EXCAVATION MANAGEMANT PLAN ATTACHMENTS

Proposed Hard Rock Quarry

Lot 800 Pruden Road, Whitby

Italia Stone Group

ATTACHMENTS PART 2 - 2

July 2016

Address Manager
Italia Stone Group
55 Miguel Road,
Bibra Lake WA 6163

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ATTACHMENT 1

OVERVIEW OF GEOTECHNICAL FACTORS AND PIT DESIGN

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OVERVIEW OF THE GEOTECHNICS AND DESIGN PROPOSED HARD ROCK QUARRY LOT 800 PRUDEN ROAD, WHITBY

1.0 Geology

Regional Setting

Lot 800 lies on the western side of the Yilgarn Plateau just back from the edge of the Darling Scarp, but protected by a spur running north south.

The location of the pit and operations has been selected to be behind a small spur, which will be raised in elevation by the formation of bunding and dense tree planting.

The Darling Scarp plateau at this point consists of portion of dissected Darling Scarp drained by Manjedal Brook to the north, which drains to the Swan Coastal Plain.

The pit is located on the brow of the Darling Scarp, rising from 105 metres at the western edge of Lot 800 to over 225 metres on the eastern side of Lot 800.

The pit and processing area are located on the southern valley side of Manjedal Brook and face north into the hill occupied by the WA Bluemetal hard rock quarry.

Geology – Geomorphology

The quarry site was examined geologically by Lindsay Stephens of landform Research who also designed the pit.

The rock of the quarry forms the western edge of the Western Gneiss Terrane just east from the Darling Fault, which separates the older eastern hard rock from the deep sediments of the Perth Basin.

The younger Proterozoic aged Cardup Group of sediments occur just west of the pit but do not outcrop. These are steeply dipping shales and sandstones that dip west but are not exposed on site.

A small west trending fault is interpreted to cut the Scarp at this point and has resulted in the development of the small valley along which Manjedal Brook runs. The fault appears to have slightly shifted the rock sequences west, north of the fault and matches faults mapped by the WA Geological Survey.

Another fracture or structure intruded by a dolerite dyke appears to run north along the western side of the proposed pit, where the rock appears softer and more weathered. This rock is proposed to be cut out to form the flat processing area and bunding, providing for an easier commencement.

The geology can be seen in Western Australian Geological Survey mapping, for example the 1 : 50 000 Perth and Environs Mapping Serpentine Sheet.

The pit is wholely located within the Gneiss Terrane. The rock in the pit is felsic to intermediate granite with some gneissic materials and lineations, which have been intruded by some minor quartz and pegmatite veins and granites with minor diorite/dolerite dykes.

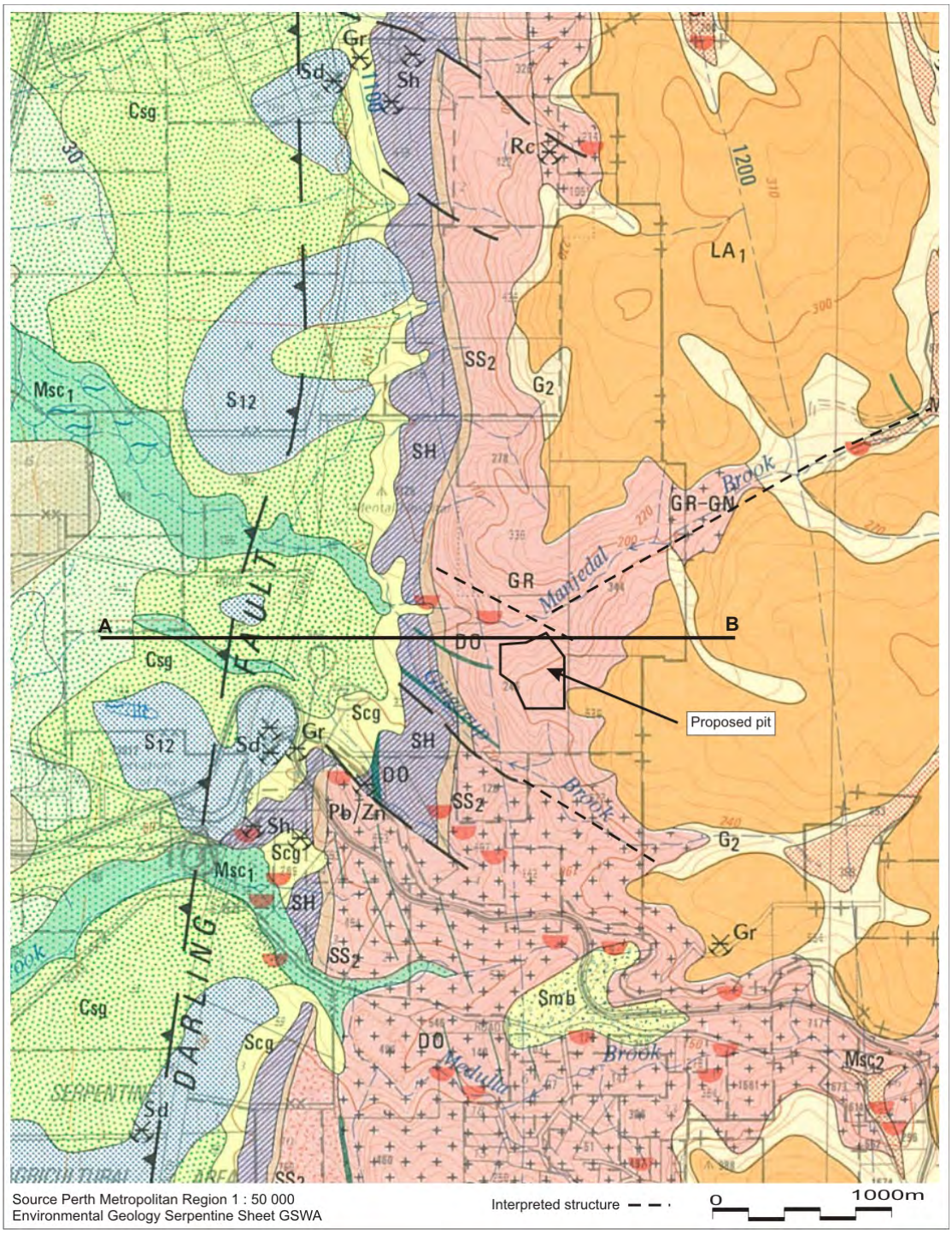
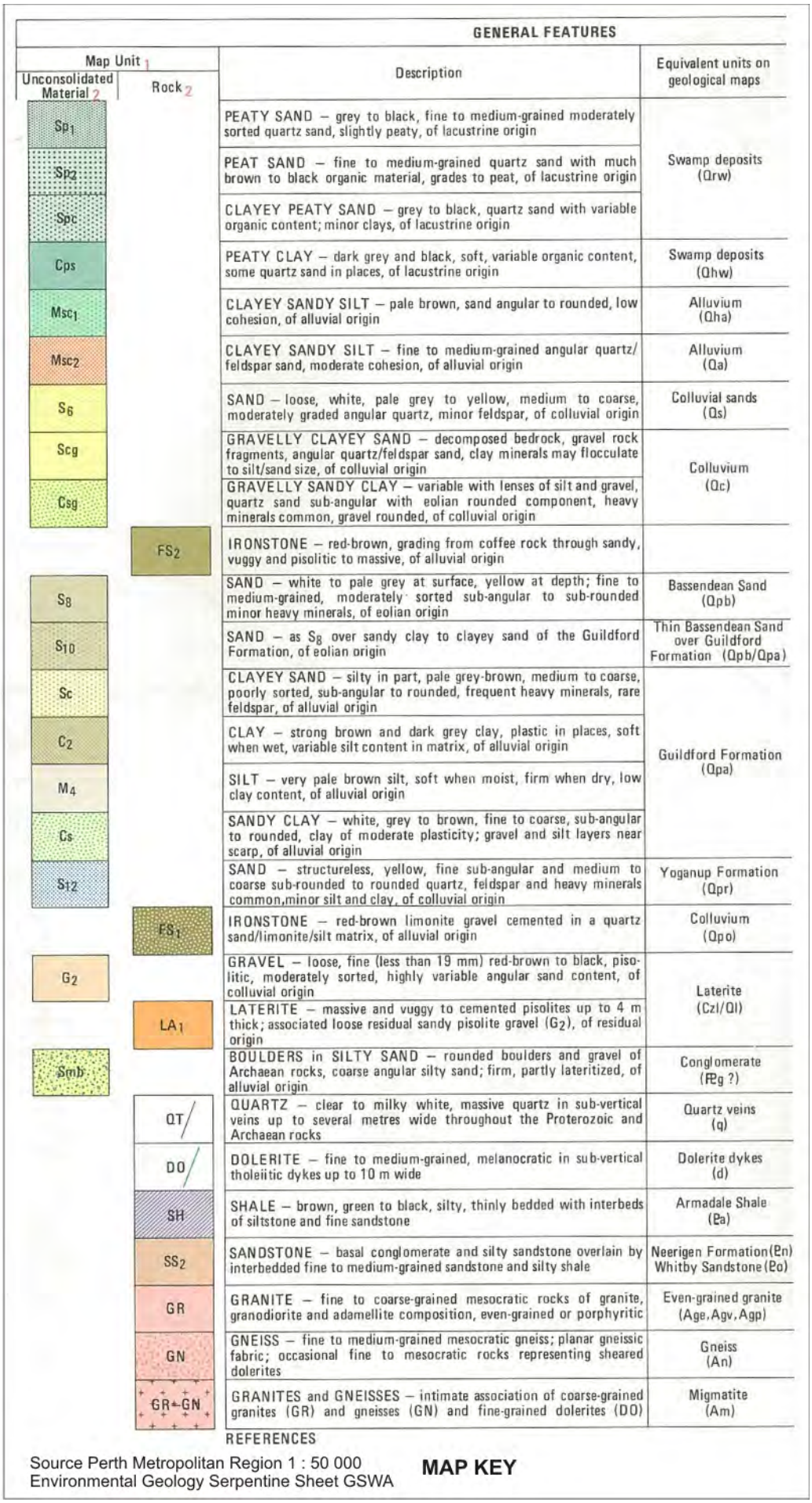


Figure 1 – 1 Geological map of the proposed pit

- The Key to the map follows on the next page



GENERAL FEATURES		
Map Unit 1 — Unconsolidated Material 2 / Rock 2	Description	Equivalent units on geological maps
Sp_1	PEATY SAND – grey to black, fine to medium-grained moderately sorted quartz sand, slightly peaty, of lacustrine origin	Swamp deposits (Qrw)
Sp_2	PEAT SAND – fine to medium-grained quartz sand with much brown to black organic material, grades to peat, of lacustrine origin	
Spc	CLAYEY PEATY SAND – grey to black, quartz sand with variable organic content; minor clays, of lacustrine origin	
Cps	PEATY CLAY – dark grey and black, soft, variable organic content, some quartz sand in places, of lacustrine origin	Swamp deposits (Qhw)
Msc_1	CLAYEY SANDY SILT – pale brown, sand angular to rounded, low cohesion, of alluvial origin	Alluvium (Qha)
Msc_2	CLAYEY SANDY SILT – fine to medium-grained angular quartz/feldspar sand, moderate cohesion, of alluvial origin	Alluvium (Qa)
S_6	SAND – loose, white, pale grey to yellow, medium to coarse, moderately graded angular quartz, minor feldspar, of colluvial origin	Colluvial sands (Qs)
Scg	GRAVELLY CLAYEY SAND – decomposed bedrock, gravel rock fragments, angular quartz/feldspar sand, clay minerals may flocculate to silt/sand size, of colluvial origin	Colluvium (Qc)
Csg	GRAVELLY SANDY CLAY – variable with lenses of silt and gravel, quartz sand sub-angular with eolian rounded component, heavy minerals common, gravel rounded, of colluvial origin	
FS_2	IRONSTONE – red-brown, grading from coffee rock through sandy, vuggy and pisolitic to massive, of alluvial origin	
S_8	SAND – white to pale grey at surface, yellow at depth; fine to medium-grained, moderately sorted sub-angular to sub-rounded minor heavy minerals, of eolian origin	Bassendean Sand (Qpb)
S_{10}	SAND – as S_8 over sandy clay to clayey sand of the Guildford Formation, of eolian origin	Thin Bassendean Sand over Guildford Formation (Qpb/Qpa)
Sc	CLAYEY SAND – silty in part, pale grey-brown, medium to coarse, poorly sorted, sub-angular to rounded, frequent heavy minerals, rare feldspar, of alluvial origin	Guildford Formation (Qpa)
C_2	CLAY – strong brown and dark grey clay, plastic in places, soft when wet, variable silt content in matrix, of alluvial origin	
M_4	SILT – very pale brown silt, soft when moist, firm when dry, low clay content, of alluvial origin	
Cs	SANDY CLAY – white, grey to brown, fine to coarse, sub-angular to rounded, clay of moderate plasticity; gravel and silt layers near scarp, of alluvial origin	
S_{12}	SAND – structureless, yellow, fine sub-angular and medium to coarse sub-rounded to rounded quartz, feldspar and heavy minerals common, minor silt and clay, of colluvial origin	Yoganup Formation (Qpr)
FS_1	IRONSTONE – red-brown limonite gravel cemented in a quartz sand/limonite/silt matrix, of alluvial origin	Colluvium (Qpo)
G_2	GRAVEL – loose, fine (less than 19 mm) red-brown to black, pisolitic, moderately sorted, highly variable angular sand content, of colluvial origin	Laterite (Czl/Ql)
LA_1	LATERITE – massive and vuggy to cemented pisolites up to 4 m thick; associated loose residual sandy pisolite gravel (G_2), of residual origin	
Smb	BOULDERS in SILTY SAND – rounded boulders and gravel of Archaean rocks, coarse angular silty sand; firm, partly lateritized, of alluvial origin	Conglomerate (Pg ?)
QT	QUARTZ – clear to milky white, massive quartz in sub-vertical veins up to several metres wide throughout the Proterozoic and Archaean rocks	Quartz veins (q)
DO	DOLERITE – fine to medium-grained, melanocratic in sub-vertical tholeiitic dykes up to 10 m wide	Dolerite dykes (d)
SH	SHALE – brown, green to black, silty, thinly bedded with interbeds of siltstone and fine sandstone	Armadale Shale (Pa)
SS_2	SANDSTONE – basal conglomerate and silty sandstone overlain by interbedded fine to medium-grained sandstone and silty shale	Neerigen Formation (Pn) Whitby Sandstone (Po)
GR	GRANITE – fine to coarse-grained mesocratic rocks of granite, granodiorite and adamellite composition, even-grained or porphyritic	Even-grained granite (Age, Agv, Agp)
GN	GNEISS – fine to medium-grained mesocratic gneiss; planar gneissic fabric; occasional fine to mesocratic rocks representing sheared dolerites	Gneiss (An)
GR+GN	GRANITES and GNEISSES – intimate association of coarse-grained granites (GR) and gneisses (GN) and fine-grained dolerites (DO)	Migmatite (Am)

REFERENCES

Source Perth Metropolitan Region 1 : 50 000
Environmental Geology Serpentine Sheet GSWA

MAP KEY

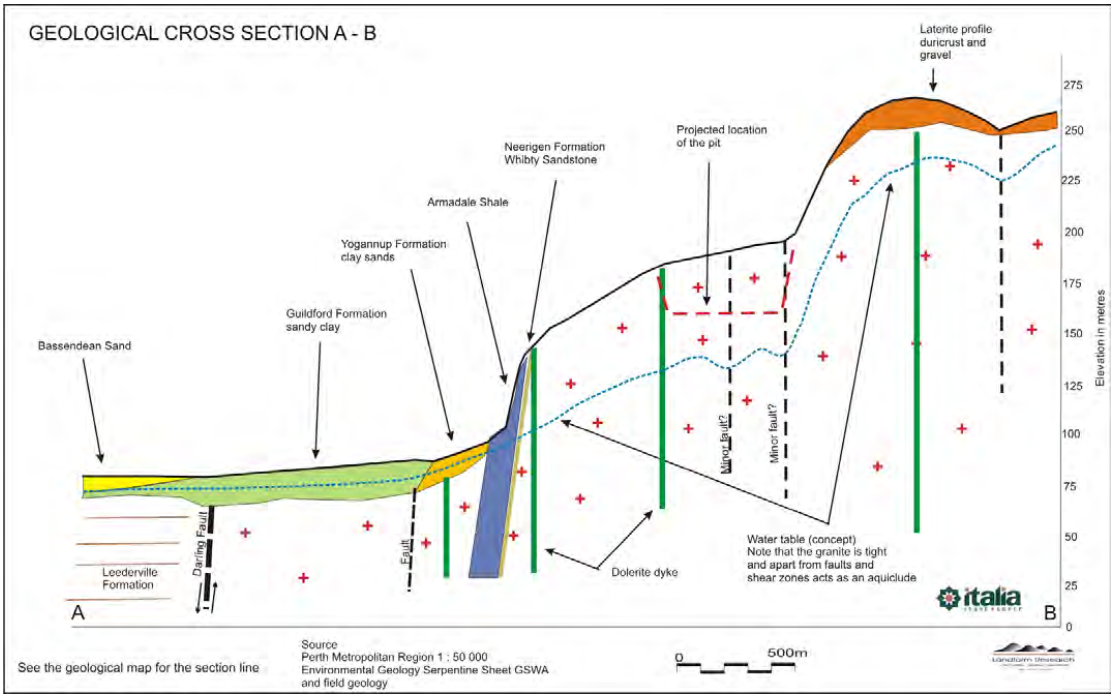


Figure 1 – 2 Geological cross section

The grainsize is relatively even coarse grained granitic rocks consisting of mixtures of granite adamellite and granodiorite that have been slightly stressed and gneissic in places.

Jointing is well spaced as shown in the outcrop patterns.

The rock has high strength and is unweathered apart from minor depths of weathering on the upper surface under the subsoils and minor weathering along fractures and the more exposed joints.

From an examination of the extensive outcrop there is no evidence of significant shearing or retrograde metamorphism that would lead to the formation of asbestiform minerals, and no evidence of such minerals was recorded.

Rock encountered in both the Hanson Byford and WA Bluemetal Pits, is anticipated because the proposed pit lies within the same geological setting.

The lithological strike is generally north. The rock has some gneissosity, aligned generally along the alignment of the Darling Fault.

Some small cross cutting north west trending faults occur, such as the alignment of Ginganup Gully and also appear to cross Manjedal Brook, with a structural alignment, probably fault, determining the location of Manjedal Brook with the intersection of the faults at the quarry site, leaving strong rock to form the small waterfall to the north west.

Figure 1 – 3 Overview of the granitic source rock

Figure 1 – 4 Granite outcrop showing the even nature of the rock and wide jointing

Figure 1 – 5 Granitic mixed rock with gneiss and granite intermixing

Figure 1 – 6 Dolerite dyke that is weathered

2.0 Pit Design

Pit Summary

All operations on a quarry fall under the requirements of the *Mines Safety and Inspection Act 1994*, which determines the nature of the excavation, operations, faces, vehicles and all operational procedures. All designs and operations will comply with the Act.

A Registered Quarry Manager must be either on site or within easy reach of site and all work is under the supervision of that manager. The operations will be registered under the SRS safety system of the Department of Mines and Petroleum.

Like all operating mines and quarries, officers from the Department of Mines and Petroleum will inspect the site regularly to ensure compliance with the *Mines Safety and Inspection Act 1994*. The design of the pit is summarised below. The figures attached to the main report should be consulted in relation to the location and design of the pit.

The speed at which the pit progresses will depend on the contracts won.

The staging is therefore not certain at this stage, but it is anticipated that 50 000 – 100 000 tonnes of product per year will be extracted initially, rising to 200 000 tonnes.

The design of the pit means that no daylighting through a ridge is possible.

The topmost bench will be made safe by laying back the face and using overburden to provide a substrate for rehabilitation.

As each bench is opened the batter slopes of any completed preceding stage will, when practicable, be rehabilitated depending on future land use, apart from working access roads and active floor and potentially benches. See Appendix 5.

At this stage the pit is anticipated to have a life to 2080 if all stages are excavated.

The eastern upper face will be 40 metres from the eastern boundary and provided with a safety bund and slopes that are safe, sustainable and compatible with the *"Guidelines on Safety Bund walls around Abandoned Open Pits",* January 1997. The 40 metre setback is sufficient to provide for an access track signage and water drainage to prevent water from entering the pit.

The safety bund will be extended around the remainder of the pit at the edge of the first stage of excavation. When the pit is expanded in the future stage the perimeter bunding will be relocated.

A 4 metre high screening bund will be located along the western boundary. See the attached quarry plan and existing contour plan

The backfill will provide a substrate for seeding. This method is most commonly used even in the large hard rock quarries in the south west of Western Australia.

For the sound rock, final slopes of up to 45 degrees, when combined with a small bench and bund at the toe, will be stable. Any backfill will be stable when placed at a stable face and bench as is completed at all hard rock quarries in the south west of Western Australia.

The proposed faces and benches will be stable and can be operated safely in compliance with DMP Guidelines. The concept and proposed benches are shown as attached in the Mining Proposal. The methods of rehabilitation are to leave the faces and benches generally in place and provide backfill to the benches to enable rehabilitation to local native vegetation, particularly trees.

Design of the pit will be to best practice, such as Read and Stacey, 2009, *Guidelines for Open Pit Design*, CSIRO Publishing and Beale and Read, 2013, *Guidelines for Evaluating Water in Pit Slope Stability*, CSIRO Publishing.

At this stage concept benches and faces can be provided, but may need to be adjusted as the rock is drilled, blasted and exposed depending on the nature of the rock, any encountered faults or shearing.

Proposed Operational Plant

The operational plant is likely to be as below, but will change as more modern plant becomes available or in response to the rock as exposed during operations.

- Track mounted percussion drill and compressor.
- 20 tonne excavator or similar.
- Rubber tyred loader
- 35 – 50 tonne off-road dump truck for internal transport of rock from the pit to the crusher.
- 20 tonne water truck or similar for dust suppression.
- Self contained maintenance vehicle to attend site as required.
- Mobile primary, secondary and tertiary crushers with related screens and conveyor belts. These will be moved across the site as excavation progresses.

Figure 1 – 7 Typical smaller quarry with similar operational plant to that proposed

Pit Design and Access

A series of benches will be formed rising from the north western corner to the south east. These are anticipated to be 15 metres apart at elevations with a floor elevation of 155 metres AHD and benches of 165, 180, 195 and 210 metres AHD.

The height of the benches may change once the real nature of the rock at depth is uncovered or if different operational plant is used. The benches will be a minimum of 15 metres wide or wider depending on the size of the operational plant.

All benches will be installed with perimeter safety bunds of rock or other approved materials. A haul road is proposed to be located along the western side of the pit behind the screening bund to provide maximum noise and visual screening. The haul road is proposed to have a gradient of no more than 1 : 10 vertical to horizontal or 10%. The width of the haul road will depend on the size of the haul truck used, but is anticipated to be a single lane road as only one haul truck is proposed to be run.

Width of the haul road will depend on the width of the haul truck but is anticipated to be 15 to 20 metres wide, installed with perimeter rock bunding. With the curves proposed, sight lines will be good with no blind spots or ramps.

UHF radio will be required in all vehicles as will normal health and safety guidelines and procedures such as flashing lights, elevated flags, low frequency reversing beepers and the like.

The nature of the pit design means that there will be very little opportunity for vehicles to be out of sight of each other.

The haul road will be separated from the road truck access and there will be no requirement for the two types of traffic to cross.

The haul road will go directly to the processing area which is to be located in the north west corner of the pit to maximize noise screeening.

Water Management

Contour banks and drains on the sloping weathered material retain water and reduce the potential for erosion. Bunding or a drain at the base of the slopes of unweathered material capture any materials that wash from the banks.

Cut off drains or bunds will be used above the face to ensure stormwater does not flow into the pit or erode the dumped materials.

Water used in the pit and the processing areas for product washing and dust suppression will be sourced from the sumps to be constructed adjacent to the processing area. This is the same method used by other hard rock quarries on the Darling Scarp.

This water, when used on the hardstand areas, will drain to a drainage system of two sumps/detention basins with a capacity of around 5 000 kL each. This will reduce the total volumes of water required and maintain the efficiency of production and environmental management.

That gives a volume of 10 000 kL with the contingency later of additional storage in the pit floor as the pit is enlarged. The volume of the sumps complies with Department of Water guidelines to retain a 1 in 10 year 2 hour rainfall event on site. The rainfall intensity is 20 mm per hour or 40 mm total.

A sump will be located in the base of the pit and when the pit footprint increases the pit will also provide water storage of at least 5 000 kL.

The sumps will be left in place at the end of excavation to provide long term water management and naturalised with local native vegetation.

See Attachment 2 for details of the water management on site.

Proposed Final Contours

These are in concept at this stage but will have a final slope of 1 : 2 to 1 : 3 depending on the strength of the rock.

If any areas of weathered rock are encountered those areas will be laid back at 1 : 3 in compliance with the normal Guidelines for slope stability.

The excavated faces will be laid back to within 40 metres of the eastern boundary and provided with a safety bund and slopes that are safe, sustainable and compatible with the *"Guidelines on Safety Bund walls around Abandoned Open Pits",* January 1997 and best practice such as Read and Stacey, 2009, *Guidelines for Open Pit Design*, CSIRO Publishing and Beale and Read, 2013, *Guidelines for Evaluating Water in Pit Slope Stability*, CSIRO Publishing.

Contour banks and drains on the sloping weathered material retain water and reduce the potential for erosion. Bunding or a drain at the base of the slopes of unweathered material capture any materials that wash from the banks.

The backfill will provide a substrate for seeding. This method is most commonly used even in the large hard rock quarries in the south west of Western Australia.

For the sound rock, final slopes of up to 45 degrees, when combined with a small bench and bund at the toe, will be stable. Any backfill will be stable when placed at a stable face and bench as is completed at all hard rock quarries in the south west of Western Australia.

These are the same methods used by Italia Stone Group (Roadstone) for closure of the Esperance Quarry for which the excavation and subsequent rehabilitation of the quarry led to Roadstone being a joint winner of the State Golden Gecko Award for Environmental Excellence, and the State and National, Case Earth Awards for best practice and innovation in Environmental Management of civil construction.

The proposed excavation and rehabilitation complies with DMP Guidelines for the closure of hard rock quarries.

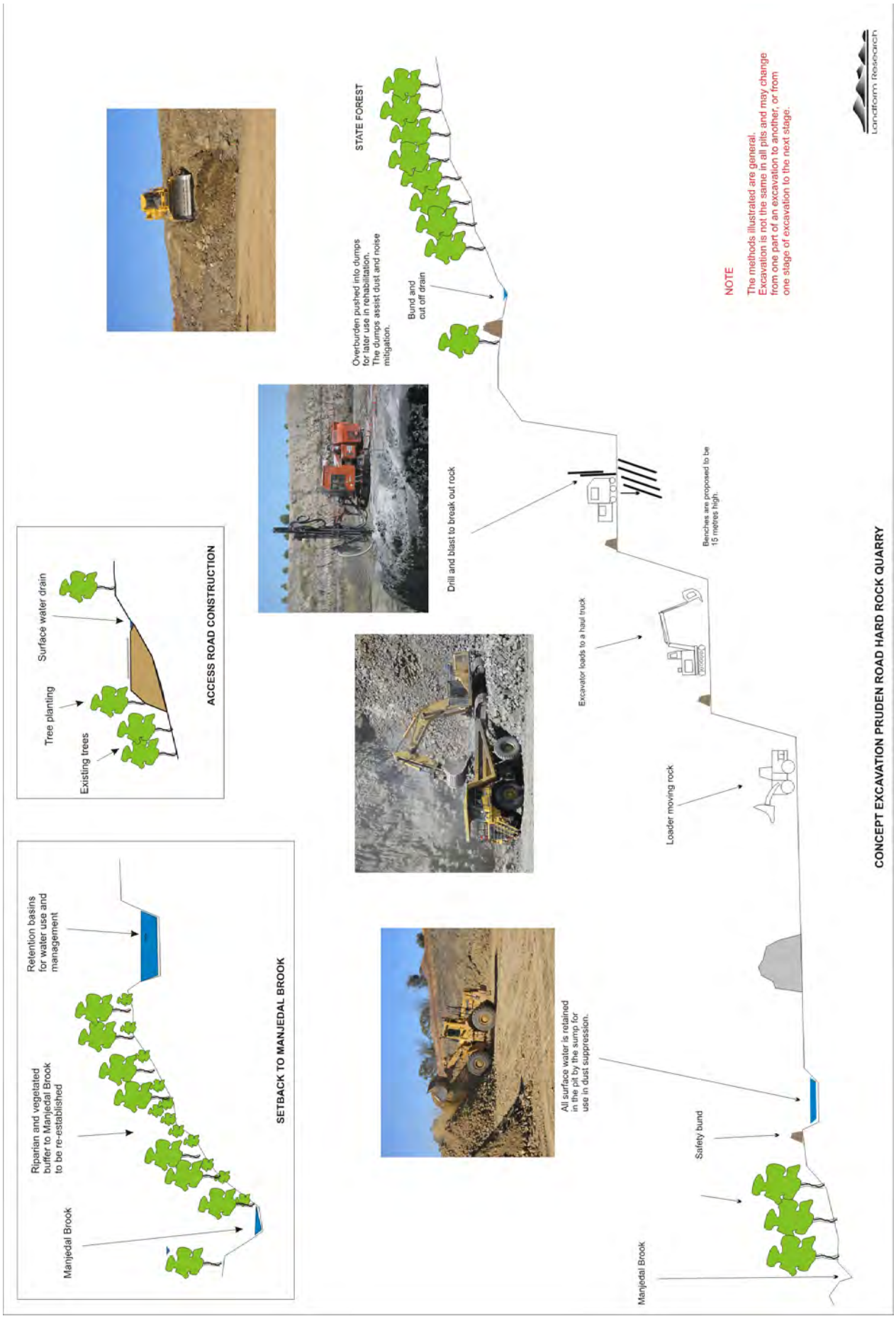


Figure 1 – 8 Concept and sketch section of pit operations

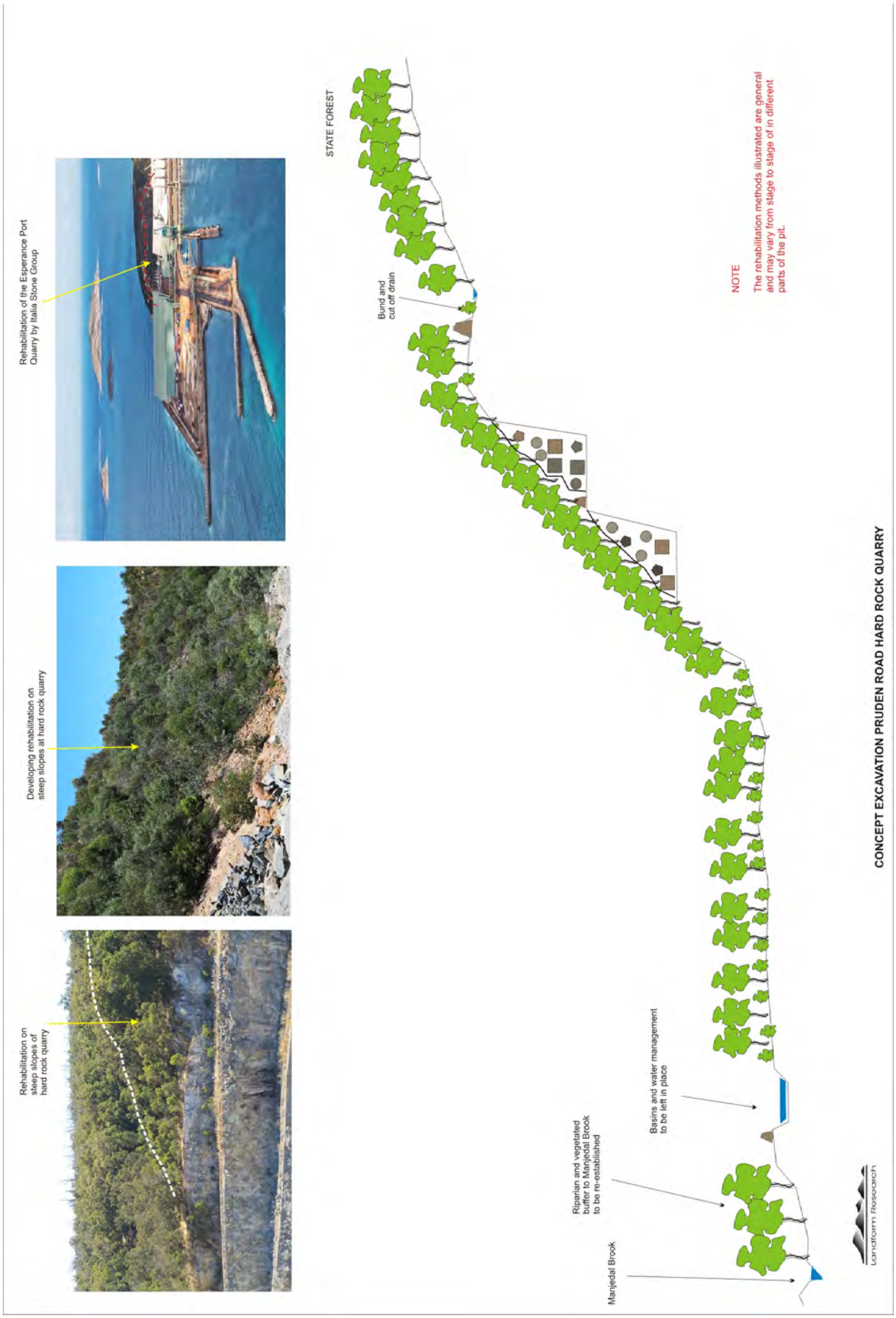


Figure 1 – 9 Concept and sketch rehabilitation

ATTACHMENTS

Figure 1 – 10 Existing Contour Plan

Figure 1 – 11 Final Contour Plan

Manjedal Brook

5 000 kL capacity

5 000 kL capacity

STAGE 1
CONSTRUCTION YEARS 2017

155 m STOCKPILE AREA

155 m CRUSHING
AREA

165 BENCH

STAGE 1
CONSTRUCTION YEARS 2017

STAGE 1
CONSTRUCTION YEARS 2017

180m BENCH

HAUL ROAD

STAGE 2
YEARS 2017 - 2030

STAGE 2
YEARS 2017 - 2030

195 m BENCH

HAUL ROAD

210 m BENCH

STAGE 3
YEARS 2030 - 2050

REHABILITATION
IN FIRST YEARS

225 m BENCH

40 METRE SETBACK WITH SAFETY BUNDING, ACCESS AND FENCES

4 METRE HIGH SCREENING BUND,
PLANTED TO TALL TREES

4 METRE HIGH SCREENING BUND,
PLANTED TO TALL TREES

Dwelling

Shed

Shed

Rainwater tanks

FUTURE STAGE 3
YEARS 2050 - 2080

ITALIA STONE GROUP	
EXISTING CONTOUR PLAN	
PROPOSED HARD ROCK QUARRY LOT 800 PRUDEN ROAD, WHITBY	
Landform Research	August 2016

Figure 1 - 10

0 200m

Manjedal Brook

RE-ESTABLISHMENT OF RIPARIAN AND CREEKLINE VEGETATION WITHIN THE FIRST THREE YEARS OF OPERATION

RE-ESTABLISHMENT OF RIPARIAN AND CREEKLINE VEGETATION WITHIN THE FIRST THREE YEARS OF OPERATION

5 000 kL capacity

5 000 kL capacity

DRAINAGE SYSTEM TO REMAIN IN PLACE

4 METRE HIGH SCREENING BUND, PLANTED TO TALL TREES TO BE ESTABLISHED PRIOR TO VOMMENCEMENT

4 METRE HIGH SCREENING BUND, PLANTED TO TALL TREES

REHABILITATION TO LOCAL NATIVE HABITAT OF TREES AND SHRUBS MATCHED TO THE MICRO HABITAT

DRAINAGE SYSTEM TO REMAIN IN PLACE

REHABILITATION TO LOCAL NATIVE HABITAT OF TREES AND SHRUBS MATCHED TO THE MICRO HABITAT

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REHABILITATION TO LOCAL NATIVE HABITAT OF TREES AND SHRUBS MATCHED TO THE MICRO HABITAT

40 METRE SETBACK WITH SAFETY BUNDING, ACCESS AND FENCES

Rainwa...

