3 Project description

This chapter provides an overview of the proposed Fingerboards Mineral Sands Project (the project) and describes in detail specific elements of the project relating to construction, mining, processing, infrastructure, sourcing and management of water, management of wastes and hazardous materials, the project workforce, and decommissioning of infrastructure, rehabilitation of mined areas and post-closure activities.

The chapter responds to the scoping requirements outlined by the Department of Environment, Land, Water and Planning (DELWP), specifically Section 3.3. The key objectives of this chapter are to describe the project in sufficient detail to:

- Allow an understanding of all components, processes and development stages of the project.
- Enable assessment of the likely potential environmental effects of the project.

3.1 Project overview

The project involves mining of mineral sands from the Fingerboards resource, which lies predominantly within the more extensive Glenaladale deposit. Kalbar proposes to mine areas of enriched grades of mineral sands occurring close to the ground surface within the project area (see Figure 2.1). The size and location of the mine and associated infrastructure are determined by the portions of the Glenaladale deposit that are most economic to mine.

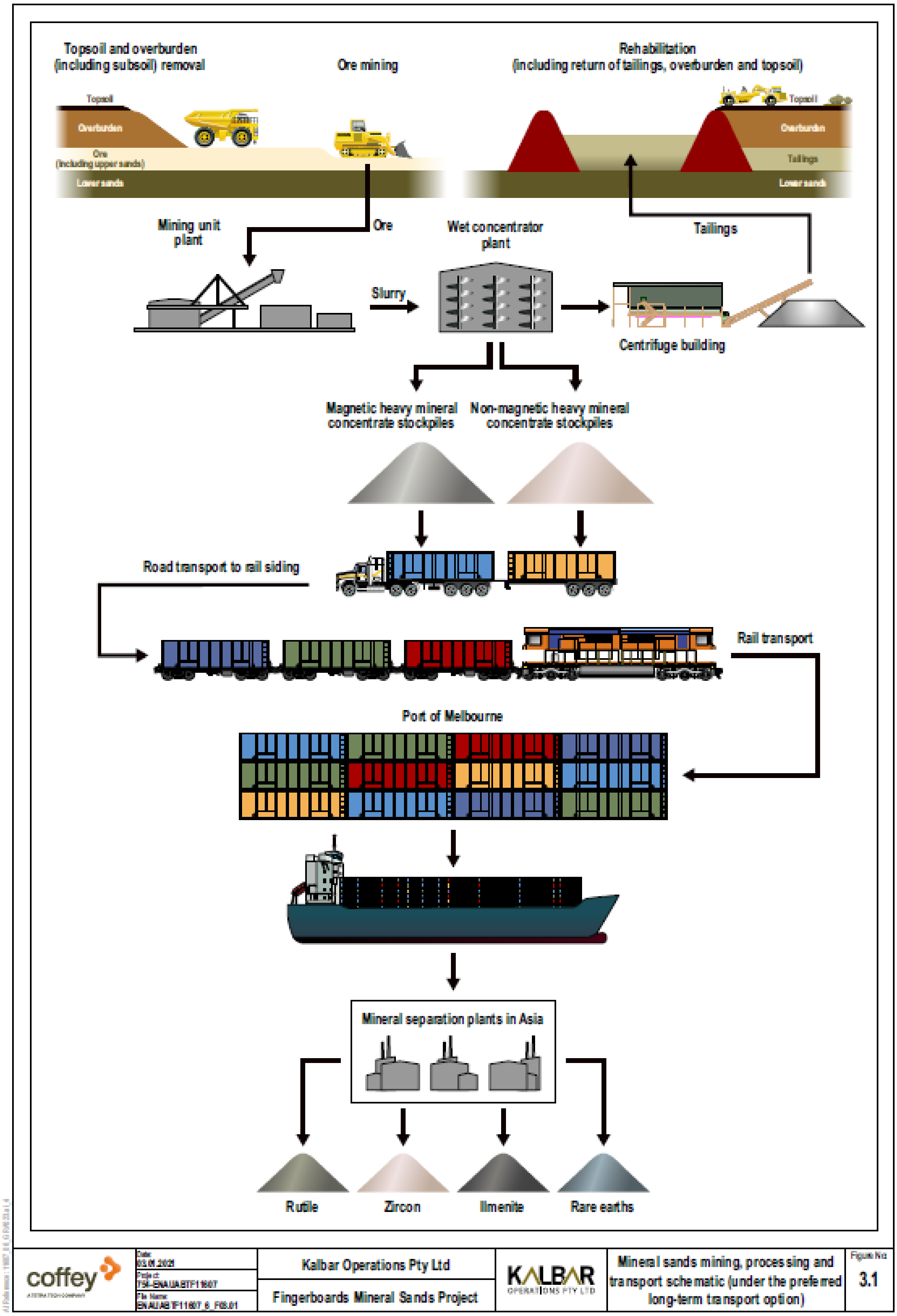
Mining is proposed to be a 24-hour, 365 days-a-year operation, using conventional earthmoving machinery, conveying systems, and a dry strip mining method. The valuable heavy minerals will be concentrated (primary processing) at the mine site facilities to produce magnetic and non-magnetic heavy mineral concentrates (HMC). Overburden and tailings (non-economic sands, silts and clay) from mining and primary processing will be returned to the mine void as part of the rehabilitation process. ~~A temporary tailings storage facility (TSF) will provide tailings storage in the initial stages of mining, before sufficient voids are mined out.~~ Fine tailings will be dewatered at a centrifuge building in close proximity to the mine void before being returned to the void as backfill. The land will be returned to pre-mining land use and capability, native vegetation, or other agreed post-mining land use.

The HMC will be exported for secondary processing in mineral separation plants in Asia. An overview of the mining process from clearing the ground surface through to export of the HMC is provided in Figure 3.1, with the preferred long-term transport option.

Infrastructure required to support mining operations will be located outside the project area within a designated infrastructure options area. This area includes pump stations and associated pipeline options to supply winterfill from the Mitchell River, a groundwater borefield to supply the project with water from the Latrobe Group Aquifer, a road diversion corridor where existing roads can be diverted and relocated and new project roads and associated security infrastructure can be constructed, rail siding options and a dedicated infrastructure corridor. The infrastructure corridor leads from the ore processing area to the proposed purpose-built rail siding on the Gippsland line south of the project area (Fernbank East rail siding). The corridor consists of a private haulage road, 66 kilovolt (kV) and 22 kV powerlines, and a water pipeline from the borefield to the contingency water dam.

Kalbar plans to produce eight million tonnes (Mt) of magnetic and non-magnetic HMC from 170 Mt of ore for up to 20 years. The mine life includes approximately two years for construction and commissioning and 15 years of production at full capacity (12 Mt/year) followed by closure activities (decommissioning, rehabilitation and post-closure). Final closure may require an additional five years of management.

Figure 3.1 Mineral sands mining, processing and transport schematic (under the preferred long-term transport option)



The layout of the project area for the first two years of the project showing the mine area (the area proposed to be mined) and other mining and infrastructure areas is shown in Figure 3.2. Specific elements of the same layout are shown on Figure 3.3 (mine workings), Figure 3.4 (water infrastructure) and Figure 3.5 (road diversions).

The proposed project area is approximately 1,675 hectares (ha), of which about 1,350 ha is proposed to be directly disturbed by mining and infrastructure over the life of the project. The progressive mining methods proposed for the project will result in a maximum area of disturbance within the project area of approximately 360 ha at any one time (excluding road diversions and relocations) as detailed in Table 3.1.

Table 3.1 Estimate of area of disturbance in project area at any point in time

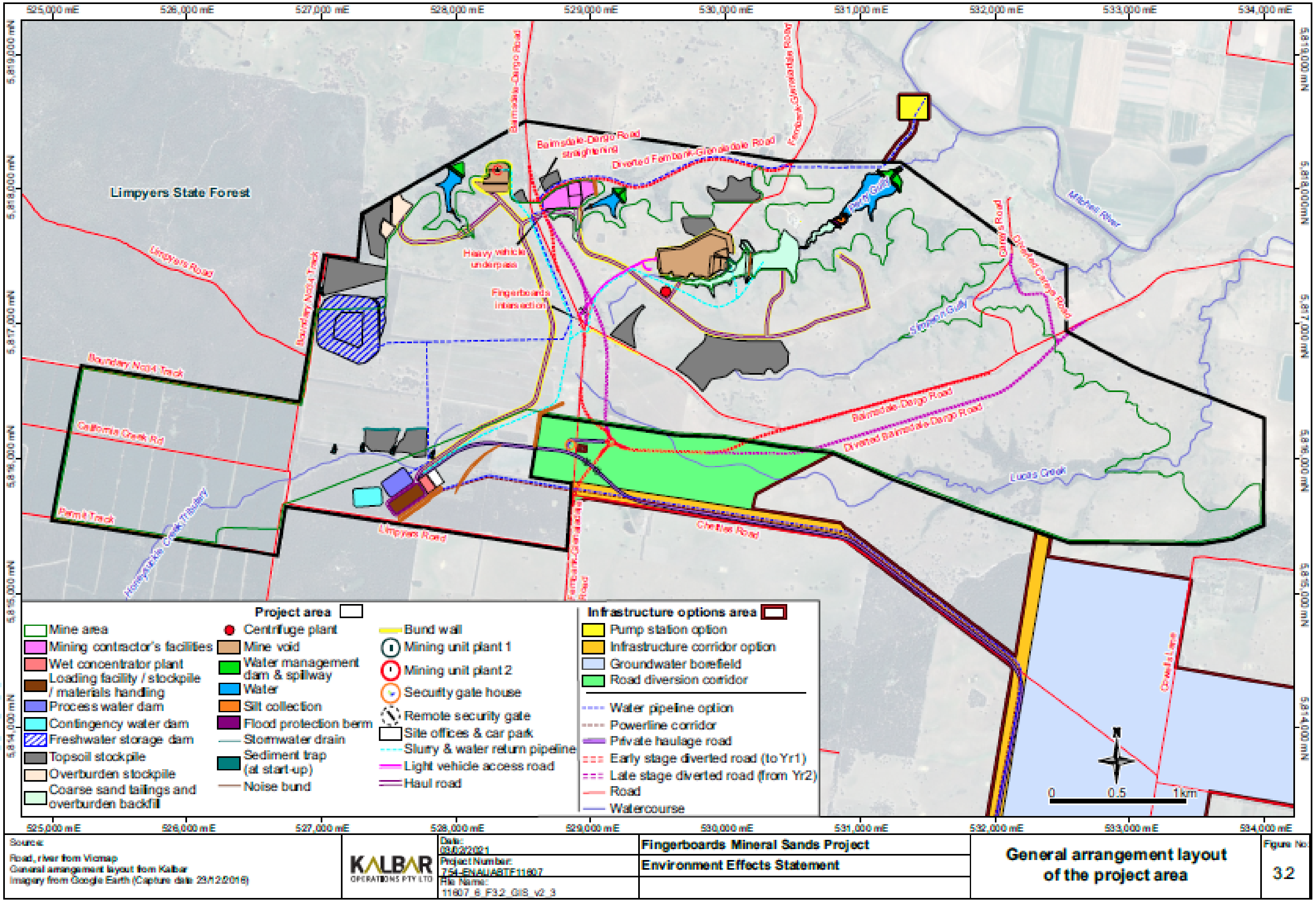
Disturbance	Area (ha)
Topsoil strip	35
Overburden strip	23
Ore and mine void floor	18
Coarse sand tailings ~~and fines tailings cell~~ construction in mine void	19
Overburden and centrifuge cake placement	5
Topsoil placement	35
Mining sub-total	**135**
~~Temporary tailings storage facility including embankments until year 5~~	~~90~~
Topsoil stockpiles	45
Off (mining) path subtotal	***~~135~~45***
Infrastructure within project area	90
Total	**~~360~~270**

Table 3.2 provides estimates of the land area that will be disturbed for infrastructure outside the project area, namely for transport and access, as well as water supply.

Table 3.2 Estimate of land area disturbed for infrastructure outside the project area

Infrastructure type	Length (m)	Width (m)	Area (ha)
Infrastructure corridor (private haulage road, water pipelines and powerlines)	7,800	20	16
Fernbank East rail siding	1,000	75	8
Groundwater borefield	-	-	5
Mitchell River pump station and surface water supply pipeline	5,100	5	3
Total (excluding public road reserves and powerlines)			**31**

Figure 3.2 General arrangement layout of the project area



Source:
Road, river from Vicmap
General arrangement layout from Kalbar
Imagery from Google Earth (Capture date 23/12/2016)

Date: 03/02/2021
Project Number: 754-ENAUABTF11607
File Name: 11607_6_F3.2_GIS_v2_3

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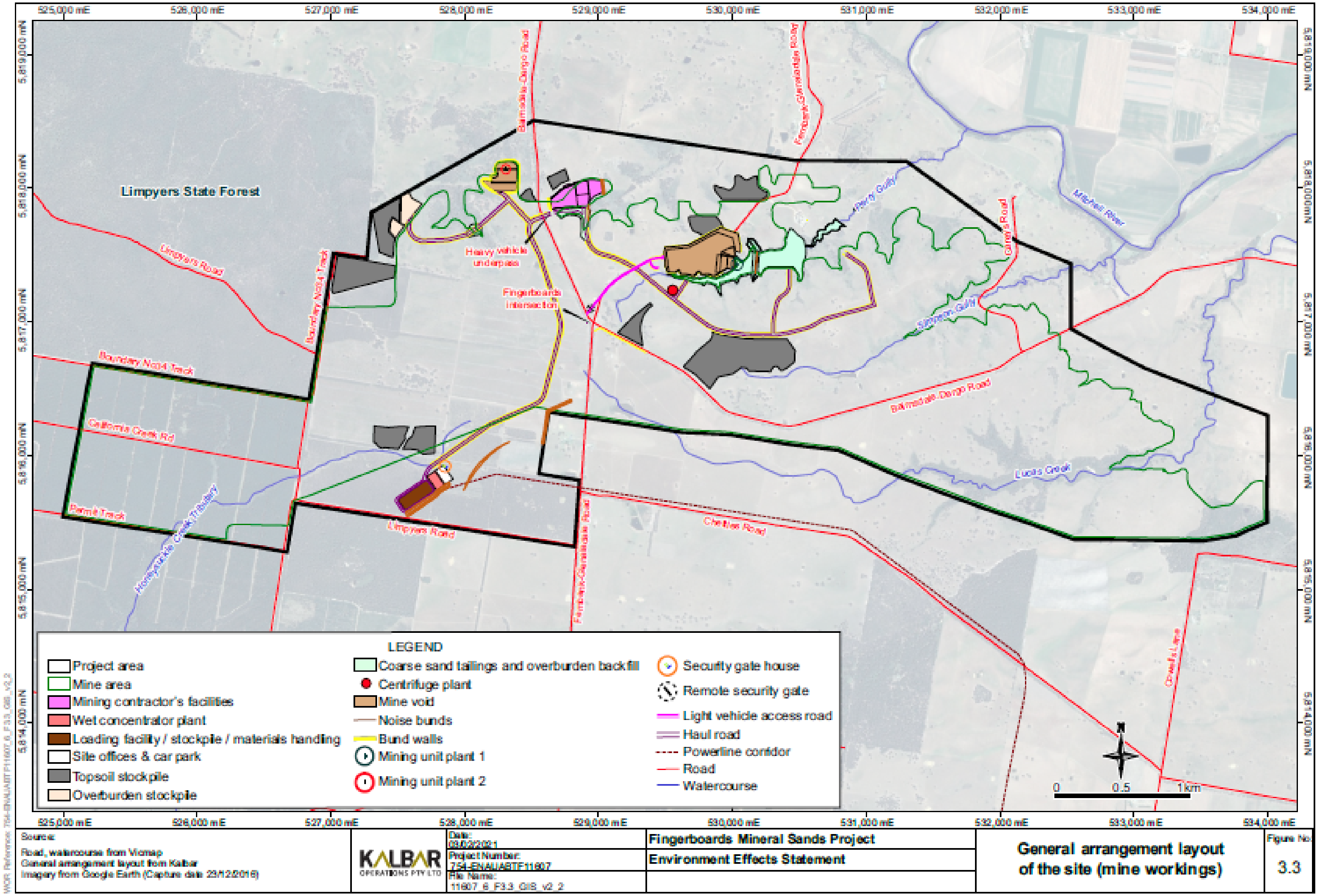
General arrangement layout of the project area

Figure No: 3.2

Figure 3.3 General arrangement layout of the site (mine workings)



Source:
Road, watercourse from Vicmap
General arrangement layout from Kalbar
Imagery from Google Earth (Capture date 23/12/2016)

Date:
09/02/2021
Project Number:
754-ENAUABTF11607
File Name:
11607_6_F3.3_GIS_v2_2

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General arrangement layout of the site (mine workings)

Figure No.
3.3

Figure 3.4 General arrangement layout of the site (water infrastructure in the initial years)

