

# HEMERDON MINE

information pack



# A Globally Significant Exporter

The UK is poised to become a globally significant tungsten exporter with the development by Wolf Minerals of a major mining project at Hemerdon, close to Plymouth, in Devon.

Hemerdon will provide security of supply for tungsten and valuable export revenue for the UK and is one of the largest tungsten and tin resources in the Western world. It will also create some 230 direct jobs and pump hundreds of millions of pounds into the Plymouth, Devon and UK economies over the next decade.

## FOREWORD

It is with an enormous amount of pride that the Wolf Minerals team is now embarked on the construction and production phase of the Hemerdon Project, having worked since 2007 to evidence the potential and viability of the mine and then, in the midst of a global recession, to bring together the finance and investment package to make the project a reality.

As an exploration and mining geologist it is incredibly exciting to be bringing metal mining back to the Westcountry where it has such a rich social and economic history.

I would like to put on record Wolf Minerals' appreciation for the warmth and support the project and our team members personally have received and for the shared enthusiasm of local people, many of whose own lives and family histories are intertwined with past and present mining for china clay in this part of Devon.

Wolf Minerals' ambition has always been to develop a modern and world class mining project at Hemerdon, and one which will generate significant economic benefits and jobs for Devon and the Plymouth area.

In doing so, we are determined to demonstrate to communities here and to investors around the world that a project such as this can be taken forward in the UK to the highest modern standards and in compliance with the latest environmental requirements.

The hope is that what we will achieve here will in turn contribute towards a broader renaissance in metals mining in the UK.



Humphrey Hale  
Managing Director

"WOLF MINERALS' AMBITION HAS ALWAYS BEEN TO DEVELOP A MODERN AND WORLD CLASS MINING PROJECT AT HEMERDON"





“THE HEMERDON AND LEE MOOR AREAS ALREADY HAVE A GREAT MINING HERITAGE AND THE INDUSTRY REMAINS A KEY DRIVER OF THE ECONOMY”



## History of Hemerdon Mine

The discovery of tungsten at Hemerdon dates back to 1867 and such is the scale of the deposit that the site is now recognised by the British Geological Survey as the fourth largest tungsten resource in the world.

The first significant workings of Hemerdon took place around the time of the First and Second World Wars, when mine plants were built and went into production, although by today's standards the operations were relatively small in scale. On the second occasion operations ceased in 1944 due to the resumption of shipments of tungsten from overseas.

Attempts during the 1960s and early 1970s to reopen the mine failed to bear fruit but in the late 1970s American mining company AMAX became involved in the mine and a significant programme of exploratory drilling got under way in 1977.

In 1981, a planning application was submitted by AMAX to mine tungsten and tin. After a Public Inquiry in 1982 the Secretary of State indicated that improvements to the visual aspects of the processing plant and waste disposal area would be regarded more favourably in a new submission.

A revised plan was submitted in 1985 which was passed by Devon County Council in 1986, subject to stringent conditions governing the development and operation of the mine.

The planning permissions to mine tungsten at Hemerdon until 2021 are still in place today and were recently updated by Wolf Minerals in 2011 with the approval of Devon County Council and the Secretary of State for Communities and Local Government.

## The right time for Hemerdon

Tungsten is in great demand at the present time and has grown in importance over the last century. At the moment the UK is almost totally dependent on supplies of the valuable metal from abroad. The site at Hemerdon has sufficient tungsten supplies to meet the demand of the UK for many years.

The project to reopen the mine and create the infrastructure will be a significant boost to the South Devon economy. When fully operational, the mine will generate about 230 direct jobs and many more indirect jobs, pumping millions of pounds into the local economy every year.

The Hemerdon and Lee Moor areas already have a great mining heritage and the industry

remains a key driver of the economy. Large scale china clay and aggregates operations continue in the area, which has been extensively mined since the mid-nineteenth century.

Beyond its hugely positive impact on the local economy, the project is an extremely important asset to the UK and has received the strong support of UK Trade and Industry (UKTI) due to the significant contribution it will make to the export market.

## Timeframe

The first major infrastructure work on the Hemerdon project was completed in 2012 when a 600m link road was built and opened between Lee Moor Road and West Park Hill in Plympton.

Work to commission the mine, its processing plant and other infrastructure is expected to start in 2013. The initial phase of this operation involves the detailed design of the processing plant and off-site fabrication.

The first significant activity on site to begin building the mine and its infrastructure is scheduled for late 2013 / early 2014, with the mine expected to be fully commissioned and in full production for 2015.

