

# Metals and Mining Note

## Phoenix Copper

28 April 2021

John Meyer

Simon Beardsmore

Sergey Raevskiy

Joe Rowbottom

SPANGEL



**Mine workings from an earlier phase of mining at Empire**

*Source: SP Angel*

# Mining Flash Note

## Phoenix Copper\* PXC LN

28th April 2021

### Stock Data

Ticker (AIM)	PXC LN
Share Price	38.25p
Market Cap	£44.5m

### Price Chart



### Research

#### John Meyer

+44 20 3470 0490  
 john.meyer@spangel.co.uk

#### Simon Beardsmore

+44 20 3470 0484  
 simon.beardsmore@spangel.co.uk

#### Sergey Raevskiy

+44 20 3470 0474  
 sergey.raevskiy@spangel.co.uk

#### Joe Rowbottom

+44 20 3470 0486  
 Joe.rowbottom@spangel.co.uk

### Sales

#### Richard Parlons

+44 20 3470 0472  
 richard.parlons@spangel.co.uk

#### Grant Barker

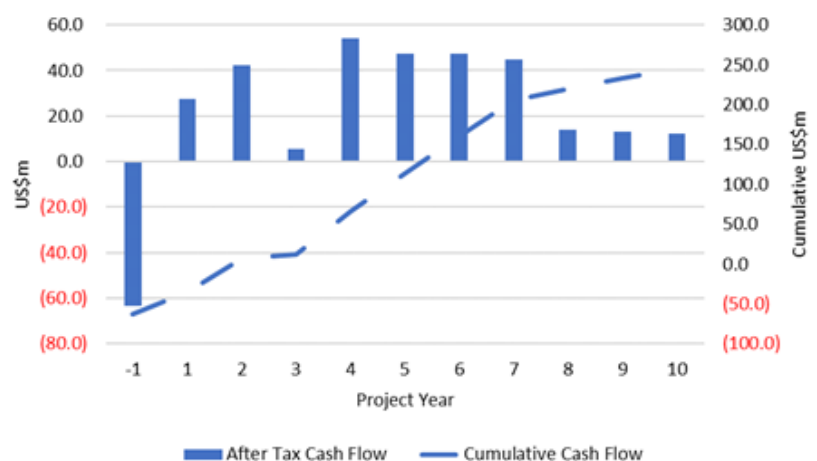
+44 20 3470 0471  
 grant.barker@spangel.co.uk

## A new Empire mine coming into focus

### Highlights

- Phoenix Copper is planning to re-open the historic Empire copper mine in Mackay, Idaho.
- Initial development of a shallow copper oxide operation will prepare the way for a reexamination of the underlying sulphide mineralisation as well as the exploration of the nearby Red Star and Navarre Creek properties in what has been described as an under-explored region of Idaho.
- The recent fund-raising and publication of a revised economic model for the Empire Mine oxide project in Idaho provides a clear trajectory for production from Phoenix Copper.
- We take the opportunity to focus on the project's characteristics relative to other North American copper mine development projects.
- The update envisages the treatment of 2.1mtpa of ore over a 10 years mine life in order to produce an average of 5,800tpa of copper and, in 1,300tpa of zinc as well as 2mozpa of silver and around 12,000ozpa of gold.
- The new study envisages a two-phase development with base metal production during the first seven years and precious metals recovery from the retreatment of ore with ammonium thiosulphate starting in the fourth year of operations and continuing until year 10.
- Pre-production capital expenditure for the first phase amounts to US\$53m with approximately US\$37m required for the precious metals recovery phase.
- Our analysis of 15 other undeveloped copper projects in North America shows that although Phoenix Copper's project is amongst the smallest in terms of overall production it is also amongst the lowest cost in both capital and operating cost terms with low capital intensity contributing to a post-tax project NPV of US\$139m and an IRR of 50% based on SP Angel's current long term commodity price assumptions.

Empire Mine Oxide Project  
 After Tax Cashflow



## Summary

Phoenix Copper's recent equity fundraising positions the company to progress its development of the Empire oxide pit rapidly without further recourse to shareholders as described by Chairman, Marcus Edwards-Jones who said that "the Directors believe this Fundraising provides the Company with a clear line of sight to production and cash flow, without the need for further equity raises in the foreseeable future".

Combining the production, grade, operating and capital cost, and recovery profiles outlined in Phoenix Copper's most recent economic update of the Empire Mine copper oxide project with our metal price assumptions, we estimate an after tax NPV8% of US\$139m for the project.

In addition to the oxide project, we ascribe a nominal US\$3.5m at this stage to the Red Star prospect adjacent to the Empire project area based upon US\$1per oz of the 2.8m inferred silver equivalent ounces outlined to date.

