NI 43-101 Technical Report

BLOOM LAKE MINE

FEASIBILITY STUDY PHASE 2

Fermont, Quebec, CANADA

This report was prepared for Quebec Iron Ore Inc. on behalf of Champion Iron Limited.

MINERAI DE FER QUÉBEC
QUEBEC IRON ORE

Prepared by qualified persons:

André Allaire, P. Eng. ....*BBA Inc.*
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Philippe Rio Roberge, P. Eng. ....*WSP Canada Inc.*

Effective Date: June 20, 2019

Signature Date: August 2, 2019

BBA SOUTEX WSP

DATE AND SIGNATURE PAGE

This report is effective as of the 20th day of June 2019.

"Signed and sealed original on file"	*August 2, 2019*
André Allaire, P. Eng. BBA Inc.	Date
"Signed and sealed original on file"	*August 2, 2019*
Isabelle Leblanc, P. Eng. BBA Inc.	Date
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Pierre-Luc Richard, P. Geo. BBA Inc.	Date
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CERTIFICATE OF QUALIFIED PERSON

André Allaire, P. Eng., PhD

This certificate applies to the NI 43-101 Technical Report for the "Bloom Lake Mine – Feasibility Study Phase 2" located in Fermont, Quebec prepared for Quebec Iron Ore Inc. (QIO) issued on August 2, 2019 (the "Technical Report") and effective June 20, 2019.

I, André Allaire, P. Eng., PhD., as a co-author of the Technical Report, do hereby certify that:

1. I am currently employed as President in the consulting firm BBA Inc.: 2020 Robert-Bourassa Blvd, Suite 300, Montréal, Québec H3A 2A5 Canada.
2. I graduated from McGill University of Montreal with a B.Eng. in Metallurgy in 1982, an M. Eng. In 1986 and a Ph.D. in 1991. I have practiced my profession continuously since my graduation. My relevant experience for the purpose of the Technical Report is:
   - (1982-1984); Process Metallurgist, Horne division, Noranda Inc.
   - (1984-1988); Graduate Studies, Metallurgical Department, McGill University
   - (1988-2000); Process Metallurgist and Study Manager, Hatch & Associés Inc.
   - (2000-2004); Manager Process and Metallurgy, Met-Chem Canada Inc.
   - (2004-2011); Director, Mining and Metals, BBA Inc.
   - (2011-2013); VP Market, Mining and Metals, BBA Inc.
   - (2013-to date); President, BBA Inc.
3. I am in good standing as a member of the Order of Engineers of Québec (# 38480) and a member of the Canadian Institute of Mining Metallurgy and Petroleum.
4. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects ("NI 43-101") and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
5. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
6. I am responsible for the coordination, consolidation and review of this Technical Report. I have also authored and am responsible for Chapters 2, 3, 4, 5, 6, 18 (except sections 18.4 to 18.6), 19, 22, 23, 24, and relevant sections of Chapters 1, 21, 25, 26, and 27.
7. I personally visited the Bloom Lake property that is the subject to the Technical Report during the week of May 28, 2018.
8. I have had prior involvement with the property that is the subject of the Technical Report having participated in the feasibility studies of Bloom Lake from 2006 to 2010.
9. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with NI 43-101.
10. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Dated and signed this 2nd day of August, 2019.

"Signed and sealed original on file"

André Allaire, P. Eng., PhD

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CERTIFICATE OF QUALIFIED PERSON

Isabelle Leblanc, P. Eng.

This certificate applies to the NI 43-101 Technical Report for the “Bloom Lake Mine – Feasibility Study Phase 2” located in Fermont, Quebec prepared for Quebec Iron Ore Inc. (QIO) issued on August 2, 2019 (the “Technical Report”) and effective June 20, 2019.

I, Isabelle Leblanc, P. Eng., as a co-author of the Technical Report, do hereby certify that:

1. I am currently employed as Department Manager of Mining and Geology in the consulting firm BBA Inc.: 2020 Robert-Bourassa Blvd., Suite 300, Montreal, Quebec H3A 2A5, Canada.
2. I graduated from the mining engineering program of École Polytechnique de Montreal in 2007 and I have practiced my profession continuously since that time.
3. I am in good standing as a member of the Order of Engineers of Québec (#144395), a member of the Australasian Institute of Mining and Metallurgy and a member of the Canadian Institute of Mining Metallurgy and Petroleum.
4. I have read the definition of “qualified person” set out in NI 43-101 – Standards of Disclosure for Mineral Projects (NI 43-101) and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
5. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
6. I am responsible for the preparation of Chapters 15 and 16 as well as the relevant portions of Chapters 1, 21, 25, 26 and 27 of the Technical Report.
7. I personally visited the Bloom Lake property that is the subject to the Technical Report during the week of September 24, 2018.
8. I have had prior involvement with the property that is the subject of the Technical Report having participated in the feasibility studies of Bloom Lake from 2006 to 2010.
9. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with NI 43-101.
10. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Dated and signed this 2nd day of August, 2019.

“Signed and sealed original on file”

Isabelle Leblanc, P. Eng.

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CERTIFICATE OF QUALIFIED PERSON

Pierre-Luc Richard, P. Geo

This certificate applies to the NI 43-101 Technical Report for the "Bloom Lake Mine – Feasibility Study Phase 2" located in Fermont, Quebec prepared for Quebec Iron Ore Inc. (QIO) issued on August 2, 2019 (the "Technical Report") and effective June 20, 2019.

I, Pierre-Luc Richard, P. Geo., as a co-author of the Technical Report, do hereby certify that:

1. I am a Principal Geologist with BBA Inc. located at 2020 Robert-Bourassa Blvd, Suite 300, Montréal, Québec, Canada, H3A 2A5.
2. I am a graduate of Université du Québec à Montréal in Resource Geology in 2004. I also obtained a M.Sc. from Université du Québec à Chicoutimi in Earth Sciences in 2012.
3. I am a member in good standing of the Ordre des Géologues du Québec (OGQ Member No. 1119), the Association of Professional Geoscientists of Ontario (APGO Member No. 1714), and the Northwest Territories Association of Professional Engineers and Geoscientists (NAPEG Member No. L2465).
4. I have worked in the mining industry for more than 15 years. My exploration expertise has been acquired with Richmont Mines Inc., the Ministry of Natural Resources of Québec (Geology Branch), and numerous companies through my career as a consultant. My mining expertise was acquired at the Beaufor mine and several other producers through my career. I managed numerous technical reports, mineral resource estimates and audits as a consultant from February 2007 to March 2018 and as a consultant for BBA since.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects (NI 43-101) and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am responsible for the preparation of Chapters 7 to 12 and 14. I am also responsible for the relevant portions of Chapters 1, 25, 26, and 27 of the Technical Report.
8. I personally visited the Bloom Lake property that is the subject to the Technical Report during the week of March 18, 2019.
9. I have had no prior involvement with the property that is the subject of the Technical Report.
10. I have the read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with the NI 43-101.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Dated and signed this 2nd day of August, 2019.

"Signed and sealed original on file"

Pierre-Luc Richard, P. Geo.

CERTIFICATE OF QUALIFIED PERSON

Mathieu Girard, P. Eng.

This certificate applies to the NI 43-101 Technical Report for the "Bloom Lake Mine – Feasibility Study Phase 2" located in Fermont, Quebec prepared for Quebec Iron Ore Inc. (QIO) issued on August 2nd, 2019 (the "Technical Report") and effective June 20th, 2019.

I, Mathieu Girard, P. Eng., as a co-author of the Technical Report, do hereby certify that:

1. I am a professional engineer employed as a senior metallurgist with Soutex, located at 357 rue Jackson, Québec City, Province of Québec, Canada;
2. I received a Bachelor's degree in Material and Metallurgy Engineering from Université Laval in 2000, and a Master's degree in Metallurgical Engineering from Université Laval in 2004;
3. I am a member in good standing of the Ordre des Ingénieurs du Québec (no. 129366);
4. I have over fifteen (15) years of experience in mineral processing operation support, optimization and design. I first worked for Algosys (now Ion) then joined Soutex in 2005 as a metallurgist;
5. I have read the definition of "Qualified Person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects (NI 43-101) and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a Qualified Person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am responsible for the preparation of chapters 13 and 17, with the exception of sections 17.10.1 and 17.10.4. I am also responsible for the relevant portions of chapters 1, 21, 25, 26 and 27 of the Technical Report.
8. I personally visited the property that is the subject to the Technical Report on March 21st, 2019.
9. I have had prior involvement with the property that is the subject of the Technical Report: Phase 1 start-up and optimisation (2009 to 2011), Phase 2 Engineering (2011-2012), Phase 1 Restart (2018).
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with NI 43-101.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Dated and signed this 2nd day of August, 2019.

"Signed and sealed original on file"

Mathieu Girard, P. Eng.

CERTIFICATE OF QUALIFIED PERSON

Philippe Rio Roberge, P. Eng.

This certificate applies to the NI 43-101 Technical Report for the "Bloom Lake Mine – Feasibility Study Phase 2" located in Fermont, Quebec prepared for Quebec Iron Ore Inc. (QIO) issued on August 2, 2019 (the "Technical Report") and effective June 20, 2019.

I, Philippe Rio Roberge, P. Eng., as a co-author of the Technical Report, do hereby certify that:

1. I am a Civil Engineer, Team Lead in geotechnical mining with WSP Canada located at 1600, René-Lévesque West, Montreal, Quebec, Canada.
2. I am a graduate of the University of Sherbrooke, Bachelor of Civil Engineering 2006, Sherbrooke, Quebec, Canada.
3. I am a member in good standing of "Ordre des Ingénieurs du Québec", license 142781.
4. My relevant experience includes 12 years of experience in tailings storage facility design and management.
5. I have read the definition of "qualified person" set out in the NI 43-101 – Standards of Disclosure for Mineral Projects (NI 43-101) and certify that, by reason of my education, affiliation with a professional association, and past relevant work experience, I fulfill the requirements to be a qualified person for the purposes of NI 43-101.
6. I am independent of the issuer applying all the tests in Section 1.5 of NI 43-101.
7. I am responsible for the preparation of chapters 1.11, 1.12, 18.4, 18.5, 18.6, 20, 21.2.5, 21.2.13, 21.3.6, 25.4, 26.4, 26.5.
8. I personally visited the property that is the subject to the Technical Report on January 8th, 2018.
9. I have had prior involvement with the property that is the subject of the Technical Report as a Qualified Person in the Phase 1 study and as a tailings consultant for the current operation.
10. I have read NI 43-101 and the sections of the Technical Report for which I am responsible have been prepared in compliance with NI 43-101.
11. As at the effective date of the Technical Report, to the best of my knowledge, information and belief, the sections of the Technical Report for which I am responsible contain all scientific and technical information that is required to be disclosed to make the portions of the Technical Report for which I am responsible not misleading.

Dated and signed this 2nd day of August 2019

"Signed and sealed original on file"

Philippe Rio Roberge, P. Eng.

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TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
σ_{ci}	Uniaxial compressive strength
3D	Three dimensional
A	Ampere
a	Annum (year)
AACE	American Association of Cost Engineers
AARQ	Atlas of Amphibians and Reptiles of Quebec
Al_2O_3	Aluminum oxide
AMP	Amphibolite
Au	Gold
B	Billion
BAPE	*Bureau d'audience publique sur l'environnement du Québec*
BBA	BBA Inc.
BHP	BHP Billiton
BID	Bedded iron deposits
BIF	Banded iron formation
BLR	Bloom Lake Railway
BPH	Booster pumphouse
Ca	Calcium
CAD or $	Canadian dollar (examples of use: CAD2.5M / $2.5M)
CaO	Calcium oxide
CAPEX	Capital expenditure
CCAA	Companies' Creditors Arrangement Act
CCIC	Cleveland-Cliffs Iron Company
CEAA	Canadian Environmental Assessment Act
CFR	Cost and Freight
CIM	Canadian Institute of Mining, Metallurgy and Petroleum
Cliffs	Cliffs Natural Resources
CLM	Consolidated Thompson-Lundmark Gold Mines Limited
Consolidated Thompson	Consolidated Thompson Gold Mines Limited
CMMS	Computerized Maintenance Management System
conc.	Concentrate
CSN	Companhia Siderúrgica Nacional
CV	Coefficient of variation
DDH	Diamond drillhole
DFO	Department of Fisheries and Oceans
Directive 019	MELCC - *Directive 019 sur l'industrie minière* (Provincial guidelines for the mining industry)

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
DL	Detection limit
DRI	Direct reduced iron
DSO	Direct shipping ore
EA	Environmental assessment
ECCC	Environment and Climate Change Canada
EEM	Environmental effects monitoring
EIA	Environmental impact assessment
EIS	Environmental impact statement
EPCM	Engineering, Procurement, Construction Management
EQA	Environmental Quality Act
et al.	et alla (and others)
F_{80}	80% passing - Feed size
Fe	Iron
FEL	Front-end loader
Fe_2O_3	Hermatite
Fe_2O_4	Magnetite
FIOD	Fermont Iron Ore District
FMG	Fortescue Metals Group Ltd.
FOB	Free on Board
FS	Feasibility study
G&A	General and Administration
Ga	Billion years
GEO	Great Oxidation Event
GFC	Global financial crisis
GN	Gneiss
GPS	Global positioning system
HDPE	High-density polyethylene (pipe)
HEN	H. E. Neal & Associates Ltd.
HLS	Heavy liquid separation
HPA	Hydraulic Placement Area
HQ	Hydro-Québec
HSE	Health, Security and Environment
HVAC	Heating, ventilation and air conditioning
I/O	Input/output
IBA	Impact and benefit agreement
ID^2	Inverse distance squared
IF	Iron formation

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
IFM	Magnetite Iron Formation
IOC	Iron Ore Company of Canada
IRA	Inter-ramp angle
IRR	Internal rate of return
ISO	International Organization for Standardization
IT	Information technology
Jalore	Jalore Mining Company Limited
J&L	Jones and Laughlin Steel Corporation
KNA	kriging neighbourhood analysis
K_{80}	80% passing – Particle size
K_2O	Potassium oxide
Lakefield	Lakefield Research
LIMS	Low Intensity Magnetic Separators
LOM	Life of mine
M	Million
MAG	Magnetic
MELCC	*Ministère de l'Environnement et de la Lutte contre les changements climatiques* (Ministry of Environment, and Action against Climate Change) - formerly known as *Ministère du Développement durable, de l'Environnement, de la Faune et des Parcs* (MDDEFP)
MDMER	Metal and Diamond Mining Effluent Regulations
MERN	*Ministère de l'Énergie et Ressources naturelles* (Ministry of Energy and Natural Resources)
MFFP	*Ministère des Forêts, de la Faune et des Parcs*
MFL	Manpower Forecasting and Levelling
Mg	Magnesium
MgO	Magnesium oxide
MLA	Mineral Liberation Analyzer
Mn	Manganese
MPa	Mega pascals
MRN	*Ministère des Ressources naturelles*
MRE	Mineral Resource Estimate
MS	Mica Schist
MSEP	MineSight Economic Planner
MTO	Material take-off
MVA	Mega volt ampere
MWDS	Mine Waste Disposal Site
M&I	Measured and Indicated

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
Na_2O	Sodium Oxide
NN	Nearest neighbour
No.	Number
NOH	Net Operating Hour
NPV	Net present value
NQ	NQ- Caliber drillhole
NSR	Net smelter return
OK	Ordinary Kriging
OPEX	Operational expenditure
OR	Operational Readiness
OHS	Occupational Health, Safety
P	Phosphor
Pa	Pascal
P_{80}	80% passing - Product size
PCN	Project change notice
PEA	Preliminary economic assessment
pH	Potential of hydrogen
PhD	Doctor of philosophy
PFD	Process flow diagram
PMF	Probable Maximal Flood
PMP	Project Management Plan
PSD	Particle size distribution
QA/QC	Quality Assurance / Quality Control
QIO	Quebec Iron Ore
QNS&L	Quebec North Shore and Labrador
QP	Qualified person
QR	Quartz rock
QRIF	Quartz Rock Iron Formation
QRMS	Quartz Rock Mica Schist
QUECO	Quebec Cobalt and Exploration Limited
QZ	Quartzite
RQD	Rock quality designation
S	Sulphur
SOE	State-owned enterprises
SARA	Species at Risk Act
SAT	Satmagan
SEDAR	System for electronic document analysis and retrieval

TABLE OF ABBREVIATIONS	
Abbreviation	**Description**
SFPPN	*La Société ferroviaire et portuaire de Pointe-Noire*
SIF	Silicate iron formation
SiO_2	Silicon dioxide / silica
SM	Suspended matter
SMC	Sursho Mining Corporation
SRM	Standard reference materials
TiO_2	Titanium dioxide
TMF	Tailings management facility
TSF	Tailings storage facility
UCC	Up-current classifier
UCS	Uniaxial compressive strength
USD or US$	United States dollar (examples of use: USD2.5M / US$2.5M)
UTM	Universal Transverse Mercator
vs.	Versus
WGM	Watts, Griffis and McOuat Ltd.
WHIMS	Wet High Intensity Magnetic Separators
WSIF	Waste Silicate Iron Formation
WTP	Water treatment plant
XRF	X-ray fluorescence

TABLE OF ABBREVIATIONS – UNITS OF MEASURE	
Unit	**Description**
Metric	
deg. or °	angular degree
m^3	cubic metre
m^3/h	cubic metres per hour
m^3/s	cubic metres per second
d	day (24 hours)
°C	Degrees Celsius
Ø	diameter
$/t	Dollars per metric tonne
dmt	dry metric ton
dmtu	dry metric ton unit
G	Giga
g	gram
h	hour (60 minutes)
Gt	Gigatonne
kg	kilogram
kg/m^2	kilograms per metre square
kg/m^3	kilograms per metre cube
kg/t	kilograms per tonne
km	kilometre
km/h	kilometre per hour
kt	kilotonne
kW	kilowatt
kWh/t	kilowatt hour per tonne
L	Litre
L/min	Litres per minute
MW	Megawatt
m	metre
m/h	metres per hour
m/s	metres per second
µm	micron
mm	millimetre
M	Million
Mt	Million tonne
Mtpy	Million tonnes per year
min	minute (60 seconds)

TABLE OF ABBREVIATIONS – UNITS OF MEASURE	
Unit	**Description**
Metric	
ppm	parts per million
%	Percent
% solids	Percent solids by weight
s	second
m^2	square metre
K	Thousand (000)
t	tonne (1,000 kg) (metric ton)
tpd	tonnes per day
tph	tonnes per hour
tpy	tonnes per year
V	Volt
W	Watt
wk	week
y	year (365 days)

TABLE OF ABBREVIATIONS – UNITS OF MEASURE	
Unit	**Description**
Imperial	
°F	Degrees Fahrenheit
ft or ‘	feet (12 inches)
ha	Hectare
hp	horsepower
in. or ”	inch
k	Kips
lb / lbs	Pound / pounds
MBtu	Million British thermal units
mesh	US Mesh
oz	Troy ounce
st	short ton (2,000 lbs)

1. EXECUTIVE SUMMARY

All monetary units in the Bloom Lake Mine – Feasibility Study Phase 2 Report (the "Report") are in Canadian dollars (CAD or $), unless otherwise specified.

1.1 Introduction

In December 2006, an environmental impact assessment (EIA) of the Bloom Lake Mine project (the "Project") was submitted to the agencies. Decree 137-2008 authorizing the Project was adopted on February 20, 2008 by the provincial government. Consolidated Thompson Iron Mines Limited began the construction of the mining infrastructure in 2008 and commenced mining operations in 2010 with the Phase 1 concentrator plant (referred to as "Phase 1 (Consolidated Thompson) plant" in this document).

The mine was sold to Cliffs Natural Resources Inc. (Cliffs) in 2011, which continued the Phase 2 (Cliffs) construction project until the Project was halted in November 2012, and conducted mining operations until they were suspended in December 2014. The site was employing approximately 600 people.

In January 2015, Cliffs sought creditor protection under Companies' Creditors Arrangement Act (CCAA), resulting in the mine being put on a care and maintenance program and placed into creditor protection.

In April of 2016, Champion Iron Limited (Champion or ''the Company'') acquired the Bloom Lake assets through its subsidiary Quebec Iron Ore (QIO) and the Quinto Claims for a cash consideration of $10.5M ($9.75M for Bloom Lake and $0.75M for Quinto) and the assumption of liabilities. Quebec Iron Ore Inc. is 63.2% owned by Champion Iron Limited, with the remaining 36.8% equity interest owned by *Ressources Québec* (RQ), acting as a mandatory of the Government of Quebec. On May 29, 2019, the Company announced a transaction to acquire RQ's 36.8% equity interest in QIO and the transaction would increase Champion's stake in QIO to 100%. For more information on the capital restructuring, please refer to the Company's press release dated May 29, 2019, available under the Company's filings on SEDAR at www.sedar.com.

Following acquisition of the Bloom Lake assets by QIO, a feasibility study to identify areas for improvement or correction was completed in February 2017 and resulted with the restart of the operation in February 2018 on time and on budget.

During its first full year of operation (2019 Fiscal Year), the Bloom Lake site produced 6,994,500 wet metric tonnes of 66.4% iron ore concentrate which is an improvement of approximately 1,000,000 wet metric tonnes over 2014 production. The production total cash cost during 2019 was $49.40/dmt and the all-in sustaining cost was $55.80/dmt.

As part of an expansion plan to increase the mine production, the design and construction of a second concentrator plant (referred to as "Phase 2 plant" in this document) was initiated to increase nominal capacity. QIO is authorized by the Decree 849-2011 to increase its production to 16 million tonnes (Mt) of concentrate per annum.

Given the amount of work that Cliffs has already committed in preparing the Phase 2 plant, mine and tailings expansion, the Bloom Lake project represents a low capital investment for a considerable increase in high grade iron ore concentrate production.

The scope of this feasibility study is to develop a plan to complete the construction of the Phase 2 concentrator including improvements to maximise production efficiency and modifications to other areas to support the operation of both concentrators. Feasibility study level engineering was performed on each of these areas to outline work to be performed. The resulting capital cost estimate reflects a Class 3 study as defined by the Association for the Advancement of Cost Engineering (AACE) as described in Recommended Practice N° 18R-97 about Cost Estimating Classification System. The expected accuracy for this study should be in the range of -10% on the low side to +15% on the high side.

The following Technical Report (the "Report") presents the results of the feasibility study (FS) for the Phase 2 expansion of Bloom Lake's operations. This Report, titled "Bloom Lake Mine – Feasibility Study Phase 2", was prepared by Qualified Persons (QPs) following the guidelines of the "Canadian Securities Administrators" National Instrument 43-101 (effective June 30, 2011), and in conformity with the guidelines of the Canadian Mining, Metallurgy and Petroleum (CIM) Standard on Mineral Resources and Reserves. The major Study contributors and their respective areas of responsibility are presented in Table 1-1.

Table 1-1: Major contributors to the feasibility study

Consulting Firm or Entity	Area of responsibility
BBA	▪ Geology; ▪ Development of the mine pit, overburden removal and required mining infrastructure facilities, geological settings and mineralization, mining plan, mining methods, explosives; ▪ Reviewing of crushing, crushed ore reclaiming and milling area; ▪ Tailings pumping and pipeline from the inlet of the plant tailings pumps to the inlet of the tailings booster pumps BPH1; ▪ Tailings pumping and pipeline from the inlet of the tailings booster pumps BPH1 to the tailings storage; ▪ Transportation of the concentrate to the port facilities; ▪ Review of Port facility study; ▪ Project Execution Plan.
Soutex	▪ Mineral processing, metallurgical testing & recovery methods; ▪ Increase in concentrate production by modifications to the gravity separation circuit along with the addition of a magnetic circuit; ▪ Metallurgical testing including design, fabrication and installation, and excluding electrical and instrumentation. ▪ Estimation of mill feed tonnage.
WSP	▪ Surface water management plan, water management structures and pumping stations; ▪ Tailings storage management; development of a new tailings filling plan; containment infrastructure; ▪ Environmental and permitting; ▪ Cost update of the site restoration plan.

All monetary units in the Study are in Canadian dollars (CAD or $), unless otherwise specified. Costs are based on second quarter (Q2 Calendar Year) 2019 dollars.

1.2 Key Project Outcomes

The following list details the key project outcomes as determined from the Study:

- Mineral reserves for the Bloom Lake project are estimated at 807 million tonnes at an average grade of 29.0% iron (Fe);
- Mine plan forecasts a life of mine (LOM) of 20 years;
- Phase 1 and Phase 2 combined average iron metallurgical recovery of 82.4% relative to average plant feed grade of 29.0% Fe;
- Cumulative non-discounted after-tax cash flow of $5.2 billion (included all forecasted CAPEX);
- After-tax net present value at 8% discount rate of $2,384 million considering Phase 1 and 2 combined;
- After-tax net present value at 8% discount rate of $956 million considering Phase 2 only;
- Pre-tax internal rate of return (IRR) of 42.4% or after-tax IRR of 33.4%, considering Phase 2 only, with a 2.4 years payback on initial capital;
- Total revenue over LOM of $24.0 billion considering Phase 1 and 2 combined;
- Initial capital costs (pre-production) of $589.8 million;
- Average yearly production of 15 million dry tonnes of iron ore concentrate at 66.2% Fe;
- Total LOM average operating costs (total cash cost) of $46.6/t, FOB Sept-Îles;
- LOM average iron ore price at 66.2% Fe CFR China (62% Fe index plus premium for extra Fe content) of USD84.1/t;
- Construction is estimated to last for a period of 21 months.

1.3 Access, Local Resources and Infrastructure

The mine site lies approximately 13 km west of the town of Fermont (central geographical coordinates 52° 50' N and 67° 16' W). A 5-km access road has been constructed to connect the Bloom Lake mine with Highway 389. It is accessible by road from Baie-Comeau on the north shore of the Saint Lawrence River, as well as by road from the Wabush airport in Newfoundland & Labrador. The Wabush airport is located approximately 30 km from the Bloom Lake mine. The mine site is located approximately 950 km northeast of Montreal.

The rail access to port consists of three separate segments. The first segment is the rail spur on site, consisting of a 31.9 km long segment that is operational and connects to the Quebec North Shore and Labrador (QNS&L) railway at the Wabush Mines facilities in Wabush, Labrador. This first segment belongs to QIO. The second segment uses the QNS&L railway from Wabush to Arnaud Junction in Sept-Îles. The third section is from Arnaud junction to Pointe-Noire (Sept-Îles), property of "*Les Chemins de Fer Arnaud*", Sept-Îles, Quebec, where the concentrate is unloaded, stockpiled, and loaded onto vessels. The third segment is owned by the SFPPN (Société Ferroviaire et Portuaire de Pointe-Noire), a limited partnership composed by the Government of Quebec through the Société du Plan Nord and other industrial partners. The assets were acquired by the SFPPN from Cliffs' CCAA. QIO is a current member of the SFPPN board of directors.

The town of Fermont has a population of 2,474 as per Statistics Canada, and is the residential town for employees working for ArcelorMittal's Mont Wright mine operations. The town has all the required infrastructure to support the employees and families who live there. QIO currently owns a total of 383 rooms in the town of Fermont distributed among the following installations:

- One house, fully furnished, located on *rue Bougainville* (with 7 rooms);
- Four houses located on rue des Mélèzes (with 5 rooms each and built in 2012);
- Twenty-two (22) houses, fully furnished, located on *rue des Bâtisseurs* (12 with 8 rooms each, 6 with 7 rooms each and 4 with 5 rooms each and built in 2009);
- Two blocks (hotels) of 99 rooms of lodging located on *rue du Fer* (built in 2013);
- One multi-purpose complex that includes a cafeteria, a gym and recreational facilities.

Current accommodations are fully equipped with furniture, linen, and wiring for communications and entertainment and can house 383 people and provide a total of 1,800 meals per day. Additional infrastructure will be added as part of the Phase 2 project in order to house additional staffing.

The electrical power for the project is supplied by Hydro-Québec from a T-tap off the 315 kV transmission line L3039 (Montagnais-Normand) which terminates in an existing 315-34.5 kV substation (Substation W), owned by QIO. The substation is located along Provincial Route 389 and includes 2 x 315-34.5 kV, 48/64/80 MVA, oil-filled power transformers. It feeds the existing concentrator plant and mine site via 34.5 kV distribution lines. The distribution lines will be modified, as described in further detail in Chapter 18, to meet the electrical needs of the power supply of the Phase 2 expansion and mine requirements. The modifications also provide an increased reliability of the site power supply.

1.4 Geology

The Bloom Lake Iron Deposit lies within the Fermont Iron Ore District (FIOD), a world-renowned iron-mining camp at the southern end of the Labrador Trough within the geological Grenville Province. The Labrador Trough extends along the margins of the eastern boundary of the Superior-Ungava craton for more than 1,200 km and is up to 75 km wide at its central part. The Bloom Lake deposit, including the Bloom Lake West property, is located within the Parautochtonous Deformation Belt of the Grenville Province of the Canadian Shield, just south of the Grenville Front. The Grenville Front, the northern limit of the Grenville Province, truncates the Labrador Trough, separating the Churchill Province greenschist metamorphic grade part of the Labrador Trough rocks from their highly metamorphosed and folded counterparts in the Grenville Province.

The Bloom Lake deposit comprises gently plunging synclines on a main east-west axis separated by a gently north to northwest plunging anticline. One of these synclines is centred on Triangle Lake, while the centre for the other is located just north of Bloom Lake. The Bloom Lake property is centred primarily on the eastern syncline but covers a portion of the northern limb of the western one. These synclines are the result of a minimum of two episodes of folding and are of regional scale.

The iron formation and quartzite are conformable within a metasedimentary series of biotite-muscovite-quartz-feldspar-hornblende-garnet-epidote schists and gneisses in a broad synclinal structure. This succession, following the first stage of folding and faulting, was intruded by gabbroic sills that were later metamorphosed and transformed into amphibolite gneiss with foliation parallel with that in adjacent metasediments.

Two separate iron formation units are present; these join northwest of Bloom Lake, but are separated by several dozen metres of gneiss and schist in the southern part of the structure. Quartzite, present below the upper member throughout the eastern part of the area, pinches out near the western end. Folded segments and inclusions of iron formation in the central part of the syncline, which are surrounded by amphibolite, are in most cases thought to be part of an overlying sheet that was thrust over the main syncline during the first period of deformation. The lower unit is less than 30 m thick in some places and is considerably thinner than the upper unit. The iron content ranges from 32% to 34% in this facies. In places, the silicate facies to the east contain more than 50% cummingtonite, which in part is magnesium rich.

1.5 Mineral Resource Estimate

BBA was retained by QIO to audit the updated Mineral Resource Estimate (MRE) for the Bloom Lake Mine project prepared by Jean-Michel Dubé, P. Geo. from QIO. Drillhole information up to 2018 was considered for this estimate with only partial information from the 2018 drilling program used for 3D modelling and classification. The 2019 Bloom Lake Mineral Resource Estimate presented herein was prepared under the supervision and approved by Pierre-Luc Richard, P. Geo., from BBA. Mr. Richard is an independent "Qualified Person" as defined by NI 43-101.

The QP reviewed the resource parameters presented by QIO, including the following items: geological model and domain strategy, statistical study of assays and composites, variography analysis, interpolation and search ellipse settings, estimation process and classification of the resource. During the course of the audit, the QP proposed revising some of the parameters that contributed to establishing the updated parameters.

Geovia Surpac 2019HF1 v.7.0.1949.0 was used for the geological modelling and to generate the drillhole intercepts for each solid, compositing, 3D block modelling and interpolation. Statistical studies were conducted using Excel and Snowden Supervisor v.8.9.

The methodology for the audit involved the following steps:

- Database verification;
- Review of the 3D modelling of the geological and structural models;
- Review of the drillhole composite generating process for each mineralized units;
- Basic statistics;
- High grade value study;
- Geostatistical analysis including variography;
- Review of the block model construction;
- Review of the grade interpolation (including all profiles, scripts and macros);
- Block model validation;
- Review of the Resource classification;
- Cut-off grade calculation and pit shell optimization;
- Review of the mineral resource statement.

Because of the folded nature of the deposit, the geological model was divided into multiple structural domains to accommodate grade interpolation. Although domains existed in the previous model, it was necessary to revisit the approach during the course of the current MRE update. A total of 22 domains were created using Geovia Surpac for the current MRE. In the QP's opinion, the geological model and the Structural Domains are appropriate for the size, grade distribution and geometry of the mineralized zones and are suitable for the resource estimation of the Bloom Lake project. The model appears to be compatible with the anticipated mining and grade control methods as well as to the size and type of equipment to be used.

For mineralized units, density values were calculated based on the formula established and used during the operational period:

$$SG = \text{Fe\%} \text{ x } 0.0284 + 2.5764$$

Density values were calculated from the density of host rock, adjusted by the amount of iron as determined by metal assays. Waste material was assigned the density of porous dolomite (2.71 g/cm^3). The calculation was made on blocks in the block model.

A 3D directional variography was carried out on the composites using the Snowden Supervisor v8.9 software. Variograms were modelled in the three orthogonal directions to define a 3D ellipsoid for each structural domain. The three directions of ellipsoid axes were set by using the variogram fans and visually confirmed with geological knowledge of the deposit. The QP participated in the variography study and considers them appropriate to be used in the ordinary kriging (OK) estimation.

The block model for the Project was set in Geovia Surpac 2019HF1 v.7.0.1949.0. The interpolation was run with the use of two passes on a set of points extracted from the 6.0 m composited data. The block model grades were estimated using OK methods constrained inside the mineralized wireframes. Every step of the block modelling process was revised to ensure fair representation of the available data in the Bloom Lake resource model.

The estimated block grades were classified into Measured, Indicated and Inferred Mineral Resource categories using drill spacing, geological continuity, number of holes used, and slope of regression. When needed, a series of clipping boundaries were created manually in 3D views to either upgrade or downgrade classification in order to avoid artifacts due to automatically generated classification. All remaining estimated but unclassified blocks were flagged as “Exploration Potential”.

The Measured, Indicated and Inferred Mineral Resources for the Bloom Lake project presented herein is estimated at a cut-off grade of 15% Fe, inside an optimized Whittle open pit shell based on a long term iron price of USD61.50/dmt for 62% Fe content, a premium of USD12.70/dmt for the 66.2% Fe concentrate and an exchange rate of 1.24 CAD/USD. The Measured and Indicated Mineral Resource for the Project is estimated at 893.5 Mt with an average grade of 29.3% Fe, and Inferred Mineral Resource at 53.5 Mt with an average grade of 26.2% Fe (Table 1-2).

Table 1-2: Mineral resources estimate for the Bloom Lake project

Classification	Tonnage (dry) kt	Fe %	CaO %	Sat %	MgO %	Al_2O_3 %
Measured	379,100	30.2	1.4	4.4	1.4	0.3
Indicated	514,400	28.7	2.5	7.7	2.3	0.4
Total M&I	893,500	29.3	2.1	6.3	1.9	0.4
Inferred	53,500	26.2	2.8	8.0	2.4	0.4

Notes on Mineral Resources:

1. The independent qualified person for the 2019 MRE, as defined by NI 43-101 Guidelines, is Pierre-Luc Richard, P. Geo, of BBA Inc. The effective date of the estimate is April 19, 2019. CIM definitions and guidelines for Mineral Resource Estimates have been followed.
2. These mineral resources are not mineral reserves as they do not have demonstrated economic viability. The MRE presented herein is categorized as Measured, Indicated and Inferred resources. The quantity and grade of reported Inferred resources in this MRE are uncertain in nature and there has been insufficient exploration to define these Inferred resources as Indicated or Measured; however, it is reasonably expected that the majority of Inferred mineral resources could be upgraded to Indicated mineral resources with continued exploration.
3. Resources are presented as undiluted and in situ for an open pit scenario and are considered to have reasonable prospects for economic extraction. The constraining pit shell was developed using pit slopes varying from 42 to 46 degrees. The pit shell was prepared using Minesight.
4. The MRE was prepared using GEOVIA Surpac 2019HF1 v.7.0.1949.0 and is based on 569 surface drillholes (141,289 m) and a total of 11,397 assays.
5. Density values were calculated based on the formula established and used by the issuer.
6. Grade model resource estimation was calculated from drillhole data using an ordinary kriging interpolation method in a block model using blocks measuring 10 m x 10 m x 14 m (vertical) in size.
7. The estimate is reported using a cut-off grade of 15% Fe. The MRE was estimated using a cut-off grade of 15% Fe, inside an optimized open pit shell based on a long term iron price of USD61.50/dmt for 62% Fe content, a premium of USD12.70/dmt for the 66.2% Fe concentrate and an exchange rate of 1.24 CAD/USD. The cut-off grade will need to be re-evaluated in light of future prevailing market conditions and costs.
8. Calculations are in metric units (metre, tonne). Metal contents are presented in percent (%). Metric tonnages are rounded and any discrepancies in total amounts are due to rounding errors.
9. The author is not aware of any known environmental, permitting, legal, title-related, taxation, socio-political or marketing issues, or any other relevant issues not reported in this Technical Report that could materially affect the Mineral Resource Estimate.

1.6 Mineral Reserves

The mineral reserve for the Bloom Lake project is estimated at 807.0 Mt at an average grade of 29.0% Fe as summarized in Table 1-3. The MRE was prepared by BBA. The resource block model was generated by Champion Iron and reviewed by BBA.

The mine design and mineral reserve estimate (MRE) have been completed to a level appropriate for feasibility studies. The MRE stated herein is consistent with the CIM definitions and is suitable for public reporting. As such, the mineral reserves are based on Measured and Indicated (M&I) Mineral Resources, and do not include any Inferred Mineral Resources. The Inferred Resources contained within the mine design are classified as waste.

Table 1-3: Mineral Reserve Estimate

Classification	Diluted ore tonnage (dry Mt)	Fe %	CaO %	Sat %	MgO %	Al_2O_3 %
Proven	346.0	29.9	1.5	4.7	1.4	0.3
Probable	461.0	28.2	2.6	7.9	2.5	0.6
Total Proven & Probable	**807.0**	**29.0**	**2.2**	**6.5**	**2.0**	**0.5**

1. The mineral reserves were estimated using the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) Standards for Mineral Resources and Reserves, Definitions and Guidelines prepared by the CIM Standing Committee on Reserve Definitions and adopted by CIM Council on May 10th, 2014.
2. The independent and qualified person for the mineral reserves estimate, as defined by NI 43-101, is Isabelle Leblanc, P. Eng., from BBA. The effective date of the estimate is May 17, 2019.
3. Inside the final open pit design, all the Measured Resources and associated dilution (waste material at 0% Fe) have been converted into Proven Mineral Reserves. Inside the final open pit design, all the Indicated Resources and associated dilution (waste material at 0%Fe) have been converted into Probable Mineral Reserves.
4. The reference point of the mineral reserve is the primary crusher feed.
5. Mineral Reserves are based on the December 31, 2020 mining surface.
6. Mineral Reserves are estimated at a cut-off grade of 15% Fe.
7. Mineral Reserves are estimated using a long-term iron price reference price (Platt's 62%) of USD60.89/dmt and an exchange rate of 1.24 CAD/USD. An Fe concentrate price adjustment of USD12.70/dmt was added.
8. Bulk density of ore is variable but averages 3.40 t/m^3.
9. The average strip ratio is 0.88:1.
10. The mining dilution was calculated using a 1 m contact skin.
11. The average mining dilution is 1.1% at a grade of 0% Fe. Dilution was applied block by block and shows a wide range of local variability.
12. The average ore loss is 0.8% at a grade of 31% Fe. Ore loss was applied block by block and shows a wide range of local variability.
13. The author is not aware of any known environmental, permitting, legal, title-related, taxation, socio-political or marketing issues, or any other relevant issues not reported in the Technical Report, that could materially affect the Mineral Reserve Estimate.
14. Numbers may not add due to rounding.

The open pit optimization was conducted to determine the optimal economic shape of the open pit to guide the pit design process. This task was undertaken using the MineSight Economic Planner (MSEP) software that is based on the Lerchs-Grossmann algorithm. The method works on a block model of the ore body, and progressively constructs lists of related blocks that should, or should not, be mined. The method uses the values of the blocks to define a pit outline that has the highest possible total economic value, subject to the required pit slopes defined as structure arcs in the software. This section describes all the parameters used to calculate block values in MSEP.

Dilution was calculated block by block by evaluating which material types are in contact. Ore loss occurs in amphibolite and overburden rock types, while dilution occurs in gneiss and quartz rock types.

For this Feasibility Study, Measured and Indicated resource blocks were considered for optimization purposes. The pit optimization parameters are stated in Table 1-4.

Table 1-4: Optimization parameters

Parameter	Base value	Unit
MINING COSTS		
Mining Cost	2.50	CAD/t mined
Incremental Bench Cost	0.039	CAD/t /14 m
PROCESSING & G&A COSTS		
G&A Cost	2.76	CAD/t milled
Concentrator Cost	3.70	CAD/t milled
Total Operating Cost	6.46	CAD/t milled
NET VALUE & PAYMENT		
CFR 62% Iron	61.50	USD/t (base selling price at revenue factor 1)
Concentrate Premium	12.70	USD/t/%
CFR 66.2% Iron	74.20	USD/t
Exchange Rate	1.24	CAD/USD
CFR 66.2% Iron	92.01	CAD/t
Shipping and Logistics	18.88	CAD/t
Selling Costs	26.04	CAD/t
Iron Price FOB Bloom Lake	47.09	CAD/t
Iron Recovery	varies	%
Weight Recovery	varies	%
Discount Rate	8.0	%
Concentrate Production Rate	15.00	Mtpy

A pit slope design study was carried out by Golder Associates Inc. (Golder) following a request from the previous owner of the project. The conclusions of this study have been used as an input to the pit optimization.

1.7 Mining

The operation consists of a conventional surface mining method using an owner mining approach with electric hydraulic shovels, wheel loaders and mine trucks. The study consists of resizing the open pit based on parameters outlined in Chapter 16 and producing a 20-year LOM plan to feed two plants at a nominal rate of 41.9 Mtpy. .

Drill and blast specifications are established to effectively single pass drill and blast a 14 m bench. For this bench height, a 311 mm blast holes size is proposed with a 6.25 m burden by 7.25 m spacing with 1.5 m of sub-drill in ore. The blast pattern in waste material varies slightly with the various rock types. These drill parameters, combined with a high energy bulk emulsion with a density of 1.2 kg/m^3, result in a powder factor of 0.40 kg/t. Blast holes are initiated with electronic detonators and primed with 450 g boosters. The bulk emulsion product is a gas-sensitized pumped emulsion blend specifically designed for use in wet blasting applications.

Loading in the pit will be done by up to four electric drive hydraulic face shovels equipped with a 28 m^3 bucket. The shovels are matched with a fleet of 218 t payload capacity mine trucks. The project already owns three Caterpillar 6060 electric drive hydraulic front shovels. The hydraulic shovels will be complemented by up to four production front-end wheel loader (FEL) with a 12 m^3 bucket. Two Komatsu WA1200-6 units are available on site as well as one LeTourneau L1850 unit.

Haulage will be performed with 218-tonne class mine trucks. The existing truck fleets consist of seven Caterpillar 793D and three Caterpillar 793F mechanical drive trucks. The initial fleet required will be 13 trucks growing to 32 trucks in Year 6.

Mining of the Bloom Lake project is planned in six phases with a starter phase and two pushbacks in both the West and Chief's Peak pits. Waste rock will be disposed of in four distinct waste dumps. The original northern location used by the previous owner and three new locations to the south. In-pit dumping has not been planned for the project to avoid the possibility of future re-handling. The open pit generates 707 Mt of overburden and waste rock for a strip ratio of 0.88:1.

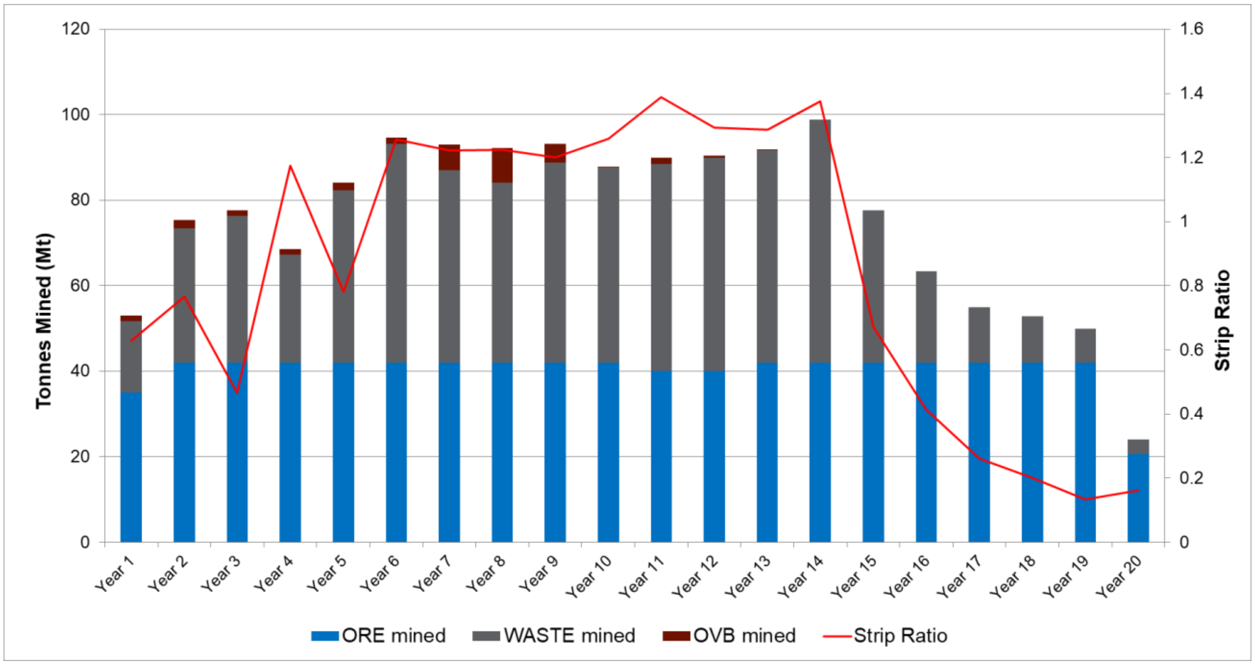

Figure 1-1: Mine production

1.8 Mineral Processing and Metallurgical Testing

The Bloom Lake deposit has been extensively tested since the mid-1970's by previous owners and has showed good potential for gravity recovery of the iron bearing minerals.

The proposed Phase 2 (QIO) flowsheet was developed to improve overall iron recovery compared to the already well-performing Phase 1 (QIO) flowsheet commissioned in February 2018. The Phase 2 concentrator has a robust design allowing for greater operational flexibility and thus aids in avoiding potential tonnage constraints.

The Phase 2 (QIO) flowsheet development was mostly based on the results from a process audit of the operating Phase 1 (QIO) concentrator and results from the test program performed at COREM under the supervision of Soutex. The test program was divided in two main stages:

1. Optimization tests were conducted for each stage to either confirm an equipment performance or test a new equipment performance. In the case where a significant quantity of material was required for a downstream equipment, a production run was also used to generate an adequate sample mass.
2. Variability tests run were performed on the developed flowsheet using five different ore blends composed from eight different ore types collected across Bloom Lake three main pits. Goal of the variability tests run was to confirm flowsheet robustness when processing different ore types and feed grades.

The proposed flowsheet is presented in Figure 1-2.

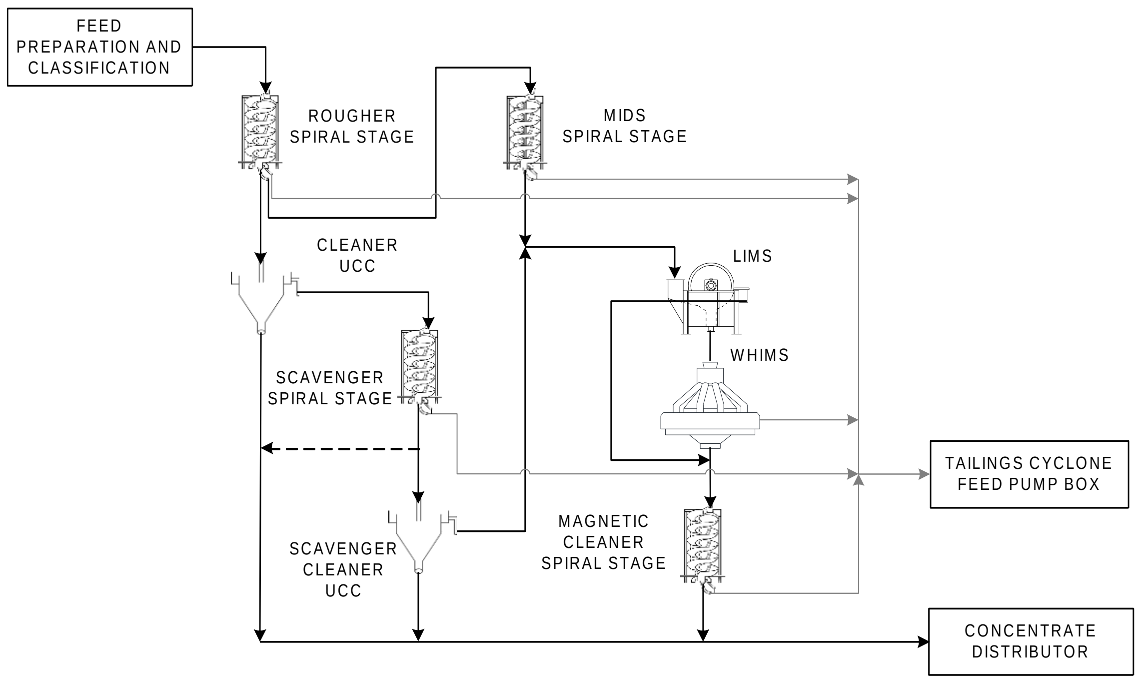

Figure 1-2: Phase 2 (QIO) flow diagram

The flowsheet developed includes the following modifications over the Phase 1 (QIO) flowsheet:

- Redirection of the mids spiral stage concentrate to the magnetic separation circuit to prevent coarse silica being sent to the cleaner up-current classifiers (UCC);
- Addition of a scavenger cleaner UCC stage to increase recovery at the scavenger spiral stage and increase robustness to feed variations.

