2018 ANNUAL GROUP REPORT GR377

MLNs 214, 341, 343, 349

Iron Blow

Au, Zn, Ag, Pb, Cu

Year ending 31 December 2018

Distribution:-

Department of Primary Industry and Resources, Darwin NT

PNX Metals Ltd, Adelaide

1:100 000 – Pine Creek
1:250 000 – Pine Creek

Charles Nesbitt
February 2019

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1 ABSTRACT

PNX Metals Ltd ("PNX") purchased the Iron Blow tenements in late 2014. This is the fourth of the Group Reports (GR377) pertaining to MLNs 214, 341, 343 and 349 collectively referred to as the "Iron Blow leases".

PNX are exploring the Iron Blow leases as part of the Hayes Creek Project, which also includes the Mount Bonnie leases located approximately 2km to the south. Iron Blow is a polymetallic Au, Zn, Ag, Pb and Cu deposit within the Pine Creek Orogen, discovered in the 1870's and mined sporadically up to 1985. It produced approximately 13,700t of oxide and sulphide ore in the early 1900's of gold and a further ~15,000t of oxide ore was treated in 1985-86.

During the 2018 reporting period, PNX continued with a Definitive Feasibility Study, which included continuing hydrological, environmental and geochemical studies and metallurgical testwork.

There was no field work undertaken during the reporting period.

The final report for the hydrological studies undertaken at the end of 2017 was received during the reporting period and results are included in this report.

Further work will include continued geochemical, metallurgical, engineering and environmental studies in support of the definitive feasibility study and environmental studies in support of project approval.

2 COPYRIGHT

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Any information included in the report that originates from historical reports or other sources is listed in the “References” section at the end of the document.

This report may be released to open file as per Regulation 125(3)(a).

3 LOCATION & ACCESS

Iron Blow is located within granted Mineral Leases approximately 145 km southeast of Darwin and 11 km east-northeast of the Hayes Creek Roadhouse, not far from the first discovery of gold in the Northern Territory in 1870 at Yam Creek, during construction of the Overland Telegraph line.

Access to Iron Blow is via Stuart Highway to the Fountain Head Road (which is sealed), right onto the Mt Wells Road which is a well-maintained dirt road, and then right again onto Grove Hill Road. Dirt tracks, which are generally accessible during the wet season, lead into the Iron Blow site. Alternatively, the Grove Hill Road can be accessed directly from the Stuart Highway a few kilometres past the Hayes Creek Roadhouse.

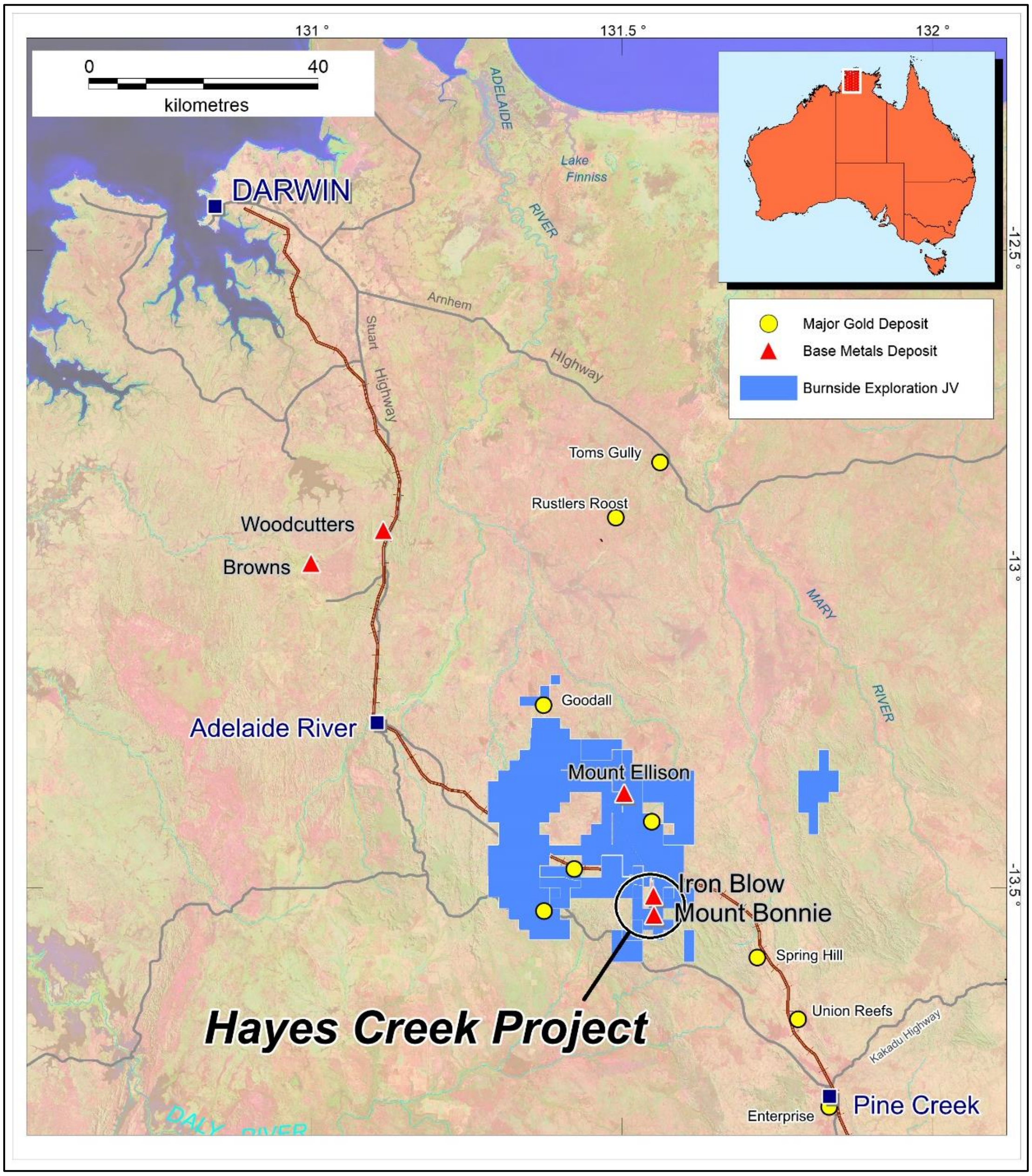

Figure 1: Iron Blow Location

4 TENEMENT DETAILS

The Iron Blow prospect comprises four granted Mineral Leases totalling 51.1 hectares (Table 1 and Figure 2). All are 100% owned by PNX. These leases were first granted as far back as 1975, but have changed ownership many times since.

Table 1: Iron Blow Tenement Summary

Tenement	Project	Grant Date	Expiry Date	Holder	Area Hectare
MLN214	Iron Blow	14/10/2004	31/12/2029	PNX Metals Ltd.	6.3
MLN341	Iron Blow	19/12/2006	31/12/2026	PNX Metals Ltd.	14.9
MLN343	Iron Blow	19/12/2006	31/12/2026	PNX Metals Ltd.	14.9
MLN349	Iron Blow	19/12/2006	31/12/2026	PNX Metals Ltd.	15
					51.1

PNX purchased the Mineral Leases at Iron Blow and Mount Bonnie in 2014 from Newmarket (then Crocodile Gold Australia).