Recognition of the wider exploration potential laterally and at depth into the underlying sulphide mineralisation in and around the Empire mine is more tenuous at this stage of the exploration and we are tentatively assigning a nominal US\$5m. We emphasise, however, that with the past history of profitable production and the underexplored nature of the opportunity, that exploration success has the potential to enhance this nominal assessment by multiples of our tentative estimate.

We have not currently assigned a value to the exploration potential of the Navarre Creek area, though its geological affinity to the multi-million ounce Carlin trend in Nevada contains the tantalising prospect that successful exploration in the area could become a transformational event in the company's life.

Our analysis indicates that, although amongst the smallest of some 18 copper development projects we have examined in North America, the Empire mine oxide project is amongst the lowest unit capital cost copper projects currently available largely as a result of its third quartile resource grade of 0.81% copper equivalent.

Capital intensity of US\$6,337/t of copper equivalent annual production is amongst the lowest amongst its peers and estimated life-of-mine operating cost lies in the lower half of the cost curve of these comparative projects while the after-tax IRR of 50% sits within the third highest quartile.

Phoenix Copper's 2018 exploration programmes have successfully trebled the 7.3mt of measured & indicated resources at the time of the company's AIM debut in 2017 to 22.9mt and almost doubled the inferred resources from 5.5mt to 10.6mt. The company has also published a maiden inferred resource for the sulphide mineralisation at the Red Star deposit which lies mid-way along a 5km long zone extending from the Empire mine, through the Horseshoe mine and into the recently acquired Windy Devil claim area.

In our view, existing, conservatively valued assets more than justify the current market value of the company with potential value enhancement through all or some of

Expansion of the resource base of the Empire oxide pit and Red Star through continuing exploration; and

- Identification of sulphide resources at depth beneath the old Empire mine and on the adjacent properties at the old Horseshoe and Bluebird mines and on the Windy Devil licence; and
- Exploration of the gold mineralisation potential of the Navarre Creek licence; and
- Crystallisation of value within the exploration licences at Redcastle and Bighorn in the Idaho Cobalt Belt of Lemhi County 100miles north of the Empire mine.

We comment that we see this as a conservative assessment at this stage with scope for the value to grow significantly as the Empire pit development gets underway and into production moving it closer to the full NPV as well as from any further exploration success at Empire, the underlying sulphide mineralisation, Red Star, Navarre Creek or from the cobalt exploration.

## Empire Copper Oxide Project

Our evaluation of the copper oxide pit is based on the NPV<sub>8%</sub> of the project, using SP Angel's current commodity price forecasts and the operating parameters disclosed in the company's February 2021 economic model.

## Conceptual Oxide Mine Model

Our model uses the following commodity price assumptions including SP Angel's current long-term copper price forecast of US\$8,950/tonne (US\$4.06/lb). The summary operating and financial statistics for comparable North American projects are shown in Appendix 1.

SP Angel's Metal Price Assumptions		
	SP Angel Assumed Price	Current Price †
Copper (US\$/t)	8,950	9,186
Zinc (US\$/t)	2,850	2,898
<i>Lead (US\$/t)</i>	<i>2,450</i>	<i>2,158</i>
<i>Molybdenum (US\$/t)</i>	<i>18,750</i>	
<i>Gold (US\$/oz)</i>	<i>1,925</i>	<i>1,809</i>
<i>Silver (US\$/oz)</i>	<i>24.00</i>	<i>28.06</i>

†23rd Feb 2021

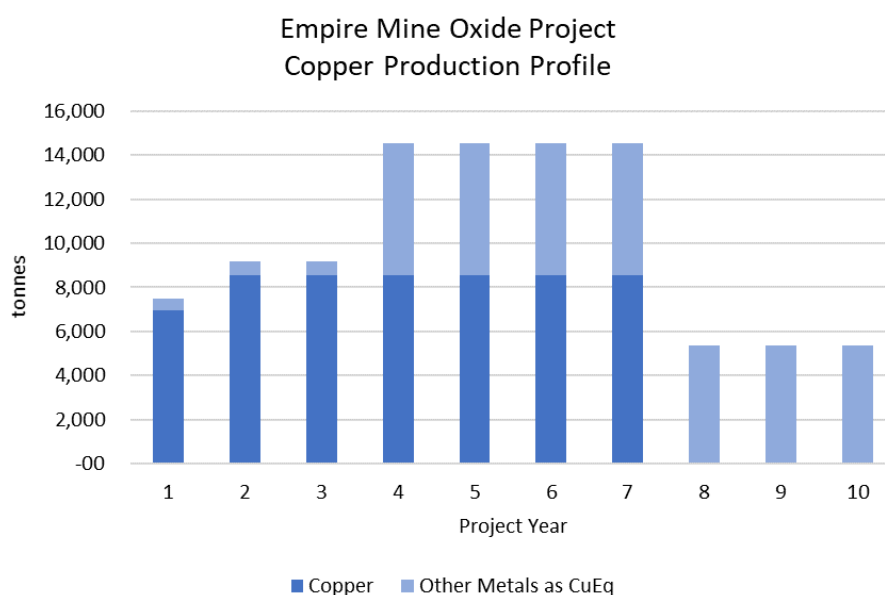
Prices in Italics used for other comparable projects as appropriate