With the information obtained from the testwork program, the variability testwork results in particular, and the operational experience of the Phase 1 (QIO) concentrator, the following recovery equation was determined:

$$\%Fe_{Rec.} = -0.03593Fe^2 + 3.1900Fe - 0.59683MgO - 0.00495MgO^2 + 0.01424FeMgO + 20.678$$

This equation takes into account the magnesium, measured as MgO, feed grade and assumes it represents actinolite, which contains iron that is not recoverable. The model is applied over the life of mine annual average iron feed grade range of 27% to 31% and MgO feed grades up to 3.5%. Figure 1-3 shows the recovery model developed for Phase 2 (QIO).

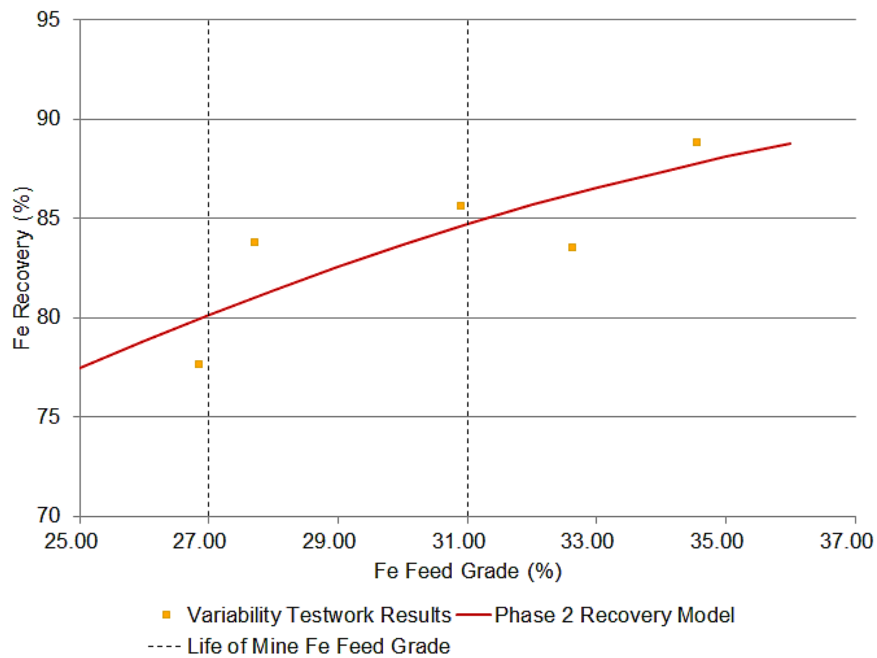

Figure 1-3: Iron recovery vs. iron feed grade

1.9 Recovery Methods

The Bloom Lake Phase 2 (QIO) is designed to process ore at a nominal rate of 2,650 tph. With the new Life of Mine design, the projected production is 7.75 Mtpy of concentrate at a 29.0% Fe feed grade and concentrate grade of 66.2% Fe. The Phase 1 and Phase 2 combined expected weight recovery is 36.0% and iron recovery is 82.4%. The simplified process flow diagram (PFD) for the new Phase 2 is presented in Figure 1-4.

1.9.1 Circuit Description

Ore from the mine is delivered to Crusher 1 and Crusher 2. Crushed ore from Crusher 2 falls on a surge conveyor, which transports it to the crushed ore buffer stockpile and is then transferred on the overland crushed ore conveyor. Crushed ore from Crusher 1 is fed to a surge bin where it is reclaimed via a conveyor system and transported to the common crushed ore stockpile area.

Crushed ore from the stockpile is fed to an AG mill by the means of the mill feed conveyor. The Phase 2 (QIO) project will upgrade the original two 7,500 hp (5,593 kW) motors to 8,400 hp (6264 kW) each. The additional available power will make it possible to increase tonnage when the power draw is high and no other constraint is active. The power increase means that ore-specific power can reach 4.7 kWh/t at the design feed rate of 2,650 tph, which is higher than the Phase 1 (QIO) design value of 4.5 kWh/t at 2,482 tph.

Ground ore is discharged from the mill to feed the scalping screens. The undersize of each scalping screen is pumped to the classification screens' feed distributors arranged to evenly split the feed to the North and South lines. Scalping and classification screen oversize is conveyed back to the AG Mill while static screens and classification screens undersize is collected in a pump box (one for each production line) to be pumped to the gravity concentration circuit. Dilution water originating from the filtrate tank is added to the classification screen undersize pump boxes to ensure a stable rougher feed density.

The Phase 2 separation circuit developed, as in Phase 1 (QIO), is a multi-stage circuit comprised of rougher, middlings, scavenger and mag cleaner spirals, cleaner and scavenger-cleaner Up-current classifiers, low intensity magnetic separators (LIMS) and wet high intensity magnetic separator (WHIMS). It is designed to remove gangue material, mostly silica, from hematite and magnetite to achieve the desired 82.5% Phase 2 iron recovery, with a key difference being the inclusion of up-current classifiers in the scavenger stage.

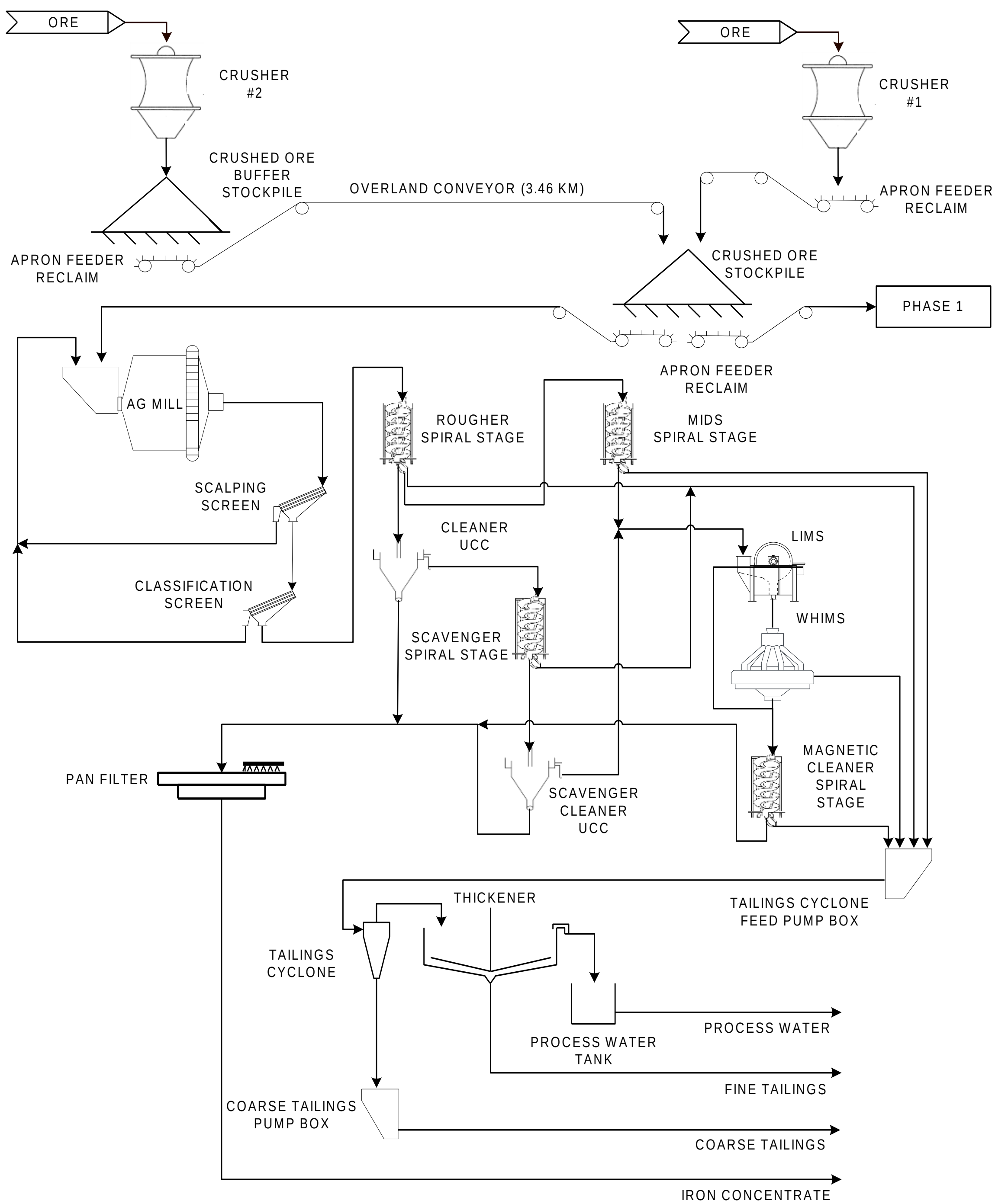

Figure 1-4: Simplified process flow diagram Phase 2 (QIO)

1.9.2 Gravity Circuit Operation

In the gravity circuit, the combination of spirals at the rougher stage and UCC at the cleaner stage enables the removal of silica of all sizes. The roughers will maximize iron recovery while preventing coarse silica from reaching the cleaner stage. The cleaner stage will remove fine and mid-sized silica to achieve a final concentrate silica grade lower than the 4.5% target. The mids spirals will recover misplaced iron from the rougher stage middlings while removing mid-size to coarse silica. Sending the mids concentrate to the magnetic separation circuit stage prevents the reintroduction of coarse silica in the cleaner UCC stage.

The tails coming from the rougher is a high flow, but low percent solids stream from which water can be recovered through dewatering cyclones and reused in the process. The rougher spirals tails dewatering cyclone overflow is pumped in the required quantity to the mill feed chute and the scalping screen pump boxes for density control.

A combination of spirals and UCC is also used at the scavenger and scavenger cleaner stages. The scavenger is operated to maximize iron recovery while removing mid-sized silica. The scavenger cleaner stage is operated to remove fine silica. To maximize iron recovery when the scavenger spiral grade meets specifications, the scavenger-cleaner UCC stage can be bypassed.

1.9.3 Magnetic Circuit Operation

A combination of LIMS, WHIMS and spirals is used to scavenge iron from the scavenger cleaner UCC overflow and mids spirals concentrate. The LIMS recovers magnetite and the remaining hematite enters the WHIMS stage to ensure the efficient operation and availability of the WHIMS. The WHIMS magnetic intensity is adjusted to maximize hematite recovery from paramagnetic minerals. The LIMS and WHIMS magnetic concentrates are fed to the mag cleaner spiral stage where the settings are adjusted to achieve the final concentrate target grade of 4.5% SiO_2.

1.9.4 Concentrate Operation

The concentrate is collected into the concentrate collector launders. From there, it goes into a 4-way pan filter feed distributor that splits the feed into 4 horizontal pan filters. The addition of a common 4-way feed distributor results in equal distribution of the concentrate to the operating filters. The concentrate pan filter area is 1.7 times that of the Phase 1 (QIO) filters, meaning that only three filters are required in operation and stopping a pan filter for maintenance will not imply tonnage reduction.

Phase 2 concentrate is transferred to the Phase 2 transfer tower. From there, it can go to Phase 1 silo, Phase 2 silo or the Phase 2 emergency stockpile. When train loading begins, the concentrate is transferred to the Phase 1 hopper and tilt chute for loading into railcars. Calcium chloride is added in the winter months to prevent the concentrate from sticking onto the railcar walls.

1.9.5 Tailings Operation

The tailings cyclone cluster feed pump boxes receive tails from the various separation stages and feed the tailings thickening cyclone clusters that produce a dense and coarse underflow reporting to the coarse tailings collection box and a fine and dilute overflow that reports to the tailings thickener.

The tailings thickener underflow is pumped to the fine tailings tank where it is mixed with Phase 1 fine tailings. The material is pumped through the booster station to the fine tailings storage facility (TSF). The tailings thickener has a surface of 2.1 times larger than that of the Phase 1 (QIO) thickener. The increased thickener surface area allows the rise rate to be greatly reduced, which increases stability and control of the overflow water quality. The thickener overflow is gravity fed into the process water tank to be reused throughout the concentrator.

The tailings cyclone cluster underflow (coarse tailings) is gravity fed to a pump box. From there, the tailings stream is pumped via a series of coarse tailings pumps to booster stations as it is transported to the coarse TSF.

1.10 Infrastructure

1.10.1 Mine Infrastructure

The entire mine infrastructure used for the current mining operations will be upgraded to the new mine plan requirements. Most of the required infrastructure is already constructed with a few new additions/modifications that will be required. The facilities breakdown is detailed in Table 1-5 .

Table 1-5: Mine infrastructure

Infrastructure	Condition (existing or new/modified)
Mine maintenance garage (Phase 1)	Existing
Mine maintenance garage (Phase 2) 2023	New
Garage SMS Secondary truck maintenance	New
Truck wash bay	Existing
Fuel storage and distribution system	Existing
Mine electrical infrastructure	New
A cafeteria at the West Pit (to minimize lost time for truck drivers' breaks)	Existing
Spare parts containers located around the site to store drilling equipment, surveyor equipment and environmental equipment	Existing
Mobile shovel bucket repair shop	Existing
Dispatch system, complete with trailers, offices and a cafeteria	Existing
Aggregates crusher plant (contractor)	Existing

1.10.2 Infrastructure Located at the Processing Plants

The vast majority of the required infrastructure for Phase 2 is available and currently used for Quebec Iron Ore operations. Figure 1-5 shows the location of the major infrastructure located at the Bloom Lake site. The process plant building required for Phase 2 has already been constructed and certain equipment has already been installed. The structure is complete and the building walls have been closed. Non-process buildings include:

- A service building attached to the Phase 1 process plant which houses:
  - Maintenance shops;
  - Unloading and warehousing completely stocked with parts and supplies;
  - Electrical/instrument repair shop;
  - Boiler plant to provide steam to both plants for heating and filter cake drying. The boiler plant also hosts the boiler water treatment system;
  - Offices for administration, purchasing, human resources, technical services (engineering and geology), training and plant operating personnel;
  - Laboratory equipped for metallurgical testwork, wet and dry assaying;
  - Lunchroom, men and women change rooms, sanitary and locker facilities;
  - Communications room;
  - Compressor room to provide service air and instrument air to both concentrators;
  - Fresh water storage tank and water treatment facilities for both plants;
  - Electrical room.
- Eight various utility domes used as warehouses or shops for contractors.

1.10.3 Train Loading Station

The Phase 2 expansion will involve the addition of a second silo having a capacity of 30,000 t and linked to the existing load-out station. A series of conveyors will allow both plants to discharge their concentrate in both silos allowing greater operational flexibility. No significant modification is planned for the existing train loading facilities apart from the connection of Silo 2 to the load out, integration of the second silo conveyor inlet and some minor systems improvements to the existing train loading facilities.

1.10.4 Rail Infrastructure

The rail network consists of three separate segments to transport iron ore concentrate from the mine site to the port.

1. **First segment** of rail referred to as the Bloom Lake Railway (BLR) consists of a 32-km long segment that connects the mine site to the Quebec North Shore and Labrador (QNS&L) railway at the Wabush Mines facilities in Wabush, Labrador;
2. **Second segment** uses the QNS&L railway from Wabush to Arnaud junction in Sept-Îles, which has a mainline track of approximately 395 km;
3. **Third segment** is from Arnaud junction to Pointe-Noire (Sept-Îles), which is the property of SFP Pointe-Noire (SFPPN).

The current fleet is composed of 735 insulated ore cars dedicated to move Bloom Lake concentrate. As part of the expansion, QIO will require an extra 450 railcars for a total of four long trains (240 railcars) and one short train (168 railcars). A 5% spare fleet allowance is considered to provide reliable operations. Rail additions will be required along the Bloom Lake railway, at Arnaud Junction and at the Pointe-Noire terminal. One of the major changes to be performed is related to the dumper track at the Pointe-Noire Terminal in order to unload the 240-car train by cuts of 82 cars instead of 55 cars as is performed for current operations. This modification reduces the unloading cycle time and maximizes the car dumper capacity.

1.10.5 Port Infrastructure

The concentrate is unloaded from railcars at Pointe Noire, which is owned by SFPPN and controlled by the Government of Quebec, and can be either loaded directly onto a vessel or stockpiled to be reclaimed and loaded at a later date. As part of the expansion project, the infrastructure must be upgraded to accommodate an average yearly throughput of 15 Mt of concentrate. To allow efficient and reliable operations, modifications will be performed to increase the stockpiling capacity, reduce the railcars unloading cycle and increase the stacking and reclaiming performance.

The infrastructure modifications required for Phase 2 operations are as follows:

- Dismantling of the existing rail segment located after the rail dumper;
- Excavation, blasting and back-fill to support the new rail segment that will be installed after the rail dumper;
- Move the existing access road for Port de Sept-Îles and Aluminerie Alouette;
- Construction of a new site service road;
- Relocation of the aqueduct network;
- Relocation of the 25 kV electrical line;

- Relocation of the Telus telecommunications infrastructure;
- Construction of new culverts;
- Addition of a new stacker-reclaimer;
- Extension of conveyors CV-2 & CV-3 by 300 m;
- Addition of 600 hp motors on conveyors CV-2 & CV-3.

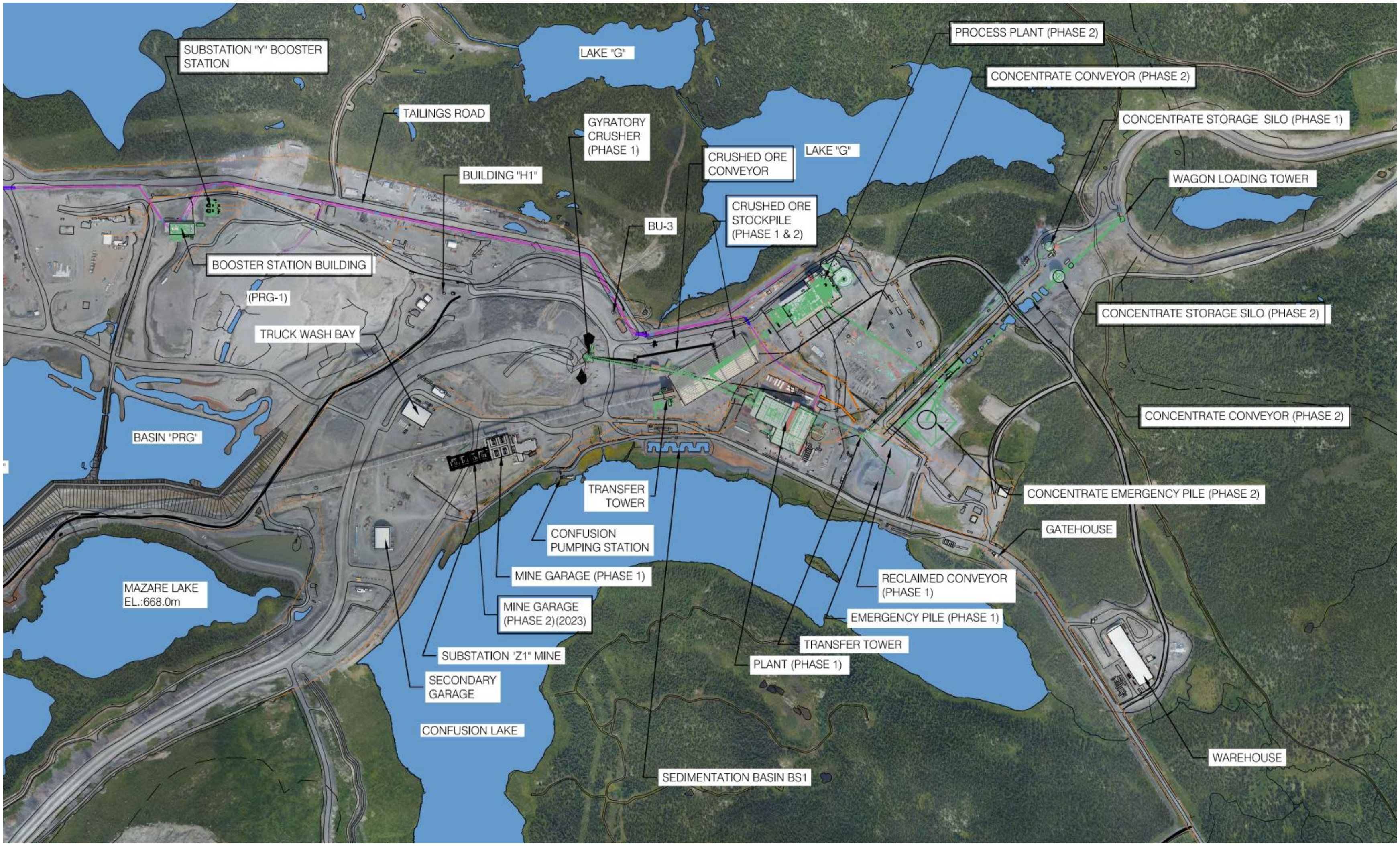

Figure 1-5: Major infrastructure located on the Bloom Lake site

1.11 Tailings and Surface Water Management

The tailings management strategy is developed around tailings slurry pumping and hydraulic placement of an annual average of 26.8 Mt of tailings that are separated in two feeds: coarse (85%) and fine (15%). This separation optimizes the footprint, utilizes the existing infrastructure and reduces the overall environmental risks by maximizing each material given their distinct properties and behaviours. Slurry pumping and hydraulic deposition is a safe and economic way to transport and store large quantities of tailings.

The tailings management strategy for the expansion project is compatible with the current management strategy. Fine tailings are stored year-round in Basin *A*, which is contained by centreline or downstream construction dikes. Coarse tailings are stored in the current *HPA-Sud* and *HPA-Ouest* storage areas as well as the new *HPA-Nord* storage area. The coarse tailings are contained by upstream 10H:1V sloped filtering dikes built solely on stable coarse draining tailings. Most construction work in the fine tailings basin is expected to be executed by contractors, while the coarse tailings management facility (TMF) will be mostly built by the QIO personnel and equipment

The surface water management system is composed of a network of ditches, collection basins, pumping stations and retention ponds. Since Bloom Lake restart, some upgrades on the current conveying surface water management system have been done to increase robustness and reliability. These improvements are applied in the design of the water management systems around the new permitted areas *HPA-Nord* TSF and *Halde-Sud* waste dump. These new permitted areas will also include water retention basins sized to hold water volumes according to applicable legislations. Therefore, they do not impact the current water management system during the spring thaw period. Water from these basins can then be pumped to the existing system in a controlled manner during the remainder of the year. These water basins are dammed by centreline construction dikes that will be built to the highest safety design and construction standards. Finally, the current water treatment plant located next to the TSF will be winterized and upgraded to accommodate increases in the required treatment capacity due to the new permitted areas. This upgrade will be necessary when the future *HPA-Nord* TSF and *Halde-Sud* waste dump are constructed.

1.12 Environment

The mine has been authorized for operation under the federal environmental authorities and provincial governments.

No other federal authorizations are required to operate the second concentrator. Therefore, Bloom Lake can increase the annual ore production to 16 Mtpy. Fish habitats (lakes, ponds, and streams) are present within *HPA-Nord* TSF and the *Halde Sud* waste stockpile locations. Under Section 36(3) of the Fisheries Act, it is forbidden to deposit deleterious substances such as tailings and waste rock in water frequented by fish. However, the MDMER includes provisions (regulatory amendment) allowing the use of a natural water body frequented by fish for mine waste disposal. The assessment of alternative reports is currently reviewed by ECCC. Upon acceptance, the process of amendment of Schedule 2 of the MDMER will be initiated. According to the Project development schedule, disposal of tailings in *HPA-Nord* and waste rock in *Halde Sud* stockpile will not be required before 2026, thus allowing sufficient time than required for QIO to complete the federal permitting process.

At the provincial level, Bloom Lake has also received operational permits for the mine, the dust collection systems, the railroad and the wastewater treatment systems. With the infrastructure facilities authorized, the expansion Project can go forward without delays. The storage capacity for waste rocks and tailings is secured by permits up to 2024 at a production rate of 16 Mtpy. Consultations and presentations to the First Nations and the local community have been conducted since December 2018 to consider their concerns throughout the development of the expansion project. Various committees are ongoing to ensure a follow-up on the IBA (First Nations) or the mine activities (community stakeholders). QIO maintains positive relationships with the community and has become a reference for First Nations involvements in terms of training, employment and environment.

The same mining effluent will be maintained with the expansion, and the requirements (Directive 019 and MDMER) in terms of monitoring will remain unchanged. Other monitoring programs are ongoing on the site with regards to groundwater and air quality.

A revised closure plan was submitted to MERN in 2018 which covered five years of mining operations. According to Section 232.6 of the Quebec Mining Act (L.R.Q., c. M 13.1), QIO shall submit a revised closure plan to the Minister for approval every 5 years or whenever amendments to the plan are justified by changes in the mining activities. QIO must also provide a financial guarantee covering the closure plan cost to the provincial government in accordance with Section 111 of the Regulation Respecting Mineral Substances other than Petroleum, Natural Gas and Brine (Chapter M-13.1, r. 2).

1.13 Market Studies

QIO engaged Wood Mackenzie to provide an iron ore market study for use in the Bloom Lake Mine Feasibility Study Phase 2 NI 43-101 technical report.

The market study covers the following topics, details can be found in Chapter 19:

1. Market study executive summary
2. Iron ore market overview
3. Iron ore products
4. Major iron ore markets size and structures
5. Major sources of internationally traded iron ore
6. Iron ore demand evolution: 2000-2018
7. Iron ore supply evolution: 2000-2018
8. Forecast demand of iron ore: 2019-2040
9. Forecast supply of iron ore: 2019-2040
10. Iron ore pricing
11. Iron ore pricing evolution
12. Dry bulk freight outlook
13. QIO's Bloom Lake concentrate price forecast

Iron ore is commonly sold on a Cost and Freight (CFR) or Free on Board (FOB) basis. Under a CFR sale, the product changes hands as it is unloaded at the arrival port and the pricing includes shipping costs. In recent years, there has been a strong trend to CFR sales, as this gives sellers control over shipping. A FOB sale is for iron ore delivered on board a vessel at the loading port, and the price is usually determined by netting back the cost of ocean freight (to China) from the CFR China price.

The future Bloom Lake concentrate prices were estimated based on the Canadian Institute of Mining, Metallurgy and Petroleum (CIM) guidance on commodity pricing adopted on November 28, 2015. Table 1-6 presents the base case price forecasts for the first three years of operation as well as for the LOM. The base case economic assumption utilizes a conservative blended average gross realized price of USD84.1/t (66.2% Fe CFR China) for the LOM. Given recent events in Brazil fail to be recognized in the 3-year moving average as suggested by CIM, the base case price assumption also incorporates analyst consensus to capture the short-term pricing dynamic in the industry. The P65 analyst consensus of 9 well recognized global research firms was utilized for the basis of the price for Years 1 to 3. For the remaining LOM, the P65 iron price is based on the average of the P65 analyst long-term consensus and the P62 3-year trailing average with a 15% premium, being a discount to the estimated long-term premium of P65 to P62 of 20% by Wood Mackenzie. Such estimates for P65 then receives a pro-rata adjustment for premium at 66.2% and marketing fees to arrive at a net realized price for the concentrate of 66.2% produced at Bloom Lake.

Table 1-6: Bloom Lake concentrate base case price estimates
Prices in USD/dry metric ton (dmt) and in real 2019 terms

Year	62%Fe Index CFR China (3-year moving avg)	62%Fe Index CFR China + 15% (3-year moving avg)	65%Fe Index CFR China analyst consensus	Realized price 66.2% CFR China net of marketing fees	Freight	Net realized price 66.2% FOB
2021			91.36	91.56	22.27	69.29
2022			88.07	88.26	21.61	66.65
2023			84.24	84.42	20.85	63.57
2024 and +	71.54	82.27	84.24	83.43	20.65	62.78
Average LOM		**83.90**		**84.10**	**21.54**	**62.56**

Source: PLATTS

1.14 Capital Cost Estimate

The capital cost estimate was based on the detailed engineering material take-offs, bids received from vendors and contractors from the previous study phase, and some data from historical projects. As the project was under construction and 65-70% complete, parts of the estimate are based on advanced detailed engineering. The initial capital cost estimate does not include taxes, replacement capital or additional working capital requirements after commissioning and start-up. The cost estimate, presented herein, is calculated and presented in Canadian (CAD or $) dollars and is dated Q2 2019. The conversion rates used to transfer foreign currencies to CAD are shown in Table 1-7.

Table 1-7: Currency conversion rates

Country	Currency	Equivalent
United States	1.00 USD	1.32 CAD

The summary table for the capital cost estimate (CAPEX) is found in Table 1-8.

Table 1-8: Estimated pre-production capital costs

Category	Pre-production
	M$
General	$28.2
Mine – Phase 2	$37.6
Crusher and stockpile	$24.3
Concentrator	$165.0
Tailings and water management	$50.2
Services	$30.5
Rail and Port	$73.4
Owner's Costs (all-inclusive indirect costs)	$105.1
Contingency	$75.5
Total	**$589.8M**
Deposits	$44.0
Total including deposits	**$633.8M**

1.15 Operating Cost Estimate (OPEX)

Mining operating costs were generally developed from first principles, internal benchmarking information for similar projects and vendor quotes. For the concentrator, G&A and tailings operating costs, a portion of the unit rates and consumptions were based on actual operation costs and consumptions as per QIO's experience with Phase 1 actual operational costs. Other costs and consumptions required were derived by QIO, and WSP for the tailings management, have been compiled from a variety of sources and are mainly based on historical data, operating budgets and vendor quotes. Costs for concentrate transportation were established by QIO based on agreements with the rail transport providers.

A summary of the average operating cost of Phase 1 and Phase 2 combined over the life of mine is shown in Table 1-9.

Table 1-9: Total estimated average LOM operating cost (Phase 1 + Phase 2) ($/t dry concentrate)

Category	Avg. (LOM)
	$/t conc.
Mining	$13.4
Crushing and Conveying	$1.7
Process Plant	$7.9
Concentrate Shipping	$16.8
Water and Tailings Management	$2.1
General and Administrative	$4.7
Total OPEX (cash cost)	**$46.6**
Sustainability	**$1.3**
Sustaining Capital (1)	**$4.4**
All-in sustaining cost	**$52.3**

(1) The total sustaining capital costs is estimated at **$4.4/t** over the LOM (capital expenses incurred from Year 1 of production to the end of the mine life), which includes items such as mine equipment fleet additions and replacements, facilities additions, rail car leasing, improvements and costs related to phasing of the TMF.

1.16 Economic Analysis

The economic/financial assessment of the Bloom Lake Phase 2 Project of Quebec Iron Ore Inc. is based on Q2-2019 price projections in USD currency and cost estimates in Canadian currency. A spot exchange rate of USD0.76 per CAD was assumed to convert particular components of the cost estimates into CAD and forward exchange rate estimates were used to convert USD market price projections into CAD. No provision was made for the effects of inflation. The evaluation was carried out on a 100%-equity basis. The evaluation presented is based on expenditures for Phase 2 only to avoid distorting the results with Phase 1 concentrate production. Current Canadian tax regulations were applied to assess the corporate taxes, while the regulations in Quebec (originally proposed as Bill 55, December 2013) were applied to assess the mining taxes. The financial indicators under base case conditions are presented in Table 1-10.

Table 1-10: Financial model indicators, Phase 2 only

Financial Results	Unit	Value
Pre-tax NPV @ 4%	M CAD	2,222.7
Pre-tax NPV @ 6%	M CAD	1,838.5
Pre-tax NPV @ 8%	M CAD	1,531.8
Pre-tax IRR	%	42.4
After-tax NPV @ 4%	M CAD	1,415.6
After-tax NPV @ 6%	M CAD	1,160.4
After-tax NPV @ 8%	M CAD	955.7
After-tax IRR	%	33.4
After-tax Payback Period on initial capital	years	2.4

A sensitivity analysis reveals that the Project's viability will not be significantly vulnerable to variations in capital costs and freight, within the margins of error associated with Feasibility-Study-level estimates. However, the Project's viability remains more vulnerable to the USD/CAD exchange rate and OPEX and to a more pronounced degree, future market prices of iron ore concentrate. Refer to Chapter 19 for further details on the market price analysis.

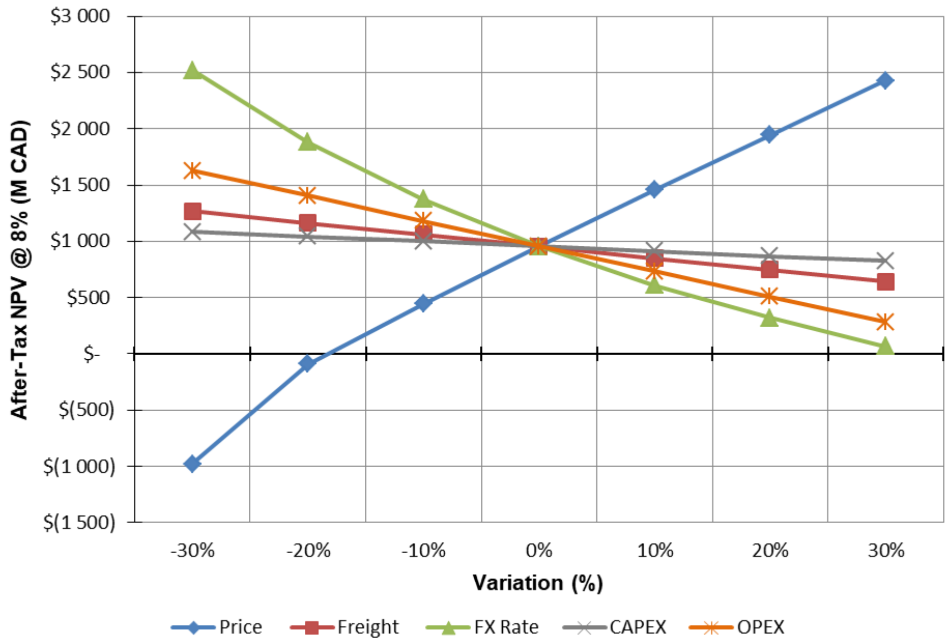

Figure 1-6: Sensitivity of the net present value (after-tax) to financial variables

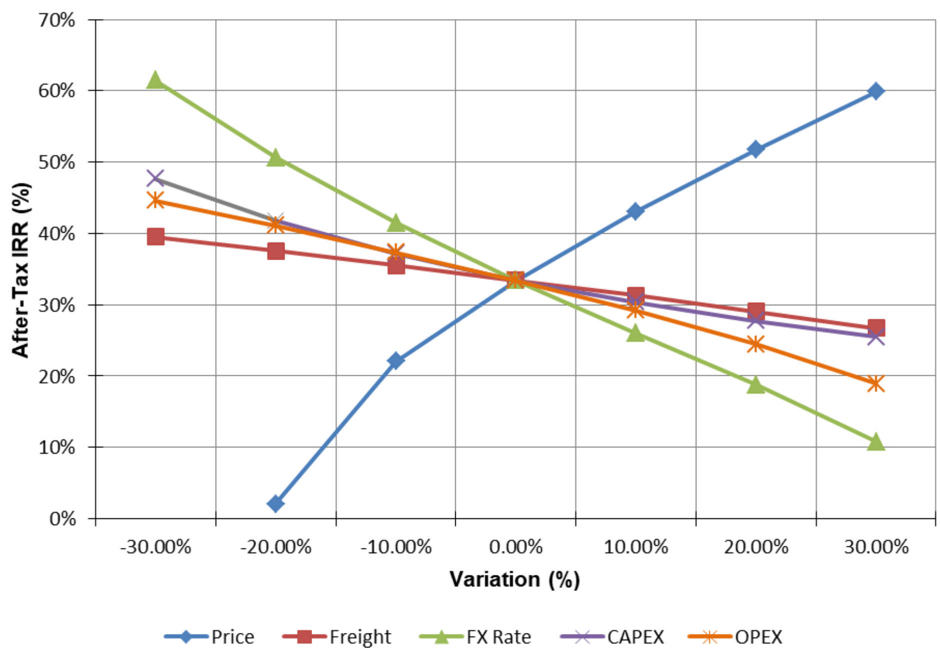

Figure 1-7: Sensitivity of internal rate of return (after-tax) to financial variables

1.17 Project Execution and Schedule

QIO has a very good understanding of the challenges involved in the Phase 2 project, which are quite different from Phase 1. The success of the Phase 2 project requires an effective execution strategy from the Project kick-off to the full production ramp-up. In this regard, QIO has started the preparation of a Project Management Plan (PMP) with the related execution plans (Health, Security and Environment (HSE), Project Execution, Engineering, Procurement, Construction, Project Services and Operational Readiness).

The preliminary project schedule is developed to a feasibility study level and will be further defined during the baseline definition exercise started in early July 2019. The preliminary schedule covers the period from the kick-off up to the commercial operation of the Phase 2 project. Pursuant to the strong economics outlined in this Study, QIO's board has approved an initial budget of $68M to advance the Project during the remainder of 2019. This budget will serve for early works during the summer of 2019, definition and procurement work for long-lead items and advancement of detailed engineering to respect the Project's major milestones. The major milestones of the Project are listed in Table 1-11:

Table 1-11: Phase 2 project schedule milestones

Milestone Month	Description
June 2019	Phase 2 Feasibility Study completion
July 2019	Phase 2 Project kick-off, start of early works and detailed engineering
M0	Board approval for remaining project budget
M9	Start of pre-commissioning activities
M12	Start of commissioning activities
M14	Start of operation and ramp-up
M19	Phase 2 commercial operation

1.18 Risk Management

Several risk identification workshops were held during the FS to identify and manage the potential risk exposures of the Bloom Lake Phase 2 project. The attendances were stakeholders from Quebec Iron Ore and the different partners collaborating to the FS. The findings of those workshops were compiled in a risk register followed by an assessment of the frequency and consequence of an item in order to get a risk priority number using a risk priority matrix. The risk register and the risk priority matrix are similar to the ones used for the restart of Bloom Lake Mine in 2017. After an exercise of mitigation done during the last workshop, the resulting division of material and main risks are reported in Figure 1-8.

The Project risk register will be revisited, reviewed and updated regularly during the Phase 2 project execution. Each risk owner will be responsible to provide any update to the mitigation action items and to re-assess the risk as the Project develops.

Additional risk workshops will be scheduled during the Project in different forms (e.g., HAZOP, HAZID, etc.) to address specific aspects in HSE, Engineering, Procurement, Construction, Commissioning and Operation.

Assessment Levels

The pie chart in Figure 1-8 indicates the risk division in the different category of the Project risk register after mitigation:

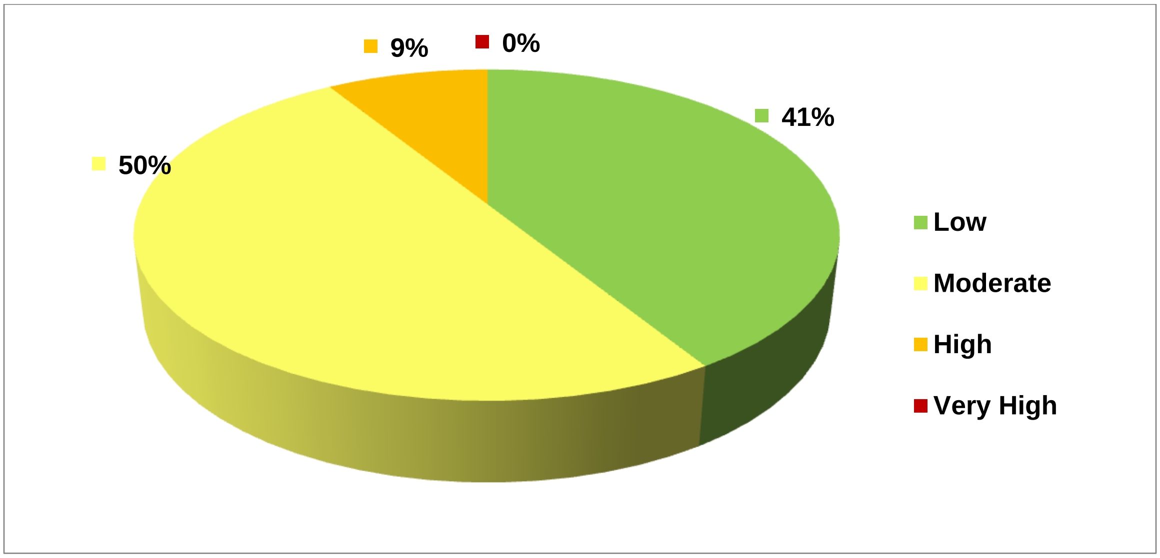

Figure 1-8: Risk register assessment levels

1.19 Conclusions

The Bloom Lake Phase 2 project is financially and technically feasible with an estimated initial capital cost of $589.8 M and initial deposits of $44M. The economic analysis of the Project shows an IRR of 33.4% and a simple payback period of 2.4 years after taxes.

The expected level of accuracy of the capital and operating cost estimates for this study should be in the range of -10% on the low side to +15% on the high side. The capital cost estimate includes a 15% contingency on the pre-production capital costs and includes contingencies on the indirect costs.

1.20 Recommendations

Given the positive financial results from the economic analysis of the Study, it is recommended that the Project advance to the next phase. The following general recommendations are put forward for the continuation of this Project into the next phases which are: detailed engineering, procurement, and construction. It is QIO's intent to start commissioning activities in month 12 of the schedule and be in commercial production by Month 19 of the schedule. For this to become a reality, it is imperative that a focus be placed on critical path purchase orders (long-lead items) and start early works and detailed engineering in a timely fashion.

2. INTRODUCTION

2.1 Background

In December 2006, an environmental impact assessment (EIA) of the Bloom Lake Mine project (the "Project") was submitted to the agencies. Decree 137-2008 authorizing the Project was adopted on February 20, 2008 by the provincial government. Consolidated Thompson Iron Mines Limited began the construction of the mining infrastructure in 2008 and commenced mining operations in 2010 with the Phase 1 concentrator plant (referred to as "Phase 1 (Consolidated Thompson) plant" in this document).

The mine was sold to Cliffs Natural Resources Inc. (Cliffs) in 2011, which continued the Phase 2 (Cliffs) construction project until the Project was halted in November 2012, and conducted mining operations until they were suspended in December 2014. The site was employing approximately 600 people.

In January 2015, Cliffs sought creditor protection under Companies' Creditors Arrangement Act (CCAA), resulting in the mine being put on a care and maintenance program and placed into creditor protection.

In April of 2016, Champion Iron Limited (Champion or ''the Company'') acquired the Bloom Lake assets through its subsidiary Quebec Iron Ore (QIO) and the Quinto Claims for a cash consideration of $10.5M ($9.75M for Bloom Lake and $0.75M for Quinto) and the assumption of liabilities. Quebec Iron Ore Inc. is 63.2% owned by Champion Iron Limited, with the remaining 36.8% equity interest owned by *Ressources Québec* (RQ), acting as a mandatory of the Government of Quebec. On May 29, 2019, the Company announced a transaction to acquire RQ's 36.8% equity interest in QIO and the transaction would increase Champion's stake in QIO to 100%. For more information on the capital restructuring, please refer to the Company's press release dated May 29, 2019, available under the Company's filings on SEDAR at www.sedar.com.

Following acquisition of the Bloom Lake assets by QIO, a feasibility study to identify areas for improvement or correction was completed in February 2017 and resulted with the restart of the operation in February 2018 on time and on budget.

During its first full year of operation (2019 Fiscal Year), the Bloom Lake site produced 6,994,500 wet metric tonnes of 66.4% iron ore concentrate, which is an improvement of approximately 1,000,000 wet metric tonnes over 2014 production. The production total cash cost during 2019 was $49.4/dmt and the all-in sustaining cost was $55.8/dmt.

As part of an expansion plan to increase the mine production, the design and construction of a second concentrator plant (referred to as "Phase 2 plant" in this document) was initiated to increase nominal capacity to about 15 Mt of concentrate per annum.

Given the amount of work that Cliffs has already committed in preparing the Phase 2 plant, mine and tailings expansion, the Bloom Lake project represents a low capital investment for a considerable increase in high grade iron ore concentrate production.

2.2 Scope

The scope of this feasibility study is to develop a plan to complete the construction of the Phase 2 concentrator including improvements to maximize production efficiency and modifications to other areas to support the operation of both concentrators. Feasibility study level engineering was performed on each of these areas to outline work to be performed. The resulting capital cost estimate reflects a Class 3 study as defined by the Association for the Advancement of Cost Engineering (AACE) as described in Recommended Practice N° 18R-97 about Cost Estimating Classification System. The expected accuracy for this study should be in the range of -10% on the low side to +15% on the high side.

The following Technical Report (the "Report") presents the results of the feasibility study (FS) for the Phase 2 expansion of Bloom Lake's operations. This Report, titled "Bloom Lake Mine – Feasibility Study Phase 2", was prepared by Qualified Persons (QPs) following the guidelines of the "Canadian Securities Administrators" National Instrument 43-101 (effective June 30, 2011), and in conformity with the guidelines of the Canadian Mining, Metallurgy and Petroleum (CIM) Standard on Mineral Resources and Reserves.

This Report is considered effective as of June 20, 2019.

Past technical reports on the Project can be accessed from SEDAR's electronic database http://www.sedar.com/.

2.3 Basis of the Report

Information presented in this Report is based on the following:

- Information provided by Quebec Iron Ore;
- Phase 1 process audit results;
- Metallurgical testwork performed by COREM in their metallurgical testing facilities using samples from the operating Phase 1 (QIO) concentrator and from the Bloom Lake mine;
- Information from the CIMA+ Phase 2 (Cliffs) design drawings and specifications;
- Current and previous operations data;
- AG Mill grinding performance studies by SGS;
- Mineral Technologies – Metallurgical testwork for the Bloom Lake restart of Phase 1 (QIO);
- Soutex – Metallurgical testwork for the Bloom Lake Phase 2 (Cliffs) concentrator.

2.4 Description of the Project

The Bloom Lake Mine Phase 2 project includes the following elements:

- A new mining plan for Bloom Lake, which will include additional support mobile equipment;
- Modifications to crusher 1 to allow feeding both concentrators;
- Process flowsheet upgrade within the existing Phase 2 concentrator. The flowsheet upgrade focus is to improve the recovery of iron by the concentrator, with specific attention given to improving recoveries of the coarser (+425 microns) and fine (-106 microns) iron minerals while having no adverse effect on the recovery of other size fractions;
- Modifications to the Phase 2 concentrator required for the upgrade to the iron recovery circuit flowsheet include:
  - Replacement of the spirals used for the restart of the Phase 1 (QIO) concentrator;
  - Installation of new spirals in a revised circuit configuration;
  - Installation of two stages of up-current classifiers to complement the spirals. The use of the two types of gravity separation technology performs well in maximizing iron recovery in a robust manner across a broad range of particle sizes;
  - Installation of an iron-scavenging magnetic circuit. The magnetic circuit uses both LIMS and WHIMS to target recovery of fine iron that otherwise reports to the gravity circuit tailings. This circuit provides an incremental increase to plant iron recoveries;
  - Additional process equipment modifications to ensure ancillary equipment specifications match the required duty of the upgraded flowsheet.
- Revised tailings management plan and storage facilities;
- Revised water management plan.

2.5 Division of Responsibility

At a high level, the division of responsibilities is as follows:

Table 2-1: High level division of responsibility

Description	Responsible
Geology	BBA
Development of the mine pit, overburden removal and required mining infrastructure, geological settings and mineralization, mining plan, mining methods, explosives	BBA
Reviewing of crushing, crushed ore reclaiming and milling area	BBA
Mineral processing, metallurgical testing & recovery methods; increase in concentrate production by modifications to the gravity separation circuit along with the addition of a magnetic circuit; metallurgical testing including design, fabrication and installation, and excluding electrical and instrumentation	Soutex
Tailings pumping and pipeline from the inlet of the plant tailings pumps to the inlet of the tailings booster pumps BPH1	BBA
Tailings pumping and pipeline from the inlet of the tailings booster pumps BPH1 to the tailings storage	BBA
Surface water management plan, water management structures and pumping stations	WSP
Tailings storage management; development of a new tailings filling plan; containment infrastructure facilities	WSP
Environmental and permitting	WSP
Cost update of the site restauration plan	WSP
Transportation of the concentrate to the port facilities	QIO/BBA
Port facilities	QIO/BBA

2.6 Qualified Persons

The qualified persons (QPs) responsible for the creation of this report are:

- André Allaire, P. Eng. – BBA Inc.
- Isabelle Leblanc, P. Eng. – BBA Inc.
- Pierre-Luc Richard, P. Geo. – BBA Inc.
- Mathieu Girard, P. Eng. – Soutex
- Philippe Rio Roberge, P. Eng. – WSP Canada Inc.

2.7 Site Visits

All qualified persons who worked on this study have visited the site either in the past or as part of this current mandate.

- Isabelle Leblanc visited during the week of September 24, 2018;
- Pierre-Luc Richard visited during the week of March 18, 2019;
- André Allaire visited during the week of May 28, 2018;
- Mathieu Girard visited during the week of March 18, 2019;
- Philippe Rio Roberge visited during the week of January 8, 2018.

3. RELIANCE ON OTHER EXPERTS

The authors have written this technical report using existing information gathered from previous studies and engineering design work undertaken for the Phase 1 and 2 operations, historical operational data from the Phase 1 concentrator, historical data from the operation of the Bloom Lake mine, technical field surveys and a metallurgical testwork campaign. The existing technical data and information was sourced from the document archives located at the Bloom Lake mine. The authors of this Report have not carried out a thorough review of each consultant's work. The sections provided for this Report were supplied by reputable consultants, and there is no reason to doubt the validity of the information.

BBA has not verified the legal titles of the Property nor any underlying agreement(s) that may exist concerning the licenses or other agreement(s) between third parties, but has relied on Quebec Iron Ore (QIO) for conducting the proper legal due diligence. The status of the mining claims under which QIO holds title to the mineral rights for the Bloom Lake project has been compiled and verified by QIO. The description of the property is provided for general information purposes only.

