a combination of both held under patented mining claims, mining leases, mining licenses of occupation and unpatented mining claims (Table 3-4). Table 3-5 provides a summary of the number and types of licenses with defined mineral resource/mineral reserve estimates, with the respective area in hectares.

VCL owns approximately 80,261 ha of patented mining rights and approximately 59,742 ha of patented surface rights which includes a combination of approximately 1,369 ha of mining and surface rights co-owned with other parties. Note that Vale S.A. 20-F includes Ontario properties outside the Sudbury area and the scope of this report; the total in the 20-F is 81,145 ha.

Municipal taxes and mining land taxes for each mine were paid in full for 2025. All assessment work due annually on the patented and unpatented mining claims was filed as at 31 December, 2025.

Mining rights cover a portion of, or all of the areas of, the townships shown in Figure 3-1, which also shows the mining operations in these townships. The total mineral rights area of the mineral resource and mineral reserve estimate footprint, determined by projecting mineral envelopes to surface and by itemizing mineral envelope boundaries by license changes, is 172 licenses (approximately 9,062 ha). Of these licenses, 168 are registered patents, two licenses are 21-year mining leases, one license is a mining license of occupation, and one license is an unpatented mining claim. Figure 3-2 to Figure 3-12 show the locations of the mining rights.

Table 3-4: Mineral Title Summary, Ontario Operations

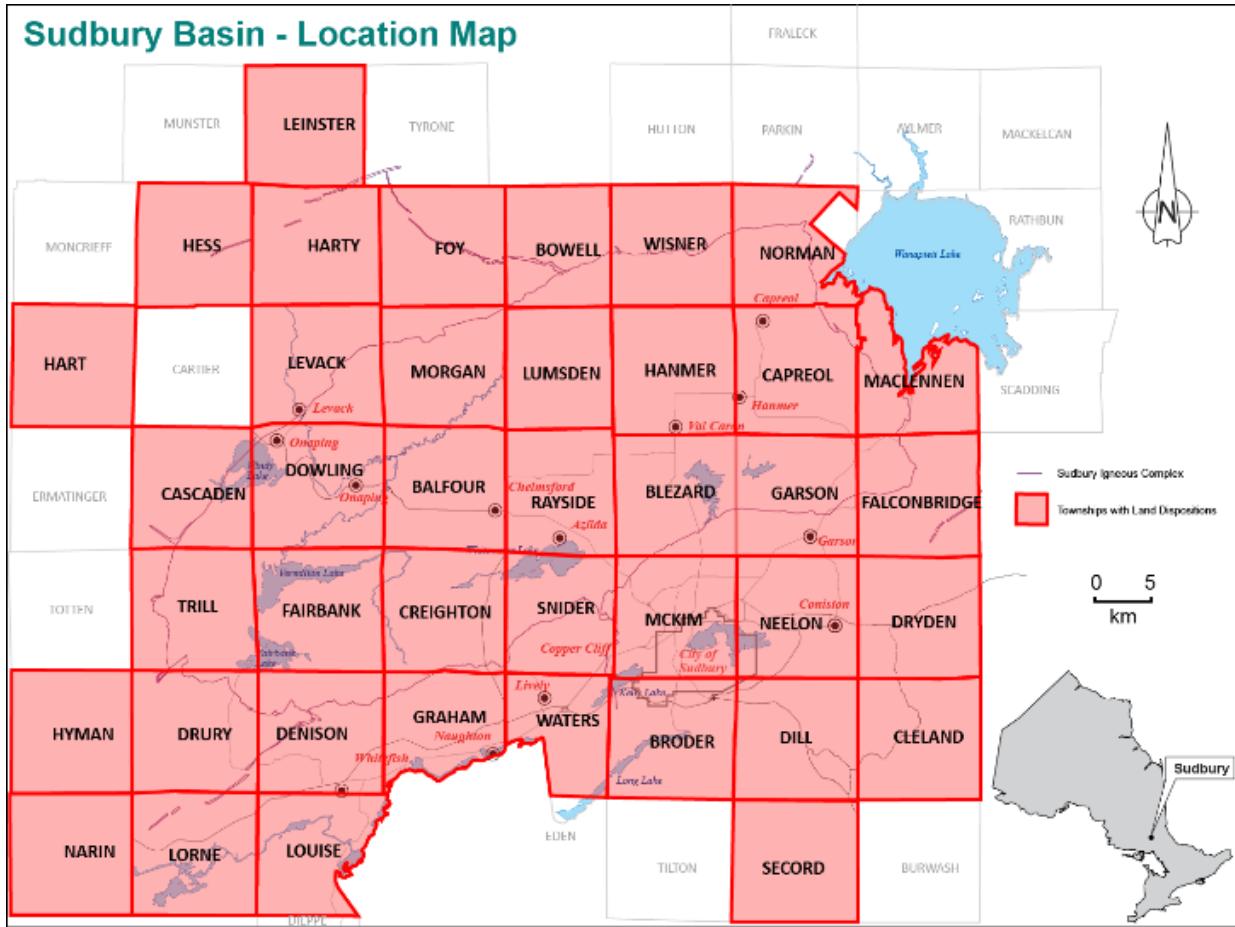
Title Type	Townships	Number of Title Type	Total Area (ha)
10 Year Mining Lease	Norman	26	1,802
21 Year Mining Lease	Bowell, Broder, Capreol, Cascaden, Creighton-Davis, Dowling, Drury, Fairbank, Falconbridge, Foy, Garson, Graham, Graham, Hanmer, Harty, Hess, Leinster, Lumsden, Mckim, Maclennan, Morgan, Norman, Snider, Trill, Waters, Wisner.	77	12,225
Mining Claim	Creighton-Davis, Denison, Drury, Fairbank, Foy, Graham, Harty, Levack, Lorne, Maclennan, Morgan, Norman, Wisner.	203	9,236
Mining Lease of Occupation	Bleazard, Bowell, Capreol, Cascaden, Creighton-Davis, Dowling, Fairbank, Graham, Hanmer, Levack, Lorne, Lorne, Lumsden, Morgan, Norman, Rayside, Snider, Trill, Wisner.	133	3,013
Patented	Balfour, Bleazard, Bowell, Broder, Capreol, Cascaden, Cleland, Creighton-Davies, Curtin, Denison, Dill, Dowling, Drury, Dryden, Fairbank, Falconbridge, Foy, Garson, Graham, Hanmer, Hyman, Levack, Lorne, Louise, Lumsden, Maclennan, Mckim, Mongowan, Morgan, Nairn, Neelon, Norman, Porter, Rayside, Secord, Snider, Trill, Waters, Wisner.	2,176	80,261
Total Vale Base Metals Mineral Title – Ontario Operations		2,615	106,537

Table 3-5: Mineral Title Supporting Resources, Ontario Operations

Deposits	Licenses						
	Mining Claim	Mining License of Occupation	Mining Lease 21 Years	Expiry	Patents	Total	Area (ha)
Bleazard	—	—	—	—	5	5	262.3
Coleman	—	—	—	—	13	13	436.4
	—	1	—	7/1/2026	—	1	9.4
Copper Cliff	—	—	—	—	43	43	2,912.3
Creighton	—	—	—	—	26	26	1,177.5
Kelly Lake	—	—	—	—	8	8	395.2
	—	—	1	12/31/2027	—	1	229.6
Garson	—	—	—	—	27	27	825.0
Copper Cliff Mine Pit (Murray)	—	—	—	—	14	14	940.9
Stobie	—	—	—	—	6	6	524.7
Totten	—	—	—	—	12	12	993.1
Nickel Rim South Extension	1	—	—	12/10/2030	—	1	0.5
	—	—	1	5/1/2026	—	1	38.2
	—	—	—	—	14	14	316.8
Total Licenses						172	9,061.8

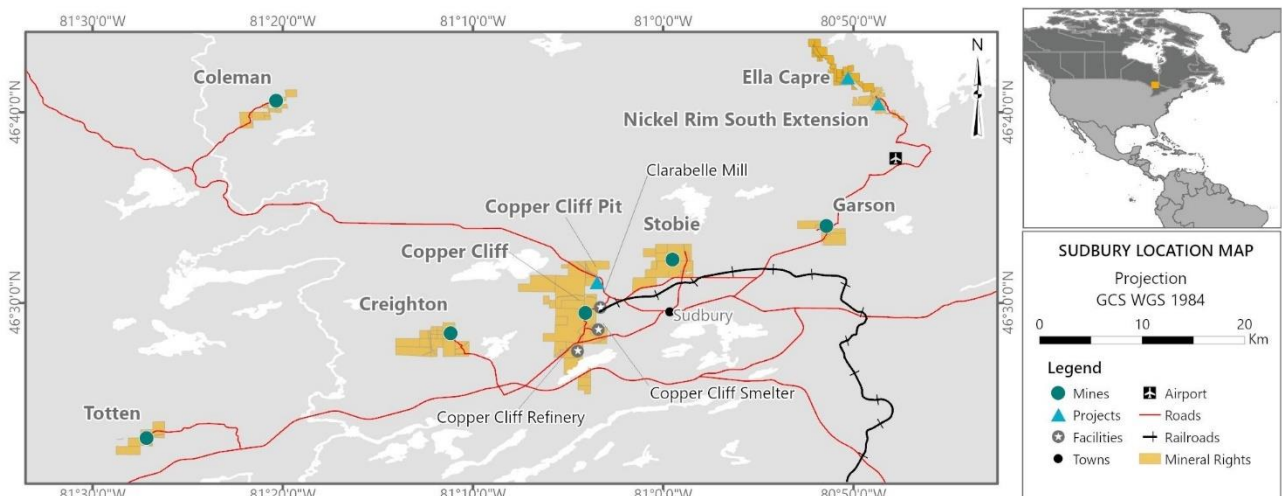
Notes: This table reflects relevant titles supporting disclosed mineral reserves and mineral resources. Some of the licenses are jointly held by VCL and third parties. Date format is month, day, year. Patent expiry dates renew annually but vary per patent. They are not included here for brevity of presentation.

Figure 3-1: Townships with Land Depositions, Ontario Operations



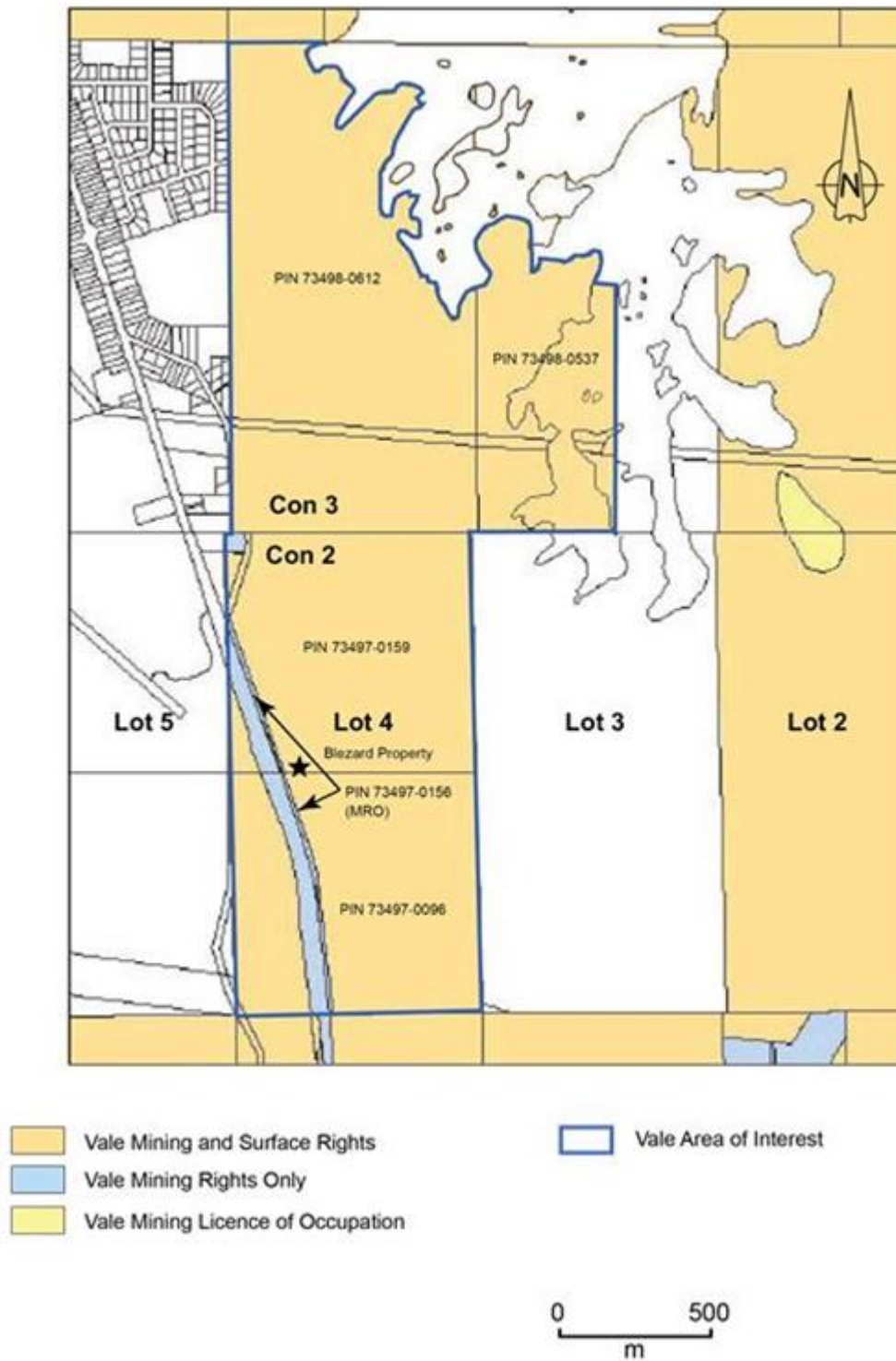
Note: Figure prepared by Vale Base Metals, 2020.

Figure 3-2: Ontario Mineral Resource and Mineral Reserve Rights



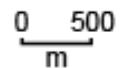
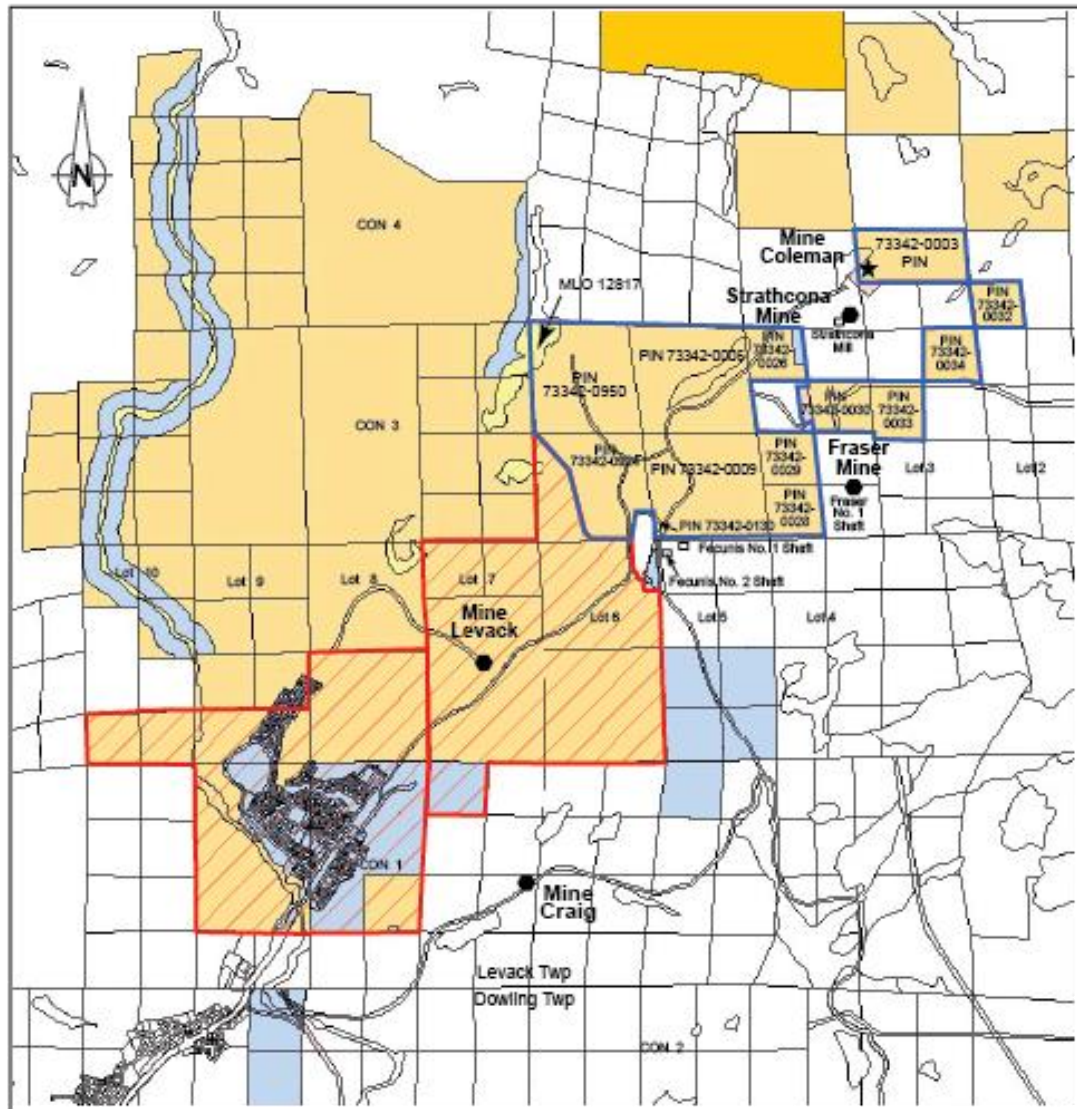
Note: Figure prepared by Vale Base Metals, 2025.

Figure 3-3: Mineral Rights – Blezard Property



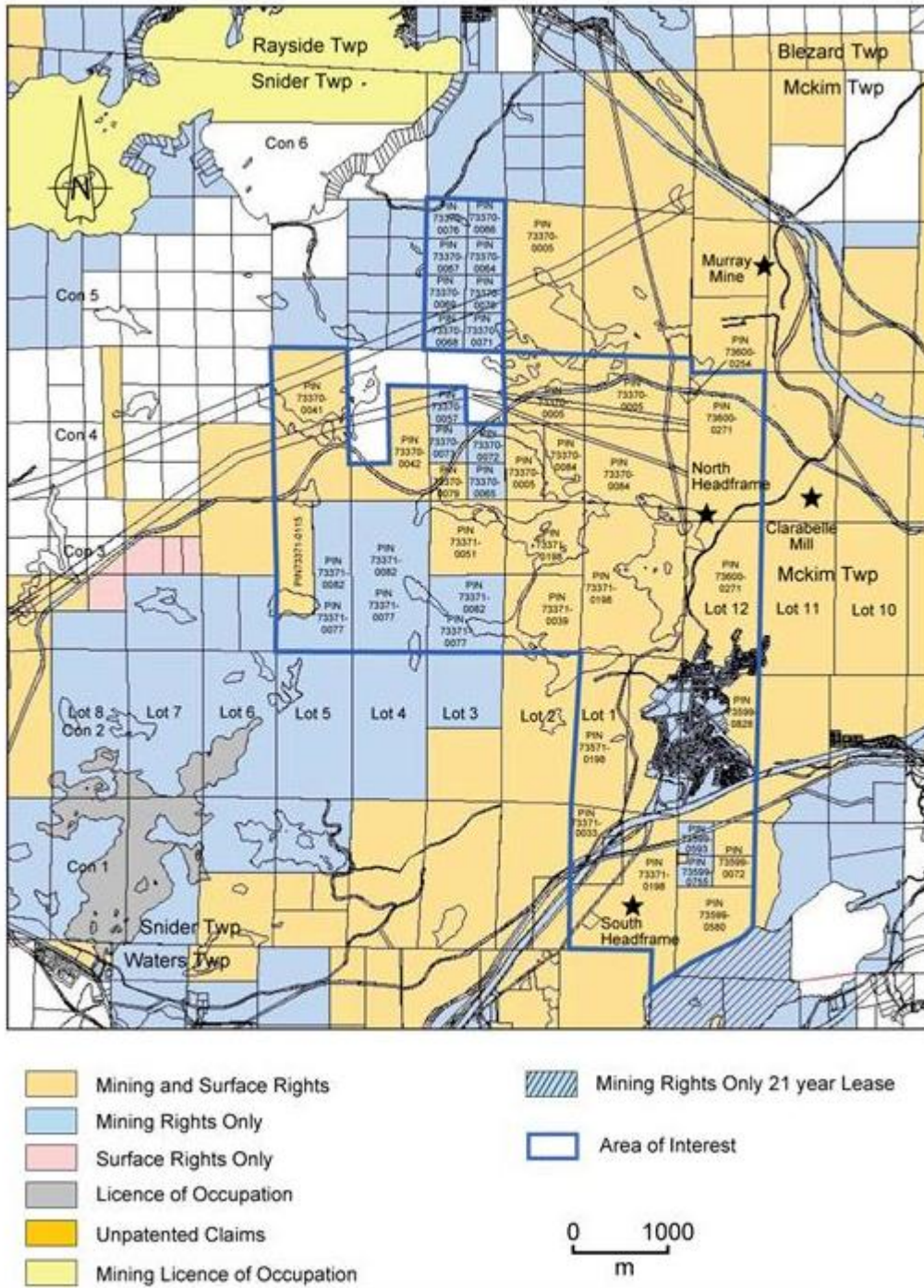
Note: Figure prepared by Vale Base Metals, 2020.

Figure 3-4: Coleman Property



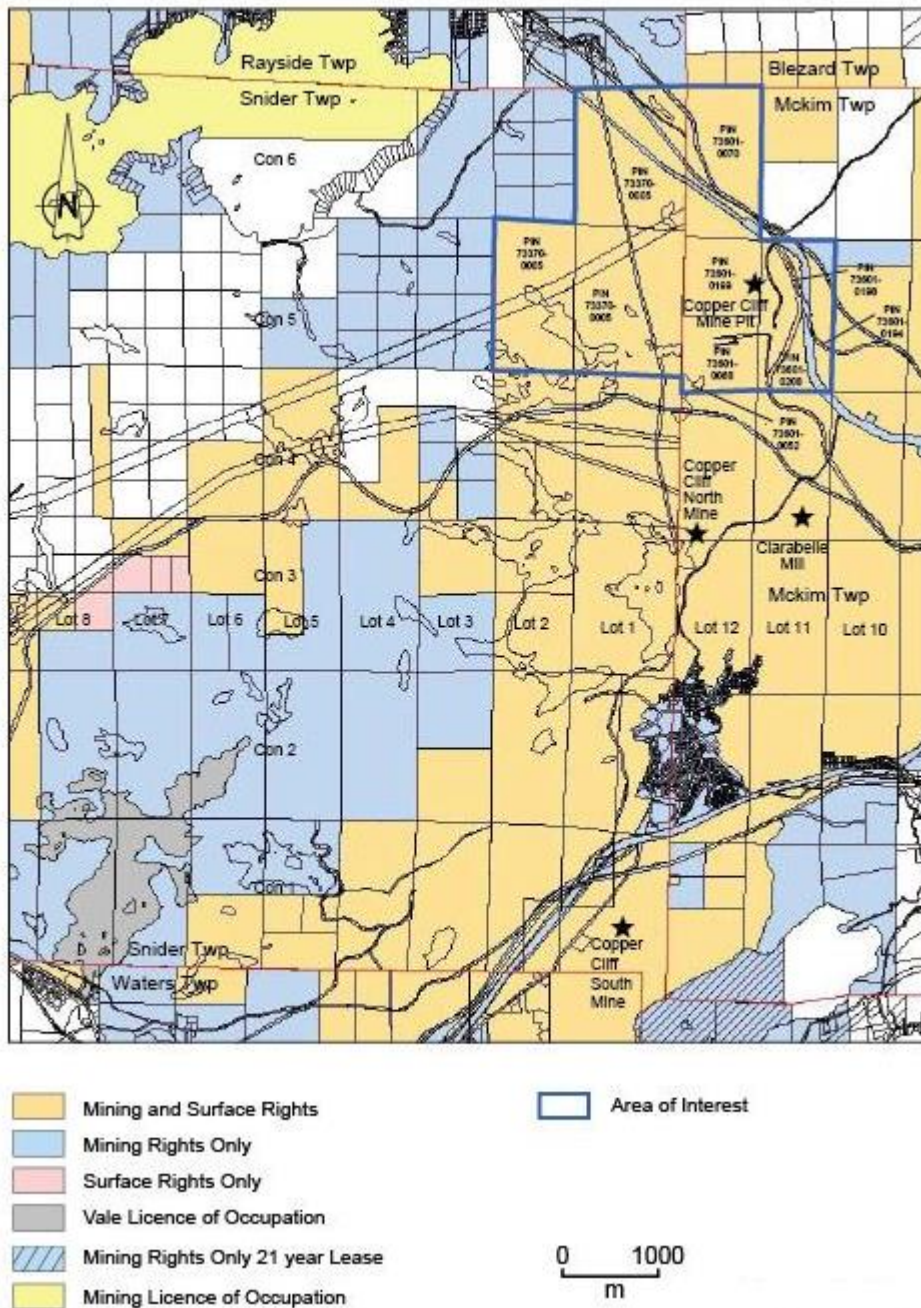
Note: Figure prepared by Vale Base Metals, 2024.

Figure 3-5: Copper Cliff Property



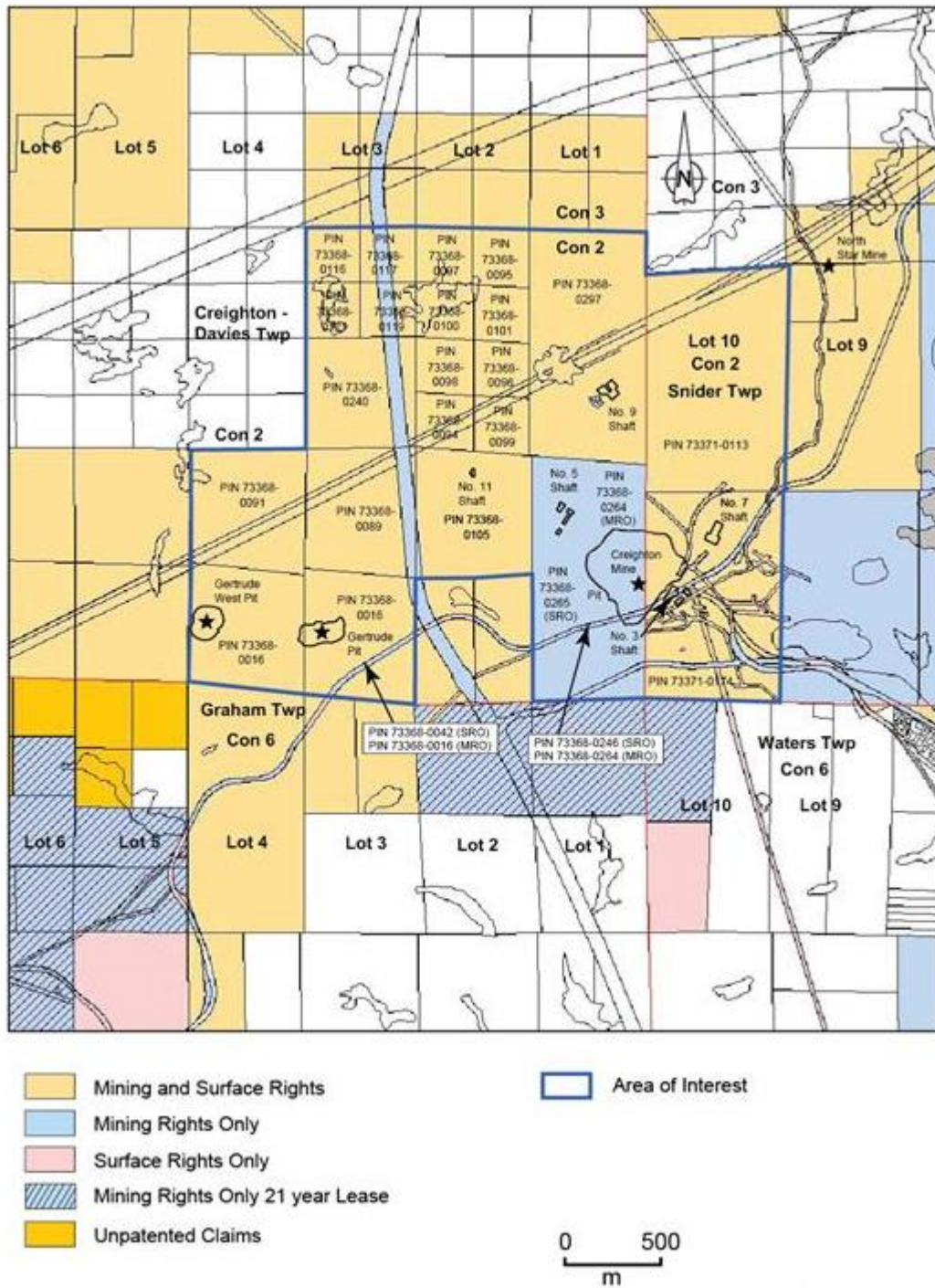
Note: Figure prepared by Vale Base Metals, 2022.

Figure 3-6: Copper Cliff Pit Property



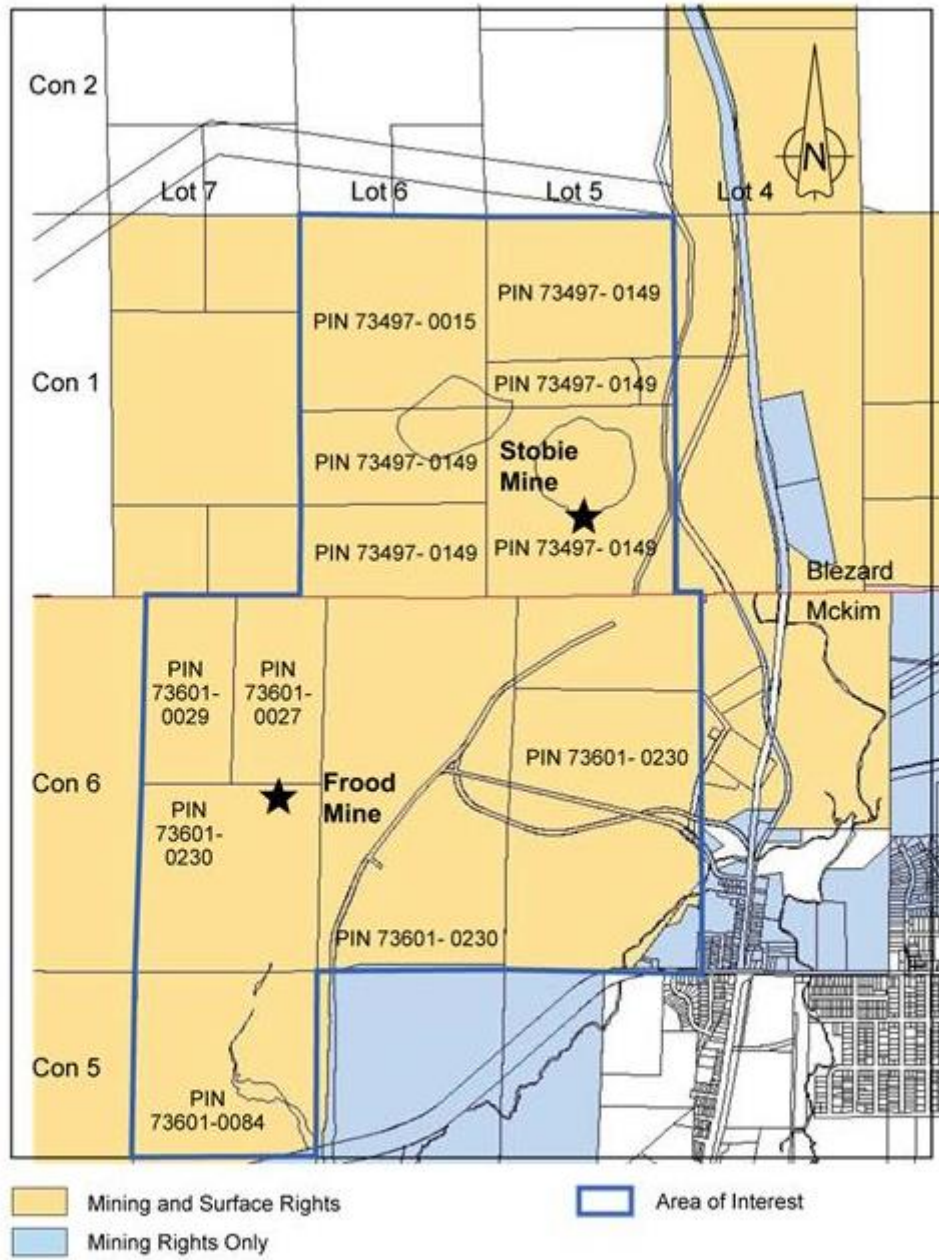
Note: Figure prepared by Vale Base Metals, 2021.

Figure 3-7: Creighton Property



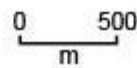
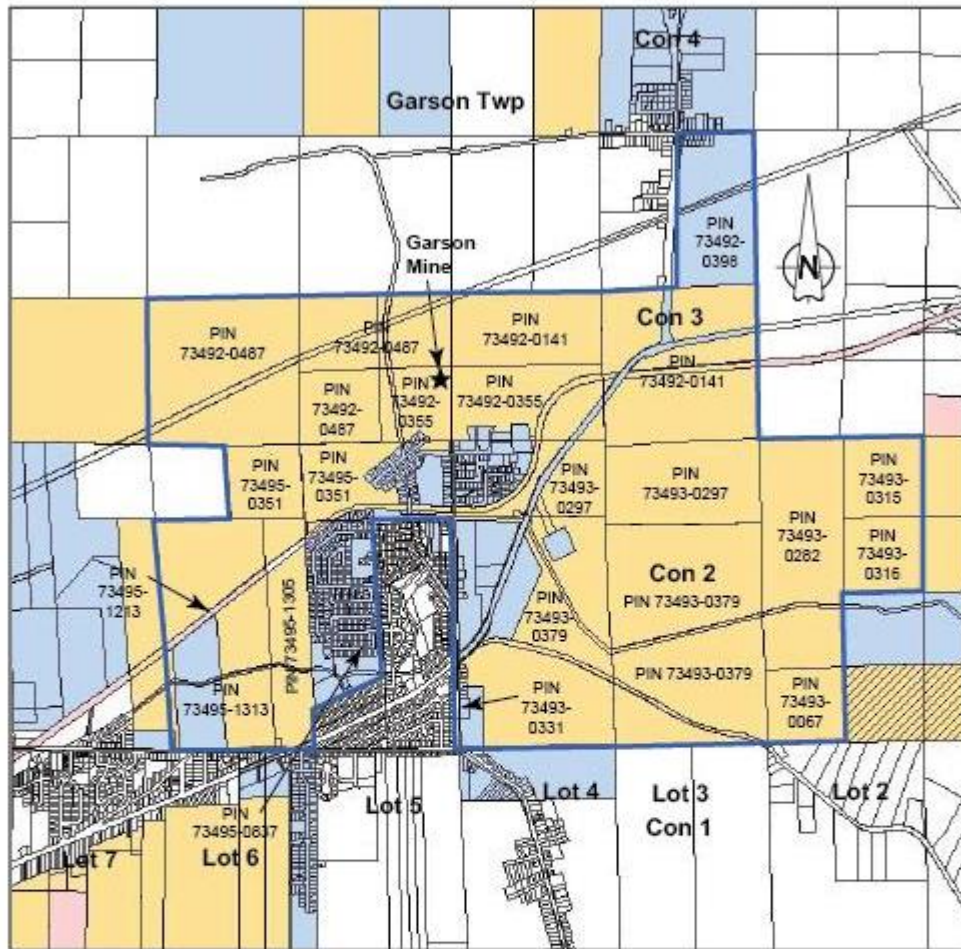
Note: Figure prepared by Vale Base Metals, 2015.

Figure 3-8: Frood-Stobie Property



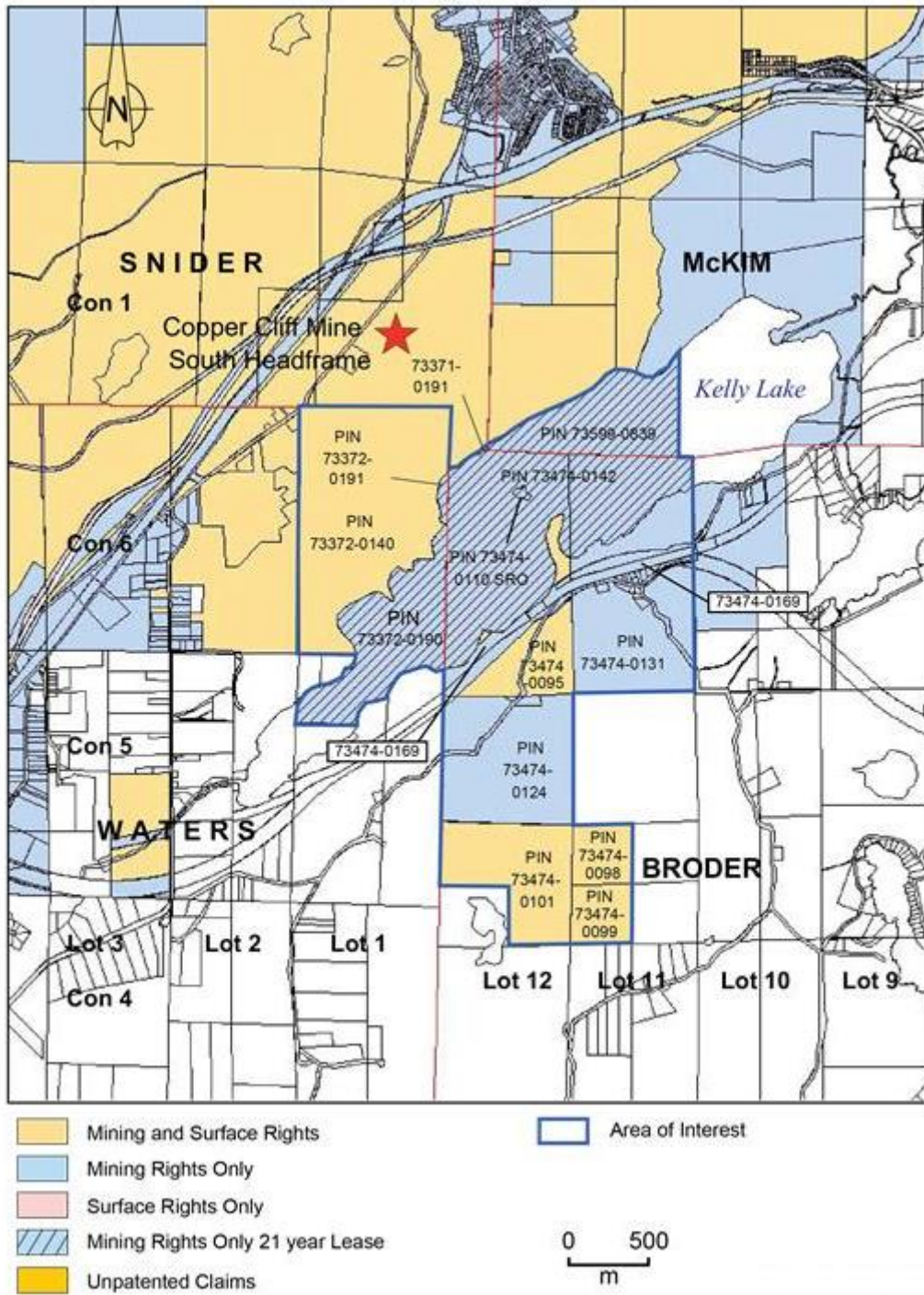
Note: Figure prepared by Vale Base Metals, 2020.

Figure 3-9: Garson Property



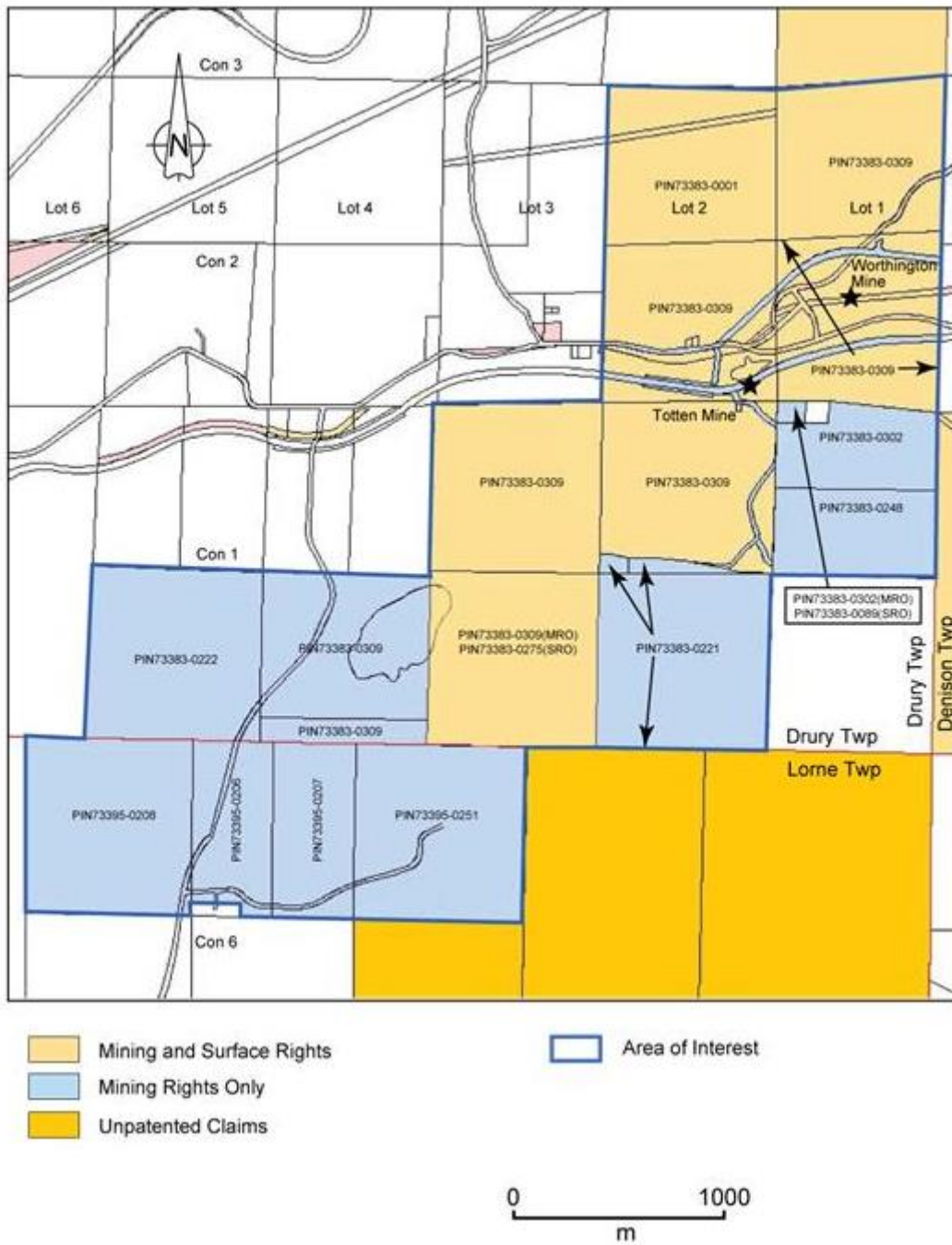
Note: Figure prepared by Vale Base Metals, 2018.

Figure 3-10: Kelly Lake Property



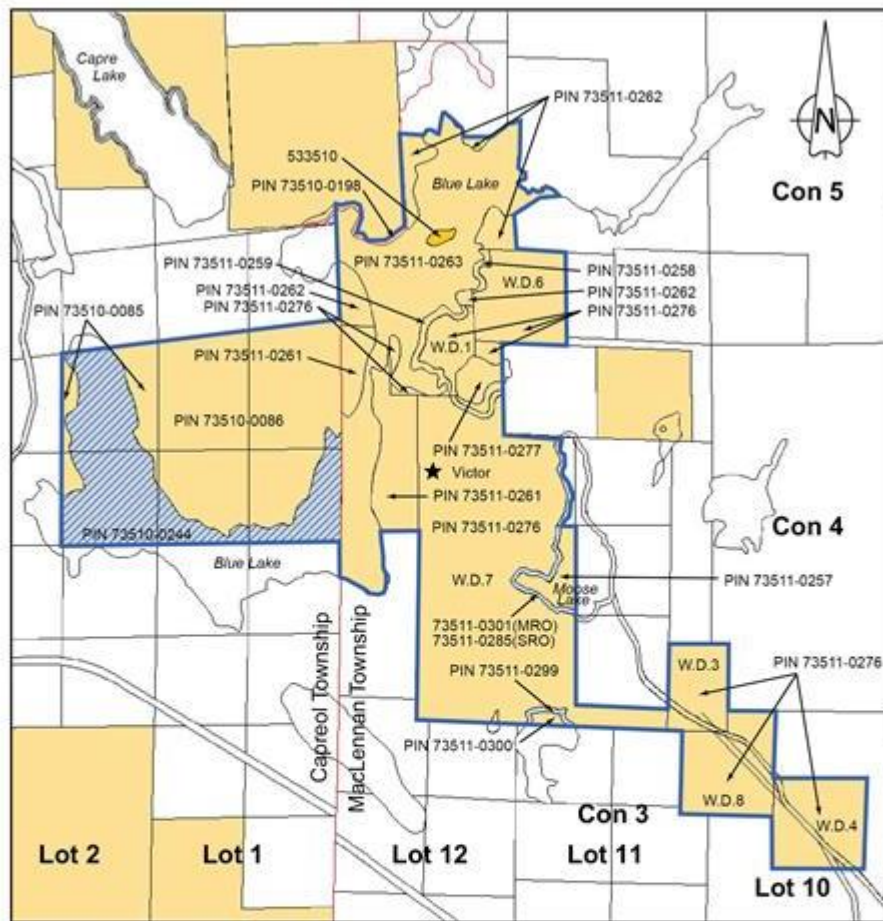
Note: Figure prepared by Vale Base Metals, 2020.

Figure 3-11: Totten Property



Note: Figure prepared by Vale Base Metals, 2020.

Figure 3-12: Nickel Rim South Extension Property



Note: Figure prepared by Vale Base Metals, 2019.

3.4.2 MINING AND SURFACE RIGHTS ON LANDS LEASED TO VALE BASE METALS

VCL holds approximately 14,057 ha of land leased from the Province of Ontario. These leased lands, which include a combination of mining and surface rights, are leased for either 10 or 21 years. Annual rentals of US\$2.30/ha are paid to the Province of Ontario to keep the leases in good standing. Leased lands that have mineral resource/mineral reserve estimates were included in Table 3-4 by deposit.

Based upon experience in renewing similar leases, Vale Base Metals does not expect any problems in obtaining renewals of the leases covering any of the land noted above which Vale Base Metals would want to renew on a timely basis, since the only requirement for renewal is payment of a nominal renewal fee.

3.4.3 MINING LICENSES OF OCCUPATION

VCL holds mining licenses of occupation covering approximately 3,012 ha in Ontario of which approximately 17 ha are held jointly with other parties.

Annual rentals of US\$3.80/ha are paid to the Province of Ontario to keep these mining licenses of occupation in good standing.

Mining licence of occupation listings with mineral resource/mineral reserve estimates were provided in Table 3-4 by deposit.

3.4.4 UNPATENTED MINING CLAIMS

VCL currently holds unpatented mining claims covering approximately 9,235 ha in Sudbury of which approximately 6,596 ha are held jointly with other parties. Unpatented mining claims are issued by the Province for the purpose of exploring the mineral potential and require that assessment work be performed to continue holding the claims.

The mining claims in the Sudbury area were established based on Method 118 for Sectional Townships with Single Fronts under Survey Methods, R.R.O. 1990. Reg. 1029 under the Ontario *Surveys Act*, R.S.O. c. S.30.

3.5 PROPERTY AGREEMENTS

There are no material property agreements that would affect the mineral resource or the mineral reserve estimates presented in this Report.

VCL has a number of third-party property agreements in support of the Ontario Operations, discussed in the following sub-sections.

3.5.1 ROADWAYS AND EASEMENTS

Given the patchwork property holdings of mining companies within the Sudbury area, VCL has multiple road and property easements with various mining companies, in particular Glencore Canada Limited (Glencore), to grant access between each party's properties for the operational and exploration activities necessary for each other's operations.

3.5.2 ACCESS AGREEMENTS

VCL and Glencore have various corridor agreements permitting development of underground corridors by the requestor through the permittee's subsurface rights area allowing access to the requestor's deposit area.

3.5.3 EXPORT AGREEMENTS

VCL holds OIC permits that allow it to export nickel, copper, and precious metals products outside of Canada for further refinement. Each permit is granted for a five-year period, and to date, the permits have been renewed as required. The OIC permit for copper expires in April 2027. The nickel and precious metals OIC permit is current until December, 2030. These permits are necessary for Vale Base Metals to further refine its product to sell demanded products. There is a reasonable expectation that the OIC permits will continue to be renewed for the duration of the life-of-mine.

3.6 SURFACE RIGHTS

Surface rights held by VCL are discussed with the mineral tenure in Chapter 3.4. Surface rights are shown in Figure 3-3 to Figure 3-12.

3.7 WATER RIGHTS

VCL holds applicable water take permits to support operations (discussed in more detail in Chapter 15.6).

While the Port Colborne Refinery water usage is a grandfathered taking, and currently has no expiry date, water takings for all other Ontario Operations facilities and uses are approved under Permits to Take Water issued under the *Ontario Water Resources Act*. Permits to Take Water are in place for the dewatering of mines and for surface and ground water takings that are required to support process, domestic and potable water needs, as well as for the interception of groundwater flow paths that are redirected for treatment. Vale Base Metals monitors Permits to Take Water expiry dates and ensures that applications to renew are submitted in accordance with requirements under the Act to maintain the Permits to Take Water required for its operations.

3.8 ROYALTIES AND STREAMING AGREEMENTS

3.8.1 ROYALTIES

There are no royalties or other similar payments made on the Ontario Operations mine properties that are the subject of this Chapter, other than those discussed in the following sub-sections.

3.8.2 STREAMING AGREEMENTS

VCL and Wheaton Precious Metals Corp. (Wheaton Precious Metals) executed an agreement in 2013 wherein VCL agreed to sell to Wheaton Precious Metals an amount of gold equal to 70% of the gold production from some of its Sudbury mines, including the Coleman, Copper Cliff, Garson, Stobie, Creighton, and Totten Mines and the Nickel Rim South Extension project for a period of 20 years.

Wheaton Precious Metals made a total upfront cash payment to VCL in March, 2013 of US\$570 million plus warrants to purchase 10 million shares of Wheaton Precious Metals common stock at a strike price of US\$65, with a term of 20 years. In addition, Wheaton Precious Metals will make ongoing payments of the lesser of US\$400/oz Au or the prevailing market price per ounce of gold delivered until the agreement expires in 2032.

3.9 ENCUMBRANCES

Various utility and communication easements and rights-of-way traverse the surface rights held by VCL that provide utilities (gas, hydro-electric, water) and communications (telephone landlines, cell) to the surrounding communities. There are no known encumbrances that would impact the LOM.

3.10 ENVIRONMENTAL CONSIDERATIONS

Environmental considerations are discussed in Chapter 17.1 and Chapter 17.2 of this Report.

3.11 PERMITTING REQUIREMENTS

Permitting and permitting conditions are discussed in Chapter 17.4 of this Report.

There are no relevant permitting timelines that apply to the Ontario Operations; the operations as envisaged in the LOM plan are fully permitted.

There are no current material violations or fines as understood in the United States mining regulatory context that apply to the Ontario Operations.

3.12 SOCIAL CONSIDERATIONS

Social considerations are discussed in Chapter 17.5 of this Report.

3.13 SIGNIFICANT FACTORS AND RISKS THAT MAY AFFECT ACCESS, TITLE, OR WORK PROGRAMS

To the extent known to the QP, there are no other known significant factors and risks that may affect access, title, or the right or ability to perform work on the properties that comprise the Ontario Operations other than those discussed in this Report.

4 ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

4.1 ACCESSIBILITY

Well-established transportation routes access the Sudbury Area. Highway 17 is the main branch of the Trans-Canada Highway connecting the city to points east and west. Highway 69, also a branch of the Trans-Canada Highway, leads south to Parry Sound, where it connects to the Highway 400 freeway to Toronto. Highway 144 leads north to Highway 101 west of downtown Timmins.

Access to the various mine and deposit sites is through a system of numbered municipal roads:

- The Blezard deposit is located approximately 9 km north of the city of Sudbury. Access to the deposit area is via Regional Road 80N from downtown Sudbury. The deposit is then accessed by turning right onto a gated gravel road adjacent to Highway 69N approximately 1 km east of the entrance to the closed Glencore Thayer-Lindsley mine;
- The Coleman Mine is located near the town of Levack, approximately 45 km northwest of the city of Sudbury. Access to the mine site is via Highway 35 (old Highway 144) then through the town of Levack. The private mine road from the town to the mine site is paved. For emergencies, a second road access is available to the mine site through Glencore's operations;
- The Copper Cliff Mine is located in the town of Copper Cliff and has two head frames. Access to North Head frame is via Highway 35 (old Highway 144), then west on Clarabelle Road. Access to the South Head frame is via Highway 55 (old Highway 17), then south on Power Street;
- The Creighton Mine is located on the west side of the Greater Sudbury area. Access to the site is via McNaughton Street from Regional Road 24 or Main Street;
- The Garson Mine is located immediately northeast of the town of Garson. Access to the site is via Church St. and Mine Road from Regional Road 86;
- The Copper Cliff Pit deposit is part of Copper Cliff Mine and is accessed through Copper Cliff Mine, which is located 8 km west of the city of Sudbury. Access to the mine is via Regional Road 35 from downtown Sudbury, then Clarabelle Road which is a private gated Vale Base Metals road. The mine is located approximately 3 km along the Clarabelle Road on the right side of the road. The Copper Cliff Pit deposit is located 3 km northeast of the Copper Cliff Mine via an unpaved mine access road;
- The Stobie Pit is located close to the city centre of Sudbury. The mine is accessed from Frood Road (Rural Route 42) at the intersection of Lasalle Boulevard;
- The Totten Mine is located approximately 40 km west of the City of Sudbury on the Worthington Offset dyke. Access to the property can be gained via Municipal Road 4 from Highway 17 West or by the Canadian Pacific Railway line that runs east west through the property immediately north of the Totten No. 2 shaft;
- The Nickel Rim South Extension deposit is located approximately 34 km northeast of the city of Sudbury. Access to the property is via the Greater Sudbury Regional Road 55 from downtown Sudbury, then Regional Road 86 through the town of Garson, and Skead Road passing Sudbury Airport and turning onto the Nickel Rim South mine road, and then a further 7 km north following the Nickel Rim South Extension mine road.

Prospects and exploration areas are accessed via a network of municipal and local private roads.

The mill, refineries and smelter are accessed as follows:

- The Clarabelle Mill is located approximately 7.5 km northwest of the city of Sudbury. Access to the mill facilities is via the Greater Sudbury Regional Road 49, 38 and 35 for 6 km, and turning left onto Clarabelle Road which is a gated private Vale Base Metals road. The mill is located approximately 1.5 km along the road, on the left side;
- The Copper Cliff Smelter is located approximately 8.5 km northwest of the city of Sudbury. Access to the smelter is via Greater Sudbury Regional Road 49 and 55 from downtown Sudbury, turning right onto Balsam Street and following Benjafield Road turning right onto Veterans Road which is a private Vale Base Metals road to the smelter entrance;
- The Copper Cliff Nickel Refinery is located approximately 12 km southwest of the city of Sudbury. Access to the refinery is via Greater Sudbury Regional Road 49 and 55 from downtown Sudbury for 11 km, turning left onto Noront Road and then left onto Industrial Road, which is a private Vale Base Metals road for approximately 2 km;
- The Port Colborne Refinery is located in the city of Port Colborne, Ontario. Access to the refinery is via Clarence Street from downtown Port Colborne for 1 km, turning right onto Welland Street and then left onto Nickel Street for approximately 1 km. The refinery is situated at the corner of Davis and Nickel streets;
- The Clydach Refinery is located in the city of Clydach, Wales. Access to the refinery from downtown Clydach is via Hebron Road/B4603 for approximately 1 km, at the roundabout, take the second exit onto Ynyspenllwch Road/B4291. At the second roundabout, take the second exit and stay on Ynyspenllwch Road/B4291 until the refinery gate is reached.

The Greater Sudbury Airport is served by regional carrier lines. Sudbury is also served by rail. There are no other means of transportation that are used to access the operations.

4.2 CLIMATE

Sudbury has a humid continental climate with warm and often hot summers and long, cold, snowy winters. Precipitation is on average 861 mm annually.

Mining operations are conducted year-round.

4.3 LOCAL RESOURCES AND INFRASTRUCTURE

The City of Sudbury is the closest major regional centre.

The processing facilities in Sudbury include a concentrator, a combined nickel and copper smelter, matte processing facilities, a carbonyl nickel refinery, a copper anode casting plant, a sulphuric acid plant and a sulphur dioxide liquefaction plant. A copper refinery was closed in 2006. Major additional Ontario Operations infrastructure includes a tailings impoundment area, a slag disposal area, and an oxygen plant.

An electro-cobalt refinery and precious metals upgrading facility are located at Port Colborne, Ontario. A portion of the production is sent to a carbonyl nickel refinery in Clydach, Wales.

The Ontario Operations currently have all infrastructure in place to support mining and processing activities discussed in more detail in Chapter 13, Chapter 14, and Chapter 15 of this Report.

4.4 PHYSIOGRAPHY

The major topographic feature of the area is the Sudbury Basin that forms an elliptical ring some 72 km in the northeast direction by 27 km wide. The topographically-higher outer portions of the Sudbury Basin are formed by igneous rocks of the Sudbury Igneous Complex (SIC). The northern, southern, and eastern parts of the rim are referred to as the North Range, South Range and East Range respectively.

Elevations range from 222–445 m above sea level with local relief in the order of 30–60 m.

The topography of the “rim” of the Sudbury Basin consists of relatively rocky hills with intermittent swamps and marshes, covered to varying degrees with mixed forest along the south range of the basin, and predominately coniferous to mixed forests on the north side of the basin.

The central part of the basin is occupied by low-lying flat agricultural land. The dominant vegetation type is temperate boreal forest.

5 HISTORY

The Sudbury district has hosted continuous nickel–copper operations since the initial discovery in 1856, with exploration and development summarized in Table 5-1.

The majority of historical work was undertaken by Vale’s predecessor, the International Nickel Company (Inco), which evolved from earlier operators including the Canadian Copper Company and Mond Nickel. Inco merged these entities and operated until its acquisition by Companhia Vale do Rio Doce (CVRD) in 2006, followed by rebranding to Vale and Vale Canada Limited. On 2024 Vale announced the successful completion of its sale of 10% equity stake in Vale Base Metals to Manara Minerals.

Table 5-1: Exploration and Development Summary Table

Year	Comment
1856	Nickel mineralization identified near the present-day location of the Creighton Mine.
1884	Discovery of Copper Cliff No. 4, Copper Cliff No. 2, Elsie, Froot, Howland and Worthington deposits
1885	Discovery of Copper Cliff, Crean Hill, Evans, Stobie, Little Stobie and Totten deposits
1886	Ellen and Victoria deposits discovered. Creighton deposit re-discovered. Canadian Copper Company of Cleveland, Ohio incorporated
1887	Vermilion and Shepard deposit discovered
1888	Copper Cliff Smelter commenced operations
1889	Levack, Big Levack, and Chicago deposits discovered.
1891	Garson, Trillabelle and Sultana deposits discovered. Orford process for separating nickel and copper in matte discovered
1892	Gertrude, McCreedy, Kirkwood and Cameron deposits discovered
1893	Tam O’Shanter deposit discovered
1897	Whistle deposit discovered
1899	North Star deposit discovered
1900	Mond Nickel Company incorporated
1902	International Nickel Company, Ltd. joint venture by the Canadian Copper Company, Orford Copper Company, and American Nickel Works. Nickel Refinery at Clydach, Wales constructed by the Mond Nickel Company
1907	MacLennan deposit discovered
1912	Capre Lake deposit discovered.
1913	British American Nickel Corporation incorporated.
1918	Refinery built by International Nickel Company in Port Colborne
1919	International Nickel Company began using the trade name Inco
1924	Acton Precious Metal Refinery built by Inco
1925–1927	Inco acquired various assets from British American Nickel Corporation incorporated
1929	Inco merged with Mond Nickel Company
1930	First Copper Cliff refinery begins operation
1935–1936	Inco acquires various assets from Canadian Nickel Company
1954	Upper and Lower Coleman deposits discovered
1959–1960	Totten No. 1 deposit discovered
1971	Clarabelle Mill constructed
1973	Opening of the second Copper Cliff Refinery
1975	Inco became the formal name of the International Nickel Company of Canada, Limited

Year	Comment
1989	Decision to centralize all milling at Clarabelle Mill
1991	Closure of Frood–Stobie Mill
2006	Companhia Vale do Rio Doce (CVRD) announced a C\$19.4 billion takeover of Inco
2007	CVRD rebranded itself to Vale and CVRD–Inco changed name to Vale Inco
2010	Vale Inco changed name to Vale Canada Limited
2011	Exploration and internal studies on the Nickel Rim South Extension/Capre and Copper Cliff deposits
2012	Implementation of the challenging ore recovery (CORE) flow sheet at the Clarabelle Mill. Production testing of the “Rail-veyor” material haulage system at the CC Mine 114 zone and Stobie surface test area. Discovery of the 163 zone at the Coleman Mine. Frood mine operations suspended. Suspension of study activities at Nickel Rim South Extension//Capre.
2013	CORE commissioning completed in October. Smelter complex to reduce to one furnace; later deferred to 2017. Underground expansion project completed at the 170 zone at Coleman. Totten changed status from a project to a mine. Mining studies at Copper Cliff Offset.
2014	Totten Mine formally opened. Ellen operations transitioned from open pit to underground. Mining studies underway at Copper Cliff and Creighton.
2015	Production affected by seismicity at Stobie and Coleman Mines. Matte processing capability affected by electrical switch room fire.
2016	Production at Stobie affected by seismicity. Creighton Mine production focused on new Division 6 area. Coleman transitioned from cut-and-fill to bulk mining methods.
2017	Transition at the smelter complex to a one furnace operation. Execution of the Clean AER project. Super stack will be decommissioned in 2019 and replaced by two smaller 137m. stacks. Stobie mine placed on care and maintenance.
2018	Completion of the Clean AER project. Commenced construction of first phase of Copper Cliff Mine Expansion (South shaft construction). Production at Creighton, Copper Cliff and Garson affected by seismicity. Production interruption at Coleman to repair shaft. Mining studies underway on Copper Cliff (725/740 deposits). Closure of Acton precious metals refinery.
2019	Production at Garson affected by seismicity. Mining studies underway at NRD/ Nickel Rim South Extension/, Copper Cliff Pit, Capre and Crydeman.
2020	Five operating underground mines: Copper Cliff, Creighton, Coleman, Garson, Totten. One mill: Clarabelle Mill. One smelter: Copper Cliff Smelter. Three refineries: Copper Cliff, Port Colborne and Clydach.
2021	Production affected by labour disruption. Production interruption at Totten due to damage to shaft. Mining studies underway at Nickel Rim Deep/ Nickel Rim South Extension, Copper Cliff Mine (Copper Cliff Pit, 178/191/712 deposits), Creighton Mine, Blezard and Stobie.
2022	Completion of the Copper Cliff Mine Phase 1 Project and first ore hoisted. Totten Mine shaft repairs completed, and ore pass returned to functioning state. Production at Garson affected by seismicity. Mining studies continuing at Creighton Mine, Coleman Mine, Copper Cliff Mine (Copper Cliff Pit, 191/178/712 deposits), Nickel Rim Deep/ Nickel Rim South Extension/, and Stobie.
2023	Stobie Pit FEL3 completed and proceeded into planning for execution. Copper Cliff Pit FEL2 study completed and proceeded to FEL3. Mining studies continuing at Creighton Mine, Coleman Mine, Copper Cliff Mine (Copper Cliff Pit, 191/178/712 deposits), and Nickel Rim Deep/ Nickel Rim South Extension.
2024	Manara Minerals, a joint venture between Ma’aden, a Saudi Arabian state-owned company, and Saudi Arabia’s Public Investment Fund, signed a binding agreement with Vale Base Metals Limited, under which Manara Minerals would acquire 10% of Vale Base Metals Limited. Completion of Ella-Capre initial assessment and supports mineral resource estimated. Stobie pit started production. Mining studies continued at Creighton Mine, Coleman Mine, Copper Cliff Mine (Copper Cliff Pit, 191/178/712 deposits), and Nickel Rim Deep/ Nickel Rim South Extension.
2025	At Coleman Mine, rehabilitation for a secondary egress commenced, and the first bulk stope was completed in the Lower 1700B. Copper Cliff Mine south shaft hoisting plant reactivation and associated orebody development were completed. Mining studies continued at Creighton Mine,

Year	Comment
	Coleman Mine, Copper Cliff Mine (Copper Cliff Pit, 191/178/712 deposits), and Nickel Rim Deep/ Nickel Rim South Extension/.

6 GEOLOGICAL SETTING, MINERALIZATION, AND DEPOSIT

6.1 DEPOSIT TYPE

Deposits within the SIC are type examples of nickel–copper mineralization formed from a meteorite impact.

Deposit models for the Sudbury nickel deposits are based on several key geological processes arising from (Morrison et al., 1994):

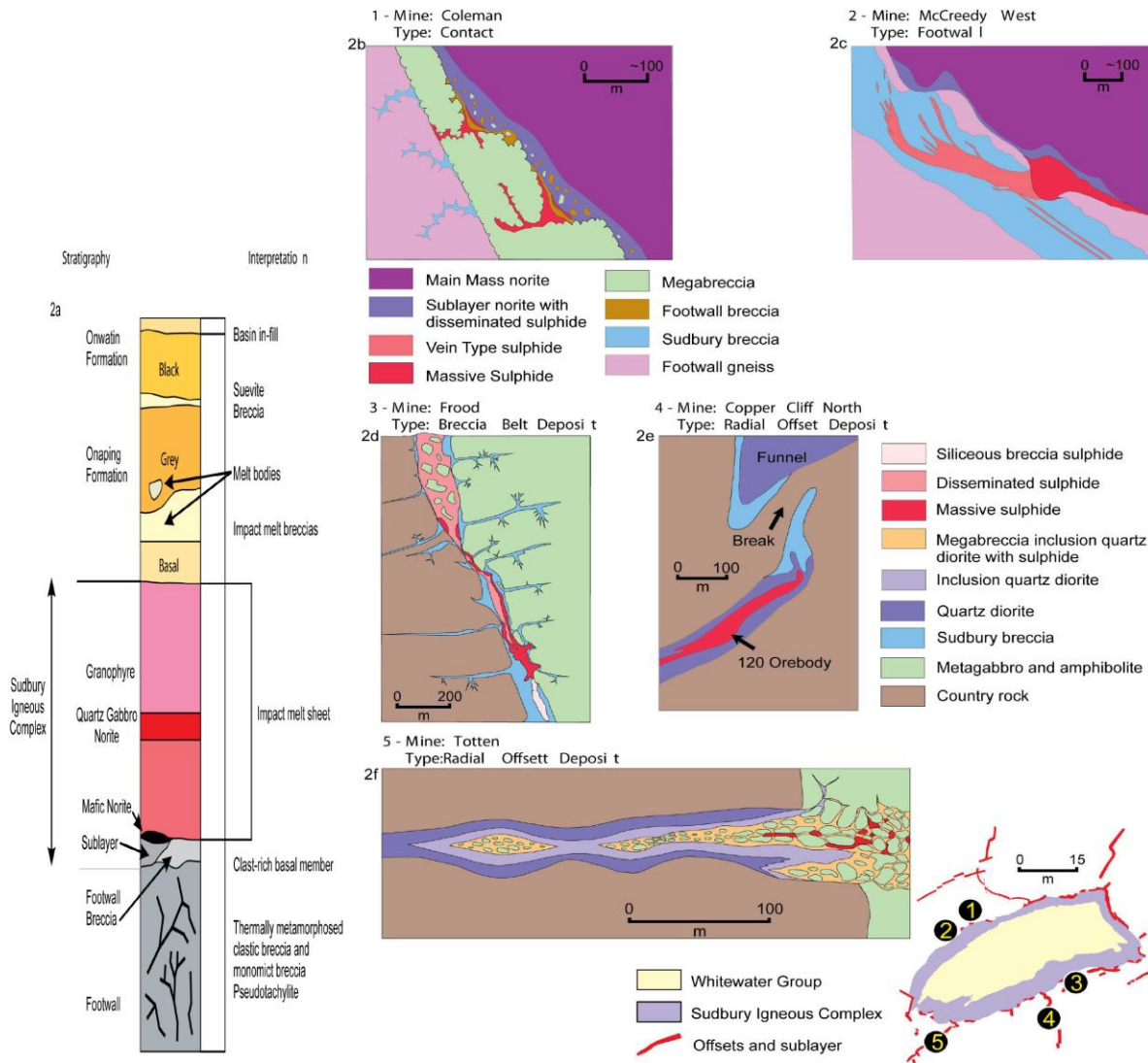
- Meteorite impact;
- Crustal melting;
- Long-lived differentiation of superheated sulphide saturated silicate magmas;
- Gravitational accumulation of sulphides;
- Remobilization of sulphides into dilational structures in the footwall.

Nickel sulphide mineralization is located proximal to the base of the SIC in three main environments (Lightfoot, 2007):

- Contact: Mineralization occurs in both small embayments (~500 m wide, 500 m long, and ~200 m deep) and sometimes as more continuous zones within troughs (~1 km wide, ~1 km deep, and extending for over 3 km);
- Offset quartz diorite dykes: Mineralization occurs in plunging lenses of inclusion-rich quartz diorite distributed at irregular intervals along the Offset Dykes;
- Footwall: Mineralization forms sharp-walled veins that cross-cut the Archean gneisses for distances of several hundred meters away from the original base of the SIC and as continuous zones for distances of up to 1 km; locally these veins are associated with patches of trace disseminated sulphides that carry elevated precious metal abundance levels.

Figure 6-1 illustrates the various deposit type models.

Figure 6-1: Deposit Models



Note: Figure from Lightfoot (2007).

The geological exploration models are supported by deposit-scale surface and borehole geophysical surveys that effectively image the strongly-conductive sulphide mineralization in contrast to barren sulphides that can be hosted in the surrounding country rock (Lightfoot, 2007).

The meteorite impact model is appropriate for exploration purposes.

6.2 REGIONAL GEOLOGY

The Sudbury magmatic copper–nickel sulphide deposits are part of the Paleoproterozoic Sudbury Structure which comprises the SIC and associated dykes, and the overlying Paleoproterozoic Whitewater group rocks. Footwall rocks to the Sudbury Structure are Archean gneisses and granitic and mafic igneous rocks to the north and Paleoproterozoic metavolcanic and metasedimentary rocks of the Huronian Supergroup to the south.

6.3 LOCAL GEOLOGY

6.3.1 GEOLOGY AND STRATIGRAPHY

The SIC is interpreted to be a differentiated impact melt sheet from a bolide collision that occurred approximately 1,850 million years ago. The Sudbury Structure is exposed as an elliptical ring with a northeast-trending long axis of about 72 km and a short axis of approximately 27 km. The upper

northeast-trending contact of the surface expression of the SIC is often referred to as the North Range, similarly the South Range is associated with the areas along or near the southern surface exposure of the SIC contact.

Margins of the SIC are characterized with an average inward dip of about 45° along the north part of the SIC; however, they are generally steeply dipping or overturned in the south and east sections.

Major components of the SIC include the differentiated norite–gabbro–granophyre Main Mass and a group of minor intrusions, collectively termed the Sublayer. Three major variants of the Sublayer are recognized:

- the first comprises igneous-textured gabbro–noritic material;
- the second consists of igneous-textured quartz diorite;
- the third variant comprises a wide variety of metamorphic-textured rocks collectively known as “footwall breccia”.

The Sublayer is localized either at the contact between the Main Mass and footwall rocks or within radiating and concentric dykes cutting footwall rocks. Sublayer units are characterized by disseminated to massive sulphide and by the presence of a variety of xenoliths of both local and unknown or “exotic” derivation.

Rocks of the Whitewater Group are found only within the central portion of the Sudbury Structure. The Whitewater Group consists of three conformable formations, in ascending order:

- Onaping impact-generated breccias;
- Onwatin siltstone and wacke; and
- Chelmsford turbidite.

All rocks defined as footwall to the Sudbury Structure are cut by occurrences of the Sudbury Breccia. This breccia occurs as small veins, irregularly-shaped patches, and large bodies, which may extend for many kilometers along strike. The breccia consists of inclusions of locally-derived footwall lithologies within comminuted footwall rock. The Sudbury Breccia has been interpreted as pseudotachylitic, formed by in-situ milling processes during formation of the Sudbury Structure. The Sudbury Breccia is known to occur more than 100 km from the SIC.