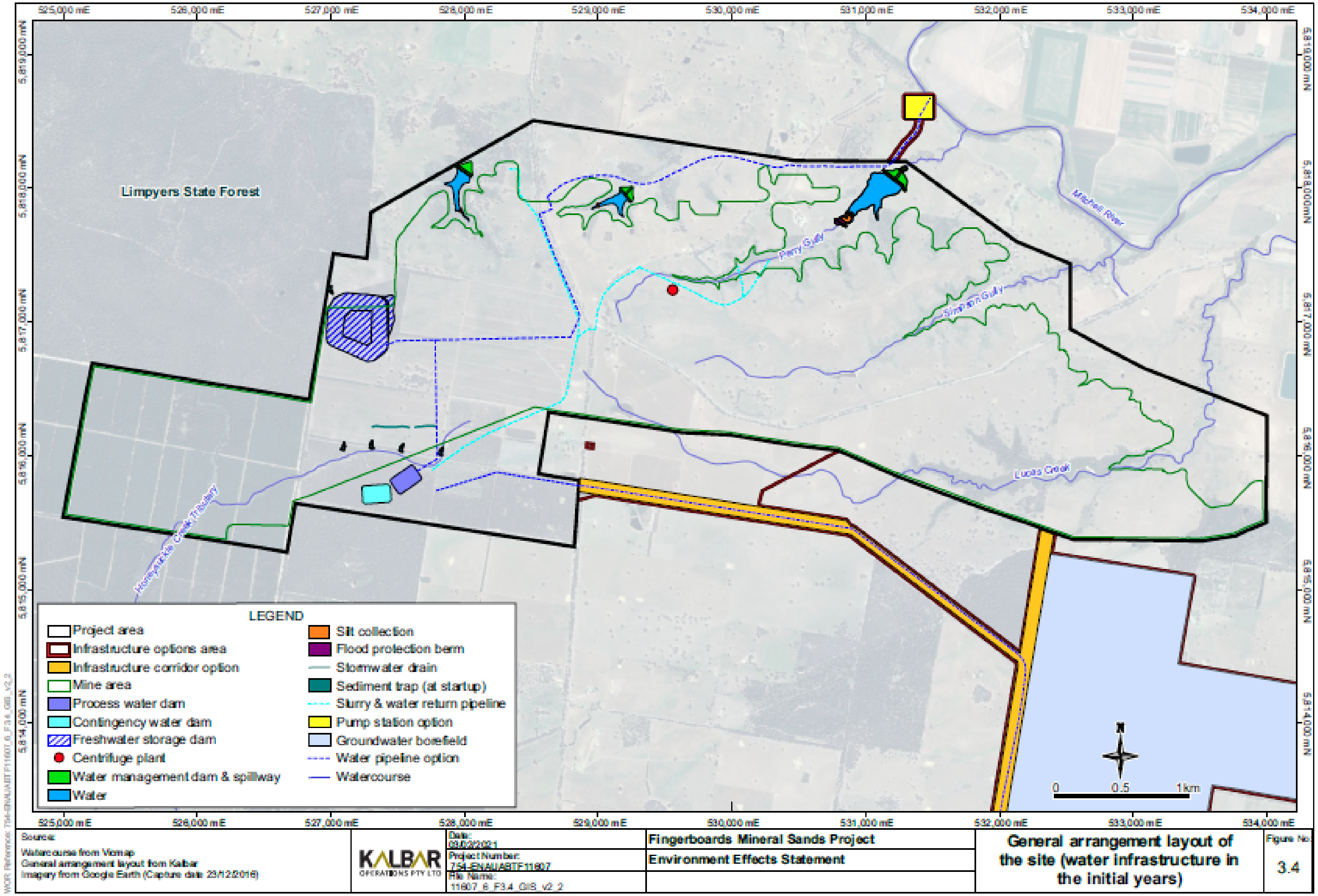
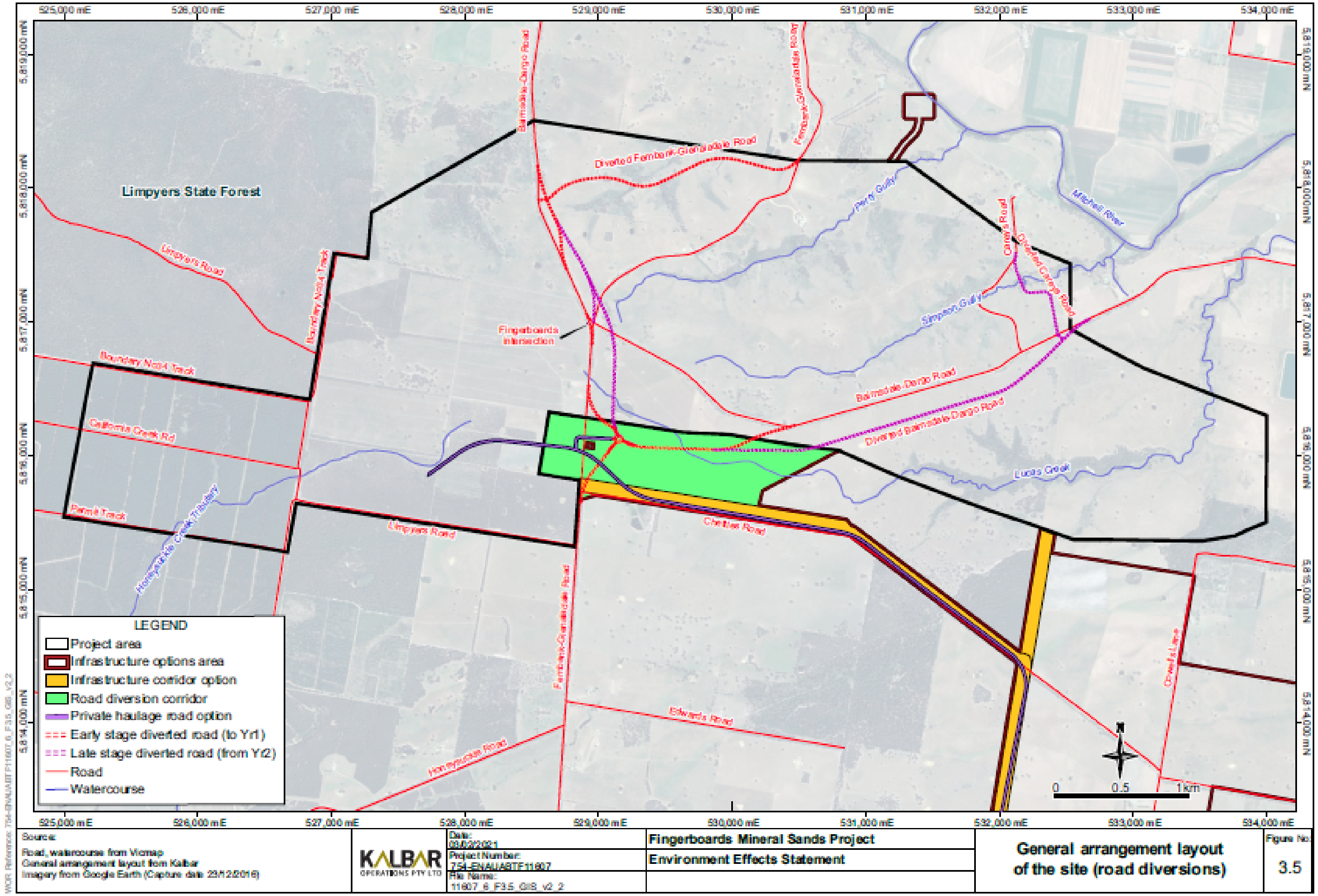


Figure 3.5 General arrangement layout of the site (road diversions)



3.2 Resource overview

The Glenaladale deposit occurs within unconsolidated sediments and contains zircon, rutile, ilmenite and rare-earth minerals (monazite and xenotime). These valuable minerals are denser than sand and clay particles and can be efficiently separated using gravity separation to form HMC. The Glenaladale deposit sits almost entirely within two retention licences and several exploration licences and exploration licence applications held by Kalbar (see Figure 2.1).

The Fingerboards resource is found predominantly within the larger Glenaladale deposit and represents the most economic and mineable ore within the area. The Fingerboards Mineral Resource Estimate is for 1.19 billion tonnes (Bt) of ore at 0.5% zircon, 1.4% titanium minerals and 0.05% rare-earth minerals.

A reserve has been demarcated within this resource that is compliant with Joint Ore Reserves Committee (JORC) 2012. The reserve contains an estimated 170 Mt of ore at in-situ grades of 1.24% zircon, 1.9% titanium dioxide and 0.11% total rare-earth oxides.

The mineral sands market is driven by the zircon and titanium dioxide industries, predominantly in Asia. Construction and operation of the project has been optimised to meet a gap in supply of magnetic and non-magnetic HMC products (see Chapter 2: Project rationale).

3.3 Construction

Should necessary approvals be obtained, construction and commissioning of the project is expected to commence in ~~2021~~ 2022 for approximately two years, with the first production of HMC planned for ~~2022~~ 2023. Construction will include the following activities (see Figure 3.2):

- General site works to prepare access roads, powerlines, water and tailings pipelines.
- Pre-stripping and stockpiling of the topsoil and overburden to expose the ore (further detailed in Sections 3.4.1 and 3.4.2).
- Constructing bunding for hazardous material storage and management around the site.
- ~~Constructing a temporary TSF for tailings disposal until the mine void is established (see Section 3.6.1).~~
- Constructing tailings embankments in the mine void.
- Constructing a freshwater storage dam, contingency water dam and process water dam and tanks (see Section 3.7.2).
- Installing a package water treatment plant.
- Constructing a groundwater borefield south of the project area in the infrastructure options area.
- Constructing a water pipeline from the Mitchell River to the freshwater storage dam; and from the borefield to the contingency water dam or the process water dam (see Section 3.7.1).
- Constructing onsite water and tailings pipelines to transport ore to the WCP and tailings back to the ~~temporary TSF~~centrifuge building and mine void for disposal.
- Undertaking site preparation works for the installation of up to two mobile mining unit plants (MUPs) within the mine void including ramps (see Section 3.5.1).
- Undertaking site preparation works for the construction of a wet concentrator plant (WCP), site offices, laboratory and maintenance workshops and storage areas (see Section 3.5.2).

- Undertaking site preparation works for the location of loading facility and concentrate stockpiles, including water removal, drainage, bunding and water recovery.
- Modifying power and telecommunications infrastructure and constructing new 66 kV and 22 kV powerlines (see Section 3.8.1).
- Constructing various site amenities, such as parking areas, ablutions, laydown areas, chemical storage, security gates and fencing (see Section 3.8).
- Constructing a purpose-built rail siding (Fernbank East rail siding) to the south of the project area and east of Fernbank (if required).
- Constructing a private haulage road in the infrastructure corridor to the Fernbank East rail siding (if required).
- Diverting intersections and roads for safety and to provide access for mining (see Section 3.9.3).
- Constructing a relocatable centrifuge building near the mining operations (two buildings, one per MUP)
- Installing MUPs, WCP, thickener, flocculation plant, concentrate stackers and other processing equipment.

Some of the activities listed above, such as pre-stripping, topsoil and overburden stockpiling, and water management will continue through to operations as mining progresses through the project area.

The WCP, centrifuge building, MUPs and other processing plant are expected to be partially modular. Fabrication of these plants will occur partially offsite. Over dimensional transport routes for the construction phase will be determined to avoid the low-clearance railway bridge on the Princes Highway at Stratford.

Figure 3.6 shows proposed infrastructure locations outside the project area including the groundwater borefield and pipeline route, winterfill water pipeline routes, powerline route, private haulage road and other road upgrades, and rail siding options. The EES addresses the potential environmental impacts from the proposed infrastructure (as an integral part of the project). This infrastructure (located largely on agricultural land) will require separate planning approvals as they will not be covered by any mining licence issued to Kalbar (see Section 5.2.3).

3.4 Mining

The general sequence of mining is illustrated in Figure 3.7. Mining operations will include site preparation (removal of topsoil and overburden to expose the ore), mining of the ore by conventional earthmoving equipment, such as bulldozers, scrapers, excavators and trucks, followed by replacement of tailings, overburden and topsoil, prior to rehabilitation and revegetation.

The timeframe for mining, from initial topsoil stripping to establishment of revegetation, can be as short as 19 months (one year and seven months) or up to 68 months (five years and eight months), as shown in Table 3.3. ~~These estimates exclude areas where fines tailings are returned to the mine void. In these areas, an additional 24 to 36 months (two to three years) is required.~~

Table 3.3 Indicative timeframe for mining activities

Stage	Indicative timeframes	
	Minimum	Maximum
Topsoil removal	1 month	9 months
Overburden (including subsoil removal)	1 month	5 months

Stage	Indicative timeframes	
	Minimum	Maximum
Mining of ore	2 months	4 months
Coarse sand tailings return~~[1]~~	1 month	12 months
Fine tailings return	1 month	5 months
Overburden (including manufactured subsoil) return	1 month	5 months
Topsoil return	1 month	9 months
Rehabilitation and revegetation (completion of vegetation establishment)	12 months	24 months
Total timeframe to revegetation completion	**19 months (1 year 7 months)**	**68 months (5 years 8 months)**

~~[1] The timeframes shown in this table are indicative and apply only to areas where fines tailings are not returned to the mine void. An additional 24 to 36 months applies to the total timeframe for areas where fines tailings are returned to the mine void.~~

Estimates of the overall tonnages of topsoil, overburden and ore to be moved during the life of the mine are shown in Table 3.4.

Table 3.4 Indicative overall material movements for the life of the mine

Unit	Tonnes (t)	Description
Topsoil	7,800,000	Topsoil – assume 300 millimetres (mm) over 1,350 ha.
Overburden	450,000,000	Combination of Haunted Hills Formation and some upper sands.
Ore	170,000,000	Combination of upper sands, marker and sub-marker horizons.

Figures 3.8 to 3.12 show the progression of mining, rehabilitation activities and re-establishment of agriculture through the landscape with indicative mining locations at years 1, 5, 8,12 and 15. Years 1 and 5 represent the periods when sources of emissions are closest to sensitive receptors and years 8 and 12 represent times of peak operation where the mobile mining equipment requirements are at a maximum. Year 15 represents a peak in the movement of overburden and mining activities located within the Perry River catchment.

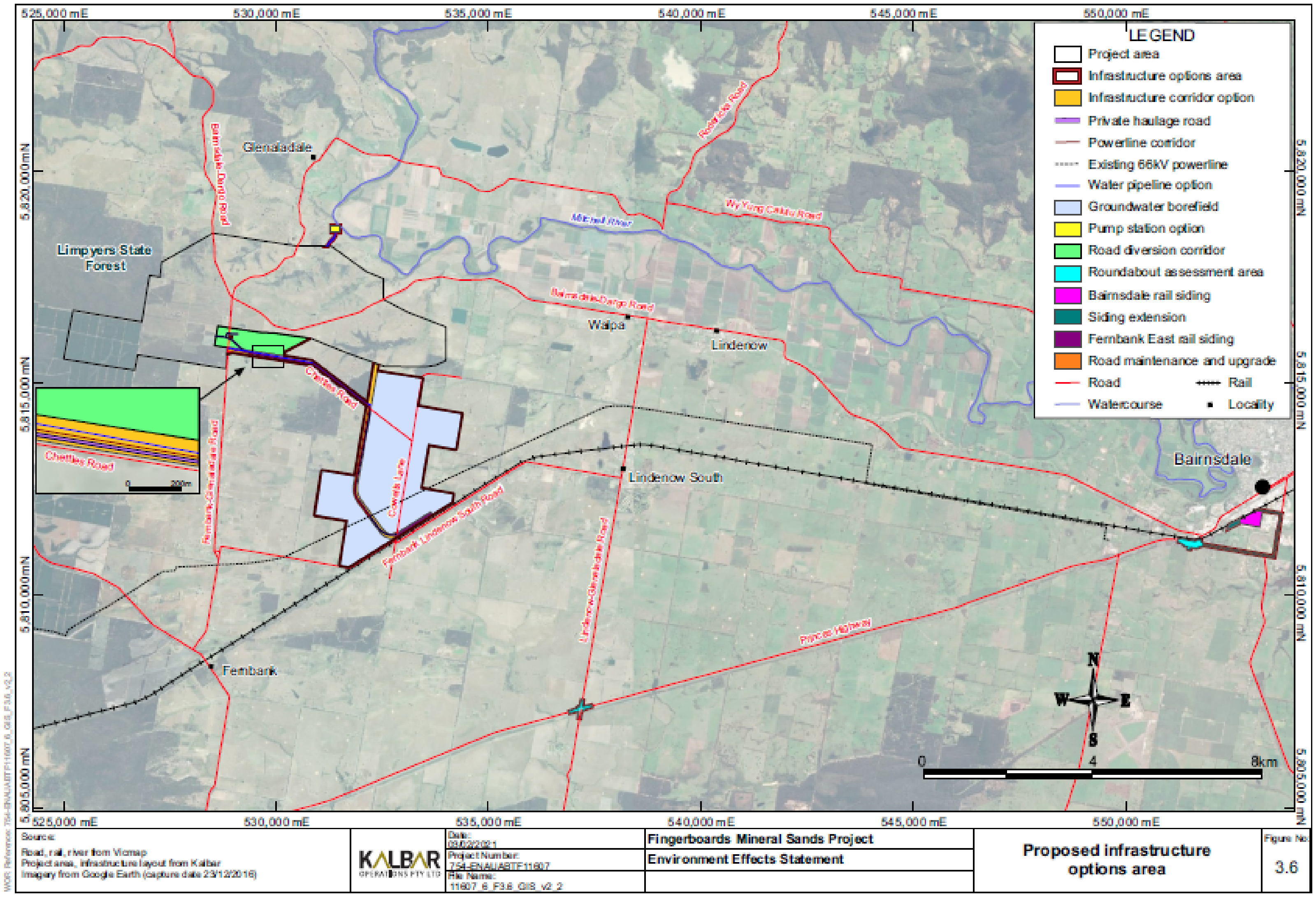
3.4.1 Site preparation (topsoil removal)

Topsoil will be stripped separately to overburden using earthmoving machinery. No blasting will be required. Any soil conditioning to improve the stability and fertility of the topsoil will occur prior to stripping. Scrapers will be used to remove topsoil and subsoil. Bulldozers may be required in some areas where the subsoil is rocky in nature.

Stripped topsoil will be either stockpiled or transferred directly to nearby rehabilitation areas. Topsoil will be stockpiled separately to overburden adjacent to the active mining area within the disturbed area. Where topsoil stockpiles are scheduled to be left in place for four months or longer, the stockpiles will be restricted to 2 m high. All topsoil stockpiles will be revegetated with crops and grasses for stability and to prevent erosion by wind and water. Some topsoil may be stockpiled for up to three years.

