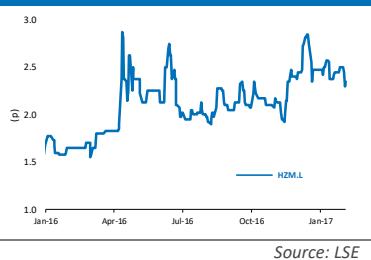


6<sup>th</sup> February 2017

## Sector: Mining



Source: LSE

## Market data

	HZM
EPIC	
Price (p)	2.48
12m High (p)	3.10
12m Low (p)	1.48
Shares (m)	1.17bn
Mkt Cap (£m)	29.0m
Free Float*	55.1%
Market	AIM & TSX

\*As defined by AIM Rule 26

## Description

Horizonte Minerals plc is a dual-listed resource development company quoted on AIM and the TSX. Horizonte's flagship project is the 100%-owned Araguaia nickel laterite project in Brazil. Araguaia is one of the highest grade, and lowest cost nickel development assets globally. Current stage: Feasibility.

## Company information

CEO	Jeremy Martin
Chairman	David Hall
Non-Exec	Owen Bavington
Non-Exec	Allan Walker
Non-Exec	Alexander Christopher
Non-Exec	William Fisher

[www.horizonteminerals.com](http://www.horizonteminerals.com)

## Key shareholders

Teck	17.9%
Richard Griffiths	14.5%
Henderson	14.1%
JP Morgan	8.4%
Glencore	6.4%
Hargreave Hale	6.4%
City Financial	5.6%

## Analyst

scsb@shardcapital.com  
020 7186 9952  
Phil Swinfin

# Horizonte Minerals

## Perfectly positioned for the next nickel up-swing

Horizonte is about to commence a full feasibility study on its 100%-owned Araguaia nickel laterite project in Brazil. Araguaia is a long-life, high grade deposit with industry-leading capital intensity. The PFS last year confirmed Araguaia as having one of the lowest C1 cash costs in the sector. The company has an experienced board and strong institutional backing. Horizonte provides strong leverage to strengthening nickel fundamentals. Despite this, the current market cap is more reflective of the cyclical low-point in the nickel industry, and represents a compelling entry point to a world-class nickel play, in our view.

- ▶ **World-class.** Araguaia is one of the largest and highest grade nickel laterite development projects globally and a true success story in terms of value-add organic exploration and well-timed value-accretive acquisitions. The project has good regional infrastructure including a network of Federal highways and access to low tariff hydroelectric power. Araguaia has a robust resource with significant upside potential.
- ▶ **Robust PFS.** After the game-changing acquisition of the nearby GAP project from Glencore, a PFS late last year demonstrated robust economics for the newly combined project, with a post-tax NPV (8%) of \$328m and IRR of 19.3% at \$12,000/t nickel. HZM expects the project to generate \$1.3bn in FCF over the LOM.
- ▶ **A low-cost project.** Our analysis indicates that Araguaia has one of the lowest capital intensities globally. Cash costs are also extremely low, with the project on the cusp of a lower quartile position. Thus, we see short capital payback, and sector leading margins.
- ▶ **De-risked.** With shallow, low-strip, free dig mining and a proven RKEF process selected, we do not see any technical red flags. Araguaia will produce a high-quality commercially attractive ferronickel product (30% Ni in FeNi). Permitting is well advanced and we believe that the most onerous hurdles have already been completed.
- ▶ **Heavyweight backing.** The Board has an excellent track-record with first-hand experience of operating in Brazil. The shareholder register is impressive for a junior company. Along with major diversified miners, Teck and Glencore, the company has strong institutional backing with JP Morgan and Henderson on the register.
- ▶ **Nickel deficit emerging.** Despite being dogged by years of structural oversupply, the nickel sector has slipped into deficit. The potential supply-side response appears shaky at best, with the project development pipeline destroyed by years of underinvestment, and high capital intensity meaning most projects have been left on the shelf. We believe that the sector is starting to emerge from a multi-year cyclical low and that first production from Araguaia is likely to coincide with a period of sustained higher prices. When nickel inventories drawdown, we see considerable scope for price increases.
- ▶ **The thrill of Brazil.** The Brazilian economy is showing signs of recovery after several challenging years. \$64bn in infrastructure investment was announced in 2015 and IMF forecasts show positive growth in 2017. Brazil is a favourable jurisdiction to develop a mining project, and a devalued domestic currency provides input cost advantages.
- ▶ **Next Steps.** Horizonte is fully-funded through to the end of Feasibility at Araguaia. The company plans to complete the feasibility study by the end of 2017.

As one of the only nickel development projects worldwide with realistic development prospects, we see considerable scope for a re-rating of the company's shares on the back of development milestones and positive nickel fundamentals.

# Horizonte Minerals

## Successful Explorer, Future Developer

Horizonte Minerals plc is a dual-listed exploration and resource development company quoted on the AIM and TSX markets (ticker: HZM). Horizonte is focused on developing nickel assets in Brazil, with the company's flagship the wholly-owned Araguaia nickel laterite project located to the south of the Carajás mineral district of northern Brazil, a favourable jurisdiction with excellent infrastructure.

Araguaia is a Tier 1 asset in terms of size and grade, and one of the largest undeveloped saprolite resources globally. There is little doubt in our mind that Araguaia will be the next major nickel project developed in Brazil. A revised PFS in October 2016 demonstrated that Araguaia is a robust high-grade, long life project which Horizonte anticipates will sit in the lower range of the global industry cost curve. Horizonte is preparing to initiate a full feasibility study in February 2017, which is fully-funded following the successful £9m fundraise in November 2016.

Horizonte is somewhat of a rarity in the resource industry by developing an asset (after Teck's initial greenfield discovery), which the company has taken from early stage exploration through resource evaluation an into development.

This is important because HZM has not built its asset base through poor value, over-dilutive M&A. Despite the recent licence acquisition from Glencore, the core development opportunity has been built organically at a very low discovery cost on a contained nickel basis. HZM has generated value directly from the drill bit.

HZM has an exceptionally strong Board and management for a junior company, in our view. CEO, Jeremy Martin has assembled an impressive team with the requisite skills in place to manage the development phase and put Araguaia into production.

### *The Glencore transaction was a game-changer*

The September 2015 acquisition of the adjacent nickel project from Glencore at a low cost, with the upfront portion paid in shares was undoubtedly a game-changer for HZM. The timing of this acquisition, at the bottom of the nickel-market cycle was quite simply sublime. Not an adjective we often have justification to use in our experience of the mining sector over recent years. The acquisition consolidates the district, extends the project life, but more critically secures ore feed at c.2%Ni over the initial 10 years of mine life. This has important implications for the project economics which is reflected in the new PFS results, resulting in a shorter pay-back and lowering the break-even nickel price.

### *A nickel market opportunity unlikely to come around again*

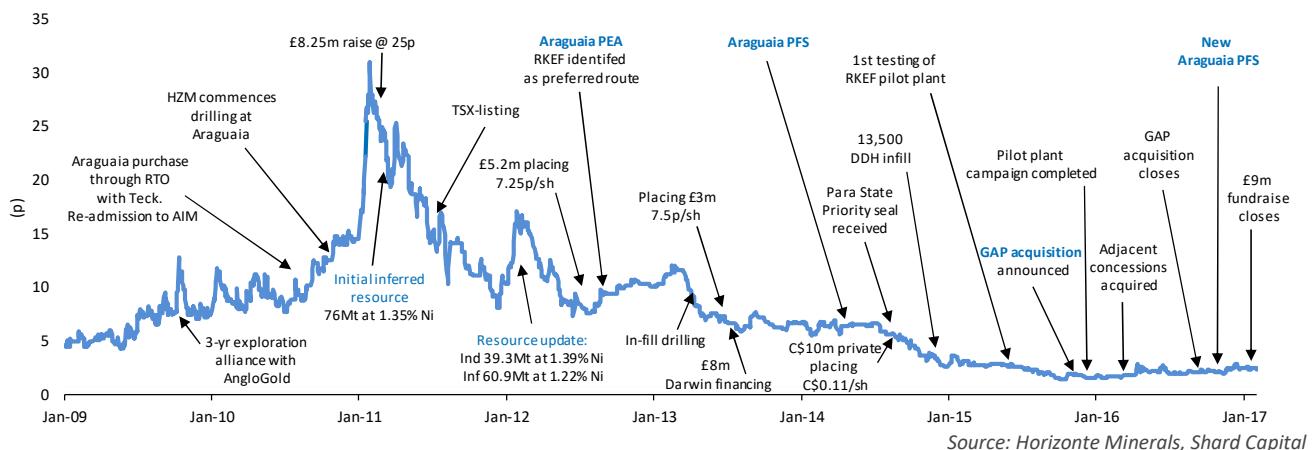
Araguaia has not been an easy win by any stretch. Whilst exploration success outlined a world-class orebody at Araguaia, volatility and weakness in the nickel market produced a myriad of challenges in moving the project along the development curve. The nickel price plunged to a 12-year low in late 2015, and steadily started regaining ground throughout 2016. Future demand appears robust, with the market expectation for an increase in the nickel price over the mid-term, meaning that Araguaia is likely to come on-stream at a time coinciding with an upswing in nickel market fundamentals. The new PFS demonstrated that Araguaia is cash flow positive at current nickel prices which means that 1.) Araguaia is one of only a few projects worldwide that is currently viable and 2.) the leverage to higher nickel prices is considerable. Thus, the timing is extremely compelling, in our view.