All mineral titles are situated within Pastoral Lease No. 903, Douglas, held by Dr Tony Haines, however there are currently no pastoral activities in the area. PNX personnel have met with Tony and commenced a cooperative relationship. During 2016 PNX signed a land access agreement with Douglas Station.

Native Title has been extinguished over the mineral titles, nevertheless PNX will take cultural heritage into consideration during any project development. A cultural heritage survey was undertaken in the area by Begnaze Pty Ltd in 2011. In 2016, PNX followed up with a new anthropological survey (Karen Martin-Stone at In-Depth Archaeology).

The Iron Blow leases show evidence of extensive mining disturbance, however in undisturbed areas there is evidence for Aboriginal occupation consistent with the broader region. Given the significant extent of disturbance within the leases, the assessment concluded that there is very low risk to Aboriginal sites within the work area.

As part of the 2017 work program, the lease boundaries were visited and differential GPS pick-ups were taken. This has shown that the digital lease boundaries are inaccurate and will need to be updated (see 2017 Report).

Figure 2: Iron Blow leasing and Infrastructure

5 GEOLOGICAL SETTING

5.1 REGIONAL GEOLOGY

The Mount Bonnie and Iron Blow deposits are situated within the Pine Creek Orogen (Figure 3), which has been interpreted as an intracratonic basin lying on Archaean basement containing a 14 km thick sequence of deformed Proterozoic sediments deposited from 2.2 Ga to 1.87 Ga.

The sedimentary sequence (Figure 4) is dominated by pelitic and psammitic (continental shelf shallow marine) sediments with locally significant inter-layered cherty tuff units. Strata of the South Alligator Group and lower parts of the Finniss River Group evolved from initial low energy, shallow basin sedimentation, to higher energy, deep water flysch facies. Pre-orogenic mafic sills of the Zamu Dolerite event (~1.87 Ga) intrude South Alligator Group formations.

During the Top End Orogeny (Nimbuwah Event ~1.87–1.85 Ga) the sequence was tightly folded, faulted and pervasively altered with metamorphic grade averaging greenschist facies, with phyllite, in sheared zones.

The Cullen intrusive event introduced a suite of fractionated calc-alkaline granitic batholiths into the sequence from ~1.84 to 1.80 Ga. These high temperature I-type intrusives induced strong contact metamorphic aureoles, ranging up to (garnet) amphibolite facies, and created regionally extensive biotite and andalusite hornfels facies.

Less deformed Middle and Late Proterozoic clastic rocks and volcanics have an unconformable relationship to the older sequences. Flat-lying Palaeozoic and Mesozoic strata, along with Cainozoic sediments and proto-laterite cementation overlie parts of the Pine Creek Orogen lithologies. Recent scree deposits, sometimes with proto-laterite cement, occupy the lower hill slopes while fluviatile sands, gravels and black soil deposits mask the river/creek flats areas.