**Table 1 Metal Price Assumptions (Source: SP Angel)**

Operating parameters reflect the current thinking of the company as reported in its announcement of 16<sup>th</sup> February 2021 and are summarised below:

Empire Oxide Project – Summary Economics				
	<b>Mining</b>			
Total Ore Tonnes (m)	14.3			
Total Waste tonnes (m)	40.7			
	Copper	Zinc	Silver	Gold
Average Grade	0.53%	0.19%	13.1g/t	0.31g/t
Average Recovery %	76%	50%	77%	83%
Total Tonnes /oz Produced (000)	58.2	13.4	14,317	117.2
	<b>Economics</b>			
	Phase 1		Phase 2	
Capital Cost (Pre-Prod)	\$52.7m		\$36.8m	
Capital Cost (Sustaining)	\$24.2m		\$7.0m	
After Tax NPV <sub>(8%)</sub>	\$139.3m			
After Tax IRR	50%			
Payback (Years)	1.8			

**Table 2 Economic Assumptions and Conclusions**



**Figure 1 Oxide Copper Production Profile**

On this basis, we estimate that the Empire mine oxide project delivers an NPV<sub>8%</sub> of US\$139.3m after financing the capital development and an IRR of 50% on an after-tax basis. We estimate payback within 2 year of a 10 years mine life.

Unsurprisingly, our sensitivity analysis shows commodity prices as the prime influence on value with a 10% change precipitating a 30% variation in our estimated project value.

Similar 10% changes in operating and capital costs generate changes of around 16% and 4% respectively as shown in Figure 2 below.

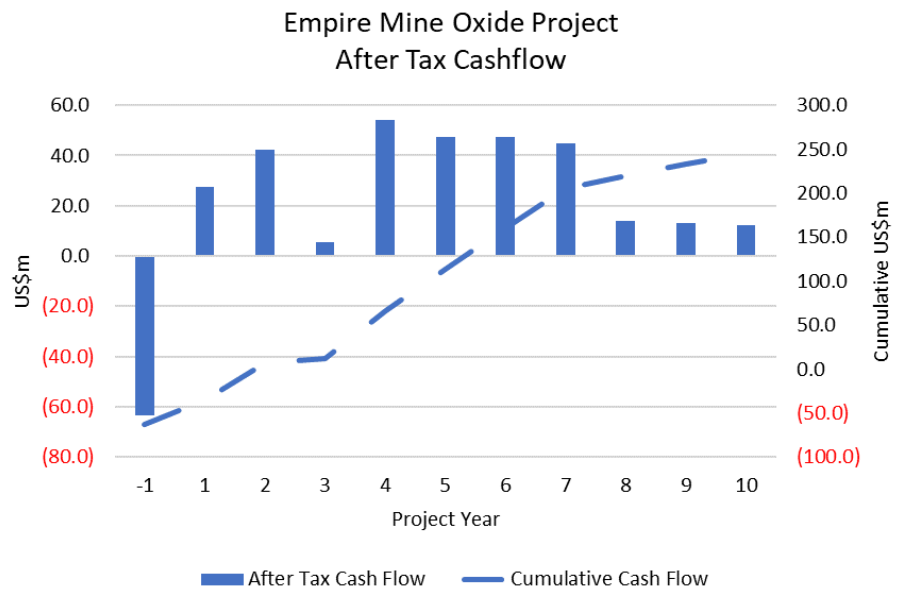


Figure 2 Cash Flow Analysis (Source: SP Angel)

