

## MINERAL SANDS EXPLORATION IN VICTORIA

Mineral sands (also known as heavy mineral sands) may not sound familiar to many people but these are critical components in some of the most frequently used household products such as sunscreen, inks and paints and tiles, as well as medical devices, welding materials and purification systems.

Mineral sands are also increasingly used in technology products, which is a key driver for increasing interest in the exploration and development of mineral sands in Victoria.

### What are mineral sands?

Mineral sand deposits contain a concentrated amount of economically important minerals known as 'heavy minerals', which are much heavier than common sand minerals such as quartz.

Mineral sands deposits typically comprise the following minerals of economic interest:

- zircon
- rutile
- leucoxene
- ilmenite
- monazite
- xenotime.

Zircon is rich in the element zirconium. Rutile, leucoxene and ilmenite contain titanium. Trace amounts of monazite and xenotime contain rare earth elements. Other minerals such as magnetite and garnet may also be present in mineral sands.

### Victoria's mineral sands deposits

Victoria's mineral sands deposits occur a long way from the modern coastline. Their locations reflect the presence of former inland seas and associated coastal processes that occurred tens of millions of years ago.

The potential for mineral sands was first recognised in the Murray Basin of northwest Victoria by the Geological Survey of Victoria in 1969.

Heavy mineral sands deposits occur in the Murray and Gippsland Basins in northwest and southeast Victoria.

The Murray Basin extends from Victoria into South Australia and New South Wales where mineral sands deposits have also been identified.

Two types of mineral sands deposits are recognised in the Murray Basin. These deposits are characterised as either strandline deposits or Wimmera-style (WIM) deposits, depending on the type of rock that hosts them.

### What are mineral sands used for?

Mineral sands are used for many purposes and can be found in a range of everyday household products.

Titanium minerals – which include ilmenite, leucoxene and rutile – are used as the feedstock to produce pigments for colourants in paints, paper and plastics. Titanium is also used in sunscreen and in joint replacement, such as knee and hip replacements.

Small amounts are also used in titanium metals and in welding materials.

Zircon is used in ceramic tiles and in metal casting, as well as in air and water purification systems.

# Mineral sands formation

## How are mineral sands deposits formed?

River systems transport sediment, including minerals created during erosion, to the coast where it may be deposited in a number of different coastal environments.

Beach sands contain the most important accumulations of heavy minerals. Waves deposit sand on beaches where heavier minerals are concentrated, while backwash carries lighter minerals such as quartz back into the sea.

Onshore winds that blow lighter grains inland can also concentrate heavier minerals at the front of coastal dunes. Old (former) shorelines, known as strandlines, which may occur some distance inland, can also be a source of heavier mineral sands.

**Strandline deposits** have a linear geometry (up to 10 m thick, more than 2 km long and 300 m wide) and are characterised by relatively low tonnages and high grades (5%-20% mineral sand content) with coarse-grained (>100 micrometre) mineral sand assemblages.

In contrast, WIM-style deposits are sheet-like and up to 10 m thick, 10 km long and 3 km wide) and are relatively high tonnage and low grade (2%-5% mineral sand content) with a fine-grained (<100 micrometre) mineral sand assemblage.

The strandline deposits of the Murray Basin in west and northwest Victoria are orientated northwest-southeast, which represents the general orientation of the former shoreline that advanced from current day South Australia and then retreated.

The top of the Murray Basin is the current flat landscape surface observed today.

The youngest strandlines remain active in The Coorong in South Australia.