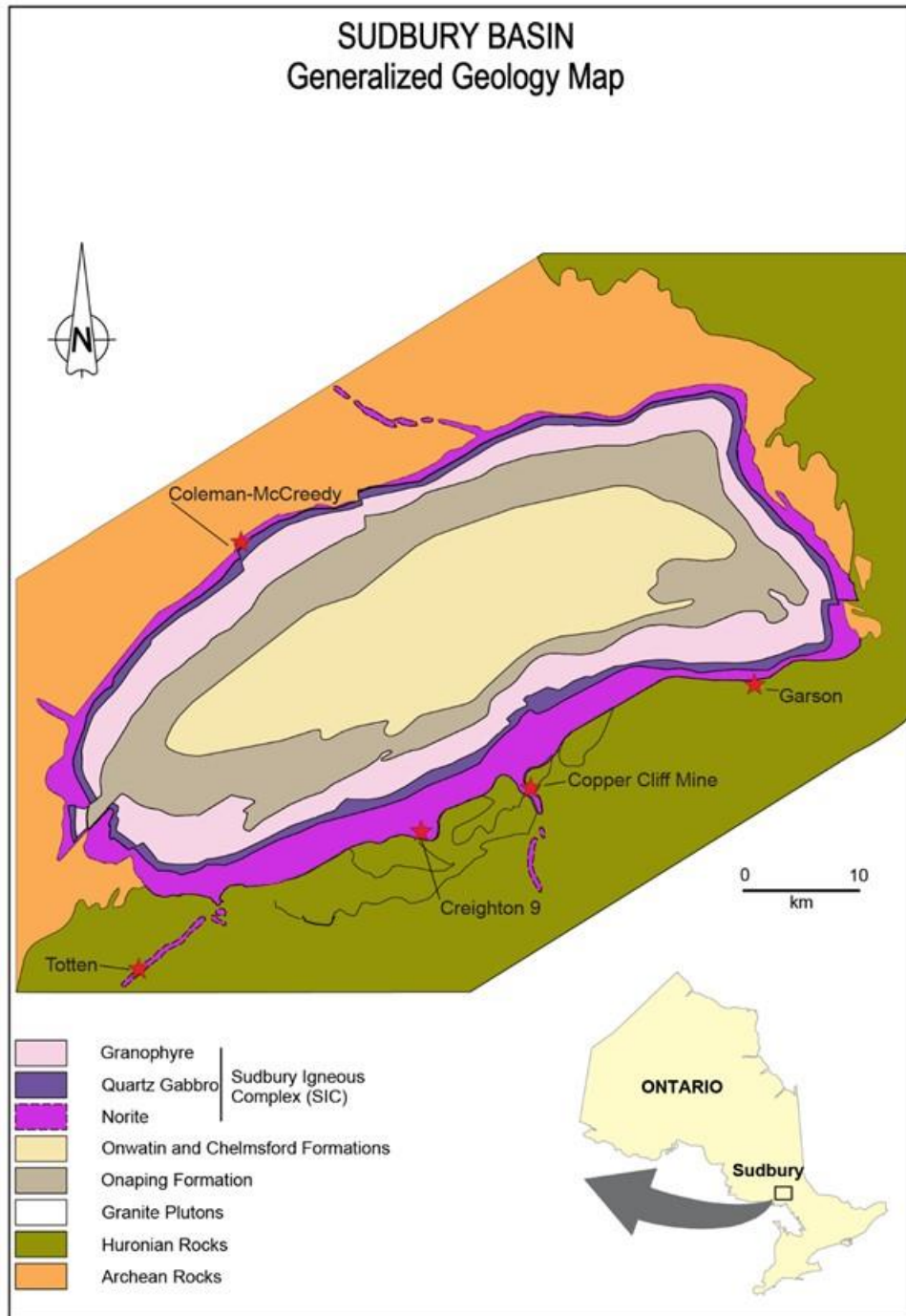
The Sudbury Structure is cut by a number of regional and local mafic dyke swarms. Archean footwall rocks on the North Range are crosscut by north–south-trending dykes of the Matachewan swarm. Northwest-trending olivine tholeiitic dykes of the Sudbury swarm crosscut the SIC and all rock units within and surrounding the Sudbury Structure. A set of east–northeast-trending lamprophyre dykes and a set of quartz–diabase dykes cut rocks of the SIC but are older than the olivine tholeiites.

The Murray and Creighton granitic plutons, part of the Cartier batholith, intrude the Huronian Supergroup, and predate the impact.

Figure 6-2 shows the general geology of the Sudbury Basin. Figure 6-3 shows a simplified stratigraphic column for the North Range and South Range of the Sudbury Basin.

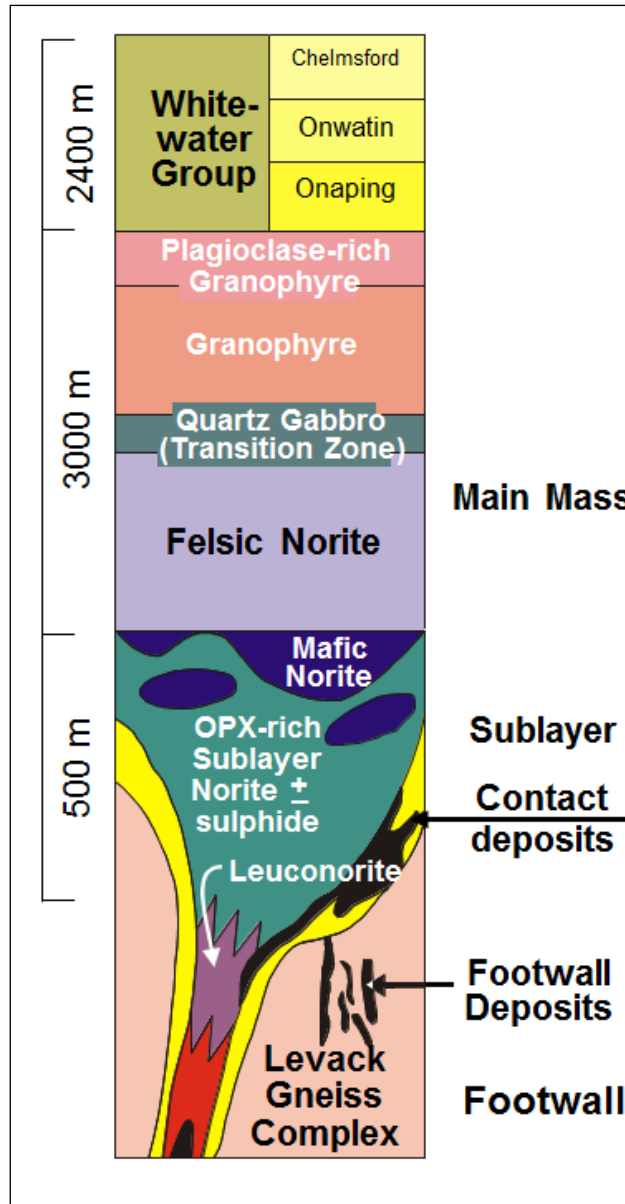
Table 6-1 summarizes the major lithological and stratigraphic units. Table 6-2 summarizes the most common rock types proximal to, or hosting, the Sudbury-area deposits as logged by the mine geologists.

Figure 6-2: Regional Geology of Sudbury Basin



Note: Figure prepared by Vale Base Metals, 2021. Red stars note the location of Vale Base Metals mines operating in 2021.

Figure 6-3: Sudbury Basin: Simplified Stratigraphic Column



Note: Modified by Vale Base Metals after Bailey (2012).

Table 6-1: Project Stratigraphy

Location	Group	Formation	Notes
Hanging wall	Whitewater Group Rocks	Chelmsford Formation	A thick sequence of proximal turbidites that exhibit well-developed Bouma sequences. Uppermost preserved unit of the Whitewater Group.
		Onwatin Formation	Is, in the absence of the Vermilion Formation, in gradational contact with the Black member of the Onaping Formation. Consists of carbonaceous and pyritic, massive to laminated, argillite and siltstone with minor interbedded wacke deposited in a stagnant, anoxygenic environment.
		Vermilion Formation	Discontinuously overlies Onaping Formation. Consists of bedded carbonate, siltstone, argillite, and chert, locally containing

Location	Group	Formation	Notes
			significant concentrations of volcanogenic copper-lead-zinc-silver massive sulphide. Interpreted as an exhalite-rich sequence deposited during the waning stages of Onaping Formation sedimentation.
		Onaping Formation	Complex of heterolithic breccia units with a total estimated thickness of up to 1,600 m. Three major stratigraphic members: Basal, Gray and Black; each consisting of a variety of breccias in numerous units composed of any combination of country rock fragments, glassy material, finely comminuted matrix material and minor sulphide mineralization. Variably interpreted as a sequence of ash-flow tuffs and lavas, impact fallback breccia and melt or, more recently, as impact-generated breccias modified by internally generated volcano/sedimentary processes
Sudbury Igneous Complex	Main Mass		North Range: basal unit of poikilitic mafic norite with orthopyroxene as the only cumulus phase, a felsic norite unit with plagioclase, ortho- and clinopyroxene as cumulate phases, a quartz gabbro unit with plagioclase, clinopyroxene, magnetite and apatite as cumulate phases and an uppermost unit of granophyre. South Range: quartz-rich norite, south range norite, quartz gabbro and granophyre. Basal units of the SIC, i.e., the mafic norite on the North Range and the quartz rich norite on the South Range may contain minor, non-economic, disseminated sulphide mineralization
	Sublayer		Copper–nickel–PGE mineralized zones at Sudbury are spatially and genetically related to relatively small bodies of inclusion-rich material localized either at the contact between the main mass of the SIC and footwall rocks (contact sublayer) or within radiating and concentric dykes cutting footwall rocks (offset dykes). Three major variants of sublayer are recognized: igneous-textured gabbronoritic material; igneous-textured quartz diorite; and a wide variety of metamorphic-textured rocks collectively known as “footwall breccia”. Gabbronoritic sublayer typically occurs in contact deposits and in the proximal (0–2 km from SIC contact) portions of the North Range offset dykes. Quartz diorite is the main component of South Range offsets and of distal (>2 km from SIC contact) portions of North Range offsets. Footwall breccia occurs as sheets and discontinuous lenses concentrated along the lower contact of the SIC and as a major component of some of the offset dykes. Igneous- and metamorphic-textured sublayer are characterized by disseminated to massive sulphide and by the presence of a variety of xenoliths of both local and unknown or “exotic” derivation.
Footwall	Footwall		Defined as rock units characterized by deformational and metamorphic features related to the 1.85 Ga Sudbury impact event; i.e., those rocks that can be shown to contain one or more inclusions of Sudbury Breccia, shatter cones or shock-induced microscopic deformation features. The impact-related features may extend more than 80 km north and east of the SIC, and to the Grenville Front south of the SIC. North Range: Archean migmatitic gneisses (Levack Gneiss) and granitoids; variably metamorphosed to amphibolite or granulite facies. Small relict Archean greenstone belts are locally present while unconformable patches of Paleoproterozoic Southern Province (Huronian) sedimentary strata and Nipissing suite mafic

Location	Group	Formation	Notes
			intrusive rocks are preserved within half graben-like structures that define a partial rim-syncline within the Sudbury Structure. South Range: Paleoproterozoic, Southern Province, basic and felsic volcanic rocks, co-eval mafic and felsic sub-volcanic intrusions, cyclic sedimentary sequences of coarse to fine clastic sediments and later mafic intrusions of the Nipissing Diabase suite.

Note: Table compiled from Muir and Peredery, 1984; Naldrett et al., 1970; Pattison, 1979; Lightfoot et al., 2002; Dressler et al, 1991.

Table 6-2: Mine-Scale Lithologies

Unit	Notes
Creighton Granite (CRGR, GYGR, GR)	Medium to coarse grained, pink to grey granite consisting primarily of quartz, feldspars, and biotite. Local porphyritic lenses. Typically, massive, but zones of foliation and shearing exist, with varying degrees of alteration in the form of chlorite, sericite, biotite, and epidote. Quartz and/or carbonate veining can be found throughout the pluton.
Black porphyry (BKPR)	Aphanitic to fine grained black mafic matrix supporting medium to coarse-grained phenocrysts of Na-feldspar. Found sporadically throughout the footwall of the Creighton environment, and has similar whole rock and mineral chemistry as the footwall granites; interpreted as a phase of the larger Creighton granite intrusive pluton.
Meta-gabbro (MTGB)	Fine to medium grained, dark to light green-grey color, typically massive, but can be strongly sheared. Includes amphibolites that may be of intrusive or volcanic origin. Quartz and/or carbonate veins are locally intense and zones of brecciation are frequently filled with a stockwork of hairline carbonate veinlets. This term is frequently applied to the Nipissing Gabbro and other pre-Sudbury event mafic intrusions.
Meta-sediment (MTSD, QTE)	Represents Huronian sedimentary rocks and is common throughout the South Range deposits. The various formations consist of metamorphosed greywacke, quartzite, and argillite, often with gradational contacts; commonly strongly foliated and locally schistose, is very fine to coarse grained, and consists of mostly quartz and mica.
Olivine diabase Dyke (OLDI)	Very fine-to-fine grained, black to dark grey, massive intrusive dykes that are mineralogically and texturally similar throughout the Sudbury Basin. Usually strongly magnetic due to abundant magnetite, and may have a plagioclase porphyritic texture. Aphanitic chill margins. Dated at ~1,240 Ma, and represent the youngest rock to cut the SIC.
Quartz diorite (QD and IQD)	Semi-continuous (or offset) dykes or lenses within metabreccia zones. Generally massive, fine to medium grained, equigranular and black to dark grey green. QD has a variable inclusion content, with the higher content referred to as inclusion quartz diorite (IQD), and commonly sulphide accumulations are associated with increased inclusion content. QD dykes extend radially and concentrically from the SIC on a scale of several kilometers, and are host to several major Ni-Cu-PGE deposits.
Sudbury Breccia (SUBX) – Metabreccia (MTBX)	Pseudotachylite unit forming irregular zones both parallel and perpendicular to the SIC. SUBX commonly has an aphanitic black matrix supporting sub-angular to sub-rounded fragments of footwall material. In the footwall zones the Sudbury Breccia is sometimes associated with chalcopyrite and PGE-Au mineralization. The Metabreccia variety has undergone varying degrees of thermal metamorphism and may be partially recrystallized.
Sublayer norite (SLNR)	Occurs as discontinuous lenses in troughs or embayments of the Sudbury Basin. Typically, a heterogeneous breccia consisting of a fine to coarse-grained dark green to grey-green, variably mineralized noritic matrix that contains inclusions of footwall and occasionally “exotic” origin. The SLNR is host to most of the “Contact” type deposits.
Diabase dyke (Trap Dyke) (TRAP, QDIA)	Very fine-to-fine grained, black to dark grey, massive intrusive dykes. Chill margins are aphanitic. Cross-cut SIC units and are thus younger than 1850 Ma. There is also an unrelated, undated Lamprophyre unit commonly logged as QDIA.

Unit	Notes
Meta-basalt (MTBS)	Medium to coarse grained, dark green to black, equigranular or foliated consisting of amphibole, (hornblende and actinolite), plagioclase, quartz, and chlorite. Meta-basalts commonly form a footwall lithology although splintered-off segments occur in the hanging wall as well.
Murray Pluton (Granite, GR)	Medium to coarse grained unit, pink to grey granite consisting primarily of quartz, Na-feldspar (microcline), and K-feldspar (plagioclase) as a groundmass. Occurs high above the sulphide mineralized hanging wall. Local porphyritic zones can form lenses. Typically, massive, but zones of foliation and shearing exist, with varying degrees of alteration in the form of chlorite, sericite, biotite, and epidote.
Amphibolite (AMPH)	Very fine-to-very coarse grained, dark grey-green amphibole; commonly represents the metamorphic equivalent of the pre-event mafic dykes, Nipissing diabase or Huronian mafic volcanic rocks.
Footwall breccia (GRBX, FWBX)	Discontinuous heterolithic breccia unit; lies between the footwall rocks and the lower most SIC unit; commonly hosts significant sulphide accumulations on the North and East Ranges. Consists of variable footwall clasts, angular to subrounded, ranging from microscopic to greater than 120 m. Fragments are generally locally derived, however exotic fragments are observed. The breccias have been partly recrystallized and annealed by heat from the overlying SIC.
Granite gneiss or mafic gneiss (GRGN, MFGN, GDGN)	Footwall rocks on the North and East Ranges, mostly represented by the Levack Gneiss Complex of the Superior Province. Composed of Archean migmatitic rocks and tonalitic to quartz–dioritic gneiss, with local mafic layers ranging from amphibolite to granulite facies. At least two generations of mafic Archean diabase dykes intrude these gneisses.

6.3.2 STRUCTURE

Rocks of the Sudbury Structure are variably affected by five major fault sets, as summarized in Table 6-3.

Table 6-3: Key Structures, Sudbury Region

Fault Orientation	Fault Type	Note
East–northeast to northwest-trending	Major, south-dipping, curvilinear, reverse faults	Form the South Range Shear Zone and include the Cliff Lake Fault
North–northwest-trending	Steeply dipping structures with a generally sinistral sense of displacement	Cut the North Range of the Sudbury Structure. Faults crosscut the mineralization at the Coleman Mine. Displacement of as much as to 914 m on the Fecunis Lake Fault
Northerly-trending	Sinistral sense of displacement	Cut at a shallow angle on the east side of the Sudbury Basin
East–west-trending	Steeply-dipping faults, displacement is right-lateral	Cut the South Range of the Sudbury Basin. Include the Murray Fault system and Creighton fault.
Late-stage	Formed by the current tectonic stress field	Commonly infilled with galena, marcasite, and carbonate minerals; sometimes associated with poor ground conditions

6.3.3 MINERALIZATION

The Sudbury deposits host a variety of different sulphide styles/textures and are listed in Table 6-4.

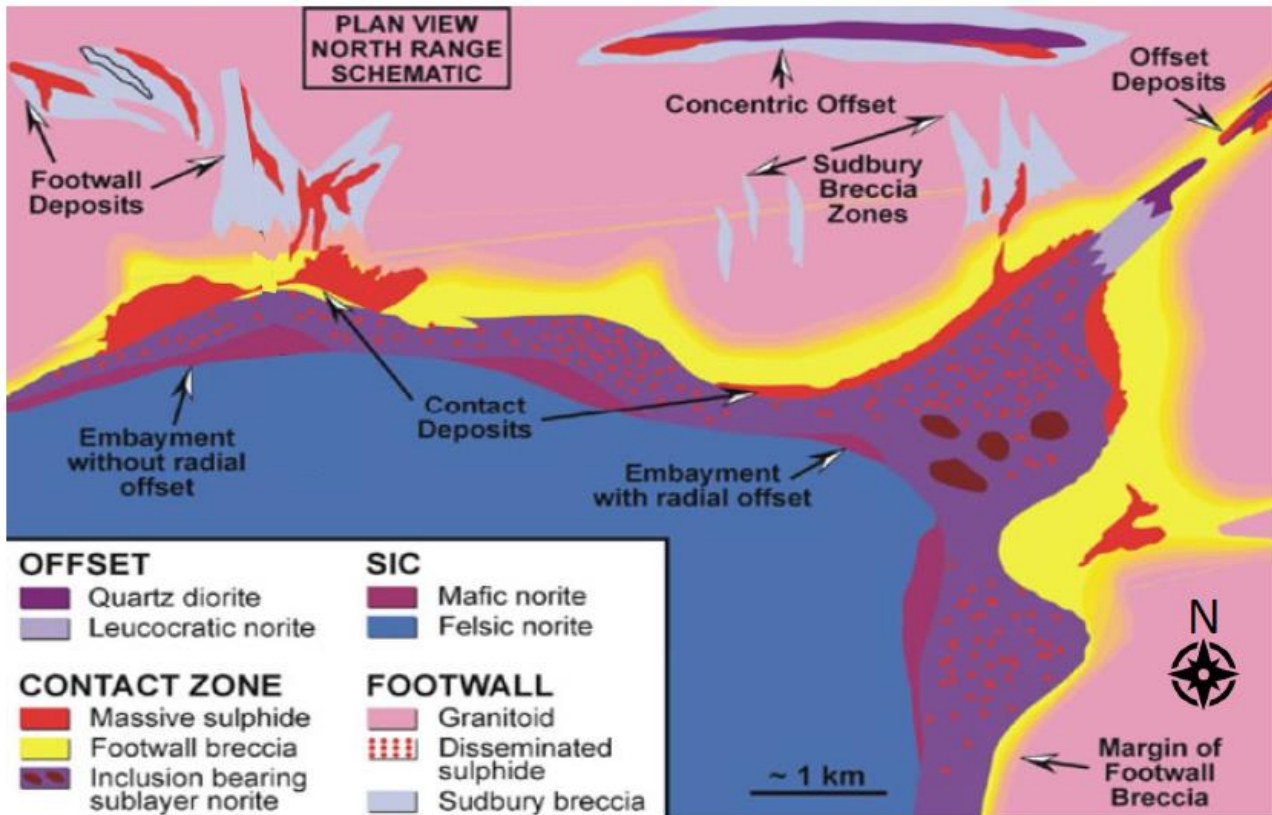
Pyrrhotite is the most common sulphide mineral. Chalcopyrite is the main copper-bearing mineral and second most common sulphide mineral. Chalcopyrite is typically (but not always) associated with elevated platinum group elements (PGEs) and precious metals. Pentlandite is the main nickel mineral and is present in all ore types. Pentlandite occurs as flames in or at grain boundaries of pyrrhotite. It commonly forms megacrystic “eyes” or elongated blebs in massive sulphide and in veins.

Figure 6-4 shows a schematic of the various mineralized environments in the Sudbury Basin, each of which are described in the following sections.

Table 6-4: Sulphide Mineralization Styles

Sulphide Type	Notes
Massive sulphide (MASU)	Generally, appears to be composed entirely by sulphide minerals, but commonly contains as much as 15% silicate as indiscrete clots and blebs plus variable amounts of magnetite. For the majority of deposit types, it contains approximately 80–85% pyrrhotite (Po), while pentlandite (Pn) and chalcopyrite (Cp) content is approximately equal. In the footwall hosted high copper vein-style deposits such as the Coleman 153 Orebody the MASU is essentially chalcopyrite with minor amounts of cubanite, pentlandite and silicate inclusions. The MASU grades into other sulphide mineralization types and locally occurs as inclusions in the quartz diorite.
Breccia sulphide (BXSU)	Composed of subrounded to angular breccia of sublayer norite and lesser amounts of surrounding wall rocks within a fine-grained matrix. It generally contains less than 50% sulphide. The sulphide consists of the typical Po–Pn–Cp assemblage and is generally fine to medium grained.
Gabbro–peridotite inclusion sulphide (GPIS)	Consists of a matrix of massive sulphide with more than 10% inclusions. The inclusions are generally derived from the sublayer but may include footwall rocks, and range up to 50 m in size. The inclusions generally differ from the adjacent footwall rocks and may represent cognate xenoliths, which may represent earlier crystallized deeper layers of the irruptive. The sulphide assemblage includes typical mineralogy (Po–Pn–Cp) and is generally medium grained. Many of the inclusions have highly altered serpentinized or talcose edges.
Disseminated (DISS)	Low sulphide mineralization containing rounded to subrounded sulphide disseminations. It generally contains less than 30% sulphide and the sulphide is composed of the typical Po–Pn–Cp assemblage.
Ragged disseminated sulphide (RGDI)	Similar to disseminated sulphide mineralization but the sulphide forms as irregular cusped blebs within a sparse noritic matrix enclosing small, altered gabbroic inclusions. The inclusions may be related to the better preserved gabbroic and ultramafic inclusions found in gabbro–peridotite inclusion sulphide, and this mineralization type is commonly gradational to gabbro–peridotite inclusion sulphide.
Inclusion massive sulphide (INMS)	Massive sulphide mineralization with >10% inclusions of footwall rocks, angular to sub-round in shape. The inclusions are entirely surrounded by sulphides, which includes the typical Po–Pn–Cp assemblage. INMS transitions to other sulphide mineralization types both gradually and sharply.
Contorted schist inclusion sulphide (CSIS)	This is a high-sulphide content mineralization containing schistose fragments within a fine-grained sulphide matrix. The fragments are often rounded, crescent or s-shaped, and make up from less than 10% to more than 50% of the mineralization. The sulphide is finer grained than in other sulphide mineralization types and generally has a lower Cu/Ni ratio. CSIS may be transitional into MASU.
Interstitial sulphide (INSU)	Similar to disseminated sulphide mineralization, but a less common mineralization type characterized by sulphide filling interstices between cumulus crystals of pyroxene and/or plagioclase.

Figure 6-4: Schematic Showing Mineralization Types



Note: Figure prepared by Vale Base Metals, 2020

6.3.3.1 CONTACT-STYLE DEPOSITS

Contact-type deposits occur at the base of the SIC in association with the Sublayer. The Sublayer volumetric distribution is controlled by the shape and morphology of the basal contact of the SIC. It is absent in some areas and >700 m thick within trough and embayment features that are distributed around the basal contact of the SIC. Sulphide mineralization within the Sublayer is generally zoned from massive sulphide at the footwall to disseminated sulphide towards the hanging wall.

6.3.3.2 OFFSET-STYLE DEPOSITS

Offset-style deposits consist of Sublayer norite and quartz diorite with a variable footwall breccia component occurring as dyke-like structures radial or concentric to the contact of the SIC. They can extend for many kilometres into the Sudbury Basin footwall rock. Mineralization consists of zones of disseminated blebby and massive nickel–copper–PGE sulphide that are spatially associated with inclusion-rich phases of quartz diorite and with local dyke structural complexities.

Inclusion-rich quartz diorite is commonly located in the center of the dykes but, on occasion, may occur at the contact with footwall rocks. Contacts between the inclusion-bearing and inclusion-free phases may be diffuse to extremely sharp in character.

Sulphide mineralogy is dominated by pyrrhotite and less abundant pentlandite and chalcopyrite. Copper to nickel ratios are approximately one, and PGE values are variable.

6.3.3.3 FOOTWALL-STYLE DEPOSITS

Footwall-style deposits are emplaced in dilatant fractures within or near thermally-metamorphosed Sudbury Breccia. A physical connection between Contact and Footwall-style mineralization is not always preserved or recognized. Footwall-style deposits host highly fractionated mineralization

compared to the contact-style mineralization. In general copper, nickel, platinum, palladium and gold grades increase from the Contact-style mineralization into the Footwall-style mineralization, while cobalt, grades decrease.

Two types of Footwall deposits are identified in the North Range. These are massive sulphide copper–PGE deposits and low-sulphide high-PGE deposits:

- The massive sulphide copper–PGE Footwall mineralization has significant PGE content. It occurs as veins and stockwork systems. These deposits may occur up to 600 m into the Huronian footwall rocks in the North Range. Sulphide mineralization is primarily massive chalcopyrite or cubanite that varies from a few millimetres to >10 m wide. Veins that consist of massive intergrown bornite, chalcopyrite and millerite characterize the distal portions of these deposits;
- Low-sulphide high-PGE footwall mineralization occurs as disseminated sulphide and fracture fillings and quartz vein sulphide adjacent to the Footwall massive sulphide copper–PGE mineralization, and as large zones of fine-grained disseminations and narrow discontinuous fracture fillings in “footwall breccia” and Sudbury Breccia in the North and East ranges of the Basin. The low-sulphide high-PGE–gold footwall mineralization is dominated by chalcopyrite and minor millerite.

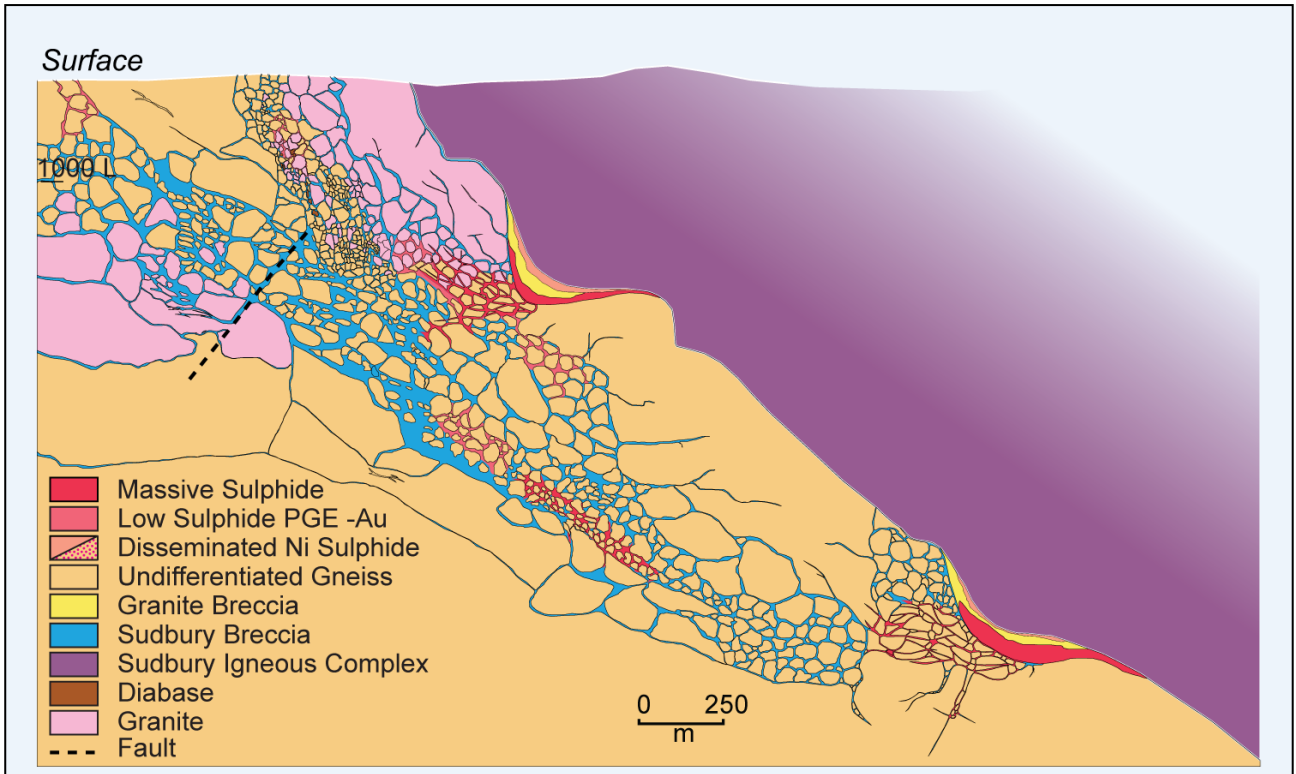
Low-sulphide–high-PGE, and to a lesser extent massive sulphide copper–PGE deposits occur in the South Range.

Most orebodies in the Sudbury area have experienced some degree of tectonic overprint. This has caused local remobilization of sulphides.

Deformation by the South Range Shear Zone tectonic overprinting has locally resulted in significant variations in the ore mineralogy by enhancement or depletion of nickel grades. Pyrite–marcasite has locally replaced pyrrhotite and pentlandite due to oxidation, and development of trace mineral assemblages, including cobaltite–gersdorffite, maucherite ($\text{Ni}_{11}\text{As}_8$), galena, and sphalerite.

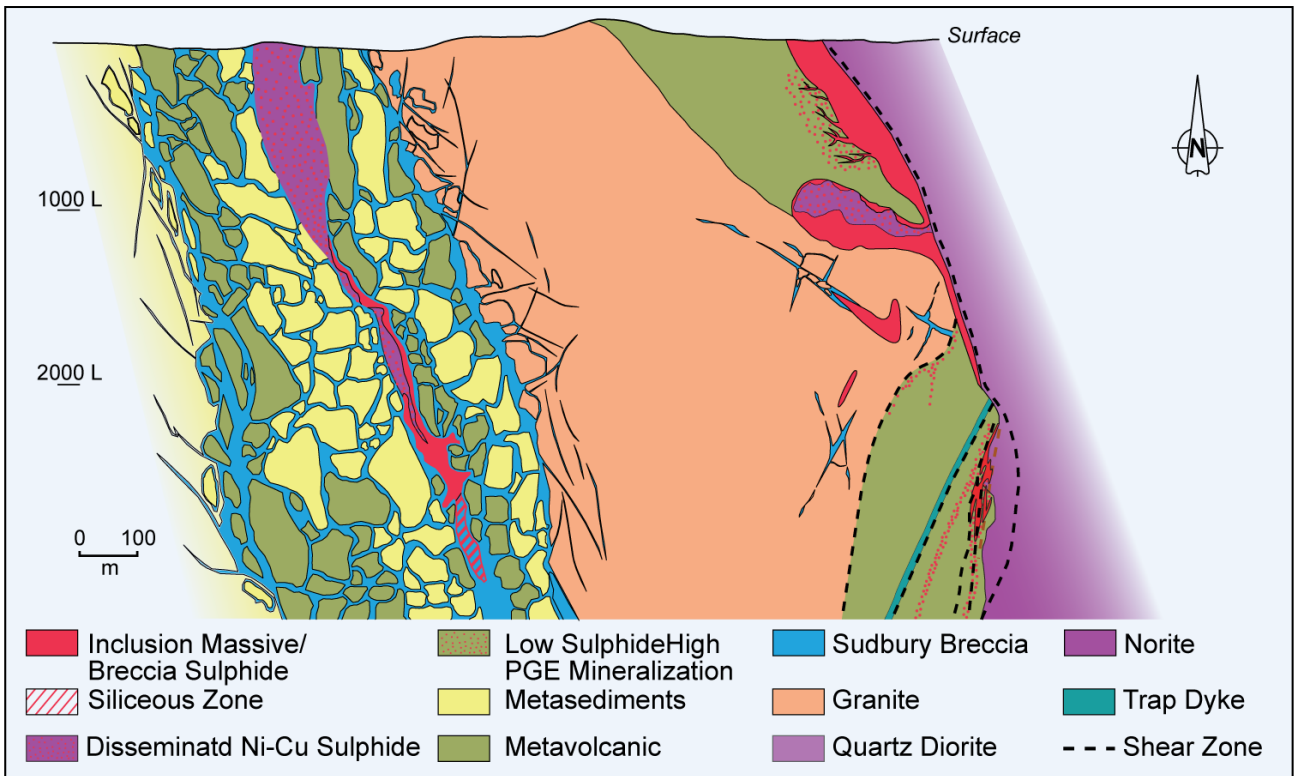
Figure 6-5 and Figure 6-6 are generalized sections for the North Range and South Range respectively, showing the typical deposit types that can be found in each of these areas.

Figure 6-5: Composite Cross-Section of North and East Range Deposit Types



Note: Figure prepared by Vale Base Metals, 2016

Figure 6-6: Composite Cross-Section of South Range Deposit Types



Note: Figure prepared by Vale Base Metals, 2016

6.4 PROPERTY GEOLOGY

The deposits that have current mineral resource estimates are discussed in alphabetical order in the following sub-sections.

6.4.1 BLEZARD

The Blezard Contact-type deposit is in a primary trough at the base of the SIC, which is situated at the northeastern end of the South Range Breccia Belt between the Stobie and Garson complexes. The near-surface part of the deposit was mined from 1889–1893. The deeper part of the Blezard deposit is undeveloped within the Vale Base Metals property holdings and continues into the adjacent Lindsley contact and footwall deposits that were mined by Glencore from 1992–2009.

6.4.1.1 DEPOSIT DIMENSIONS

The Blezard Contact-type deposit is approximately 969 m long, ranges in width from 46–213 m, averaging 137 m, and ranges in thickness from 55–91 m, averaging 61 m. The deposit is currently delineated from surface to a depth of 671 m, dips at about 45°, and plunges to the northeast at 45°.

6.4.1.2 LITHOLOGIES

The SIC in the Blezard area includes the Sublayer, South Range Norite and quartz gabbro. The Sublayer forms an irregular, discontinuous sheet at the base of the SIC. It can include fragments of norite, basalt, gabbro, granite, and ultramafic rocks set in a fine-grained matrix. The Sublayer has a sharp contact with the underlying tholeiitic basalt, mafic tuff and gabbro units. The upper contact is gradational with the South Range Norite.

The major host rock types to the sulphide mineralization include metamorphosed gabbro-norite, amphibolite and diorite. In all cases, primary minerals and textures have been subjected to greenschist facies metamorphism and locally, lower-temperature alteration.

All rock types are cut by late mafic and olivine diabase dykes that are associated with northwest-trending brittle deformation zones within the footwall and SIC units.

6.4.1.3 STRUCTURES

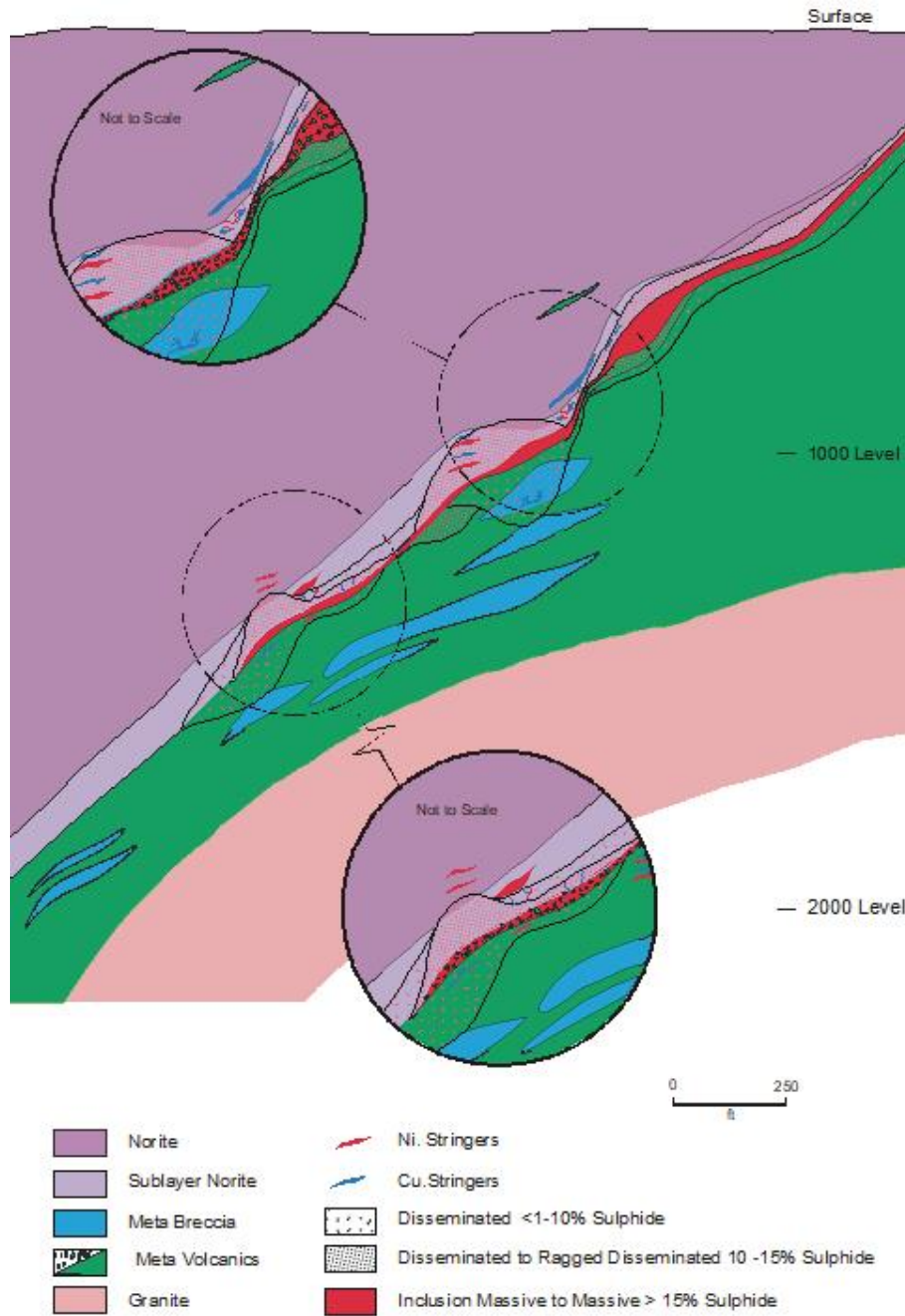
Shearing, interpreted as post-mineralization, has formed zones of biotite schist along the footwall/Sublayer contact.

6.4.1.4 MINERALIZATION

Blezard mineralization is hosted within the SIC contact containing between 5–65% sulphides. The breccia matrix consists of pyrrhotite, chalcopyrite, pentlandite, minor quartz, and magnetite as disseminations, ragged masses, and veins, within fine-grained norite. Pyrrhotite, chalcopyrite, and pentlandite are the major sulphides. Pyrite is only a minor constituent. Galena and sphalerite can occur in late north-trending cross-cutting veins, in association with calcite and marcasite. Platinum group elements include michenerite (PdBiTe) and sperrylite (PtAs₂).

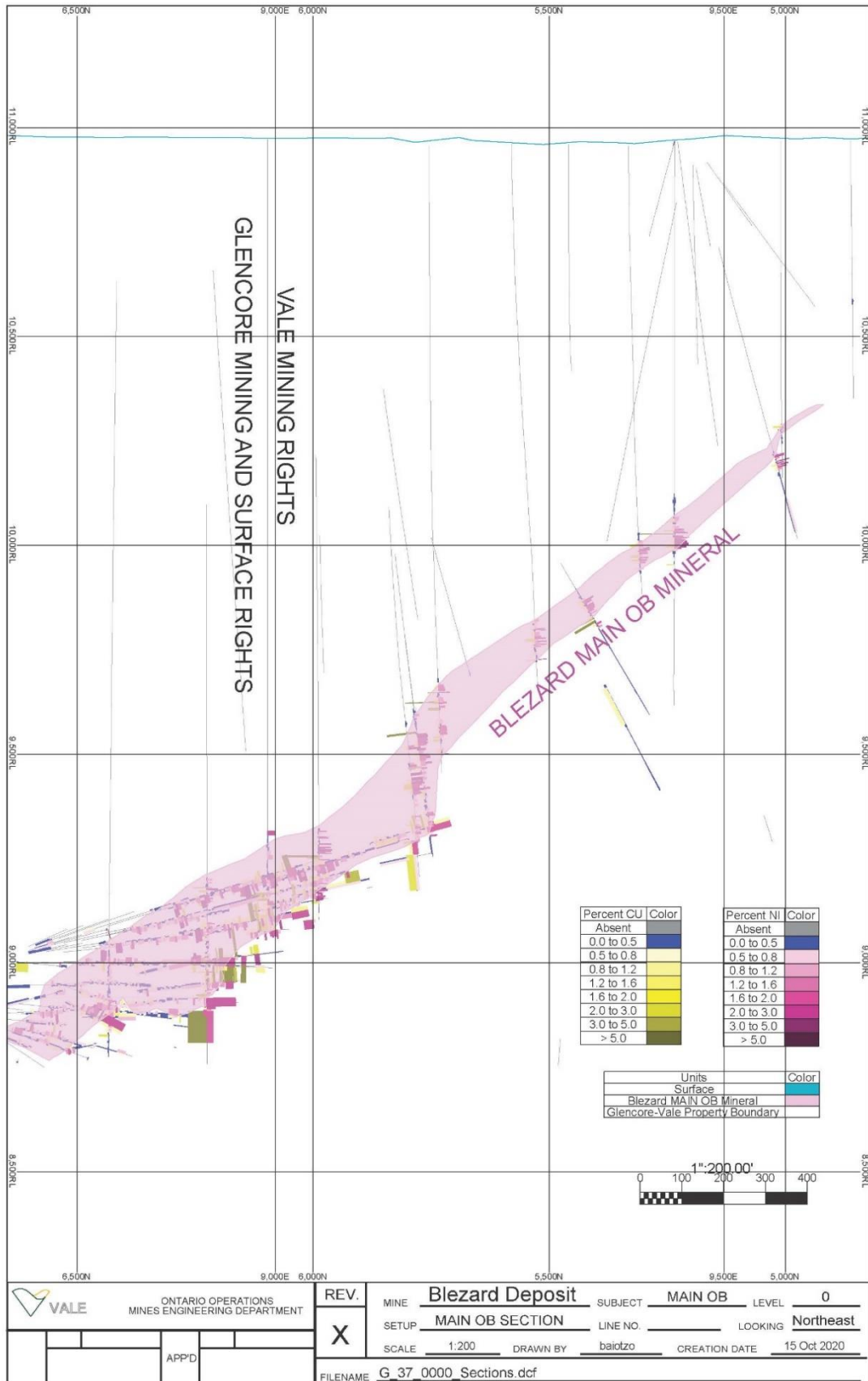
A schematic geology section is shown in Figure 6-7. A representative drill section showing the orientation of the drilling to the mineralization, and examples of mineralization grades is shown in Figure 6-8.

Figure 6-7: Schematic Geological Section, Blezard (17500 N)



Note: Figure prepared by Vale Base Metals, 2018. Section looks east.

Figure 6-8: Example Cross-Section, Blezard



6.4.2 ELLA–CAPRE

6.4.2.1 DEPOSIT DIMENSIONS

The Ella and Capre deposits are a set of mineralized lenses in Sudbury’s central East Range, approximately 5 km north of the Nickel Rim South Extension exploration shaft. The area contains both nickel-rich contact and high copper–nickel–total precious metals footwall styles of mineralization. The Ella-Capre area spans 4.3 km long with the SN Ella zones in the north, Ella South in the center and the Capre zones in the south. The deposits are currently delineated from surface to a depth of 1,250 m.

6.4.2.2 LITHOLOGIES

Ella–Capre features a mix of felsic and mafic norites, sublayer norite, granite breccia, and metamorphosed footwall lithologies dominantly metadiabase and various Archean gneisses, with Sudbury Breccia (SUBX) zones like the Amy Lake Breccia Zone and Proterozoic diabase dykes cutting through. Contact-style nickel–copper sulfide mineralization—mainly pyrrhotite, pentlandite, and chalcopyrite—occurs in sublayer norite and granite breccia and has been intersected from surface to depths of 1,250 m. Additionally, footwall-type mineralization includes copper–nickel–platinum group element-rich veins and stringers, typically chalcopyrite-dominant, associated with Sudbury Breccia zones.

6.4.2.3 STRUCTURES

The area is geologically complex due to a combination of brittle and ductile deformation along multiple fault and shear zones. Regionally, arcuate north-south brittle-ductile faults like the Waddell, West Bay, and Amy Lake faults repeat SIC and footwall units, influencing the geometry of basal breccias and potentially detaching contact and footwall mineralization from their original stratigraphic positions.

The Archean gneissic footwall exhibits strong pre-SIC ductile fabrics and complex folding, with polydeformational refolded folds and steeply dipping fabrics. Several fault generations exist, with the youngest being northeast-trending faults, followed by moderate west-dipping normal faults, and older east-dipping faults. Locally, the SN Ella area is affected by the SN Ella, Central, and east–west-trending faults, while the Capre area is influenced by the Amy Lake Fault system, which shows significant sinistral and dip-slip displacement.

Additional shallow brittle faults with quartz-carbonate infill crosscut the felsic norite. At Ella South, west-dipping faults dominate, forming topographic features and fault windows in the mineralized SIC base, offering strong exploration potential. East-dipping faults in this area may represent earlier structures with minimal offset.

6.4.2.4 MINERALIZATION

6.4.2.4.1 CONTACT MINERALIZATION

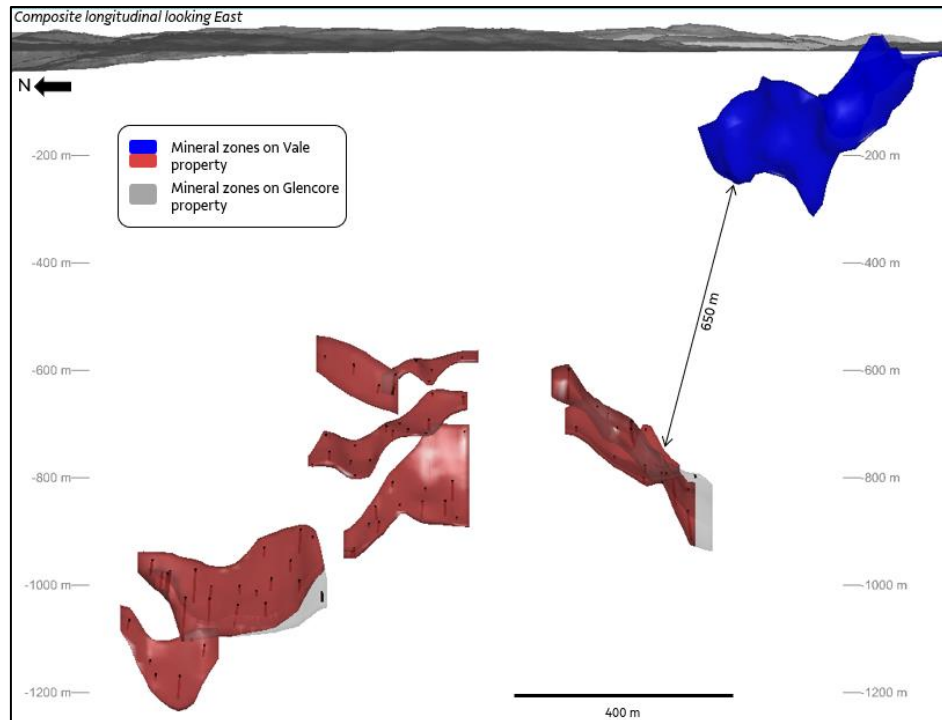
This mineralization is organized into three main zones: SN Ella, Ella South and Capre, each with multiple stacked pods influenced by structural complexity and faulting. Mineralization is known to extend from surface down to at least 1,250 m and the dip of individual lenses vary from 30° to 65°.

At SN Ella, contact mineralization is hosted in multiple stacked, irregular pods within sublayer norite and granite breccia near the SIC basal contact, distributed across three structurally-complex zones, Ella North, SEN, and Central. Each zone contains distinct mineralized bodies, structurally offset by the SN Ella and Central faults. The mineralization is dominated by pyrrhotite, pentlandite, and chalcopyrite, with pyrite content increasing near faults. See Ella cross section in Figure 6-9.

At Capre, zones are hosted in sublayer norite and granite breccia, and dip moderately to steeply west. High-grade pods occur within a lower grade halo and structures locally repeat the mineralization resulting in a thickening of the sulfide lens. Ella South features two stacked zones within a narrow embayment bounded by a structure to the north. Sulfide mineralogy across these

areas is typical of Sudbury contact-style deposits, with alteration assemblages including chlorite, amphibole, biotite, and magnetite, often linked to faulting. Detailed mineralogical studies confirm the dominance of pyrrhotite and pentlandite, with localized variations and alteration textures reflecting structural complexity.

Figure 6-9: Example Cross-Section, Ella



Note: Figure prepared by Vale Base Metals, 2025.

6.4.2.4.2 FOOTWALL MINERALIZATION

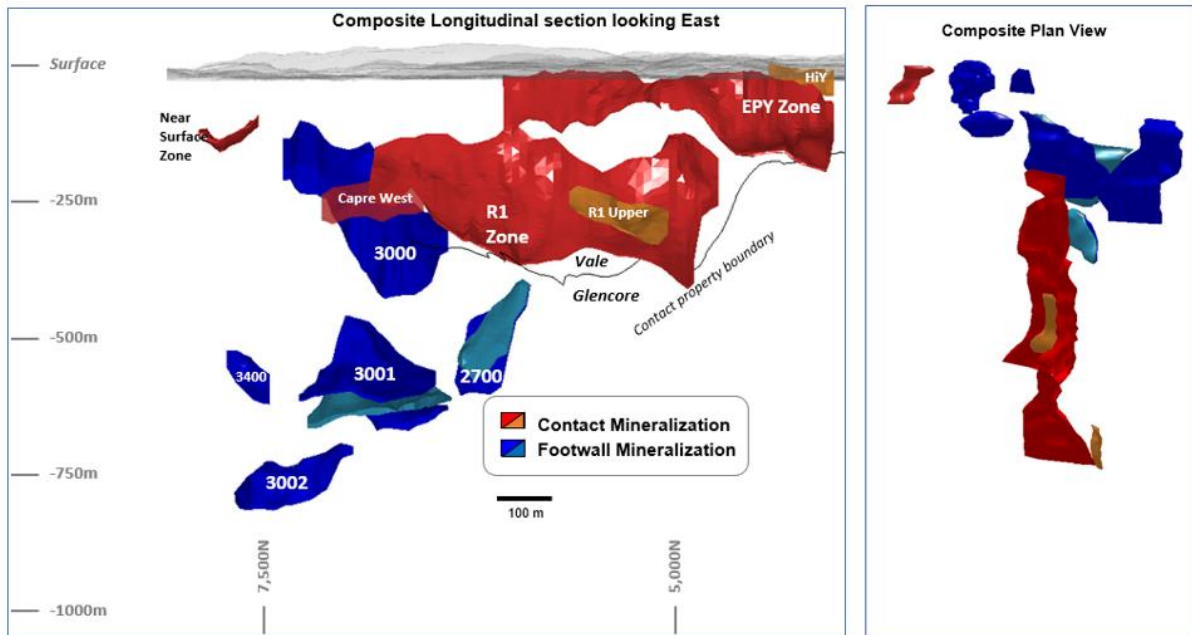
Capre hosts three significant footwall zones, 3000, 3001, and 3002, located 200–700 m below and north of the Capre Main contact zone within the Amy Lake Breccia Belt. These zones, striking north–south and dipping 40–65° west, are structurally controlled and consist of semi-massive to massive sulfide veins and stringers surrounded by disseminated and blebby sulfides.

The 3000 Zone features copper–nickel–platinum group element–gold mineralization within Sudbury Breccia, with a diverse sulfide and precious metal assemblage, and is hosted in altered gneiss. The 3001 Zone, lying 300 m down-dip, shares similar mineralogy and textures, with mineralization hosted in Sudbury Breccia and granitic inclusions. The 3002 Zone also mirrors the mineralogical and structural characteristics of the other two, with massive sulfide veins and stringers of chalcopyrite–pentlandite–millerite–pyrite, and minor high-precious-metal occurrences.

A 2013 structural study confirmed the dominant vein orientation as shallow west-dipping, with a secondary high-total precious metals population dipping northeast, reinforcing the zone’s spatial coherence and exploration potential.

Example cross sections for Ella and Capre are shown in Figure 6-10.

Figure 6-10: Example Cross-Section, Capre



Note: Figure prepared by Vale Base Metals, 2025.

6.4.3 COLEMAN

The Coleman Mine includes the original Coleman deposits, consisting of the Upper and Lower Coleman, and the High Shaft Copper deposit. No mining is currently conducted in these areas. It also includes the McCreedy East deposits, including the Main, West, 153 and 170 deposits where active mining is occurring. Other deposits include the inactive East and 7386/6166 Footwall Zone areas.

6.4.3.1 DEPOSIT DIMENSIONS

A summary of the deposit dimensions for the major zones in the Coleman Mine is provided in Table 6-5. Zones are classified as Footwall- or Contact-type.

Table 6-5: Dimensions, Coleman Zones/Orebodies

Zone Designation	Type	Length (m)	Width/Strike (m)		Thickness (m)	
			Average	Range	Average	Range
148	Footwall Cu	455	30	3–60	10	0.5–10
153	Footwall Cu	305	30	5–60	20	0.5–25
170	Footwall Cu	275	90	5–185	10	0.5–20
Main (MOB)	Contact	580	60	5–175	50	10–150
6166	Footwall Cu	150	45	5–60	20	0.5–30
7386 CLM	Footwall Cu	335	65	5–65	30	0.5–45
East OB	Contact	220	15	2–35	10	2–30
W Chutes	Contact	220	15	5–45	10	3–45
West OB	Contact	215	30	5–50	30	2–30
Zone Designation	Depth (m)	Dip (°)	Plunge (°)			
148	870–1205	30	5 W			
153	1250–1585	50	80 E			
170	1645–1830	40	55 N			
Main (MOB)	1045–1330	40	40 SW			
6166	1080–1310	45	45 S			
7386 CLM	1310–1435	30	15 S			
East OB	995–1125	50	40 E			
W Chutes	1310–1345	50	35 E			
West OB	1165–1335	64	40 SW			

6.4.3.2 LITHOLOGIES

The Coleman Mine is situated at the central and eastern limits of an extensively mineralized, 9 km long portion of the North Range of the SIC known as the Levack Embayment.

The main lithological units of the Levack Embayment include:

- Main Mass of the SIC. Towards the base of the main SIC, overlying the embayment, the basal, mafic norite contain rare inclusions and sulphide disseminations;
- Sublayer norite, occurring discontinuously along the contact between the base- of mafic norite and the country rocks. Sublayer norite consists of 55–70% dominantly mafic, fine to medium-grained sub-rounded to rounded fragments within a mafic igneous matrix of noritic composition;
- Footwall/granite breccia, which is locally developed along the SIC-footwall rock interface as the basal unit of the Sublayer norite. The footwall/granite breccia is a matrix-supported heterolithic breccia with clast sizes ranging from 1 cm to hundreds of metres in diameter. The clasts are typically sub-angular to sub-rounded and represent approximately 70–80% of the rock mass. The composition of clasts ranges from gabbro, diabase, mafic gneiss to granitic gneiss and granite;
- Sudbury Breccia, occurring as veinlets and veins in fractured footwall rock to the SIC and form irregularly-shaped masses up to hundreds of metres thick. The Sudbury Breccia is a matrix-supported fragmental rock with a black to light gray, aphanitic to fine-grained and variably re-crystallized matrix composed of feldspars, quartz, amphibole, biotite. Rounded

and equant footwall clasts range to as much as 30 m in diameter and consist of gabbro, diabase, mafic gneiss, intermediate gneiss, granite gneiss and granite;

- Footwall rocks of the Levack Gneiss Complex, which is largely composed of granite and mafic gneiss. The granitic component of the complex is medium to coarse-grained and massive to incipiently foliated. Mafic gneiss is medium-grained, massive to incipiently foliated with 30–40% interstitial feldspar occurring as a mosaic laths interstitial to amphiboles. The gneissic banding can be regular or contorted and locally is continuous over tens of feet. Lenses of mafic gneiss commonly occur as boudins within granitic gneiss.

The basal contact of the SIC dips south-southeast at approximately 35° on the Coleman Mine property. Footwall/granite breccia thickness range from <1 m to >30 m in “plumes” that cross-cut the basal SIC stratigraphy up into the sublayer norite and mafic norite. The sublayer norite displays similar range of stratigraphic thicknesses. Both footwall/granite breccia and Sublayer norite host Contact-style nickel-rich mineralization which is generally developed in troughs and irregularities at or near the basal SIC contact with the footwall rocks of the Levack Gneiss Complex. Contact-style mineralization grades into Footwall-style mineralization within Sudbury Breccia. Footwall-style mineralization extends as much as 450 m below the SIC-footwall contact.

An olivine diabase dyke cuts through the northeastern portion of the deposit. A diabase dyke occurs in the footwall area. It is locally fragmented and has been linked to several large magnitude seismic events.

6.4.3.3 STRUCTURE

There are three major structural features encountered at the Coleman Mine:

- Fraser #2 Fault: also known as the #2 East Fault, strikes approximately north to south and is steeply dipping (60–80°). A splay of the Fraser #2 Fault has intersected the upper Main Orebody and has caused some localized difficult mining conditions;
- Lunchroom Fault: strikes roughly north to south, with a variable dip of 50–70° to the northeast along its length. Encountered on nearly every cut on the Main Orebody; locally associated with bad ground;
- Bob’s Lake Fault: strikes roughly northwest, and dips to the east at approximately 70–90°; locally associated with bad ground.

6.4.3.4 MINERALIZATION

Contact-style mineralization forms high-grade nickel-rich pods or sulphide concentrations, that are surrounded by a low-grade halo in the host sublayer norite or footwall/granite breccia. The sulphide mineral assemblage consists of pyrrhotite, pentlandite, chalcopyrite and minor pyrite. Variations in style and orientation of mineralization occur abruptly over small distances, resulting in a complex mode of sulphide occurrence. The sulphide is mostly present as fine disseminations, blebs, and stingers in breccia matrix, locally as fracture fillings, or as semi-massive and massive ores. The Cu:Ni ratio for the Coleman contact nickel ores is approximately 0.7.

Footwall-style copper–nickel–PGE mineralization is hosted in Sudbury breccia. It is characterized by a sulphide mineral assemblage dominated by chalcopyrite, with lesser pentlandite, millerite, cubanite, bornite and pyrrhotite. The copper content in all footwall deposits is very high, with the Cu:Ni ratio typically exceeding 6.5, with correspondingly high PGE tenors (Pt + Pd + Au > 7.7 g/t).

A schematic cross-section showing the geology of the Coleman and McCreedy areas is shown in Figure 6-11 and Figure 6-12 respectively. A representative drill section showing the orientation of the drilling to the mineralization, and examples of mineralization grades is shown in Figure 6-13.

Figure 6-11: Coleman Mine 153 Orebody (schematic section looking east)

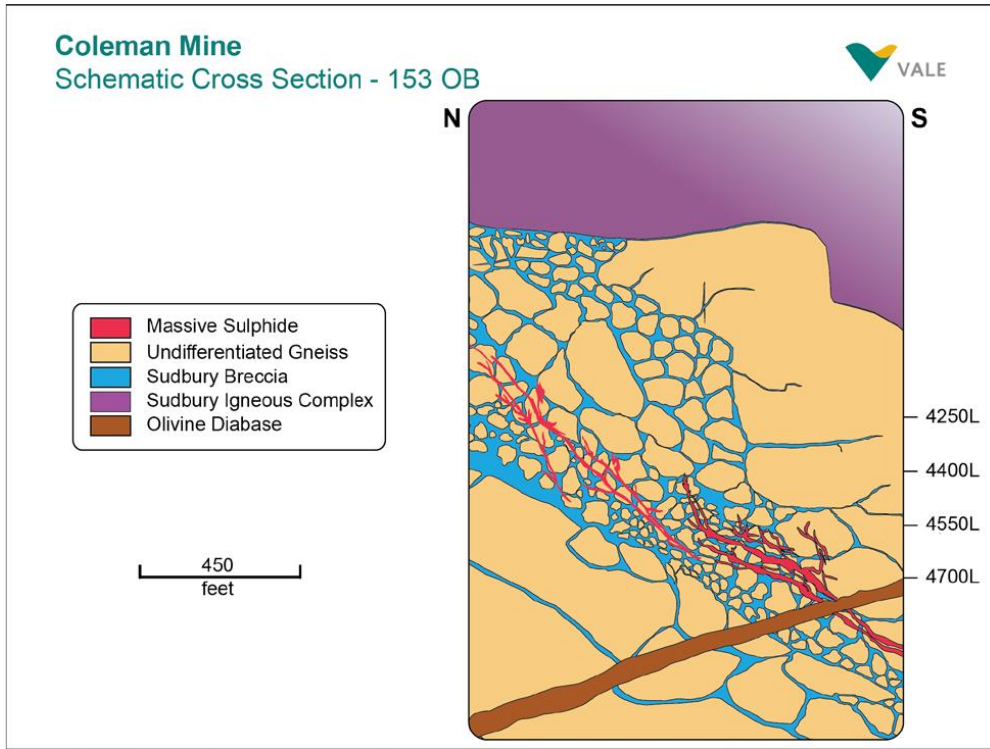


Figure prepared by Vale Base Metals, 2016.

Figure 6-12: McCreedy East Section (north–south)

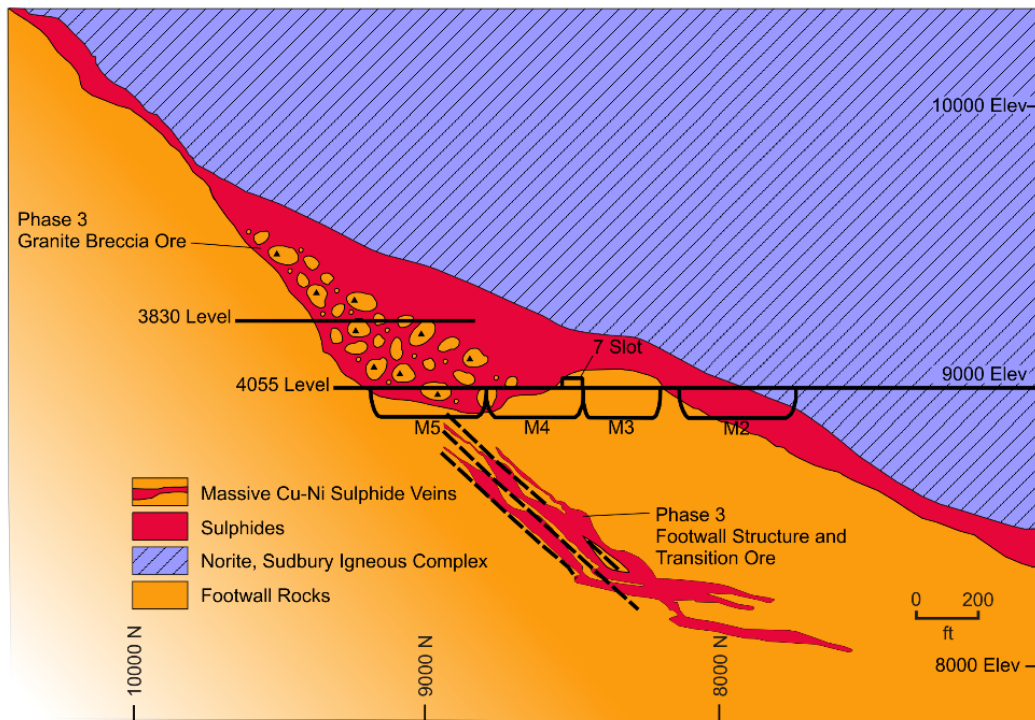
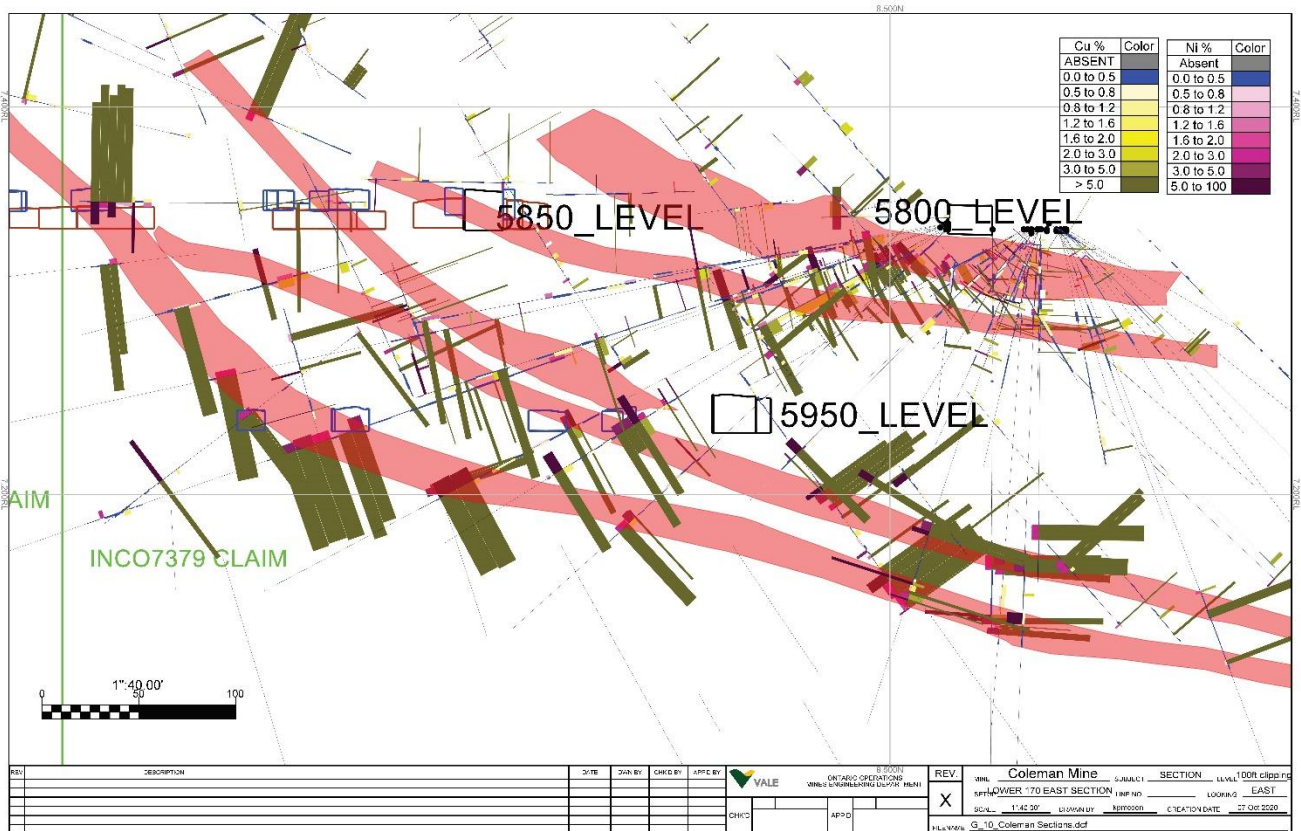


Figure prepared by Vale Base Metals, 2016. M1–M5 denote mining divisions in the deposit.

Figure 6-13: Example Cross-Section, Coleman (Lower 70 east)



6.4.4 COPPER CLIFF

The Copper Cliff deposit consists of numerous mineralized zones. The major zones include the actively-mined 120, 100, 900, 880, 865, 860, 830, 810 orebodies, and the currently inactive 191, 178, 138, 890, 850, 790, 740, 725, and 712 zones.

6.4.4.1 DEPOSIT DIMENSIONS

A summary of the deposit dimensions for the major zones in the Copper Cliff Mine is presented in Table 6-6.

Table 6-6: Dimensions, Copper Cliff Zones/Orebodies

Zone Designation	Type	Length (m)	Width/Strike (m)		Thickness (m)	
			Average	Range	Average	Range
191	Offset	1160	730	90–975	50	15–75
178	Offset	425	395	35–580	30	10–45
138	Offset	335	60	25–105	20	5–25
120	Offset	1355	260	45–365	20	5–25
100	Offset	1890	105	30–120	20	10–45
900	Offset	1850	190	50–245	20	5–25
890	Offset	1190	245	120–305	20	10–30
880	Offset	995	320	245–365	20	3–25
865	Offset	1495	275	85–320	20	3–45
860	Offset	495	245	105–355	20	5–45
850	Offset	975	305	45–455	20	5–30
830	Offset	1065	200	105–365	30	10–45
810 (805, 800)	Offset	455	365	50–505	20	5–35
712 (KL 710/720)	Offset	975	535	150–685	20	5–30
725 (KL)	Offset	520	200	25–380	10	5–15
740 (KL)	Offset	215	215	90–275	20	5–25
Zone Designation	Depth (m)	Dip (°)	Plunge (°)			
191	490–1,575	70–90	—			
178	1,220–1,630	50–70	—			
138	305–1,340	90	90			
120	1,160–1,675	70–90	90			
100	0–1,890	90	90			
900	120–1,850	80–85	90			
890	1,035–2,180	90	90			
880	120–1,280	70–75	90 (sub-vertical)			
865	990–1,880	75–80	0 (sub-horizontal)			
860	990–1,525	70	30 S			
850	0–1,585	60–75, 40–70	90 (sub-vertical)			
830	610–1,640	70	90 (sub-vertical)			
810 (805, 800)	1,010–1,555	80	90 (sub-vertical)			
712 (KL 710/720)	680–1,690	80–85	48 S			
725 (KL)	110–640	90	30–40 S			
740 (KL)	275–490	90	—			

6.4.4.2 GEOLOGY

Copper Cliff is predominantly an Offset-style deposit with associated minor Contact- and Footwall-type mineralization styles. Mineralization is hosted in a quartz–diorite dyke, the Copper Cliff Offset, which strikes 15 km south into footwall rocks from the base of the SIC, is steeply dipping, and

averages 40 m wide. The Copper Cliff Offset is cut by narrow aplitic, quartz diabase, and olivine diabase dykes, locally referred to as “trap dykes”.

Contact-style mineralization associated with Sublayer norite is present in the North Copper Cliff Mine area. Sudbury Breccia occurs in footwall rocks adjacent to the Copper Cliff Offset.

6.4.4.3 STRUCTURE

The Copper Cliff Offset is affected by post-impact displacement along the Creighton and Murray faults and several smaller splay faults.

The Copper Cliff Offset is folded about northeasterly-trending open fold axes that have steeply-dipping axial planes. Folding of the quartz–diorite dyke is confined to part of the dyke south of the Creighton fault. West-trending diabase and northwest-trending olivine diabase dykes post-date the folding.

6.4.4.4 MINERALIZATION

The offset mineralization is mainly associated with coarser grained quartz diorite and rarely crosscuts footwall rocks. Mineralization consists of disseminated and ragged disseminated sulphides, interstitial sulphides, inclusion massive sulphides, gabbro peridotite inclusion sulphides, contorted schist inclusion sulphides and massive sulphides.

The major sulphides are pyrrhotite, chalcopyrite and pentlandite. Minor sulphides include pyrite, cobaltite, sphalerite, galena, and gersdorffite (NiAsS). The precious metal mineral assemblage includes sperrylite, froodite (PdBi₂), michenerite, hollingworthite ((Rh, Pt, Pd) AsS), native gold, argentite (Ag₂S) and hessite (Ag₂Te).

Sulphide content increases towards the centre of the ore zones and with depth. Typically, chalcopyrite content increases from the centre along strike and down-dip. The Copper Cliff Mine zones have variable copper to nickel and pyrrhotite to nickel ratios.

The local geology of the Copper Cliff deposit is shown in plan view in Figure 6-14. A representative drill section showing the orientation of the drilling to the mineralization, and examples of mineralization grades is shown in Figure 6-15.