## Horizonte Minerals

### Potted History

Horizonte was admitted to trading on London's AIM market in May 2006, and obtained an additional listing on the Toronto Stock Exchange in 2011. We have plotted the key events over the last several years below, with a focus the development milestones for Araguaia.

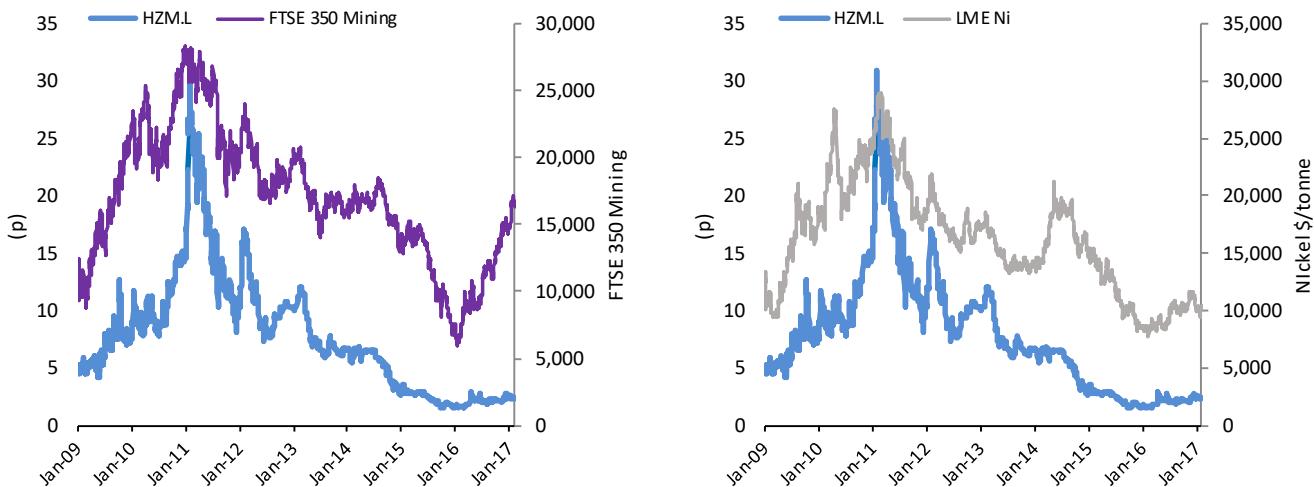
Figure 1 - Horizonte's timeline – Evolution of Araguaia



### Share Price Comparison Charts

Historically, the HZM share price has tracked the trajectory of both the FTSE 350 Mining Index and the LME cash nickel price.

Figure 2 - Long range HZM share price vs. FTSE 350 Mining and LME Nickel

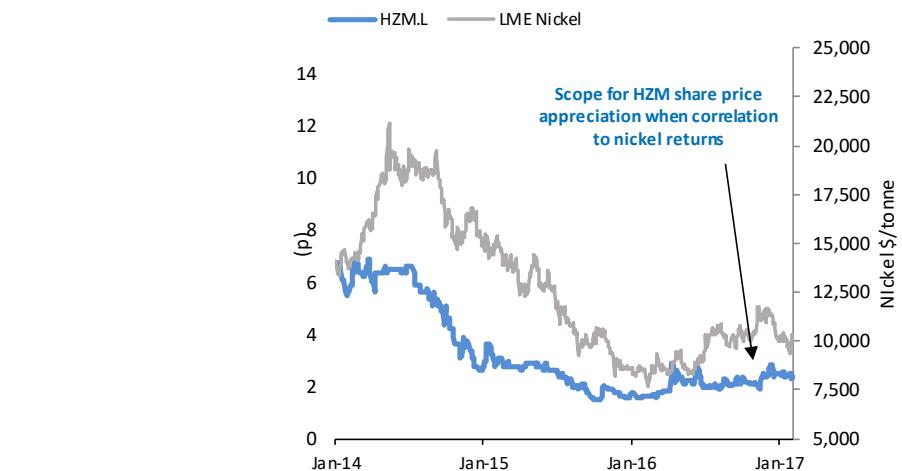


Source: Horizonte Minerals, LME, LSE, Shard Capital

## Horizonte Minerals

The medium range chart indicates that HZM's shares followed nickel's path downwards from mid-2014 onwards. Given that we expect the company to have a relatively strong correlation to movements in the nickel price, we note that HZM's shares over the last 12 months show a disconnect to this relationship. With Araguaia firmly on the development path, we see scope for share-price appreciation on the back of any potential nickel price rally as correlation returns.

*Figure 3 - HZM share price vs. LME Nickel – historically well correlated*



*Source: Horizonte Minerals, LME, Shard Capital*

## Financial Position

As of the end of Sep 2016 (last published financials), Horizonte had £1.18m cash on the balance sheet. This does not reflect the proceeds from the November £9m private placement. As a result, the company is now fully funded through to the end of the Araguaia feasibility study.

## Timeline and Key Catalysts

*Figure 4 - Timeline and next steps – gearing up for production*



*Source: Shard Capital estimates*

## Board of Directors

### *David Hall - Non-Executive Chairman*

**BA (hons), MSc, Fellow SEG, P.Geo.** David Hall over 30 years' experience in the exploration and mining sector and has worked on and assessed, exploration projects and mines in over 40 countries. Key roles include: Chief Geologist for Minorco, Consultant geologist for Minorco South America, Exploration manager for AngloGold South America in 1999 (inc. Morro Velho and Crixas mines in Brazil) and Founder of Stratex International Plc.

### *Jeremy Martin - CEO*

**MSc, ASCM.** Extensive exploration, development and executive management experience in South America and Europe. Involved in the formation of a number of AIM and TSX listed resources companies. Mr Martin holds a degree in Mining Geology from the Camborne School of Mines, and a Master's Degree in mineral exploration from the University of Leicester. Mr Martin has established a number of JV partnerships with major mining companies and has been involved in the formation of four AIM and TSX traded companies.

### *Owen Bavinton - Non-Executive Director*

**BSc (Hons), MSc, DIC, PhD.** Dr. Bavinton has over 40 years' varied international experience in the minerals exploration and mining sector in several commodities. Key roles have included: Director of WMC's activities in Brazil, CEO of Aredor Guinea SA and an 18-year stint at Anglo American. Latterly Dr. Bavinton was Head of Exploration and Geology for the Anglo American Group responsible for worldwide exploration and geosciences. BSc (Hons) Geology, Queensland, MSc Mineral Exploration, Imperial, PhD Economic Geology, ANU, Canberra.

### *Allan Walker - Non-Executive Director*

**MA.** Over 30 years' experience in investment banking and funds management, primarily focussed on project finance and private equity in the energy and natural resource sectors. Key roles: Head of Project Finance on the Institutional Investment and Infrastructure team at UK Trade and Investment. Head of power and infrastructure in London for Standard Bank Plc. Director in the Global Energy and Project Finance Group of Credit Suisse and Mr. Walker ran the energy group at CSFB Garantia in Sao Paulo, Brazil from 1998 to 2001.