In defining the proposed mine design in Chapter 16, BBA has relied upon pit design slope profile recommendations provided by Golder Associates Inc. (Golder) as well as underground inflows for the Chief's Peak pit. Golder updated their historical geotechnical assessment (Golder, 2014) based on site experience gained from Phase 1 operations (Golder, 2019).

Technical evaluation and costing of the Phase 2 modifications related to the rail and port systems were sub-contracted to SYSTRA Canada (SYSTRA) and AXOR Experts-Conseils (AXOR) respectively. Technical reports were provided to QIO and reviewed by BBA for their integration into the Study.

Wood Mackenzie was retained by QIO to provide an updated product market study. Wood Mackenzie is a specialist economics consultant in the metals and mineral resources sector. They provide high-level or in-depth, independent advisory and consulting services, market analysis, and project reviews across a range of mineral and metals industries for resources and infrastructure companies, investment organizations, financial institutions, public sector enterprises, consultancies, and legal firms. The study provided by Wood Mackenzie is used as support of the iron ore selling price used in the Project economic analysis for this study as reflected in the financial analysis of Chapter 22.

For this Feasibility Study Report, BBA has performed the economic analysis on a pre-tax basis and has relied on QIO and its tax consultant to provide annual tax payment estimates for performing the post-tax economic analysis, as outlined in Chapter 22 of this Report. Any statements and opinions expressed in this document are given in good faith and in the belief that such statements and opinions are not false or misleading at the effective date of this Report.

4. PROPERTY, DESCRIPTION AND LOCATION

The Bloom Lake property is located in the Labrador Trough area straddling the border between Quebec and Labrador. There are several iron ore mines in the area including Mont-Wright owned by ArcelorMittal and Carol Lake owned by Iron Ore Company of Canada (IOC). Scully Mine, located in Labrador and once owned by Cliffs Natural Resources (Cliffs), ended its activities in 2014 and is now owned by Tacora Resources (Tacora). Tacora has recently reactivated operations at Scully Mine; the first train of concentrate from the concentrator arrived in Pointe Noire at the end of June 2019.

The Bloom Lake property is owned by Quebec Iron Ore (QIO). QIO has owned the property and the facilities at the Bloom Lake mining site since April 12, 2016.

4.1 Property Description and Location

The mining site is located in the north-eastern part of the province of Quebec, adjacent to the Labrador/Newfoundland border, in Normanville Township, Kaniapiskau County. The property is centred at latitude 52° 50' North and longitude 67° 16' West, 13 km west of the town of Fermont and 30 km southwest of the municipalities of Wabush and Labrador City (Figure 4-1).

All of the surface rights are property of the Crown, that is, the Federal Government of Canada.

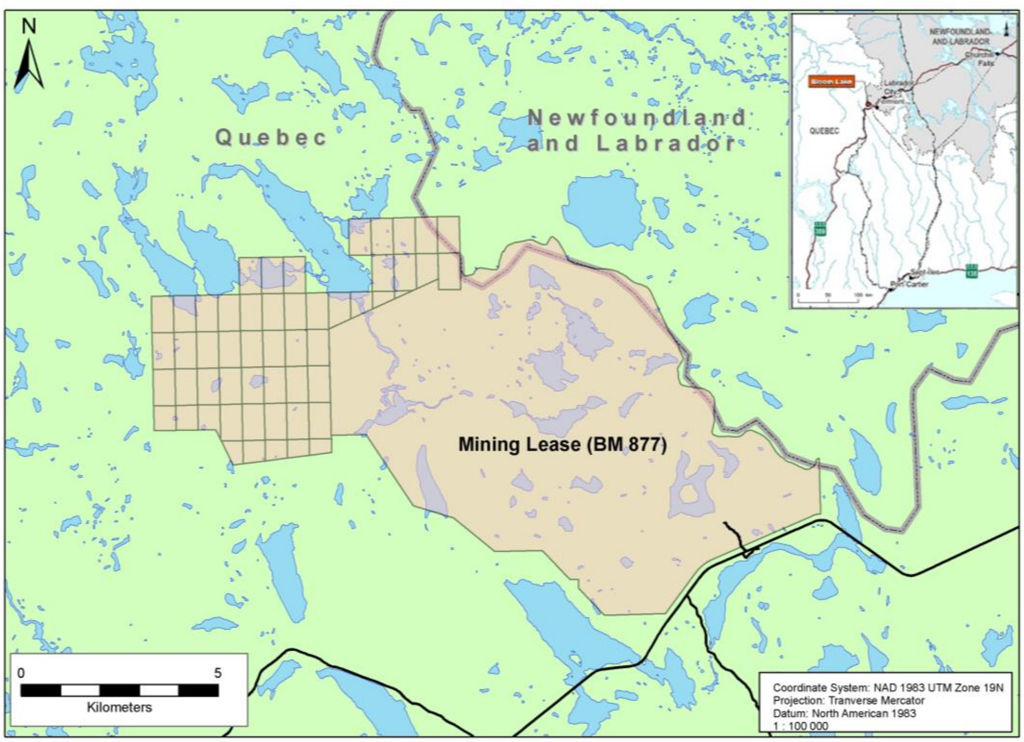

Figure 4-1: Property overview map

4.2 Mineral Titles

4.2.1 Nature and Extent of Issuer's Interest

As of May 2019, QIO holds 100% of 53 claims located north and northwest of the Mining Lease (BM877); these claims cover a total of 2,392.3 ha. The claims outside the mining lease are in good standing and are listed, with the Mining Lease, in Table 4-1.

Table 4-1: QIO Mining lease and claims

BM 877	CDC 99937	CDC 1133847	CDC 2082936	CDC 2082960
CDC 99894	CDC 99938	CDC 2082926	CDC 2082937	CDC 2082961
CDC 99895	CDC 99939	CDC 2082927	CDC 2082938	CDC 2082975
CDC 99902	CDC 99965	CDC 2082928	CDC 2082939	CDC 2082976
CDC 99903	CDC 99969	CDC 2082929	CDC 2082940	CDC 2082977
CDC 99910	CDC 99970	CDC 2082930	CDC 2082941	CDC 2082978
CDC 99911	CDC 99971	CDC 2082931	CDC 2082946	CDC 2082979
CDC 99918	CDC 99972	CDC 2082932	CDC 2082947	CDC 2082980
CDC 99919	CDC 1133844	CDC 2082933	CDC 2082957	CDC 2082981
CDC 99935	CDC 1133845	CDC 2082934	CDC 2082958	CDC 2188096
CDC 99936	CDC 1133846	CDC 2082935	CDC 2082959	

4.3 Royalties, Agreement and Encumbrances

There are no royalties, agreements or encumbrances on the mining site.

4.4 Permitting

The mine has already been authorized for operation under the federal environmental authority including the Department of Fisheries and Oceans (DFO) Canada, Transport Canada, Natural Resources Canada and Environment Canada.

Overall, a total of 38 certificates of authorization have been issued by the provincial government to the Bloom Lake iron mine in the past and the most relevant are listed in Table 20-1 in Chapter 20. Note that infrastructure such as the pit, waste rock piles, tailings management facilities and water management structure, as well as the treatment plant, have all been authorized. A few of these authorizations will require modifications to consider the new mine plan including the new waste rock dumps.

4.5 Other Significant Factors and Risks

There are no other known significant factors or risks that have not been disclosed in this report.

5. ACCESSIBILITY, CLIMATE, LOCAL RESOURCES, INFRASTRUCTURE AND PHYSIOGRAPHY

5.1 Access

The mine site lies approximately 13 km west of the town of Fermont (central geographical coordinates 52° 50' N and 67° 16' W). A 5-km access road has been constructed to connect the Bloom Lake mine with Highway 389. It is accessible by road from Baie-Comeau on the north shore of the Saint Lawrence River, as well as by road from the Wabush airport in Newfoundland & Labrador. The Wabush airport is located approximately 30 km from the Bloom Lake mine. The mine site is located approximately 950 km northeast of Montreal.

The rail access to port consists of three separate segments. The first segment is the rail spur on site, consisting of a 31.9-km long segment that is operational and connects to the Quebec North Shore and Labrador (QNS&L) railway at the Wabush Mines facilities in Wabush, Labrador. This first segment belongs to QIO. The second segment employs the QNS&L railway from Wabush to Arnaud Junction in Sept-Îles. The third section is from Arnaud junction to Pointe-Noire (Sept-Îles), property of "*Les Chemins de Fer Arnaud*", Sept-Îles, Quebec, where the concentrate is unloaded, stockpiled, and loaded onto vessels. The third segment is owned by the SFPPN (*Société Ferroviaire et Portuaire de Pointe-Noire*), a limited partnership composed by the Government of Quebec through the *Société du Plan Nord* and other industrial partners. The assets were acquired by the SFPPN from Cliffs' CCAA. QIO is a current member of the SFPPN board of directors.

5.2 Climate (Source: Environment Canada)

The climate at Fermont is defined as sub-arctic with temperatures ranging from -40°C to +25°C. The prevailing winds are mostly from the west at an average speed of 14 km/h. Average daily maximum temperatures above freezing normally starts in April and falls below freezing by end of October.

5.3 Local Resources, Infrastructure

The town of Fermont has a population of 2,474 as per Statistics Canada, and is the residential town for employees working for ArcelorMittal's Mont-Wright mine operations. The town has all the required infrastructure to support employees and families who live there. QIO currently owns a total of 383 rooms in the town of Fermont distributed among the following installations:

- One house, fully furnished, located on rue Bougainville (with seven rooms);
- Four houses located on *rue des Mélèzes* (with five rooms each and built in 2012);

- Twenty-two (22) houses, fully furnished, located on *rue des Bâtisseurs* (12 with eight rooms each, six with seven rooms each and four with five rooms each and built in 2009);
- Two blocks (hotels) of 99 rooms of lodging located on *rue du Fer* (built in 2013);
- One multi-purpose complex that includes a cafeteria, a gym and recreational facilities.

Current accommodations are fully equipped with furniture, linen, and wiring for communications and entertainment and can house 383 people and provide a total of 1,800 meals per day. Additional infrastructure will be added as part of the Phase 2 project in order to house additional staffing.

The electrical power for the Project is supplied by Hydro-Québec from a T-tap off the 315 kV transmission line L3039 (Montagnais-Normand), which terminates in an existing 315-34.5 kV substation (Substation W), owned by QIO. The substation is located along Provincial Route 389 and includes 2 x 315-34.5 kV, 48/64/80 MVA, oil-filled power transformers. It feeds the existing concentrator plant and mine site via 34.5 kV distribution lines. The distribution lines will be modified, as described in further detail in Chapter 18, to meet the electrical needs of the power supply of the Phase 2 expansion and mine requirements. The modifications also provide an increased reliability of the site power supply.

5.4 Physiography

The topography of the claims' area is relatively hilly. The average elevation varies between 671 m and 762 m and the highest peaks culminate at about 808 m.

6. HISTORY

6.1 Prior Ownership and Exploration

In 1951, following the discovery of a cobalt showing at Bloom Lake, James and Michael Walsh staked claims for Mr. Bill Crawford of Sursho Mining Corporation (SMC). In February 1952, Quebec Cobalt and Exploration Limited (QUECO) was incorporated to acquire the claims held by SMC.

In 1952, a crew of six prospectors, under the supervision of Mr. K. M. Brown, began a program to prospect an area that included the Bloom Lake property. In June 1952, Mr. R. Cunningham, a mining geologist with Québec Metallurgical Industries, began to map the various cobalt occurrences at Bloom Lake. Although the results for cobalt were disappointing, several zones of magnetite-hematite iron formation (IF) were identified between Bloom Lake and Lac Pignac and were sampled. Further exploration was conducted in 1953.

In 1954, Cunningham supervised a program to investigate the iron occurrences through line cutting, geological mapping, and magnetometer surveys. In 1955, Jones and Laughlin Steel Corporation (J&L) optioned the property from QUECO. Cleveland-Cliffs Iron Company (CCIC) joined with J&L and conducted a diamond drill program from 1956 through 1957. Two drills were brought to the property and two series of holes, the "QC" and the "X" series, were drilled to test IF on the Bloom Lake property. Holes X-1 to X-11 (XRT - ¾" diameter core) amounted to 446 m and Holes QC-1 to QC-30 (AXT size 1.28" diameter core) totalled 4,769 m. The holes were largely drilled on sections of 800 ft to 1,000 ft apart (244 m to 305 m). Four of these drillholes were drilled on the west part of the property.

More drilling was conducted in 1966 by Boulder Lake Mines Incorporated, a subsidiary of CCIC, and Jalore Mining Company Limited (Jalore), a subsidiary of J&L. Holes X-12 to 20, totalling 175 m, and other holes were drilled as part of this campaign, but these were not on the present property. Some ground magnetometer surveying was also conducted in 1966. J&L's option on the property was terminated in 1968.

In 1971, exploration on the property was renewed by a QUECO-sponsored program that was managed by H. E. Neal & Associates Ltd. (HEN). The exploration program consisted of line cutting, geological mapping, gravity and magnetometer surveys, and diamond drilling in 1971 and 1972.

These holes were drilled to investigate the potential for IF beneath the amphibolite on the eastern side of the property. Nine drillholes were done in 1971 for a total of 1,834.23 m (341 samples) and 12 were drilled in 1972 (3,497.79 m and 341 samples). Eight of the drillholes were done on Bloom Lake West in 1971 and five were drilled in 1972. The mapping and magnetometer surveys were designed to fill in areas not previously surveyed. The gravity survey was conducted to help evaluate the potential for IF beneath the amphibolite.

In 1973, Republic Steel Corporation optioned the property and HEN prepared a "Preliminary Evaluation" of the property that consisted of currently held property and claims further to the west. This work was conducted until 1976. The evaluation included "mineral reserve" estimates, a metallurgical test program, and preliminary mine design. The mine design included pit outline, dump area, access roads, and railway spur. Dames and Moore prepared the mine design and "reserve" estimates. Lakefield Research (Lakefield) conducted the metallurgical testwork.

In 1998, a major exploration program was conducted by Watts, Griffis and McOuat (WGM) for QCM, which then held the Bloom Lake property under option from Consolidated Thompson-Lundmark Gold Mines Limited (CLM). QCM held the option on the property until 2001, but no work was conducted between 1998 and 2005. The 1998 program included line cutting, surveying, road building, camp construction, diamond drilling, geological mapping, mini-bulk sampling, bench-scale preliminary metallurgical testwork, preparation of a "mineral resource" estimate, camp demobilization, and site clean-up.

In 2005, CLM retained WGM to conduct a technical review, including the preparation of a mineral resource estimate for the Bloom Lake iron deposit to assist CLM in making business decisions and future planning. The technical review was prepared in compliance with the standards of NI 43-101 in terms of structure and content. The mineral resource estimate was prepared in accordance with NI 43-101 guidelines and CIM standards. In 2006, Consolidated Thompson-Lundmark Gold Mines Limited changed the name of the Company to Consolidated Thompson Iron Mines Limited (Consolidated Thompson). This name change reflected the Company's focus on iron ore mining and exploration.

From 2006 to 2007, Consolidated Thompson drilled 17 drillholes (2,884.36 m) on the site of the future pit in order to get a sample for metallurgical testwork. The Lakefield laboratory performed these tests. In 2006, bulk sampling took place in the area of the future pit.

Overall, 243 drillholes were made between 1957 and 2009 for a total of 45,386 m and 273 drillholes in 2010, 2012 and 2013 for a total of 89,197 m. Four geotechnical holes were drilled in 2014. The complete description of the drill programs are described in Chapter 10.

The construction of the Bloom Lake mining started in 2008 and the plant was commissioned by Consolidated Thompson Iron Mines Limited in December 2009.

Almost immediately after start-up, Consolidated Thompson started a feasibility study to double the Bloom Lake site production by the addition of a second concentrator. The study was completed in June 2010 and the construction of the Phase 2 concentrator started in Q4 of 2010 under CLM and continued after the acquisition of the Bloom Lake site by Cliffs Natural Resources (Cliffs) in May 2011.

The Phase 2 concentrator construction was halted in November 2012 due to falling iron ore prices. Operations at the Bloom Lake site were halted in December 2014 due to the declining iron ore concentrate prices and high operating costs.

On April 12, 2016, Champion Iron Mines Limited acquired the Bloom Lake assets in a CCAA proceeding and restarted the operations on February 16, 2018.

6.2 Operations Under Current Ownership

Operations at the Bloom Lake site were resumed in February 2018 after completing major modifications to the beneficiation circuit as well as to other parts of the site with the aim to increase concentrate production while ensuring a low production cost. The site achieved a concentrate production of 6,994,500 wet metric tons for its first full year of operation (fiscal year ending March 31, 2019).

6.3 Historic Production

Table 6-1 shows the historical mining extraction and concentrate production from 2010 to 2019 in dry metric tons per year unless otherwise stated.

Table 6-1: Production at the Bloom Lake Mine from 2010 to 2019

	2010	2011	2012	2013	2014(1)	2015 to 2017	2018 (2) (3)	2019 (2) (3)
Iron ore mined	10.3	16.9	17.0	17.6	19.3	0	2.7	19.7
Iron ore processed	8.2	15.6	15.8	18.4	18.9	0	1.8	18.5
Iron ore concentrate production	3.2	5.5	5.5	5.9	5.9	0	0.6	7.0

(1) Production halted in mid-December 2014.

(2) Fiscal years ending on March 31, 2018 and 2019 respectively.

(3) Values provided are in wet metric tons.

7. GEOLOGICAL SETTING AND MINERALIZATION

7.1 Regional Geology

The Bloom Lake Iron Deposit lies within the Fermont Iron Ore District (FIOD), a world-renowned iron-mining camp at the southern end of the Labrador Trough within the geological Grenville Province. The Labrador Trough extends along the margins of the eastern boundary of the Superior-Ungava craton for more than 1,200 km and is up to 75 km wide at its central part. The Bloom Lake deposit, including the Bloom Lake West property, is located within the Parautochtonous Deformation Belt of the Grenville Province of the Canadian Shield, just south of the Grenville Front. The Grenville Front, the northern limit of the Grenville Province, truncates the Labrador Trough, separating the Churchill Province greenschist metamorphic grade part of the Labrador Trough rocks from their highly metamorphosed and folded counterparts in the Grenville Province.

The western half of the Labrador Trough, consisting of a thick sedimentary sequence, can be divided into three sections based on changes in lithology and metamorphism (north, central and south). The Trough is comprised of a sequence of Proterozoic sedimentary rocks including iron formations (IF), volcanic rocks and mafic intrusions known as the Kaniapiskau Supergroup. The Kaniapiskau Supergroup consists of the Knob Lake Group in the western part of the Trough and the Doublet Group, which is primarily volcanic, in the eastern part. The Kaniapiskau Supergroup within the Grenville Province is highly metamorphosed and complexly folded. It was named Gagnon Group before correlations were made between sequences located on each side of the Grenville Front. It occurs as numerous isolated segments. From the base to the top, it includes a sequence of gneisses and schists, a group of chemically precipitated sediments, and more schists, including some distinctive aluminous varieties. Gabbro sills intrude parts of the sequence, and granites are found in the gneiss.

The Central or Knob Lake Range section extends for 550 km south from the Koksoak River to the Grenville Front located 30 km north of Wabush Lake. The principal iron formation unit, the Sokoman Formation, part of the Knob Lake Group, forms a continuous stratigraphic unit that thickens and thins from sub-basin to sub-basin throughout the fold belt.

Iron deposits in the Grenville part of the Labrador Trough comprise Bloom Lake, Lac Jeannine, Fire Lake, Mont Wright and Mount Reed, and the Luce, Humphrey and Scully deposits in the Wabush area. The high-grade metamorphism of the Grenville Province is responsible for recrystallization of both iron oxides and silica in primary iron formation, producing coarse-grained sugary quartz, magnetite, specular hematite schists (meta-taconites) that are of improved quality for concentrating and processing.

Figure 7–1 shows the simplified geological map of the Labrador Trough.

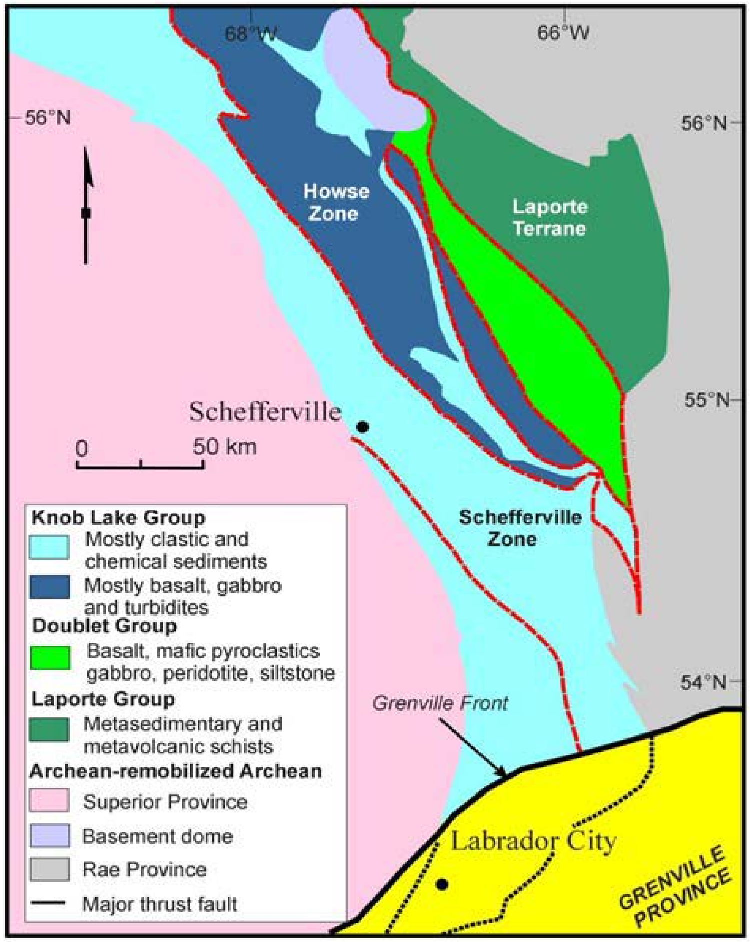

Figure 7–1: Simplified geological map of the Labrador Trough (Gross, 2009)

In the region, at least two stages of deformation are recognized. The first stage produced linear belts that trend northwest, like the well-defined structural trends in the central part of the Labrador geosyncline; the second stage formed linear belts that trend east to northeast, parallel with the major structural trends developed in the Grenville Province. Folds now present both stages of deformation in form and orientation. For example, in the Wabush Lake area, folds trend N20°E and in the central part of the area, around Lamelee Lake and Midway Lake, they trend N35°W. Isoclinal and recumbent folds overturned to the west or southwest are common, and it is inferred that this deformation produced thrust faults striking northwest and dipping east. Structures developed during the earlier stage of deformation are believed to have been similar to those now seen in the central part of the Labrador geosyncline, and it is highly probable that the structures produced by this early stage of deformation, in the south and those in the central and northern regions, were the result of the same orogeny.

The second stage of structural deformation took place during the Grenville orogeny between 0.8 and 1.2 Ga years ago. Its effects are not so intense north of Wabush Lake near the margin of the Grenville belt as they are throughout the region to the south. Near the margin of the Grenville belt, cross-folds trending east or northeast appear to be superimposed on the earlier northwest-trending structures. Around Mont Wright and farther south, the trend of the overall structure is east to northeast and the prevailing dip of foliation is 55°N. Tightly folded and faulted structures developed during the earlier stage of deformation were further deformed by folding and faulting during the Grenville orogeny. Oblique sections through the resulting complex fold structures are exposed at the present erosion surface. Many of the minor folds appear to plunge steeply to the northwest, but the axes of these folded folds are not straight for any appreciable distance.

Regional structures developed during the Grenville orogeny play out against the stable craton area of the ancient Superior Province. Folds and faults along the northwest margin of the Grenville Province trend west, and the general pattern of folds overturned to the south or southeast formed in conjunction with north-dipping reverse faults indicates overriding of the northerly blocks towards the southeast. The relative amount of movement between adjacent fault blocks is suggested by the position of iron formation in local structures. At Bloom Lake, iron formation is present in a relatively simple syncline that extends to a much greater depth than that in the Boulder Lake basin situated at the north. Still farther south at Mont Wright, the erosion surface cuts the upper part of steeply plunging folds. Southeast froms the margin of the Grenville belt, the dips of westerly striking faults are progressively less steep, and the greatest amount of movement appears to have taken place between the Bloom Lake fault block and the Mont Wright block.

The iron formation and associated metasedimentary rocks, which were derived from an assemblage of continental shelf-type sediments, do not appear to extend south beyond a line trending northeast from the Hart-Jaune River linear to Plaine Lake and northeast to Ossokmanuan Lake. Granite-gneisses, charnockites and anorthosites are part of the rock assemblage south of this line. These typical deep-seated Grenville rocks may have been thrust northwest along a system of faults that coincide with this line. The large suite of gabbro intrusions in the area between Wabush Lake and Ossokmanuan Lake were probably intruded along faults in this linear zone.

7.2 Local Geology

7.2.1 General

The geology and geological interpretations for the Bloom Lake property are based on data from a number of sources. These sources include the diamond drilling and mapping done on the property as part of the 1998 program, presented by Watts, Griffs and McOuat in 2005, as well as the drilling conducted in 1956, 1957, 1967, 1971, 1972 and 2007-2014 programs. The geological interpretation relies heavily on the mapping programs conducted in 1952 and the ground magnetic surveys carried out in 1967 and 1971/72 as compiled in 1973 and the survey done in April 2008. The calculated magnetic vertical gradient in the Bloom Lake area is presented in Figure 7–2.

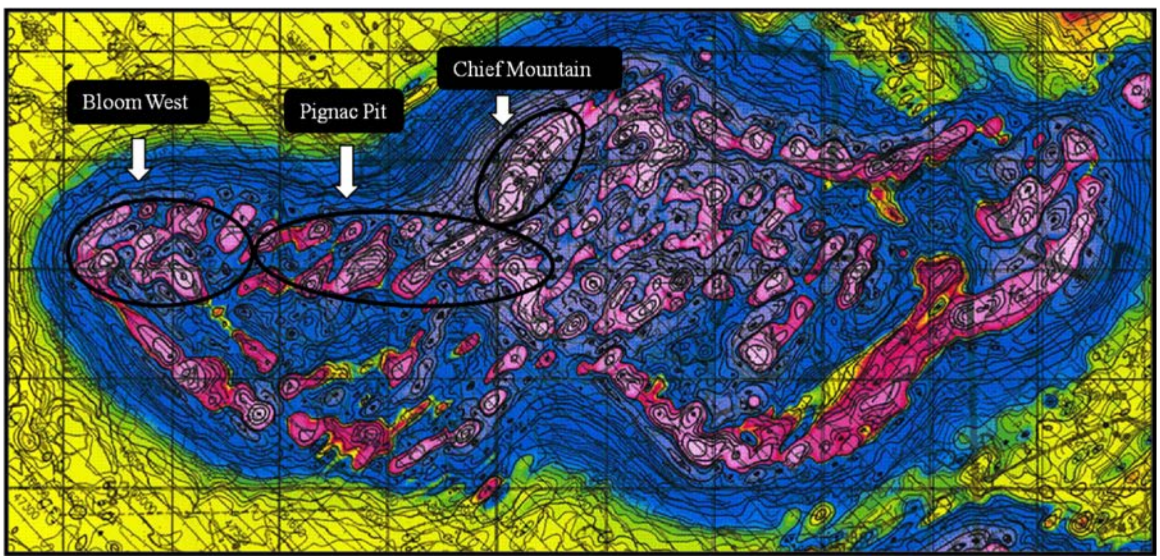

Figure 7–2: The calculated magnetic vertical gradient in the Bloom Lake area

The following local geology description and structural interpretation are mostly from Rioux (2009).

Several rock type codes are hybrid codes of the main rock types and are not described separately. Iron formations are described in Section 7.3 of this chapter.

Gneiss (GN)

With the current knowledge, gneiss constitutes the basic unit for metasedimentary rocks. This rock presents a typical banding varying from 1 cm to 2 m. Most of its composition is mafic and the felsic bands are dominated by feldspars with quartz in minor quantity. Biotite is abundant through the gneiss and many transitions to mica schists occur. The gneiss contains less mica but more feldspar and quartz than QRMS (see below). The basal QRMS sequence consists mostly of muscovite and biotite schist with characteristic porphyroblasts of garnet and feldspar.

Quartz Rock (QR) and its Related Variant Quartz Rock Iron Formation (QRIF)

QR is used to define a rock type consisting mostly of quartz, 95%+, vitreous, grey or pinkish colour, with minimal to no specularite and/or magnetite content. This material may have been derived from chert, quartzite or quartz pebble conglomerate and the various textural varieties are not distinctly coded or distinguished.

QRIF intervals were defined on the basis of a quartz dominant rock containing less than 15% of total iron, but containing some iron in the form of specularite and/or magnetite or silicate. QRIF is therefore a rock often transitional between IF and QR, or SIF and QR. The QRIF may contain minor actinolite-SIF.

Quartz Rock Mica Schist (QRMS)

It is used mainly for the schist sequence at the base of the IF sequence beneath the QR unit. QRMS has occasionally, however, been used for coding thin mica-rich units within the IF sequence.

Silicate Iron Formation (SIF)

Two main types have been recognized on the property. One of them is dominated by actinolite, while in the other, grunerite is most prevalent. The two types can be transitional into one another and likely there is also some tremolite-rich SIF present. The IF in these areas is also often enriched in magnetite as compared with specularite. These units are less abundant in the west part of the property than in the eastern half of the Bloom Lake pit area and Chief's Peak.

Amphibolite (AMP)

It is dominantly a competent, dark green to black, medium to coarse grained rock consisting mainly of hornblende, biotite and feldspar. This rock is relatively homogeneous and marked by a very pronounced foliation. Grain size varies widely. The occurrence of millimetric reddish garnet is observed over distances of 10 m. The amphibolite-IF contacts are sharp. A narrow argillized zone of amphibolite often occurs immediately above the IF contact.

Gabbro

Bodies of medium-grained gabbro and amphibolite stand as hills among the quartz-bearing rocks of the Gagnon Group. They were apparently injected into the competent rocks during deformation and themselves remobilized during the later stages of metamorphism. The gabbro was originally ophitic in texture with speckled textures into foliated amphibolite. Gabbro is more common in the northern part of the injected zone and amphibolite is more present in the southern part. In places, gabbro cores remain in the centre of thick amphibolite sills. The typical gabbro of this type contains 40% to 50% plagioclase with other mafic minerals (olivine, hypersthene) and a few percent of opaque oxides.

7.2.2 Structural Geology

The Bloom Lake deposit comprises gently plunging synclines on a main east-west axis separated by a gently north to northwest plunging anticline. One of these synclines is centred on Triangle Lake, while the centre for the other is located just north of Bloom Lake. The Bloom Lake property is centred primarily on the eastern syncline but covers a portion of the northern limb of the western one.

These synclines are the result of a minimum of two episodes of folding and are of regional scale.

In addition to these regional scale folds, which have created the large-scale shape of Bloom Lake deposit, there are several other folds of diverse orientation on the property. It is not clear if all folding directions represent distinct folding episodes or progressive change in fold orientation with time.

Clearly visible on the ground magnetic survey map, a major discontinuity oriented north-northeast can be seen in the central portion of the west part. In drillhole, many zones of gravel, gouges, muddy and brecciated are clearly associated with it, suggesting a fault zone. More so, difficulties in correlating orebodies on each side of the possible fault strongly militate in that direction.

Also, thorough interpretation of geomorphic lineaments from aerial photographs demonstrates a north-northeast tendency, it is important to note that Triangle Lake and associated stream configuration suggest a north-northwest discontinuity associated with the north-northeast one.

7.3 Mineralization

The Bloom Lake deposits are about 24 km southwest of Labrador City and about 8 km north of the Mont Wright range. The western 6 km of this range contains very large reserves of specular hematite-magnetite iron formation in a synclinal structure that is regarded as a southwest extension of the Wabush Lake ranges.

The iron formation and quartzite are conformable within a metasedimentary series of biotite-muscovite-quartz-feldspar-hornblende-garnet-epidote schists and gneisses in a broad synclinal structure. This succession, following the first stage of folding and faulting, was intruded by gabbroic sills that were later metamorphosed and transformed into amphibolite gneiss with foliation parallel with that in adjacent metasediments. Two separate iron formation units are present; these join northwest of Bloom Lake, but are separated by several dozen metres of gneiss and schist in the southern part of the structure. Quartzite, present below the upper member throughout the eastern part of the area, pinches out near the western end. Folded segments and inclusions of iron formation in the central part of the syncline, which are surrounded by amphibolite, are in most cases thought to be part of an overlying sheet that was thrust over the main syncline during the first period of deformation. The large amphibolite mass in the central part of the area was apparently emplaced along the zone of weakness created by this early thrust fault.

Iron formation in the western 5 km to 6 km of the structure is predominantly thehematite-quartz facies that form the major zones of potential ore. The hematite is of the specularite type and has a silvery-grey colour and is non-magnetic. It is most often occurring as anastomosing to discontinuous stringers and of bands less than 10 cm thick in a quartz or actinolite-quartz matrix. Bands tend to be folded and deformed but also can be regular and tabular. Quartz is milky and granular.

Magnetite is scarce and typically occurs in narrow millimetric veinlets associated with quartz-carbonate veining material. The crystals are sub- to euhedral and demonstrate the typical dull to sub- metallic luster. When associated to hematite-enriched mineralization, the magnetite occurs as blebs of porous grains, often granoblastic, that may extend up to several centimetres. Enriched magnetite horizons are mostly found, but not always, in the upper portion of the iron formations in close contact with the amphibolite mass.

With the actual state of geological knowledge in the western sector of the Bloom Lake deposit, magnetite-rich IF is less important in volume than in the eastern half of the Bloom Lake pit area. The thickness of drillhole intercepts is lower than 10 vertical metres. Many drillholes did not return significant magnetite intersections. Very few actinolite or grunerite minerals associated with magnetite mineralization were described in the western holes.

A fairly abrupt change in facies takes place along strike east of a line passing northwest across Bloom Lake, east of where the grunerite-Ca-pyroxene-actinolite-magnetite-carbonate facies predominates.

The lower unit is less than 30 m thick in some places and is considerably thinner than the upper unit. The iron content ranges from 32% to 34% in this facies. In places, the silicate facies to the east contain more than 50% cummingtonite, which in part is magnesium rich, and the manganese content ranges from 0.1% to more than 2.0%. Mueller (1960) studied the complex assemblage of minerals in this rock and discussed chemical reactions during metamorphism in considerable detail. He has shown that a close approach to chemical equilibrium in the amphibolite metamorphic facies is indicated by the orderly distribution of Mg, Fe and Mn among coexisting actinolite, Ca-pyroxene and cummingtonite, and the restriction in the number and type of minerals in association with each other. Furthermore, a comparison between the composition of the silicates and the presence or absence of hematite shows that the Mg to Mg plus Fe ratio is increased, but is much less variable when hematite is present.

Re-modelling of the deposit in 2014 added two new domains in the ore classification (MAG – Magnetite Iron Formation and WSIF – Grunerite-rich Iron Formation) in addition to the existing HEM (Hematite Iron Formation) and SIF (Silicate Iron Formation).

The iron formation forms a long doubly plunging syncline that is canoe-shaped but buckled across the centre to produce two distinct oval-shaped basins. Although this structure appears to be relatively simple in form, it seems to have been developed during two stages of deformation. Folding along northwest-trending axes and overthrusting of the upper iron formation during the first stage of deformation appear to have been followed by gabbro intrusion, folding along east-west axes, faulting, and metamorphism during the Grenville orogeny.

8. DEPOSIT TYPES

Bloom Lake property mineralization style is a deposit typical of the Superior-Lake type.

The peaks in iron sedimentation took place between ~2.65 and 2.32 Ga and again from ~1.90 to 1.85 Ga. Their deposition is linked to the geochemical and environmental evolution of the planet such as the Great Oxidation Event (GOE) at ca. 2.4 Ga, the growth of continents, as well as the mantle plume activity and rapid crustal growth (see Figure 8–1).

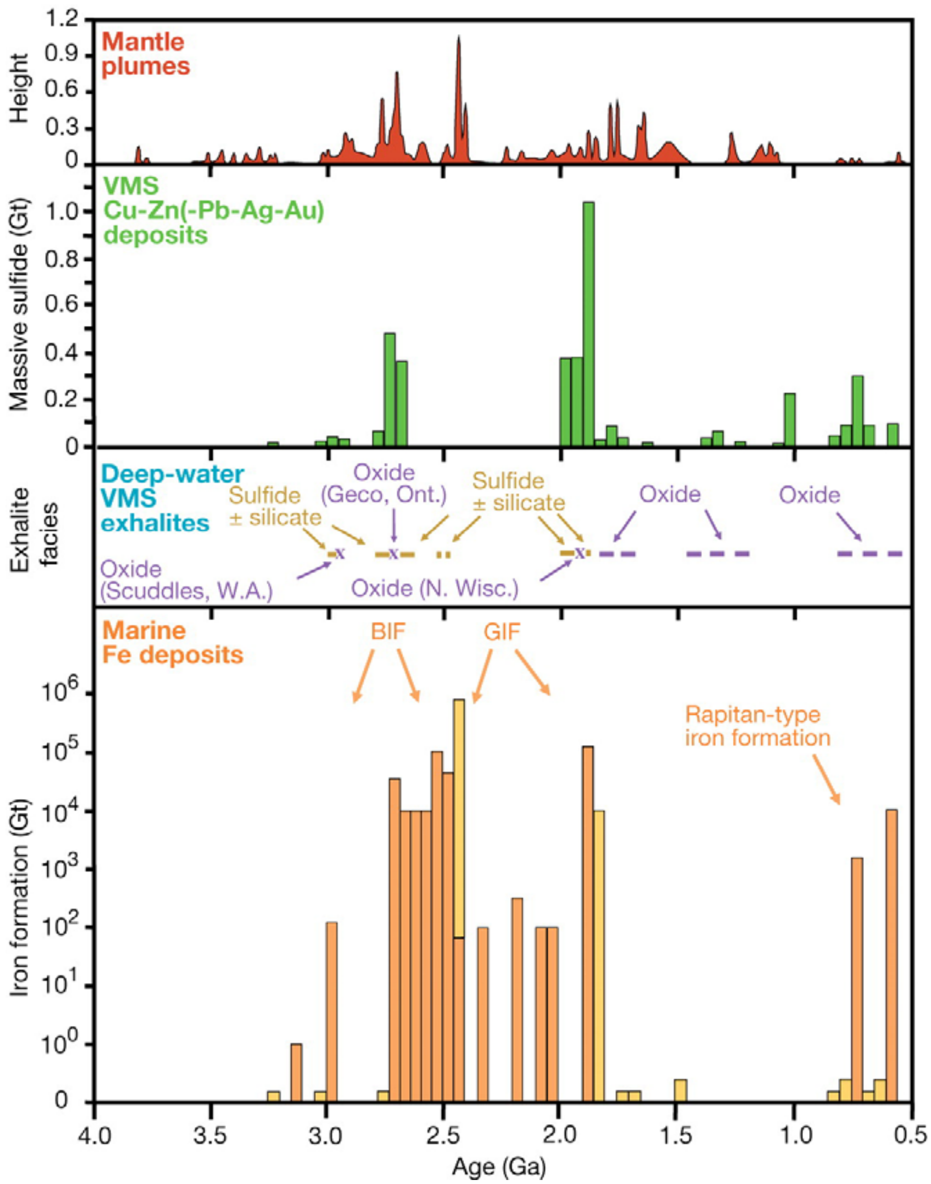

Figure 8–1: Time distribution of the iron formation deposition (Bekker et al., 2011)

The Labrador Trough contains four main types of iron deposits:

1. Soft iron ores formed by supergene leaching and enrichment of the weakly metamorphosed cherty iron formation (IF); they are composed mainly of friable fine grained secondary iron oxides (hematite, goethite, limonite).
2. Taconites, the fine-grained, weakly metamorphosed iron formations with above average magnetite content; they are commonly called magnetite iron formation.
3. More intensely metamorphosed, coarser-grained iron formations, termed metataconites that contain specular hematite and subordinate amounts of magnetite as the dominant iron minerals.
4. Minor occurrences of hard high-grade hematite ore occur southeast of Schefferville.

Secondary enrichment included the addition of secondary iron and manganese that appear to have moved in solution and filled pore spaces with limonite-goethite. Secondary manganese minerals, i.e., pyrolusite and manganite, form veinlets and vuggy pockets. The types of iron ores developed in the deposits are directly related to the original mineral facies. The predominant blue granular ore was formed from the oxide facies of the middle iron formation. The yellowish-brown ore, composed of limonite-goethite, formed from the carbonate-silicate facies, and the red painty hematite ore originated from mixed facies in the argillaceous slaty members.

All iron ore deposits in the Labrador Trough formed as chemical sediments on a continental margin that were lithified and variably affected by alteration and metamorphism that had important effects on grade, mineralogy and grain size. Faulting and folding led to repetition of sequences in many areas, increases the surface extent and mineable thicknesses of the iron ore deposits. Underlying rocks are mostly quartzite or mica schist. Transition from these rocks and the mineralized iron formation may happen up to over 10 m vertically. All rock sequences have been heavily metamorphosed by intense folding phases that are part of the Grenville Orogen.

IF sequences range commonly from 25% to 40% iron oxide, mainly hematite of the specularite type with minor amount of magnetite (remainder mostly quartz) and can have thicknesses (ignoring minor intercalated bands of schist and quartz rock) of up to 200 m. These are the sequences that are of economic importance.

For iron formation to be mined economically, the iron content must generally be greater than 30%, but also iron oxides must be amenable to concentration (beneficiation) and the concentrates produced must be low in manganese and deleterious elements such as silica, aluminum, phosphorus, sulphur and alkalis. For bulk mining, the silicate and carbonate lithofacies, as well as other rock types interbedded within the iron formation, must be sufficiently segregated from the magnetite. Iron formations repeated by folding are often required to produce sufficiently thick sections for mining in the Mont Wright / Wabush area.

9. EXPLORATION

This chapter of the report will briefly describe all relevant exploration work other than drilling conducted by Quebec Iron Ore on the Bloom Lake project from March 17, 2017 (corresponding to the effective date of the previous NI 43-101 Technical Report on the Bloom Lake Mine Restart Feasibility Study) to January 1, 2019. The complete description of the drill programs is described in Chapter 10.

9.1 2018 Magnetic Survey

During the summer of 2018, a drone-born magnetic survey was done on some of the Quebec Iron Ore claims north and west of the Bloom Lake Mining Lease (Figure 9-1). The survey was done with a 50-m line spacing to the north and 100 m line spacing to the west. The decision to switch from 50 m to 100 m was made in order to cover as much ground as possible as the fall weather was settling in. The survey was not completed as planned, but is scheduled to be resumed during summer of 2019.

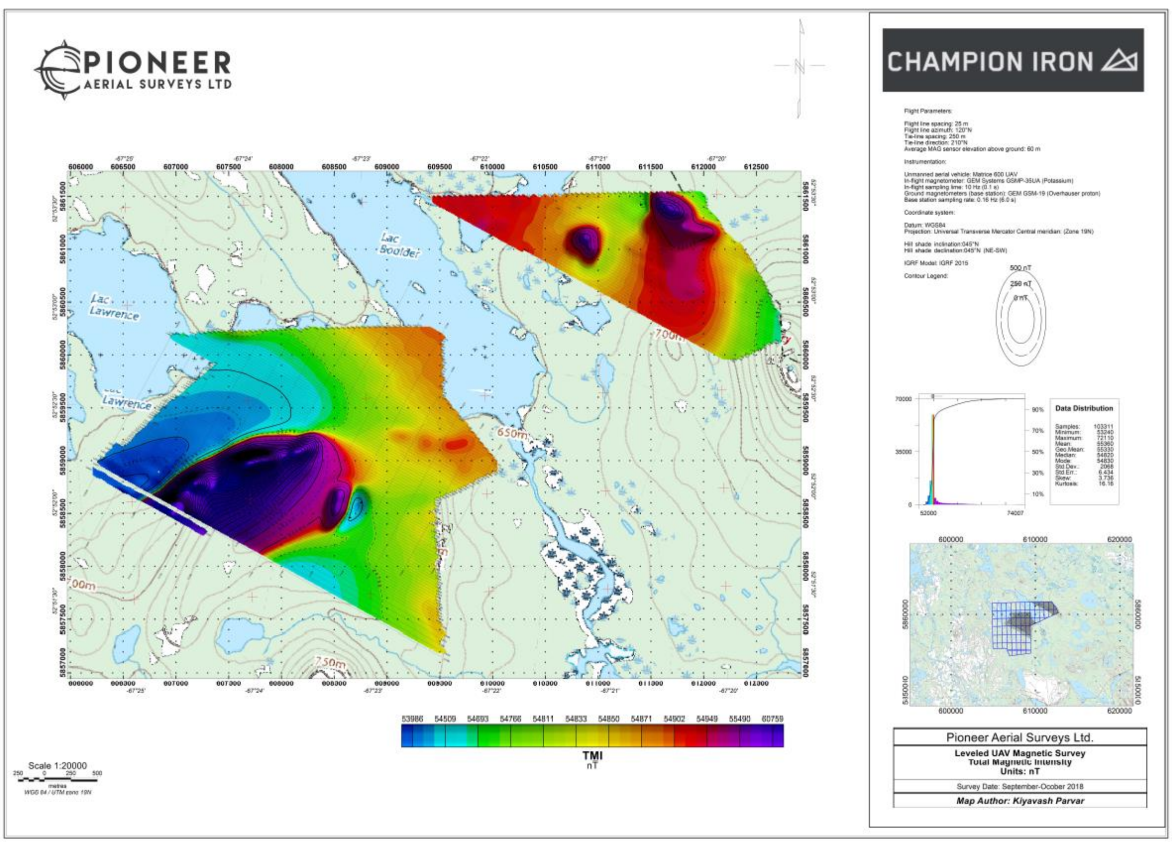

Figure 9-1: Plan view of the magnetic survey conducted in 2018

9.2 2018 Database Standardization

The restart of the Bloom Lake mining operation provided the opportunity to review and homogenize the lithological descriptive codes. This was required due to major discrepancies between exploration, production and drill and blast databases as well as between various drilling programs throughout the years.

The rock names and chemical limits for the different types of mineralization were preserved as often as possible, but the numerical codes were modified, and a more systematic approach was implemented. As shown in Table 9-1, all the mineralization related codes now start with “2” (200 series) with the oxide-rich mineralization having “0” as a second digit (20x), and the silicate mineralization having “1” as the second digit (21x). The limonite mineralization has “2” as the second digit (22x). The third digit adds an extra layer of information in regard to the mineralogy.

The same logic was used for unmineralized material where the first digit “3” indicates unmineralized material, the second digit represents the type of material and the third digit represents mineralogical or textural details. Table 9-1 summarizes the new lithological codification throughout the years and various databases.

This review made it significantly more convenient for the use of macro-commands in the block-modelling software.

Table 9-1: Lithological codification throughout the years and various databases

Description	Rock Type (current)	Rock_Code (current)	Rock Type (Cliffs era)	Rock_Code (Cliffs era)	Rock Code Phase 1 FS
Iron Formation (undiff.)	IF	200	IF/IF-PKJ/PKJ	200, 214	20
Oxides Iron Formation	OIF	201	OIF	210	20
Hematite Iron Formation	IFH	202			20
Magnetite Iron Formation	IFM	203	IFM	212	21
Low grade Iron Formation (<15% Fe)	QRIF	204	QR/QRIF	213	31
Geothite Iron Formation	IFG	205			
Hematite-silicates Iron Formation (4% < Cao+Mgo < 6%)	IFHS	208			
Magnetite-silicates Iron Formation (4% < Cao+Mgo < 6%)	IFMS	209			
Silicates Iron Formation	SIF	210	SCIF/SIF	220	23
Actinolite Iron Formation	SIFA	211	SIFA	222	24
Grunerite Iron Formation	SIFG	212	GIF/GSIF/SIFG	221	25
High Silicates Iron Formation (>12% Cao+Mgo)	WSIF	213	WSIF	223	34
Fine-grained Limonitic Mineralization	LIMO	221	LIMO	42	22
Quartzite (<5% Fe)	QR	330	QR	30	30
Quartz-Mica Schist	QRMS	331	QRMS/QR-GN	31	32
Mica Schist	MS	332	MS	32	33
Amphibolite	AMP	340	AMP	40	40
Gabbro	GAB	341	GAB	41	40
Argilite	ARG	342	FAI	42	22
Gneiss	GN	350	GN/GNF/GNM	50	50-51-52
Marbe	MAR	360	DOL	60	360
Core Lost	CNR	390	CNR	999	60
Overburden	OB	391	MT	10	10
Mine Waste or Filling	REM	392			
Casing	CAS	393			
Air	AIR	399			99

10. DRILLING

This chapter summarizes the drilling completed on the Property by Quebec Iron Ore during the 2018 drilling program from February to June 2018. The complete drilling database consists of 569 surface drillholes from historical and recent drilling programs that occurred between 1957 and 2018 for a total of 141,288 m. Historical drilling information dated before the 2018 campaign may be referred to in the 2017 Technical Report on the Bloom Lake Mine Re-Start Feasibility Study (Ausenco, 2017).

10.1 2018 Drilling Program

In 2018, 36 holes totalling 4,938.3 m were drilled. The holes are listed in Table 10-1.