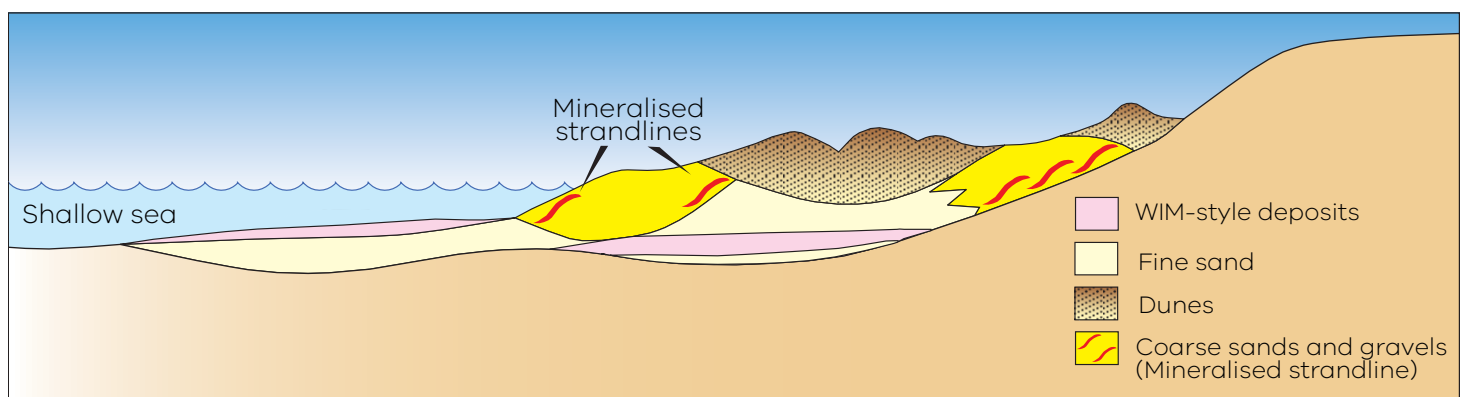


## KEY TERMS

**Grade:** The grade of a mineral sands deposit refers to the quantity of minerals found within the deposit relative to other material.

For example, a high-grade mineral sands deposit will have a higher amount of minerals relative to other material compared with a low-grade deposit which will have low amounts of minerals relative to other material.