### *Alexander Christopher - Non-Executive Director*

**BSc (Hons), PGeo.** 30 years' experience in mineral exploration and the mining industry. Mr. Christopher currently holds the position of Vice President, Exploration at Teck. Mr. Christopher has been with Teck since the mid-1980's holding a number of positions within the company.

### *William Fisher - Non-Executive Director*

**BSc, PGeo.** Extensive industry experience in Africa, Australia, Europe and Canada in both exploration and mining. Key roles: Karmin Exploration (discovered the Aripuanã base metal sulphide deposits in Brazil), VP Exploration for Boliden AB, GlobeStar Mining Corp (developed and operated the Cerro de Maimon mine), Chairman of Aurelian Resources (acquired by Kinross in 2008 for \$1.2bn). Currently serves as Executive Chairman of Goldquest Mining Corp. (TSX: GCQ), director of Treasury Metals Inc. (TSX: TML) and Chairman of Rame Energy (AIM: RAME).

## Company Structure

### Corporate Structure

Horizonte has a relatively simple corporate and asset holding structure by virtue of the combined Araguaia project being wholly-owned by the company. The company's licences in Brazil are held through a number of 100%-owned subsidiaries. Horizonte Minerals plc is registered in England and Wales, having been incorporated in 2006.

### Capital Structure – a high quality register

Horizonte's shares are quoted on London's AIM market (IPO in 2006), with an additional listing on Canada's TSX (2011). The company has 1.17bn ordinary shares in issue as of the 5<sup>th</sup> December 2016. The fully diluted share capital is effectively the same, as currently the exercise of share options would be anti-dilutive. As of the end of 2015, 30.6m potentially dilutive share options were exercisable at a weighted average price of 12.4p/sh. The free-float is 55.1%.

HZM has some quality names on the share register, in our view. Notably, two major diversified mining companies Teck and Glencore, with Teck the largest shareholder (17.9%) on the back of the 2010 Araguaia transaction (Teck held 50% post transaction), and Glencore (6.4%) as a result of the GAP acquisition.

Richard Griffiths, Chairman of Ora Capital Partners holds 14.5%. It is worth noting that Teck's interest was reduced from 26% to 18% after the December 2016 £9m placement. However, institutional support increased with JPM and Henderson upping their stakes. Overall, some high quality institutional support for a junior.

*Figure 5 - Significant shareholders*

Shareholder	Number of shares	% of issued capital
Teck Resources	210,207,179	17.90%
Richard Griffiths	169,414,049	14.50%
Henderson Global Investors	165,376,242	14.10%
JP Morgan	98,394,838	8.40%
Glencore	74,507,195	6.40%
Hargreave Hale	75,000,000	6.40%
City Financial	65,333,333	5.60%

*Source: Horizonte Minerals*

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## PFS Summary

In October 2016, Horizonte released results from a new Pre-Feasibility Study (PFS) on Araguaia. This updated the March 2014 PFS and due to a number of optimisations and the inclusion of Glencore's GAP, resulted in considerably improved physical and economic outputs. For example, base-case capex has been reduced to \$353m from \$582m in the earlier iteration, the ferronickel (FeNi) grade quality has been increased to 30% from 20%, and C1 opex lowered to \$3.15/lb from \$4.16/lb. The main parameters of the October PFS are set out below:

*Figure 6 - October 2016 PFS Parameters, inputs and outputs*

PFS Key Indicators	Base case	
Nickel price	\$12,000	\$14,000
NPV 8%	\$328m	\$581m
IRR Post-tax	19.3%	26.4%
Initial Mine Life	28	28
Pre-production capital cost	\$354m	\$354m
C1Operating cost	\$3.15/lb	\$3.15/lb
	\$6,948/t	\$6,948/t
FCF over LOM (after capital payback)	\$1.26bn	\$1.95bn
Payback period (post tax)	4.5 years	3.4 years
Average annual nickel production	14,500tpa	14,500tpa
Average nickel grade: years 1-10	1.96%	1.96%
Average nickel grade: years 11-28	1.70%	1.70%
Product grade quality (Ni in FeNi)	30%	30%

Physicals and project parameters	Unit	Value
Ore throughput –Year 1to Year 10	Mt/a (dry)	0.90
LOM ore processed	kt	24,646
LOM waste mined	kt	59,061
Ore grade –design (average first 10 years)	% Ni	2
Overall nickel recovery	%	93
Final metal Ni production –design capacity	t/a Ni	16,400
Furnace power (one furnace)	MW	50
Ni grade in the final product metal	%	30
LOM average product Fe grade	%	70
Plant configuration	One RKEF line	
Refining system	Ladle furnace	
Final FeNi product	Granulated FeNi	

Capex schedule	Value
Plant direct	202.4
Plant indirect	22.5
Owners costs	21.4
Infrastructure	35.3
Slag storage facility	5.2
Social	1.9
Mining	2.9
Environmental	2.9
Land Acquisition & Resettlement	11.5
Contingency at 15%	46.3
First-fills and spares	1.2
<b>Total pre-production capital costs</b>	<b>353.5</b>

*Source: Horizonte Minerals*

## Upside, Optimisation, Potential risks

### *Araguaia is a leveraged play on nickel price recovery*

We believe that Araguaia provides compelling leverage to any increase in the nickel price. Given the industry is potentially re-surfacing from one of the most severe cyclical down-turns in history, we think investors with a positive long-term view on the nickel price will start to seek out projects like Araguaia. It is worth noting that the nickel price has averaged \$20,000/t over the last 10 years.

### *The nickel grade kicker*

Araguaia is already a long-life operation with a 28 year LOM. Extending this further would have limited impact on the project valuation due to the discounting of long-dated cash flows at the end of the mine life. Instead, we see an immediate increase in flow-through value on the back of any increase in nickel ore grade delivered to the processing plant, or by a expansion in throughput.

Whilst the grade in years 1-10 averages 1.96%, the overall LOM grade is 1.77% Ni. Any increase in grade would likely have considerable impact on both the project's NPV and IRR. The high-grade potential of the project is demonstrated by drilling such as at Serra do Tapa, which returned an intersection of 83.4m at 2.06% Ni, including 62.8m at 2.36% Ni.

### *Recovery improvement straight to bottom line*

Any increase over the base-case metallurgical Ni recovery of 93% would provide immediate incremental value-add.

### *Doubling up*

Once in production, longer term potential exists to add a second RKEF production line which would effectively double production, and significantly boost the project economics. We believe that it may cost c.\$200m to add in a second RKEF line.

### *Mining will require close supervision*

Despite mining itself being straightforward with shallow, low-strip and essentially free-dig (blasting not required) ore, we see ore scheduling and blending as one of the challenges of the project. This is because ore will be sourced from 8 separate pits, with 3-5 pits in operation at any given time.

Achieving the correct production rate to feed a large enough ROM stockpile in order to allow blending prior to processing, will require thorough planning and detailed scheduling. Maintaining the required head-grade will require close supervision of grade control and mineralogy. It is not just the Ni-grade (and Fe) that varies between pits, but also the amount of impurities such as SiO<sub>2</sub>, MgO and Al<sub>2</sub>O<sub>3</sub> which will also affect blending requirements at any given time.

Over and above the schedule, we think it is possible that with variable operating conditions, equipment availability or adverse weather conditions, it may not always be possible to mine from individual pits as per the schedule. We believe this risk is easily mitigated with the close supervision and planning as indicated above.

### *Ramp up and Process risk*

RKEF is a proven process for the recovery of nickel with c.20 operating plants worldwide. However, as with all mining operations, risk exists during the ramp-up phase in meeting throughout and recovery targets post-commissioning.