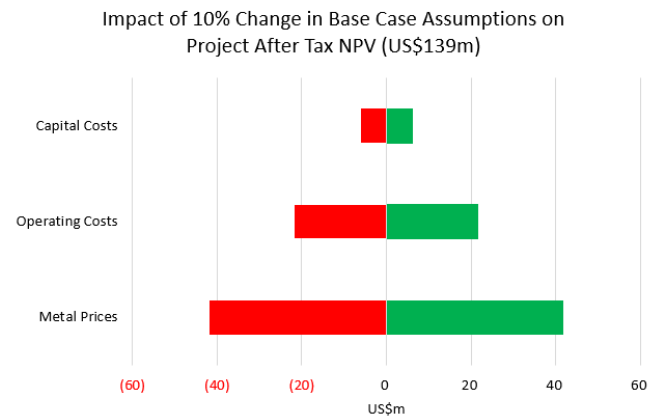
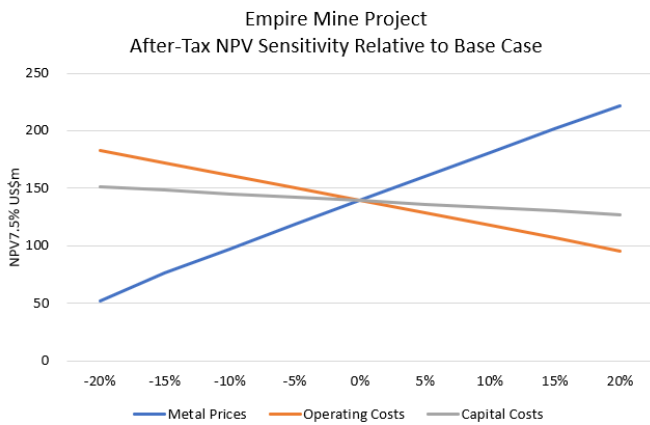


Figure 3 Empire Mine Oxide Project NPV Sensitivity (Source: SP Angel)

## American Copper Development Projects

SP Angel has examined the published data on a total of 14 undeveloped American copper projects where information is available on the proposed production profile, capital and operating costs at a minimum of the pre-feasibility level. In the interests of consistency, we have assessed the economic returns of the individual projects using a standard suite of SP Angel's published long-term metal price assumptions (Table 1) expressed as the after tax NPV discounted at 8%.

The results are summarised in tabular form as Appendix 1.

In summary, although the Empire mine copper oxide project is currently the smallest of the North American projects we have reviewed, in other respects it features several positive characteristics:

- Copper resource grade of 0.38% (Measured & Indicated) lies in the 3<sup>rd</sup> highest quartile of the available projects while the copper equivalent grade of 0.81% lies in the highest quartile.
- Life of mine cash operating costs, which the company estimates to be around US\$1.83/lb of copper equivalent production during phase1 are in the third quartile of costs
- Capital intensity of US\$6,337 of pre-production expenditure per tonne of average annual copper equivalent production is within the lowest cost quartile
- Estimated IRR of 50% lies in the 3<sup>rd</sup> highest quartile of the projects we have surveyed.
- Estimated project payback of 1.8 years is in the lowest quartile of the companies in our sample.

## Empire Mine Oxide Mineral Resource

The Empire mine oxide mineral resource has grown steadily and following the October 2020 resource estimate is shown in the following table:

Empire Mine Oxide Resources					
	Tonnes (m)	Cu %	Zn%	Ag g/t	Au g/t
Measured	8.3	0.42	0.22	11.4	0.33
Indicated	14.6	0.36	0.18	9.7	0.32
<b>Sub Total</b>	<b>22.9</b>	<b>0.38</b>	<b>0.19</b>	<b>10.3</b>	<b>0.32</b>
Inferred	10.6	0.40	0.14	7.4	0.34
<b>Total</b>	<b>33.5</b>	<b>0.39</b>	<b>0.18</b>	<b>9.4</b>	<b>0.33</b>

Source: Company 26<sup>th</sup> October 2020

**Table 3 Empire Mine Oxide Resource**

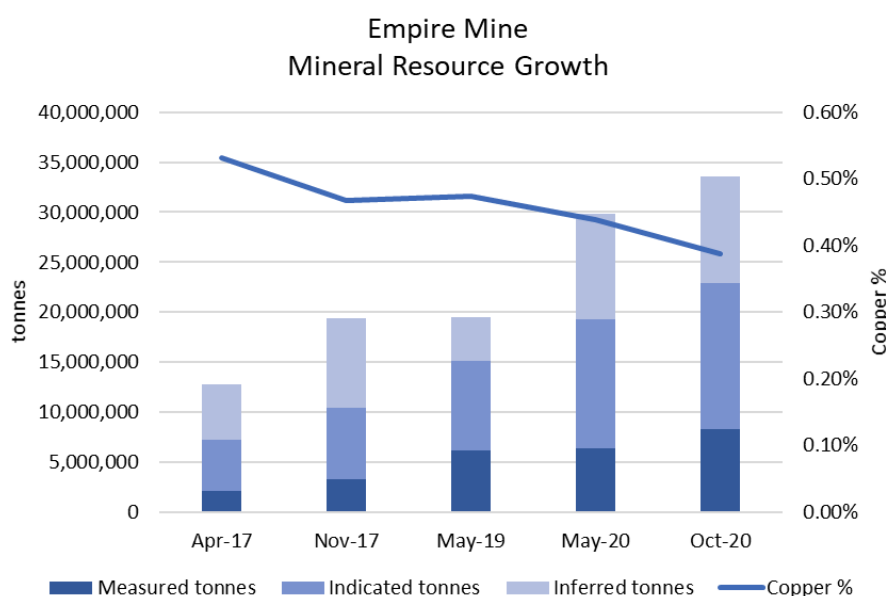
In comparison to the previous estimate in May 2020, measured and indicated resources have increased by around 2.6mt to 22.9mt in the most recent estimate with the proportion classed as measured rising from 33% to 36%. Inferred resources remain at approximately 10.6mt.