ROAD

ITALIA STONE GROUP	
CONCEPT FINAL CONTOUR PLAN	
PROPOSED HARD ROCK QUARRY LOT 800 PRUDEN ROAD, WHITBY	
Landform Research	August 2016

Figure 1 - 11

0 200m

ATTACHMENT 2

Water Management Plan

Lot 800 Pruden Road, Whitby

Italia Stone Group

August 2016

Landform Research
Land Systems - Quarries - Environment
ABN 29 841 445 694

CONTENTS

WATER QUALITY MANAGEMENT

FIGURES

WATER QUALITY MANAGEMENT

1.0 BACKGROUND

1.1 Overview

A Quarry is proposed for Lot 800 Pruden Road, Whitby, which lies approximately 950 metres from South Western Highway, with the pit approximately 1 300 metres from the highway.

The pit is approximately 3 500 metres east from Mundijong townsite and approximately 1 500 from the Whitby Urban Area.

Lot 800 occupies the upper face of the Darling Scarp, but the valley of Manjedal Brook cuts the Scarp and provides a north facing slope on which the quarry will be located, facing into the ridge to the north and protected to the west.

The design of the pit takes into account the potential for visual impacts and is provided with a narrow north facing throat combined with a western bund to better manage any visual impact.

Excavation is anticipated to be 50 000 – 100 000 tonnes of product per year.

1.2 Water Source Protection Areas

The site is not listed as a water source protection area.

1.3 Water Source

The quarry will be used to produce a higher proportion of larger rock for armour and other rock for coastal work therefore at times requiring less water use for dust suppression.

For other products, once sitting on site, product in stockpiles will be subject to rainfall which will wash fines from the products.

Water used in the pit and the processing areas for product washing and dust suppression will be sourced from the sumps to be constructed adjacent to the processing area. This is the same method used by other hard rock quarries on the Darling Scarp.

This water, when used on the hardstand areas, will drain to a drainage system of two sumps/detention basins with a capacity of around 5 000 kL each. This will reduce the total volumes of water required and maintain the efficiency of production and environmental management.

That gives a volume of 10 000 kL with the contingency later of additional storage in the pit floor as the pit is enlarged.

A sump will be located in the base of the pit and when the pit footprint increases the sump will also provide water storage of at least 5 000 kL.

Department of Water guidelines are to retain a 1 in 10 year 2 hour rainfall event on site. The rainfall intensity is 20 mm per hour or 40 mm total.

The area of pit and processing area is 11 hectares for the first 30 years. Initially the footprint will be around 8 hectares with a further 3 hectares in the micro catchment. At full size the pit will be 12 hectares plus 4 hectares of processing and storage. That is 16 hectares. The rainfall generated in a 10 year 2 hour event is;

40 mm x 160 000 m^2 x 90% runoff = 5 760 kL

In the initial stages the runoff from such a storm event, allowing for some uncleared land, will be;

40 mm x 80 000 m^2 x 90% runoff + 40 mm x 30 000 ^{m2} x 50% runoff = 3 480 kL

With two detention basins of 5 000 kL the proposed water storage will easily handle a ten year 2 hour storm event.

For a water supply through the year and a conservative annual rainfall of 700 mm (Note Whitby Falls has 975 mm annually), the total water supply in the early stages of the pit operation will be

700 mm x 80 000 m^2 x 90% runoff + 40 mm x 30 000 m^2 x 50% runoff = 60 900 kL annually. Some of that water will be lost through evaporation and some may run off, reducing the available volumes to say 40 000 kL per year.

That volume of water with recycling from washed products compares to other quarries in Western Australia producing similar or greater volumes of rock. As the quarry enlarges the supply of water captured will increase as will the storage capacity by cutting an additional sump in the floor of the pit.

In addition, with the quarry producing more larger products that do not require washing, short haul roads and bitumen access roads, less water will be required than some other operations.

For such a water supply, water will be used through the year and will be recycled from the stockpile and processing area in addition to capturing the lesser rainfall events in the drier months. For example Gosnells, over the drier months of January to March inclusive, has on average just over 43 mm rainfall which in an average year will add around 3 500 kL additional water during that dry period to top up the storage.

As a further contingency, other water requirements will be brought to site as required from the dam in the south on Gingagup Gully.

Gingagup Gully has excess water and overflows every winter. The Department of Water will be consulted on whether a Licence is required to access this water if there is insufficient captured within the pit. The calculations show that it is unlikely that water from Gingagup Gully will be required.

Potable water will be brought to the site. Serviced portable support facilities and ablutions are to be at the western end of the site.

It is unlikely that water will be available from bores.

The proposed design will therefore be adequate for the proposed operation.

1.4 Water Quality Protection Guidelines

The protection of water whether groundwater or surface water is an important part of the management of quarries. Different types of quarries have different potential impacts which are listed below in general terms. Not all potential impacts will apply to this quarry and the main impacts affecting this site are also listed.

Guidance on the quality of water can be found in;

- *Western Australian Water Quality Guidelines for Fresh and Marine Waters, EPA Bulletin 711, 1993.*
- *ANZECC, 1992, Australian Water Quality Guidelines for Fresh and Marine Waters.*

A number of documents provide guidance on the management and disposal of surface water that can lead to waterways, wetlands and underground water systems. These mainly apply to urban development but the methods are also applicable to the quarrying industry.

- *Engineers Australia 2003, Australian Runoff Quality, National Committee on Water Engineering.*
- *Stormwater Management Manual for Western Australia, Department of Environment WA, 2004.*
- *Guidelines for Groundwater Protection in Australia, ARMCANZ, ANZECC, September 1995.*

Documents specific to the mining and quarrying operations are the DOW – DMP Water Quality Protection Guidelines for Mining and Mineral Processing.

- *Overview*
- *Minesite water quality monitoring*
- *Minesite stormwater*
- *WQPN 28 Mechanical servicing and workshop (2006)*
- *Mine dewatering*
- *WQPN Landuse Compatibility in Public Drinking Water Source Areas (2004)*
- *WQPN 11 Water quality management in mining and mineral processing: mine dewatering.*
- *WQPN 15 Extractive Industries near sensitive water resources.*
- *Department of Water – Water resource considerations for extractive industries.*
- *Department of Water South West Region Guideline – Water resource considerations for extractive industries.*

The most relevant documents are WQPN 15 *Extractive Industries near sensitive water resources* and *South West Region Guideline – Water resource considerations for extractive industries* and *Department of Water, 2013, Western Australian water in mining guideline*

The proposed excavation complies with all the documents above.

A water monitoring program is proposed. See the end of the Water Management Section.

2.0 PHYSICAL ATTRIBUTES

2.1 Geology and Geomorphology

The quarry is located on the brow of the Darling Scarp, rising from 105 metres at the western edge of Lot 800 to over 225 metres on the eastern side of Lot 800. The pit and processing area face north into the hill occupied by the WA Bluemetal hard rock quarry.

The site lies on the western side of the Yilgarn Plateau just back from the edge of the Darling Scarp, but protected by a spur running north south. The location of the pit and operations has been selected to be behind a small spur which will be raised in elevation by the formation of bunding and dense tree planting.

The Darling Scarp plateau at this point consists of portion of dissected Darling Scarp drained by Manjedal Brook to the north, which drains to the Swan Coastal Plain.

The rock of the quarry forms the western edge of the Western Gneiss Terrane just east from the Darling Fault, which separates the older eastern hard rock from the deep sediments of the Perth Basin. The younger Proterozoic aged Cardup Group of sediments occurs just west of the pit but does not outcrop. These are steeply dipping shales and sandstones that dip west.

A small west trending fault probably cuts the Scarp at this point and has resulted in the development of the small valley along which Manjedal Brook runs. The fault appears to have slightly shifted the rock sequences west, north of the fault.

Another fracture or structure appears to run north along the western side of the proposed pit, where the rock appears softer and more weathered. This rock is proposed to be cut out to form the flat processing area and bunding providing for an easier commencement.

The geology can be seen in Western Australian Geological Survey mapping, for example the 1 : 50 000 Perth and Environs Mapping of 1970 Sheet 4.

The pit is wholly located within the Gneiss Terrane. The rock in the pit is felsic to intermediate gneisses which have been intruded by multiple veins and dykes of granites and minor diorite/dolerite dykes.

Above this is a shallow soil profile capped by laterite gravel and duricrust to the east in State Forest outside Lot 800.

Additional notes on the geotechnical aspects of the rock, operations and closure are shown in Attachment 1. A geological Section is attached.

2.2 Regolith and Soils

The soils overlying the weathered granite with some dolerite are generally thin brown loam soils over light coloured and mottled local clay and clay subsoils.

There is no evidence of soil salinity and none would be expected on this site with high winter rainfall and drainage.

The soils are deeper on the dolerite dyke and this is to be used to open the quarry and gain material to construct the processing and stockpile area, by providing the access cut to form the relatively flat hard stand for processing and stockpiling.

The soils and overburden from the remainder of the site will be stripped off to form the 4 metre western bund and the processing and stockpile area.

Material from the two 5 000 kL dams will be used to form the dam walls and additional hardstand area.

2.3 Climate

Climate is a typically Mediterranean with hot dry Summers and cool wet Winters.

Rain falls mainly in Winter with 80% falling in the five months May to September inclusive. Mean annual rainfall at Whitby Falls is 975 mm. Evaporation exceeds rainfall in all but the four wettest months May to August.

In Summer the prevailing winds are easterly in the morning and south westerly in the afternoon. In Winter the dominant wind direction is less distinct. Of particular significance are the strong katabatic easterly air flows occurring on summer mornings which can add additional dust management issues.

Temperature inversions can occur on still winter mornings and may influence the distance noise is transmitted. Data from Perth Airport shows that 90% of inversions are broken up by solar heating alone by 12.30 pm, and 100% by 2.00 pm.

Of local significance are the katabatic winds that blow from the Scarp on summer mornings. At Kelmscott the katabatic winds blow from midnight to midday, with the strongest winds between 4.00 and 6.00 am. Katabatic winds are strong and are commonly over 20 kph but can exceed 50 kph at Guildford (Mitchell 1979). Similar winds can be expected at Byford - Whitby, based on local experience.

Accordingly the study area is characterised by hot dry summers with strong easterly winds in summer.

The perimeter bunds and vegetation provide effective wind breaks and wind screening. Winds crossing the site are slowed by the perimeter tree and shrub vegetation. This reduces the speed of the winds across the floor of the pit.

When winds exit the pit or cross out of the pit they have to travel across a vegetated buffer that slows the speed of the wind and allows the coarser particles to drop from suspension.

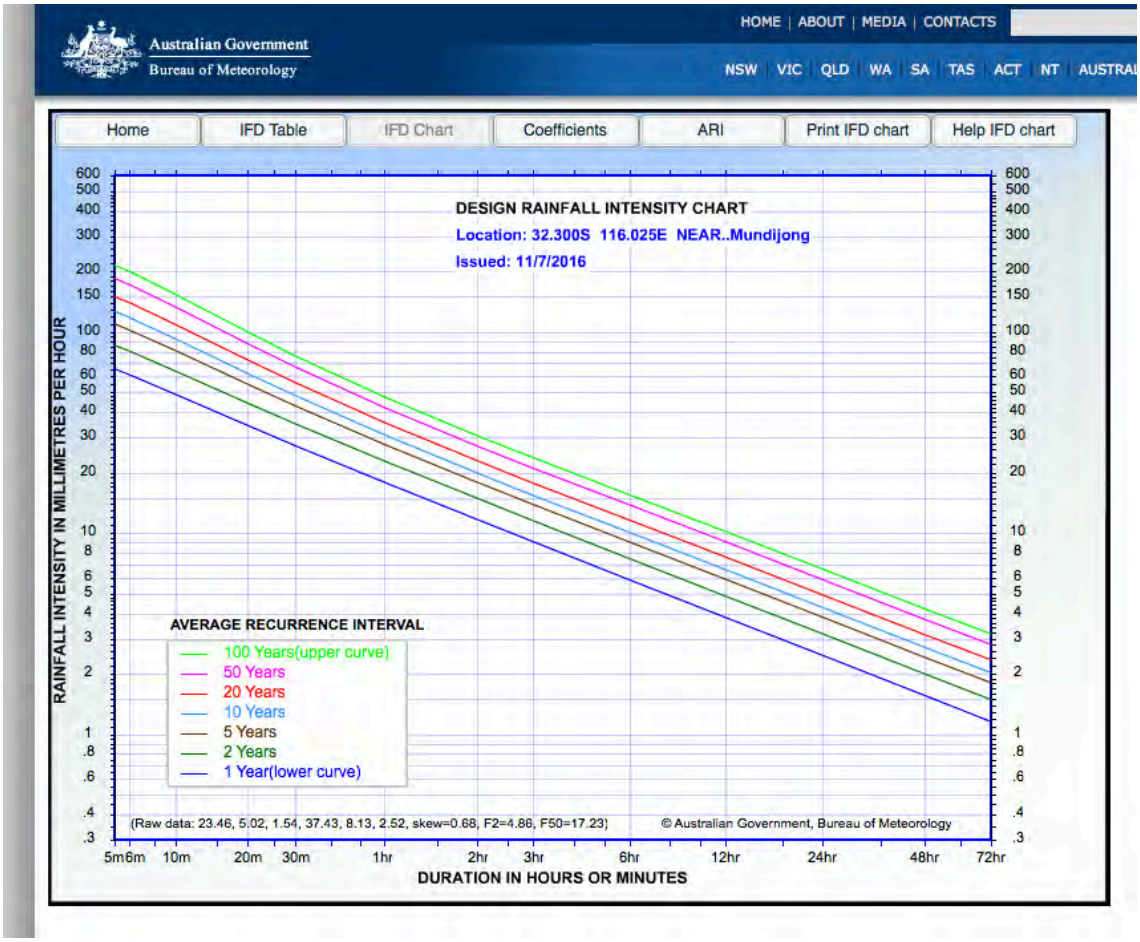

Figure 2 - 1 Rainfall Intensity Chart

3.0 Hydrogeology

3.1 Background

The quarry and processing area sits high on a north facing slope on the Darling Scarp.

3.2 Surface Water

The pit lies on the southern valley side of Manjedal Brook that drains west to the Swan Coastal Plain.

A 50 metre setback from Manjedal Brook will be established, in line with other Hard Rock Quarries on the Darling Scarp. For those other quarries that have been There is no apparent impact on the Brook from the past excavation and the disturbances are already in place from historical excavation.

Water used in the pit and the processing areas for product washing and dust suppression will be sourced from the sumps to be constructed adjacent to the processing area. This is the same method used by other hard rock quarries on the Darling Scarp.

This water, when used on the hardstand areas, will drain to a drainage system to two sumps/detention basins with a capacity of around 5 000 kL each. This will reduce the total volumes of water required and maintain the efficiency of production and environmental management.

That gives a volume of 10 000 kL with the contingency later of additional storage in the pit floor as the pit is enlarged. The volume of the sumps complies with Department of Water guidelines to retain a 1 in 10 year 2 hour rainfall event on site. The rainfall intensity is 20 mm per hour or 40 mm total.

A sump will be located in the base of the pit and when the pit footprint increases the sump will also provide water storage of at least 5 000 kL.

The sumps will be left in place at the end of excavation to provide long term water management and naturalised with local native vegetation.

A small area of rocky rapids and waterfall lies to the west outside Lot 800. That feature will not be impacted, with water from the proposed quarry and processing area being retained in two large detention basins with a total capacity of 10 000 kL combined with a third sediment settlement basin, to provide final water management and sampling and release points.

The release point to Manjedal Brook is 300 metres upstream from the rapids – waterfall. There will be no additional placement of materials closer to the Brook than currently exists.

The fringing and riparian vegetation along Manjedal Brook is totally degraded and will be replanted and re-established to local riparian and forest species matching habitat to species choice, to re-form the original community types.

Manjedal Brook peters out west of South Western Highway on the Swan Coastal Plain where the water infiltrates into the sediments of the plain.

A small tributary of Manjedal Brook, Gingagup Brook, crosses the south western corner of Lot 800, where it has been dammed by a farm dam.

As a comparison other hard rock quarries have been excavated near watercourses with no impacts on the water quality through the use of detention basins, bunding and water management. Hanson Red Hill Quarry sits near Susannah Brook and has been approved with a 50 metre setback to the brook, although the pit does not approach as close as that.

As a further comparison Boral Orange Grove Pit has a creek to the north which is also provided with a setback of 50 metres. A drainage line runs through the approved pit and stockpile areas and drains to a constructed detention basin before release of excess water downstream.

WA Bluemetal Quarry at Whitby also lies near a significant watercourse. Water collects in the pit and processing area, is directed to three detention basins with the overflow directed to Manjedal Brook. A setback of approximately 100 metres is applied to Manjedal Brook from WA Bluemetal operations.

The proposed pit complies with the setbacks used for other hard rock quarries.

Surface water from up slope will be cut off by cut off drains and bunding to prevent surface inflow to the pit.

There are no water courses that will be impacted on by the pit or proposed processing area.

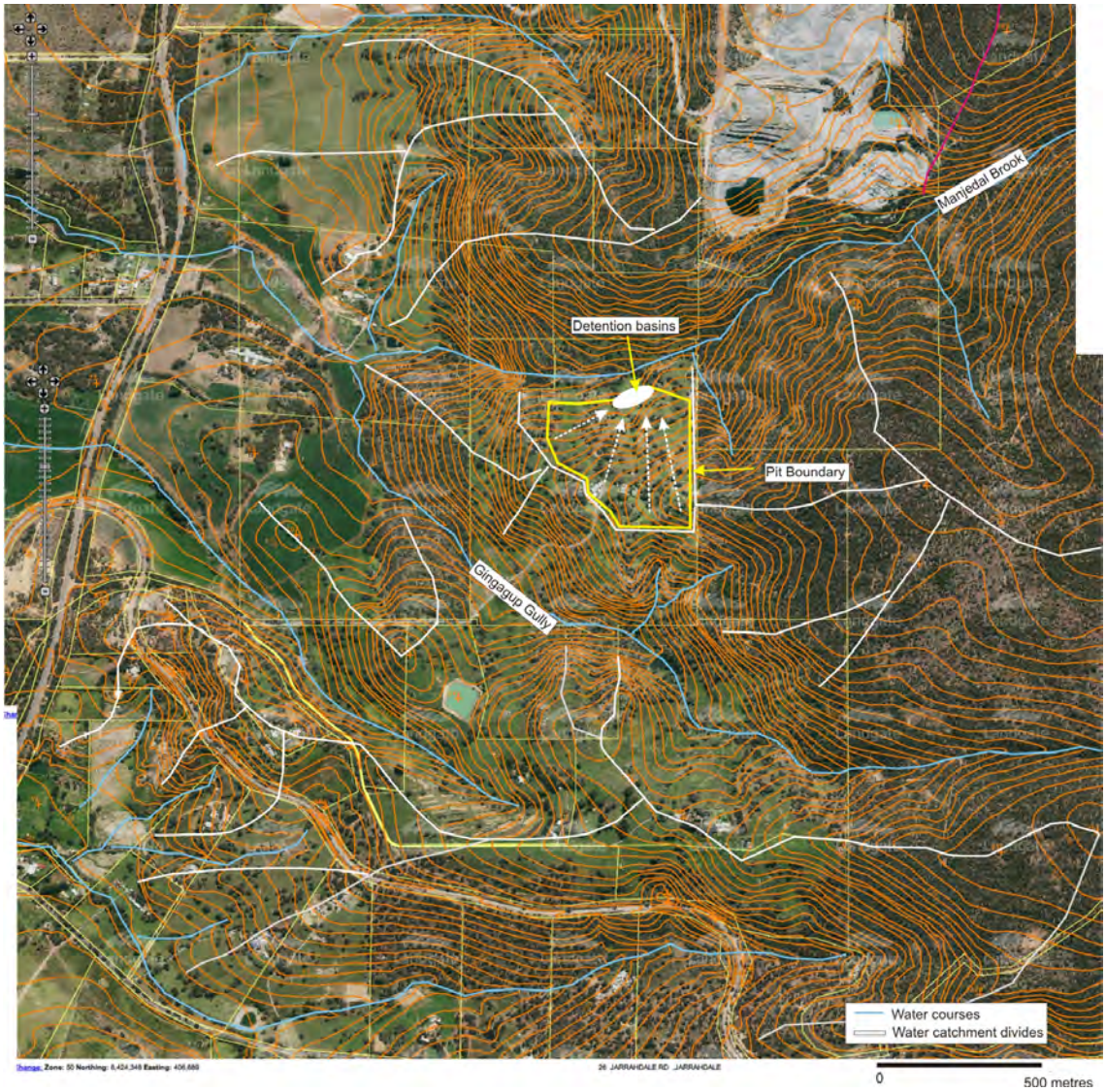

Figure 2 - 2 Water catchment boundary and quarry site

3.3 Groundwater

Hard rock is tight and has some fractures. The elevation of the proposed pit is well above creek elevation so the water table will not be intersected. There may be some minor perched or trapped water occurring in fractures of the hard rock. See Figure 6 (attached).

The elevation of the proposed pit is well above Manjedal Brook elevation so the water table will not be intersected. The proposed hard stand for the processing and stockpile are is to be at 155 metres AHD, 5 metres above the elevation of Manjedal Brook at the eastern upstream end.

There may be some minor perched or trapped water occurring in fractures of the hard rock, that are trapped and non flowing, but this does not constitute the water table.

There is almost no catchment distance upslope from the quarry and therefore little or no potential for springs or water seepages of any consequence to occur or impact on the operations.

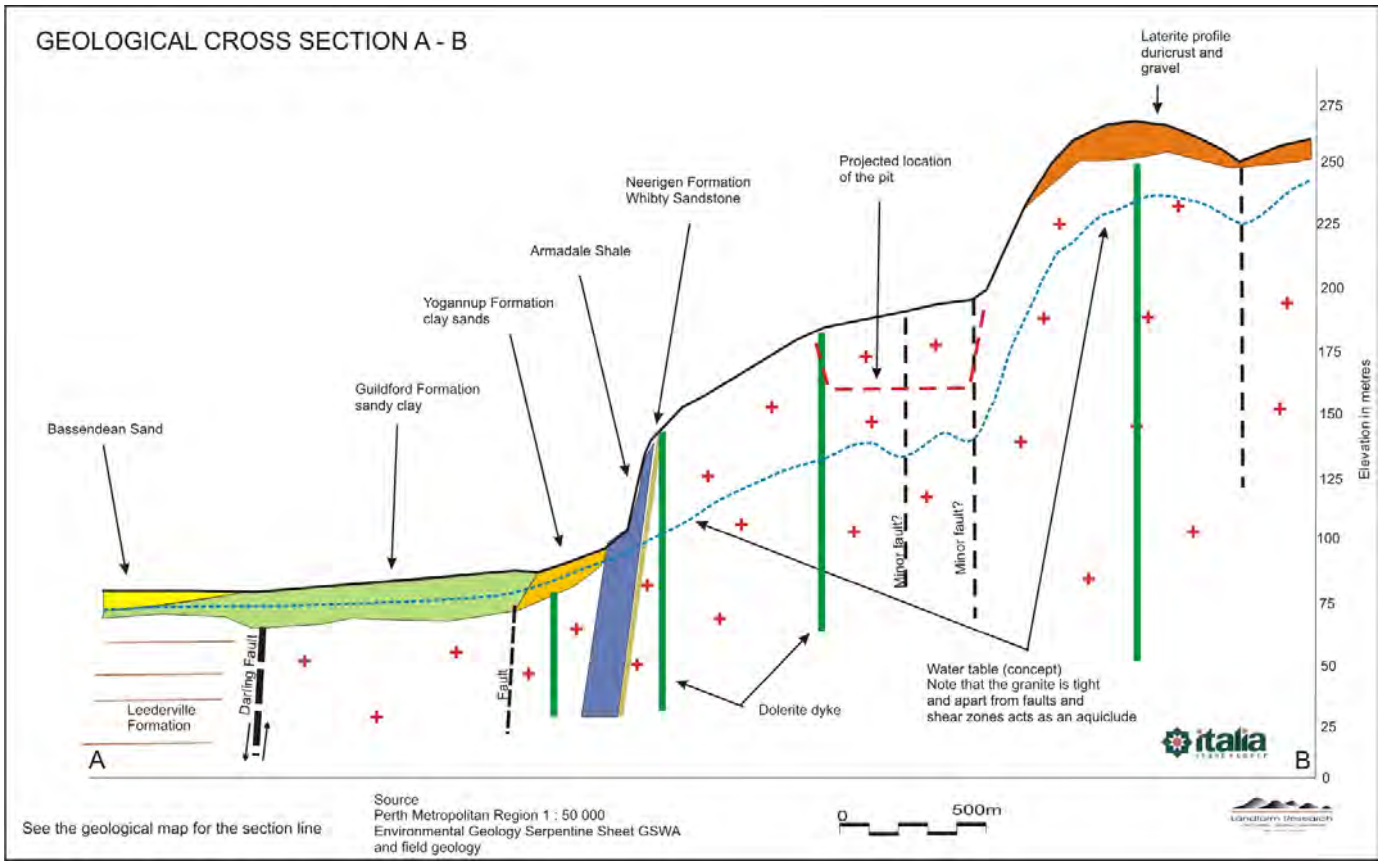

Figure 2 – 3 Geological cross section

3.4 Dewatering

No dewatering is proposed to be directed to Manjedal Brook. All water collected in the pit and from the processing and stockpile area will be directed to the detention basins. Flows are proposed to be directed to the western basin then overflow to the eastern basin and then to a small sediment trap before release to Manjedal Brook.

There is no dewatering required.

3.5 Recharge

There will be no changes to recharge from rainfall or flow in the Brook.

The rocks are not porous and therefore there will be little change to recharge. The volumes of the catchment captured is, in the early phases, 11 hectares, rising to 16 hectares in the later stages of the pit. That is very small compared to the catchment of Manjedal Brook which will not be impacted.

There will be no change to the recharge after excavation as the site will return to the original conditions of native vegetation on steeper slopes.

3.6 Salinity

Water collecting on the surface of the quarry is rainwater and fresh. Water in the Brook is also fresh being runoff from the granitic areas of the Darling Scarp.

4.0 PROTECTION OF WATER QUALITY

4.1 Surface Water, Dewatering and Drainage

Currently the only connection of Manjedal Brook to the area of the pit is some surface runoff from the steep slopes and granite outcrops.

The materials and rock to be impacted in the quarry are natural and will not chemically change, being soils, hard rock and overburden. What can occur, if it is not controlled, is that runoff carrying grey aggregate/granite chips or fines could flow to the Brook. The grey colour would not be typical of the local soils and overburden.

The design of the pit is such that this will not be able to occur directly but rather water will have to flow through the two larger detention basins that will have a capacity approximately double the potential runoff from the 1 in 10 year 2 hour storm event. Department of Water normally requires the basins to be able to retain and treat the 2 hour 1 in 10 year event which in this case is 40 mm.

The extraction of hard rock is a chemically free operation with the only liquids used being lubricants for machinery. Extractive Industries are one of the few industries permitted to operate in Groundwater Source Protection Areas.

Therefore the protection of the Brook is a management of surface water runoff.

Department of Water Guidelines for the South West require retention of the 10 year 2 hour event being prevented from leaving site without being detained. These rainfall events are 20 mm.

Cut off drains are proposed to be placed around the top of the face of the upper bench to prevent water from entering the pit, by directing the captured surface water to the natural landform as it did prior to excavation.

This will separate the natural stormwater from stormwater originating from disturbed areas. The cut off drain directs all surface water around the excavation.

Therefore the detention basins will be formed in various locations on site, sized in total to retain the 40 mm rainfall events based on the catchments of each particular part of the site. In order to provide this level of retention two basins are proposed combined with a small sediment trap.