Figure 6-14: Local Geology of Copper Cliff Deposit

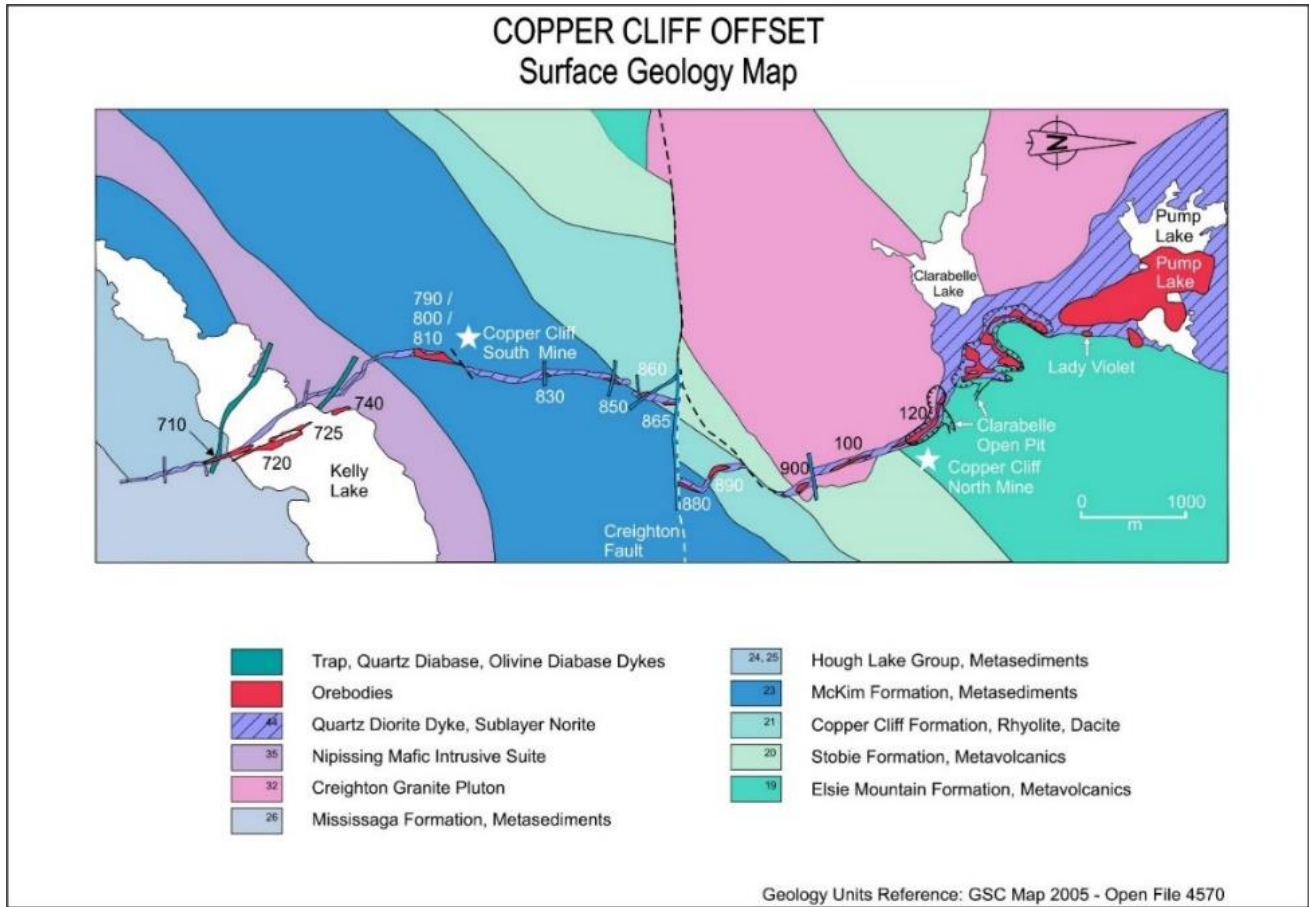
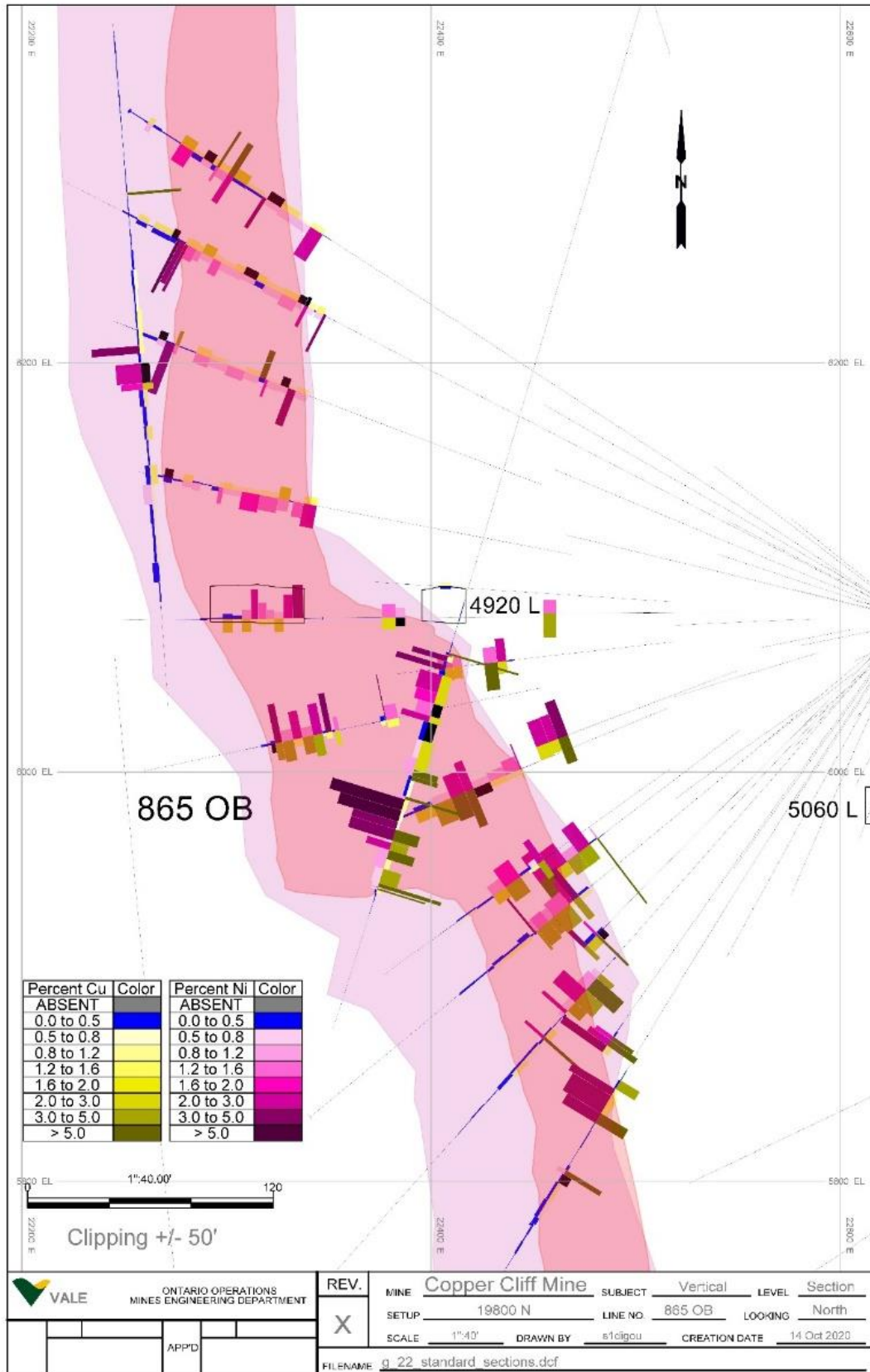


Figure prepared by Vale Base Metals, 2016.

Figure 6-15: Example Cross-Section, Copper Cliff (865 orebody)



6.4.5 COPPER CLIFF PIT

6.4.5.1 DEPOSIT DIMENSIONS

The Copper Cliff Pit deposit is approximately 914 m long, ranges from 305–427 m in width, averaging 366 m, and ranges in thickness from 15–76 m, averaging 24 m. The deposit is currently delineated from surface to a depth of 1,524 m, dips at 40–50°, and plunges to the north at 40–60°.

6.4.5.2 GEOLOGY

Contact-style mineralization is hosted in Sublayer norite above Huronian metasedimentary rocks and the Murray granite pluton.

The Copper Cliff Pit sulphide mineralization occupies a lenticular embayment or trough in the footwall rocks on the south contact of the SIC. The Murray embayment/trough is 914 m wide at surface, decreasing to 610 m at the 1000 level, and 1,074 m wide at the 4000 level. It strikes northeast–southwest and dips variably at 40–60° towards the north. Towards the northeast, the embayment pinches, becoming a narrower zone of sulphide mineralization.

6.4.5.3 STRUCTURE

Many of the identified and modelled structures in the vicinity of the Copper Cliff Pit are preliminary interpretations and may not be an accurate representation of all the structural geology in the Copper Cliff Pit area. Most of the existing structural wireframes created are based on drill hole intersections and logs with some guidance from televiewer surveys. Most of the drill holes in the area are historic drill holes (>60 years old) and most of these drill holes do not have detailed logs/comments, and core photos are limited to the sampled zones.

The historic surface geological mapping indicates the presence of two post-mineralization olivine diabase dykes on the east side of the mineral model. Due to the sub-vertical, north–south orientation of the dykes, the rock units appear in a limited number of drill holes near surface above ~1500 Level. The 2014–2020 core drill programs intersected the dykes in variable locations. Only the eastern-most dyke, which is 46 m thick, was used to deplete the block model. The additional dyke(s) are considered too narrow to be selectively segregated due the bulk open-pit mining process. However, the accuracy of the location, orientation and dip of these dykes is recognized as variable.

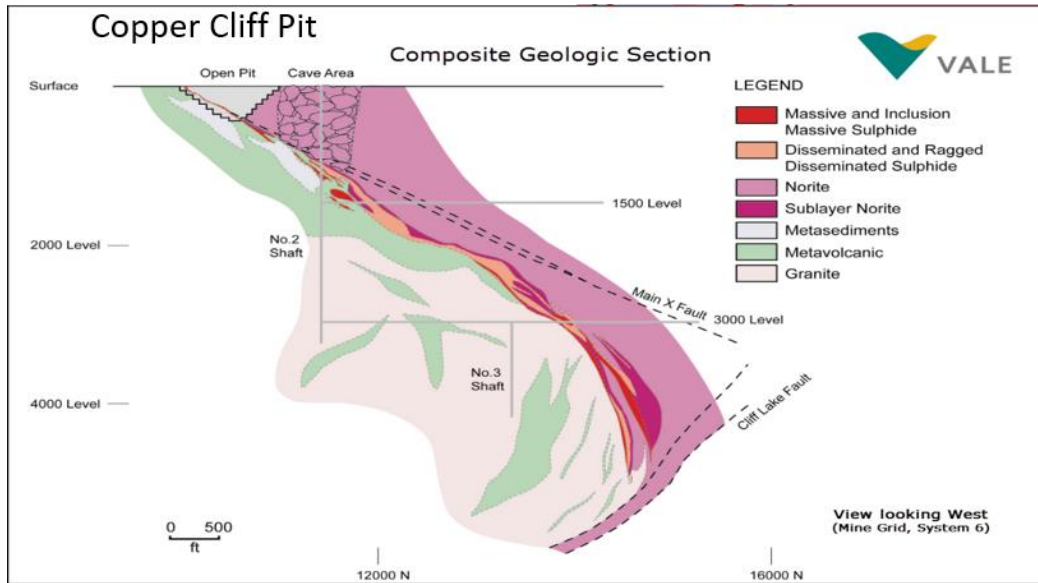
A major fault, the Main X-fault was mapped from surface to a depth of 900 m. The fault crosscuts the entire deposit geology, strikes east–west and dips between 30–50° north. It is defined by a 3–9 m wide zone of highly sheared rocks and up to 30 cm of fault gouge. The Main X-Fault corresponds to the South Range Shear Zone—a large, variably developed ductile shear zone at the contact between the SIC rocks and the metavolcanic and metasedimentary rocks of the Huronian Group.

6.4.5.4 MINERALIZATION

Copper Cliff Pit contact mineralization is typically zoned, the lowest zone consisting of inclusion massive sulphide containing variable amounts of irregular angular wall rock fragments with rare high-grade copper and nickel stringers of sulphide that project into the footwall rocks.

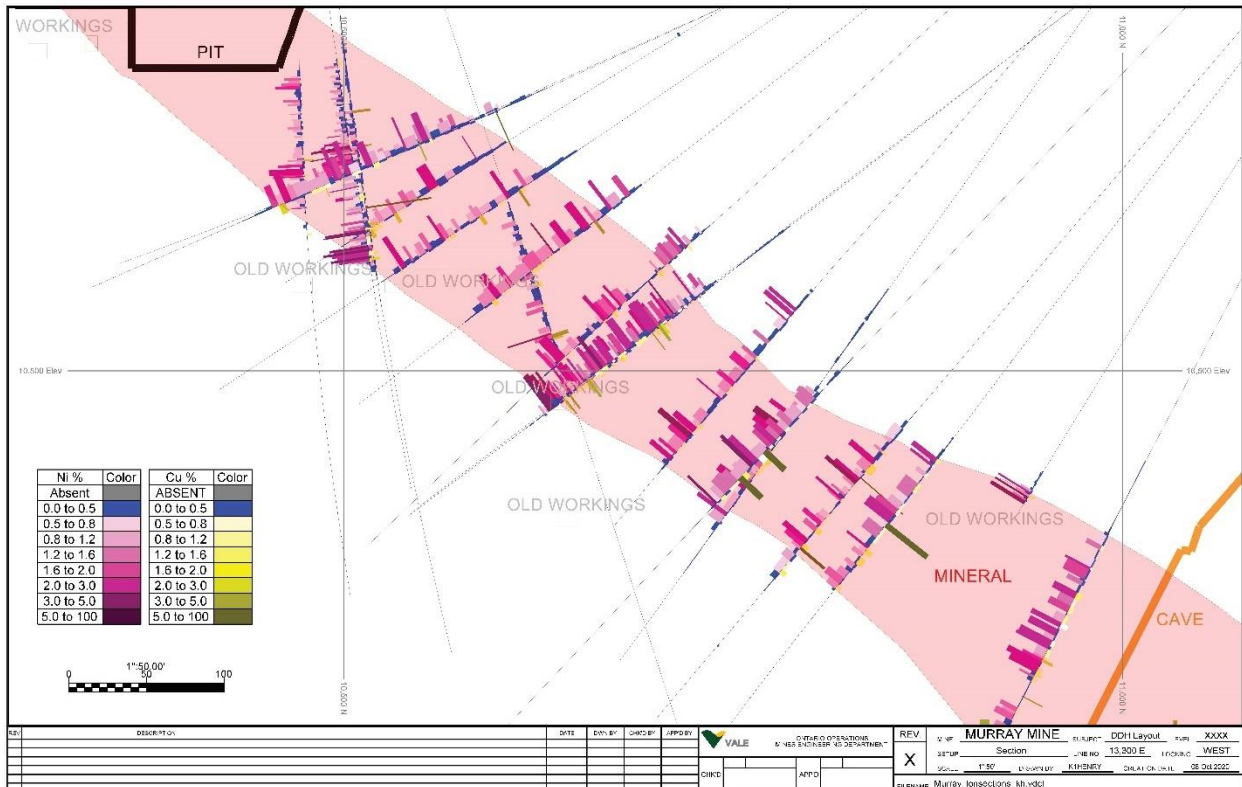
A geological composite section showing the geology in relation to the mineralization is provided in Figure 6-16. A representative drill section through the deposit showing the orientation of the drilling to the mineralization, and examples of mineralization grades is shown in Figure 6-17.

Figure 6-16: Geological Section, Copper Cliff Pit



Note: Figure prepared by Vale Base Metals, 2022.

Figure 6-17: Example Cross Section, Copper Cliff Pit (13,300 m east)



6.4.6 CREIGHTON

The Creighton deposit consists of the actively mined 300, 310, 400, 461 orebodies and the inactive Creighton 404, 315, 320 zones.

6.4.6.1 DEPOSIT DIMENSIONS

Deposit dimensions for the major zones that are currently being mined are presented in Table 6-7.

Table 6-7: Dimensions, Creighton Zones/Orebodies

Zone Designation	Type	Length (m)	Width/Strike (m)		Thickness (m)	
			Average	Range	Average	Range
300	Contact	1,065	250	55–300	30	3–155
310	Contact	520	210	55–270	10	3–70
315	Footwall	100	40	7-55	5.5	3-9
320	Footwall	325	125	10–175	10	3–60
400	Contact/ Footwall	670	240	45–295	10	5–190
404	Footwall	250	50	10–80	10	3–35
461	Footwall	230	95	30–130	10	3–50
Zone Designation	Depth From/To (m)	Dip (°)	Plunge (°)			
300	2,135–3,200	70–90	90			
310	2,420–3,000	90	45 E			
315	2,490-2,584	56	45 W			
320	2,650–2,980	70	90			
400	2,295–2,965	70	90			
404	2,460–2,695	90	90			
461	2,410–2,635	90	90			

6.4.6.2 GEOLOGY

The Creighton deposit hosts Contact- and Footwall-style mineralization. Mineralization is hosted within the Creighton Embayment and is controlled by two troughs or indentations into the footwall region. Quartz diorite, quartz diabase and olivine diabase dykes occur. Footwall rocks consist of the Paleoproterozoic Creighton Granite/Gabbro that intrudes lower Huronian Metavolcanic rocks and metasediments. Sudbury Breccia occurs within the footwall rocks.

6.4.6.3 STRUCTURE

The Creighton Fault cuts the Creighton embayment just south of the Creighton deposit. It is a steeply-dipping, east–west-trending fault system and has been interpreted as primarily dextral strike slip with a lesser normal component of displacement.

The Cliff Lake Fault is a major, shallow south–southeast dipping thrust structure related to the South Range Shear Zone. Drilling at Creighton Mine has intersected the Cliff Lake Fault at a depth of approximately 3.1 km. Displacement has been interpreted up to 4 km.

Throughout the Creighton deposit, evidence of significant structural influence on footwall ore emplacement, geometry and sulphide fractionation is evident. Major shears include the 6 Shaft, 117, 118, 400 East, 1290 and 2000N shears. There are several other minor shears within the mine area.

6.4.6.4 MINERALIZATION

Contact-style mineralization has a generalized sequence of sulphide styles from hanging wall to footwall of disseminated sulphide, interstitial sulphide, ragged disseminated sulphide, gabbro peridotite inclusion sulphide, contorted schist inclusion sulphide, inclusion-bearing massive sulphide and massive sulphide.

The major sulphides are pyrrhotite, chalcopyrite and pentlandite. Minor sulphides include pyrite, cubanite (CuFe_2S_3), cobaltite, sphalerite, galena, and gersdorffite. The precious metal mineral assemblage includes michenerite, hollingworthite, irarsite ((Ir, Ru, Rh, Pt) AsS), froodite, Pd-melonite (PdNiTe_2), sperrylite and native gold. The zones contain low levels of arsenic, lead, and zinc. The Creighton zones have variable copper to nickel and pyrrhotite to nickel ratios.

Figure 6-18 shows a generalised geology plan and Figure 6-19 shows a composite cross-section of the Creighton deposit. A representative drill section showing the orientation of the drilling to the mineralization, and examples of mineralization grades is shown in Figure 6-20.

Figure 6-18: Geological Plan, Creighton Mine Area

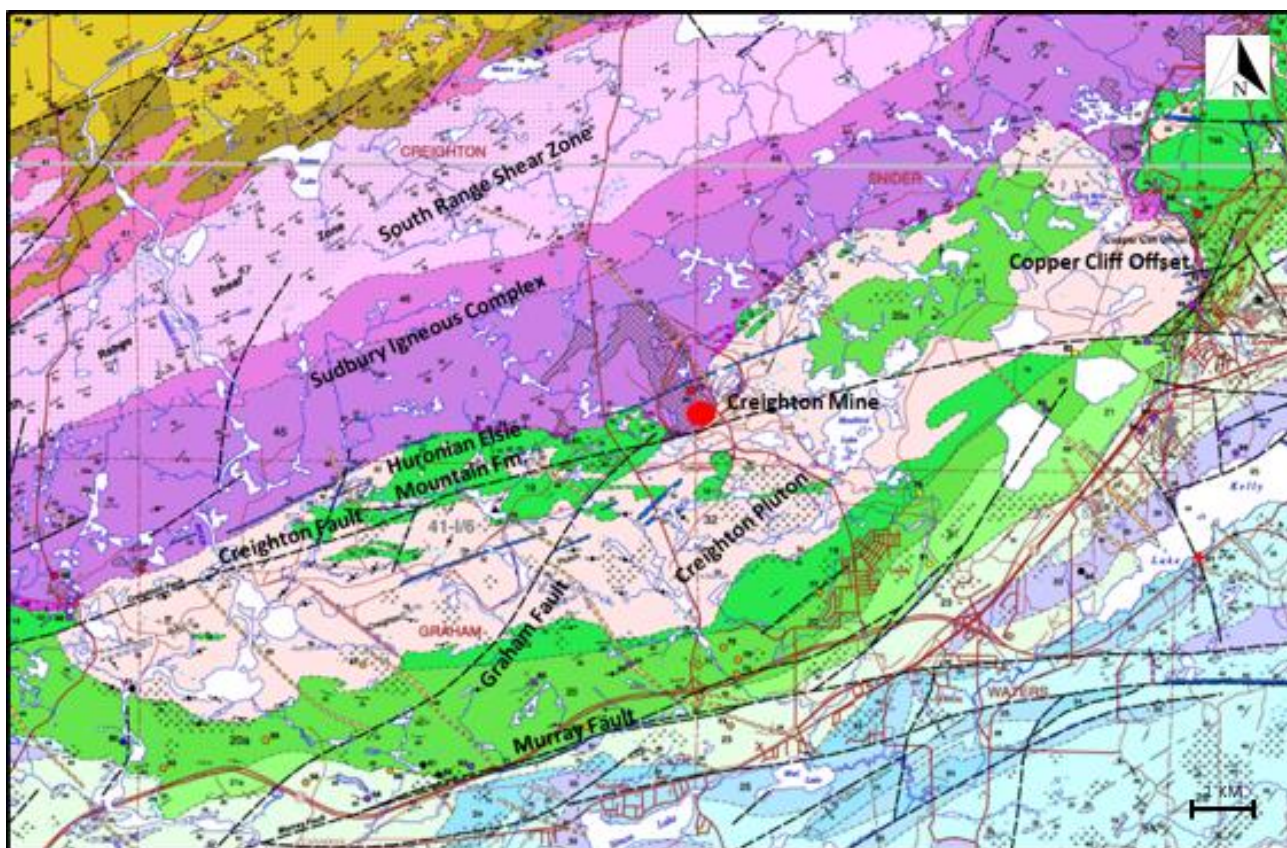


Figure prepared by Vale Base Metals, 2016.

Figure 6-19: Composite Cross Section, Creighton Mine

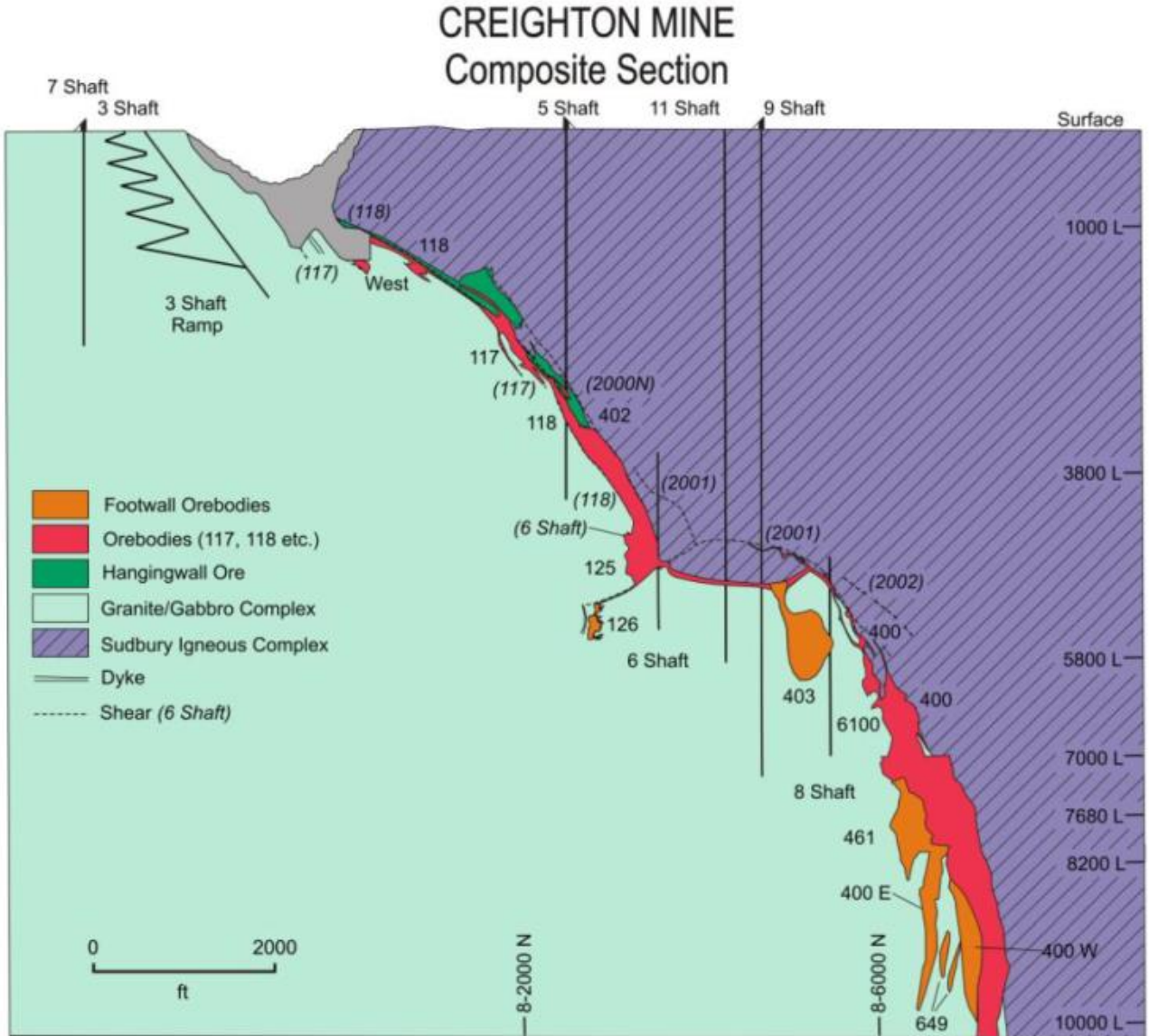
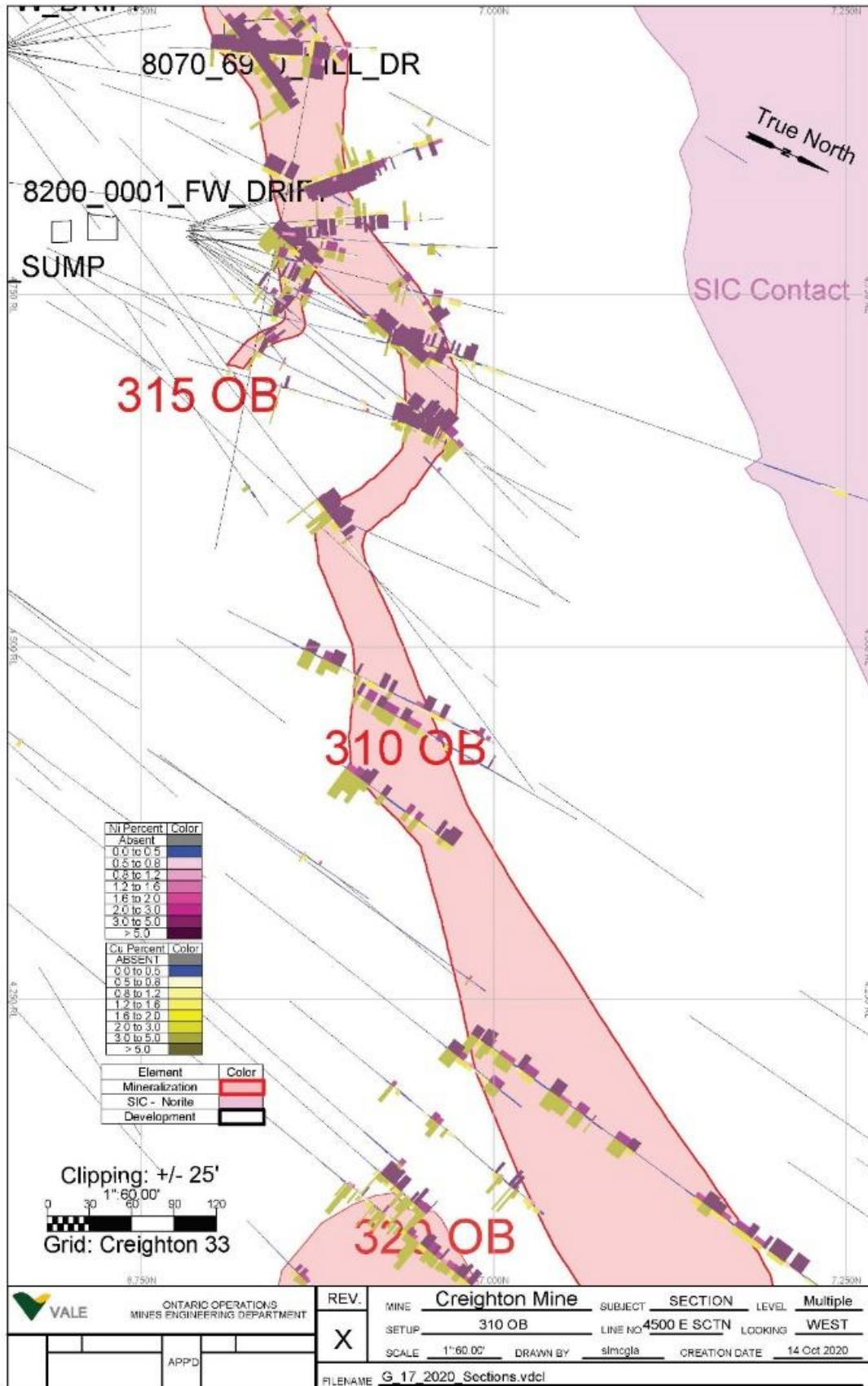


Figure prepared by Vale Base Metals, 2023. Figure looks west.

Figure 6-20: Example Cross Section, Creighton (4,500 east)



6.4.7 STOBIE

The active mining area is the Stobie 37 block being mine via open pit. No other zones in Frood–Stobie are currently in operation.

6.4.7.1 DEPOSIT DIMENSIONS

The Stobie 37 block is approximately 705 m long, ranges in width from 162–317 m, averaging 261 m, and ranges in thickness from 5–137 m, averaging 52 m. The 37 block is currently delineated from surface to a depth of 430 m.

6.4.7.2 GEOLOGY

The Frood and Stobie deposits have zones that have been classed as Contact, Footwall and Offset-style mineralization. The deposits lie within a breccia belt which is roughly parallel to the SIC Main Mass norite–footwall contact 1.5 km to the north. The breccia belt is composed of:

- Fragments and blocks of Proterozoic footwall rock;
- Anastomosing network of Sudbury Breccia;
- Discontinuous pods of quartz diorite.

The quartz diorite pods are assumed to be co-magmatic with the SIC and contain inclusions of country rock, exotic lithologies, and barren to weakly-mineralized quartz diorite. In addition to rock fragments, angular to rounded massive sulphide inclusions have been documented within the inclusion quartz diorite. Barren gabbro and peridotite inclusions to 45 m in diameter are found within the quartz diorite and Sudbury Breccia.

The breccia belt strikes northeast, and dips from 65–75° to the northwest. Two mineralized bodies are connected by a narrow bridge of disseminated sulphide mineralization that occurs above a “saddle” of unmineralized rock.

The 37 Block area of the Frood–Stobie deposit is hosted in an inclusion-bearing quartz diorite and consists of a low-grade, copper–nickel-bearing, disseminated-style mineralization.

6.4.7.3 STRUCTURE

Structure does not appear to play a significant part in the location of the mineralization at Stobie, but local shearing parallel to the walls of the structure sometimes create challenging ground conditions. Two main structures at Frood are as follows:

- The “Main Cross Fault”, which has been traced from the south nose of the mineralized zone above 1000 Level downwards towards 2600 Level. At 1000 Level, the fault strikes normal to the ore zone and dips north at slightly less than 30° northward. The fault intersects progressively lower levels and the strike rotates through 90°. At 2600 Level the strike of the fault is indistinguishable from other sub-parallel faults at the same horizon. An apparent offset of up to 15 m is observed locally but on other areas no offsetting by the fault is apparent;
- Frood Proper Footwall Shear. The footwall has been extensively sheared throughout the length of the orebody, but shearing is particularly heavily developed in the metasedimentary rocks above 1200 Level. Localized mining-related slippage of 3–6 m that occurred along the shear plane into the Footwall has resulted in local ground problems

There are two mining-related subsidence structures:

- The 60 and 19 Block Footwall Structure is a major crack in the footwall of the Frood North Extension Pit first noted in mid-2007;
- Ore Zone Structure consists of an area of parallel fractures dipping 30–50° towards the footwall.

The Frood deposit is shaped like an elongated funnel, with a northeast to southwest strike axis, and a northwesterly dip of 70°. The mineralization is approximately 1,350 m in length and reaches a maximum width of nearly 300 m wide. The mineralization is continuous down-dip from surface to 2800 Level below which it splits in two along strike and progressively becomes narrower at depth until the orebody pinches out on the 3600 Level.

Chalcopyrite, pentlandite and pyrrhotite are found in discrete blebs in a silicate matrix in the upper zones of mineralization. Below the 2800 Level this disseminated mineralization merges with massive sulphides. Copper–nickel ratios are constant at 1:1, but locally change laterally and generally increase with depth in the brecciated zones. Copper content increases with depth.

Two pendants of precious metal-enriched “siliceous” mineralization occur at the base of the Frood orebody, beneath the massive sulphide mineralization.

Most of the Frood deposit was mined or is no longer accessible. The remaining blocks of mineral resources were assigned to Stobie, but were mined by the Frood Division. Currently no workings at the Frood mine below the 1400 Level is accessible.

6.4.7.4 MINERALIZATION

The dominant mineralization styles at Frood–Stobie are disseminated and inclusion massive sulphide. Sulphide mineralization consists primarily of pyrrhotite, pentlandite and chalcopyrite. Secondary mineralization at Stobie consists of discontinuous veins of marcasite, galena, and carbonate, with minor occurrences of pyrite and violarite. At Frood, a cubanite-rich zone is present at the base of the massive and breccia sulphide, above the precious metal-enriched siliceous zone.

The continuity of the quartz diorite at Stobie is interrupted above the 1,000 Level by two large lobes of footwall rock extending downward into the disseminated mineralization. The mineralization to the north by this lobe of footwall averages 120 m in width, while in the south mineralization reaches a maximum width of 170 m at the 2000 Level. Below the 2200 Level, the mineralization gradually narrows and eventually bottoms above the 4100 Level.

Copper–nickel ratios are relatively constant throughout the Stobie deposit, averaging 0.92:1. There is no indication of copper enrichment at depth, but the copper content of the inclusion massive sulphide does increase at the extreme north end as mineralization narrows before pinching out completely.

Contacts with the surrounding footwall rocks are sharp, quite distinct, and generally regular.

The generalized geology is shown in plan view in Figure 6-21. Mineralized domains are shown in long section in Figure 6-22. A representative drill section showing the orientation of the drilling to the mineralization, and examples of mineralization grades for the 37 Block is shown in Figure 6-23.

Figure 6-21: Frood–Stobie Generalized Geology Plan

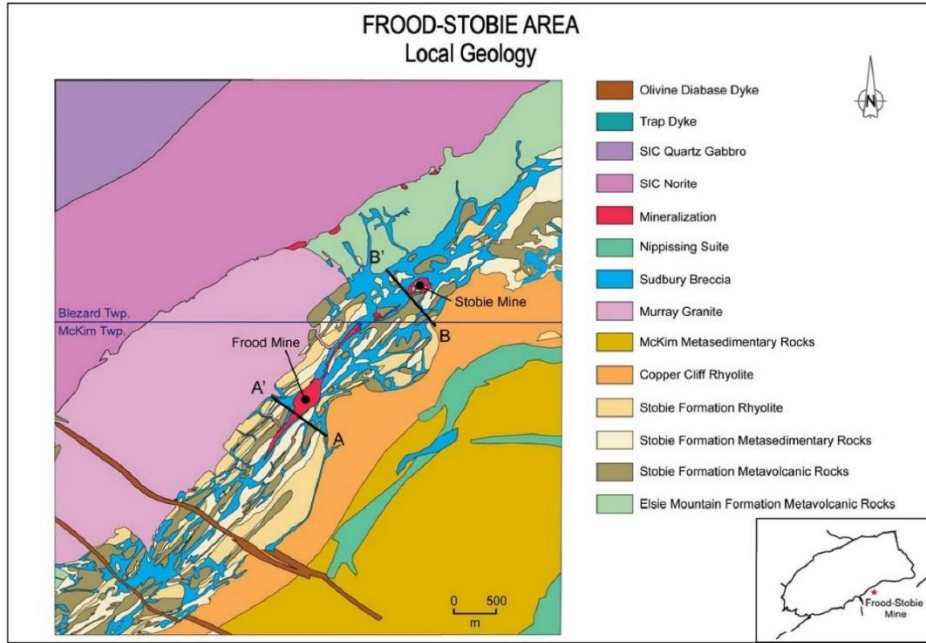


Figure prepared by Vale Base Metals, 2023.

Figure 6-22: Frood–Stobie Mineralization Type Distribution (long section)

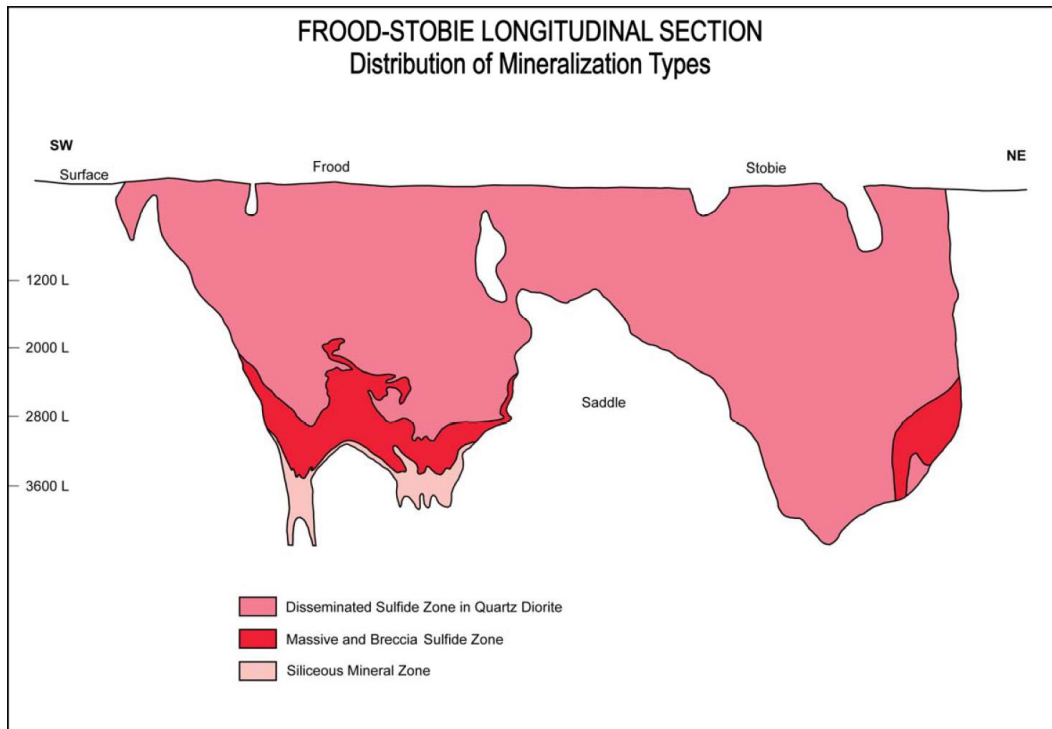
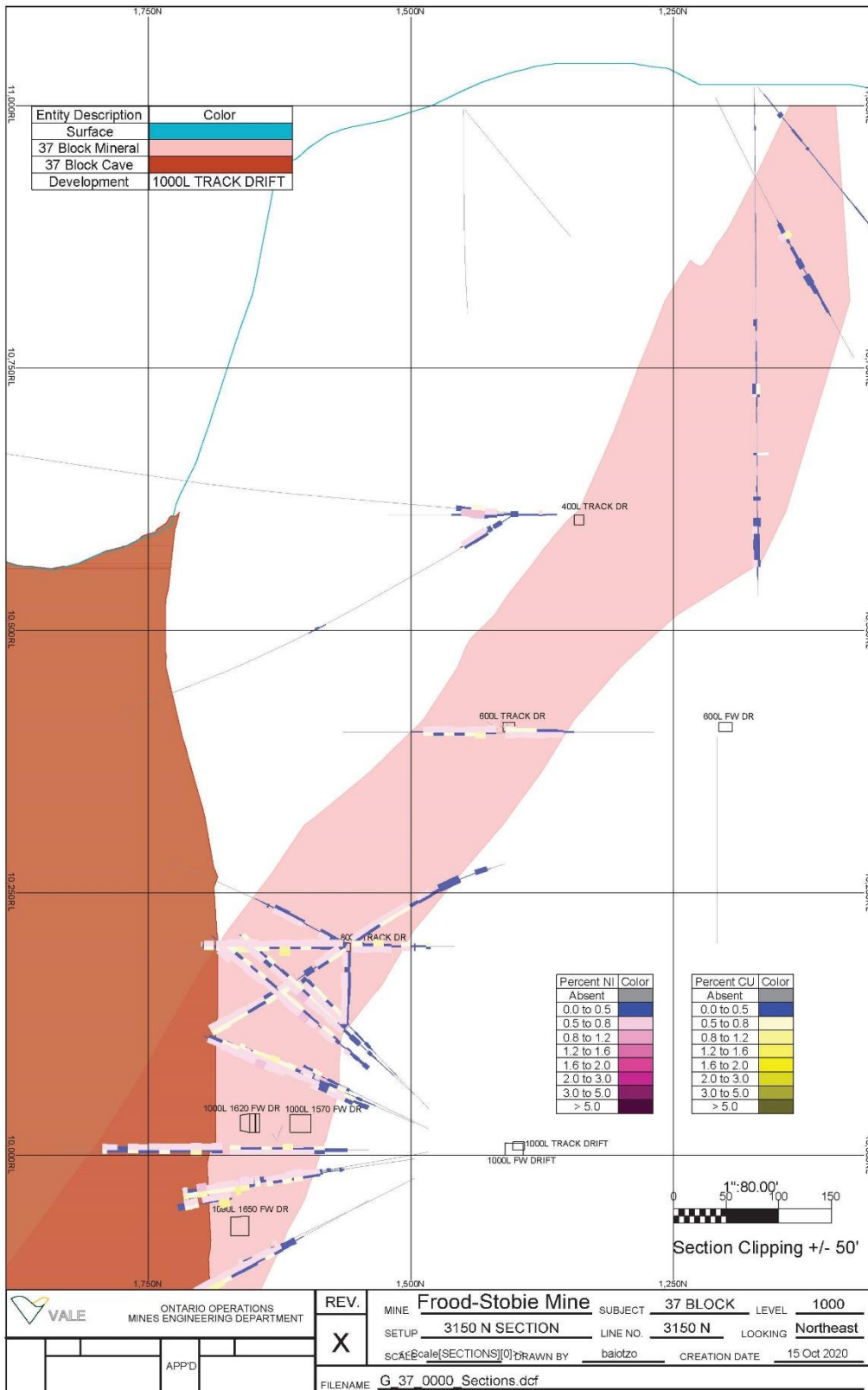


Figure prepared by Vale Base Metals, 2016.

Figure 6-23: Example Cross-Section, Block 37 (3150 N)



6.4.8 GARSON

The Garson deposit includes the actively mined McConnell deposit, surface ramp (13 and 360), and Garson Mine #1 Shear, #3 Shear, and #4 Shear deposits. Inactive deposits include the Garson ramp (600) zones.

6.4.8.1 DEPOSIT DIMENSIONS

Dimensions of the major zones within the Garson deposit are provided in Table 6-8.

Table 6-8: Dimensions, Garson Zones/Orebodies

Zone Designation	Type	Length (m)	Width/Strike (m)		Thickness (m)	
			Average	Range	Average	Range
1 Shear	Contact	760	455	120–610	10	3–60
4 Shear	Contact	1130	855	700–1065	10	3–20
360	Contact	150	90	45–185	20	10–20
McConnell	Offset	434	131	61-174	18	9-30
13 OB	Contact	245	305	150–365	10	3–20
Zone Designation	Depth From/To (m)	Dip (°)	Plunge (°)			
1 Shear	915–1,675	75 S	70 E			
4 Shear	1,220–1,980	60 S	50 E			
McConnell	0-411	75	70 S			
360	185–305	60 S	90			
13 OB	90–255	60 S	70 E			

6.4.8.2 GEOLOGY

Garson is a deformed Contact-style deposit. Contact-style mineralized zones are remobilized into a series of near-parallel ductile shear zones. Shear-hosted copper–nickel sulphides are offset by later stage dykes and possible late-stage shearing. The 1 Shear and 4 Shear are the primary mineralized zones.

The 1 Shear extends from surface to below 6500 Level, a distance of approximately 1,980 m. It has a strike length of 120–600 m, with strike length decreasing with depth. Hanging wall to footwall widths along the orebody vary between 3–60 m, with an average width of 10 m.

The 4 Shear extends from the 2800 Level to a currently known limit of 6700 Level, a distance of approximately 1,200 m. It has a strike extent of 685 m and an average width of 7 m. It strikes east–west and generally dips 70° south. The 4 Shear orebody runs parallel to the 1 Shear orebody, lying approximately 45 m to 60 m to the northwest.

Both shears dip at a slightly shallower angles than the SIC contact, which means that above the 4000 Level the shears are mostly hosted in the SIC with the dominant lithology being Sublayer Norite and below the 4000 Level the shears cut the metasedimentary and metavolcanic Huronian footwall rocks.

The deposit is crosscut by two separate olivine diabase dykes. These dykes are sub-parallel to each other and range in width from 15–60 m.

6.4.8.3 STRUCTURE

The Garson region was subjected to significantly more structural activity than the rest of the Sudbury Basin. This structural activity caused the Huronian footwall rocks to overturn and form the hanging wall. This overturning caused a significant amount of shearing sub-parallel to the strike of the Garson Contact-style deposits producing a series of near-parallel shears.

Major geological structures include the Garson Fault, the 2500 Shear, and the 3500 Shear. The 2500 shear and the 3500 structures and are roughly 12–23 m wide, strike north–northwest and dip steeply to the east. Fractures are commonly filled with calcite, galena, marcasite, and sphalerite. Late-stage faults and fractures also deform the orebodies.

There are a number of “cross-over” sulphide zones that connect the 1 Shear and 4 Shear orebodies. These cross-over zones are near vertical and <3 m wide.

6.4.8.4 MINERALIZATION

The mineralization is dominated by inclusion massive sulphide and massive sulphide lenses and stringers, contorted schist inclusion sulphide, ragged disseminated and sulphide breccia. Pyrrhotite is the most common sulphide mineral. Pentlandite is the main nickel-bearing mineral. Chalcopyrite is the main copper-bearing mineral, and is locally associated with elevated precious metals. Trace to minor amounts of cobaltite–gersdorffite, niccolite (NiAs), nickeliferous pyrite, marcasite, sphalerite, galena and argentopentlandite ($\text{Ag}(\text{Fe}, \text{Ni})_8\text{S}_8$) are distributed throughout the 4 Shear.

Platinum-group minerals include michenerite, hollingworthite, irarsite, froodite, Pd-melonite and sperrylite. The oxide mineral assemblage is composed of magnetite, with magnetite content varying from 0.5–2%. Rare and local clustering of lead and zinc mineralization occurs as veinlets associated with late fracture zones and within major structures. The hydrothermal alteration assemblage consists of marcasite (FeS_2) and violarite (FeNi_2S_4).

Arsenic-bearing mineral assemblages occur primarily along the strongly sheared hanging wall and footwall-sulphide contacts. Arsenic also occurs within the main sulphide zones associated with late-stage structural/schistose zones. Commonly, occurrences can be found associated with shear planes in the halo of the main mineral zone associated with low-grade disseminated and copper rich veinlets. The dominant As-bearing minerals are niccolite and cobaltite–gersdorffite. Maucherite ($\text{Ni}_{11}\text{As}_8$) has been reported but is relatively rare. Other arsenide and sulpharsenide minerals are present in trace amounts including sperrylite. Stockpiling and re-handling of high arsenic content ore is done to ensure processing requirements are achieved.

A schematic cross-section showing the locations of the mineralized zones is provided in Figure 6-24. Representative drill sections through the deposit showing the orientation of the drilling to the mineralization, and examples of mineralization grades are shown in Figure 6-25 and Figure 6-26.

Figure 6-24: Garson Mine Typical Cross-Section (looking east)

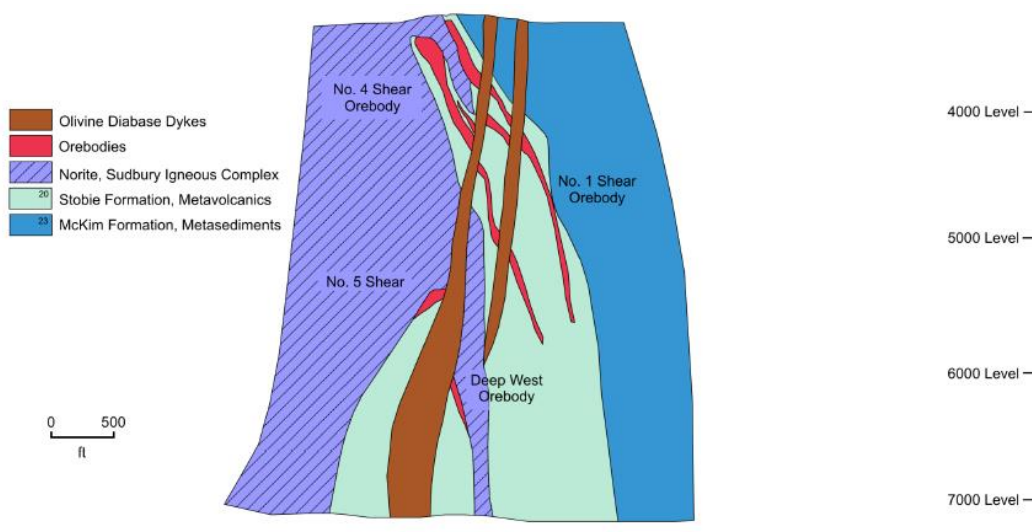


Figure prepared by Vale Base Metals, 2016.

Figure 6-25: Example Cross-Section, Garson (level 3250 E)

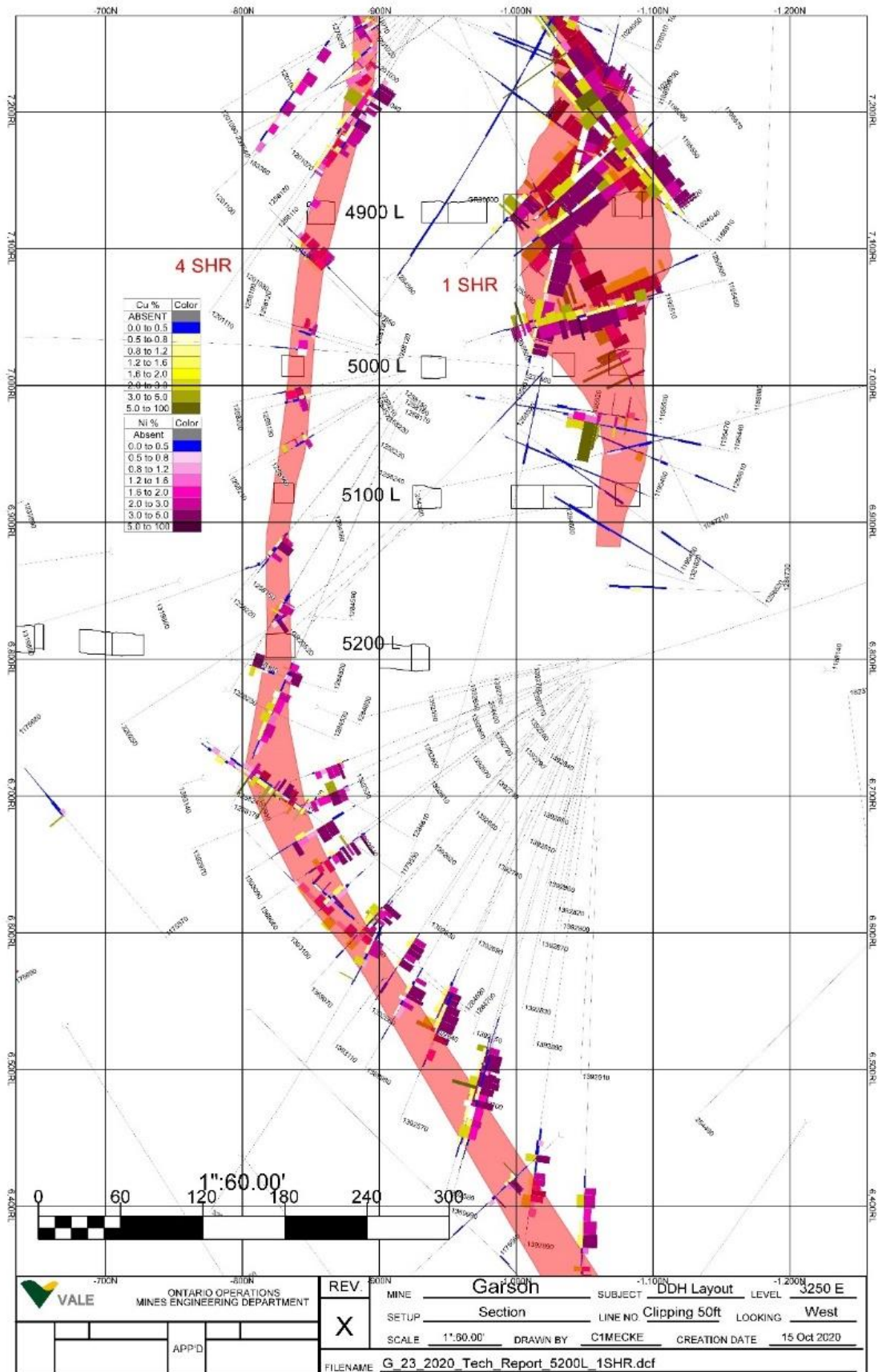
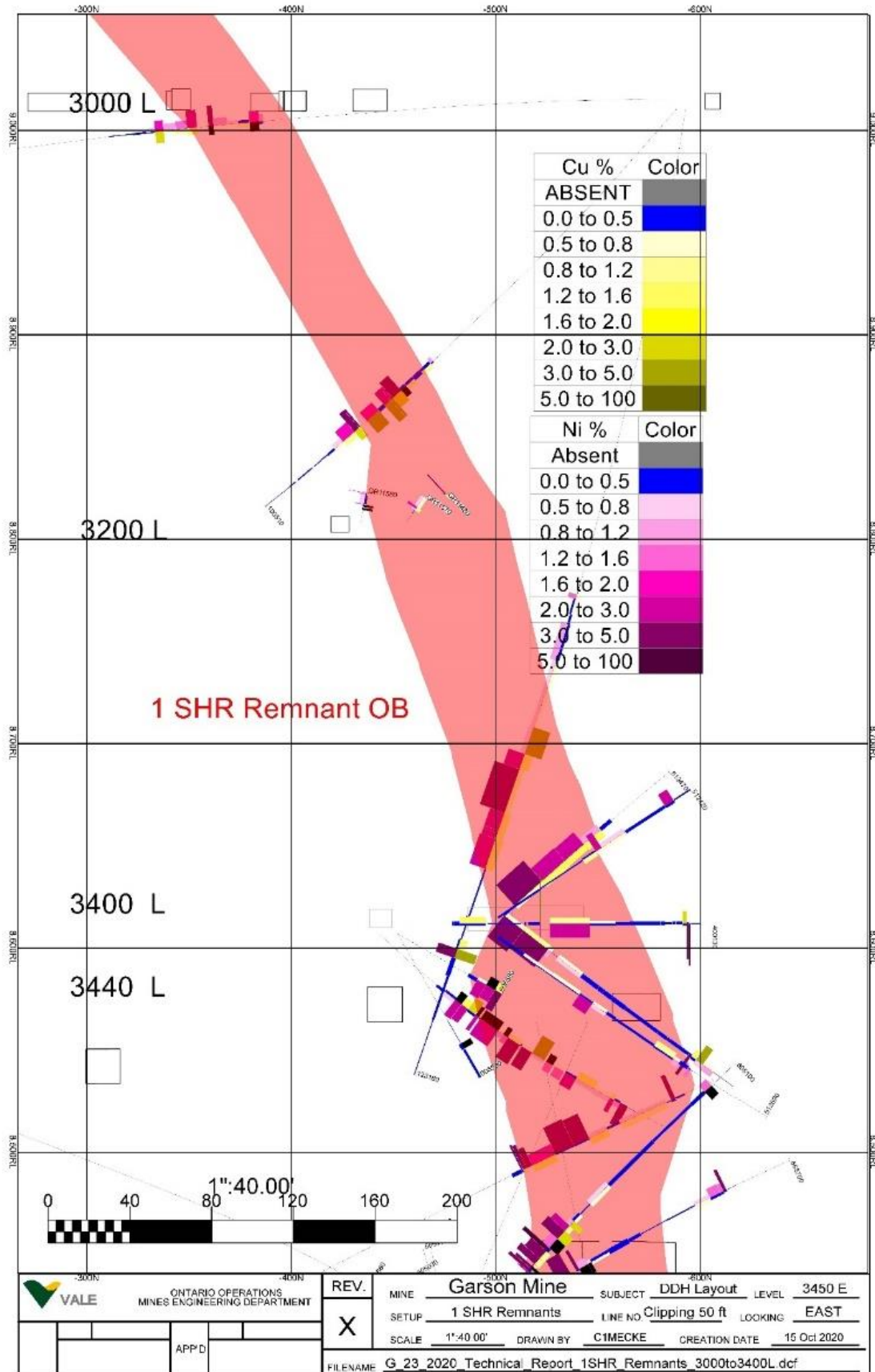


Figure 6-26: Example Cross-Section, Garson (level 3450 E)



6.4.9 GARSON–MCCONNELL

Although proximal to, and along strike from the Garson Mine orebodies, the McConnell deposit is in a different geological setting with different geological and mineralogical characteristics and is classified as an Offset-type deposit.

6.4.9.1 DEPOSIT DIMENSIONS

The McConnell deposit is approximately 434 m long, ranges from 61–174 m in width, averaging 131 m, and ranges in thickness from 9–30 m, averaging 18 m. The deposit is currently delineated from surface to a depth of 411 m, dips at about 75°, and plunges to the south at 70°.

6.4.9.2 GEOLOGY

Mineralization at the McConnell deposit is associated with a narrow, concentric, quartz–diorite dyke that has intruded into metasedimentary units within the Stobie Formation. The dyke strikes at 85° east and dips at 70° south. The immediate foot and hanging walls consist of quartz diorite acting as an envelope around the mineralization. Beyond this, the country rocks consist of embedded greenstone and quartzite with zones of Sudbury Breccia.

6.4.9.3 STRUCTURE

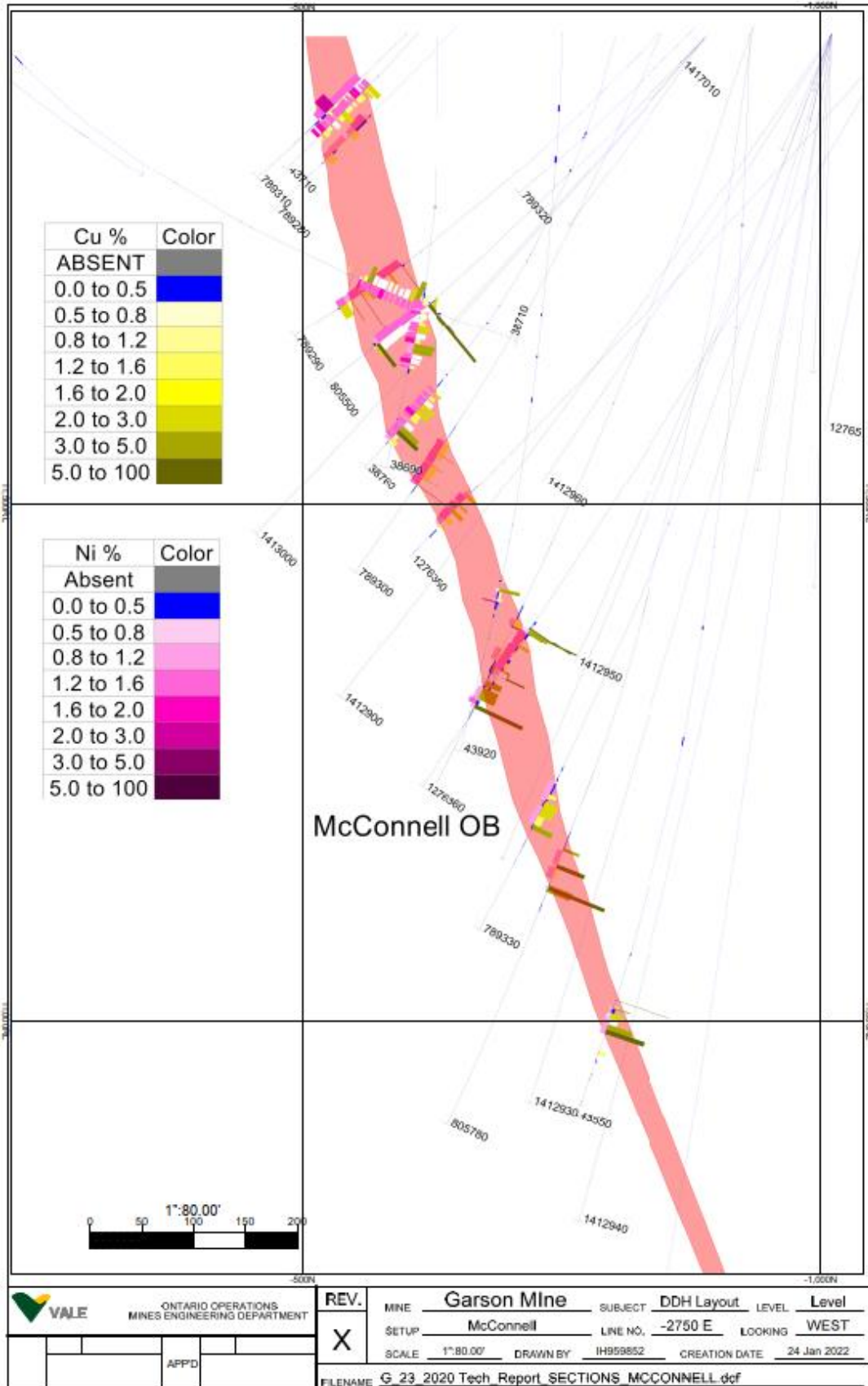
No significant cross-cutting dykes or structures have been identified or interpreted; however, the presence of shearing has been noted.

6.4.9.4 MINERALIZATION

The mineralization consists of massive sulphide and contorted schist inclusion sulphide with a high pyrrhotite/nickel ratio, above-average precious metals content and negligible arsenic content. The sulphides occur as 1–2 cm blebs within the quartz diorite, but mainly as disseminated sulphides in the surrounding breccia.

A representative drill section showing the orientation of the drilling to the mineralization, and examples of mineralization grades is provided in Figure 6-27.

Figure 6-27: Example Cross Section, McConnell (level 2750 east)



6.4.10 TOTTEN

The Totten Mine deposits consist of the actively-mined Totten Main (215) zones, and other mineralized zones including the 230, 260, 242, 235, 238, 238 West, Howland, and McIntyre zones.

6.4.10.1 DEPOSIT DIMENSIONS

Dimensions of the major zones within the Totten deposit are provided in Table 6-9.

Table 6-9: Dimensions, Totten Zones/Orebodies

Zone Designation	Type	Length (m)	Width/Strike (m)		Thickness (m)	
			Average	Range	Average	Range
215 (Main)	Offset	1420	305	60–455	20	2–30
230	Offset	230	90	20–165	4	3–8
238	Offset	130	30	5–115	6	3–20
Zone Designation	Depth From/To (m)	Dip (°)	Plunge (°)			
215 (Main)	565–1,525	90	45 S			
230	1,205–1,290	90	30 N			
238	315–440	90	40 S			

6.4.10.2 GEOLOGY

The Totten deposit is hosted within the Worthington Offset Dyke which extends 12 km south from the SIC. The dyke attains a thickness of 45 m in the Totten Mine area, strikes approximately 045°, and has steep variable dips.

Metasedimentary rocks and the Nipissing meta-gabbro sill underlie the Totten Mine area. The sill is 365 m thick, trends east–west and dips at approximately 65° to the southeast. The Worthington Offset cuts both the metasedimentary rocks and the gabbro sill. Late quartz diabase and olivine diabase dykes crosscut all lithologies.

The contact between meta-gabbro and Worthington Offset Dyke is characterized by a meta-gabbro breccia with fragments up to 10 m diameter. Locally the meta-gabbro is invaded by an inclusion quartz diorite stockwork and mineralized stringers. These breccia and stockwork features are not developed in metasedimentary rocks.

Two quartz diabase dykes occur in the immediate vicinity of the Totten Mine and bound the majority of the high-grade mineralization hosted in the Totten Main orebody. The quartz diabase dykes are steeply dipping and vary in thickness from <3–10 m. Quartz diabase dykes are generally fractured especially along the contacts resulting in local poor ground conditions. Several olivine diabase dykes of variable width occur to the north of the Totten Main orebody.

6.4.10.3 STRUCTURE

The Worthington Offset has been displaced by two major faults. The Creighton fault strikes east–west, is vertical to steeply dipping to the north, and dextrally displaces the Worthington Offset Dyke by approximately 1 km. The Murray fault also strikes east–west, is vertically dipping and dextrally displaces the Worthington Offset by approximately 1 km.

Between the Creighton and Murray faults the local rock mass has been subjected to northwest–southeast fracturing and weak faulting. Minor displacement occurred locally on some of the larger fractures.

6.4.10.4 MINERALIZATION

Copper–nickel–PGE–gold sulphides are hosted within an inclusion quartz diorite phase of the Worthington Offset. This sulphide zone consists of variable thicknesses of massive and semi-massive copper–nickel-bearing sulphides surrounded by a disseminated and blebby sulphide halo.

The massive sulphide varies in true thickness from 2–15 m and is dominantly pyrrhotite and pentlandite. The massive sulphide thins and splays into 2.5 cm to 1 m thick copper-rich stringer zones within the disseminated sulphide halo. Semi-massive sulphides are also typically pyrrhotite and pentlandite rich, but are spatially associated with chalcopyrite-rich patches. In areas where large meta-gabbro inclusions are present, metal grades tended to be higher than in portions of the dyke containing only amphibolite inclusions.

Thick, localized accumulations of ore are situated to the north and south of the quartz diabase dykes. Nickel and copper mineralization become progressively higher grade with depth and towards the core of the mineralization.

PGE–gold minerals are spatially associated with more copper-rich sulphides. Platinum and palladium grades increase with depth, but the gold grade does not. The highest PGE–gold grades are concentrated at depth around a portion of the southernmost quartz diabase dyke.

Mineral zone boundaries are locally characterized by arsenic-bearing minerals such as niccolite and gersdorffite. Niccolite stringers are also encountered in the quartz diabase dyke and sometimes in quartz diorite and inclusion quartz diorite proximal to the Worthington Offset.

Figure 6-28 shows the general geology along the Worthington Offset in the Totten Mine area. Drill sections through the deposit showing the orientation of the drilling to the mineralization, and examples of mineralization grades are provided as Figure 6-29 and Figure 6-30.

Figure 6-28: Worthington Offset Regional Geology

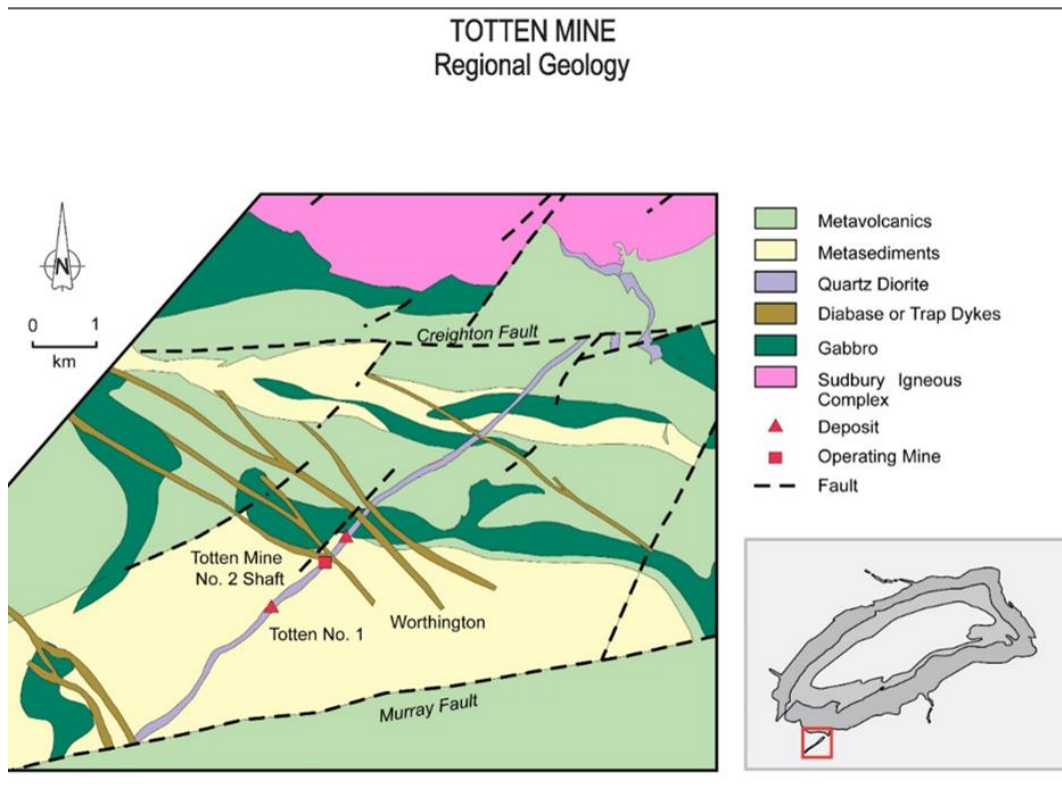


Figure prepared by Vale Base Metals, 2023.