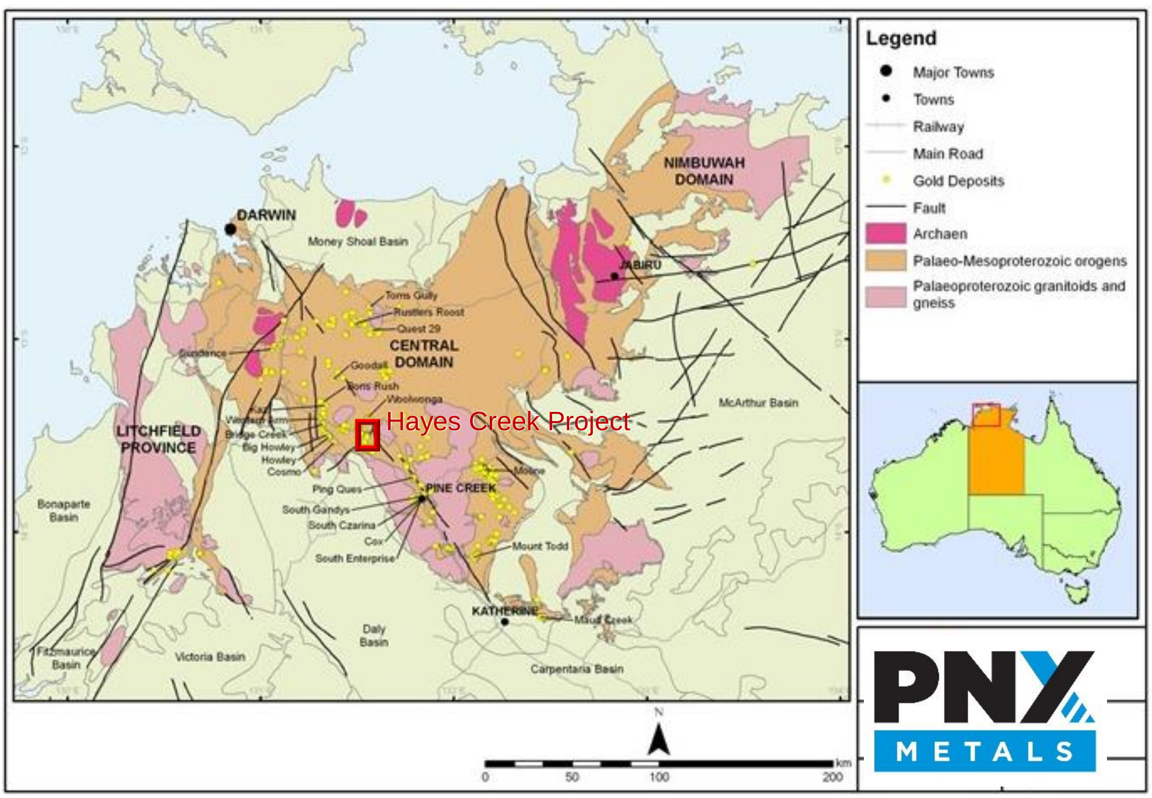

Figure 3: Regional Geology

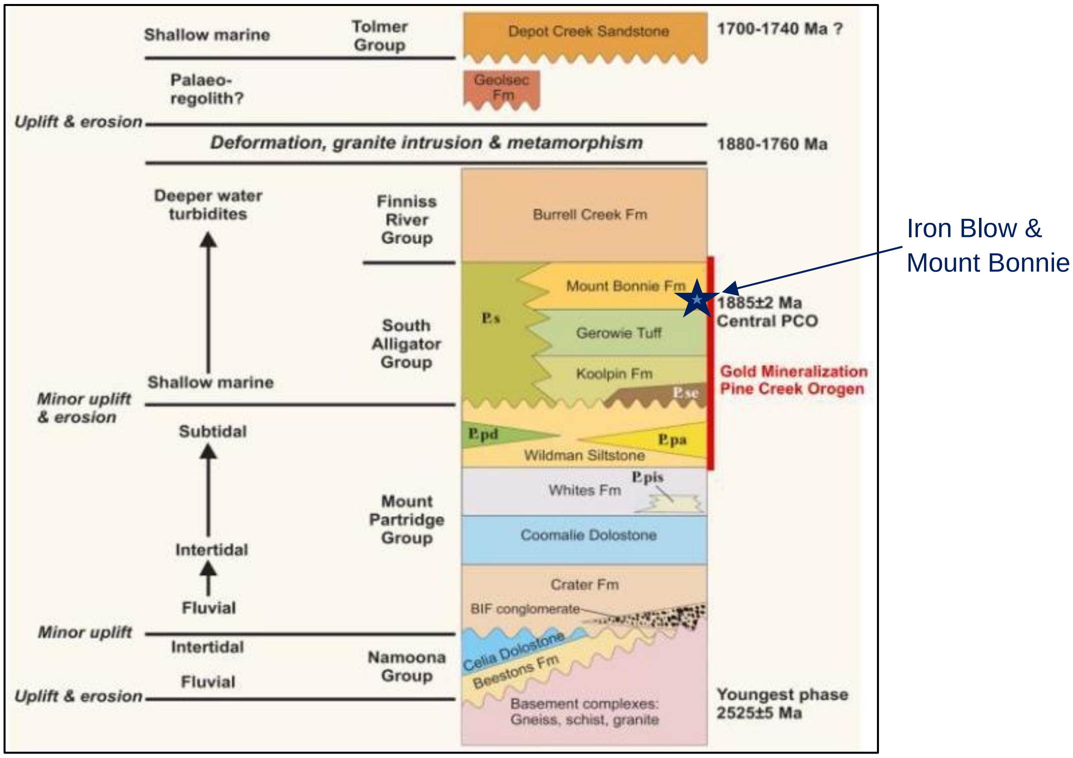

Figure 4: Stratigraphic Column, Pine Creek Orogen

5.2 Local Geology

The Mount Bonnie and Iron Blow deposits occupy approximately the same stratigraphic location near the bottom of the Mount Bonnie Formation in the Margaret Syncline close to the contact with the underlying Gerowie Tuff (Figure 5). Both are mineralogically similar deposits, thought to be volcanogenic massive sulphide (VMS) deposits formed at or near the sea floor by submarine felsic volcanic activity. The fumaroles circulated metal-rich hydrothermal fluids into the local sediments.

These strata were deformed at approximately 1875 Ma during an event which produced open upright folds in the sedimentary sequence. The folds strike approximately north-south and plunge to the north. The deposits were rotated down towards the north-south trending axis of the Margaret Syncline and lie more or less on their sides. Both deposits have been partly dismembered by east-west trending cross faults and sheared by thrust faults operating approximately along the bedding planes. The massive sulphides possibly represent ductile boudins in the more brittle enclosing sedimentary package and are the focus for shearing and offset faulting which occurred during the folding.

The key sedimentary units consist of dark grey, silicified felsic tuff and tuffaceous siltstone (the Gerowie Tuff), overlain by a sequence of turbidity current-related mudstones, siltstones and grey sandstones (the Mount Bonnie Formation). Mineralisation is stratiform, located near the base of the Mount Bonnie Formation sequence. Later intrusion of granite batholiths in the region has not substantially affected mineralisation. The area has remained structurally stable since Proterozoic times and has been more or less under continuous erosion.

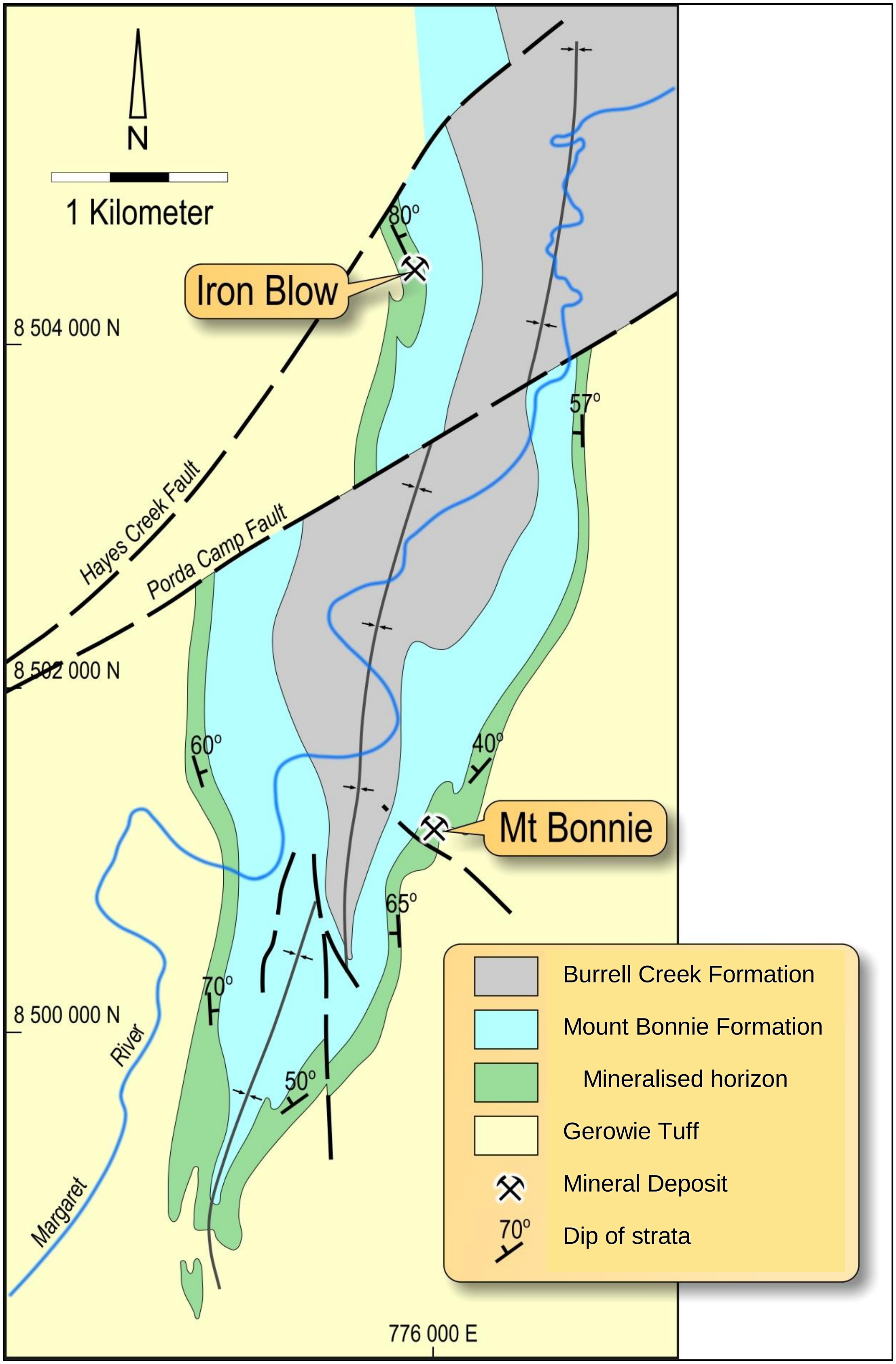

Figure 5: Local Geology

6 PROJECT HISTORY

The Iron Blow lode was discovered in 1873, as part of the gold rush that followed discovery of gold during post-hole digging of the overland telegraph line at nearby Yam Creek. There was little work done on the ironstone outcrops while prospecting at first focussed on quartz reefs in the area, and presumably, because the gold at Iron Blow could not be readily panned. The first investigations of the outcrop were around 1888 due to its supposed similarity with the newly discovered Broken Hill lode in NSW. The first assay result returned 408 oz per ton silver. The lode was worked for the gold and silver content of the gossan and when examined in 1891, it was reported that 20t had been crushed for 10oz of gold and 70t had been crushed at 6 dwt gold per ton, and that an 85-foot shaft had been sunk with a short northerly drive.