## TIMETABLE TO FULL PRODUCTION

DEFINITIVE  
FEASIBILITY  
STUDY PUBLISHED



2011

600M  
LINK ROAD  
COMPLETED



2012

PROJECT  
FINANCE DEAL  
COMPLETED



2013

PROCESSING PLANT  
& INFRASTRUCTURE  
COMMENCES



2013

ON-SITE MINE  
CONSTRUCTION  
COMMENCES



2014

FULL  
PRODUCTION  
COMMENCES



2015

# Wolf Minerals

Wolf Minerals Limited is a speciality metal exploration and development company, with a focus on tungsten and tin.

The company is listed on both the Australian (ASX) and London (AIM) stock exchanges and its strategic objective is to become a world class tungsten producer, through the development of the Hemerdon project which has become the main focus of its activities.

On December 5, 2007 Wolf Minerals announced that it had entered into an agreement with the Hemerdon Mineral Trust and the Olver Trust to acquire the 40 year lease to the mineral rights and rights to mine the Hemerdon deposit.

Following this, extensive investigations by Wolf Minerals and a comprehensive feasibility study (published May 2011) confirmed the extent of winnable minerals within the site and a viable plan for mining and processing these over the following decade.

Wolf Minerals has gone on to assemble a truly international finance and investment package to enable work on the £130 million project to begin.

This includes major shareholders drawn from sector specialists and major corporations in the USA, Australia and New Zealand. Debt facilities have been secured from European banks ING, Unicredit and CAT Financial, and binding offtake agreements have been signed for 80 per cent of Hemerdon's production on a five year term with leading processors Global Tungsten & Powders (Plansee) and Wolfram Bergbau und Hutten (Sandvik).

## THE WOLF MINERALS TEAM

Wolf Minerals Limited is managed by a high quality and dedicated team of British and Australian mining professionals with extensive technical and corporate experience in the minerals sector. As the focus of the Hemerdon project moves from exploration and development to construction and production the Wolf Minerals team is growing significantly. This includes the recruitment of a highly skilled project team based in Plymouth, many of whom have strong local connections with the South West and several of whom are returning to the area having gained considerable international mining experience.

### MANAGEMENT TEAM

#### Humphrey Hale

##### Executive Managing Director

Englishman Humphrey is a graduate of Cardiff University and has over 19 years experience in the exploration and mining industry.

Prior to his appointment with Wolf Minerals, Humphrey was employed by AngloGold Ashanti, where his role included managing exploration and development of a feasibility study at the major Australian mine at Sunrise Dam.

#### John Hopkins

##### Non Executive Chairman

A barrister and solicitor for more than 35 years, John Hopkins is a highly experienced senior business professional and has been on the board or chairman of nearly 20 public listed companies since 1985 (both in Australia and Canada).

He has extensive experience in the financing and development of many gold, base metal, energy (coal and oil and gas), mineral sands and other resource projects in both Australia and overseas.

He is a Fellow of the Australian Institute of Company Directors and leads a board at Wolf Minerals which includes highly experienced non-executive directors.

### NON-EXECUTIVE DIRECTORS

#### Michael Wolley

Vice President Minerals for the Todd Corporation and with a wealth of experience including with Mobil Oil Australia, the Lynas Corporation as a director of several ASX listed mining and resources companies.

#### Jim Williams

Highly experienced mining consultant and a graduate of the Camborne School of Mines, Jim has enjoyed a long and successful career spanning the globe in open pit and underground mining engineering. Most recently, Jim was the founding Head of Mining for Fortescue Metals Group Ltd.

#### Don Newport

Based in the UK, Don has a wealth of mining project finance experience having spent 35 years in banking, of which 25 were in the mining and resources sector. He recently retired as the head of Standard Bank's Global Mining Finance Business and formerly led the Barclay's Capital Mining Sector Team.

#### Chris Corbett

Currently employed by Resource Capital Fund, Chris has over 13 years experience in mining, corporate business development and investment management. A graduate of the University of Western Australia with degrees in Engineering and Commerce, he also has postgraduate qualifications in Mining and Finance.

### UK OPERATIONS



#### Jeff Harrison

##### UK Operations Manager

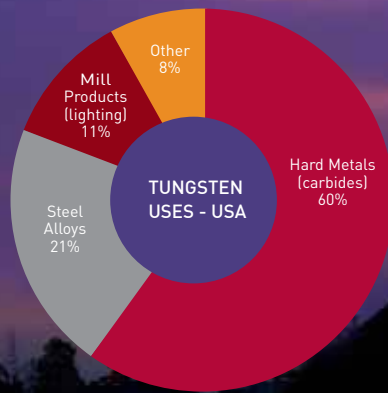
Wolf opened its Plymouth office in 2012 at Tamar Science Park and has been growing its team under the direction of UK Operations Manager Jeff Harrison.