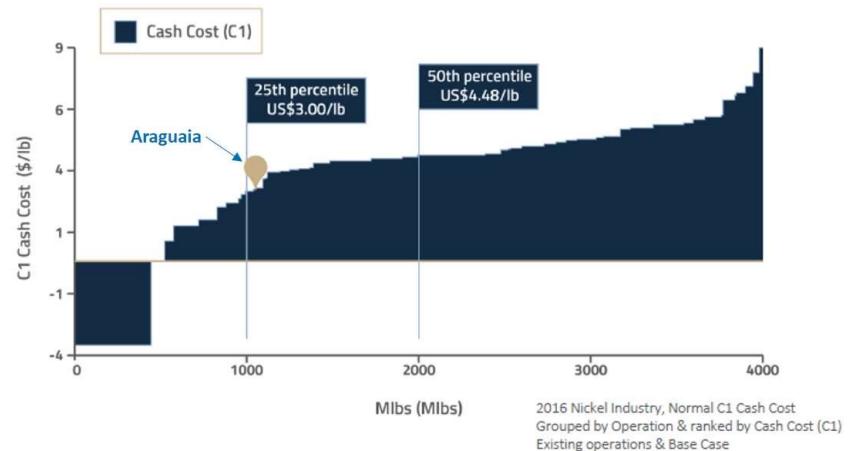
Will also envisage that HZM will have to be vigilant in monitoring ore feed to the ROM pad from the mining operation to manage variations in ore type that may affect metallurgical performance. This includes the ore from the GAP project, which whilst similar to HZM Araguaia ore, may behave differently in the flowsheet. Again, easily mitigated with comprehensive metallurgical testwork.

## Putting Araguaia into Context

### *A low cash cost project...*

Horizonte's new October PFS indicates a C1 cash cost of \$3.15/lb (\$6,948/t) which puts the project on the cusp of being lower quartile, and one of the lowest cost nickel development projects worldwide.

Figure 7 - Araguaia C1 Cash cost

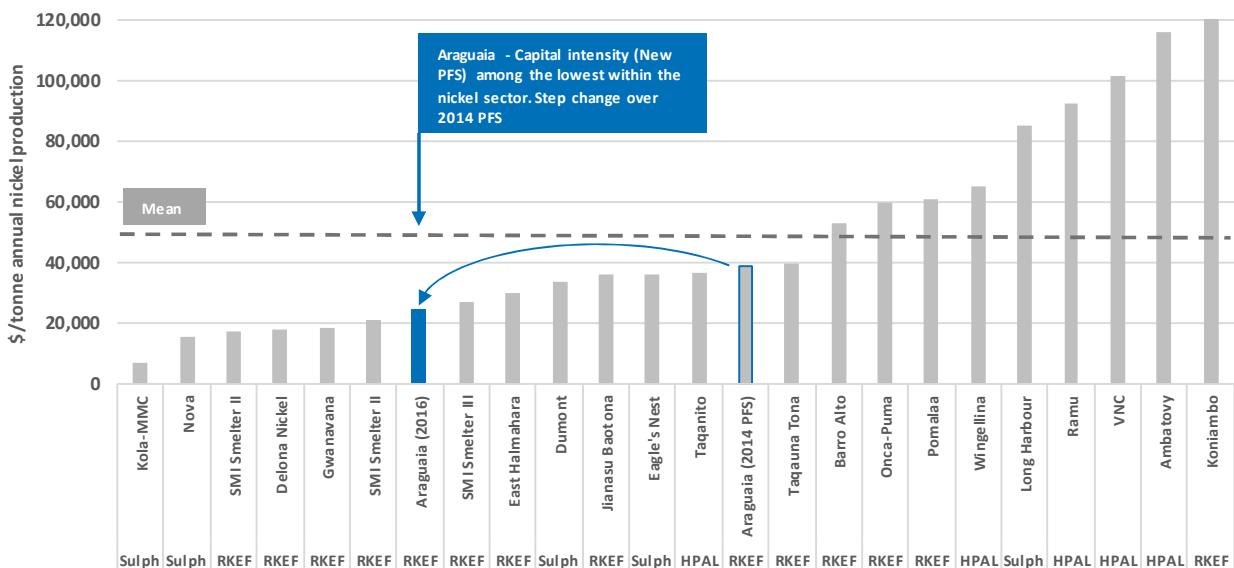


Source: Horizonte Minerals

### *...with low capital intensity*

Araguaia has one of the lowest capital intensities in the industry, both for development projects and mines already in production. We calculate Araguaia has a capital intensity of c. \$24,500/t, below the mean of \$48,000/t for the project universe below. Typical FeNi capital intensity is c. \$60,000/t and HPAL capital intensity is \$90,000-\$100,000/t.

Figure 8 - Araguaia has a low capital intensity on the world stage



Source: AME Group, Company reports, Shard Capital estimates

## Horizonte Minerals

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Araguaia is a laterite project which will utilise RKEF technology (Rotary Kiln Electric Furnace) to produce a FeNi product. As such the capital intensity is lower than other processes, particularly HPAL (high-pressure acid leach) which is a complex hydrometallurgical process.

### *The economics are robust*

The PFS indicates that the economics are robust. With nickel not far off the cyclical low point, and given our positive long-term outlook for the metal, Araguaia has considerable leverage with the potential to generate sector-leading levels of free cash flow.

### *Fully-funded through to the end of feasibility*

On the back of the November 2016 £9m placing, Horizonte is fully-funded through to the completion of the upcoming Araguaia feasibility study. This removes a significant portion of funding risk, and removes the prospect of additional dilution for shareholders over the next phase of development.

### *A World-class, long life project, a model of exploration success*

It's easy to become complacent when researching mining projects, however, it is worth emphasising that we view HZM and Araguaia as a true exploration and M&A success story.

From a grassroots discovery by Teck, Horizonte has grown the total resource base to 1,694kt of contained nickel, trebling the resource over the last four years through rigorous exploration and well timed value-accretive acquisitions. Araguaia already has a 28 year LOM, and we see significant scope to extend both the resource and reserve base.

### *Infrastructure is already in place*

Araguaia has good regional infrastructure including a network of Federal highways and roads, with access to low tariff hydro-electric power.

### *A favourable jurisdiction*

Compared to the location of other nickel development projects, we view Brazil as a favourable location to build a mine. The government is supportive of mining projects with a well-established legislation framework. The economy is showing signs of recovery and the devaluation of the domestic currency increases the purchasing power for miners by lowering key input costs.

### *Permitting is well advanced*

The project is located 100% within Pará State with no messy cross-border issues. The process is largely de-risked with the Preliminary Licence already approved, meaning that all the environmental and social issues have been ticked off. The next key step is to apply for the Installation Licence which permits the start of construction.

### *A quality Board and heavy-weight register*

We have already covered this in the capital structure section of this note but it's worth looking again at both Horizonte's Board and the list the major shareholders. The Board, in our view has an excellent mix of technical and financial experience, with decades of accumulated experience, most of which is garnered from major mining companies, with an impressive track-record that includes nickel and Brazilian operating experience.

The capital register is impressive for a junior company and the last placing had strong institutional support. Major diversified mining houses, Teck and Glencore have major holdings. The real differentiator versus other AIM companies is the presence of some heavy-weight institutions, including JP Morgan, Henderson and Hargreave Hale. We believe this gives HZM a good start along the road to securing financing for the project.

### *Araguaia's grade advantage – it eclipses Barro Alto*

Currently, about 60% of world nickel production comes from sulphide ores, with the 40% balance from laterites. Figure 18 (next page) indicates that the ore grade from both future sulphide and laterite projects is set to decline drastically.

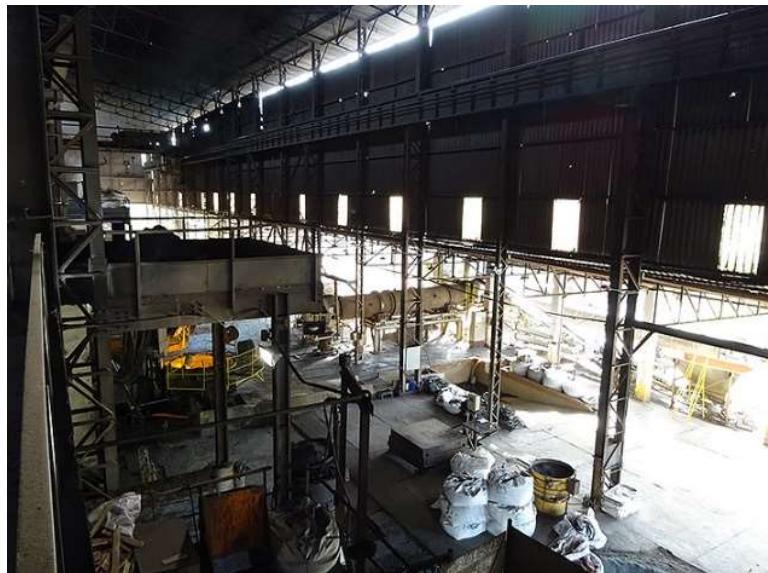
Araguaia, is not only one of the largest nickel saprolite projects in the world, but also one of the highest grade, with the 2% head-grade over the first 10 years of operation, well above the industry average. Araguaia's reserve grade is 1.77% Ni which compares favourably with Anglo American's world-class Barro Alto which has a reserve grade of 1.49% Ni.