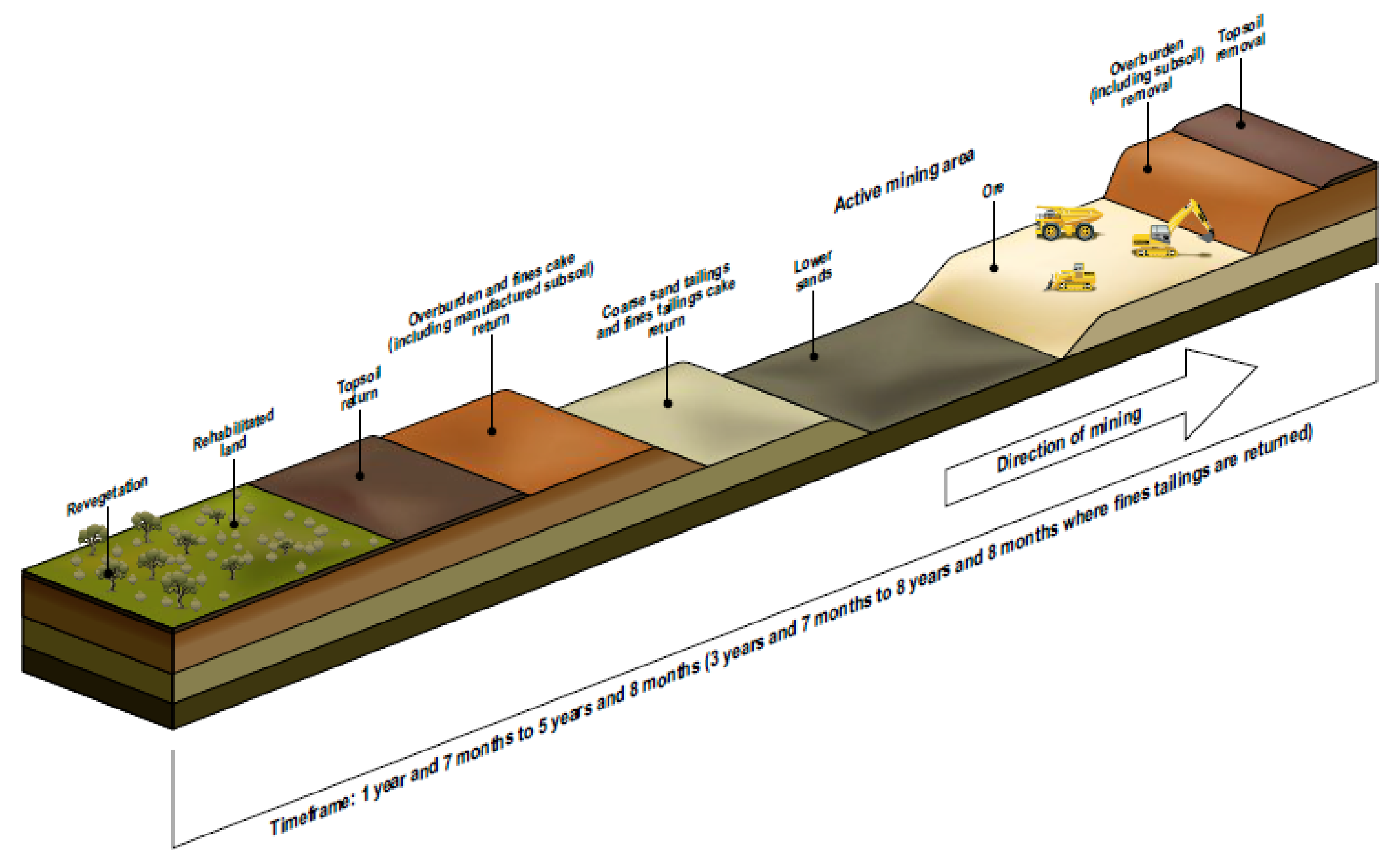
Topsoil removal rates will be determined by the requirement to remove soils and overburden in advance of the working mine face, the presence and nature of the soils, and the prevailing weather conditions. The amount of topsoil to be removed each year will vary due to the scheduled mining rate. An average of 520,000 t of topsoil is expected to be removed annually. Chemical and structural analysis of topsoils will be conducted prior to soil stripping so that targeted soil conditioning, management and rehabilitation can be achieved (see Chapter 11: Closure).

Figure 3.6 Proposed infrastructure options area



Source:
Road, rail, river from Vicmap
Project area, infrastructure layout from Kalbar
Imagery from Google Earth (capture date 23/12/2016)

Figure 3.7 Mining activity schematic



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Date: 03.02.2021
Project: 754-ENAUABTF11607
File Name: ENAUABTF11607_6_F03.08

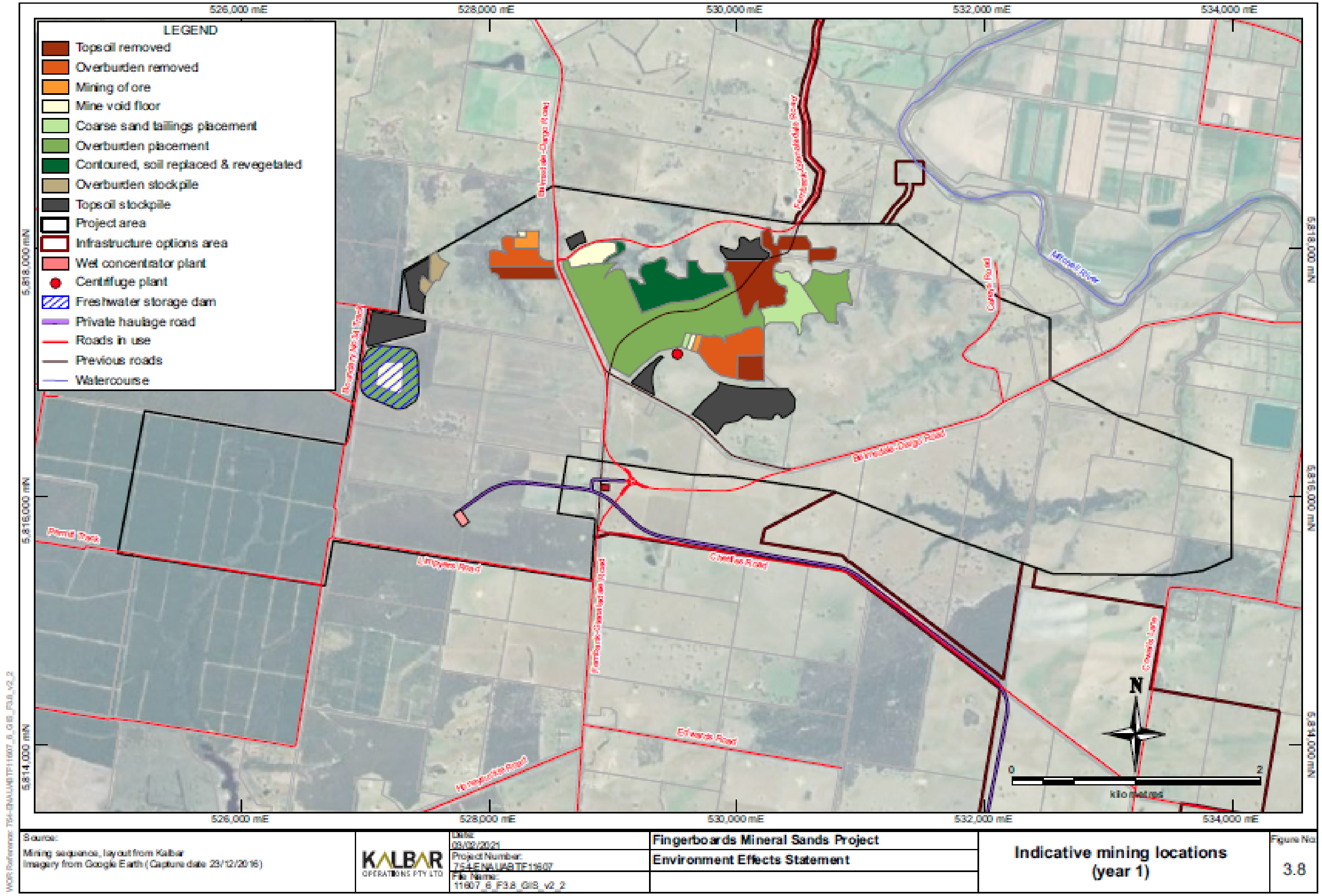
Kalbar Operations Pty Ltd
Fingerboards Mineral Sands Project

KALBAR OPERATIONS PTY LTD

Mining activity schematic

Figure No: 3.7

Figure 3.8 Indicative mining locations (year 1)



WOR Reference: 754-ENAUABTF11607_6_GIS_F3.8_v2_2

Source:
Mining sequence, layout from Kalbar
Imagery from Google Earth (Capture date 23/12/2016)

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03/02/2021
Project Number:
754-ENAUABTF11607
File Name:
11607_6_F3.8_GIS_v2_2

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Indicative mining locations (year 1)

Figure No:
3.8

Figure 3.9 Indicative mining locations (year 5)

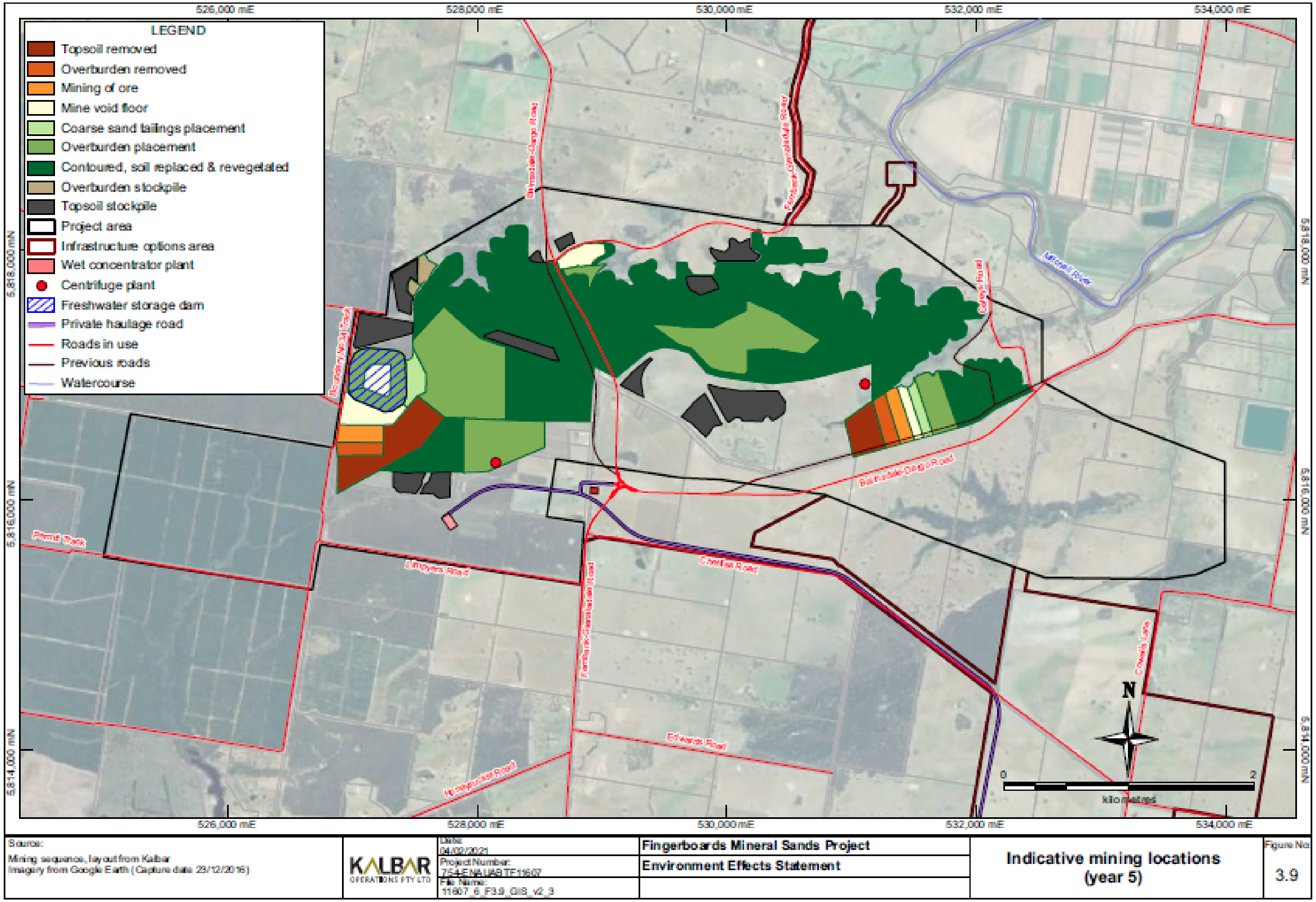


Figure 3.10 Indicative mining locations (year 8)

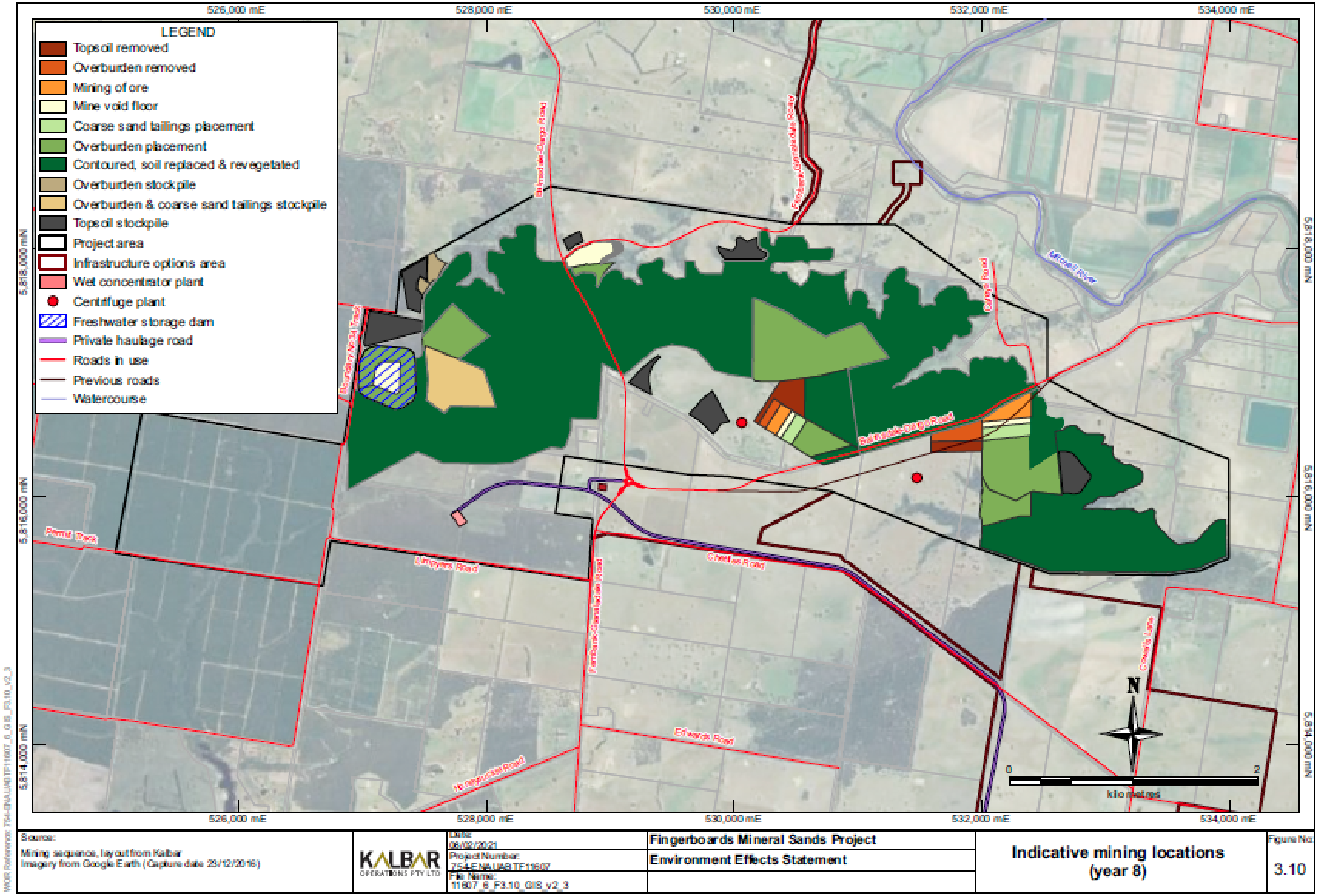


Figure 3.11 Indicative mining locations (year 12)