Figure 6-29: Example Cross Section, Totten (20,500 N)

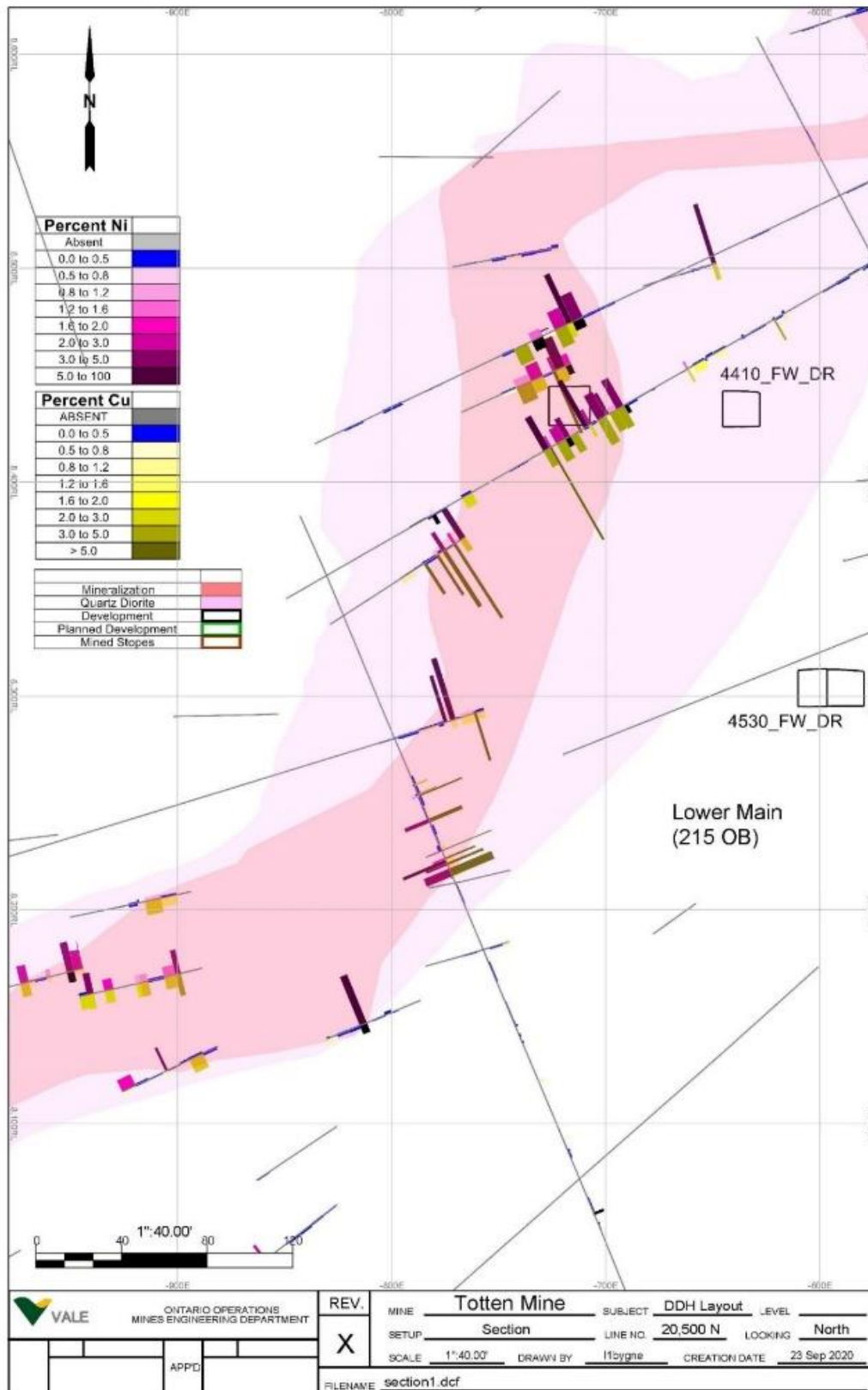
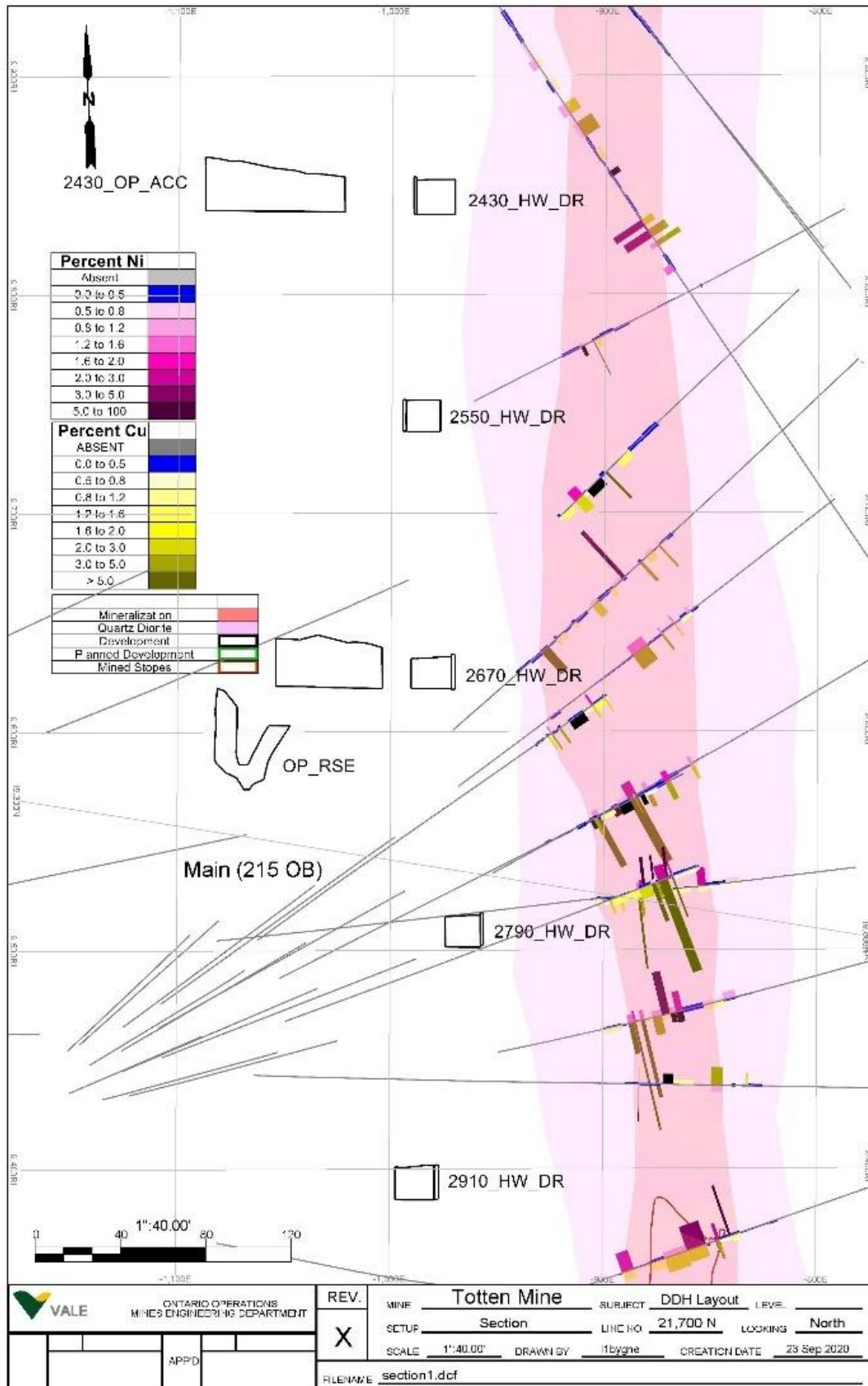


Figure 6-30: Example Cross-Section, Totten (21,700 N)



6.4.11 NICKEL RIM SOUTH EXTENSION

The Nickel Rim South Extension deposit includes the Main, NR14, 24N, and BL28 zones. The NR14 and BL28 zones are currently divided by a Glencore/Vale Base Metals claim boundary and are collectively known as Deep-Cu.

6.4.11.1 DEPOSIT DIMENSIONS

Dimensions of the major zones within the Nickel Rim South Extension deposit are presented in Table 6-10.

Table 6-10: Dimensions, Nickel Rim South Extension Deposit

Zone/Orebody	Type	Length (m)	Width/Strike (m)		Thickness (m)	
			Average	Range	Average	Range
Main	Contact	1035	120	30–150	20	3–45
NR14	Footwall	385	215	150–305	20	3–55
24 N	Footwall	70	120	30–185	10	3–30
BL28	Footwall	335	305	275–335	20	3–40
Zone/Orebody	Depth From/To (m)	Dip (°)	Plunge (°)			
Main	1,310–1,940	50–65	60–65 S			
NR14	2,370–2,690	45–55	50–55 S			
24 N	595–745	60–70	45–50 S			
BL28	2,465–2,680	45–55	50–60 S			

6.4.11.2 GEOLOGY

The deposit footwall consists of felsic, intermediate, and mafic gneisses, diabase sills, and Sudbury breccia. The SIC lithologies include felsic norite, sublayer norite (dark norite breccia), mafic norite (dark norite) and late granite breccia. The preferred host lithology for the contact mineralization is the late granite breccia and sublayer.

6.4.11.3 STRUCTURE

Five fault types are differentiated. Cataclasite faults range from a few centimetres in width to as much as 4 m, and have no significant displacement. They are post-SIC, competent structures that show sharp to variable contacts, and are often associated with quartz–carbonate veins and infilled joints. A second fault type, consisting of a low RQD fracture zone hosts numerous chlorite-coated fractures. The Nickel Rim South Extension Shear is characterized by pervasive epidote/chlorite alteration. The fourth major fault set consists of a set of 4–6 m thick parallel, brittle structures that do not appear to disrupt stratigraphy but do cross-cut NR14 and BL28.

6.4.11.4 MINERALIZATION

Three copper–nickel sulphide mineralization types occur:

- Nickel-rich Contact mineralization occurs at the base of the SIC, predominantly hosted by late-granite breccia and lesser amounts of sub-layer;
- Fractionated Contact mineralization migrated to the gneissic footwall and Sudbury breccia, typically exploiting planes of structural or lithological weakness, forming copper-rich footwall deposits;

- Hanging wall nickel mineralization occurs above the base of the SIC, hosted predominantly in norite breccia and upper portions of a late-granite breccia (Glencore/Vale Base Metals – Nickel Rim South Extension Project, 2020).

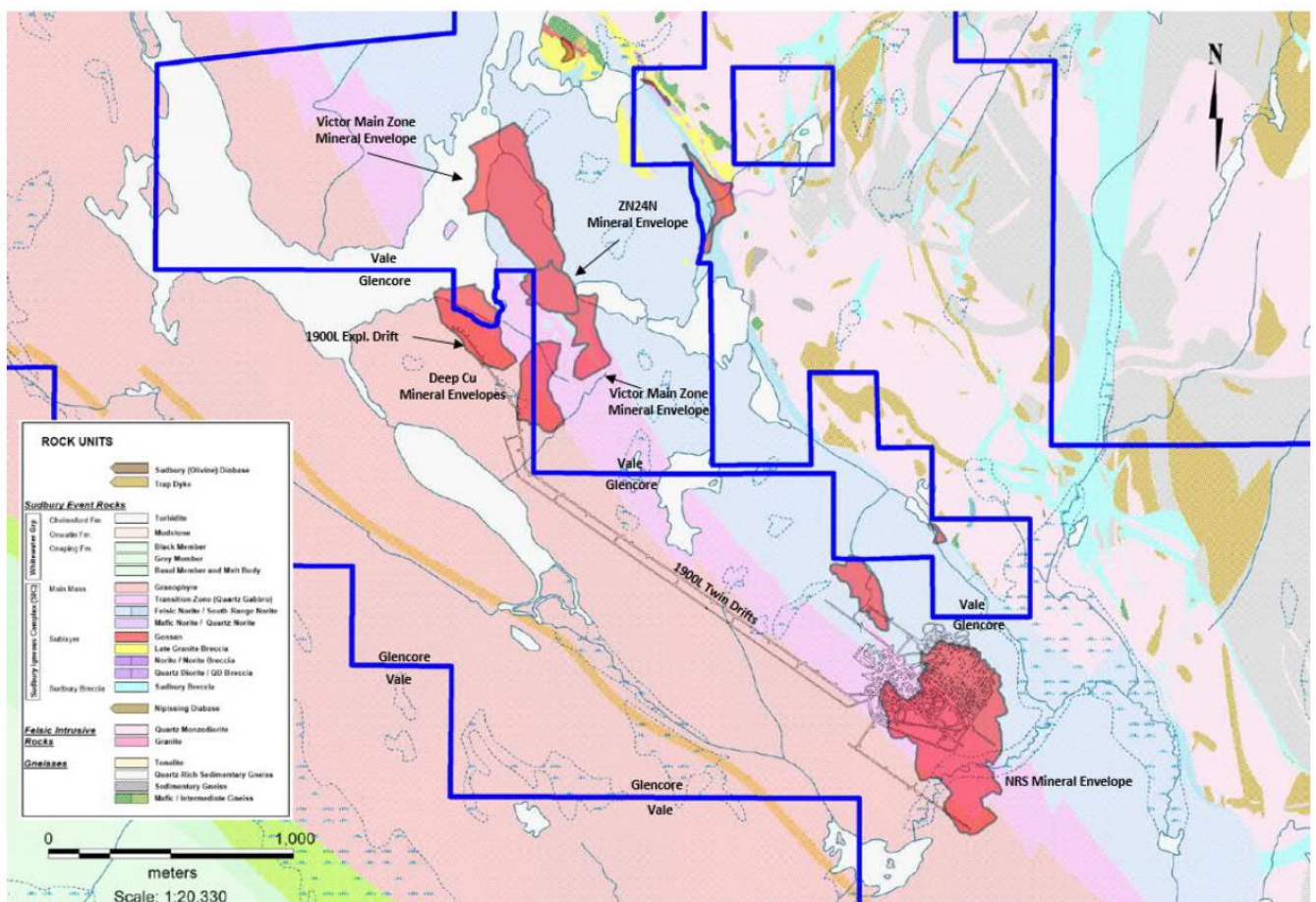
In the Main zone, mineralization consists of massive to disseminated sulphide textures composed predominantly of pyrrhotite with accessory pentlandite and chalcopyrite with trace to patchy pyrite.

The Footwall-style mineralization in the 24 N zone consists of a massive sulphide zone comprising massive chalcopyrite veins and accessory blebby pentlandite and streaks of millerite. The massive sulphide zone transitions into narrow (<10 m) zones of chalcopyrite stringer-stockwork style textures with occurrences of millerite and bornite.

Deep Copper Footwall-style mineralization occurs as variable width stringers / veins forming a stockwork with high rock inclusion content (50 to 70%). The mineralization consists of massive chalcopyrite-cubanite-bornite and chalcopyrite-millerite-pentlandite stringers and vein systems with a highly variable distribution and range in thickness from one inch to several meters.

A geological plan is included as Figure 6-31. Drill sections through the deposits showing the orientation of the drilling to the mineralization, and examples of mineralization grades are shown in Figure 6-32 and Figure 6-33.

Figure 6-31: Geological Plan, Nickel Rim South Extension Area



Note: Figure prepared by Vale Base Metals, 2020.

Figure 6-32: Example Cross Section, BL28 N (7,500 m east)

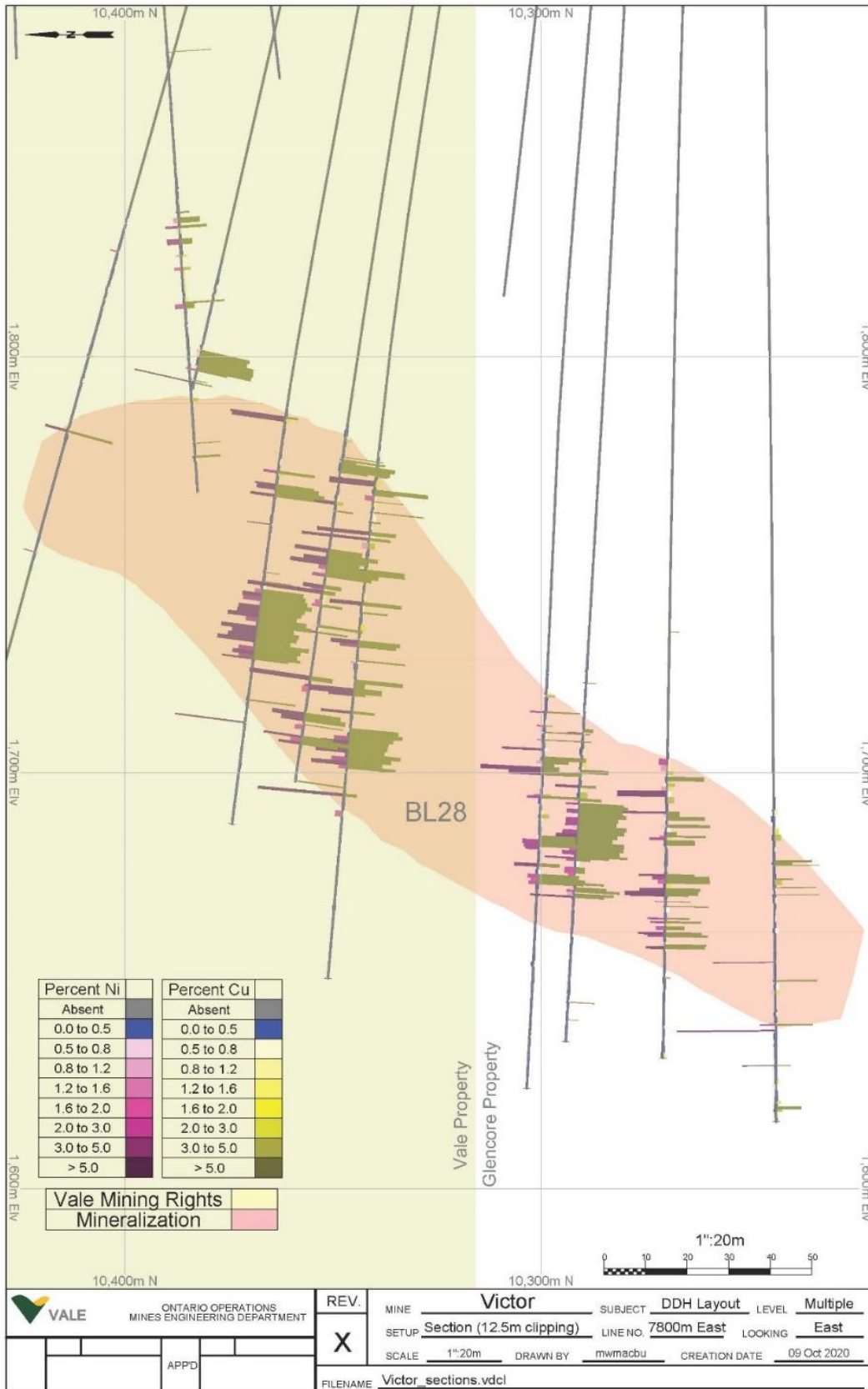
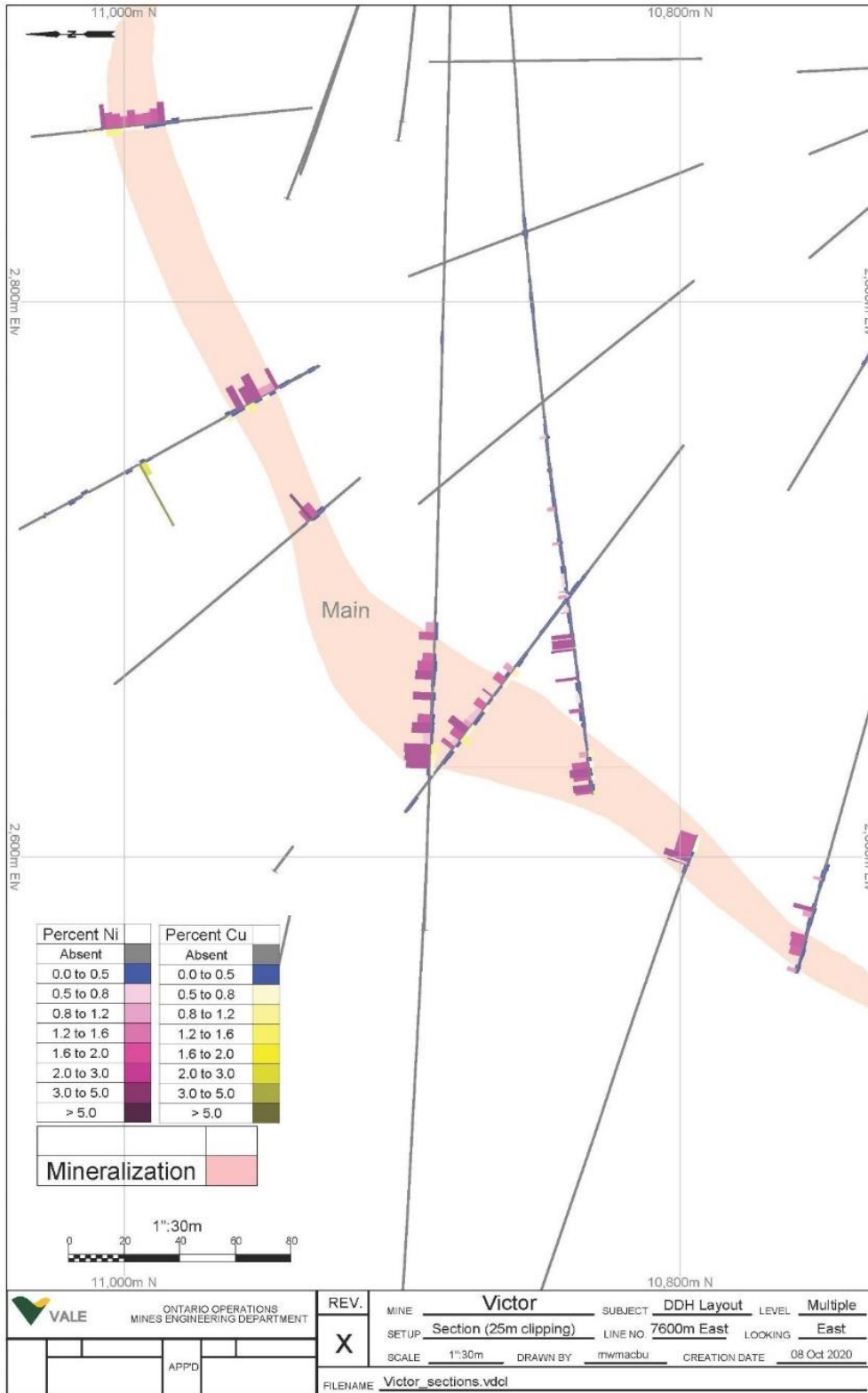


Figure 6-33: Example Cross Section, Nickel Rim South Extension Main (7,600 m east)



7 EXPLORATION

7.1 EXPLORATION

7.1.1 GRIDS AND SURVEYS

Current topographic surveys are completed on an as-needs basis. In active operations surveyors may complete measurements daily, while in areas with no active work, surveys may be years apart. The datum used for each property varies and could include local mine grids.

7.1.2 GEOPHYSICS

The primary borehole geophysical methods applied in Sudbury Basin exploration include the (UTEM-4) borehole electromagnetic system, optical and acoustic televewers, cross hole radio imaging (RIM) and down-hole induced polarization (IP).

The UTEM-4 system is an on-time electromagnetic method that is optimized to detect and discriminate defining massive sulphides. Depending on the presence of conductive material, UTEM-4 can locate targets beyond and between boreholes. Imaging, modelling, and inversion methods are applied to these data to generate estimates of the location and attitude of the boundaries of sulphide mineralization.

A televewer is an in-hole probe that records an optical and acoustic image of the walls of the drill hole and provides true three-dimensional orientations of contacts and planar features.

The RIM system generates a cross-section profile of conductivity contrasts between two select drill holes of comparable lengths. The resolution is primarily dependent on the size of the conductors and the distance between the holes.

Down-hole IP methods are deployed in areas with mineralization occurring as disseminated, ragged disseminated or interstitial sulphides that are otherwise difficult to detect with conventional electromagnetic systems.

7.1.3 QUALIFIED PERSON'S INTERPRETATION - EXPLORATION INFORMATION

The Sudbury Basin has been extensively explored for over 100 years, and a considerable information database has developed from both exploration and mining activities.

The primary exploration method is core drilling and assay collection. However, advancements in geophysics, in particular, borehole geophysical surveys, have improved the amount and quality of data that can be used for geological interpretations and geological modelling. The geophysical information is integrated with the drill hole database to improve deposit model interpretations.

7.1.4 EXPLORATION POTENTIAL

The Ontario Operations continue to actively explore within the current mining operations area. Areas that are planned to be drill tested include:

- Coleman: Recent exploration activities have concentrated on near-infrastructure nickel contact mineralization within the East Orebody and the #4 Up Dip zone, which represents a potential surface mining opportunity. Additional efforts have targeted transitional copper-nickel mineralization within the western chutes, as well as footwall copper mineralization in the 148 and 170 Extension areas. Exploration initiatives include evaluation of the #4 Contact Corridor (Ni), 9 Scoop (Cu-Ni), 160 Zone (Cu), and High Shaft Copper (Cu) targets.
- Copper Cliff: depth extents of 114ET, 120, 890, and 900 orebodies with future targets including the 178 and 191 orebodies on the north side. The south side targets include the 810, 830, 850, and 860 orebodies.

- Creighton: above infrastructure targets including the 300, western extents of the 310, and 1290 orebodies. Upper Creighton targets include the 402, Gertrude West, and 118 orebodies.
- Garson: Exploration activities in 2025 were primarily directed toward further delineation of the Garson Ramp mineral potential across the 360, 13, and 1 SHR orebodies. At Garson Main Mine, drilling programs targeted the 1,3, 4 and 5 SHR West zones, with definition and expansion drilling conducted between the 3800 and 6000 Level elevations.
- Totten: Ongoing work continues to delineate the spatial extents and cutoff parameters of the Totten Main, Deep, and Shelf zones, as well as the 230 and 238 orebodies. Recent drilling programs have concentrated on areas proximal to existing infrastructure and near-surface targets, including the #2 Shaft Orebody. Additionally, efforts have been directed toward evaluating the continuity of mineralization between the surface orebodies (242 and 260) and the 238 Orebody. In 2025, an airborne magnetotelluric (MT) survey was completed to investigate the northern and southern extents of the Worthington Offset, supporting future target generation initiatives.

Exploration is conducted underground from existing infrastructure and services with the aim of discovering and delineating additional mineralization that is within reach of the active mine infrastructure.

Brownfields exploration is focused on areas in the Sudbury basin within a reasonable radius of existing infrastructure. Greenfields exploration is conducted throughout the Ontario Operations area to identify new stand-alone nickel and copper deposits.

7.2 DRILLING

7.2.1 DRILLING ON PROPERTY

Drilling totals 9,573,582 m of drilling on properties that have current mineral resources. Total drilling for all Vale Base Metals owned properties within the Sudbury Basin includes 93,110 core drill holes for 14,666,348 m of drilling to year-end 2025. Drill data can be excluded if the data are considered questionable, see discussion in Chapter 11.3. Drill totals do not include blasthole drilling.

The drilling for areas that have current mineral resource estimates are summarized in Table 7-1 by drill hole purpose, and do not include blast holes. Drill collar location plans are provided in Figure 7-1 to Figure 7-10.

The QP notes that due to the historical nature of some of the data, there may be drill holes that have not been captured in the current drill databases. Geotechnical and geomechanical drill holes are included as part of the exploration/resource definition category.

Table 7-1: Drill Summary Table

Location/Mine	Exploration Total (m)	Definition Total (m)	Total (m)
Totten	225,315	269,445	494,761
Creighton	1,256,676	494,325	1,751,001
Garson	531,369	382,034	913,402
Coleman	555,294	373,714	929,008
Copper Cliff Mine	1,326,892	1,190,272	2,517,164
<i>Underground Subtotal</i>	<i>3,895,546</i>	<i>2,709,790</i>	<i>6,605,336</i>
Big Levack	1,200	—	1,200
Creighton	218,758	786	219,543
Garson	142,240	4,036	146,176
North Range Phase 2	255,906	—	255,906
Copper Cliff Pit	139,690	656	140,346
Copper Cliff	742,935	10,580	753,515
Coleman	322,381	125	322,505
Ella–Capre (Capreol Twp)	465,909	—	465,909
SN Ella	47,879	—	47,879
East Range Phase 2	16,439	—	16,439
South Range	299,429	—	299,429
Totten	298,485	914	299,399
<i>Surface Subtotal</i>	<i>2,951,251</i>	<i>17,097</i>	<i>2,968,246</i>
Total	6,846,797	2,726,887	9,573,582

Figure 7-1: Drill Collar Location Plan, Blezard

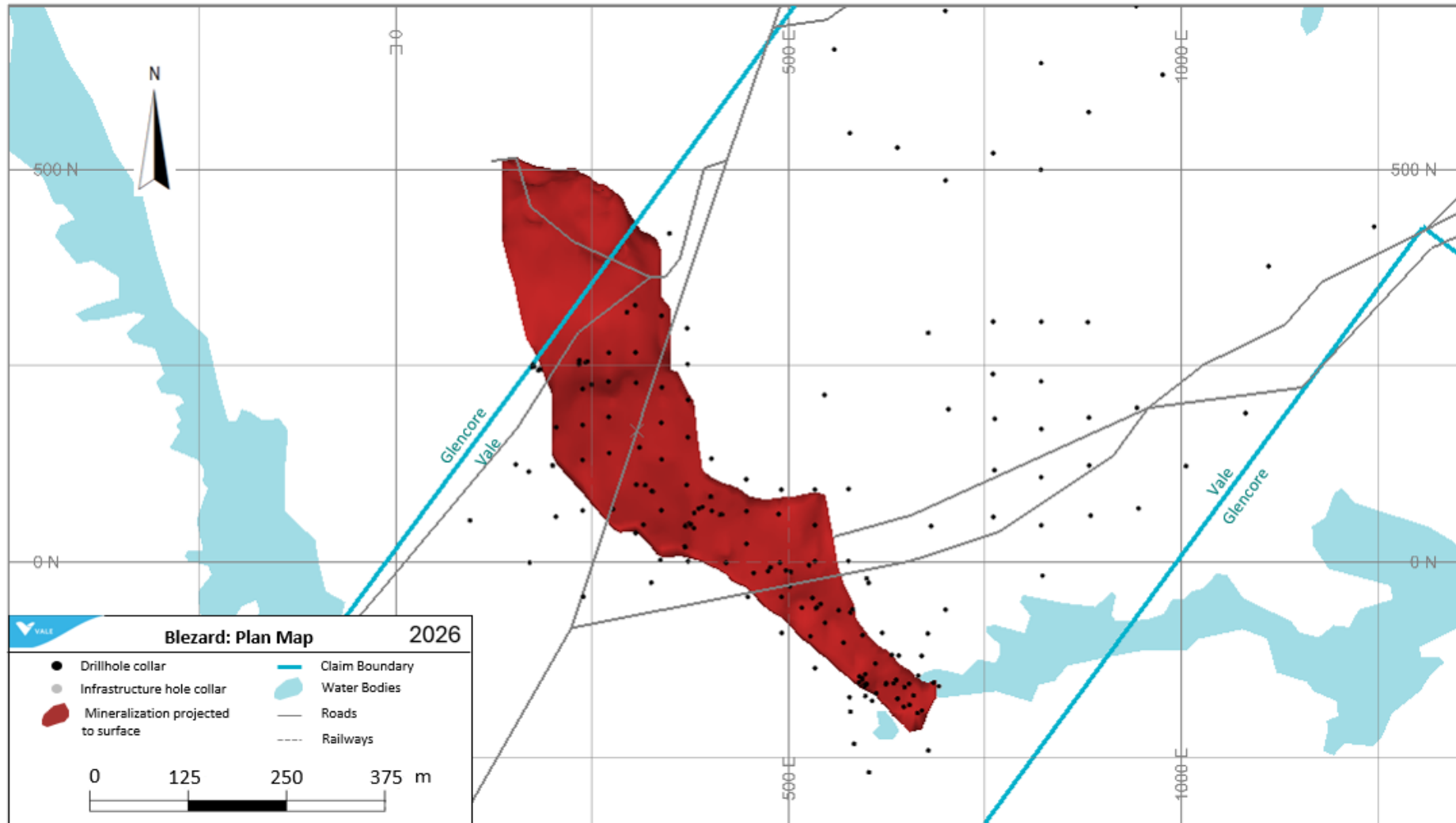


Figure 7-2: Drill Collar Location Plan, Coleman

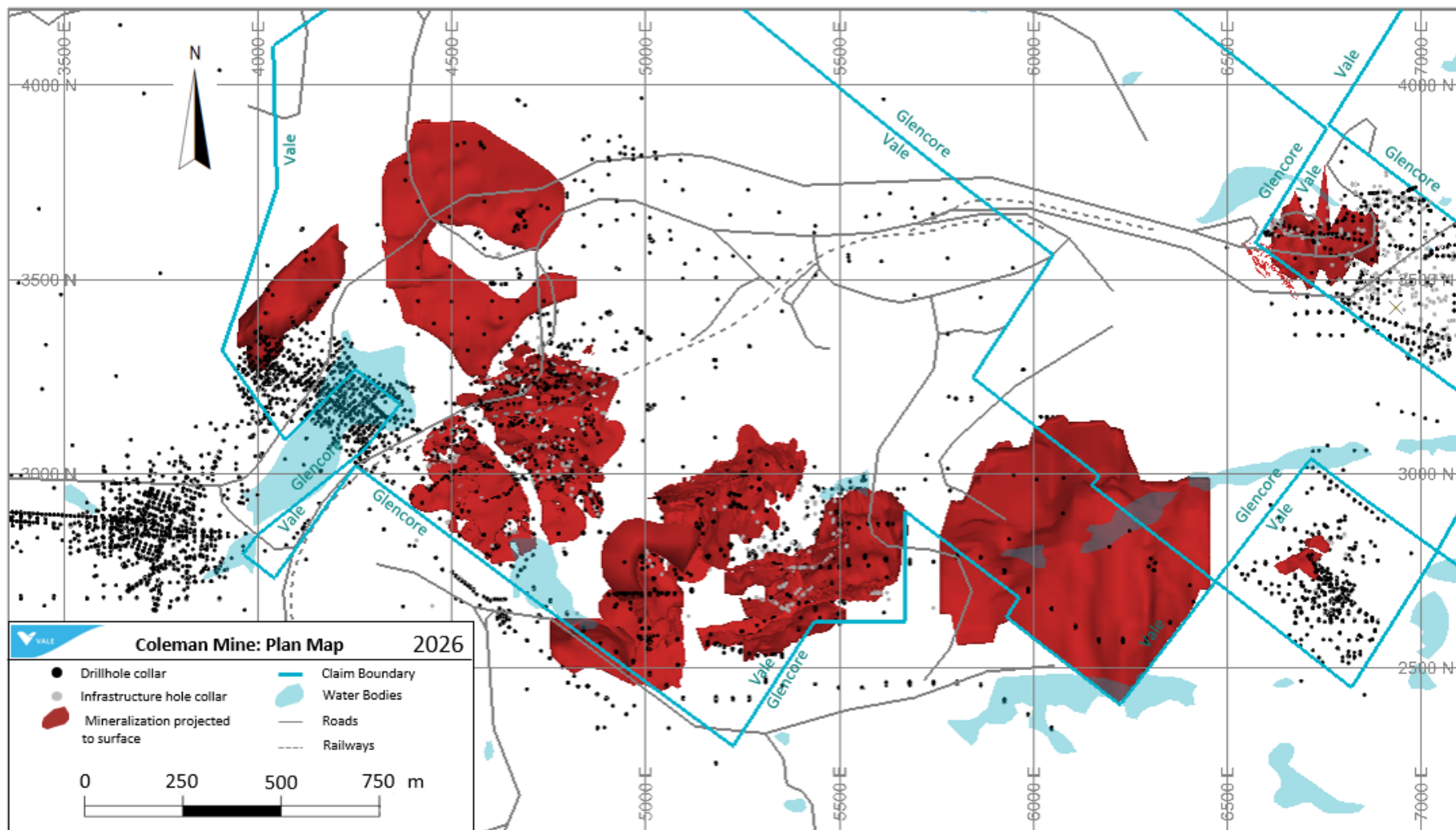


Figure 7-3: Drill Collar Location Plan, Copper Cliff

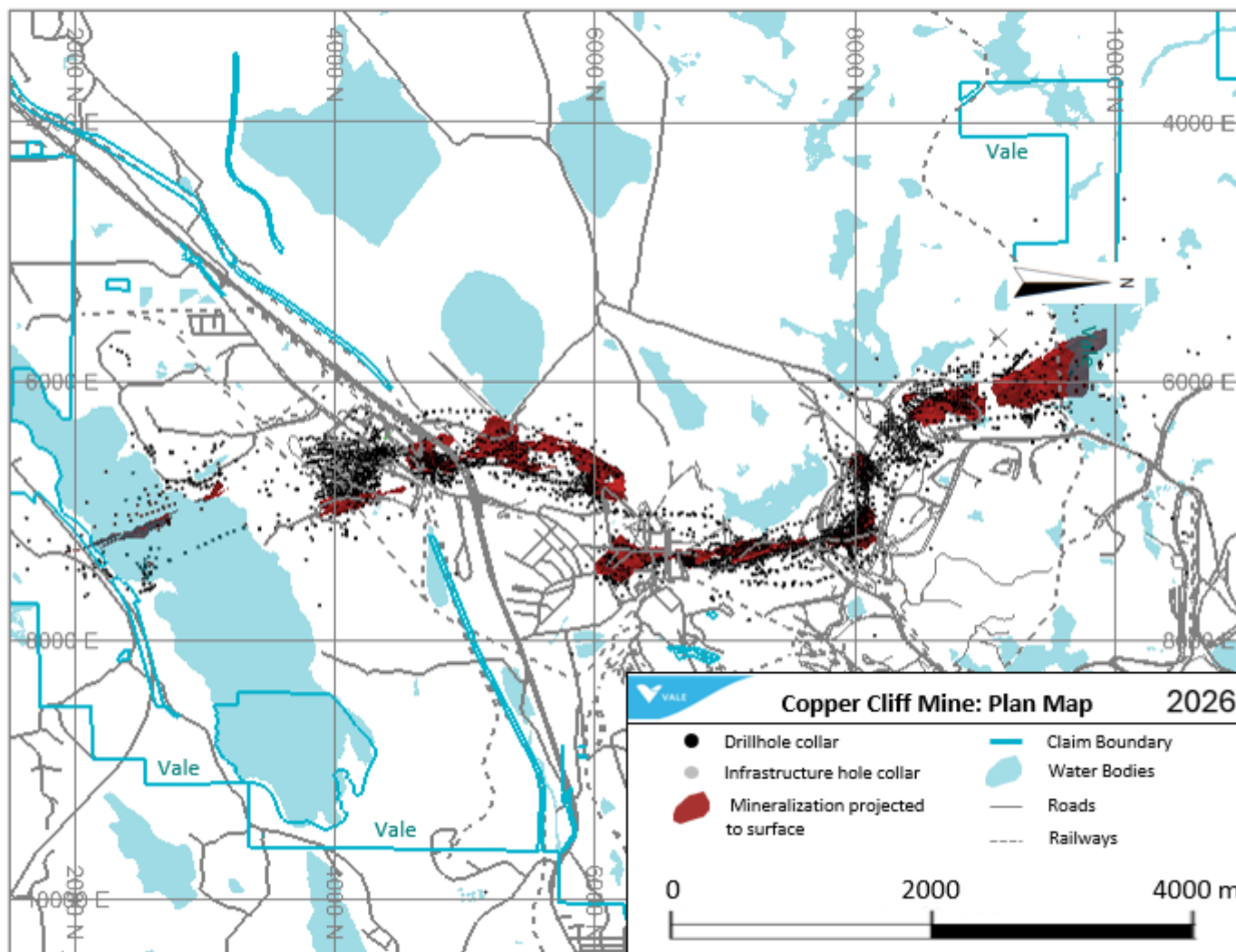


Figure 7-4: Drill Collar Location Plan, Creighton

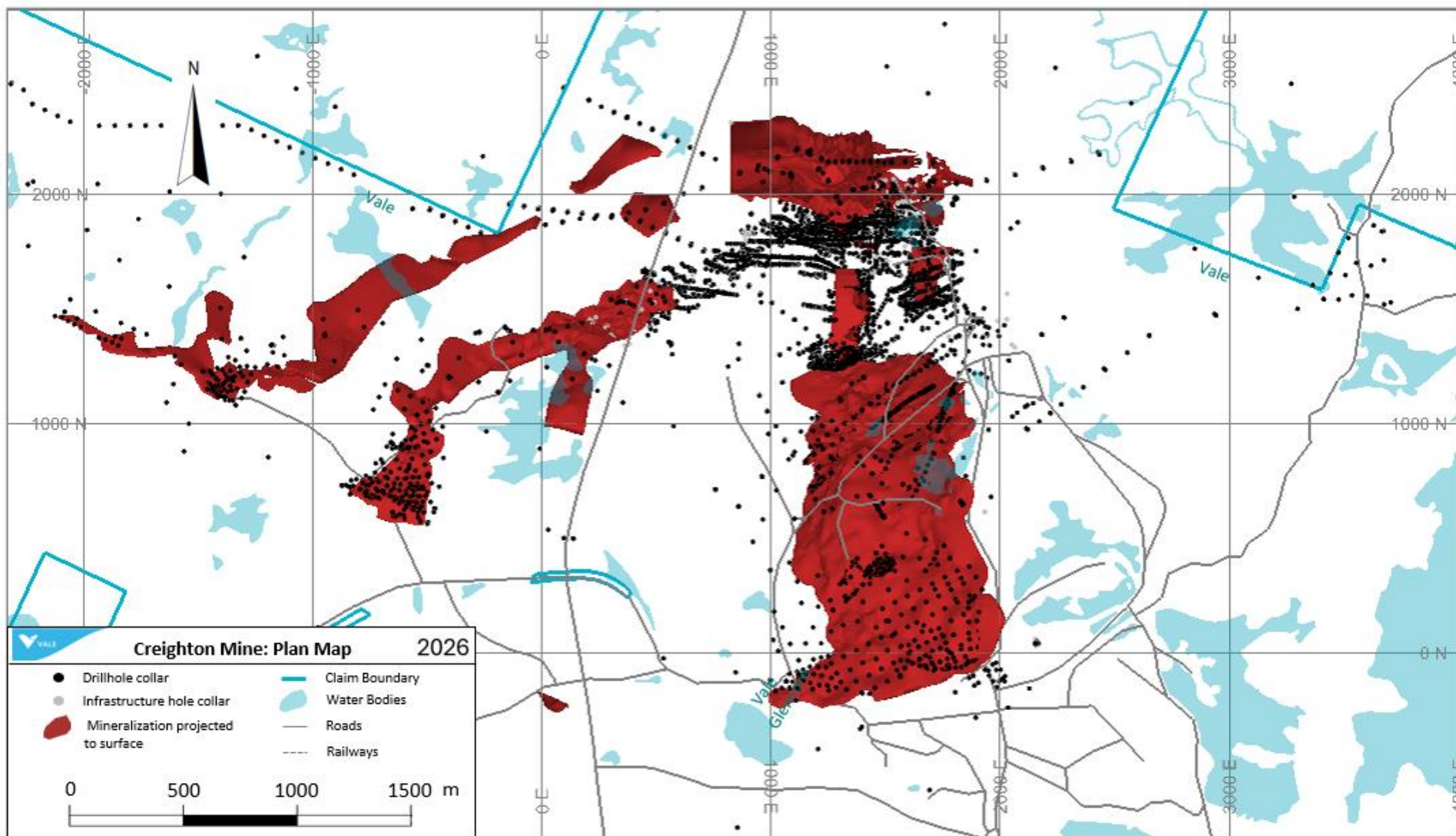
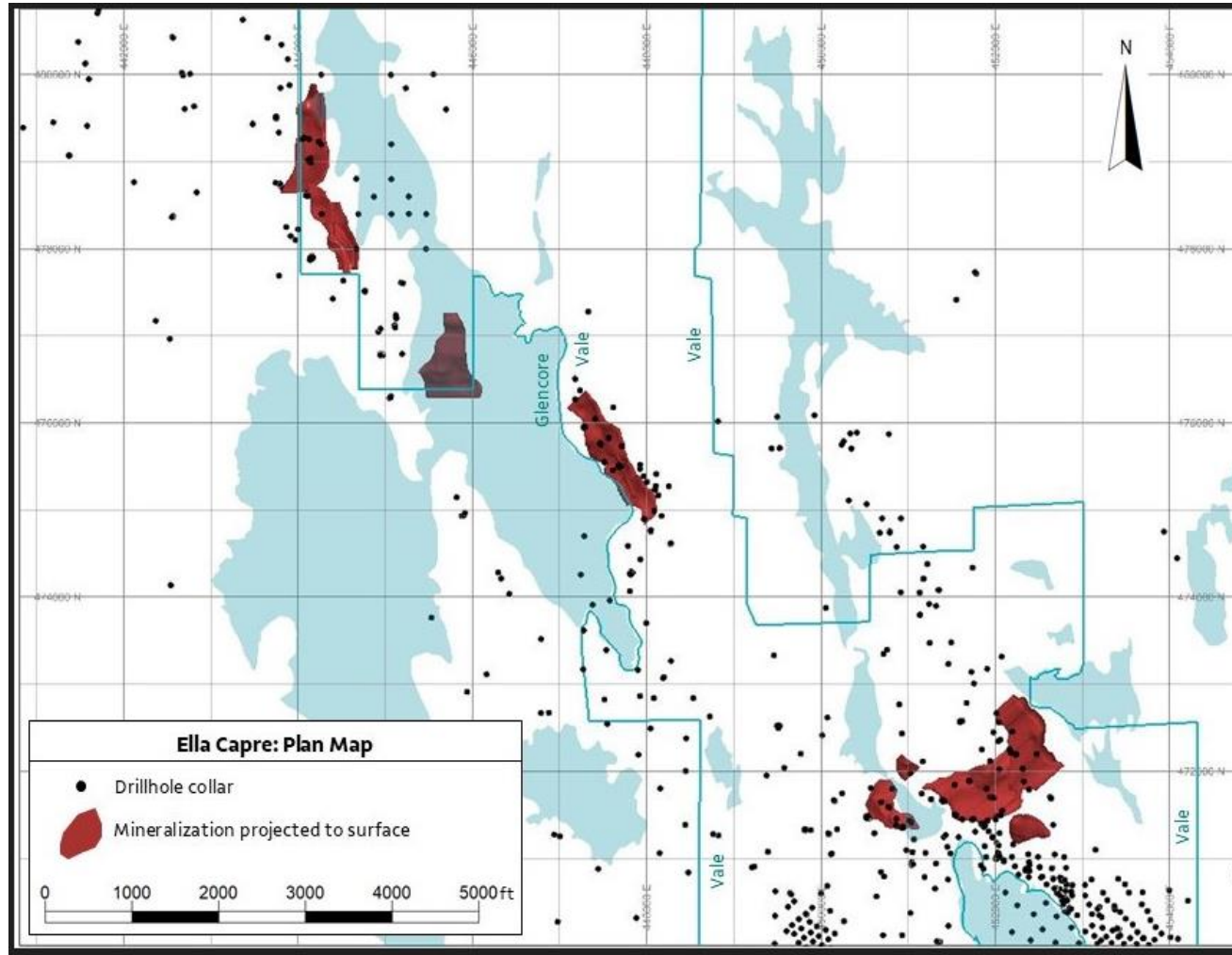


Figure 7-5: Drill Collar Location Plan, Ella-Capre



Note: Figure prepared by Vale Base Metals, 2026

Figure 7-6: Drill Collar Location Plan, Frood–Stobie Block 37

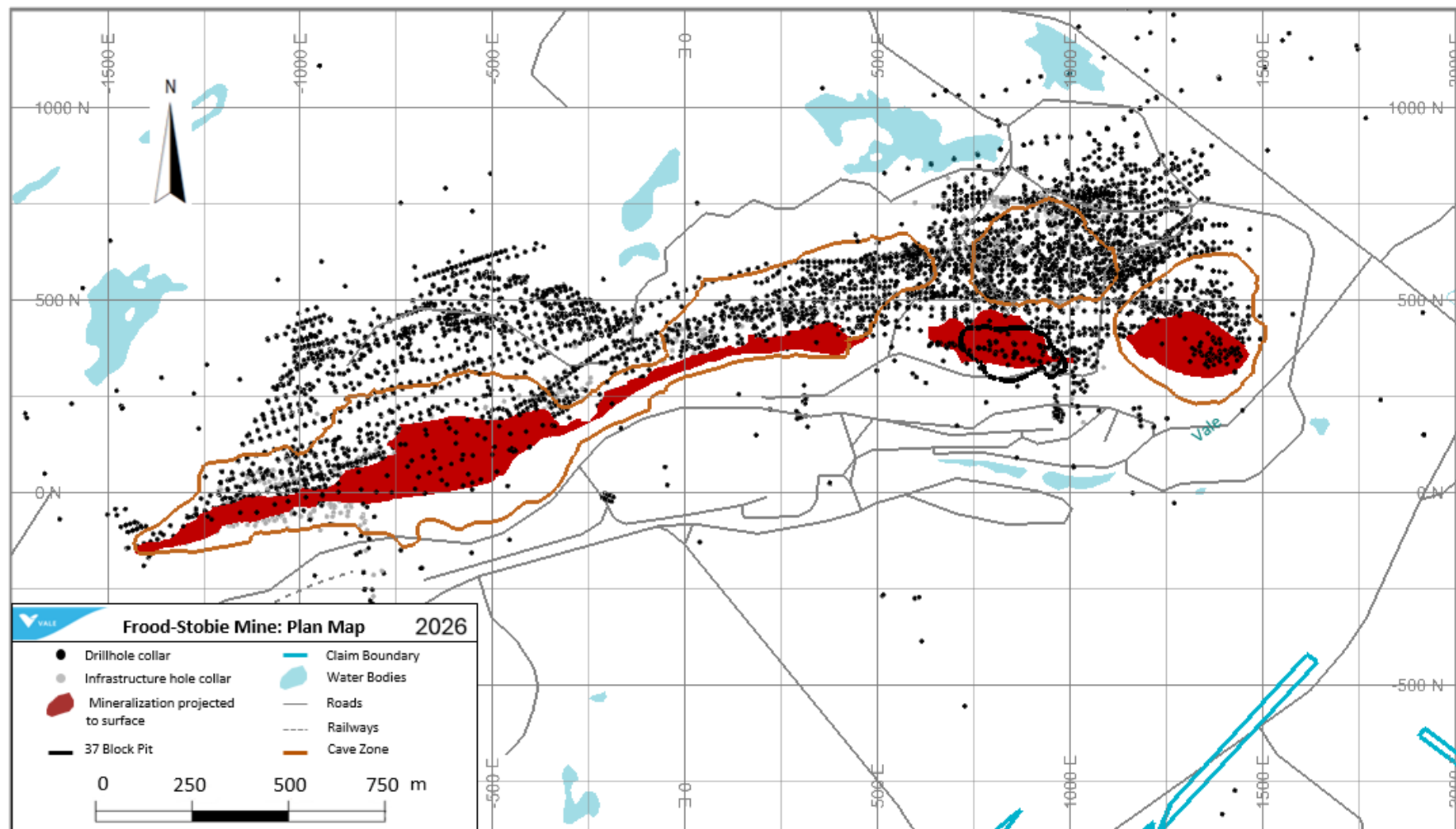


Figure 7-7: Drill Collar Location Plan, Garson

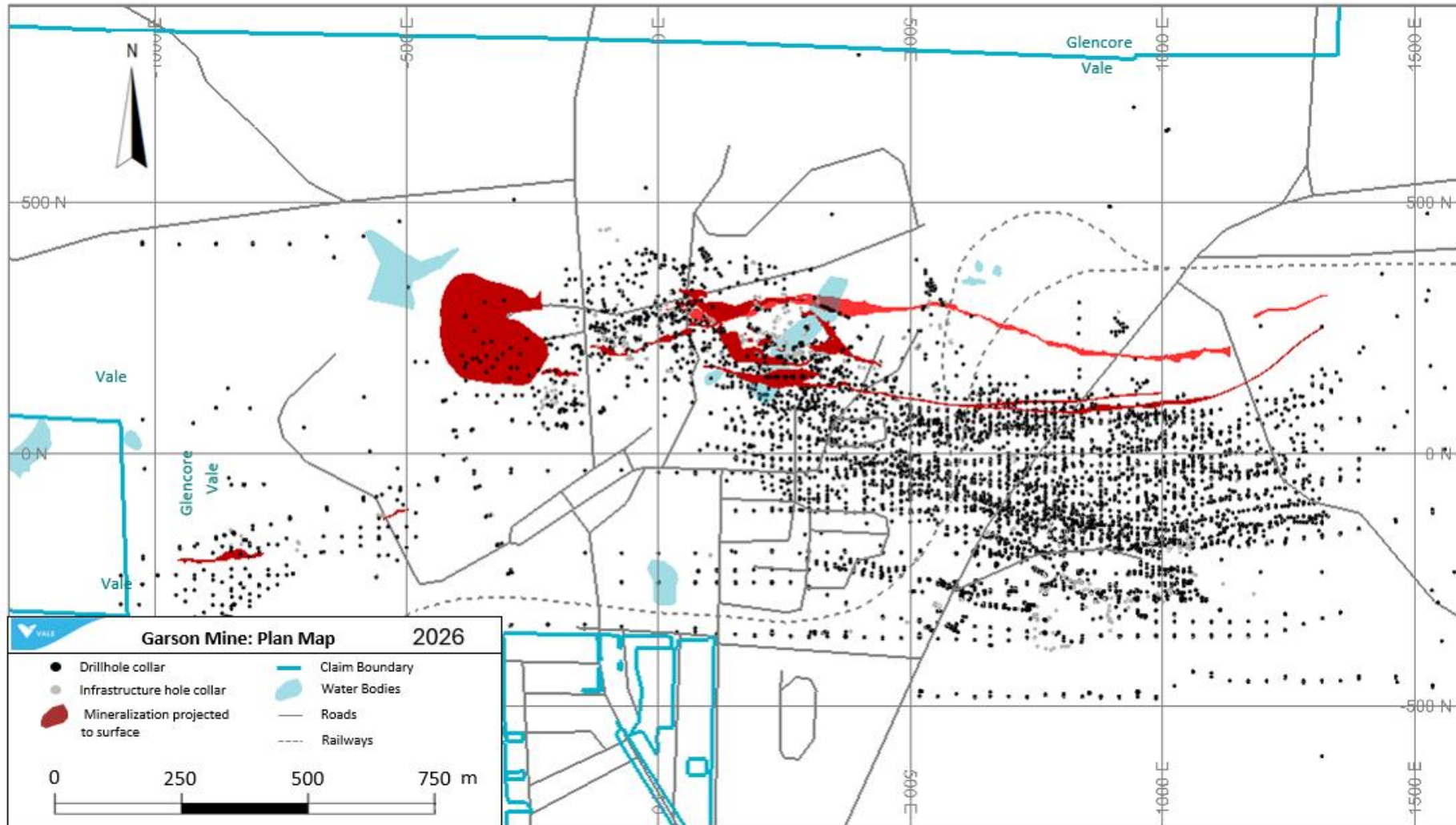


Figure 7-8: Drill Collar Location Plan, Copper Cliff Pit

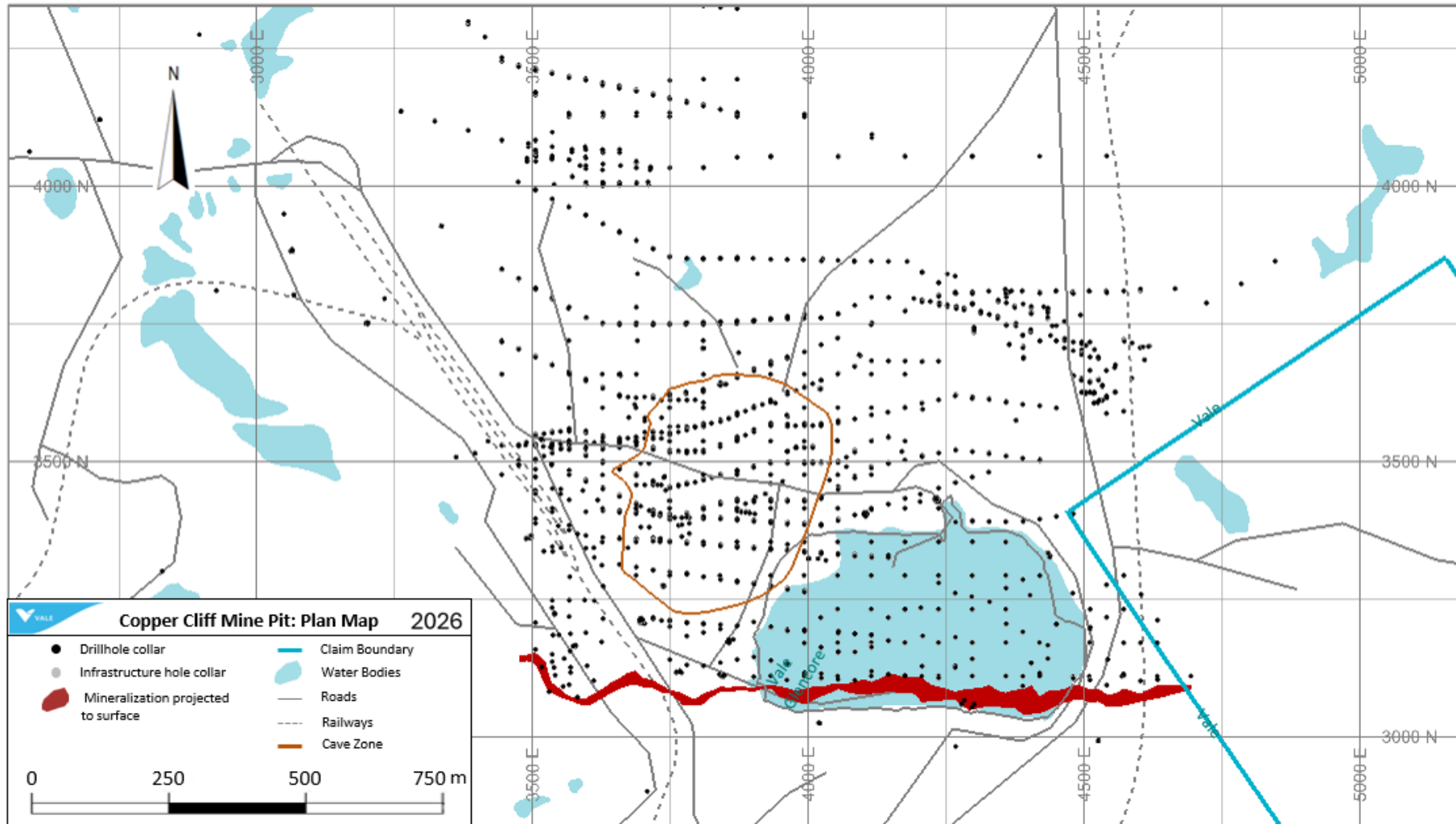


Figure 7-9: Drill Collar Location Plan, Totten

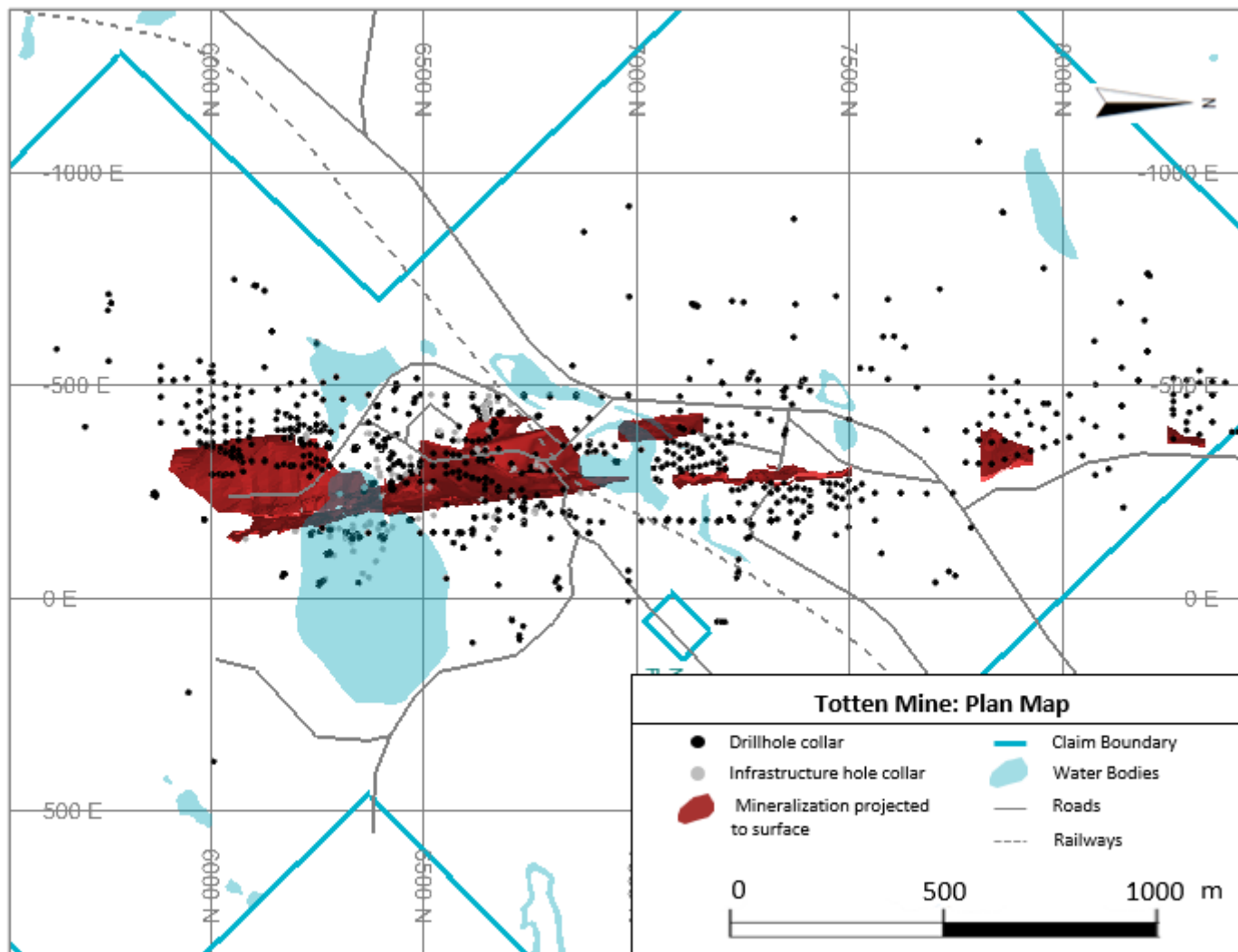
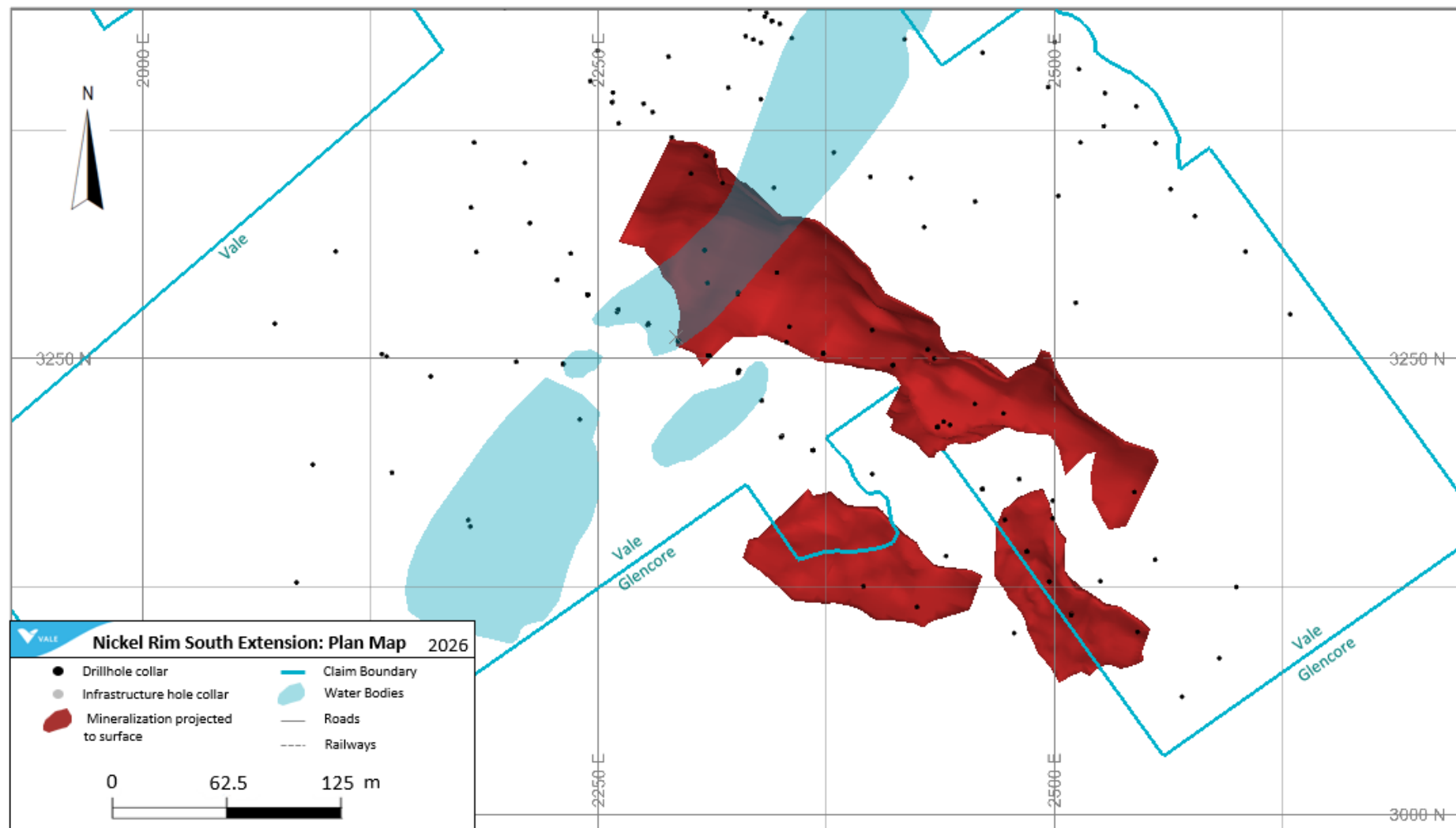


Figure 7-10: Drill Collar Location Plan, Nickel Rim South Extension



7.2.2 DRILL METHODS

The primary drill method is core drilling. Typical drill spacing is >100 m for exploration and 10–50 m for resource definition drilling.

Current underground drill programs for exploration and operations purposes use a core size of BQ (36.4 mm diameter). Surface programs use NQ size (47.6 mm). AQTk (35 mm diameter) core was used historically.

7.2.3 LOGGING

Standardized logging procedures and software are used to record geological and geotechnical information including lithology, description of mineralization and percentage sulphide content, mineralogy, major structures, rock quality designation (RQD) and rock mass rating (RMR).

7.2.4 RECOVERY

Core recovery is generally good at all deposits, with rock quality designation values generally >90. Areas of poor recovery are usually limited to fault and shear zones.

7.2.5 COLLAR SURVEYS

The required azimuth direction of the drill collar layout, for both surface and underground, are identified using front sight and back sights with contract drillers also using a gyro-compass, IMDEX's TN-14. On surface, global positioning system (GPS) coordinates are used for collar locations, while underground, drill collar locations are measured from survey control points.

7.2.6 DOWN HOLE SURVEYS

The deviation and deflection from changing rock properties and/or lithological units is considered when determining the starting dip angle of a proposed drill hole. As a result, the starting dip and azimuth can be modified based on historical, local drill hole responses to ensure target locations are accurately acquired.

Currently, the trajectory of all surface holes and many of the underground holes are surveyed using multi-shot gyroscopic orientation tools. Non-magnetically susceptible instruments (e.g., north-seeking gyro) are used for exploration holes. Shorter definition holes use single shot and/or multi-shot surveys using tools such as FlexIt and VisionR. These tools are influenced by magnetic properties; therefore, azimuth data are calculated rather than measured.

Pre-2009 borehole dip measurements were taken using an acid tube test. Historical boreholes are occasionally resurveyed using a gyroscopic instrument for trajectory verification.

7.2.7 QUALIFIED PERSONS INTERPRETATION – DRILLING RESULTS

Drilling and surveying were conducted in accordance with industry-standard practices at the time of drilling and provide suitable coverage of the zones of copper–nickel mineralization. Collar and down hole survey methods used generally provide reliable sample locations. Drilling methods provide good core recovery. Logging procedures provide consistency in descriptions.

These data are considered to be suitable for mineral resource and mineral reserve estimation. There are no drilling or core recovery issues that are known to the QP that could materially impact the accuracy and reliability of the results in the drilling that supports the estimates.

7.3 HYDROGEOLOGY

7.3.1 INTRODUCTION

Hydrogeological information is collected during exploration, project evaluation and mining closure phases to support the characterization of groundwater conditions relevant to mine feasibility, planning and design, operations, and permitting.

Related hydrogeological topics assessed during these phases include dewatering planning and strategy, surface water management, water balance and efficiency, hydrogeochemistry, water sources and security, and water quality.

Data may be acquired through installation of monitoring locations and associated instrumentation, evaluation of pre-mining water use and quality, identification of subsurface characteristics, identification of surface water systems and watersheds, regional hydrogeological characterization, and identification of potential receptors..

7.3.2 SAMPLING METHODS AND LABORATORY DETERMINATIONS

Vale Base Metals has undertaken regular groundwater and surface water quality sampling since 1999. Monitoring is currently conducted at approximately 1,700 groundwater wells and approximately 700 surface water stations, located throughout the Ontario Operations area. Groundwater well and surface station numbers vary through time, due to well damage or decommissioning, inaccessibility issues, the establishment of new wells and surface water locations

The sampling schedule is seasonal, with sampling conducted by third-party consultant (Pinchin Ltd) in the spring and fall (ground and surface water), summer (surface water only). Field parameters such as pH, conductivity, temperature, oxidation–reduction potential (ORP) and water levels are measured in the field. Samples are submitted with field duplicates and blanks inserted in the sample stream.

Water samples are analysed by Testmark Laboratories, in Garson, Ontario (Testmark). Testmark is independent of Vale Base Metals, and holds Canadian Association for Laboratory Accreditation Inc. accreditations for selected analytical techniques. The following parameters are measured by Testmark: pH, conductivity, alkalinity, hardness, acidity, sulphate, nitrate, nitrite, ammonia, chlorite, dissolved metals (45-element suite), total dissolved solids, total suspended solids (surface water only), and turbidity (surface water only). Results are provided to Pinchin who review the results within their quality assurance/quality control (QA/QC) practices. Regular reports for defined monitoring periods are provided by Pinchin to Vale Base Metals in which the groundwater quality is compared to relevant provincial guidelines. Vale Base Metals documents the findings to the provincial government as required to meet monitoring and regulatory reporting obligations.

7.3.3 QUALIFIED PERSON'S INTERPRETATION – HYDROGEOLOGY EVALUATION RESULTS

Hydrogeological data collected across the Ontario Operations provide a robust basis for understanding groundwater and surface water conditions at the exploration, development, and operational stages. The results support hydrogeological conceptual and numerical models used for mine planning, permitting, and water management.

The available data indicate that hydrogeological conditions are generally well understood and consistent with historical operational experience. No material hydrogeological constraints have been identified that would adversely affect current or planned activities, provided that established monitoring and management practices continue to be applied.

7.4 GEOTECHNICAL

7.4.1 OVERVIEW

Geotechnical core logging and laboratory strength testing activities start during early-stage exploration and feasibility studies. Data collection continues once mines are operating and is integrated with definition drilling and expansion projects. This information is used as the basis for empirical, analytical, and numerical analyses to support mine design activities.

7.4.2 SAMPLING METHODS

Geotechnical data collection, including core logging and geotechnical field mapping are the principal data collection methods. Currently, information is directly logged into databases at the core logging

facilities. If surface access (e.g., open pit) or underground access (e.g., mine workings) is available, then the geotechnical core logging results may be confirmed or supplemented with field geotechnical mapping of broader exposures.

Typical data collected from core logging and mapping programs are used to determine rock mass quality and establish both the intact and rock mass strengths of various lithological/geotechnical domains. Intact strength parameters are using point load test machines and are validated with additional samples sent for laboratory testing.

The rock mass quality is assessed using well established characterisation systems, primarily the Q system (Barton et al., 1974), RMR (Bieniawski, 1974 and Laubscher, 1990). Data collected may include parameters such as RQD (Deere, 1968), joint frequency, number of joint sets, joint spacing, joint roughness, joint alteration, joint in-filling, persistence, point load tests, rock mass fabric characterization and information on discrete structural features.

Typical structural characterization consists of documenting joint sets (including bedding, foliation), faults, shear zones, and dykes via non-oriented core, acoustic and optical televiewer surveys, and field mapping. Data collected can include observations such as dip, dip direction, spacing, and persistence.

Three-dimensional geological structural models are being developed/updated at each individual mine site to investigate the effect of structures on mine seismicity and/or stability of the excavations.

In deep mines, well-known indicators related to field stresses are documented using observations such as core dinking and borehole breakouts. Such observations are proven indicators that help to identify zones of high stress and stress relief within the rock mass. Back analyses using microseismic data and numerical models can be undertaken to establish confidence in forward looking stress models that are used to evaluate mine designs.

In active operations, data collection includes inspection of each active heading on at least a monthly basis, and one of the objectives of these inspections is to determine whether the support system installed is appropriate for the ground conditions. Underground site visit observations are recorded in a ground control logbook.

Microseismic arrays are deployed at all of the seismically active mines in Ontario to locate seismic events underground and consist of a mix of uniaxial, triaxial sensors and geophones. In addition, a strong ground motion system is installed to detect large magnitude seismic events.

An mXrap tool is being used by the ground control engineers at all mine sites to carry out advanced seismic data analysis for the assessment of seismic hazards in all active mining areas.

Falls of ground, rockbursts, unusual seismicity, ground support failure, and significant changes in ground conditions are classified as ground control unusual occurrences, and data relating to the unusual occurrences are recorded in Logbook and the trends are tracked in a dashboard using Power BI.

Backfill materials are tested to measure the unconfined compressive strength of samples, which are taken at the discharge point and the preparation plant on surface or underground. Where appropriate, other data collected may include particle size analysis, the temperature of the prepared samples, and water content of the solid material.

Cemented rock fill or cemented aggregate fill is also tested to evaluate the UCS of samples taken at the discharge point. Moisture contents, the particle size distributions of aggregates or waste rock are also evaluated.

A backfill quality control program has been implemented at each of the operating mines that use backfill. Backfill Management Plans are being developed for all active mine sites.

A range of monitoring instrumentation including extensometers, either single-point or multi-point units, closure stations, and slough meters can be used to monitor displacements. A slope stability radar is also strategically deployed at one of the legacy open pits to monitor potential slope

movements in real time. Loading devices, including stress cells, can be strategically installed to understand load/stress conditions of rock mass and/or ground support system behaviour. Drones can be used to assist with visual inspections and allow for LiDAR surveys to be carried out in areas previously not accessible due to high worker exposure to hazardous areas.

7.4.3 LABORATORY TESTING

Laboratory testing, comprising unconfined compressive strength, Young's modulus (or elastic modulus), and Poisson's ratio, is currently performed at third-party consultants WSP's Burnaby, British Columbia rock mechanics laboratory (WSP Burnaby) or Geomechanica's Oakville, Ontario rock mechanics laboratory (Geomechanica Oakville).

The laboratory may be requested to perform point load index, triaxial compressive strength, Brazilian tensile tests, or direct shear tests in specific instances. Both WSP Burnaby and Geomechanica Oakville are independent of Vale Base Metals. Historically, independent laboratories used for geotechnical work have included the Queen's University Rock Mechanics Laboratory (Kingston), Laurentian University (Sudbury) and Wood (Mississauga). These laboratories all follow ASTM D7012-14 or approved equivalent standards.