Jeff is a graduate of Nottingham University and holds a masters degree in Engineering Rock Mechanics from the Royal School of Mines.

He has significant experience of mining in the South West, having been Operations Manager at Imerys Minerals Ltd, including at the company's former Lee Moor operations close to the Hemerdon site.

Jeff also brings a wealth of international mining experience, including as General Manager Magnesite at Queensland Magnesia and Senior Rock Mechanics Engineer at Zambia-based Nchanga Consolidated Mines.

# EVERYTHING TUNGSTEN



## History and uses of Tungsten

In 1758, the Swedish chemist and mineralogist, Axel Fredrik Cronstedt, discovered and described an unusually heavy mineral that he called "tung-sten", which is Swedish for heavy stone. He was convinced that this mineral contained a new and, as yet undiscovered, element.

Its properties mean it has the highest melting point of any metal - 3410 degrees Celsius - and the highest tensile strength.

It is silver grey in colour. Tungsten has the smallest compressibility of any metal, good corrosion resistance, good thermal and electrical conductivity and a low coefficient of expansion.

Worldwide demand continues to grow and today the metal is used in many industries and products including cutting and grinding tools (for example tungsten carbide), the aircraft industry, and filaments for electric lamps and lighting.

## Demand

The US Geological Survey estimates that about 60 per cent of the world's known tungsten reserves are in China, with other major known deposits located in Russia, Kazakhstan, Canada and of course in the UK, where Hemerdon is cited by the British Geological Survey as being the fourth largest deposit in the world.

During the 1980s and 1990s there was a significant rise in China's already dominant position as the world's largest tungsten producer and a fall in global prices in an oversupplied market.

It is a different situation today, with the price and demand for tin and tungsten having risen sharply and China now consuming much of its own resources.

The significance of the Hemerdon deposit in being able to meet the UK's entire tungsten needs for many years to come was highlighted when Wolf Minerals presented evidence to the House of Commons Science and Technology Select Committee inquiry examining the importance of strategic metals to the UK.

This in turn followed a report by the European Commission which named tungsten as one of 14 'critical raw minerals' essential for the EU economy and the impact on these of global resource scarcity.

The background to both inquiries is a developing global shortfall of proven reserves of tungsten that are economically recoverable and accessible.

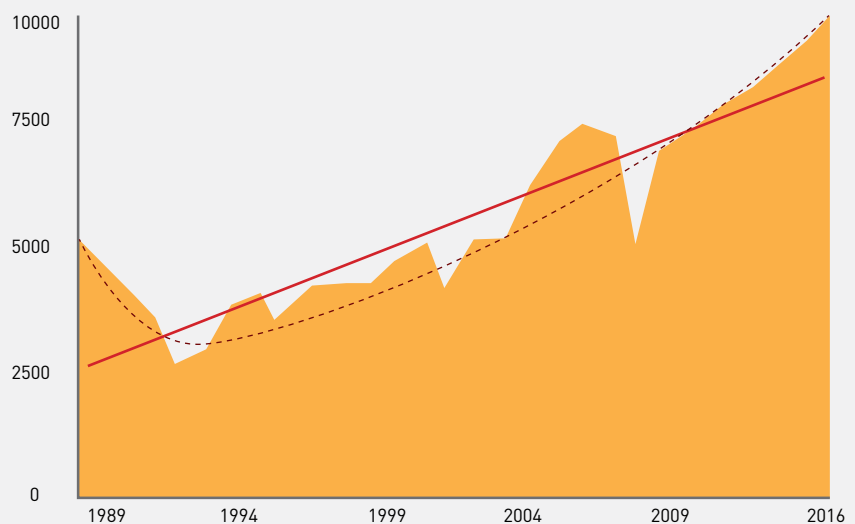
## Pricing

The price and demand for tungsten has risen sharply over recent decades and new capacity is required to meet Western demand.

The average annual price of tungsten since 1950 has fluctuated between US \$10 per metric tonne unit (equivalent to 10kg) in 1963 rising to US \$175 in 1977 before dropping back to \$60 per metric tonne unit. Prices are mainly based on the quotations published twice a week by London's 'Metal Bulletin', although other trade journals also publish quotations or indicative prices.