Table 10-1: 2018 drilling program

Hole-ID	UTM Easting	UTM Northing	Elevation	Final depth	Dip	Azimuth
BL-18-01	615,025.00	5,854,295.00	799.25	197	-60	180
BL-18-02	614,875.10	5,854,200.00	808.82	190	-60	180
BL-18-03	614,874.90	5,854,093.00	806.18	133	-50	180
BL-18-04	614,575.10	5,854,194.00	811.14	212	-60	180
BL-18-05	614,375.10	5,854,249.00	796.18	187	-50	180
BL-18-06	614,374.90	5,854,363.00	802.13	262	-55	180
BL-18-07	614,085.90	5,854,436.00	775.21	241	-55	180
BL-18-08	613,849.80	5,854,497.00	763.91	122	-55	180
BL-18-09	614,945.00	5,854,139.00	799.99	136	-60	180
BL-18-10	615,625.00	5,855,304.00	703.43	70	-55	360
BL-18-11	615,625.00	5,855,302.00	703.43	230	-60	180
BP-18-01	614,425.00	5,855,240.00	704.00	112	-50	0
BP-18-02	614,500.00	5,855,250.00	704.00	241	-50	0
BP-18-03	614,590.00	5,855,290.00	690.00	91	-60	0
BP-18-04	614,950.00	5,855,300.00	704.00	140	-90	0
BP-18-05	615,325.00	5,855,150.00	704.00	205	-45	0
BP-18-06	615,400.00	5,855,250.00	704.00	165	-50	0
BP-18-06A	615,400.00	5,855,250.00	704.00	142	-60	180
BP-18-07	615,475.00	5,855,350.00	704.00	133	-50	0
BP-18-08	614,603.00	5,855,365.00	704.00	130	-60	0
BP-18-09	614,425.00	5,855,414.00	704.00	73	-60	0
BP-18-10	615,625.00	5,855,440.00	718.00	151	-60	0

Hole-ID	UTM Easting	UTM Northing	Elevation	Final depth	Dip	Azimuth
BP-18-11	615,099.90	5,855,358.00	691.39	117	-60	0
BP-18-12	615,174.90	5,855,391.00	691.15	57	-59	0
BP-18-13	615,249.80	5,855,392.00	691.46	72	-68	0
BP-18-14	615,325.00	5,855,400.00	690.00	87	-63	0
BP-18-15	615,399.30	5,855,362.00	691.68	48	-74	0
BP-18-15A	615,399.30	5,855,362.00	691.68	116	-74	0
BP-18-16	615,250.00	5,855,330.00	691.57	99	-90	0
BP-18-17	615,174.90	5,855,330.00	691.20	117	-90	0
BP-18-18	614,499.80	5,855,398.00	706.11	132	-75	0
BP-18-19	614,575.00	5,855,415.00	704.00	117	-85	0
BP-18-20	614,665.00	5,855,389.00	691.62	108	-65	0
BP-18-21	614,799.90	5,855,390.00	678.67	90	-62	0
BP-18-22	614,950.10	5,855,365.00	679.90	108	-57	0
BP-18-23	614,758.10	5,855,375.00	692.52	108	-50	0

10.1.1 Drilling Results

Results for the 2018 drill program were pending during the preparation of the block model for the current resource estimate.

Partial results (180 out of 471) were received during the redaction of this Report confirming that the mineralized zones were actually mineralized with significant grades above the cut-off grade, hence confirming the model.

The QP has not been provided with all the results, therefore conclusions herein are based on limited information.

10.2 Drilling Methodology

10.2.1 Drillhole Location / Set-up

The holes were collared on-site with a portable Garmin GPS. This position could vary from a few metres to accommodate drilling, depending on the ground conditions, but still maintain the relative position and spacing relative to the other holes.

10.2.2 Drillhole Orientation at Start-up

Drilling azimuth reference was provided through calculation of points of coordinates. The traditional use of a compass was not recommended due to the high level of magnetism developed by some horizons of the underlying iron formations.

10.2.3 Downhole Deviation Tests

Deviation and inclination tests were carried out in the holes. A Flexit instrument was used to measure both orientation and inclination of all the drillholes. This instrument provided useful magnetic susceptibility values.

Readings were taken every 15 m to 30 m with an overall average of 24.6 m. All the data obtained with the Flexit instrument were analyzed and all the inappropriate data were eliminated if deviation was too large and/or if the magnetic susceptibility was too high.

10.2.4 Coring

Drill cores are provided by the Drilling Contractor in NQ size (47.6 mm). The core is collected in a standard drilling tube and the drillers place the core into wooden core boxes. The driller marks the depth in metres (m) after each run, usually every 4 m.

The drillhole is terminated by the Bloom Lake site geologist once the targeted depth is reached and the core at the drill site is reviewed with respect to target lithologies, alteration and mineralization.

Once the drillhole is terminated and the final downhole survey reading collected, the drill crew pulls the rods for mobilization to the next drill site.

Casings can be left in the hole, but are usually removed.

10.2.5 Collar Surveying

All the drillhole collars were surveyed in-house by the mine site surveying team. Surveyors used a Trimble R8 instrument to survey the drillhole collars. Survey measurements were precise to three decimals, but for unexplained reasons, some of the recent hole coordinates were rounded to the nearest integer before importing the data into Surpac.

The inclination and direction of the drill collars were measured using a clinometer and then the direction was verified against Flexit readings for most holes.

10.2.6 Core Handling

At the drill rig, all the used core boxes were carefully closed with tape and were transported by either snowmobile or ATV to a pick-up truck that brought them to the core shack at the end of each shift. No core boxes were left outside the core shack.

The core shack was established inside an industrial dome on site used for various purposes. The author was able to visit the core shack during his site visit. In the core shack area, a number of inclined tables were installed for core logging with several core racks for boxes storage. An area was also organized for sampling.

All the boxes were labelled, photographed in lots of five and most of them were photographed in detail, three to four pictures being taken for each box. The core boxes were systematically measured to validate the marks of the drillers. Measuring was also done to calculate the rock quality designation (RQD) and the core recovery.

10.2.7 Core Logging

The core was logged using standard methods. Rock types were identified and intervals were measured according to the marks done by the drillers. Geological logging took into account the general colour of the rock, the relative percentage of constituents, the grain size distribution, the alteration, the contact with other rocks, the texture and the variation of these elements, when significant. A particular attention was given to the orientation of foliations relative to the core axis. Geotechnical features in the core, such as RQD were noted.

The mineralized units to be sampled were marked with a grease pencil at 3 m to 6 m intervals, depending on the mineral content, with some exceptions as low as 1.25 m and as long as 15 m.

10.2.8 Core Storage

The core was stored at the mine site, underneath the snow at the time of the author's site visit.

11. SAMPLE PREPARATION, ANALYSES AND SECURITY

11.1 Sampling Methods

11.1.1 Assay Samples

11.1.1.1 Sampling (Core Sample Selection)

In general, only mineralized intervals are sampled. The iron content of samples must be equal to or greater than 15%. This estimate is done visually by the person core logging.

The two factors that are taken into consideration are the grade cut-off for samples and the length of the samples. Samples are taken before, through and after the potentially mineralized zone.

To create representative and homogenous samples, sampling honours lithological contacts. The protocol states that the minimum sample interval in the hole will not be less than 1.0 m. The maximum sample interval will not exceed 6.0 m. No sample will cross a major rock boundary, alteration boundary or mineralization boundary.

Sampling intervals are determined by the geologist during logging and marked on the core boxes or on the core itself using coloured lumber pencils with a line drawn at right angles to the core axis.

The sample sequence includes blank samples and duplicate samples that are inserted into the sample stream using sample numbers that are in sequence with the core samples. No Standard Reference Materials (SRMs) were used for the 2018 program.

The sample length for the majority of intervals collected varies from 3.0 m to 6.0 m. A total of 21 samples out of 314 are outside this interval.

11.1.1.2 Core Sampling (Core Saw Splitting)

A geotechnician trained in core cutting procedures executes the core cutting at the Core Shack. The logging geologist has already clearly marked out all pertinent cores for cutting and sampling. The geologist staples a paper sample tag containing a sample number corresponding with the required sample interval at the start of the sample interval. The logging geologist also staples a metal tag containing the sample number onto the box. This is a permanent sample reference that will remain on the wooden core tray. The geotechnician removes the paper sample tag and places it inside of the plastic bag.

The core is divided in half using an hydraulic splitter. One half is retained and kept in the core box for later reference and the other half is put into a plastic sample bag. A sample assay tag is placed in the plastic sample bag and the bag is tied off.

For quality assurance purposes, "DUPLICATE" core samples are generated by sending the second ½ core sample to the lab. The sample bags are prepared in the same manner as the original sample and immediately follow the original core sample with the corresponding sample number.

A "BLANK" is included in the sequence as part of the QA/QC process. Blank material is technically devoid of any metals.

11.1.2 Density Samples

Specific gravity was determined using an air comparison pycnometer. It should be noted that this method does not take into account existing porosity in a rock and some of the oxide iron formation does contain vugs due to calcite removal.

Although the degree of porosity has not been quantified, it is estimated on the basis of visual examination of the drill core to be generally less than 2%. It should be noted that specific gravity was not measured for all drillholes.

11.1.3 Lab Methods of Preparation, Processing and Analysis

Core samples were shipped to the COREM Laboratory in Quebec City, Quebec, for analysis in 2018.

11.1.3.1 Lab Accreditation and Certification

COREM was accredited in 2017 by the Standards Council of Canada under ISO 17025:2005.

Quality control for the routine sample analysis included COREM's own quality control procedures, involving internal and external checks.

11.1.3.2 Sample Analysis Procedure

At COREM, the samples were crushed to reduce each sample to 3.35 mm (6 mesh).

A whole rock analysis was done on each sample to measure the following parameters (in %): Fe_{Total}, SiO_2, Al_2O_3, Fe_2O_3, MgO, CaO, Na_2O, K_2O, TiO_2, MnO, P_2O_5, Cr_2O_3, V_2O_5, ZnO, and loss on ignition (LOI).

The LOI at 400°C and 1,000°C is determined during the procedure.

Additional analyses included determination of magnetic iron with a Satmagan magnetic analyzer.

11.1.4 Sample Shipping and Security

At the Bloom Lake site, sample bags are stored in a core shack until they are removed to be delivered to TST Overland Express in Wabush, using pick-up trucks. Once delivered to TST Overland Express in Wabush, the bags are put on pallets and sealed with plastic wrap-ups.

11.2 Quality Assurance and Quality Control (QA/QC)

Canadian National Instrument 43-101 (NI 43-101) Standards of Disclosure for Mineral Projects requires mining companies to report results in Canada to comply with the CIM Best Practice Guidelines. The guidelines describe which items are required to be in the reports, but do not provide guidance for Quality Assurance and Quality Control (QA/QC) programs.

QA/QC programs have two components: Quality Assurance (QA) deals with the prevention of problems using established procedures, while Quality Control (QC) aims to detect problems, assess them, and take corrective actions. QA/QC programs are implemented, overseen and reported on by a Qualified Person as defined by NI 43-101.

QA programs should be rigorous, applied to all types and stages of data acquisition and include written protocols for: sample location, logging and core handling; sampling procedures; laboratories and analysis; and data management and reporting.

QC programs are designed to assess the quality of analytical results for accuracy, precision and bias. This is accomplished through the regular submission of standards, blanks and duplicates with regular batches of samples submitted to the lab, and the submission of batches of samples to a second laboratory for check assays.

The materials conventionally used in mineral exploration QC programs include standards, blanks, duplicates, and check assays. Definitions of these materials are presented hereunder:

- **Standards** are samples of known composition that are inserted into sample batches to independently test the accuracy of an analytical procedure. They are acquired from a known and trusted commercial source.
- **Blanks** consist of material that is predetermined to be free of elements of economic interest to monitor for potential sample contamination during analytical procedures at the laboratory.
- **Duplicate** samples are submitted to assess both assay precision (repeatability) and to assess the homogeneity of mineralization. Duplicates can be submitted from all stages of sample preparation with the expectation that better precision is demonstrated by duplicates further along in the preparation process.
- **Check Assays** consist of a selection of original pulps that are submitted to a second analytical laboratory for the same analysis as at the primary laboratory. The purpose is to assess the assay accuracy of the primary laboratory relative to the secondary laboratory.

Quality control samples were inserted into the sample batches sent to the laboratory during the 2018 drilling program. Inserts included duplicate samples and blank samples. No standards were inserted.

11.2.1 Lab QA/QC

Quality control for the routine sample analysis included COREM's own quality control procedures, involving internal and external checks.

11.2.2 Quebec Iron Ore QA/QC

In addition to the Lakefield's internal QA/QC protocol, Quebec Iron Ore inserted duplicate and blank samples in the drill core samples.

No external check was carried out for the 2018 drill program.

11.2.2.1 Duplicates

Duplicate samples are submitted to assess both assay precision (repeatability) and to assess the homogeneity of mineralization.

QIO utilizes core duplicates with one half of core being used for the primary analysis and the other half for the subsequent duplicate analysis, leaving no core in the core box for record keeping.

Results for the 2018 drill program were pending during the preparation of the block model for the current resource estimate.

Partial results (180 out of 471) were received during the redaction of this Report confirming that the mineralized zones were actually mineralized with significant grades above the cut-off grade, hence confirming the model.

The QP has not been provided with all the results, therefore conclusions can only be partial based on the limited information received.

11.2.2.2 Blanks

Blanks are used to monitor for potential sample contamination that may take place during sample preparation and/or assaying procedures at the primary laboratory. There are three types of blanks commonly used in QC programs, these being "Coarse Blanks", "Fine Blanks" and "Pulp Blanks". Only coarse blanks were used for the 2018 drilling program.

Samples coming from barren lithologies, mainly amphibolites, were used for blanks during the 2018 drilling program.

Results for the 2018 drill program were pending during the preparation of the block model for the current resource estimate.

Partial results (180 out of 471) were received during the redaction of this Report confirming that the mineralized zones were actually mineralized with significant grades above the cut-off grade, hence confirming the model.

The QP has not been provided with all the results, therefore conclusions can only be partial based on the limited information received.

11.3 Assessment of Results

Results were received by email in Excel files by representatives of Quebec Iron Ore.

11.3.1 Conclusion

Results for the 2018 drill program were pending during the preparation of the block model for the current resource estimate. Partial results (180 out of 471) were received during the redaction of this Report confirming that the mineralized zones were actually mineralized with significant grades above the cut-off grade, hence confirming the model. The QP has not been provided with all the results and, therefore, conclusions can only be partial based on the limited information received for the 2018 drilling program.

The QP reviewed the sample preparation, analytical and security procedures, as well as insertion rates and the performance of blanks and duplicates for the drilling program up to 2018, during discussions with on-site geologists, and concluded that no significant assay biases are present. According to the QP’s opinion, the procedure and the quality of the data are adequate to industry standards and support the mineral resource estimate.

12. DATA VERIFICATION

The Mineral Resource Estimate (MRE) in this report is based on drill data from different drilling programs held since 1956. The most recent program was held in 2018 by the issuer.

For the purpose of this MRE, BBA performed a basic validation on the entire database. All data were provided by Quebec Iron Ore in UTM NAD 83 Zone 19. The database close-out date for the resource estimate is May 19, 2019; data from 569 drillholes (141,289 m) were incorporated in the resource estimate.

12.1 Site Visit

Pierre-Luc Richard of BBA visited the Bloom Lake project from March 19 to March 21, 2019. The site visit included a visual inspection of available core, a field tour (Figure 12-1) and discussions of the current geological interpretations and block modelling approach with geologists and engineers of Quebec Iron Ore.

Figure 12-1: Pits visited during the site visit

The site visit also included a review of sampling and assays procedures, QA/QC program, downhole survey methodologies, and descriptions of lithologies (Figure 12-2).

Figure 12-2: Core review in the core logging facility

12.2 Drilling and Sampling Procedure

Quebec Iron Ore procedures are described in Chapters 10 and 11 of the current report. Discussions held with on-site geologists allowed to confirm said procedures were adequately applied.

The bulk of the core was under the snow during the site visit. BBA could only review some limited amount of core sections. All core boxes reviewed were labelled and either laid out on logging tables or properly stored inside the core shack. Sample tags were present in the boxes and it was possible to validate sample numbers and confirm the presence of mineralization in witness half-core samples from the mineralized zones (Figure 12-2).

No drilling was underway during the QP's site visit. On-site geologists explained the entire path of the drill core, from the drill rig to the logging and sampling facility and finally to the laboratory.

12.3 Historical Drillhole Database

The historical information used in this report was taken mainly from reports produced before the implementation of NI 43-101. In most cases, little or no information is available about sample preparation, analytical or security procedures. However, BBA assumes that exploration activities conducted by previous companies were in accordance with prevailing industry standards at the time.

The conversion of the old drillholes coordinates was done by Watts, Griffis and McOuat Limited (WGM) in 2005. The method of conversion was not specified in their report dated May 26, 2005.

The latest database validation was performed by G-Mining in 2017 and is reported in a technical report dated July 2017. G-Mining has taken core samples to compare with assay grades available in the drilling database of the Bloom Lake project. The sampling was carried out independently by the qualified person responsible for the resource estimate during a site visit in September 2016. A total of 12 samples were selected and analyzed for iron content. G-Mining was of the opinion that the check assay results are reasonably close to those of the original assays and that consequently, the assay results included in the database of the Bloom Lake Project are reliable and can be used for resource estimation.

12.4 Recent Drillhole Database

Quebec Iron Ore provided a database to BBA. The database contained coordinates of drillhole collars, deviation tests, lithological contacts, and assay results. Verifications were done to make sure logging was made in accordance with protocols.

12.4.1 Assays

Results for the 2018 drill program were pending during the preparation of the block model for the current resource estimate.

Partial results (180 out of 471) were received during the redaction of this Report confirming that the mineralized zones were actually mineralized with significant grades above the cut-off grade, hence confirming the model.

Since the QP has not been provided with all the results, conclusions herein can only be based on limited information. That being said, it is the opinion of the QP that sufficient validation was made to ensure that the data used for the MRE is valid. Note that assay results from the 2018 drill program were not used for interpolation.

12.4.2 Drillhole Location

For drilling conducted in 2018, all drill collars have been surveyed using differential GPS equipment.

BBA validated that the difference between the coordinates used for the block model and the survey is not material to the purpose of this MRE. Differences within 1 m were locally noted.

12.4.3 Downhole Survey

During the 2018 drilling program, a Flexit instrument was used to measure both orientation and inclination of the drillholes. This instrument provided useful magnetic susceptibility values. Readings were taken every 15 m or 30 m. All data obtained with the Flexit instrument were analyzed and all inappropriate data were eliminated if deviation was too large and/or if the magnetic susceptibility was too high. For some 45 holes drilled in 2012 and 2013, deviation and inclination readings were taken with a Gyro instrument every 5 m.

12.4.4 QA/QC

Historical data was reviewed and did not yield issues.

Results for the 2018 drill program were pending during the preparation of the block model for the current resource estimate. Partial results (180 out of 471) were received during the redaction of this Report. Therefore, the QP has not been provided with the QA/QC reports for the 2018 drill program.

12.5 Conclusion

The QP is of the opinion that the drilling protocols in place are adequate. The database for the Bloom Lake Project is of good overall quality. Minor variations may have been noted during the validation process but have no material impact on the MRE. It is the QP’s opinion that the Bloom Lake database is appropriate to be used for a Mineral Resource Estimate.

13. MINERAL PROCESSING AND METALLURGICAL TESTING

The following nomenclature is used in the current section to differentiate the various operation of the Bloom Lake Mine:

- Phase 1 (Consolidated Thompson or CLM): Phase 1 operation as designed and started under the Consolidated Thompson ownership and operated until 2014;
- Phase 1 (QIO): Phase 1 operation as designed and started under the Quebec Iron Ore ownership and operated since 2018;
- Phase 2 (Cliffs): Phase 2 project as designed and partially constructed under the Cliffs Natural Resources;
- Phase 2 (QIO): Phase 2 project detailed in the current report.

13.1 Introduction

In 2018, the Phase 1 (QIO) restart showed that the flowsheet, which was based on the original Phase 2 (Cliffs) flowsheet along with improvements proposed by Mineral Technologies, allows for high iron recoveries and an excellent final concentrate grade control. The combination of spiral and up-current classifier (UCC) stages allows silica of all particle sizes to be removed, while keeping iron losses to a minimum. The inclusion of the magnetic circuit has allowed iron, that otherwise would have been sent to tails, to be recovered. For this reason, the Phase 1 (QIO) flowsheet was used as the basis for the Phase 2 (QIO) flowsheet design. The Phase 1 (QIO) separation circuit is presented in Figure 13-1.

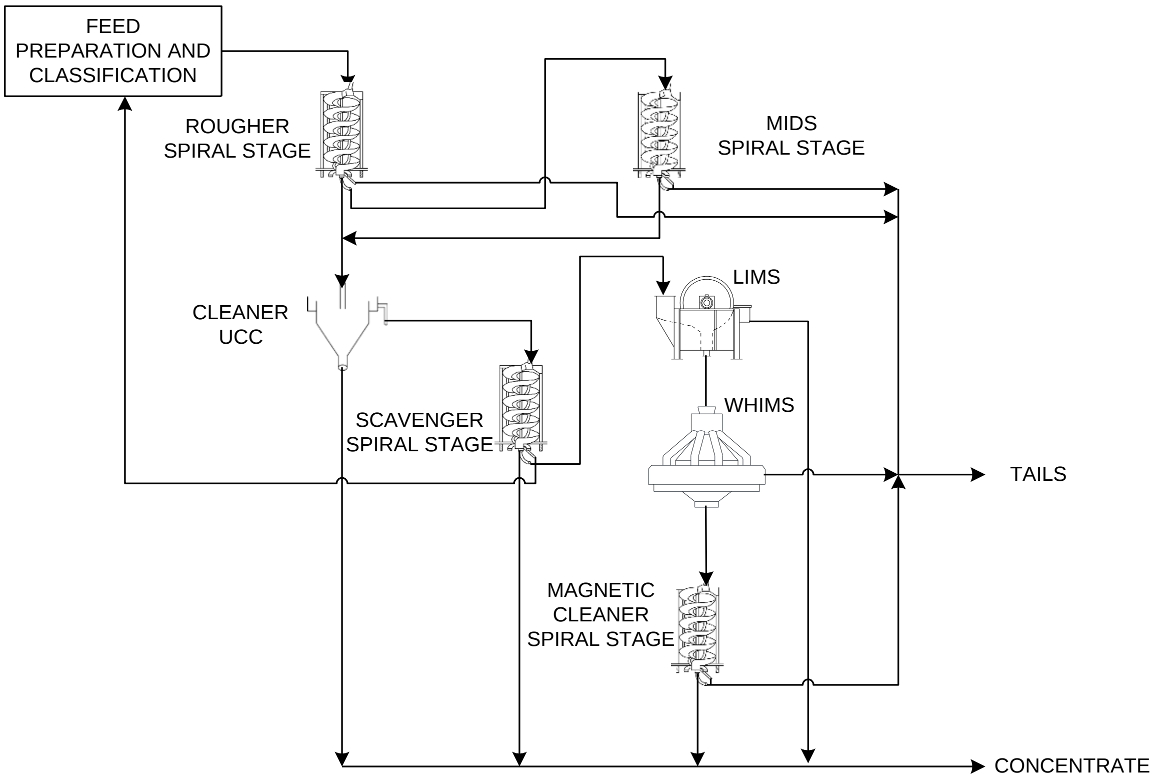

Figure 13-1: Separation circuit Phase 1 (QIO)

The operational experience acquired since the Phase 1 (QIO) restart has highlighted improvement opportunities in some of the process stages. The main opportunities are to:

- Improve the scavenger stage to allow for better concentrate grade control;
- Assess the possibility of scavenging fine iron from the rougher stage tails;
- Increase the fine tailings thickening capacity, as well as the concentrate filtration and handling capacity, to maximize production.

With these opportunities in mind, and the extensive historical testwork and operation data available, a testwork program was established for the separation circuit to represent the envisioned Phase 2 (QIO) flowsheet. The separation flowsheet proposed for the Phase 2 (QIO) concentrator is presented in Figure 13-2.

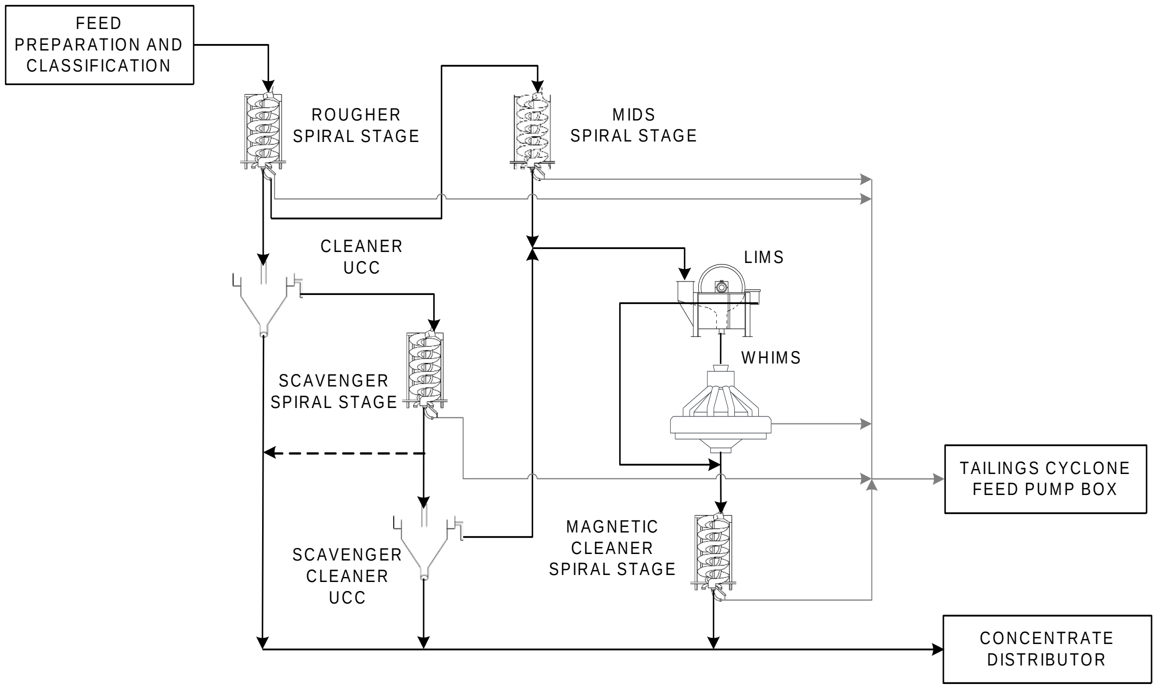

Figure 13-2: Separation circuit Phase 2 (QIO)

A validation of the Phase 1 (QIO) flowsheet performances was done by conducting extensive sampling campaigns to establish a base case prior to optimization work. Furthermore, screening, thickening and filtration lab scale testwork was conducted to ensure sufficient capacity of these stages.

This chapter presents a summary of the historical testwork and the Phase 2 (QIO) testwork, including:

- The flowsheet audit of Phase 1 (QIO);
- Phase 2 (QIO) testwork at COREM;
- Screening testwork at Derricks;
- Settling testwork at FLSmidth;
- Filtration testwork at Bokela.

Finally, the recovery model developed for Phase 2 (QIO) is presented.

13.2 Historical Testwork

The QIO ore has been extensively tested over the past several decades. This section covers the historical testwork prior to this project, presented in the light of Bloom Lake successive development phases:

- Testwork prior to Phase 1 (Consolidated Thompson) (before 2010);
- Original Phase 2 (Cliffs) Testwork (2010 – 2014);
- Phase 1 (QIO) Restart Testwork (2016 - 2017).

13.2.1 Testwork Prior to Phase 1 (before 2010)

Several engineering studies were carried out before the Phase 1 start-up in early 2010. BBA conducted a Conceptual Study for the development of a 5 Mtpy iron ore concentrate mine and concentrator in 2005-2006. In the feasibility that followed in 2007 the project was expanded to 7 Mtpy. Another feasibility study was realized in 2008 for the production of 8 Mtpy of iron ore concentrate (Consolidated Thompson Iron Mines Ltd and BBA inc., 2008). This section includes the testwork that was realized to support each study.

Metallurgical Testwork at Lakefield Research (1975-1976)

In 1975-1976, Republic Steel Corporation requested a metallurgical testwork program from Lakefield Research on drill core samples from the Bloom Lake property. Seventeen drill core composites of magnetite-specularite samples were withdrawn; nine samples from the Chief's Peak Pit and eight samples from the Western Extension of the Chief's Peak Pit, known as West Pit. All samples were crushed to minus 35 mesh (425 µm) and tested on a Wilfley Table to produce a gravity concentrate.

Metallurgical Testwork at Lakefield Research (1998)

In 1998, Watts, Griffis and McOuat (WGM), on behalf of Quebec Cartier Mining, which then held the property under option, requested Lakefield Research Limited to carry out metallurgical testwork on drill core samples of the Bloom Lake property. A total of 75 holes were drilled and heavy liquid tests were done on 1,267 samples.

Metallurgical Testwork at SGS (2005)

In 2005, WGM, on behalf of Consolidated Thompson-Lundmark Gold Mines Ltd. (Consolidated Thompson), requested metallurgical testwork at SGS Laboratory (Lakefield). Eleven mini-bulk samples, each weighing about 500 kg, were taken from outcroppings on Bloom Lake property and were sent to the SGS Laboratory for gravity separation testwork

Confirmatory Metallurgical Testwork at SGS (2006)

In 2006, Breton Banville & Associés (BBA), on behalf of Consolidated Thompson Iron Mines, (A. Allaire, et al., 2006), requested a metallurgical testwork program at the SGS Laboratory. Thirty-two (32) drill core samples for metallurgical testing and 32 drill core samples for grindability testing were obtained from 12 bore holes located in the west, central, northeast and southeast areas of the Bloom Lake pit. The samples were collected at different depths.

13.2.1.1 Gravity Separation

Table 13-1 summarizes the different weight recovery relations that were obtained over the different studies performed for the Phase 1 (Consolidated Thompson) gravity circuit.

The relatively high concentrate grade and iron recovery for gravity separation suggested that the ore was well liberated at 35 mesh (425 µm) throughout the ore body and that it could be possible to perform gravity separation at a coarser grind. The Phase 1 start-up in early 2010 was realized with classification screens with 35 mesh (425 µm) apertures, but the screens' openings were increased to 20 mesh (850 µm) sometime after start-up with no negative impact on concentrate grade or recovery observed.

In the 1976 report by WGM it was assumed that, in the worst case, any iron tied up with MgO in the form of actinolite would not be recovered. It was estimated that for each 1% MgO in the ore, there was 0.194% Fe attached to it. The 2006 confirmatory testwork confirmed that the actinolite was rejected with the silica during the gravity concentration process. No correction for MgO was implemented for the 2006 weight recovery curves.

Table 13-1: Gravity separation weight recoveries

Testwork	Average concentrate Fe grade (%)	Weight recovery relationship	Weight recovery (%)	Fe recovery (%)
1975-1976	67.1	WR = 1.16 * % Fe (head) + 2.48	37.3	83.3
2005	67.2	WR = 1.3788 * % Fe (head) - 3.1746	38.2	85.6
2006	67.8	WR = 1.3015 * % Fe (head)	39.0	88.3

13.2.1.2 Magnetic Separation

At 10% Fe_3O_4 feed grade, the magnetic confirmatory testwork results showed that an additional weight recovery of 2.5% could be accounted for if a magnetite plant was implemented. The magnetite plant, planned for Year 3 of Phase 1 (CLM), was not implemented due to lower than expected magnetite content in the magnetite plant feed and lower than expected Phase 1 (CLM) production rates.

13.2.1.3 Grindability

The grindability confirmatory tests confirmed that a 36' x 19'-9'' AG mill with an installed power of 10,071 kW (13,500 hp) was appropriate for processing the tonnage required for the 7 Mtpy iron ore concentrate production. The average mill feed rate was 2,156 tph and the power consumption in primary grinding was 3.82 kWh/t of concentrator feed. In the 8 Mtpy study, the AG Mill selected was a 36' x 20' long mill driven by dual 5,590 kW (7,500 hp) motors. The average mill feed rate was 2,372 tph and the power consumption in primary grinding was 4.2 kWh/t of concentrator feed.

13.2.1.4 Phase 1 Flowsheet

Figure 13-3 presents Phase 1 (CLM) high level flowsheet that was developed and commissioned in 2010. The gravimetric flowsheet is a classic 3-stage spiral flowsheet with recirculation of the cleaner and recleaner tails. The magnetic scavenging circuit was never built.

After the start-up the classification screens aperture was set at 850 µm and was operating without any liberation issues until operations stopped in 2014.

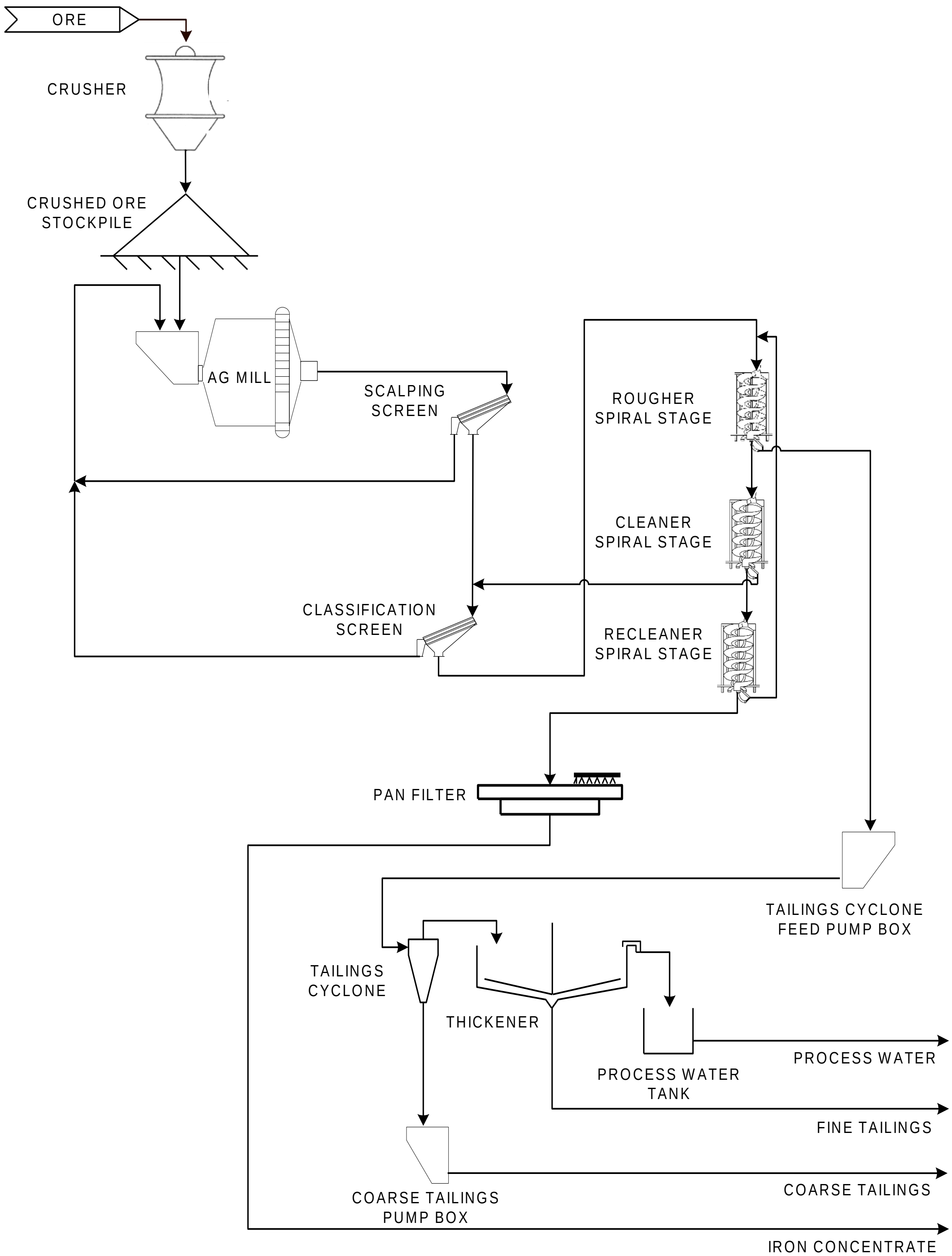

Figure 13-3 : Phase 1 (Consolidated Thompson) high level flowsheet

13.2.2 Phase 2 (Cliffs) Testwork (2010-2011)

The Phase 1 concentrator commenced operations in 2010 at a production target of 8 Mtpy of concentrate. As part of an expansion plan to increase the mine production, the design of a second concentrator plant (Phase 2) was then initiated to increase the nominal capacity to about 16 Mtpy of concentrate (Soutex, 2012). To support Phase 2 engineering, testwork was realized to characterize the future zones to be mined and to support flowsheet improvements from Phase 1. The subsections below summarize the testwork that was conducted.

13.2.2.1 West Pit (2010) Characterization

In 2010, 40 samples were utilized in testwork to characterize the ore from the West pit. The objective was to compare West pit samples' characteristics to the ones of the Chief's Peak pit, which was processed in the Phase 1 (Consolidated Thompson) concentrator. These tests included mineralogy analysis, heavy media separation tests, Wilfley Table tests, and grindability testwork (Soutex, 2011a).

From a mineralogical point of view, grinding the ore at 100% passing 850 µm, as done in the Phase 1 concentrator, enabled adequate hematite liberation for recovery by a subsequent gravity separation process. However, three composites characterizing the three main zones of Bloom West pit were generated, ground to 95% passing 425 µm for comparison with the previous Chief's Peak pit Characterization tests and underwent heavy media testing using a media of density 3.3.

The heavy media tests confirmed that a high iron grade concentrate can be produced at a particle size distribution of 95% passing 425 µm with the samples from West pit, as this was the case with those from the Chief's Peak pit tested before 2010.

Samples were tested on a Wilfley Table. The West pit test results were better or comparable to the results from the Chief's Peak pit samples.

Thirty-eight (38) samples from West pit were subject to SPI grindability tests. The results are compared to the Chief's Peak pit Confirmatory Testwork realized in 2006 in Table 13-2.

Table 13-2: West pit grindability hardness data

Zone	Year	Ci (kWh/t)	SPI (minutes)	Standard Deviation (%)
West Pit	2010	14.7	7.1	3.9
Chief's Peak Pit	2006	9.2	21.8	18.1

The results showed that the Chief's Peak pit samples were harder (with higher SPI values) than the West Pit samples.

13.2.2.2 Phase 2 (Cliffs) Piloting (2011)

Pilot tests were conducted in the Phase 1 concentrator in order to evaluate the performance and operational ease of new process equipment at different locations according to a proposed more efficient flowsheet. Figure 13-4 schematically represents the four pilot tests conducted on the process (Soutex, 2011b).

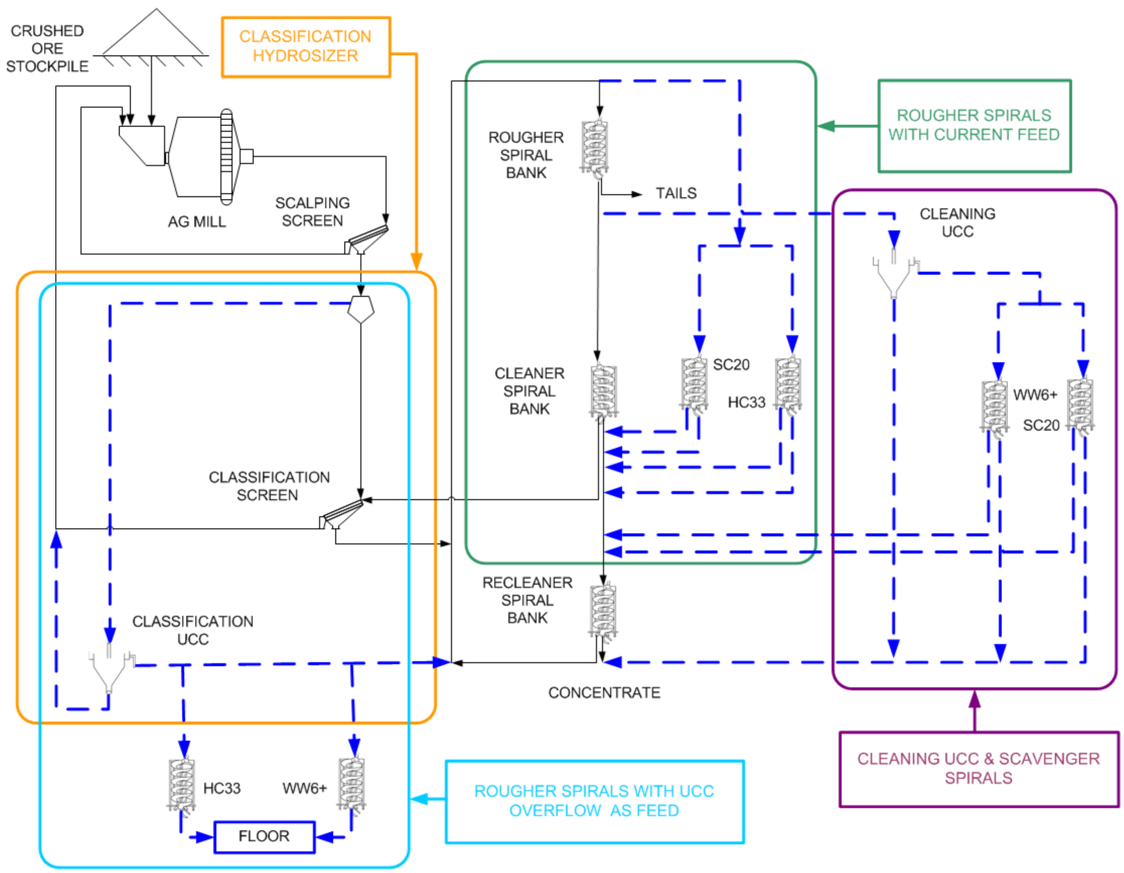

Figure 13-4: Phase 2 pilot tests - 2011

Figure 13-5 presents the Phase 2 (Cliffs) proposed flowsheet following piloting. Phase 2 (Cliffs) was never completed. The Phase 2 (Cliffs) construction project was halted in November 2012 and Phase 1 (Consolidated Thompson) operations were suspended in December 2014 by Cliffs.

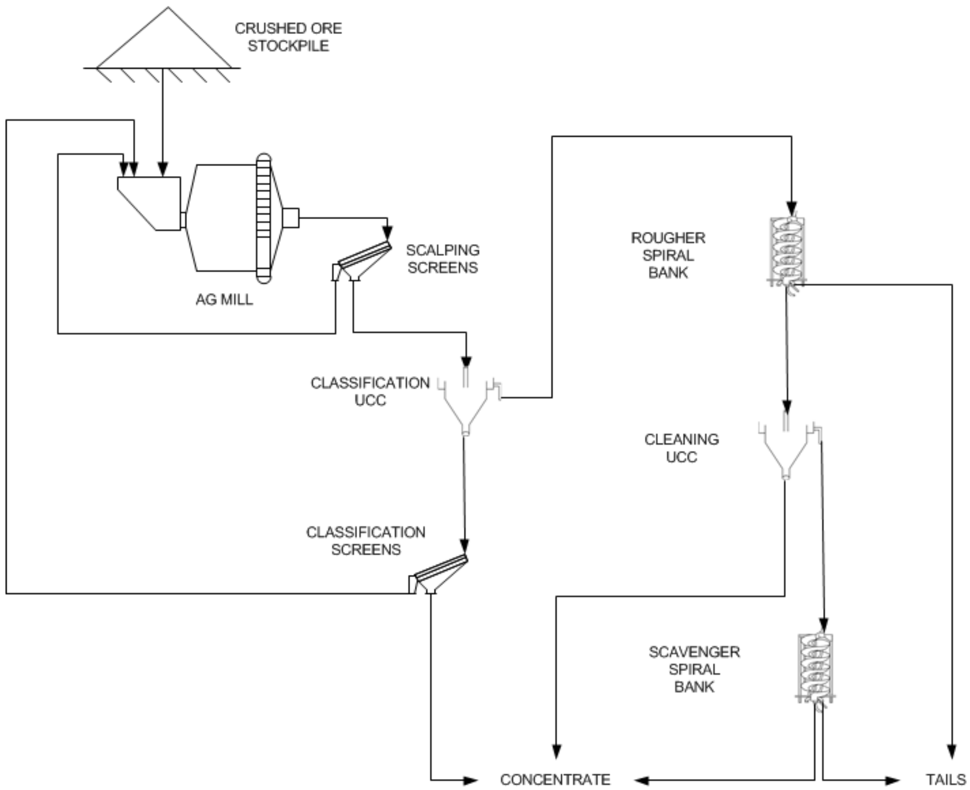

Figure 13-5: Phase 2 (Cliffs) simplified flowsheet

13.2.2.3 Magnetite Plant Testwork

In the previous Phase 1 8-Mtpy study, a magnetite plant was planned in order to recover 600,000 tpy of magnetite concentrate (for one phase). This assumption was based on:

- The Chief's Peak pit mine plan that stated the crude ore contains approximately 30% iron and 10% magnetite (it had since been revised to 8%);
- A very limited amount of mineral concentration testwork.

In order to develop a process flowsheet for the magnetite plant processing the gravity tailings from Phase 1 and 2 concentrators, bench scale testwork program was conducted at SGS (Lakefield, Ontario) in 2011 (Soutex, 2013a) and a pilot plant testwork program was conducted at COREM (Soutex, 2013b).

The magnetite plant testwork (Soutex, 2013c) has shown that:

- The iron under the magnetite form, in the gravity separation circuit, concentrates in a similar way to the hematite;
- The weight recovery obtained, in the magnetite separation circuit, increases linearly with the magnetite grade in the magnetite separation circuit feed.

Considering the gravity plant weight recovery, the weight yield obtained of 1.4% from crude ore at the nominal magnetite grade of 8% is significantly lower compared to the 2.5% value predicted in the original 8-Mtpy study. The mag plant was judged to be non-economically viable and was therefore never built.

13.2.2.4 Phase 2 (Cliffs) Settling Testwork

In September 2011, FLSmidth undertook sedimentation and rheology testing on fine tailings samples from the Bloom Lake concentrator (FLSmidth, 2011). All the tests were conducted with a thickener feed at 3.3% solids. The results from the testing program indicated that one 45 m diameter High Rate Thickener with a sidewall of 4.3 m is sufficient to handle 351 tph of tailings.

13.2.2.5 Phase 2 (Cliffs) Filtration Testwork

In 2011, Bokela undertook a study to evaluate the performance of the XL-Type filters (68 m^2) for the Bloom Lake Phase 2 Expansion (Bokela, 2011). Bokela confirmed that the maximum design throughput of 342 tph can be achieved with this filter and indicated that the XL-Type filter could filter up to 500 tph.

13.2.3 Phase 1 (QIO) Testwork

After Quebec Iron Ore (QIO) acquired the Bloom Lake assets from Cliffs in early 2016, Mineral Technologies was mandated to design an upgraded flowsheet for the Phase 1 concentrator (Ausenco, 2017). The Phase 1 upgrade would be facilitated by making use of the process equipment already bought in the Phase 2 concentrator, which was under construction when the mine’s operation had stopped.

The Phase 1 (QIO) upgraded flowsheet development was initially based on historical Phase 1 (Consolidated Thompson) data, Phase 2 (Cliffs) piloting and the proposed Phase 2 (Cliffs) flowsheet design as well as Mineral Technologies experience.

The proposed flowsheet was similar to the Phase 2 (Cliffs) flowsheet with the following modifications:

- An expected increased iron recovery, thanks to the processing of a portion of the gravity tailings streams in a scavenging magnetic circuit for the production of a lower grade Magnetic circuit concentrate;
- A method to process the rougher spirals middlings without recirculation back to the rougher spirals feed;

- A classification circuit comparable to the initial Phase 1 (Consolidated Thompson) flowsheet, which involves screening only instead of using classification up-current classifier as initially planned in the Phase 2 (Cliffs) flowsheet.

The proposed and tested flowsheet is presented in Figure 13-6 below.

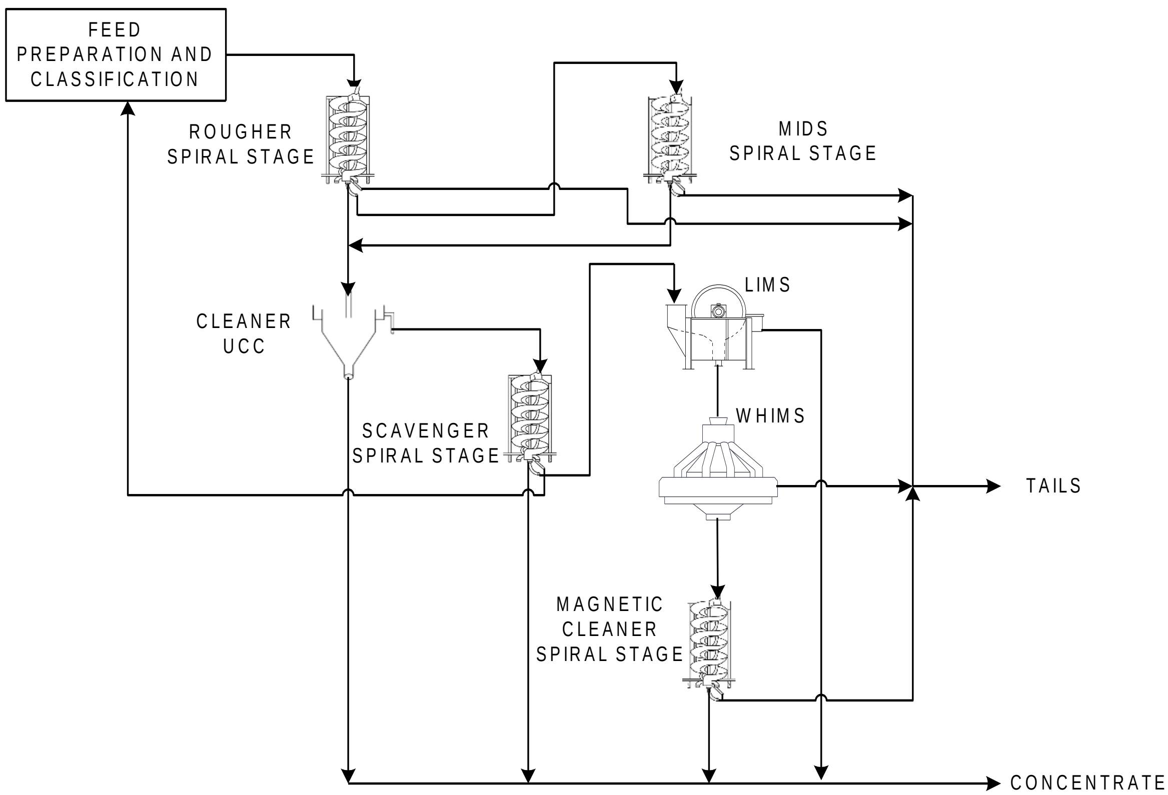

Figure 13-6: Phase 1 (QIO) tested flowsheet

Table 13-3 presents the metallurgical balance resulting from the testwork. The results showed a weight yield to the gravity concentrate of 37.8% with an additional 1% coming from the LIMS/WHIMS scavenger circuit and translates to an overall iron recovery of 81.1%.