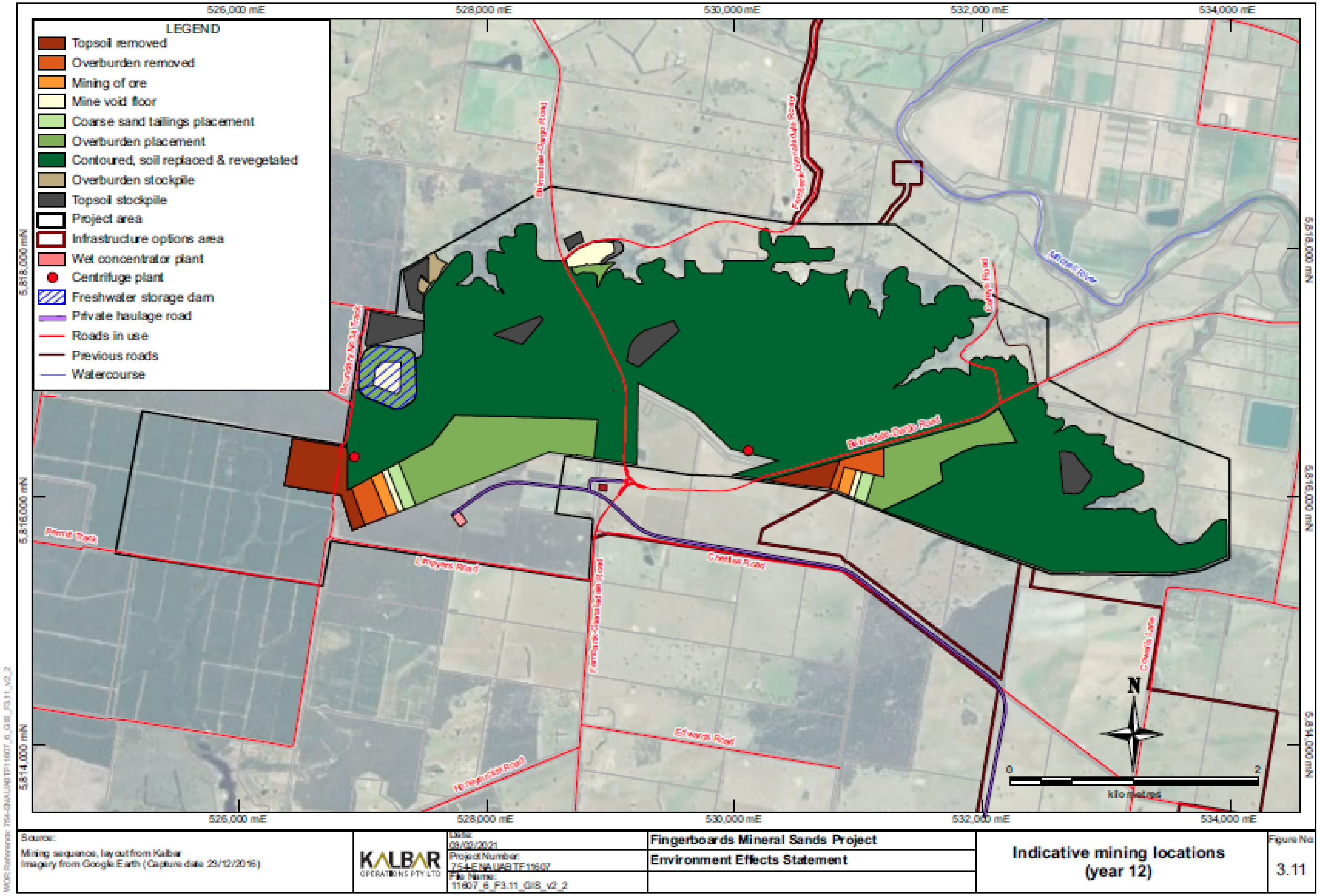
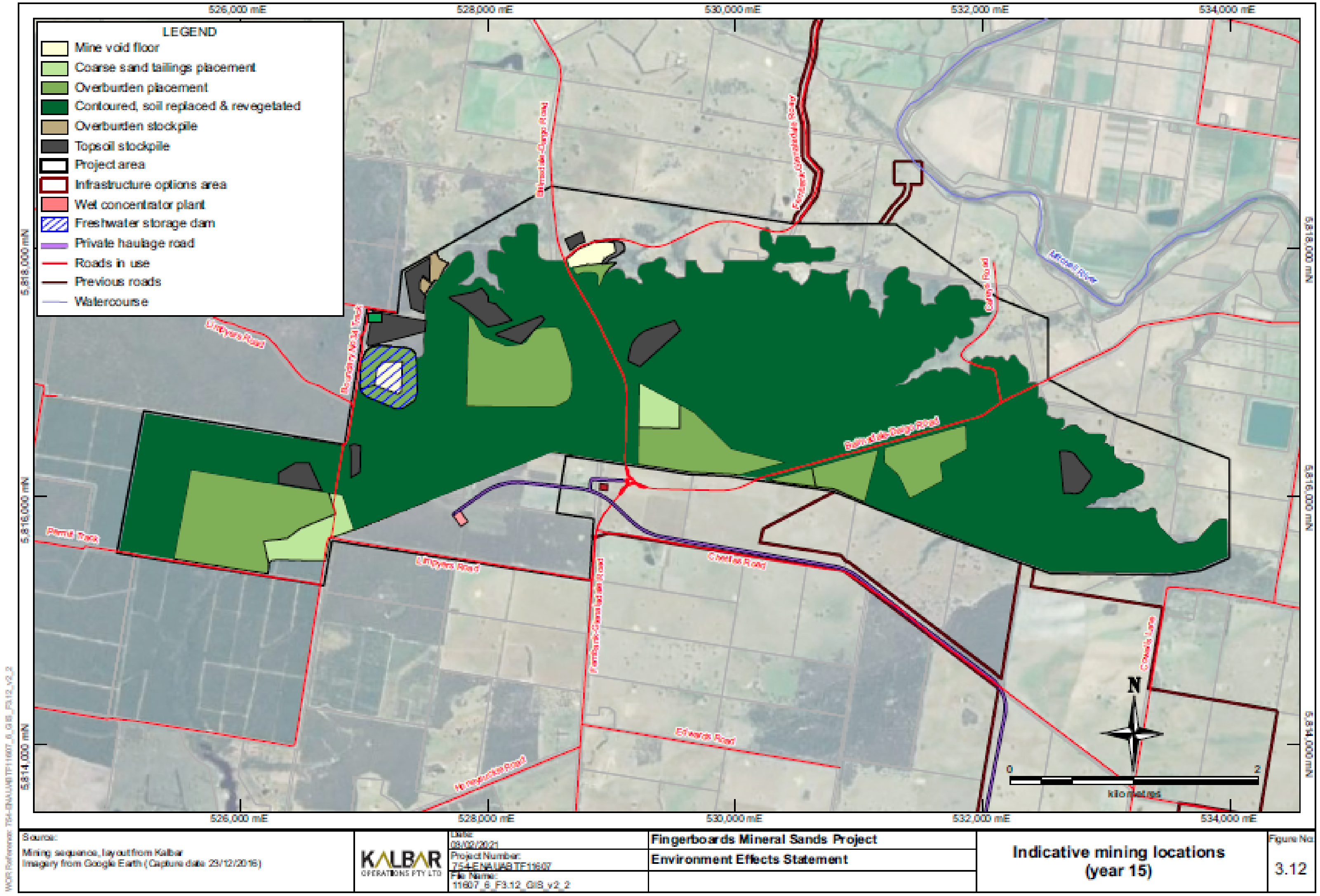


Figure 3.12 Indicative mining locations (year 15)



Source:
Mining sequence, layout from Kalbar
Imagery from Google Earth (Capture date 23/12/2016)

3.4.2 Overburden removal

Approximately 30 Mt of overburden will be moved on an annual basis. This tonnage is lower in the earlier years due to the lower strip ratio in the northern part of the mine (i.e., a lower volume of overburden (or waste material) relative to the tonnage of ore extracted). The maximum overburden moved in a year will be approximately 50 Mt.

The overburden material comprises gravel and sandy clays interspersed with clay layers of the Haunted Hills Formation. This material will be used for road construction to improve trafficability and the armouring of slopes and embankments within the project area.

Overburden will be removed by conventional earthmoving machinery including scrapers, excavators, trucks, conveying systems and stackers. Subsoil will be incorporated into the overburden and treated as overburden. Scrapers will be used for short haul distances (less than 500 m), and excavators and trucks for longer hauls or larger movements.

During the first year of operations, temporary stockpiles of overburden may be established adjacent to the active mining area. For safety reasons, the overburden will be stockpiled to a maximum height of 15 m. Overburden will be initially stockpiled until the mine void is large enough for direct return of this material. The stockpiles will be located adjacent to the mine void on an area stripped of topsoil and strategically positioned to create visual and noise barriers.

After this initial period, during steady state mining and once the initial mine void has been established, overburden will be returned directly to the void on top of consolidated coarse sand tailings. Dewatered fine tailings cake will be trucked to the void and backfilled together with the overburden. This method will reduce the overall footprint of the disturbed area. ~~The time involved in establishing this sequence will depend on the drying time of the tailings.~~

3.4.3 Mining of ore

Within the project area, the Coongulmerang Formation (host formation of the Glenaladale deposit) is a fine silty sand with very low levels of oversize gravel (>1 mm) and no evidence of induration (hardening). The sand contains between 20 and 25% fines (particles smaller than 38 μm), which will be removed from the ore prior to gravity separation of the heavy minerals.

The ore has been shown to readily disaggregate with no evidence of forming clay balls or clumps in feed preparation of bulk samples taken during exploration. The heavy mineral liberates easily from the clay and silts.

The thickness of the ore is expected to vary between 10 and 30 m, with thinner ore horizons scheduled to be encountered in the earlier years of the project. Ore extraction will be conducted initially using scrapers or front-end loaders, as these are cost-effective in the thinner ore horizons and provide the most flexibility with respect to the mine plan. The mobile equipment will transport the ore to one of the MUPs.

After this initial period, dozers and a dozer trap MUP or front-end loaders and a mining unit are likely to be used for mining the ore. Up to two MUPs will operate in two locations within the project area from year two to sustain concentrate output. Each MUP will have a capacity of around 1,000 tonnes per hour (t/h) to allow for sustained production during MUP moves, breakdowns or maintenance.

A mining floor and working faces will be established in the initial mine void. The active mining area will advance approximately 2.5 kilometres (km) per year. The selected mining layout is a series of cells approximately 300 m wide by 1,000 m long. The mine is expected to have two active mine voids of less than 60 ha each at any one time, with an area of 10 ha within each void being used for tailings disposal. The mine voids will average 29 m deep with a maximum depth of 50 m. All mining will occur above the watertable and no dewatering is required. The wall angle of the mine voids will be approximately 40 degrees.

Mined cells will be progressively backfilled with coarse sand tailings and covered with dewatered centrifuge cake, overburden (including manufactured subsoil) and topsoil (see Figure 3.7). The time from overburden stripping to completion of rehabilitation and re-establishment of agriculture (or an alternative agreed land use) is expected to be between three and five years. Progressive rehabilitation behind the active mining areas will result in a maximum area of disturbance of approximately 360 ha at any one time.

3.4.4 Mining equipment

A list of mobile mining equipment that will be located on site during construction, pre-stripping, mining of the ore and closure (including decommissioning and rehabilitation) is provided in Table 3.5.

Table 3.5 List of mobile equipment likely to be in use during mining

Type	Number	Uses
Dozers (D9 to D11)	6	Mining, support, rehabilitation
Front end loaders	2 2	Mining, mining support, loading concentrates for transport Site works Centrifuge cake loading
Scrapers/ tractor-scoop (657G; 600 t/h)	4	Topsoil removal, mining and rehabilitation
Excavators (300 t)	2	Overburden removal
Compactor	1	Earthworks, engineering
Haul trucks (777 or 785)	5 2*	Overburden relocation Centrifuge Cake Haul
Graders	1	Road maintenance, rehabilitation
Light vehicles	5	General transport
Fuel trucks, service vehicles	2	Support to mining fleet
Water trucks	2	Transport of water, dust suppression
~~Amphirols~~	~~2~~	~~Fines tailings management~~

*** Dayshift haul**

3.4.5 Tailings and overburden return

Overburden and tailings (non-economic sands, silts and clay) from mining and primary processing will be returned progressively to the mine void as the working face advances (see Figure 3.7). Coarse sand tailings will initially be deposited in an area off the mine path (Perry Gully) for storage. After approximately four months, when the mine void has enough capacity, coarse sand tailings will be deposited into the mine void.

Fines tailings will be dewatered through solid bowl centrifuges located within a building near the mine void to produce s damp cake. Two centrifuge buildings are proposed, each one serving an active mining area and MUP. The cake will be stockpiled and trucked to the mine void during the day and evening shifts where it will be filled together with the overburden to the commencement level of the final subsoil rehabilitation layer. ~~initially be deposited into a constructed temporary TSF. As mined out areas of the void become available, the fines tailings will be placed in contained cells within the mine void. The fines tailings from the temporary TSF will be placed within the mine void prior to the mining of the ore under the TSF.~~ The land will be returned to pre-mining land use and capability, native vegetation, or other agreed post-mining land use.

3.4.6 Rehabilitation and closure

The aim of rehabilitation will be to restore the land to at least its pre-mining land capability and land use, or alternative agreed end land use. The plan for progressive rehabilitation includes:

- Allowing the deposited coarse sand tailings ~~and fines tailings material~~ to settle and dry sufficiently to support earthmoving machinery.
- ~~Ripping the dried tailings material.~~Placing overburden and fine tailings cake during backfill operations.
- Applying gypsum and other soil conditioners to the selected rehabilitation areas.~~.~~
- Applying additional ~~overburden,~~ manufactured subsoils (to improve plant growth and reduce risk of erosion) and replacing topsoil stripped from the area.
- Applying cover crops or pasture.

Project infrastructure, such as buildings, fences, pipelines, powerlines, haul roads and other pavements, will be removed for closure. Processing plant including the WCP, centrifuge building, loading facilities and thickeners will be decommissioned and removed. The area will be cleared of any debris, rehabilitated and revegetated. Some infrastructure may be retained at the request of landholders, Southern Rural Water, East Gippsland Shire and/or other stakeholders.

Chapter 11: Closure, provides further detail on the proposed rehabilitation process.

3.5 Ore processing

The stages in initial processing of the ore within the project area are described below, from the point where the ore enters the MUPs within the mine, through to separation into magnetic and non-magnetic HMCs that are ready for transport and export.

3.5.1 Mining unit plants

On reaching the MUPs, the ore will be wet screened to remove oversize material. Up to two MUPs will be used to support the project (MUP 1 and MUP 2). Each MUP will operate within a mine void and is comprised of three main components:

- An ore mining unit consisting of a dozer trap arrangement or a front-end loader hopper unit.
- A static oversize screen to remove material greater than 300 mm in diameter prior to pumping.
- An ore hopper (a large bin or funnel) in which ore is loaded from the top and mixed with water to make a slurry.

The MUPs will be skid-mounted to enable relocation around the mine void as the hopper is moved with every advance of the mining-face. The size of each MUP, including the slurry-pumping hopper, is approximately 10 m wide by 10 m long and 5 m high.

The expected processing capacity of the MUPs is 1,000 t/hr of ore. The screened oversize material (approximately 1% of the ore) will fall into a bunded area adjacent to the MUP within the mine void. Plate 3.1 shows a typical ore screening unit. The oversize material will be removed using front-end loaders and used as road base and for other construction purposes. The ore will then be slurried in the hopper and pumped from the MUPs through a slurry pipeline up to 5 km from the mine voids to the WCP.

3.5.2 Wet concentrator plant

The slurried ore will be pumped from the MUP to the WCP. The WCP separates out the heavy minerals from the ore. A schematic and general layout of the WCP is shown in Figure 3.13 and a photograph of a typical WCP with gravity spirals is shown in Plate 3.2.

On entering the WCP, a vibrating screen plant will remove material greater than 1 mm in diameter from the ore. Machines called hydrocyclones will then remove material smaller than 38 µm in diameter (material known as overflow fines). The process uses centrifugal forces to remove the fines (20 to 25% of the ore or about 300 to 375 t/hr) which will then be sent to the high-rate thickener. The fines tailings will be thickened to about 35% solids using flocculant. The flocculant helps to dewater the fines tailings. Overflow water from the thickener will be returned and reused in the process water circuit. The output from the thickener is an underflow slurry that will be pumped to the centrifuge building for dewatering to a solid cake. ~~disposed of initially in the temporary TSF, and then later in the mine void.~~

The remaining ore will be sent to a surge bin, which helps to regulate the flow rate and density of the slurry entering the gravity circuit in the WCP. The gravity separation phase of ore processing involves segregating the heavy minerals from the non-economic sands.

The gravity separators consist of spirals and reflux classifiers. Wet screening units may also be used within the gravity circuit to assist with mineral separation. No chemicals or thermal processes will be used for the separation of the heavy minerals. Both the spirals and reflux classifiers use the gravity differential between the heavy minerals and quartz in a slurry environment to separate the valuable minerals from the quartz. Between 3 and 10% of the ore entering the gravity circuit will become HMC. The amount of concentrate generated will be dependent upon the grade of the ore. The remaining coarse sand tailings will be pumped back to the tailings disposal areas and dewatered to greater than 65% solids using dewatering cyclones.

The HMC will be further separated into magnetic and non-magnetic concentrates for export. A wet high intensity magnetic separator will be used in the final circuit within the WCP to separate the minerals to produce magnetic and non-magnetic concentrates.