The location of these may change as the quarry is excavated and rehabilitated. The basins will be equipped to handle higher rainfall events by providing protected outlets to prevent erosion.

A sump is proposed for the base of the pit but that will not be possible until the floor elevation is reached.

Once full the sump is proposed to have an outlet protected by rock draining along the existing drainage line to Flaherty Brook.

All surface water originating in the pit or disturbed areas is captured and retained on the floor of the pit where it is directed to the western detention basin to settle prior to entering the eastern basin and then prior to overflow through a sediment trap to Manjedal Brook. Only excess water, after having time to settle, is able to leave the pit sump. This is the same sediment management that is used at other hard rock quarries on the Darling Scarp and complies with Best Practice and DOW Guidelines.

Water management during operations and for closure will be an ongoing investigation to ensure that the buffers to Manjedal Brook are maintained and enhanced.

The 50 metre buffer to Manjedal Brook will be maintained and replanted to local creek line and riparian vegetation with species matched to the location of the planting in relation to the geomorphology.

Figure 2 – 4 Manjedal Brook, view east. Note the lack of native understorey

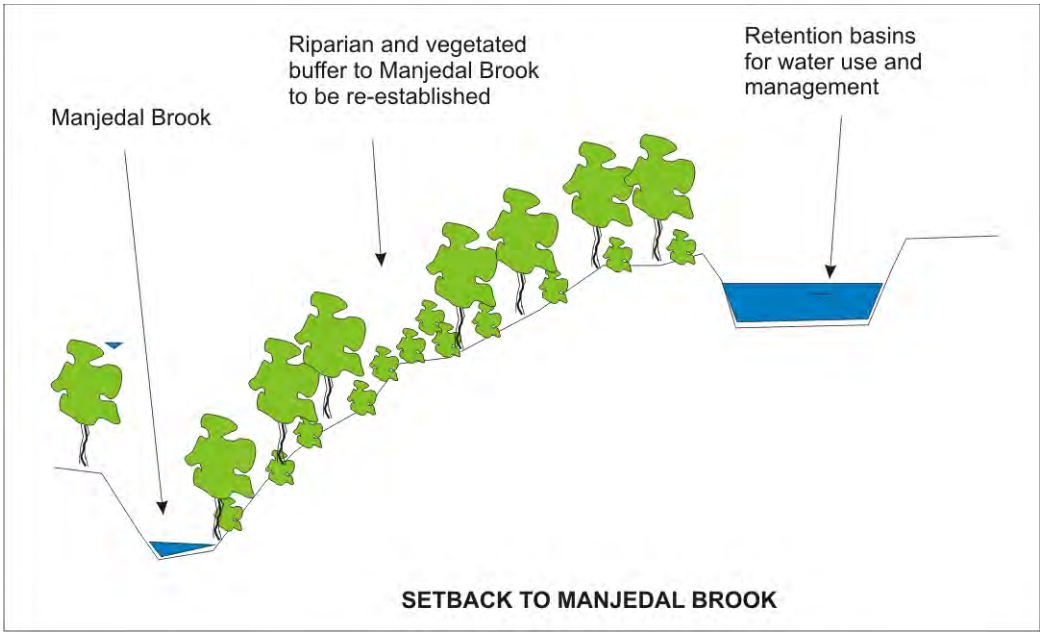

Figure 2 – 5 Sketch section to Manjedal Brook

The access road will have edge gutters of the access road that are stable, vegetated and working. That water will flow across pasture prior to entering the creeks and therefore will not impact on them.

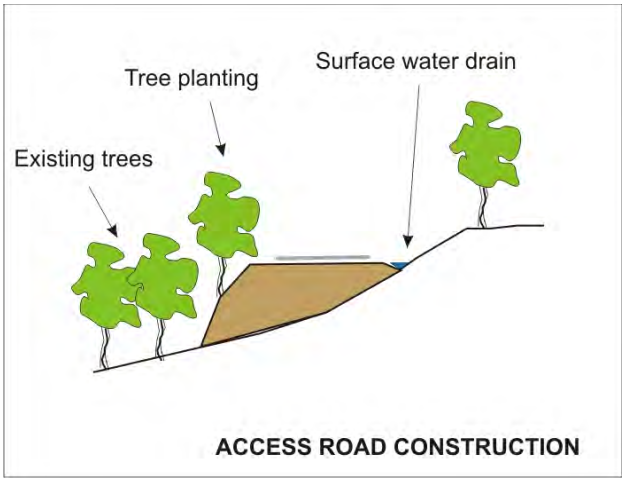

Figure 2 – 6 Sketch section showing the concept section of the access road

Figure 2 - 7 Examples of rip rap and stone pitching to mange water on slopes, slow the water flows. All detention basins will be provided with rock pitching to protect the outlets

Figure 2 - 8 Examples of rip rap and stone pitching to mange water on slopes, slow the water flows. All detention basins will be provided with rock pitching to protect the outlets

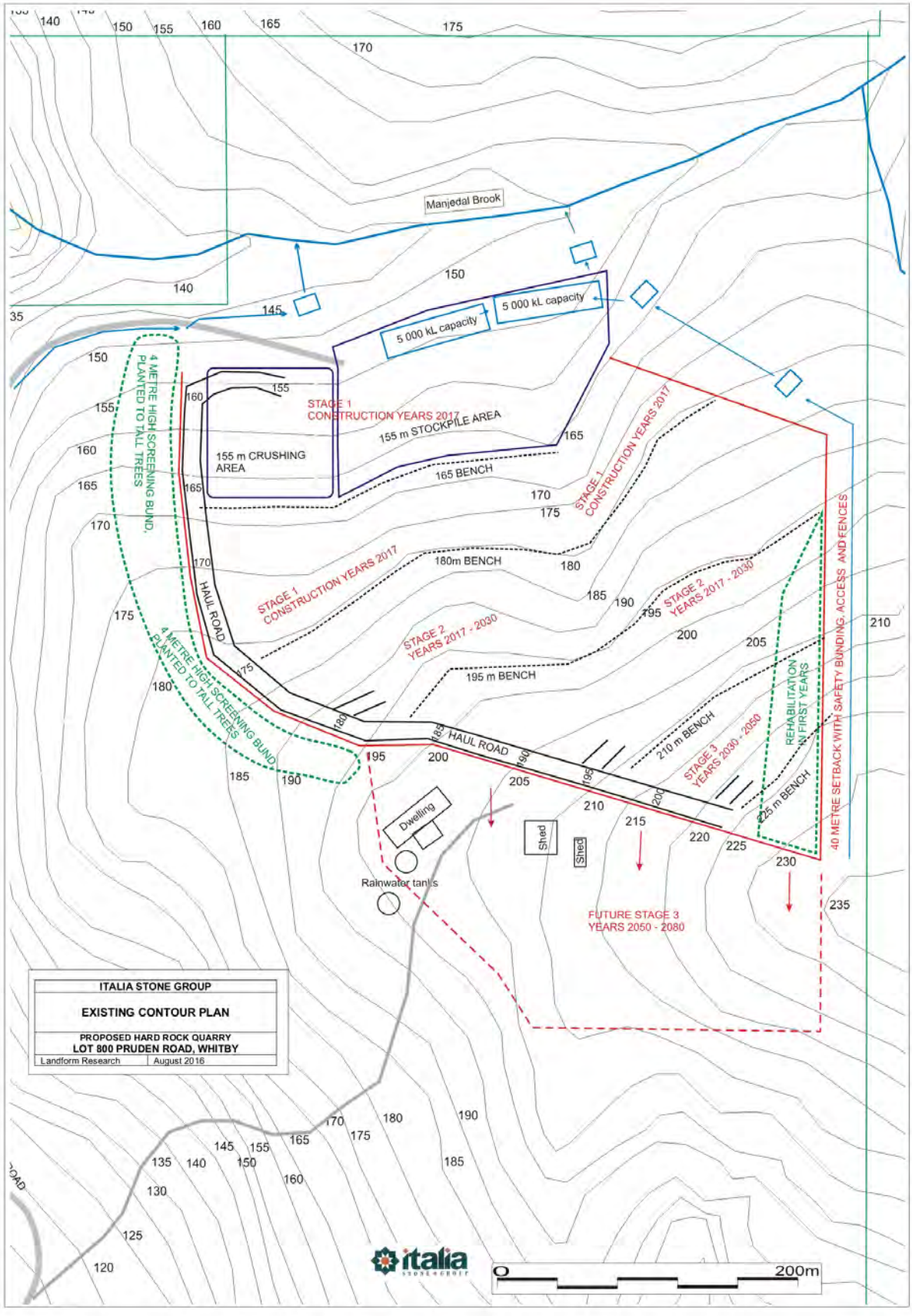

Figure 2 - 9 Proposed pit design and water management

4.2 Groundwater Protection and Water Use

The granite basement rock is very tight and only minor water will seep through joints and weak structures. There is no evidence of water seepages in the rock faces apart from small surface water flows. The water table is not intersected and not likely to be because the water table will be at or below the base of Manjedal Brook and grade correspondingly up slope.

Tight granite rock like this normally prevents groundwater flows in or out apart from minor surface seepages through fractured areas. No other hard rock quarry on the Darling Scarp, for example, has significant water seepages into it apart from winter storm flows.

Therefore the main water management relates to surface water.

4.3 Salinity Protection

The only potential changes to salinity is through use of water, over pumping of groundwater or evaporation. None of these scenarios occur as a result of hard rock excavation on the Darling Scarp in a high rainfall zone, and therefore there will be no change to salt levels in the water.

Sub surface salinity can, in some parts of the State, be mobilised when vegetation is cleared because of increased recharge of subsoil moisture.

The amount of clearing is minimal, the vegetation is very sparse and there is no evidence of subsurface salinity. Therefore the proposed clearing will not change the local recharge. These areas with granite outcrop on the Darling Scarp in high rainfall areas are well known to be not susceptible to salinity risk because of the flushing by the high rainfall over thousands of years.

The laterite deep weathering profiles occur up slope and to the east of Lot 800 and will be separated by cut off drains and bunding on the eastern side of the pit and operations.

4.4 Recharge and Water use

The access road and stockpile area site is already cleared. These areas have been cleared for many years with the pit area comprising approximately 16.0 hectares when all stages are taken.

There will be minor clearing of scattered trees so there will be little increase in recharge from clearing. Tree planting and revegetation of the upper eastern face and screening bunds will be undertaken and this will compensate for any clearing with respect to recharge. At the end of excavation the steeper batter slopes will be planted to local native vegetation.

Over time as the quarry is worked and revegetated the recharge will drop slightly.

4.5 Acid Sulfate Risk

There has been an increased interest in acid sulfate soils since the release of WAPC Planning Bulletin 64. However the interest has been over reactive and conditions and risk applied in many areas where there is no geological risk or evidence of acid sulfate.

Definitive survey procedure is produced in DEC (DER) 2013, *Identification of Acid Sulfate Soils and acidic Landscapes* and within document Acid Sulfate Soil Management Advisory Committee NSW, 1998, *Acid Sulfate Manual.* This information forms the basis for much of the assessment procedures in Australia, including those adopted by the Western Australian Planning Commission and the Department of Environment Regulation.

The *Acid Sulfate Manual* adopts the procedure of reviewing the published data followed up by field assessment, which has been completed for this site. If a geological risk is determined, then a Preliminary Acid Sulfate Assessment is conducted.

Acid Sulfate Soils can potentially form under reducing conditions when there is a source of carbon and a source of sulfur (normally from sea or saline water). Micro-organisms are thought to play an important role in reducing the sulfates within the sediments to form the iron sulfide. It is a natural phenomena, that can be exacerbated by disturbance.

Potential acid sulfate conditions most commonly form under current or past estuarine conditions, peaty conditions, and may also result from weathering of some geological formations and situations which contain sulfides.

The soils most at risk are normally saline/estuarine soils, gley soils, peat and some organoferricretes when exposed to the atmosphere.

Acid sulfate only becomes a potential risk when a number of circumstances are present.

- There is rock, soil or regolith present that is carrying sulfides.
- Sulfide carrying materials from below the water table are to be exposed to the atmosphere.
- Excavation below the water table is to be carried out exposing the sulfide carrying materials to oxygen in the atmosphere.
- Dewatering of the sulfide carrying materials is proposed, exposing them to oxygen.
- Exposure of peat or organoferricrete materials, that were permanently under reducing conditions, to the air.

None of these at risk conditions occur on site.

The site is elevated and the soils oxidised with no evidence of reducing conditions or other risk factors and none would be expected in this geological environment.

The main risk will come from the potential for sulfides to be present in the hard rock. Sulfides weather to very characteristic stainings and bodies such as gossans. No evidence of sulfides or their weathered products are found in the surface rocks.

Therefore the risk of acid sulfate conditions is minimal to nil and would only occur if significant sulfides were exposed during excavations. That situation does not occur in other hard rock quarries, cuttings and other such rocks in the south west. Such situations only occur in mines where the sulfides form extractable ores for base or other metals. From working with the other hard rock quarries on the Darling Scarp there is no evidence of acid sulfate conditions within the granites and gneisses of the western edge of the Darling Scarp.

Therefore there is no risk of acid sulfate conditions.

4.6 Waste Rock and Tailings Management

Waste and Tailings management is considered in;

- *Department of Mines and Petroleum, 1999, Mining Environmental Management Guidelines, Safe Design and Operating Standards for Tailings Storage.*

As all the rock is used in one type of product or another there is no waste rock or tailings. Overburden is used to provide a physical and landscape banks barrier around the site, along the west and now extending to the north.

Partially weathered or subgrade hard rock is in this case going to be utilised and used in blended construction and road making products.

Subgrade materials will be incorporated into the bunding or used by inclusion into one of the quarry products. Quarry fines will be used in products.

Potential "at risk" Waste Inventory - Characterisation

Type	Comment	Treatment
Saline surface water	Not present	
Saline ground water	Not present	
Acidic materials and drainage	Not present	
Sodic or dispersive materials	Not present	
Asbestos – asbestiform minerals	None present	
Radioactive materials	Not present	
Metallic or chemical materials	Not present	
Tailings storage	Not required	
Ablutions waste		Serviced portable facilities
Dangerous Goods and Hazardous Materials	***None will remain on closure***.	There are normally no hazardous materials used for hard rock quarrying, apart from fuel, blasting and servicing. The only other materials are for tasks such as weed management and are dealt with under those sections.
	EXPLOSIVES ***None will be stored on site.***	Explosives will be brought to site as required. None will be stored on site. See Blast Management Plan contained in the Offsite Risks Management Plan
	FUEL The various plant will be refueled from mobile tanker. ***None will remain on closure***.	Any soil or other materials with drips and spills will be removed offsite to an approved waste site or location. Fuel is discussed in the Water Management Plan, Attachment 2.
	SERVICE MATERIALS Only minor lubrication will be conducted on site All major servicing will be conducted offsite. ***None will remain on closure***	Any wastes will be collected and removed from site promptly to an approved recycling or waste disposal area. Servicing is discussed in the Water Management Plan, Attachment 2.
General waste		Regularly removed from site to an approved disposal area

- Wastes generated will be recycled wherever possible and periodically disposed of at an approved landfill site.

4.7 Unauthorised Access and Illegal Dumping

The potential for rubbish to be dumped relates mainly to unauthorised access and is low as the site is set back from roads. Access restrictions such as gates or barriers will be installed when the site is unmanned and equipment retained on site.

This is unlikely to occur because the pit is located in a relatively isolated location away from South Western Highway.

- Any illegally dumped materials are to be removed promptly to an approved landfill or other suitable site, depending on the nature of the material.

4.8 Solid Domestic and Light Industrial Wastes

Non essential or old plant and materials will be removed from the site. Locked gates and the existing fences will be maintained to prevent illegal dumping and contamination of water.

All solid domestic and light industrial wastes will be stored in commercial waste storage containers and/or removed to an approved landfill facility. There will be no waste disposal on site. Waste storage containers will be sealed so that rainfall cannot enter, therefore preventing the formation of leachates.

Wastes generated will be recycled wherever possible and periodically disposed of at an approved landfill site. Any illegally dumped materials are to be removed promptly to an approved landfill or other suitable site, depending on the nature of the material.

Regular inspections (at least weekly) are conducted to ensure no wastes, litter and the like are present in or around the excavation and processing area.

4.9 Wastewater Disposal

A service portable toilet system will be used when the site is manned, during construction and in the early stages of the pit, or the facilities at the dwelling will be used.

Serviced means they are pumped out by a licensed contractor from Perth or locally.

4.10 Refuelling

The protection of water from fuels and other chemicals is an important part of the management of quarries. Different types of quarries have different potential impacts which are listed below in general terms. Not all potential impacts will apply to this quarry and the main impacts affecting this site are also listed

Extraction of hard rock is a clean operation similar to sand excavation in the nature of the risk to groundwater. Similar quarries have operated locally for many years with no known significant pollution incidents.

No chemicals are used apart from normal lubricants, which is similar to sand excavation, and sand excavation is one of the few industries that are permitted to operate in a Priority 1 Public Drinking Water Source Area, indicating the clean nature of the activity. See Department of Water *Land Use Compatibility in Public Drinking Water Source Areas.*

All spills are to be cleaned up in accordance with the summarised procedures following.

Documents specific to the fuel and maintenance are the DOW – DMP Water Quality Protection Guidelines for Mining and Mineral Processing

- *Mechanical servicing and workshop facilities*
- *Above-ground fuel and chemical storage*
- *WQPN 28 Mechanical servicing and workshop (2006)*
- *WQPN 15 Extractive Industries near sensitive water resources.*
- *Department of Water – South West Region Guideline – Water resource considerations for extractive industries.*

A list of the management actions for maintenance is provided. The actions will be used where applicable and as the opportunity presents to maintain water quality on this site.

Italia have safety and pollution management procedures for all their operations. They also use self contained service and recovery vehicles to undertake minor servicing in the field.

Fuel Management Plan

Fuel Storage

Currently it is proposed to use mobile tankers to refuel mobile and fixed plant when the site is manned.

Minor fuels will also be required for smaller mobile and fixed plant.

However for an excavation campaign, fuel storage may be required, using a mobile self contained double skinned facility located in a bunded and lined enclosure in accordance with DOW - DMP Water Quality Protection Guidelines for Mining and Mineral Processing, *Above-ground fuel and chemical storage.* See Servicing and Maintenance and Fuel Spill Management Plan below.

Such fuel will only be retained on site where the site is manned.

Any drums for smaller plant will be retained on trucks and if placed on site will be stored in a bunded lined facility to retain 110% of the volume stored.

Fuel Spill Management Plan

- Fuel and maintenance will be carried out in accordance with the DOW – DMP Water Quality Protection Guidelines for Mining and Mineral Processing, *Mechanical servicing and workshop facilities* and *Above-ground fuel and chemical storage*.

- Diesel fuel will be stored in either a bunded lined approved tank or a double lined tank or transported to site as required by mobile tanker.

- Soils and roadbase hardstand such as those on this site are adsorptive. The main risk of contamination is the minor drips that occur during the removal of hoses etc. Minor spills are quickly degraded by soil microbial matter.

- Refuelling and lubricating activities only occur in designated areas. Equipment for the containment and cleanup of spills is to be provided in these areas.

- Spillage will be contained in plant and working areas by shutting down plant or equipment if the plant or equipment is the source of the spill (provided it is safe to do so).

- In the event of a spill or adverse incident, activities will be stopped in that area until the incident is resolved.

- Any spills will be contained by the excavation or processing area. A fluid spill emergency response kit is in place. For larger spills soil and resource will quickly be placed around the spill to contain it in as small an area as possible. When contained, the contaminated aggregate/loam soils will be scooped up and removed to an approved landfill or other approved site.

- All significant adverse incidents (such as a fuel spill of >5 litres) in one dump, are recorded, investigated and remediated. A record is to be kept of incidents and the Local Authority and Department of Environment Regulation notified within 24 hours. No such incidences have been recorded at the quarry.

- The only other risk is from a tank rupture, but tanks are designed to manage this eventuality. A commitment is made to notify Department of Environment Regulation/Department of Water and Shire of Serpentine-Jarrahdale of any spill greater than 5 litres in one dump. This is much less than the DOW requirement trigger of 100 litres. Soil contaminated by large spills will be removed from the site to an approved disposal area.

- No significant non compliances have been recorded.

- Spillage will be contained in plant and working areas by shutting down plant or equipment if the plant or equipment is the source of the spill (provided it is safe to do so).

- Transport chemicals in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code).

4.11 Dangerous Goods and Hazardous Substances

There is no transport, storage or handling of hazardous materials involved in hard rock extraction.

Fuel will be carried on vehicles when brought to site for refuelling. Fuel cartage will be governed by normal mobile fuel transport management and the DMP/DOW guidelines listed above. Minor fuel may be required for small on site mobile and fixed plant and hand equipment but this will not be stored on site unless personnel are on site.

4.12 Servicing and Maintenance

Documents specific to the fuel and maintenance are the DOW – DMP Water Quality Protection Guidelines for Mining and Mineral Processing

- *Mechanical servicing and workshop facilities*
- *Above-ground fuel and chemical storage*

The main risk of contamination comes from tank or hose rupture on earth moving machines. A spill kit containing absorbent granules is located on site for emergency use. A commitment is made to notify Department of Water and DMP of any spill greater than 5 litres. DER Guidelines suggest 100 litres but this is felt to be too high.

- All major servicing of vehicles will be conducted off site.

- Servicing plant and equipment will be in accordance with a maintenance schedule.

- Lubricating and maintenance activities are to occur in designated areas in the processing area and pit. Equipment for the containment and cleanup of spills is to be provided.

- Spillage will be contained in plant and working areas by shutting down plant or equipment if the plant or equipment is the source of the spill (provided it is safe to do so).

- Waste substances and chemicals will be stored in accordance with the Site Waste Guidelines.

- Waste oil and other fluids derived from the routine maintenance of mobile machinery, will be transported off site and disposed off at an approved landfill site. Grease canisters, fuel filters, oil filters and top-up oils will be stored in appropriate containers in a shed or brought to the site as required.

- Vehicle washdown is not proposed.

- Regular inspections and maintenance of fuel, oil and hydraulic fluids in storages and lines will be carried out for wear or faults.

- Accidental spill containment and cleanup protocol will be implemented as necessary.

- Any waste chemicals derived during routine maintenance activities will be stored in appropriate sealed containers within a designated storage area or taken from site and disposed of at an approved facility.

- Rubbish generated is to be recycled wherever possible and periodically disposed of at an approved landfill site.

- The site will be maintained in a tidy manner by removing all rubbish regularly offsite.

5.0 Monitoring

A water monitoring program is proposed. Generally the water will only be sampled in winter to early spring, when there is water leaving the site, at a suitable location on the exit to Manjedal Brook at a location where it is possible to sample. No sampling will be required when there is no water flow to the natural watercourses.

Water will be sampled for pH, salinity, total dissolved solids and total suspended solids and hydrocarbons.

Downstream water quality criteria < 20mg/L TDS and TSS increase compared to upstream.

Monitoring of ground or surface water is not considered necessary because the excavation is designed to comply with Department of Water requirements for Drinking Water Catchments and therefore complies with normal water management in other areas.

REFERENCES

DOW and DMP (2000). *Water Quality Protection Guideline: Above Ground Fuel and Chemical Storage.*

DOW and DMP (2000). *Water Quality Protection Guideline: Mechanical and Servicing Worksop Facilities.*

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ATTACHMENT 3

Offsite Impacts Management Plan

Lot 800 Pruden Road, Whitby

Italia Stone Group

June 2016

Landform Research
Land Systems - Studies - Environment

Manjedal Brook

Proposed quarry footprint

15 metre bunds

Future Stage

Access road

Gingagup Gully

160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235

145 150 155 160 165 170 175 180 185 190 135 140 130 125 120 115 110

Landgate

Landform Research

italia STONE GROUP

Figure 3 - 1

PROPOSED HARD ROCK QUARRY
LOT 800. PRUDEN ROAD, WHITBY

LAND SURFACE

0 200m

0 **Northing:** 6,426,526 **Easting:** 407,324

1617 SOUTH WESTERN HWY ,WHITBY

Whitby Urban Precinct

PhotoMaps | MultiView | Terrain | Roadmap

Street Maps ☐

Properties ☑

A

B

C

D

E

F

G

Proposed quarry footprint

Future Stage

Sensitive premises

Shed

Identified from aerial photography

0 200m

Landform Research

italia STONE GROUP

PROPOSED HARD ROCK QUARRY
LOT 800. PRUDEN ROAD, WHITBY

nearmap current. clear. change.

100 m | Terms of Use

Figure 3 - 2

2A BUFFERS AND SETBACKS

The quarry has been designed to maximise the setbacks to the closest sensitive premises.

The quarry is located on a north facing slope on the southern side of the Manjedal Brook, facing along the scarp, rather than west to the Swan Coastal Plain. The proposed operations are 1 km from South Western Highway.

The location has been chosen to minimise or mitigate the visual impacts from the Swan Coastal Plain and sensitive premises. A visual analysis shows that the site is not visible from South Western Highway because of the extensive tree growth along the road verge of the highway.

The only location where the top of the upper eastern slope of the pit footprint will be seen through two small windows where Manjedal Brook crosses South Western Highway.

The pit is located behind a low spur which forms the western boundary and can be added to with bunding, and behind existing trees.

The access road is chosen to provide suitable gradient as well as being located behind existing trees on site.

The pit footprint has also been chosen behind the break of slope of a spur along the west of the site to provide visual and noise screening.

In addition a bund 4 metres high is proposed to be located along the western side of the pit with the pit cut deep behind the spur and screening bund.

The direction of excavation and staging is then selected to provide maximum screening for noise visual, dust and all other potential environmental risks.

There are no nearby sensitive premises. The closest dwellings or sensitive premises have been identified from aerial photography and ground observations. There are other dwellings at further distances, but these represent the closest and are typical of the potential impacts.

See the attached plans.

Residence A 770 metres north west - (partially protected by screening bund and landform)

Residence B 820 metres west north west - (behind screening bund)

Residence C 1 150 metres south west - (behind landform)

Residence D 1.220 metres south west - (behind landform)

Residence E 1 370 metres south west - (behind landform)

Residence F 1 050 metres from to pit to 2050 - (930 metres from the proposed future stage, behind landform of future quarry stage)

Residence G 1 470 metres south - (behind landform)

The urban areas of Whitby Precinct, west of South Western Highway lie 1 200 metres away.

The land size is restricted providing little potential to alter the number of additional dwellings that might be constructed locally.

Herring Storer have been commissioned to undertake noise assessments of the operations and made assessments for the closest residences. The numbering system for the closest residences are used here.

Policies

A number of Government Policies relate to buffer distances and the protection of basic raw materials. *State Planning Policy No 4.1, State Industrial Buffer Policy*, (draft July 2004) discusses the need to consider adjoining land uses when locating buffers but does not prescribe set buffers for operations such as this.

SPP 4.1 discusses the need to buffers both on site and offsite with respect to industry including extractive industries. It does not however specify any distance for the buffer, but notes that site specific studies should be prepared that will demonstrate that the extractive industry can operate in a manner compatible with nearby sensitive premises.

The State Industrial Policy 4.1 does not specify a set buffer distance, but notes that buffers are to be based on "scientific study" and are flexible. It further specifies the buffers by reference to other documentation such as the Environmental Protection Policies, EPA and DEP standards and DEP Generic Industrial Buffer Guidelines; that is the EPA 1 000 metre generic buffer used in SPP 2.4 and SPP 2.5 that are used in the absence of supporting or scientific studies and information.

State Planning Policy No 2.4, Basic Raw Materials, makes provision for the extraction of basic raw materials. SPP 2.4. It states in Section 6.3.2 that before determining an application within 1000 metres of a sensitive land use *"the Commission or Local Government must consider the following as appropriate.*

> *An application may require referral to the Department of Environment Protection,*
>
> *The significance of the resources in terms of whether it is a key extraction area, priority resource area or extraction area;*
>
> *The likely effects of vehicular traffic, noise blasting, dust, vibration arising from the extractive industry on the proposed land use or development."*

SPP 2.4 goes on to state in Section 6.4.1

> *Applications for extractive industry operations are to be accompanied by a management plan and report which:*
>
> *Demonstrates that sensitive land uses within 1 000 m of the proposal will not be adversely affected by the extractive industry operations;*
>
> *Identifies appropriate buffer distances, being those distances required for extraction that are needed to buffer the impact of operations to adjacent land users.*
>
> *Provides details of the proposed use, development and management of the site including the environmental and water resource management standards, quarry areas, stockpiles, machinery maintenance areas, processing plants, fuel storage and on site access roads, parking of cars and other vehicles used on the site and proposals for landscaping to screen activity on the site;*
>
> *Describes arrangements for access to the site, including the roads which it proposes will be the main vehicular access and likely traffic flows; and*
>
> *Sets outs proposals for the progressive and ultimate rehabilitation for its intended use.*

All the potential impacts on nearby residences have been considered and addressed within this documentation for the quarry proposal.

The issue of appropriate buffers is a matter of the distance and protection measures to prevent impact on adjoining land users. This applies mainly to noise, dust and visual impact, all of which are treated separately.

EPA guidance "Separation Distances between Industrial and Sensitive Land Uses", June 2005 lists the generic buffers for hard rock quarries as 1 000 metres depending on the extent of processing.

A generic buffer relates to the distance at which there are unlikely to be any impacts without further investigations. It does not mean that smaller buffers are not acceptable. EPA Guidance for the Assessment of Environmental Factors No 3, June 2005, provides for a case by case separation, based on the potential impacts.

A generic buffer relates to the distance at which there are unlikely to be any problems without some further investigations and does not mean that smaller buffers are not acceptable.

There are three residences/sensitive premises within or close to 1 000 metres from the pit and operations; Residence A to the north west and Residence B the Murdoch University facilities are to the north west Residence F, which lies behind the southern face of the quarry and is hidden from the quarry, is 1050 metres from the stage of the pit to 2050 and 930 metres to the future stage of the pit.

The selection of the pit footprint and its design have been developed to provide the maximum separation distances and landform buffering.

The development and processing of the resource has been designed to maintain maximum buffer distances. In situations where the buffers are less, actions such as the provision of perimeter bunding to provide visual and noise management, tree planting and operational procedures are used to mitigate and reduce impacts. This is proposed.

The buffers in relation to visual management are discussed in Visual Management at Attachment 3.

Herring Storer Acoustics have been commissioned to undertake noise assessments of the operations and made assessments for the closest residences. The numbering system used for Herring Storer is the same as that used below.

The closest dwellings or sensitive premises have been identified from aerial photography and ground observations. There are other dwellings at further distances, but these represent the closest and are typical of the potential impacts.

Residence A is located down the Manjedal Valley. The pit is designed to operate behind a western spur and that, combined with the 4 metre screening bund along the western boundary and the north eastern section of the pit site not being excavated in Stage 1, will assist in reducing visual impact from that location.

It is just possible that from Residence B, which is a sensitive premises, but not a dwelling, being associated with Murdoch University, that the top of the eastern face will be visible for the first few years of the pit, until that portion of that face can be rehabilitated. See Attachment 3 for visual management and section lines. A 4 metre bund is proposed to be planted with tall trees to mitigate the risk of the top of the eastern face being visible.

Residence is to the south behind the southern face out of the view shed and protected by landform.

The requirement for buffers mainly relates to dust and noise. Distances to the closest sensitive premises remain sufficient for the mitigation of noise and dust, and rarely to never are there any complaints relating to these parameters.

Compared to other hard rock quarries on the Darling Scarp and other locations, the available buffers are much greater than Boral Orange Grove Quarry, Hanson Bunbury, Mt Barker and Gelorup Quarries, Holcim Gelorup and Albany Quarries and all of which have a number of dwellings at 500 plus metres or less and all have operated for many years.

The buffers and setbacks are similar to those available to Hanson Byford Quarry.

This is the same method used by Roadstone (Part of the Italia Stone Group) during excavation and rehabilitation of the hard rock quarry in Esperance in 2000 - 2003. The removal of material from the Esperance Pit combined with the reduction in angles of the face and rehabilitation completely transformed the quarry location in Esperance, and the same methods will be used here.

The sequence of photographs from the Port Authority of Esperance Annual reports shows the rehabilitation of the quarry after excavation and rehabilitation from 2004 to 2014.