Since the first mineral resources estimate was released in the April 2107 listing statement, Phoenix Copper's subsequent exploration has more than tripled the volume of measured and indicated resources from 7.3mt to 22.9mt. Although the average copper grade of the measured and indicated resources has reduced from 0.55% to 0.28%, this is more than counterbalanced by the recent strength of the copper price which sees the equivalent value of the copper content some 15% higher at current prices than it was at the higher grades reported in the April 2107 mineral resources estimate

In addition, the subsequent metallurgical progress which enables recovery of the precious metals and zinc using environmentally benign technology has increased the copper equivalent grade to 0.75% in the most recent estimate.

The resource update also shows a progressive increase in the grades of zinc and precious metals since they were initially reported in November 2017. increased grades of zinc (from 0.14% in November 2017 to 0.19%) and, possibly of greater economic significance, of silver (from 9.6g/t to 10.3g/t with gold grades improving from 0.21g/t to 0.32g/t).

The evolution of the resource is illustrated in Figure 5 below.



**Figure 4 Empire Mine Oxide Resource Development (Source: SP Angel)**

## Red Star

As well as the oxide resource upgrade, the company has an initial, inferred, sulphide mineral resource estimate from the Red Star prospect, which was discovered during the 2018 exploration programme. Mineralisation is predominantly a skarn-hosted at the contact between the Eocene aged Mackay Granite and the surrounding Mississippian aged White Knob Limestone.

Based on three drill-holes at this stage, the company reports an inferred resource of approximately 104,000 tonnes of mineralisation at an average grade of 173.4g/t silver, 0.85g/t gold with 0.33% copper, 3.85% lead and 0.92% zinc. The silver potential of the area towards the NW remains largely untested and does not appear to have been a major contributor to historic production in the area.

Red Star is located to the NNW of the planned oxide pit and mid-way along the emerging mineralised trend which extends for more than 5km from the Empire site, through Red Star and into Phoenix Mining's other licence areas covering the historic Horseshoe mine and the Windy Devil Claims. Judging by the initial results from Red Star, further exploration of the more extensive northern part of this trend may prove fruitful as the company's assessment of its wider holdings evolves.