WSP Burnaby and Geomechanica Oakville use the methodologies set out in ASTM D7012-14: Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures.

All laboratories, including laboratories currently used by Vale Base Metals, and proposed to be used by Vale Base Metals in the future, must meet ASTM testing standards.

7.4.4 QUALITY ASSURANCE AND QUALITY CONTROL

The quality assurance in place at WSP Burnaby includes regular equipment calibration, accredited by Cal-Check Canada Inc, a third-party calibration inspection facility. Depending on the testing type, the quality program undertaken at WSP Burnaby may include senior peer reviews or auditing of laboratory and office procedures, to ensure that all information and recommendations are consistent.

There is a formal Ground Support Quality Control Program, and local ground control personnel manage this program at the individual mine sites. The Ground Support Quality Control Program includes review of contractual agreements with suppliers regarding specifications of support products and how these specifications are checked and assured. It also incorporates actions to be taken if material test results do not conform to the required specifications, the quantity and types of tests for the various support systems installed, delivery and storage practice of support products, how these products are protected against damage, quality control programs for shotcrete and backfill including information on types of testing, testing frequency and correction measures if the results are not within the design range, and by whom and how often task observations and inspections are conducted, and whether records of these observations and inspections are kept on file.

In addition to regular testing of the backfill materials, system audits, instrument calibration and test data analysis are part of the backfill/cemented rock fill/cemented aggregate fill quality control program.

7.4.5 QUALIFIED PERSON'S INTERPRETATION - GEOTECHNICAL EVALUATION RESULTS

The integration of historical and current geotechnical data supports a reliable characterization of ground conditions across the Ontario Operations. Geotechnical evaluations confirm that the data quality and coverage are adequate to support mine design, ground support selection, and risk management.

Geotechnical results indicate that ground conditions are consistent with long-term operational experience in the Sudbury Basin. No material geotechnical uncertainties have been identified that would preclude continued operations or advancement of projects, subject to ongoing monitoring and periodic review as additional data become available. These data and mining experience support the

geotechnical recommendations, including seismic hazard map generation, that support the mine plans discussed in Chapter 13 of this report.

8 SAMPLE PREPARATION, ANALYSES, AND SECURITY

Vale Base Metals has established corporate governance procedures to support the integrity of data used in mineral resource and mineral reserve estimation. Each operation has documented protocols and internal controls governing drilling, sampling, sample preparation, and assaying, all of which are approved using Vale Base Metals internal governance protocols. These protocols are maintained to remain current, and personnel receive appropriate training to ensure their consistent and correct application. All data are uniquely identified using reference numbers that allow drill hole information to be reliably reconstituted from independent collar, survey, geology, physical properties, and assay tables.

Data are verified and validated prior to database entry. Sampling practices and assaying methodologies are clearly documented, technically sound, and appropriately supported. The proficiency and technical capabilities of the sample preparation and assaying facilities contracted by the Ontario Operations are confirmed through periodic reviews and/or audits. The database contains all information relevant to mineral resource and mineral reserve estimation and is considered unbiased and representative. Any material issues identified through QA/QC programs are addressed through appropriate corrective actions, which are documented and disclosed as required.

Given the longevity of the Ontario Operations, sample preparation methods, analytical methods, QA/QC procedures, database upload and verification processes, and sample security practices have evolved over time. The material procedures and protocols applicable to each operating period are described in the following subsections, organized by operator.

8.1 SAMPLING METHODS

Drill core is visually examined to assess the distribution of mineralization. High- and low-grade intervals are identified and sampled separately. Continuous samples are collected throughout the entire mineralized zone, with barren samples taken on either side to bracket the interval. Non-mineralized inclusions within the mineralized zone are also sampled to allow for appropriate statistical evaluation of mineral distribution. Care is taken to ensure that mineralization from high-grade intervals is not included in adjacent low-grade samples.

The sampling interval is established by minimum or maximum sampling lengths and geological and/or structural criteria. The minimum sampling length is 15 cm while the maximum is 3 m. The core from underground drilling is typically sampled in its entirety. Surface exploration programs split most mineralized intersections and half of the core is stored, half sent for assay.

Core from underground drilling is typically sampled in its entirety. In surface exploration programs, core from mineralized intercepts is split and sampled. Any remaining unsampled core is discarded.

8.2 SAMPLE SECURITY METHODS

All drill core is boxed and secured at the drill site using fibre tape. The core boxes are then transported to both Stobie Geoscience Core Logging Facility or Butler Building for storage, logging and sampling. Both facilities are secured with restricted access and surveillance.

Coarse and pulp reject material from underground drill core samples is retained at the ALS Geochemistry sample preparation laboratory in Sudbury until all required analytical checks and assay verification are completed, generally for a period of up to one year, after which the material is discarded. Coarse and pulp reject material from surface exploration drill core samples is similarly stored at the ALS Geochemistry Sudbury sample preparation laboratory for up to one year and disposed of following completion of analytical data verification.

Skeletonized half core samples from surface exploration programs are retained and stored in designated core farms located at the Copper Cliff Mine and at the former Little Stobie Mine.

8.3 DENSITY DETERMINATIONS

The specific gravity (SG) values in the database (Fusion/GDMS) are estimated for both mineralized and non-mineralized samples using the following theoretical regression (“Alcock”) formula:

- $SG = 100 / (100 / 2.88 + 0.0166 * Cu - 0.1077 * Ni - 0.328 * S)$.

This formula uses copper, nickel, and sulphur assay values and assumes a specific gravity of 2.88 for the rock matrix. The calculation estimates the proportion of chalcopyrite (assumed to host all copper) and pentlandite (calculated from the measured nickel content minus the contribution of nickel from pyrrhotite, assumed to contain 0.7% Ni). The remaining sulphur, after accounting for chalcopyrite and pentlandite, is attributed to pyrrhotite. The formula is applicable to most orebodies; however, inaccurate specific gravity estimates may be generated for samples containing atypical sulphide minerals such as millerite, bornite, or pyrite.

Where sulphur assay data were unavailable (primarily for pre-1971 samples), a regression based on copper and nickel was used.

Estimated specific gravity values were periodically validated by comparison with water-immersion specific gravity measurements collected during logging and sampling, either in-house or at the sample preparation facility prior to sample preparation. Water-immersion measurements were conducted in accordance with written procedures. Comparative analyses between measured and estimated specific gravity values were completed by lithological unit and mineralization style during the exploratory data analysis stage, prior to block model construction.

Density values were reported in U.S. customary units of tons per cubic foot (ton/ft³) by converting specific gravity using a factor of 32.05. Resulting metric reported values ranged from a minimum of 2.8 t/m³ (non-mineralized material) to a maximum of 5.0 t/m³, with mean values for mineralized material typically ranging from 3.11–3.43 t/m³.

8.4 ANALYTICAL AND TEST LABORATORIES

The analytical and testing laboratories used to generate data supporting the mineral resource and mineral reserve estimates are summarized in Table 8-1.

Table 8-1. Apart from the Inco Field Exploration Laboratory, the Ontario Operations Central Process Technology Laboratory, and the Vale Base Metals Technical Development (Canada) Limited Laboratory, all laboratories used for sample preparation and analysis were independent of Inco and Vale Base Metals.

Table 8-1: Analytical and Test Laboratories, Ontario Operations

Laboratory Name	Year	Accreditation	Purpose	Note
Ontario Operations mine laboratory (Central Process Technology laboratory), Copper Cliff, ON	Prior to 1999 (mostly pre-1970)	ISO/IEC Guide 25:1990 (since 1998) and subsequent ISO 17025:1999, 2005 and 2017	Sample preparation and analysis.	
Inco's Field Exploration (ITSL) Laboratory, Copper Cliff, ON	Prior to 1999 (mostly 1971-1998)	Not accredited	Sample preparation and analysis.	
ALS Geochemistry, Mississauga, ON/Vancouver, BC	1999–2005	ISO 9001: 2000	Primary sample preparation	

Laboratory Name	Year	Accreditation	Purpose	Note
ALS Geochemistry, Sudbury, ON	2005 to date	ISO 9001: 2008 (until mid-2014) ISO/IEC 17025:2005/2017 (after mid-2014) Current accreditation executed on November 1, 2024, expiring on July 29, 2029.	Primary sample preparation	The sample preparation procedures adhere to a protocol designed for all operating mines in the Ontario Operations.
ALS Geochemistry, Vancouver, BC	1999 to date	ISO 9001:2000 (until 2005) ISO/IEC 17025:2005/2017 Current accreditation executed on November 1, 2024, expiring on May 18, 2029.	Primary analytical laboratory	Used for assaying of all Ontario Operations samples.
Central Process Technology laboratory, Copper Cliff, ON	1999–2005	ISO/IEC Guide 25:1990 (since 1998) and subsequent ISO 17025:1999, 2005 and 2017	Secondary analytical laboratory	A representative portion of the samples analyzed by ALS Vancouver re-assayed.
SGS Lakefield Research, Lakefield, ON	2006–2015	ISO/IEC 17025:2005/2017	Secondary analytical laboratory	A representative portion of the samples analyzed by ALS Vancouver re-assayed
Vale Base Metals Technical Development Limited, Mississauga, ON	2016 to 2022	ISO/IEC 17025:2005/2017	Secondary analytical laboratory	A representative portion of the samples analyzed by ALS Vancouver re-assayed.
Activation Laboratories Ltd., Ancaster, ON	2022 to date	ISO/IEC 17025:2017 Most recent accreditation on December 20, 2025, and valid until February 27, 2030	Secondary analytical laboratory	A representative portion of the samples analyzed by ALS Vancouver re-assayed.

8.5 SAMPLE PREPARATION

8.5.1 INCO (PRE-2006)

Inco drill core samples were crushed in their entirety using a combination of jaw crushers of varying sizes to achieve a nominal size of 75% passing –10 mesh (2 mm). In some cases, a cone crusher was used following the coarse jaw-crushing stage. A sub-sample of approximately 150 g was then split and pulverized to produce a pulp with 95% passing 150 mesh (0.105 mm).

8.5.2 VALE BASE METALS (POST-2006)

Samples are currently prepared at the ALS Minerals (ALS) facility in Sudbury, Ontario. The ALS analytical facility in Vancouver is the primary analytical laboratory and has been used since 1999. Activation Laboratories Ltd. in Ancaster, Ontario, is currently used as secondary analytical laboratory. Both laboratories are accredited by the Standards Council of Canada.

Each sample is crushed to a minimum of 70% passing 10 mesh, then pulverized to 85% passing 200 mesh.

8.6 ANALYSIS

8.6.1 INCO (PRE-2006)

Analytical procedures used prior to 1971 by the Central Process Technology Laboratory for determination of copper, nickel, cobalt, and locally sulphur and precious metals (gold, platinum,

palladium) were not formally documented. Based on practices common at the time, it is considered likely that wet chemical techniques (e.g., colorimetric methods) were used for base-metal analyses until the mid-1960s, followed by four-acid and/or aqua regia digestion with an atomic absorption spectroscopy (AAS) finish thereafter. Precious-metal analyses were most likely carried out using fire assay with an arc-spark emission spectrometry finish.

Beginning in 1971, all Inco drill core samples from the Sudbury area were analyzed at the Inco Field Exploration Laboratory using a Philips 1270 simultaneous X-ray fluorescence (XRF) unit equipped with 14 analytical channels (Si, Fe, Mg, Co, Ni, Al, S, Cu, Ca, Ti, Mo, K, Zn, and As). The XRF instrument was calibrated using approximately 200 reference samples representing the major ore deposits of the Sudbury District. Samples were prepared as pressed pellets in aluminum cups using a binder and pressed for 12 seconds at 14 tonnes on a Herzog press.

XRF results for drill core samples were routinely reported for copper, nickel, cobalt, iron, and sulphur. The XRF analytical program also calculated specific gravity values based on intensity measurements from all 14 channels. Three internal control samples spanning a range of sulphide contents were routinely analyzed to verify calibration stability and analytical performance.

Gold, platinum, and palladium assays were primarily conducted at the Central Process Technology Laboratory using fire assay followed by a variety of analytical finishes. These included arc-spark emission spectrometry on silver beads, as well as direct current plasma and inductively coupled plasma (ICP) analysis. In later years, the laboratory also analyzed gold, platinum, palladium, rhodium, and silver using an arrested cupellation technique on lead buttons produced during fire-assay fusion.

During the early to mid-1990s, a portion of the drill core samples was submitted to the Central Process Technology Laboratory for analysis using a sodium-peroxide (Na_2O_2) fusion followed by ICP determination of a base-metal suite. Some mine samples were also dispatched to ALS Geochemistry (formerly Chemex, ALS Chemex, and ALS Minerals), where the same fusion procedure was applied for base-metal analysis, and precious metals were determined by fire assay with an ICP finish.

Beginning in 1999, all drill core samples were prepared and analyzed at ALS Geochemistry laboratories. Base metals, iron, and sulphur were determined using a Na_2O_2 fusion with ICP analysis, while gold, platinum, and palladium were analyzed by fire assay with an ICP finish.

8.6.2 VALE BASE METALS (POST-2006)

All samples were analyzed for copper, nickel, cobalt, iron, sulphur, arsenic, lead, and zinc using a sodium-peroxide fusion with an inductively coupled plasma–atomic emission spectroscopy (ICP-AES) finish (ALS method ME-ICP81). When requested, lime (CaO), magnesia (MgO), and silica (SiO_2) were also reported.

Platinum-group elements and gold were determined on 30g aliquots using a lead-collection fire-assay fusion with an ICP-AES finish (ALS methods PGM-ICP23 and/or PGM-ICP27).

Arsenic and lead at trace concentrations were analyzed using an aqua regia digestion followed by an ICP finish (ALS method ME-ICP41).

Samples exceeding the upper detection limits of the analytical methods were automatically re-assayed using ALS Vancouver's standard over-limit procedures.

Lower detection limits for ALS analytical methods are summarized in Table 8-2.

Activation Laboratories Limited employed analytical methods comparable to those used by ALS Geochemistry, including sodium-peroxide fusion with ICP-AES finish for base-metal analyses and lead fire-assay with ICP-AES finish for precious metals. Lower detection limits for these methods are consistent with those summarized in Table 8-2.

Both ALS Geochemistry and Activation Laboratories are ISO/IEC 17025:2017 accredited by the Standards Council of Canada. Their scopes of accreditation cover all analytical procedures used for the analysis of Ontario Operations samples.

Table 8-2: Lower Detection Limits (ALS Geochemistry)

ME-ICP81							
Cu (%)	Ni (%)	Co (%)	Fe (%)	S (%)	As (%)	Pb (%)	Zn (%)
0.002	0.002	0.002	0.05	0.01	0.01	0.01	0.002

ME-ICP41		PGM-ICP23		
As (ppm)	Pb (ppm)	Au (opt)	Pt (opt)	Pd (opt)
2	2	0.00003	0.0001	0.00003

8.7 QUALITY ASSURANCE AND QUALITY CONTROL

8.7.1 INCO (PRE-2006)

8.7.1.1 LOGGING

The geologist and technologist responsible for the drill program performed an error review of each drill log. Prior to upload into the master drill hole database, the logging software executed automated validation checks on each drill hole. These checks were designed to identify and minimize potential errors, including incorrect hole azimuths and dips, sample number sequencing issues, invalid lithological codes, and inconsistencies in hole depths. Drill log data were also reviewed through comparison with adjacent drill holes that had already been verified and validated.

8.7.1.2 ASSAYS

Inco quality-control samples were reported together with the corresponding check results and compiled to confirm that analytical performance met internal standards. The Inco laboratory routinely re-assayed any outliers identified during internal quality control. Check samples that fell outside expected precision limits—together with the surrounding primary samples—were reviewed by the contract laboratory to determine whether the discrepancies reflected systematic issues affecting groups of samples or isolated analytical errors. Where discrepancies were resolved, corrected results were issued by the laboratory.

The Inco quality-control program evaluated both sampling and assaying procedures employed by the contract laboratory and promoted continual improvement aimed at minimizing both systematic and random errors. Precision and accuracy metrics derived from these checks were routinely reviewed to ensure that assay results remained within acceptable error limits.

Periodic assay checks of original pulps were also undertaken at the Inco laboratory to confirm accuracy at the assaying stage. Care was taken to avoid selection of older, potentially oxidized pulp samples, as oxidation could introduce additional analytical bias.

Elements other than nickel and copper were either analyzed using composite samples (for sulphur prior to 1971 and precious metals, including Au and PGE prior to 1973) or estimated using factor-based methods (cobalt prior to 1968). Composite samples were prepared by combining pulps from four to five sequential samples, which were not necessarily characterized by similar lithology or degrees of mineralization. Sulphur and precious metal (PGE–Au) assay results obtained from these composites were subsequently assigned back to the individual samples comprising each composite.

This practice tended to smooth grade variability and limited the ability to fully characterize the spatial distribution of precious-metal mineralization, particularly in narrow-seam environments.

Pre-1971 assay data for sulphur, pre-1973 assay data for precious metals (Au and PGE), as well as pre-1968 cobalt data, are not used in mineral resource modelling. The impact of these legacy datasets, which were generated using sampling and analytical methods different from those currently employed, is evaluated primarily through regression analysis. Where appropriate, regression-based adjustment factors are applied to ensure consistency with modern analytical data.

8.7.2 VALE BASE METALS (POST-2006)

8.7.2.1 LOGGING

Three primary quality-control checks are performed during drill core logging:

- Weight check: comparison of the geologist's estimated sample weight with the measured weight reported by the analytical laboratory;
- Assay check: comparison of visually estimated nickel and copper grades with laboratory assay results for nickel and copper;
- Sulphide check: comparison of visually estimated sulphide content with calculated sulphide values.

Where assay data are consistent with the geologist's visual estimates, a geologist formally signs off on the drill hole quality control. This sign-off is a mandatory component of drill hole finalization and is integrated into the drill hole database workflow; drill holes cannot be finalized without completion of the quality-control sign-off. Any drill holes that have not received quality-control approval are considered incomplete.

A comprehensive quality-control review of all assay data received during a given month is conducted by QA/QC personnel from the Mines Technical Services department for all operating mines. The results of these reviews are communicated to site personnel and formally reported on a monthly basis.

8.7.2.2 QA/QC

The quality assurance and quality control (QA/QC) protocol includes in-house and certified standard reference materials at a rate of 4%, coarse preparation blanks at 2%, coarse reject duplicates at 2.5%, pulp duplicates at 2.5% and field (split-core) duplicates at 2.5%. An external check assay program is implemented using an independent laboratory, with a check insertion rate of approximately 3.5%. These insertion rates are consistent with industry-accepted practices. The frequency of individual quality-control checks may be increased where additional control is considered necessary. In addition to these steps the sample preparation laboratory and assay laboratories are audited every year and two to three years, respectively.

Vale Base Metals Mineral Resource Group (Canada) conducts an annual review of QA/QC sample performance and issues a summary report to the Mines Technical Services group.

8.8 DATABASES

The sample and analytical database includes geological, survey, geophysical, geochemical, assay, rock quality, and tonnage factor data, and may also contain information related to mineability, mineralogy, metallurgy, and economics.

Until October 2025, data were stored and managed within the in-house Mines Exploration Borehole System, at which time the database platform transitioned to the Fusion/GDMS software. The database used for mineral resource estimation clearly distinguishes interpreted or derived data (e.g., calculated density values) from primary measured data (e.g., density measurements obtained by the water-displacement method).

Multiple validation steps are implemented to verify data, minimize data-entry errors, and maintain database integrity. The majority of these controls are automated through software-based validation routines. Overall responsibility for database validation and integrity rests with the operations Qualified Person (as defined in Section 9.1.2), who provides direct oversight through the database manager, reporting directly to the operations Qualified Person.

The database is subject to regular backup procedures to ensure data security and continuity.

8.9 QUALIFIED PERSON'S OPINION ON SAMPLE PREPARATION, SECURITY, AND ANALYTICAL PROCEDURES

The sample preparation, analytical, quality-control, and security procedures employed by the Ontario Operations have evolved over time in response to changing industry standards and best practices. At the time the data were collected, the procedures in use were consistent with industry-standard practices and, in many cases, reflected industry-leading approaches.

Vale Base Metals currently applies a system of layered responsibility to ensure that only appropriately verified and validated data are used for mineral resource and mineral reserve estimation (see discussion in Section 9.1).

The Qualified Person is of the opinion that the sample preparation, analytical, quality-control, and security procedures are adequate to support the estimation of mineral resources and mineral reserves.

9 DATA VERIFICATION

9.1 INTERNAL DATA VERIFICATION

9.1.1 DATA VALIDATION

The Mines Geology department within the Ontario Operations performed monthly assay data validation through three principal quality indicators:

- Weight checks;
- Assay checks;
- Sulphide checks.

These validations were carried out through multiple steps, most of which relied on automated software routines designed to rigorously verify data integrity. All new assay data added to the database were monitored daily and validated monthly for accuracy and consistency by comparing data transferred to the GDMS/Fusion application against assay certificates received from ALS Vancouver. The same validation routines previously used in the in house application remain in place.

Vale Base Metals had data collection procedures in place that included several verification steps designed to ensure database integrity. Vale Base Metals staff also conducted regular logging, sampling, laboratory, and database reviews. In addition to these internal checks Vale Base Metals contracted independent consultants to perform laboratory, database, and mine study reviews. The process of active database quality control and internal and external audits generally resulted in high-quality data.

Prior to use in mineral resource estimation, data were downloaded from the internal database into a project file and reviewed for improbable entries and anomalous values. Errors were flagged and corrected. Quality control graphs were plotted at a minimum for:

- Assayed Cu+Ni versus estimated grade;
- Measured sample weight versus estimated weight;
- Calculated sulphide (from assayed sulphur) versus estimated sulphide;

Discrepancies were investigated, and re-assays were requested where required.

A preparation facility audit completed in 2025 concluded that established operating procedures and the performance of laboratory staff during task execution were satisfactory. Annual laboratory reviews and audits, which were suspended from 2020–2022 due to the COVID-19 pandemic, resumed in 2023.

9.1.2 MINERAL RESOURCE AND MINERAL RESERVE ESTIMATES

Mineral resource and mineral reserve estimates follow a structured governance process defined in Vale Base Metals' Mineral Resource and Mineral Reserve Guidelines, based on a system of layered responsibility and QP sign-offs.

This layered responsibility system ensures that each operational level—mine, operations, and corporate—assumes accountability for the parts of the estimation process relevant to the level's role, with appropriate documentation, review, and approval by QPs.

Mine and operations QPs are responsible for preparing mineral resource, mineral reserve, and exploration target estimates and ensuring they comply with Vale Base Metals' internal guidelines. These estimates are then submitted to corporate QPs, who review, consolidate, and confirm compliance with internal standards, governance requirements, and public-disclosure rules.

Vale Base Metals' guidelines and standards for mineral resource and mineral reserve estimation and reporting are maintained and updated corporately. QPs at all levels must ensure that estimation inputs, QA/QC, classification, and supporting technical information follow these requirements.

An annual technical review of each operation is conducted by the internal Vale Base Metals Resource Management Group which evaluates the estimates, identifies risks, and records required mitigation actions.

9.1.3 STUDIES

Vale Base Metals staff perform a number of internal studies and reports in support of mineral resource and mineral reserve estimation for the various Ontario Operations mines. These include reconciliation studies, mineability and dilution evaluations, investigations of grade discrepancies between model assumptions and probe data, drill hole density evaluations, long-range plan reviews, and mining studies to meet internal financing criteria for project advancement.

9.1.4 PEER REVIEW BY SUBJECT MATTER EXPERTS

The QPs requested that information, conclusions, and recommendations presented in the body of this Report be reviewed by Vale Base Metals experts or experts retained by Vale Base Metals in each discipline area as a further level of data verification.

Subject matter experts were requested to cross-check, where applicable, numerical data, flag any data omissions or errors they identified, review the manner in which the data were summarized and reported in the technical report summary, check the interpretations arising from the data as presented in the Report, and were asked to review that the QP's opinions stated as required in certain Report Chapters were supported by the data and by Vale Base Metals future intentions and Project planning.

Feedback from the subject matter experts was incorporated into the Report as required.

9.2 EXTERNAL DATA VERIFICATION

Vale Base Metals and its predecessor companies commissioned a number of audits and third-party reviews of block models, mineral resources and mineral reserves. External audit requirements follow the Vale Base Metals Guidelines for Mineral Resources and Reserves Management.

9.3 DATA VERIFICATION BY QUALIFIED PERSON

The Qualified Person (QP) has reviewed the procedures and results of internal and external data verification programs conducted by Vale Base Metals for the Ontario Operations. Reviews included:

- Assessment of QA/QC protocols: the QP examined the quality assurance and quality control measures applied to drilling, sampling, and assaying, including duplicate samples, blanks, and certified reference materials;
- Database integrity checks: the QP verified that assay data were uploaded to the GDMS/Fusion database using established validation routines and confirmed that historical validation protocols remain in place;
- Cross-checks against certificates: the QP confirmed that assay results in the database match original laboratory certificates and that discrepancies were investigated and resolved;
- Review of internal audits: the QP reviewed laboratory audit reports and noted that the 2025 preparation facility audit concluded established operating procedures were being followed and were deemed satisfactory;
- External verification: the QP considered recent third-party audits (e.g., WSP 2024) and concluded that these independent reviews support the reliability of the data;

- Peer reviews: the QP confirmed that mineral resource estimates underwent peer reviews by subject matter experts in relevant disciplines. Feedback from these reviews was incorporated into the final estimates when deemed significant; otherwise, recommendations were recorded and applied to future updates.

9.4 QUALIFIED PERSON'S OPINION ON DATA ADEQUACY

Based on the reviews described in this Section, the QP is satisfied that the data verification procedures applied are consistent with industry-accepted practices and Vale's internal standards. The QP is of the opinion that the data are adequate for use in mineral resource and mineral reserve estimation and notes there has been no limitations on or failure to conduct verification. Data that have been verified on upload to the database, and checked using applicable Vale Base Metals protocols, are acceptable for use in mineral resource and mineral reserve estimation.

10 MINERAL PROCESSING AND METALLURGICAL TESTING

10.1 INTRODUCTION

The mineralogy and metallurgical performance of the sulphide deposits at the Ontario Operations are generally well understood due to the extensive drill hole coverage, mill performance records and mineralogical and metallurgical studies conducted over approximately the last 100 years. These metallurgical studies, ranging from bench-scale to multi-tonne pilot testing, also included academic and industrial research. Based on these studies, flowsheet evolution and optimization has continued.

Specific deposits and/or ore zones possess unique characteristics with respect to sulphide and gangue mineralogy. Geochemical domains are identified and documented by a mine or project geologist familiar with the deposit through assessment of:

- Geological (mineralogical) mapping (e.g., high-grade copper zones, alteration zones, structural-influenced zones);
- Assay results (copper–nickel, pyrrhotite–nickel, high PGE–low sulphide zones);
- Elemental ratio plots, for example sulphur against copper, nickel and PGE, assessing for bi- or multi-modal distributions;
- Normative sulphide mineralogical calculations and plots using the “normative mineralogy” functions available through Datamine Studio scripts.

Samples for metallurgical testwork from mineralogical domains and associated documents prepared by geologists are provided to metallurgical specialists at Vale Base Metals Technical Development (VTD), located in Mississauga, Ontario. The documents include a spatial and geological description, elemental scatter-plots, three-dimensional views of normative mineralogy and a reference to nearby samples previously analyzed.

Samples taken during exploration and strategic study drilling are used for metallurgical testing during the scoping, prefeasibility and feasibility studies. For current orebodies where the ore types are well understood, drilling is performed to delineate the response from those particular areas. Where there is less geological information, definition-style drill holes, bulk or grab samples may be selected for additional metallurgical testing. The test samples consist of either drill core or sample rejects representative of a portion or complete deposit/zone

10.2 TEST LABORATORIES

Metallurgical testing is primarily done at Vale Base Metals Sheridan Park testwork facility. This facility is not independent of Vale Base Metals, or its predecessor company, Inco. There is no international standard of accreditation provided for metallurgical testing laboratories or metallurgical testing techniques. The analytical laboratory in Sheridan Park is ISO/IEC 17025:2017 accredited for technical competence in the field of chemical testing.

The laboratory at the Vale Base Metals' Sheridan Park facilities demonstrates a strong commitment to rigorous quality standards through well-defined QA/QC, sample custody, and reproducibility controls, rather than through explicitly stated third-party accreditations. The facility is staffed with a team of technical experts - mineralogists, metallurgists, process engineers with high qualifications and experience. The facility emphasizes controlled sample handling, traceability, and verification, including head assays that are systematically compared against back-calculated product assays to ensure data integrity. These practices underpin all laboratory and miniplant work and are embedded throughout mineral processing test programs to maintain consistency and reliability of results across projects. The facility also investigates and rigorously tests new technology designs in the industry through purchase or rental of lab-scale units to validate performance and support flowsheet development for both greenfield and brownfield operations.

Operational standards are further reinforced through technician training, repeatability checks, and standardized testing procedures across comminution, flotation, mineralogy, and chemical analysis. The laboratory regularly verifies reproducibility between different operators and equipment, adopts automated systems (such as automatic froth scalping), and applies mass-balance validation methods during miniplant operation to confirm steady-state conditions. Analytical work is supported by calibrated advanced instrumentation (ICP-OES, ICP-MS, XRF, LECO, ion chromatography, TEMA), ensuring dependable analytical performance aligned with industry best practices. The laboratory also investigates and rigorously tests new equipment designs through purchase or rental of lab-scale units to validate performance and support flowsheet development for both greenfield and brownfield operations.

Vale Base Metals uses a standard procedure that is calibrated against the Clarabelle Mill.

10.3 METALLURGICAL TESTWORK

Metallurgical testing programs were implemented and continue to be conducted for all primary production ore zones as well as for any future ore zones prior to development. Ore evaluation and full circuit simulation flotation studies are performed as a joint effort between the Ontario Operations technical services staff, and the Sheridan Park facility.

Vale Base Metals has adopted standard test procedures to develop throughput and recovery models for the existing mine and future mineralized zones. These procedures are based on the existing processing flowsheet, operating conditions, and reagent suite, calibrated against the Clarabelle Mill.

Samples have historically been, and are currently, composited from $\frac{1}{2}$ or $\frac{1}{4}$ contiguous drill core

The ore zones currently in production may be subject to testing to investigate the following:

- The expected metallurgical performance for non-typical ores, such as low sulphide content, copper-rich sulphides with elevated precious metals content, zones with high hexagonal pyrrhotite content, and lower nickel-tenor disseminated sulphide in norite;
- Reasons for local variations in recovery (liberation during grind and separation in the rougher scavenger circuit, differences in abundance of pyrrhotite polytype, PGM–sulphide–silicate intergrowth and natural grain size differences);
- The impact of deleterious elements (mineralogy and mode occurrence) on grade and recovery;

Some drill core samples are submitted for grindability testing (i.e., Bond work index), but all samples have grind time determined in a laboratory rod mill, which supports the assessment of relative hardness.

Ore zones planned to be brought into production are subject to similar tests. The testwork is performed sufficiently ahead of production scheduling to allow characterization of the material for inclusion in mine planning.

10.4 RECOVERY ESTIMATES

The Ontario Operations produce nickel–copper–PGE ores that are blended and treated in the Clarabelle Mill to produce sulphide concentrates containing the valuable metals. The Sudbury ores contain cobalt, gold, silver, platinum, and palladium that are typically associated with the valuable sulphides.

The forecast smelting and refining recovery factors are determined from the annual metals plan models, which incorporate current metallurgical factors, processing and unaccounted losses in smelting and refining processes.

The anticipated metal recoveries at the Clarabelle Mill are based on an empirical mill process model based on ore attributes (nickel:pyrrhotite ratio, nickel grade, etc.) which were developed internally by Vale Base Metals personnel. The model rejects the same percentage of pyrrhotite from all the

mineralization going to the mill at the same metal grades (annually adjusted to plan). Similarly, the rock tailings are rejected at the same metal grades (annually adjusted to plan) for all mineralization. The model contains assumptions as to the behaviour of typical ores based on grade and pyrrhotite content. Maximum allowable values for recoveries are set for ores that may exceed the known expected recoveries.

The milling recovery for nickel is estimated based on the nickel head grade and the calculated amount of pyrrhotite. The forecast milling recoveries for cobalt are scaled to nickel recovery and the forecast copper recoveries are estimated using the annual copper head grades in the feed. The milling recovery assumptions for platinum, palladium and gold are estimated based on historical actual recoveries and are driven by the head grade of each precious metal.

Table 10-1 shows a comparison of the actual recoveries to mill prediction for the period 2019–2025.

The Ontario Operations model predicted recoveries are reasonably reflective of the actual measured recoveries and are within expected accuracy (+/-2%) with no observable bias .

Smelter and refinery recoveries for all metals are calculated monthly. These recovery rates include all recoveries from processing the nickel–copper concentrate to finished nickel and other intermediate metals or finished metals to customers. The actual smelter and refinery recoveries for 2019–2025 are provided in Table 10-2.

Table 10-3 summarizes the predicted average metallurgical recoveries for the LOM. Cobalt recoveries are expected to improve with the commissioning of the slag cleaner planned in 2026.

Table 10-1: Clarabelle Mill Recoveries, 2023–2025

Year	Status	Clarabelle Mill Actual Data					Model Predicted		Actual Less Predicted	
		Cu (%)	Ni (%)	S (%)	Cu Rec (%)	Ni Rec (%)	Cu Rec (%)	Ni Rec (%)	Cu Rec (%)	Ni Rec (%)
2023	Actual	1.60	1.30	8.9	96.1	83.4	95.8	83.2	0.3	0.2
2024	Actual	1.44	1.16	8.1	95.9	81.3	95.5	82.7	0.4	-1.4
2025	Actual	1.33	1.10	7.14	95.8	81.5	95.7	81.6	0.1	-0.1

Note: Source of data is Clarabelle month end base-metal balances, model recoveries from mill budget model.

Table 10-2: Combined Smelter and Refining Recoveries, 2023–2025

Year	Cu Rec. (%)	Ni Rec. (%)	Co Rec. (%)	Pt Rec. (%)	Pd Rec. (%)	Au Rec. (%)
2023	92.9	95.2	38.4	96.0	96.1	94.3
2024	92.6	95.1	33.3	96.0	96.0	94.0
2025	92.8	95.4	36.6	96.1	96.1	94.3

Table 10-3: Long Term Average Processing Metal Recoveries

Metal	Mill Recovery to Bulk Concentrates (%)	Smelter and Refinery Recovery of Ni Concentrate (%)
Ni	85.3	94.6
Cu	94.6	92.8
Co	78.4	40.7
Pt	79.3	95.9
Pd	83.1	95.9
Au	74.1	93.7

Note: Data source is the mill model contained within the 2025 mineral reserves only financial model. Smelter and refinery recovery is for the bulk Ni–Cu concentrate. Recoveries are total average values over the life of mine.

10.5 METALLURGICAL VARIABILITY

Tests were performed on samples that are considered to be representative for the different orebodies/zones and the mineralogy of the various orebodies and zones.

10.6 DELETERIOUS ELEMENTS

The deleterious elements for smelting are arsenic, lead, zinc, and chromium. With these typical deleterious element concentrations, the mill concentrate feed (nickel concentrate currently) for the smelter routinely meets smelter specifications.

10.7 QUALIFIED PERSON'S OPINION ON DATA ADEQUACY

Based on metallurgical testwork, reconciliation, and production data, the Qualified Person is of the opinion that the metallurgical assumptions applied to the estimation of mineral resources and mineral reserves, and to the associated economic analysis, are reasonable and appropriate. Short-term recovery variability due to changes in ore type, blending, adjustments cut-off grades, modifications to the process flowsheet, or changes to reagent additions and plant parameters to meet concentrate quality, production, and economic targets is expected; however, recoveries are anticipated to trend toward forecast values over annual reporting periods.

11 MINERAL RESOURCE ESTIMATES

11.1 INTRODUCTION

Mineral resources were estimated for selected zones within the Blezard, Coleman, Copper Cliff, Creighton, Ella–Capre, Stobie, Garson (McConnell is included with Garson), Totten and Nickel Rim South Extension deposits.

Resource estimation across all Ontario Operations sites follows a standardized approach, governed by Vale’s protocols and internal guidelines. These include:

- Comprehensive characterization of lithological and mineralization domains.
- Systematic selection and compositing of representative drill hole samples.
- Statistical validation of sample lengths and variables pre- and post-compositing.
- Assessment of statistical properties within and between estimation domains.
- Evaluation of spatial continuity using variograms or correlograms.
- Identification and appropriate treatment of outliers and skewed variables.
- Selection of selective mining unit (SMU) size tailored to deposit geometry and mining considerations.
- Choice of suitable modelling and interpolation techniques, with defined parameters.
- Robust validation of estimates through visual and statistical checks, including bias and grade smoothing assessment.
- Final resource classification.

All mineralogical, exploration boreholes and supporting information were provided to the estimators by the geological staff at the mines or by exploration staff. Geological modeling and mineral domain interpretation were completed using Datamine Studio RM and Leapfrog Geo. Grade estimation was completed in Datamine Studio RM.

The block size was based on the spacing of the drill holes and the potential mining method. The block size generally represents the smallest possible mining unit (SMU) with block sizes in the X, Y and Z directions varying from 2.0 meters to 6.0 meters depending on the style of mineralization, density of data and anticipated mining method.

11.2 EXPLORATORY DATA ANALYSIS

A complete review of the deposit drill hole database was conducted prior to initiating modelling. A statistical query of the variables in the drill hole database was independently performed for all geological and grade domains.

Bivariate and multivariate statistical and spatial data reviews were conducted on the data for each zone estimated to identify outlier values that would require influence restrictions, mean values, spatial geochemical trends, evidence of fractionation, and a review of the drilling based on age and campaign.

11.3 GEOLOGICAL MODELS

Domain wireframes were constructed using data from surface and underground, including drill holes from different time periods, ranging from discovery-style drilling to exploration and infill drill programs and geological mapping, when available. Wireframes were verified to ensure there were no modelling construct issues such as merge, boundary, or crossover strings. The strings were checked to ensure they were snapped to relevant drill hole points and encompassed the interpreted mineralized system.

A thorough review of the drill holes, and the samples captured within the wireframes, were completed to identify any issues such as poor selection of the drill hole orientation, inconsistent geological interpretations, poorly-constrained drill trajectories, poor logging and analytical methodologies, lost core intervals, and instances where the drill hole was never logged or assay data were pending. All drill holes considered inappropriate for use in resource modeling were removed from the estimation dataset with the reasons for exclusion recorded in the dataset.

Vale Ontario Operations has a standard set of rules for treating missing values and unlogged intervals. Intervals logged as “lost core” were assigned an absent value for all elements, unless such intervals were specifically identified as waste inclusions, in which case a value of 0.0 was assigned for all elements.

11.4 DENSITY CALCULATION

As noted in Chapter 8.3, density values were calculated for each sample using a regression formula. These density values for each sample are then used as part of the estimation process, described in remaining section of this chapter.

11.5 GRADE CAPPING/OUTLIER RESTRICTIONS

Scatter, probability, co-efficient of variation, and cumulative metal plots were assessed for outliers and their spatial distribution reviewed to determine whether grade capping should be applied.

The estimation strategy was reviewed to best represent the distribution of deleterious elements.

11.6 COMPOSITES

Compositing standardizes sample lengths to

- Reduce bias from variable sample lengths;
- Match support of the estimation block
- Facilitate variogram analysis.

The anticipated block size and distribution of sample lengths was examined to determine the appropriate composite length. Due to Vale Base Metals sampling practices, 1.5 m was frequently selected.

11.7 UNFOLDING/DYNAMIC ANISOTROPY

Depending on the characteristics of the deposit and the specific estimation domain, either unfolding or dynamic anisotropy is employed to accurately represent complex mineralization geometries and improve grade distribution within resource models.

Unfolding is applied where appropriate to address intricate geometries, such as changes in strike and dip or localized pinch–swell structures. This method enhances grade sample distribution within irregular mineralized wireframes by creating unfold strings and unfolding composited samples according to standard modelling procedures. The process includes validating the starting points of all strings and confirming that sample unfolding maintains the original sample length in the unfolded coordinate space. Upper control points of the unfold strings are positioned to follow the dominant mineralization trend, ensuring the spatial accuracy of grade samples.

Dynamic anisotropy is preferentially used in more recent models to capture local variations in geometry, especially in areas affected by pinch-and-swell features, while preserving geological continuity. Guide-plane dip and dip directions are interpolated into the parent model and validated before grade estimation, allowing for a more refined representation of complex structural features and enhancing the robustness of the resource model.

11.8 VARIOGRAPHY

Variographic analyses were completed by domain, using Snowden Supervisor or Datamine RM. Variogram or correlogram models were fitted to experimental variograms where sufficient data existed within the domain. Search ellipses for use in the various estimation passes were rotated and scaled according to the relative axis dimensions and orientations for each estimation domain. Visual checks of the search ellipses against the underlying geologic model and interpreted mineralization controls to ensure consistency were done using Datamine RM.

11.9 ESTIMATION/INTERPOLATION METHODS

Grades were estimated into the block models using ordinary kriging (OK), with search distances informed by the long-range distance or second structure of the variogram model. The estimation process followed the methodologies developed by Ontario Operations and used customized Datamine scripts.

Kriging neighbourhood analysis (KNA) was completed for many of the models to determine optimal block size, sample counts, and block discretization. A consistent search distance ratio was maintained. The across strike direction was commonly decreased to half of the range to avoid excessive grade spreading, as per current resource modelling practices.

Associated elements were grouped together. Frequently, the base metals (Ni, Cu, Co) with sulphur and density, the precious metals (Pt, Pd, Au), and the deleterious elements (As, Pb) were grouped together with coordinating search distances.

The models were estimated in three successive passes, and a final, fourth pass was completed to estimate blocks that were not informed during the first three passes. Blocks estimated during the fourth pass were not classified as Mineral Resources, and are used to define drill targets.

Grades were also estimated using Inverse Distance Weighting (IDW) to support the validation process and assess the reasonableness of the OK estimates. Standard nearest-neighbor (NN) models were also estimated to provide an unbiased comparison of global mean grades and to identify areas where drilling density or sample clustering may influence grade distribution. The IDW and NN models were reviewed in three dimensions against the informing drill hole data to confirm that the OK estimates appropriately reflect the underlying sample grades and spatial trends.

11.10 VALIDATION

Validation was conducted according to the Vale Ontario Operations procedures. Validation steps included the checking:

- block model volumes against the mineralization wireframe volumes;
- model grades against drill hole composite grades;
- for over-smoothed grades and modifying search and estimation parameters where necessary;
- if the model was unfolded, that all drill holes were appropriately captured;
- ensuring that all relevant samples were captured within the wireframes;
- the comparison of the OK and NN estimates against drill hole composites that the block grades reasonably matched the drill hole composite grades, and, where applicable, the grade trends paralleled the footwall and hanging wall contacts.

Swath plots were used to review the distribution of the base, precious and deleterious metals along strike, through the vertical ranges, and from the footwall to hanging wall contact.

All resource estimates were presented to stakeholders, consisting of personnel from the relevant mine or exploration program depending on deposit location, and representatives of the Mineral Resources and MRMR teams. Resource estimates were subjected to a Senior Review completed

by a competent peer, within the Mineral Resources, MRMR teams, or an external consultant. Senior Reviews were classified by three categories: fatal flaw, due diligence, and comprehensive. The level of review was determined based on the materiality of the deposit and the expected changes to the mineral resources.

11.11 CONFIDENCE CLASSIFICATION OF MINERAL RESOURCE ESTIMATES

11.11.1 MINERAL RESOURCE CONFIDENCE CLASSIFICATION

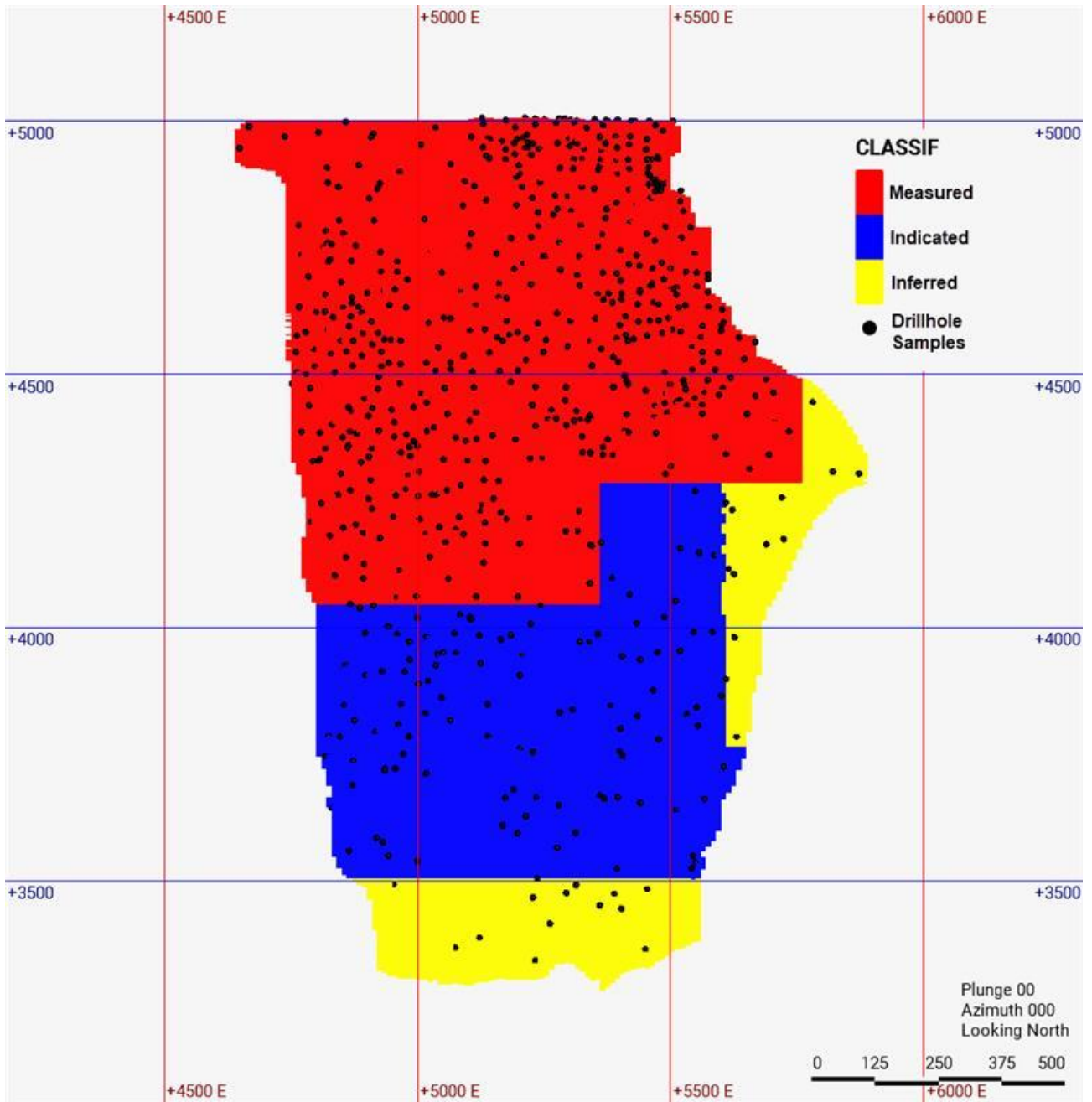
The mineral resource confidence categories were assigned based on a combination of factors, including geological understanding and confidence, drill hole support, grade estimation confidence relative to planned production rates, and identified risk factors (e.g., metallurgy). Guidance for mineral resource classification is provided by the Vale Base Metals Corporate MRMR team based on deposit type. The resource classification assignments were reviewed considering factors relevant to confidence in the geological and grade continuity, including drilling density, data quality, geological interpretation, and estimation performance. An example of the resulting confidence classifications is provided in Figure 11-1 for the Creighton 400 deposit.

Where mining has occurred or is currently active, the mined-out volumes were wireframed, classified as either void or fill, and overprinted upon the resource model to account for mining depletion.

11.11.2 UNCERTAINTIES CONSIDERED DURING CONFIDENCE CLASSIFICATION

Uncertainties regarding sampling and drilling methods, data processing and handling, geological modelling, and estimation were incorporated into the classifications assigned. The areas with the most uncertainty were assigned to the inferred mineral resource category, and the areas with fewest uncertainties were classified as measured mineral resource.

Figure 11-1: Example Assigned Confidence Classifications, Creighton 400 Deposit



Note: Figure prepared by Vale Base Metals, 2026

11.12 REASONABLE PROSPECTS OF ECONOMIC EXTRACTION

11.12.1 INPUT ASSUMPTIONS

For each resource estimate, the following was assessed:

- likely infrastructure;
- mining and process plant requirements;
- mining methods;
- process recoveries and throughputs;

- environmental, permitting and social considerations relating to the mining and processing methods;
- waste disposal; and
- technical and economic considerations in support of an assessment of reasonable prospects of economic extraction.

All material is assumed to be blended at the Clarabelle Mill, and milling throughput rates will depend on the blending strategy in place at the mill at the time the material is processed.

Mineralization that has been determined as potentially suitable for underground mining methods was delineated within mineable shapes generated by the Stope Optimizer (SO) module in Deswik software.

Mineralization that has been determined as potentially suitable for open pit extraction was constrained within a conceptual pit shell produced using the Lerchs–Grossmann (LG) algorithm in Deswik software.

Key parameters used to constrain the resource estimates are summarized in Table 11-1. These parameters are presented in ranges as the values used in various estimates are based on the information available at the time of that estimation.

11.12.2 COMMODITY PRICE

Commodity pricing forecasts in Table 11-1 used in mineral resource estimation are based on long-term analyst and bank forecasts. The forecast prices may vary locally by the individual mines and deposits to reflect the time at which the mineral resources are updated. All forecast commodity prices are expressed in un-escalated real US dollars. This approach is considered reasonable for support of mineral resource estimates, as it is in line with common industry practice.

Table 11-1: Input Parameters

Parameter	Unit	Underground	Open Pit
Ni sale price	US\$/tonne	13,376–20,822	18,800
Cu sale price	US\$/tonne	6,100–9,500	7,500
Co sale price	US\$/tonne	45,000–56,300	50,000
Pt sale price	US\$/oz	1,124–1,350	1,200
Pd sale price	US\$/oz	925–1,450	1,400
Au sale price	US\$/oz	1,000–1,950	1,450
Exchange rate	USD/CAD	1.26–1.30	1.26
Mining recovery ¹	%	100	100
External Dilution ¹	%	0	0
Mine operating cost	US\$/tonne mineralization mined	50-180	12-60
Mill operating cost ²	US\$/tonne processed	6-27	
Smelting and Refining cost ³	US\$/tonne Ni concentrate	740-1140	
Mill Ni recovery ⁴	%	71.3-88.9	
Mill Cu recovery ⁴	%	91.3-97.3	
Smelter/Refinery Ni recovery ⁵	%	94.6	
Smelter/Refinery Cu recovery ⁵	%	92.8	
Cut-off ⁶	US\$/tonne	70-182	33

Notes:

1. Applied to schedule for basis of reasonable prospects of economic extraction.
2. Varies depending on mill feed head grade and cost allocation; includes site general and administrative costs.
3. Varies depending on cost allocation to specific sites/projects; includes smelting, refining, matte processing, electrowinning, acid processing, site general and administrative costs
4. Recovery to bulk concentrate
5. Smelter/refinery recovery for Copper Cliffs smelter-fed concentrate
6. Net processing return cut-off
7. These parameters are presented in ranges as the values used in various estimates are based on the information available at the time of that estimation
8. All prices and costs are in real, unescalated, US\$

11.12.3 CUT-OFF

Cut-off grades at Ontario Operations are determined using a Net Processing Return (NPR) approach. Because mineralization contains multiple payable metals with different prices and recoveries, each block is assigned an NPR value based on long-term metal price and exchange rate assumptions, net of processing and applicable site costs. Material is classified as ore when the NPR value exceeds the full mining operating cash cost per short ton; otherwise, it is treated as waste.

11.12.4 QP STATEMENT

The QP believes that any technical or economic challenges affecting economic extraction can be addressed with further work. Mineral resource estimates are based on well-documented geology in a district with over 100 years of mining experience. Vale Base Metals is knowledgeable about the local economic factors and has consistently secured permits, social licence, and met environmental standards. There is adequate time within the commodity price forecast period for Vale Base Metals to resolve issues or conduct additional drilling, test work, and engineering studies as needed.

11.13 MINERAL RESOURCE STATEMENT

Mineral resources current as at 31 December, 2025, are reported using the mineral resource definitions set out in S-K 1300, and are reported exclusive of those mineral resources converted to mineral reserves. The reference point for the estimate is in-situ.

Mineral resources are presented both on a 100% basis, based on Vale Base Metals' view, and on a 90% basis, considering only the ownership attributable to Vale, the registrant. The measured and indicated mineral resource estimates for the Ontario Operations are provided in Table 11-2. The inferred mineral resource estimates are included in Table 11-3. The Qualified Person for the estimate is Mr. Henrique Vigario, MAusIMM, a Vale Base Metals employee.

Table 11-2: Ontario Operations – Measured and Indicated Mineral Resource Statement

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Blezard	Measured		—	—	—	—	—	—	—
	Indicated		7,887	0.68	0.99	0.04	0.26	0.27	0.08
	Sub-total Measured + Indicated		7,887	0.68	0.99	0.04	0.26	0.27	0.08
Coleman	Measured		1,103	1.37	1.23	0.03	0.89	1.13	0.29
	Indicated		762	0.88	1.91	0.05	0.25	0.24	0.04
	Sub-total Measured + Indicated		1,865	1.17	1.51	0.04	0.63	0.76	0.19
Copper Cliff	Measured		617	0.78	1.09	0.04	0.56	0.70	0.20
	Indicated		4,572	1.07	1.28	0.04	1.12	1.67	0.39
	Sub-total Measured + Indicated		5,189	1.04	1.26	0.04	1.05	1.55	0.37
Creighton	Measured		1,597	0.80	1.10	0.03	0.85	1.23	0.21

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
	Indicated		4,416	0.90	1.17	0.04	0.40	0.39	0.12
	Sub-total Measured + Indicated		6,013	0.88	1.15	0.03	0.52	0.62	0.14
	Measured		2,208	0.89	1.47	0.05	0.44	0.25	0.12
Garson	Indicated		4,546	1.07	1.01	0.04	0.66	0.89	0.27
	Sub-total Measured + Indicated		6,754	1.02	1.16	0.05	0.59	0.68	0.22
	Measured		9,250	0.48	0.95	0.05	0.13	0.20	0.04
Copper Cliff Pit	Indicated		3,329	0.56	1.05	0.05	0.14	0.20	0.03
	Sub-total Measured + Indicated		12,579	0.50	0.98	0.05	0.13	0.20	0.04
	Measured		446	0.40	0.44	0.02	0.16	0.19	0.07
Stobie Pit	Indicated		4	0.28	0.43	0.02	0.09	0.09	0.04
	Sub-total Measured + Indicated		450	0.39	0.44	0.02	0.16	0.19	0.07
	Measured		868	1.02	0.86	0.02	0.86	0.79	0.31
Totten	Indicated		421	1.61	0.74	0.02	1.31	1.13	0.43
	Sub-total Measured + Indicated		1,289	1.21	0.82	0.02	1.01	0.90	0.34
	Measured		—	—	—	—	—	—	—
Nickel Rim South Extension	Indicated		14,919	4.09	1.70	0.03	1.38	1.69	0.55
	Sub-total Measured + Indicated		14,919	4.09	1.70	0.03	1.38	1.69	0.55
	Measured		16,091	0.67	1.04	0.04	0.35	0.42	0.10
Total Ontario Operations Vale Base Metals	Indicated		40,857	2.04	1.33	0.04	0.83	1.03	0.31
	Total Measured + Indicated	100%	56,947	1.65	1.24	0.04	0.69	0.86	0.25
	Vale S.A. Equity Interest								
Total Ontario Operations Vale S.A. ⁸	Measured		14,482	0.67	1.04	0.04	0.35	0.42	0.10
	Indicated		36,771	2.04	1.33	0.04	0.83	1.03	0.31
	Total Measured	90%	51,253	1.65	1.24	0.04	0.69	0.86	0.25

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
	+ Indicated								

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
Blezard	Measured		—	—	—	—	—	—
	Indicated		54	78	3	67	68	21
	Sub-total Measured + Indicated		54	78	3	67	68	21
Coleman	Measured		15	14	0	31	40	10
	Indicated		7	15	0	6	6	1
	Sub-total Measured + Indicated		22	28	1	38	46	11
Copper Cliff	Measured		5	7	0	11	14	4
	Indicated		49	59	2	165	245	58
	Sub-total Measured + Indicated		54	65	2	176	259	62
Creighton	Measured		13	18	0	44	63	11
	Indicated		40	52	2	57	56	16
	Sub-total Measured + Indicated		53	69	2	100	119	27
Garson	Measured		20	32	1	31	18	8
	Indicated		49	46	2	96	130	39
	Sub-total Measured + Indicated		69	79	3	127	148	47
Copper Cliff Pit	Measured		44	88	4	39	58	11
	Indicated		19	35	2	15	22	4
	Sub-total Measured + Indicated		63	123	6	54	80	15
Stobie Pit	Measured		2	2	0	2	3	1
	Indicated		0	0	0	0	0	0
	Sub-total Measured + Indicated		2	2	0	2	3	1
Totten	Measured		9	7	0	24	22	9
	Indicated		7	3	0	18	15	6

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
	Sub-total Measured + Indicated		16	11	0	42	37	14
Nickel Rim South Extension	Measured		—	—	—	—	—	—
	Indicated		610	254	4	662	812	266
	Sub-total Measured + Indicated		610	254	4	662	812	266
Total Ontario Operations Vale Base Metals	Measured		108	168	7	182	217	54
	Indicated		834	541	15	1,085	1,354	410
	Total Measured + Indicated	100%	941	709	22	1,267	1,571	464
Vale S.A. Equity Interest								
Total Ontario Operations Vale S.A. ⁸	Measured		97	151	6	164	196	48
	Indicated		750	487	13	977	1,218	369
	Total Measured + Indicated	90%	847	638	20	1,141	1,414	418

Table 11-3: Ontario Operations – Inferred Mineral Resource Statement

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Bleazard	Inferred		—	—	—	—	—	—	—
Coleman	Inferred		5,339	0.8	0.4	0.01	1.3	2.1	0.7
Copper Cliff	Inferred		41,684	0.9	0.8	0.03	0.7	0.8	0.3
Creighton	Inferred		13,890	1.1	1.4	0.04	0.5	0.7	0.2
Ella–Capre	Inferred		14,104	1.1	0.7	0.02	1.0	1.2	0.3
Garson	Inferred		4,226	0.9	1.1	0.04	0.5	0.3	0.2
Copper Cliff Pit	Inferred		287	0.6	1.1	0.06	0.2	0.2	0.1
Stobie Pit	Inferred		—	—	—	—	—	—	—
Totten	Inferred		1,040	1.5	0.7	0.02	2.1	1.1	0.6
Nickel Rim South Extension	Inferred		877	2.4	1.0	0.02	0.4	0.6	0.3
Total Ontario Operations Vale Base Metals	Inferred	100%	81,449	1.0	0.9	0.03	0.8	0.9	0.3
Vale S.A. Equity Interest									
Total Ontario Operations Vale S.A.⁸	Inferred	90%	73,304	1.0	0.9	0.03	0.8	0.9	0.3

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
Bleazard	Inferred		—	—	—	—	—	—
Coleman	Inferred		44	24	1	222	357	119
Copper Cliff	Inferred		371	352	12	961	1,132	401
Creighton	Inferred		148	195	5	236	315	74
Ella-Capre	Inferred		157	100	3	443	561	134
Garson	Inferred		36	45	2	72	44	24
Copper Cliff Pit	Inferred		2	3	1	1	2	0
Stobie Pit	Inferred		—	—	—	—	—	—
Totten	Inferred		16	8	0	69	36	18
Nickel Rim South Extension	Inferred		21	8	0	11	16	7
Total Ontario Operations Vale Base Metals	Inferred	100%	794	735	23	2,015	2,463	778
Vale S.A. Equity Interest								
Total Ontario Operations Vale S.A.⁸	Inferred	90%	715	661	21	1,814	2,216	700

Notes to accompany mineral resources tables:

1. The mineral resource estimate has been prepared using industry accepted practice and complies to the disclosure requirements of S-K1300.
2. The reference point for the mineral resource estimate is in situ.
3. Mineral resources for Vale Base Metals (VBM) are reported on a 100% basis. Vale owns a 90% interest and Manara Minerals the remaining 10% interest
4. The estimate is current as at 31 December, 2025. The Qualified Person for the estimate is Mr. Henrique Vigario, MAusIMM, a Vale Base Metals employee.
5. Mineral resources are reported exclusive of those mineral resources converted to mineral reserves. Mineral resources that are not mineral reserves do not have demonstrated economic viability.
6. The estimate uses the following key input parameters: open pit mining methods or underground bulk stoping or narrow vein cut-and-fill mining methods; copper sale price of US\$6,100–9,500/t, nickel sale price of US\$13,376–20,822/t, cobalt sale price of US\$45,000–56,300/t, platinum sale price of US\$1,124–1,350/oz, palladium sale price of US\$925–1,450/oz, gold sale price of US\$1,000–1,950/oz; variable copper recovery by deposit and zone ranging from 91-97% for milling and average 93% for smelter/refinery, variable nickel recovery ranging from 71-89% for milling and average 95% for smelter/refinery; underground mine operating costs ranging from US\$50-180/t mined, open pit mine operating cost US\$13/t mined, process costs ranging from US\$6-27/t milled and US\$78-292/t concentrate. Pricing data are shown as ranges, due to the variability in specific deposit requirements and timing of the associated estimate. Cut-offs used in estimation vary by deposit, ranging from US\$70-182/t for underground mining and US\$33/t for open pit mining. Nickel Rim South Extension mineral resources reported only consider the portion of the project within Vale Base Metals' mineral rights.
7. Numbers have been rounded.
8. Ontario mineral resources, reflecting Vale's 90% ownership interest, the registrant, as required by item 1303(B)(3)(iii) of Regulation S-K.

11.14 UNCERTAINTIES THAT MAY AFFECT THE MINERAL RESOURCE ESTIMATE

Factors that may affect the mineral resource estimate include: changes to long-term metal price and exchange rate assumptions; changes to geological and grade shape, and geological and grade continuity assumptions; changes to metallurgical recovery assumptions; changes to the input assumptions used to derive the potentially-mineable shapes; changes to the forecast dilution and mining recovery assumptions; changes to the cut-off values applied to the estimates; variations in geotechnical, hydrogeological and mining method assumptions; and changes to environmental, permitting and social license assumptions.

Specific factors that may affect individual estimates include:

- Blezard: Although recent drilling has materially reduced reliance on historical data, approximately 33% of the current volume remains informed by older (pre-1974) drillholes. The 2020 surface drilling program confirmed the general lithological interpretation, geometry, and grade tenor indicated by the historical data, supporting its continued use. Nevertheless, portions of the estimate underpinned by the older drilling retain a higher level of uncertainty, as historical sampling and assay procedures may have locally over- or under-represented grades. The incorporation of recent drilling decreases, but does not eliminate the risk associated with potential local biases in the legacy dataset;
- Copper Cliff 710 and 720 (712): The current drillhole coverage consists primarily of steeply oriented surface drilling with variable spacing and differences in drillhole trajectories between historical and recent programs. These factors introduce uncertainty in the continuity of grade and geometry and may affect the confidence level assigned to portions of the estimate. Additional drilling and refinement of geological interpretation would be required to support higher-confidence classification in accordance with current criteria;

To the extent known to the QP, there are no other known environmental, permitting, legal, title-related, taxation, socio-political or marketing issues that could materially affect the mineral resource estimate that are not discussed in this Report.

12 MINERAL RESERVE ESTIMATES

12.1 INTRODUCTION

Mineral reserves in the Ontario Operations area are estimated for the underground operations of Coleman, Copper Cliff, Creighton, Garson and Totten, and for the open pit operation of Stobie. Only Proven and Probable reserves were used to support the economic analysis.cash flow

Mining plans and engineering studies were completed for all mineral reserve estimates. All engineering studies were at a minimum prefeasibility-level studies.

Vale Base Metals uses analyst and bank forecasts when considering long-term commodity price forecasts. The forecast prices may vary locally by the individual mines and deposits to reflect the time at which the mine plans are updated, cash flows are conducted, and the local cut-off grade employed to suit each individual operation based on hoisting capacity, mining method, and geotechnical considerations. The estimated timeframe used for the price forecasts is the 21-year LOM that supports the mineral reserve estimates. All forecast commodity prices are expressed in un-escalated real US dollars.

All run of mine from the Ontario Operations is processed as a blended product at Clarabelle Mill. The mill generates a copper concentrate which is sold to market and a nickel concentrate which is further processed at Vale Base Metals smelting and refining facilities. For more detail on the process and the final products sold to market see chapter 14: PROCESSING AND RECOVERY METHODS.

Only measured and indicated mineral resources were converted to proven and probable mineral reserves.

12.2 UNDERGROUND

For each mine and mineral zone with mineral reserves to be mined, a mining plan was developed that included selection of mining method, stope production sequencing, consideration of development, equipment and infrastructure requirements, and estimation of capital and operating costs. Mining plans and engineering studies were completed for all mineral reserve estimates. All engineering studies were at a minimum prefeasibility level.

Based on the selected mining method, and using the mineral resource block model, a mine design was prepared for each individual stope. Only measured and indicated mineral resources were converted in the stope design to estimate proven and probable mineral reserves.

Cut-off grades at Ontario Operations are determined using a Net Processing Return (NPR) approach. Because mineralization contains multiple payable metals with different prices and recoveries, each block is assigned an NPR value based on long-term metal price and exchange rate assumptions, net of processing and applicable site costs. Material is classified as ore when the NPR value exceeds the mining operating cash cost per tonne; otherwise, it is treated as waste.

Stopes were created using Stope Optimizer commercially available software at the required stope height, length and cut-off criteria based on the mine area. There can be considerable variation in stope sizing from mine to mine and within each mine, depending on geology, geometry, logistical and geotechnical considerations, and historical data. Stopes can range from about 4,500 to >50,000 t.

External dilution and mining recovery for each stope are estimated after consideration of the planned mining method and stope design and are applied as a modifying factor in the form of a percentage allowance of the in-situ estimated tonnage of the stope. Estimates of external mining dilution are based on historical data and stoping experience at the mines, which is tracked through a reconciliation procedure of planned versus actual production for each stope mined. The allowance also includes provision for external dilution by backfill material from adjacent backfilled stopes that is broken during blasting or sloughs during production and cannot be separated from ore during mucking. The estimate of external dilution can be reduced by a further allowance, again based on

experience, for waste rock separated from the broken mineralized rock in the stope by mucking under geological control.

Mining recovery factors include an allowance, based on local experience, for ore broken but not recovered during final mucking using remote-controlled load–haul–dump (LHD) vehicles. Oxidation of blasted ore frequently occurs where ore has been left in the stope for an extended period of time before removal. This leads to the ore consolidating as the sulphide content oxidizes, and makes it difficult to muck with LHDs, causing the loss of recovery. Mineral reserves within the design limits of the stope that are not recovered due to drilling and blasting limitations (e.g., stope shoulders) can also contribute to mining losses.

The throughput rate for each mine is based on a detailed mining plan that includes consideration of current and planned mining methods, geotechnical constraints and risks, materials handling system, mining equipment fleet, labour resourcing, infrastructure such as power supply and reticulation, dewatering, backfilling, and ventilation. Life-of-mine plans, as well as more detailed five-year plans, are developed for each mine.

The resulting mineral reserves in each stope for each mine were scheduled in the mine operations LOM production plan. The LOM plan included capital, operating and corporate costs estimates, and was assessed for economic viability. All mineable units or stopes that were scheduled for mining were included in the mineral reserves and were tested in the overall Ontario Operations production plan. Material that did not meet economic criteria following the financial analysis of the production plan were not converted to mineral reserves.

Mine plans are adjusted by mine planners to minimize the risk of ground failures and seismicity through the establishment of an optimal mining block size and shape, and mine sequencing. All of the underground mines are relatively dry, with only small groundwater inflows.

The mining methods used in the Ontario Operations are a combination of bulk stoping and cut-and-fill approaches (refer to discussion in Chapter 13.5).

Input parameters for the mineral reserve estimates are summarized in Table 12-1.

Table 12-1: Underground Mining LOM Plan NPR Formula Input Parameters

Parameter	Unit	Value/Range
Nickel sale price	US\$/t	13,376–18,800
Copper sale price	US\$/t	6,100–7,500
Cobalt sale price	US\$/t	45,000–50,000
Platinum sale price	US\$/oz	1,200–1,225
Palladium sale price	US\$/oz	925–1,400
Gold sale price	US\$/oz	1,300–1,450
Exchange rate	US\$/C\$	1.26–1.30
Mining recovery	%	70-100
External dilution	%	0-33
Mine operating cost	US\$/tonne ore	50-168
Mine sustaining capital cost	US\$/tonne ore	0-62
Mill operating cost ¹	US\$/tonne processed	6-27
Smelting and Refining cost ²	US\$/tonne Ni concentrate	740-1140
Mill Ni recovery ³	%	71.3-88.9
Mill Cu recovery ³	%	91.3-97.3
Smelter/Refinery Ni recovery ⁴	%	94.7
Smelter/Refinery Cu recovery ⁴	%	93.1
Cut-off ⁵	US\$/tonne	70-182

Notes:

1. Varies depending on mill feed head grade and cost allocation; includes site general and administrative costs.
2. Varies depending on cost allocation to specific sites/projects; includes smelting, refining, matte processing, electrowinning, acid processing, site general and administrative costs
3. Recovery to bulk concentrate
4. Smelter/refinery recovery for Copper Cliffs smelter-fed concentrate
5. Net processing return cut-off
6. All prices and costs are in real, unescalated, US\$

12.3 OPEN PIT

Mineral reserves were estimated using conventional open pit mining methods. Only measured and indicated mineral resources were converted to estimate proven and probable mineral reserves.

Pit optimization software was used to generate nested pit shells for Stobie pit. A pit-by-pit graph was used to select the ultimate pit shell, and intermediate pit phases, which the final designed operating pit and schedule were based. Dilution was included in the optimization and the mining schedule.

Stobie Pit, now in production, is the only open-pit reserves declared for Ontario Operations. The Stobie Pit is an expansion of mining the historical open pit on site and will extract the mineral reserve between the surface and the remnants of underground mine below, which is no longer in operation. The optimization work involved pit-shells analysis with Lerchs-Grossman (LG) algorithm available in standard software packages applying net smelter return (NSR) as grade descriptor and geomechanical constraints.

An operational schedule was developed in order to determine the optimal pit shell for each deposit; schedule inputs include the minimum mining width, and vertical rate of advance, mining rate and mining sequence. A marginal cut-off grade of US\$33/t for the Stobie Pit was used as the discriminator between ore and waste at the pit rim in design and schedules.

A dilution rate of 8% was selected for the Stobie Pit based on hanging wall and footwall contact with the orebody in the block model. Additional dilution for contacts between the underground workings and ore body was not added to prevent double counting because this dilution is already built into the block model. The assumed mining recovery for the Stobie Pit was 95%.

Input parameters for the mineral reserve estimates are summarized in Table 12-2.

A dilution rate of 8% was selected for the Stobie Pit based on hanging wall and footwall contact with the orebody in the block model. Additional dilution for contacts between the underground workings and ore body was not added to avoid double counting because this dilution rate is already built into the block model. The assumed mining recovery for the Stobie Pit was 95%.

Table 12-2: Pit Optimization Input Factors Input Parameters

Parameter	Unit	Value/Range
Nickel sale price	Real US\$/t	18,800
Copper sale price	Real US\$/t	7,500
Cobalt sale price	Real US\$/t	50,000
Platinum sale price	Real US\$/oz	1,200
Palladium sale price	Real US\$/oz	1,400
Gold sale price	Real US\$/oz	1,450
Exchange rate	US\$/C\$	1.26
Mining recovery	%	95
External dilution	%	8
Mine operating cost	Real US\$/tonne mineralization mined	12
Mill operating cost ¹	Real US\$/tonne processed	6
Treatment and Refining cost ²	Real US\$/tonne concentrate	78
Mill Ni recovery ³	%	71.3
Mill Cu recovery ³	%	91.3
Smelter/Refinery Ni recovery ⁴	%	94.6
Smelter/Refinery Cu recovery ⁴	%	92.8
Cut-off ⁵	Real US\$/tonne	33
Overall pit slope	°	36-44

Notes:

1. Varies depending on mill feed head grade and cost allocation; includes site general and administrative costs.
2. Varies depending on cost allocation to specific sites/projects; includes site general and administrative costs
3. Recovery to bulk concentrate
4. Smelter/refinery recovery for Copper Cliffs smelter-fed concentrate
5. Net processing return cut-off

12.4 MINERAL RESERVE STATEMENT

Mineral reserves were classified and reported using the mineral reserve definitions set out in S-K 1300. The reference point for the mineral reserve estimate is the tonnage and grades at point of delivery to the process plant (Clarabelle Mill).

Mineral reserves are presented both on a 100% basis, based on Vale Base Metals' view, and on a 90% basis, considering only the ownership attributable to Vale, the registrant.

Mineral reserves that are reported in Table 12-3 are current as at 31 December, 2025. The Qualified Person for the estimate is Mr. Jody Todd, FAusIMM, a Vale Base Metals employee.