At the moment, the price of tungsten trades in units of ammonium paratungstate (APT) at approx US\$405/mtu subject to change.

## FORECAST TUNGSTEN DEMAND 1989 - 2016



# Mining for tungsten at Hemerdon

With an estimated production of 5,000 tonnes per annum of tungsten concentrates, the £130 million Hemerdon project will be one of the world's most important tungsten mines.

The mine itself will be state of the art - constructed and operated to the latest international regulations and best practice.

Most of the valuable tungsten and tin at Hemerdon can be found within the large deposits of granite. The granite contains veins of tungsten and tin which has been identified by diamond drilling.

The extraction of tungsten will take place through open pit mining, with the pit measuring about 850m long by 450m wide and extending to a depth of 200 metres. The sides of the pit will be cut in benches to allow for safe working as the mine gets deeper.

When mining the open pit the overburden (or waste rock known as killas) will be loaded

by excavators on to dump trucks and driven via internal haul roads direct to the mine waste facility on Crownhill Down.

Granite removed from the pit will be taken first to the processing plant where it will be crushed and ground to remove the minerals from the rock and then separated by using various gravity and water methods.

Once the mine is in full production an estimated 7 million tonnes of waste rock and 3 million tonnes of granite will be mined annually. From this, 5,000 tonnes of tungsten concentrate and 500 tonnes of tin will be produced each year – the equivalent of one truck a day leaving the mine for export to specialist off-takers in Europe and the USA.





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## Mine Waste Facility (MWF)

The operations at Hemerdon will result in a significant volume of both coarse and fine mine waste – rocks, gravels and sands – transported by truck and a slurry pumped through a pipeline. These will be stored in a purpose-built mine waste facility. Approximately 80 per cent of the mine waste facility is rock.

The material being deposited in the waste facility is classified as non-hazardous.

The Hemerdon mine waste facility will be located at Crownhill Down, which is situated off the Lee Moor Road north of Plympton and to the south-east and south-west respectively of the three southernmost china clay workings and mine waste facilities associated with the Lee Moor china clay mining area.

The mine waste facility is designed to be inherently stable. Its construction consists of a 113 metre high rockfill embankment progressively constructed from run-of-mine waste. Finer residues (tailings) and excess process water are contained within this embankment and allowed to settle, with the water recycled to be used in the on-site processing plant.

It has similarities with the china clay tips already familiar in the area at nearby Lee Moor and throughout mid-Cornwall.

The Hemerdon mine waste facility will include settlement ponds together with all necessary infrastructure such as emergency spillways, decant structures, tailings and return water pipelines and seepage control systems – all designed and constructed to the latest national and international guidelines and statutory requirements.

An additional embankment dam, the Tory Pond, will be constructed immediately downstream of the mine waste facility to provide additional process water supply and ultimate control for all seepage flows and site runoff from Crownhill Down.

## Environment

Wolf Minerals is well aware of its responsibilities to the environment and is investing significantly in designing a modern mine with both systems and procedures to ensure best possible environmental management.

There are strict conditions within the planning consent which cover matters such as hours of operation, traffic and minimising noise and dust. A number of Environment Agency permits are also required which cover the technical and environmental operations of the mine, including abstracting and discharging water and a mine waste facility permit in line with the recently introduced European Mine Waste Directive.

The Environment Agency will be reviewing all aspects of the Wolf mine waste facility application and will only permit its construction and operation when they are confident the design meets all the relevant requirements for safety, noise, dust and water management.

An ongoing and rigorous programme of monitoring by Wolf Minerals, Devon County Council, the Environment Agency and independently appointed experts will ensure that the mine and associated facilities operate as they were designed to and that the mine meets all its statutory requirements.



## Landscaping

The Hemerdon mine waste facility will be a visually large landform but has been designed so that its highest point will be below the Crownhill ridge line.

Phase one of the rock dump and tailings facility will be built on Crownhill Down to the east of the existing Lee Moor Road [B3417].

The Lee Moor Road will be relocated (probably in 2016) to provide sufficient area for the complete tip. Once Lee Moor Road has been relocated the outside rock bund will be immediately constructed and landscaped whilst working behind it.

Every year a landscaping plan will be agreed with Devon County Council based on the agreed Restoration Concept for the site. This involves lower levels being planted with deciduous woodland, higher levels to be reinstated as heathland and the top flat levels to be wet areas but with no standing water.

## Archaeology

A major archaeological investigation has been taking place at Crownhill Down to examine and record the archaeology of the area before the mine waste facility is constructed. Much of the archaeology is associated with previous mining activity on the site since the Bronze Age.