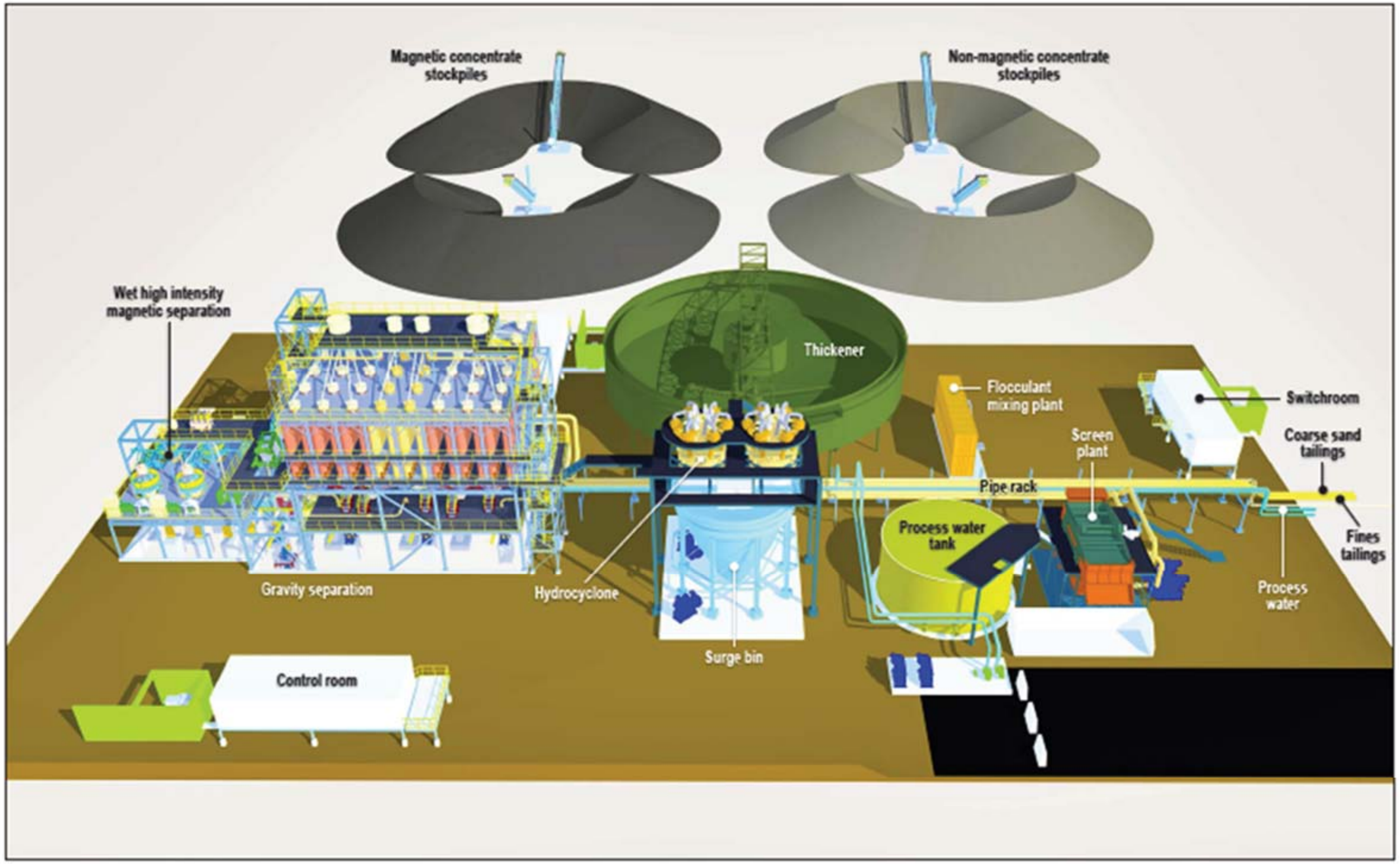
A gradual increase in production is proposed following commencement of mining and commissioning of the WCP. The plant will initially commence at a rate of 500 t/hr and increase to a design capacity of 1,500 t/hr or 12 Mt/year.

A loading facility will be constructed adjacent to the WCP to stockpile the concentrates awaiting transport to a port via road and rail. The volume of concentrate stockpiles will vary from 5,000 to 50,000 t and will be continuously depleted and replenished as concentrate is removed for transport and new material is added from the WCP. The stockpiled concentrates are dewatered to less than 5% moisture to allow for safe and effective management and handling during transportation and shipping.

The concentrates will be shipped from suitable ports in Victoria to mineral separation plants in Asia for final processing.

Other facilities at the WCP will include a control room and switchroom, as well as water management and treatment facilities, including process water tanks, dams, make-up water supply and return pipelines.

Figure 3.13 **Schematic of wet concentrator plant**



Source: Kalbar 2016

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Fingerboards Mineral Sands Project

Schematic of wet concentrator plant

Figure No:
3.13

3.6 Tailings management

Two types of tailings will be produced from the processing of the ore in the WCP: fines tailings from the thickener in the WCP; and coarse sand tailings from the gravity separators. Both types of tailings are non-economic materials and need to be managed within the project area.

~~3.6.1 Temporary tailings storage facility~~

~~Fines tailings will initially be disposed of into a temporary TSF, consisting of up to four storage cells, located close to the WCP on the mine path (see Figure 3.2). In year 5, the temporary TSF will be decommissioned. Fines tailings from this site will be deposited in the mine void for the remaining life of the mine. The area underneath the temporary TSF will then be mined for ore and subsequently rehabilitated.~~

~~The temporary TSF will cover an area of up to 90 ha with a capacity of 6,600,000 m^3 of fines tailings. The engineered design, construction, monitoring and rehabilitation of the temporary TSF will comply with Earth Resources' Technical Guideline, Design and Management of Tailings Storage Facilities, April 2017 (DEDJTR, 2017).~~

~~Construction of the temporary TSF will involve:~~

- ~~Removing and stockpiling topsoil, subsoil and overburden to a depth of approximately 3 m.~~
- ~~Using overburden (clay and Haunted Hills Formation soils) to form walls and local (subsoil) for lining the walls.~~
- ~~Compacting clay to seal the base and prevent seepage from the fines tailings.~~
- ~~Installing a decant system, including drains and sumps, to harvest water for use in the process water circuit.~~
- ~~Constructing spoon drains along the perimeter to divert any surface runoff from outside the temporary TSF.~~

~~The temporary TSF will be founded on the upper clay unit of the Haunted Hills Formation, on material free of gravels and 11 to 16 m thick. Geotechnical testing of this material showed that it is stiff to hard, with moderate plasticity. More recent dune deposits are present over part of the TSF footprint. Loose silty sand and alluvium will be stripped off along with topsoil as part of preparing the TSF foundations. A detailed geotechnical assessment of the TSF design is planned following project approval and will consider the physical properties of the foundation and construction material, as well as of the contained fines tailings.~~

~~The external walls of the tailings storage cells within the temporary TSF will comprise homogeneous earth embankments with 1:2.5 (vertical:horizontal) slopes both upstream and downstream. The embankments will be constructed using low permeability material sourced from local borrow pits and Haunted Hills Formation overburden. The upstream slopes of the perimeter embankments will be stabilised with 3% lime due to the potentially dispersive nature of the on-site soils. This technique has been used successively in water storage structures in other locations in the local area. Further testing will be conducted during the detailed design stage to confirm the suitability of this approach. A general crest width of 10 m has been designed to accommodate pipework and other operational infrastructure. Figure 3.14 shows a cross section of an embankment (wall) of the temporary TSF.~~

~~Figure 3.14 Typical tailings storage facility embankment cross section~~

~~(Refer to pdf version for figure)~~

~~The potential hazards and risks posed by the temporary TSF were identified and assessed as part of the design process and development of the operation strategy. The assessment focused on two potential scenarios, an embankment failure and uncontrolled release of tailings or seepage of water from the facility. Two sets of guidelines published by the Australian National Committee on Large Dams (ANCOLD) were used in the assessment:~~

- ~~Guidelines on Tailings Dam – Planning, Design, Construction, Operation and Closure (ANCOLD, 2012a).~~
- ~~Guidelines on the Consequence Categories for Dams (ANCOLD, 2012b).~~

~~The design and operations philosophy considered potential for uncontrolled releases of water from the temporary TSF. Water recovered from the tailings will be pumped from depressions in the tailings (decant ponds) to the WCP for re-use. The location of the ponds will keep water away from the perimeter embankments.~~

~~Water could also be released from the temporary TSF during a storm event. The facility has no external catchment and small perimeter drainage ditches will manage local runoff. A centrally located depression against the embankments will provide additional volume for containment of water during storm events. The greatest potential for an uncontrolled release of water will occur when the maximum volume of tailings occupies the temporary TSF. At such a time, the design allows for storage of water within the temporary TSF during a 1% annual exceedance probability (AEP), 72-hour storm event, representative of an 'east coast low'. A storm of this size and intensity could generate around 240 mm of direct rainfall (corresponding to approximately 167,670 m^3 of inflow to the temporary TSF).~~

3.6.1 Centrifuge Building

The fines tailings underflow from the thickener is pumped to two centrifuge buildings, each located near an active mining area within which a MUP is operating. A dewatering centrifuge works by increasing the G-forces that act on the slurry, increasing the separation of the heavier solids from the lighter water in fine tailings. A flocculant is added to the slurry in the centrifuge to increase coagulation of the clay particles. Typical operating bowl speeds are in the 1,000 to 1,800 rpm range, where the developed G-force range is from 600 to more than 1800 G. After being processed through the centrifuge, two products are produced. Firstly, a clear overflow water (called the centrate) containing very little suspended solids and secondly a readily transportable solid cake.

The trucking of the cake to the mine void, where backfilling is occurring, will take place during the day shift. During evening and night periods, the cake will accumulate on the stockpile for loading and haul to pit during the following dayshift. The stockpiles are designed to store for a maximum volume of up to 24 hours fines production, being the Sunday evening/night shift duration. This will result in a total stockpile volume of approximately 3,600m^3 (6,000 tons) at each of the two centrifuge plants. A front-end loader (FEL) will reclaim material from the cake stockpile and load the dump trucks.

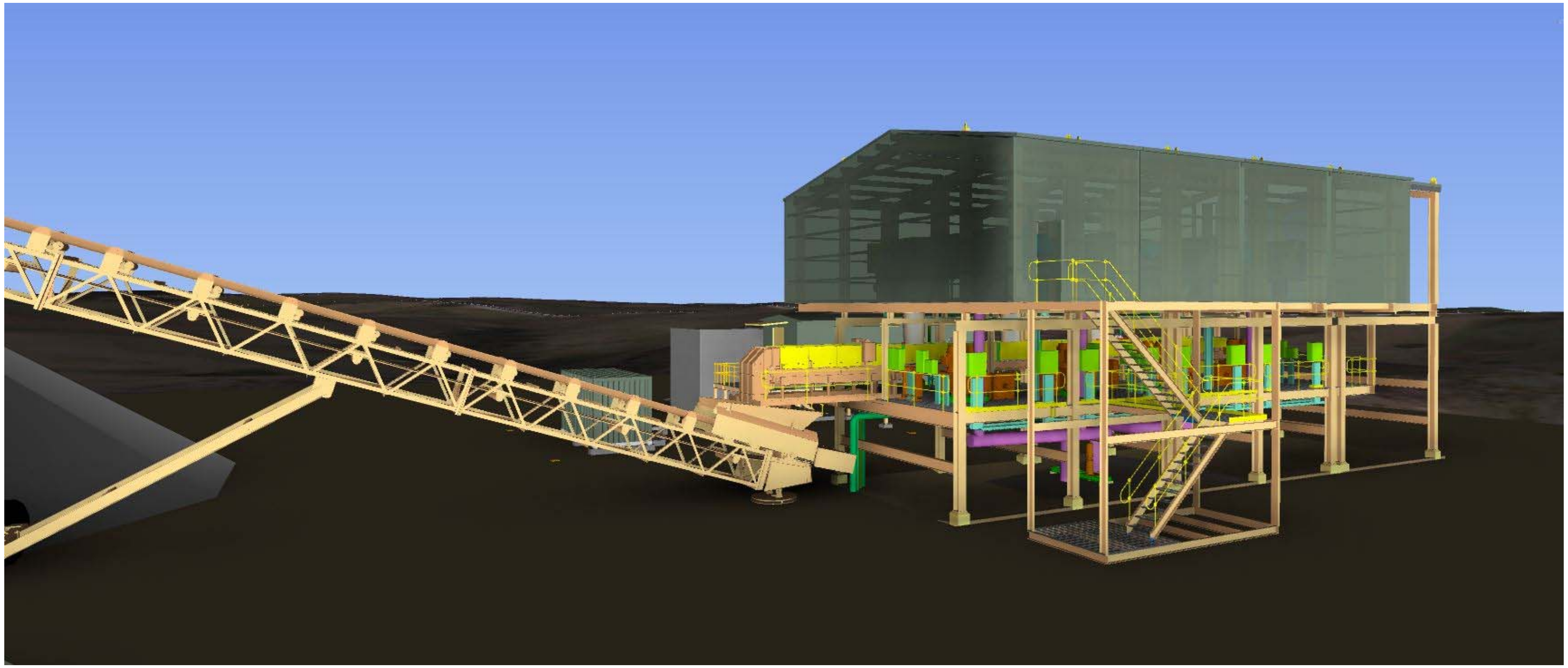
In the mining void, the centrifuge cake will be placed as backfill with the overburden. In total, the fines cake will represent only 7% - 8% of the total overburden backfill volume and stability of the backfill is not compromised. Ancillary equipment around the plant will be a flocculant mixing tank, electrical switchroom, transformer enclosure and a bypass sump.

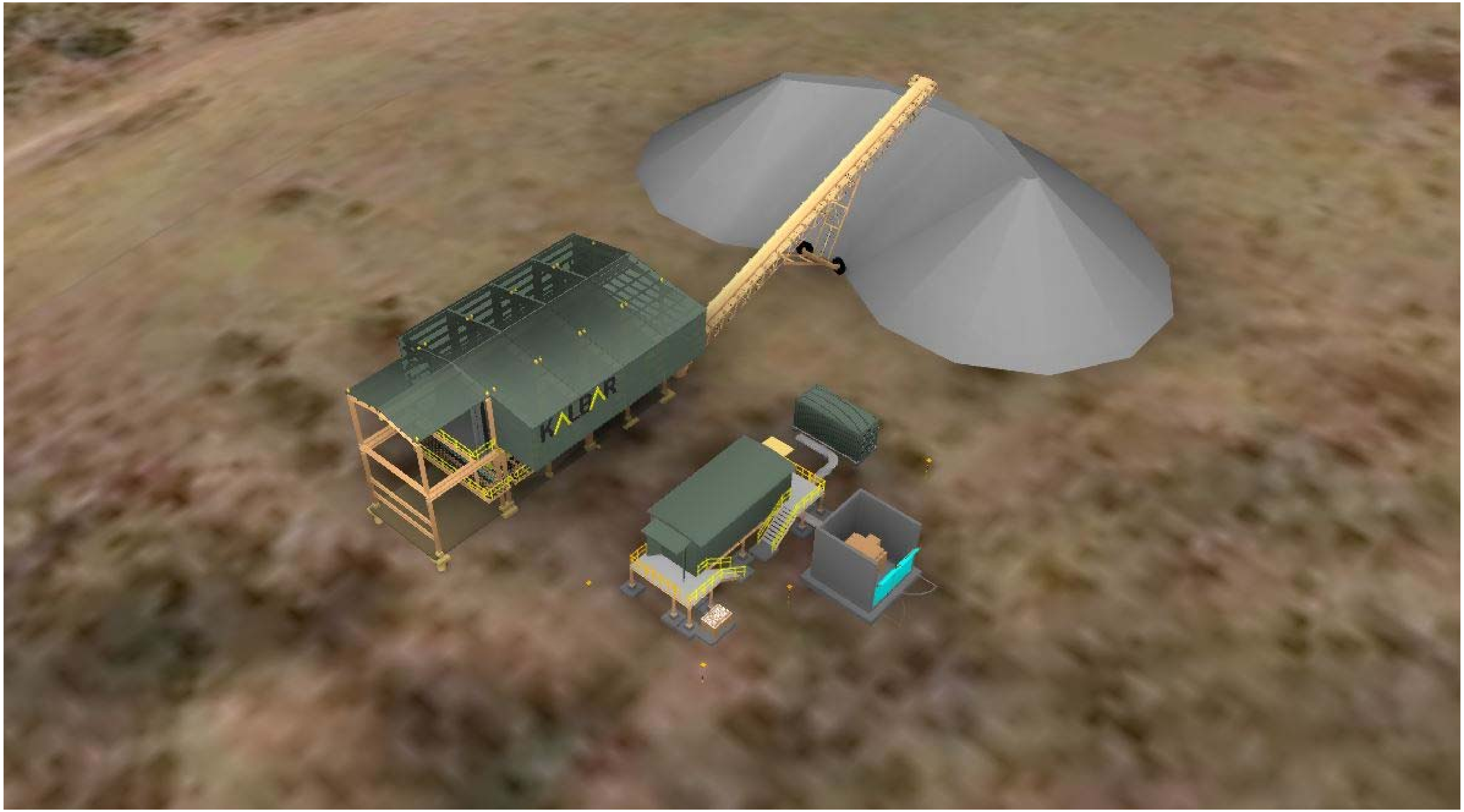
The centrifuge plants would be located in close proximity to the mining area in order to reduce the overland haul distance of the centrifuge cake back the mining void, and thereby minimise noise and dust generation. Based on the preliminary mine planning, it is anticipated that each centrifuge plant would be relocated to a new position every four to five years. The plant has been designed to be modular and will dismantled and trucked to the new location, when required. The plant positions have been selected such that the average one-way haul distance from the plant to the mine void is an average of 750m for all locations.

A bypass sump is located at the centrifuge building area to allow for the containment of fines tailings slurry in the event that power supply to the buildings is interrupted and the slurry pipeline must be emptied.

A schematic and general layout of the centrifuge building is shown in Figure 3.14.

Figure 3.14 A schematic and general layout of the centrifuge building

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3.6.2 Mine void tailings disposal

When the mine void has been established with sufficient capacity, both coarse sand and fines tailings will be returned to the void , the fine tailings as a cake (described in section 3.6.1) and the coarse sand tailings as described below. ~~and placed in tailings cells. Once the fines tailings disposal moves to the mine void, the temporary TSF will provide contingency for tailings disposal, if required, until the area under the facility is mined.~~

The coarse sand tailings will be pumped back to the tailings disposal areas and dewatered to greater than 65% solids. Additional water will be recovered from the coarse sand tailings using subsurface drains. The dewatered coarse sand tailings will be spread within the tailings disposal areas within the mine void using conventional earthmoving equipment.