Table 12-3: Ontario Operations – Proven and Probable Mineral Reserve Statement

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Coleman	Proven		6,932	1.95	0.78	0.02	1.70	2.10	0.80
	Probable		1,771	2.99	0.59	0.01	1.25	2.10	0.71
	Sub-total Proven + Probable		8,703	2.16	0.74	0.02	1.61	2.10	0.79
Copper Cliff	Proven		7,981	1.4	1.02	0.03	1.29	1.04	0.51
	Probable		23,353	1.19	1.14	0.03	1.12	1.55	0.40
	Sub-total Proven + Probable		31,334	1.25	1.11	0.03	1.16	1.42	0.43
Creighton	Proven		7,115	2.55	2.78	0.05	0.93	1.06	0.30
	Probable		11,222	1.79	2.36	0.05	0.68	0.75	0.20
	Sub-total Proven + Probable		18,338	2.09	2.52	0.05	0.78	0.87	0.24
Garson	Proven		2,480	1.23	1.43	0.04	0.54	0.33	0.20
	Probable		1,393	1.11	1.16	0.04	0.50	0.32	0.17
	Sub-total Proven + Probable		3,873	1.19	1.33	0.04	0.53	0.32	0.19
Stobie Pit	Proven		740	0.37	0.41	0.02	0.17	0.17	0.07
	Probable		2,874	0.39	0.43	0.02	0.17	0.18	0.07
	Sub-total Proven + Probable		3,614	0.39	0.43	0.02	0.17	0.17	0.07
Totten	Proven		3,699	1.39	1.10	0.03	1.36	0.76	0.44
	Probable		857	1.23	0.58	0.01	1.47	0.97	0.48
	Sub-total Proven + Probable		4,556	1.36	1.00	0.02	1.38	0.80	0.45
Total Ontario Operations	Proven		28,948	1.77	1.42	0.03	1.21	1.18	0.48
	Probable		41,471	1.37	1.39	0.04	0.93	1.21	0.33

Operations/Deposit	Category	Ownership	Tonnage (kt)	Grade					
				Cu (%)	Ni (%)	Co (%)	Pt (g/t)	Pd (g/t)	Au (g/t)
Vale Base Metals	Sub-total Proven + Probable	100%	70,419	1.54	1.40	0.03	1.04	1.20	0.39
Vale S.A. Equity Interest									
Total Ontario Operations Vale S.A. ⁶ .	Proven		26,053	1.77	1.42	0.03	1.21	1.18	0.48
	Probable		37,324	1.37	1.39	0.04	0.93	1.21	0.33
	Sub-total Proven + Probable	90%	63,377	1.54	1.40	0.03	1.04	1.20	0.39

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
Coleman	Proven		135	54	1	378	468	179
	Probable		53	10	0	71	120	41
	Sub-total Proven + Probable		188	64	1	450	588	220
Copper Cliff	Proven		112	81	2	330	267	132
	Probable		279	267	7	839	1,166	298
	Sub-total Proven + Probable		391	348	10	1,169	1,432	430
Creighton	Proven		182	198	4	213	242	69
	Probable		201	265	6	245	270	72
	Sub-total Proven + Probable		383	462	10	458	512	141
Garson	Proven		30	35	1	43	26	16
	Probable		16	16	1	22	14	7
	Sub-total Proven + Probable		46	52	2	66	40	23
Stobie Pit	Proven		3	3	0	4	4	2
	Probable		11	12	1	16	16	7
	Sub-total Proven + Probable		14	15	1	20	20	8
Totten	Proven		51	41	1	161	90	53
	Probable		11	5	0	40	27	13
	Sub-total Proven + Probable		62	46	1	202	117	66
	Proven		513	412	9	1,130	1,097	450

Operations/Deposit	Category	Ownership	Metal					
			Cu (kt)	Ni (kt)	Co (kt)	Pt (koz)	Pd (koz)	Au (koz)
Total Ontario Operations Vale Base Metals	Probable		570	575	15	1,233	1,613	438
	Sub-total Proven + Probable	100%	1,083	988	24	2,363	2,710	888
Vale S.A. Equity Interest								
Total Ontario Operations Vale S.A. ⁶	Proven		462	371	8	1,017	987	405
	Probable		513	518	13	1,110	1,451	394
	Sub-total Proven + Probable	90%	975	889	22	2,127	2,439	799

Notes to accompany mineral reserves table:

1. Mineral reserves are reported using the mineral reserve definitions set out in S-K 1300. The reference point for the mineral reserve estimate is the point of delivery to the process plant.
2. Mineral reserves for Vale Base Metals (VBM) are reported on a 100% basis. Vale owns a 90% interest and Manara Minerals the remaining 10% interest
3. The estimate is current as at December 31, 2025. The Qualified Person for the estimate is Jody Todd, FAusIMM, a Vale Base Metals employee.
4. The estimates use the following key input parameters: open pit, bulk stoping or narrow vein cut-and-fill mining methods; copper sale price of US\$6,100–7,500/t, nickel sale price of US\$13,376–18,800/t, cobalt sale price of US\$45,000–50,000/t, platinum sale price of US\$1,200–1,225/oz, palladium sale price of US\$925–1,400/oz, gold sale price of US\$1,300–1,450/oz; variable copper recoveries ranging from 91-97% for mill and average 93% for smelter/refinery, variable nickel recoveries ranging from 71–89% for mill and average 95% for smelter/refinery; mine operating costs ranging from US\$50-168/t mined for underground and US\$12/t mined for open pit; mill costs ranging from US\$6-27/t milled; smelter/refinery operating cost of US\$78-292/t concentrate; mining recovery ranging from 70–100%, and unplanned dilution ranging from 0–33%. Costs, metallurgical recovery, and pricing data are shown as ranges, due to the variability in specific deposit requirements and timing of the associated estimate.
5. Numbers have been rounded.
6. Ontario mineral reserves, reflecting Vale's 90% ownership interest, the registrant, as required by item 1303(B)(3)(iii) of Regulation S-K.

12.5 UNCERTAINTIES THAT MAY AFFECT THE MINERAL RESERVE ESTIMATE

Factors that may affect the mineral reserves estimate include: long-term commodity price and exchange rate assumptions; long-term consumables price assumptions; changes to mineral resources input parameters; changes to constraining stope designs; changes to cut-off grade and NPR assumptions; changes to geotechnical and hydrogeological factors; changes to metallurgical and mining recovery assumptions; the ability to control unplanned dilution; impact of seismicity on operations; ability to manage any impact of onsite waste rock to surface and groundwater; and assumptions as to the continued ability to access the site, retain mineral and surface rights titles, maintain environment and other regulatory permits, and maintain the social license to operate.

Specific factors that may affect individual estimates include:

- Coleman: Coleman still leverages infrastructure from Glencore Fraser Mine. Currently developing a second egress drift to Levack mine which will then make Vale Base Metals reliant on the infrastructure owned and operated by Magna Mining.
- Copper Cliff: execution of Phase 3 and Phase 4 projects in time to meet production requirements;
- Creighton: achieving planned development rates and maintaining adequate ventilation for deepest parts of the mine;

- Garson: potential metals leaching/acid rock drainage issues arising from historical stockpile areas; geological and grade interpretations, mine designs, and mine recovery assumptions due to the structurally complex mine setting;
- Stobie Pit: uncertainties in the old working and productivity of remote control equipment near these high risk areas;
- Totten: maintaining required ventilation for operation in deepest part of the mine.

To the extent known to the QP, there are no other known environmental, permitting, legal, title related, taxation, socio-political or marketing issues that could materially affect the mineral reserve estimates that are not discussed in this Report.

13 MINING METHODS

13.1 INTRODUCTION

The Ontario Operations use conventional bulk stoping or cut-and-fill mining methods, depending on the mine and geological setting. Conventional open pit mining is conducted in the Stobie Pit.

Underground mines are owner operated, and use conventional equipment. The Stobie open pit also uses conventional equipment and is operated by a third-party contractor.

13.2 GEOTECHNICAL CONSIDERATIONS

13.2.1 GUIDANCE DOCUMENTS

13.2.1.1 UNDERGROUND

Vale Base Metals has technical guidelines and standards in place to ensure that valid geotechnical data are collected and interpreted using appropriate methods, and that existing or planned risk mitigation measures that support mine designs are based on those data and interpretations. Documentation meets the requirements of Section 6 of Regulation 854 for Mines and Mining Plants, under the Occupational Health and Safety Act of Ontario, R.R.O. 1990.

All underground mines must have an effective Ground Control Management Plan, also referred to as the “Mine Design Package”, which is a single coherent document developed through application of sound geotechnical engineering practices, conform to local mining regulations, and be aligned with Vale Base Metals safety and underground mine geotechnical standards.

The document covers a wide range of technical topics including:

- geology;
- geotechnical information,
- mine arrangement,
- mining methods,
- ground control methods and support standards,
- ground control procedures,
- ground support quality control program,
- ground monitoring program,
- geomechanical evaluation,
- record keeping and communications,
- ground control training,
- mining-induced seismicity,
- geotechnical considerations in mine design and risk assessment and management.

The Ground Control Management Plan is annually updated by a ground control engineer and reviewed and signed off by various key stakeholders including the mine manager. This provides a robust basis for geotechnical evaluation, modelling, and mitigation measures.

The Ontario Operations maintain a Seismic Risk Management Plan, which is designed to identify, assess, and manage seismic hazards. All five operating underground mines - Coleman, Creighton, Copper Cliff, Garson, and Totten - are seismically active.

A Geotechnical Review Board was established in 2017 with a five-year mandate to assess these operating mines. The Geotechnical Review Board:

- reviews the existing controls
- comments on the effectiveness of controls in place at the mine at a high level and
- provides additional recommendations to effectively manage seismicity if any shortcomings are observed in the existing seismic management practices and procedures relative to industry peers.

Additional support can be provided when requested; for example, Vale Base Metals may request the Geotechnical Review Board to determine root causes and recommend mitigations to prevent or reduce the impact of large, high-risk seismic events if they occur.

The review board is the highest level of professional review assisting Vale Base Metals in assessing and providing appropriate designs.

13.2.1.2 OPEN PIT

Vale Base Metals has technical guidelines and standards in place to ensure that valid geotechnical data are collected and interpreted using appropriate methods, and that existing or planned risk mitigation measures that support mine designs are based on those data and interpretations.

All open pit mines must have an effective Ground Control Management Plan, which is a single coherent document developed through application of sound geotechnical engineering practices, conforming to local mining regulations, and aligned with Vale Base Metals safety standards. The document covers a wide range of technical topics, similar to the underground mines management plan.

For the Stobie Pit, a Ground Control Management Plan has been developed and is currently in use.

13.2.2 UNDERGROUND

13.2.2.1 GEOTECHNICAL DESIGNS AND SUPPORT

Geotechnical data collection and rock mass characterization are used to define domains. For each domain, a simplified set of ground support requirements is specified for each categorized ground condition through the iterative process of support element selection, consideration of support system coherence, application of different design methods and local regulations. These ground support requirements also take into consideration, excavation size and shape, required life of excavation, stress conditions, proximity to present and future openings, personnel exposure, and local historical experiences.

Geotechnical assessments are completed to:

- Identify high stress zones;
- Evaluate the stability of major infrastructure;
- Assess the influence of major geological structures;
- Evaluate the stability of permanent pillars and other long-term excavations;
- Design optimal ground support systems to ensure the safety and stability of the excavations for the intended service life.

The results of geotechnical assessments are recommendations for vertical development, lateral development, and mining stopes, as well as the mine plan, which may have specific sequences of stope extraction. Old workings or natural voids are also considered where present.

For each mine, the mine's Ground Control Management Plan (see discussion in Chapter 13.2.1) sets out the considerations for the selection of ground support elements for various ground conditions including mine and service life, seismicity, corrosion potential and product characteristics. If shotcrete is applied at a mine, information on the types of material used (wet-mix, dry-mix, plain or reinforced) and the required thickness of application in different circumstances is incorporated into

the document. The plan provides the justification process for the mine support standards and provides information on the selected pattern for each support category. It documents the scaling techniques used in each mine and related procedures. Standard development drilling and blasting patterns and their application with respect to various conditions and controlled perimeter blasting techniques are provided. The dewatering/depressurization requirements and methods are noted. Areas that routinely receive exceptionally high levels of ground support are recorded.

A complete ground support system for each mine consists of a series of activities and techniques such as scaling, local reinforcement (bolting), loose retention (meshing or strapping), shotcreting and cable-bolting. Primary support can include resin grouted rebar, friction and swellex bolts, and shotcrete. Secondary support is typically used for openings with a span of >7 m, and can consist of different elements such as cable bolts, Super-swellex bolts, strand-lok resin cables, and shotcrete arches and posts. Dynamic ground support systems (i.e., Par-1 dynamic bolts & #0 Gauge Mesh Straps) are installed in rockburst-prone and/or high seismic hazard areas.

13.2.2.2 BACKFILL

Either sand or mill rock tailings are used as a hydraulic backfill, with the type of fill materials dependent on the proximity of a mine to the Clarabelle Mill and the availability of proximal alluvial sand sources. The Copper Cliff and Creighton Mines use mill rock tailings, the Garson and Totten Mines use alluvial sands, and the Coleman Mine uses a mix of mill rock tailings and alluvial sands.

High-density (paste) backfill is currently used at the Main area of the Garson Mine. Alluvial sand and silt from the Garson sand pit are used in paste production, and the binder consists of 90/10 (slag/Portland cement). The stope plugs are poured at a sand-to-binder ratio of 10:1, achieving a minimum unconfined compressive strength of 30 psi before proceeding to pour the body of the stope at a sand-to-binder ratio between 20:1 and 30:1 depending on backfill strength requirements.

13.2.3 OPEN PIT

Stobie Pit is operated by Thiess under a lease agreement with Vale Base Metals, and are conducting their own geotechnical design work.

13.3 HYDROGEOLOGICAL CONSIDERATIONS

13.3.1 UNDERGROUND

The deep portions of the Sudbury underground mines are relatively dry, due to the depth of the mines and dewatering that has occurred over the long history of the operations. More significant groundwater inflow is noted in shallow near-surface underground locations at some of the mine sites. In general, most of the water that needs to be pumped from the underground mines enters as process water, or as contained moisture in the backfill slurry.

Copper Cliff and Creighton Mines have open pits or cave areas that are connected to the underground workings. Inflow into the mine from the pit/cave areas is minimal, except during spring freshet and occasionally during heavy fall rainfalls. These mines have been in operation for many years and are familiar with managing spring freshet and fall rainfalls through water management infrastructure and procedures to handle these inflows.

Water management strategies for the underground mines are summarized in Table 13-1. By Provincial Regulation a Water Management Plan is also updated annually to reflect current conditions.

Table 13-1: Hydrological Considerations

Operation	Note	Comment
Coleman	Minor groundwater inflows. Primary water sources are process water from mining operations, and decant water from hydraulic fill.	Process water is supplied via the Onaping River. There are four main sumps (1950L, 3410 L, 3770L and 5440L). Water from the Levack mine shaft on 3600L is dewatered through the 3410L sump and all the site water is discharged to surface from 1950L. Coleman dewaterers on average 1,100 m ³ of water per day from underground. About 400 m ³ per day is recycled or reused for backfill. On surface, water is sent to Glencore's operations for treatment.
Copper Cliff	Inflows from the surface pit connections during spring freshet and occasionally during heavy fall rainfalls. Storage and pumping capacity limits can be stressed due to inflows. Deeper parts of Copper Cliff Mine have minor water inflow, with the majority of dewatering due to process water and backfill.	Process water is supplied from the Vermilion Water Treatment Plant. There are two main sumps on the north side of the mine (2200L and 4000L) with water stopes for additional water storage as required. Water is discharged to surface from 2200L. There are three main sumps on the south side of the mine (2250/2300L, 4000L and 5200L), where water is discharged to surface from 2250/2300L. Copper Cliff dewaterers on average 4500 m ³ per day from underground. On surface, water reports to the Central Tailings Area (CTA), where water in the CTA is treated at either the Copper Cliff Waste Water Treatment Plant or Nolin Creek Waste Water Treatment Plant depending on the watershed.
Creighton	Surface pit inflows increase during the spring freshet, potentially stressing storage and pumping limits. For the rest of the year, most dewatering is from process water and backfill.	Process water is supplied from the Vermilion Water Treatment Plant. There are five main sumps (1900L, 3800L, 5400L, 7000L and 7400L), where water is discharged to surface from 1900L. Creighton dewaterers on average 1700 m ³ per day from underground. On surface, water reports to the Central Tailings Area (CTA), where water in the CTA is treated at either the Copper Cliff Waste Water Treatment Plant or Nolin Creek Waste Water Treatment Plant depending on the watershed.
Garson	The main part of the mine accessed via the shaft receives minor groundwater inflow. A high density hydraulic backfill is used which introduces much less water into the main mine than typical hydraulic backfill. Groundwater inflows are present in the Garson ramp area of the mine due to it's proximity to surface. Additional water sources in the ramp area include process water and water from hydraulic fill.	Process water is supplied from a groundwater well. The main mine has 3 main sumps (1000L, 3000L and 4000L), where water is discharged to surface from 1000L. In the ramp, water reporting to 420L is pumped to 640L. A network of boreholes drains the water to 1000L, where water is discharged to surface. Garson dewaterers on average 3000 m ³ per day from underground. On surface, water is treated on site before release to Junction Creek.
Totten	Minor groundwater inflows. Primary water sources are process water from mining operations, and decant water from hydraulic fill.	Totten is generally closed loop, although a PTTW allows limited withdrawal from Victoria Creek to supply certain on-site buildings. There are two main sumps (2000L and 4000L), where water is pumped to surface from 2000L. Totten dewaterers on average 980 m ³ per day from underground. On surface water is treated on site and either re-used or discharged to Victoria Creek depending on site pond levels during the spring and fall.

13.3.2 OPEN PIT

The Stobie underground mine, which was formerly allowed to flood during care-and-maintenance, is now an active open pit mining operation undergoing de-watering through a pre-existing shaft. Water is extracted from existing underground workings to draw down the water level so that it remains below the pit bottom level.

The fractured nature of the Stobie geology and pre-existing underground workings acts as a conduit/drain for contact water within the pit, and with active de-watering, in-pit water accumulation is anticipated to be minimal. Water from the Stobie site is delivered to the existing water collection and treatment system for discharge. Dewatering rates vary depending on the time of year and the capacity which the water treatment system can handle. Required dewatering rates are well below the permitted rate of 19,000 L per minute (19 m³ per minute).

Water level drawdown from dewatering activities is monitored and surroundings areas in compliance with the Permits to Take Water.

13.4 MINE ACCESSES

13.4.1 COLEMAN

The primary access to the Coleman Mine is by the #1 Shaft and a series of internal ramps. In 1987, the #1 Shaft was deepened from the 2210 Level to the current shaft bottom at the 3450 Level. The Lower Coleman Mine is situated approximately 914 m south of the Upper Coleman Mine, at a depth of approximately 1 km. Ramp access is provided from 3370 Level to all active regions of the Coleman Mine via a 5 km ramp system stretching west from the Coleman #1 Shaft at the 3370 Level.

The main access drift and the conveyor drift are connected to the #1 Shaft at the 3370 Level and 3090 Level, respectively. The service ramp extends from 3370 Level to the 3575, 3770 and 3860 Levels. In parallel, the Kiruna haulage ramp extends from 3370 Level to the 3575 and 3770 Levels, and then splits into two branches below 3770 Level: the lower main haulage ramp which extends to the 4055 and 4215 Levels, and the 153 OB Kiruna haulage ramp.

There is also an emergency escape way from the 3575 Level via Glencore Canada's Fraser mine 3600 Level track drift (the Fecunis escape way). This escape route was established in 2006, from the 3511 Level to Fraser mine 3600 Level. The Fraser mine is currently planned for closure in 2026. As a mitigation for Fraiser mine closure; a new second egress drift is being driven to connect Coleman to Levack Mine (owned and operated by Magna Mining) which is planned to connect in 2026. An agreement was made with Glencore for Vale Base Metals to operate the Fraiser infrastructure after closure until this drift connection is complete.

13.4.2 COPPER CLIFF

The main underground mine is accessed via the Copper Cliff North #1 Shaft on the north side of the mine, the Copper Cliff South #1 Shaft on the south side of the mine, and a surface portal ramp on south side. Both the North #1 and South #1 shafts have a level access approximately every 61 m at vertical intervals; however, only a few levels are connected to other parts of the mine via internal ramp systems. Vertical escapeways (ladder systems) are established and maintained where needed to serve as a means of secondary egress from the mine. The main ramp system on south side is currently connected to north side workings on the 2050, 2400/2490 and 3400 Levels. The 114 orebody is accessed via the 114 orebody portal and ramp system from surface, and is not connected to either of the #1 Shafts or the main ramp system and has its own separate secondary egress.

13.4.3 CREIGHTON

The main mine is accessed via the #9 Shaft with the shaft bottom extended to about 37 m below the 7000 Level. There is a ramp system from surface to the 2600 Level via the #3 Shaft. A series of vertical escapeways and connections established between #9 Shaft and #3 Shaft ramp serves as a means for secondary egress from the mine.

The #9 Shaft has level openings at approximately 61 m vertical intervals. Two internal ramp systems are available from the #9 Shaft. The upper ramp system is located between the 3310 and 5400 Levels, while the lower ramp system extends from the 6600 Level to beyond the 8400 Level. The bottom of the lower ramp system is currently at the 8590 Level. The Creighton Extension Study plans to extend the ramp to the 9760 Level.

13.4.4 GARSON

The Garson Main mine is accessed via the 1,293 m deep Garson #2 Shaft while the surface ramp area is accessed through a portal at surface, situated approximately 400 m west of the shaft collar. The main level accesses from #2 Shaft are 3800 and 4000. The secondary means of egress for the Main mine is through a ladder system in the power raise from surface to 3400 Level. Primary and secondary egresses from the bottom of the Main mine on the 5200 Level to 3400 Level are a combination of haulage declines and relatively short ladderway systems.

The Garson Main mine and Garson surface ramp operations are physically connected on the 200, 400 and 600 Levels. The 200 Level has an escapeway to surface and serves as a secondary means of egress for the surface ramp operation. On the 400 Level of the surface ramp, access to the Main mine is via the 400 Level track drift. The 400 Level has an escapeway to the 200 Level. This level also serves as a secondary means of egress for the surface ramp. A third location as secondary means of egress between the surface ramp and the Main mine uses the 660 Level and 790 Level escapeway drift. The 790 Level escapeway drift is accessed from the 660 Level access drift on the surface ramp side and connects to the 600 Level main sill drift on the Main mine side.

13.4.5 STOBIE PIT

Stobie Pit is accessed via the existing Stobie site via site roads that lead to the pit ramp. Connecting roads have been developed to allow transportation of waste from the operating pit to dump in a section of non-operating historical pit.

13.4.6 TOTTEN

The 1,260 m deep #2 Shaft is the primary entry and exit point into the mine for personnel, materials, and ore/waste.

The secondary means of egress is a ladder system from surface down to the 4530 Level. A ramp has been connected to shaft access levels on the 3850 and 3150 Levels and it serves as second egress for the workings between the 3150 and 3800 Levels. Apart from the shaft, ramp access now exists from the 4650 to 2330 Levels. When ramp development is completed, the mine will have ramp access from the 1850 to 4650 Levels.

13.5 MINING METHODS

A number of mining methods are used across the Ontario Operations (Table 13-2). The Ontario Operations mines each have a substantial history for which mining methods work best under various geological and geotechnical conditions. This experience combined with analysis was used to select the mining methods and stope sizes for the individual zones within each mine.

Table 13-2: Mining Methods by Mine

Mine	Mining Method
Coleman	Open Stoping
	Mechanized cut-and-fill
Copper Cliff	Open Stoping
	Mechanized cut-and-fill
Creighton	Open Stoping

Garson	Open Stoping
Stobie Pit	Open pit
Totten	Open Stoping
	Mechanized cut-and-fill

13.5.1 OPEN STOPING

This method is also referred to as blast-hole stoping, slot–slash stoping or sub-level open stoping. The stoping is done in a transverse or longitudinal orientation and is a bulk mining method.

The mining cycle begins with the development of a haulage drift parallel to the orebody strike or a sill drift through the ore. If required, crosscuts are then developed through the ore to the ore contact. Pillar widths are dependent on crosscut spacing and stope dimensions. Generally, stopes are divided in panels if the ore is >30 m thick, and are mined from hanging wall to footwall or vice-versa depending on the level configuration. Typically, bottom sill long wall slashes are required to create a void for blasting.

Slots are excavated in the form of drop raises or raisebore raises. Production blast holes are drilled around the raise, and across the width of the entire panel in the slot drift. After the slot and production holes are drilled, they are blasted, usually in two to three blasts, to excavate the entire stope. Blasts are designed individually, based on the amount of void, and the location of the stope. Mucking is carried out with a LHD vehicle (typically 8 yd³) equipped with remote-control operating capabilities. Following mining, the stope void is measured with a cavity monitoring system laser-based surveying tool mounted to an aerial drone.

Following surveying, the stope void is filled with backfill, typically consisting of a 10:1 cemented hydraulic sand fill plug at the bottom of the stope, followed by a cemented hydraulic sand fill body. Unconsolidated waste rock can be added to the body of the stope if permitted.

Longitudinal open stoping is used in narrow portions of orebodies and in stopes adjacent to trap dykes. At the Totten Mine to avoid cross cuts through trap dykes, a footwall drift is developed through the trap dyke without any transverse cross cuts. The longitudinal sill is developed from the first cross cut after crossing the trap dyke within ore. In some cases, where the mineralization is very wide, two parallel sills can be developed to extract the entire width of the orebody. Stopes are very narrow, so that longwall slashes may or may not be needed in the bottom sill. Typically, stoping starts in the orebody extremity and retreats towards the main access.

Most of the main ore body at the Totten Mine is mined using transverse primary–secondary stoping. Transverse stoping is also common at the Coleman, Creighton and Copper Cliff Mines. A footwall drift is initially developed parallel to the strike of the ore body. Cross cuts or ore sills at 12–15 m intervals are developed normal to the footwall drift and cross cuts extend up to the hanging wall contact of the orebody. Bottom sill longwall slashes are required to completely recover the ore in the bottom sills. All of the production drilling is done from the top sills. Generally, where the orebody width is >30 m, the panel is divided into two or more stopes, from the hanging wall side to the footwall side.

13.5.2 MECHANIZED CUT-AND-FILL

Mechanized cut-and-fill is used for flat-lying and narrow-vein deposits that are not suitable for bulk blasthole mining. Two distinctive types of mechanized cut-and-fill mining methods are used. The first is a narrow-vein approach whereby a set of sequential cuts 2.7–3.7 m high are mined with small equipment (i.e., one-boom drill jumbos, 3 yd³ LHDs and rock bolting using hand-held drills such as jacklegs and stopers). Depending on the width of the vein, it is mined in one pass (narrow vein) or with multiple passes (drift-and-fill). With these methods, over-hand mining is the most common approach, but under-hand mining is also used. For larger flat-lying zones post-pillar cut-and-fill is used, with the cuts at approximately 6 m high and varying from 6–9.8 m in width. Regularly sized

and spaced pillars are left to support the openings. The pillars are either post- or rib-type and generally are not recoverable. Both approaches extract the ore in horizontal slices over the entire deposit strike length then are backfilled before the next slice is mined. Production drilling is done with Jumbo drills.

Backfill is a combination of unconsolidated rock fill placed by the LHD into the empty cut as tight to the back as possible, and/or sand fill.

13.5.3 OPEN PIT

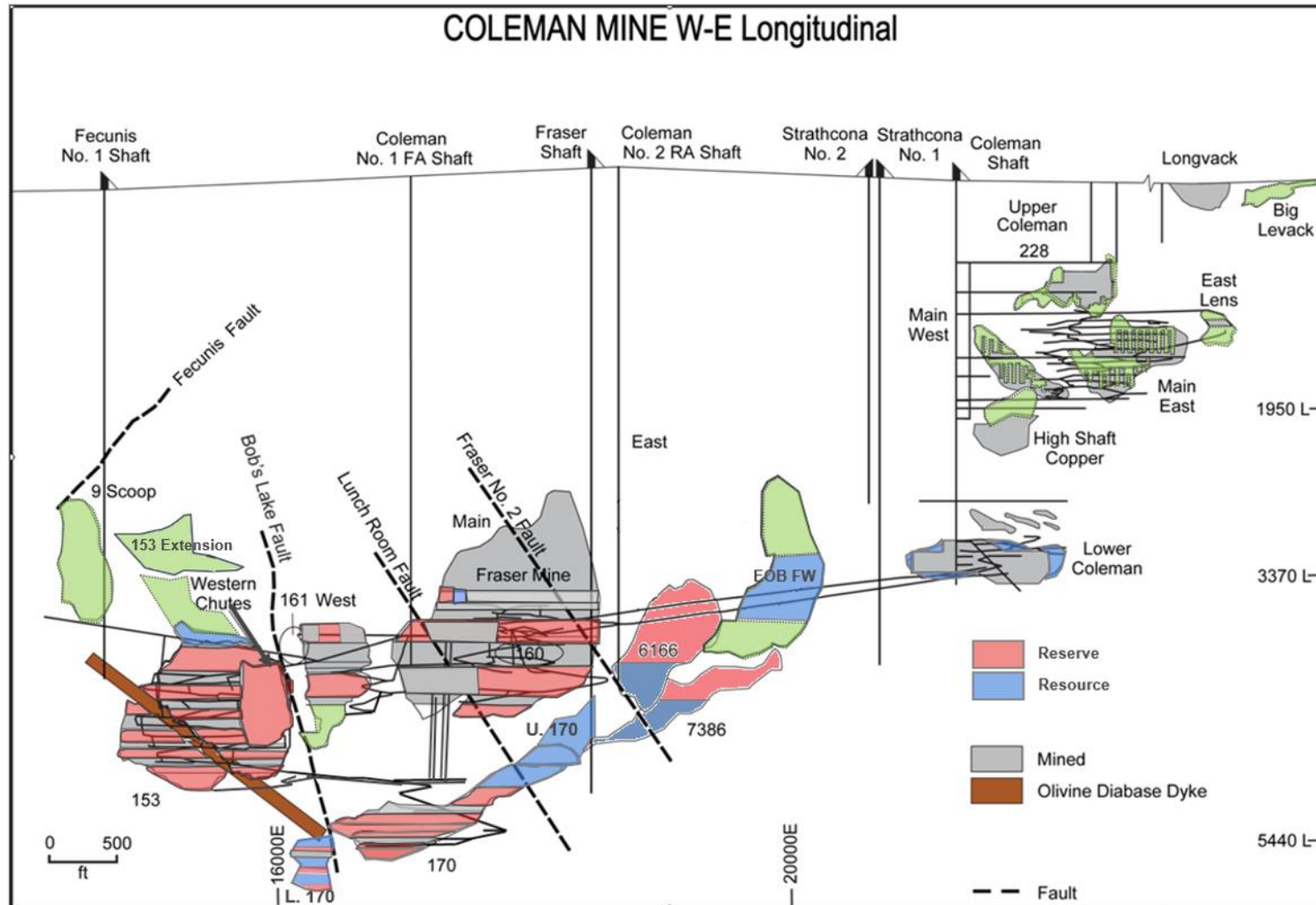
Open pit mining is used to extract near-surface ores resulting in a typically oval-shaped excavation profile that is wider at the top than at the pit bottom, with staggered levels (benches) that also typically decrease in width as the pit becomes deeper. Ramps are used to provide access into the open pit.

The open-pit mining cycle includes drilling and blasting of ore and waste, ore loading and hauling to the process plant for processing or to stockpiles for process plant feed later in the mine life, and waste rock loading and hauling to a designated waste rock storage facility.

13.6 MINE PLANS

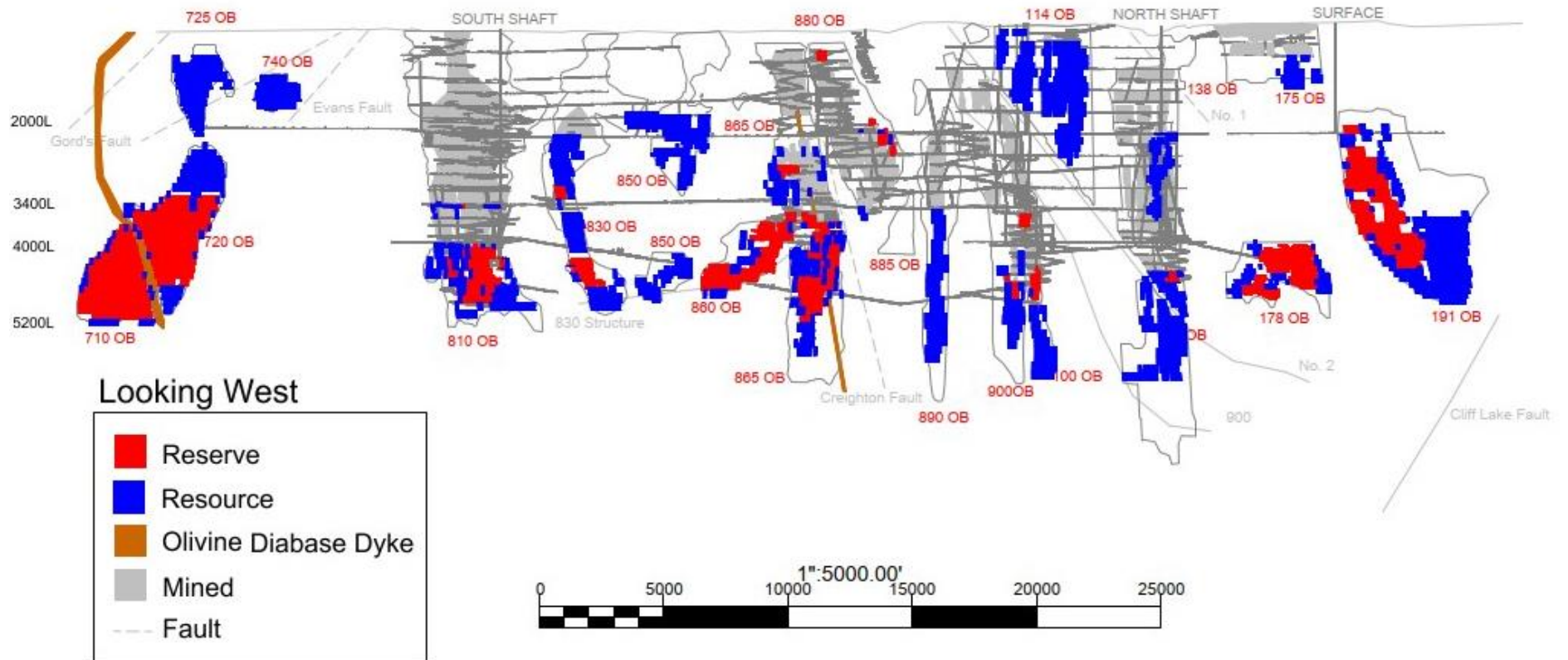
Figures showing the final mine layouts are provided in Figure 13-1 to Figure 13-7.

Figure 13-1: Coleman Mine Long-Section



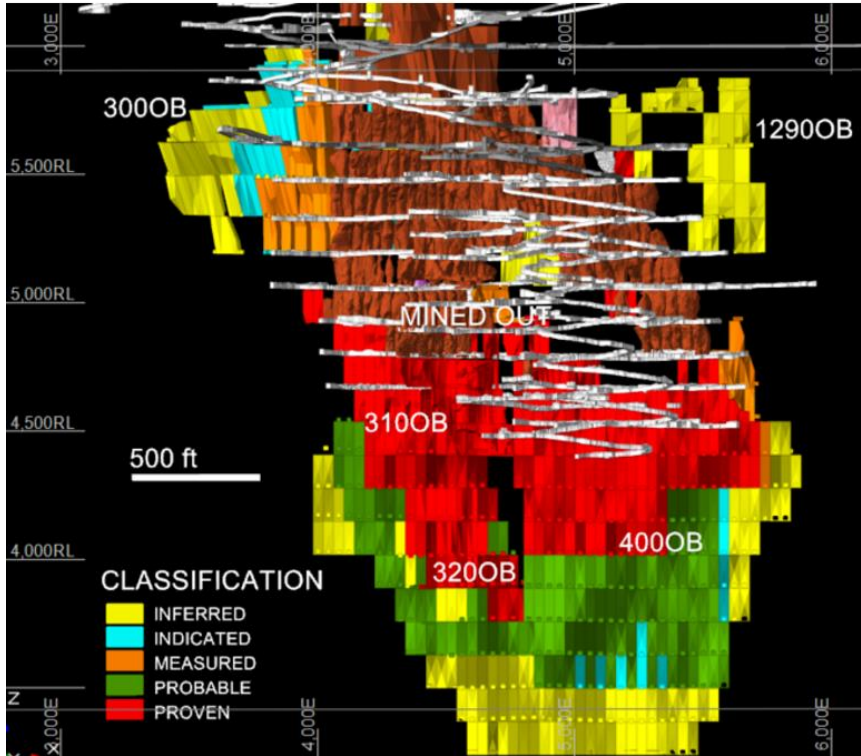
Note: Figure prepared by Vale Base Metals, 2025.

Figure 13-2: Copper Cliff Mine Cross-Section



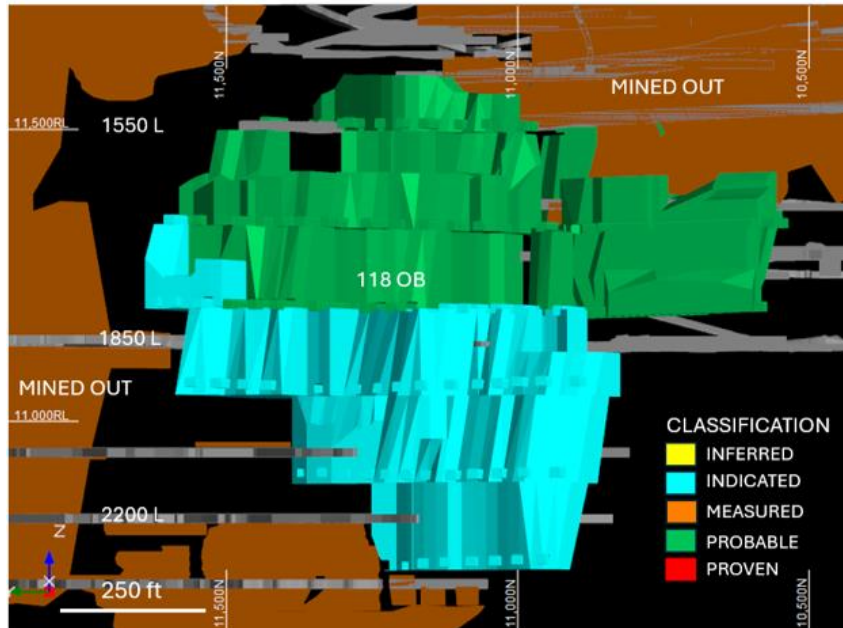
Note: Figure prepared by Vale Base Metals, 2025.

Figure 13-3: Creighton Mine Division 6 Long-Section



Note: Figure prepared by Vale Base Metals, 2025.

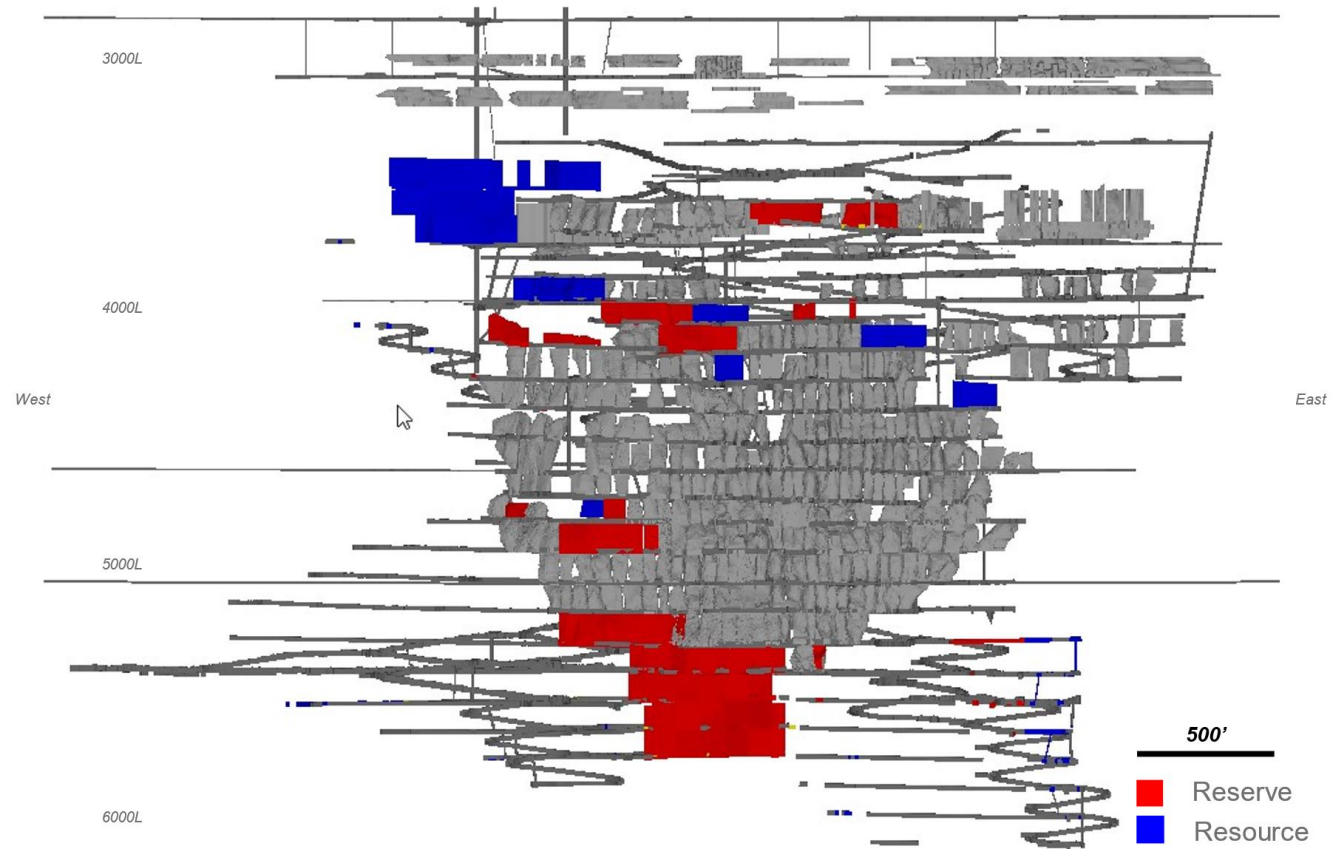
Figure 13-4: Creighton Mine Division 3 Long-Section



Note: Figure prepared by Vale Base Metals, 2025.

Figure 13-5: Garson Main Mine 1 Shear Long-Section

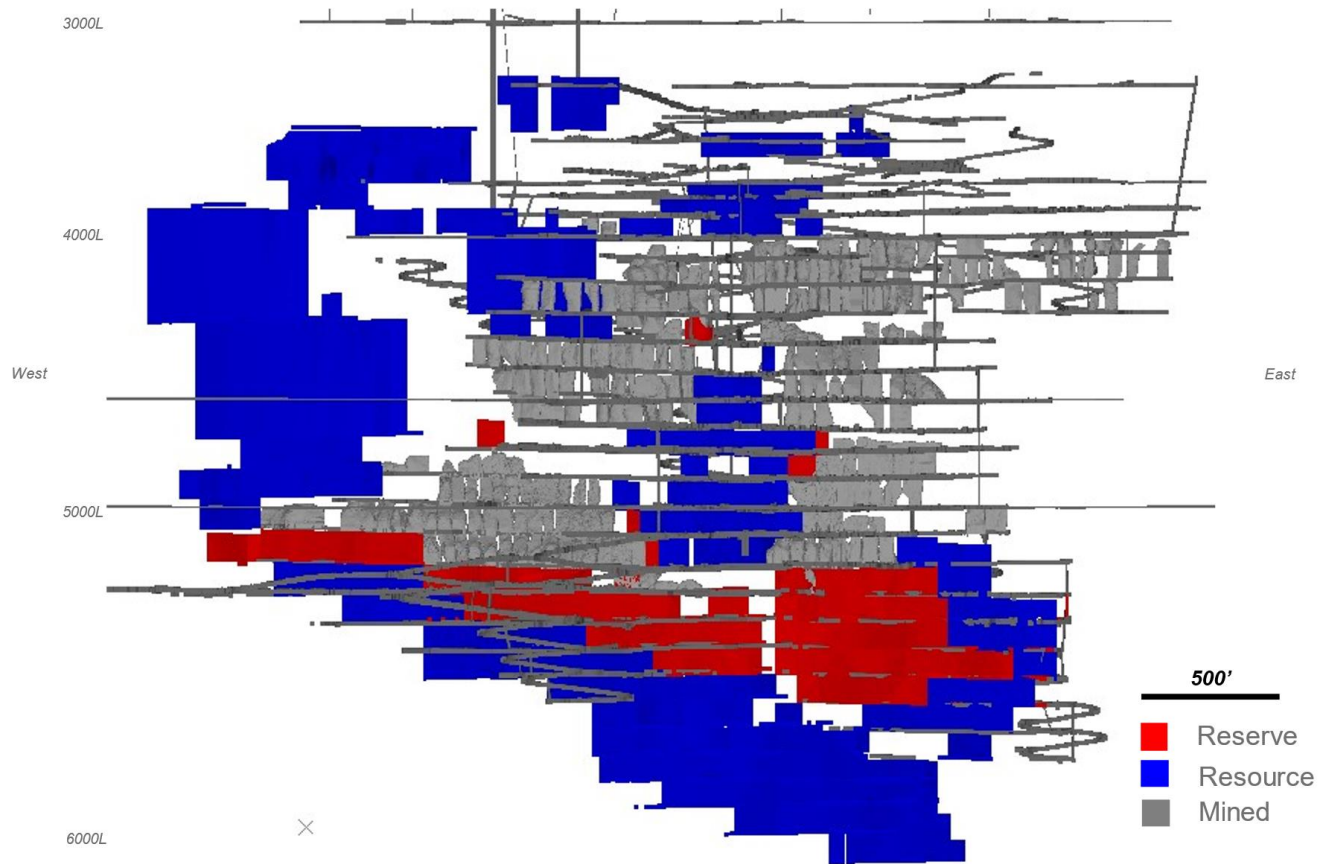
GARSON Main Mine 1 Shear Longitudinal Section Looking North Resources and Reserves



Note: Figure prepared by Vale Base Metals, 2025.

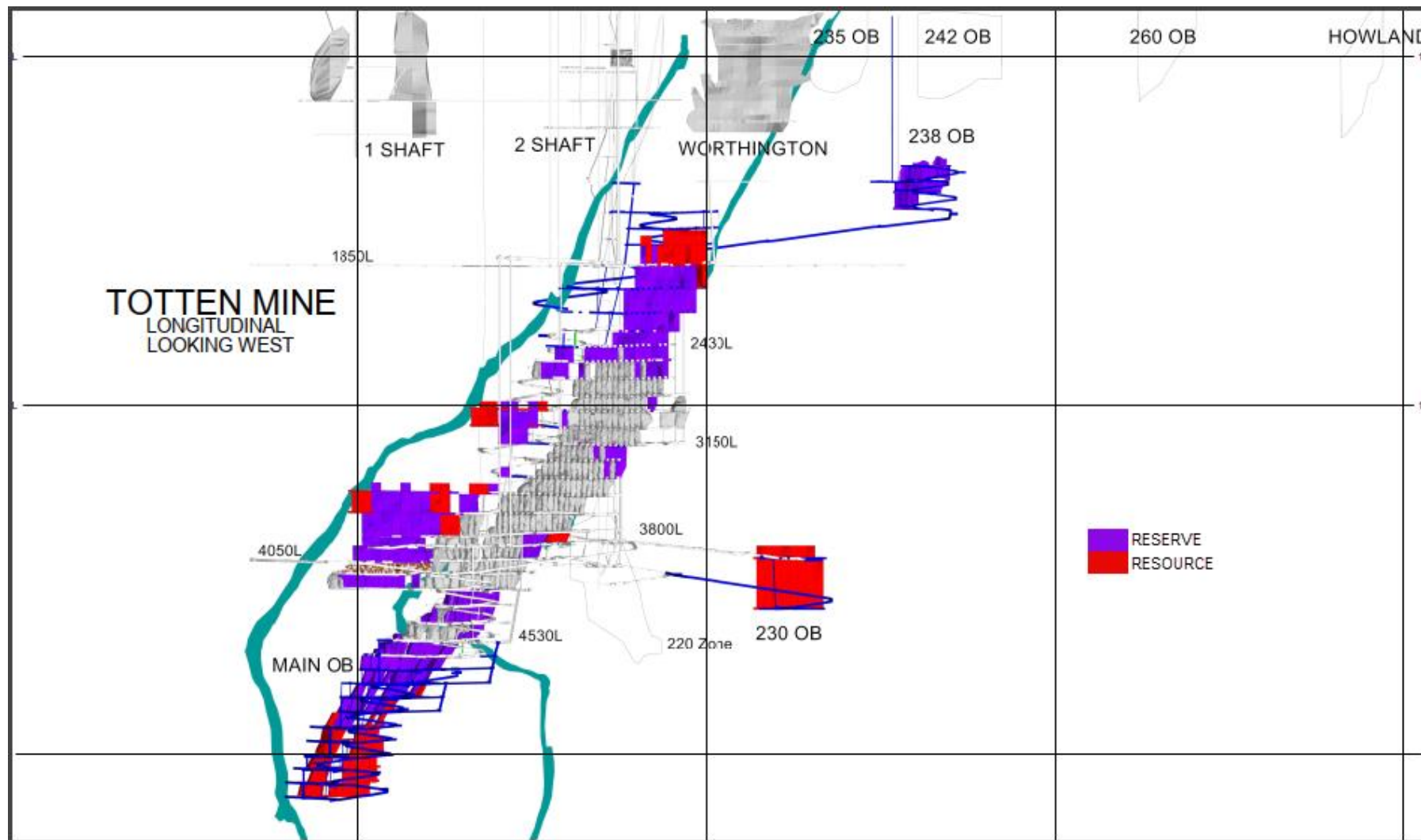
Figure 13-6: Garson Main Mine 4 Shear Long-Section

GARSON Main Mine 4 Shear Longitudinal Section Looking North Resources and Reserves



Note: Figure prepared by Vale Base Metals, 2025.

Figure 13-7: Totten Long-Section



Note: Figure prepared by Vale Base Metals, 2025.

13.7 BLASTING AND EXPLOSIVES

13.7.1 UNDERGROUND

The types of explosives used, and blasting procedures vary depending on the mine, and the mining method.

For blast-hole stoping, 7.6–15 cm diameter blastholes are charged with emulsion while electronic (i-kon) detonators with boosters are used to initiate the blasts.

For mechanized cut-and-fill mining, blastholes typically 4.3 cm diameter by 3.7 m long are pneumatically loaded with ANFO, primed with NONEL-type detonators, hooked up with blasting cord, and initiated with electric caps.

13.7.2 OPEN PIT

Standard patterns for open pits will be drilled with 6" (152 mm diameter) drill bits. Matted patterns (i.e., patterns that will use blast mats) will be drilled with 4" (102 mm) drill bits because this is the maximum size that can be used with blast mats. Explosive product and accessories (boosters, caps, det cord) will be supplied by an explosives manufacturer. Bulk emulsion product will be loaded into blast holes using a mobile manufacturing unit, and no explosive storage or manufacturing on site is envisioned. There is adequate local supply and several explosives suppliers to choose from in the Sudbury area.

Due to the presence of a high-water table and water entering the pit during operations, a bulk emulsion type explosive is planned to be used. Electronic detonators are proposed for all blasts.

13.8 ORE CONTROL

Ore control procedures for underground operations include geological mapping, production blasthole conductivity probing, post-probe block modelling, stope grade calculations, and stope block laser scan (cavity monitor surveys) reconciliations. Vale Base Metals has established standard operating procedures for grade control that are used at all of the underground mines.

Ore control for Stobie Pit include geological mapping, assessment of production blasthole drill hole cuttings, assessment of metal grade estimates for blast control, geologist visual ore/waste sorting of broken material where possible, and bench survey reconciliations.

13.9 ORE AND WASTE HANDLING

13.9.1 UNDERGROUND

Ore and waste handling varies by underground operation.

13.9.1.1 COLEMAN

Ore is transported by LHD equipment and diesel haulage trucks from the primary locations or storages to internal ore passes. From these ore passes, ore is hauled to the muck circuit by 45 t capacity Kiruna electric trolley haulage trucks.

Crushed ore is conveyed from the underground crusher to the Coleman #1 Shaft, where it is hoisted to surface by two 17.2 t skips operating in balance. The shaft has a rated hoisting capacity of 455 t/hr.

On surface, ore is transported by 36 t highway trucks to a load-out at the rail head, for stockpile and rail transportation to the Clarabelle Mill.

Waste rock is used as rock fill in mined-out areas. Rock is therefore re-handled underground and not hoisted to surface, although waste rock hoisting will likely be required in the future due to increased waste development activity and fewer cut and fill areas available for disposal of waste fill.

13.9.1.2 COPPER CLIFF

Ore and waste rock are mucked using LHDs and handled at the North Shaft as follows:

- Muck is initially dumped in central loading areas, where it is subsequently loaded into 27 t trucks;
- Ore is trammed to the 2639 ore pass (on the 2,600 and 3,400 Levels) or dumped directly into the crusher (on the 3,935 Level);
- Crushed ore is hoisted to surface through #1 Shaft in 13.6 t skips that have a capacity of 270 t/hr;
- Ore is then trucked to surface stockpiles for blending with other ore sources to meet milling requirements.

The majority of waste rock is used underground as fill. Some waste rock is hoisted to surface and permanently placed in a formerly producing open pit mine on the property. Currently the two main production constraints are trucking capacity and ventilation requirements.

The following system was commissioned in 2022 for the South #1 Shaft:

- Muck is loaded by LHD into 27 t and 36 t trucks and hauled to the 3,930 Level;
- On the 3,930 Level there is a truck dump with rock breaker and grizzly that feeds a 180 t coarse ore bin, and two storages with 907 t capacity each. A LHD feeds the truck dump between truck loads and operate between shifts (automated from surface) to maintain inventory in the bin. The coarse ore bin feeds a crusher on the 4,000 Level;
- Crushed ore is hoisted to surface through the South #1 Shaft in 16.3 t skips that are rated for 390 t/hr;
- On surface there is a 1,362 t load out bin and 317 t rock bin.

13.9.1.3 CREIGHTON

Production ore is mucked by LHD to internal ore bins or re-muck storage on each of the main production levels. The ore is then chuted loaded, or side loaded in trucks and hauled up a ramp from the ore bins or storage areas, using a mixed fleet of electric trolley and diesel-powered trucks, to the truck dump at the 6,970 Level. Material is fed through the 7,000 Level crusher, and to the 6,680 Level loading pocket, via a conveyor.

The mining operation will extend this system to the 9,760 Level. Each production level will have LHDs move ore and waste to internal ore bins and re-muck storages, and trucks will haul material up a ramp system. The current methodology of dumping, crushing and skip loading on 6,970, 7,000 and 6,680 Levels will continue as is.

The ore hoisted up #9 Shaft uses a 7,000 HP double drum hoist and two 14.5 t aluminum skips. The skipping rate from the 6,680 Level loading pocket is currently 225 t/hr with planned improvements in hoisting speed and capacity increasing the rate to 282 t/hr. Ore from the 118 orebody is trucked via the ramp system at the #3 Shaft from 2600 level to surface. All personnel and materials access the mine via the #9 Shaft cage and the surface ramp at #3 Shaft.

Waste rock brought to the surface by hoist or ramp is processed through the ore system (i.e., crusher, bins, belts etc.) but is directed into a separate chute from the ore once on the surface.

13.9.1.4 GARSON

Ore and waste rock is mucked using LHDs to re-muck storages on each level and side loaded into 45 t (50 ton; common) or 27 t (30 ton; less common) diesel trucks. Ore is hauled up the ramp and dumped into a storage bin from where it is loaded through a chute into rail cars. The ore is then trammed by rail along the 4,000 Level and into another chute feeding a crusher. Crushed ore is hoisted to surface via # 2 Shaft in 10 t skips that have a capacity of 231 t/hr.

The majority of waste rock is used underground as fill, though some hoisting of rock does take place. Waste rock is loaded into 45 t diesel trucks by LHDs and hauled up the ramp and handled through a rock system that is independent of the ore system but uses the same loading pockets and skips as the ore system.

The Garson ramp mining zone hauls ore and waste from underground in 36 t trucks via a ramp to surface for ore crushing and shipment to the mill or disposal. Production ore capacity is approximately 450 t/day.

13.9.1.5 TOTTEN

The main haulage level is the 3,800 Level. An ore pass links the 1,850 Level down to the 3,800 Level. The ore circuit also involves the trucking of material from below the 3,950 Level for dumping into an ore pass on the 3,800 Level. The crusher is located below the 3,850 Level and is ramp accessible. The rock breaker is equipped for remote control operation, and the crusher is automated. Crushed ore is hoisted to surface via 16.3 t skips (over cage arrangement) with a capacity of 272 t/hr.

The waste rock circuit is equipped with truck-loading chutes to transport the waste rock. The waste pass extends from the 3,150 Level down to the 3,800 Level. Waste rock is also hoisted via the skip through a rock handling system that is separate from the ore handling system.

13.9.2 OPEN PIT

The proposed waste rock storage facility that will support Stobie Pit is discussed in Chapter 15.3.2.

13.10 UNDERGROUND INFRASTRUCTURE FACILITIES

13.10.1 MINE MOBILE EQUIPMENT MAINTENANCE

The underground mines use a combination of underground maintenance facilities of varying sizes and capacities. These shop areas are equipped with the necessary tools and equipment to service large industrial rock moving and drilling equipment. Most of the mobile equipment repairs are completed at these permanent facilities while smaller repairs can be done in the field by trained mechanics.

13.10.2 COMMUNICATIONS

The underground mines are equipped with leaky feeder communication in most underground work areas, with all employees being equipped with two-way radios. The surface buildings and underground refuge stations have wired telephones. Underground communications are linked to surface through fibre optic broadband systems. Underground wireless LTE network coverage is now available in most underground workings.

13.10.3 LOGISTICS AND SUPPLIES HANDLING

Mine supplies and personnel (e.g., employees, ground support products, fuel, safety supplies and explosives) are transported underground via the mine hoisting shafts (with the exception of the Garson ramp and Copper Cliff Mine portals). To place the materials in the shaft conveyance they can either be loaded on a timber rail car or be handled with a mobile forklift. Once the material has arrived at the underground destination level it is unloaded from the cage, and eventually brought to underground supplies storage locations with a boom truck or forklift.

13.10.4 VENTILATION

The mine ventilation systems are summarized in Table 13-3.

Table 13-3: Ventilation Systems

Mine	Ventilation Capacity (kcfm)	Ventilation System	Comment
Coleman	1,600	Two fresh air and two return air systems	Currently 400 kcfm of fresh air is supplied to Coleman from the Fraser mine infrastructure. A ventilation changeover at Coleman is planned to mitigate the loss of this fresh air source once Fraiser closes in 2026.
Copper Cliff	3,200	North-side and south-side ventilation supply each consisting of three separate fresh air and return sub-systems	New 860 return air system project in execution now and planned to be online mid-2026
Creighton	1,630	Three parallel fresh air systems; one return air system	Below 8590 Level will have two return air systems (east and west) with one central fresh air system. Will not add more flow to the system but allow the existing capacity to be utilized deeper in the mine. A cooling plant will be constructed on 8400 Level to cool air on 8720 Level and below. Creighton 3 shaft/118 OB will have a new vent system operating by mid-2026 providing an additional 250kcfm.
Garson	1,050	One major fresh air system; four return air systems	The Garson ramp circulates 300 kcfm.
Totten	1,000	One major fresh air system; one main return air system	System capacity increases to a maximum of 1,200 kcfm over the life of mine plan.

13.10.5 COMPRESSED AIR AND PROCESS WATER

Each of the mines uses compressed air and process water for numerous mining related activities such as drilling, dust suppression, and fire sprinklers and to operate some equipment such as pumps, ore-pass gates, and mining equipment. Each plant is structured in a similar fashion to provide compressed air and water services to the mining areas.

Large compressors situated on surface create the necessary air volumes at required working pressures (~80–120 psi). Varying diameter pipes are hooked up to the compressors and are directed underground. A series of pipes then direct the compressed air to all active working areas. In areas where the permanent feed is insufficient or cannot be accessed, free-air compressors are used.

Process water is sourced from suitable surface supplies, groundwater supply or is sourced from recycled process water from the underground workings. Similar to compressed air, the process water supply is delivered underground through a network of pipes that are directed throughout the underground work areas.

13.11 PRODUCTION SCHEDULES

Each underground and open pit mine developed a production schedule that contained production and cost information for every producing area within the mine, based on mineral reserve estimates. Production schedules were limited for the underground mines by process and infrastructure constraints such as ventilation, drift development, blasthole drilling, LHD/haulage, backfilling, and muck circuit/storage. The open pit production schedule (currently only Stobie Pit) is limited by equipment, personnel, mining sequence and available mill capacity. The assemblage of mining process activities is used to derive costs based on historical and budgeted rates. These plans were collated into an overall production schedule for the Ontario Operations. Based on this schedule, the forecast mine life for the mineral reserves is 21 years (2026–2046). The annual production schedule is presented below in Table 13-4 and Table 13-5.

Table 13-4: LOM Production Schedule (2026-2035)

Production	Unit	LOM Total	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
ROM	Mt	69	5	5	5	5	5	5	4	4	3	3
Cu	kt	1064	61	67	67	80	84	64	63	61	55	52
Ni	kt	972	49	52	51	57	60	60	51	50	44	45
Co	kt	22	1	1	1	1	1	1	1	1	1	1
Pt	k oz	2249	124	141	147	161	171	142	126	129	106	117
Pd	k oz	2497	113	127	128	143	179	129	125	147	131	142
Au	k oz	849	38	50	54	64	78	48	52	46	40	44

Table 13-5: LOM Production Schedule (2036-2046)

Production	Unit	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
ROM	Mt	3	3	3	3	3	2	2	2	2	1	1
Cu	kt	51	49	45	47	41	38	34	32	28	27	19
Ni	kt	46	44	46	47	49	47	46	40	36	31	19
Co	kt	1	1	1	1	1	1	1	1	1	1	0
Pt	k oz	128	129	101	98	82	83	61	59	57	49	39
Pd	k oz	172	179	144	128	114	94	80	77	60	49	34
Au	k oz	53	51	44	43	30	26	25	21	17	14	14

*Run of mine (ROM) and contained metal values shown

13.12 EQUIPMENT

13.12.1 UNDERGROUND

Vale Base Metals has a large fleet of mobile equipment consisting of approximately 650 units distributed between the operating mines depending on each mine's operational requirements. The number of units for each mine changes over the LOM as development and production rates and haulage distances vary on an ongoing basis.

The total production and development fleet consists of over 200 units, consisting of production drills, development jumbos, LHDs, haulage trucks, and specialty vehicles to load explosives.

Drilling equipment is selected to suit the mining methods with bulk mining; down-hole drill units being the most predominant blasthole drilling equipment. The in-the-hole (ITH) drills use booster compressors to provide high pressure compressed air for higher penetration speeds and typically drill production blastholes of either 11.4 cm or 15 cm diameter. For up-hole blastholes, electric hydraulic top-hammer drill rigs are used typically drilling 8.9 cm diameter blastholes. For mechanized post-pillar cut-and-fill mining, two-boom electric hydraulic drill jumbos are used, and for narrow-vein cut-and-fill, one-boom jumbos are used. Specialized vehicles are used to load either ANFO or emulsion-type explosives.

Loading equipment includes both 7.2 t and 9 t capacity LHDs, although Totten has some 5.4 t units. Smaller 2.3–3.2 t LHDs are used as utility vehicles in all the mines.

Haulage equipment includes 27 t, 36 t, and 45 t capacity haulage trucks. Coleman Mine has six 45 t capacity electric trolley trucks working on a truck-priority haulage ramp.

The support equipment fleet consists of over 430 units including rockbolters, scissor lifts, shotcrete sprayers, shotcrete and cement transporters, mobile rock breakers, utility trucks with hydraulic lifting booms, graders, rail locomotives and rail ore cars, backhoes, personnel vehicles including small tractors, personnel carriers, and other trucks used for transporting materials such as fuel trucks.

13.12.2 OPEN PIT

Mining equipment for Stobie open pit was selected based on production requirements set out in the mine schedule. This involved equipment matching procedures and calculation of productivities for loading and hauling equipment.

The mine plan incorporates a mixed ore and waste rock haulage fleet. The haulage fleet will consist of a mix of 60 tonne and 100 tonne rigid-frame haul trucks.

A mixed digging fleet of face shovels, front-end-loaders, and excavators, with buckets ranging from 7.5–22 yd³ (5.7–16.8 m³) is used. The drill and blast plan requires a mixed fleet of drill rigs with larger drills with 6-inch (15 cm) drill bits and smaller drill rigs with 4-inch (10 cm) drill.

Support equipment will include track-type dozers, rubber-tire dozers, graders, water trucks, fuel lube trucks, cable reeler, tire manipulator, tractor-trailer lowbed, crew cab pickups, maintenance trucks, utility backhoe, and forklifts.

13.13 PERSONNEL

A total of approximately 4,000 personnel support the Ontario mining operations.

14 PROCESSING AND RECOVERY METHODS

14.1 PROCESS METHOD SELECTION

The process plant design was based on a combination of metallurgical testwork and familiarity gained during historical processing. Clarabelle Mill was originally built in 1971 and subsequently underwent a number of major modifications. The hourly design throughput of the plant was based on a yearly throughput of approximately 7 M tonnes. The utilization calculation was based on an assumption that the plant would operate 350 days per year, with an availability of 92%, for a net utilization of 88.2%. In 2017, the crushing plant and rod mill circuit was put on care and maintenance, and the Clarabelle Mill became a SAG-only operating plant. The yearly throughput based on SAG-only operation is approximately 5.5 Mt. In 2026, the crushing plant and rod mill circuit will be brought back online with a target production of 6.2 Mt.

At the concentrator, the ore is crushed and ground and fed to the froth-flotation cells. The multi-staged froth flotation separates the sulphide minerals into a nickel concentrate and a copper concentrate. The tailings are disposed of in tailings ponds. The nickel concentrate typically averages 11% Ni and 4% Cu. The copper concentrate typically averages 31.5% Cu and 0.4% Ni. The Clarabelle Mill is operated in such a way to place as much copper into the saleable copper concentrate as possible, then recover remaining copper and maximum possible nickel into a high-grade nickel–copper bulk concentrate to maximize the product NSR values.

The copper concentrate is dewatered by two pressure filters and shipped to market buyers. The nickel–copper bulk concentrate is dewatered at the smelter, and upgraded to Bessemer matte by processing through fluid-bed dryers, flash furnace, and Pierce–Smith converters. The magnetic metallics (containing nickel, copper, and precious metals) are sent to the Copper Cliff Nickel Refinery. The nickel sulphides are roasted in a fluid-bed roaster to produce nickel oxides which are then sent to the Copper Cliff refinery in Ontario, or the Clydach Refinery in Wales.

The Copper Cliff Nickel Refinery complex includes three areas: nickel refinery converter (NRC), Inco pressure carbonyl (IPC) and electrowinning (EW). Nickel sulphides and oxides from the smelter complex and other feeds are blended and fed to top blown rotary converters, which produce a high-grade nickel matte. This matte is granulated, dried, and fed into one of three carbonylation reactors in the IPC, where nickel and trace iron are extracted by reaction with carbon monoxide. The mixture is separated into a pure nickel carbonyl stream and an iron/nickel carbonyl stream. Material from both streams is decomposed at high temperature to produce pure nickel pellets, pure nickel powders and ferro-nickel pellets, which are sold directly to market. The residue left in the reactor, high in copper, cobalt and precious metals, is ground and pumped to the EW plant as a slurry.

In the EW process, copper is removed from IPC residue. Copper cathodes are plated from solution and sold to market. Three other products are made at EW: a nickel–cobalt carbonate slurry, a slurry-rich in precious metals containing platinum-group metals, silver and gold and a slurry enriched in platinum-group metals and selenium–tellurium. These are sent to the Port Colborne Refinery for further processing.

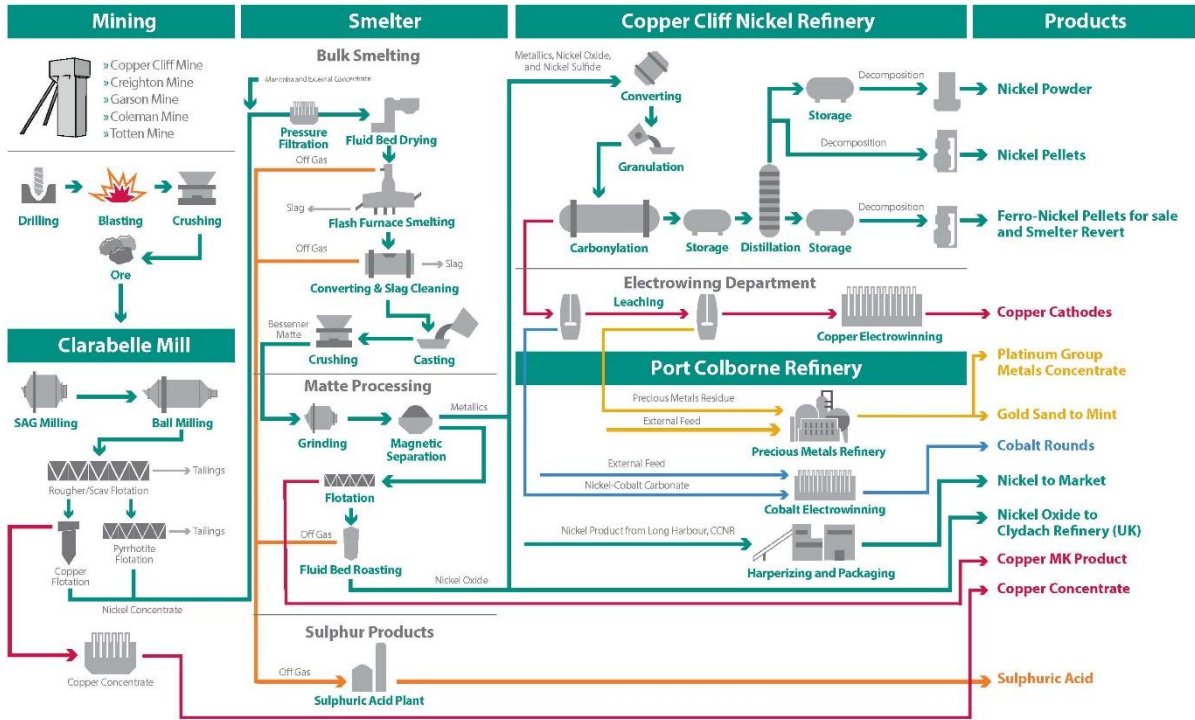
14.2 PROCESS PLANT

14.2.1 FLOWSHEET

An overview of the process flowsheet from the mill to smelter and refinery is provided in Figure 14-1. A simplified process flowsheet is included as Figure 14-2 and Figure 14-3.

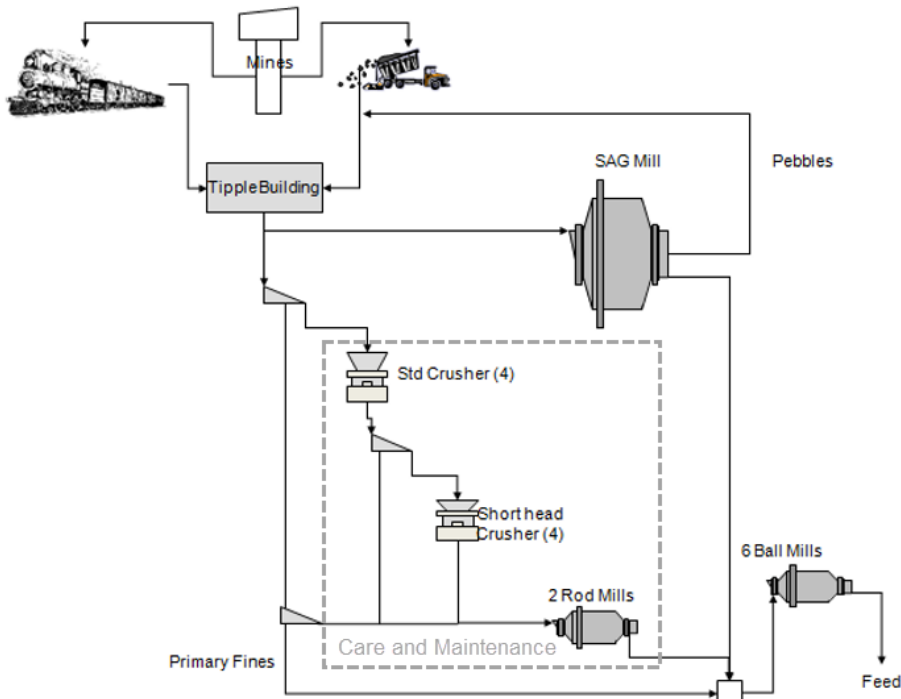
Figure 14-1: Process Overview Flowsheet

Ontario Operations Flowsheet



Note: Figure prepared by Vale Base Metals, 2020.