The testwork data was used to update a metallurgical model developed by MT. The model predicted a theoretical maximum iron recovery from the flowsheet of 85.3% and an expected plant recovery of 83.3% from a continuous plant operation treating ore of similar characteristics to the sample tested at the expected life of mine (LOM) feed grade of 30% Fe. This recovery of 83.3% for a 30% Fe feed grade, was used for Phase 1 (QIO) design.

Table 13-3: Testwork global metallurgical balance

Product	% weight	Assays									Distribution		
		Fe (%)	SiO_2 (%)	Al_2O_3 (%)	P (%)	S (%)	CaO (%)	TiO_2 (%)	Mn (%)	MgO (%)	Fe (%)	SiO_2 (%)	Al_2O_3 (%)
Gravity Concentrate (total)	37.8	66.9	3.53	0.27	0.01	0.01	0.09	0.16	0.08	0.09	79.5	2.6	13.4
Magnetic Circuit Concentrate	1.0	48.2	29.3	0.40	0.02	0.01	0.31	0.26	0.09	0.30	1.6	0.6	0.6
Magnetic Circuit Rejects	13.5	7.5	85.8	1.29	0.04	0.01	0.81	0.11	0.03	0.77	3.2	22.1	23.4
Gravity Circuit Rejects	47.6	10.5	82.3	0.98	0.02	0.01	0.43	0.09	0.03	0.53	15.7	74.8	62.6
Calculated Feed	100.0	31.8	52.4	0.75	0.02	0.01	0.35	0.12	0.05	0.39	100.0	100.0	100.0

13.3 Phase 1 (QIO) Flowsheet Audit at QIO

Sampling campaigns were conducted in the Bloom Lake Phase 1 (QIO) concentrator in November, 2018. The campaigns' goals were:

- To set a base case for Phase 2 (QIO) design by characterizing the Phase 1 (QIO) concentrator performances under various feed conditions;
- To gather bulk samples for the testwork to be performed at COREM.

13.3.1 Phase 1 Characterization

A total of 41 samples were gathered for each of the four sampling campaigns performed between November 12 and 15, 2018 (Soutex, 2019). The North and South circuits were sampled individually to allow comparison. Size by size assays were performed on every sample and data reconciliation was performed. Figure 13-7 shows the campaign sampling points' locations.

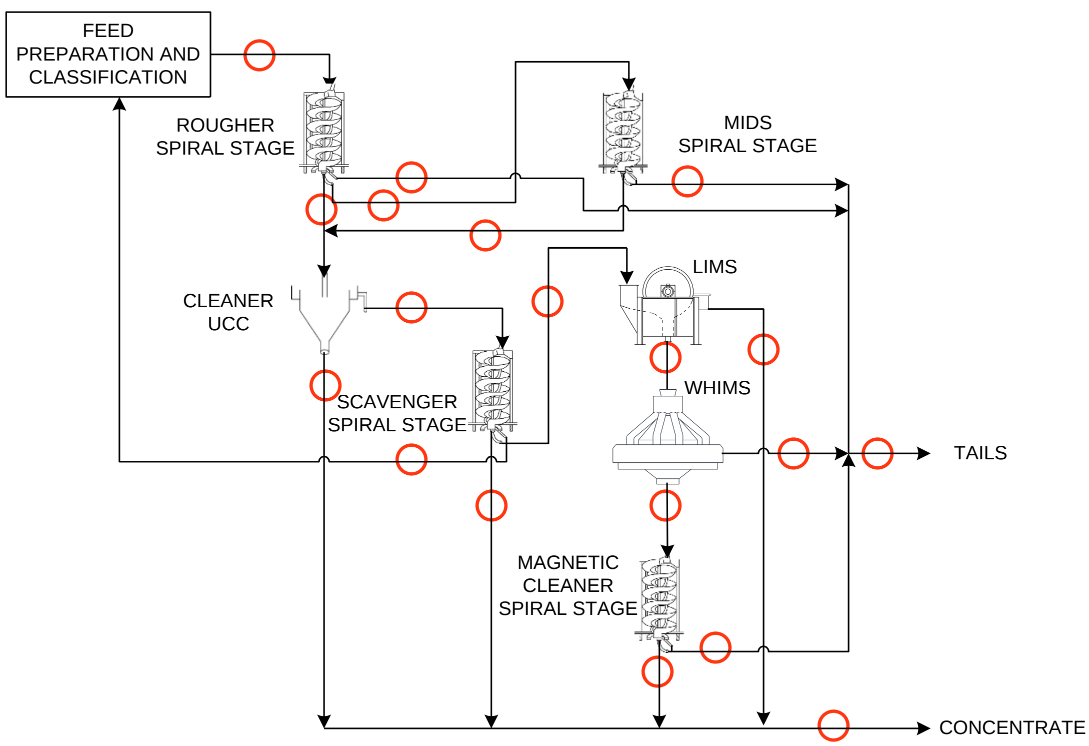

Figure 13-7: Sampling points in Phase 1 (QIO) concentrator

The sampling points covered the entirety of both the North and South gravity and magnetic separation circuits with the exception of the north WHIMS tails due to a faulty sampling valve.

Mining operations were adjusted throughout the campaigns so as to produce ore blends that were representative of typical concentrator feed blends:

- Blend containing limonite;
- Life of mine blend;
- Blend containing silicates.

The results from the campaigns were compared to the Phase 1 (QIO) design values. Table 13-4 presents the comparison between the campaigns and the design. The detailed results are presented in the sampling campaigns report.

Table 13-4: Sampling campaigns results vs. design values

Stream	Campaigns average					Design values				
	Weight Rec.		Grade	Fe Rec.		Weight Rec.		Grade	Fe Rec.	
	Global	Stage	Fe	Global	Stage	Global	Stage	Fe	Global	Stage
	%	%	%	%	%	%	%	%	%	%
Fresh Feed	94.7	-	33.2	98.0	-	96.0	-	29.9	99.5	-
Rougher Spirals										
Rougher Spirals Feed	100.0	100.0	32.1	100.0	100.0	100.0	100.0	28.8	100.0	100.0
Rougher Spirals Concentrate	49.8	49.8	55.2	85.7	85.7	45.0	45.0	49.2	76.9	76.9
Rougher Spirals Tails	30.1	30.1	9.5	8.9	8.9	22.0	22.0	7.2	5.5	5.5
Rougher Spirals Middlings	20.1	20.1	8.7	5.4	5.4	33.0	33.0	15.4	17.6	17.6
Mids Spirals										
Mids Spirals Concentrate	2.4	12.1	28.4	2.2	39.7	10.2	31.0	29.7	10.6	59.9
Mids Spirals Tails	17.6	87.9	6.0	3.3	60.3	22.8	69.0	8.9	7.1	40.1
Cleaner Up Current Classifiers										
Cleaner UCC Feed	52.3	100.0	53.9	87.9	100.0	55.2	100.0	45.6	87.4	100.0
Cleaner UCC Overflow	24.0	45.9	37.4	28.0	31.8	25.3	45.8	19.5	17.1	19.6
Cleaner UCC Underflow	28.3	54.1	67.9	59.9	68.2	29.9	54.2	67.7	70.3	80.4
Scavenger Spirals										
Scavenger Spirals Concentrate	10.9	45.4	59.8	20.3	72.6	5.8	23.0	61.8	12.5	72.9
Scavenger Spirals Middlings	7.8	32.4	23.4	5.7	20.3	15.4	61.0	7.7	4.1	24.2
Scavenger Spirals Tails	5.3	22.2	12.1	2.0	7.2	4.0	16.0	3.6	0.5	2.9
LIMS										
LIMS Feed	7.8	100.0	23.4	5.7	100.0	15.4	100.0	7.7	4.1	100.0
LIMS Concentrate	0.1	0.8	58.3	0.1	2.1	0.2	1.0	54.0	0.3	7.0
WHIMS Feed	7.7	99.2	23.1	5.6	97.9	15.3	99.0	7.3	3.8	93.0
WHIMS										
WHIMS Tails	6.3	82.0	16.0	3.2	56.8	12.4	81.0	2.6	1.1	29.3
Mags Cleaner Spirals Feed	1.4	18.0	55.4	2.4	43.2	2.9	19.0	27.0	2.7	70.7
Mags Cleaner Spirals										
Mags Cleaner Spirals Concentrate	1.1	76.1	62.9	2.1	86.5	1.1	38.0	49.4	1.9	69.5
Mags Cleaner Spirals Tails	0.3	23.9	31.3	0.3	13.5	1.8	62.0	13.3	0.8	30.5
Global										
Tailings Cyclones Feed	54.4	54.4	9.2	15.6	15.6	58.3	58.3	7.1	14.4	14.4
Pan Filters Concentrate	40.3	40.3	65.5	82.4	82.4	37.0	37.0	66.2	85.0	85.0

13.3.1.1 Rougher Spirals Stage

The iron recovery at the rougher stage was, on average, 85.7% in the concentrate and 5.4% in the middlings. The rougher concentrate recovery was significantly higher and the rougher middlings recovery was significantly lower in the campaigns than their design values. This resulted in a slightly lower overall iron recovery at that stage and a significantly lower feed rate to the mids spirals. The rougher spirals were eliminating coarse silica very well and produced on average a concentrate at 55.2% Fe and middlings at 8.7% Fe.

13.3.1.2 Mids Spirals Stage

The iron recovery at the mids spirals stage was, on average, 39.7% representing 2.2% of the global recovery. This was significantly lower in the campaigns than the design values but was offset by a higher than design recovery at the rougher concentrate. The combined rougher and mids stages recovery, 87.9%, was slightly higher than the design value of 87.5%. The mids spirals were eliminating coarse silica very well except during one of the campaigns. This resulted in sending coarse silica to the cleaner up-current classifiers stage. On average, the mids concentrate grade was 28.4% Fe which is consistent with the design value.

13.3.1.3 Cleaner Up-Current Classifiers Stage

The iron recovery at the cleaner UCC underflow was, on average, 68.2%. This was significantly lower in the campaigns than the design value which resulted in sending more feed to the scavenger spirals stage. The cleaner UCC were eliminating fine silica very well but could also remove mid-sized silica at the expense of iron recovery. The coarse silica getting to the cleaner UCC feed was reporting to the underflow, meaning that not properly removing coarse silica at the rougher and mids stages, as happened during one of the campaigns, impacted the final concentrate grade.

13.3.1.4 Scavenger Spirals Stage

As a result of the lower recovery at the cleaner up-current classifier underflow, the scavenger spirals were receiving almost twice the amount of iron than designed but a tonnage similar to the design. This led to producing more scavenger spirals concentrate while less cleaner UCC concentrate was produced. On average, the scavenger spiral concentrate iron grade was 59.8%, which is low compared to the design value of 61.8%. The iron recovery was similar to the design value. That lower grade combined with the higher proportion of scavenger concentrate in the final concentrate meant that, on average, the final concentrate grade and iron recovery were lower than designed. The scavenger spirals mids, feeding the LIMS stage, had an iron grade three times higher than the design at a lower tonnage.

13.3.1.5 LIMS Stage

The LIMS concentrate tonnage was very low during the campaigns as a result of the low magnetite content in the ore. The average iron grade obtained was slightly higher than in the design at 58.3%. Although below the final concentrate target grade, the LIMS concentrate tonnage was too low to significantly affect the final concentrate.

13.3.1.6 WHIMS Stage

The iron recovery at the WHIMS stage was well below the design value at 43.2%, on average, compared to 70.7%. This might have been caused by the higher amount of iron feeding the WHIMS as a result of the high scavenger mids iron grade.

13.3.1.7 Magnetic Cleaner Spirals Stage

The magnetic cleaner spiral stage performed better during the campaign compared to the design values because of the higher iron feed grade and lower feed tonnage. The iron recovery was 85.6%, on average, compared to the 69.5% design value and the iron grade obtained was 62.9% compared to 49.4% in the design. This higher concentrate iron grade helped minimize the impact of the proportionally higher tonnage of scavenger concentrate in the final concentrate.

13.3.2 Flowsheet Audit Conclusions

The Phase 1 (QIO) flowsheet audit has allowed valuable information to be gathered, which was used to define the testwork program. The main conclusions are:

- The rougher stage performs well and its concentrate iron recovery is higher than designed;
- The mids stage receives less feed and its concentrate iron recovery is lower than expected but is offset by the higher recovery to rougher concentrate;
- The recovery at the cleaner stage's underflow is lower than expected and result in more material being sent to the scavenger stage;
  - This requires being more aggressive at the scavenger stage to meet final concentrate grade.
- The scavenger stage has been identified as the stage where the most potential gain was possible both in terms of grade and recovery;
- The magnetic circuit did not perform as expected in the WHIMS stage where the iron recovery was lower than expected.

13.4 Phase 2 (QIO) Testwork

Testwork at COREM was started in November 2018 (COREM, 2019). The main objectives of the metallurgical testwork were to:

- Improve the scavenger stage to allow for better concentrate grade control and higher recovery;
- Assess the possibility of scavenging fine iron from the rougher tails;
- Validate the performances of the stages already performing well in Phase 1 (QIO).

13.4.1 Testwork Program

The testwork program was based on the experience acquired through the Phase 1 (QIO) operation and results from the sampling campaigns. The sections of the Phase 1 (QIO) process that are performing well were tested without modifications and the ones that needed optimization were more extensively tested. Given past testwork on spiral model comparison and the benefits of having both phases operating with the same spiral model, only WW6+ spirals were tested.

13.4.1.1 Testwork Flowsheet

The following is a list of the main points concerning the testwork flowsheet:

- The rougher stage was tested with no flowsheet modifications on a WW6+ spiral;
- The mids stage was tested with no flowsheet modifications on a WW6+ spiral;
- The cleaner stage was tested on an up-current classifier. Unlike in the Phase 1 (QIO) concentrator, the mids scavenger spiral concentrate was not fed to the cleaner stage because of its low iron grade. The mids scavenger spiral concentrate is rather combined with the scavenger cleaner stage tails for further upgrading.
- The scavenger stage required more extensive testing to optimize its grade and recovery. As a result, a scavenger-cleaner stage was added to the test program so that the scavenger stage could be set at maximizing recovery while the scavenger-cleaner stage would provide a high grade concentrate. The following technologies were tested as a scavenger-cleaner stage:
    - WW6+ Spirals;
    - Reflux ®Classifier;
    - Up-Current Classifier (UCC).

- The magnetic circuit was tested with scavenger-cleaner UCC overflow and mids concentrate as feed. A LIMS/WHIMS (horizontal carousel) configuration was tested as in Phase 1 (QIO) testwork. Testwork was also done on the mags cleaning stage with a WW6+ spiral processing the LIMS & WHIMS magnetic concentrate. The objective was to maximize recovery with the LIMS/WHIMS stage, while the cleaner stage would provide a high grade concentrate.
- A scavenger LIMS & WHIMS stage was tested on the screened rougher tails to assess the possibility of recovering fine iron particles from the rougher tails.

The testwork program flowsheet overview is shown in Figure 13-8.

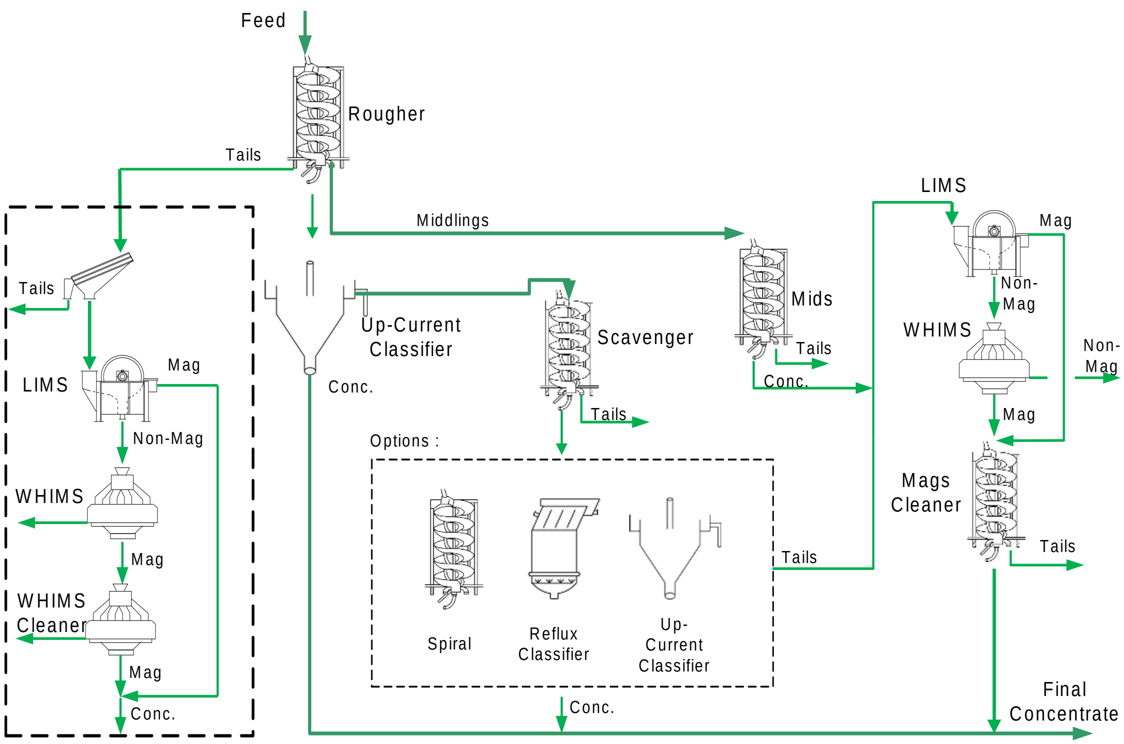

Figure 13-8: Testwork flowsheet

The analysis in the metallurgical testwork included:

- X-ray fluorescence (XRF) chemical assays on all streams;
- Satmagan magnetite grade on all streams;
- Particle Size Distributions on selected streams;
- XRF chemical assays per size on selected streams;
- Percent solids on selected streams;
- Determination of Fe by titration on selected streams.

13.4.1.2 Approach

The testwork objectives were:

- Evaluate the individual equipment performance with respect to iron recovery and concentrate grade;
- Evaluate rough optimal throughput for each piece of processing equipment;
- Perform preliminary optimization of process parameters.

A staged approach was used during the testwork, with each upgrading stage being tested and roughly optimized before testing the downstream upgrading stage.

As a first step, optimization tests were conducted for each stage. In the case where a significant quantity of material was required for a downstream process, a production run was also used to generate an adequate sample mass.

Variability testwork was conducted on different ore blends to assess the metallurgical performance of each blend. Five ore blends were prepared from eight mine samples collected from selected zones.

13.4.2 Sample Description

Samples were taken from the Phase 1 (QIO) concentrator and in the pits to provide material for the testwork:

- A bulk rougher feed sample;
- A cleaner UCC overflow sample;
- A rougher tails bulk sample;
- And variability bulk samples.

13.4.2.1 Bulk Rougher Feed (3 t) Sample

A bulk rougher feed sample was taken to be used as feed material for the rougher stage testwork. The concentrate and middlings obtained from the tested rougher stage were then used as feed material for the cleaner and mids stages respectively. To ensure an adequate quantity of samples for testing, the bulk rougher feed (3 t) sample was taken from two sources:

- Operational Backup samples:
  - Mass totalled 600 kg;
  - Composited from the period of February 16 to September 15, 2018.

- Daily samples:
  - Mass totalled 2,400 kg;
  - Composited from the Day Shift operation samples during the period of September 15 to 17, 2018.

The material was blended at COREM.

13.4.2.2 Cleaner UCC Overflow Sample

Two Cleaner UCC Overflow samples were taken:

- Small 21 kg composite sample;
- Large 7-tonne sample.

A 21 kg composite sample of Cleaner UCC Overflow was sampled from October 25 to 28, 2018. This sample was sent to COREM and allowed a rapid chemical evaluation on a size by size basis and mineralogical analysis in order to plan the testwork. The size by size assays are shown in Table 13-5 and the size by size assay distributions are shown in Table 13-6.

Table 13-5: Cleaner overflow size by size assays

Size fraction (µm)	Weight (%)	Mag. (%)	SiO_2 (%)	Fe_T (%)	MgO (%)	CaO (%)
+300	3.5	1.2	86.1	6.4	1.9	1.6
-300+212	7.8	2.2	77.3	12.4	2.3	1.8
-212+150	19.3	6.0	52.8	30.7	1.7	1.4
-150+75	44.7	11.2	29.7	47.6	1.3	1.1
-75+45	14.6	14.6	23.8	51.6	1.2	1.2
-45+38	2.8	14.4	25.4	49.6	1.7	1.3
-38	7.2	10.5	42.0	35.8	2.6	2.0
Calculated feed	100	9.7	39.8	39.9	1.6	1.3
Analyzed feed	100	9.8	39.8	39.2	1.6	1.3

Table 13-6: Cleaner overflow size by size assay distributions

Size fraction (µm)	Weight (%)	Mag. (%)	SiO_2 (%)	Fe_T (%)	MgO (%)	CaO (%)
+300	3.5	0.4	7.7	0.6	4.2	4.4
-300+212	7.8	1.8	15.2	2.4	11.4	10.9
-212+150	19.3	11.9	25.6	14.8	20.6	20.1
-150+75	44.7	51.8	33.4	53.3	37.7	37.9
-75+45	14.6	22	8.7	18.9	11.1	13.2
-45+38	2.8	4.2	1.8	3.5	3.0	2.8
-38	7.2	7.8	7.6	6.4	12.0	10.7
Total	**100**	**100**	**100**	**100**	**100**	**100**

It was expected that the amount of cleaner overflow generated would not be sufficient for the testwork program on subsequent stages. Therefore a cleaner UCC overflow bulk sample was taken in the plant and used as feed material for the scavenger stage, hence generating material for the scavenger cleaner and mags circuit stages. The sample is slightly different from the cleaner UCC overflow generated by the Phase 2 (QIO) flowsheet because the mids concentrate is not to be fed to the cleaner stage. However, because of the small quantity of mids concentrate feeding the cleaner stage compared to the rougher concentrate, the sample still represents, very well, the Phase 2 (QIO) cleaner overflow. A composite Cleaner Overflow bulk sample of approximately seven tons was taken from November 13 to 16, 2018. This sample was used as a scavenger stage feed during the testwork program.

The cleaner up-current classifier overflow sample was collected into 24 drums filled from four different up-current classifiers, two on the north side and two on the south side. The collecting was performed by unplugging a scavenger spiral feed hose, coming from the cleaner up-current classifier overflow, and tying it to a temporary hose leading to the drums.

13.4.2.3 Rougher Tails Sample

A 19 kg composite sample of rougher tails was sampled from October 25 to 28, 2018. This small sample was sent to COREM and allowed a rapid chemical evaluation on a size by size basis and mineralogical analysis in order to plan the testwork. The size by size assays are shown in Table 13-7 and the size by size assay distributions are shown in Table 13-8. The qualitative mineralogical analysis of the rougher tails sample is shown in Table 13-9.

Table 13-7: Rougher tails size by size assays

Size fraction (µm)	Weight (%)	Mag. (%)	SiO_2 (%)	Fe_T (%)	MgO (%)	CaO (%)
+850	3.3	0.7	99.3	3.0	0.6	0.9
-850+600	6.4	0.7	92.4	3.6	0.7	1.1
-600+425	11.1	0.6	92.2	3.6	0.9	1.1
-425+300	13.2	0.6	92.9	3.2	1.0	1.0
-300+212	11.6	0.6	93.2	2.6	1.3	1.1
-212+150	9.5	0.6	88.8	2.2	1.7	1.4
-150+75	12.9	0.8	75.9	3.5	2.8	2.0
-75+45	7.9	2.8	65.6	11.0	3.9	2.6
-45+38	3.0	5.2	65.6	18.6	3.7	2.6
-38	21.2	5.4	58.8	22.6	3.5	2.6
Calculated feed	100.0	2.0	82.9	8.3	2.1	1.7
Analyzed feed	100.0	1.8	82.5	8.1	2.2	1.7

Table 13-8: Rougher tails size by size assay distribution

Size fraction (µm)	Weight (%)	Mag. (%)	SiO_2 (%)	Fe_T (%)	MgO (%)	CaO (%)
+850	3.3	1.2	3.7	1.2	0.9	1.8
-850+600	6.4	2.3	7.1	2.7	2.1	4.1
-600+425	11.1	3.4	12.3	4.7	4.9	7.0
-425+300	13.2	4	14.8	5.1	6.4	7.9
-300+212	11.6	3.5	13	3.7	7.1	7.8
-212+150	9.5	2.9	10.6	2.5	7.5	7.6
-150+75	12.9	5.2	13.8	5.3	17.0	15.2
-75+45	7.9	11.2	7.2	10.4	14.3	12.2
-45+38	3.0	7.9	2.4	6.7	5.2	4.6
-38	21.2	58.4	15.1	57.7	34.6	31.9
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Table 13-9: Rougher tails mineralogical analysis

Size fraction (µm)	Iron oxides Liberation	Comments
+850	< 10 %	Associations with quartz mostly as inclusions - Large amphiboles particles
-600+425	< 10 %	
-425+300	30-50 %	Few free particles and mostly inclusions in quartz
-300+212	60-80 %	Free particles and inclusions in quartz
-212+150	80-90 %	Large and free Fe oxides particles with very few associations with quartz and inclusions
-150+75	80-90 %	
-75	80-90 %	Large amount of goethite/limonite covering the particles

The qualitative mineralogical analysis of the rougher tails sample is based on binocular observations made for each size fraction. In this context, the iron oxides particles are considered liberated when at least 90% of their surface is hematite or magnetite.

The results from the sample's analysis showed that most of the iron (about 75%) is in the -75 µm fraction and that iron particles finer than 212 µm are liberated at 80-90%, which represents 83% of the iron oxides. Based on this information, a composite rougher tails bulk sample of approximately 3 tons was taken from November 13 to 16, 2018 to provide material for fine iron scavenging testwork.

The rougher spiral tails were collected into 12 drums filled from two samplings points, one on the north side and one on the south side. The filling was performed by unplugging the manual sampler discharge port hose and tying a temporary hose leading to the drums. The manual sampler consists of a cutter mounted on guiding rods inside a box fed from the top by the tails from one rougher spiral bank. The cutters were positioned in the middle of the stream for time needed to fill the drums. This way of sampling is not ideal so a comparison between this bulk sample and the rougher tails' samples taken during the sampling campaigns was done. The bulk sample has a similar iron distribution and slightly lower iron grade compared to the campaigns' average, so the bulk sample is considered representative. Between each filling of the drums, the material was left to settle and the excess water removed. This process was done several times until the drums were full.

13.4.2.4 Bulk Variability Samples

13.4.2.4.1 Description

Eight samples of approximately two to three tonnes each, and representing different lithologies, were taken from the three pits in the mine: West, Pignac and Chief's Peak.

Figure 13-9 shows the locations where the variability samples were collected in the different pits.

Figure 13-9: Bulk variability samples location

The eight samples descriptions and chemical composition are presented in Table 13-10 and Table 13-11 respectively.

Table 13-10: Variability bulk samples identification

Sample No.	Description	Pit
1	Hematite 1	West Pit
2	Hematite 2	West Pit
3	Hematite 1	Pignac Pit
4	Hematite 2	Pignac Pit
5	Hematite	Chief's Peak Pit
6	Silicates	Pignac Pit
7	Silicates 1	Chief's Peak Pit
8	Silicates 2	Chief's Peak Pit

Table 13-11: Variability bulk samples head grades

Sample	Analysis				
	Fe (%)	SiO_2 (%)	MgO (%)	CaO (%)	Mag. (%)
Hematite 1 West Pit	34.4	51.1	-	-	0.9
Hematite 2 West Pit	32.9	51.2	0.2	0.2	1.8
Hematite 1 Pignac Pit	29.9	55.4	0.3	0.3	1.8
Hematite 2 Pignac Pit	25.5	62.9	0.1	0.1	2.8
Hematite Chief's Peak Pit	37.8	41.4	2.0	1.4	7.5
Silicates Pignac Pit	19.9	56.5	6.5	4.9	9.4
Silicates 1 Chief's Peak Pit	30.6	46.8	4.3	3.5	8.1
Silicates 2 Chief's Peak Pit	26.9	52.9	3.4	2.5	29.5

13.4.2.4.2 Sample Comminution

The bulk variability samples were sent to SGS Lakefield for initial preparation. Samples were first stage crushed to 100% passing 12.7 mm using two jaw crushers, a cone crusher and a screen. A portion of roughly 200 kg of the Chief's Peak pit Hematite sample was used for batch HPGR tests and a locked-cycle HPGR test with a 850 µm screen. These tests' results were used to set the parameters for processing the batch samples. The bulk samples were crushed in a HPGR and screened to 100% passing 850 µm. The particle size distributions obtained are presented in Figure 13-10.

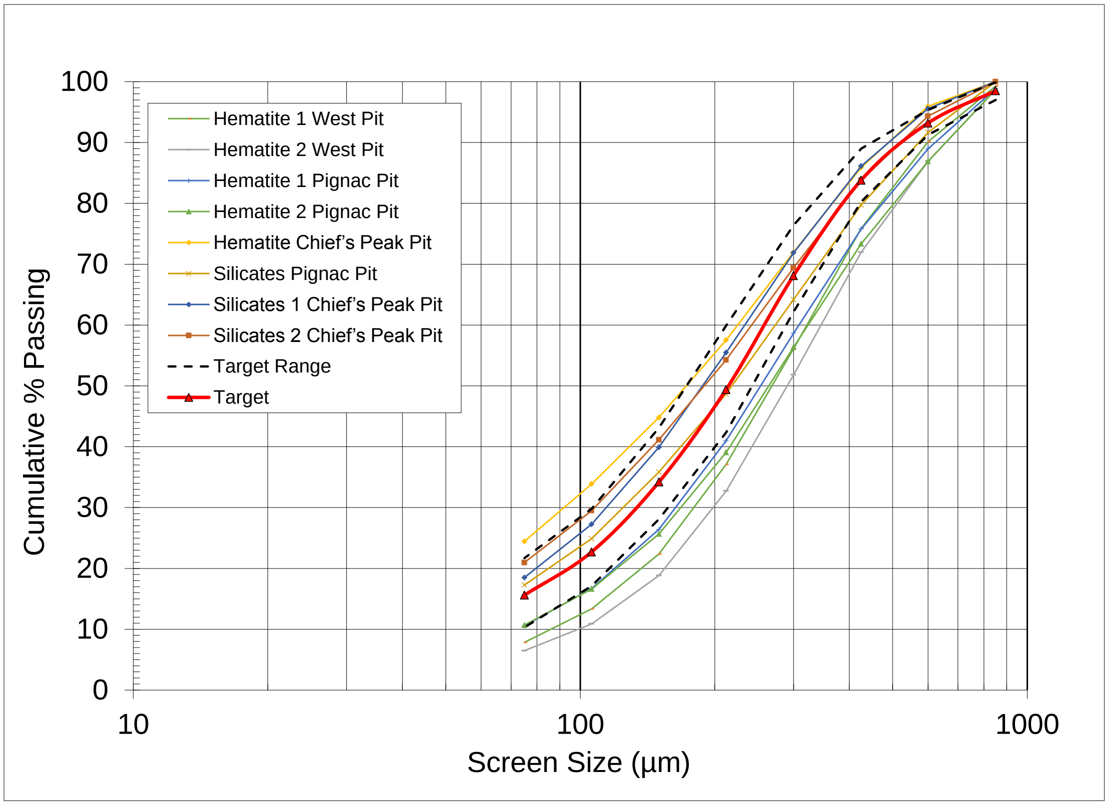

Figure 13-10: Variability samples particle size distributions

The samples P_{80} are between 362 µm and 523 µm, which is a coarser range than what is generally seen in the Phase 1 (QIO) concentrator (around 325 µm to 425 µm). Hematite samples from West pit and Pignac pit are the samples with the highest P_{80}. It is, however, considered normal to have a broader particle size distribution on the eight variability samples than what is observed in operation since operation PSD are measured on blended material.

Each of the eight variability samples was subjected to a complete mineralogical characterization (MLA), including a modal analysis (or a determination of mineral proportions) and a liberation analysis. An iron oxide particle is considered free if more than 95% of its content corresponds to valuable iron oxide minerals. The variability bulk samples modal analysis is shown in Table 13-12 and the variability bulk samples liberation analysis is shown in Table 13-13.

Table 13-12: Variability bulk sample modal analysis

Sample	Weight (%)				
	Hematite	Magnetite	Quartz	Iron hydroxides	Amphiboles
Hematite 1 West Pit	51.2	1.0	46.9	0.3	0.1
Hematite 2 West Pit	49.8	1.1	45.2	0.6	0.3
Hematite 1 Pignac Pit	41.9	2.2	50.2	1.4	0.2
Hematite 2 Pignac Pit	34.4	3.3	57.0	4.5	0.4
Hematite Chief's Peak Pit	49.4	7.8	34.1	0.7	4.5
Silicates Pignac Pit	19.1	10.7	36.4	0.3	24.2
Silicates 1 Chief's Peak Pit	39.5	9.3	31.5	0.1	15.8
Silicates 2 Chief's Peak Pit	6.0	33.1	42.3	0.2	7.4

Table 13-13: Variability bulk sample liberation analysis

Sample	+600 µm	-600+425 µm	-425 +300 µm	-300 +212 µm	-212 +106 µm	-106 µm	Total
Hematite 1 West Pit	89.5	88.7	88.1	93.2	96.7	98.1	92.8
Hematite 2 West Pit	93.8	94.5	93.3	95.4	97.4	97.9	95.3
Hematite 1 Pignac Pit	78.6	79.1	84.1	89.7	94.5	96.6	89.0
Hematite 2 Pignac Pit	48.3	55.3	67.8	75.6	86.3	91.3	73.9
Hematite Chief's Peak Pit	93.9	94.8	95.0	95.6	97.6	96.6	96.1
Silicates Pignac Pit	68.9	78.9	87.2	91.1	95.4	97.1	90.9
Silicates 1 Chief's Peak Pit	80.1	84.5	87.6	91.3	94.2	98.0	93.1
Silicates 2 Chief's Peak Pit	71.5	77.1	84.8	93.1	95.6	96.7	91.4

13.4.2.4.3 Heavy Liquid Tests

The eight variability samples were submitted to heavy liquid separation (HLS) and results were compared to Bloom Lake heavy liquid results database for the corresponding lithologies: iron formation (IF), mostly consisting of hematite, and silicate iron formation (SIF). The separation was performed at a density of 3.3 and the -75 µm fraction was removed, as for the historical HLS tests. The HLS database consists of testwork results from drill core samples taken throughout the deposit. A diamond drillhole map for the Bloom Lake project is presented in Figure 14-23.

The comparison of the sink iron grade and HLS iron recovery for the eight variability samples with the Bloom Lake HLS results database are presented in Figure 13-11 and Figure 13-12 respectively. The dots appearing above the distributions' bars represent the variability samples. Their colour matches the pit and lithology they represent. Their location on the X-axis indicates the sample Fe grade or Fe recovery, while their location on the Y-axis is arbitrary and was selected for clarity purposes.

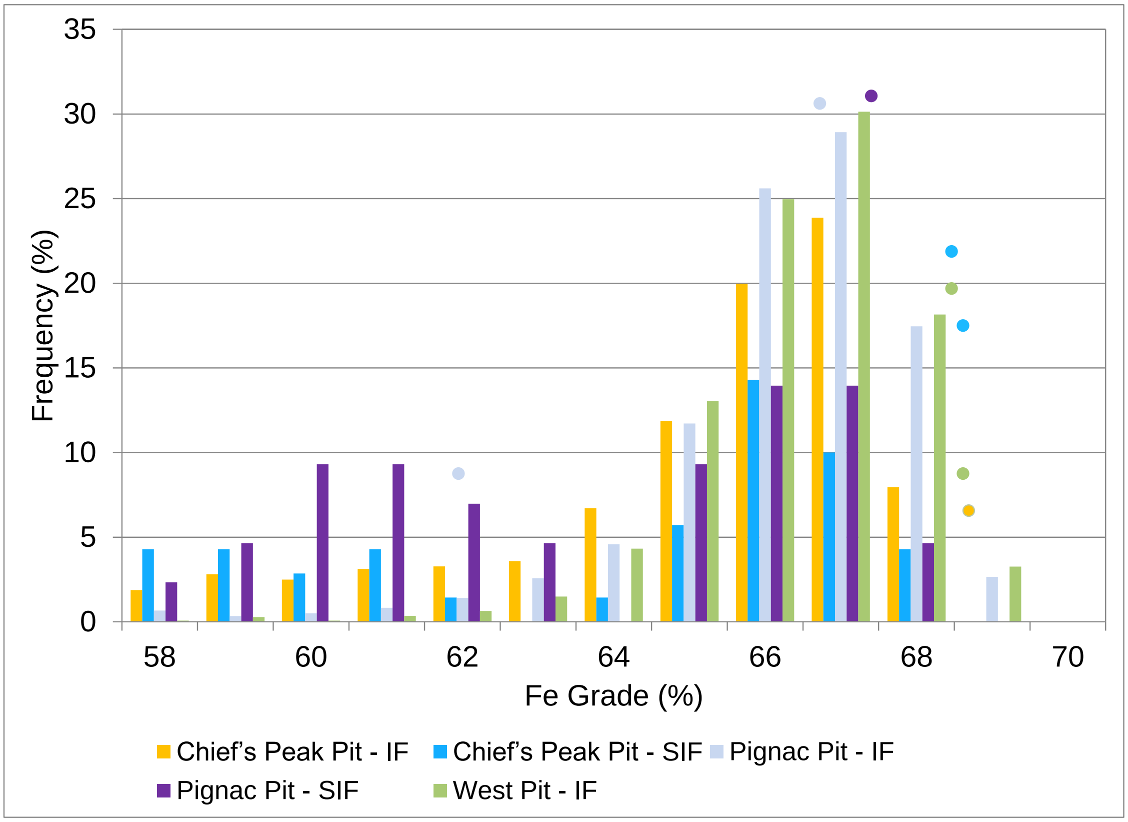

Figure 13-11: HLS sink iron grade comparison

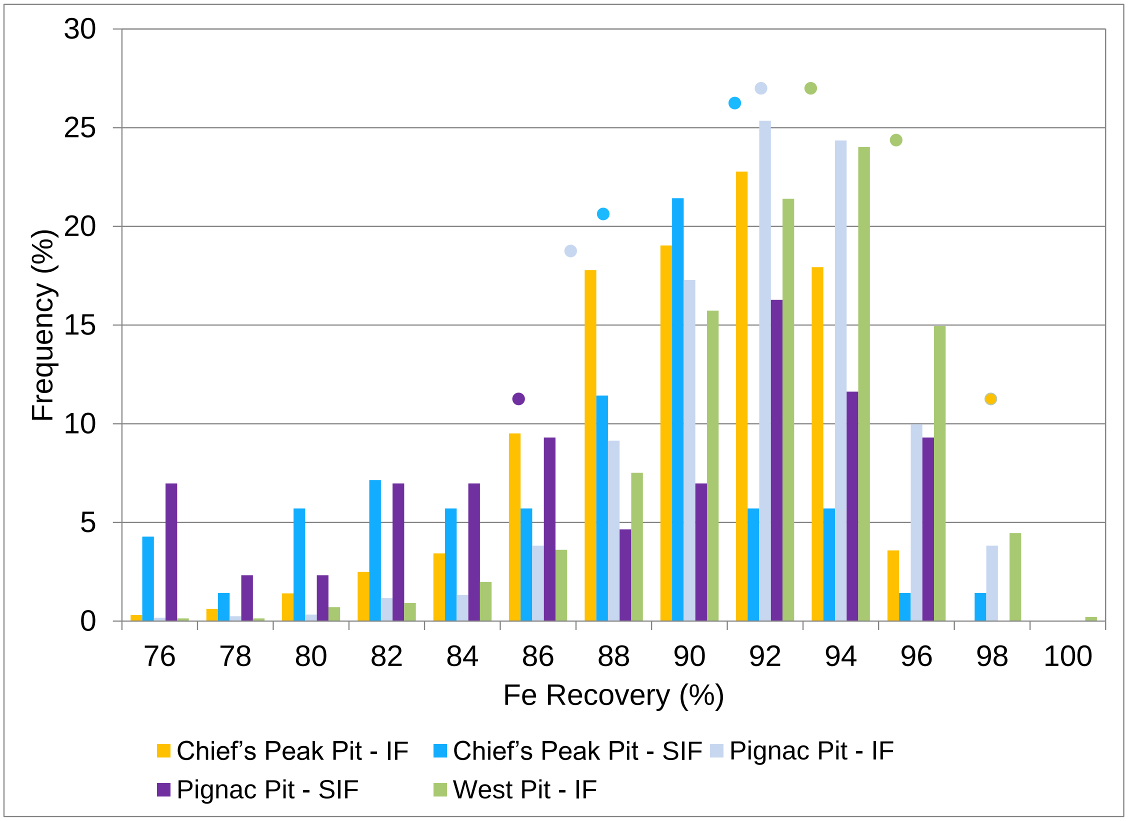

Figure 13-12: HLS iron recovery comparison

The variability samples HLS sink iron grades and recoveries are well distributed within the high frequency range of the historical HLS iron grades and recoveries. The iron grades of the variability samples are on the high side of the distribution. This can be explained by the coarser grind used for the historical HLS. Special care was taken with the variability sample to generate a size distribution close to the operation, which is significantly finer and can be assumed more liberated.

The eight variability samples can be considered representative of the Bloom Lake deposit.

13.4.2.4.4 Variability Blend Composition

The eight variability samples were combined into five ore blends based on operational experience and life of mine plan to assess the developed flowsheet performance robustness to ore type variations.

For the variability testing the five ore blends were combined, as indicated in Table 13-14 .

Table 13-14: Variability sample composition

<table>
<tr><th rowspan="2">Blend</th><th rowspan="2">Proportion %</th><th rowspan="2">Sample</th><th colspan="4">Assays</th></tr>
<tr><th>Fe %</th><th>SiO_2 %</th><th>MgO %</th><th>CaO %</th></tr>
<tr><td rowspan="2">1</td><td>50</td><td>Hematite 1 West Pit</td><td rowspan="2">34.6</td><td rowspan="2">46.6</td><td rowspan="2">1.6</td><td rowspan="2">1.4</td></tr>
<tr><td>50</td><td>Silicates 1 Chief's Peak Pit</td></tr>
<tr><td rowspan="2">2</td><td>60</td><td>Hematite 2 Pignac Pit</td><td rowspan="2">26.9</td><td rowspan="2">56.7</td><td rowspan="2">1.5</td><td rowspan="2">1.2</td></tr>
<tr><td>40</td><td>Silicates 2 Chief's Peak Pit</td></tr>
<tr><td rowspan="2">3</td><td>50</td><td>Hematite 1 West Pit</td><td rowspan="2">30.9</td><td rowspan="2">54.4</td><td rowspan="2">0.2</td><td rowspan="2">0.2</td></tr>
<tr><td>50</td><td>Hematite 1 Pignac Pit</td></tr>
<tr><td rowspan="3">4</td><td>40</td><td>Silicates 1 Chief's Peak Pit</td><td rowspan="3">32.6</td><td rowspan="3">47.4</td><td rowspan="3">2.1</td><td rowspan="3">1.7</td></tr>
<tr><td>30</td><td>Hematite Chief's Peak Pit</td></tr>
<tr><td>30</td><td>Hematite 1 Pignac Pit</td></tr>
<tr><td rowspan="3">5</td><td>50</td><td>Silicates Pignac Pit</td><td rowspan="3">27.7</td><td rowspan="3">51.1</td><td rowspan="3">3.5</td><td rowspan="3">2.7</td></tr>
<tr><td>20</td><td>Hematite Chief's Peak Pit</td></tr>
<tr><td>30</td><td>Hematite 2 West Pit</td></tr>
</table>

13.4.3 Assay QC/QA

Data reconciliation was performed on all the testwork results using Bilmat software. Step by step testwork reconciliation was performed by prioritizing chemical analysis, particle size distributions, chemical analysis per size and percent solids respectively. Variability testwork reconciliation was performed on chemical analysis only.

Throughout the testwork program, chemical analysis of the samples was conducted using the X-Ray fluorescence method (XRF) at COREM. To ensure the quality of the assays, the variability testwork samples iron was also analyzed by potassium dichromate titration. COREM lab is ISO/CEI 17025 certified and that certification covers both XRF and titration analysis methods. Both methods gave identical results within the methods precision level. The results are presented in Figure 13-13.

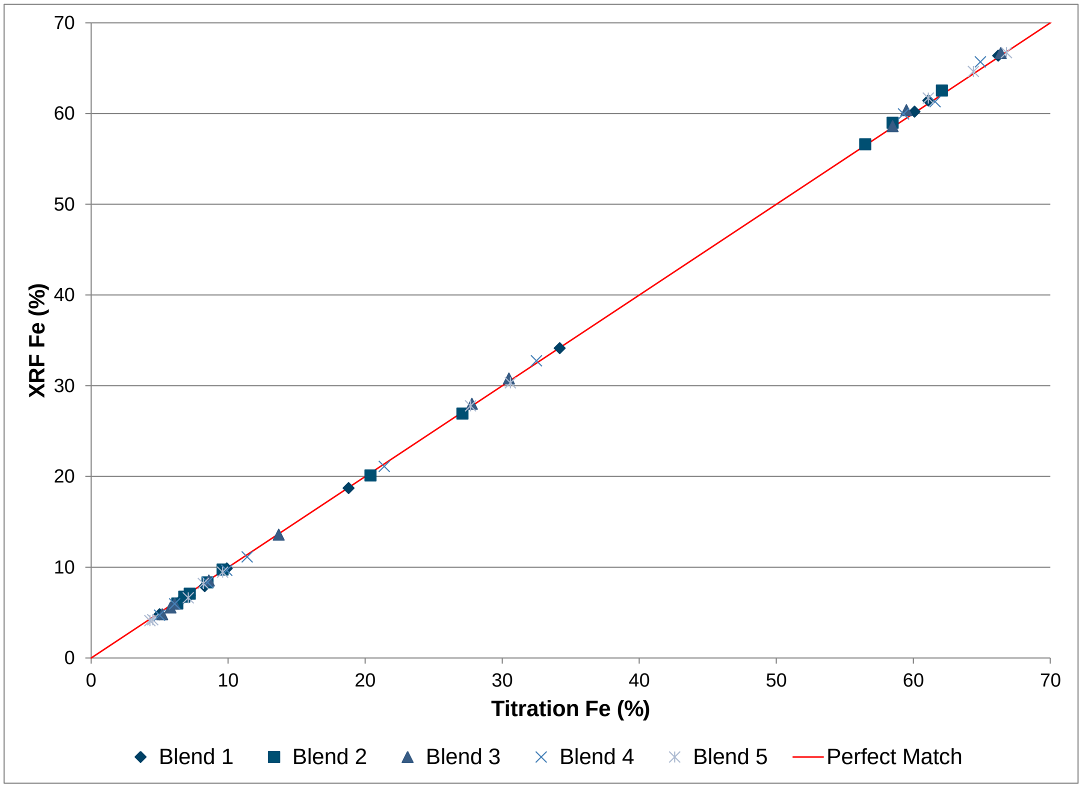

Figure 13-13: Iron assay method comparison

13.4.4 Step by Step Testwork

13.4.4.1 Data Processing

Given the nature of the spiral testwork setup, it was necessary to normalize weight and iron recoveries at the measured fresh feed assay in order to be able to compare the closed loop tests and open circuit production. The weight recovery to the iron concentrate and the iron recovery are calculated based on the same feed grade for all the spiral tests at each stage. The equations used for normalization are as follows, with the feed grade being the analyzed head sample and not the recalculated one:

$$Weight\ Recovery = \frac{Fe\ Grade_{Feed} - Fe\ Grade_{Tails}}{Fe\ Grade_{Concentrate} - Fe\ Grade_{Tails}}$$

$$Iron\ Recovery = Weight\ Recovery \times \frac{Fe\ Grade_{Concentrate}}{Fe\ Grade_{Feed}}$$

The test results from all the tests were reconciled using the Bilmat software.

13.4.4.2 Rougher Testwork

20 optimization tests were done. The solids tonnage per spiral start was varied from 1.8 tph to 3.0 tph. The wash water and % solids parameters were held at 1.1 tph (same as Phase 1 (QIO) concentrator) and 40% respectively. Two (2) concentrate port opening patterns were tested and the better one was chosen for the following tests.

The production tests involved running the test with all the available material while using the optimized conditions as found in the optimization tests.

The production test was performed at 2.1 tph at 40% solids. The Rougher concentrate generated was used in the UCC Cleaner tests and the Rougher middlings generated were used in the mids spirals testwork.

The Rougher optimization and production test results are presented in Table 13-15. The iron recovery versus solids feed rate is presented in Figure 13-14. The iron recovery versus the concentrate iron grade is presented in Figure 13-15.