**Assemblage:** Various minerals and other materials that make up a rock formation.

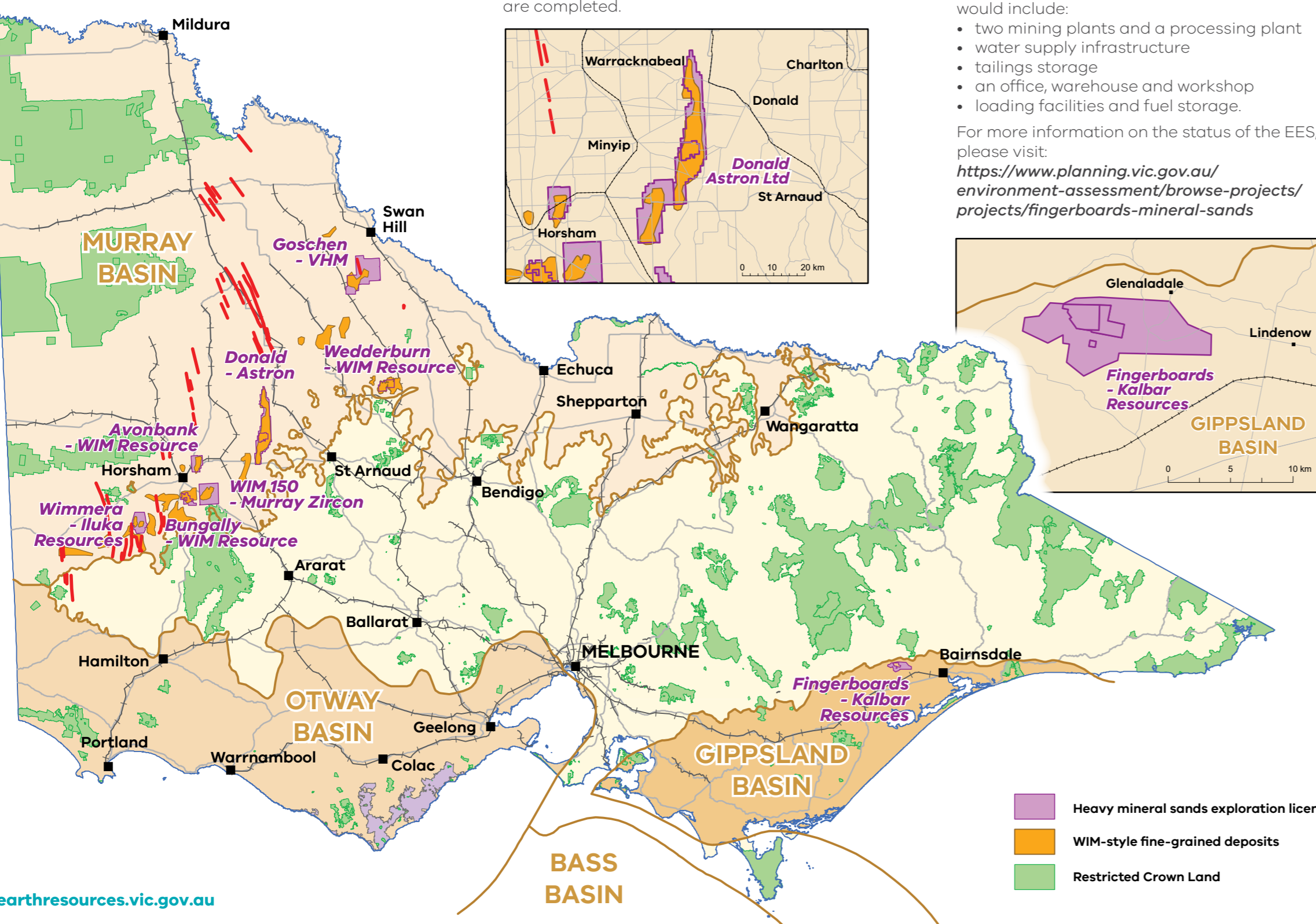


Idealised relationships between 'WIM' and 'strand-style' mineral sands deposits. From Base Minerals Ltd.

### Mineral sands projects in Victoria

There are currently no commercial mineral sands projects operating in Victoria.

However, in the 2018/19 financial year, more than \$24 million was spent on mineral sands exploration in Victoria and there are five projects listed here at various stages of development. There are also several mineral sands projects currently in the post-mining and rehabilitation phases.

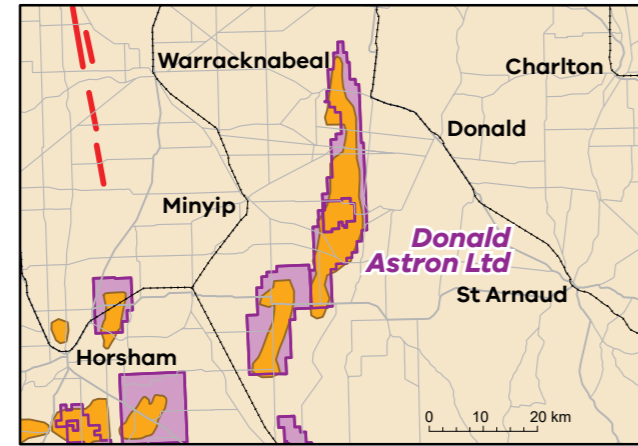


### Donald Mineral Sands

The Donald Mineral Sands project owned by Astron was the subject of an Environment Effects Statement (EES) in 2008 and was granted approval in November 2008.

The project subsequently went on to be granted a Mining Licence (ML5532) in 2012.

A final draft Work Plan will be submitted to Earth Resources Regulation when all details of the final stages of the project development are completed.



### Kalbar Fingerboards Mineral Sands Project

Kalbar's Fingerboards Mineral Sands Project in East Gippsland is currently going through an EES.

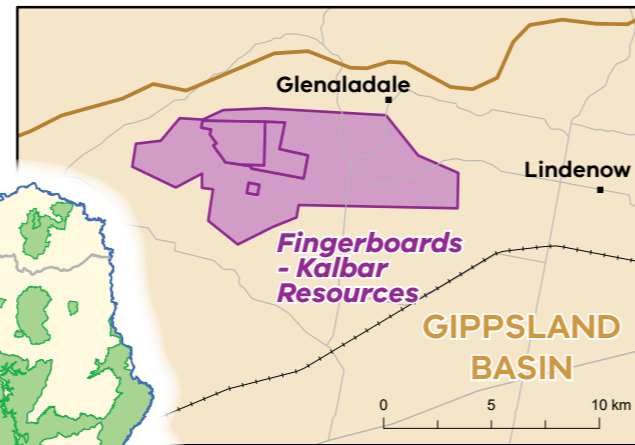
The proposed mining method involves open pit mining to extract approximately 170 million tonnes of ore over a projected mine life of 20 years.