In 1896, the Iron Blow lease (along with numerous other leases in the area) were taken up by Northern Territory Gold Fields of Australia and a pumping and winding plant was installed in 1898. In 1900, a shaft was sunk to 60 feet, and 70 feet of drives were developed. 2t of ore were sent to England for treatment. In 1901, the shaft was deepened to 100 feet. In 1903, a new three-compartment (4 ft^2 each) main shaft was sunk and lined with iron plate to 75ft, timbered thereafter. New compressors, boilers and winding plant were installed in 1904 to cope with the inflow of water. The company announced that an estimated 17,000t of sulphide ore was in sight, containing payable quantities of copper (averaging 7%), silver (averaging 9.21 oz/t) and gold (averaging 2.6 dwt/t). Another estimate given in this year included 14,000t of gossan ore grading 1% Cu, 12.65 oz/t Ag, and 7.8 dwt/t gold. These estimates were for ore above the 100 feet level, the lode was reported to be 20 feet wide, and opened up for a length of nearly 400 feet.

In 1904 the Main shaft was deepened to 215 feet, and the levels at 50, 80 and 100 feet were extended and winzes sunk at these levels. 7,862 tons of ore drawn from these three levels and from the outcrop were smelted.

In 1905 a level was opened up at 200 feet, with drives to the north of 210 feet and drives to the south of 42 feet, with about 100 feet of crosscutting and some winzes from the 100 feet level (Figure 6). The ore was shown to exist in two lenses separated by 60 feet. No record is available of the amount of ore smelted in this year, but the smelter product (which may not be from Iron Blow) was 117.5t. The ore was reportedly becoming poorer with depth to the 200ft level. Sulphide ores were known to contain a complex mixture of copper, lead and zinc, with variable gold and silver. Zinc grading up to 20% was noted. Based on survey measurements, and the average of some hundreds of assays, the ore contained approximately 5 dwt/t Au, 12 oz/t Ag, 6% Zn, 5% Pb and 0.5% Cu, the rest being pyrite and 8 to 10% silica. Gossan grades were significantly enriched in gold and silver, averaging 11.5 dwt/t Au and 24 oz/t Ag. A small amount of auriferous “siliceous capping” material was also noted, varying from 1-10 dwt/t Au.

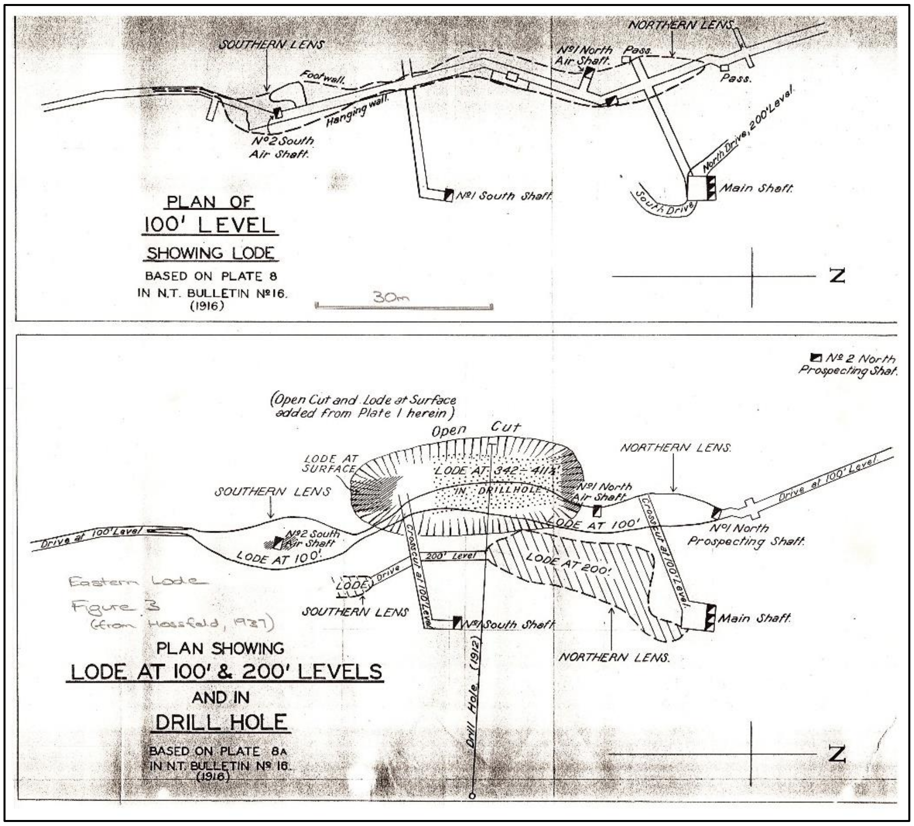

Figure 6: Historical plans of Iron Blow underground

Mining consisted of 5 shafts, the deepest to 215ft. The Eastern Lode was exposed in a shaft (No.2 South) 21m to the south of the original open cut. The No.1 North Shaft was sunk on this lode to the north. The No.1 North Prospecting shaft was sunk on the dip of the Lode to an unknown depth below the water level. These operations gave plans of the workings on the 100ft level (84mRL) and the 200ft level (53mRL). The ore was too low grade to be treated on its own and was blended with copper ore from Mt Ellison (20km to the north of the smelter). Tramways extended north to Mt Ellison and south to Iron Blow from the smelter. The Yam Creek smelter ran from 1898 to 1906 and was located 2km to the north of the Iron Blow Mine. The current Grove Hill road runs across the smelter floor and old slag may be seen by the roadside.

Between 1905-6, Iron Blow was stated to be the most productive mine in the Northern Territory, but operations were curtailed due to low yields in the sulphide ores. During the first six months of 1906 during, 5,838t of ore were smelted before the mine was closed down and abandoned, and the shaft filled with water. One diamond hole was drilled ("B1") in 1906 but did not penetrate any lode.

No further activities are known until 1912, when Mr. Frank Powell examined the locality and plans. In response to his request, a diamond drill hole was completed by the Government to test the lode at depth. This hole (now known as "B2") was drilled to 467.5 feet and dipping -65 degrees westerly. "Lode matter" was intersected downhole between 377.5 and 454 feet. The core was only assayed in bulk, over two sections:

- 377.5 to 439 feet: 0.53% Cu, 4.5% Zn, 2 dwt/t Au, 13 dwt/Ag
- 439 to 454 feet: 0.16% Cu, 7.0% Zn, 19 grains Au, 13 dwt/Ag

Mr. Powell apparently did no further work on learning the low nature of the assay results.