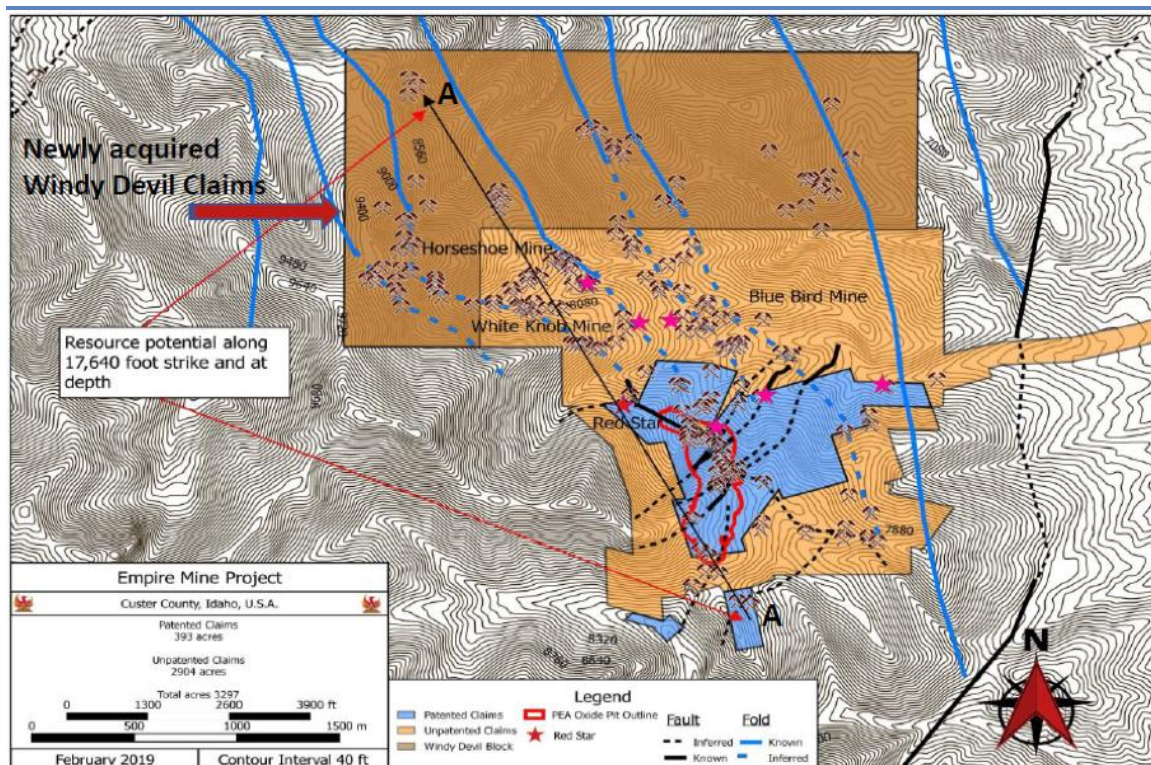


Figure 5 Phoenix Copper Land Holdings (Source: Company)

## Exploration potential at the Empire mine

At this stage, exploration of the wider licence areas bordering the Empire mine at the old Horseshoe mine claims and the Windy Devil and Navarre Creek claims is in its early stages. Similarly, the depth potential of sulphides mineralisation beneath the old Empire mine itself remains to be established, however, the comment of the company's consulting geologist, Nigel Maund that "only 1-2% of the potential ore system has been explored" sets a relatively low hurdle for a meaningful exploration success as the project develops. At this stage, we are assigning a nominal and relatively undemanding US\$5m value to the additional exploration potential within the broader exploration area.

## Navarre Creek

Recent published comments from the company compare the geological setting at the 9.8km<sup>2</sup> Navarre Creek licence area with that of the prolific Carlin trend in Nevada with similar argillic alteration, volcanic tuff hosted quartz stockworks and similar geochemical signatures observed along 6.1km of mineralised strike length. At this stage, the exploration potential of the Navarre Creek licence has still to be realised but discovery of only a small fraction of the 84+moz of gold produced from the Carlin trend since the early 1960s would clearly prove transformational for Phoenix Copper.

## Idaho Cobalt property

In March 2018, based on First Cobalt's acquisition of the Iron Creek Cobalt project in the Idaho Cobalt Belt, we estimated a value of US\$9.4m for Phoenix Copper's nearby Redcastle and Bighorn cobalt projects. March 2018, however, proved to be the zenith of recent interest in cobalt and cobalt prices have declined from the US\$90,000/t level

to a current level around \$51,800/t. We have therefore reduced our estimated value for the cobalt properties in a similar proportion to US\$5.4m which equates to approximately US\$11,500/hectare and is broadly consistent with the market valuation per hectare of other cobalt exploration companies active in the Idaho Cobalt Belt.

## Risk Assessment

As with any mining or mineral exploration project, the successful development of the Empire pit and future success of the company's continuing exploration programmes are subject to a range of technical, commodity price and geopolitical risks.

### Technical risks

More than one third of the measured and indicated mineral resource estimate at Empire is classified at the highest, measured, level of confidence providing containing the risk that the expected resources will not be validated during mining. The estimate is based on the results of over 400 drill-holes, including both historical work and additional drilling conducted under Phoenix Copper's stewardship.

Metallurgical testing has validated the proposed ore treatment and has identified that the use of the environmentally benign reagent ammonium thiosulphate enables the precious metals to be recovered at recovery rates comparable with those achievable through the more conventional cyanide leach.

The Phoenix Copper management team is composed of experienced mining professionals with a proven track record of successfully building, commissioning and running mines across the world. We believe that the team's record should reassure investors that there is expertise to deliver a relatively straightforward, shallow open pit operation in a mining-friendly jurisdiction.

### Commodity price risk

All mining projects are subject to the vagaries of commodity price fluctuations. In the case of the Empire oxide project, the principal product, copper, is an industrial commodity essential to the rapidly evolving 'green energy' revolution. Many commentators see a widening supply shortage for copper which, despite recent pull back, is enjoying robust prices.

The by product zinc and precious metals production may also provide a measure of product risk diversification while contributing to the costs of producing the principal copper product.

### Geopolitical risks

All Phoenix Copper's development and exploration is located in the US State of Idaho, which is recognized in the 2020 edition of the prestigious Fraser Institute's Annual Survey of Mining Companies as the jurisdiction with the best perceived policies towards mining in the world. Idaho, which was one of six US States rated in the worldwide top ten in terms of policy has also moved into the top ten rankings globally on the Fraser Institute's Investment Attractiveness Index.