### *A proven process*

Horizonte has completed a full pilot plant campaign which demonstrated that Araguaia will produce a high-grade commercial ferronickel (FeNi product) with a grade of 30% nickel and low impurities, which should make the product attractive for international markets. Drying and agglomeration produced excellent feed for calcination and no critical flaws were identified in the flow sheet. We view RKEF as a much lower risk technology than HPAL.

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*Figure 9 - A fully integrated RKEF pilot plant has proven the flowsheet*



*Source: Horizonte Minerals*

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## Horizonte Minerals

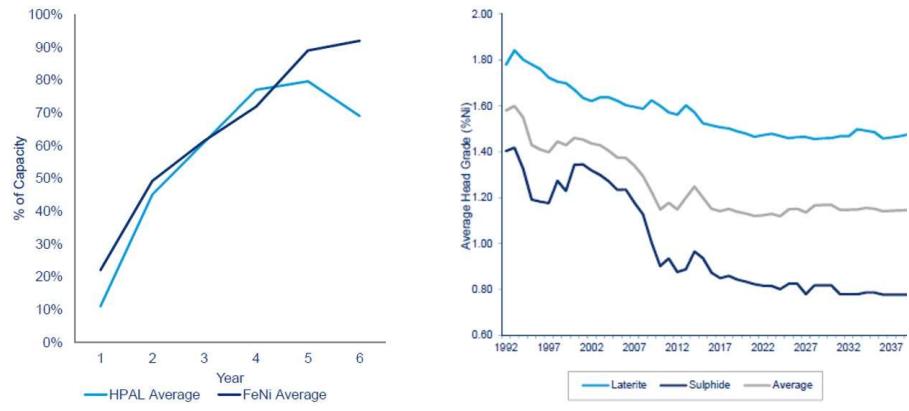
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### RKEF FeNi – a number of advantages over HPAL and others

The cost of RKEF is approximately 10% lower than other pyrometallurgical processes such as traditional electric furnaces. Furthermore, RKEF has much lower technical risk than the hydrometallurgical processes such as HPAL. Over the past 10 years, RKEF has become the process of choice in China, with RKEF accounting for approximately 58% of China's NPI output.

RKEF and FeNi is a tried and tested technology and research by Wood Mac indicates that beyond initial ramp-up, it maintains its trajectory towards nameplate capacity. In contrast, HPAL ramp-up is significantly lower than general industry expectations, with numerous cases of over promising and under delivering.

*Figure 10 -(LHS) Ramp-up performance; FeNi vs HPAL. (RHS) ore grade forecasts*



*Source: Wood Mackenzie*

*Figure 11 - Ferronickel bar from Araguaia Pilot Plant 2015*



*Source: Horizonte Minerals*

## Positive LT Nickel Fundamentals

**Nickel is a late-cycle commodity – used in high-end applications, and not easily substituted, especially in stainless steels. NCA and NCM Lithium batteries for electric/hybrid vehicles is a key growth market, but little consensus on the pace of uptake.**

**Global refined nickel consumption is approximately 2Mtpa. Demand appears to be improving and the supply response looks shaky. The final requirement is for nickel inventories on the LME and other exchanges to work down, which may start in earnest in 2017 as the stainless-steel sector re-stocks.**

**Supply crunch?**  
**Domestic Chinese supply is stable at best. Philippine resources are limited. Endemic underinvestment in new supply.**

We do not give an overview of nickel in general in this note as we believe the topic is well-covered elsewhere. Suffice to say that nickel is predominately used in alloying along with other elements such as chromium. 65% of nickel is used in the manufacture of stainless steels with another 20% used in other steel and non-ferrous alloys. Minor, but growing applications include batteries for hybrid cars. Stainless steels frequently contain between 8-12% Ni, as nickel provides superior strength and corrosion resistance.

### Key Points:

#### Demand drivers

Nickel demand has grown significantly over the last 25 years. The primary first-use of the metal is in stainless steel manufacture. As such, nickel use is inherently correlated to construction and infrastructure development with economic growth the engine. Asia is responsible for c.65% of all nickel demand, almost half of which is China. As with most base-metals, the Chinese demand story of urbanisation and infrastructure is a key catalyst.

An additional end-use which may act as a fillip for demand is the automotive industry. According to Norilsk, nickel demand in the automotive industry is set to rise as much as three to five-fold due to increased output of hybrid and electric vehicles which use lithium-ion batteries. This thesis has been floating around for a while, and our view is that any growth in this sector will be fairly gradual, but an important growth sector for nickel, nonetheless.

#### Demand outlook

The International Nickel Study Group believes that world nickel usage will continue to grow in 2017 due to the increase in production of the austenitic stainless steel grades in all main markets. This is supported by world stainless steel melting production, which after reaching 41.5 Mt in 2015, recorded a 4.1% increase during the first half of 2016, the last period for which data is available. Demand may also pick up in the US on the back of Trump's new infrastructure policy. According to the INSG, the non-stainless steel sectors primary nickel demand will maintain a positive trend in the aerospace industry and in the battery sector.

#### Supply outlook

Bringing on new nickel supply is becoming costlier, and development time-lines are getting longer. For successful projects, a lag of 10-15 years from discovery to development is not uncommon. The nickel price in recent years has not been high enough to incentivise new supply and we view many projects in the pipeline as either challenging or having very high capital intensities, or both!

Given that the nickel price hit a 12-year low in 2016, numerous marginal (and loss making) nickel mines have closed and are unlikely to reopen.

Add to this, recent and unprecedented volatility in nickel supply from the major producing countries of Indonesia and the Philippines, then the industry supply response looks rather muted over the next several years.

## Deficit has Arrived; stocks hold up the party

### Nickel stocks remain high

The fundamental problem with the nickel sector is the structural oversupply which has dogged the market post the GFC in 2008, with a number of new projects ramping up production coupled with demand-side weakness, adding to stocks.

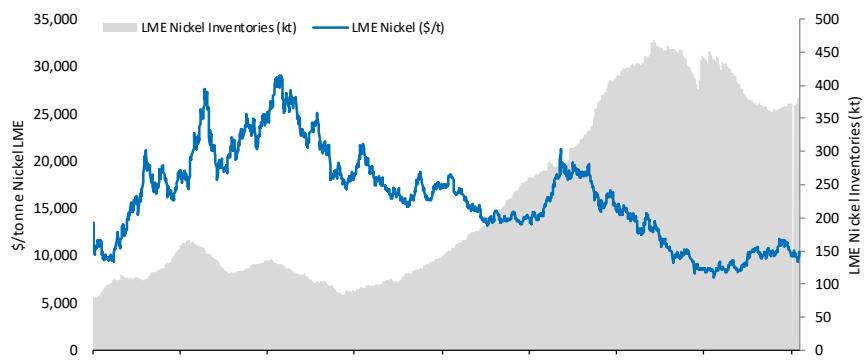
**Between 2010-2015, nickel demand showed an annual growth rate of 5%, Going forward, consensus is for 2-4% for 2017**

LME nickel stocks are currently 370kt, although global inventories are closer to 750kt including metals on the SHFE and in non-bonded warehouses in China and other locations. Whilst LME inventories have reduced from the 470kt peak in June 2015, they remain high in relative terms.

The key point is that once excess stocks are depleted, the supply response looks uncertain, with the pipeline of new projects hindered by lack of investment and high capital costs. Prices need to rise to incentivise long-term investment in nickel.

Production cuts were a feature of 2016, with numerous small sulphide miners closing operations. Wood Mac estimates that last year, 60% of the industry was making a loss at \$4.00/lb (\$8,818/t).