The project area is about 1,675 hectares and would include:

- two mining plants and a processing plant
- water supply infrastructure
- tailings storage
- an office, warehouse and workshop
- loading facilities and fuel storage.

For more information on the status of the EES, please visit:

<https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/fingerboards-mineral-sands>



### WIM Resource Avonbank Mineral Sands Project

WIM Resources Pty Ltd proposes to develop the Avonbank Heavy Mineral Sands project which covers an area of around 2,500 hectares and is located about 15 km northeast of Horsham.

The Avonbank deposit contains around 300 million tonnes of ore and is proposed to produce a heavy mineral concentrate containing zircon, rare earths and titanium minerals.

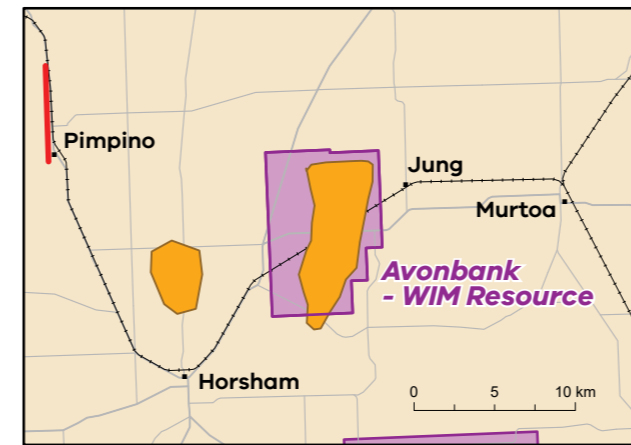
The proposal includes:

- a mineral sands mine
- wet concentrator plant
- starter ore and overburden stockpiles
- slurry pipelines
- additional site facilities, such as site office, warehouse, workshop, rail loading facilities and fuel storage.

The proposed mining methods involve open-pit mining to extract around 9 million-15 million tonnes of ore per year over a projected mine life of 30 years to produce between 350,000 to 600,000 tonnes of heavy mineral concentrate per year. Mine products are proposed to be transported via road or rail for export overseas.

In August 2019, the Minister for Planning directed WIM Resource Pty Ltd to prepare an EES to assess the potential environmental effects of the project.

For more information on the status of the EES: <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/avonbank-mineral-sands/overview>



### Iluka Resources Wimmera (WIM100) Mineral Sands

Iluka Resources Limited proposes to develop the Wimmera Mineral Sands project which covers an area of around 2,600 hectares and is located about 35 km south-west of Horsham.

The WIM100 deposit contains around 200 million tonnes of heavy mineral sands ore which is proposed to be extracted and refined on site to produce zircon, titanium oxide and rare earth products.

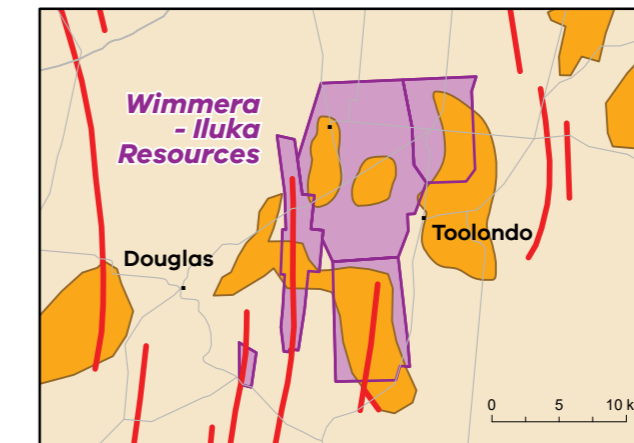
The proposal includes:

- development of a mineral sands mine
- processing plants (including a mineral separation, zircon refinery and rare earthy refinery)
- ore receipt and liquification system
- mine by-products transport and containment infrastructure
- offsite infrastructure: powerlines, water pipelines, access roads and a temporary construction camp
- additional offsite infrastructure such as administration buildings, water storage dams, fuel storage and lay down areas.

The proposed mining method is likely to be progressive mining using mobile earthmoving equipment. About 9 million-10 million tonnes of ore per year will be extracted, which will be refined on site to produce 192,000 tonnes of recoverable mineral product per year, over the projected 25-year mine life.