~~As with the temporary TSF, amphirols will be used within the mine voids to consolidate the fines and improve water recovery from deposition areas (Plate 3.3).~~

~~A maximum of four tailings cells (each with an area of 10 to 15 ha) will be available within each of the two mine voids at any one time. This approach provides for adequate drying of tailings before overburden is replaced during the rehabilitation process.~~

Plate 3.1 Pilot unit used to screen ore from the Fingerboards Mine at Nagrom Laboratories

Plate 3.2 Photograph of a typical WCP using spirals for gravity separation

~~**Plate 3.3 Photo of an amphirol operating on a fines tailings storage facility**~~

3.7 Water management

The project will require water for ore processing, dust suppression, rehabilitation, wash down and onsite drinking water and ablutions.

3.7.1 Water sources

Water for the project will be sourced from surface water (winterfill from the Mitchell River) and groundwater from the Latrobe Group Aquifer (from a proposed borefield within the infrastructure options area) (see Figure 3.6). Allocations and licences for both groundwater and surface water for the project will need to be sought from Southern Rural Water or purchased from existing licence holders.

Surface water will be pumped from the Mitchell River as per the winterfill licence requirements and transported via pipeline to the freshwater storage dam near the WCP. Two options for pumping water from the river are assessed in this EES as follows:

- Water from the existing pump station on the Mitchell River (no longer being pursued): The pump station is operated by East Gippsland Water and may not have the capacity to supply multiple users. The distance to pump water to the project area would be longer than for the new purpose-built pump station option.
- Water from a purpose-built pump station (preferred option): This option would mean a shorter pumping distance (and therefore pipeline) to the project area. The pipeline would also be available for discharge of offset water from the freshwater storage dam.

Groundwater extracted from the Latrobe Group Aquifer will be delivered via a pipeline to the contingency water dam (see Figure 3.6). Temporary transfers of groundwater licences may potentially provide access to the fully allocated Latrobe Group Aquifer.

Only winterfill from the Mitchell River and treated surface water will be stored in the freshwater storage dam to maintain the required water quality for possible water offsets (discussed in Section 3.7.4.1). Potential pipeline routes are shown in Figure 3.6 for the water from the Mitchell River and from the borefield. The freshwater pipeline from the Mitchell River will cross under the Fingerboards intersection via a culvert. The pipeline from the borefield will be located within the infrastructure corridor.

The project will reuse water where practicable (such as ~~flood~~ rainfall runoff ~~and supernatant water from the temporary TSF and tailings area~~ within the mine void) and optimise operations to maximise water use efficiency.

3.7.2 Water storage (onsite dams)

The project includes construction of dams for freshwater storage, process water, contingency water, and water management. Pipelines will be constructed from the borefield (south of the project area) to the contingency water storage dam and from the Mitchell River to the freshwater storage dam.

All water sourced from the Mitchell River will be stored in the 2.2 GL freshwater storage dam, with a design storage allowance for a 1% AEP, 72-hour storm event. The freshwater storage dam is located northwest of the WCP~~temporary TSF~~. The design, construction and operation of the freshwater storage dam will follow the ANCOLD Guidelines on the Consequence Categories for Dams (October 2012). The freshwater storage dam will store water for use in the processing circuit (MUPs, WCP and the thickener), firefighting (in the event of a fire), dust suppression and as the source of potable water.

Construction of the freshwater storage dam will involve:

- Removing and stockpiling topsoil and subsoil with stockpiles to be located adjacent to the dam.
- Removing and stockpiling overburden and extracting and stockpiling ore near the freshwater storage dam (until the processing plants have been commissioned).
- Using overburden (clay and Haunted Hills Formation soils) to form dam walls and local clay or plastic to line the walls.
- Compacting clay to seal the base and prevent seepage.
- Constructing spoon drains along the perimeter to divert surface water runoff around the dam.

The process water dam will be constructed onsite and sized to provide storage for 17 hours of processing requirements, and sufficient design storage allowance for a 1% AEP, 72-hour storm event. The dam will be a 'turkey-nest' style storage and will receive water from the freshwater storage dam, excess stormwater from water management dams, and recovered thickener overflow water from the WCP. Compartments within the dam will assist in trapping silt from the reused water.

The contingency water dam will also be a turkey-nest style storage and constructed from overburden near the WCP. The dam will receive predominantly groundwater from the borefield pipeline. The design storage capacity will allow for a 1% AEP, 72-hour storm event.

Water management dams capturing runoff will be constructed using scour-resistant materials to reduce erosion and designed with a capacity to retain a 1:100-year annual exceedance probability 72-hour storm event. Dams that receive volumes greater than their capacity will discharge excess water via an engineered spillway to the downstream catchment. The mine's water management system will be able to draw down dam storage levels prior to predicted rainfall events, increasing the ability of dams to retain water during storm events.

The water management dams will be designed to limit spillway discharge to a storm event that occurs at a frequency of three times in every 100-years. Emergency spillways for all sediment storages will be designed in accordance with the Guidelines on the Consequence Categories for Dams (ANCOLD, 2012b).

Nineteen water management dams are proposed to be located across the mine site over the life of the project (Figure 3.15). The number of operational water management dams is dependent on the configuration of active mining areas (Figure 3.16). The dams will function until rehabilitation in the catchment is complete. Decommissioning of dams will not occur until water quality monitoring demonstrates that runoff from the catchment no longer requires active management.

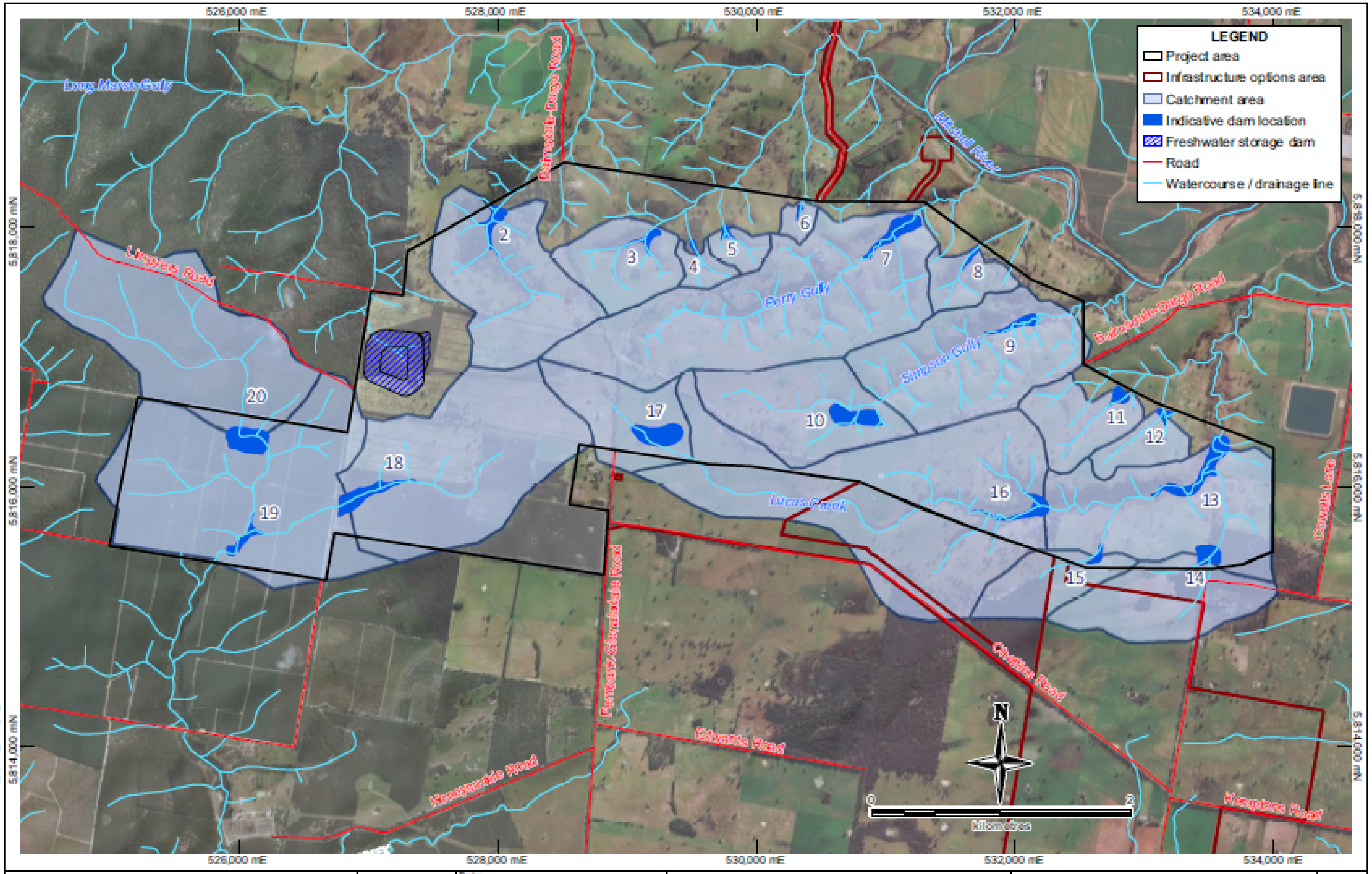
3.7.3 Water requirements

Approximately 3 GL of water will be required annually during operations. The major uses of water for the project will be for processing of the ore and dust suppression.

3.7.3.1 Process water

Process water will be used to transport ore as a slurry through the processing circuits from the MUPs and centrifuge buildings to the WCP in what will effectively be a closed water circuit. As required, supplemental water will be sourced from the water storages and water management dams on the mine site. Approximately 300,000 litres per hour (L/hour) of water is expected to be lost from the system, bound up with the coarse sand and fines cake~~tailings~~. Only 65% of the water in the tailings stream will be recovered from the

Figure 3.15 Indicative water management dam locations



Source:
Adapted from EMM Consulting: Conceptual Surface Water Management Strategy and Water Balance, (Fingerboards Mineral Sands Project, Report S180008), Figure 4.3, April 2019; GA (2015); VicMap (2010)

KALBAR OPERATIONS PTY LTD

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Fingerboards Mineral Sands Project
Environment Effects Statement

Indicative water management dam locations

Figure No:
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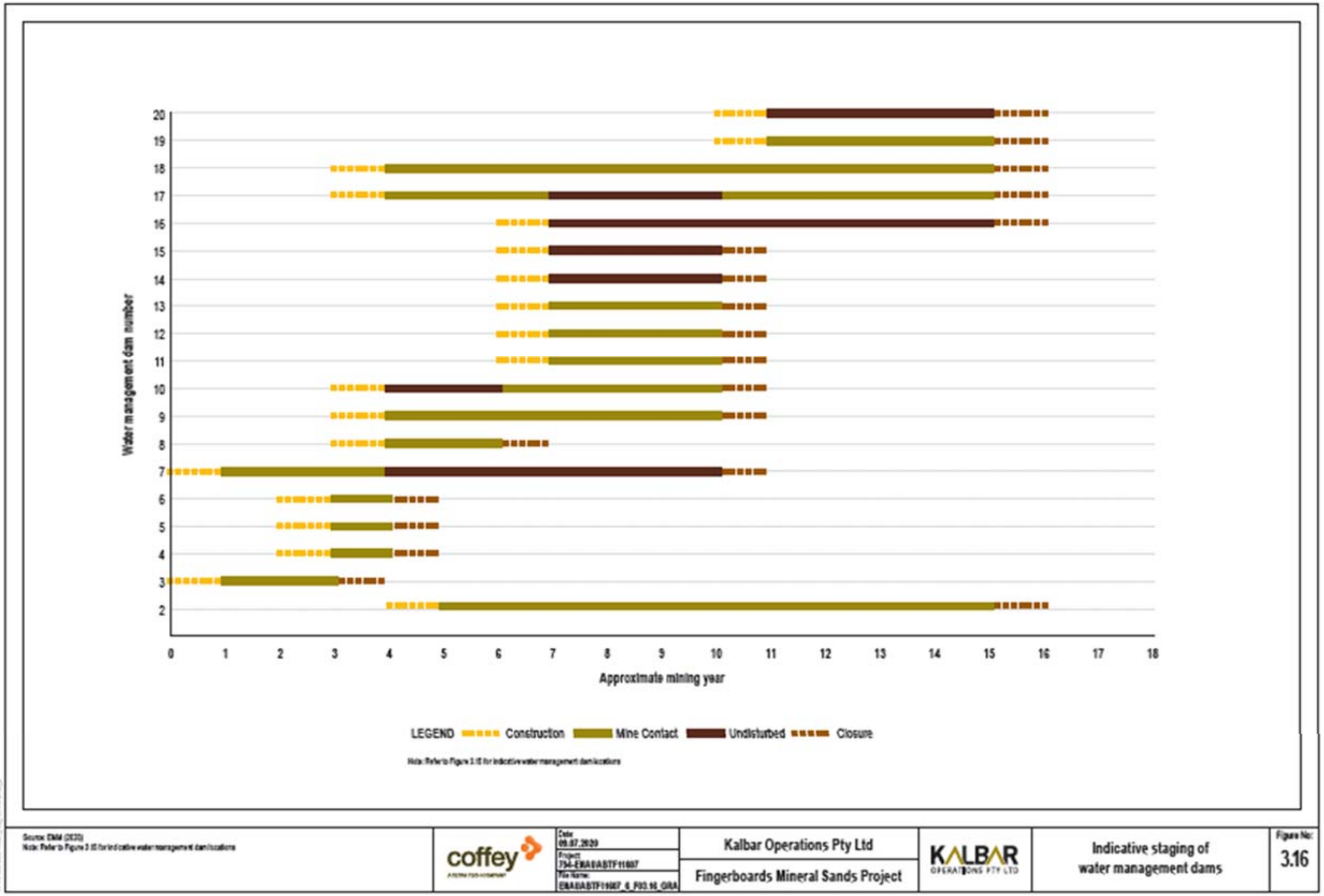
Figure 3.16 Indicative staging of water management dams



Note: Refer to Figure 3.15 for indicative water management dam locations

Source: EMM (2020)
Note: Refer to Figure 3.15 for indicative water management dam locations

Indicative staging of water management dams

~~temporary TSF or the tailings disposal areas in the~~ centrifuge plant and coarse sand tailings in the mine voids.

Water will be reused wherever possible on site. Processing does not require the use of good quality water and is not affected by pH or turbidity. Mine contact water will report to the process water circuit from dams downstream, and within, active mining areas.

3.7.3.2 Dust suppression

Dust suppression will be the other major use (after process water) of water on site during construction and operations. Water trucks will routinely spray water onto exposed areas, roads and within the mine void to suppress fugitive dust created by mobile plant and equipment movements. An estimated 400 megalitre (ML) of water per year will be used for dust suppression.

Water for dust suppression will be sourced from the process water dam and existing farm dams within the project area. The quality of process water will likely reflect the predicted quality of tailings seepage water (which is expected to be within the drinking water health criteria, with dissolved concentrations of aluminium (0.07 mg/L) and iron (0.09 mg/L) that may create aesthetic issues only, e.g., colour and/or taste).

3.7.3.3 Auxiliary water

Less than 1 ML/year of auxiliary water will be required for drinking water, ablutions and other domestic uses. This water will be pumped from the freshwater storage dam. Two package water treatment plants will provide potable water to the WCP, administration area and mining contractor’s facilities.

3.7.4 Water management

The overarching water management objective for the project is to reduce the consumption of water by the project and minimise potential environmental impacts of sourcing, storing and using water. The surface water (runoff) management objective is to minimise the impact on existing natural flows to downstream receptors and prevent the uncontrolled release of sediment-laden runoff from the mine site, where practicable. The specific water management mitigation measures to be implemented by the project are presented in sections 9.3.2.2, 9.3.3.2 and 9.3.4.2 in the surface water impact assessment section of this EES. The project will require a works approval or licence for any proposed discharge of water from site.

Water within the project area will be segregated according to its quality, as far as practicable. Water management dams will be constructed to separately manage water from undisturbed areas and areas of disturbed ground.

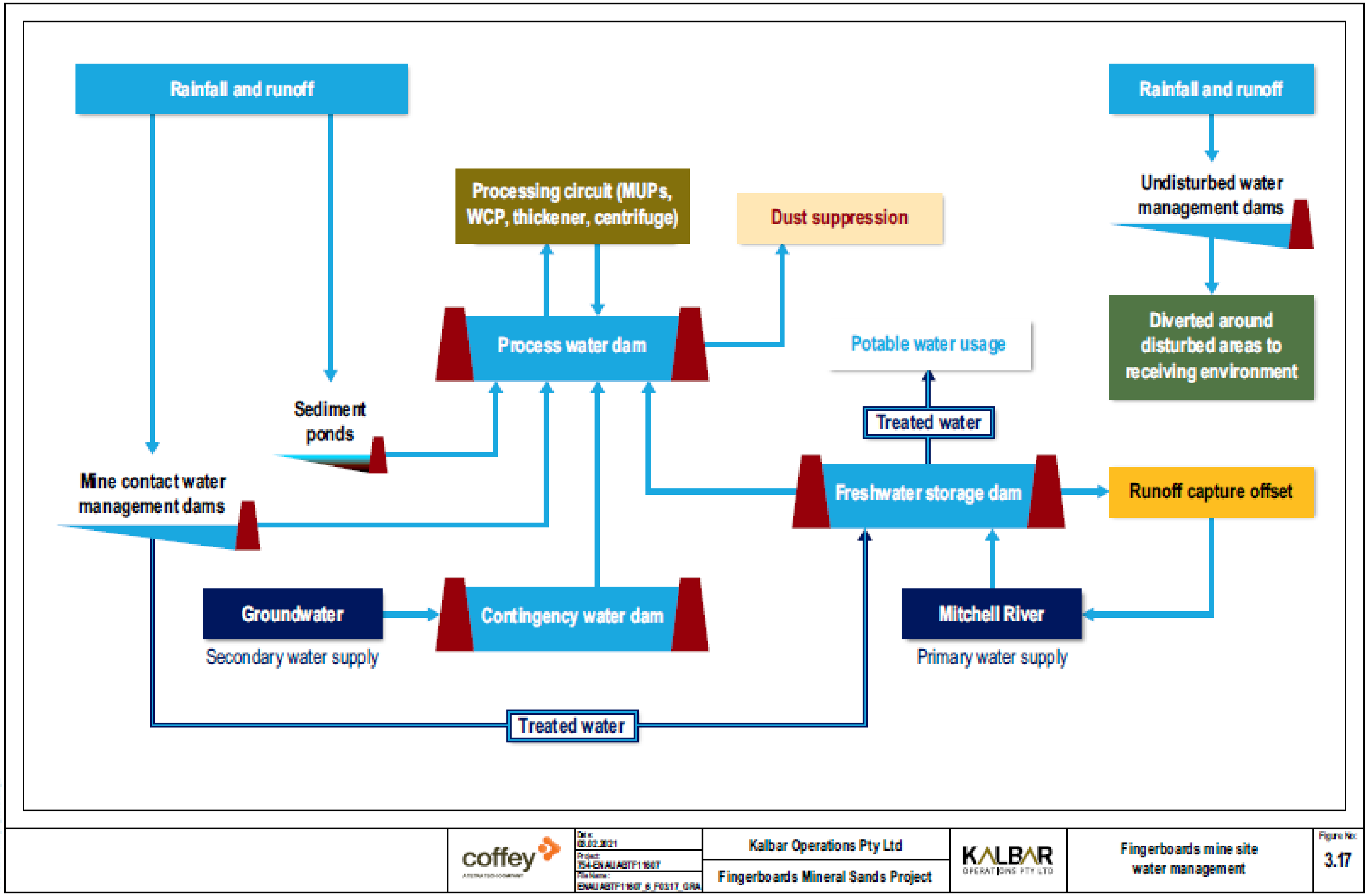
The project’s mine site water management plan is illustrated in Figure 3.17, including the sources and flow of water through the site and the relationship between different types of water management dams.