Figure 12 - LME cash nickel price (LHS) and LME nickel inventories (RHS)



Source: LME

### Supply is down, deficit is forecast to grow

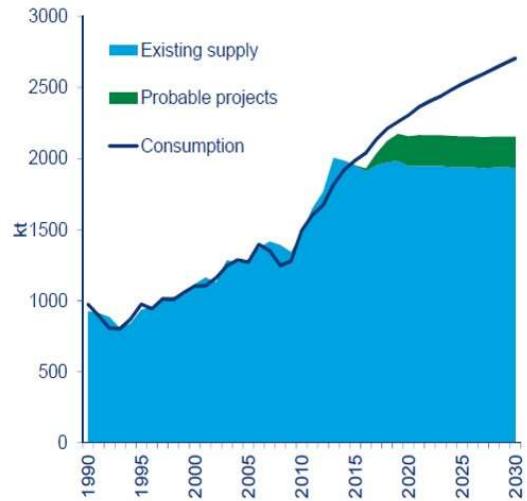
On the NPI front (nickel pig iron), ore supply from Indonesia has effectively dried up and shipments of Philippines have collapsed (see swings and roundabouts). China's inventories of MG/HG ore have decreased 68% from pre-Philippine ban levels, a situation considered to be critical by Glencore.

In addition to the reduction in NPI output from China, output ex-China has also decreased due to price-induced closures (Queensland Nickel, Panoramic Resources, Mincor, Votorantim, Cunico-Kosovo, Ban Phuc and Mirabela) and supply disruptions (Norilsk, Taganito, Ramu, Fenix and Antam).

According to most metal commentators including Wood Mackenzie, the nickel market moved into deficit in Q2 2016, and is expected to remain in deficit over the next several years. There are several drivers of this, but the main contributor is the expected decline in Chinese NPI production which has been impacted by the Indonesian ban on exports of un-beneficiated nickel ore.

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*Figure 13 - Refined nickel supply and consumption – deficit forecast*



Source: Wood Mackenzie

**The real pinch point where more supply is required appears to be from 2020 onwards.**

**Our view is that the Indonesian ban will remain, as enforcing FeNi/NPI production in-country has been a huge success with imports into China moving from zero in 2014 to 200kt FeNi (per quarter) from Q2 2016.**

Beyond 2019, even including the development of new projects in the pipeline and the formation of a replacement NPI sector in Indonesia, WoodMac estimates that 775kt of new nickel supply is required by 2030 to balance the market. Araguaia is thus expected to come on stream at a time of potentially higher nickel prices, according to this analysis.

### *Swings and roundabouts – Philippines and Indonesia*

After the January 2014 ore shipments ban, the fall-back in Indonesian ore exports was initially replaced by ore from the Philippines. However, in October 2016, the Philippine government ordered an environmental audit, which three-quarters of mines were reported to fail, according to press reports.

Deutsche Bank estimates that if the audit is enforced the impact of nickel supply loss from the Philippines could be anywhere from 50ktpa of contained nickel to an outright ban on unprocessed ore exports. As of September 2016, a further 20 mines were ordered to suspend operations, bringing the total to 30 mines representing around half the county's nickel output.

Back in Indonesia, reports in late 2016 suggested that the government was drafting a regulation that may ease the way to resume exports which would likely cause the nickel price to fall. However, these press rumours are contrary to quotes from the Indonesian mining minister who said that "there is little scope to change the export regulation" and "it is unlikely that a revision in the law could be concluded". Either way, the source of ore to feed Chinese NPI production looks uncertain.

## Araguaia Overview

### Location

**A low population-density area, and no indigenous community**

Araguaia is located 45km northwest of the town of Araguaia, on the eastern margin of the State of Pará, north-eastern Brazil. The area is approximately 200km southeast of the prolific Carajás Mining District, host to several major iron and copper mines operated by mining major Vale SA.

Figure 14 - Araguaia location – well established infrastructure



Source: Horizonte Minerals

### Infrastructure

**Araguaia is located in an area of excellent infrastructure. Marabá, situated 150km from the project area, is a major industrial city (population 262,000) which serves the Carajás Mining District and acts as a major logistics hub for the region, with a port on the Tocantins River.**

**Araguaia power consumption: 50MW**

**Roads.** The project is accessible via a network of unsealed roads which link to major highways, and onto Marabá which itself is crossed by five major highways.

**Rail.** The nearby North-South railway links into the Carajás railway, the railhead used by Vale for iron ore to be embarked at the São Luis Deepwater port.

**Port.** Existing deep-water port at Itaqui, São Luis, 1,150km from Araguaia

**Water.** River supply. With a pronounced rainy season, hydrological studies suggest provision of water not to be an issue.

**Power.** Access to low-tariff hydro-power via the grid. The area is well serviced with a 500kV transmission line linking to the Tucuruí generation plant (8,300 MW capacity). Potential to connect to Belo Monte, shortening distance by 35km.

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Figure 15 - Araguaia - straightforward terrain to build a mine – Photo of location of planned Vale dos Sonhos pit

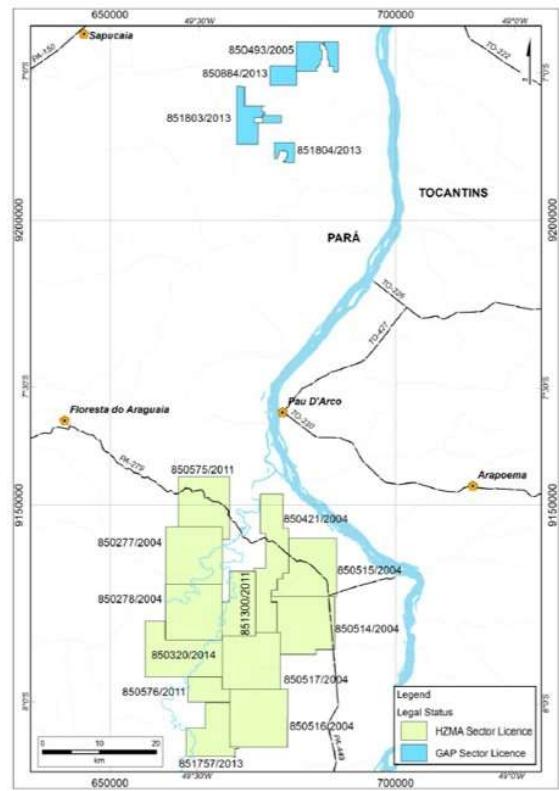


Source: Horizonte Minerals

## Licences

Overall, Araguaia is composed of two separate areas; Araguaia (HZMA) which is the original Horizonte project, and the GAP Project, both are 100%-owned by Horizonte through its Brazilian subsidiaries. The GAP Project was acquired from Glencore in 2015 and lies approximately 60km to the north of Araguaia. The two licence areas have now been combined into an enlarged project and simply referred to as "Araguaia". The project as a whole consists of 16 exploration licences encompassing an area of 1,100km<sup>2</sup>. The area is not subject to any environmental or native title reserves.

Figure 16 - Project licence areas: HZMA (green) and GAP (blue)



Source: Horizonte Minerals, Snowden PFS

## Permitting

Permitting at Araguaia is well advanced, a key component in de-risking the project through the final development stages. To develop an operating mine, a project must go through a three-step environmental licencing stage.

1. A preliminary licence obtained at the planning stage (“LP”);
2. The installation licence (“LI”), which permits the start of construction;
3. Finally, the licence to operate once construction is complete (“LO”).

Horizonte has been granted the LP and is now in the process of requesting the LI. It is worth noting that the grant of the LP means that a large portion of the onerous environmental and social permitting steps have already been completed.