The Survey quotes an exploration company president saying that "Idaho has timely and efficient approval processes for drilling explorations" and the Fraser Institute comments that no respondents to its survey "expressed concerns over the state's infrastructure, its socioeconomic agreements and community developments, its labour regulations, and security". Statistics generated by the Fraser Institute suggest that 29% of exploration permit applications are resolved within 2 months of application and 43% within six months.

More generally, the established legal, fiscal and legislative infrastructure in the United States provides clear pathways for mining approvals and an proven system for dispute resolution in instances where it may be needed.

# Appendix 1 North American Copper Projects

## North American Copper Projects Summary

Based on Copper price of US\$/lb 4.06

Project name	Ann Mason	Arctic Project	Black Butte	Carmacks	Contact Copper Project	Copper Creek	Copper King	Empire Mine	Florence Copper Project	Galore Creek	Gunnison - In Situ Leach	Harper Creek	Kutcho	La Verde	New Ingerbelle	Rosemont	Schaft Creek	van Dyke Copper Project	Zonia Project	
<b>Ownership</b>																				
Owner	HudBay	Trilogy Metals	Tintina Resources	Copper North Mining	Copperbank Resources	Copperbank Resources	US Gold Corp	Phoenix Copper	Taseko Mines Limited	Galore Creek Mining British Columbia	Excelsior Mining Arizona	Yellow Head Mining British Columbia	Kutcho Copper British Columbia	Solaris Copper Mexico	Copper Mountain Mining British Columbia	HudBay Arizona	Copper Fox Metals British Columbia	Copper Fox Metals Arizona	Cardero Resource Corp Arizona	
Location	Nevada	Alaska	Montana	Yukon	Nevada	Arizona	Wyoming	Idaho	Arizona	Columbia	Arizona	Columbia	Columbia	Mexico	Columbia	Arizona	Columbia	Arizona	Arizona	
Ore type																				
<b>Mineral Resources</b>																				
Cut-Off Cu%	0.2%		1.60%	0.2%	0.07%	0.5%	0.11%	0.18%	0.05%	0.20%			0.20%	1.0%	0.2%			0.15%	0.05%	0.2%
<b>Measured</b>																				
Tonnes (m)	412.0	0.0	2.7	7.9	68.5	33.5	13.7	8.3	296.0	39.5			348.5	7.7	57.5	57.3	697.4	146.6		15.4
Cu%	0.33%	0.00%	2.99%	0.82%	0.21%	0.88%	0.20%	0.42%	0.35%	0.25%			0.31%	1.89%	0.45%	0.26%	0.44%	0.31%		0.42%
Cu Eq %	0.37%	0.00%	2.99%	1.11%	0.21%	0.96%	0.63%	0.81%	0.35%	0.54%			0.34%	3.18%	0.51%	0.38%	0.50%	0.54%		0.42%
<b>Indicated</b>																				
Tonnes (m)	988.0	36.0	13.0	15.9	124.9	105.9	40.5	14.6	134.0	247.2			466.5	9.2	350.4	118.1	567.1	1,081.9		61.4
Cu%	0.31%	3.07%	3.48%	0.85%	0.19%	0.71%	0.18%	0.36%	0.28%	0.34%			0.28%	1.89%	0.40%	0.23%	0.26%	0.26%		0.31%
Cu Eq %	0.35%	5.46%	3.48%	1.07%	0.19%	0.75%	0.51%	0.72%	0.28%	0.55%			0.31%	3.46%	0.44%	0.34%	0.31%	0.44%		0.31%
<b>Measured &amp; Indicated</b>																				
Tonnes (m)	1,400.0	36.0	15.7	23.8	193.3	139.4	54.2	22.9	430.0	286.7			815.0	16.9	408.0	175.4	1,264.5	1,228.6	183.1	76.8
Cu%	0.32%	3.07%	3.40%	0.84%	0.20%	0.75%	0.19%	0.38%	0.33%	0.33%			0.29%	1.89%	0.41%	0.24%	0.36%	0.26%	0.33%	0.33%
Cu Eq %	0.35%	5.46%	3.40%	1.09%	0.20%	0.80%	0.54%	0.76%	0.33%	0.55%			0.33%	3.33%	0.45%	0.35%	0.42%	0.45%	0.33%	0.33%
<b>Operations</b>																				
Average Mining Rate mtpa Ore	41.8	3.6	1.1	1.7	14.1	8.7	3.3	2.1		30.7			29.3	0.9	30.9	16.3	30.0	44.8		8.4
Average LOM Copper Grade	0.30%	2.32%	3.11%	0.98%	0.22%	0.77%	0.19%	0.53%		0.59%			0.26%	2.01%	0.43%	0.24%	0.45%	0.27%		0.31%
Average LOM Copper Prodn (Eq Annual tonnes)	117,006	124,688	29,531	18,020	23,068	56,298	13,527	8,312	33,941	154,829	40,932	62,851	23,699	105,211	39,204	110,000	159,742	0	23,445	
Mine Life Years	21	12	11	7	10	18	17	10	23	18	24	28	12	20	12	19	21	14	9	
Pre-Production Capex US\$m	1,191.0	779.5	217.8	187.7	180.0	857.1	111.1	52.7	199.8	4,637.5	46.9	752.2	168.8	1,036.0	129.9	1,920.9	3,158.9	156.4	177.0	
LOM Cash Cost US\$/lb of Copper	1.99	2.01	1.44	1.54	1.61	1.84	1.69	2.15	1.13	1.06	0.65	1.18	0.98	1.78	1.88	1.43	1.84		1.45	
<b>Project Economics (US\$m)</b>																				
NPV Discounted at 8%	2,394.0	2,481.4	630.2	81.7	212.4	1,003.7	408.1	139.3	1,286.1	3,051.4	1,668.0	2,272.1	742.2	2,623.8	802.6	3,411.9	3,374.5		445.3	
IRR	23.7%	44.7%	44.8%	32.1%	44.4%	24.3%	95.3%	50.2%	72.4%	16.8%	90.3%	38.4%	76.7%	53.6%	72.3%	31.5%	20.8%		73.2%	
Payback (Years)	3.8	1.5	2.1	159.4	1.9	2.7	0.9	1.8	3.5	3.3	2.6	1.9	2.4	98.5	0.9	2.6	3.1		0.9	
<b>Benchmarks</b>																				
NPV/Pre-production Capex	2.0	3.2	2.9	0.4	1.2	1.2	3.7	2.6	6.4	0.7	35.6	3.0	4.4	2.5	6.2	1.8	1.1		2.5	
Capital Intensity US\$/Annual tonne	10,179	6,252	7,374	11,405	14,355	15,224	8,212	6,337	5,887	8,387	1,145	11,969	7,121	9,847	3,312	17,463	19,775		11,331	