3.7.4.1 Freshwater

Water will be pumped from the Mitchell River to the freshwater storage dam and used for drinking water, firefighting (in the event of a fire) and as offset water for runoff captured on the mine site. This water will supplement the dust suppression and process water circuit.

Water in the freshwater storage dam will be discharged from the project area to offset surface water

Figure 3.17 Fingerboards mine site water management



captured onsite from disturbed areas. Water captured in water management dams in the Mitchell River catchment during the non-winterfill period (November to June) will be offset by transfers to the Mitchell River via the same pipeline used to draw water from the river during the winterfill period (at a maximum rate of 25 ML/day). Water captured in water management dams in the Perry River catchment (all year round) will be offset by discharges to the headwaters of the Perry River system upstream of the project area at a maximum rate of approximately 5 ML/day.

During most phases of mining, the water intercepted by the mine contact water dams will arise from the Mitchell River catchment. At these times, discharged treated water will only be discharged to the Mitchell River. A Works Approval Application to discharge water back to the Mitchell River is being exhibited in conjunction with this EES. Once the effective and reliable operation of the dissolved air flotation (DAF) water treatment plant (see Section 3.7.4.3) has been demonstrated during the first three years of mining, Kalbar would seek approval for a second licensed discharge point to allow treated water to flow to the Perry River system. The Perry River catchment flow will not diminish markedly from mining activity during the first nine years of operations.

Any rainfall falling or draining into the mine voids and associated mine infrastructure will be removed using sump pumps and pumped to the process water dam.

3.7.4.2 Runoff management

Rainfall runoff from undisturbed areas of the project area, clean, contributing upstream catchment areas, and completed rehabilitation areas will be diverted around active mining areas, where possible, and released to the downstream catchment. Water that cannot be diverted around active mining areas will be captured and transferred to the process water circuit. Diversions may include temporarily capturing rainfall runoff from undisturbed areas to specific water management dams to prevent it from entering active mining areas. These dams will specifically cater for runoff from undisturbed areas. The dams and collection drains will use scour-resistant materials to reduce erosion downstream of the discharge point. Water will be released from these water management dams to existing downstream flow paths via purpose-built pipelines in a controlled manner.

Sediment-laden runoff from topsoil stockpiles and minor disturbance areas will be managed via sediment ponds constructed at appropriate sites. The dams will reduce the potential for transport of soil and sediment to downstream environments. The sediment ponds will be designed in accordance with the International Erosion Control Association Australasia’s Best Practice Erosion and Sediment Control (BPESC) (IECA Australasia, 2008). ‘Type D’ sediment pond design guidelines will be adopted, and dams sized to achieve an average annual overflow frequency of two to four spills per year, with a settling zone (the area in the dam where sediment falls out of the water column) sized for rainfall from a 90th percentile, five-day rainfall event (precipitation levels which 90% of all rainfall events for a five day period do not exceed).

The objective of surface water management around disturbed areas of the mine site will be to slow water flow and direct it to primary and secondary sediment ponds. Sediment ponds will be dewatered following storm events with sediment-laden water transferred to the process water circuit using pumps fitted with flow meters.

Rainfall runoff that contacts the mine void and active mining areas (mine contact runoff) may have elevated levels of suspended solids, nutrients and/or elements. This runoff will be managed in mine contact water management dams located on drainage lines downstream (and upstream where necessary) of mining activities. Dams will be sized to capture runoff for a 1% AEP, 72-hour storm event.

Dams will be managed to allow maximum freeboard for storm events and emptied to the process water circuit as soon as practicable in anticipation of further storm events. Water will be transferred from water management dams to the process water circuit using pumps fitted with flow meters, and volumes will be recorded by Kalbar to inform licence or offset requirements.

3.7.4.3 Water treatment

The rate of rainfall runoff collecting in water management dams may exceed the capacity of the process water circuit to drain the dams. In such cases, mine contact water would be pumped to a water treatment plant so that it can be directed to the freshwater storage dam.

Surface water intercepted on the site that is not exempt from surface water licencing will be offset by the release of water from the freshwater storage dam. Intercepted water may require treatment to maintain water quality in the freshwater storage dam at levels acceptable for release to the downstream surface water environment.

A DAF water treatment plant with a nominal capacity of 24 ML/day will be constructed close to the process water dam to provide sufficient treatment capacity. Dissolved air flotation is a water treatment process that clarifies water by removing suspended solids and some chemical impurities. The separation is achieved by dissolving air into the water under pressure and then releasing the air at atmospheric pressure in a flotation tank. The released air forms tiny bubbles that adhere to the suspended solids allowing them to float to the surface of the water, where they are then removed by a skimming device. In some cases, flocculants or coagulants are added to assist the process. Dissolved air flotation is widely used in treating industrial wastewater effluent. The treatment plant will operate on days following high rainfall events, treating water to meet water quality objectives relevant to the Mitchell River. The final footprint of the plant, and details of the treatment process, will be determined by a suitably qualified water treatment engineer during detailed design.

3.7.5 Wastewater

All recoverable process water will be reused in the process water circuit. All reused water will be kept in the process water dam separate to the freshwater storage dam.

Wastewater from ablutions and the administrative offices adjacent to the WCP will be treated with a BioMAX 40EP BioMAX C40 in-ground systems on site. Sewage and wastewater from the contractor yard will be removed periodically by a licenced waste removalist operator.

The BioMAX system uses an aerobic process to treat up to 4,000 L/day of sewage. The treated effluent is clear and odourless and discharged to land through a subsurface irrigation system. The disposal area will be located near the WCP and the mining contractor’s facilities. The BioMAX system will meet EPA requirements for the treated effluent including:

- Five-day biochemical oxygen demand less than 20 milligram (mg) per litre.
- Suspended solids less than 30 mg/L.
- Faecal coliform organisms less than 10 per 100 millilitre (mL).

3.8 Infrastructure in project area

Non-mining infrastructure such as site offices and the main access roads to the mine will be located on privately owned land which is currently used as a blue gum plantation. Mining infrastructure, including mining contractor’s facilities and haul roads, will be located near the boundary of the start-up mine void north of the current Fingerboards intersection, also on private land.

The general site layout, showing the location of non-mining infrastructure, the WCP, freshwater storage dam, access roads and initial mine voids is shown in Figure 3.2.

3.8.1 Energy supply

The power demand for the MUPs and WCP is estimated at 14~~9~~,000 kilovolt-ampere (kVA) and will be supplied from the national 66 kV grid. A powerline from the 66 kV grid to the project area will be required.

The proposed alignment for power supply follows the infrastructure corridor (see Figure 3.6). This alignment will be extended for about 1 km to the southern corner of the project area, before running parallel to Limpyers Road to a sub-station. A 66 kV sub-station and transformers to lower voltages will be installed within the mine site. Power will be reticulated through and from the project area to the infrastructure options area using 22 kV powerlines. The new powerline infrastructure will resemble existing poles and cables within the landscape.

During construction, three to four 7 kVA diesel generator units will be required for the active mining areas. Fifteen 20 kVA units will be required for construction offices and ablutions until the power supply has been upgraded to the location of the WCP and initial location of the first MUP.

3.8.2 Communications

The mine site is located within an area of existing mobile phone coverage. Other communications will consist of landline telephones, internet, computer and video conferencing, and local two-way radios within the mine site area.

A telecommunication system will be installed to the mine site offices by a telecommunication company. Existing telecommunication lines and fibre optic cables may need to be realigned as the intersections with local roads and culverts are constructed.

3.8.3 Buildings and workshops

The administration area and mining contractor’s facilities will be portable structures located next to the WCP. The administration area will also contain an onsite laboratory for exploration and metallurgy testing, and quality control.

The ablutions block will include showers, toilets and change rooms for the operations workforce of approximately 200 people. The facilities will cater for peak times such as shift change-overs and maintenance shut-downs. The crib rooms will include first aid facilities, and meeting and training rooms. The ablutions block and crib rooms will be arranged in a cluster adjacent to the administration area and workshops.

3.8.4 Laydown areas

Laydown areas will be located adjacent to the administration area, the WCP, and near the contractor workshop area and active mining area. The laydown areas will be surfaced as required. Stormwater runoff from laydown areas will be captured in drains and stored in sediment ponds.

3.8.5 Lighting

The lighting proposed within the project area and the infrastructure options area will consist of three types of light sources: fixed and permanent lights, stationary work lights and vehicle headlights. These forms of lighting will be in place during all phases of the project.

Fixed and permanent lights comprise lighting installed as part of the permanent project infrastructure, for example, the WCP, main administration complex, contractor facilities, Fernbank East rail siding, equipment storage compounds and product stockpile areas. Lighting may also be required at the intersection of the main mine access road with the surrounding road network, such as the intersection of the proposed private haulage road and Fernbank-Glenaladale Road.

Stationary work lights are associated with mining activities in the area in which mining and tailings disposal is occurring. These primarily trailer-mounted lights comprise a number of directional, shielded lights mounted on a post above a small generator. In many cases, these lights would be obscured from view within mine voids or behind stockpiles.

Vehicle headlights will be mounted on working trucks, loaders and bulldozers. Vehicles operating within the project area would have headlights and hazard lights operating at all times due to occupational health and safety requirements. Much of this equipment would be operating below ground level in the mine void or within areas where bunds will be constructed to visually screen active mining areas.

3.9 Road access and transport

Access to the mine site will require upgrades to the existing road network to ensure public safety, including at key intersections. Some roads in the project area will need to be diverted to allow mining to occur.

3.9.1 Internal haul roads and access roads

On the mine site, access and haul roads will connect the mining contractor’s facilities, active mining areas and overburden stockpiles. Internal haul roads will allow mine materials to move around the mine site. Internal access roads will be used by construction and operations staff, contractors and delivery personnel, and trucks transporting concentrates from site. The internal access roads will enable the movement of mining materials around the mine site and ensure that mine traffic does not use local or public roads. The local road network will not be used for mine operations.

Internal haul roads and access roads will be unsealed and constructed using overburden and local stone material. Chemical or physical dust suppressants (for example, dustmag and magnesium chloride) will be the main form of dust control used on unsealed internal access roads. Road construction techniques and final road surfacing will vary, depending on the surface and substrate, to achieve an all-weather trafficable surface.

The roads will be wide enough to allow safe passage for haul trucks and light vehicles. Haul road design will be determined after equipment fleets are finalised and are estimated to be 20 to 30 m wide.

A heavy vehicle underpass will be constructed to provide passage beneath Bairnsdale-Dargo Road north of the existing Fingerboards intersection. Prior to mining commencing on the southern side of Bairnsdale-Dargo Road, a second heavy vehicle underpass will be constructed to allow mining equipment to access ore in the southeastern part of the mine site. Only internal mine traffic will have access to the underpasses.

3.9.2 Site access roads

Access to the mine site for vehicles will be provided via a private road adjacent to the intersection of Chettles Road and Fernbank-Glenaladale Road. A dedicated access road will be constructed in the project area from the Fernbank-Glenaladale Road. This road will run to the administration and WCP area. A remote security gate will control vehicles entering the site offices area.

The main access road is likely to be sealed from the Fernbank-Glenaladale Road intersection to the WCP and administration area. Rumble or shaker strips are likely to be installed to prevent mud tracking onto the local road network.

Concentrate transport trucks will access the site via an automatically gated entrance off Fernbank-Glenaladale Road. The trucks will leave the mine site via a sealed, private road running parallel to Chettles Road within the infrastructure corridor from the mine site to the Fernbank East rail siding (see Section 3.9.5).

3.9.3 Public roads

Public roads will need to be diverted, realigned, re-constructed and/or enhanced prior to mine commencement, during mine operations and as part of the final rehabilitation (Figure 3.18). Diversions will be conducted in consultation with East Gippsland Shire Council and VicRoads to meet the safety requirements of local road users. Section 9.8: Roads, traffic and transport of the EES provides information on potential project impacts and their management in relation to roads, traffic and transport.

Table 3.6 outlines the proposed road alignments, diversions and upgrades within the project area during key years throughout the project. No changes are proposed for Limpyers Road and Chettles Road due to potential impacts to native vegetation and public road safety issues associated with mine access.

Table 3.6 Proposed road alignment, diversions and upgrades in project area throughout key project stages

Timing	Proposed upgrades
Year 0 – Construction	• Construction of new Fingerboards roundabout 1 km south of existing Fingerboards intersection. • Partial permanent diversion of existing Bairnsdale-Dargo Road to intersect Fernbank-Glenaladale Road at the new Fingerboards roundabout. • Relocation of Fernbank-Glenaladale Road at Chettles Road to intersect Bairnsdale-Dargo Road at the new Fingerboards roundabout. • Removal of existing Fernbank-Glenaladale Road north of the new Fingerboards roundabout. • Permanent relocation of Fernbank-Glenaladale Road to intersect the existing Bairnsdale-Dargo Road 1 km north of existing Fingerboards intersection. • Construction of private haulage road parallel to Chettles Road. • Construction of heavy vehicle underpass beneath Bairnsdale-Dargo Road approximately 800 m north of existing Fingerboards intersection.
Year 1	• Diversion of Bairnsdale-Dargo Road 500 m north of the existing Fingerboards intersection.
Year 2	• Diversion of Bairnsdale-Dargo Road between the existing Fingerboards intersection and heavy vehicle underpass.

Timing	Proposed upgrades
Year 3	• Diversion of existing Careys Road to 250 m east of its current alignment.
Year 5	• Diversion of existing Bairnsdale-Dargo Road from west of the new Careys Road to the previously diverted section (see year 0). • Diversion of Bairnsdale-Dargo Road between the previously diverted section (see year 2) and the new Fingerboards roundabout. • Realignment of the new Fingerboards roundabout to include alignment with Bairnsdale-Dargo Road (see above). • Extension of new Careys Road to intersect diverted Bairnsdale-Dargo Road.
Year 8	• Reinstatement of diverted Bairnsdale-Dargo Road to original alignment between Careys Road and permanently relocated Bairnsdale-Dargo Road (see year 0).
Year 10	• Reinstatement of Careys Road to original alignment.

Each of the roads requiring treatment or upgrade are discussed below.

3.9.3.1 Bairnsdale-Dargo Road

During construction, the intersection of Bairnsdale-Dargo Road and Fernbank-Glenaladale Road will be permanently relocated 1 km south of the existing Fingerboards intersection and upgraded to a four-arm roundabout.

In year 5, a portion of Bairnsdale-Dargo Road east of Careys Road will be temporarily diverted south of the existing road alignment to form part of the new Fingerboards intersection. After year 8, the road will be partially reinstated to its original alignment between Careys Road and the new Fingerboards intersection.

The road will continue north from the new Fingerboards intersection where it intersects again with the relocated Fernbank-Glenaladale Road. Three temporary diversions will occur between the new Fingerboards roundabout and the new Fernbank-Glenaladale Road in years 1, 2 and 5.

During construction, a heavy vehicle underpass will be constructed under the road approximately 800 m north of the existing Fingerboards intersection to eliminate conflict between public road users and plant and machinery during mining operations.