George Buttle took up the lease and re-opened the mine with government subsidy. Attempts to dewater the shaft were only successful to the 100 ft level. On inspection, more stopes and consequently less ore remained than what was expected above the 100 ft level. An assay plan prepared before the mine was closed showed 33,000 tons of ore between the 100 and 200 ft levels.

During 1914, Mr. Buttle placed machinery in position on the mine, much of which was loaned by the Department from the Zapopan mine. A new reverberatory furnace was also erected. The plant was ready to commence smelting operations, but the outbreak of war disorganised metal prices, and Mr. Buttle found it necessary to surrender the mine and plant to the Government.

In summary of the early underground production, despite incomplete records, it is reasonable to assume that about 15,000t ore were mined. Further, it is likely that there is no ore remaining above the 100ft level, but most of the ore between the 100-200ft level remains, as the long sections indicate minimal stoping.

No further records are known until Hossfield (1937) and Rayner and Nye (1937) published geological and geophysical reports respectively of the Iron Blow area. A geophysical survey was conducted using the electro-magnetic and self-potential methods. The data showed possible indications of the lode continuing to the north.

In 1963 the NTA Mines Branch under agreement with United Uranium NL drilled six holes into the deposit, (DDHs 1 to 6). Of these 6 holes, 3 intersected ore; DDH 1 hit the Eastern Lode with an interval of 6m @ 7.6% Zn, 1g/t Au and 30.8g/t Ag, DDH 2 hit the Western Lode with an interval of 12.4m @ 3.16% Zn, 1.06g/t Au and 24.8 g/t Ag, and DDH 5 hit the Western Lode; grades were very low. DDHs 3 and 4 were situated on geophysical anomalies and did not intersect anything, while DDH 6 was drilled under the Eastern Lode.

A Geopeko-BHP JV explored the Iron Blow deposit as “Quest 53” from 1975, drilling 15 diamond core holes, eight of which met with massive sulphide. This drilling confirmed that the Iron Blow deposit is comprised of two stacked lenses. The Upper Lode contained 92,000t, averaging 400g/t Ag, 8.1% Zn, 3.0% Pb, 0.4% Cu and 4.3g/t gold. The Lower Lode was larger, and of lower grade comprising 887,500t averaging 87.3g/t Ag, 6.7% Zn, 0.7% Pb, 0.4% Cu, and 1.9g/t gold. These are considered ‘Historic Resources” and are not to modern JORC standards.

In 1983 a mill was established at Mount Bonnie, 3km to the south of Iron Blow. In 1984, the Mount Bonnie Gold Unit Trust (MBGUT) undertook a costeaning program, with 11 costeans known (IBCOST1-11). Anomalous results to the west of the old open pit encouraged drilling of three shallow percussion holes, (PH1-3) but narrow widths and low grades discouraged further work in this area. Also in 1984, the MBGUT drilled a diamond hole into the eastern sulphide lode (D20). Reasonable assay and metallurgical test results encouraged the rehabilitation and dewatering of the main shaft. It was planned to enter the 100- and 200-foot levels to obtain grade and tonnage data of unmined material, and to collect more metallurgical samples, however, poor ground conditions in the shaft meant that this was only successful on the 100-foot level. The underground workings were dewatered and the 100ft level was surveyed, but the shaft was only cleaned out to 41m.

MBGUT, and the many and varied corporate identities, conducted two open cut mining campaigns. Ore was treated for gold and silver recovery at the nearby Mt Bonnie Mill, which was then operating as a Merrill-Crowe plant. Approximately 10,000t of gossan oxide ore grading 8g/t Au and 250g/t Ag was treated in 1985, and another campaign of 5,000t at similar grades was undertaken in 1986. Grade control trench sampling data and level plans have been sourced.

On completion of oxide mining, the deposit went through a series of ownership changes, during which time it is believed nine diamond holes were drilled in 1988, D20-D24 to the west and D26-D30 to the east, initially for MBGUT and then for the Tanami JV. This data has never been reported and is only available in partial hardcopy plans and notes sourced by PNX. Geological logs are complete, but assay data is incomplete.

In 2005, GBS Gold Australia (GBS) purchased the assets of Northern Gold and in 2008, GBS drilled six diamond holes (IBDH001-006), the highlight of which was IBDH006 which intersected 48.36m@ 9.1% Zn, 3.53g/t Au, 429 g/t Ag, 3.37% Pb and 0.27 % Cu from 94.94m downhole depth. Conclusions from this work were:

- Mineralisation consists of multiple parallel massive-sulphide lodes dipping at approximately 70ºE;
- True widths of up to 18 meters of massive sulphides;
- Elevated gold grades associated with zinc together with discrete gold intervals peripheral to the massive-sulphides;

During 2008, GBS also trenched and sampled the waste dumps at Iron Blow. The larger eastern dump is approximately 80 metres long, 70 metres wide and from 1 to 2.5 metres thick. The western dump is about 35 x 25 metres and about 1 metre thick. A rough estimate of available tonnage is 10,000 -15,000 tonnes. 270 samples were taken. The main body of waste in the eastern dump averaged approximately 5.1 g/t Au, 28g/t Ag, 0.1% Cu, 0.4% Pb and 0.5% Zn.

Newmarket Gold Inc. (then Crocodile Gold) picked up the liquidated assets of GBS in 2009 and undertook a Mineral Resource estimate in accordance with Canadian Securities Administrators' National Instrument 43-101 standards. This estimated an Inferred Mineral Resource of 3.175Mt @ 2.08 g/t Au, 3.28% Zn, 101 g/t Ag, 0.76% Pb and 0.19% Cu, using a 1 g/t Au cut-off.

In 2009, the area was also covered with a very detailed airborne magnetometer and radiometric survey commissioned by Thundellara exploration over an adjacent exploration tenure. Line spacing was 25 metres.

In 2011, Newmarket commissioned a VTEM (versatile time domain electromagnetic) survey at 150 metre spacing over the wider Hayes Creek area which identified strong conductive and magnetic bodies over Iron Blow and Mount Bonnie.

Newmarket drilled a further 13 diamond holes during 2011 (IBDH007-022), the highlight of which was IBDH007, which intersected a number of mineralised lenses, including one assaying 20.3m @ 13.92% Zn, 5.89 g/t Au, 482 g/t Ag, 3.1% Pb and 0.61% Cu from 192.95m downhole depth. One of GBS' trenches in the eastern waste dump was resampled, producing a result of 2.76 g/t, compared to GBS's 3.68 g/t for the same 30m long trench.

In 2014, a detailed drone survey produced an excellent topographic and aerial photo dataset. The deposit was however deemed unsuitable for Newmarket's Union Reefs gold plant, and the property was sold to PNX Metals Ltd (then Phoenix Copper Ltd).

During 2014, PNX undertook a Mineral Resource estimate according to the JORC Code (2012) incorporating results of the 2011 drilling. The mineral resource estimated by this work is shown in Table 2.