Table 13-15: Rougher testwork results summary

	Feed		Concentrate			Middlings			Tails		
	Flowrate	Assays	Assays	Recovery		Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
RGH 1	3.00	31.8	55.8	88.9	50.8	6.4	3.4	16.9	7.6	7.7	32.3
RGH 2	3.00	31.8	59.1	88.8	47.9	7.4	6.0	25.9	6.2	5.1	26.2
RGH 11	3.01	31.8	54.4	90.9	53.2	6.5	5.1	24.9	5.8	4.0	21.9
RGH 16	2.94	31.8	56.8	90.4	50.7	5.4	4.2	24.7	7.0	5.4	24.6
RGH 3	2.70	31.8	55.5	91.6	52.6	5.8	3.3	18.3	5.5	5.1	29.1
RGH 4	2.70	31.8	55.4	91.7	52.7	5.3	4.5	26.6	5.9	3.8	20.7
RGH 12	2.70	31.8	55.4	91.9	52.8	5.6	4.8	27.0	5.2	3.3	20.2
RGH 17	2.70	31.8	57.0	90.8	50.8	5.5	4.5	26.1	6.4	4.7	23.2
RGH 5	2.40	31.8	54.7	92.2	53.7	5.1	4.8	29.6	5.7	3.0	16.6
RGH 6	2.40	31.8	56.6	91.3	51.3	5.5	5.4	31.3	6.0	3.3	17.3
RGH 13	2.40	31.8	55.5	91.4	52.5	5.7	4.7	26.2	5.7	3.8	21.3
RGH 18	2.42	31.8	57.3	90.9	50.5	5.4	5.3	30.9	6.6	3.9	18.6
RGH 7	2.10	31.8	57.0	91.5	51.1	5.4	5.5	32.4	5.8	3.0	16.5
RGH 8	2.10	31.8	57.4	91.0	50.5	6.1	6.2	32.3	5.2	2.8	17.2
RGH 14	2.10	31.8	55.6	91.6	52.5	5.7	5.0	27.9	5.6	3.5	19.6
RGH 19	2.10	31.8	56.0	91.7	52.1	5.1	4.9	30.8	6.3	3.4	17.1
RGH 9	1.80	31.8	56.2	91.4	51.8	5.9	6.0	31.9	5.1	2.6	16.3
RGH 10	1.80	31.8	55.3	91.4	52.6	6.2	6.4	32.9	4.8	2.2	14.4
RGH 15	1.83	31.8	55.2	92.0	53.1	5.5	5.2	30.5	5.3	2.7	16.5
RGH 20	1.80	31.8	55.8	92.1	52.5	4.8	5.2	34.7	6.8	2.7	12.7
RGH Prod.	2.10	31.8	55.3	87.2	50.2	6.6	6.0	28.8	10.4	6.9	21.0

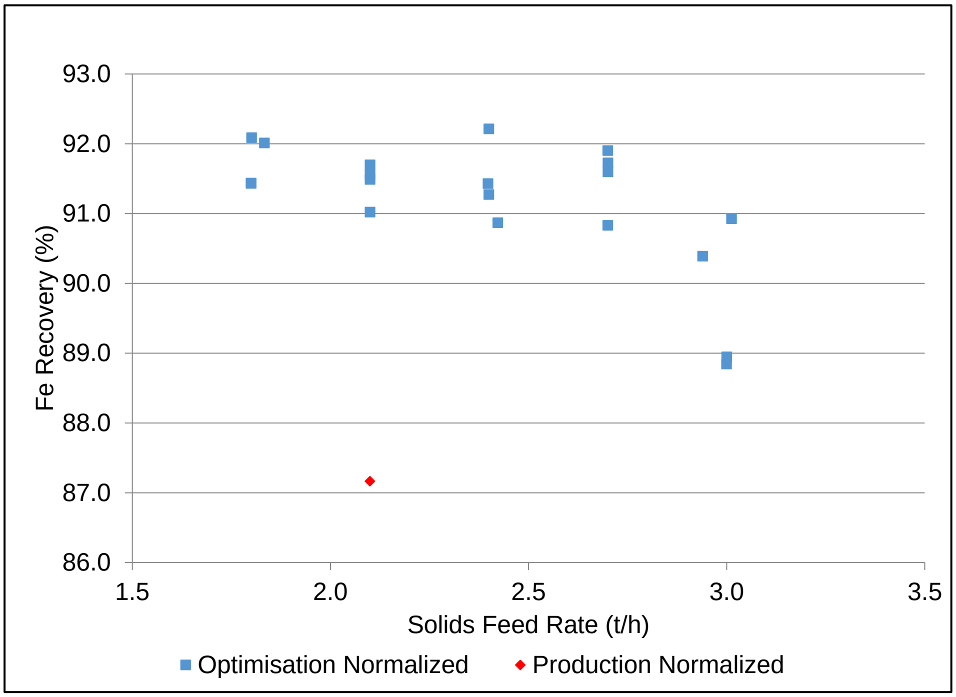

Figure 13-14: Rougher testwork – Iron recovery vs. solids feed rate

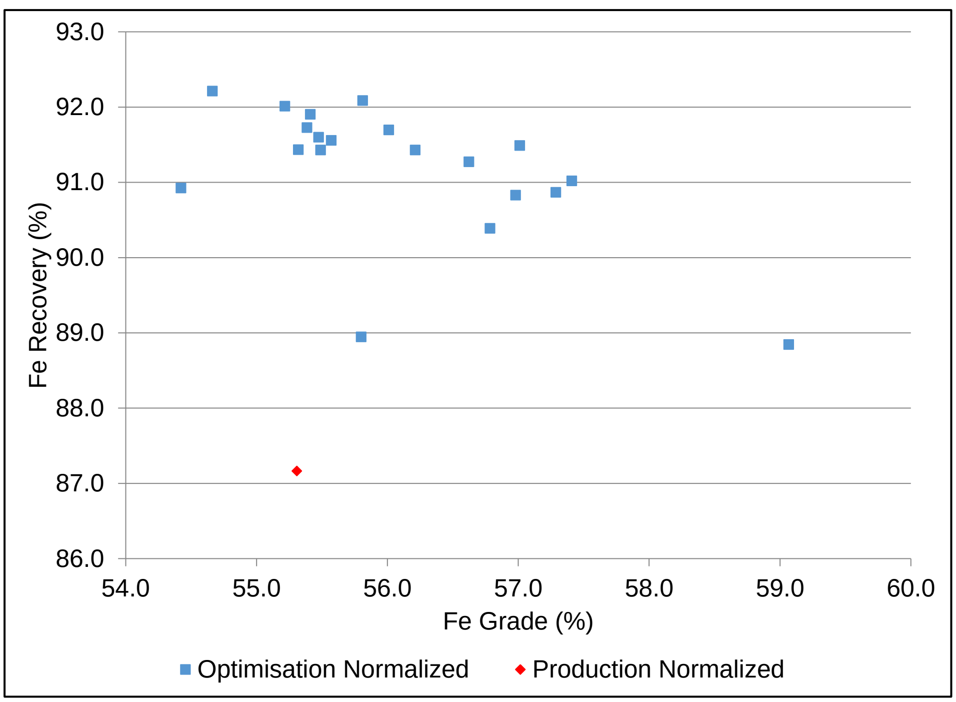

Figure 13-15: Rougher testwork – Recovery vs. iron grade curve

The main conclusions of these tests are:

- There is a significant decrease in the spirals iron recovery at 3.0 tph. Below this tonnage, the iron recovery is stable;
- The final concentrate iron grades are not significantly different from one another (majority from 55 to 57.5%);
- The middlings iron grade is very low;
- The rougher performance is very high, at mostly above 90% iron recovery.

The production test was significantly less efficient than the optimization tests, but coherent with plant performance. This difference in performance is caused by the closed loop set up used at COREM for the optimization tests versus no recirculation for the production tests, even though the results were normalized.

13.4.4.3 Mids Testwork

Four mids tests were performed with spirals. The feed for the mids testwork originated from the rougher production tests. The solids tonnage per spiral start was varied from 1.5 tph to 3.0 tph. The wash water and % solids parameters were held at 1.1 tph and 40% respectively.

The production tests involved running the test with all the available material while using the optimized conditions as found in the optimization tests.

The results led to one production test at 2.3 tph at 40% solids. The mids spiral concentrate generated was used in the LIMS/WHIMS tests.

The mids optimization and production test results are presented in Table 13-16. The solids feed rate versus the iron recovery is presented in Figure 13-16. The solids feed rate versus the iron grade is presented in Figure 13-17. The recovery curve versus concentrate grade is presented in Figure 13-18.

Table 13-16: Mids testwork results summary

	Feed		Concentrate			Tails		
	Flowrate	Assays	Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
MIDS 1	2.94	6.60	41.27	21.12	3.37	5.38	78.88	96.63
MIDS 2	2.35	6.60	33.59	25.17	4.94	5.19	74.83	95.06
MIDS 3	1.76	6.60	24.86	27.58	7.32	5.15	72.42	92.68
MIDS 4	1.52	6.60	23.78	27.90	7.74	5.15	72.10	92.26
MIDS Prod.	2.34	6.60	23.56	37.08	10.38	4.63	62.92	89.62

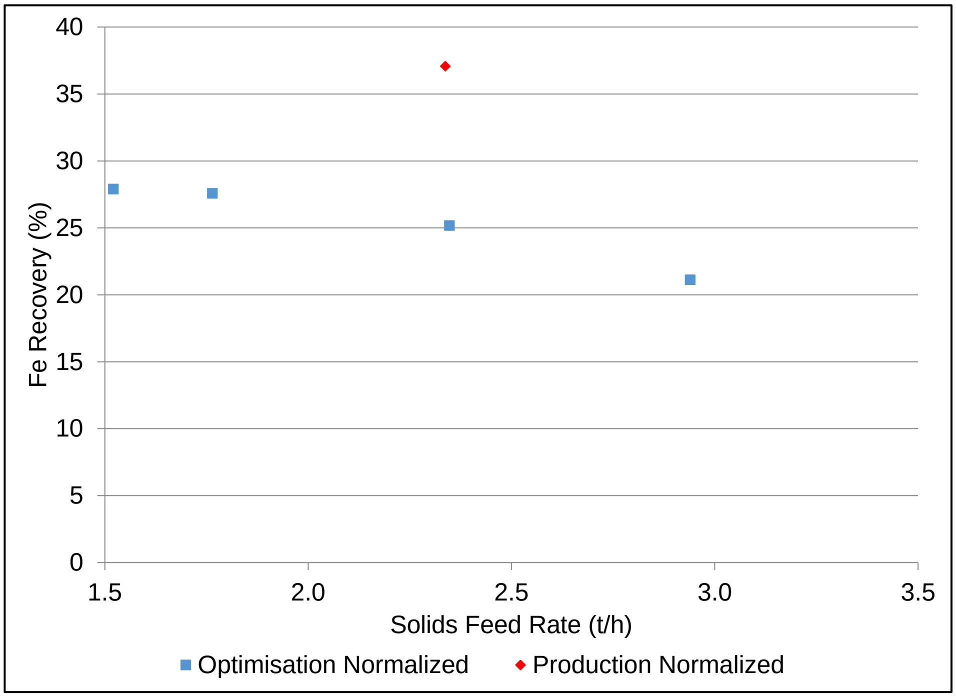

Figure 13-16: Mids testwork – Iron recovery vs. solids feed rate

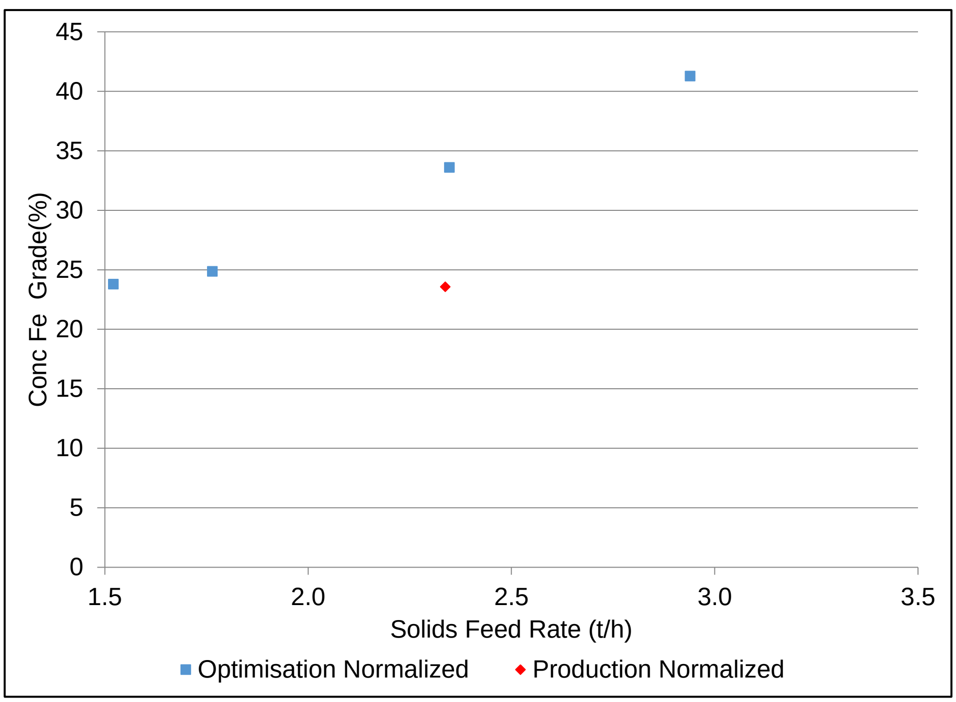

Figure 13-17: Mids testwork – Concentrate iron grade vs. solids feed rate

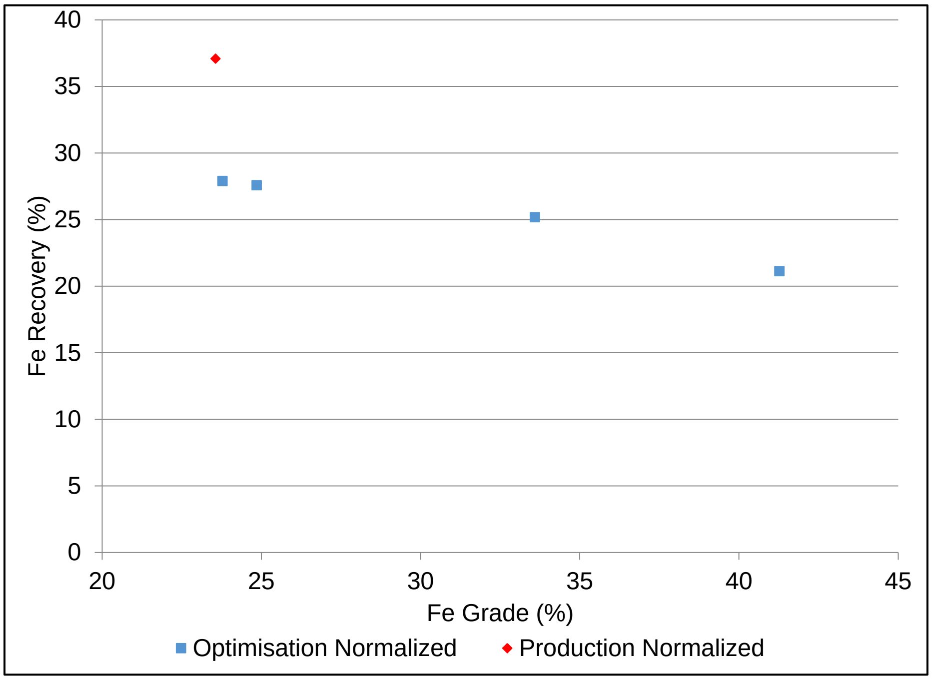

Figure 13-18: Mids testwork – Recovery vs. iron grade curve

The main conclusions derived from these tests are:

- The head grade was very low for the testwork which led to low recoveries and grade;
- The iron recovery decreases as the tonnage increases;
- The concentrate iron grade increases as feed tonnage increase.

The results of the production test show:

- This test performed significantly better than the optimization testwork which could be explained by the smaller concentrate quantity generated, relative to the mids and tails, compared to what is generated at the rougher stage. The bias between the closed loop tests and open circuit production is therefore less important;
- This test performance is close to the performance observed in the Phase 1 (QIO) concentrator.

13.4.4.4 Cleaner UCC Testwork

Two Cleaner UCC tests were performed on the rougher spiral concentrate. These tests were performed using only the splitters concentrate (C1) from the rougher therefore at a higher feed grade than what it would be in operation. The wash water addition rates tested were 0.50 and 0.65 m^3/t feed. The feed rate was held at 1.2 tph. No production tests were required for this stage.

In contrast to the Phase 1 operation, the mids concentrate was not mixed with the rougher concentrate to feed the cleaner stage. This modification was made based on the mids testwork and sampling campaign results showing that the mids concentrate represents a very low iron tonnage, has a very low iron grade and can potentially present coarse silica if not operated adequately To avoid potentially contaminating the cleaner stage with coarse silica, the mids concentrate was tested in a magnetic circuit.

The Cleaner UCC optimization test results are presented in Table 13-17. The concentrate iron recovery versus the rise rate is presented in Figure 13-19.

Table 13-17: Cleaner UCC testwork results summary

	Feed			Underflow			Overflow		
	Solids	Rise	Assays	Assays	Recovery		Assays	Recovery	
Test	Loading (tph/m^2)	Rate (cm/sec)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
Cleaner 1	29.1	1.4	60.1	68.2	73.3	64.6	45.3	26.7	35.4
Cleaner 2	29.1	1.2	60.1	68.1	81.8	72.2	39.5	18.2	27.8

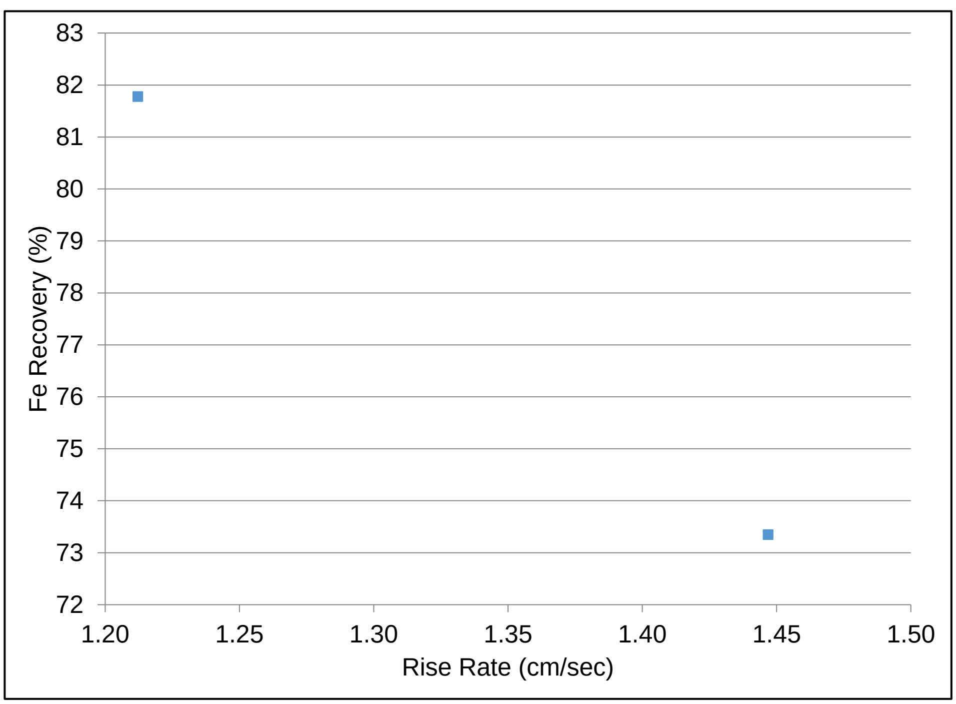

Figure 13-19: Cleaner UCC iron recovery vs. rise rate

The main conclusions derived from these tests are:

- The cleaner UCC stage produces a concentrate at the desired grade with a stage Fe recovery of around 80%;
- The testing was conducted at a low loading due to the limitation in feed availability and the available equipment size;
- The feed density was more or less controlled, because water was added to provide adequate pumping conditions;
- The iron recovery follows the rise rate for same solids loading.

13.4.4.5 Scavenger Spirals Testwork

Twenty (20) scavenger tests were performed with spirals. The solids tonnage per spiral start was varied from 0.8 tph to 1.8 tph. The wash water addition rate varied from 1.1 to 2.0 tph. The % solids varied from 20 to 40% solids.

The production test involved running the test with all the available material while using the optimized conditions as found in the optimization tests.

One production test was performed at 1.1 tph and 28% solids. The scavenger spiral concentrate generated was used in the scavenger cleaner tests.

The scavenger spiral optimization and production test results are presented in Table 13-18. The concentrate iron grade versus the iron recovery is shown in Figure 13-20 and the concentrate iron grade versus the solids feed tonnage is shown in Figure 13-21

Table 13-18: Scavenger spiral testwork results summary

	Feed	Concentrate			Middlings			Tails		
	Flowrate	Assays	Recovery		Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
SCV 1	1.49	52.8	93.7	65.4	6.1	2.2	13.4	7.1	4.1	21.3
SCV 2	1.49	54.0	93.1	63.5	6.3	2.2	12.9	7.3	4.7	23.6
SCV 3	1.46	56.8	92.6	60.0	6.5	2.5	14.4	7.0	4.8	25.6
SCV 4	1.45	58.3	91.6	57.8	7.1	2.8	14.5	7.5	5.6	27.7
SCV 5	1.45	55.4	92.7	61.6	6.1	2.4	14.7	7.6	4.9	23.7
SCV 6	1.79	59.5	89.0	55.0	6.8	3.3	18.0	10.5	7.7	26.9
SCV 7	1.53	58.9	91.3	57.1	6.5	3.4	19.3	8.2	5.3	23.5
SCV 8	1.35	58.7	92.4	58.0	6.1	3.4	20.5	7.2	4.2	21.6
SCV 9	1.14	60.0	92.7	56.9	5.9	3.9	24.5	6.6	3.4	18.7
SCV 10	0.84	61.0	92.3	55.8	7.4	4.7	23.5	5.2	2.9	20.8
SCV 11	1.17	60.3	89.7	54.7	7.6	4.0	19.4	9.0	6.3	25.8
SCV 12	1.21	59.7	90.3	55.6	6.8	3.6	19.4	9.1	6.2	25.0
SCV 13	1.16	58.4	91.4	57.6	7.2	2.8	14.1	7.5	5.8	28.3
SCV 14	1.19	58.7	91.6	57.4	7.6	3.3	16.1	7.1	5.1	26.5
SCV 15	1.22	56.3	92.2	60.3	7.6	2.5	11.9	7.1	5.3	27.8
SCV 16	1.43	51.2	93.5	67.2	5.7	1.9	12.4	8.3	4.6	20.5
SCV 17	1.41	56.4	91.9	60.0	7.2	2.7	14.0	7.6	5.4	26.1
SCV 18	1.38	57.8	91.9	58.5	8.3	2.7	11.9	6.8	5.4	29.6
SCV 19	1.52	58.2	90.8	57.4	10.4	2.9	10.1	7.2	6.3	32.4
SCV Prod.	1.10	57.3	93.0	59.8	6.0	2.3	14.4	6.6	4.7	25.9

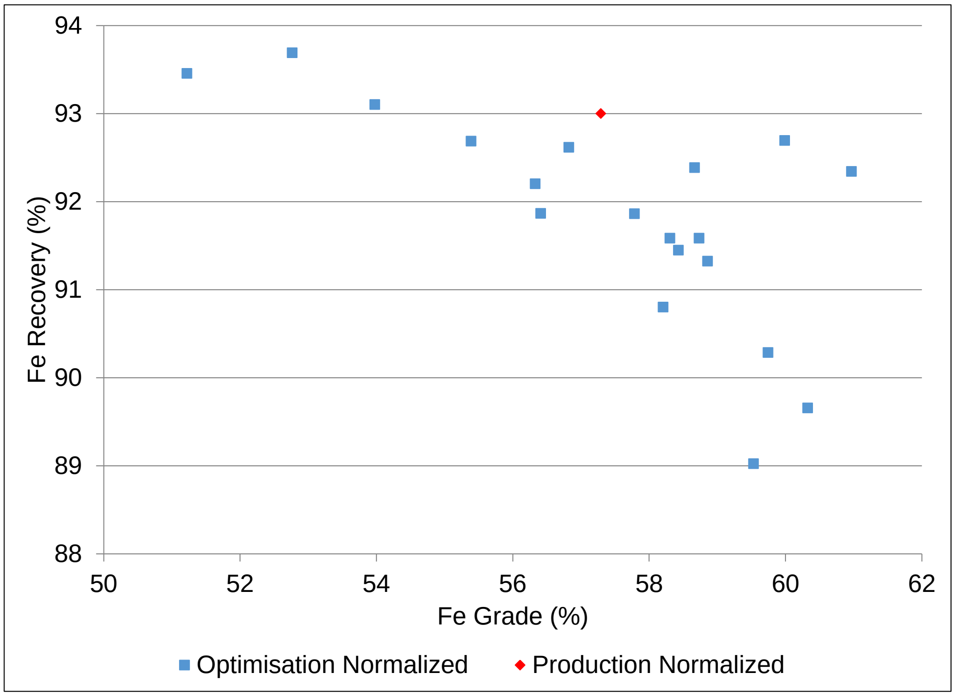

Figure 13-20: Scavenger spirals iron recovery vs. iron grade

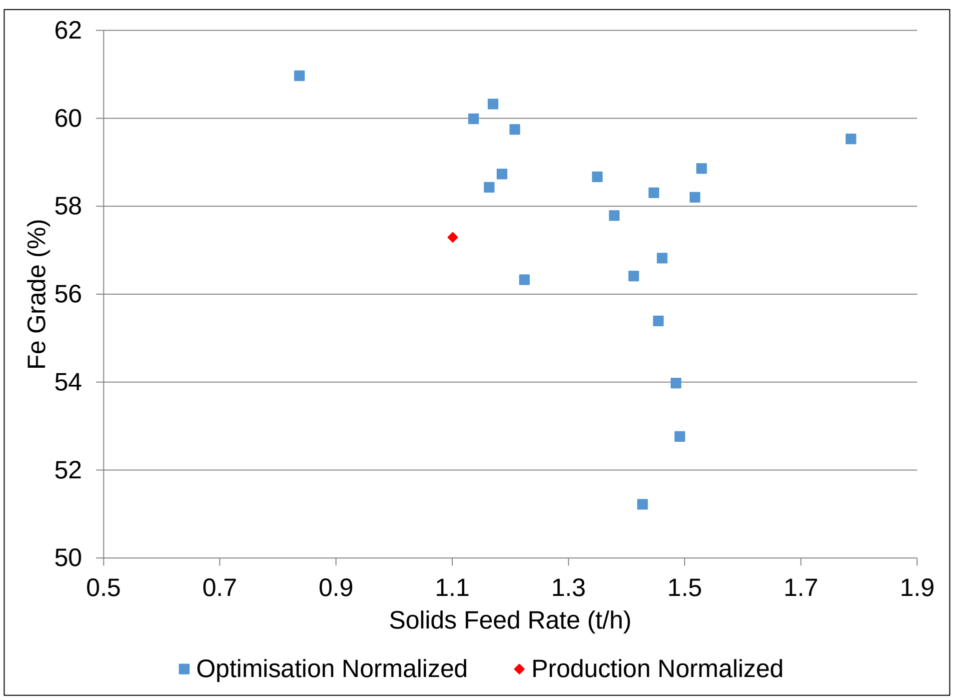

Figure 13-21: Scavenger spirals iron grade vs. feed tonnage

The production test was slightly above the recovery versus grade curve of the optimization tests. As opposed to the rougher spiral testwork, the production test result is very similar to the optimization test results. The coarse iron present at the rougher stage tends to collect more rapidly in the spirals' splitters and sinks faster to the bottom of the pump box compared to the fine iron present at the scavenger stage. In optimization tests, the fine iron at the scavenger stage had a longer retention time in the spiral and pump box compared to the rougher stage thus reducing the bias observed in closed loop spiral tests.

The main conclusions derived from these tests are:

- There were large differences in Fe recoveries between the tests in laboratory and the sampling campaigns, irrespective of the loadings;
- The tests were not able to produce a concentrate above 60% Fe with the C1+C2 concentrates, and not above 63% Fe with the C1 concentrate only. It, therefore, does not meet the final concentrate grade target;
- The testwork on the feed rate has shown an improvement of the performance with a lower feed rate;
- The testwork has shown an improvement of performance at higher feed densities;
- The production of a high iron grade scavenger concentrate results in high losses in recovery and confirms the need for a scavenger-cleaner stage.

13.4.4.6 Scavenger Cleaner Testwork

As observed in the sampling campaigns, the scavenger stage could not achieve a final concentrate iron grade in one stage. Therefore, a scavenger cleaner stage was tested. Three different technologies were tested to see which one produced the best results. The technologies tested were:

- Spirals;
- Reflux Classifier™;
- Up-Current Classifier (UCC).

The following three sections elaborate on the testing conducted for each technology.

13.4.4.6.1 Scavenger Cleaner - Spirals Testwork

Twelve (12) Scavenger Cleaner tests were performed with spirals. The solids tonnage per spiral start was varied from 0.86 tph to 1.80 tph. The % solids varied from 30 to 45% solids. The wash water flowrate varied from 1.1 tph to 1.56 tph.

The scavenger cleaner spiral optimization test results are presented in Table 13-19.

Table 13-19: Scavenger cleaner spirals testwork results summary

	Feed		Concentrate			Tails		
	Flowrate	Assays	Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
Spiral Scav 1	1.76	57.07	63.75	93.97	84.13	21.68	6.03	15.87
Spiral Scav 2	1.48	57.07	64.24	95.20	84.57	17.77	4.80	15.43
Spiral Scav 3	1.10	57.07	64.16	96.01	85.40	15.61	3.99	14.60
Spiral Scav 4	0.86	57.07	63.76	98.05	87.77	9.08	1.95	12.23
Spiral Scav 5	1.34	57.07	64.00	97.13	86.62	12.24	2.87	13.38
Spiral Scav 6	1.40	57.07	64.21	96.55	85.82	13.88	3.45	14.18
Spiral Scav 7	1.42	57.07	63.69	96.36	86.35	15.23	3.64	13.65
Spiral Scav 8	1.32	57.07	64.40	96.45	85.47	13.95	3.55	14.53
Spiral Scav 9	1.38	57.07	63.27	97.14	87.62	13.20	2.86	12.38
Spiral Scav 10	1.33	57.07	63.64	96.93	86.92	13.38	3.07	13.08
Spiral Scav 11	1.80	57.07	63.64	94.75	84.96	19.93	5.25	15.04
Spiral Scav 12	1.45	57.07	62.62	95.91	87.41	18.55	4.09	12.59

The concentrate iron recovery versus solids feed rate is presented in Figure 13-22 and the concentrate iron recovery versus iron grade is presented in Figure 13-23.

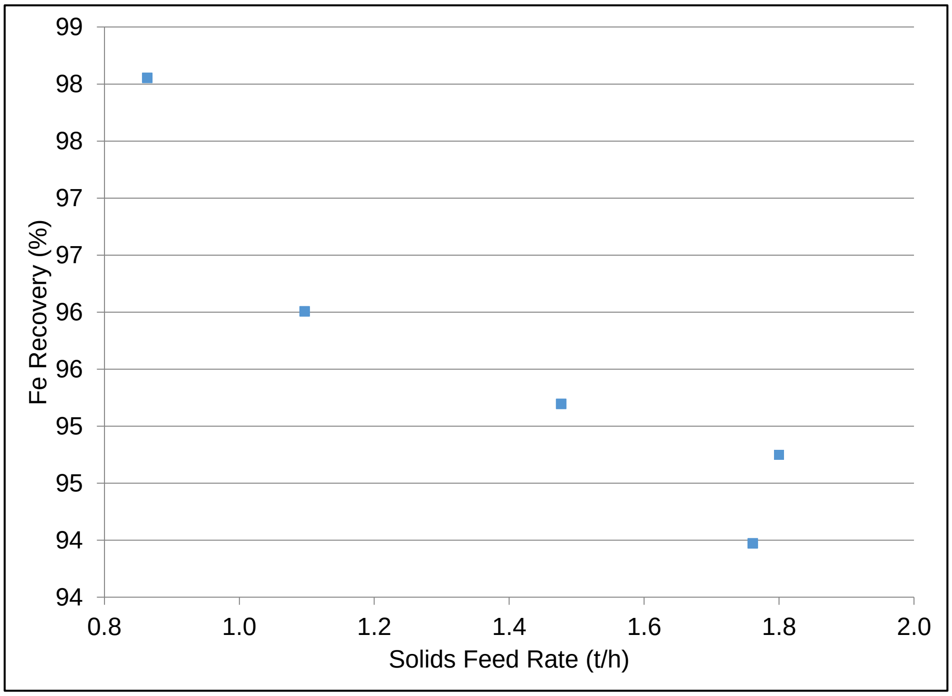

Figure 13-22: Scavenger cleaner spirals, iron recovery vs. solids feed rate

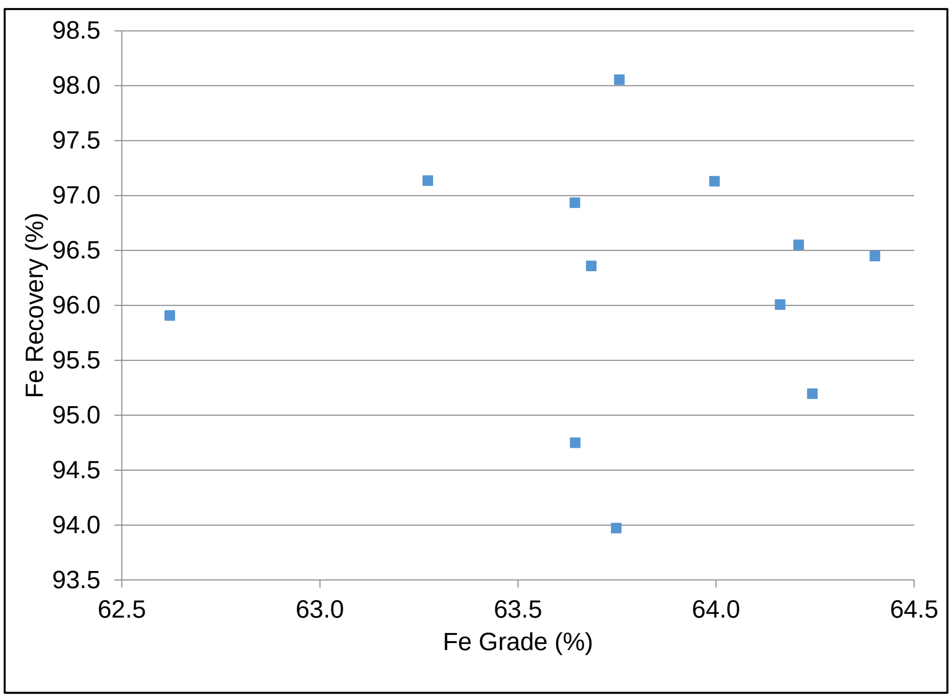

Figure 13-23: Scavenger cleaner spirals, iron recovery vs. iron grade

The main conclusions derived from these tests are:

- The iron recoveries obtained with the scavenger spirals stage are very high;
- It was not possible to produce a concentrate at the final grade, although producing a grade as high as possible was attempted. As a result, no production test was performed using this equipment;
- Rougher, mids and scavenger spirals have performed significantly better in closed-loop testwork than what is observed in the plant (5 to 10% less iron recovery). As a result, lower recoveries could be expected in operation compared to the presented results;

13.4.4.6.2 Scavenger Cleaner - Reflux Testwork

Five reflux scavenger cleaner tests were performed on the scavenger spiral concentrate. The wash water addition rates tested ranged from 1.0 to 4.0 L/min. The feed rate was held at 0.09 tph.

The results of the reflux scavenger cleaner testwork are presented in Table 13-20. The reflux scavenger concentrate iron recovery versus wash water is shown in Figure 13-24.

Table 13-20: Reflux scavenger testwork results summary

	Feed		Underflow			Overflow		
	Flowrate	Assays	Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
Reflux Scav 1	0.09	57.07	69.04	76.31	63.09	36.62	23.69	36.91
Reflux Scav 2	0.09	57.07	69.34	83.80	68.97	29.80	16.20	31.03
Reflux Scav 3	0.09	57.07	69.07	90.52	74.79	21.47	9.48	25.21
Reflux Scav 4	0.09	57.07	68.39	83.96	70.07	30.58	16.04	29.93
Reflux Scav 5	0.09	57.07	68.95	33.79	27.96	52.46	66.21	72.04

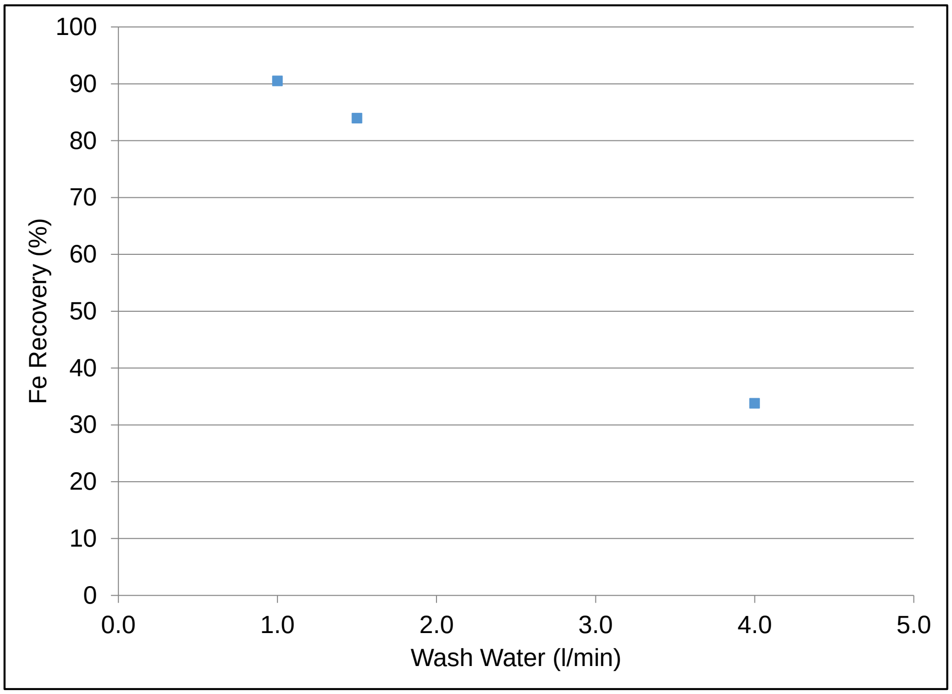

Figure 13-24: Reflux scavenger iron recovery vs. wash water flowrate

The main conclusions derived from these tests are:

- The reflux classifier testing led to an extremely high concentrate grade with high recoveries;
- Additional time and more sample material would have been required to perform extensive testwork;
- Operational experience with the reflux classifier is limited in iron ore processing. However, the achieved concentrate grade and high recoveries confirm the equipment potential to recover fine iron when compared to UCC;
- Extensive piloting would be required to introduce this technology in the flowsheet.

Although the tests showed very good results, no production tests were performed using this equipment due to the high level of uncertainty surrounding this equipment at this stage.

13.4.4.6.3 Scavenger Cleaner - UCC Testwork

Four UCC scavenger cleaner tests were performed on the scavenger spiral concentrate. The wash water addition rates tested ranged from 3 to 10 L/min. The feed rate ranged from 0.70 tph to 0.80 tph.

The laboratory scale UCC requires a high amount of material for testwork:

- To achieve a minimum loading, more than 0.7 tph must be fed to the equipment;
- The underflow compaction zone held a significant amount of material, thus:
  - Each test conditions must be held for a minimum of time for the compaction zone to be in steady state;
  - Operation in close loop is not a way to reduce the amount of required material since a very large pump box and sample weight would be needed to palliate the different residence time of the underflow and overflow.

Consequently, a limited amount of optimization tests were performed.

One production test was performed with the UCC. The overflow generated was tested in the LIMS and WHIMS. The wash water addition was set at 4 L/min and the feed rate was set at 0.8 tph.

A summary of the UCC scavenger cleaner is shown in Table 13-21. The concentrate iron recovery versus iron grade is shown in Figure 13-25. The size-by-size weight, iron and silica recovery to the scavenger-cleaner UCC underflow is shown in Figure 13-26.

Table 13-21: UCC scavenger testwork results summary

	Feed		Underflow			Overflow		
	Flowrate	Assays	Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
UCC Scav 1	0.80	57.07	68.78	84.14	69.82	29.99	15.86	30.18
UCC Scav 2	0.80	57.07	68.81	43.01	35.68	50.56	56.99	64.32
UCC Scav 3	0.70	57.07	68.60	80.89	67.30	33.35	19.11	32.70
UCC Scav 4	0.70	57.07	68.70	71.25	59.19	40.21	28.75	40.81
UCC Scav Prod.	0.80	57.07	68.61	74.08	61.63	38.55	25.92	38.37

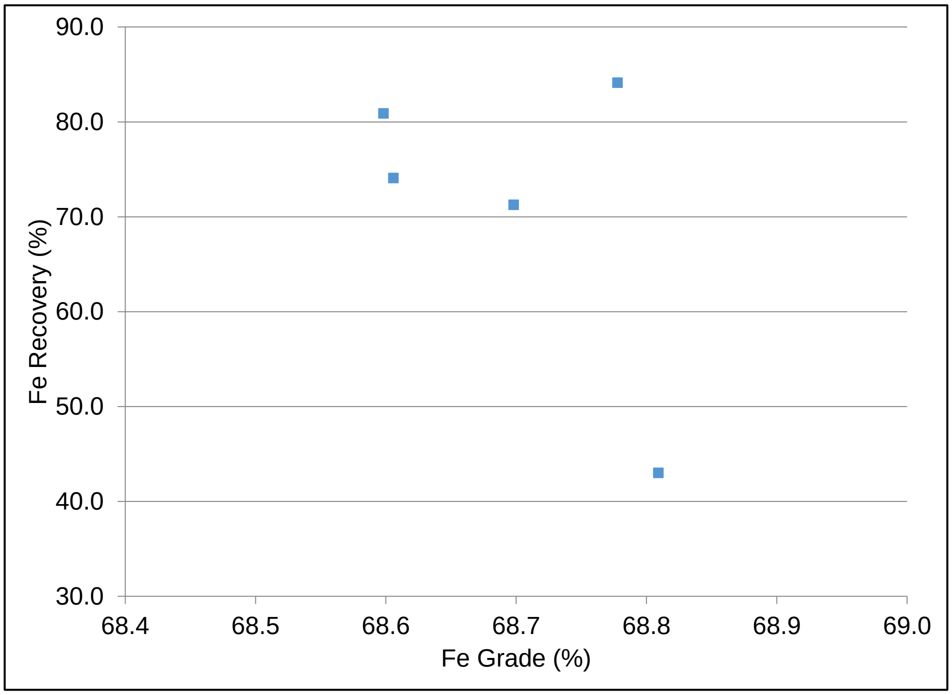

Figure 13-25: UCC scavenger-cleaner iron recovery vs. iron grade

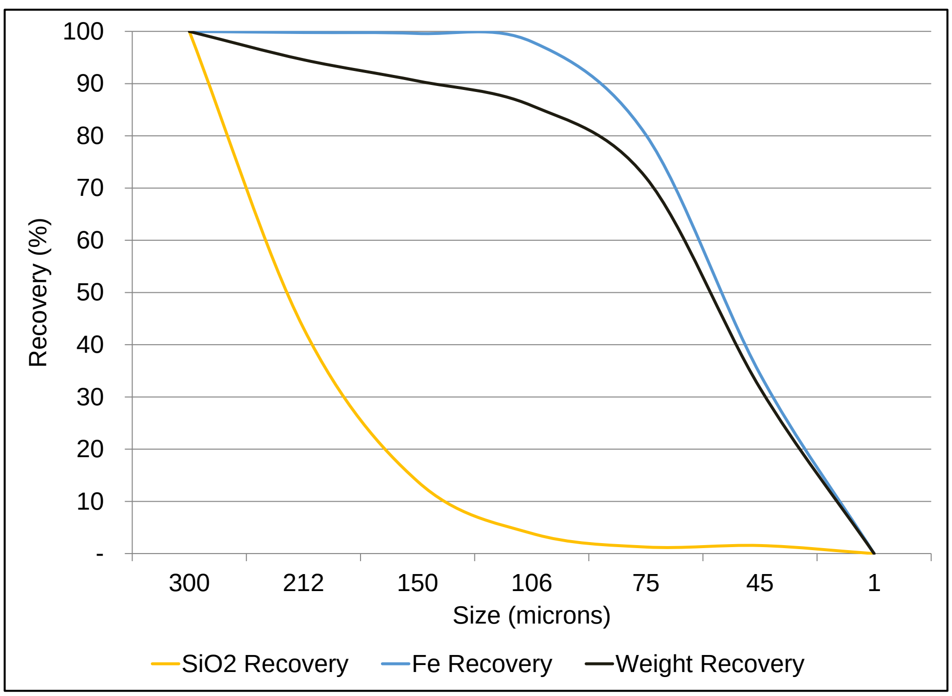

Figure 13-26: Size-by-size recovery to scavenger-cleaner UCC underflow

The main conclusions derived from these tests are:

- The Up-Current Classifier allowed the production of a very high grade concentrate;
- The recoveries obtained are considered satisfying:
  - All tests led to concentrate above 68.5% Fe grade for Fe recoveries as high as 85%;
  - The results present a potential for higher recoveries at lower Fe concentrate grade, which were not tested due to limited sample.
- The Up-Current Classifier allowed the removal of fine silica more efficiently than spirals;
- The use of an Up-Current Classifier for the cleaning of a spiral concentrate does not present a risk as its performance has been demonstrated in operation.

13.4.4.7 LIMS and WHIMS Testwork

A series of LIMS and WHIMS test was performed in lab scale equipment on mids concentrate and on scavenger cleaner UCC overflow separately, as well as on a feed composed of 40% mids concentrate and 60% scavenger cleaner UCC overflow. The aim of those tests was to compare the performance of each feed. The ratio used was deemed representative of what will feed the magnetic circuit in the Phase 2 (QIO) concentrator.

The LIMS and WHIMS optimization testwork was performed on the scavenger cleaner UCC overflow only. The non-magnetic tails of the LIMS was used as WHIMS feed. Four optimization tests were performed in which the WHIMS magnetic field intensity was varied at the following levels: 7,000, 9,000, 11,000 and 13,000 Gauss.

The production tests involved running the test with all the available material while using the optimized conditions as found in the optimization tests.

The results led to two production tests. The production tests were conducted on a feed composed of 40% mids spiral concentrate and 60% UCC overflow. The production tests were done at 11,000 Gauss for the WHIMS stage. Production test #1 was performed with the WHIMS' six concentrate hoses reporting to the magnetic concentrate. In production test #2, a portion (one hose out of six) from the WHIMS magnetic stream was diverted to a non-magnetic stream to see if the grade could be improved.

A summary of the LIMS and WHIMS lab scale testwork is shown in Table 13-22. A summary of the LIMS and WHIMS optimization and production testwork is shown in Table 13-23. The optimization testwork LIMS and WHIMS concentrates were combined prior to analysis due to the low magnetite content in the feed thus resulting in very low LIMS concentrate quantity. The production concentrate results show the value of combined LIMS and WHIMS assays. The concentrate iron recovery versus iron grade is shown in Figure 13-27.

Table 13-22 LIMS and WHIMS lab scale testwork results summary

Stream	Mids Concentrate		Scav Cleaner UCC O/F		60/40 Mix	
	Fe Grade (%)	Fe Recovery (%)	Fe Grade (%)	Fe Recovery (%)	Fe Grade (%)	Fe Recovery (%)
Feed	38.9	100.0	22.2	100.0	32.4	100.0
Concentrate	53.2	97.8	30.5	95.3	44.3	95.8
Tails	3.0	2.2	3.4	4.7	4.6	4.2

Table 13-23: LIMS and WHIMS testwork results summary

Test	WHIMS Magnetic Field Intensity (Gauss)	Feed		Concentrate			Tails		
		Flowrate	Assays	Assays	Recovery		Assays	Recovery	
		Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
40/60 Prod 1	11,000	0.20	32.41	49.85	96.81	62.94	2.79	3.19	37.06
40/60 Prod 2	11,000	0.20	32.41	56.27	94.17	54.24	4.13	5.83	45.76
Scav Cleaner OF 1	7,000	0.20	38.54	58.87	93.53	61.23	6.43	6.47	38.77
Scav Cleaner OF 2	9,000	0.20	38.54	58.53	93.50	61.56	6.52	6.50	38.44
Scav Cleaner OF 3	11,000	0.20	38.54	58.32	94.22	62.26	5.90	5.78	37.74
Scav Cleaner OF 4	13,000	0.20	38.54	55.81	97.09	67.04	3.41	2.91	32.96

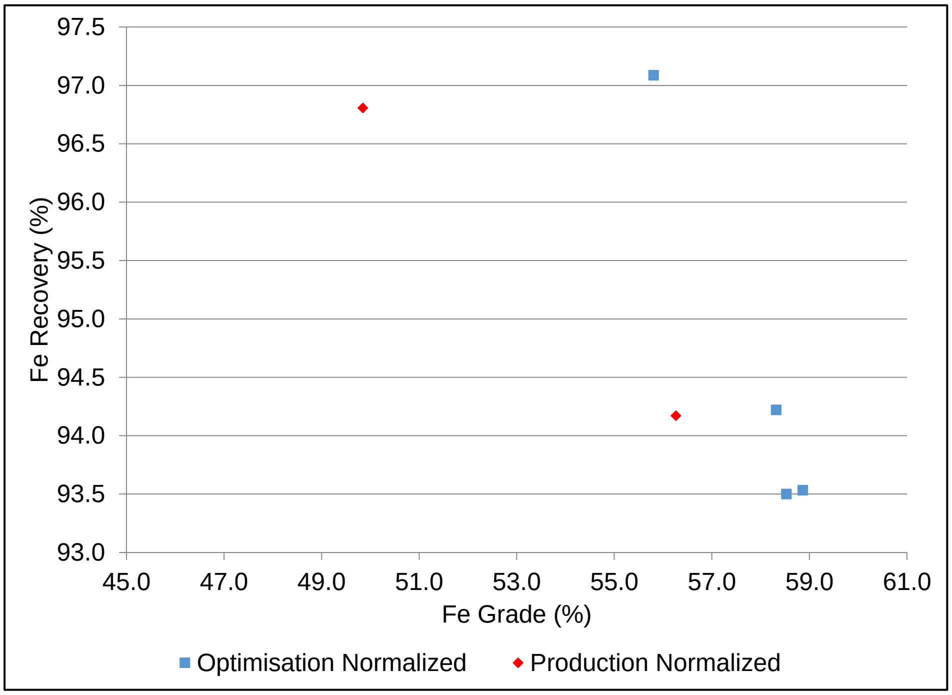

Figure 13-27: LIMS-WHIMS iron recovery vs. iron grade

The main conclusions drawn from the tests are:

- There was no significant difference between 7,000 and 9,000 Gauss on the WHIMS;
- Increasing the WHIMS magnetic field strength to 11,000 Gauss gave a slightly better iron recovery without significantly affecting the iron grade;
- Having a WHIMS magnetic field intensity at 13,000 significantly increases the iron recovery but also significantly decreases the iron grade;
- The optimization and production testwork produced similar results;
- Mixing 40% mids concentrate and 60% UCC scavenger cleaner overflow did not significantly affect the iron recovery but it did decrease the concentrate iron grade;
- The production tests performed better than Phase 1 (QIO) results in terms of iron recovery and iron grade.