*Figure 17 - Permitting is well advanced*

Araguaia Mine Permit Process in Brazil from Exploration to Construction	
Exploration License	<ul style="list-style-type: none"> <li>✓ National Mining Department (DNPM) grants mineral exploration rights</li> <li>✓ Company elaborates exploration license</li> <li>✓ State Environmental Agency (SEMAS) approves exploration license</li> </ul>
Social & Environmental Impact Assessment	<ul style="list-style-type: none"> <li>✓ Company formally requests Preliminary mine License (LP)</li> <li>✓ State Environment Agency publishes LP request</li> <li>✓ Company completes full year baseline data collection</li> <li>✓ Company finalises and submits Social &amp; Environmental Impact Assessment</li> </ul>
Public Hearing	<ul style="list-style-type: none"> <li>✓ Public Hearing conducted in local community to discuss Social &amp; Environmental Impact Assessment for mine</li> <li>✓ Company presents Public Hearing documentation to State Environmental Agency</li> </ul>
Preliminary License Approval (LP)	<ul style="list-style-type: none"> <li>✓ Site Visit with State Environmental Agency technical team</li> <li>✓ State Environmental Agency governing body meeting to approve Preliminary mine License</li> <li>✓ Formal approval and publication of Preliminary mine License</li> </ul>
Installation License Approval (LI)	<ul style="list-style-type: none"> <li>• Company formally requests mine Installation License (LI)</li> <li>• State Environment Agency publishes LI request</li> <li>• Company elaborates environmental control plans and other permits in accordance with obligations set out in the Preliminary License</li> <li>• State Environmental Agency analysis and approval of mine Installation License (LI)</li> </ul>

*Source: Horizonte Minerals*

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## Brief Exploration History

HZM commenced exploration in the area in 2006 with regional stream sediment sampling which resulted in the discovery of seven nickel targets, with initial licences known as the Lontra Project. From 2006 to 2008, Teck undertook five stages of exploration at Araguaia including airborne geophysics and drilling. Joint venture work with Falconbridge also resulted in the discovery of mineralisation between the Teck and Lontra discoveries.

In July 2010, HZM entered into an agreement with Teck to acquire Teck Cominco Brasil, which owned Teck’s Araguaia project, which resulted in the merger of the Lontra and Araguaia projects. GAP’s history is similar with initial exploration commencing in 2003 by Falconbridge, which later became Xstrata, and subsequently Glencore.

## Geology and Mineralisation

Both Araguaia and GAP lie within the Neoproterozoic Araguaia Fold Belt, a large north-south trending orogenic zone along the contact of the Amazon craton. The belt consists of metamorphosed and deformed marine-clastic sediments.

Locally, the geology is dominated by meta-sediments, and plateau areas characterised by a hard iron-rich duricrust developed over mafic and ultramafic bodies. Numerous bodies such as these have been identified from magnetic data and outcrop.

A distinctive laterite sequence formed by tropical weathering is developed over the ultramafic and mafic rocks within the Araguaia project area, though the thickness and extent varies from location to location. The laterite sequence is split into six main facies types from top to bottom; soil > ferricrete > limonite . transition > saprolite > fresh rock. The higher nickel grades (ore grade) are hosted in the transition and saprolite zone, with leaching of the nickel from the limonite and concentration in the underlying saprolite zone.

## Resources and Reserves

The latest NI-43-101 resource and reserve statements as of 30<sup>th</sup> September 2016 were included in the updated PFS and are as follows:

**Figure 18 - Araguaia - Resources (Sep 2016), 0.9% Ni cut-off grade**

Araguaia	Category	Material type	Tonnage (kt)	Bulk density	Contained Ni metal (kt)	Ni (%)	Fe (%)	MgO (%)	SiO <sub>2</sub> (%)
Subtotal	Measured	Limonite	1,232	1.39	15	1.2	37.43	2	17.15
Subtotal	Measured	Transition	6,645	1.26	116	1.75	18.89	10.2	42.06
Subtotal	Measured	Saprolite	10,291	1.40	130	1.27	12.03	24.08	41.24
<b>Total</b>	<b>Measured</b>	All	<b>18,168</b>	<b>1.35</b>	<b>261</b>	<b>1.44</b>	<b>16.26</b>	<b>17.51</b>	<b>39.91</b>
Subtotal	Indicated	Limonite	19,472	1.40	218	1.12	36.2	2.39	20.53
Subtotal	Indicated	Transition	31,143	1.20	444	1.43	21.39	11.24	38.92
Subtotal	Indicated	Saprolite	51,279	1.32	610	1.19	11.82	25.79	40.58
<b>Total</b>	<b>Indicated</b>	All	<b>101,893</b>	<b>1.30</b>	<b>1,272</b>	<b>1.25</b>	<b>19.4</b>	<b>16.87</b>	<b>36.24</b>
<b>Total</b>	<b>Measured + Indicated</b>	All	<b>120,061</b>	<b>1.30</b>	<b>1,533</b>	<b>1.28</b>	<b>18.93</b>	<b>16.97</b>	<b>36.8</b>
Subtotal	Inferred	Limonite	2,837	1.37	31	1.08	34.8	2.97	23.05
Subtotal	Inferred	Transition	4,955	1.20	65	1.31	21.2	11.11	39.05
Subtotal	Inferred	Saprolite	5,643	1.35	65	1.16	11.8	24.31	41.8
<b>Total</b>	<b>Inferred</b>	All	<b>13,435</b>	<b>1.30</b>	<b>161</b>	<b>1.2</b>	<b>20.12</b>	<b>14.94</b>	<b>36.83</b>

Source: Horizonte Minerals

**Figure 19 - Araguaia – Mineral Reserves, using \$12,000/t nickel spot price**

Class	Deposit	Ore dry mass (kt)	Ni (%)	Fe (%)	Al <sub>2</sub> O <sub>3</sub> (%)	SiO <sub>2</sub> /MgO
Probable	Baião	2,381	1.8	18.7	4.93	2.52
Probable	Pequizeiro	11,828	1.73	16.8	5.91	2.83
Probable	Pequizeiro West	165	1.67	19.7	4.47	3.58
Probable	Jacutinga	1,198	1.82	16.7	3.16	2.16
Probable	Vila Oito East	1,190	1.64	15	3.74	1.99
Probable	Vila Oito	2,449	1.79	14.2	3.62	2.05
Probable	Vila Oito West	549	1.73	20.3	5.04	3.65
Probable	VDS	4,886	1.85	22.7	6.28	2.72
<b>Total Probable</b>		<b>24,646</b>	<b>1.77</b>	<b>17.9</b>	<b>5.39</b>	<b>2.58</b>
Proven	-	-	-	-	-	-
<b>Total Proven and Probable</b>		<b>24,646</b>	<b>1.77</b>	<b>17.9</b>	<b>5.39</b>	<b>2.58</b>

Source: Horizonte Minerals

### *A robust resource*

We view Araguaia's resource as extremely robust, being based on 40,330m of drilling (1,494 holes) at Araguaia, and 28,680m (839 holes) at GAP.

The Araguaia resource classification was based on the following drilling density:

- Measured              50m x 50m or less
- Indicated              100m x 100m or less
- Inferred              >100m x 100m and up to 150m

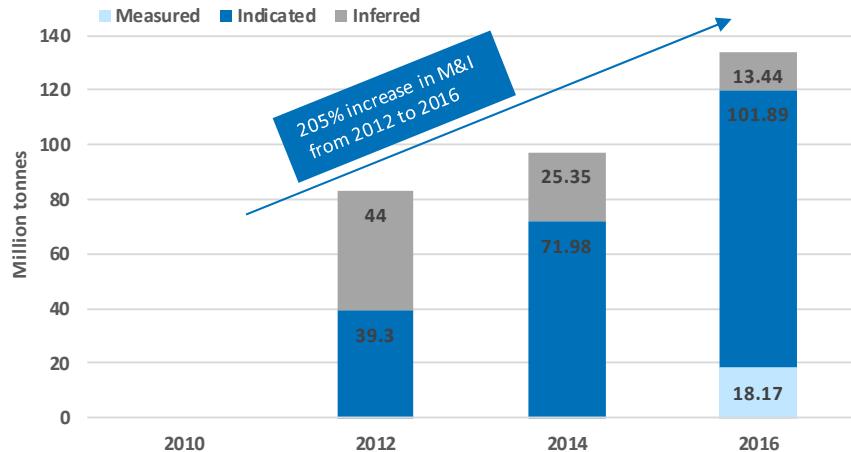
The measured resource at HZMA (AGA South) has been drilled out at 50m centres, which provides substantial confidence in the continuity and grade of the resource, in our view. At GAP (AGA North) the measured resource was drilled at 40m x 40m.

The resource was calculated using standard JORC-compliant techniques, with the main parameters being a block size of 25m x 25m x 2m, composited assay intervals and estimation carried out by Ordinary Kriging.

### *Resource growth*

Horizonte has successfully grown the resource base through a combination of exploration and acquisitions, whilst increasing the portion of the resource that sits in the higher confidence M&I category.