Table 2: Iron Blow Inferred Mineral Resource Estimate as at 8th October 2014.

Depth	AuEq cut-off (g/t)	Tonnes	AuEq (g/t)	Au (g/t)	Ag (g/t)	Cu (%)	Pb (%)	Zn (%)	ZnEq %
> -90 mRL	0.7	2.2Mt	6.7	2.4	140	0.3	1.0	4.9	11.8
< -90 mRL	3.0	0.4Mt	5.6	2.7	71	0.4	0.4	4.1	10.0
Total Inferred Mineral Resource		2.6Mt	6.5	2.4	130	0.3	0.9	4.8	11.5
Total Contained Metal			**543,000 oz**	203,000 oz	10,700,000 oz	7,000 t	23,000 t	125,000 t	**300,000 t**

*

Note:

gold-equivalent (AuEq) g/t = [(Au grade g/t x (Au price per Oz/31.1034768) x Au recovery) + (Ag g/t x (Ag price per Oz/31.1034768) x Ag recovery) + (Cu grade % x (Cu price per t/100) x Cu recovery) + (Pb grade % x (Pb price per t/100) x Pb recovery) + (Zn grade % x (Zn price per t/100) x Zn recovery)] / (Au price per Oz/31.1034768).

zinc-equivalent (ZnEq) % = [(Au grade g/t x (Au price per Oz/31.1034768) x Au recovery) + (Ag g/t x (Ag price per Oz/31.1034768) x Ag recovery) + (Cu grade % x (Cu price per t/100) x Cu recovery) + (Pb grade % x (Pb price per t/100) x Pb recovery) + (Zn grade % x (Zn price per t/100) x Zn recovery)] / (Zn price per t/100).

The following factors were used in determining the AuEq and the ZnEq:

Element	Unit Price	Unit	Recovery
Cu	$7,000	USD / t	70%
Pb	$2,250	USD / t	70%
Zn	$2,350	USD / t	70%
Ag	$20.00	USD / troy oz	90%
Au	$1,300	USD / troy oz	90%

Note; total grades are subject to rounding

During 2014, PNX also completed:

- Two diamond holes (IBDH023 and IBDH024) for 705.8 metres. IBDH023 intersected into the highest value drilling result into the orebody to date, comprising 50.39m @ 10.12% Zn, 2.65 g/t Au, 283 g/t Ag, 1.41% Pb and 0.57 % Cu.
- Mapping of the pit and surrounds.
- Geophysical modelling of VTEM and magnetic data.

7 PREVIOUS EXPLORATION

7.1 YEAR 1 - 2015

During the 2015 reporting year, PNX completed surface pXRF geochemical sampling (114 measurements), fixed loop EM ground geophysics (3.5-line kilometres), downhole EM surveying (IBDH023), RC drilling (3 holes for 240m) and metallurgical testwork. During the end of the reporting period, a Scoping Study commenced to investigate the possible development of the Hayes Creek Project.

7.2 Year 2 - 2016

During the 2016 reporting year, PNX completed the scoping study, drilled 34 holes for 5,563m, primarily for resource evaluation and geotechnical purposes and undertook further engineering studies in support of a Prefeasibility study.

7.3 Year 3 - 2017

During the 2017 reporting period, PNX, completed a prefeasibility study, which included metallurgical testwork, process plant design, geotechnical studies, hydrogeological studies, environmental studies, resource estimation, surveying and financial evaluation. Drilling during the period consisted of 3 diamond holes, carried over from the 2016 resource work program and 6 RC holes for hydrogeological testing. In addition, a SkyTEM helicopter-borne EM system was flown at 100m spacing over Iron Blow and surrounding leases.

8 EXPLORATION DURING THE CURRENT PERIOD

8.1 Summary

During the reporting period, PNX completed environmental and geochemical studies along with metallurgical testwork. This is for the preparation of a Definitive Feasibility Study.

There was no field work undertaken during the reporting period.

The final report for the hydrogeological studies undertaken at the end of 2017 was received during the reporting period and is reported on herewith.

8.2 2017 Hydrology Investigation

Seven RC drill holes were completed in December 2017 (Bennett, 2018), as part of local groundwater investigations for the Definitive Feasibility study. The field program consisted of drilling and bore construction, aquifer testing and collection of water samples for water quality analysis.

The groundwater investigation was designed and managed by CDM Smith on behalf of PNX to:

- Install groundwater bores to be utilized in the future for water level monitoring, water quality sampling and aquifer testing.
- Collect observations to provide a better understanding of the physical and hydraulic properties of the hydrostratigraphic units (HSU's) present in the vicinity of Iron Blow.
- Conduct hydraulic tests on completed bores to estimate the hydraulic properties of the HSUs present in the vicinity.
- Collect water samples from surface water and groundwater sites for chemical analysis to assess the baseline water quality of the HSUs and surface water features in the vicinity of the Iron Blow deposit.

Six bores were planned at Iron Blow, however, due to difficult drilling conditions that resulted in two abandoned holes, a total of seven bores were drilled but only five completed as monitoring bores.

The findings from the study are outlined in Section 9 and in the digital appendices.

8.3 Definitive Feasibility Study

Seven RC drill holes were completed in December 2017 (Bennett, 2018), as part of local groundwater investigations for the Definitive Feasibility study. The field program consisted of drilling and bore construction, aquifer testing and collection of water samples for water quality analysis.

Definitive Feasibility studies were underway during 2017 and continued through 2018. PNX engaged environmental, geochemical, and metallurgical consultants to assist with key technical work.

8.4 Environmental Studies

A Notice of Intent (NOI) prepared by ERIAS Group, was submitted in February 2018. The NOI describes the:

- Project overview
- Land use history
- Existing environment, including natural environment, cultural and heritage environment, and social and economic environment
- Potential impacts and measures to avoid or mitigate them
- Matters of national environmental significance.

PNX has identified that the management of waste rock and tailings (in particular, materials classified as potentially acid forming (PAF) and surface water management) are key considerations for the project. These considerations will require close attention to ensure impact on the environment is negated and/or minimised and have resulted in an approach towards the project development which has focused specifically on identifying how these materials will be managed to enable the project to be developed, operated and closed with minimum adverse impact on the environment. As a result of this approach, the closure plan for the Hayes Creek Project is a key driver in its development.

Identification and detailed assessment of suitable sites for the process plant location and tailings management was completed. The main considerations were proximity to the mining centres at Mt Bonnie and Iron Blow, suitability of a historic mining void for in-pit tails deposition and permanent water cover, and access to the preferred area. The Fountain Head site was identified as being the most suitable for long-term, stable tailings management and also enables a substantial part of the footprint of the Project to be limited to areas that have already been disturbed.

An EPBC Referral was prepared for the project during the reporting period and submitted subsequent to the period.