13.4.4.8 Mag Cleaner Spirals Testwork

Two mag cleaner tests were performed on the WHIMS concentrate in a WW6+ spiral. The wash water addition rates tested ranged from 1.1 tph to 1.3 tph. The feed rate ranged from 1.2 tph to 1.3 tph. No production test was required at this stage.

The mag cleaner spiral testwork results are shown in Table 13-24. The mag cleaner spiral concentrate iron recovery versus iron grade is shown in Figure 13-28.

Table 13-24: Mag cleaner spiral testwork results

	Feed		Concentrate			Tails		
	Flowrate	Assays	Assays	Recovery		Assays	Recovery	
Test	Solids (tph)	Fe (%)	Fe (%)	Fe (%)	Mass (%)	Fe (%)	Fe (%)	Mass (%)
Mag Cleaner 1	1.19	50.3	60.0	89.7	75.3	20.9	10.3	24.7
Mag Cleaner 2	1.32	50.3	64.8	73.7	57.3	30.9	26.3	42.7

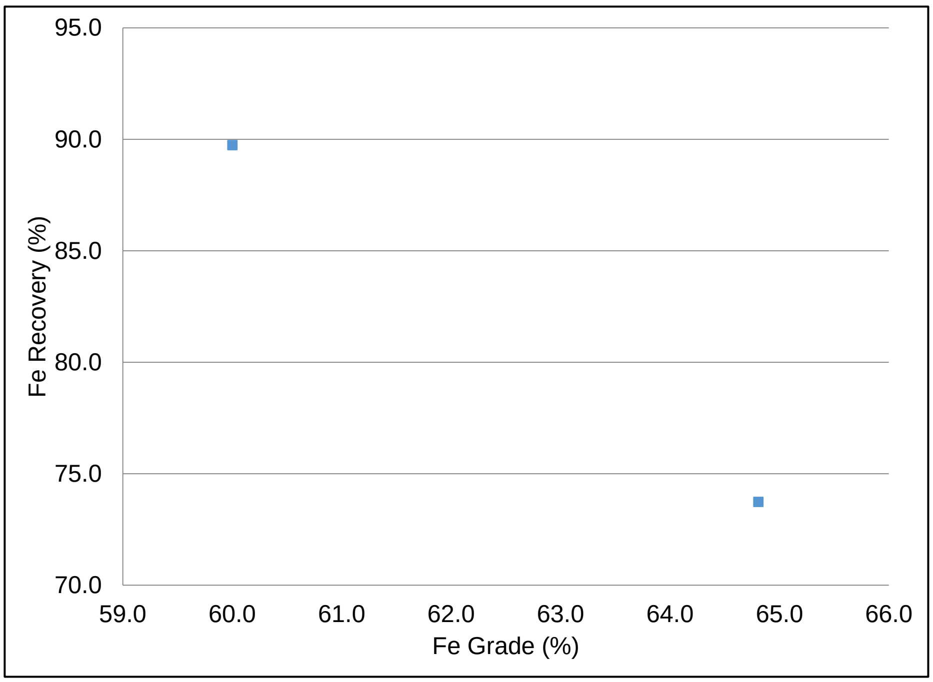

Figure 13-28: Mag cleaner spirals iron recovery vs. iron grade

The testwork results show that:

- The feed provided to the Mag Cleaner spiral is different from the Phase 1 (QIO) feed. However, the performance obtained are similar;
- A concentrate grade at 64.8% Fe was achieved with the spirals at a low iron recovery of 73.4%;
- The iron recovery decrease significantly with the production of a higher Fe grade concentrate.

13.4.4.9 Rougher Tails Testwork

LIMS and WHIMS exploratory testwork was performed to investigate the possibility of recovering iron from the rougher tails. For the testwork, the rougher tails were screened at 150 µm as the material finer than 150 µm contained most of the iron. The -150 µm portion represented approximately 52% of the sample mass, 83% of the sample iron, at a 19% Fe grade. The testwork flowsheet is presented in Figure 13-29.

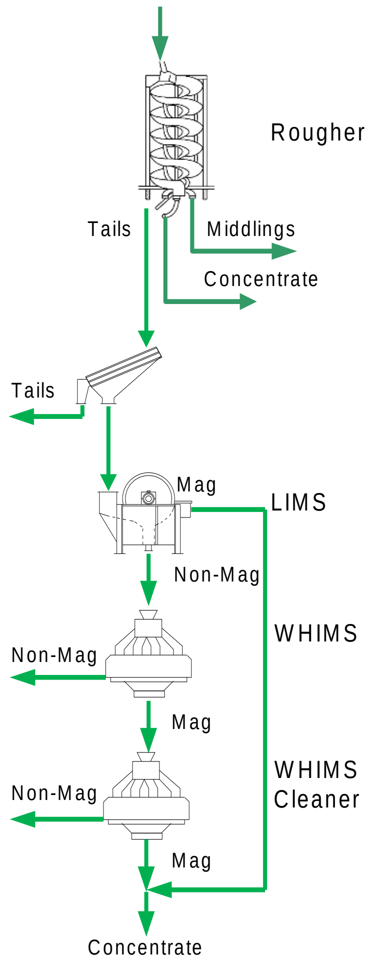

Figure 13-29: Rougher tails testwork

The rougher tails passing 150 µm was subjected to a LIMS and a WHIMS stage. Four optimization tests were performed in which the magnetic field intensity of the WHIMS was varied at 7,000, 9,000, 11,000 and 13,000 Gauss. The LIMS intensity was kept constant at 2,000 Gauss.

The production test was optimized and performed at 11,000 Gauss.

Additional WHIMS cleaner stage tests were also performed on the concentrate generated during the production test.

A summary of the LIMS testwork is shown in Table 13-25 while WHIMS testwork are presented in Table 13-26. The amount of magnetic concentrate recovered at the LIMS stage during the optimization tests was considered not significant. Table 13-27 presents a reconciled mass balance of the rougher tails scavenging testwork that included a cleaner WHIMS stage.

Table 13-25: Rougher tails LIMS testwork summary

Test	Magnetic strength (Gauss)	Concentrate			
		Mass Rec. (%)	SiO_2 (%)	Fe_T (%)	Fe_T Rec. (%)
Optimization	2,000	N/A	36.3	42.5	N/A
Production	2,000	0.8	27.6	48.7	24.6

Table 13-26: Rougher tails WHIMS testwork summary

Test	Magnetic Strength (Gauss)	Concentrate				Tails			
		Mass Rec. (%)	SiO_2 (%)	Fe_T (%)	Fe_T Rec. (%)	Mass Rec. (%)	SiO_2 (%)	Fe_T (%)	Fe_T Rec. (%)
1	7,000	21.6	32.3	43.3	48.8	78.4	73.8	12.5	51.2
2	9,000	39.5	37.1	39.3	77.6	60.5	81.6	7.4	22.4
3	11,000	42.2	39.5	36.8	81.0	57.8	83.2	6.3	19.0
4	13,000	45.3	40.7	36.2	82.1	54.7	83.0	6.5	17.9
Production	11,000	54.4	48.8	30.7	88.7	45.6	82.9	7.3	11.3
Production Cleaner	11,000	35.4	9.7	60.0	69.2	64.6	69.9	15.2	30.8

Applying the results presented in Table 13-27 to the Phase 2 (QIO) mass balance, the rougher tails scavenger option would represent approximately an additional 40 tph of concentrate for Phase 2 (QIO), and 3.0% of iron recovery. Given that the rougher tails scavenger concentrate does not meet the target of 66.2% Fe, the other three concentrates (cleaner UCC, scavenger cleaner UCC and mags cleaner spirals) would have to be slightly upgraded for the final concentrate to be at 66.2%. The Phase 2 (QIO) mass balance produced uses a very conservative Fe grade at the scavenger cleaner UCC concentrate and an increase of this concentrate grade is easily achievable.

Table 13-27: Rougher tails scavenger testwork mass balance

Stream	Recovery Weight (%)	Recovery Fe (%)	Grade SiO_2 (%)	Grade Fe (%)
Rougher tails	100	100	79.3	11.9
Rougher tails +150 µm	48	16	93.7	4.1
Rougher tails -150 µm	52	84	66.3	19.0
LIMS Concentrate	0	2	27.6	48.7
WHIMS Concentrate	25	66	48.9	30.8
WHIMS Tails	27	17	83.2	7.4
WHIMS Cleaner Concentrate	9	45	9.7	60.0
WHIMS Cleaner Tails	16	21	69.9	15.2
Final Concentrate	9	46	10.5	59.5

The testwork results show that:

- It was possible to produce a Fe concentrate grade of 59.5% while recovering 46% of the iron lost to the rougher tails with two stages of WHIMS;
- Further testwork is required to improve the flowsheet and finalise the economics of the circuit.

13.4.5 Variability Testwork

Following the step by step testwork and based on Phase 1 (QIO) experience, a flowsheet was developed with the aim of producing a low silica concentrate at a high iron recovery while allowing a good robustness to feed characteristics variations.

Variability tests were conducted on five different ore blends to assess the metallurgical performance of each blend. These tests were performed in open circuit except for the mag cleaner stage which was performed in closed circuit due to the low quantity of material making its way through the circuit to feed that stage. The rougher spirals were fed between 2.2 tph and 2.3 tph. The wash water was set at 1.1 tph on all the spiral stages. The UCC wash water was set at 10 L/min and 4 L/min for the cleaner and scavenger cleaner stages respectively. The spiral adjustment used were those determined during the step by step testwork and were not adjusted for the different ore blends.

A summary of the testwork results of the variability samples is provided in Table 13-28 while the detailed results for each blend are detailed in Table 13-29 to Table 13-33.

Table 13-28: Variability blend testwork summary of results

Blend	Stream	Analysis				Recovery (Global)			
		Fe (%)	SiO_2 (%)	MgO (%)	CaO (%)	Fe (%)	SiO_2 (%)	MgO (%)	CaO (%)
1	Feed	34.6	46.6	1.6	1.4	100.0	100.0	100.0	100.0
	Final concentrate	66.9	3.9	0.3	0.2	88.3	3.8	8.2	8.0
	Final tails	7.2	82.8	2.8	2.3	11.7	96.2	91.8	92.0
2	Feed	26.9	56.7	1.5	1.2	100.0	100.0	100.0	100.0
	Final concentrate	63.5	8.0	0.3	0.3	78.4	4.7	7.5	9.1
	Final tails	8.8	80.9	2.0	1.5	21.6	95.3	92.5	90.9
3	Feed	30.9	54.4	0.2	0.2	100.0	100.0	100.0	100.0
	Final concentrate	66.9	4.0	0.0	0.1	84.6	2.9	10.5	15.5
	Final tails	7.4	87.3	0.3	0.3	15.4	97.1	89.5	84.5
4	Feed	32.6	47.4	2.1	1.7	100.0	100.0	100.0	100.0
	Final concentrate	65.3	4.6	0.5	0.5	83.6	4.0	10.1	11.0
	Final tails	9.1	78.2	3.3	2.6	16.4	96.0	89.9	89.0
5	Feed	27.7	51.1	3.5	2.7	100.0	100.0	100.0	100.0
	Final concentrate	66.0	4.1	0.8	0.6	83.5	2.8	7.6	7.1
	Final tails	6.9	76.8	5.0	3.8	16.5	97.2	92.4	92.9

All the blends gave very good results with respect to the concentrate silica target of 4.5% and iron recoveries except blend #2, which consisted in hematite from the Pignac pit and silicates and magnetite from Chief's Peak pit. Despite having all the same operation parameters (wash water flowrates, feed rates, etc.) all the blends gave recoveries consistent with the recovery model established which means that the Phase 2 flowsheet is robust under a variety of feed blends.

Of the five blends, blend #2 is the one with the lowest feed iron grade (26.85%) which is also lower than the rougher feed bulk sample iron grade (31.84%) used for the optimization and production testwork. This is in line with the recovery model's predictions.

13.4.5.1 Rougher and Mids Stages

The rougher and mids stages iron grades and recoveries for the five blends are shown in Table 13-29.

Table 13-29: Rougher and mids stages iron and silica grades and recoveries

Stream	Blend 1 (%)	Blend 2 (%)	Blend 3 (%)	Blend 4 (%)	Blend 5 (%)
Fe Grade					
Rougher spirals feed	34.6	26.9	30.9	32.6	27.7
Rougher spirals concentrate	50.5	48.8	53.3	49.6	54.3
Rougher spirals tails	8.5	9.7	9.1	11.2	8.2
Rougher spirals mids	6.5	7.1	6.2	5.9	4.8
Mids spirals concentrate	20.4	16.6	17.9	12.9	12.9
Mids spirals tails	4.9	6.0	5.1	4.9	4.1
SiO_2 Grade					
Rougher spirals feed	46.6	56.7	54.4	47.4	51.1
Rougher spirals concentrate	25.4	27.4	22.9	25.2	18.3
Rougher spirals tails	80.4	78.4	84.2	73.7	73.6
Rougher spirals mids	84.6	85.2	90.0	84.8	81.4
Mids spirals concentrate	63.3	70.4	72.7	72.6	67.8
Mids spirals tails	87.0	86.8	91.7	86.5	82.5
Fe Recovery (Stage)					
Rougher spirals feed	100.0	100.0	100.0	100.0	100.0
Rougher spirals concentrate	92.0	82.2	87.5	88.5	86.7
Rougher spirals tails	4.5	12.4	8.3	8.4	8.9
Rougher spirals mids	3.6	5.4	4.2	3.1	4.5
Mids spirals concentrate	32.1	23.2	25.7	26.8	19.8
Mids spirals tails	67.9	76.8	74.3	73.2	80.2

The rougher stage gave pretty consistent results under the various blends. As would be expected, the lower feed grades resulted in lower concentrate iron grades and recoveries with blend #5 showing better than expected results. The mids stage gave lower concentrate Fe recoveries and grades than what was observed during the sampling campaigns which is the result of the high rougher concentrate recoveries.

The particle size distribution of the Hematite 2 Pignac pit sample, used in blend #2, is coarser than what is usually seen in the Phase 1 (QIO) concentrator. Therefore liberation was probably at cause, as the liberation for iron oxide in this sample was poor (see Table 13-13).

13.4.5.2 Cleaner Stage

The cleaner stage iron grades and recoveries for the five blends are shown in Table 13-30. The cleaner UCC underflow silica distribution is shown in Figure 13-30

Table 13-30: Cleaner stage iron and silica grades and recoveries

Stream	Blend #1 (%)	Blend #2 (%)	Blend #3 (%)	Blend #4 (%)	Blend #5 (%)
Fe Grade					
Cleaner UCC feed	50.5	48.8	53.3	49.6	54.3
Cleaner UCC underflow	67.6	64.0	67.4	65.5	66.1
Cleaner UCC overflow	25.6	23.6	27.0	31.5	24.5
SiO_2 Grade					
Cleaner UCC feed	25.4	27.4	22.9	25.2	18.3
Cleaner UCC underflow	3.0	7.4	3.6	4.1	4.0
Cleaner UCC overflow	58.1	60.4	59.3	49.1	54.3
Fe Recovery (Stage)					
Cleaner UCC feed	100.0	100.0	100.0	100.0	100.0
Cleaner UCC underflow	79.4	81.8	82.4	70.2	87.3
Cleaner UCC overflow	20.6	18.2	17.6	29.8	12.7

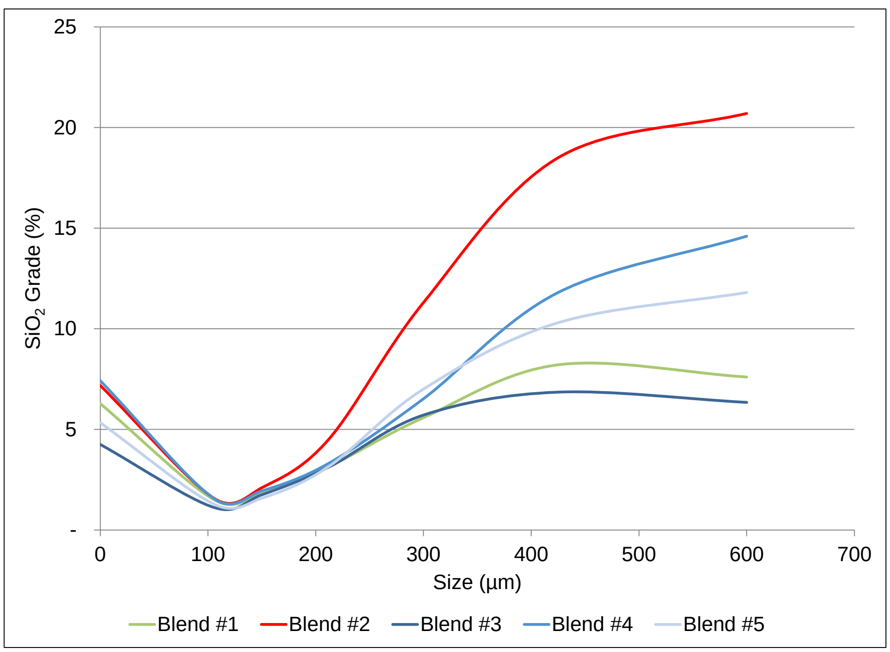

Figure 13-30: Silica grade by size in cleaner UCC underflow

Blends #1 and #3 to #5 all had similar rejection of fine silica but various levels of mid-sized and coarse silica at the cleaner stage. All of them gave good underflow grades and recoveries and the parameter adjustments in operation would easily allow maximising those grades and recoveries. Blend #2, on the other hand, has by far the highest proportion of coarse silica of all the tests meaning that coarse silica rejection was insufficient at the rougher stage. Given that the cleaner concentrate accounts in this case for 85% of the final concentrate, a better coarse silica rejection at the rougher stage would have significantly improved the final grade.

13.4.5.3 Scavenger and Scavenger Cleaner Stages

The scavenger and scavenger cleaner grades and recoveries for the five blends are shown in Table 13-31.

Table 13-31: Scavenger and scavenger cleaner stages iron and silica grades and recoveries

Stream	Blend #1 (%)	Blend #2 (%)	Blend #3 (%)	Blend #4 (%)	Blend #5 (%)
Fe Grade					
Scavenger spirals feed	25.6	23.6	27.0	31.5	24.5
Scavenger spirals concentrate	47.8	41.7	48.3	51.5	48.0
Scavenger spirals mids and tails	6.7	8.2	5.8	8.5	6.6
Scavenger-cleaner UCC underflow	65.3	65.8	64.6	65.5	64.8
Scavenger-cleaner UCC overflow	34.8	35.2	35.0	37.0	40.8
SiO_2 Grade					
Scavenger spirals feed	58.1	60.4	59.3	49.1	54.3
Scavenger spirals concentrate	28.0	35.6	28.6	22.7	24.4
Scavenger spirals mids and tails	83.5	81.5	89.7	79.5	77.0
Scavenger-cleaner UCC underflow	6.5	5.5	6.3	5.0	5.1
Scavenger-cleaner UCC overflow	44.0	43.6	46.8	41.0	32.7
Fe Recovery (Stage)					
Scavenger spirals feed	100.0	100.0	100.0	100.0	100.0
Scavenger spirals concentrate	85.8	81.1	89.2	87.4	84.8
Scavenger spirals mids and tails	14.2	18.9	10.8	12.6	15.2
Scavenger-cleaner UCC underflow	58.4	33.2	60.1	64.6	40.6
Scavenger-cleaner UCC overflow	41.6	66.8	39.9	35.4	59.4

The scavenger spiral concentrate grade ranged from 41.7% Fe to 51.5% Fe under the various blends as the result of the variation in the cleaner UCC overflow. Despite that variation, the scavenger cleaner stage gave very consistent grades under all the blends. As can be seen on Figure 13-31, the silica distribution in the scavenger cleaner concentrate is very similar for all the blends. This means that the addition of the scavenger cleaner stage will greatly stabilize the grade of that portion of the final concentrate.

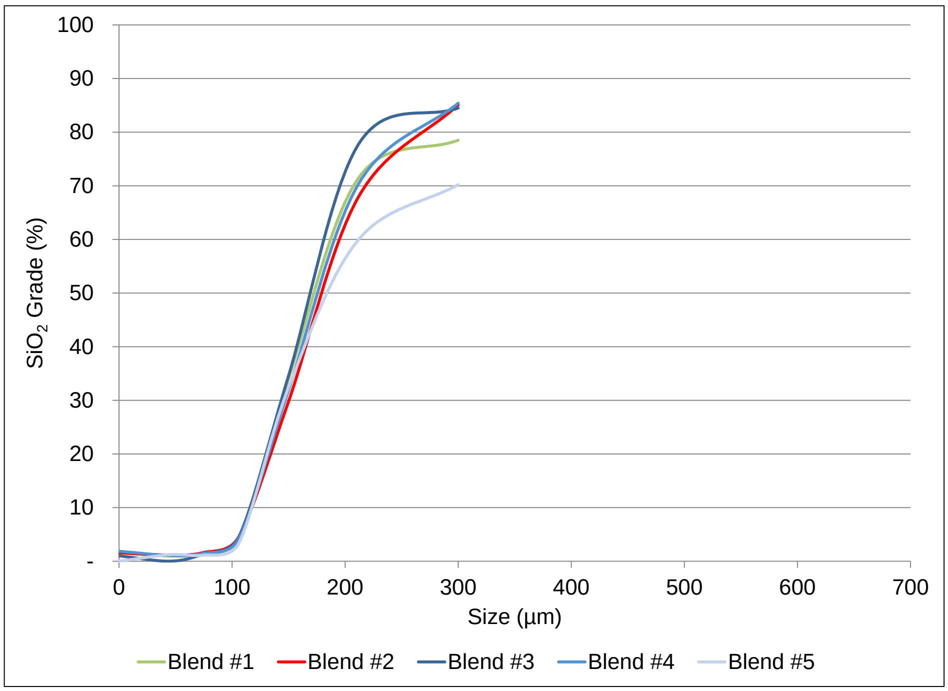

Figure 13-31: Silica grade by size in scavenger cleaner UCC underflow

13.4.5.4 LIMS, WHIMS and Mags Cleaner Stages

The LIMS, WHIMS and mags cleaner stages grades and recoveries for the five blends are shown in Table 13-32.

Table 13-32: LIMS, WHIMS and mags cleaner stages iron and silica grades and recoveries

Stream	Blend #1 (%)	Blend #2 (%)	Blend #3 (%)	Blend #4 (%)	Blend #5 (%)
Fe Grade					
LIMS feed	31.6	30.6	30.2	31.5	31.5
LIMS mag	60.3	59.7	49.9	60.4	63.4
LIMS non-mag	29.3	18.3	30.0	28.8	25.2
WHIMS non-mag	10.7	7.1	13.7	10.1	9.6
WHIMS mag	43.5	31.3	55.3	47.6	46.4
Mag cleaner spirals concentrate	60.7	58.0	63.9	62.3	66.8
Mag cleaner spirals tails	19.2	21.0	27.0	22.3	31.5
SiO_2 Grade					
LIMS feed	48.4	50.2	54.1	48.2	44.5
LIMS mag	12.7	14.8	27.0	13.8	9.0
LIMS non-mag	51.1	65.3	54.3	51.5	51.5
WHIMS non-mag	77.1	81.5	77.5	76.8	70.3
WHIMS mag	31.4	46.3	18.3	26.0	25.7
Mag cleaner spirals concentrate	10.3	14.2	6.6	8.2	3.4
Mag cleaner spirals tails	61.8	62.3	57.1	58.3	43.4
Fe Recovery (Stage)					
LIMS feed	100.0	100.0	100.0	100.0	100.0
LIMS mag	13.7	58.1	1.5	16.9	33.2
LIMS non-mag	86.3	41.9	98.5	83.1	66.8
WHIMS non-mag	15.7	20.8	27.8	17.6	22.1
WHIMS mag	84.3	79.2	72.2	82.4	77.9
Mag cleaner spirals concentrate	84.5	83.4	88.5	85.8	74.2
Mag cleaner spirals tails	15.5	16.6	11.5	14.2	25.8

The magnetic circuit produced a concentrate grade ranging from 58% Fe to 66.8% despite WHIMS magnetic concentrate grade variations from 31.3% Fe to 55.3% Fe.

Results also show that for blend #2 the WHIMS stage generated a concentrate at a much lower iron grade than the other tests possibly caused by a higher proportion of material not sufficiently liberated and by a lower feed grade coming from the LIMS. This caused the mag cleaner feed iron grade to be much lower thus making it more difficult to achieve a high concentrate grade at that stage.

13.4.5.5 Variability Testwork Conclusions

The following conclusions can be drawn from the variability testwork results:

- All the blends except blend #2 allowed for the final concentrate to be on or below the silica target of 4.5%, although the operating parameters of the equipment (wash water, cutters, etc.) were fixed for all the testwork;
- Insufficient liberation in the case of blend #2 may have contributed to the high final silica grade;
- The scavenger cleaner stage gave a very stable underflow iron grades under all the blends proving its benefits to the Phase 2 flowsheet;
- The final iron recoveries for all the blends were consistent with the feed iron grades.

As seen throughout the testwork program, the proposed Phase 2 (QIO) concentrator flowsheet addresses the improvement opportunities of the Phase 1 (QIO) flowsheet and is very robust under various feed conditions. The finer rougher feed particle size distributions in operation as well as the possibility of adjusting the various control parameters will make that flowsheet even more robust.

13.5 Screening Testwork

A composite sample was taken of the classification screen feed on November 24, 2018 between 11:00 am and 2:30 pm (Derrick, 2019).

The sample was sent to Derrick for testing. The test objective was to determine the optimum screen operating conditions for an 850 µm screen opening application. The testing was conducted on a full-scale (1.2 m wide by 1.5 m long) single deck machine.

Derrick concluded that:

- The recommended feed rate for a 5-deck Stack Sizer with a screen opening of 850 µm is 225 tph to 250 tph;
- The recommended feed rate is 275 to 300 tph with a 900 µm screen opening;
- Most efficient separations were achieved with 59% solids (by volume) feed density;
- The re-pulp spray system improved the undersize recovery.

A summary of the screening testwork results are presented in Table 13-33.

Table 13-33: Screening testwork results

Panels	Spray water (m^3/h)	Dry feed (tph)	Efficiency at 850 µm		
			Oversize	Undersize	Overall
850 µm Polyweb	36	228	94.5	97.3	96.7
850 µm Polyweb	-	262	96.3	91.0	92.1
850 µm Polyweb	36	341	97.2	93.2	94.0
850 µm Polyweb	-	341	97.1	90.5	91.9
850 µm Polyweb	36	257	95.9	94.0	94.4
850 µm Polyweb	-	257	96.9	92.4	93.4
850 µm Polyweb	-	257	95.8	91.2	92.2
850 µm Heavy Construction	36	223	91.9	97.4	96.7
850 µm Heavy Construction	-	261	96.2	93.7	94.0
900 µm Polyweb	36	262	94.4	96.3	95.9
900 µm Polyweb	36	341	94.7	95.9	95.7

13.6 Settling Testwork

A confirmatory testing program was carried out by FLSmidth in February 2019 (FLSmidth, 2019). A composite sample was taken November 24, 2018 between 8:50 am and 11:30 am.

The sample consisted of 20 litres of tailings at 38% solids. A 20-litre sample of process water was also sent.

The results from the testing program are similar to the results of 2011:

- A flocculant with a very high molecular weight and very low charge density produced the best settling rates;
- The optimum feedwell densities are in the range of 6% to 8% solids;
- The solids minimum unit area is 0.08 m^2/tpd;
- The thickener can produce an underflow concentration of approximately 60% to 61% solids with two hours of retention time;
- The recommended yield stress for rake design is 30 Pa.

The thickener originally purchased for the Phase 2 (Cliffs) project is appropriate for the expected Phase 2 (QIO) duty.

13.7 Filtration Testwork

A confirmatory test was conducted on new slurry in March 2019 by Bokela (Bokela, 2019).

A 14 kg composite sample of iron ore concentrate was sent to Bokela. The concentrate composite sample was taken November 24, 2018 between 8:40 am and 11:15 am.

The test results confirm that a throughput of 350 tph can be safely achieved with a concentrate moisture content of less than 3% which is sufficient for the Phase 2 duty. The filter has a maximum capacity of 500 tph at a final moisture content of 3.7%.

13.8 Phase 2 Recovery Model

With the information obtained from the testwork program, the variability testwork results in particular, and the operation experience of the Phase 1 (QIO) concentrator; the following recovery equation was determined:

$$\%Fe_{Rec.} = -0.03593Fe^2 + 3.1900Fe - 0.59683MgO - 0.00495MgO^2 + 0.01424FeMgO + 20.678$$

This equation takes into account the magnesium, measured as MgO, feed grade and assumes it as actinolite, which contains iron that is not recoverable. The model is applied on the life of mine annual averages iron feed grades of 27% to 31% and MgO feed grades up to 3.5%. Figure 13-32 shows the comparison of the recovery model developed for Phase 2 (QIO) and the variability testwork results.

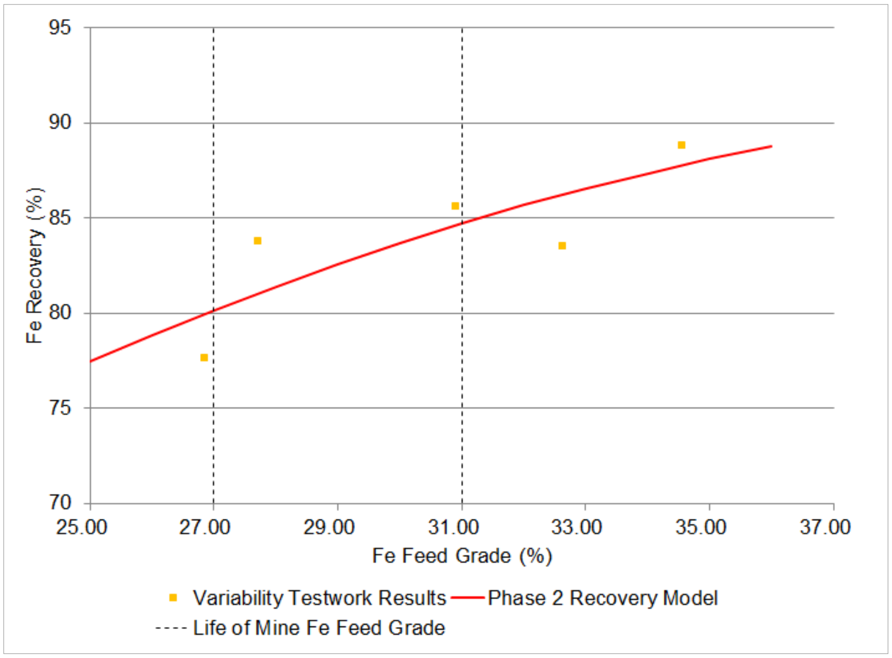

Figure 13-32: Iron recovery vs. iron feed grade

13.9 Mineral Processing and Metallurgical Testing Conclusions

The QIO ore has been extensively tested over the past several decades prior to this current Bloom Lake project throughout these developmental phases:

- Testwork prior to Phase 1 (Consolidated Thompson) (before 2010):
  - A concentrate above 67% Fe grade can be produced at a Fe recovery above 83% for a grinding size of 425 µm;
  - The ore contains actinolite, which can reduce the Fe grade and be a source of MgO and CaO in the concentrate;
  - A three spirals stage flowsheet was developed for Phase 1 and was in operation from 2010 to 2014.
- Original Phase 2 (Cliffs) Testwork (2010 – 2014):
  - West Pit ore was tested and characterized. The ore is softer, well liberated at 850 µm and presented similar metallurgical performances than Chief's Peak Pit;
  - A Phase 2 flowsheet that included rougher spirals, cleaner UCC and scavenger spirals was piloted and presented significant improvement to the Phase 1 flowsheet.

- Phase 1 (QIO) Restart Testwork (2016 – 2017):
  - A flowsheet inspired by the Phase 2 (Cliff) flowsheet was developed by Mineral Technologies and implemented in Phase 1. This flowsheet includes a scavenger circuit using magnetic separators.

Sampling campaigns were conducted in the Bloom Lake Phase 1 (QIO) concentrator. The Phase 1 (QIO) flowsheet audit has allowed valuable information to be gathered, which was used to define the testwork program. The main conclusions are:

- The rougher stage performs well and its concentrate iron recovery is higher than designed;
- The mids stage receives less feed and its concentrate iron recovery is lower than expected but is offset by the higher recovery to rougher concentrate;
- The recovery at the cleaner stage's underflow is lower than expected and result in more material being sent to the scavenger stage:
  - This requires being more aggressive at the scavenger stage to meet final concentrate grade.
- The scavenger stage has been identified as the stage where the most potential gain is possible, both in terms of grade and recovery;
- The magnetic circuit did not perform as expected in the WHIMS stage where the iron recovery was lower than expected.

The objective of the metallurgical testwork program undertook for this study was to improve the Phase 1 (QIO) flowsheet based on the experience acquired and the challenges to come. The testwork has shown that:

- Addition of a cleaner-scavenger UCC to process the scavenger spirals concentrate allows the production of a final grade concentrate at a high iron recovery;
- Reducing the load on the scavenger and magnetic cleaner spirals will improve their performances;
- Sending the middling spirals concentrate to the magnetic scavenging circuit will improve the circuit's robustness;
- Sending the LIMS concentrate to the magnetic cleaner spirals will improve the circuit's robustness.

Phase 2 flowsheet includes those changes. Based on the mine plan developed for this study, at an average feed Fe grade of 29%, the Phase 2 concentrator will allow a Fe recovery of 82.5% while producing an average concentrate grade of 66.2%.

14. MINERAL RESOURCE ESTIMATE

14.1 Introduction

BBA was retained by Quebec Iron Ore (QIO) to audit the updated Mineral Resource Estimate (MRE) for the Bloom Lake project (the "Project") prepared by Jean-Michel Dubé, P. Geo. from QIO. Drillhole information up to 2018 was considered for this estimate with only partial information from the 2018 drilling program used for 3D modelling and classification.

The QP reviewed the resource parameters presented by QIO, including the following items: geological model and domain strategy, statistical study of assays and composites, variography analysis, interpolation and search ellipse settings, estimation process and classification of the resource. During the course of the audit, the QP proposed revising some of the parameters that contributed to establishing the updated parameters.

14.2 Methodology

The herein MRE covers the whole Bloom Lake project with an east-west strike length of 4.6 km and a north-south width of approximately 2.7 km, down to a vertical depth of 400 m below surface. Figure 14-1 shows the location of the Bloom Lake project.

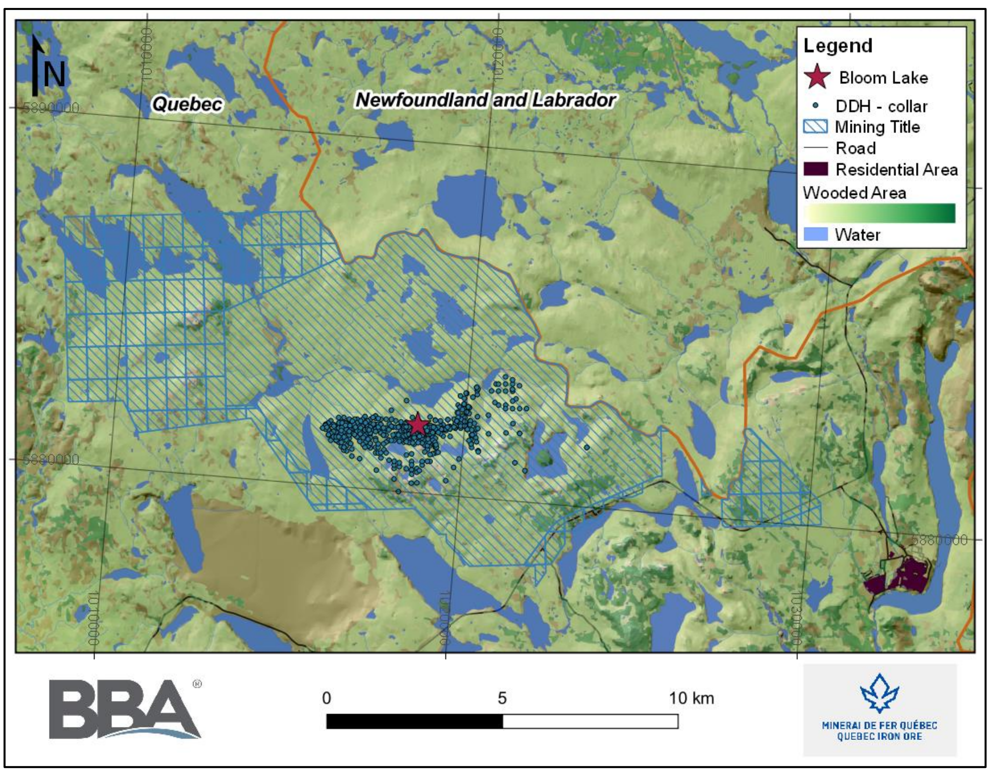

Figure 14-1: Overall plan view for the Bloom Lake project

Geovia Surpac 2019HF1 v.7.0.1949.0 was used for the geological modelling and to generate the drillhole intercepts for each solid, compositing, 3D block modelling and interpolation. Statistical studies were conducted using Excel and Snowden Supervisor v.8.9.

The methodology for the audit involved the following steps:

- Database verification;
- Review of the 3D modelling of the geological and structural models;
- Review of the drillhole composite generating process for each mineralized units;
- Basic statistics;
- High grade value study;
- Geostatistical analysis including variography;
- Review of the block model construction;
- Review of the grade interpolation (including all profiles, scripts and macros);
- Block model validation;
- Review of the Resource classification;
- Cut-off grade calculation and pit shell optimization;
- Review of the mineral resource statement.

14.3 Resource Database

The drilling database consists of 569 surface drillholes from historical and recent drilling programs that occurred between 1957 and 2018 for a total of 141,288 m (Figure 14-2). The average length of a drillhole is 248 m. The database was validated as part of the current mandate.

The modelling and resource estimation focuses on the Bloom Lake project delimited by the block model area and consequently excludes holes located outside the area of interest.

The resource estimation for the Bloom Lake project relies mainly on recent drilling programs as the database includes 165 historical holes (before 2008) and 404 recent drillholes (since 2008). The QP accepted the historical drillhole information into the resource estimation for the following reasons: 1) historical information was verified as part of the mandate and no discrepancies were found; and 2) recent drillholes were drilled in the vicinity of historical drillholes and the results showed comparable geology and mineralization outlines.

From 445 holes, a total of 11,345 sample intervals were analyzed for Fe%, 11,310 for magnetic iron (Mag Fe or Satmagan) and approximately 9,650 for Oxides. The database also includes some 5,250 Heavy Liquid Separation samples (HLS) analyzed for iron recovery (Fe Rec) and silica concentrate (Si Conc). These HLS analyses were not used for the block model, but are of interest for the material characterization to be sent to the process facility.

Figure 14-2 below shows the location of the drillholes that were used for the resource estimate.

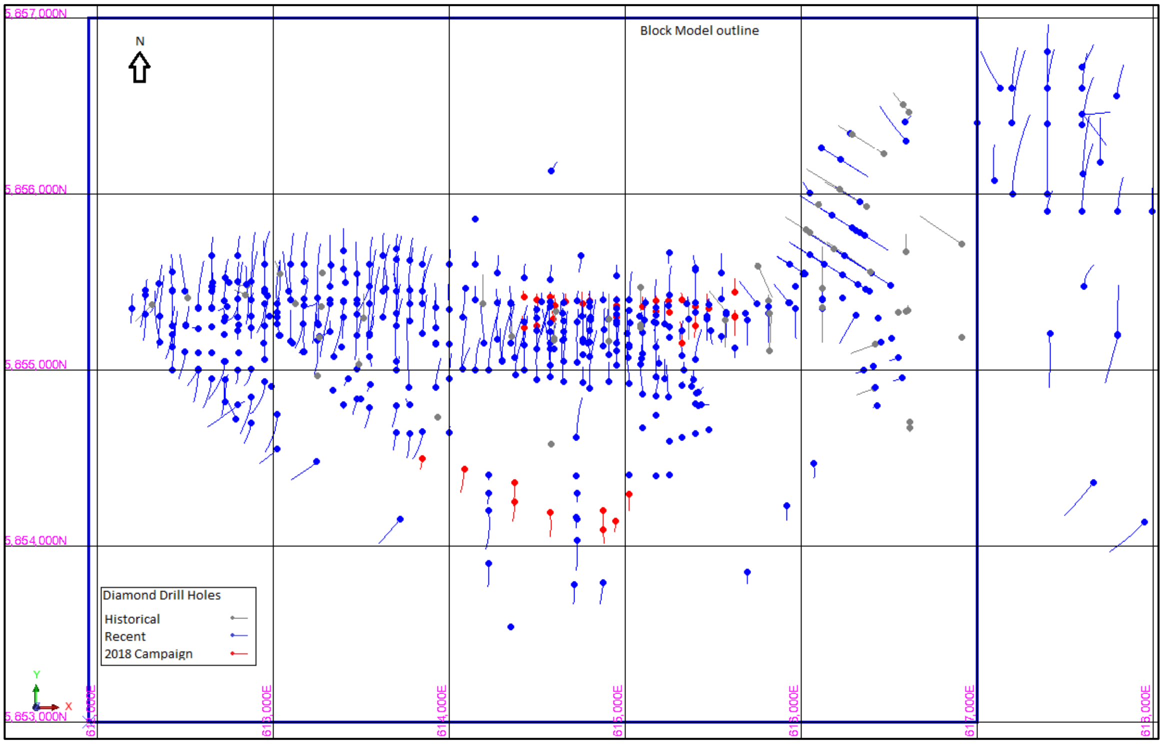

Figure 14-2: Plan view of the diamond drillholes for the Bloom Lake project

The resource database was validated before proceeding to the resource estimation. The validation steps are detailed in Chapter 12 of this report. Minor variations have been noted during the validation process but have no material impact on the 2019 MRE.

The QP is of the opinion that the database is appropriate for the purposes of the mineral resource estimation and that the sample density allows a reliable estimate to be made of the size, tonnage and grade of the mineralization in accordance with the level of confidence established by the mineral resource categories in the CIM Standards.

14.4 Geological Interpretation and Modelling

The Bloom Lake Gems project includes a geological model and structural interpolation domains.

14.4.1 Geological Model

The geological model was initially inherited from Cliffs in 2014 and was reported to be produced in Geovia Gems. The interpretation was based on diamond drillholes (DDH), geological maps, ground magnetic surveys and production data. Cross-sections were generated at 75 m to 150 m spacing, west to east. The geologists at Bloom Lake interpreted two sets of interpretation, vertical cross-section and plan view section.

Eight geological units were modelled:

1- Tabular to folded and anastomosing mineralized bands including:
   a. Hematite Iron Formation (IF)
   b. Magnetite Iron Formation (IFM)
   c. Silicate Iron Formation (SIF)
   d. Waste Silicate Iron Formation (WSIF)

2- Unmineralized units sitting below and above the mineralization as well as intercalated between the mineralized bands, including:
   a. Amphibolite (AMP)
   b. Quartzite (QZ)
   c. Mica Schist (MS)
   d. Gneiss (GN)

Through various steps, vertical cross-section interpretation was converted to plan views every 14 m (upper portion of the model; 410 m and up) and every 28 m (lower portion of the model; below 410 m). The interpretation was created at the centre of each bench and then extruded to the bench height to create solids.

QIO revised the geological model in 2018 and 2019 for some local area using Geovia Surpac. Modifications were brought to the “Patte Pignac” and to the north wall of the Pignac pit based on recent drilling and observations made during operation.

The QP reviewed the geological model in 3D views, plan views, and cross-sections and is of the opinion that the level of detail to which the geology model was constructed represents adequately the complexity of the folded structures and stratigraphy of the Bloom Lake project for the material contained within the resource pit shell. Some sterile units are currently not taken into account in the block model, but it is not believed to be material to the mineral resource estimate. QIO is currently working towards improving the geological model and recommendations were made in order to improve the model for future updates.

In the QP's opinion, the geological model is appropriate for the size, grade distribution and geometry of the mineralized zones and is suitable for the resource estimation of the Bloom Lake project. The model appears to be compatible with the anticipated mining and grade control methods as well as to the size and type of equipment to be used. Figure 14-3 and Figure 14-4 show typical cross-section and plan views of the current model.

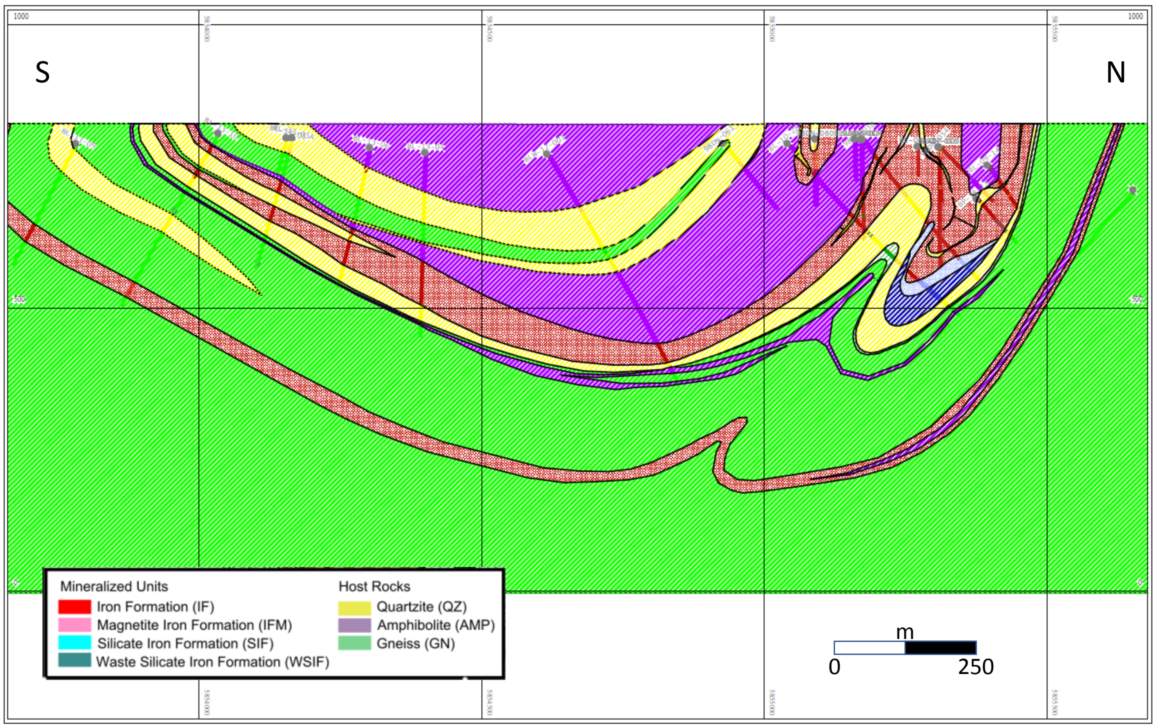

Figure 14-3: Typical cross-section looking west showing the geological interpretation and drillholes

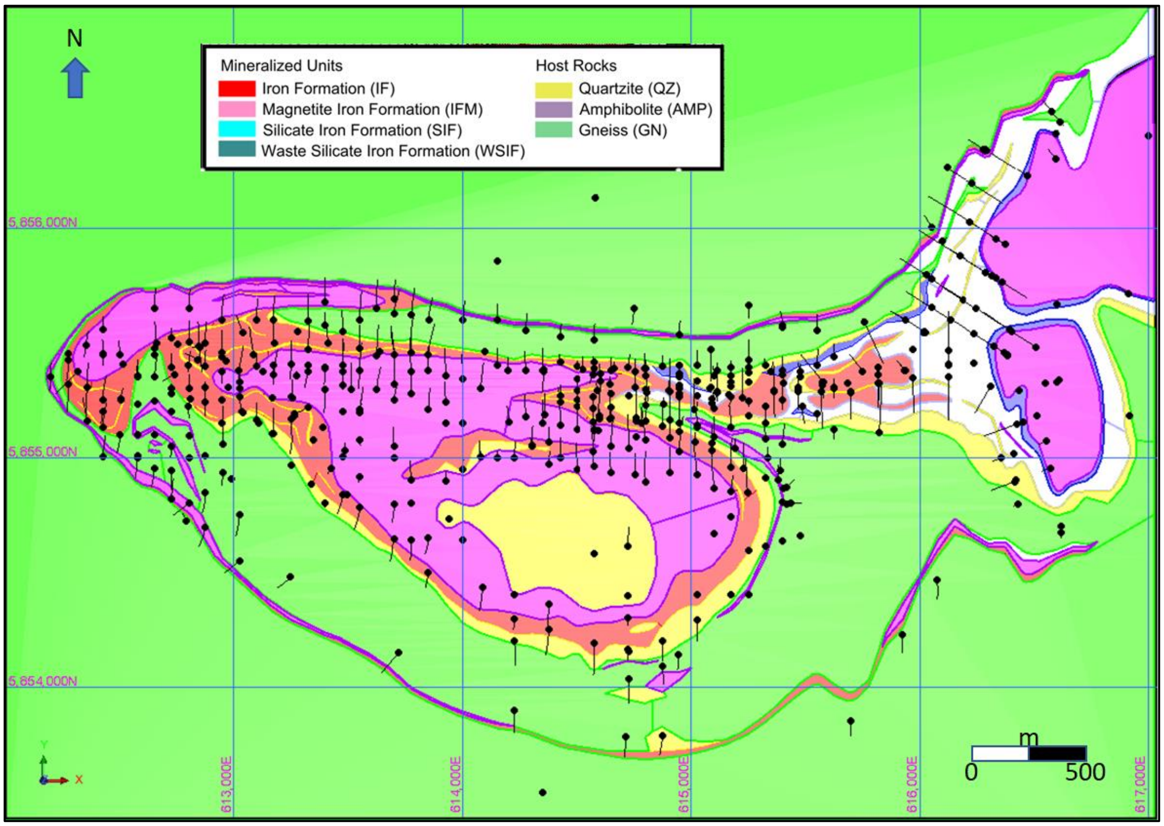

Figure 14-4: Typical plan view (Elevation 620 m) showing the geological interpretation and drillholes

14.4.2 Structural Domains

Because of the folded nature of the deposit, the geological model was divided into multiple structural domains to accommodate grade interpolation. Although domains existed in the previous model, it was necessary to revisit the approach during the course of the current MRE update. A total of 22 domains were created using Geovia Surpac for the current MRE.