For their efforts on rehabilitation the Port of Esperance/Roadstone Quarries were a joint winner of the Golden Gecko Award for Environmental Excellence and a winner of the State and National Case Earth Awards for best practice and innovation in Environmental Management and civil construction.

Landform Research was instrumental in assisting with the approvals to undertake the work and for the design of the quarry closure and rehabilitation techniques.

2A BLAST MANAGEMENT

2A.1 Need for Blasting

The area selected for the pit is a geologically mapped hard rock source that can be developed in a manner that does not compromise local values.

The site was also chosen as being adjacent to existing hard rock quarries, therefore not introducing a hard rock quarry into an area where none exists but rather to consolidate and restrict hard rock quarrying to this locality.

The pit has been selected and designed to minimise impacts.

As this is a hard rock resource the rock must be won using blasting.

2A.2 Geology

The rock of the quarry forms the western edge of the Western Gneiss Terrane just east from the Darling Fault, which separates the older eastern hard rock from the deep sediments of the Perth Basin. The younger Proterozoic aged Cardup Group of sediments occurs just west of the pit but does not outcrop. These are steeply dipping shales and sandstones that dip west.

A small west trending fault probably cuts the Scarp at this point and has resulted in the development of the small valley along which Manjedal Brook runs. The fault appears to have has slightly shifted the rock sequences west, north of the fault.

Another fracture or structure appears to run north along the western side of the proposed pit, where the rock appears softer and more weathered. This rock is proposed to be cut out to form the flat processing area and bunding providing for an easier commencement.

The geology can be seen in Western Australian Geological Survey mapping, for example the 1 : 50 000 Perth and Environs Mapping of 1970 Sheet 4.

The pit is wholely located within the Gneiss Terrane. The rock in the pit is felsic to intermediate gneisses which have been intruded by multiple veins and dykes of granites and minor diorite/dolerite dykes.

Above this is a shallow soil profile capped by laterite gravel and duricrust to the east in State Forest outside Lot 800.

Additional notes on the geotechnical aspects of the rock, operations and closure are shown in Attachment 1.

The quarry is located on the brow of the Darling Scarp, rising from 105 metres at the western edge of Lot 800 to over 225 metres on the eastern side of Lot 800. The pit and processing area face north into the hill occupied by the WA BLuemetal hard rock quarry.

See Attachment 1 Geotechnical Assessment and Management.

2A.3 Discussion of Blasting Techniques

Blasting is used to break the rock from the face. This is achieved by drilling holes into the rock in a defined pattern. The holes are then filled with explosive and capped. An electric detonator is used to remotely detonate the charge by triggering the chemical reaction within the explosive. This produces a very large volume of gas in a very short time which places pressure on the sides of the drill hole, fracturing and breaking the adjoining rock.

Blasts are normally designed in a rectangular pattern of multiple holes that are fired with milli-second delays in a particular pattern that lifts and pushes the rock from the face in a sequence. The pattern of blasting can be designed to maximise the production of a certain sized rock fragment which can assist in reducing the amount of crushing or secondary breaking that is required.

Blast impacts consist of air blast overpressure and ground vibration. Ground vibration tends to push back into the face whereas airblast is an air pressure wave that emanates forwards out into the quarry, usually in the opposite direction to ground vibration. Both ground vibration and air blast spread out in a spherical manner and, with the same impact spreading out in an increasingly large volume or area, both dissipate quickly with distance.

For ground vibration there is also normally a distinct drop off of impact with distance, although occasionally the geology can reduce this drop off impact under certain conditions or may even lead to an enhancement of ground vibration. There are certain situations such as a particular geological structure or land surface that may lead to an impact travelling further in one direction than another.

Generally there is a distinct drop off of blast effects with distance. This is most pronounced with airblast. However there can be times when airblast carries further, such as the direction of the blast, or under conditions when the airblast is restrained such as under a temperature inversion. The nature of the blast in terms of the degree of fracturing of the rock to be moved, the orientation of the face, the size of the blast and the weather conditions can all influence the potential impact of a blast. Therefore it is not uncommon for each blast to appear different in character.

Therefore potential blast impacts consist of air blast overpressure and ground vibration.

Changes to the blast levels of air blast overpressure and ground vibration, received at a particular sensor, depend on which face is being excavated.

With progress of the proposed pit, and the orientation of the face, it can be expected that when the northern face is fired, airblast will have a greater tendency to travel south. Ground vibration from the northern face blast will have a greater tendency to travel north.

Sometimes it is difficult for residents to distinguish between air blast or ground vibration because both can make windows rattle under certain conditions. The Statutory Blast limits are set at levels that will not lead to structural impacts but yet may still be heard.

Therefore monitoring of blast impacts is undertaken to provide better design of the succeeding blasts and better management of potential impacts.

2A.4 Normal Blasting Procedures used at Quarries

Blasting today is much better understood and controlled than previously, with good control of blast design, strength of the blast and potential impacts.

Nowadays consultants and good operators are able to closely predict the likely implications after several test blasts, and design the drilling and blasting pattern accordingly. This will be undertaken on this site.

Blasts are designed with millisecond delays so they do not go off with one bang but are sequential and provide heave to the rock. The blast also has to be designed to provide the correct fracturing and the desired rock size for the purpose.

However normal procedure is to undertake several test blasts and monitor the blast levels. From the data, adjustments, as necessary, can be made to the drilling and blasting pattern.

Considering the distances, and the geology as known, it is unlikely that any blast impacts will have significant impact on sensitive premises. In any event the blast design can be used to mitigate any such impacts. Residents are likely to notice the blasting but, based on other quarries and modern blast techniques, blasting will be able to be managed and kept well below the guidance and statutory limits.

Mitigation can, for example, include which face is fired, the design of the excavation, the amount of rock fired, the depth of drill holes, the spacings of the drill patterns, the number of blasts, time of firing and the time delay patterns.

Explosives will not be stored on quarry site, but will be brought to site as required. The materials commonly used are fertiliser and petroleum substances that only become explosive when mixed in a particular ratio and manner and when triggered by a detonator in an enclosed situation. Detonators will be brought to site as required for each blast.

Explosives management procedures are required. People using explosives are required to hold a Shotfirer's Licence through the Department of Mines and Petroleum.

2A.5 Regulation

The *Environmental Protection (Noise) Regulations 1997* state that no blast should exceed 120 dB for a sensitive premises and 125 dB for a non sensitive location when a person is not present. In addition nine in every 10 consecutive blasts are required to be below 115 dB for a sensitive premises when a person is present and 120 dB for a non sensitive premises when a person is not present.

Italia Stone Group will consider the limits for persons being present as the limit. Typical and achievable blasting at quarries is around 105 dB but will depend on the firing conditions.

Ground vibration is controlled by *Australian Standard AS2187 Explosives Storage Transport and Use,* which lists a maximum vibration of 10mm/sec for dwellings and 20mm/sec for commercial premises. Heritage buildings are listed at 5 mm/sec. AS2187 provides very structured guidelines on blasting and the methodology to be used.

AS2187 Explosives Storage Transport and Use also provides control on the transport, storage and use of explosives. Storage and Transport and use of explosives is controlled by the Department of Mines and Petroleum and there are several Guidelines and Regulations relating to them, for example *Dangerous Goods Handling and Storage Regulations 1992.*

Blasting controls are also covered by *the Mines Safety and Inspection Act 1994 and Regulations 1995.* These are now covered by compliance with *Australian Standard AS2187 Explosives Storage Transport and Use.*

DER Licence requirements normally require blasts to comply with 9 out of 10 blasts below 5mm/sec with none above 10mm/sec. Where peak particle velocity exceeds 5mm/sec, notification of the Director of the DER is normally required within 24 hours.

Even though the Statutory Blast limits are set at levels that will not lead to structural impacts they may still be heard or felt.

Ground vibration is often set in Western Australia at 5mm/s with only one in every 10 consecutive blasts being permitted above that level. The Australian Standard for dwellings is 10mm/s for which no blast is to exceed. Typical and achievable ground vibration for quarries is around 2 mm/sec at the available distances but does depend on the geology.

2A.6 Proposed Blast Methodology

When blasting is required, a section of the face will be pattern drilled and then blasted with explosives. Millisecond delays are used on all blasts to reduce both the air blast over-pressure and the ground vibration.

All drilling equipment will be fitted with noise suppression features and regularly checked to ensure compliance with all safety standards.

No explosives are to be kept on site. They will be brought to site as required by the explosives contractor.

Consultants will design the blasts in conjunction with Italia staff, and the same consultants will monitor each blast and provide written documentation to the company.

The blast holes are to be located in the patterns and spacings, combined with blast design using various combinations of airdecks, charging and stemming to produce the best outcome with the least impact. The blasts will then be fired using millisecond delay detonators to reduce noise and ground vibration.

At the time of each blast, the weather conditions are to be recorded. The main weather conditions of concern are the wind speed and direction, and the possibility of a temperature inversion in the atmosphere, which may have the potential to reflect blast noise downwards.

To minimise these features the shots will be fired, wherever possible, around midday, when temperature inversions have broken up and when the wind is most commonly from the south west, blowing away from the main settled areas to the west of the quarry.

Blasting will be conducted below the surrounding level of the hills, located low in the landscape, with the adjoining ridges adding to the shielding of adjoining properties.

It is anticipated that blasting will be in the order of four times per year.

The Shire of Serpentine - Jarrahdale and the nearest residences will be contacted prior to each blast as a matter of courtesy.

A consultation program and liaison group will be implemented prior to commencement of construction and therefore prior to blasting.

A complaints register will be maintained and all complaints will be investigated. As far as is known no complaints have been received within the last five years relating to noise.

2A.7 Potential Blast Impacts

Number of Blasts Proposed

For normal operations it is anticipated that 50 000 – 100 000 tonnes of resource will be removed from the pit annually potentially rising to 200 000 tonnes at five years.

It is anticipated that up to 4 production blasts will be used per year, initially. However during construction, preparation of the faces and benches, testing, and opening the pit, there will be a number of additional smaller blasts required.

The small blasts will provide the opportunity to monitor the smaller blasts and better design the larger production blasts. After the initial period of operation when the quarry potentially moves to 200 00 tonnes of production in the future the number of blasts is likely to be between 4 and 8 per year.

It is noted that there are a number of factors that determine the number of blasts,

- The stage of the pit. For example during construction there will be more and smaller blasts, but during normal operations there will be less and larger blasts.
- The design of the pit to be achieved.
- The type of resource to be extracted.
- The location of the blast within the pit.
- The efficiency of the blasting. For example there can be more smaller blasts or less larger blasts.

However when the faces have been formed, such as the laying back and making safe the faces, a number of small construction blasts may be required.

The design of the pit is summarised below. The figures attached to the main report should be consulted in relation to the location and design of the pit.

The mine plan design will be updated in line with the land survey being undertaken.

The upper bench and face will be made safe and laid back using small construction blasts.

Compliance of Blasts – Dwellings

The existing land uses of the area surrounding the quarry have not changed within the time the quarry has been operating. The dwellings to the south have been constructed in view of the quarry and in the knowledge of the quarry's existence.

The surrounding land is hilly pasture with mainly grazing activities.

The only nearby dwellings are isolated and a significant distance from the site. There is a cluster of sensitive premises to the south west.

The closest dwellings are shown in the Buffers and setbacks at 2A above. Those distances are greater than for a number of other quarries as discussed below and are similar to Hanson Byford Quarry. Based on the known quarrying techniques, blast technology, past experience such as operating the Esperance Port Quarry, and existing hard rock quarries, Italia is confident that blast levels will be well within compliance levels.

2A.8 Existing Quarry Data

Italia Stone Group is a large company that has extensive experience in extraction of basic raw materials and quarries.

They will use the assistance of consultants to plan the quarry and design the blasting and operation of the hard rock quarry.

Some background on current quarrying in Western Australia will illustrate how this site matches other hard rock quarries and the risk that may apply from blasting.

Other major hard rock quarries are located at much closer distances to dwellings than this quarry (see below).

In fact the proposed quarry will have some of the largest buffers to any hard rock quarry. The examples below illustrate how well blasting is now understood and the minimal impacts that can be designed for. Lindsay Stephens of Landform Research is familiar with all the examples below and worked in some capacity on those quarries.

For example the closest dwellings to Boral quarry at Orange Grove are located 500 metres from the active face. Boral is a major hard rock quarry producing perhaps ten times the amount of rock annually that this quarry is to produce and yet all blasts are well within compliance.

Italia Stone Group (as Roadstone), operated the Esperance Quarry to provide rock for the port extension in 2001 – 2004.

At Esperance the buffer available when the Port of Esperance was expanded was very small. The quarry produced rock for the break water construction and the contractor monitored all blasts. There were 399 blasts, all in compliance with the Regulations/ Standards, with the closest dwelling being as close as 220 metres from one edge of the quarry. See the pages under Visual Management, in attachment 3.

At Hanson Mt Barker Quarry the nearest dwelling is 120 metres from the closest face, there is a second dwelling at 300 metres and other dwellings at 700 metres. Blasting is within compliance.

At Bunbury the closest dwellings to the Hanson Quarry are 600 metres. The closest distance from Holcim Quarry at Gelorup is 250 metres. Again blasting is in compliance.

At Byford, the Hanson and WA Bluemetal Quarries have dwellings at 800 metres, the same as the proposed quarry. Blast levels are also in compliance.

The above quarries, like all such operations, comply with the *Environmental Protection (Noise) Regulations 1997* for air pressure and *Australian Standard AS2187 Explosives Storage Transport and Use* for ground vibration and illustrate the significant improvements that have taken place in blast technology, design and monitoring in recent years.

Compared to the distances available for this proposed quarry, the risks are considered to be low with effective design and management of blasting. The only difference is that the face of the pit is relatively exposed to the three eastern and southern dwellings.

The main points demonstrated from the existing quarries is that blasting techniques today are very good and can be designed to minimise airblast and ground vibration at relatively small distances that would apply to the existing dwellings.

In addition the data shows that there is a large difference between isolated dwellings and a new urban or rural living development. For example the proposed quarry has only four isolated residences in the locality. This should be compared to urban land at Orange Grove, Esperance and Gelorup which are near the quarries in those locations.

For new blasting operations in hard rock the allocation of larger buffers is very prudent to prevent potential real or perceived landuse conflicts.

2A.9 Required Buffer for Hard Rock Quarries

A study of the buffer requirements for the Gelorup Area was commissioned by the Western Australian Planning Commission; *Orica, 2001, Gelorup Basalt Quarry Buffer Study – Bunbury WA*.

Whilst the rock types are different, basalt versus granite and some dolerite, the principles are the same. Orica concluded that it was likely that at distances of less than 1 000 metres compliance was likely to be able to be achieved and this has generally proven to be the case.

They noted that there was a risk that occasional blasts may exceed the recommended limits. The report was conducted 14 years ago and blasting techniques have improved.

Landform Research works with 6 large hard rock quarries in the Perth Metropolitan Area, Bunbury and Mt Barker and prepares the annual reports. The data shows that compliance to blasting is always achieved even at distances down to 500 metres for quarries producing over one million tonnes of hard rock annually.

In 2000 the WAPC released the Greater Bunbury Region Scheme. In the Strategic Minerals and Basic Raw Materials Resource Policy of the Greater Bunbury Region Scheme, the WAPC nominated a 1 000 metre buffer referral area in Section 3.0 Application and Figure 1.

A number of other Government Policies relate to buffer distances and the protection of basic raw materials. State Planning Policy No 4.1, State Industrial Buffer Policy, (draft July 2004) discusses the need to consider adjoining land uses when locating buffers but does not prescribe set buffers for operations such as this.

EPA guidance No 3, "Separation Distances between Industrial and Sensitive Land Uses", June 2005 lists the generic buffers for hard rock quarries as 1000 metres depending on the extent of processing. A generic buffer relates to the distance at which there are unlikely to be any problems without some further investigations and does not mean that smaller buffers are not acceptable. This guideline is currently being updated and there is also now a draft Department of Environment Regulation Guideline for buffers that includes quarries.

The pit is almost at the generic buffer with the smallest distance being 770 metres for the closest dwelling, 820 metres for the Murdoch University facilities and 1 050 metres for the next dwelling which will drop to 930 metres for the future stage of the pit after 2050.

For comparison the location of dwellings to other hard rock quarries is provide below.

> Some background on current quarrying in Western Australia will illustrate how this site matches other hard rock quarries and the risk that may apply from blasting.
>
> Other major hard rock quarries are located at much closer distances to dwellings than this quarry. For example, WA Bluemetal, Byford, Hanson at Byford, Boral at Orange Grove, Hanson at Red Hill and Holcim at Gosnells.
>
> In fact the proposed quarry will have some of the largest buffers to any hard rock quarry. The examples below illustrate how well blasting is now understood and the minimal impacts that can be designed for. Lindsay Stephens of Landform Research is familiar with all the examples below and worked in some capacity on those quarries.
>
> For example the closest dwellings to Boral quarry at Orange Grove are located 500 metres from the active face. Boral is a major hard rock quarry producing perhaps ten times the amount of rock annually that this quarry is to produce and yet all blasts are well within compliance.
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>
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At Byford, the Hanson and WA Bluemetal Quarries have dwellings at 800 metres. Blast levels are also in compliance.

The above quarries, like all such operations, comply with the *Environmental Protection (Noise) Regulations 1997* for air pressure and *Australian Standard AS2187 Explosives Storage Transport and Use* for ground vibration and illustrate the significant improvements that have taken place in blast technology, design and monitoring in recent years.

As is normal practice, blasting consultants will be used to design and monitor blasts, to ensure that the most efficient, safe and environmentally sensitive blasting techniques are used.

There is no means of definitively modeling blast impact prior to blasting occurring, because the geology cannot be intimately known until the quarry commences and faces of rock are exposed. However current knowledge of blasting has reached a level of sophistication that quarry operators and Blast Management Consultants can be confident that blasts can be designed and fired in compliance with the regulations and standards, and that potential impacts are minimised.

Normal practice used by Italia when opening a quarry is to use small blasts to check compliance. When monitored results are available, and the first faces are exposed, the design of the blasts can be adjusted and increased, to the point where greater production efficiency is achieved whilst maintaining compliance and minimising any blast impacts on local residents.

Blasts at the large hard rock quarries in the south west of Western Australia are normally in the range of 95 to 110 dB for airblast with occasional blasts between 110 dB and 115 dB together with and < 2mm/sec for ground vibration, at the monitoring stations which are normally located at the closest dwellings.

The existing hard rock quarries demonstrate that blasting can be managed within the buffer distances available.

Italia Stone Group is committed to minimising any adverse impact on the existing local residents and will work with them to ensure a satisfactory outcome is achieved.

2A.10 Management of Blasting

Italia Stone Group is committed to minimising any risk of impact on local residents or structures and will ensure that the concerns of residents are noted and incorporated into all operational and blast procedures.

Blasting is designed to comply with best practice such as *Read, J and P Stacey Eds, 2009, Guideline for Open Pit Slope Design, CSIRO CRC.*

A number of mechanisms are available to minimise blast impact from airblast and ground vibration. These are summarised from *Orica, 2001, Gelorup Basalt Quarry Buffer Study – Bunbury WA* and current practices.

- Use smaller diameter drill holes.
- Reduce the height of benches.
- Use blast initiation sequences that drive away from areas of concern.
- Achieve the best firing time delays. This can raise other issues and is not always available.
- Increase stem lengths in blast holes.
- Splitting charges in half to reduce the kg of explosives per delay.
- Manipulate the delay sequences and point of initiation.
- Use greater front row burdens.

- Generate ground vibration reduction trenches, although this may not be possible in all situations on site.
- Firing more holes less frequently, because it is found the local people generally prefer less blasts rather than more blasts even if they are smaller.
- Use of pre-splitting or line drilling to create a smooth face and reduce impacts.
- Use of air decks to manipulate the blast.

The following Blast Management is proposed.

1. No explosives or detonators will be stored on site. Blasting materials will only be brought to site by a licensed supplier. The materials will be blended on site, only at the time of charging the blast holes; the same practice used in all hard rock quarries.

2. Italia Stone Group will inform the nearby residents prior to the commencement of blasting.

3. Italia Stone Group will undertake blasting in compliance with *Australian Standard 2187* which sets out good management practices and procedures for blasting.

4. Italia Stone Group will comply with the *Environmental Protection (Noise) Regulations 1997* for air blast over pressure and *Australian Standard AS2187 Explosives Storage Transport and Use* for ground vibration. They will also comply with any Department of Environmental Regulation Licences, if they condition blasting.

5. Blasting consultants will be used to design all blasts, to ensure that the most efficient, safe and environmentally sensitive blasting techniques are used.

6. All drilling equipment will be fitted with noise suppression devices and regularly checked to ensure compliance with all standards.

7. All blasts will be designed to heave the rock with millisecond delays in firing to reduce the impacts. This produces a slightly extended rumble rather than a loud bang.

8. There is potential to have smaller more frequent blasts or larger less frequent blasts. At other quarries residents prefer larger less frequent blasts and Italia Stone Company will use this procedure.

9. For each blast an assessment of the risks from fly rock will be made to determine what management is required for each individual blast for site operations.

10. All initial blasts will be monitored by a consultant. Later blasts will be monitored either by consultants or by Italia Stone Group staff under the supervision of consultants depending on the frequency of blasts.

11. Initial blasts will be small, with blast size increasing only gradually. The blasts will be monitored and the size of subsequent blasts will only be increased when Italia Stone Group and the consultants are confident that impacts of a larger blast can be maintained within the required levels.

12. Blast monitoring stations will be established at strategic locations, if available at the nearest dwelling or on Pruden Road. The monitoring equipment will be rotated around the monitoring sites and when the most representative site is found that will be used as the main monitoring station.

13. Initial monitoring will be conducted at two sites, but as the characteristics of the pit become better known, and bearing in mind the distances involved, it may be possible for one monitoring station to be representative of potential impacts. On the other hand there may be occasions when more monitoring stations are used.

14. Italia Stone Company will have in place an operational Blast Management Plan that will detail, among other procedures, that only a licensed Shotfirer will be permitted to use explosives, and the procedures for on site warning of an impending blast, traffic and road management. This will be based on an appropriate guideline such as *The Institute of Quarrying Australia, Explosives Management.*

15. A record will be kept of all blast monitoring and the weather conditions at the time of blasting.

16. Blasts will normally be conducted between 11.00 am and 2.00 pm.

17. During normal operations, the Shire of Serpentine - Jarrahdale and any of the four closest residences who wish to be informed will be notified 24 hours prior to a blast occurring.

18. A complaints register will be maintained and all complaints will be investigated. Records will be kept of all complaints and the results of the investigations into those complaints.

2.C NOISE MANAGEMENT

Operations

A small quarry operation set 1 km back from South Western Highway behind the existing and proposed landform provides good mechanism to provide for noise screening.

Italia Stone Group has undertaken discussions with close residents as discussed below.

Noise Management is designed to comply with Best Practise, such as *Institute of Quarrying Australia/Queensland Government, Noise Management.*

Regulatory Framework

Noise can originate from a number of operations and may impact on onsite workers, or travel offsite and impact on external sensitive premises. Both potential noise impacts are addressed by reducing the noise generated from the quarrying and processing operations.

Offsite noise is governed by the *Environmental Protection (Noise) Regulations 1997.*

The *Environmental Protection (Noise) Regulations 1997*, require that sensitive premises including dwellings in non industrial and rural areas, are not subjected to general noise levels (excluding blasting), during the hours 7.00 am to 7.00 pm Monday to Saturday that exceed 45 dBA. Allowable noise to 55 dBA is permitted for up to 10% of the time and to 65 dBA for 1% of the time. Noise levels are not to exceed 65 dBA during normal working hours.

Between 9.00 am and 7.00 pm on Sundays and Public Holidays, and between 7.00 pm and 10.00 pm on all days, the base level is 40 dBA.

At night, between 10.00 pm and 7.00 am Mondays to Saturday, and before 9.00 am on Sundays and Public Holidays the permitted level drops to 35 dBA.

The 10% and 1% “time above” allowances apply at night and on Sundays and Public Holidays as well.

There are penalties for tonality of 5 dB, modulation 5 dB and 10 dB for impulsiveness, that are added to the permitted levels. That is, if the noise is tonal or modulated the permitted levels drop by 5 dB. Impulsiveness is not likely to be relevant for the quarry under normal circumstances.

The Noise Regulations provide for Construction Noise exemptions to enable construction of the site such as the building of the western screening bund.

Influencing factors that raise the allowable noise levels are activities such as external industrial noise, some nearby land uses and busy roads. These are not relevant to this site.

Under Schedule 1 of the Noise Regulations the premises on which the extraction of basic raw materials are extracted, is classified as Industrial Land for the purposes of calculating influencing factors. This was defined as the whole cadastral boundaries in State Administrative Tribunal decision {2013} WASAT 139, Bushbeach v City of Mandurah. In this case the premises is quite small and approximates the area of disturbance and will have little impact on the influencing factors.

At a distance greater than 15 metres from the sensitive premises (eg dwelling), and commercial premises, a base level of 60 dBA applies at all times, with the 10% time permitted to be up to 75 dBA and the 1% permitted to be up to 80 dBA. For industrial premises the base level is 65 dBA at all times with the 10% time permitted to be up to 80 dBA and the 1% permitted to be up to 90 dBA.

Environmental Noise Management

A noise assessment has been carried out by Herring Storer Acoustics and is included in the following information.

The Herring Noise Assessment was modeled on the anticipated quarrying operation. See the attached report.

There are no permanent facilities currently on site associated with quarrying. There is a dwelling on site to be used as a caretaker's residence, sheds and associated water storage tanks.

During operations a mobile crushing screening plant will be utilised on site.

The types of equipment proposed to be used are listed below. Not all plant will be on site at any one time and that provides for contingencies in relation to reduce the operational noise on site if necessary at certain times.

Herring Storer also modeled the transport route across Lot 800.

Anticipated equipment required for the production of coastal rock, such as armour rock.

- Track mounted percussion drill and compressor.
- 20 tonne excavator or similar.
- Rubber tyred loader
- 35 – 50 tonne off-road dump truck for internal transport of rock from the pit to the crusher.
- 20 tonne water truck or similar for dust suppression.
- Self contained maintenance vehicle to attend site as required.

Herring Storer modeled a loader loading road trucks and transport along the access route during the night time period, prior to 7.00 am. See the attached report.

For day time operations they modeled, a front end loader within the crusher stockpile area, excavator within the pit loading a quarry haul truck, quarry dump truck, crushing and screening plants and the drill rig.

Herring Storer found by modeling at all the closest sensitive premises that night time operations would be restricted to two truck in and two truck out per hour, but that the day time activities would be unrestricted.

The urban areas west of South Western Highway lie 1 200 metres away. As Residences A and B that are closer comply with the Noise Regulations so will noise levels at the zoned urban areas.

It is also possible that when all equipment is operating the noise levels of some operations in a particular location in the quarry will lead to higher noise levels. If that is the case onsite operational noise monitoring will be conducted to determine what additional noise management is required if at all.

It is likely that the most effective noise management will be to reduce the number and type of plant operating at any time. Any processing and screening plant will be located low in the landscape on the floor of the pit.

Comprehensive noise management is provided, with pit excavation and processing located below natural ground level where possible and below the local ridges.

The measures proposed, combined with the setbacks, provide effective noise management and enable compliance with the Noise Regulations.

General Noise Management		
OPERATIONAL PROCEDURES	**COMMITMENTS**	**MANAGED RISK**
• Comply with the *Environmental Protection (Noise) Regulations 1997.*	• Italia Stone Group is committed to compliance with the Regulations. • Herring Storer conducted noise modeling of the proposed operations and found the activities to be in compliance with the Regulations. • Herring Storer modelled all close residences and found that night time operations would be restricted to two truck in and two truck out per hour, but that the day time activities would be unrestricted. See the Attached Herring Storer Report. • The urban areas west of South Western Highway lie 1 200 metres away. As Residences A and B that are closer comply with the Noise Regulations so will noise levels at the zoned urban areas. • The Noise Regulations provide for Construction Noise exemptions to enable construction of the site such as the building of the western screening bund.	Noted
• Maintain adequate buffers to sensitive premises.	• There are only three sensitive premises located within 1 000 metres Residence A to the north west at 770 metres, Residence B (Murdoch University Facilities) at 820 metres and Residence F which is 1 050 metres south from the operations to 2050 and the 930 metres to the pit past 2050. • The pit is designed so that all sensitive premises are located behind landform or screening bunds. • The land size is restricted providing little potential to alter the pit and no ability to increase the buffers.	Low
• Locate exposed features behind natural barriers and landform.	• All crushing and screening is to take place on the floor of the pit behind a natural spur and 4 metre high western bund, below the natural land surface, as low in the landscape as possible on a constructed hard stand area. • The Faces and benches of the pit are designed to face north into the hill occupied by Hanson and WA Bluemetal quarries, providing the	Low

	ridge to the south as landform screening to the dwellings. • The access road is to be sealed.	
• Operate from the floor of the pit below natural ground level.	• See above. • The noisiest part of the operations is the breaking out and processing of the rock, rock breakers if used and crushing if used. These will be located behind the landform in the pit itself. • The crushing plant is to be located adjacent to the western screening bund and land form to maximise noise mitigation.	Low
• Design site operations to maximise the separation and protection from sensitive premises.	• The quarry has been designed to maximise the setbacks to the closest sensitive premises. • The quarry is located on a north facing slope on the southern side of the Manjedal Brook, facing along the Scarp, rather than west to the Swan Coastal Plain. The proposed operations are 1 km from South Western Highway. • The location has been chosen to minimise or mitigate the visual impacts from the Swan Coastal Plain and sensitive premises. A visual analysis shows that the site is not visible from South Western Highway because of the extensive tree growth along the road verge of the highway. • The pit is located behind a low spur which forms the western boundary and can be added to with bunding, and behind existing trees. • The access road is chosen to provide suitable gradient as well as be located behind existing trees on site.	Low
• Maintain all plant in good condition with efficient mufflers and noise shielding.	• This will be used and is committed to.	Low
• Maintain haul road and hardstand surfaces in good condition (free of potholes, rills and product spillages) and with suitable grades.	• The access road is chosen to provide suitable gradient as well as be located to provide visual and noise screening. • These methods are used to minimise banging of trays and other transport noise. See dust management	Low
• Implement a site code outlining requirements for operators and drivers.	• A site code is in place at other Italia quarries and will be used on this site. • Italia is committed to site induction and training for all personnel for all parts of the operations. • This may include limiting the number and type of plant operating at any one time as required to maintain compliance with the Noise Regulations.	Low
• Shut down equipment when not in use.	• Shutdown is used to save fuel and maintenance costs in addition to noise minimisation.	Low

• Scheduling activities to minimise the likelihood of noise nuisance.	• Quarrying and processing operations are to be conducted during normal working hours between 7.00 am to 5.00 pm, Monday to Saturday. • The only operations outside that time may be the loading of two trucks per hour prior to 7.00 am or maintenance that will comply with the Noise Regulations. • Contingencies are available to reduce noise levels further such as limiting the number and type of plant operating at any one time as required to maintain compliance with the Noise Regulations.	Low
• Fit warning lights, rather than audible sirens or beepers, on mobile equipment wherever possible.	• Lights or low frequency frog beepers are used rather than high pitched beepers to restrict noise intrusion.	Low
• Provide a complaints recording, investigation, action and reporting procedure.	• A complaints recording and investigation procedure is to be implemented and maintained. • A community liaison group is to be established with the owners – occupiers of the closest residences.	Low
• Conduct training programs on noise minimisation practices.	• Italia Stone Group conducts site induction and training for all personnel.	Low
• Provide all workers with efficient noise protection equipment.	• All personal noise protection equipment is provided to staff.	Low
• Blasting and rock breaking	• The site is relatively remote from sensitive premises but requires careful operational design and conduct to maintain minimal risks of offsite no impact from blasting and rock breaking.	Low

Occupational Noise

Occupational noise associated with the quarrying processes falls under the Mines *Safety and Inspection Act 1994 and Regulations 1995*.

The management of occupational noise is normally handled by providing all necessary hearing protection, as well as conducting worker inductions and educational programs for all staff. Regular site audits of quarry and mining operations are normally conducted by the Department of Mines and Petroleum.