In August 2019, the Minister for Planning directed Iluka Resources Limited to prepare an EES to assess the potential environmental effects of the project.

For more information on the status of the EES: <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/wimmera-mineral-sands>



### VHM Goschen Mineral Sands and Rare Earths Project

VHM Limited proposes to develop the Goschen Mineral Sands and Rare Earths project which covers an area of around 8,300 hectares and is located about 20 kilometres south of Swan Hill.

The Goschen deposit contains around 300 million tonnes of ore and is proposed to produce:

- zircon
- rutile concentrate
- titanium concentrate
- a rare earth concentrate.

The proposal includes:

- development of a mineral sands mine
- mining unit plant and wet concentrator plant
- interim tailings storage facility (TSF)
- solar drying beds for tailings,
- slurry pipelines to transfer ore from pits to the processing facilities
- site office, warehouse and workshop facilities
- loading facilities and fuel storage.

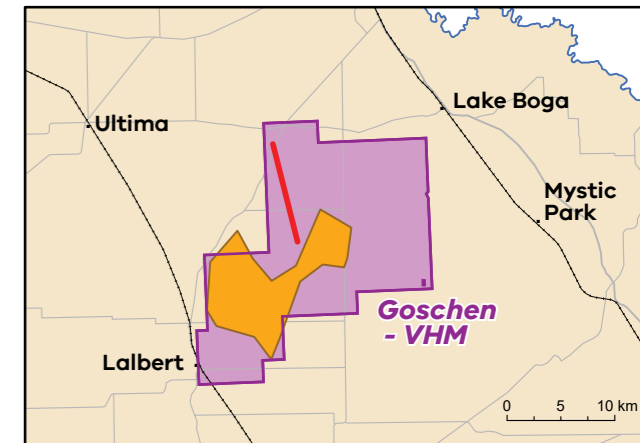
Proposed mining methods involve open pit mining to extract about 5 million tonnes of ore per year, increasing to 10 million tonnes per year over a projected mine life of 30 years.

Mine products are proposed to be transported via road or by rail for export overseas.

It is anticipated that between 3 gigalitres to 5.5 gigalitres per year will be required for the first few years of mining and this will be reduced once tailings water is available for reuse.

In October 2018, the Minister for Planning directed VHM Exploration (now known as VHM Limited) to prepare an EES to assess the potential environmental effects of the project.

For more information on the status of the EES: <https://www.planning.vic.gov.au/environment-assessment/browse-projects/projects/goschen-mineral-sands-and-rare-earths-project>



# Mineral sands mining

## Are minerals sands hazardous?

Mineral sands may contain very low levels of hazardous materials such as crystalline silica and uranium.

The presence of these elements in mineral sands deposits is typically so low that the risk is similar to standing on a black sand beach.

## How are mineral sands mined?

Mineral sands deposits can be excavated using wet or dry mining techniques.

Wet mining involves dredging the mineral sands from under the surface of a pond created for extraction purposes.

Dry mining uses traditional earth moving equipment such as scrapers, trucks, excavators and front-end loaders to excavate the mineral sands deposit.

In both methods, after the deposit has been mined, the overburden material which comprises topsoil, subsoil and clay, is removed from the sand containing the minerals which is then processed to separate the high-value heavy minerals sands.

Once the sand deposit has been extracted the overburden material is replaced (generally within 12 months) and the land rehabilitated to be suitable for non-mining uses.



The information above is provided for information purposes only. It should not be considered to be advice or relied on as such. Parties are required to make their own enquiries.

## FURTHER INFORMATION

For information visit:  
[earthresources.vic.gov.au](http://earthresources.vic.gov.au)  
Email: [mdv@ecodev.vic.gov.au](mailto:mdv@ecodev.vic.gov.au)  
Phone: 1300 366 356 .

Authorised by the State Government of Victoria, Melbourne.

© Copyright State Government of Victoria 2020

This publication is copyright. No part may be reproduced by any process except in accordance with provisions of the *Copyright Act 1968*.

### Accessibility

If you would like to receive this publication in an accessible format, such as large print or audio, please email [mdv@ecodev.vic.gov.au](mailto:mdv@ecodev.vic.gov.au)