8.5 Geochemical Studies

A total of 12 leach columns were set up for the entire Hayes Creek Project (Iron Blow and Mt Bonnie) to assess the leaching characteristics of waste rock dumps and stockpiles, and materials in the final pit void and underground workings. These are long term tests, and typically run for 1 year or greater, an update from part way through the tests during 2018 is included below. There are three columns representative of Iron Blow in the study. Leach column testing was proposed for the following mine materials:

- NAF (Non-Acid Forming) FWtb materials to evaluate neutral drainage chemistry (salinity, alkalinity elemental leaching) from NAF materials. These tests will be used to confirm that the NAF materials are benign and suitable for surface placement in dumps, and the results would also be used as inputs for final void and underground water quality. 1 column.

- PAF (Potentially Acid Forming) MSU (Massive Sulphide Unit) ore to evaluate leaching rates from stockpiles and residual ore in underground workings and pit voids. Note that although the MSU ore may not be stockpiled for long, this highly sulphidic unit will be a major potential source of AMD from underground workings and the final pit void, and the leaching characteristics will be a key input for final void and underground water quality modelling. 2 columns.

Interim results are outlined in Section 9 and further detailed in the digital appendices.

8.6 METALLURGY AND PROCESSING

The DFS mineral process development testwork program was once again designed and managed by BHM Process Consultants on behalf of PNX to further investigate and confirm flotation tests on ore from the Iron Blow multi-element resource. This will further qualify and define the technical and economic components from the Hayes Creek Pre-Feasibility Study (PFS).

The testwork was undertaken on material remaining from the previous PFS with the aims of confirming the process flowsheet proposed in the PFS and:

- Determining the impact or recirculating loads to increase economic outcomes in particular;
    - Increase Grade & Recovery of the target elements (Zn & Ag primarily)
    - Depression of gangue minerals to reduce penalty rates to both the Zn & bulk concentrates
    - Increasing flowsheet confidence
- Determining alternative process options in removal of gangue minerals (talc and carbonates in particular) to reduce penalty elements concentration with the generated carbonates.

A discussion of the interim results of the flotation testwork is provided in the following Section and in the digital appendices.

Further testwork remaining involves larger scale locked cycle to be conducted on new composites closer to the resource average. This is not possible on the currently available material. For Iron Blow, utilising current reserves ~14kg of material is required to balance out to generate a resource average composite. These are;

Table 3: Iron Blow drill holes required for resource average

Drill hole	Depth (m)	
IBDH045	90.8 – 91.8	D6824
IBDH045	93.2 – 93.52	D6827
IBDH045	93.52 – 94.3	D6828

This testwork was commenced during 2018 and final results of these are still underway, however, interim reports are provided in the digital appendices.

9 CONCLUSIONS & RECOMMENDATIONS

The main findings of the hydraulic properties' investigation were:

- The highest estimated transmissivity (at HCM-17) is around 170 m^2/day (Table 4).
- Estimates of hydraulic conductivity (K) for the fractured Mt Bonnie Formation range between 0.2 and 3 m/day.
- Approximate elevations for the main inflow zones within the fractured Mt Bonnie Formation ranged between 79 and 100 m AHD.

The main findings of the water quality results were:

- The salinity of groundwater HCM-17 is approximately three to eight times the salinity of groundwater at other bore sites.
- Exceedances of ANZECC (2000) metal concentration guidelines for freshwater were observed for groundwater sampled from HCM-16, 17, 19, 20 and 21 (Table 5).

Table 4: Summary details of Iron Blow airlift recovery test analyses.

Bore ID	Lithology / aquifer	Aquifer interval (b)		Average airlift pumping rate (L/s)	Test duration (minutes)	Estimated T (m^2/day)	Estimated K (m/day)
		(m)	Explanation				
HCM-16	Mt Bonnie Formation (mudstone)	33	First water strike (15 m bgl) to depth of peak yield (48m bgl)	3.5	56.3 (airlifting) 82.3 (recovery)	50	1.5
HCM-17	Mt Bonnie Formation (siltstone & sandstone)	56	First water strike (24 m bgl) to depth of last significant water cut (80m bgl)	10.0	55.0 (airlifting) 52.0 (recovery)	168	3.0
HCM-19	Mt Bonnie Formation (siltstone)	42	First water strike (15 m bgl) to depth of peak yield (57m bgl)	3.4	40.5 (airlifting) 60.8 (recovery)	43	1.0
HCM-20	Mt Bonnie Formation (siltstone)	52	First water strike (18 m bgl) to depth of last significant water cut (70m bgl)	2.2	42.5 (airlifting) 19.4 (recovery)	11	0.2
HCM-21	Mt Bonnie Formation (mudstone)	34	First water strike (20 m bgl) to depth of peak yield (54m bgl)	6.5	60 (airlifting) 60 (recovery)	N/A – data logger files were corrupted.	

Table 5: Iron Blow laboratory water quality results.

Analyte	**Units**	**ANZECC (freshwater guideline)** [1]	**HCM-16**	**HCM_17**	**HCM-19**	**HCM-20**	**HCM-21**
ph	-	-	7.02	7.91	7.86	7.6	7.11
TDS [2]	mg/L	-	269	1310	466	186 [3]	165
Ca	mg/L	-	3	134	36	4	10
Mg	mg/L	-	9	118	44	17	10
Na	mg/L	-	6	48	16	18	4
K	mg/L	-	3	5	3	2	2
Cl	mg/L	-	<1	3	2	1	<1
SO_4	mg/L	-	37	748	218	86	65
F	mg/L	-	0.6	0.5	0.8	1.2	0.7
Si	mg/L	-	<1	<1	<1	<1	<1
CO_3	mg/L as $CaCO_3$	-	12	141	101	27	28
HCO_3	mg/L as $CaCO_3$	-	<1	<1	<1	<1	<1
OH-	mg/L as $CaCO_3$	-	12	141	101	37	28
Total alkalinity	mg/L as $CaCO_3$	-	44	730	271	46	66
Total hardness	mg/L as $CaCO_3$	-	5	6	4	2	10
Total acidity	mg/L as $CaCO_3$	-	13.4	16.4	15.4	5.24	13.6
Silver (Ag)	ug/L	0.05	<1	<1	<1	<1	<1
Aluminium (Al)	ug/L	55	20	<10	70	90	<10
Antimony (Sb)	ug/L	-	4	18	22	7	73
Arsenic (As)	ug/L	13	222	96	913	5	1680
Boron (B)	ug/L	370	<50	<50	<50	<50	<50
Barium (Ba)	ug/L	-	<1	<1	<1	<1	<1
Beryllium (Be)	ug/L	-	1	26	16	8	27
Cadmium (Cd)	ug/L	0.2	18	<0.1	4	<0.1	5
Chromium (Cr)	ug/L	1	<1	<1	<1	<1	<1
Cobalt (Co)	ug/L	-	3	4	4	<1	5
Copper (Cu)	ug/L	1.4	4	<1	<1	<1	<1
Iron (Fe)	ug/L	-	<50	1380	660	<50	2160
Mercury (Hg)	ug/L	0.6	<0.1	<0.1	<0.1	<0.1	<0.1
Lead (Pb)	ug/L	3.4	<1	1	<1	<1	3
Manganese (Mn)	ug/L	1900	383	1580	562	69	792
Molybdenum (Mo)	ug/L		3	35	19	29	4
Nickel (Ni)	ug/L	11	3	4	6	3	7
Selenium (Se)	ug/L	11	<10	<10	<10	<10	<10

Tin (Sn)			9	351	55	8	10
Strontium (Sr)			<1	<1	<1	<1	<1
Thorium (Th)			<1	<1	<1	<1	<1
Uranium (U)			<1	2	<1	<1	<1
Zinc (Zn)		8	1910	34	109	10	3360

Notes: Grey cells indicate an exceedance of the ANZECC guideline concentration for freshwater ecosystems (ANZECC, 2000)

1. 95% species protection trigger for freshwater (ANZECC, 2000)
2. Gravimetrically determined total dissolved solids (TDS)
3. TDS unable to be determined gravimetrically due to sample turbidity. Value represents the sum of all dissolved analytes.