*Figure 20 - Resource growth*



*Source: Horizonte Minerals, Shard Capital*

## Mining

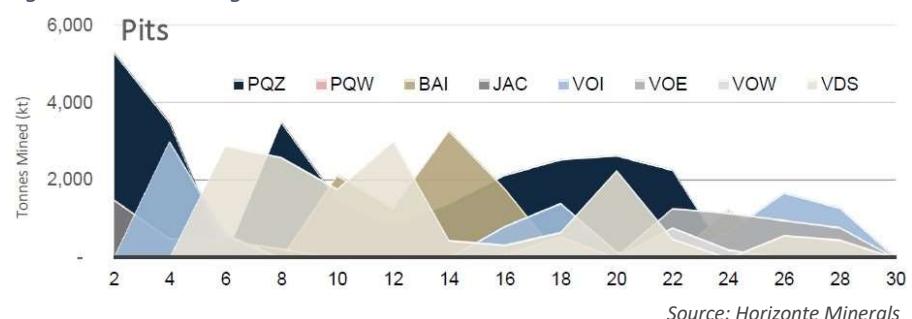
Mining will be by straightforward open pit methods. Araguaia benefits from being a shallow, flat-lying resource which results in a low strip ratio. The base case in the PFS assumes that mining is undertaken by a contractor fleet. Equipment will be conventional truck and excavator. The laterite profile is by its nature, highly weathered and it is anticipated that blasting with explosives will not be required.

The mineralisation is largely hosted by the saprolite and transition horizons, but also includes the bottom of the limonite horizon. The transition has an average thickness of 3-5m and is practically all ore grade. The saprolite averages 4m in thickness and is nearly all ore grade. The saprolite will be mined separately because of its different chemistry, with the MgO of the plant feed largely controlled by the saprolite component.

Mining will take place by 8 separate open pits, 7 for HZMA and 1 for GAP. The active number of pits in production at the same time varies from 3 to 5. Ore will be mined at rates above the 0.9Mtpa processing capacity in order to build a stockpile to allow blending of the ore to optimise feed to the plant. Low grade ore will be stockpiled and processed at the end of the project life.

The PFS mining schedule envisages 24Mt of total ore mined during the 28 year LOM. Mining will be ramped up over a 13 month period. The mining schedule targets high-grade feed over the first 10 years, resulting in a grade of 1.96% from years 1-10.

*Figure 21 - Pit mining schedule*



Source: Horizonte Minerals

*Figure 22 - Planned Vale Dos Sonhos Pit*



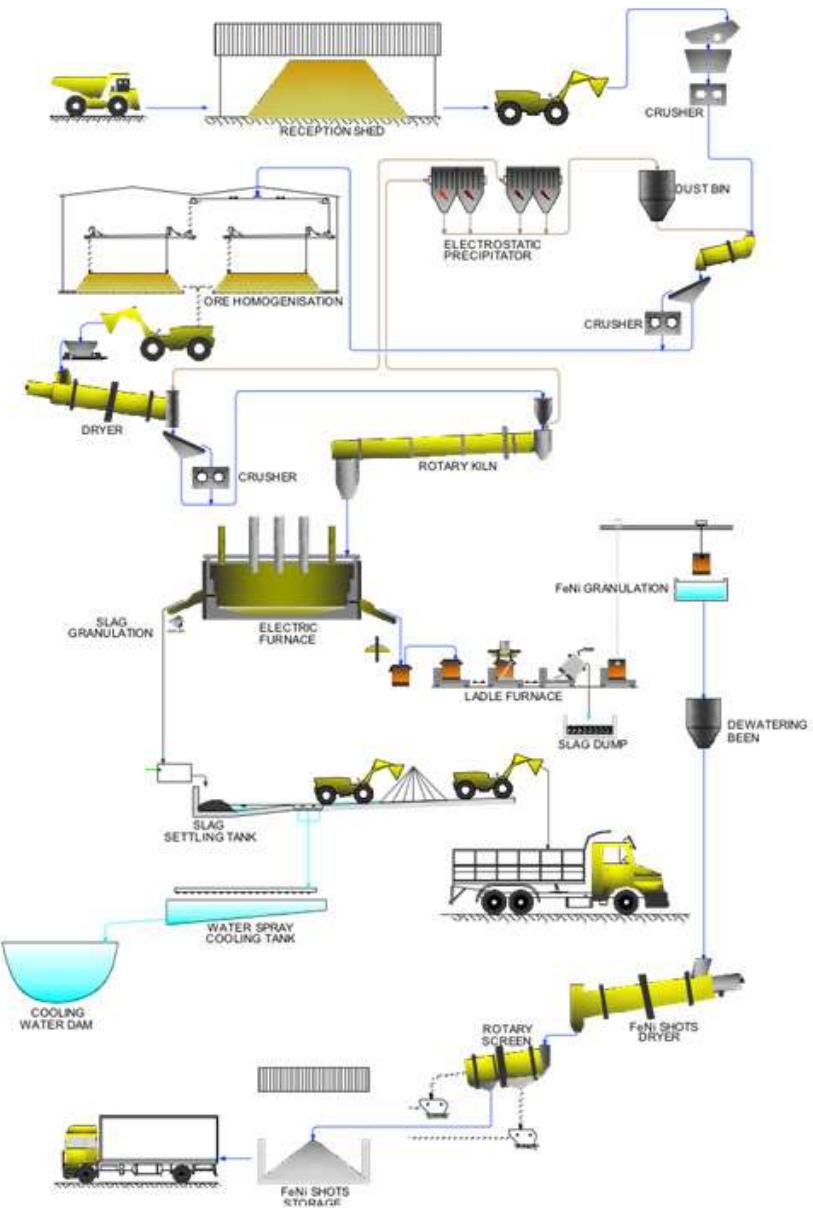
Source: Horizonte Minerals

## Metallurgy

Horizonte plans to employ proven nickel saprolite processing technology. The metallurgical test-work and full-scale pilot plant testing indicates that Rotary Kiln Electric Furnace (RKEF) technology can produce a high-grade, commercial ferronickel (FeNi) product.

The flow sheet is straightforward process. Ore is crushed, homogenised, dried and fed to a kiln for calcining which removes chemically combined moisture and pre-reduces to ore. The calcine is then transferred to the electric furnace for the separation of metal and slag at high temperatures. Finally, the metal is conveyed to the refining stage where the final FeNi product is granulated, screened and stockpiled prior to despatch to the market.

*Figure 23 - Araguaia proposed flow sheet.*



*Source: Horizonte Minerals*

### *Tried and tested technology*

RKEF is a tried and tested pyrometallurgical technology. There are over 20 operational RKEF plants in the world, and the technology is booming in China, due to cost advantage over blast and electric furnaces.

RKEF technology has not been dogged by the technical challenges of other techniques such as the hydrometallurgical HPAL (high-pressure-acid-leach). HPAL for instance, is an extremely capital-intensity process that often failed to deliver on its promises, with poor ramp-up and operational stability.

***With the projected growth in the use of RKEF technology and the fact that laterite ore is the most important raw material in NPI, accounting for 40% of the cost, we anticipate that gaining control of laterite supplies will increasingly become an imperative for NPI producers.***

### *Full pilot plant testwork has been performed*

We gain conservable confidence in the selection of process route for Araguaia, with the suitability of the ore for RKEF based on a comprehensive pilot plant testwork campaign. The pilot testing was carried out in 2015 at the Morro Azul facility in Minas Gerais, and in total, processed a bulk sample of c.220t of Araguaia ore. One tonne of commercial grade FeNi was produced in the pilot plant furnace in South Africa.

### *A quality product*

The pilot plant testwork confirmed the production of high quality FeNi from bulk sample, which importantly, was deemed to be representative of the ore that Horizonte plans to mine during commercial operation. The final product showed good agglomeration and is low in impurities.

*Figure 24 - FeNi granules from Araguaia ore and quality analysis*



Element	Content (% Max)
Nickel (Ni)	28-32
Cobalt (Co)	0.8
Copper (Cu)	0.06
Silicon (Si)	0.04
Phosphorus (P)	0.03
Sulphur (S)	0.04
Carbon (C)	0.04
Iron (Fe)	Balance

*Source: Horizonte Minerals*

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