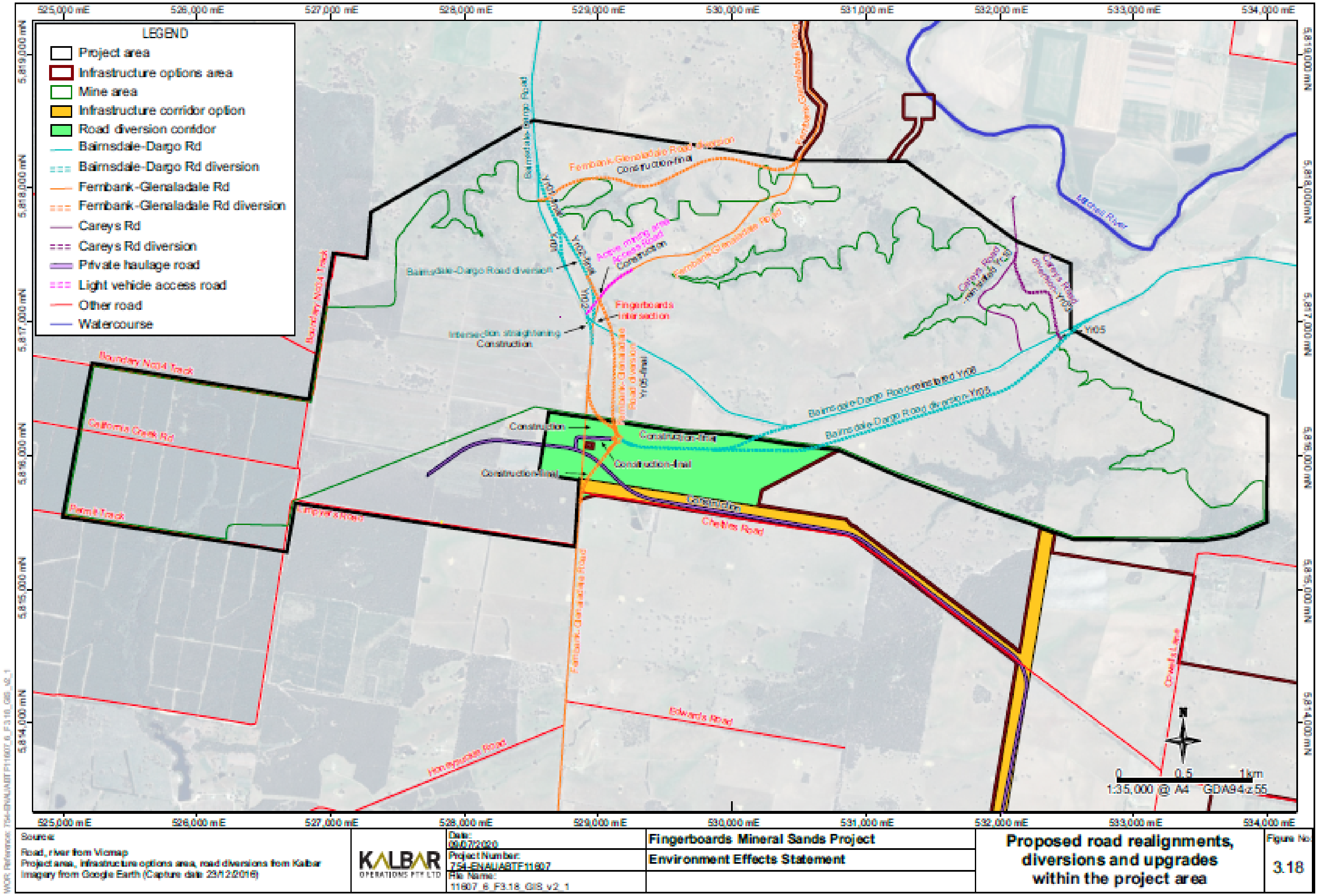
3.9.3.2 Fernbank-Glenaladale Road

During construction, the existing Fernbank-Glenaladale Road will be relocated at Chettles Road to intersect Bairnsdale-Dargo Road at the new Fingerboards roundabout. The existing Fernbank-Glenaladale Road alignment will be permanently removed and restart 1 km north of the existing Fingerboards intersection.

3.9.3.3 Careys Road

In year 3, the existing Careys Road will be temporarily diverted 250 m east of its current alignment. Following the diversion of Bairnsdale-Dargo Road in year 5, the new Careys Road will be extended to intersect the new Bairnsdale-Dargo Road alignment. Careys Road will be returned to its original alignment in year 1.

Figure 3.18 Proposed road realignments, diversions and upgrades within the project area



3.9.4 Car parking

Appropriately surfaced car parking for up to 100 light vehicles will be located adjacent to the administration and WCP area. Additional car parking will be provided at the mining contractor's facilities. The car parking area will have bus parking during the construction period for workers travelling from Bairnsdale and Sale.

3.9.5 Product handling and transport

The concentrates will be transported to port via road and rail. During operations, the project will generate approximately 40 return B-double trips per day, or 80 total B-double movements per day, comprising 40 trips from the mine site to the first delivery point and 40 trips back to the mine site.

All truck loads will be covered or containerised and vehicles will not travel in convoys. Concentrate product will be loaded into lined containers from the stockpiles at the loading facility near the WCP.

The Victorian government proposes to build a new rail bridge over the Avon River at Stratford. The bridge will be constructed on the north side of the existing rail bridge and south of the Princes Highway bridge. The bridge will improve capacity on the Gippsland Line and will allow for freight and passenger rail travel at 90 km/hr. The new bridge is due to be completed in 2021, which should be prior to the commencement of product transportation from the project.

The ability to have freight trains on the Gippsland Line allows for the HMC to be transported by rail to existing ports in Victoria. Kalbar's preferred option is to construct a purpose-built rail siding close to the project area within the infrastructure options area and to use a private haul road to access this siding from the project area. This option presents several distinct benefits over alternative transport options, namely:

- Product haulage trucks will avoid travelling on public roads resulting in a marked decrease in road accident risk.
- The haulage distances are minimised, reducing fuel consumption and greenhouse gas emissions.
- Product haulage can be achieved predominantly during day-time hours with some overflow into evening hours, thereby avoiding impacts at night such as noise to nearby communities.

The alternative to a nearby purpose-built rail siding would be to upgrade the existing rail siding in Bairnsdale. This option would involve 40 return B-double trips per day via Bairnsdale-Dargo Road, Lindenow-Glenaladale Road, Princes Highway, Racecourse Road, Forge Creek Road and Bosworth Road. This option will require truck movements to operate 24-hours-a-day, seven-days-a-week on public roads for the life of the operations to meet the product tonnage output.

Further transport alternatives were assessed in the event that the upgrading of the Avon River rail bridge was delayed. Under these alternatives, approximately half of the concentrates will be transported in bulk by road from the mine site to Port Anthony or the adjacent Barry Beach Marine Terminal. Twenty B-double trips from the mine to the port will be required, and 20 trips from the port back to the mine each day.

The remaining concentrates will be transported in containers from the project area to the existing rail siding in Maryvale. Current capacity constraints at the Maryvale siding allow for only 50% of the concentrate to be transported by rail. Twenty B-double trips will be needed from the mine to the Maryvale rail siding and 20 trips from the rail siding back to the mine each day. Containerised concentrate will be taken by rail from the Maryvale rail siding to the Port of Melbourne. Rail transport will occur overnight due to capacity restraints on the metropolitan rail network.

The most likely route to deliver bulk concentrates from the project area to Port Anthony/Barry Beach Marine Terminal will be east along Bairnsdale-Dargo Road to Lindenow-Glenaladale Road, then south along Lindenow-Glenaladale Road to the Princes Highway and then southwest along Princes Highway to Sale (Figure 3.19). From Sale, the trucks will continue south along South Gippsland Highway to Port Anthony/Barry Beach Marine Terminal on Barry Road, Agnes. All roads along this route are accredited for B-double use.

Transport of containerised concentrates to the Maryvale rail siding will be via Bairnsdale-Dargo Road to Lindenow-Glenaladale Road, then south along Lindenow-Glenaladale Road to the Princes Highway, then southwest along Princes Highway to Sale and finally west along Princes Highway to the Maryvale rail siding.

3.9.6 Port facility

Port Anthony and Barry Beach Marine Terminal are located approximately 160 km from the project area. Both facilities have adequate capacity, suitable facilities for stockpiling the concentrates and access to appropriate shipping fleets for exporting heavy minerals. No works associated with the project are expected to be required at Port Anthony or Barry Beach Marine Terminal for the export of the concentrates.

The Port of Melbourne will be the export port for concentrates transported by rail. The port has adequate capacity for containerised transport of the HMC and no project-related works are required for the export of mineral sands products from this port.

3.10 Waste management

The project will generate various non-hazardous recyclable and non-recyclable wastes and waste hydrocarbons during construction, operations and closure.

3.10.1 Solid waste

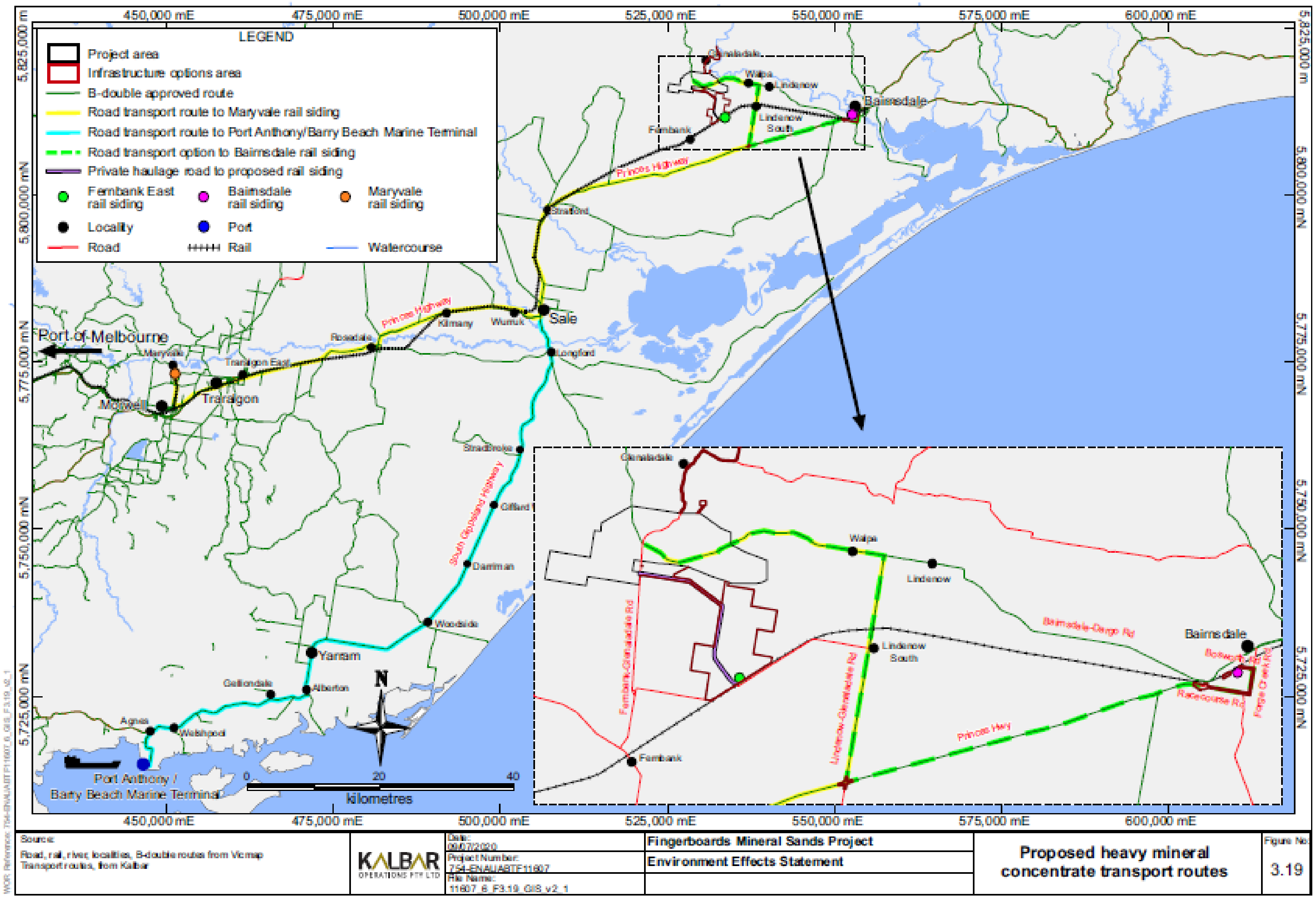
All non-toxic waste (including perishable and inert waste) will be securely stored in appropriate receptacles. Waste management facilities will allow waste to be segregated into streams that reflect the waste management principles of avoid, reduce, reuse, recycle and proper disposal.

All solid waste will be removed from the project area and disposed of by licensed contractors in accordance with Environment Protection Authority (EPA) requirements. Bins will be located where food is consumed to keep the project area tidy and free of litter. Recyclable materials (such as aluminium cans, glass and recyclable plastics) will be collected and sent to a licensed recycler by a licensed waste contractor. All receptacles for solid waste storage will be located near the WCP.

Processing plants (MUPs, centrifuge building and WCP) will be modular in design and assembled offsite. This approach will reduce the volume of construction waste generated onsite. Construction waste will include scrap steel, timber, packaging, domestic garbage, and concrete which will be reused and recycled where possible. The construction and operation workforce are estimated to generate approximately 30 t of domestic waste annually.

The design of infrastructure for the proposed mine will consider environmentally sustainable approaches to minimising waste generation and waste disposal requirements.

Figure 3.19 Proposed heavy mineral concentrate transport routes



3.10.2 Waste hydrocarbons

Operation of the mining fleet and mobile plant and equipment will generate waste hydrocarbons such as oils, greases and hydraulic fluids. This waste will be stored in suitable containers for removal from the mine site for disposal at either a hydrocarbon waste site approved by the Victorian EPA or an approved recycling depot.

Runoff water from mobile equipment service areas, fuel storage areas and the mining contractor's facilities will be directed to an interceptor trap to extract hydrocarbons, prior to it being discharged to the drain and sump network. The trap will be emptied of hydrocarbons routinely by a licensed contractor for disposal at a licensed facility.

A refuelling facility for vehicles and plant will be located at the mining contractor's facilities and will be bunded and serviced by a triple interceptor trap. The water from this inceptor would then go to an oil and water separator.

3.11 Hazardous materials management

No chemicals will be used in the processing of mineral sands ore to produce the magnetic and non-magnetic heavy mineral concentrates, except for flocculant. A fuel storage area (fuel farm) will be established at the mining contractor's facilities to supply all heavy and light vehicles with fuel. Other hazardous materials expected to be used on site include acetylene, compressed oxygen, oil and grease, and lime. Floccula~~e~~nt will also be used on site to manage water quality, and agricultural fertilisers and soil conditioners will be used in the rehabilitation process.

All hazardous materials will be stored, transported and managed in accordance with the appropriate safety data sheets. Inappropriate storage and handling of hazardous materials increases the risk of spills and generation of hazardous wastes for disposal. No hazardous materials will be brought to site without the appropriate approval of the construction manager or mine manager.

Management of hazardous materials is discussed further in Chapter 12: Environmental management framework.

3.11.1 Storage

All hazardous materials will be stored in designated areas. Bunding around areas of hazardous materials storage will be designed and constructed to ensure hazardous materials are suitably contained in the event of a spill. The capacity (bund height), storage, stormwater control and maintenance, and operation of bunded areas will comply with EPA bunding guidelines (EPA Victoria, 2015), including vehicles operating in bunded areas. Bunding for the fuel storage area will be in accordance with Australian Standard (AS) 1940:2004 (AS, 2004).

Bunded areas will not be located near a watercourse or the freshwater storage dam.

3.11.2 Transport

Hazardous materials will be transported in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (NTC, 2017). A transport procedure will be developed and implemented for the mine. Transport of these materials will, in most cases, be the responsibility of contractors.

3.11.3 Handling

The classification, packaging, labelling and safe transport of hazardous materials will be the responsibility of the manufacturers, suppliers and transport contractors. All contractors and suppliers will be required to comply with all relevant statutory requirements including Dangerous Goods (Storage and Handling) (Victorian State Government, 2000), AS 1940:2004 (AS, 2004) and safety data sheets. When necessary, Kalbar will seek advice from appropriate authorities or manufacturers.

3.12 Workforce

Kalbar aims to employ local people in the construction and operation of the project.

3.12.1 Personnel

Kalbar will appoint a contractor to execute the construction phase of the project. The onsite and offsite construction workforce is estimated to be up to 200 people (with a maximum daily workforce of up to 130 people expected on site) and will include approximately 10 Kalbar staff. Workforce numbers will vary throughout the different stages of construction. Where possible, construction workers will be employed from the local area.

The operations workforce is likely to consist of about 200 people. Kalbar expects to source most of the workforce locally, with the opportunity to train personnel once the mine is operational. Specialist skills and previous experience are required for positions such as mine manager, mining and metallurgical engineers, geologist and environment, health and safety personnel. These roles are likely to be sourced from both within and outside the local area. Around half the workforce will be contractors associated with mining activities and the transport of concentrates.

Scheduled maintenance and shutdown activities may require additional contractors during operations. No onsite accommodation is needed for these contractors. Depending upon the nature of the activities, up to 35 additional contractors may be required during maintenance and shutdown periods.

Construction and operations hours will be 24-hours-a-day, seven-days-a-week. The construction and operations workforce will work across two 12-hour shifts, typically 6:00 a.m. to 6:00 p.m. and 6:00 p.m. to 6:00 a.m.

3.12.2 Accommodation

Adequate accommodation is expected to be available in nearby towns (Stratford, Sale and Bairnsdale) for non-local construction workers and no construction camp will be required. Contractors and employees may be transported by bus from neighbouring towns to the mine site, which will reduce road traffic and the area required for vehicle parking.

3.12.3 Safety management

Prior to project commencement, Kalbar will develop and implement a project-specific environmental, health, safety, and community (EHSC) management system. The system will set out the requirements for Kalbar and its contractors, including for implementing specific EHSC policies, standards and guidelines.

All contractors, staff and visitors will require site inductions and training prior to working on site to ensure they are familiar with and comply with the management system and associated standards. All incidents will be reported and acted upon by site management.

3.12.4 Site security

During construction, access to the site will be controlled via a security gate house located on the access road from Fernbank-Glenaladale Road. A second security post may be established to the north of Bairnsdale-Dargo Road during construction of the mining contractor’s facilities and heavy vehicle underpass.

During operations, assets that require security will be fenced to prevent unauthorised access. The premises will be sign-posted, and remote security gates will prevent unauthorised vehicle access to the administration and WCP area, the mining contractor’s facilities and the active mining area. Visitors will always be accompanied by an authorised company representative.