Table 14-1 lists the plane attitudes defining each of the structural domains outlined at Bloom Lake.

Table 14-1: List of plane attitudes defining the structural domains

Domain	Plane attitude	
	Orientation	Dip
1000	120	40
2000	105	35
3000	27	25
4000	88	22
5000	90	0
6000	90	0
7000	90	0
8000	95	0
9000	70	0
10000	260	15
11000	90	5
12000	255	55
13000	270	65
14000	240	55
15000	270	35
16000	272	55
17000	268	0
18000	270	15
19000	270	75
20000	225	50
21000	0	70
22000	136	70

The QP reviewed the structural domains and is of the opinion that the wireframes adequately subdivide the geological model into individual orientation subsets of grade continuity. Consequently, the QP considers the structural model to be appropriate for the resource estimation of the Bloom Lake project.

14.4.3 Overburden and Topography

The topographic surface was created by QIO in Surpac and is based on a Lidar flown in 2018 and drillholes collar coordinates. The overburden/bedrock interface is based on downhole descriptions.

14.4.4 Voids Model

There are no underground voids on the Project. Up-to-date open-pit depletion was adequately applied.

14.5 Data Analysis

14.5.1 Assay Statistics

The drillhole intervals intersecting the mineralization wireframes were identified to the corresponding lithological unit and assays were coded accordingly. These coded intercepts were used to produce basic statistics on sample lengths and grades on a per mineralized lithology domains basis (IF_only, IF_QRIF, SIF, LIMO).

Statistics are presented in Table 14-2 to Table 14-5.

Table 14-2: Descriptive statistics for the IF_only assays

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	8,592	7,321	7,616	7,619	7,256	7,600	8,562	7,621
Minimum	0.310	0.005	0.005	0.005	0.005	0.005	0.010	0.005
Maximum	68.74	22.80	19.30	4.69	1.24	3.61	61.20	12.69
Mean	29.46	0.40	1.07	0.09	0.04	0.05	4.04	0.94
Median	30.40	0.15	0.04	0.02	0.02	0.01	0.90	0.06
Variance	59.70	1.74	5.15	0.05	0.01	0.05	54.41	3.18
Standard Deviation	7.73	1.32	2.27	0.22	0.07	0.22	7.38	1.78
Coefficient of Variation	0.26	3.30	2.12	2.42	1.85	4.45	1.82	1.90

Table 14-3: Descriptive statistics for the IF_QRIF assays

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	9,312	7,958	8,264	8,270	7,890	8,251	9,280	8,272
Minimum	0.310	0.005	0.005	0.005	0.005	0.005	0.010	0.005
Maximum	68.74	22.80	19.30	4.69	1.75	3.61	61.20	13.10
Mean	28.08	0.43	1.12	0.09	0.04	0.05	3.94	0.96
Median	29.70	0.15	0.05	0.02	0.02	0.01	0.97	0.06
Variance	82.70	1.90	5.39	0.05	0.01	0.05	51.26	3.27
Standard Deviation	9.09	1.38	2.32	0.23	0.08	0.22	7.16	1.81
Coefficient of Variation	0.32	3.24	2.08	2.41	1.90	4.44	1.82	1.88

Table 14-4: Descriptive statistics for the SIF assays

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	10,232	8,594	8,900	8,906	8,526	8,887	10,200	8,908
Minimum	0.310	0.005	0.005	0.005	0.005	0.005	0.010	0.005
Maximum	68.74	22.80	19.30	4.69	1.75	3.61	61.20	16.20
Mean	27.35	0.44	1.52	0.12	0.04	0.05	4.49	1.34
Median	29.03	0.15	0.05	0.02	0.02	0.01	1.12	0.06
Variance	87.20	2.02	8.82	0.07	0.01	0.05	56.86	5.67
Standard Deviation	9.34	1.42	2.97	0.27	0.08	0.23	7.54	2.38
Coefficient of Variation	0.34	3.23	1.96	2.28	1.89	4.40	1.68	1.78

Table 14-5: Descriptive statistics for the LIMO assays

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	9,338	7,984	8,290	8,296	7,916	8,277	9,306	8,298
Minimum	0.310	0.005	0.005	0.005	0.005	0.005	0.010	0.005
Maximum	68.74	22.80	19.30	4.69	1.75	4.10	61.20	13.10
Mean	28.09	0.44	1.11	0.09	0.04	0.05	3.93	0.96
Median	29.70	0.15	0.05	0.02	0.02	0.01	0.98	0.06
Variance	82.84	2.06	5.39	0.05	0.01	0.06	51.14	3.27
Standard Deviation	9.10	1.43	2.32	0.23	0.08	0.24	7.15	1.81
Coefficient of Variation	0.32	3.28	2.08	2.40	1.93	4.53	1.82	1.88

14.5.2 Compositing

Compositing of drillhole samples was conducted in order to homogenize the database for the statistical analysis and remove any bias associated to the sample length that may exist in the original database. The composite length (6.0 m) was determined using original sample length statistics, thickness of the mineralized zones, and mining units.

Inside the mineralized zones, 90% of the samples are between 3.0 m and 6.0 m in length. The average sample length is 4.8 m. Composites were generated with a length of 6.0 m, but allowing tail redistribution along the intervals, resulting in 99.25% of the composites being between 3.0 m and 6.0 m.

Missing samples were ignored during the compositing procedure as per QIO protocol. Although BBA made the recommendation to include missing samples with a grade of 0% Fe, unless justification such as sample lost or bad recovery are noted in the logs. That being said, verification was made to make sure ignoring unsampled intervals were not bringing a material bias in the model.

Table 14-6 to Table 14-9 show the basic statistics for the 6.0 m composites.

Table 14-6: Description statistics for the IF_only composites

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	8,105	7,378	7,543	7,540	7,341	7,503	8,049	7,546
Minimum	1.81	0.01	0.01	0.01	0.01	0.01	0.05	0.01
Maximum	66.80	18.53	16.85	4.24	0.98	3.41	48.92	11.20
Mean	29.32	0.38	1.15	0.10	0.04	0.05	4.12	1.00
Median	30.15	0.16	0.05	0.02	0.02	0.02	1.07	0.06
Variance	49.92	0.80	5.18	0.05	0.00	0.02	49.49	3.13
Standard Deviation	7.07	0.90	2.28	0.23	0.06	0.15	7.03	1.77
Coefficient of Variation	0.24	2.38	1.98	2.36	1.49	3.21	1.71	1.77

Table 14-7: Descriptive statistics for the IF_QRIF composites

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	8,800	8,021	8,195	8,192	7,983	8,154	8,741	8,198
Minimum	0.32	0.01	0.01	0.01	0.01	0.01	0.05	0.01
Maximum	66.80	18.53	16.85	4.24	1.75	3.41	50.80	12.61
Mean	27.73	0.40	1.21	0.10	0.04	0.05	3.98	1.03
Median	29.38	0.16	0.05	0.02	0.02	0.02	1.13	0.07
Variance	74.06	0.87	5.44	0.05	0.00	0.02	45.51	3.21
Standard Deviation	8.61	0.94	2.33	0.22	0.06	0.15	6.75	1.79
Coefficient of Variation	0.31	2.32	1.93	2.28	1.55	3.16	1.70	1.74

Table 14-8: Descriptive statistics for the SIF composites

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	8,921	8,031	8,196	8,193	7,994	8,157	8,866	8,199
Minimum	1.36	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Maximum	66.80	18.53	18.70	4.24	0.98	3.41	48.92	15.84
Mean	28.38	0.40	1.61	0.13	0.04	0.05	4.59	1.43
Median	29.48	0.17	0.06	0.03	0.02	0.02	1.26	0.08
Variance	58.69	0.94	8.81	0.08	0.00	0.02	52.04	5.70
Standard Deviation	7.66	0.97	2.97	0.28	0.06	0.15	7.21	2.39
Coefficient of Variation	0.27	2.42	1.85	2.17	1.51	3.20	1.57	1.67

Table 14-9: Descriptive statistics for the LIMO composites

Variable	Fe (%)	Al_2O_3 (%)	CaO (%)	MnO (%)	P_2O_5 (%)	TiO_2 (%)	Sat (%)	MgO (%)
Number	8,141	7,414	7,579	7,576	7,377	7,539	8,085	7,582
Minimum	1.81	0.01	0.01	0.01	0.01	0.01	0.05	0.01
Maximum	66.80	18.53	16.85	4.24	0.98	3.55	48.92	11.20
Mean	29.34	0.39	1.15	0.10	0.04	0.05	4.11	1.00
Median	30.16	0.16	0.05	0.02	0.02	0.02	1.07	0.06
Variance	50.48	0.90	5.16	0.05	0.00	0.03	49.27	3.12
Standard Deviation	7.10	0.95	2.27	0.23	0.06	0.16	7.02	1.77
Coefficient of Variation	0.24	2.45	1.98	2.36	1.53	3.40	1.71	1.77

14.5.3 High Grade Handling

There was no top cutting applied to higher iron grade assays for the Project.

It is common practice to statistically examine the higher grades within a population and to trim them to a lower grade value based on the results of a statistical study. The capping is performed on high grade values considered to be outliers. BBA conducted a basic statistical study to validate QIO's choice of not applying any capping. Figure 14-5 to Figure 14-8 show graphs supporting the absence of capping.

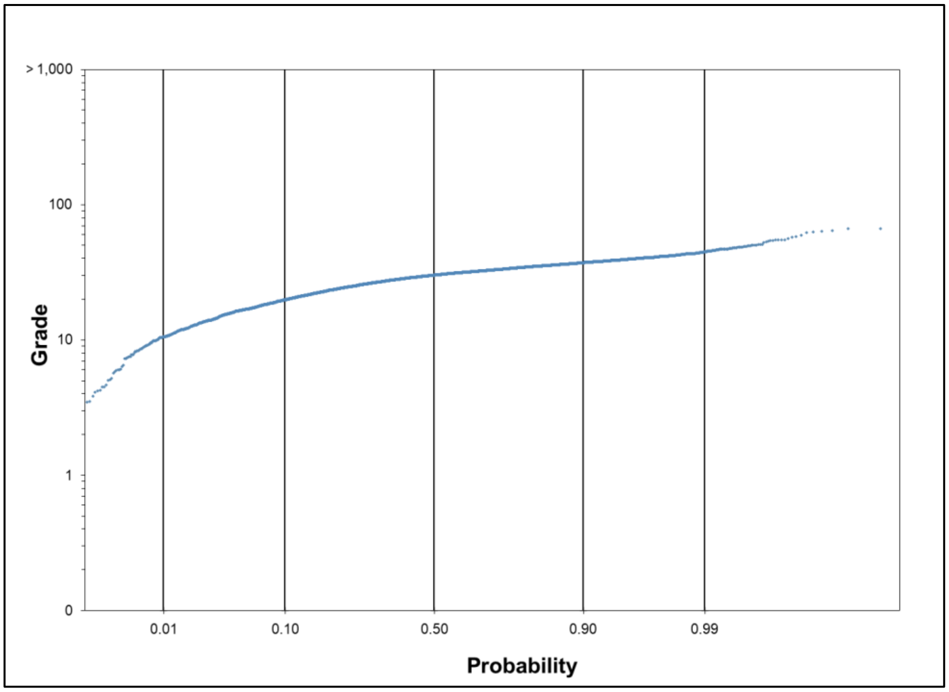

Figure 14-5: Probability plot of grade distribution for the IF_only composites

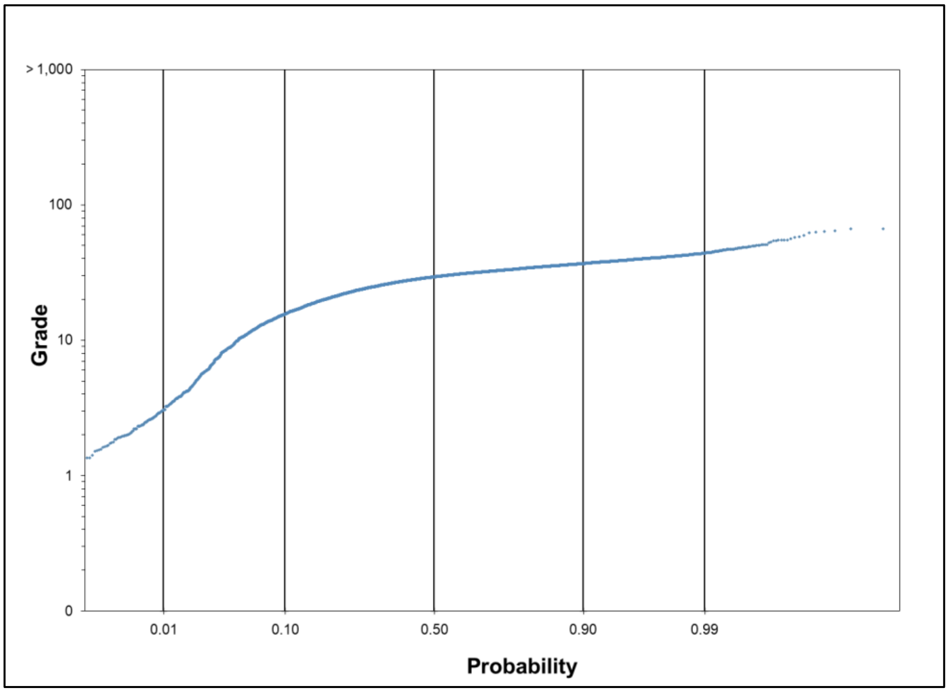

Figure 14-6: Probability plot of grade distribution for the IF_QRIF composites

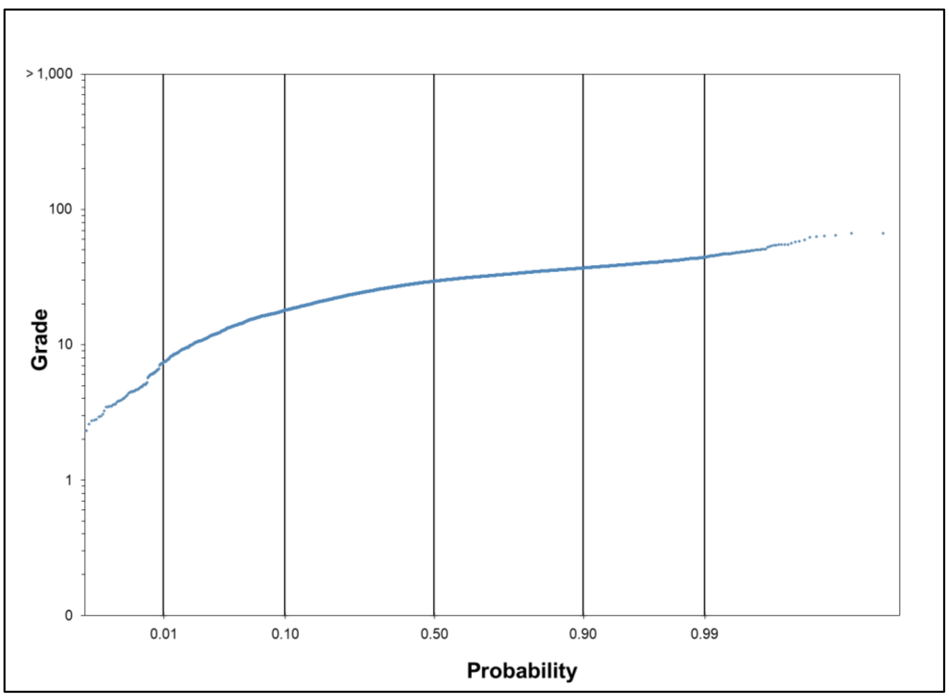

Figure 14-7: Probability plot of grade distribution for the SIF composites

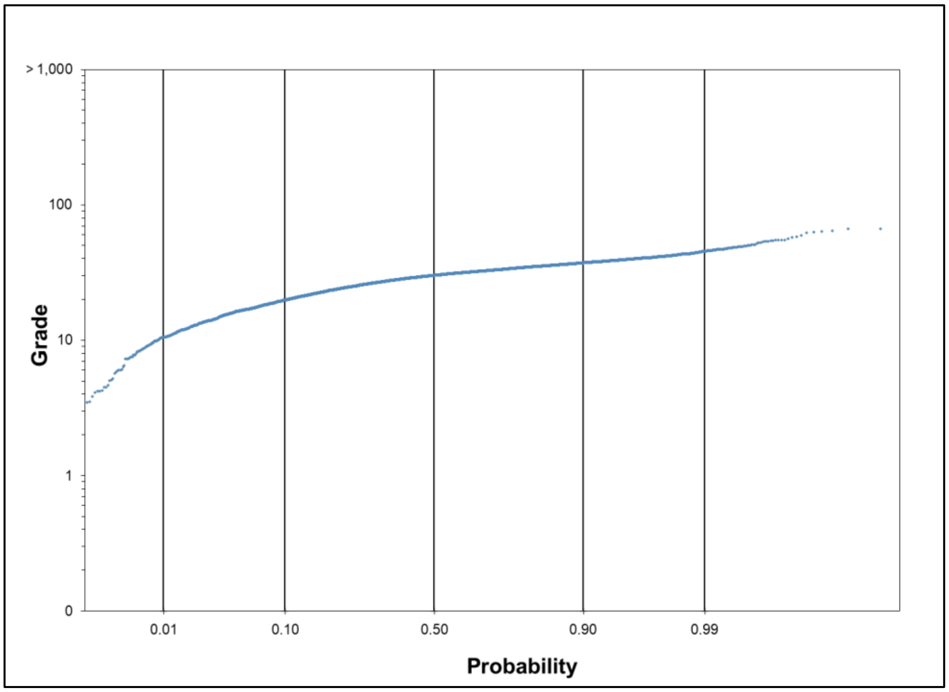

Figure 14-8: Probability plot of grade distribution for the LIMO composites

14.5.4 Density

For mineralized units, density values were calculated based on the formula established and used during the operational period:

$$SG = \text{Fe\%}\ \text{x}\ 0.0284 + 2.5764$$

Density values were calculated from the density of host rock, adjusted by the amount of iron as determined by metal assays. Waste material was assigned the density of porous dolomite (2.71 g/cm^3). The calculation was made on blocks in the block model.

Validations were performed to gain confidence that the formula presented above can be used for the purpose of the current MRE.

Unmineralized material was assigned fixed densities varying from 2.33 g/cm^3 to 3.19 g/cm^3 based on measurements from different laboratories.

It is the QP’s opinion that the densities were measured and recorded at appropriate intervals, and in an appropriate manner, for this kind of deposit.

Average and median densities of the mineralized units were tabulated for the entire Project (Table 14-10).

Table 14-10: Descriptive statistics of the calculated density for mineralized units

Geology unit	Lithology code	Rock code	Count	Min	Max	Mean	Median
Iron Formation	IF	200	86,991	2.84	4.09	3.45	3.46
Iron Formation Magnetite	IFM	203	12,242	3.06	3.72	3.44	3.45
Silicate Iron Formation	SIF	210	83,427	2.86	3.66	3.35	3.37
Silicate Iron Formation with actinolite	SIFA	211	3,612	2.83	3.52	3.20	3.19
Orange limonite	LIMO	221	1,458	2.80	2.80	2.80	2.80

14.5.5 Variography Analysis

A semi-variogram is a common tool used to measure the spatial variability within a zone. Typically, samples taken far apart will vary more than samples taken close to each other. A variogram gives a measure of how much two samples taken from the same mineralized zone will vary in grade depending on the distance between these samples, and therefore allowing building search ellipsoids to be used during interpolation.

A 3D directional variography was carried out on the composites using the Snowden Supervisor v8.9 software. Variograms were modelled in the three orthogonal directions to define a 3D ellipsoid for each structural domain. The three directions of ellipsoid axes were set by using the variogram fans and visually confirmed with geological knowledge of the deposit.

Then, a mathematical model was interpreted in order to best-fit the shape of the calculated variogram for each direction. Three components were defined for the mathematical model: the nugget effect, the sill, and the range. After completing the study, it was judged more appropriate to assign the variogram parameters of the iron grade throughout the deposit to all domains and adjust the orientation of the ellipsoids based on the structural planes of each domain. All elements were assigned the same variogram parameters.

The QP participated in the variography study and considers them appropriate to be used in the ordinary kriging (OK) estimation. Table 14-11 presents the chosen variogram model parameters, and Figure 14-9 to Figure 14-11 illustrate the variography results.

Table 14-11: Variogram model parameters

	First spherical structure				Second spherical structure			
Nugget	Sill	Range X (m)	Range Y (m)	Range Z (m)	Sill	Range X (m)	Range Y (m)	Range Z (m)
0.21	0.32	83	33	35	0.47	345	140	60

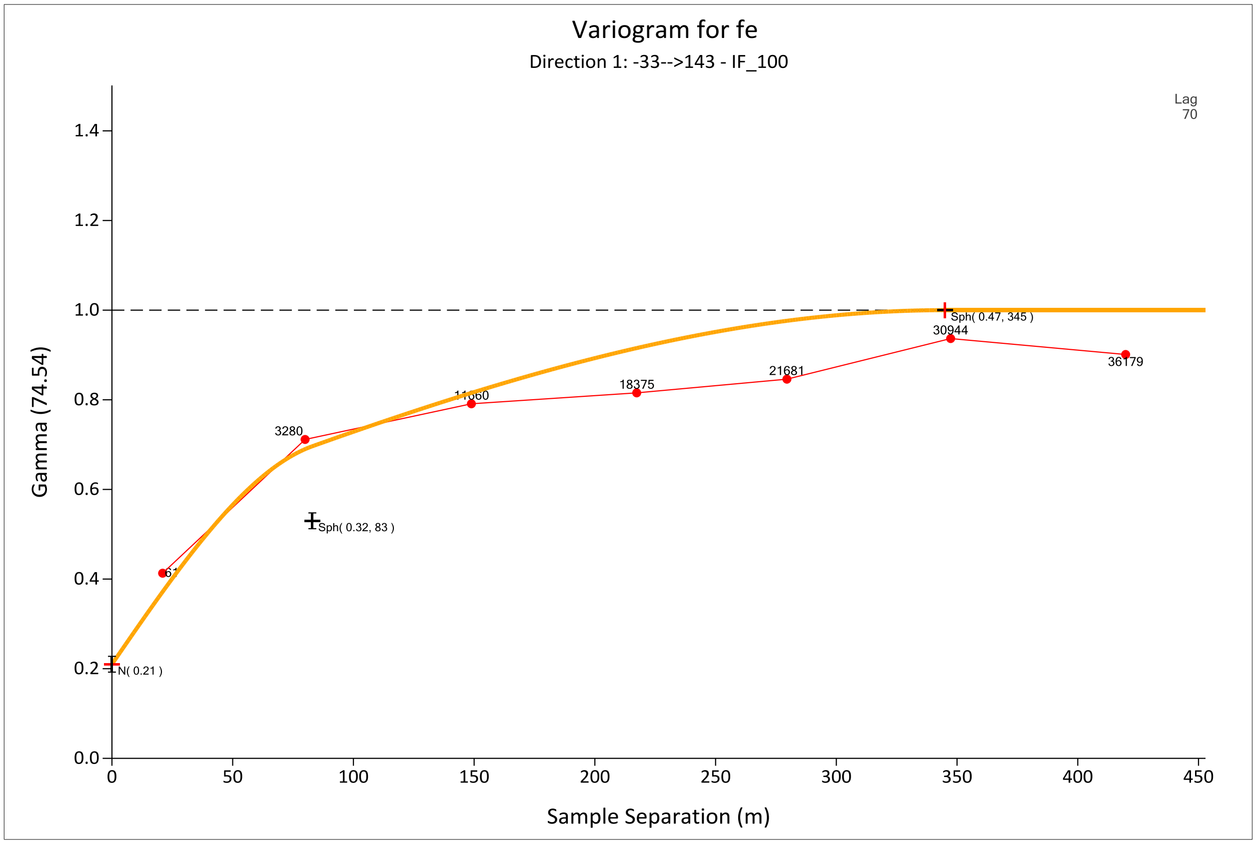

Figure 14-9: Major axis variography study for the iron content

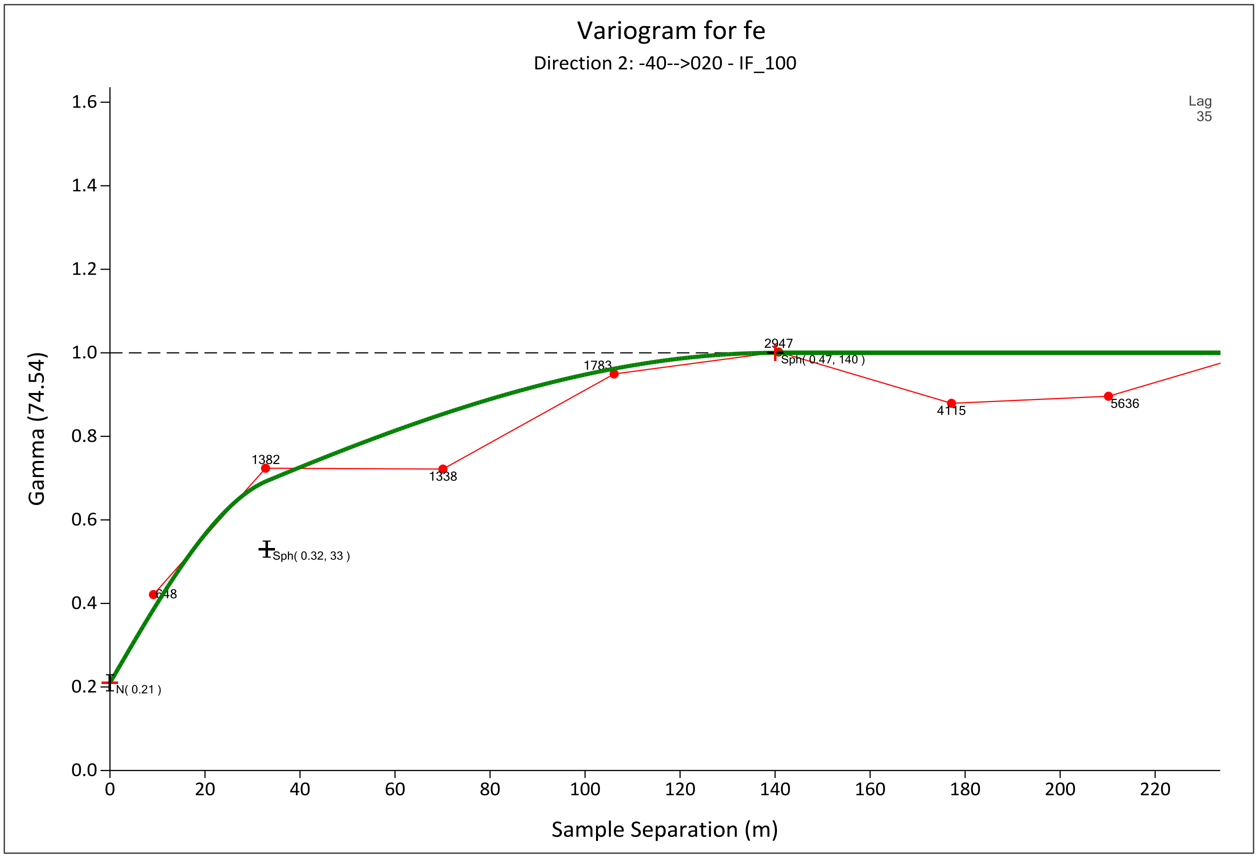

Figure 14-10: Semi-major axis variography study for the iron content

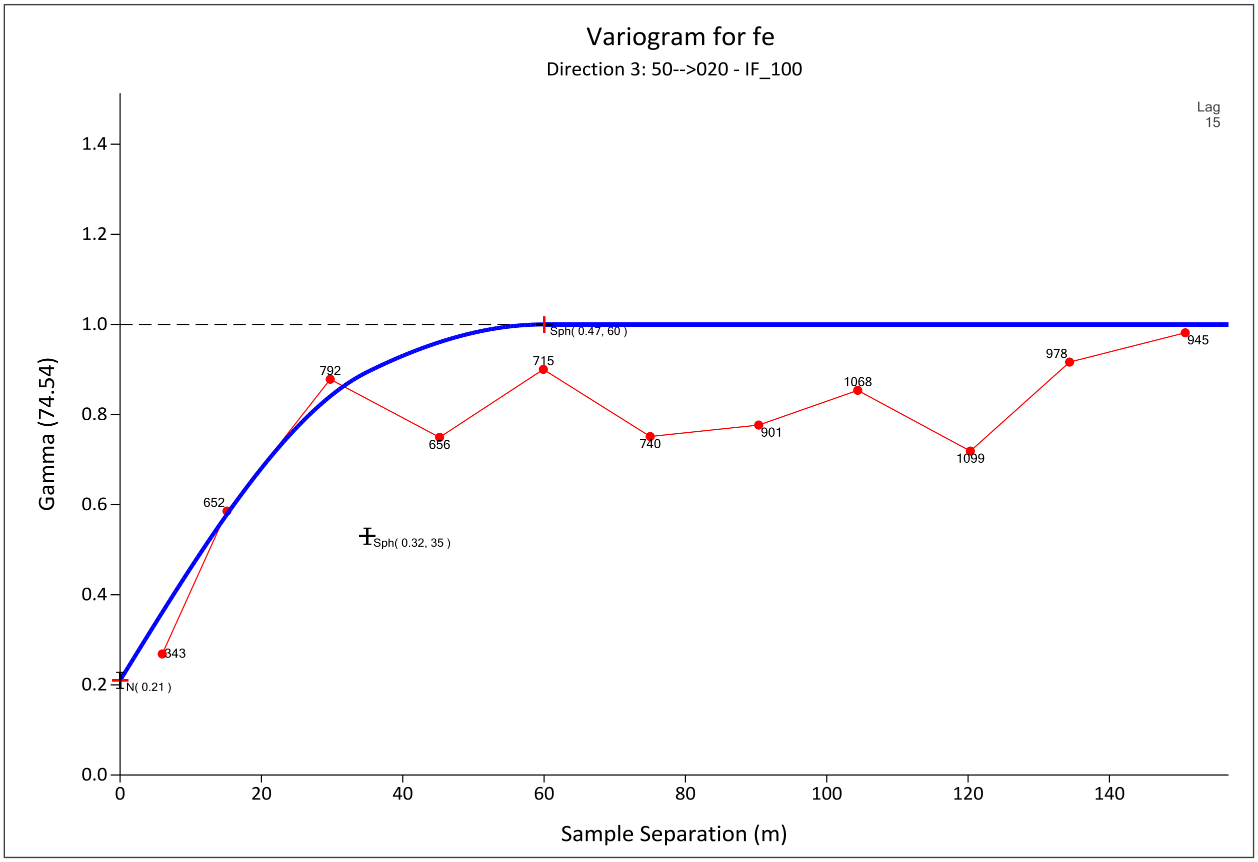

Figure 14-11: Minor axis variography study for the iron content

14.6 Block Modelling

The block model for the Bloom Lake project was set in Geovia Surpac 2019HF1 v.7.0.1949.0.

14.6.1 Block Model Parameters

The size of the blocks were chosen to best match the drilling pattern, the thickness of the zones, the complexity of the geology model and the open pit mine planning. The block model parameters are summarized in Table 14-12.

Table 14-12: Block model parameters

Properties	X (column)	Y (row)	Z (level)
Origin coordinates	611,800	5,853,000	-24
Number of blocks	640	400	72
Block extent (m)	6,400	4,000	1,008
Block size (m)	10	10	14
Rotation	No rotation		

The block model was coded using the 50-50 model method, reflecting the proportion of each wireframe inside every block. Rock codes were attributed to each block according to the highest proportion of lithology included in the block. Additionally, blocks that were located at least 50% inside the overburden solid and at least 99% above the topography surface were identified as overburden and air, respectively.

14.6.2 Search Ellipsoid Strategy

One search ellipsoid was used for each structural domain in the interpolation of all grade attributes. Ranges and orientations of the ellipses are representative of the anisotropy ratios and directions as determined from the variography analysis. Table 14-13 details search parameters by structural domain.

Table 14-13: Search ellipsoid orientation and ranges presented by structural domain

			Pass 1			Pass 2 (mostly for exploration purposes)		
	Orientation		Search ellipsoid ranges			Search ellipsoid ranges		
Blockcode	Azimut	Dip	X (m)	Y (m)	Z (m)	X (m)	Y (m)	Z (m)
1000	120	40	345	138	60	1,035	414	180
2000	105	35	345	138	60	1,035	414	180
3000	27	25	345	138	60	1,035	414	180
4000	88	22	345	138	60	1,035	414	180
5000	90	0	345	138	60	1,035	414	180
6000	90	0	345	138	60	1,035	414	180
7000	90	0	345	138	60	1,035	414	180
8000	95	0	345	345	345	1,035	1,035	1,035
9000	70	0	345	138	60	1,035	414	180
10000	260	15	345	138	60	1,035	414	180

			Pass 1			Pass 2 (mostly for exploration purposes)		
	Orientation		Search ellipsoid ranges			Search ellipsoid ranges		
Blockcode	**Azimut**	**Dip**	**X (m)**	**Y (m)**	**Z (m)**	**X (m)**	**Y (m)**	**Z (m)**
11000	90	5	345	138	60	1,035	414	180
12000	255	55	345	138	60	1,035	414	180
13000	270	65	345	138	60	1,035	414	180
14000	240	55	345	138	60	1,035	414	180
15000	270	35	345	138	60	1,035	414	180
16000	272	55	345	57.5	57.5	1,035	172.5	172.5
17000	268	0	345	138	60	1,035	414	180
18000	270	15	345	345	345	1,035	1,035	1,035
19000	270	75	345	138	60	1,035	414	180
20000	225	50	345	138	60	1,035	414	180
21000	0	70	345	345	345	1,035	1035	1035
22000	136	70	345	138	60	1,035	414	180

14.6.3 Interpolation Parameters

With a large search ellipse within large units, the number of composites to be used during the interpolation becomes a key estimation parameter.

A kriging neighbourhood analysis (KNA) was conducted on the most representative zones with the Snowden Supervisor software. KNA provides a quantitative method of testing different estimation parameters (i.e. block size, discretization and min/max of composites used for the interpolation) by evaluating their impact on the quality of the results.

Following this study, the parameters provided in Table 14-14 were chosen for the interpolation of the Bloom Lake block model.

Table 14-14: Composite constraints used for the estimation of each element

Interpolation parameters	Pass 1	Pass 2
Minimum number of composites used	3	3
Maximum number of composites per drillhole used	4	4
Maximum number of composites used	32	32

14.6.4 Interpolation Methodology

The interpolation was run with the use of two passes on a set of points extracted from the 6.0 m composited data. The block model grades were estimated using OK methods constrained inside the mineralized wireframes.

Hard boundaries between the mineralized zones were used in order to prevent grades from adjacent zones being used during interpolation. Soft boundary was used between structural domains to avoid artificial breaks in the grade distribution. As a block was estimated, it was tagged with the corresponding pass number.

For comparison purposes, additional grade models were generated using 1) inverse distance squared (ID^2); and 2) nearest neighbour (NN).

14.7 Block Model Validation

Every step of the block modelling process was revised to ensure fair representation of the available data in the Bloom Lake resource model.

More specific validations were completed on the block model including visual review of the interpolated grades in relation to the raw and composited data, checks for global and local bias, graphical validation (swath plots), statistical analysis of the model, comparison to other estimation methods and reconciliation with production data.

14.7.1 Visual Validation

Block model grades were visually compared against drillhole composite grades and raw assays in cross-section, plan, longitudinal and 3D views. This visual validation process also included confirming that the proper coding was done within the various domains.

The visual comparison shows a good correlation between the values without excessive smoothing. Visual comparisons were also conducted between ID^2, OK and NN interpolation scenarios. The OK scenario used for the resource estimate produced a grade distribution honouring drillhole data and the style of mineralization observed at Bloom Lake.

14.7.2 Statistical Validation

Grade averages for the OK, NN and ID^2 models were tabulated in Table 14-15. This comparison did not identify significant issues.

The average iron grades generated by the NN and ID^2 interpolation methods are very close to those reported from the OK interpolation method.

Table 14-15: Comparison of the block and composite mean grades at a zero cut-off grade (blocks > 50% inside a mineralized zone)

Unit	Number of composites	Average composite grade (% Fe)	Number of blocks	OK grade model (% Fe)	ID^2 grade model (% Fe)	NN grade model (% Fe)
SIF	8,921	28.38	185,837	29.07	29.26	29.14
LIMO	8,141	29.34	100,256	30.79	30.95	30.94
IF_QRIF	8,800	27.73	98,798	30.78	30.95	30.93
IF_only	8,105	29.32	98,798	30.78	30.95	30.93

14.7.3 Block Model Reconciliation

The previous block model showed local divergence, but it is expected that the current block model will provide better predictions by the fact that:

- Recent modelling updates address local observations allowed by recent mining operation;
- The improved structural domains provide a better control of the orientation of the grade interpolation;
- Grade distribution better honours the drillhole database.

14.8 Mineral Resource Classification

The mineral resources for the Bloom Lake project were classified in accordance with CIM Standards.

14.8.1 Mineral Resource Definition

The "CIM Definition Standards for Mineral Resources and Reserves" published by the Canadian Institute of Mining, Metallurgy and Petroleum for the resource classification clarifies the following:

> <u>*"Inferred Mineral Resource:*</u>
>
> *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. Geological evidence is sufficient to imply but not verify geological and grade or quality continuity.*
>
> *An Inferred Mineral Resource has a lower level of confidence than that applying to an Indicated Mineral Resource and must not be converted to a Mineral Reserve. It is reasonably expected that the majority of Inferred Mineral Resources could be upgraded to Indicated Mineral Resources with continued exploration.*

<u>Indicated Mineral Resource:</u>

*An **Indicated Mineral Resource** is that part of a Mineral Resource for which quantity, grade or quality, densities, shape and physical characteristics are estimated with sufficient confidence to allow the application of Modifying Factors in sufficient detail to support mine planning and evaluation of the economic viability of the deposit.*

Geological evidence is derived from adequately detailed and reliable exploration, sampling and testing and is sufficient to assume geological and grade or quality continuity between points of observation.

An Indicated Mineral Resource has a lower level of confidence than that applying to a Measured Mineral Resource and may only be converted to a Probable Mineral Reserve.

<u>Measured Mineral Resource:</u>

*A **Measured Mineral Resource** is that part of a Mineral Resource for which quantity, grade or quality, densities, shape, and physical characteristics are estimated with confidence sufficient to allow the application of Modifying Factors to support detailed mine planning and final evaluation of the economic viability of the deposit.*

Geological evidence is derived from detailed and reliable exploration, sampling and testing and is sufficient to confirm geological and grade or quality continuity between points of observation.

A Measured Mineral Resource has a higher level of confidence than that applying to either an Indicated Mineral Resource or an Inferred Mineral Resource. It may be converted to a Proven Mineral Reserve or to a Probable Mineral Reserve."

14.8.2 Mineral Resource Classification for the Bloom Lake Project

The estimated block grades were classified into Measured, Indicated and Inferred Mineral Resource categories using drill spacing, geological continuity, number of holes used and slope of regression (see Table 14-16).

When needed, a series of clipping boundaries were created manually in 3D views to either upgrade or downgrade classification in order to avoid artifacts due to automatically generated classification. All remaining estimated but unclassified blocks were flagged as "Exploration Potential".

It must be noted that the 2018 drill program was used for classification purposes although assay results had not been received. The QP does not recommend doing so, but verifications allowed determining that these drillholes affected a very limited amount of material throughout the deposit (less than 1% of the tonnage). Additional verifications allowed confirming that mineralization was identified in the 2018 drillholes at similar visual content as adjacent holes. Once results are received by QIO and included in a future update of the block model, it is anticipated that tonnage will not be affected, but grade could locally be slightly lower or higher for the limited amount of blocks within interpolation reach of the 2018 drillholes. The anticipated variations are judged non-material by the QP and will have an insignificant impact on the mineral resource estimate Figure 14-12 shows the distribution of the classified blocks within the resource pit shell.

Table 14-16: High level guidelines used to classify resources at Bloom Lake

Parameters	Measured	Indicated	Inferred
Minimum number of holes	6	3	1
Average distance to composites	≤ 150	≤ 250	-
Slope of regression	≥ 0.8	≥ 0.5	-

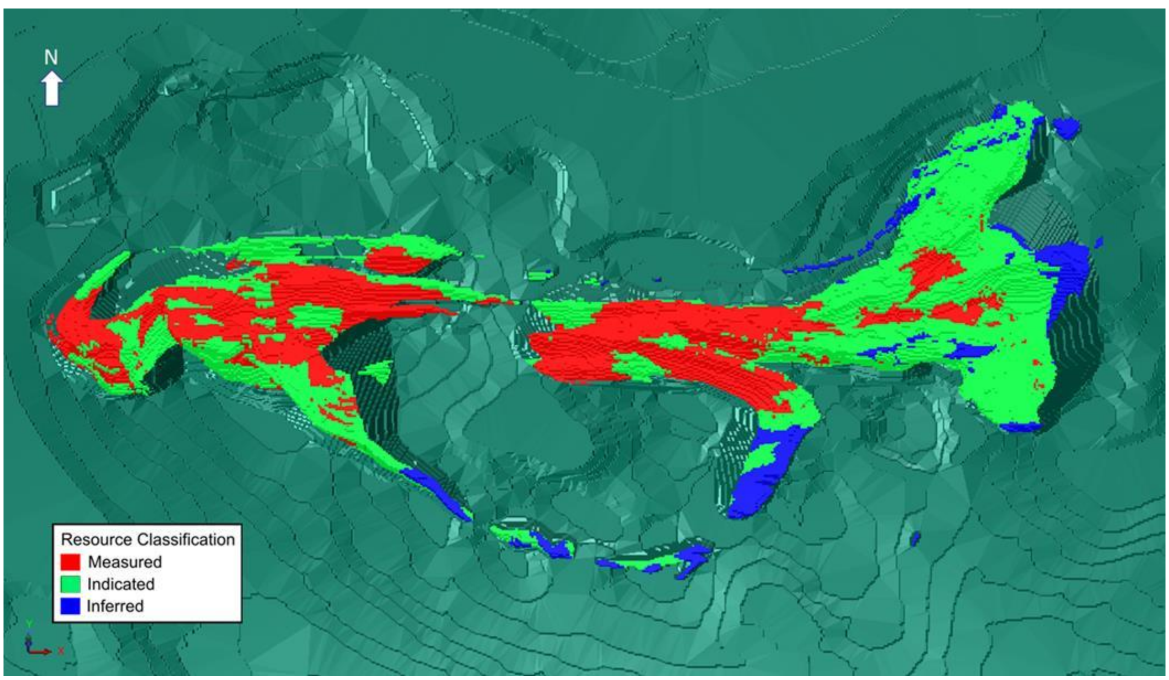

Figure 14-12: 3D view showing block classification

14.9 Cut-off Grade and Pit Optimization

According to CIM's Definition Standards, in order for a deposit to be considered a Mineral Resource it must be proven that there are "reasonable prospects for eventual economic extraction". This requirement implies that the quantity and grade estimates meet certain economic thresholds and that the Mineral Resources are reported at an appropriate cut-off grade that takes into account extraction scenarios and processing recoveries.

In order to determine the quantity of mineralization that shows a "reasonable prospect for eventual economic extraction" using open pits mining methods, BBA carried out a pit optimization analysis using Hexagon MineSight's Economic Planner. This analysis evaluates the profitability of each mineralized block in the model based on its value. The pit optimization parameters are presented in Table 14-17.

It is important to note that the results from the pit optimization exercise are used solely for testing the "reasonable prospects for eventual economic extraction" by open pit mining methods and do not represent an economic study.

The cut-off grade used for the Mineral Resource Estimate is 15% Fe. The pit optimization analysis carried out for the Mineral Resource Estimate used the same parameters as for the pit optimization for the economic study presented in this Report, but allowed for Inferred material to be considered.

Table 14-17: Bloom Lake optimization parameters

Parameter	Base value	Unit
Mining costs		
Mining cost	2.50	CAD/t mined
Incremental bench cost	0.039	CAD/t / 14 m
Processing & G&A costs		
G&A cost	2.76	CAD/t milled
Concentrator cost	3.70	CAD/t milled
Total operating cost	6.46	CAD/t milled
Net value & payment		
CFR 62% iron	61.50	USD/t
Concentrate premium	12.70	USD/t / %
CFR 66.2% iron	74.20	USD/t
Exchange rate	0.81	USD/CAD
CFR 66.2% iron	92.01	CAD/t
Shipping and logistics	18.88	CAD/t
Selling costs	26.04	CAD/t
Iron price FOB Bloom Lake	47.09	CAD/t
Iron recovery	varies	%
Weight recovery	varies	%
Discount rate	8.00	%
Concentrate production rate	15.00	Mtpy

It is the QP's opinion that the calculated cut-off grade is relevant to the grade distribution of this Project and that the mineralization exhibits sufficient continuity for economic extraction under the cut-off applied.

14.10 Bloom Lake Mineral Resource Estimate

The Measured, Indicated and Inferred Mineral Resources for the Bloom Lake project presented herein is estimated at a cut-off grade of 15% Fe, inside an optimized Whittle open pit shell based on a long term iron price of USD61.50/dmt for 62% Fe content, a premium of USD12.7/dmt for the 66.2% Fe concentrate and an exchange rate of 1.24 CAD/USD. The Measured and Indicated Mineral Resource for the Bloom Lake project is estimated at 893.5 Mt with an average grade of 29.3% Fe, and Inferred Mineral Resource at 53.5 Mt with an average grade of 26.2% Fe. Table 14-18 presents the resource estimation tabulation by category. Figure 14-13 shows a 3D view of the grade distribution within the open pit optimized shell.

Table 14-18: Mineral resources estimate for the Bloom Lake project

Classification	Tonnage (dry) kt	Fe %	CaO %	Sat %	MgO %	Al_2O_3 %
Measured	379,100	30.2	1.4	4.4	1.4	0.3
Indicated	514,400	28.7	2.5	7.7	2.3	0.4
Total M&I	893,500	29.3	2.1	6.3	1.9	0.4
Inferred	53,500	26.2	2.8	8.0	2.4	0.4

Notes on Mineral Resources:

1. The independent qualified person for the 2019 MRE, as defined by NI 43-101 Guidelines, is Pierre-Luc Richard, P. Geo, of BBA Inc. The effective date of the estimate is April 19, 2019. CIM definitions and guidelines for Mineral Resource Estimates have been followed.
2. These mineral resources are not mineral reserves as they do not have demonstrated economic viability. The MRE presented herein is categorized as Measured, Indicated and Inferred resources. The quantity and grade of reported Inferred resources in this MRE are uncertain in nature and there has been insufficient exploration to define these Inferred resources as Indicated or Measured; however, it is reasonably expected that the majority of Inferred mineral resources could be upgraded to Indicated mineral resources with continued exploration.
3. Resources are presented as undiluted and in situ for an open pit scenario and are considered to have reasonable prospects for economic extraction. The constraining pit shell was developed using pit slopes varying from 42 to 46 degrees. The pit shell was prepared using Minesight.
4. The MRE was prepared using GEOVIA Surpac 2019HF1 v.7.0.1949.0 and is based on 569 surface drillholes (141,289 m) and a total of 11,397 assays.
5. Density values were calculated based on the formula established and used by the issuer.
6. Grade model resource estimation was calculated from drillhole data using an ordinary kriging interpolation method in a block model using blocks measuring 10 m x 10 m x 14 m (vertical) in size.
7. The estimate is reported using a cut-off grade of 15% Fe. The MRE was estimated using a cut-off grade of 15% Fe, inside an optimized open pit shell based on a long term iron price of USD61.50/dmt for 62% Fe content, a premium of USD12.70/dmt for the 66.2% Fe concentrate and an exchange rate of 1.24 CAD/USD. The cut-off grade will need to be re-evaluated in light of future prevailing market conditions and costs.
8. Calculations are in metric units (metre, tonne). Metal contents are presented in percent (%). Metric tonnages are rounded and any discrepancies in total amounts are due to rounding errors.
9. The author is not aware of any known environmental, permitting, legal, title-related, taxation, socio-political or marketing issues, or any other relevant issues not reported in this Technical Report that could materially affect the Mineral Resource Estimate.