As part of its commitments, Italia Stone Group will be pro-active with its worker safety awareness;

- by providing all necessary safety equipment such as ear protection,
- identifying sections of the plant where hearing protection is required, as well as,
- conducting induction and educational programs for its staff.

All staff are provided with comprehensive ongoing training on noise protection as part of Italia commitment to occupational health and safety.

Warning signs are used to identify areas of potential noise associated with mobile plant.

The operating noise levels around the site are regularly monitored by independent consultants in accordance with the *Mines Safety and Inspection Act 1994*, and the results communicated to the Department of Mines and Petroleum (DMP).

All staff are provided with comprehensive ongoing training on noise protection as part of Italia's commitment to occupational health and safety.

The DMP conducts inspections of all quarries and that will continue at this site.

2D DUST MANAGEMENT

2D.1 Environmental Dust

Background

Excessive dust has the potential to impact on both the workers and the adjoining land. However the potential generation of dust must be taken in context.

There are a number of key aspects to dust impacts;

- What is the source of particles?
- What is the potential for the particles to be disturbed?
- What is the nature of the particles and how are they likely to behave?
- What types of impacts are the particles likely to have if they move?
- What management actions can be used to mitigate or reduce dust impacts?

The most common form of disturbance is by mobile plant and vehicle impacts. In this local area dusty roads have the most potential to produce dust, such as the access road and traffic on the pit floor.

In many situations the fine particles are stablised by vegetation, soil microbial materials and reactions and interactions between particles.

Once disturbed however dust can be generated and may continue to be a problem until the fine particles are wetted down or return to a relatively stable condition. With effective treatment of dust by water, which is proposed, the risks of onsite, and consequently offsite, dust are minimised.

Excessive dust has the potential to impact on both the workers and the adjoining land. However if occupational dust is managed environmental dust will also be managed.

Dust can originate from a number of operations and may impact on onsite workers, or travel offsite. Potential dust impacts are addressed by reducing the dust generated from the quarrying, processing and transport operations. Most dust is generated during vehicle movements.

Occupational dust associated with the quarrying processes falls under the *Mines Safety and Inspection Act 1994 and Regulations 1995* overseen by the Department of Mines and Petroleum who regularly inspect the site.

2D.2 Assessment of Dust Risk

Dust Guidelines

Dust management is an integral part of the extraction of hard rock.

Dust emissions fall under the *Guidance for the Assessment of Environmental Factors, EPA, March 2000*. Assessments of the potential dust risk are normally made using the Land development sites and impacts on air quality, *Department of Environmental Protection and Conservation Guidelines, November 1996.* These are still in place but are incorporated into the *DEC (DER) 2011 Guideline for Managing the Impacts of Dust and Associated Contaminants from Land Development Sites, Contaminated Sites Remediation and other Related Activities.*

The *DEC (DER) in 2008* released a *draft Guideline for the Development and Implementation of a Dust Management Plan.*

The documents are not really applicable with the buffer distance available for a hard rock quarry to the nearest sensitive premises.

Onsite Risks

The main risks from dust are from dust on the bitumen access road, vehicle activities and processing (crushing and or screening) and to worker amenity. It is noted that the main use of the rock is for coastal works which reduces the need for crushing and screening although this will be used to remove subgrade materials from site.

The main rock produced will be for coastal work where boulders and large rock are required, rather than crushed products. This reduces the potential for dust generation.

The key Environmental Objectives for the operations are;

- Manage the potential for the generation of dust.
- Visually monitor dust levels and take steps to reduce the potential impact of dust on occupational and environmental aspects of the operation and local area.

2D.3 Buffers

The setbacks provide effective dust management and comply with the EPA generic buffer guidelines for all but three premises as noted above in 2A Buffers and setbacks. Even so the landform screening and tree belts in place comply with all dust Guidelines and Department of Health Guidelines.

The closest dwellings are shown below. See the attached plans for their location;

Residence A 770 metres north west - (partially protected by screening bund and landform)

Residence B 820 metres west north west - (behind screening bund)

Residence C 1 150 metres south west - (behind landform)

Residence D 1.220 metres south west - (behind landform)

Residence E 1 370 metres south west - (behind landform)

Residence F 1 050 metres from to pit to 2050 - (930 metres from the proposed future stage, behind landform of future quarry stage)

Residence G 1 470 metres south - (behind landform)

The Whitby Urban Precinct west of South Western Highway lie 1 200 metres away. As Residences A and B, that are closer, comply with the Noise Regulations so will noise levels at the zoned urban areas.

The access road to the pit is to be sealed.

It is noted that the buffers available to sensitive premises are greater than for other operating quarries that are producing much larger volumes of material. For example the available and proposed buffers are much greater than Boral Orange Grove Quarry, Hanson Bunbury, Mt Barker and Gelorup Quarries, Holcim Gelorup and Albany Quarries and all of which have a number of dwellings at 500 plus metres or less and all have operated for many years.

The buffers and setbacks are similar to those available to Hanson Byford Quarry.

Dust particles are readily stopped by tree belts and distance, with which the site complies. Tree belts slow the wind and allow the dust to settle. See *Planning Guidelines Separating Agricultural and Residential Land Uses, Department of Natural Resources Queensland 1997(Pages 65 – 111) and Department of Health WA, 2012, Guidelines for Separation of Agricultural and Residential Land Uses which uses the same criteria (Pages 112 – 118).*

The Queensland Guidelines predominantly relate to agricultural spray drift, but based on particle size also relate to dust. They are based on field studies and demonstrate the effectiveness of tree belts and distance in providing screening against particulate travel.

The Guidelines provide for a buffer of 300 metres for open agricultural land, dropping down to 40 metres where an effective tree belt is in place. The Western Australian Department of Health also uses the same guidelines.

The operations comply with the Department of Health buffer recommendations, with landform screening, tree belts and 770 metres of separation distances.

The other factor locally is the strong easterly morning katabatic winds that blow down the Darling Scarp.

The available buffers and trees belts will mitigate the dust risk, combined with wetting down that can occur prior to commencement of quarrying and processing at 7.00 am when vehicle traffic and on site activities could potentially generate dust. There is also the proposed contingency to stop work when abnormal conditions significantly increase the dust risks.

2D.4 Occupational Dust

Italia Stone Group provides induction and protective equipment for all persons on site.

The DMP require personal dust monitoring to ensure dust levels comply with health risk guidelines.

The dust management procedures used on site comply with these guidelines.

2D.5 Actions and Management

There are a number of management actions that can be taken in quarries to minimise dust generation or travel and these are used wherever possible. The general management actions are summarised in the tables below, together with the potential dust issues that relate to this site. The actions are used where applicable and as the opportunity presents to minimise dust on this site.

A dedicated water truck is to be retained on site for the wetting down of roads and other dust suppression activities. In addition the access road is to be sealed and maintained.

Loads on trucks that have the potential to generate dust are required to be covered.

Methods that are available, and will be selected from as appropriate, are listed below. The most effective by far is the use of water management from a water truck, sprinklers, water canon or other such mechanism.

DESIGN AND SITE

1. Minimising the amount of ground open.
2. Minimising the amount of ground being subject to traffic.

3. Locating access roads away from sensitive premises, which has been used in the design of the pit. The access road is located with existing trees along the western edge.
4. Design of the pit to reduce wind speed and potential dust lift off. The pit is set low in the landscape, with the floor elevation well below natural land surface.
5. Maintaining effective setbacks.
6. Constructing perimeter bunds to reduce wind speed.
7. Planting and maintaining the existing tree buffers.
8. Providing wind break fencing generally and on top of bunds as required.
9. Maintaining a secure, fenced site, to prevent illegal access.
10. Rehabilitate and stabilise all completed areas as soon as practicable.
11. Clearing and replacing topsoil and overburden during wetter times.

OPERATIONS

12. Locate active areas away from windy locations.
13. Locate active areas away from sensitive premises. The design of the pit has located the processing low in the landscape, behind the landform and a proposed vegetated screening bund and existing trees.
14. Working on the floor of the pit.
15. Operate some parts of the pit only when conditions are suitable. This remains a contingency.
16. Locating mobile plant and stockpiles in sheltered areas.
17. Design staging to minimise dust risk.
18. Conduct higher dust risk operations such as topsoil clearing and placement during more favourable conditions.
19. Shut down equipment that is not required.

ACCESS AND HARDSTAND

20. Constructing the haul road and access road from hard materials that resist dust generation. The access road is to be sealed.
21. Maintaining a water truck on site for road and other wetting down.
22. Using a sealant such as a polymer, chemical or emulsified oil or bitumen on the internal roads to reduce water use.
23. Using sprinklers and water canon on internal roads, traffic areas and stockpiles.

PROCESSING

24. Applying water sprays, mists and additives to crushing and screening cycles.
25. Providing screening and shielding of mobile plant.
26. Use and maintain filters on all suitable plant.
27. Ensure regular appropriate emptying of filter collection devices.
28. Face hoppers away from prevailing winds.
29. Maintain reduced pressure in plant, hoppers and bins to prevent loss of dusty air.

STOCKPILES

30. Minimise the number of stockpiles.
31. Maintain stockpiles in sheltered areas located low in the landscape, well below the natural surface.
32. Reduce the elevation of stockpiles.
33. Limit the drop height to stockpiles and loading.
34. Locate finer products inside or screened by stockpiles of coarse materials.
35. Locate stockpiles away from sensitive premises.

TRANSPORT

36. Cover all loads.

37. Ensure all trucks are dust free and not carrying pebbles and other materials outside the tray.
38. Choose the best transport routes.
39. Wet down or sweep the cross over and access roads.

HEALTH AND COMMUNITY

40. Maintain air conditioned cabins on all vehicles.
41. Provide a readily auditable trigger of no visible dust to cross the property boundary in line with DER Licence and best practice in WA.
42. Provide a comprehensive visual monitoring program.
43. Conduct effective site induction and awareness training for all staff.
44. Training should include observation and mitigation where possible of all dust emissions.
45. Providing a complaints investigation, mitigation and recording procedure, which is proposed.
46. Liaising with the owners/occupiers of the nearby sensitive premises through a liaison group.
47. Ceasing operations when conditions are not favourable or when visible dust is crossing the boundary.
48. Obtain the latest weather conditions to increase the awareness of dust risk.
49. Cease operations during adverse weather conditions.
50. Operate during wetter months or when the soils are moist.

2D.6 Dust Management Actions

ACTIVITY	POSSIBLE RISK SEVERITY and FREQUENCY	OPERATIONAL PROCEDURES AND COMMITMENTS	RISK AFTER MANAGE MENT
GENERAL			
Legislation	----	• Italia Stone Group will comply with the provisions of the *Mines Safety and Inspection Act 1994 and Regulations 1995.*	----
Buffers	----	• The main area where dust might be an issue is along the internal haul roads and processing in dry conditions. • Most dust is generated from vehicle movements on roads rather than excavation. Dust can also be generated from crushing and screening and tipping. • See the setbacks above. • The access road is located away from sensitive premises where it is already screened by existing trees.	----
Landform	----	• Activities are designed and located behind the natural ridges, where possible by excavating from the base of the pit. • The separation distances mitigate the dust risk to the residences from excavation and processing. • Transport dust risks pose the greatest offsite risk.	----
	----	• The pit is worked from the floor and lower benches where possible to reduce wind on the floor and to enable the face to provide barriers to dust lift off and carry.	----
		• Perimeter bunding is used where applicable and possible to increase the elevation of the screening to reduce wind impacts and dust carry.	----
Vegetation	----	• Vegetated buffers of 1000 metres are in place and no tree planting is required for the dwellings to the south and east. • There are large existing trees along the access road. Additional planting will be undertaken in areas where no trees are present.	----
Pit Design and Staging	----	• Design and staging have been selected to maximise management.	----
Screening	----	• Perimeter bunding is used to increase the elevation of the screening to reduce wind impacts and dust carry where possible.	----

		• The buffer distance are large enough for tree belts not to be required for quarrying and processing. • Operating on the floor of the pit reduces wind speed and lessens the risk of dust lift off. • See "Vegetation" above for the Access road.	
MANAGEMENT			
Occupation	----	• Air conditioning and enclosed cabs are used for on site operational mobile plant.	----
Monitoring	----	• A monitoring system is in place. See Trigger Conditions below.	----
Trigger conditions	----	• Most dust is generated from vehicle movements and uncontrolled crushing. • The trigger for dust management is the generation of visual dust. • The site supervisor is normally the loader driver who is in the best position to assess dust generation and to direct remediation. • A commitment is made that no visible dust will cross the boundary to impact on dwellings. • On site operators are instructed to visually monitor dust, report and treat any visible dust.	----
Adverse weather	Moderate - Uncommon in winter, more common in summer.	• When winds are sufficiently strong, or other weather conditions are unacceptable to negate the effects of dust management, operations will cease until conditions improve and compliance can be achieved.	Low
Equipment failure	Low to moderate - Uncommon	• Machines and site activities are shut down in the event of breakdowns that prevent adequate dust management.	Low
Training	----	• Italia Stone Group use on site induction and training to all personnel at all operations.	----
Complaints	----	• A record of all dust complaints is to be maintained together with the mitigation measures to be used to reduce the dust impacts. • All complaints relating to dust are to be investigated immediately on receipt of a complaint.	----
EARTHWORKS			
Land Clearing	Moderate - Once per year	• Clearing will be required apart from that needed to lay back the upper face. • The clearing will be conducted in campaigns. • Where possible clearing will be completed in wetter months or when winds are blowing away from sensitive premises.	Low
Overburden removal	Moderate - Once per year	• This is used. • Overburden removal is infrequent. • Where possible overburden removal, stripping and soil restoration will be completed in wetter months or when winds are blowing away from sensitive premises.	Low
Land restoration	Moderate - Once or twice per year	• Scheduled activities such as ripping, overburden and topsoil spreading on exposed ridgelines are undertaken at times when the materials are less likely to blow or during suitable wind conditions.Land restoration is infrequent and normally conducted only once per year. • Where possible clearing will be completed in wetter months or when winds are blowing away from sensitive premises.	Low
EXCAVATION - PROCESSING			
Excavation	High - Frequent	• Similar excavation methods are proposed with most product being large rock for coastal work rather than aggregates. • The excavation of hard rock is not generally dusty in itself, it is the traffic on the floor of the pit and on hard stand areas and any processing that is more likely to generate excessive dust. • The use of rock breaker and blasting can generate small amounts of dust but is managed through normal quarry operational procedures. • Transport and operations are anticipated to be intermittent through the year rather than continuous.	Low

Processing	High - Frequent	• Maintain hardstand surfaces in good condition (free of potholes, rills and product spillages) and with suitable grades. • Treatment with water is used where possible. • A water truck is located on site as necessary during operations and the active hardstand and access road is treated as needed. • However treatment with water is not always possible because of its lack of availability. • Plant location, and approach with respect to wind directions, will be used to minimise impact on operators. • All crushing and screening plant will be located on the pit floor below natural ground level to reduce wind speed and reduce dust lift off.	
Loading and Stockpile Creation	Moderate to High - Frequent and in campaigns	• Hard rock for coastal work forms little dust when loaded or stockpiled.	Low
		• Stockpiles are located on the floor of the pit at generally low elevations. • It is the vehicle movements during dry conditions that generate the greatest dust risk.	
		• Treatment with water is used as required. • A water truck is located on site as necessary during operations and the active hardstand and access road is treated as needed. • Plant location, and approach with respect to wind directions, will be used to minimise impact on operators. • The internal roads are graded as required to minimise dust.	
TRANSPORT			
Road condition	Moderate to High - Frequent	• The access road is no different to any other local gravel road and is used only to service the pit. • The access road is to be maintained in good condition (free of potholes, rills and product spillages). • Water or soil stabiliser will be used to wet down the access road as required. • The cross over to South Western Highway and Pruden Road will be maintained.	Low
		• A dedicated water truck is retained on site when dust lift off is a potential hazard. Sprinklers may be used in some parts of the operation.	
Road Transport	Moderate to High - Frequent	• Trucks are required to install tarpaulins or cover prior to exiting the quarry. • Transport and operations are anticipated to be intermittent through the year rather than continuous.	Low
		• A site code and induction system is used for the quarry.	
		• Italia and other road trucks are maintained in a clean condition. • Individual contractors are required to do likewise.	
Loading Trucks	Moderate to High - Frequent	• Italia Stone Group has a policy of covering or wetting down loads and instructs drivers to report and clean up spillages.	Low
		• This forms part of Italia Stone Group normal operational procedures. • Loader drivers are instructed on the best means of loading to minimise overflow and spillage. • Trucks are inspected prior to leaving the site and brushed down as necessary.	

2D.7 Dust Monitoring

The most effective dust monitoring is the sighting of visible dust. Dust can be detected as soon as it leaves the wheels of vehicles and detection is not reliant on dust travelling to a machine monitor located near the boundary.

When trigger conditions are detected and/or alerted, relevant action is taken. This can include additional water suppression, modification of procedure, delay until more favourable conditions are present, use of alternative equipment etc.

Human monitoring can detect potential dust risks prior, and take action prior, to significant dust being generated. They notice dust immediately such as from tyres, whereas machine monitoring has to rely on significant dust being generated, travelling to the boundaries of the premises and triggering an alarm. The operators would be negligent if they let the dust get to that level of impact prior to taking action.

The auditable condition is visible dust crossing the boundary of the premises; the lot boundary. This is the condition used on Department of Environment Regulation Licences and all other quarries such as sand, limestone and hard rock quarries in Western Australia and has worked well in the past.

It is also the method used by the Department of Mines and Petroleum to rapidly assess occupational dust on site.

Most dust generated from processing and vehicle movements has a very large visible component. Lesser risks emanate from excavation and land clearing. As invisible dust can be generated with the visible dust, recognising and dealing with visible dust is a very effective instantaneous method of recognising excessive dust.

The quarry manager and leading hand are ultimately responsible for site supervision of dust. They will travel around the operations and pit frequently and are in two way radio contact with all mobile plant.

All operators on site are instructed to be vigilant to dust generation and management and report any excessive dust or potential dust management issues.

Visual monitoring is even more effective when complemented by an extensive reporting and complaints process and this is used.

The effectiveness of the dust management is shown by no complaints regarding dust normally being received. No complaints are known relating to dust from excavation within the past five years.

2D.8 Greenhouse Gas

The development of the Perth and Peel Regions has generated the need for construction products and aggregates for coastal works and other constructions

Over the years trucks have become more efficient with respect to greenhouse gas emissions, particularly with the use of truck and trailer and road train configurations.

Italia Stone Group continues to seek ways to reduce the amount of fossil fuels used, and has obtained more efficient mobile plant and equipment when this has become economically available.

The internal design of the operations attempts to minimise the haulage route to save energy use and potential impacts.

2D.9 Complaints procedure

Visual monitoring is more effective when complemented by an extensive reporting and complaints process.

An effective complaints mechanism is an essential part of the dust identification and management and is proposed.

A complaints book that lists the items below will be used. The book will be available as requested.

- The complaint,
- Nature of the complaint, time and date,
- Source of the complaint,
- Investigations of the complaint,
- Results of the investigation,
- If the complaint is valid, any mitigation actions that result,
- Any communication with the complainant.

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LANDFORM RESEARCH

ROCK QUARRY
LOT 800 PRUDEN LANE, WHITBY

ACOUSTIC ASSESSMENT

JULY 2016

OUR REFERENCE: 20685-1-16159

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LANDFORM RESEARCH

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CONTENTS

APPENDICIES

1. INTRODUCTION

Herring Storer Acoustics was commissioned by Landform Research, on behalf of Italia Stone Group to undertake an acoustic assessment of noise emissions from a proposed quarry operation to be located at Lot 800 Pruden Road, Whitby. The objectives of the study were to:

- Determine, by modelling, noise propagation from the quarry.
- Assess the predicted noise levels received at the neighbouring noise sensitive premises, for compliance with the *Environmental Protection (Noise) Regulations 1997*.
- If exceedances are predicted, investigate possible noise control options that will reduce noise emissions to achieve compliance with the regulations.

For information, a locality plan is attached in Appendix A.

2. SUMMARY

An acoustic assessment has been conducted of the noise emissions from the proposed hard rock quarry to be located at Lot 800 Pruden Road, Whitby.

The quarry would only operate during the day period (i.e. Monday to Saturday 0700 to 1700 hours). However, we understand that there will be a limited number of trucks that would be loaded in the period between 0600 and 0700 hours. Therefore, at the neighbouring residences, noise emissions from the quarry operations need to comply with the assigned L_{A10} day period noise level of 45 dB(A). Additionally, the loading of trucks in the period between 0600 and 0700 hours needs to comply with the assigned L_{A10} night period noise level of 35 dB(A). Finally, trucks movements to and from the site need to comply with comply with the assigned L_{A1} noise level for both the day and night periods of 55 and 45 dB(A), respectively.

Noise received at the residential premises has been determined, to be 35 dB(A) for the quarry operations, with the inclusion of a 4 metre high bund, the extent of which is shown on the locality plan attached in Appendix A. Additionally, noise received at the neighbouring residence from trucks being loaded during the night period (ie between 0600 and 0700 hours) has been determined to be 28 dB(A). Hence, noise received at the neighbouring residence from these operations, would comply with the requirements of the Environmental Protection (Noise) Regulations 1997 with the inclusion of a 4m high bund constructed as shown the plan attached in Appendix A.

With regards to truck movements, analysis shows that the maximum noise level received at a neighbouring residence is 40 dB(A), which even with the addition of a +5 dB(A) penalty for a tonal component would comply with the assigned night period L_{A1} noise level of 45 dB(A). However, for noise emissions from truck movements to be considered as an L_{A1}, the number of truck movements needs to be limited to 4 per hour (ie 2 entering and 2 leaving). It is also noted that during the day period, noise received from the whole quarry operation including truck movements would comply with the assigned L_{A10} noise level of 45 dB(A). Hence, the restriction on truck movements would only apply to the period between 0600 and 0700 hours.

Given these operating parameters and with the inclusion of a 4 metre high barrier, noise levels received at the nearest premises has been calculated to comply with the *Environmental Protection (Noise) Regulations 1997* for the operating times as outlined in this assessment, even with the inclusion of a +5 dB(A) penalty for tonality.

3. CRITERIA

The allowable noise level at the surrounding premises is prescribed by the *Environmental Protection (Noise) Regulations 1997*. Regulations 7 & 8 stipulate maximum allowable external noise levels at a premises in receipt of the noise. For the highly sensitive area of a noise sensitive premise (ie within 15 metres of a residence) the assigned noise level is determined by the calculation of an influencing factor, which is then added to the base levels shown below. The influencing factor is calculated for the usage of land within two circles, having radii of 100m and 450m from the premises of concern. For any other part of a noise sensitive premises, a commercial premises or industrial premises, the allowable noise levels are set. Table 3.1 lists the base allowable noise levels for noise sensitive premises and the allowable noise levels for commercial and industrial premises.

TABLE 3.1 - BASELINE ASSIGNED OUTDOOR NOISE LEVEL

Premises Receiving Noise	Time of Day	Assigned Level (dB)		
		$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
Noise sensitive premises : Highly sensitive area	0700 - 1900 hours Monday to Saturday (Day)	45 + IF	55 + IF	65 + IF
	0900 - 1900 hours Sunday and Public Holidays (Sunday / Public Holiday Day Period)	40 + IF	50 + IF	65 + IF
	1900 - 2200 hours all days (Evening)	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and Public Holidays (Night)	35 + IF	45 + IF	55 + IF
Noise sensitive premises : any area other than highly sensitive area	All Hours	60	75	80
Commercial premises	All Hours	60	75	80
Industrial and Utility Premises	All Hours	65	80	90

Note: L_{A10} is the noise level exceeded for 10% of the time.
L_{A1} is the noise level exceeded for 1% of the time.
L_{Amax} is the maximum noise level.
IF is the influencing factor.

It is a requirement that received noise be free of annoying characteristics (tonality, modulation and impulsiveness), defined below as per Regulation 9.

"impulsiveness" means a variation in the emission of a noise where the difference between L_{Apeak} and $L_{Amax\ Slow}$ is more than 15 dB when determined for a single representative event;

"modulation" means a variation in the emission of noise that –

(a) is more than 3dB $L_{A\ Fast}$ or is more than 3 dB $L_{A\ Fast}$ in any one-third octave band;
(b) is present for more at least 10% of the representative assessment period; and
(c) is regular, cyclic and audible;

"tonality" means the presence in the noise emission of tonal characteristics where the difference between –

(a) the A-weighted sound pressure level in any one-third octave band; and
(b) the arithmetic average of the A-weighted sound pressure levels in the 2 adjacent one-third octave bands,

is greater than 3 dB when the sound pressure levels are determined as $L_{Aeq,T}$ levels where the time period T is greater than 10% of the representative assessment period, or greater than 8 dB at any time when the sound pressure levels are determined as $L_{A\ Slow}$ levels.

Where the noise emission is not music, if the above characteristics exist and cannot be practicably removed, then any measured level is adjusted according to Table 3.2 below.

TABLE 3.2 - ADJUSTMENTS TO MEASURED LEVELS

Where **tonality** is present	Where **modulation** is present	Where **impulsiveness** is present
+5 dB(A)	+5 dB(A)	+10 dB(A)

Note: These adjustments are cumulative to a maximum of 15 dB.

The nearest potential noise sensitive premises to the proposed quarry have been identified using the area map in Figure 1.

FIGURE 1 – RECEIVER LOCATIONS

The influencing factor at the closest residence has been assessed as 0 dB. Therefore, the assigned noise level is as noted in Table 3.1.

4. QUARRY OPERATIONS

It is understood that the quarry, including crushing, would only operate during the day period, this being between 0700 and 1900 hours Monday to Saturday (excluding Public Holidays). Therefore, noise emissions from the entire quarry operations need to comply with the assigned L_{A10} day period noise level of 45 dB(A) at the neighbouring residences.

With regards to the transport of material from site, we understand that the majority of these truck movements would occur during the day period (ie 0700 to 1900 hours Monday to Saturday). However, we also understand that on occasions, the transport of material would also occur between 0600 and 0700 hours Monday to Saturday (excluding Public Holidays). Additionally, it is also understood that the number of truck movement hauling material from site would be limited to around 20 per day. Analysis of the noise received at the neighbouring residence from the movement of trucks, indicates that if the number of truck movements was limited to 4 per hour (ie 2 entering and 2 leaving) then noise emissions from the truck movement would need to comply with the assigned L_{A1} criteria. Additional to the above, it is also noted that the loading of the trucks during the night period (i.e. between 0600 and 0700 hours) would need to comply with the assigned L_{A10} night period noise level.

Thus, based on the above, the following scenarios need to be considered with regards to noise emissions from the equipment used within the quarry :

NIGHT PERIOD

Scenario N1 - Truck loading with a Front End Loader.

DAY PERIOD

Scenario D1 - Quarry operations, with the following equipment;

- Front end loader within crusher stockpile area.
- Excavator within pit loading quarry truck.
- Quarry (dump) truck.
- Crushing plant.
- screens (3 off).
- Drill rig.

Note : For this quarry, there would be some diversity of operation in equipment. However, to be conservative, it has been assumed that all equipment would operating at the same time.

Assuming that the number of truck movements is limited, such that noise received at the neighbouring residence needs to comply with the assigned L_{A1} noise level. Hence, an additional scenario (T1) relating to noise emissions from trucks also needs to be considered.

5. CALCULATED NOISE LEVELS

Noise received at the nearest neighbouring residential premises, due to noise associated with the proposed rock quarry operations, were modelled with the computer programme SoundPlan. Sound power levels used for the calculations are based on measured sound pressure levels of similar equipment proposed for use on site.

The modelling of noise levels has been based on noise sources and sound power levels shown in Table 5.1.

TABLE 5.1 – SOUND POWER LEVEL - NOISE SOURCES dB(A)

Element name	Unit	Frequency Hz										dB(A)
		31.5	63	125	250	500	1k	2k	4k	8k	16k	Sum
Excavator	dB(A)/unit	62	83	89	89	92	92	91	87	79	-	98
Crusher	dB(A)/unit	57	81	97	94	101	103	103	99	92	80	113
		65	82	90	96	103	104	101	97	89	-	
		70	88	95	97	103	103	101	95	85	-	
Screening Plant (3 off)	dB(A)/unit	66	80	84	90	93	95	95	95	87	-	101
Drill Rig	dB(A)/unit	97	114	103	104	106	110	113	111	110	108	118
Dozer	dB(A)/unit	55	72	86	92	99	99	99	97	91	83	109
		57	72	89	89	97	100	101	95	88	80	
		64	81	94	95	95	98	97	93	86	79	
Haulage Truck	dB(A)/unit	60	71	82	85	97	91	89	85	80	72	102
		64	75	83	89	93	91	87	83	78	70	
		66	72	82	87	91	89	85	81	75	66	
Front End Loader	dB(A)/unit	46	72	73	80	86	93	90	87	82	69	105
		48	60	70	81	89	93	91	86	78	63	
		58	68	76	85	91	91	89	88	73	54	
Quarry Truck	dB(A)/unit	55	86	87	90	91	96	93	89	80	66	106
		65	77	97	84	90	94	93	87	78	63	
		67	89	97	85	98	96	89	84	73	61	

Based on the proposed operation of the quarry, noise modelling was undertaken for the scenarios as outlined in Section 4 – Quarry Operations.

Additional to the equipment assumed in the modelling, the following conditions have also been applied to the modelling:

- The extraction pit will progress towards the south east.
- The crusher will be located within the plant area.
- Includes a 4 metre high bund on western side of quarry, as indicated on the plan attached in Appendix A.

The following input data was used in the calculations:

a) Google Earth backgrounds;
b) Sound Power Levels listed in Table 4; and
c) Ground contours as provided.

Weather conditions for modelling were as stipulated in the Environmental Protection Authority's "*Draft Guidance for Assessment of Environmental Factors No. 8 - Environmental Noise"* and for the day and night periods are as listed in Table 5.2.

TABLE 5.2 – WEATHER CONDITIONS

Condition	Night	Day
Temperature	15°C	20°C
Relative humidity	50%	50%
Pasquill Stability Class	F	E
Wind speed	3 m/s*	4 m/s*

* From sources, towards receivers.

6. RESULTS

The calculated noise levels associated with the noise emissions from the proposed quarry for the assumed scenarios, are summarised below in Table 6.1.

TABLE 6.1 – CALCULATED NOISE LEVELS AT NEAREST NEIGHBOURS, dB(A)

Residential Location	Scenario / Calculated Noise Level (dB(A))		
	N1 - Truck Loading (L_{A10})	D1 - Plant Operation (L_{A10})	T1 - Truck Movement (L_{A1})
A	28	35	34
B	23	29	34
C	8	21	23
D	7	19	20
E	16	23	40
F	17	24	36
G	15	22	27

7. ASSESSMENT

7.1 TRUCK LOADING (L_{A10})

The applicable adjustments to the calculated noise levels, in accordance with the *Environmental Protection (Noise) Regulations 1997*, are listed in Table 7.1. Based on the calculated noise levels at the nearest premises, noise levels are unlikely to be tonal in characteristics. However, to be conservative, we have included a +5 dB(A) penalty for a tonal component.

TABLE 7.1 – APPLICABLE ADJUSTMENTS AND ASSESSABLE LEVEL OF TRUCK LOADING, dB(A)

Receiver	Calculated Noise Level, dB(A)	Applicable Adjustments To Measured Noise Levels, dB(A)			Assessable Noise Level, dB(A)
		Where Noise Emission Is Not Music			
		Tonality	Modulation	Impulsiveness	
A	28	+5	-	-	33
B	23	+5	-	-	28
C	8	+5	-	-	13
D	7	+5	-	-	12
E	16	+5	-	-	21
F	17	+5	-	-	22
G	15	+5	-	-	20

Hence, Table 7.2 summarises the applicable Assigned Noise Levels, and assessable noise level emissions, for the scenario considered.