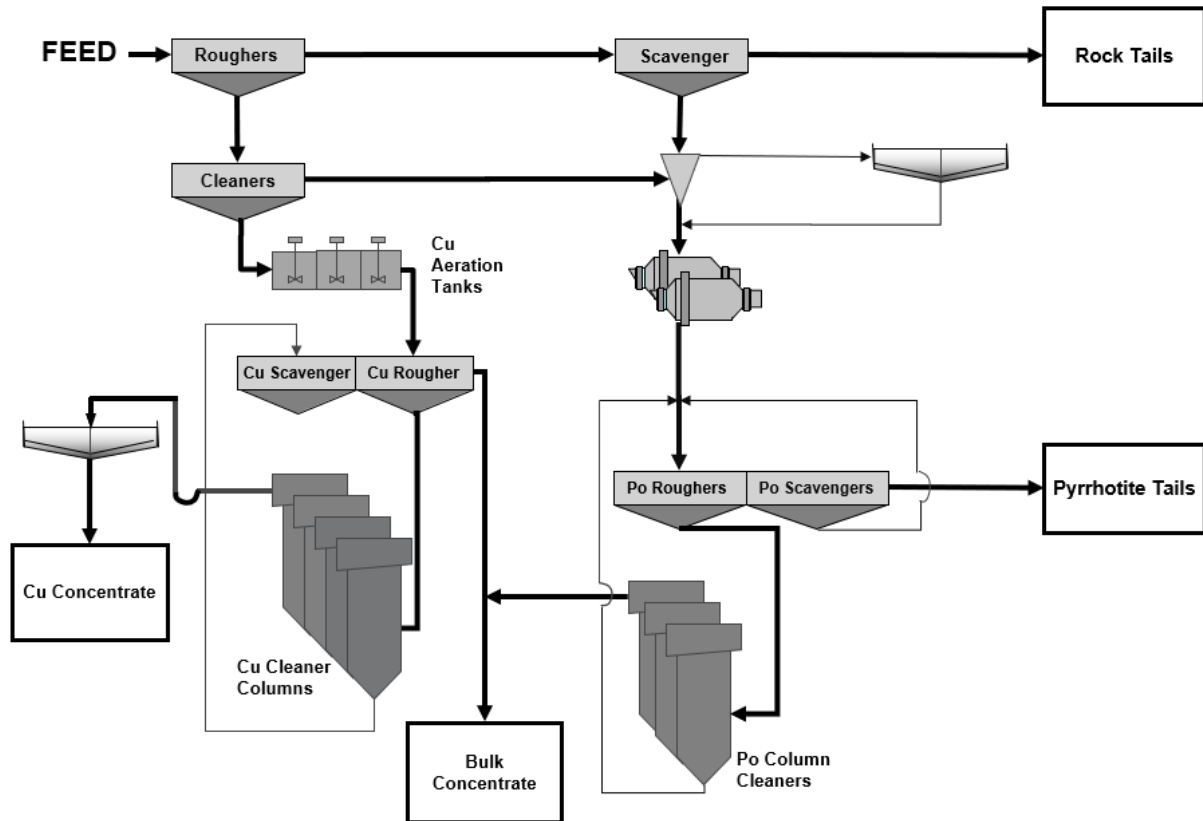
Figure 14-2: Simplified Comminution Flowsheet



Note: Figure prepared by Vale Base Metals, 2024.

Figure 14-3: Simplified Flotation Flowsheet

Flotation Flowsheet



Note: Figure prepared by Vale Base Metals, 2026. Po = pyrrhotite.

14.2.2 PLANT DESIGN

Ore is transported from the Ontario Operations mines and third-party feed suppliers by rail and truck to the Clarabelle Mill where the material is blended. From the tipple building, feeders send the material along one of two comminution paths:

- Circuit 1: Ore feeds the semi-autogenous grind (SAG) mill where ore is ground with added water. Discharge passes through a trommel; coarse trommel oversize material is transferred back to the tipple building by conveyor, while the trommel undersize is pumped to vibrating screens located near the feed of the SAG mill. Screen oversize is fed back into the SAG mill while the screen undersize is pumped to the ball mill feed distribution pumping system;
- Circuit 2: Material from the tipple building is fed into a fine crushing circuit. This circuit consists of primary screening, four secondary (in closed circuit with screens) and four tertiary crushers. Product from this circuit feeds two rod mills. This circuit has been in care and maintenance since 2017 and is planned for restart in 2026.

Product from both primary grinding circuits (SAG and rod mills) feeds the ball mill feed distribution system, which can send slurry to the cyclone feed pumpboxes of six ball mills. Each ball mill in combination with its own cyclone system grinds the material to a target of 80% passing 150 µm (106 µm for sulphides). Once the material is ground to the correct size, the slurry is sent to flotation.

Material entering flotation passes through the rougher circuit which recovers most of the copper and a high proportion of the nickel to a mixed bulk concentrate. This concentrate is sent to the rougher cleaners. Rougher-cleaner tails material is sent to the pyrrhotite separation circuit via the pyrrhotite

regrind circuit. Rougher–cleaner concentrate is sent to the copper roughers which in turn provide a concentrate to the copper cleaners. The copper cleaners produce a saleable copper concentrate while the tails from the copper cleaners return to the copper roughers. The copper rougher tails are a mixed high-grade nickel–copper concentrate which is sent to the Sudbury smelter complex for further processing.

The rougher tails are processed in the scavengers. These produce a scavenger concentrate and a final rock tailings that can either be sent to a mine backfill plant or to the TSF. The scavenger concentrate is sent to cyclones which separate out a coarse fraction and a fine fraction which is then thickened and recombined with the coarse fraction.

This dewatered scavenger concentrate is combined with the rougher–cleaner tails and sent through a regrind circuit. The product of the regrind is sent to the pyrrhotite roughers and scavengers. The pyrrhotite rougher concentrate is cleaned through cleaning columns and joins the high-grade nickel–copper concentrate being sent for processing to the smelter complex. The pyrrhotite scavenger concentrate is recirculated to the head of the pyrrhotite feed. The pyrrhotite tails are sent to the TSF for disposal.

In total, two concentrate products and two tailings streams are produced. The two different concentrates reporting for sale or to the smelter are:

- A high-grade copper concentrate grading approximately 31.5% Cu and 0.4% Ni;
- A nickel–copper concentrate grading approximately 4.0% Cu and 11% Ni.

The tailings (rock and pyrrhotite) contain most of the gangue minerals, and report to either a mine backfill plant or the TSF.

The copper concentrate is sold to market while the nickel–copper concentrate is dewatered, mixed with custom concentrate feed and high-grade silica flux, and conveyed to the smelter.

14.2.3 PLANT CAPACITY

Current Annual Capacity: 5.5Mt run of mine feed per year using SAG only

Planned Annual Capacity: 6.2Mt run of mine feed per year using SAG with crushing plant and rod mill circuit, which are planned to be brought online in 2026.

14.2.4 EQUIPMENT SIZING

The key equipment in the Clarabelle Mill is summarized in Table 14-1.

Table 14-1: Key Equipment, Clarabelle Mill

Area	Equipment	Number	Note	Comment
Ore discharge	Holding bin	1	22,700 t	Ore is received at -6 inch (-152 mm)
	Conveyor belts	2	1.22 x by 579 m	
	Coarse ore bin	1	2,270 t	
SAG circuit	SAG feed bin	1	8,000 t	
	SAG mill	1	9.75 m by 4.11 m	The SAG mill processes 785 st/hr (700 t/hr) ore on average, net of pebble production. Control of the SAG mill is through a Foxboro DCS. The mill employs a SAG APC system (Andritz ACE) for process control.
	Ball size		127 mm	
	Mill speed		8.0–10.8 rpm	
	Critical speed		79% max	

Area	Equipment	Number	Note	Comment
	AC drive motor	2	4,100 kW variable speed	
	Shell liners		76 mm by 330 mm with integrated lifters.	
	Discharge grates		51 mm slots with an open area of 0.16 m ²	
	Rubber panels		16 mm by 51 mm slots.	
	Pebble bin		363 t	Approximately 12% of the SAG mill feed is removed as pebbles.
	Tramp metal magnetic separator	2		
	Double-deck, vibrating screens	2	2.43 m by 7.31 m	The upper polyurethane deck has 0.25 inch (6 mm) wide slots while the lower deck has 0.125 inch (3 mm) wide slots.
Ball mill grinding circuit	Ball mill	5	4.11 m by 5.49 m	SAG feed is distributed to any one of five ball mills via a six-way pressurized distributor. Targets P80 of 150 µm. Particle size is analyzed by an on-stream, particle size monitor
	Ball size		63 mm	
	Mill speed		17.3 rpm	
	Critical speed		83%	
	Motor		1,492 kW	
Primary flotation circuit	Cyclones	5	0.051 m	Operated in closed circuit.
	Rougher flotation cells	2 parallel banks of 5	100 m ³ tank cell volume	Total 1,000 m ³
	Scavenger flotation cells	6 parallel banks of 8	38 m ³	Total 228 m ³
Copper circuit	Rougher cleaner	2 banks of 7 cells	20 m ³ tank cell volume	Total 280 m ³
	Conditioning tanks			
	Copper rougher	Nine 20 m ³ flotation cells		
Copper concentrate dewatering and storage	Copper cleaner	Four columns		The number of columns in operation at any given time is driven by the amount of copper concentrate recovery required to obtain the desired Cu:Ni ratio in final nickel concentrate based on the smelter needs.
	Thickener	dia. 28.2 m		
	Filter presses	Two	Larox vertical filter presses	

Area	Equipment	Number	Note	Comment
Pyrrhotite regrind circuit	Regrind mills	Two	Two 4.11 m x 5.49 m ball mills. 1,492 kW motor. Operate at 83% of critical speed.	Closed circuit. Product grind target of P80 of 60 µm
		Cyclones	One ball mill has a nest of seven 0.13 m cyclones and the other has 16 0.25 m cyclones	
		One	Isamill	Open circuit
		Cyclones	Nest of six 0.38 m cyclones	
Pyrrhotite rejection circuit	Rougher flotation tank cells	2 rows	Each with three 100 m ³ cells	
	Scavenger flotation tank cells	2 rows	Each with two 100 m ³ cells	
	Cleaner columns	3	4.5 m diameter	
Concentrate dewatering & storage	Thickeners	4	33.5 m	
	Concentrate storage tanks	4		Provide concentrate surge capacity between the mill and the smelter when there is an imbalance between what the mill produces and what the smelter can take in as feed
Water treatment plant	Clariflocculators	2	41.1 m	

14.2.5 POWER AND CONSUMABLES

The power consumption for the Ontario Operations is described in Chapter 15.9.

14.2.6 PERSONNEL

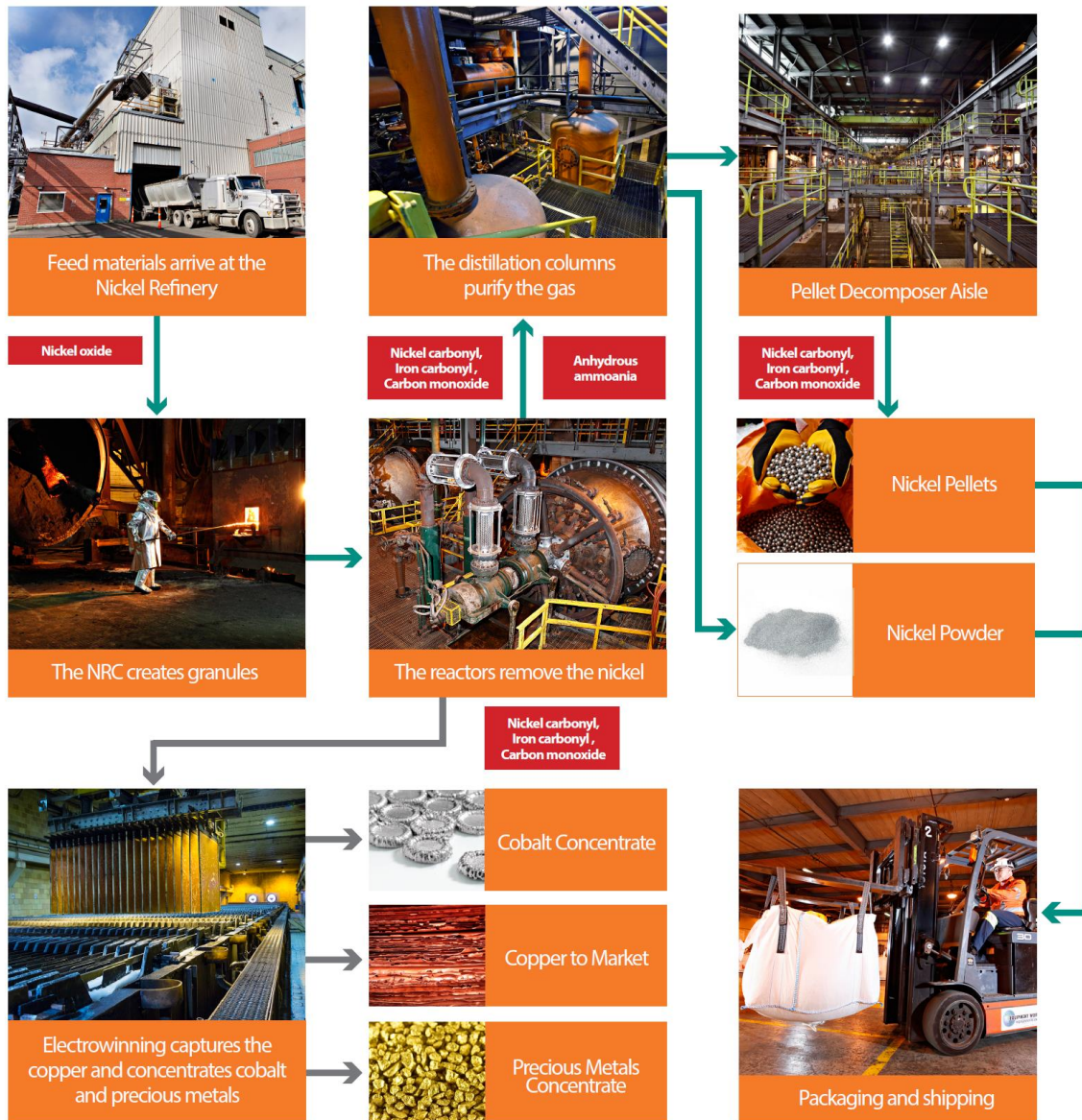
Approximately 200 persons are employed at the Clarabelle Mill, the tailings area, and the water treatment plants.

14.3 REFINERY/SMELTER

14.3.1 FLOWSHEET

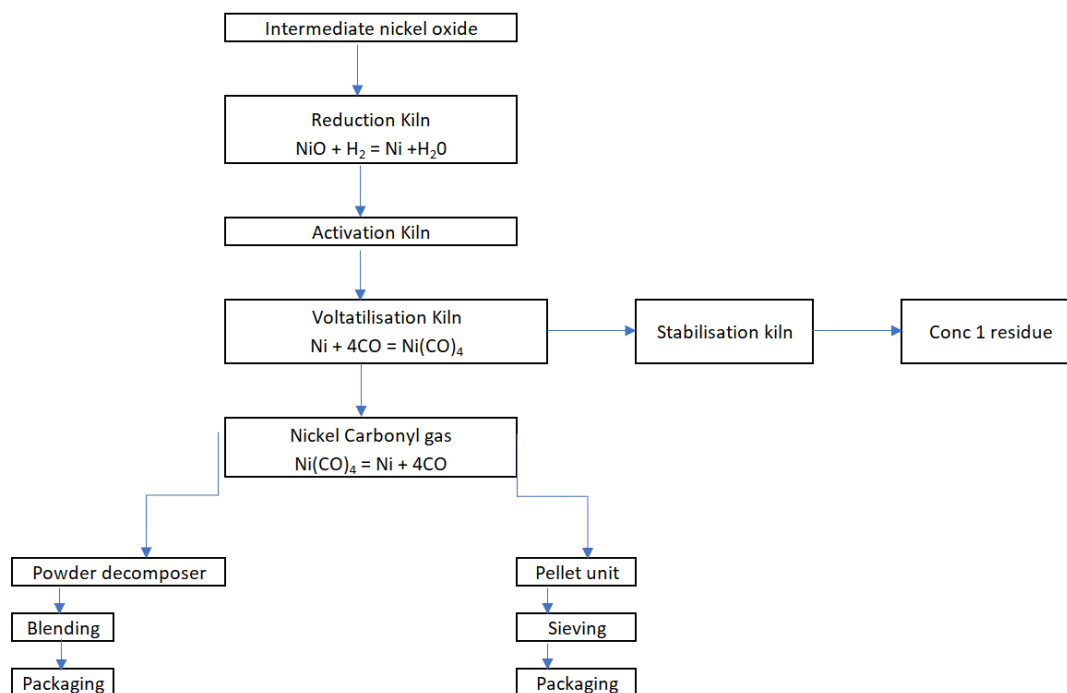
A simplified process flowsheet for the Ontario Operations was included as Figure 14-1. An illustrated schematic of the flowsheet for the Copper Cliff Nickel Refinery is included as Figure 14-4. Figure 14-5 is a simplified flowsheet for the Clydach Refinery.

Figure 14-4: Schematic Flowsheet, Copper Cliff Nickel Refinery



Note: Figure prepared by Vale Base Metals, 2020.

Figure 14-5: Simplified Flowsheet, Clydach Refinery



Note: Figure prepared by Vale Base Metals, 2021

14.3.2 DESIGN

14.3.2.1 COPPER CLIFF SMELTER

Bulk concentrate is sent from the Clarabelle Mill to the Copper Cliff Smelter. The concentrate is dewatered in a filter plant. The 20 wt% Cu–Ni–Co concentrate is fed to an INCO flash furnace, and is blown with oxygen burners located on opposite end walls of the vessel. Silica is added as a flux to ensure immiscibility of nickel sulphide-rich matte and iron oxide-based slag. Once the target matte level is reached the matte is tapped and sent to converters. The furnace slag is removed, and sent to a slag storage facility. Sulphur dioxide from the flash furnaces, converters, and fluid bed roasters is fixed and sold as sulphuric acid.

Removal of the remaining iron in the matte is accomplished by the use of Peirce-Smith converters. Charging of the converter occurs when matte is poured into the vessel through an opening in the top. The molten matte is blown with oxygen-enriched air to remove the remaining iron and silica flux is added to produce a slag. Sulphur dioxide is generated during the process. The converter slag is skimmed and returned to the flash furnace to recover oxidized cobalt and nickel prior to disposal. The Bessemer matte produced in the converter is subsequently cast into moulds and slow-cooled to produce a coarse crystal structure. The Bessemer matte is crushed, ground, and separated into metallic, nickel sulphide and copper sulphide materials by magnetic separation and flotation in a matte separation plant.

Consumables in the process plant include grinding media, frother, sodium cyanide, flocculant, lime, xanthate, electrical materials, lubricants, and maintenance supplies.

Water for process and potable needs is sourced from the Vermilion River, or is recycled from the plant. Average water consumption is approximately 327,000 m³. This level of water consumption is projected to remain approximately the same for the duration of the LOM.

All of the precious metal-bearing metallic material is sent to the Copper Cliff Refinery. The nickel sulphide is roasted in fluid bed roasters. The resulting nickel oxide is processed in the Copper Cliff refinery and the Clydach Refinery. Sulphur dioxide from the roasters is fixed as sulphuric acid.

Copper sulphide from matte separation is filtered and sold to market.

The current annual plant capacity is 792,000 dry smelter charge tonnes. There are no planned changes to capacity in the current LOM plan.

14.3.2.2 COPPER CLIFF NICKEL REFINERY

There are three main facilities at the Copper Cliff Nickel Refinery: the nickel refinery converter plant, the Inco pressure carbonyl plant, and an electrowinning building.

At the nickel refinery converter plant, feed input (nickel sulphide crudes, nickel–copper metallics, nickel oxides, precious metal-bearing intermediates and refinery intermediates, and fluxing agents) are charged into two top blown rotary converters, and melted using natural gas-oxygen lance burners. Once the temperature of the bath has reached approximately 1,600°C, petroleum coke is added to reduce the oxygen content. High-pressure oxygen is occasionally blown into the bath to desulphurize it if the sulphur content is too high. The melted product is transferred to a teeming ladle and poured through high velocity water jets to granulate the product. The resultant granules are dewatered, dried in a gas-fired kiln, and conveyed to the Inco pressure carbonyl plant.

At the Inco pressure carbonyl plant, the granules are batch-reacted with carbon monoxide in three 150-t rotating reactors. Nickel and iron are extracted as carbonyl vapours, while copper, cobalt, precious metals and other impurities are retained in the residue. This residue is milled and pumped to the electrowinning plant. The nickel and iron carbonyl vapor is distilled in two parallel vertical distillation columns; nickel carbonyl separate and rises to the top of each column while iron carbonyl settles at the bottom of each column.

At the electrowinning building, the Inco pressure carbonyl residue is treated in a first stage metathetic acid leach circuit to remove nickel, cobalt, iron, arsenic, and other minor element contaminants. A second stage oxidative leaching circuit is used to dissolve copper, selenium, and tellurium from the first leach solid residue. The second stage slurry is filtered and the residue is sent to the Port Colborne Refinery to extract the precious metals. The filtrate is pumped into tanks and an electrical current is applied through titanium cathodes and lead anodes. The copper plates onto the cathode over a two-week period. The copper sheets are removed from the cathodes and sent to market. The first stage leach solution is fed to the iron/arsenic removal circuit and then through a copper clean-up circuit. The nickel and cobalt are precipitated from the solution with soda ash. The resultant carbonate stream is thickened and sent to Port Colborne.

The current annual plant capacity is 65,000 nickel tonnes from the nickel refinery and 9,000 copper cathode tonnes from electrowinning. There are no planned changes to capacity in the current LOM plan.

14.3.2.3 CLYDACH REFINERY

Nickel oxide feedstock is continuously fed into a reduction kiln where it is tumbled in a stream of hydrogen, the reduced feed is then fed to the activation kiln. The activated nickel matte is sent to a volatilisation kiln, where the nickel reacts with carbon monoxide to form nickel carbonyl gas. The nickel carbonyl gas is piped to an adjacent plant for thermal decomposition into pure nickel pellet or powder.

To produce powder, the nickel carbonyl gas is injected at a metered rate into the top of eight decomposer towers, each 10 m high and 2 m in diameter. The walls of the towers are heated. The gas decomposes instantly to form nickel powder which settles at the bottom of the unit. The nickel powder is collected, blended for uniformity, screened, and packaged for sale.

When nickel carbonyl gas is heated in a pellet unit, it decomposes to form nickel metal and CO gas; this occurs when the gas comes into contact with hot nickel pellets. Nickel pellets grow in size each

time they pass through a reactor (approx. once every 30 minutes). Once they reach saleable size, they are collected via a make screen. The nickel pellet is collected, sieved, and packaged for sale.

The current annual plant capacity is 44,125 nickel tonnes. There are no planned changes to capacity in the current LOM plan.

14.3.2.4 PORT COLBORNE REFINERY

The Port Colborne Refinery is an electro-cobalt refinery and precious metals upgrading facility.

In the precious metals upgrading facility, slurry feed shipments of residues or process intermediates are received from the Sudbury Operations. The facility also processes toll materials from third-parties. The refinery is a hydrometallurgical process that uses several oxidative and reductive reaction steps along with acidic and basic leach steps to selectively remove impurities and purify targeted metals in each step. Base metals are precipitated and recycled back to Sudbury. Fiberglass and stainless-steel tanks are typically used as reaction vessels along with settlers and filters for liquid solids separation. The process produces gold, silver, and platinum group metal concentrate products for external customers. In addition, tellurium dioxide, selenium, bismuth, and lead carbonate are produced as by-products that are sold to market.

In the electro-cobalt refinery, slurry feed is received from the Copper Cliff Nickel Refinery that contains nickel, cobalt carbonates, and other impurities. This slurry is dissolved with sulphuric acid and then pH adjusted with soda ash. The mixture is filtered to remove calcium and iron along with other metals. The solid phase is rejected and liquid phase is sent through several other purification steps including copper ion exchange, and zinc ion exchange. The remaining liquid containing purified cobalt and nickel is treated with sodium hypochlorite to separate the cobalt from the nickel. The remaining nickel solution is treated with soda ash producing a nickel carbonate precipitate which is sent in slurry form to the fluid bed roasters at the Copper Cliff Smelter. Cobalt hydrate is precipitated, filtered, and sent to the electro-cobalt refinery building.

In the electro-cobalt refinery, the cobalt hydrate feed is subjected to additional purification through ion exchange, settling and filtering. Soluble cobalt contained in acidic liquor is pumped into plating cells containing cathodes and a sacrificial lead anode. Metallic cobalt is electrolytically deposited onto mandrels. Several hundred cobalt disks form on each mandrel to a size of about three centimetres in diameter. Once removed from the mandrel, the rounds are polished, degassed in an electrically heated kiln and packaged for market in 250 kg drums.

Nickel products are received from Vale Base Metals operations, including the Ontario Operations. Nickel rounds go through a sulphuric acid dip for cleaning followed by screening, a water rinse and polishing. Nickel pellets, disc, and rounds are also received in bulk containers for repackaging. The products are packaged into 10 kg bags, 250 kg drums or tonne bulk bags for shipment to market.

The current annual plant capacity is 1,500 tonnes of cobalt rounds. There are no planned changes to capacity in the current LOM plan.

14.3.3 EQUIPMENT SIZING

Key equipment sizes for the Copper Cliff Smelter are provided in Table 14-2, for the Copper Cliff Nickel Refinery in Table 14-3, for the Port Colborne Refinery in Table 14-4, and for the Clydach Refinery in Table 14-5.

Table 14-2: Equipment List, Copper Cliff Smelter

Item	Number	Size/Model	Manufacturer/Make
Pressure filters	4		FL Smidth
Flash furnace	1		Hatch Eng. - Inco type
Pierce–Smith converters	2	13' x 45'	Anmar – Peirce–Smith converter
Slag cleaner	1		Howden Parsons (Howden Buffalo). Currently not in use
Main aisle overhead cranes	3	Two x 65/20 ton; one by 65/15 ton	Virginia Crane 65/20 ton; Dominion Engineering
Casting building overhead crane	2	65/15 ton	Dominion Bridge
Casting building crushers	3	Traylor crusher, 48" x 66" jaw; GG crusher, 48" x 15" jaw; Symons crusher	Gatex Fuller; B & D Manufacturing; Nordberg (Metso Minerals)
Rod mill	2		Metso Minerals
Ball mill	5		Metso Minerals
Recleaner column	2		Eriez
Flotation cell	16 cells in 4 banks		Denver
Fluid bed roaster	2		
Acid plant blowers	2		AC compressor
Plant compressor	19	air, oxygen, nitrogen	Ingersoll Rand; York; Delaval; Joy Electrical Company; Sulzer Ltd.
Plant separator	1	Oxygen	Peerless Pump Company
Plant regenerator	1	Nitrogen	

Table 14-3: Equipment List, Copper Cliff Nickel Refinery

Area	Item	Number	Size/Model	Manufacturer/Make
Converter		2	50 Ton Kaldo	Davy Ashmores
Granulation	Dewatering bin	2	15'-6" I.D. Cone x 15'-3" High	ASH Fluid Transport
	Granulation rotary dryer	1	Model: 502-32 / Size: 5'-1 1/4" I.D. x 31'-1 1/2" LG	FMC Technologies
	Granulation sluice	3	22'-7 1/8" LG x 3'-0" Wide	Div Shops
	Thickener	1	Model: 3900	Parson Corporation
	Granulation cooling tower	1	Series 15 #457-202	Marley Canadian Limited
Nickel refinery converter	Top blown rotary converter baghouse	2		
	Stack	1		
Inco pressure carbonyl	Inco pressure carbonyl reactors	3		
	Distillation column	2		
Overhead cranes	75 ton main aisle crane	1	6754/ 75T main hoist /15T aux hoist, 4 girder hot metal crane, 55ft span ; Rerated to 75T from 65T in 1974	Alliance Machine Company
	EW 8T Crane	1	8T Crane, Class D Rerated to 8T from 6T in 2009	Provincial Crane Division
	IPC 20T Pellet Crane	1	DL-DMR-3, 55ft span, 65ft lift	Shawbox
	MGC 10T Crane	1	DL-DMR-2, 52'-6" span, 35ft lift	Shawbox
Main gas compressors	CO reciprocating Compressors	3	5HHE 5MGC, 5083	Ingersoll Rand
Pellet and powder decomposer	Pellet Decomposer units	18	43500,Rex ChainBelt Shop Code: 682	Rex Chainbelt Canada Limited
	Powder decomposer	10	28'-0" ft long x 6'-6" I.D.	Shell unknown, heating: EW Playford Company Limited
Electrowin cells, rectifiers	Concrete T and L sections	48T, 2L	Precast 'T' and 'L' concrete panels	Fisher Wavy Inc.
	Composite liners	49	FRP Cell Liners	Chemposite INC
	Tankhouse rectifier	1	45KA 150VDC	ABB

Table 14-4: Equipment List, Port Colborne Refinery

Area	Item	Number	Size/Model	Manufacturer/Make
Cobalt hydrate	North feed receiving tank	1	H: 30', dia: 13'6"; capacity 121,576 L	Troy
	South feed receiving tank	1	H: 30', dia: 13'6"; capacity 121,576 L	Troy
	Slurry leach tank	3	H: 10, dia: 8'; capacity 12,800 L	Mak Enterprises
	Leach-polish feed tank		H: 28', dia:12'; capacity 72,000 L	Ceilcote Canada Ltd
	Nickel solution tank 1	1	H: 30', dia: 12'; capacity 72,000 L	Precisioneering Ltd
	Nickel solution tank 2	1	H: 28', dia: 12'; capacity 60,000 L	Precisioneering Ltd
	Cobalt precipitation tank	2	107,530 L capacity each	
	Cobalt hydrate settling tank	3	approx. 30' x12'	Precisioneering Ltd
	Nickel sol surge tank	2	H: 30'; dia: 8',	Precisioneering Ltd
Cobalt ECR	Cobalt hydrate surge tank	2	H: 20', dia: 16'; capacity 98,410 L	Protective plastics ltd
	Leach Tank A	1	H: 15', dia: 13'; capacity 52,333 L	Scepter Manufacturing
	Leach tank B	1	H: 15', dia: 13'; capacity 52,333 L	Scepter Manufacturing
	Leach tank C	1	H: 15', dia: 13'; capacity 52,333 L	Scepter Manufacturing
Precious metals recovery	Screw conveyor	1	AGCL/SiO ₂ Fltr Dchrg, 40-9	Perrin
		1	SiO ₂ FltrDchrg, 70-20, 2FI,	
	Scrubber	1	Process vacuum circuit, 90-1-CT	
	Scrubber	1	Process SO ₂ ventilation circuit, 90-2-CT	
	Tank	1	OPM Tank, 20-9.1-TK, 2FI	
		1	Copper surge, 20-20-TK	
1		Cu/Ni precipitation, 20-12.2-TK		
Nickel processing	Conveyor	1	East speed belt	
	Line conveyor	1	Palletizer infeed	
	Line conveyor	1	Palletizer eject	
	Line conveyor	1	East incline	
	Line conveyor	1	Magnetic	
	Line conveyor	1	Air, Gardner Denver,	
	Line conveyor	1	Escalator, #2	
	Line conveyor	1	Reject &test weigh	
	Line conveyor	1	Reversing	
	Line conveyor	1	South squares	
	Tank	1	Acid dip tank, Ni processing	

Table 14-5: Equipment List, Clydach Refinery

Area	Item	Number	Size/Model	Manufacturer/Make
Process gas plant	Recycle hydrogen compressor	3	Capacity 45 m ³ /hr: motor 4 kW	The Bryan Donkin Company Ltd.
	Start-up circulating compressor	1	Capacity 120 m ³ /hr: Power 37.1 HP	Reavell & Co. Ltd.
	Vaporiser	2	External dimensions 2.4 x 2.4 m mounted on 2.5 m legs. Topped with a 3.8 m cone tapering to a 25 m long 70 mm flue.	Unknown
	Desulphuriser	2	14 m high x 1.5 m diameter. Stainless steel clad.	Old Park Engineering Ltd.
	Reforming furnace	2	4 x 4 x 10m. 10 reforming tubes	Power-Gas Corporation Ltd.
	Benfield solution absorber	1	33 m high x 660 mm ID	Danks Of Netherton Ltd.
	Benfield regenerator	1	36 m high x 1.4 m ID	Wefco (Gainsborough) Ltd.
	DEA Absorber	1	16.3 m high x 1 m ID	Wefco (Gainsborough) Ltd.
	DEA Regenerator	1	11.3 m high x 1.2 m ID	Wefco (Gainsborough) Ltd.
	Copper liquor absorber	1	32 m high x 1.1 m	Wefco (Gainsborough) Ltd.
	Copper liquor absorber wash tower	1	50 m x 400 mm	Power-Gas Corporation Ltd.
	Copper liquor regenerator	1	18.5 x 1.4 m	Wefco (Gainsborough) Ltd.
	Hydrogen gas holders	2	19 m high x 15.5 m	
	CO ₂ holder	1	10 m high x 10.5 m	GW Walker
	CO holder	1	10 m high x 10.5 m	GW Walker
Kiln plant	Reduction kiln	2	38 m long x 3.9 m	F.L. Smidth-Fuller Ltd.
	Hydrogen blower	2	Capacity 6000 m ³ /hr with outlet pressure of 3 psi: power 165 HP	George Waller & Son Ltd.
	Primary scrubber	2	5.3 m high x 1 m	Projex Solutions Ltd
	Activation kiln	2	20 m long x 2 m	F.L. Smidth-Fuller Ltd.
	Volatilisation kiln	2	55 m long x 4.6 m	F.L. Smidth-Fuller Ltd.
	Stabilisation kiln	2	16 m long x 1.5 m	Unknown
Pellet plant	Carbonyl blower	6	355 mm x 890 mm, Mark 2 Roots type,	Waller
	Pellet units (standard)	17	Contains 30 t Ni	International Nickel (MOND) Ltd.
	Pellet units (double capacity)	2	Contains 45/60 t Ni	International Nickel (MOND) Ltd.

Area	Item	Number	Size/Model	Manufacturer/Make
Powder plant	Powder decomposers	6	10 m long x 2 m	Caper Neil/Mortec
	Powder Blower	2	355 mm x 890 mm, Mark 2 Roots type,	Waller

14.3.4 POWER, WATER, AND CONSUMABLES

The power consumption for the Ontario Operations is described in Chapter 15.9.

Consumables include:

- Copper Cliff Smelter : spare parts, electrical materials, maintenance supplies, refractories, quartz, sand, lime, coke, natural gas;
- Copper Cliff Nickel Refinery: refractories, lime, coke, MgO, dolime, sulphuric acid, soda ash, maintenance supplies;
- Port Colborne Refinery: soda ash, sodium hydroxide, sodium hypochlorite, sulfur dioxide, sulphuric acid, hydrochloric acid, hydrogen peroxide, chlorine, lime, maintenance supplies;
- Clydach Refinery: refractories, nickel sulphate, liquid ammonia, diethanolamine (DEA), potassium hydroxide (Benfield solution), sulphur dioxide, sodium hydroxide, sulphuric acid, maintenance supplies.

Water requirements and water sources vary by smelter/refinery location.

The Copper Cliff Smelter and Copper Cliff Nickel Refinery source freshwater from the Vermilion River, and recycle process water from the plant operations. During the period from 2021 to 2025, the total annual freshwater requirements from the Vermilion River for all users—including Creighton and Copper Cliff Mines, Clarabelle Mill, Smelter, Refinery, and the town of Copper Cliff—ranged from 10.6–11.0 Mm³. Additionally, process (recycled) water requirements ranged from 170–196 Mm³/a.

The Port Colborne Refinery sources its freshwater and process water needs from the Welland Canal. Annual water usage is permitted up to 10.72 Mm³/a, with average annual usage from 2022–2025 of 3.0 Mm³/a.

As discussed in Chapter 3.7, a complex recycled cooling water circuit was installed and phased into operation for the Clydach Refinery in 2022 and has been fully operational since that date. There has been no water abstraction from the Tawe River since 2022. Process water is supplied via the recycled water circuit at a rate of 2 Mm³ and Towns Water (Welsh Water) at a rate of 0.1 Mm³ for 2025.

Following installation of the recycled water circuit, no water is planned to be sourced from the River. However, the previously granted water license has been retained for emergency back-up purposes.

Fresh water is sourced from the municipal water supply system for the Clydach Refinery. This water is primarily for domestic usage, but a portion is also used for topping up the closed loop process water circuits.

The LOM plan assumes similar water usage patterns.

14.3.5 PERSONNEL

Approximately 1,000 persons are employed in the refining and smelting operations.

15 INFRASTRUCTURE

15.1 INTRODUCTION

Major infrastructure currently in place for the underground mine sites is summarized in Table 15-1.

The processing facilities in Sudbury include a concentrator, a combined nickel and copper smelter, matte processing facilities, a carbonyl nickel refinery, a copper anode casting plant, a sulphuric acid plant and a sulphur dioxide liquefaction plant. The copper refinery was closed in 2006.

Ontario Operations infrastructure also includes a tailings impoundment area, a slag disposal area, and an oxygen plant.

All underground mines use a combination of several underground maintenance facilities of varying sizes and capacities. These shop areas are equipped with the necessary tools and equipment to service large industrial rock moving and drilling equipment. Most of the mobile equipment repairs are completed at these permanent facilities while smaller repairs can be done in the field by trained mechanics.

Table 15-1: Current Mine Site Infrastructure

Mine	Key Surface Infrastructure	Comment
Coleman	Headframe, warehouses, mechanical and electrical shops, hoist room buildings, a sand plant, fan houses, a first aid/security station, training rooms, offices, and change/shower facilities.	The Levack water system, owned by Coleman Mine, provides industrial water.
Copper Cliff	Two headframes, open, cold, and heated warehouses, mechanical and electrical shops, hoist room buildings, fan houses, sand plant, a first aid/security station, training rooms, offices, and change/shower facilities.	Water is sourced from the Vermillion water treatment plant located at the Creighton Mine.
Creighton	Headframe, warehouses, mechanical and electrical shops, hoist room buildings, a sand plant, fan houses, a first aid/security station, training rooms, offices, and change/shower facilities.	Creighton Mine owns the Vermillion Water Treatment Plant that provides industrial water. Creighton Mine is also home to a government operated research facility, the Sudbury Neutrino Observatory.
Garson	Headframe, warehouses, mechanical and electrical shops, hoist room buildings, a first aid/security station, training rooms, offices, paste fill plant, Aran sand plant, fan houses and a change house.	Water sourced from No 2. Well.
Stobie	Main office and change/shower facilities, warehousing, surface lay down, a maintenance shop and a diamond drillhole core logging and sampling facility.	Buildings and warehouse use is shared by central mine service departments and Stobie open pit operations.
Totten	Headframe, collar house, hoist house and compressor room, dry/office building, sewage treatment plant, process water storage tank and pump house, fuel storage facility, mine water treatment system, surface repair facilities, slick line system, dewatering pipeline, backfill plant, fan houses.	

15.2 ROADS AND LOGISTICS

Road access is described in Chapter 4.2.

15.3 WASTE ROCK STORAGE FACILITIES

15.3.1 UNDERGROUND

Waste rock from underground operations is primarily stored underground. One active permanent waste rock disposal location used by the Garson and Copper Cliff Mines is a non-producing open pit on the north side of the Copper Cliff Mine property.

15.3.2 STOBIE OPEN PIT

Waste rock from the Stobie Pit is planned to be dumped in another historical open pit to the west of the active workings. This is currently being planned and executed by Thiess, who have a lease agreement with Vale Base Metals for operating the Stobie Pit site.

15.4 TAILINGS STORAGE FACILITIES

The Copper Cliff tailings impoundment or Central Tailings Area became operational in 1936 and has become the primary management site for tailings generated from the Ontario Operations. The facility encompasses some 2,430 ha, and divided into several areas according to eras of tailings disposal: A-Area, M-Area, CD-Area, P-Area, Q-Area, R-Area, and the Upper Pond Area (UPA). A current general location plan is provided in Figure 15-1.

The UPA is the oldest area, dates to the 1930s, and is inactive in tailings disposal terms, but is used as a process water supply for Clarabelle Mill. The A-Area followed in the late 1930's and covers about 421 ha. The A-Area Dam lies in the southeast corner. The A-Area collects seepage from other parts of the Central Tailings Area as well as runoff from a large watershed. Hill Station sump overflows also report to A-Area. When sump overflows exceed the flow capacity to A-Pond, excess flow reports to the Hill Station Emergency Overflow pond.

The M-Area usage start date is uncertain, but may have been the 1950s. It is currently inactive in tailings disposal terms, covers about 121 ha, and includes a storage pond. The M-Area is bounded to the southeast and northeast by the M-Area South and M-Area North Dams. The remaining portions of the M-Area are connected to other tailings areas. The dams are currently being buttressed to allow future deposition of dredged tailings in the M-Area.

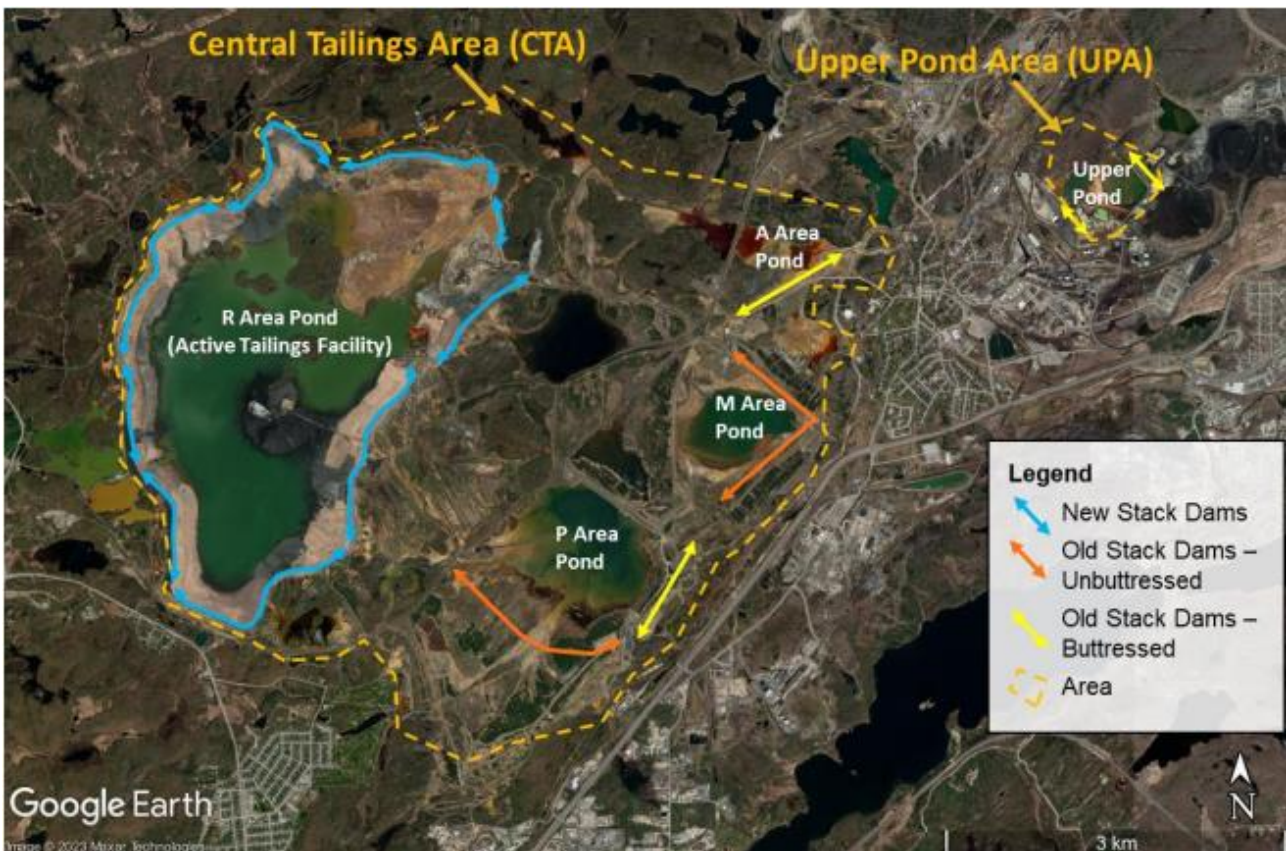
The P-Area began being used in the 1960s and is currently inactive in tailings disposal terms; however, it remains an important attenuating element for water management. A total of six perimeter dams make up the impoundment: Whissel Dam, Rock Dam, Mikkola Dam, Pistol Dam, Kallio Dam, and Cecchetto Dam. The P-Area Pond is the final storage pond for process water prior to discharge from the Central Tailings Area, receiving water from the combined flow from the R-Areas pond, CD-Area, Q-Area, and M-Area.

The Q-Area and CD-Area are both inactive in terms of tailings storage and are bounded on all sides by other tailings storage areas.

The R-Area was originally split into four separate areas (R1, R2, R3 and R4), and are currently combined into one, referred to as the R Pond, as the elevation of the R4 pond has risen to form a common pond with the R1, R2, and R3 Areas.

The original R1-Area was approximately 162 ha in size and bounded to the southwest by an internal dam, Dam C, and to the northeast by the Pyrrhotite Dam that separates the R1 Area from A-Area. The R2 Area lies to the northwest and is separated by a series of internal dykes known as Dams K, L, M, and N. The R1 Area is separated from CD-Area and Q-Area by the R1-CD and Guindon North Dams. Seepage from the Pyrrhotite Dam flows into A-Area. The R1 Area also receives seepage from the R2-Area flowing through the internal dykes.

Figure 15-1: Central Tailings Impoundment



Note: Figure prepared by Vale Base Metals, 2025.

The former R2-Area encompasses some 263 ha and makes up the northern region of the Central Tailings Area. It is bounded by 12 perimeter dams along the western and northern ends and the R1-Area on the southern end. A series of four separator dykes separate the R1- and R2-Areas. Seepage from Dams R-1 through R-9 flows to the A-Area drainage system. Seepage from Dams R-10, R-11, and R-12 is collected in a downstream seepage pond and pumped back to the R2 Area via the #1 Seepage Pumping Station. Two seepage containment dams downstream are used to minimise seepage escaping to the local environment.

The former R3-Area is approximately 202 ha in size and lies in the northwest region of the Central Tailings Area. It is bounded by five perimeter dams (Dams R-13 to R-17) on the western side. Seepage from the perimeter dams is captured by a series of ponds and channels, conveyed to a collection pond, and pumped back to the R3 Area via the #2 Seepage Pumping Station. Downstream seepage containment dams minimise seepage from escaping to the downstream environment.

The former R4-Area covers about 344 ha, and forms the southwestern portion of the Central Tailings Area. There are 10 perimeter dams (Dams R-18 through R-27) and one internal dam (Guindon Dam). Seepage from the majority of the perimeter dams is contained within a large collection pond and pumped back to the R4 Area via the #3 Seepage Pump Station. A series of seepage recovery dams was built in the late 1980s to divert water back to the seepage pump back stations at the downstream side of R3 between Dams R-10 and R-16.

In addition to tailings deposition, the Central Tailings Area receives an assorted stream of wastes including non-hazardous solid waste, water and process treatment plant sludges, and asbestos.

A site-wide seismic hazard assessment for the tailings areas was completed in 2022. There are no outstanding actions resulting from the 2022 seismic hazard assessment. The outcomes from the seismic hazard assessment informed subsequent design reviews for seismic stability.

Vale Base Metals meets the requirements of the Ontario Northern Development, Mines, Natural Resources and Forestry, Lakes, and Rivers Improvement Act, uses safety guidance provided by the Canadian Dam Association, and internal risk management frameworks to ensure dam safety. Vale Base Metals has undertaken numerous studies on the Central Tailings Area to update various aspects of the facility to meet current dam engineering practices.

A detailed Operations Manual was developed that includes water management procedures, tailings delivery procedures, dam construction and safety procedures, instrumentation and monitoring procedures, environmental control procedures, management and control procedures, and the emergency preparedness and response plan. This manual is regularly updated.

As part of Vale Base Metals commitment to risk management for the Central Tailings Area and the UPA, Vale Base Metals established a Technical Review Board in the 1990s. Board members are specialists in tailings and water management and dam safety with several years of experience. The Technical Review Board meetings typically involve presentations from Vale Base Metals and their engineering consultants and discussion on the key issues related to the Central Tailings Area. The Technical Review Board work with Vale Base Metals to address these issues and bring them to the attention of senior management. Vale Base Metals has a recommendations-tracking database to monitor the recommendations from the Technical Review Board and their status.

15.5 SLAG DISPOSAL FACILITY

The smelter operation generates approximately 0.5 Mt of slag annually.

Furnace slag is tapped and poured into a series of slag pot rail cars. The slag pots are taken to one of three locations on the Copper Cliff Smelter Complex property, emptied, and the slag is allowed to cool. The main slag facilities are continuously managed to provide storage of additional molten slag by active cleaning with bulldozers, excavators, and other mobile equipment.

There are two main storage areas in the central and northeastern areas of the smelter that are designated for storage of cooled slag. Haulage trucks transport the slag from the main facilities to these storage areas.

15.6 WATER MANAGEMENT

15.6.1 WATER MANAGEMENT STRATEGY

The general water management strategy for facilities peripheral to the Central Tailings Area involves collecting and treating impacted runoff. The strategy is common to the Copper Cliff (underground and planned open pit) and Creighton Mines, the Stobie property, Clarabelle Mill, the Central Tailings Area, UPA, Copper Cliff Smelter complex, Copper Cliff Refinery, and the Copper Cliff and Nolin Creek wastewater treatment plants.

The Ontario Operations monitor levels, flows and water balances on a weekly basis. Raw field data (flow, pond level, snowpack and precipitation) are incorporated into water balance and storage calculations. These data are reviewed by Vale Base Metals internal Water Management Committee, which includes representatives from the process plant, water treatment plants and environmental department. Once a review is complete, the Water Management Committee issues minutes to the individual operations and internal stakeholders. The individual operations are responsible for implementing recommendations.

15.6.2 WATER TREATMENT

15.6.2.1 COPPER CLIFF MINE, CREIGHTON MINE, CLARABELLE MILL, COPPER CLIFF SMELTER COMPLEX AND COPPER CLIFF REFINERY

Surface water over areas potentially affected by acid rock drainage is managed using two systems; the Copper Cliff and Nolin Creek water management systems. The Copper Cliff water management system consists of seven sub-watersheds covering approximately 5,300 ha and has 22 reservoirs. Flows are either treated at the Copper Cliff wastewater treatment plant or recycled for mill process water. There are a number of creeks within the Town of Copper Cliff that also convey water to the Copper Cliff wastewater treatment plant. The Nolin Creek water management system consists of a separate watershed, comprising a single, three-reservoir catchment covering approximately 890 ha. Associated flows are treated at the Nolin Creek wastewater treatment plant. There are two large storage reservoirs in front of the Nolin Creek wastewater treatment plant to help provide attenuated water during peak flow events.

15.6.2.2 TOTTEN MINE

All mine water and surface contact waters are directed to the west surge pond, including mine dewatering, surface run-off and water pumped from the Worthington cave zone and through the dewatering wells installed around the return and fresh air raises. Water is pumped from the west surge pond to a high-density sludge treatment plant, where metals and solids are removed through hydroxide precipitation, settling and filtration. The treated water is released to the polishing pond. Water from the polishing pond is primarily used as process water at the mine, with discharge to the environment required only when inputs exceed mine demand (typically seasonally). Domestic sewage is treated at the onsite sewage treatment plant with effluent discharged to the west surge pond within the larger Totten Mine wastewater treatment system.

15.6.2.3 GARSON MINE

Waste water at the Garson Mine is managed through a wastewater treatment plant that is supported by a series of upstream reservoirs and downstream settling ponds. Mine dewatering is pumped directly to a surge pond at the intake of the wastewater treatment plant, though can also be directed to the R2 reservoir if needed. Surface contact waters are collected in the north pond, and the R1 and R2 reservoirs and are pumped to a surge tank for treatment. The wastewater treatment plant uses a metal hydroxide precipitation process. Water discharged from the wastewater treatment plant reports to the settling pond, flowing then to the polishing Pond and is pH adjusted using CO₂ prior to discharge to the environment.

15.6.2.4 COLEMAN

The Coleman Mine operates within an integrated wastewater management system, tying in inputs from Vale Base Metals operations as well as those from Magna Mining and Glencore's operations in the area. Mine dewatering from the Coleman and Levack mines, as well as domestic sewage treated in a small sewage treatment plant, report to the process water sump in the sewage treatment plant, which equalizes with Strathcona Lake. Strathcona Lake also receives inputs from the gravel pit pond, which receives runoff from the former tailings area, inputs from the Grassy Creek and Pike Lake interceptor wells, and water collected in the Levack runoff containment area. The Strathcona pumphouse then moves the water from the lake for subsequent treatment within Glencore's Moose water treatment system.

15.6.3 WATER SOURCES

Process water for the Clarabelle Mill is sourced from the UPA. The Upper Pond consists of a water reservoir, two pumphouses that pump process water to Clarabelle Mill, and a gravity overflow structure that provides process water to the filter plant. Ancillary infrastructure that supports the Upper Pond includes the process water supply pipeline, two containment dams (north and south), roads, and power systems. Secondary uses for the Upper Pond include providing process water for

the concentrate storage domes, dust suppression in the active slag facility, and providing gland water to the booster station. The Upper Pond also serves as a settling pond to settle out precipitated solids from the lime treated process water.

Fresh and drinking water is sourced primarily from the Vermilion River catchment. The Vermilion River water intake is owned and operated by Vale Base Metals. The intake pumps raw water from the river to Creighton to be treated at the Vermilion water treatment plant. After treatment, water is supplied to Copper Cliff and Creighton Mines, the Clarabelle Mill, Copper Cliff Smelter, and the Copper Cliff refinery. The treatment plant also provides water to the City of Sudbury.

Process water for Garson Mine is supplied via a groundwater well, process water for the Coleman Mine is supplied from the Onaping River, the Stobie Pit process water is supplied from Whitson Lake and Totten is generally closed loop, although a PTTW allows limited withdrawal from Victoria Creek to supply certain on-site buildings.

The primary water source for the Port Colborne Refinery is the Welland Canal.

15.7 BUILT INFRASTRUCTURE

All major infrastructure to support the Ontario Operations mining activities envisaged in the LOM is in place.

15.8 CAMPS AND ACCOMMODATION

No accommodations camps are operated. Personnel live either in Sudbury or in surrounding settlements.

15.9 POWER AND ELECTRICAL

Electrical power for the Ontario Operations is primarily sourced from the Ontario provincial supply (approximately 80%). Power is transmitted on the Hydro One transmission system and is connected to two locations in Sudbury and one in Port Colborne. In Sudbury, all incoming grid-connected power and hydroelectric generation is distributed to mines and processing plants through Vale Base Metals electrical distribution network, consisting of 69 kV distribution power lines, substations, transformers, breakers, disconnects and other electrical equipment. This distribution system is owned, operated, and maintained by Vale Base Metals.

A portion of the demand (about 20%) is met by Vale Base Metals hydroelectric power facilities. Vale Base Metals consumes 100% of its self-produced hydro generation behind-the-meter, i.e., Vale Base Metals does not inject power onto the Ontario grid. The hydroelectric facilities have a nameplate capacity of 55 MW.

The Clydach Refinery obtains all of its power from a local utility.

The average annual usage by major area, based on actual 2025 data is summarized in Table 15-2. These usage levels are forecast to remain approximately the same for the LOM.

Table 15-2: Annual Power Usage

Facility	Power (MWh)
Mining operations	597,273
Clarabelle Mill	224,000
Copper Cliff Smelter	302,187
Copper Cliff nickel refinery	177,187
Port Colborne refinery	25,925
Water treatment	29,529
General and administrative	119,575
Clydach	37,000
Total power usage	1,512,676

Note: 2025 Actuals. Numbers have been rounded.

16 MARKET STUDIES

16.1 PRODUCTS

The Clarabelle Mill produces copper concentrate that is sold to the market. The nickel concentrate is sent to be processed at Copper Cliff Smelter. The Smelter produces intermediate copper concentrate (so-called MK). The Copper Cliff Nickel Refinery (CCNR) produces high-purity nickel chips, pellets, and powders. CCNR also produces copper cathodes in its Electrowinning plant. The Port Colborne Refinery produces electro-cobalt, and intermediates of gold, silver and PGEs. The Clydach Refinery produces nickel powder and pellets. Some Vale Base Metals products sell at a premium due to their strong buyer appeal.

16.2 MARKETS

16.2.1 NICKEL

16.2.1.1 DEMAND

As a first use, nickel is consumed in plating, alloy steel, non-ferrous alloys, foundry, batteries, and stainless steel. These are then used in several applications in varying industries including aerospace, automotive (including electric vehicles), appliances, electronics and energy production and consumption.

The largest demand segment is stainless steel accounting for 63% of total primary nickel demand in 2025 (Wood Mackenzie, 2025a). Uses in alloy steel, non-ferrous alloys, plating, and foundry applications make up 20% with the battery market and other applications filling the remaining demand. This dynamic is expected to change as demand for batteries in electric vehicles grows.

Total consumption, net of stainless steel scrap, was 3.5 Mt in 2025.

16.2.1.2 SUPPLY

Nickel production is traditionally broken out into distinct streams:

- Class 1: high purity nickel products;
- Class 2: lower purity nickel such as nickel pig iron (NPI) and ferronickel (FeNi), primary feedstock for the stainless-steel industry;
- Nickel sulphate: predominantly used to make battery chemicals.

Primary nickel supply is expected to increase led by growth in Indonesia (Wood Mackenzie, 2025a).

16.2.2 COPPER

16.2.2.1 DEMAND

Copper consumption can be divided into first use product groups, such as copper wire rod, copper billet and copper cake or slab (Wood Mackenzie, 2025b). In general, these products are consumed in broad sectors of the global economy, such as construction, electrical network, industrial machinery, transport and consumer and general products. These copper products are vital to the rapidly growing green economy, such as renewable energy generation and storage, electric vehicles, and upgrades to the energy grid that support the trends of electrification and digitization of the economy.

Electrical network and construction are the largest copper consuming sectors, accounting for approximately 30% and 24% of total copper consumption in 2025, respectively (Wood Mackenzie, 2025b). Among the main wire and cable and copper products consumed in the construction industry are building wires, power cables, air conditioning tube, copper sheet and alloy products. Consumer & general and the Transport sector rank third and fourth, with both sectors combined accounting for about 35% of copper demand.

Copper demand is diverse, which is why it is often describes as an “economic bellwether” for the global economy. Stable demand growth from traditional segments is expected and novel uses of copper for energy transition will unlock even more growth. The long-term growth forecast is supported by global policy with decarbonization targets, increasing adoption of renewable energy and investments in the green economy. This acceleration will lead to a pivot towards more copper-intensive uses in renewable energy and transportation projects related to electric vehicles as well as the required infrastructure to support the grid in a world with more electrification and digitization.

Copper demand, net of direct scrap material, was 28 Mt in 2025 (Wood Mackenzie, 2025b).

16.2.2.2 SUPPLY

According to Wood Mackenzie, global copper supply is projected to grow a reflecting ongoing efforts to expand mining capacity and improve production efficiency. However, in the longer term, growth in supply will have rely on supply additions to keep up with demand, which is driven by the accelerating energy transition, including the expansion of electric vehicles, renewable energy infrastructure, and grid modernization.

16.2.3 COBALT

16.2.3.1 DEMAND

Cobalt is used in a wide variety of applications. Cobalt can be magnetized and is used to make magnets, including particularly powerful magnets when alloyed with aluminum and nickel. Other alloys of cobalt are used in jet turbines and gas turbine generators, where high-temperature strength is important. Cobalt salts have been used for centuries to produce blue colors in paint, porcelain, glass, pottery, and enamels. The main end use markets include batteries for electric vehicles, tablet and smartphones, superalloys for use in aerospace, land-based turbines and medical prosthetics, and tool materials for use in mining and drilling.

The largest demand segment is battery chemicals, accounting for 66% of total cobalt demand in 2025 (Macquarie, 2025). Uses in superalloys, tooling materials and other markets such as catalysts, pigments and magnets make up the remaining demand. The market share of battery chemicals is expected to change as demand for batteries in electric vehicles grows.

Cobalt demand was 213 kt in 2025 .

16.2.3.2 SUPPLY

Cobalt is mined across the world, and the majority is produced as a by-product from large-scale copper and nickel mines. Roughly 73% of the global cobalt mined production in 2025 was in the Democratic Republic of Congo. Refined cobalt production is concentrated in China, accounting for over 70% of global refined output in 2025.

16.2.4 PLATINUM

16.2.4.1 DEMAND

The PGEs are a group of metals comprising platinum, palladium, rhodium, iridium, ruthenium, and osmium. These metals have similar physical and chemical properties and tend to occur together in the same mineral deposit. The usefulness of PGEs is determined by their particular chemical and physical properties.

Certain of these properties are shared by other materials, but it is the unique combination of properties that makes the PGEs so valuable in their end-markets. The PGEs have high and specific catalytic activity, high thermal resistance, are chemically inert, biocompatible and are hard but malleable for forming into shapes.

Platinum, palladium and rhodium are used in higher-volume industrial applications, while iridium and ruthenium have niche high-technology applications. Alongside their established applications, PGEs’ attractive properties make them all the subject of intensive research and development into novel

end-uses.

The main uses of platinum are as a catalyst for automotive emissions control, in a wide range of jewellery pieces and in industrial catalytic and fabrication applications. The hydrogen economy is currently a small portion of total platinum demand but is expected to grow; it is an emerging end-use in electrolyzers and fuel cells (Metals Focus, 2025a). Autocatalyst applications made up 41% of platinum demand in 2025 while jewellery made up 29% with the remaining consumed in other segments such as glass, chemicals and other industrial uses.

Overall platinum demand was 7.4 Moz in 2025, and it is expected to decrease at a compound annual growth rate of 0.2% between 2025 and 2030 in line with lower autocatalyst and jewellery demand partly offset by growth in the hydrogen and glass sectors.

16.2.4.2 SUPPLY

The majority of platinum is supplied from resources in South Africa. Russia, Zimbabwe, Canada and the United States are also import sources of platinum. In 2025, South Africa accounted for 72% of total platinum mine production.

16.2.5 PALLADIUM

16.2.5.1 DEMAND

Palladium is primarily used as a catalyst in the automotive sector, mainly in gasoline-powered on-road vehicles. The second main use of palladium is in electrical components, specifically in multi-layer ceramic capacitors, as conductive pastes and in electrical plating.

Autocatalyst applications made up 82% of palladium demand in 2025 while electronics and chemicals made up 7% and 5%, respectively, with the remaining consumed in the jewellery, dental and other industrial markets (Metals Focus, 2025a).

Overall palladium demand was 9.5 Moz in 2025, and it is expected to decrease at a compound annual growth rate of 0.9% between 2025 and 2030 in line with the decline in palladium used in autocatalysts as internal combustion engine vehicle production declines while electric vehicle production grows.

16.2.5.2 SUPPLY

The supply sources listed for platinum previously are also the sources of palladium. The majority of global palladium supply comes from by-product production, with output supported by base metals and other PGE revenues. In 2025, South Africa accounted for 36% of total mine palladium production with Russia contributing the majority share at 43%.

16.2.6 GOLD

16.2.6.1 DEMAND

Gold is used in jewellery, as an investment instrument, in technology for industrial demand, and to manage central banks' reserves.

Gold jewelry is the largest demand sector, accounting for over 39% of total demand in 2025 (Metals Focus, 2025b). In 2025, net official sector buying, which includes central bank purchases, accounted for approximately 19% of total demand, and other physical investments, including hedging demand, in gold accounted for approximately 34% of total market demand. Volatile markets sustain demand for gold in investment portfolios to protect purchasing power and minimize losses during market shocks. The unique properties of gold drive technological uses, with an industrial demand market share of approximately 8%.

The demand for gold has moved in the past decade to the emerging economies of China and India. India is one of the largest consumers of gold and that metal plays a central role in the country's culture as a status symbol.

16.2.6.2 SUPPLY

The geographical diversity of mined gold, mined on every continent except Antarctica, allows for stability in the market. Mine production of gold accounted for roughly 72% of total market supply in 2025 with recycled material making up the balance.

16.2.7 COMMENTS ON MARKET STUDIES

There are no agency relationships relevant to the marketing strategies used by Vale Base Metals Operations.

Product valuation is included in the economic analysis in Chapter 19 and is based on a combination of the metallurgical recovery, commodity pricing, consideration of processing charges, and allocations, where applicable for premiums paid on the products from the operations.

Since gold is a by-product of the Vale Base Metals operations, there is no technical specification for end-users to be saleable.

Based on the demand forecast figures, there is a reasonable expectation that there will be a demand for all of the commodities discussed in Chapter 16. The figures support that there is a large and expanding market for nickel, copper, and cobalt, which are the main value drivers in the economic analysis in Chapter 19.

16.3 COMMODITY PRICING FORECAST

At the beginning of each annual cycle, Vale Base Metals sets long-term price and exchange rate assumptions used to estimate Mineral Resources and Mineral Reserves.

The company uses a consensus-based approach to forecast metal price and exchange rate assumptions. This is based on long-term forecasts published by analysts and financial institutions.

The metal price applied to demonstrate the mineral reserve economic viability is based on the median forecast from analysts and financial institutions, considering annual estimates for the period 2026–2031, followed by a long-term constant price from 2031 onward for the remaining life mine.

The metal price applied to assess reasonable prospects for economic extraction of mineral resources is based on the 80th percentile of long-term price forecasts provided by analysts and financial institutions.

The annual and long-term commodity price, in real unescalated US\$, and foreign-exchange forecast curves used for the economic analysis supporting Mineral Reserves are presented in Table 16-1.

Table 16-1: Commodity Price Forecasts (Real US\$)

Item	Units	2026	2027	2028	2029	2030	2031	Long-term
Nickel price	US\$/t	15,400	15,750	16,975	17,400	17,575	17,575	17,625
Copper price	US\$/t	9,600	10,075	10,225	10,025	10,000	9,950	9,950
Cobalt price	US\$/t	27,525	29,275	35,875	35,175	39,450	39,175	39,125
Platinum price	US\$/oz	1,350	1,275	1,325	1,325	1,325	1,325	1,325
Palladium price	US\$/oz	1,025	950	1,000	1,000	1,025	1,050	1,050
Gold price	US\$/oz	3,675	3,200	3,025	2,750	2,650	2,650	2,650
Foreign exchange rate	C\$/US\$	1.33	1.32	1.31	1.31	1.30	1.30	1.30

Source: Average analyst bank forecast – Sept 2025

16.4 EXCHANGE RATE

The LOM exchange rate forecast of 1.30 (C\$:US\$) uses a consensus approach based on long-term analyst and bank forecasts. The forecast uses annual predictions for the period 2026–2031, reverting to a long-term fixed forecast from 2032 for the remaining mine life.

16.5 CONTRACTS

16.5.1 NICKEL

The terms contained within the refined nickel sales contracts are typical and consistent with standard industry practice and are similar to contracts for the supply of nickel throughout the world. Depending on the specific contract, the terms for the refined nickel sales are predominantly negotiated annually, or in the case of spot agreements, based on market terms negotiated at the time of sale. There are some instances where a longer contract duration may be negotiated, but this is typically the exception. The differences between the individual contracts are generally in relative quantity of refined nickel that is covered under the sale.

16.5.2 COPPER

Vale Base Metals has agreements at typical copper concentrate industry benchmark terms for metal payables, treatment charges and refining charges for concentrates produced. Treatment costs and refining costs vary depending on the concentrate type and the destination smelter.

The terms contained within the copper concentrate sales contracts are typical and consistent with standard industry practice and are similar to contracts for the supply of copper concentrate throughout the world. Depending on the specific contract, the terms for the copper concentrate sale are either annually negotiated, benchmark-based treatment and refining charges, or in the case of spot agreements are based on fixed treatment and refining charges based on market terms negotiated at the time of sale.

16.5.3 COBALT

The majority of the cobalt production is sold under annual or multi-year contracts. These contracts are based on market pricing using a negotiated formula based on the Fastmarkets cobalt price plus a premium or discount. The remaining production is sold on a spot basis. These sales are based on the current market pricing at the time of sale, using similar pricing methodology as described previous, or at a spot or fixed current market price.

Any finished cobalt sales to affiliated parties are sold at market pricing similar to external parties.

16.5.4 PGE AND GOLD

PGE concentrate and gold sands are typically sold using spot pricing terms with end-users based on prevailing market conditions. As metals contained in copper products, the terms for gold and PGEs are determined through a payable mechanism on metal content based on typical market terms. As is typical for concentrates, the product is generally contracted under a medium-term contract.

A portion of the Ontario Operations gold production is sold under a multi-year streaming agreement.

16.5.5 VALE BASE METALS AFFILIATES

Intercompany agreements between Vale Base Metals affiliates are negotiated under the arm's length principle, based on market terms and rates that would be achieved had the contract been negotiated with an unaffiliated third party.

16.5.6 GOODS AND SERVICES

Contracts may be entered into with third-parties for goods and services required to operate underground mining operations. On occasions, mining contractors may be employed for specific mine development projects. The largest in-place contracts include transportation, purchase of fuel,

reagents and other process consumables, ground support, and mining equipment leases. The terms contained within the contracts are typical of, and consistent with, standard industry practices.

17 ENVIRONMENTAL STUDIES, PERMITTING, AND PLANS, NEGOTIATIONS, OR AGREEMENTS WITH LOCAL INDIVIDUALS OR GROUPS

17.1 BASELINE AND SUPPORTING STUDIES

17.1.1 HISTORY

Vale Base Metals Ontario Operations are one of the largest integrated mining complexes in the world, including both mines and processing operations, some dating back to the early and mid-1900s. Environmental regulations and awareness have progressed significantly from the beginning of the Ontario Operations, and Vale Base Metals has engaged in baseline studies, various improvement and legacy reclamation initiatives and other activities to ensure compliance as the regulatory regime changes.

All pertinent baseline information as per standard of the day is available in the Closure Plans for the mine sites and surface plants, including land use, topography, regional geology, local geology and mineralogy, soil, climate and hydrology, hydrogeology, terrestrial plant and animal life and aquatic plant and animal life, with relevant updates provided in the subsequent Closure Plan amendments.

As the mines and plant sites have continued to expand, supporting environmental studies have been completed to assess site environmental conditions, and to support permit applications and decision-making processes.

17.1.2 CURRENT ACTIVITIES

At all mines, baseline and supporting environmental studies are completed to assess both pre-existing and ongoing site environmental conditions, as well as to support decision-making processes, and if applicable, permit applications for new projects as these are brought on stream or works and undertakings within sites. Characterization studies are completed for all environmental media including soil, water, waste, air, noise and closure.

Plans were developed and implemented for all Ontario Operation mine sites to address waste management, spill prevention and contingency planning, water management and fugitive dust management. Noise levels generally meet the required guidelines.

Vale Base Metals maintains an Environmental Management System (EMS) for its Ontario Operations compliant with ISO14001:2015. The EMS has objectives to identify aspects and risks to the environment and to manage and reduce these environmental risks to the lowest level reasonably achievable, thereby minimizing impacts on the environment and meeting compliance obligations. Baseline and supporting studies are an important part of the environmental management system and understanding of the significant environmental aspects under management.

17.2 ENVIRONMENTAL CONSIDERATIONS/MONITORING PROGRAMS

17.2.1 WASTE ROCK

In general, the presence of comparatively large quantities of waste rock onsite presents a significant environmental liability. Waste rock is present throughout the Ontario Operations areas, and is both confined to specific piles or storage areas and distributed throughout the sites. Surface and groundwater monitoring has shown water quality to generally be acidic with elevated concentrations of metals. Specific areas requiring remedial work, including some associated with legacy waste rock storage and handling practices, were identified and prioritized using the Water Quality Management Plan (see Chapter 17.2.3).

17.2.2 TAILINGS

The Copper Cliff tailings impoundment, the Copper Cliff Central Tailings Area, became operational in 1936 and was the primary management site for tailings generated from the Sudbury milling

operations. The tailings area footprint is approximately 2,500 ha and currently contains approximately 560 Mt of tailings within seven internal cells. The perimeter was developed using upstream construction. In 1985, deposition commenced in the last cell, called the “R” area, and deposition will continue in this area over the next several decades with the potential to reach an elevation of 335 m. Since tailings deposition could resume over “A” Area and given tailings will continue to be used for underground backfill, it is expected that there will be sufficient tailings storage until at least 2050.

Historically, the Frood mine tailings were piped to the Vale Base Metals Central Tailings Area; however, tailings were occasionally discharged within the closure area within the Frood emergency tailings area when they could not be accepted offsite. Runoff that is captured in the Frood emergency tailings area is pumped back to Frood Pond.

Tailings were historically impounded onsite in the Levack tailings area. During operation most of the tailings produced by the Levack mill were stored onsite for permanent disposal. The tailings are no longer actively deposited into the Levack tailings area. Tailings impacted surface and groundwater seepage is collected by a series of interception wells. The overall environmental impact of the tailings is reduced due to minimal water infiltration and the interception well system. A receiving water study showed that the perimeter seepage management systems are effective in preventing contaminant migration to surrounding natural water bodies.

In 2021, Vale Base Metals conducted a tailings closure study for the closed facilities at the Frood emergency tailings area, Levack tailings area, and the Shebandowan tailings area. The objectives of the study were to provide additional details regarding tailings characterization, as well as considering alternative closure strategies for these facilities. These scoping-level studies are complete. A technical study for the Frood emergency tailings area was initiated. With the start of excavation of tailings for process use from the Levack tailings area, the initiation of a more detailed technical study for this facility was deferred, and following the scoping-level study for the Shebandowan tailings area, a decision was made to maintain the current closure strategy.