Table 6 shows the acid forming characteristics and ARD classification for each leach column. Also included are descriptions of the purpose of the leach columns and status. The leach columns had been operating for 40 weeks at the time of the report, with collections carried out every 4 weeks. A summary of results for the Iron Blow columns is as follows:

- One NAF column has high As in the solid (>1000 mg/kg) and has produced elevated As in circum-neutral pH leachates, indicting As contents will need to be considered in management of NAF waste rock.
- The low-grade ore sample is generating slightly acidic leachate with elevated metals/metalloids
- Both ore samples have high ANC, and remain in the lag phase, with some elevated metal release.

The columns are expected to continue for 52 weeks and will be re-evaluated for the need for continuation. It is likely that the majority of the columns will be recommended to continue for an additional 12 months.

Table 6: Acid forming characteristics of Iron Blow leach column samples.

EGi Sample Number	Column Description	ACID-BASE ANALYSIS					SINGLE ADDITION NAG			ARD Classification	Column Aim	Column Status
		Total %S	MPA	ANC	NAPP	ANC/MPA	NAGpH	$NAG_{(pH4.5)}$	$NAG_{(pH7.0)}$			
13136	NAF FWtb - Iron Blow	0.09	3	48	-45	16.98	7.3	0	0	NAF	Assess neutral drainage chemistry from NAF materials	Circum-neutral to week 40 with steady alkalinity, slightly elevated As (1.7 to 3.9mg/L) (high As in solids) and low other metal/metalloid concentrations.
13145	MSU Iron Blow/Mt Bonnie	25.50	780	171	609	0.22	2.7	7	50	PAF	Evaluate leaching characteristics of typical ore PAF materials	Circum-neutral (Lag phase) to week 40, with elevated SO4, elevated Mn and Zn. Continuing.
13147	MSU LGAU Iron Blow	20.80	636	152	484	0.24	2.2	31	63	PAF	Evaluate leaching characteristics of typical ore PAF materials	Circum-neutral (Lag phase) to week 40, with elevated SO4, elevated Mn, slightly elevated Fe. Continuing.

Key

MPA = Maximum Potential Acidity (kgH_2SO_4/t)
ANC = Acid Neutralising Capacity ($kg\ H_2SO_4/t$)
NAPP = Net Acid Producing Potential (kgH_2SO_4/t)
NAGpH = pH of NAG liquor
$NAG_{(pH4.5)}$ = Net Acid Generation capacity to pH 4.5 (kgH_2SO_4/t)
$NAG_{(pH7.0)}$ = Net Acid Generation capacity to pH 7.0 (kgH_2SO_4/t)

NAF = Non-Acid Forming
PAF = Potentially Acid Forming

In respect to previous metallurgical testwork and the PFS basis, a comparison can be seen in Table 7.

Table 7: PFS PDC comparison of Iron Blow

	Previous	Current
Bulk Con Mass %	5.43	3.81
Zn Con Mass %	7.52	9.02
Total	**12.95**	**12.83**
Au to Bulk	38.40	32.57
Ag to Bulk	61.60	62.66
Zn to Bulk	11.36	5.44
Pb to Bulk	68.61	54.35
Zn to Zinc Conc	72.70	80.24
Total Zn Recovered	84.06	85.68
Total Ag Recovered	74.00	81.38

As can be seen, the overall metal recovery of Zn & Ag has improved, however the Pb & Au recovery to the bulk concentrate has decreased. The overall yield of concentrate has increased, with more Zn concentrate being generated.

The penalty elements and their impact can be seen below. In general, there has been an improvement, however the Bulk (Ag) Concentrate still has high penalty elements.

Table 8: Zn concentrate and penalty elements

				Penalty $US/MT)	
Zn Con	**Penalty**	**New**	**Old**	**Current**	**Old**
MgO	0.30	0.56	1.17	5.17	17.40
SiO2	3.00	1.12	2.49	0.00	0.00
Pb	3.50	2.08	1.09	0.00	0.00
As	0.30	0.86	0.65	11.26	6.97
Fe	9.00	11.74	11.04	5.48	4.08
Total				**21.91**	**28.46**

Table 9: Bulk Concentrate penalty elements

				Penalty $US/MT)	
Ag Con	**Penalty**	**New**	**Old**	**Current**	**Old**
As	0.10	1.26	1.78	23.16	33.61
Fe	8.00	10.35	12.45	4.68	8.91
SiO2	5.00	27.57	23.08	45.15	36.17
Mg	5.00	8.51	11.76	7.02	13.51
Total				**80.02**	**92.19**

From the testwork that has been done to date on the DFS the following points are relevant:

- The flowsheet that has obtained the greatest result has been when the Zn Cleaner Tail reports to the Zn Rougher feed instead of the Ag Rougher Feed. This minimizes distributions in the silver circuit and ensures there is less "Zn contamination" in the Ag/Bulk concentrate.
    - The addition of frother and collector is necessary to the Zn Re-cleaner with Iron Blow as it appears reagents are not carrying over. The lack of reagent addition will result in a recirculating load in the Zn circuit which destabilises both the Zn and Ag circuits.
- When comparing the increased Zn recovery to the Zn concentrate by increasing depressant ($ZnSO_4$) in the silver circuit, the net result is negative as can be seen in Table 10. The loss in Ag, Au & Pb outweigh the gains in the Zinc concentrate.

Table 10: Cost comparison of depressant in Ag circuit, 100t feed basis.

	Depressant	**Baseline**
Zn Con	$7,734	$6,917
Ag Con	$5,585	$6,725
Total	**$13,319**	**$13,642**

- Iron Blow has seen an improvement in performance in comparison to the PFS.
    - However, the silica and magnesium concentrations are well above penalty rates for Iron Blow within the silver circuit.
        - This is present as talc.
- Talc removal in a pre-flotation stage is possible, however it incurs heavy Zn & Ag losses. A removal of 20% of the talc (pre-float on the rougher feed has had the best result) with a loss of 5-10% Zn & 20-30% Ag.
    - Much of the talc, 80-95%, is rejected normally through to the Zn rougher tail. As a result, further rejection of talc should focus on either;
        - Depressing the talc in the final stages of cleaning, or;
        - Cleaning up the final concentration with a talc flotation step

Definitive feasibility studies for the Hayes Creek Project, including the Iron Blow leases, are well underway. PNX is working to finalise access to the Fountain Head site as the preferred site for processing ore, and exploring options for project financing.

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