TABLE 7.2 – ASSESSMENT OF L_{A10} NOISE LEVELS FOR QUARRY OPERATIONS

Receiver	Assessable Noise Level, dB(A)	Applicable Times of Day	Applicable L_{A10} Assigned Noise Level (dB)	Exceedance to Assigned Noise Level (dB)
A	33	Night	35	Complies
B	28			Complies
C	13			Complies
D	12			Complies
E	21			Complies
F	22			Complies
G	20			Complies

7.2 PLANT OPERATION (L_{A10})

The applicable adjustments to the calculated noise levels, in accordance with the *Environmental Protection (Noise) Regulations 1997*, are listed in Table 7.3. Again, based on calculated noise levels at the nearest premises, noise levels are unlikely to be tonal in characteristics. However, to be conservative, we have included a +5 dB(A) penalty for a tonal component.

TABLE 7.3 – APPLICABLE ADJUSTMENTS AND ASSESSABLE LEVEL OF QUARRY OPERATIONS, dB(A)

Receiver	Calculated Noise Level, dB(A)	Applicable Adjustments To Measured Noise Levels, dB(A)			Assessable Noise Level, dB(A)
		Where Noise Emission Is Not Music			
		Tonality	Modulation	Impulsiveness	
A	35	+5	-	-	40
B	29	+5	-	-	34
C	21	+5	-	-	26
D	19	+5	-	-	24
E	23	+5	-	-	28
F	24	+5	-	-	29
G	22	+5	-	-	27

Hence, Table 7.4 summarises the applicable Assigned Noise Levels, and assessable noise level emissions, for the scenario considered.

TABLE 7.4 – ASSESSMENT OF L_{A10} NOISE LEVELS FOR QUARRY OPERATIONS

Receiver	Assessable Noise Level, dB(A)	Applicable Times of Day	Applicable L_{A10} Assigned Noise Level (dB)	Exceedance to Assigned Noise Level (dB)
A	40	Day	45	Complies
B	34			Complies
C	26			Complies
D	24			Complies
E	28			Complies
F	29			Complies
G	27			Complies

7.3 TRUCK MOVEMENTS (L_{A1})

The applicable adjustments to the calculated noise levels, in accordance with the *Environmental Protection (Noise) Regulations 1997*, are listed in Table 7.5. Based on calculated noise levels at the nearest premises, noise levels are unlikely to be tonal in characteristics. However, to be conservative, we have included a +5 dB(A) penalty for a tonal component.

TABLE 7.5 – APPLICABLE ADJUSTMENTS AND ASSESSABLE LEVEL OF TRUCK MOVEMENTS, dB(A)

Receiver	Calculated Noise Level, dB(A)	Applicable Adjustments To Measured Noise Levels, dB(A)			Assessable Noise Level, dB(A)
		Where Noise Emission Is Not Music			
		Tonality	Modulation	Impulsiveness	
A	34	+5	-	-	39
B	34	+5	-	-	39
C	23	+5	-	-	28
D	20	+5	-	-	25
E	40	+5	-	-	45
F	36	+5	-	-	41
G	27	+5	-	-	32

Hence, Table 7.6 summarises the applicable Assigned Noise Levels, and assessable noise level emissions, for the scenario considered.

TABLE 7.6 – ASSESSMENT OF L_{A1} NOISE LEVELS FOR TRUCK MOVEMENTS

Receiver	Assessable Noise Level, dB(A)	Applicable Times of Day	Applicable L_{A1} Assigned Noise Level (dB)	Exceedance to Assigned Noise Level (dB)
A	39	Night	45	Complies
B	39			Complies
C	28			Complies
D	25			Complies
E	45			Complies
F	41			Complies
G	32			Complies

8. CONCLUSION

An assessment has been conducted on the proposed quarry to be located at Lot 800 Pruden Road, Whitby.

At the neighbouring residences, the influencing factor has been taken to be 0, thus noise emissions from the various quarry operations need to comply with the baseline assigned noise levels, as listed in Table 3.1.

Noise received at the neighbouring residences from the quarry operations, has, with the inclusion of a 4 metre high bund, as indicated on the Figure attached in Appendix A, been determined to be 35 dB(A) for the worst case location. Thus even with the inclusion of a +5 dB(A) penalty for tonal characteristics, noise received at the neighbouring residence would comply with the requirements of the *Environmental Protection (Noise) Regulations 1997*.

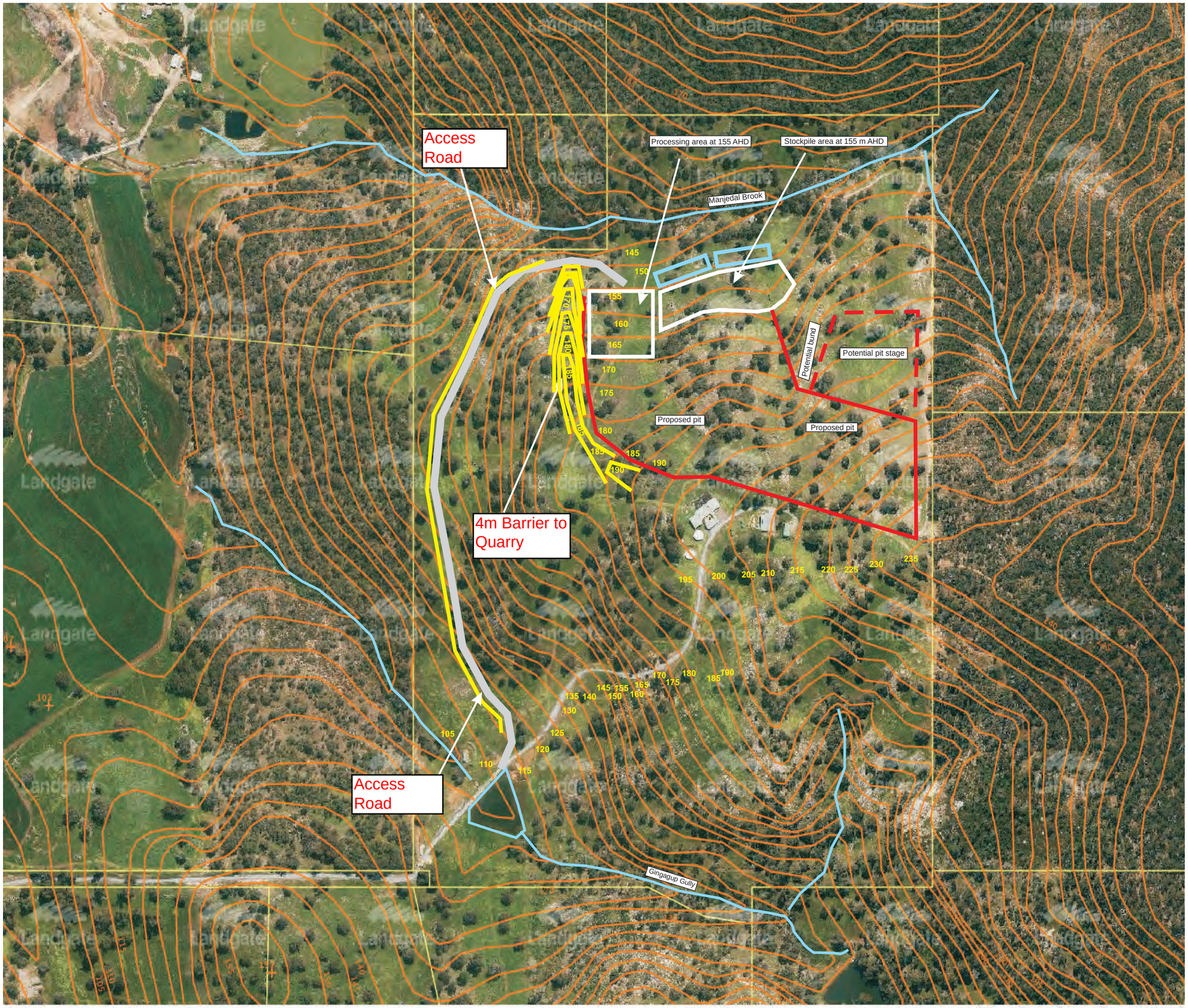
For the loading of truck during the night period (ie between 0600 and 0700 hours), noise received at the neighbouring residence has, in the worst case location, been determined to be 28 dB(A). Noise emissions from this activity would, even with the inclusion of a +5 dB(A) penalty for tonal characteristic, noise received at the neighbouring residence would comply with the requirements of the *Environmental Protection (Noise) Regulations 1997*.

With regards to truck movements, analysis shows that the maximum noise level received at a neighbouring residence is 40 dB(A), which even with the addition of a +5 dB(A) penalty for tonal characteristic would comply with the assigned night period L_{A1} noise level of 45 dB(A). However, for noise emissions from truck movements to be considered as an L_{A1}, the number of truck movements needs to be limited to 4 per hour (ie 2 entering and 2 leaving). It is also noted that during the day, noise received at the neighbouring premises from the whole quarry operation, including truck movements, would comply with the assigned L_{A10} noise level of 45 dB(A). Hence, the restriction on truck movements would only apply to the period between 0600 and 0700 hours.

Given these operating parameters and with the inclusion of a 4 metre high barrier, noise levels received at the nearest premises has been calculated to comply with the *Environmental Protection (Noise) Regulations 1997* for the operating times as outlined in this assessment, even with the inclusion of a +5 dB(A) penalty for tonality.

APPENDIX A

SITE LAYOUT



0 Northing: 6,426,526 Easting: 407,324

1617 SOUTH WESTERN HWY ,WHITBY

0 200m

ATTACHMENT 4

Visual Management Assessment and Mitigation Plan

Lot 800 Pruden Road, Whitby

Italia Stone Group

June 2016

Landform Research
Land Systems - Quarries - Environment

VISUAL MANAGEMENT

Background

The operation is located just back from the brow of the Darling Scarp protected by a north south spur along the western side of the proposed pit.

The Darling Scarp is identified either formally through documentation and policies or informally by the community as having high aesthetic values that are desirable to protect.

The quarry is located on a north facing slope on the southern side of the Manjedal Brook, facing along the scarp, rather than west to the Swan Coastal Plain.

The location has been chosen to minimise or mitigate the visual impacts from the Swan Coastal Plain and sensitive premises.

The Darling Scarp is listed as a significant landscape feature in State and Local Government Planning as it is a prominent feature, visible from the Swan Coastal Plain. Community concern, rightly so, is for no visual impact from hard rock quarries on the Darling Scarp and to this end the older quarries have all been modified to minimise existing and future visual impacts.

Methodology

WAPC 2007, *Visual Landscape Planning in Western Australia* has been viewed and the project considered against that document. The relevant section is Part Three, pages 144 to 152 of the Guideline and the site has been assessed against the relevant sections.

The Shire of Serpentine Jarrahdale has in place *Local Planning Policy No 67, Landscape and Vegetation*. Whilst not generally applying to the Darling Scarp or extractive industries the principles of the policy are relevant and have been used to assess and mitigate potential visual impacts. The principles of vegetation management have been incorporated in the plans for the operations and for rehabilitation of disturbed and completed land.

The *Shire of Serpentine – Jarrahdale LPP8 Landscape Protection Policy* may apply to the operations. With the excavations unlikely to be visible from most of South Western Highway, the setback from Jarrahdale Road and the short nature of the operations, it is considered that whilst there may be some short term conflict with the intent of the policy the use of the sand for fill for local developments provides substantial environmental offsets in costs, transport impacts and reduced greenhouse gas emissions when compared to sourcing sand from further away.

Other methodologies were taken from various articles, guidelines, studies and policies across Australia. All documents essentially used similar procedures, which have been used in this assessment and for the mitigation measures.

There is also an older document, *Department of Planning and Urban Development, 1993, Darling Scarp Range Regional Park and Landscape Study*. That shows the location as High Landscape Value

The methods of assessment used are listed below;

- An analysis of the landform through contour mapping and site inspections was undertaken. The quarry was located in the best situation where the least visibility from outside the site and in particular the Swan Coastal Plain was selected.

- The distribution of the landform and trees was considered and the quarry located behind a western spur.

- The construction of a 4 metre visual screening and noise management bund was proposed and considered in the planning and design.
- Assessment from a number of areas to the west and nearby were viewed and the areas from which the pit may be visible were identified and photographs taken
- The site was extensively walked and views back towards the west and Swan Coastal Plain were viewed and photographs taken.
- Section lines were then drawn from various viewpoints.
- The land from which part of the quarry may be visible was identified on mapping.
- The design of the quarry staging and rehabilitation were then completed to mitigate and reduce any potential visual impacts at the area where the pit may be visible

Analysis

The quarry footprint was selected to provide the maximum screening of operations. The pit is located behind a low spur which forms the western boundary and can be added to with bunding, and behind existing trees.

The access road is chosen to provide suitable gradient as well as being located behind existing trees on site.

The pit footprint has also been chosen behind the break of slope of a spur along the west of the site to provide visual and noise screening.

The direction of excavation and staging will then be selected to provide maximum screening for noise visual, dust and all other potential environmental risks.

In addition a bund 4 metres high is proposed to be located along the western side of the pit with the pit cut deep behind the spur and screening bund.

This is the same design and management used at other hard rock quarries along the Darling Scarp.

The proposed quarry operation is set 1 km back from South Western Highway.

The main potential impacts, if visible, will be the faces of the pit, which will be grey in the landscape when compared to the surrounding pasture and trees, and exposure of overburden which will be light coloured and brown when compared to the winter green pasture and trees on the Darling Scarp.

Therefore a significant amount of effort has gone into the site selection and quarry design to minimise visual impacts.

Of the two newer quarries, the adjoining WA Bluemetal is not visible from Swan Coastal Plain and Hanson Red Hill Quarry has been designed to minimise its view footprint.

From the visual assessments the proposed quarry is unlikely to be visible from South Western Highway and is well hidden behind existing tree belts and proposed bunding along the west.

In terms of potential visual impacts the assessed impacts are significantly less than for all the hard rock quarries on the Darling Scarp with the exception of WA Bluemetal.

An analysis of the visual impact demonstrates that the operations are unlikely to be visible from South Western Highway because of the landform, design of the pit and trees along South Western Highway.

The construction of a 4 metre visual screening and noise management bund was proposed and considered in the planning and design.

It is possible that the rear face of the pit may be visible in the early stages of excavation from a point to the north west on South Western Highway and from a further distance on the Swan Coastal Plain, however analysis suggests that this will be temporary until the top benches are rehabilitated.

The visual management is therefore similar to that used for other hard rock quarries on the Darling Scarp although the visual impacts are assessed to be less than some other quarries.

There are several dwellings at distance to the south, but these are visually protected by the design of the quarry. Similarly the sensitive premises to the north west is protected by the design of the pit and the proposed screening bund.

The location and pit design has been chosen to minise or mitigate the visual impacts from the Swan Coastal Plain and sensitive premises. A visual analysis shows that the site is not visible from South Western Highway because of the extensive tree growth along the road verge of the highway.

The only location where the top of the upper eastern slope of the pit footprint will be seen, is from two small windows where Manjedal Brook crosses South Western Highway. These two small windows are so small in a 110 kph zone that it is doubtful anyone would be able to see the top of the eastern face of the pit. The visible section will be rehabilitated at the earliest opportunity during construction and operation.

It is proposed to rehabilitate the top face as soon as practicable to reduce the visual impacts.

Residence A is located down the Mandjedal Valley. The construction of a 4 metre visual screening and noise management bund was proposed and considered in the planning and design.

It is just possible that from Residence B, which is a sensitive premises, but not a dwelling, being associated with Murdoch University, that the top of the eastern face will be visible for the first few years of the pit, until that portion of that face can be rehabilitated. See Attachment 3 for visual management and section lines. A 4 metre bund is proposed to be planted with tall trees to mitigate the risk of the top of the eastern face being visible.

Residences is to the south behind the southern face out of the view shed and protected by landform.

A visual analysis shows that the site is not visible from South Western Highway because of the extensive tree growth along the road verge of the highway.

WAPC 2007, *Visual Landscape Planning in Western Australia* has been viewed and the project considered against that document. The relevant section is Part Three, pages 144 to 152 of the Guideline.

Revegetation, screening bunds and tree belts will be used where possible as will be rehabilitation of the completed areas as soon as practicably possible.

The other consideration is that there is a net community benefit from having a quarry located on the Darling Scarp. With a quarry in place the land will continue to be used for farming and the required buffers will negate the potential for other developments to be located on the Darling Scarp.

During the life of the quarry there will be no change locally to the land uses and visual impacts as no other developments or subdivisions are likely to be approved. This will potentially provide greater protection of the landscape values of the Darling Scarp.

*Italia Stone Group is committed to minimising visual impacts and will implement the measures outlined in the **Visual Management** attached in the Offsite Impacts Management Plan at Attachment 3.*

Shire of Serpentine – Jarrahdale Landscape Protection Policy LPP 8

The *Shire of Serpentine – Jarrahdale LPP8 Landscape Protection Policy* may apply to the operations. With the excavations unlikely to be visible from most of South Western Highway, the setback from Jarrahdale Road and the short nature of the operations, it is considered that whilst there may be some short term conflict with the intent of the policy the use of the sand for fill for local developments provides substantial environmental offsets in costs, transport impacts and reduced greenhouse gas emissions when compared to sourcing sand from further away.

Some aspects from the policy are listed in italics with the response and management shown below.

The objectives of the policy as stated are:

"To preserve the amenity deriving from the scenic value of the Darling Scarp;"

Management

The land is cleared to parkland pasture, located behind a spur and trees in a situation where the potential visual impacts are small and restricted to an area of land to the west – north west.

"*To maintain the integrity of landscapes within the Landscape Protection Area;"*

Management

The visual consideration suggest that the excavation will not have a large impact on the local area. The remainder of the land will be retained as rural land which will restrict the development pressure locally and the potential for other development on the Darling Scarp. Apart from the small area that may be temporarily visible the rest of the land will continue unchanged as a cattle grazing property.

"*To maintain the integrity of landscapes in the line of sight view corridor along identified scenic routes in the Shire, including but not limited to South West Highway,... Jarrahdale Road,... both the North-South and East-West Railway lines and natural water courses;"*

Management

The only location on a road where the top of the upper eastern slope of the pit footprint will be visible, is from two small windows where Manjedal Brook crosses South Western Highway. These two small windows are so small in a 110 kph zone that it is doubtful anyone would be able to see the top of the eastern face of the pit. The visible section will be rehabilitated at the earliest opportunity during construction and operation.

The two small windows could be replanted.

"Development Considerations ... the following will also be considered when assessing a development application within the Landscape Protection Area: The 'seen area' of the development from the coastal plain, major roads and tourist routes, and major recreation areas;"

Management

As noted above the impacts from view corridors will be small and short term until the rehabilitation of the top of the eastern face.

"The visual intrusiveness of the development within the 'seen area';"

Management

The colour of the open ground will be brown grading to grey. Only the upper part of the eastern face will be visible in the shorter term until rehabilitated, when the grey colour will be mitigated.

The overburden is the natural soil currently on site.

"The landscape values of the area;"

Management

This is addressed above under other issues raised. The landscape values will be impacted on from a very limited area for a short period of time.

"All development (including access roads) in the policy area shall not be permitted:
"1. On ridge lines or spur, bluff or knoll, escarpments, hill tops or visually exposed areas..."

Management

The land is on a sloping rise located behind a spur and proposed screening bund, behind existing trees, on a north facing valley slope.

The site is well screened from the adjoining roads, although the top of the eastern bench of the pit is likely to be seen for a relatively short time.

The site is not part of the skyline and that line will not be altered.

The site is not a ridgeline, bluff, knoll or escarpment. It lies behind features such as those listed.

As there will be no change to the views from all but a very small area, the proposal is compatible with the development guidelines mentioned.

"In areas having a generalised slope greater than 25 percent."

Management

The land, the subject of the Application, is rock and not subject to erosion. All water generated on site will be captured and fed through three detention basins.

"Developments

Screening around proposed extractive and industrial developments or operations will be required to minimise visual impacts."

Management

Extensive natural screening combined with vegetation, visual and noise management and bund wall to the west will provide this management.

"These types of developments are not to be seen from the coastal plain, major roads and tourists routes, and major recreation areas"

Management

As noted earlier the visual impact will be relatively small for a short time.

"Approval for these types of development will not be given unless the visual impact of the proposal on the Darling Scarp has been addressed to Council's satisfaction".

Management

Effective visual management is proposed. Council will consider the issues and potential for approval.

Revegetation onOther Sites by Italia Stone Group

Extensive visual management and rehabilitation are proposed. The same methods of rehabilitation that Roadstone (Italia) used at the Esperance Port Quarry will be used.

This is the same method used by Roadstone (Part of the Italia Stone Group) during excavation and rehabilitation of the hard rock quarry in Esperance in 2000 - 2003. The removal of material from the Esperance Pit, combined with the reduction in angles of the face and rehabilitation, completely transformed the quarry location in Esperance and the same methods will be used here.

The sequence of photographs from the Port Authority of Esperance Annual reports shows the rehabilitation of the quarry after excavation and rehabilitation from 2004 to 2014.

For their efforts on rehabilitation the Port of Esperance/Roadstone Quarries were a joint winner of the Golden Gecko Award for Environmental Excellence and a winner of the State and National Case Earth Awards for best practice and innovation in Environmental Management and civil construction.

Landform Research was instrumental in assisting with the approvals to undertake the work and for the design of the quarry closure and rehabilitation techniques.

The same methodology used at the Esperance Port will be used at Roelands, initially with the restoration of the upper bench and on closure of the quarry.

Figure 4 – 1 Esperance Port 2004 – Note the bare ground of the completed quarry to the left of the large sheds

Figure 4 – 2 Esperance Port 2006 – Vegetation has commenced to grow on the rehabilitated quarry.

Figure 4 – 3 Esperance Port 2014 – The revegetation of the old quarry where the faces have been laid back is providing good visual management.

Summary of the Proposed Visual Management

The main potential visual impacts will be the top of the eastern face of the pit, which will be grey in the landscape when compared to the surrounding pasture and trees.

The location and design of the pit have been selected and designed to minimise visual impact. The pit is to face north, behind a natural small spur along the west that is protected by existing trees and will be added to by a 4 metre bund that will be planted to trees.

- A buffer of 1 km to dwellings is mostly available with only two sensitive premises being closer that are not protected by existing landform.
- The pit is to be operated from the lower levels of the pit.
- Plant, buildings or other portable structures are to be located on the floor of the pit to minimise the risk of viewing from external points such as the closest dwellings, and it is assessed that they will not be visible from South Western Highway and dwellings.
- The pit is to be worked from the inside and south via the access road as low down as possible to enable the landform to the south to assist with visual protection.
- The location and landform, and elevation of the workings, are designed to ensure that there are no breaks in the skyline.
- Overburden and interburden dumps are to be pushed into positions where they will be less visible or are used to form screening barriers such as the 4 metre western screening bund. This will be used where possible but its use will be limited by the need for working space on the benches.
- All screening bunds will be planted to tall trees.
- The amount of ground open is to be minimised.

- Completed sections of the pit that have been excavated are to be rehabilitated as soon as practicable following completion of that section.

- The top most benches of the eastern face will be rehabilitated as soon as practicable to reduce the potential for that portion of the pit to be visible. That is the only part of the pit which is potentially visible.

- The alignment of the access road has been selected to provide screening from existing trees.

- Night time activities are not proposed, although it is possible for security reasons that lighting may be required, in which case the lighting will be directed away from sensitive directions.

- Italia Stone Group maintain a tidy work environment on all sites. Waste is regularly removed off site to an approved waste facility and locked gates are in place to prevent illegal dumping.

- Any litter and illegally dumped materials and rubbish is promptly removed.

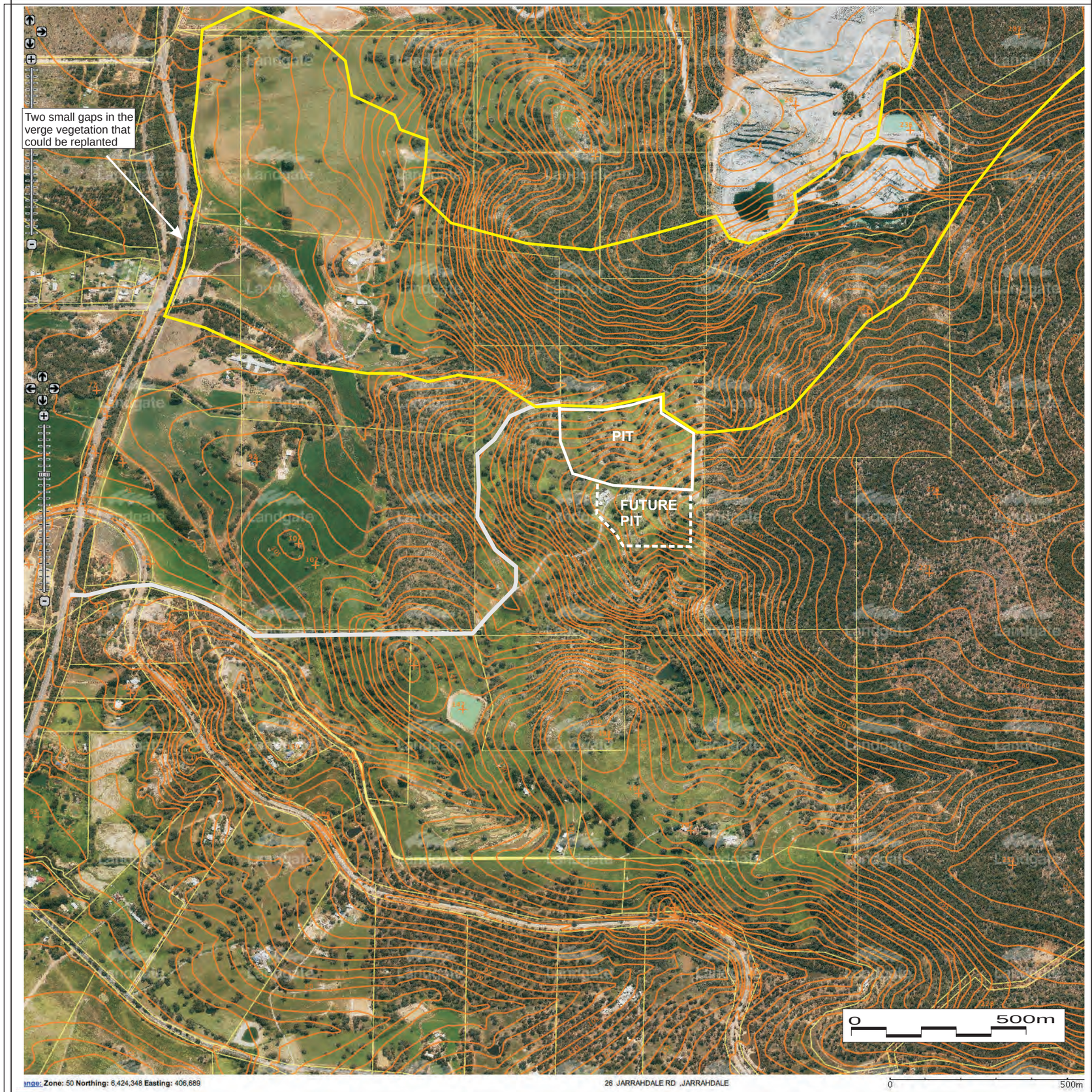
- Italia and their contractors are instructed to minimise spill by ensuring the trucks are not overloaded or material is not left on the outside of trays.

- Drivers are instructed to be responsible for their loads. Collection of spills is carried out when reported.

- The operating policies require that all loads are required to be covered during transport.

ATTACHMENTS

Figure 4 – 4 Contour Plan
Figure 4 – 5 Oblique View from the west
Figure 4 – 6 Section A – B
Figure 4 – 7 Section C – B
Figure 4 – 8 Section D – B
Figure 4 – 9 Section N – S
Figure 4 – 10 Access Road



Interpreted area from which part of the pit may be visible. From the west this is likely to be the top most eastern benches only.

See the section lines.