The results of this will be published in due course but early indications are that while the extent of any artefact finds has been limited the opportunity to undertake a dig of this type is providing interesting insights into the processes used in the early mining and tin steaming activities in this area. It is hoped that this will also help to shed light on how workings may have been carried out on nearby Dartmoor (where such investigations within the National Park area are difficult to undertake).

# Frequently Asked Questions

## How large will the site at Hemerdon be?

The development of the mine will result in the excavation of an open pit approximately 850 metres long by 450 metres wide and 200 metres deep. The current site is approximately 220 metres above sea level.

## How many tonnes of tungsten do you intend to mine?

It is anticipated that when full production is reached Wolf Minerals (UK) Ltd will produce approximately 5,000 tonnes of tungsten concentrate per annum and 500 tonnes of tin concentrate per year at the Hemerdon site.

## Why is Hemerdon going to be mined in an open pit environment and not underground?

The size and shape of the Hemerdon ore body visible at surface allows for efficient open pit mining. It may be possible in the future to mine at depth by underground mining if economically viable.

## How long do you intend to mine at Hemerdon?

The planning consent for mining at Hemerdon is in place until 2021. Exploration drilling has shown that there is significant mineral reserves at depth. Any decision to extend the life of the mine below the current planned 200 metres would be subject to future economic viability and a further planning process.

## At what times will you be operating the mine?

Wolf Minerals aims to operate most of the mine 24 hours a day, six days a week. There are restrictions on using the waste tip at night and there are restrictions on blasting times. No mining will take place on Sundays but this will allow for planned maintenance work. Wolf will need to comply with all planning conditions for noise and dust.

## Will there be any danger to health for nearby residents?

No. Dust will be controlled and continuously monitored to meet established planning conditions. China clay operations have been in the area for many years and are mining the same granites. The milling and processing of tungsten ores is predominantly by crushing and gravity processes which require no large scale chemical additions.

## How will you control dust and pollution from the site?

There are a range of accepted good mining practices for controlling dust and most involve spraying water, building wind breaks and hydroseeding. Strict environmental controls have been placed on the mining operation by the local and regulatory authorities including Devon County Council. These will remain in place at the start of and throughout any mining process. Careful monitoring to ensure that the air quality stays within Government guidelines will be implemented. Wolf has already started premining dust measurement and this will continue throughout the life of the mine.

## What noise can be expected from the mining operation and how will you monitor and control this?

Any noise emitted during the operation of the mine will be closely monitored and Wolf Minerals will work with the appropriate regulatory authorities to ensure this is kept to a minimum and within the levels set in the planning conditions.

## How will you ensure the overall safety of the mine?

The site will have the appropriate security measures to ensure the mine is only accessed by those with permission to operate on behalf of Wolf Minerals. There will only be one access point to the mine. Staff will be highly trained in mining safety and appropriate health and safety working regulations will be enforced at all times.

There will be Wolf personnel on site at all times, inspecting and monitoring the operation to ensure operations are carried out safely at all times.

## How will the mine waste and tungsten concentrate be transported?

Tungsten concentrate will be filled into drums and transported in containers by trucks from the mine site, with one truck per day leaving the site when at full production.

Waste rock and spoil will be transported by large 65 tonne Caterpillar dump trucks using the internal site haul roads.

## Where will you dump waste soil and rock?

The mine waste facility will be located at Crownhill Down, off the Lee Moor Road north of Plympton and to the south-east and south-west respectively of the three southernmost china clay workings and mine waste facilities associated with the Lee Moor china clay mining area.

## How big will the mine waste facility be?

At its outer edge the rockfill embankment will be 113 metres high. The mine waste facility will cover 175 hectares. The storage capacity of the mine waste facility will be approx 30 million m<sup>3</sup> waste rock storage and 10 million m<sup>3</sup> of tailings storage.

## Why does the waste facility need to be on Crownhill Down?

The location of the mine waste facility was considered in detail during a full Public Inquiry in 1981 and planning permission was granted in 1986.

## Will the mine waste facility contain hazardous materials?

The material being deposited in the waste facility is classified as non-hazardous.

## How will the mine and mine waste facility be made safe when it is completed?

Once production is complete, the pit will fill naturally with rain and groundwater to become a lake and all the production plant and other infrastructure will be removed.

There is an agreed Restoration Concept with Devon County Council for the mine waste site. This involves the lower levels being planted with deciduous woodland, higher levels to be reinstated as heathland and the top flat levels to be wet areas but with no standing water.

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