17.2.3 WATER QUALITY

Monitoring of treated mine effluent and receiving water quality is ongoing as per permit and regulatory requirements. Acid mine drainage and management of wastewaters from the processing of sulfidic ores is the main water quality issue at all the sites.

Routine sampling, in accordance with the stated regulatory and permit requirements, is conducted on an ongoing basis at the Port Colborne Refinery, Totten Mine, Garson Mine, Crean Hill (Ellen Pit), and the Whistle mine, as well as for the Copper Cliff central area. The Copper Cliff central area, serviced by the Copper Cliff and Nolin Creek wastewater treatment plants (CCWWTP and NCWWTP), encompasses mine and process water, as well as surface contact water, from the Creighton and Gertrude mines, Copper Cliff Mine (north and south sides), Stobie Pit, and from surface milling, smelting and refining facilities. Regulatory limits at regulated final effluent discharge points are consistently met, with three exceptions in 2025: total suspended solids limit exceedance from Totten Mine in April, a *Daphnia magna* toxicity test failure following testing of effluent from the Copper Cliff wastewater treatment plant in April, and a pH limit exceedance from the Copper Cliff wastewater treatment plant in June. Work is ongoing to assess and continually improve effluent treatment processes and spill prevention.

A summary of the major water treatment facilities is provided in Table 17-1.

Table 17-1: Key Water Treatment Infrastructure

Plant	Comments
Copper Cliff wastewater treatment plant	Manages water from the Central Tailings Area and other site sources of contact water, including from the Clarabelle Mill, smelter complex and refinery sites and the Creighton, Copper Cliff and Stobie Pit sites. The Copper Cliff wastewater treatment plant also treats municipal runoff. Capacity of up to 227,000 m ³ /day
Nolin Creek wastewater treatment plant	Treats contact waters from the smelter complex, CCM Pit, slag pile areas, the Clarabelle Mill property, as well as excess Clarabelle Mill reclaim thickener water. Capacity of up to 26,450 m ³ /day
Garson Mine wastewater treatment system	Treats mine water and site contact water
Totten Mine wastewater treatment system	Treats mine water and site contact water
Whistle mine wastewater treatment system	Treats mine water and site contact water
Crean Hill (Ellen Pit) wastewater treatment system	Treats mine water and site contact water
Coleman Mine	Mine water and surface contact water are collected and transferred to the Glencore operations for treatment in their wastewater facilities.
Port Colborne effluent treatment plant	Treats process water and site contact water.

Legacy impacts to surface and ground water exist across Vale Base Metals Ontario Operations, and they are identified and addressed through a Water Quality Management Plan (WQMP) initiated in 2010. The Water Quality Management Plan allows Vale Base Metals to proactively manage environmental risks to water quality from legacy conditions in a scientifically-informed, risk-based, and prioritized manner. The Water Quality Management Plan incorporates monitoring data from over 1600 groundwater wells and more than 700 surface water monitoring locations.

The management of water quality impacts, and the associated regulatory implications, resulting from past practices when environmental protection programs and regulations were less robust remains a significant risk.

17.2.4 AIR QUALITY AND SULPHUR DIOXIDE EMISSIONS

Ontario Regulation 419/05 requires all Ontario Operations mines and metallurgical plants to meet ambient air quality standards by both measurement and air dispersion modeling. Dispersion modeling is the tool used to predict offsite concentrations based on a reasonable worst-case production scenario and local meteorological data.

All Ontario Operations currently meet Ontario Regulation 419/05 standards, except the Copper Cliff Smelter and the Copper Cliff Nickel Refinery. The Copper Cliff Smelter operates under a site-specific standard for annual nickel emissions, and the smelter and refinery operate in compliance with Ontario Regulation 652/21 relative to SO₂ emissions.

17.3 CLOSURE AND RECLAMATION CONSIDERATIONS

17.3.1 CLOSURE PLANNING

Vale Base Metals has 16 closure plans for aspects of the Ontario Operations, covering the Central Tailings Area, Clarabelle mill, the Copper Cliff Nickel Refinery, Crean Hill mine, Creighton Mine, Frood–Stobie mine, Garson Mine, Levack–Onaping Complex (including Coleman Mine), Copper Cliff north mine, Port Colborne Refinery, Shebandowan mine and mill, Copper Cliff Smelter complex, Copper Cliff South mine, Whistle mine, and Totten Mine.

Closure Plans were submitted to the relevant regulatory authority in 2001 in accordance with Part VII of the Ontario *Mining Act*. As required by regulation and internal guidelines, these documents are updated in five-yearly intervals to ensure they accurately depict onsite liabilities, as well as whenever there is a significant change made to a site.

17.3.2 CLOSURE COSTS

Vale Base Metals developed closure cost estimates associated with the chosen rehabilitation strategy for each property. The estimate also includes an expected schedule for closure-related expenditures.

Closure costs are included in the mine site financial models as cash costs, on an annual basis for all sites. The largest closure costs are associated with the process plant and mining infrastructure.

The closure cost estimate for the Ontario Operations, as at year-end 2025 and totaled from the estimates as they appear in the Closure Plans, is approximately US\$2,279 million (C\$2,963 million), using a 1.30 exchange rate.

Financial assurance in the form of bonds, letters of credit, and financial tests are filed with the Ministry of Energy and Mines to ensure that the rehabilitation work outlined in a closure plan is successfully performed. In Ontario financial assurance is estimated based on the closure cost plan, over time, using a 3% discount rate. The total financial assurance for Ontario Operations is C\$1,315 million (US\$1,012 million). Financial assurance must be included with the submission of a closure plan.

17.4 PERMITTING

All known and anticipated environmental permits and approvals are in place to support mining and processing operations, as well as for shorter term works, undertakings or activities carried out on mine or plant site footprints. Where permits have specific terms, renewal applications are made to the relevant regulatory authority as required, prior to the end of the permit term.

For new mining projects that may be incorporated into future mine plans, assuming mineral resources can be converted to mineral reserves with the appropriate supporting studies, the expectation is that environmental/impact assessments (if required) will be near completion, and the permits required for mine development will be understood and advancing, where possible, with baseline and supporting studies completed to facilitate application submissions and detailed design.

17.5 SOCIAL CONSIDERATIONS, PLANS, NEGOTIATIONS AND AGREEMENTS

Indigenous Peoples have Aboriginal and Treaty Rights and traditional territory where Vale Base Metals operates as well as lands in which Vale Base Metals has mineral rights. In Canada, the Crown has a duty to consult with Indigenous communities to address possible infringement of their rights. This obligation may need to be satisfied by the Crown in connection with development on Vale Base Metals lands, which may affect those rights. The Crown also frequently delegates the procedural aspects of this duty to consult proponents such as Vale Base Metals.

In accordance with revisions made to O. Reg. 240/00 (under the *Ontario Mining Act*), Vale Base Metals is also required to consult with Indigenous communities, as directed by the Director of Mine Rehabilitation, before filing a certified Closure Plan or a certified amendment to a Closure Plan.

Vale Base Metals routinely engages with five Indigenous communities in the Sudbury Basin including Atikameksheng Anishnawbek First Nation, Wahnapiatae First Nation, Sagamok Anishnawbek First Nation, Whitefish River First Nation and the Métis Nation of Ontario – Region 5. Vale Base Metals has signed agreements with Atikameksheng Anishnawbek First Nation, Sagamok Anishnawbek First Nation and the Métis Nation of Ontario – Region 5. Vale Base Metals is also currently renegotiating its agreements with Atikameksheng Anishnawbek, Sagamok Anishnawbek and Wahnapiatae First Nations.

There are currently no known consultation obligations which would materially impact the mineral reserve estimates. However, consultation obligations may need to be satisfied before new areas that currently only have mineral resource estimates can be developed.

Vale Base Metals does not currently have agreements or established relationships with Indigenous communities near the Port Colborne Refinery. This is largely due to the fact that the Crown has not identified any impact from the Port Colborne Refinery to Indigenous traditional territories in the region. However, Vale Base Metals has established a positive relationship with Mississauga of the Credit First Nation.

Due to the proximity of Vale Base Metals Ontario Operations to local communities, the company continues to engage the local communities of interest that may be impacted by future development. There are a variety of communication channels for community engagement including Annual Reports to the Community, annual Open Houses, a Community Liaison Committee, a company website, local media relations and advertising. Vale Base Metals has also established a grievance mechanism known as the Community Concerns Line to receive community concerns, complaints, and other matters; there are also a number of email communication channels to register grievances. These grievances are recorded in a grievance database and tracked for mitigation and conclusion.

The workforce at the Vale Base Metals Ontario Operations is largely unionized. Employees across the mining, milling, smelting, and refining operations in the Sudbury area are represented by several bargaining units of the United Steelworkers (USW). The principal bargaining unit is United Steelworkers Local 6500, which represents production and maintenance employees at the Ontario Operations' mines, concentrator, smelter, and refineries. In addition, other employee groups within the Ontario Operations are represented by United Steelworkers Local 2020-05 under separate collective bargaining agreements.

Employment terms and conditions for unionized employees, including wages, benefits, work rules, and health and safety provisions, are governed by collective bargaining agreements negotiated between Vale Base Metals and the respective unions. These agreements are reflected in the operating cost, labour availability, and productivity assumptions used in life-of-mine planning and in the preparation of the mineral resource and mineral reserve estimates presented in this Technical Report Summary.

17.6 QUALIFIED PERSON'S OPINION ON ADEQUACY OF CURRENT PLANS TO ADDRESS ISSUES

Vale Base Metals Environmental Management System provides framework for managing significant environmental aspects of its operations. All environmental permits required for operations are in place and monitored through EMS procedures, and compliance with permit conditions and regulatory requirements are further managed through the EMS. The EMS, and aspect- and regulation-specific plans, prepared for the Ontario Operations are adequate for addressing environmental issues.

Remediation of potential water impacts from historical operations, which has often involved capturing additional site surface runoff and seepages, will need to be balanced with clean water diversion and/or appropriate management to ensure that the wastewater treatment plant capacities are not exceeded.

18 CAPITAL AND OPERATING COSTS

18.1 INTRODUCTION

All capital and operating cost estimates are at a minimum at a pre-feasibility level of confidence, having an accuracy level of $\pm 25\%$ and a contingency range not exceeding 15%. The numbers presented in this Chapter are to demonstrate the economic viability of the mineral reserve. Information in this Chapter may differ from other information Vale Base Metals publishes on an annual detailed basis.

18.2 CAPITAL COST ESTIMATES

18.2.1 BASIS OF ESTIMATE

Capital costs are based on recent prices or operating data. Unit costs for in-house mine development are based on historical actual costs. Mobile equipment and fixed asset costs are based on supplier quotations and/or current examples. Sustaining capital cost forecasts are based on forecast mine development and construction needs, mobile equipment re-build/replacement schedules and fixed asset replacement and refurbishment schedules.

18.2.2 CAPITAL COST FORECASTS

Across the Ontario Operations, sustaining capital cost forecasts are prepared considering three main categories:

- Annual capital development: sustaining capital investments required to open up new mine production areas. This category includes underground tunneling and new infrastructure construction that will be in use for more than two years (e.g., ramps, ventilation raises, ore passes, switch rooms, backfill stations);
- Mobile equipment: acquisitions, replacements, and rebuilds;
- Asset integrity: capital investments required to maintain existing main infrastructure, and rebuild and replace fixed assets (e.g., shafts, main fresh air fans, material handling systems, mill equipment, smelting equipment).

In addition to the sustaining capital costs, costs may be assigned as “project” or “other”.

- “Project” capital costs consist of dedicated funds specific to a build generally exceeding a total cost of US\$50 M;
- Other costs include provision for elements such as the power department (electrical power generation and distribution), the divisional shops (custom parts repair and manufacturing), the transportation department, the Health, Safety and Environment department, and the Central Area Water Treatment and Utilities departments.

In addition, where the scope of a sustaining investment exceeds US\$50 M estimated capital cost, the project is developed following a front-end loading (FEL) methodology and subject to an internal process of technical review and stage gate approval. Currently there are no ongoing major capital projects in the reserves only mine plan.

18.2.3 CAPITAL COST ESTIMATE SUMMARY

The overall capital cost estimate for the LOM is US\$6,051 M as shown in Table 18-1. The capital cost estimates presented in this Report demonstrate the economic viability of the mineral reserve. This information may differ from other capital cost estimates Vale Base Metals publishes on an annual detailed basis.

Table 18-1: LOM Capital Cost Estimate (Real US\$)

Area	Capital Cost Type	Unit	Value
Mining	Annual capital development	US\$ M	1,036
	Mobile Equipment	US\$ M	499
	Asset integrity (Facilities/Buildings)	US\$ M	1,840
	Asset integrity (Fixed Equipment)	US\$ M	596
Milling	Sustaining	US\$ M	530
Smelting and refining	Sustaining	US\$ M	503
Other	Sustaining	US\$ M	1,047
Total		US\$ M	6,051

Note: All numbers have been rounded. "Other" costs include provision for elements such as the power department (electrical power generation and distribution), the divisional shops (custom parts repair and manufacturing), the transportation department, the environment department, and the central engineering department.

18.3 OPERATING COST ESTIMATES

18.3.1 BASIS OF ESTIMATE

Operating costs are based on actual costs from operations, and are projected through the LOM plan.

Historical costs are used as the basis for operating cost forecasts for supplies and services unless there are current contract terms for these items.

Labour and energy costs are based on budgeted rates applied to headcounts and energy consumption estimates.

The long-term mine operating cost model accounts for the impact of varying production rates on the direct and indirect variable cost items as per Vale Base Metals finance department definitions. As a mine approaches the end of mine life, some fixed (e.g., labour) and distributed costs are reduced in line with the projected lower production rates. The processing operating cost estimates are the budget year cash costs applied to the mineral reserves mined throughout the LOM plan. These processing costs include both variable and fixed plant components. The mineral reserves throughput for the processing plant decreases relative to the strategic plan that includes externally purchased feeds and transfers of feed from other Vale Base Metals operations over the LOM plan. As a result, the fixed cash cost component of the processing plant is stepped down in a logical progression as the feed decreases.

18.3.2 OPERATING COST ESTIMATE SUMMARY

Operating costs total US\$18,751 M over the LOM (Table 18-2).

The operating cost estimates presented in this Report demonstrate the economic viability of the mineral reserve. This information may differ from other operating cost estimates Vale Base Metals publishes on an annual detailed basis.

Table 18-2: LOM Operating Cost Estimate (Real US\$)

Area	Total LOM Cost	
	Unit	Value
Mining	US\$ M	8,510
Milling+Tailings	US\$ M	1,391
Smelting	US\$ M	2,181
Refining	US\$ M	2,088
General and administrative/corporate overhead	US\$ M	4,099
Logistics and distribution costs	US\$ M	482
Total	US\$ M	18,751

Note: All numbers have been rounded.

19 ECONOMIC ANALYSIS

19.1 INTRODUCTION

The aim of the economic evaluation presented in this Report Chapter is to demonstrate the economic viability of the mineral reserve. The production rates, operating efficiencies, costs and expenditures, taxes and other information presented can differ from other information Vale Base Metals publishes. The planned production extraction may vary due to continuous mineral exploration and technical studies to add new mineral reserves.

19.2 METHODOLOGY

The financial model that supports the mineral reserve declaration is a standalone model that calculates annual cash flows based on scheduled ore production, processing recoveries, metal sale prices, a C\$/US\$ exchange rate, projected operating and capital costs and estimated taxes.

The financial analysis is based on an after-tax discount rate of 6.3% following a mid-year convention and a long term C\$/US\$ exchange rate of 1.30. All costs and prices are in unescalated “real” dollars. The currency used to document the cash flow is US\$.

Operating cost estimates are based on fixed and variable expense definitions that are driven by planned activities and volumes. Capital cost estimates are derived from the budget rates and project studies and applied to planned development, construction, and asset purchase and refurbishment requirements.

Revenue is calculated from the recoverable metal and the long-term forecast of metal prices and exchange rates. Revenue from the sale of a copper concentrate is included, based on the contained metal, accountability factors and the long-term forecast for metals prices and exchange rates. Confidential premiums that Vale Base Metals receives are not included in external disclosure but are considered in the evaluation of mineral resources and mineral reserves and the resulting economic analysis.

The cash flow presented in this report does not include other materials treated by Sudbury processing assets, such as Ontario mineral resources external feeds acquired by Vale Base Metals from other mining companies and Manitoba concentrate.

19.3 INPUT PARAMETERS

For the economic analysis, the mineral reserves estimate used were summarized in Chapter 12.4, the metallurgical recovery forecast was provided in Chapter 10.4, the Commodity prices were discussed in Chapter 16.3; the capital costs were summarized in Chapter 18.2; the operating costs were summarized in Chapter 18.3; the royalties were summarized in Chapter 3.8; the closure and reclamation costs were discussed in Chapter 17.3.

The economic analysis is based on 100% equity financing and is reported on a 100% project ownership basis.

19.4 TAXATION CONSIDERATIONS

Vale Base Metals Canada Limited is subject to income and mining taxes, which are both profit-based taxes.

The financial estimates are based on a combined federal and provincial income statutory tax rate of 25% and a provincial mining tax rate of 10%, before processing allowance.

Depreciation rates for corporate income tax purposes have been applied, on a declining balance basis, at the base rates of 25% for depreciable tangible capital property and 30% for mine development. For mining tax purposes, depreciation has been approximated on a declining balance basis for mining (30%) and processing property (15%). Provincial mining processing allowance is further deducted as applicable. The mining tax paid is deductible for corporate income tax purposes.

The resulting total taxes shown below appear low, however this is due to a large offset from input tax credits.

19.5 RESULTS OF ECONOMIC ANALYSIS

The post-tax NPV 6.3% is US\$1,951 million (Table 19-1). A cash flow summary in grouped annual basis is provided in Table 19-2. We believe presenting the grouped cash flows over these periods accounts for the uncertainty in the actual timing and amounts of the cash flows and better represent the material information about the economic viability of mining the reserves which has a long mine life. The average closure costs are summarized as a long-term group (2047–2151) and indicated in the cash flow footnote (3) accompanying those tables

Figure 19-1 is an annualized cash flow from 2026–2046. The high initial cashflow results in negative free cashflow for 2026–2028, but this is necessary for asset development and sustaining future production.

As the cash flows are based on existing operations where all costs are considered sunk to 1 January 2026, considerations of payback and internal rate of return are not relevant.

Table 19-1: Economic Analysis Summary Table (Real \$US)

Item	Sub-item	Units	Total/Average
Production	Tonnes Ore Processed	Mt	69
	Copper	%	1.55
	Nickel	%	1.42
	Cobalt	%	0.03
	Platinum	g/t	1.02
	Palladium	g/t	1.13
	Gold	g/t	0.39
Metal recovery	Copper	kt	967
	Nickel	kt	770
	Cobalt	kt	7
	Platinum	koz	1,730
	Palladium	koz	2,025
	Gold	koz	616
Economic results	Total revenue	US\$ M	29,432
	Total operating costs	US\$ M	(18,751)
	Total capital costs	US\$ M	(6,051)
	Tax	US\$ M	(1)
	Closure	US\$ M	(1,268)
	Working capital	US\$M	301
	Free cash flow post-tax	US\$ M	3,662
	NPV @ 6.3%	US\$ M	1,951

Note: Totals may not sum due to rounding. All tonnages in metric tonnes. Economic analysis reported on a 100% Vale Base Metals basis; Vale owns a 90% interest and Manara Minerals the remaining 10% interest. Please refer to the note regarding forward-looking information at the front of the Report. Taxes are largely offset by input tax credits. The closure costs total US\$2.3 billion – financial model runs to 2060; the value in table above is discounted at 6.3% for 2061-2151. Figures shown do not deduct the stream amounts. For a description of the streaming arrangement with Wheaton Precious Metals, see Chapter 3.8

Table 19-2: Ontario Grouped Annual Cash flows 2026–2046

Cash flow	Unit	Grouped Periods				
		2026-2028	2029-2031	2032-2036	2037-2041	2042-2046
Average annual ore processed	Mt	4.9	4.8	3.6	2.7	1.6
Average annual nickel production	kt	36	46	38	38	29
Average annual copper production	kt	59	64	53	40	26
Average annual cobalt production	kt	0.3	0.4	0.3	0.3	0.3
Average annual platinum production	k oz	103	122	93	77	41
Average annual palladium production	k oz	96	121	118	108	49
Average annual gold production	k oz	31	47	35	29	13
Total revenue	US\$ million	4542	5766	7628	6866	4630
Total operating costs, expenses, royalties, and closure costs	US\$ million	-3549	-3481	-4799	-3987	-3331
Total tax and working capital change	US\$ million	67	37	-29	-76	-164
Total capital cost estimate	US\$ million	-1734	-1018	-1838	-917	-544
Total free cash flow	US\$ million	-718	1296	1086	1963	770

Notes:

(1) Metal sale prices can be found in Chapter 16.3.

(2) Figures shown do not deduct the stream amounts. For a description of the streaming arrangement with Wheaton Precious Metals, see Chapter 3.8.

(3) The closure costs from 2047–2151 total US\$2.0 billion. The closure costs over the full LOM (including progressive closure costs during 2026-2046) are US\$2.3 billion.

(4) The sole purpose of the presented numbers is to demonstrate the economic viability of the mineral reserve; therefore, these numbers can differ from other information Vale publishes and should not be considered as a guidance.

(5) Production values shown here are based on reserves only mine plan and does not include external feed – which results in the ore processed shown being lower than Clarabelle Mill capacity. The production metal values represent the final sold product.

Figure 19-1: Annual Cash flow

Annual Cash Flow - US\$ million



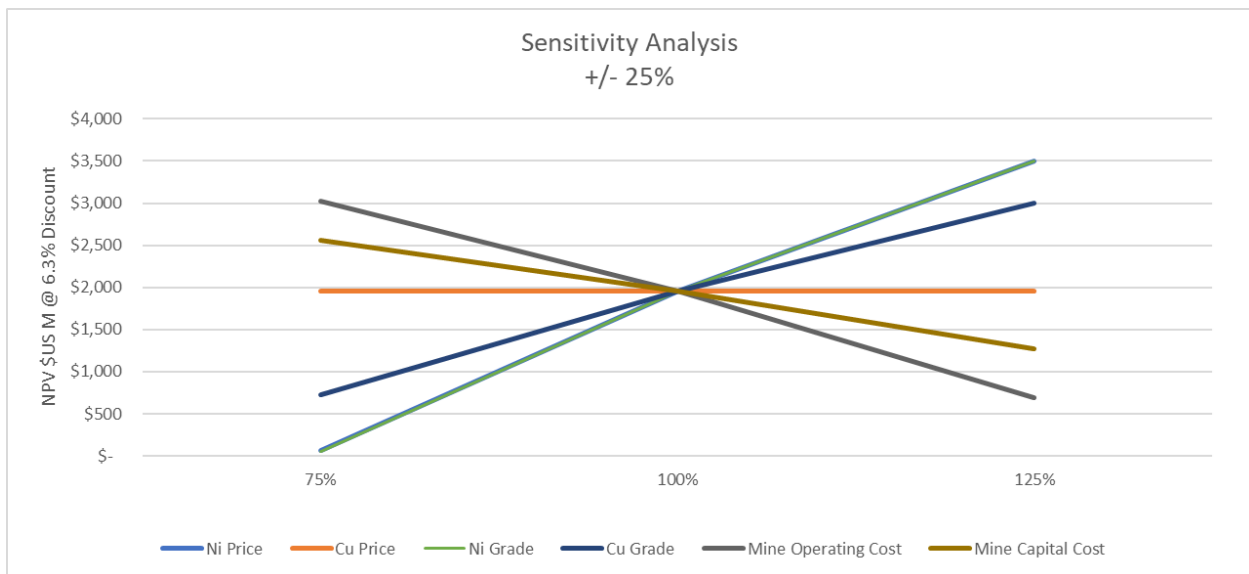
Notes: Figure prepared by Vale Base Metals, 2026. (1) Metal sale prices can be found in Chapter 16.3. (2) Figures shown do not deduct the stream amounts. For a description of the streaming arrangement with Wheaton Precious Metals, see Chapter 3.8. (3) The closure costs from 2047–2151 total US\$2.0 billion. The closure costs over the full LOM (including progressive closure costs during 2026-2046) are US\$2.3 billion. (4) The sole purpose of the presented numbers is to demonstrate the economic viability of the mineral reserve; therefore, these numbers can differ from other information Vale Base Metals publishes and should not be considered as a guidance.

19.6 SENSITIVITY ANALYSIS

A sensitivity analysis was performed on metal prices, metal recovered, capital costs and operating costs. These sensitivities are presented in Figure 19-2 at a $\pm 25\%$ range to illustrate the impact of the changes on the parameters shown to the economic analysis presented in this Report.

The Ontario Operations are primarily influenced by, in descending order: nickel price, nickel grade, operating cost, capital costs, copper price, and copper grade.

Figure 19-2: Sensitivity Analysis



Note: Figure prepared by Vale Base Metals, 2025.

20 ADJACENT PROPERTIES

This Chapter is not relevant to this Report.

21 OTHER RELEVANT DATA AND INFORMATION

This Chapter is not relevant to this Report.

22 INTERPRETATION AND CONCLUSIONS

The QPs note the following interpretations and conclusions in their respective areas of expertise, based on the review of data available for this Report.

22.1 EXPLORATION, DRILLING, AND SAMPLING

The exploration and drilling programs in the Sudbury basin and Ontario Operations area are appropriate for the deposit styles present. Drilling, sampling, and data collection methods meet industry standards and are suitable for mineral resource and reserve estimation. The quantity and quality of geological, geotechnical, and survey data are sufficient to support reliable resource and reserve estimates. Sampling is representative of the mineralization, and grades for nickel, copper, and PGEs are accurately reflected. Density estimation methods are robust and have been validated over time. QA/QC protocols, including blanks, duplicates, and standards, are in place and meet industry requirements, ensuring data reliability and integrity.

22.2 DATA VERIFICATION

Data verification procedures, including internal reviews and independent audits, confirm that the Ontario Operations database is reliable and suitable for mineral resource and reserve estimation. Verified data meet quality standards and support geological interpretations.

22.3 METALLURGICAL TESTWORK

Metallurgical testwork was conducted in accordance with industry standards, using representative samples from various mineralization types and deposit depths. Recovery factors are appropriate for the mineralization and process routes, with plant performance trending to forecast recovery values over time. Deleterious element concentrations in mill concentrate routinely meet smelter specifications. Process adjustments and cut-off grade modifications are made as needed to maintain concentrate quality and economic targets. Overall, the testwork and operational data support reliable metallurgical performance for mineral resource and reserve estimation.

22.4 MINERAL RESOURCE ESTIMATES

Mineral resources for the Blezard, Coleman, Copper Cliff, Creighton, Ella–Capre, Stobie, Garson (including McConnell), Totten, and Nickel Rim South Extension deposits were estimated following Vale Base Metals' established protocols and internal controls. Estimates comply with S-K 1300 definitions and exclude resources converted to reserves; the reference point is in situ. Key uncertainties impacting the estimates include assumptions related to long-term metal prices and exchange rates, local geological interpretations, mineralization continuity, drill data density, metallurgical recoveries, mining methods, dilution, recovery, cut-off values, and permitting or social licence factors.

22.5 MINERAL RESERVE ESTIMATES

Mineral reserves for the Coleman, Copper Cliff, Creighton, Garson, and Totten Mines (underground) and Stobie Pit (open pit) have been estimated in accordance with S-K 1300 definitions, using established protocols and validated data. Reserves were converted from measured and indicated mineral resources, applying mine-specific economic cut-off grades, mining recovery, and dilution factors. Only stopes meeting or exceeding forecast cut off value are included in the reserve estimate. The reference point is delivery to the process plant. Key uncertainties that may materially impact the reserve estimates include assumptions on long-term pricing, exchange rates, consumables, geotechnical and hydrogeological factors, metallurgical and mining recoveries, and continued access and permitting. Overall, the QP considers the mineral reserve estimates are reliable and suitable for public reporting under S-K 1300.

22.6 MINING METHODS

The Ontario Operations utilize conventional underground bulk stoping and cut-and-fill methods, as well as open pit mining at Stobie Pit, with equipment and approaches appropriate for the geological settings. All underground mines are Owner-operated, with open pit mining managed by a contractor. Robust Ground Control and Seismic Risk Management Plans are in place and updated regularly, addressing identified seismic hazards, particularly at Coleman, Creighton, Copper Cliff, Garson, and Totten. Backfill practices are appropriate to site logistics, and hydrological management systems are effective for current and anticipated inflows. Mining methods and stope designs have been selected based on extensive operational experience and geotechnical analysis. Production schedules are supported by mineral reserve estimates and account for infrastructure constraints. Based on these plans, the forecast mine life for Ontario Operations is 21 years (2026–2046). The Qualified Person considers the mining methods and schedules appropriate.

22.7 RECOVERY METHODS

The Clarabelle Mill, Copper Cliff Smelter and refinery, Clydach Refinery, and Port Colborne Refinery employ processes and equipment appropriate for the mineralization and product streams. Process variations are managed to achieve forecast recoveries over reporting periods. Specialized processes, such as the pressure carbonyl method, are well established and operate reliably. All facilities are suitable for mineral resource and reserve estimation, and support consistent product delivery to market. The Qualified Person considers the recovery methods and plant designs appropriate and fit for purpose.

22.8 INFRASTRUCTURE

All essential infrastructure for mining and processing at the Ontario Operations is in place and suitable to support the Life of Mine (LOM) plan. Waste rock is effectively managed, primarily stored underground, while the Central Tailings Area and slag storage sites provide sufficient capacity for LOM requirements. Water and power supplies are reliable, with established sources and contingency provisions adequately meeting operational needs. Environmental controls and dam safety are maintained in line with current regulatory standards and best practices. Overall, the infrastructure is robust and appropriate for sustaining long-term operations.

22.9 ENVIRONMENTAL, PERMITTING AND SOCIAL CONSIDERATIONS

Vale Base Metals Ontario Operations have established robust environmental management practices and comply with evolving regulatory requirements. Baseline studies, closure plans, and regular updates are in place for all mine and plant sites, ensuring accurate depiction of onsite conditions and liabilities. Closure cost estimates, totalling US\$2,279 million (C\$2,963 million) as at year-end 2025, are integrated into financial models and updated as required. All necessary permits and approvals are maintained, with renewal applications submitted as needed. The company actively engages with Indigenous communities and local stakeholders through formal agreements, ongoing consultations, and established grievance mechanisms. There are no known consultation obligations materially impacting mineral reserve estimates, though such obligations may apply to future developments. The Qualified Person considers environmental, permitting, and social practices appropriate and sufficient for continued operations.

22.10 CAPITAL AND OPERATING COST ESTIMATES

Capital cost estimates for the LOM are based on recent pricing, historical data, and supplier quotations, totalling US\$6,051 million. Sustaining capital projections reflect forecasted mine development, equipment replacement, and fixed asset refurbishment. Operating costs, projected at US\$18,751 million over the LOM, are grounded in actual site costs, contract terms, and budgeted rates for labour and energy. Both capital and operating cost estimates are considered robust and demonstrate the economic viability of the mineral reserve. The QP notes that these estimates may differ from annual detailed reports published by Vale Base Metals.

22.11 ECONOMIC ANALYSIS

The financial model that supports the mineral reserve declaration is a standalone model that calculates annual cash flows based on scheduled ore production, processing recoveries, metal sale prices, a C\$/US\$ exchange rate, projected operating and capital costs and estimated taxes. All costs and prices are in unescalated “real” dollars. The currency used to document the cash flow is US\$.

Absent from the reserve-only cash flow are Ontario mineral resources, external feeds acquired by Vale Base Metals from other mining companies and Manitoba concentrate treated by the Sudbury processing assets.

The post-tax NPV 6.3% is US\$1,951 million. As the cash flows are based on existing operations where all costs are considered sunk to 1 January 2026, considerations of payback and internal rate of return are not relevant.

22.12 RISKS AND OPPORTUNITIES

22.12.1 RISKS

Factors that may affect the mineral resource and mineral reserve estimates were identified in Chapter 11.14 and Chapter 12.5 respectively.

Risks to the Ontario Operations as a whole include:

- Changes to the regulatory, permitting and monitoring regimes set out in Chapter 17.1, Chapter 17.2, and Chapter 17.4, and the taxation assumptions in Chapter 19.4 could affect mine planning, infrastructure operation, closure planning, capital cost assumptions, overall operating cost assumptions, the duration of the LOM plan, and the economic analysis that supports the mineral reserve estimates;
- Changes to the social licence assumptions, changes to relationships with First Nations groups, and changes to relationships with stakeholders in the Sudbury area could affect the social licence to operate, and the duration of the LOM plan;
- Non-renewal of the OIC permits, such that Vale Base Metals cannot export nickel, copper and precious metals products outside of Canada for further refinement. This could affect operation of the Clydach Refinery. Changes could also affect marketing assumptions, operating assumptions, the duration of the LOM plan, and the economic analysis that supports the mineral reserve estimates;
- Five of the mining operations are classified as seismically active. While those operations have a Seismic Management Plan in place, designed to identify, assess and manage seismic hazards, there remains potential for unexpected seismic disturbance. Seismic events have the potential to change geotechnical and hydrological assumptions, sterilize portions of the mine plan, result in an increase in capital costs to repair damaged equipment and infrastructure, increase operating costs due to mitigation measures, and impact the economic analysis that supports the mineral reserve estimates;
- Geotechnical and hydrological assumptions used in mine planning consider historical performance, and to date historical performance has been a reasonable predictor of current conditions. Any changes to the geotechnical and hydrological assumptions could affect mine planning, affect capital cost estimates if any major rehabilitation is required due to a geotechnical or hydrological event, affect operating costs due to mitigation measures that may need to be imposed, and impact the economic analysis that supports the mineral reserve estimates;
- Mining methods are based on a combination of historical performance of selected mining methods in the various Sudbury mines, orebody orientations, and consideration of factors such as geological, geotechnical, and hydrological settings. The selected mining method as envisaged in the LOM plan may vary due to operational reasons. Changes could occur in

that instance to the actual mine plan in terms of redesigns and resequencing, in supporting requirements such as ventilation, haulage, equipment, and production rate, in estimations of sustaining capital and operating costs, production schedules, and could impact the economic analysis that supports the mineral reserve estimates;

- Recovery methods assume the Clarabelle Mill, Copper Cliff Smelter and Refinery, Clydach Refinery and Port Colborne Refinery will be operational for the LOM. The LOM plan incorporates costs and recoveries for these facilities based on historical performance, and to date historical performance has been a reasonable predictor of current conditions. However, if costs and recoveries vary, either positively or negatively in future performance, there is a risk that the assumed process (mill, smelter, refinery) recoveries, capital or operating costs will differ from those envisaged in this Report, and that there could be an impact on the economic analysis that supports the mineral reserve estimates;
- The Central Tailings Area is the central repository for tailings and certain types of waste for the Ontario Operations. It is also a major process water source. While Vale Base Metals has undertaken numerous studies on the Central Tailings Area to update various aspects of the facility to meet current dam engineering practices, there may be areas that require additional updates or upgrades. Where these have not been contemplated in the LOM plan, such updates could affect capital and operating cost estimates, and there could be an impact the economic analysis that supports the mineral reserve estimates;
- Closure costs for the entire Ontario Operations are estimated at US\$2,279 million, and closure costs are estimated out to 2151. This forecast may change if additional mineral reserves can be identified that would prolong the mine life, or if mining activities cease prior to the projected 2046 date;
- As part of our Water Quality Management Plan, water quality studies remain actively underway and identifying new liabilities through updated study work. New mitigations are added to closure plans as FEL work is completed which may increase future closure plan cost estimates;
- The Smelter Complex operates under a Nickel Site-Specific Standard expiring in 2031, with an action plan to achieve compliance with O.Reg 419/05 in due course. Failure to meet provincial standard for annual nickel emissions could result in operational and reputational risks;
- Assumptions that the long-term reclamation and mitigation of the Ontario Operations can be appropriately managed within the estimated closure timeframes and closure cost estimates;
- The management of water quality impacts, and the associated regulatory implications, resulting from past practices when environmental protection programs and regulations were less robust remains a significant risk;
- Market studies, commodity prices, and exchange rates are based on the most current information available to Vale Base Metals. While mineral resource, mineral reserve and economic analysis for the LOM use this information, there is a risk of recession or upturn in commodity markets that could have an impact, either negative or positive, on the commodity pricing and exchange rate assumptions, and on the economic analysis that supports the mineral reserve estimates;
- Capital costs are considered to have a reasonable basis, assuming equipment and infrastructure operates as envisaged. Unexpected equipment or infrastructure failures will result in increases to the capital cost estimate as such equipment or infrastructure is repaired or replaced. That will have an effect on the economic analysis that supports the mineral reserve estimates;
- Operating costs are considered to have a reasonable basis, assuming equipment and infrastructure operates as envisaged, and inputs, such as wages, power costs, consumables

costs remain as forecast in the LOM plan. Changes to these assumptions will result in changes to the operating cost estimates, and on the economic analysis that supports the mineral reserve estimates;

- The mines have many legacy old workings that cannot be accessed and assessed for asset condition, and historical mining that connects to surface old workings. As such, there are uncertainties with the operations' ability to manage water and prevent water inrush;
- The Ontario Operations are planning productivity improvements as a result of the implementation of new processes such as dispatch and short-term scheduling. There is a risk that the mines will not achieve the forecasted improvement, potentially impacting cash flow.

22.12.2 OPPORTUNITIES

Opportunities for the Ontario Operations as a whole include:

- Conversion of some or all of the measured and indicated mineral resources currently reported exclusive of mineral reserves to mineral reserves, with appropriate supporting studies;
- Vale Base Metals conducts internal mining studies using mineral resource estimates to determine if there is potential for new or in-mine expansion projects to be built. If these studies support mineral reserve estimates and can be incorporated into the LOM plan, such projects represent upside potential for the Ontario Operations;
- Upgrade of some or all of the inferred mineral resources to higher-confidence categories, such that such better-confidence material could be used in mineral reserve estimation;
- Higher metal prices than forecast could present upside sales opportunities and potentially an increase in predicted Project economics;

22.13 CONCLUSIONS

Under the assumptions presented in this Report, the Ontario Operations have a positive cash flow, and mineral reserve estimates can be supported.

23 RECOMMENDATIONS

The QPs make the following recommendations for Ontario Operations:

- Complete, in conjunction with Glencore, an updated feasibility study to support conversion of Nickel Rim South Extension to reserves. As the deposit crosses the boundary between Glencore and Vale Base Metals ownership – a collaborative effort is assumed for the mining of Nickel Rim South Extension. The study should consist of developing the 24N, BL28, and NR14 zones, located at 1,500–2,800 m below surface at the Nickel Rim South Extension property. The study should focus on using existing Nickel Rim South mine infrastructure for the development evaluation. The estimated cost to complete the study is approximately US\$ 11 million
- Complete a pre-feasibility study to support the addition of mineral resources at the Ella-Capre and Murray deposits. The estimated cost to complete the study is approximately US\$ 50 million.

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24.2 ABBREVIATIONS AND SYMBOLS

Acronym, Abbreviation or Symbol	Term
'	foot
"	inch
3D	three dimensions, three dimensional
AQTK	core size (35 mm diameter) used in drilling
ALS	ALS Minerals Laboratories
As	arsenic
Au	gold
BQ	core size (36.4 mm diameter) used in drilling
BXSU	breccia sulphide
C\$	Canadian Dollar
CAGR	compound annual growth rate
CC	Copper Cliff
CC Pit	Copper Cliff Pit
cm	centimetre
CORe	challenging ore recovery (flowsheet/project)
Cp	chalcopyrite
CSIS	contorted schist inclusion sulphide
Cu	copper
CuEq	copper equivalent (see metal equivalent in definitions)
DCP	direct current plasma (analytical method)
dia	diameter
DISS	disseminated sulphide
DTM	digital terrain model
EW	electrowinning
FCS	Full circuit simulation
Fe	iron
FEL	front-end loading (engineering study phase)
FEL1	Vale Base Metals term for an internal conceptual study, used to evaluate the potential of a business
FEL2	Vale Base Metals term for an internal mining study (prefeasibility level), used to define the best project development alternative
FEL3	Vale Base Metals term for an internal mining study (feasibility level) focusing on detailed engineering, risk mitigation, cost accuracy, and execution planning (often called FEED or Basic Engineering), to solidify the project's scope, budget (e.g., +/-10%), and schedule for a final go/no-go decision before committing to major spending.
FeNi	ferronickel
ft	foot (feet)
G&A	general and administrative (costs)
g/t	grams per tonne

Acronym, Abbreviation or Symbol	Term
GDMS	Geoscience Data Management System
GPIIS	gabbro–peridotite inclusion sulphide
GPS	global positioning system
ha	hectare(s)
hp	horsepower (745.7 w)
ICP	inductively coupled plasma (analytical method)
ICP-AES	inductively coupled plasma–atomic emission spectrometry
IDW	inverse distance weighting (estimation method)
in	inch
Inco	International Nickel Company of Canada, Limited
INMS	inclusion massive sulphide
INSU	interstitial sulphide
IP	induced polarization (geophysical method)
IPC	Inco pressure carbonyl process (part of the Copper Cliff refinery complex)
ISO/IEC	The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), two non-governmental bodies that create global benchmarks for quality, safety, and consistency across various industries.
ITH	in-the-hole drills
kA	kilo (thousand) amps
kcfm	thousand cubic feet per minute (ventilation)
km	kilometres
KNA	kriging neighbourhood analysis
kt	kilotonnes (1,000 tonnes)
Kt/a	kilotonnes per year (annum)
kV	kilovolt (1000 volts)
kW	kilowatt(s)
L	litre or “level”
LHD	load-haul-dump (underground mining equipment)
LiDAR	light detection and ranging - this is a remote sensing technology that uses pulsed laser light to measure distances, creating precise 3d maps.
LOM	life-of-mine
LOM Plan / LOMP	life-of-mine plan
µm	micrometre
m	metre
m ³	cubic metre
m ³ /hr	cubic metres per hour
M	million
MASU	massive sulphide
metal Eq	metal equivalent
mm	millimetre

Acronym, Abbreviation or Symbol	Term
MHP	mixed hydroxide precipitate
Mt	million tonnes
MW	megawatt(s)
MWh	megawatt hour
NQ	core size (47.6 mm diameter) used in drilling
Ni	nickel
NN	nearest neighbour
NPI	nickel pig iron
NPR	net processing return
NPV	net present value
NRC	nickel refinery converter
NSR	net smelter return
OIC	Order-in-Council
OK	ordinary kriging (estimation method)
ORP	oxidation-reduction potential
oz	ounce
oz/t	troy ounces per short ton
P&E	preliminary economic assessment
Pd	palladium
PGE	platinum group elements
pH	q logarithmic scale used to specify the acidity or basicity of aqueous solutions
Pn	pentlandite
Po	pyrrhotite
psi	pounds per square inch
PTTW	permit to take water
Pt	platinum
QA/QC	quality assurance / quality control
QP	Qualified Person
QPE	Qualified Person's estimate
RGDI	ragged disseminated sulphide
RIM	radio imaging method (geophysical)
RMR	rock mass rating
RPM	revolutions per minute
RQD	rock quality designation
SAG	semi-autogenous grinding (mill/process)
S	sulphur
SG	specific gravity
SIC	Sudbury Igneous Complex
S-K 1300	Regulation S-K 1300 (mining disclosure standard)

Acronym, Abbreviation or Symbol	Term
SMU	selective mining unit
SRM	standard reference material
SUBX	Sudbury breccia
t	tonne (metric ton)
t/d	tonnes per day
ton/ft ³	US customary (short) tons per cubic ft
TSF	tailings storage facility
UCS	unconfined compressive strength, also known as uniaxial compressive strength.
UPA	Upper Pond Area (tailings/water management)
US\$	United States dollar
US\$ M	million US dollars
UTEM-4	University of Toronto Electro Magnetometer (geophysical)
VDC	volts direct current
VTD	Vale Base Metals Technical Development
WWTP	waste water treatment plant
XRF	X-ray fluorescence (analytical method)
yd ³	cubic yard

24.3 GLOSSARY OF TERMS

Term	Definition
acid rock drainage/ acid mine drainage	Characterized by low pH, high sulfate, and high iron and other metal species.
amphibolite facies	One of the major divisions of the mineral-facies classification of metamorphic rocks, the rocks of which formed under conditions of moderate to high temperatures (500° C, or about 950° F, maximum) and pressures. Amphibole, diopside, epidote, plagioclase, almandine and grossular garnet, and wollastonite are minerals typically found in rocks of the amphibolite facies
ANFO	A free-running explosive used in mine blasting made of 94% prilled aluminum nitrate and 6% No. 3 fuel oil.
azimuth	The direction of one object from another, usually expressed as an angle in degrees relative to true north. Azimuths are usually measured in the clockwise direction; thus an azimuth of 90 degrees indicates that the second object is due east of the first.
backfill	Material used to fill voids in underground mines
ball mill	A piece of milling equipment used to grind ore into small particles. It is a cylindrical shaped steel container filled with steel balls into which crushed ore is fed. The ball mill is rotated causing the balls themselves to cascade, which in turn grinds the ore.
benchmark	Benchmarking is comparing a mine's performance (costs, efficiency, safety, environmental impact, product selling price) against peers or industry standards to find inefficiencies, identify best practices, and set improvement goals, using data on KPIs like cost per ton, labor productivity, and equipment utilization.

Term	Definition
blasthole	A hole drilled for the placement of explosives
Bond work index (BWi)	A measure of the energy required to break an ore to a nominal product size, determined in laboratory testing, and used to calculate the required power in a grinding circuit design.
Cataclasite	a band of ground rock fragments found in the core of a fault, often formed by the fragmentation of rock due to high crack density
comminution/crushing/grinding	Crushing and/or grinding of ore by impact and abrasion. Usually, the word "crushing" is used for dry methods and "grinding" for wet methods. Also, "crushing" usually denotes reducing the size of coarse rock while "grinding" usually refers to the reduction of the fine sizes.
concentrate	The concentrate is the valuable product from mineral processing, as opposed to the tailing, which contains the waste minerals. The concentrate represents a smaller volume than the original ore
conductivity	Measures a material's ability to transmit energy, most commonly electrical current, by movement of charged particles (electrons or ions). The reciprocal of resistivity.
correlogram	A plot showing how the correlation between data values changes with distance (lag), revealing spatial patterns where nearby points are more similar than distant ones, typically decreasing to zero correlation, and serves to visualize spatial dependence, check for randomness,
crosscut	A horizontal opening driven across the course of a vein or structure, or in general across the strike of the rock formation; a connection from a shaft to an ore structure.
crown pillar	An ore pillar at the top of an open stope left for wall support and protection from wall sloughing above
cut-and-fill stoping	If it is undesirable to leave broken ore in the stope during mining operations (as in shrinkage stoping), the lower portion of the stope can be filled with waste rock and/or mill tailings. In this case, ore is removed as soon as it has been broken from overhead, and the stope filled with waste to within a few feet of the mining surface. This method eliminates or reduces the waste disposal problem associated with mining as well as preventing collapse of the ground at the surface.
cut-off grade	A grade level below which the material is not "ore" and considered to be uneconomical to mine and process. The minimum grade of ore used to establish reserves.
data verification	The process of confirming that data has been generated with proper procedures, has been accurately transcribed from the original source and is suitable to be used for mineral resource and mineral reserve estimation
decline	A sloping underground opening for machine access from level to level or from the surface. Also called a ramp.
deleterious elements	Impurities like arsenic (As), mercury (Hg), lead (Pb), bismuth (Bi), antimony (Sb), cadmium (Cd), fluorine (F), and zinc (Zn) that increase smelting/refining costs, cause environmental issues, affect worker health, and can lead to penalties or rejection by smelters.
density	The mass per unit volume of a substance, commonly expressed in grams/ cubic centimeter.
depletion	The decrease in quantity of ore in a deposit or property resulting from extraction or production.

Term	Definition
development	Often refers to the construction of a new mine or; Is the underground work carried out for the purpose of reaching and opening up a mineral deposit. It includes shaft sinking, cross-cutting, drifting and raising.
diabase	US terminology for an intrusive rock whose main components are labradorite and pyroxene, and characterized by an ophiolitic texture. Corresponds to a diorite.
dilution	Waste of low-grade rock which is unavoidably removed along with the ore in the mining process.
discounted cash flow (DCF)	Concept of relating future cash inflows and outflows over the life of a project or operation to a common base value thereby allowing more validity to comparison of projects with different durations and rates of cash flow.
dolime	Dolime, also known as dolomitic quicklime or burnt dolomite, is calcium magnesium oxide (CaO·MgO) produced by heating (calcining) dolomitic limestone.
drift	A horizontal mining passage underground. A drift usually follows the ore vein, as distinguished from a crosscut, which intersects it.
dynamic anisotropy	Dynamic anisotropy in mining uses software to create a flexible, block-by-block search ellipsoid that adapts to the changing orientation (trend and dip) of mineralization, improving resource estimation by precisely following orebody shapes, unlike static methods that use a single orientation
easement	Areas of land owned by the property owner, but in which other parties, such as utility companies, may have limited rights granted for a specific purpose.
electrowinning.	The removal of precious metals from solution by the passage of current through an electrowinning cell. A direct current supply is connected to the anode and cathode. As current passes through the cell, metal is deposited on the cathode. When sufficient metal has been deposited on the cathode, it is removed from the cell and the sludge rinsed off the plate and dried for further treatment.
encumbrance	An interest or partial right in real property which diminished the value of ownership, but does not prevent the transfer of ownership. Mortgages, taxes, and judgements are encumbrances known as liens. Restrictions, easements, and reservations are also encumbrances, although not liens.
escapeway	An escapeway is a passage designed for emergency exit, most commonly referring to the critical, separate routes miners use to escape underground mines, often featuring ladders, refuge chambers, and clear maps for rapid evacuation in emergencies like fires or collapses
feasibility study	<p>A feasibility study is a comprehensive technical and economic study of the selected development option for a mineral project, which includes detailed assessments of all applicable modifying factors, as defined by this section, together with any other relevant operational factors, and detailed financial analysis that are necessary to demonstrate, at the time of reporting, that extraction is economically viable. The results of the study may serve as the basis for a final decision by a proponent or financial institution to proceed with, or finance, the development of the project.</p> <p>A feasibility study is more comprehensive, and with a higher degree of accuracy, than a pre-feasibility study. It must contain mining, infrastructure, and process designs completed with sufficient rigor to</p>

Term	Definition
	serve as the basis for an investment decision or to support project financing.
ferronickel	An iron-nickel alloy, rich in nickel (often 20-40%), produced from nickel ores and primarily used as a key ingredient in making stainless steel and heat-resistant alloys
flotation	Separation of minerals based on the interfacial chemistry of the mineral particles in solution. Reagents are added to the ore slurry to render the surface of selected minerals hydrophobic. Air bubbles are introduced to which the hydrophobic minerals attach. The selected minerals are levitated to the top of the flotation machine by their attachment to the bubbles and into a froth product, called the "flotation concentrate." If this froth carries more than one mineral as a designated main constituent, it is called a "bulk float". If it is selective to one constituent of the ore, where more than one will be floated, it is a "differential" float.
flowsheet	The sequence of operations, step by step, by which ore is treated in a milling, concentration, or smelting process.
footwall	The wall or rock on the underside of a vein or ore structure.
frother	A type of flotation reagent which, when dissolved in water, imparts to it the ability to form a stable froth
gangue	The fraction of ore rejected as tailing in a separating process. It is usually the valueless portion, but may have some secondary commercial use
geotechnical	Relating to the engineering properties of earth materials
grade capping	The process of limiting the influence of high-grade samples by limiting the maximum grade off at a certain level.
granulite facies	One of the major divisions of the mineral facies classification of metamorphic rocks, the rocks of which formed under the most intense temperature-pressure conditions usually found in regional metamorphism. At the upper limit of the facies, migmatite formation may occur. Temperatures of 650–1,100 °C (1,200–2,000 °F) and pressures of 3–10 kilobars may be reached. The more common minerals include pyroxene, biotite, garnet, calcium plagioclase, and quartz or olivine.
greenschist facies	One of the major divisions of the mineral facies classification of metamorphic rocks, the rocks of which formed under the lowest temperature and pressure conditions usually produced by regional metamorphism. Temperatures between 300 and 450 °C (570 and 840 °F) and pressures of 1 to 4 kilobars are typical. The more common minerals found in such rocks include quartz, orthoclase, muscovite, chlorite, serpentine, talc, and epidote
grizzly	A heavy steel grate or set of parallel bars used for coarse screening to separate large rocks from smaller material, preventing oversized chunks from jamming ore chutes or damaging crushers below
hanging wall	The wall or rock on the upper or top side of a vein or ore deposit.
hydrogeology	The study of groundwater and its movement through soil and rock
hydrometallurgy	A type of extractive metallurgy utilizing aqueous solutions/solvents to extract the metal value from an ore or concentrate. Leaching is the predominant type of hydrometallurgy.
indicated mineral resource	An indicated mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of adequate geological evidence and sampling. The term adequate

Term	Definition
	<p>geological evidence means evidence that is sufficient to establish geological and grade or quality continuity with reasonable certainty. The level of geological certainty associated with an indicated mineral resource is sufficient to allow a qualified person to apply modifying factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.</p>
inferred mineral resource	<p>An inferred mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of limited geological evidence and sampling. The term limited geological evidence means evidence that is only sufficient to establish that geological and grade or quality continuity is more likely than not. The level of geological uncertainty associated with an inferred mineral resource is too high to apply relevant technical and economic factors likely to influence the prospects of economic extraction in a manner useful for evaluation of economic viability.</p> <p>A qualified person must have a reasonable expectation that the majority of inferred mineral resources could be upgraded to indicated or measured mineral resources with continued exploration; and should be able to defend the basis of this expectation before his or her peers.</p>
initial assessment	<p>An initial assessment is a preliminary technical and economic study of the economic potential of all or parts of mineralization to support the disclosure of mineral resources. The initial assessment must be prepared by a qualified person and must include appropriate assessments of reasonably assumed technical and economic factors, together with any other relevant operational factors, which are necessary to demonstrate at the time of reporting that there are reasonable prospects for economic extraction. An initial assessment is required for disclosure of mineral resources but cannot be used as the basis for disclosure of mineral reserves</p>
internal rate of return (IRR)	<p>The rate of return at which the Net Present Value of a project is zero; the rate at which the present value of cash inflows is equal to the present value of the cash outflows.</p>
Interpolate/interpolation	<p>The process of estimating unknown data values that fall between known data points, assuming a continuous trend or pattern connects them.</p>
IP	<p>Geophysical method, induced polarization; used to directly detect scattered primary sulfide mineralization. Most metal sulfides produce IP effects, e.g., chalcopyrite, bornite, chalcocite, pyrite, pyrrotite</p>
ISO/IEC	<p>The International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), two non-governmental bodies that create global benchmarks for quality, safety, and consistency across various industries.</p>
kriging	<p>A geostatistical method for spatial interpolation, estimating unknown values at locations based on known sampled data points by considering their spatial relationships and continuity.</p>
kriging neighbourhood analysis (KNA)	<p>The primary goal of KNA is to optimize the parameters used in kriging to ensure that the block model's grade estimates are both accurate and reliable. The process optimizes the search radius, number of samples, block discretization, and the anisotropy and variogram models.</p>
liberation	<p>Freeing, by comminution, of particles of specific mineral from their interlock with other constituents of the ore.</p>

Term	Definition
life of mine (LOM)	Number of years that the operation is planning to mine and treat ore, and is taken from the current mine plan based on the current evaluation of ore reserves.
magnetic separation	Use of permanent or electro-magnets to remove relatively strong ferromagnetic particles from para- and dia-magnetic ores.
measured mineral resource	A measured mineral resource is that part of a mineral resource for which quantity and grade or quality are estimated on the basis of conclusive geological evidence and sampling. The term conclusive geological evidence means evidence that is sufficient to test and confirm geological and grade or quality continuity. The level of geological certainty associated with a measured mineral resource is sufficient to allow a qualified person to apply modifying factors, as defined in this section, in sufficient detail to support detailed mine planning and final evaluation of the economic viability of the deposit.
metal equivalent	A metal equivalent formula converts the value of multiple metals in an ore into a single metal's value, accounting for metal prices, recovery rates, and assay values to simplify reporting for investors.
metathetic	Chemical reaction between two compounds in which parts of each are interchanged to form two new compounds
mill	Includes any ore mill, sampling works, concentration, and any crushing, grinding, or screening plant used at, and in connection with, an excavation or mine.
mineral reserve	<p>A mineral reserve is an estimate of tonnage and grade or quality of indicated and measured mineral resources that, in the opinion of the qualified person, can be the basis of an economically viable project. More specifically, it is the economically mineable part of a measured or indicated mineral resource, which includes diluting materials and allowances for losses that may occur when the material is mined or extracted.</p> <p>The determination that part of a measured or indicated mineral resource is economically mineable must be based on a preliminary feasibility (pre-feasibility) or feasibility study, as defined by this section, conducted by a qualified person applying the modifying factors to indicated or measured mineral resources. Such study must demonstrate that, at the time of reporting, extraction of the mineral reserve is economically viable under reasonable investment and market assumptions. The study must establish a life of mine plan that is technically achievable and economically viable, which will be the basis of determining the mineral reserve.</p> <p>The term economically viable means that the qualified person has determined, using a discounted cash flow analysis, or has otherwise analytically determined, that extraction of the mineral reserve is economically viable under reasonable investment and market assumptions.</p> <p>The term investment and market assumptions includes all assumptions made about the prices, exchange rates, interest and discount rates, sales volumes, and costs that are necessary to determine the economic viability of the mineral reserves. The qualified person must use a price for each commodity that provides a reasonable basis for establishing that the project is economically viable.</p>
mineral resource	A mineral resource is a concentration or occurrence of material of economic interest in or on the Earth's crust in such form, grade or quality, and quantity that there are reasonable prospects for economic extraction.

Term	Definition
	<p>The term material of economic interest includes mineralization, including dumps and tailings, mineral brines, and other resources extracted on or within the earth's crust. It does not include oil and gas resources as defined in Regulation S-X (§210.4-10(a)(16)(D) of this chapter), gases (e.g., helium and carbon dioxide), geothermal fields, and water.</p> <p>When determining the existence of a mineral resource, a qualified person, as defined by this section, must be able to estimate or interpret the location, quantity, grade or quality continuity, and other geological characteristics of the mineral resource from specific geological evidence and knowledge, including sampling; and conclude that there are reasonable prospects for economic extraction of the mineral resource based on an initial assessment, as defined in this section, that he or she conducts by qualitatively applying relevant technical and economic factors likely to influence the prospect of economic extraction.</p>
mining recovery	The percentage of ore removed from an orebody during mining relative to the planned tonnage
mixed hydroxide precipitate	Intermediate product in nickel processing, especially from low-grade laterite ores, containing both nickel and cobalt hydroxides, and serves as a primary feedstock for producing materials for lithium-ion batteries (like NMC cathodes) and other nickel products, often produced via High Pressure Acid Leaching (HPAL) and further refined through hydrometallurgical or carbonyl processes.
modifying factors	The factors that a qualified person must apply to indicated and measured mineral resources and then evaluate in order to establish the economic viability of mineral reserves. A qualified person must apply and evaluate modifying factors to convert measured and indicated mineral resources to proven and probable mineral reserves. These factors include, but are not restricted to mining; processing; metallurgical; infrastructure; economic; marketing; legal; environmental compliance; plans, negotiations, or agreements with local individuals or groups; and governmental factors. The number, type and specific characteristics of the modifying factors applied will necessarily be a function of and depend upon the mineral, mine, property, or project.
muck	<p>1) (noun) A general term for the broken rock, ore, etc., excavated from tunnels or shafts after drilling and blasting.</p> <p>2) (verb) A general term for digging and moving muck</p>
net present value (NPV)	The present value of the difference between the future cash flows associated with a project and the investment required for acquiring the project. Aggregate of future net cash flows discounted back to a common base date, usually the present. NPV is an indicator of how much value an investment or project adds to a company.
net processing return (NPR)	The net in situ value of the mineralized material before it is extracted, then the processing costs and certain direct corporate costs are subtracted from the anticipated revenue of the recoverable metal using the appropriate long-term sale price and exchange rate assumptions.
net smelter return	The revenue (or estimated revenue) a mine receives from selling its mineral products (like ore or concentrate) after deducting costs for transportation, smelting, refining, and other off-site expenses, but before accounting for on-site mining and processing costs.
net smelter return royalty (NSR)	A defined percentage of the gross revenue from a resource extraction operation, less a proportionate share of transportation, insurance, and processing costs.

Term	Definition
nickel pig iron (NPI)	Nickel pig iron (NPI) is a low grade ferronickel invented in China as a cheaper alternative to pure nickel for the production of stainless
open pit	A mine that is entirely on the surface. Also referred to as open-cut or open-cast mine.
open stope	In competent rock, it is possible to remove all of a moderate sized ore body, resulting in an opening of considerable size. Such large, irregularly-shaped openings are called stopes. The mining of large, inclined ore bodies often requires leaving horizontal pillars across the stope at intervals in order to prevent collapse of the walls.
ore pass	A vertical or inclined passage for transferring ore underground
oxidation–reduction potential	Measures a solution's ability to gain or lose electrons, indicating its oxidizing or reducing power, expressed in millivolts (mV). Positive ORP means oxidizing (electron-stealing) conditions, like in disinfected water, while negative ORP means reducing (electron-donating) conditions, crucial for assessing water quality, disinfection effectiveness (e.g., chlorine), and biological activity in pools, drinking water, and wastewater treatment.
pastefill	A specific type of backfill using a mixture of tailings and binder
peridotite	A plutonic rock which has a mafic content equal to or greater than 90, and the olivine content, divided by the total plagioclase, orthopyroxene and clinopyroxene content is greater than 40.
pillar	A body of rock, pillar, left behind during mining to support the mine's roof.
plant	A group of buildings, and especially to their contained equipment, in which a process or function is carried out; on a mine it will include warehouses, hoisting equipment, compressors, repair shops, offices, mill or concentrator.
portal	The surface entrance to a tunnel or adit
Poisson's ratio	The fraction of expansion divided by the fraction of compression
preliminary economic assessment	A study, other than a pre-feasibility or feasibility study, that includes an economic analysis of the potential viability of mineral resources
preliminary feasibility study, pre-feasibility study	<p>A preliminary feasibility study (prefeasibility study) is a comprehensive study of a range of options for the technical and economic viability of a mineral project that has advanced to a stage where a qualified person has determined (in the case of underground mining) a preferred mining method, or (in the case of surface mining) a pit configuration, and in all cases has determined an effective method of mineral processing and an effective plan to sell the product.</p> <p>A pre-feasibility study includes a financial analysis based on reasonable assumptions, based on appropriate testing, about the modifying factors and the evaluation of any other relevant factors that are sufficient for a qualified person to determine if all or part of the indicated and measured mineral resources may be converted to mineral reserves at the time of reporting. The financial analysis must have the level of detail necessary to demonstrate, at the time of reporting, that extraction is economically viable</p>
probable mineral reserve	A probable mineral reserve is the economically mineable part of an indicated and, in some cases, a measured mineral resource. For a probable mineral reserve, the qualified person's confidence in the results obtained from the application of the modifying factors and in the estimates of tonnage and grade or quality is lower than what is sufficient for a classification as a proven mineral reserve, but is still sufficient to demonstrate that, at the time of reporting, extraction of the

Term	Definition
	<p>mineral reserve is economically viable under reasonable investment and market assumptions. The lower level of confidence is due to higher geologic uncertainty when the qualified person converts an indicated mineral resource to a probable reserve or higher risk in the results of the application of modifying factors at the time when the qualified person converts a measured mineral resource to a probable mineral reserve. A qualified person must classify a measured mineral resource as a probable mineral reserve when his or her confidence in the results obtained from the application of the modifying factors to the measured mineral resource is lower than what is sufficient for a proven mineral reserve.</p>
<p>proven mineral reserve</p>	<p>A proven mineral reserve is the economically mineable part of a measured mineral resource. For a proven mineral reserve, the qualified person has a high degree of confidence in the results obtained from the application of the modifying factors and in the estimates of tonnage and grade or quality. A proven mineral reserve can only result from conversion of a measured mineral resource.</p>
<p>qualified person</p>	<p>A qualified person is an individual who is a mineral industry professional with at least five years of relevant experience in the type of mineralization and type of deposit under consideration and in the specific type of activity that person is undertaking on behalf of the registrant; and an eligible member or licensee in good standing of a recognized professional organization at the time the technical report is prepared.</p> <p>For an organization to be a recognized professional organization, it must:</p> <p>(A) Be either:</p> <p>(1) An organization recognized within the mining industry as a reputable professional association, or</p> <p>(2) A board authorized by U.S. federal, state, or foreign statute to regulate professionals in the mining, geoscience or related field;</p> <p>(B) Admit eligible members primarily on the basis of their academic qualifications and experience;</p> <p>(C) Establish and require compliance with professional standards of competence and ethics;</p> <p>(D) Require or encourage continuing professional development;</p> <p>(E) Have and apply disciplinary powers, including the power to suspend or expel a member regardless of where the member practices or resides; and;</p> <p>(F) Provide a public list of members in good standing.</p>
<p>raise</p>	<p>A vertical or inclined underground working that has been excavated from the bottom upward</p>
<p>raisebore</p>	<p>A method for creating vertical or inclined shafts</p>
<p>ramp</p>	<p>another name for a decline</p>
<p>reclamation</p>	<p>The restoration of a site after mining or exploration activity is completed.</p>
<p>refining</p>	<p>A high temperature process in which impure metal is reacted with flux to reduce the impurities. The metal is collected in a molten layer and the impurities in a slag layer. Refining results in the production of a marketable material.</p>
<p>right-of-way</p>	<p>A parcel of land granted by deed or easement for construction and maintenance according to a designated use. This may include highways, streets, canals, ditches, or other uses</p>

Term	Definition
rock quality designation (RQD)	A measure of the competency of a rock, determined by the number of fractures in a given length of drill core. For example, a friable ore will have many fractures and a low RQD.
rockbolter	A specialized machine that drills holes and installs rock bolts, cables, or other roof support systems in underground mines.
rockburst	A sudden, violent failure and ejection of rock into underground mine openings, caused by stress in deep underground excavations. These pose severe hazards to workers and operations, and often occurs in hard, brittle rock where built-up strain energy is released explosively, requiring seismic monitoring and specialized control measures for safety.
royalty	An amount of money paid at regular intervals by the lessee or operator of an exploration or mining property to the owner of the ground. Generally based on a specific amount per tonne or a percentage of the total production or profits. Also, the fee paid for the right to use a patented process.
seismicity	The occurrence or frequency of earthquakes/seismic events, especially in mining contexts
semi-autogenous grinding (SAG)	A method of grinding rock into fine powder whereby the grinding media consists of larger chunks of rocks and steel balls.
shaft	A vertical or inclined excavation for the purpose of opening and servicing a mine. It is usually equipped with a hoist at the top, which lowers and raises a conveyance for handling men and material
shotcrete	Shotcrete is concrete or mortar pneumatically sprayed at high velocity onto surfaces, creating strong, durable structures for tunnels,
sill drift	A drift cut in ore along the strike of the orebody
slimes	Slimes are ultrafine mineral particles, frequently clays or talc, that are formed during flotation that usually hinder separation of sulphides from the rest of the ore by increasing reagent use, pulp viscosity, and entraining gangue into the froth, reducing concentrate grade and recovery, though sometimes slimes can help by acting as carriers for coarser particles if conditioned correctly.
sloughmeter	Sloughmeters are devices that provide early warning of ground failure in places where some caving or "sloughing" is expected.
specific gravity	The ratio of the mass of a substance to the mass of an equal volume of pure water at 4°C.
stope	An excavation in a mine, other than development workings, made for the purpose of extracting ore.
stopping	The process of extracting ore from an underground mine
strike	Direction of the long axis of a structural surface (fault), rock unit, mineral deposit, or geochemical anomaly.
strike length	The horizontal distance along the long axis of a structural surface, rock unit, mineral deposit, or geochemical anomaly.
tailings	Material rejected from a mill after the recoverable valuable minerals have been extracted.
tailings impoundment (pond)	A storage area for tailings
Trommel	A rotating, screened cylindrical drum used to separate coarse from fine material in mineral processing.

Term	Definition
tunnel	A horizontal underground passage that is open at both ends; the term is loosely applied in many cases to an adit, which is open at only one end
unfolding	A geostatistical method that involves transforming complex, folded geological structures (like mineral deposits) into a simpler, flat (undeformed) space, allowing for easier geostatistical analysis (variogram, kriging, simulation) and then mapping the results back to the original folded geometry, essentially reversing the folding process to model true spatial relationships. It's used in mining and petroleum to handle complex geology, making modeling more reliable by analyzing data on a flattened reference surface before restoring to the actual folded state, especially useful for vein-type or tabular deposits.
unconfined compressive strength	The maximum axial compressive stress a soil or rock sample can withstand before failing under zero lateral confinement, measured by applying a load to a cylindrical specimen until it shears.
uniaxial compressive strength	A measure of the strength of a rock, which can be determined through laboratory testing, and used both for predicting ground stability underground, and the relative difficulty of crushing.
variogram/variography	A core geostatistical tool that visually and mathematically describes how data similarity changes with distance and direction, showing that closer points are generally more alike (lower variance) while distant points are less related (higher variance), forming a key component for spatial modeling.
wireframe	3D digital models (wireframes) of geological features, like ore bodies, built from points and lines, can be open (surfaces) or closed (solids with volume) and are used to visualize, calculate volumes, grade resources, and design excavation layouts for both surface and underground mines.
Young's modulus (elastic modulus)	A property of a material that defines how easily that material can stretch and deform

25 RELIANCE ON INFORMATION PROVIDED BY THE REGISTRANT

25.1 INTRODUCTION

The QPs fully relied on the registrant for the information used in the areas noted in the following sub-sections. The QPs consider it reasonable to rely on the registrant for the information identified in those sub-sections, for the following reasons:

- The registrant has been owner and operator of the mining operations for more than 100 years;
- The registrant has employed industry professionals with expertise in the areas listed in the following sub-sections;
- The registrant has a formal system of oversight and governance over these activities, including a layered responsibility for review and approval;
- The registrant has considerable experience in each of these areas.

25.2 MACROECONOMIC TRENDS

Information relating to inflation, interest rates, discount rates, and taxes was obtained from the registrant.

This information is used in the economic analysis in Chapter 19. It supports the assessment of reasonable prospects for economic extraction of the mineral resource estimates in Chapter 11, and inputs to the determination of economic viability of the mineral reserve estimates in Chapter 12.

25.3 MARKETS

Information relating to market studies/markets for product, market entry strategies, marketing and sales contracts, product valuation, product specifications, refining and treatment charges, transportation costs, agency relationships, material contracts (e.g., mining, concentrating, smelting, refining, transportation, handling, hedging arrangements, and forward sales contracts), and contract status (in place, renewals), was obtained from the registrant.

This information is used in the marketing section in Chapter 16, and the economic analysis in Chapter 19. It supports the assessment of reasonable prospects for economic extraction of the mineral resource estimates in Chapter 11, and inputs to the determination of economic viability of the mineral reserve estimates in Chapter 12.

25.4 LEGAL MATTERS

Information relating to the corporate ownership interest, the mineral tenure (concessions, payments to retain property rights, obligations to meet expenditure/reporting of work conducted), surface rights, water rights (water take allowances), royalties, encumbrances, easements and rights-of-way, violations, and fines, permitting requirements, and the ability to maintain and renew permits was obtained from the registrant.

This information is used in support of the property description and ownership information in Chapter 3, the permitting and mine closure descriptions in Chapter 17, and the economic analysis in Chapter 19. It supports the reasonable prospects of economic extraction for the mineral resource estimates in Chapter 11, and the assumptions used in demonstrating economic viability of the mineral reserve estimates in Chapter 12.

25.5 ENVIRONMENTAL MATTERS

Information relating to baseline and supporting studies for environmental permitting and monitoring requirements, ability to maintain and renew permits, emissions controls, closure planning, closure and reclamation bonding requirements, sustainability accommodations, and

monitoring for and compliance with requirements relating to protected areas and protected species was obtained from the registrant.

This information is used when discussing property ownership information in Chapter 3, the permitting and closure discussions in Chapter 17, and the economic analysis in Chapter 19. It supports the reasonable prospects of economic extraction for the mineral resource estimates in Chapter 11, and the assumptions used in demonstrating economic viability of the mineral reserve estimates in Chapter 12.

25.6 STAKEHOLDER ACCOMMODATIONS

Information relating to social and stakeholder baseline and supporting studies, hiring and training policies for workforce from local communities, partnerships with stakeholders (including national, regional, and state mining associations; trade organizations; fishing organizations; state and local chambers of commerce; economic development organizations; non-government organizations; and state and federal governments), and the community relations plan was obtained from the registrant.

This information is used in the social and community discussions in Chapter 17, and the economic analysis in Chapter 19. It supports the reasonable prospects of economic extraction for the mineral resource estimates in Chapter 11, and the assumptions used in demonstrating economic viability of the mineral reserve estimates in Chapter 12.

25.7 GOVERNMENTAL FACTORS

Information relating to taxation and royalty considerations at the Project level, monitoring requirements and monitoring frequency, bonding requirements, and violations and fines was obtained from the registrant.

This information is used in the discussion on royalties and property encumbrances in Chapter 3, the monitoring, permitting and closure discussions in Chapter 17, and the economic analysis in Chapter 19. It supports the reasonable prospects of economic extraction for the mineral resource estimates in Chapter 11, and the assumptions used in demonstrating economic viability of the mineral reserve estimates in Chapter 12.