Figure 4 - 4

CONTOUR PLAN

Landform Research

italia STONE GROUP

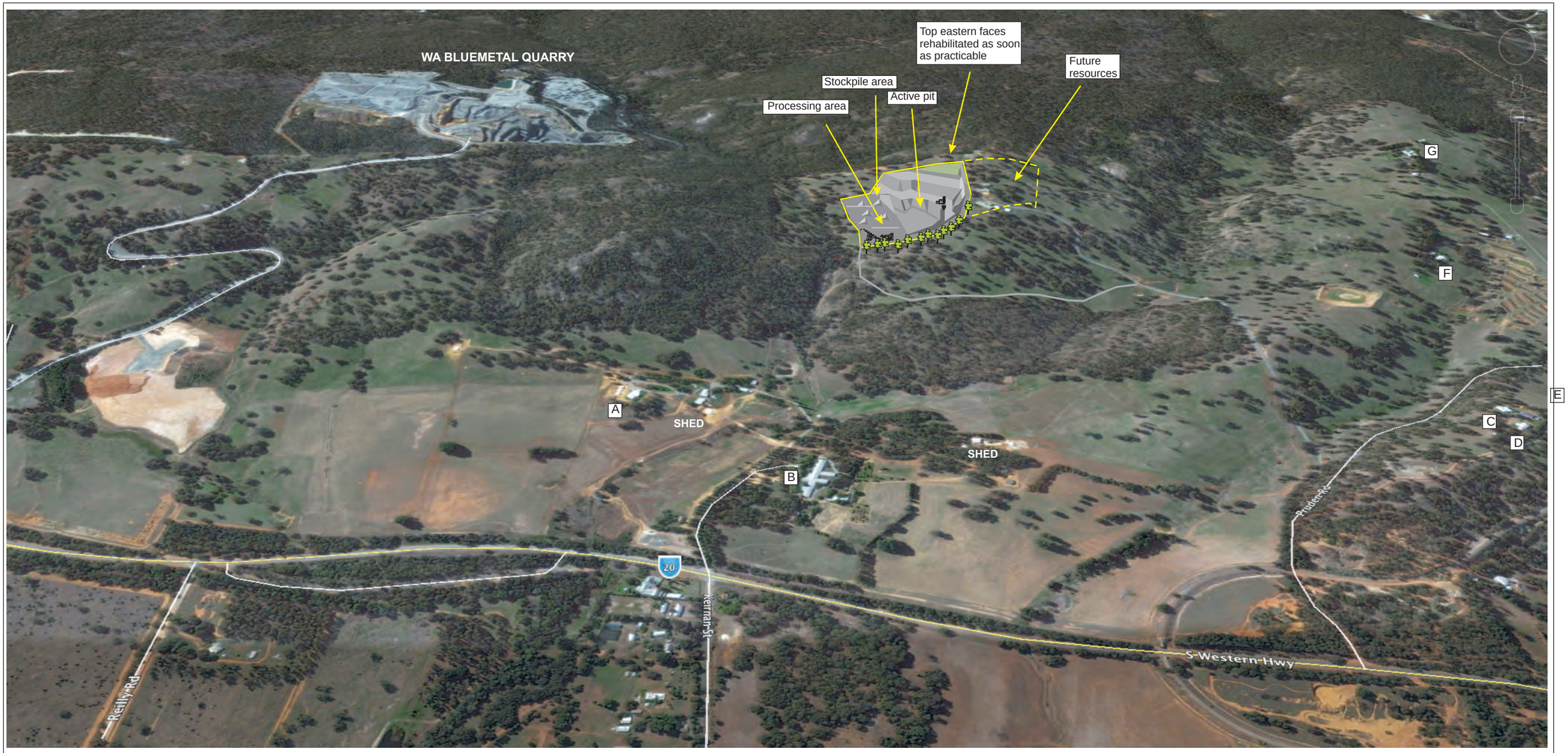
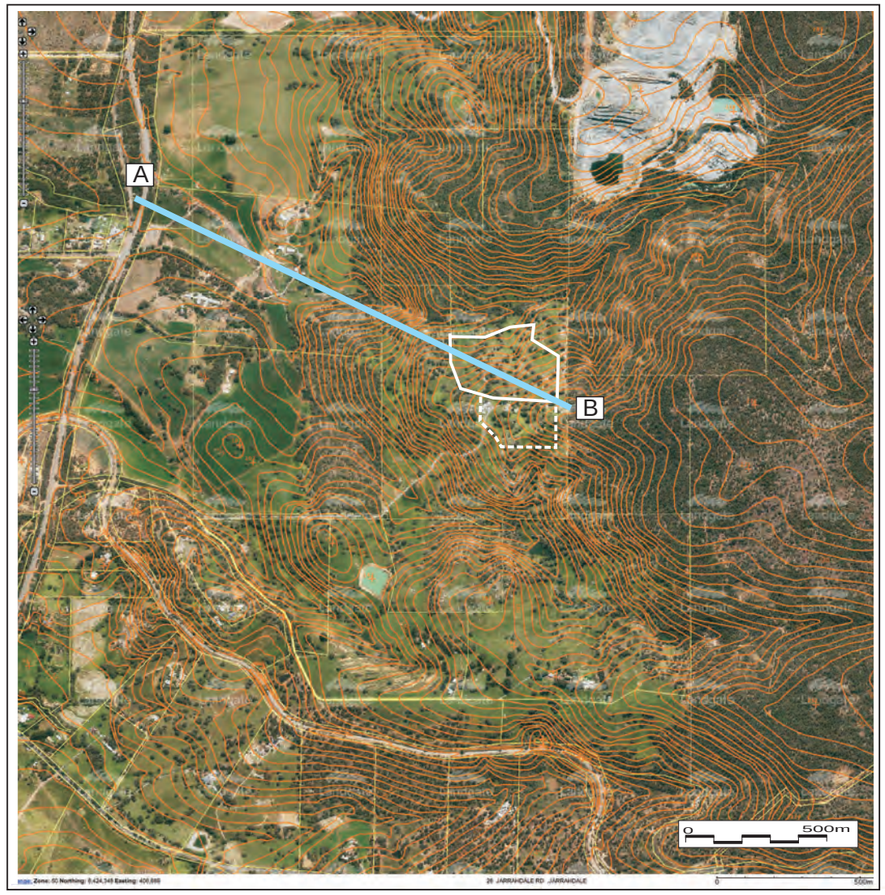


Figure 4 - 5 OBLIQUE VIEW FROM THE WEST

Landform Research

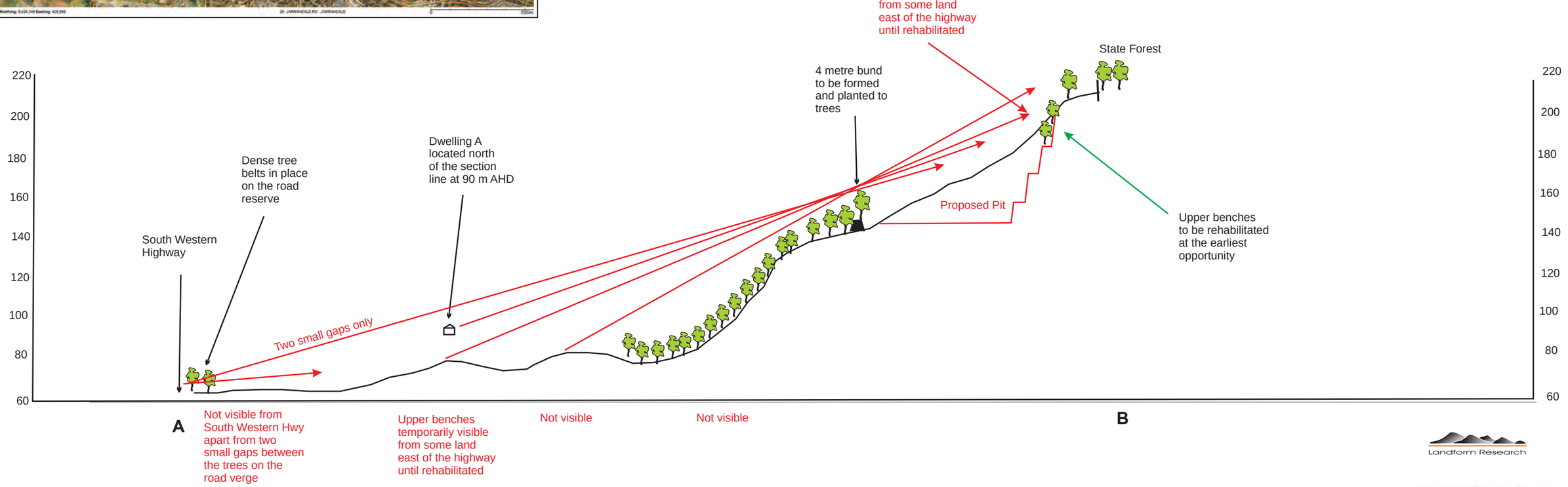
italia STONE GROUP



The two small gaps in the roadside vegetation at Manjedal Brook Crossing on South Western Highway

Access road is behind these trees

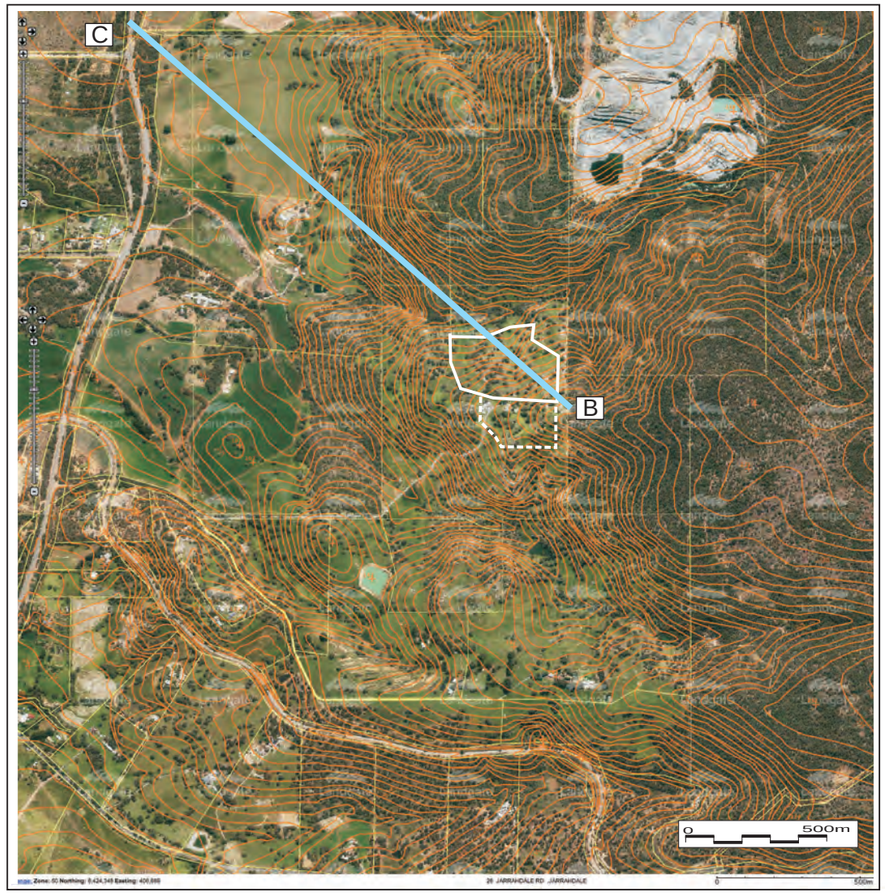
View towards the quarry through the two small gaps in the roadside vegetation, showing the small area of top bench that may be visible prior to rehabililitation.



Landform Research

Figure 4 - 6 PROPOSED QUARRY, LOT 800 PRUDEN ROAD, WHITBY SECTION A - B

italia STONE GROUP



View of the proposed western screening bund and the only glimpse pf the Swan Coastal Plain from that elevation

Landform Research

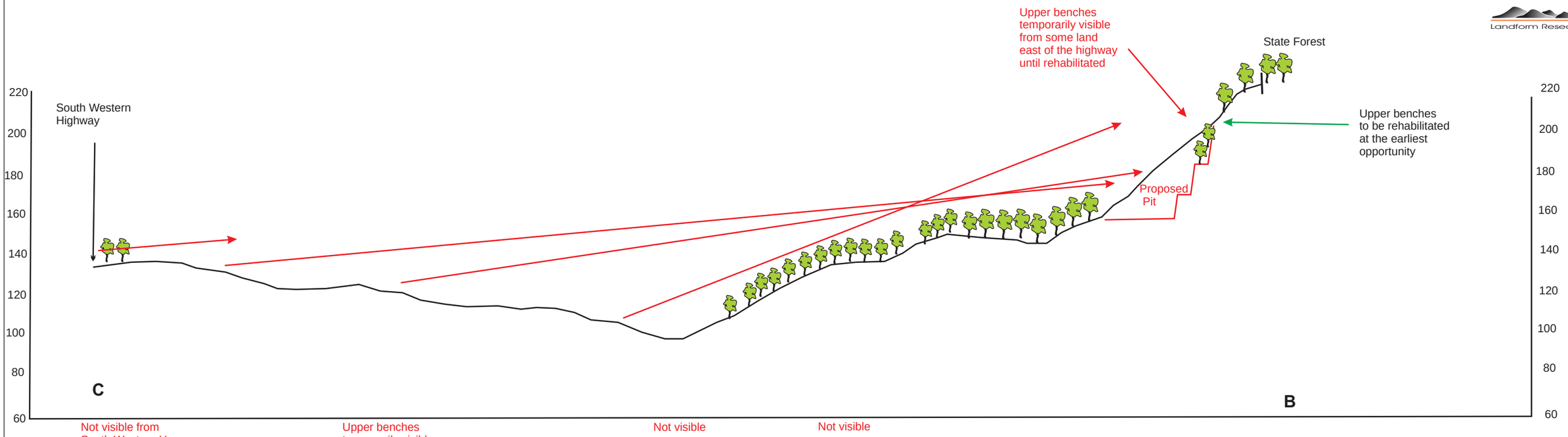
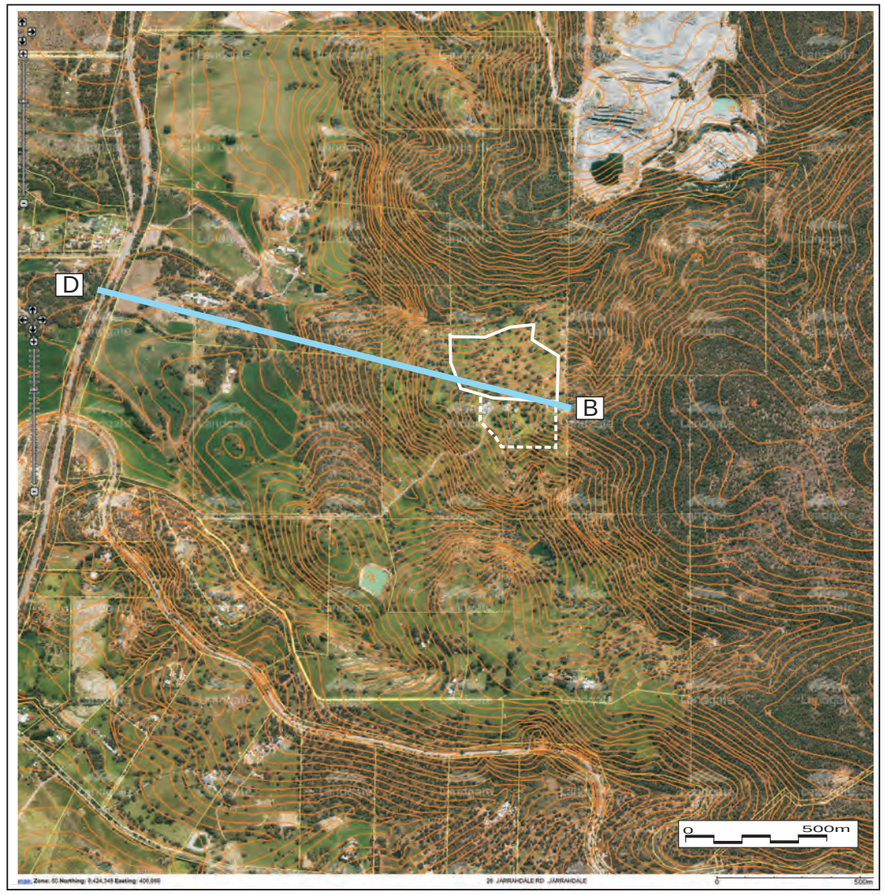
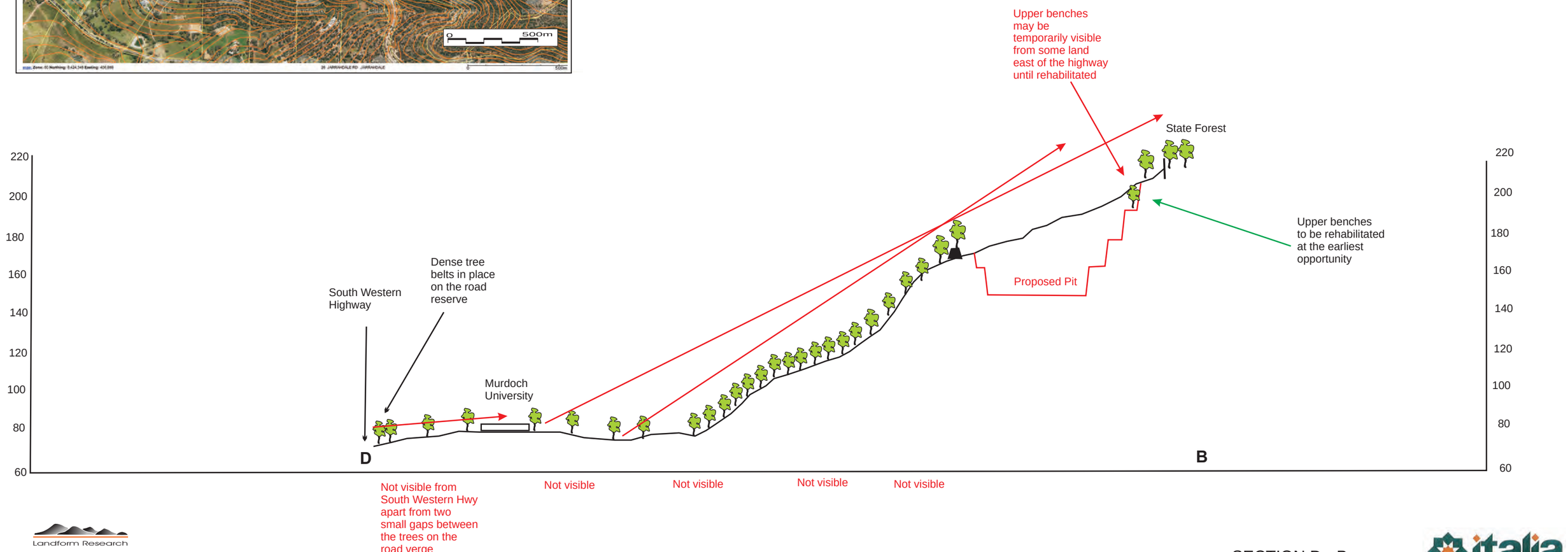


Figure 4 - 7 PROPOSED QUARRY, LOT 800 PRUDEN ROAD, WHITBY SECTION C - B

italia STONE GROUP





Landform Research

Figure 4 - 8 PROPOSED QUARRY, LOT 800 PRUDEN ROAD, WHITBY SECTION D - B

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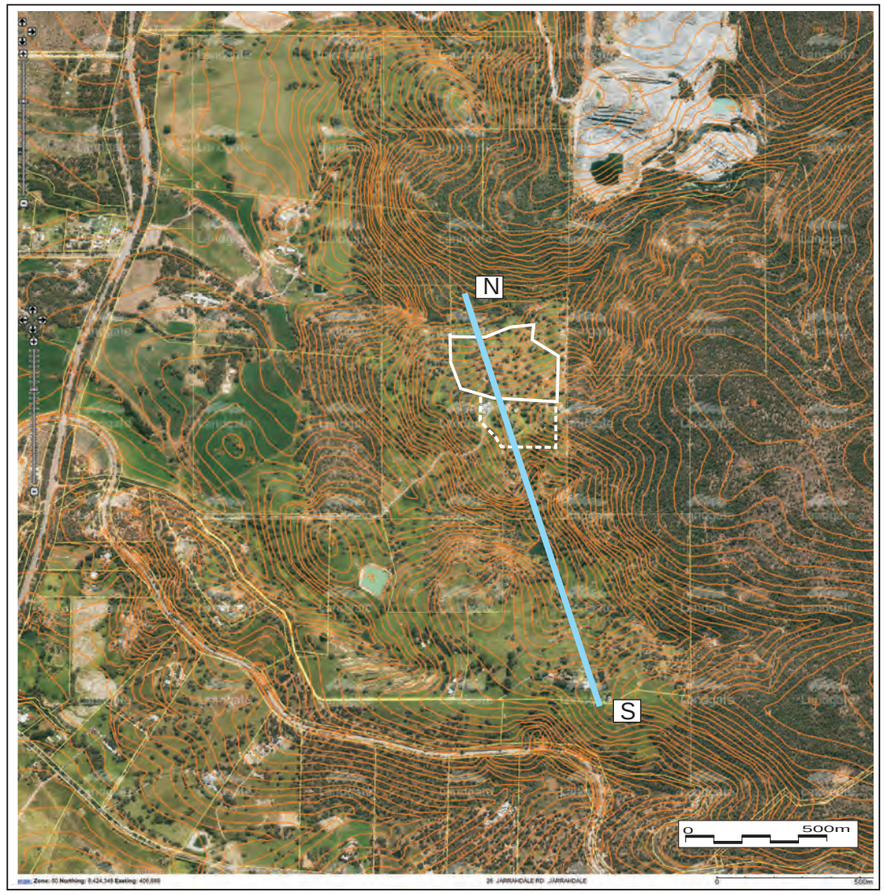
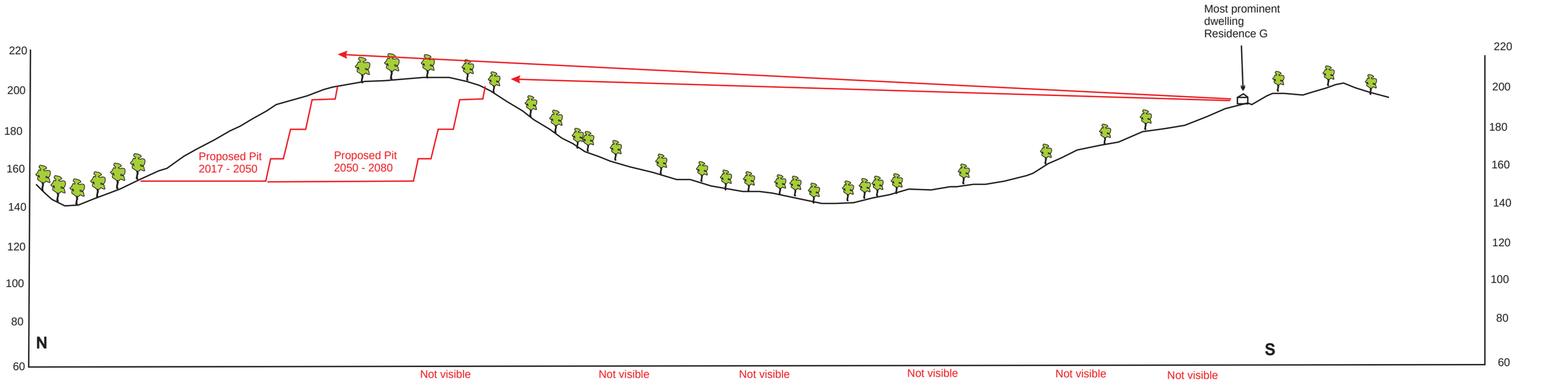


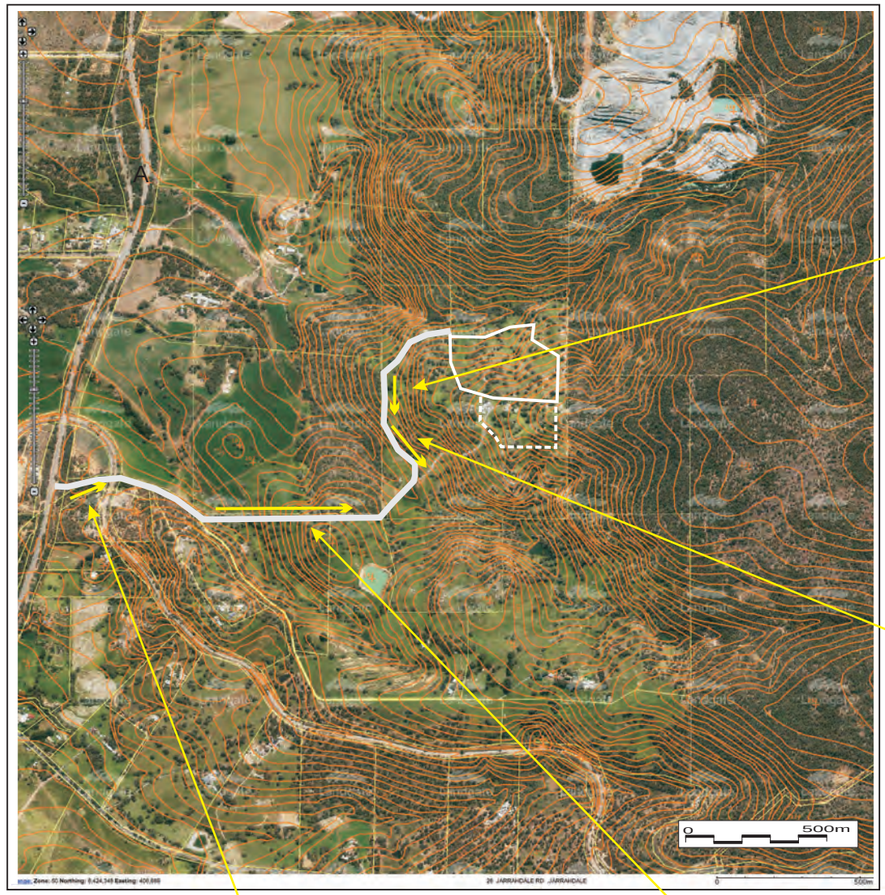
View of the southern portion of the ridge behind which the quarry will operate



Landform Research

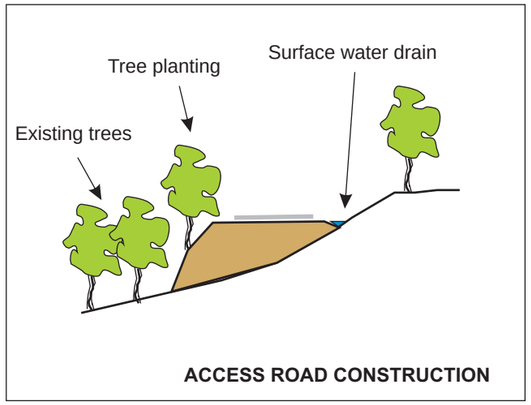
Figure 4 - 9 PROPOSED QUARRY, LOT 800 PRUDEN ROAD, WHITBY SECTION N - S

italia STONE GROUP



Proposed access road showing the existing trees which will provide visual screening from the Swan Coastal Plain. View South

View of the proposed access road. View south



Pruden Road, view east

Pruden Road, view east

Landform Research

ACCESS ROAD

Figure 4 - 10

PROPOSED QUARRY, LOT 800 PRUDEN ROAD, WHITBY

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ATTACHMENT 5

OVERVIEW OF TRANSPORT

Proposed Hard Rock Quarry

Lot 800 Pruden Road, Whitby

Italia Stone Group

July 2016

Address Manager
Italia Stone Group
55 Miguel Road,
Bibra Lake WA 6163

Phone 9418 1437

OVERVIEW OF THE TRANSPORT SUPPORTING THE PROPOSED HARD ROCK QUARRY LOT 800 PRUDEN ROAD, WHITBY

1.0 Location

Lot 800 lies approximately 950 metres from South Western Highway with the pit approximately 1 300 metres from the highway.

The pit is approximately 3 500 metres east from Mundijong townsite and approximately 1 500 metres from the Whitby Urban Area.

Lot 800 occupies the upper face of the Darling Scarp, but the valley of Manjedal Brook cuts the Scarp and provides a north facing slope on which the quarry will be located, facing into the ridge to the north and protected to the west.

The design of the pit takes into account the potential for visual impacts and is provided with a narrow north facing throat combined with a western bund to better manage visual any visual impact.

The quarry location is centred on

408 382 E and 6426 157 N

Access to Lot 800 is via Pruden Road from South Western Highway.

2.0 Background

Hard rock quarrying has been undertaken on land to the north east for many years, firstly on the Hanson Quarry site and later, in addition, by WA Bluemetal.

Lot 800 adjoins and touches the south western corner of the WA Bluemetal site.

Lot 800 was part of Yarrabah property that was subdivided some years ago and sold off as a number of parcels of land.

The hard rock resource on Lot 800 was first identified in the *Basic Raw Materials Policy of the mid 1980's* as a site listed to be considered for hard rock quarrying.

Basic Raw Materials Policy of 1992 identified the site as lying within the buffer of the southern most hard rock quarry area.

In the *Department of Planning and Urban Development, 1993, Darling Range Regional park and Landscape Stud*y the site is listed as Site Number 29/19.

The Geological Survey of WA mapping, which identifies Strategically Important Basic Raw Materials recognises the hard rock resources that touch the northern edge of Lot 800 and extend onto the north eastern corner of Lot 800 on the Fremantle – Jarrahdale Sheet Mapsheet. The nomination is the location of the proposed quarry.

In State Planning Policy 2.4 Basic Raw Materials, 2000, the site is adjacent to the Priority Hard Rock Resource number 29/28, which is listed as a Priority Resource but has since been dropped through a land swap. This land, being cleared, does not have the same environmental restrictions.

3.0 Proposal

Summary

The proposed hard rock quarry is to extract 50 000 to 100 000 tonnes of hard rock per year initially, rising to 200 000 tonnes in the future.

Rock will be extracted by drill and blast with an excavator. A 35 tonne haul truck will take the resource to the processing area where a mobile crushing plant will be used to produce a range of products and a number of stockpiles.

Access will use Pruden Road and then an access road along the western side of Lot 800.

Planning Approval of 20 years is sought to provide long term security, combined with an Extractive Industries Licence.

Hours of Operation

The quarry and processing operate to the *Environmental Protection (Noise) Regulations 1997.* Quarrying is normally restricted to daylight hours, with processing and transport during daylight and at other times as required.

Other ancillary activities such as maintenance are conducted outside these hours in line with normal industry practice. These are site restricted activities that are not likely to impact on the local community.

Wide operational hours are necessary to maximise operations and ensure that the full excavation, processing and transport times are available to satisfy community demands for products at certain times.

It is anticipated that the quarry will be worked in campaigns initially and then move to a full time operation.

The hours of operation will be determined by the Noise Assessments made by Herring Storer Acoustics. See Attachment 3.

From the Noise Assessment Herring Storer have determined that the operational hours should commence at 7.00 am for quarrying operations with limited transport able to operate before that time.

Transport is proposed to be 6.00 – 6.00 pm six days per week, Monday to Saturday excluding Public Holidays. The number of truck movements prior to 7.00 am is restricted by the Noise Regulations. Prior to 7.00 am the number of truck movements permitted is 4 (2 inbound and two laden).

Crushing drilling and blasting is proposed to be 7.00 am to 5.00 pm Monday to Saturday exclusive of Public Holidays, to assist with compliance with the Noise Regulations.

Between the hours of 6.00 am to 7.00 am and 5.00 pm and 6.00 pm, the only work conducted on site will be low noise activities such as maintenance, preparation for site activities, and minor loading and tidying.

Figure 5 – 1 Location and access

Figure 4 – 2 Oblique view of the proposed quarry and access

Type and Number of Trucks

A range of road trucks and trailers are to be used to transport rock from the site.

The number of trucks will be dependent on the contracts won but cannot exceed the permitted number based on the Noise Regulations.

During normal operations the truck traffic is anticipated to include;

- semi-trailer trucks with a load capacity of 20 – 25 tonnes,
- truck and dogs with a capacity of 40 – 50 tonnes may be used.

Which vehicles are used depends on the transport operator, the distance to the destination of the product and the nature of the contract that is being supplied.

A few points are relevant to truck transport and show that the use of smaller trucks does not necessarily benefit the community.

- Trucks are able to operate legally on the roads used and are regulated by Main Roads and the Shire on lesser roads.

- The transport of material is the greatest cost of product over longer distances with costs being 20 to 30 cents per tonne per kilometre travelled. The cheaper costs occur when larger trucks are used, and all costs are reflected in the construction of developments and are ultimately borne by the community.

- Larger trucks are more fuel efficient per tonne of material carried, and therefore have significantly lower greenhouse gas emissions per tonne.

Access Route

The access route is underlain by grantitic rocks of the Western Gneiss Terrane with the western section near South western Highway located on sandstones of the Cardup Group and, adjacent to the Highway, on Yogannup Formation.

The vegetation along the transport route is pasture that is used for cattle grazing with several Marri (*Corymbia/Eucalyptus calophylla*) trees.

There is a section of Pruden Road in the west which consists of Marri and Wandoo Woodland over native understory although the road verge is partially disturbed and has reduced numbers of species.

Figure 4 – 3 Pruden Road crossover to South Western Highway, view south

Figure 4 – 4 Pruden Road crossover to South Western Highway, view north

4.0 Traffic Management

4.1 Context

Access to Lot 800 will be along Pruden Road.

Traffic Management is designed to comply with Best Practice, such as *Institute of Quarrying Australia/Queensland Government, Traffic Management.*

Greenfield Technical Services (Traffic Engineers) have been commissioned to assist with the traffic design requirements for the access road and the linkages to the normal road network of South Western Highway.

Greenfield Technical Services determined that access to South Western Highway was possible at the location of Pruden Road, because of the configuration of the roads and the speed limits on South Western Highway at that point. The speed limit is 90 kph at the intersection of the pit and South Western Highway.

An email form Greenfields Technical Services is attached and summaries the issues identified by them during their site inspection.

The design of the road and access network will be completed by Greenfield technical Services through discussions with the Shire of Serpentine – Jarrahdale, Main Roads and the local residents who use Pruden Road.

4.2 Current Road Network

The current access route has the following features;

- ***Pruden Road***
- A very wide apron and cross over to South Western Highway
- Gravel road from South Western Highway across the closed rail line to the intersection with the new section of Pruden Road. This section has overhanging trees, and narrows to the east.
- The existing road is 5 – 6 metres wide.
- There is a stone gateway entrance statement that is single lane and represents the original entrance to Yarrabah property.
- East of the stone gateway Marri trees crowd the road and the road is predominantly a single lane.
- The new section of Pruden Road is bitumen and steep in places at > 8 % which is unsuitable for the proposed trucks which require a gradient of 5 – 6 %.
- Some overhead power lines are present and may need to be relocated.
- The new section of Pruden Road is 3 metres wide located within a 20 metre road reserve.
- The bitumen section of Pruden Road has a speed limit of 30 kph.
- The eastern section of Pruden Road is steep and will require the crest to be lowered.
- A lockable gate is maintained at the entrance to Lot 800.

Figure 4 – 5 Pruden Road near South Western Highway

Figure 4 – 6 Pruden Road showing the entry statement

Figure 4 – 7 Pruden Road eastern end, view towards the ridge

Figure 4 – 8 Existing access and proposed access road on Lot 800, view north.

- ***Access Road***

- The existing access road to the dwelling is very steep, is unsuitable for access and is not located in the correct position.

- A section of access road is proposed to sweep from the existing access road, around the western boundary of Lot 800.

- ***South Western Highway***

- South Western Highway is wider on the western north bound lane where a passing lane terminates just to the north of the access point from South Western Highway.

- A speed limit of 90 kph applies across the intersection of Pruden Road.

- Sight lines appear adequate for 90 kph.

4.3 Proposed Access

Pruden Road is the only legal access to Lot 800 and will require some modification to reduce the slopes at the eastern end to enable truck transport to access the proposed pit. Some widening of Pruden Road may also be required.

The current access road is a single lane road along the old railway alignment, with some locations for passing. In places there are trees close to the road and the carriageway is not wide enough.

Any changes or upgrades to Pruden Road will be through extensive discussion with the Shire of Serpentine – Jarrahdale and the local residents who may potentially be affected.