Summary	Max	Min	Tot/Avg
Resource tonnes (M&I)	1,400.0	15.7	6,770.1
Resource Grade Cu Eq %	5.46%	0.20%	0.44%
Copper Eq Production Rate tpa	159,742	0	60,226
Mine Life (Years)	28	7	16
Pre-Production Capex \$(m)	4,637.5	46.9	840.1
Capital Intensity	19,775	1,145	9,754
LOM Cash Cost US\$/lb	2.15	0.65	1.54
Total NPV 8%	3,411.9	81.7	1,384.6
Average IRR	95.3%	16.8%	50.3%
NPV/Pre-Prod Capex	35.6	0.4	4.5
Payback (Years)	159.4	0.9	16.3

Based on Commodity Price Assumptions	
Copper (\$/lb)	4.06
Gold (\$/oz)	1,925
Silver (\$/oz)	24.00
Zinc (\$/lb)	1.29
Lead (\$/lb)	1.11
Molybdenum (\$/lb)	11.00

SP Angel | Prince Frederick House | 35-39 Maddox Street | London | W1S 2PP | United Kingdom

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A full analysis is available on our website here <http://www.spangel.co.uk/legal-and-regulatory-notices.html>. If you have any queries, feel free to contact our Compliance Officer, Tim Jenkins ([tim.jenkins@spangel.co.uk](mailto:tim.jenkins@spangel.co.uk)).

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## SP Angel Contact List

### Research

#### John Meyer

+44 20 3470 0470

john.meyer@spangel.co.uk

#### Simon Beardsmore

+44 20 3470 0484

simon.beardsmore@spangel.co.uk

#### Sergey Raevskiy

+44 20 3470 0474

sergey.raevskiy@spangel.co.uk

#### Joe Rowbottom

+44 20 3470 0486

joe.rowbottom@spangel.co.uk

### Sales

#### Richard Parlons

+44 20 3470 0472

richard.parlons@spangel.co.uk

#### Abigail Wayne

+44 20 3470 0534

Abigail.wayne@spangel.co.uk

#### Rob Rees

+44 20 3470 0535

rob.rees@spangel.co.uk

#### Grant Barker

+44 20 3470 0471

grant.barker@spangel.co.uk



4th Floor  
Prince Frederick House  
35-39 Maddox Street  
London, W1S 2PP  
United Kingdom

Tel: +44 20 3463 2260  
Fax: +44 20 7629 1341  
Web: [www.spangel.co.uk](http://www.spangel.co.uk)