A number of transport scenarios can be considered to ensure safe use of Pruden Road by all parties that can be achieved without significantly impacting on the amenity.

This discussions might include, but not be limited to;

a) Upgrade of Pruden Road to provide wider safer carriageways for all users.

b) Reforming and widening of the road and alignment as required. Greenfield Technical Services recommend a 7 metre wide seal to the reformed road.

c) Removal of the Yarrabah entry statement.

d) The width of Pruden Road in the section accessed only by trucks; whether single lane with communication arrangements or double lane at 7 metres

e) Modification to the gradients on Pruden Road, to bring them down to 5 – 6 % and suitable for the proposed 19 metre, semi trailer trucks.

f) Greenfield Technical Services have determined that the road reserve is sufficiently wide to enable the cuts, provided steep reinforced batters are provided.

g) Fences in the form of 1.8 diamond mesh steel fencing is proposed above sections of road cuttings.

h) Radio and other communications between trucks, in the proposed operations.

i) Left turn exit only onto South Western Highway for laden trucks.

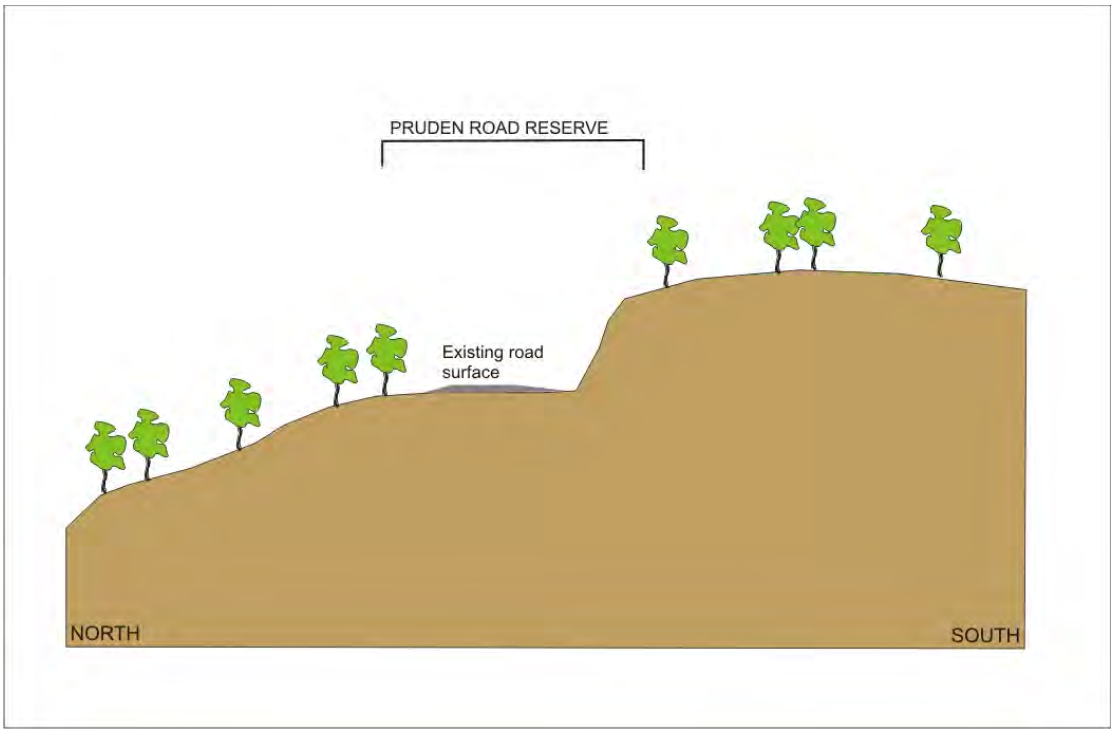

Figure 4 – 9 Existing sketch section across the ridge on Pruden Road

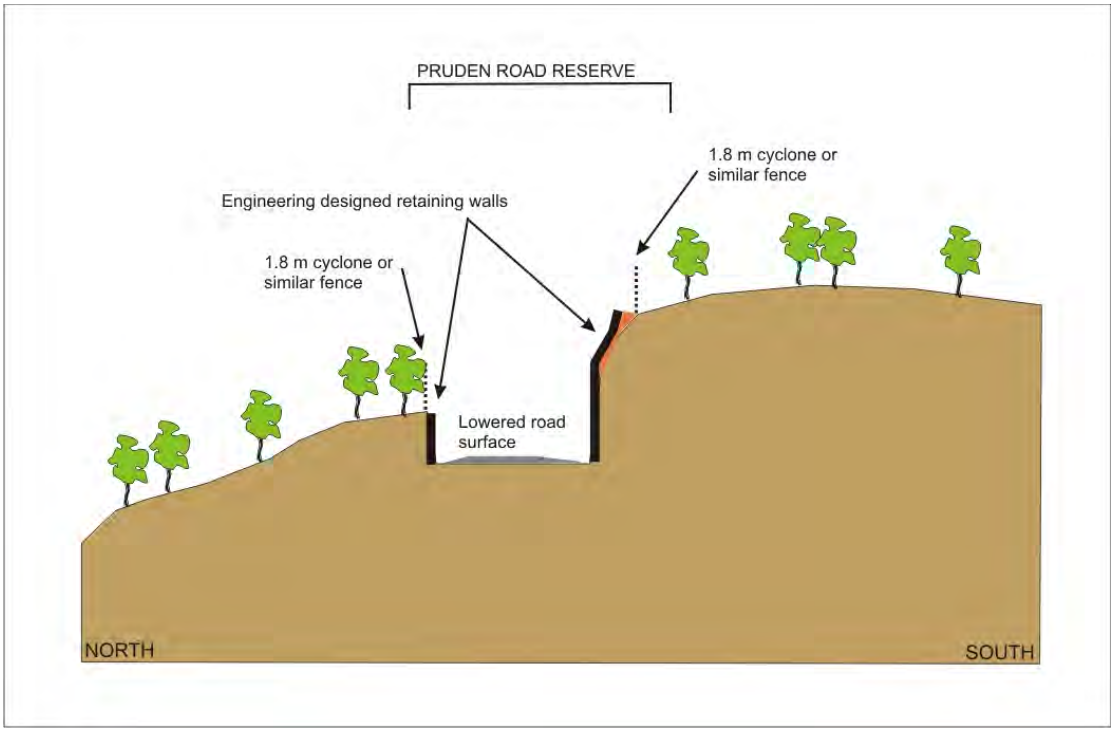

Figure 4 – 9 Existing sketch section across the ridge on Pruden Road showing the concept lowering

j) Additional signs to South Western Highway as required.

k) Modifications to the crossover with South Western Highway with slip lanes or turning pockets as required.

l) A system of local traffic lights or flashing warning lights when a truck is present on Pruden Road to mitigate any potential conflicts with the local landholders who use Pruden Road.

m) Offset tree planting and revegetation to mitigate clearing or other environmental impacts.

n) Hours and types of operation.

o) Formation of a public consultation group to provide input to the design, implementation and use of the access routes.

From Pruden Road the access road to the processing and stockpile area will run along the existing internal road alignment across the existing dam wall and then along the western edge of Lot 800 to the north western corner. It will be formed and sealed.

The access road will need to be widened. The main vegetation along the access road is scattered *Eucalyptus (Corymbia) calophylla* trees of which some will have to be taken to widen Pruden Road.

Extensive tree planting of local taller growing trees is proposed for the western edge of the access road to mitigate views of the trucks from the west or South Western Highway, in situations where the existing tree vegetation is reduced.

The Herring Storer Noise Study determined that the transport of products and the movement of road trucks will comply with the Noise Regulations (See Appendix 3) if restricted to daylight hours and two truck movements prior to 7.00 am, which is acceptable to Italia Stone Group.

ATTACHMENTS

Email from Greenfield Technical Services

Subject: Italia stone, Pruden Road, GTS Scope 07 Aug 2015
Date: Friday, 7 August 2015 6:00:35 pm Australian Western Standard Time
From: Michael Keane
To: Lindsay Stephens, Landform Research.

Lindsay,
Further to our meeting today with Tinus and Sam at Pruden Road, I thought it best to confirm your request for service, per my notes below;

Italia Stone seek to develop a hard-rock quarry high on the hill behind the house.
Greenfield scope is to;

1. Formulate the transport proposal – vehicle type, traffic periods, traffic impacts, identify processes and approvals required.
2. Develop preliminary horizontal and vertical design along the gazetted public roadway from the property driveway to South West Hwy.
3. Satisfy the Shire's requirements with regard to legal access for neighbours affected by the proposal
4. Establish any MRWA requirements with regard to access onto South West Highway

1. Transport Proposal
The Transport Proposal is to cart marine size rock from the proposed Italia Stone Quarry located off Pruden Road at Mundijong to Kwinana Freeway via South West Hwy and Mundijong Road. The proposed haul vehicle is a standard as-of-right semi trailer.
Quarry production is likely to be approx 50,000 tonnes per annum however, cartage will be carried out on a campaign basis, nominally say 25,000 tonnes over a 3 month period, happening twice a year. This equates to approx 1400 loads over 90 days = 15 loads per day spread over 10 hours.
Total of 3 truck movements per hour on Pruden Road.

2. Preliminary Road Design
Section 1, Ch 0-250
Existing gravel road (approx 5-6m wide) includes narrow "entry statement" which may need to be removed / circumvented.
Client seeks to retain existing road as is but with traffic signal system to alert any other road users.
Road will most likely need to be sealed. If sealed, most likely seal will be 7m wide.

Section 2, ch 250-400
Existing 3m sealed road within 20m road reserve – already cut to grade.
Client seeks to retain existing road as is but with traffic signal system to alert any other road users.
Shire / residents / client may prefer to take it out to 7m wide.
Any road widening will most likely require relocation of minor overhead power lines.

Section 3, Ch 400-1200
Existing 3m wide sealed road constructed by the previous land-owner along gazetted road reserve presents as a private driveway.
The road appears to provide legal access to adjacent properties but those adjacent properties are currently using alternative access.
The existing road includes gradients in excess of 8%. This gradient is not suitable for proposed trucking.
Design vehicle is a 19m semi.
Italia Stone seek a road solution which will achieve gradients in the range of 5-6%.
Roadworks are constrained by the existing 20m road reserve. Cuttings in rock can have steep batters so 20m road reserve should be sufficient.
The design level at Ch 1200 is not constrained.

Actions by GTS for Sections 1, 2 and 3:

- Source good contour mapping with cadastral information.
- Set design horizontal alignment within road reserve.
- Set design vertical alignment to ensure batters are within road reserve.
- Identify cut / fill quantities
  Design Width is 7m seal.
  Design vehicle is 19m long as-of-right semi-trailer.

3. Liaise with Shire

Meet with Shire to identify opportunities to regularise access to all properties and to Identify any Shire issues relating to the transport proposal.

4. Liaise with MRWA

Meet with MRWA to identify any concerns relating to trucks turning in and out of Pruden Road. This should be little more than a formality since the proposed truck unit is an as-of-right vehicle nevertheless, the base needs to be covered in case there are other issues that we are not aware of.

Please advise if the scope described above needs any amendment.

For our starting point, we will source the available digital contour mapping and establish if the level of accuracy is sufficient for preliminary design purposes.
Hopefully, I can report back to you within a fortnight. Maybe you can point us in the direction of your source for the mapping which you have provided.

regards

Michael Keane | Principal
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ATTACHMENT 6

BIODIVERSITY MANAGEMENT, REHABILITATION and CLOSURE PLAN

Proposed Hard Rock Quarry

Lot 800, Pruden Road, Whitby

Italia Stone Group

July 2016

Address Manager
Italia Stone Group
55 Miguel Road,
Bibra Lake WA 6163

Phone 9418 1437

TABLE OF CONTENTS

FIGURES

Prepared by

Lindsay Stephens BSc Geology), MSc (Plant Ecology) 25 Heather Road Roleystone WA 6111
Mem Aus Geomechanics Soc – MEIANZ – FIQA Tel 9397 5145, landform@iinet.net.au

1.0 PROJECT OVERVIEW

Background

Lot 800 lies approximately 950 metres from South Western Highway with the pit approximately 1 300 metres from the highway.

The pit is approximately 3 500 metres east from Mundijong townsite and approximately 1 500 from the Whitby Urban Area.

Lot 800 occupies the upper face of the Darling Scarp, but the valley of Manjedal Brook cuts the scarp and provides a north facing slope on which the quarry will be located, facing into the ridge to the north and protected to the west.

The design of the pit takes into account the potential for visual impacts and is provided with a narrow north facing throat combined with a western bund to better manage visual any visual impact.

Project Summary

ASPECT	CURRENT DISTURBANCE	DISTURBANCE
Area of excavation	Nil	7.0 hectares pit and 4.0 hectares of processing and stockpiles year 2017 – 2040 Potential final pit and size 12.0 hectares at 2080.
Processing Infrastructure. Product stockpiles, laydown and related areas	Nil	4.0 hectares
Roads, dams and related infrastructure etc	Nil	2.5 hectares
Revegetation	Nil	3.0 hectares at 20 years
Hard Rock extraction	Nil	50 000 – 100 000 tonnes per year, initially, potentially rising to 200 000 tonnes at 5 years.
Estimated reserve		3 million cubic metres based on the concept quarry plan.
Life of project		60 years
Dewatering requirements		Nil
Depth of excavations	Nil	60 metres

Resource Sought

Larger granite rock for coastal construction, sized according to the requirements for coastal developments such as breakwaters, groynes and other coastal protection.

Undersize and waste rock will be crushed and used for hard rock products such as minor roadbase and aggregates.

Proposed facilities

- ***Production of coastal rock, such as armour rock.***

- Track mounted percussion drill and compressor.

- 20 tonne excavator or similar.

- Rubber tyred loader

- 35 – 50 tonne off-road dump truck for internal transport of rock from the pit to the crusher.

- 20 tonne water truck or similar for dust suppression.

- Self contained maintenance vehicle to attend site as required.

- ***Processing of aggregates in campaigns as required.***

- Mobile primary, secondary and tertiary crushers with related screens and conveyor belts. These will be moved across the site as excavation progresses.

- ***Water management***

- Two detention basins of 5 000 kL storage capacity each combined with a sump in the base of the pit in later years. A range of protected small detention basins, channels and drains to manage water on site and on closure.

- ***Facilities***

Site office/lunchroom	A mobile site office/lunchroom is potentially to be maintained on site for the management and security of small items particularly during campaigns.
Toilet system	The facilities at the dwelling, approved serviced portable toilet system or septic system is to be installed when the site is manned. Serviced means they are pumped out by a licensed contractor as required.
Storage sheds	A storage shed may be used for the storage of maintenance items during excavation campaigns.
Fenced compound	A fenced compound may be used for the storage of mobile plant.
Weighbridge	At this stage a weighbridge is not proposed but may be installed at a later date near the stockpiles if required.
Fuel Storage	Vehicles will be refuelled from mobile tankers. It is anticipated that no fuel will be stored on site. However there remains the possibility that fuel might be stored for a short campaign, in approved containers to DMP and DOW Standards as outlined in the attached Water Management Plan. See Attachment 4.

- ***Quarrying***

- The methods of extraction will be the same as any hard rock quarry.

- The pit will be operated with a series of north facing faces with benches 15 metre high. This configuration has been selected based on the rock type, configuration of the pit and landform.

- The height of the benches will depend on the mobile plant used and is likely to eventually go to three x 15 metre benches at 165 m AHD, 180 metres AHD and 195 metres AHD. A small temporary top bench of 210 metres will be used to form the top of the eatern face and allow for its early rehabilitation.

- The hardstand and processing area and sediment settlement basins will be located at 155 metres AHD.

- A western perimeter screening bund will be 4 metres high.

- ***Processing***

- The hard stand area to be used for processing will be formed at 155 metres AHD from overburden and subgrade rock extracted from the first stages of mining and clearing for the pit.

- The hard stand will be installed with edge bunding for safety and water management and drain to the proposed detention basins.

- The crushing and screening operation will be located on the western edge of the hard stand where it will be afforded maximum landform screening to mitigate noise.

- Perimeter bunding approximately 1 metre high will be placed around the edge of the flat area for safety and water management. Surface water will be directed back to the detention basins.

Waste Rock and Tailings

There is no waste material. The only materials remaining on site will be subgrade rock that cannot be used, some overburden of weathered rock and topsoil. All are natural products with no potential to cause pollution.

The rock has no, or only traces, of pyrite (iron sulfide), similar to all other hard rock quarries, at levels that cannot cause any deleterious effects.

Potential "at risk" Inventory

Type	Comment	Treatment
Saline surface water	Not present	Surface water is fresh, like all streams on the Darling Scarp.
Saline ground water	Not present	All water on site is fresh.
Acidic materials and drainage	Not present	
Sodic or dispersive materials	Not present	All water on site is fresh. The soils are not sodic or dispersive.
Asbestos – asbestiform minerals	None present	The pit will be assessed regularly during operations by the quarry manager and consultants to determine the presence of asbestiform minerals and any action that needs to be taken to mange those materials.
Radioactive materials	Not present	Granitic rock such as this contains such low levels of radioactive materials that no testing is required. The resource is similar to the other hard rock quarries on the Darling Scarp.

Metallic or chemical materials	Not present	
Tailings storage	Not required	All crushed materials and fines will be used or used to form on site roads and backfill.
Ablutions waste		The existing facilities at the dwelling will be used. If those become unavailable if used as a caretaker's residence then serviced portable facilities or an approved septic system will be used.
Dangerous Goods and Hazardous Materials	***None will remain on closure***.	There are normally no hazardous materials used for hard rock quarrying, apart from fuel, blasting and servicing. The only other materials are for tasks such as weed management and are dealt with under those sections.
	EXPLOSIVES ***None will be stored on site.***	Explosives will be brought to site as required. None will be stored on site.
	FUEL The various plant will be refueled from mobile tanker. ***None will remain on closure***.	Any soil or other materials with drips and spills will be removed offsite to an approved waste site or location.
	SERVICE MATERIALS Only minor lubrication will be conducted on site All major servicing will be conducted offsite. ***None will remain on closure***	Any wastes will be collected and removed from site promptly to an approved recycling or waste disposal area.
General waste	***None will remain on closure***	Regularly removed from site to an approved disposal area

2.0 BIODIVERSITY MANAGEMENT DURING OPERATIONS AND ON CLOUSRE

2.1 Flora

2.1.1 Community Types

- ***Lot 800 – Disturbance Footprint***

The original vegetation type is not possible to determine but was either a Marri Forest or Jarrah Marri Forest. No Jarrah trees are now present.

The vegetation is pasture that is used for cattle grazing with several Marri (*Corymbia/Eucalyptus calophylla*) trees that are regrowth.

Scattered *Eucalyptus rudis* occur along the lower slopes and along Manjedal Brook, although currently there is no riparian vegetation associated with the Brook at this location.

There is no understorey. The only understorey taxa observed was a few plants of *Cheilanthes austrotenuifolia* growing in cracks in the granite outcrops.

The pasture consists of common introduced agricultural pasture species.

Scattered Cotton Bush occur on site but are currently kept in check by the cattle grazing.

The pit is located on an area originally of the Darling Scarp Complex of *DEC 1980, Atlas of Natural Resources Darling System, Western Australia. Markey 1997, A Floristic Survey of the Northern Darling Scarp, CALM, DEP, WACC and AHC* considered the vegetation complexes of the Darling Scarp but there is so little vegetation remaining that the vegetation cannot be ascribed to any particular complex.

Plant Density

The vegetation was not measured for plant density because it consists of scattered Eucalypts over pasture.

The vegetation of the pit and processing area is classified as Completely Degraded (Parkland Pasture).

The structure is summarised in the table below.

VEGETATION STRUCTURE	HEIGHT	MARRI PARKLAND PASTURE
Overstorey	> 4 m	Degraded to Good
Tall Shrub layer	2 – 4 m	Absent
Lower Shrub Layer	0.5 – 2 m	Absent
Ground Cover	<0.5 m	Absent Dominated by pasture and exotic species.

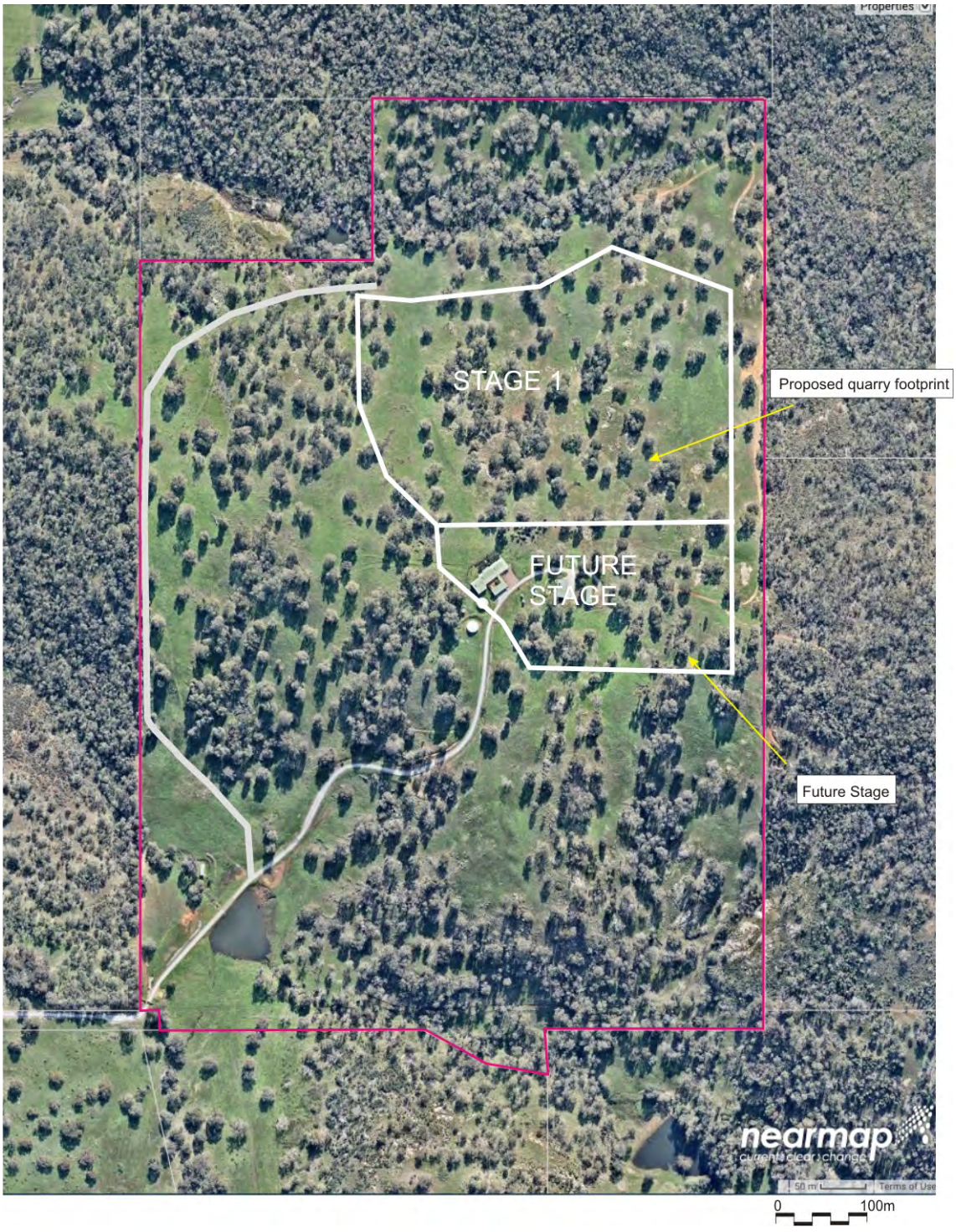

Figure 6-1 Aerial Photograph of Lot 800 showing the quarry footprint and the scattered regrowth Marri Trees

Figure 6 – 2 Proposed quarry site showing regrowth Marri trees

Figure 6 – 3 Proposed quarry site showing regrowth Marri trees and granite outcrop

Figure 6 – 4 Proposed quarry site showing regrowth Marri trees

- ***Pruden Road Access***

The section of Pruden Road that may require clearing was assessed by Lindsay Stephens of Landform Research on 11 August 2016.

The access along Pruden Road consists of scattered Marri (*Corymbia/Eucalyptus calophylla*) trees in all but the western end of the road access.

The western portion of the road access crosses vegetation associated with Yogannup Sands.

The road verge vegetation on the Yogannup Sands was assessed and a species list provided below. It appears that there may have been some rehabilitation or tree planting along that portion of the access based on the species present, such as two small trees of *Eucalyptus accedens.*

FAMILY	**GENUS - SPECIES**	**Western end of Pruden Road Between the old rail line and South Western Highway**
Cyperaceae	*Mesomelaena tetrogona*	*x*
Euphporbiaceae	*Phyllanthus calycinus*	*x*
Fabaceae	*Acacia pulchella*	*x*
	Acacia saligna	*x*
	Acacia urophylla	*x*
Haemodoraceae	*Haemodorum sp*	*x*
Hemerocallidaceae	*Dianella revoluta var divaricata*	*x*
Myrtaceae	*Eucalyptus accedens*	*x*
	Eucalyptus (Corymbia) calophylla	*x*
	Hypocalymma robustum	*x*

Proteaceae	*Banksia grandis*	*x*
	Hakea cristata	*x*
	Hakea lissocarpha	*x*
	Jacksonia sternbergiana	*x*
Zamiaceae	*Macrozamia fraseri*	*x*
TOTAL NATIVE SPECIES	**15**	

The number of species is very restricted, indicating how degraded the road verge of Pruden Road is. The remainder of the species are exotic and include the invasive Love Grass.

The access road is located on an area originally of the Forrestfield Complex of *DEC 1980, Atlas of Natural Resources Darling System, Western Australia. Gibson et al 1994, A Floristic Survey of the southern Swan Coastal Plain CALM, DEP, WACC and AHC,* considered the vegetation complexes of the Swan Coastal Plain including the Yogannup Formation. The vegetation on site would best be related to FCT 20b or FCT 20C based on the location and the few species present, however the paucity of species in the small area of road verge that may be required to be cleared makes it difficult to be definitive.

Plant Density

The vegetation was not measured for plant density because it consists of scattered Eucalypt understory with such a small area of potential clearing at the edge of the road verge that, with the disturbances, made surveys invalid.

Figure 6 – 5 Section of Pruden Road near South western Highway that will require widening by about 2 metres

Figure 6 – 6 Section of Pruden Road near South western Highway that will require widening by about 2 metres

Vegetation Structure and Condition

The vegetation along the small section of the Access Road near South West Highway is classified as Degraded to Good.

The structure is summarised in the table below.

VEGETATION STRUCTURE	HEIGHT	EUCALYPT BANKSIA WOODLAND REMNANT
Overstorey	> 4 m	Good
Tall Shrub layer	2 – 4 m	Degraded
Lower Shrub Layer	0.5 – 2 m	Degraded to Good
Ground Cover	<0.5 m	Degraded to Good Impacted by pasture and exotic species.

2.1.2 Significant Vegetation

Declared Rare, Priority or Significant Taxa

No plant recorded is listed as Threatened or Priority species.

Threatened or Priority Ecological Communities

The vegetation is not listed as a Threatened or Priority Community, but is less well represented and larger remnants are worthy of protection.

The proposed road widening may take 1 – 2 metres on either side of a small section of Pruden Road immediate east from South West Highway.

EPBC Legislation

Databases held under the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* were searched.

No vegetation or taxa listed under Commonwealth legislation were observed during the site investigations. In addition no unusual or unidentified species were recorded.

Vegetation Representation

EPA Position Statement No 2, December 2000, *Environmental Protection of Native Vegetation in Western Australia*, specifically targets the retention of native vegetation in the Agricultural Areas in *4.1, Clearing in the agricultural areas for agricultural purposes*. In 4.3, *Clearing in other areas of Western Australia*, it is unclear what "other areas" refers to, but may refer to retention of a 30% threshold in non agricultural areas.

Section 4.3 *Clearing in other areas of Western Australia*, (EPA Position Statement No 2, December 2000) expects that clearing will not take vegetation types below the 30% of the pre-clearing vegetation as recommended by ANZECC, 1999, *National Framework for the Management and Monitoring of Australia's Native Vegetation*. The National Objectives and Targets for Biodiversity Conservation 2001 - 2005 (Commonwealth of Australia 2001) also recognise 30% as the trigger value.

- **Pit and Processing Area**

The vegetation on site is classified as parkland pasture and therefore does not have applicability with respect to vegetation representation.

The vegetation does have value from an aesthetic perspective and as an interface between the State Forest to the east and being located on the Darling Scarp.

The quarry will lead to the clearing of the parkland pasture gradually over a period of many years.

This will be offset by the planting of the upper portion of the eastern face as soon as practicable during excavation and the reinstatement of the riparian vegetation along Mandjedal Brook.

- **Pruden Road Verges**

The vegetation is not listed as a Threatened or Priority Community, but is less well represented and larger remnants are worthy of protection.

The proposed road widening may take 1 – 2 metres on either side of a small section of Pruden Road immediate east from South West Highway.

EPA Guidance No 10, 2003, Level of Assessment for proposal affecting natural areas within System 6 region and Swan Coastal Plain portion of the System 1 region list the Forrestfield Complex as having 17% remaining of the Pre-European vegetation of which 61% is located in secure tenure.

The amount of clearing that would be required for widening the access road for about 50 metres is minimal and consists of perhaps around 100 m^2, but that cannot be determined until the access road alignment is known.

Management of Flora and Vegetation

The vegetation consists of pasture with scattered regrowth trees of Marri (*Corymbia/Eucalyptus calophylla*) with minor *Eucalyptus rudis*. There is no native understory. The pasture consists of common introduced agricultural pasture species.

The vegetation around the quarry is so disturbed and altered that it is not possible to determine the original vegetation community.

Extensive planting will be carried out on the western screening bund and within the 50 metre setback to Manjedal Brook, which will reform a linkage from the west to the State Forest.

The additional species and planting will assist in compensating for the clearing of the Marri Trees.

The vegetation along the section of Pruden Road that will require widening was assessed and found to only contain 15 species, none of which is listed as Priority or Threatened. The small section of vegetation is in Degraded to Good Condition.

2.2 Fauna

Macrofauna

The reduced vegetation with a predominance of pasture will result in a reduction in the number of fauna. The shrubs and trees will be providing some habitat.

Whilst no specific fauna study has been conducted, the native vegetation and the fauna associated with that vegetation have been considered. Native fauna will be living in or using the Marri Trees and other vegetation.

The amount of fauna is anticipated to be limited because of past continuous grazing on site. The return of the disturbed areas to local native vegetation will compensate for the small amount of clearing to be required to make the pit safe and lay back the face for rehabilitation.

See the quarry restoration conducted by Roadstone (part of the Italia Stone Group) conducted in restoration of the Esperance Port Quarry contained under visual management in the Offsite Impacts Management Plan.

The main fauna to be considered will be the potential for a family of possums, and feeding habitat for Black Cockatoos, mainly Carnaby's in this location. Fauna will be assessed by the Department of Environment Regulation as part of the Clearing Permit Application under the *Environmental Protection (Clearing of Native Vegetation Regulations 20*04)

Examination of the trees on site to be regrowth Marri. *Corymbia (Eucalyptus) calophylla* that do not exceed the criteria for referral under the *EPBC Act 1999*. The trees are relatively young, small and do not contain hollows. See the attached photographs.

Whether referral under the *EPBC Act 2009* is required will be assessed at the time of application for the Clearing Permit, in line with *EPBC referral guidelines for the three threatened species of black cockatoo 2012*.

There is the Bilateral Agreement between the Commonwealth and Western Australia in relation to Clearing Permits. which began on 1 January 2015, in which matters listed under the *EPBC Act 1999* are considered during the Clearing Permit application process.

Based on the initial site investigations the proposed quarry site with clearing of 11 hectares into 2040 will not trigger the *EPBC Act 1999,* but that will be determined at the time of lodgement of the Clearing Permit.

Extensive planting of the buffer to Manjedal Brook and the screening bunds are proposed to help compensate for the proposed clearing of the scattered trees.

Short Range Endemics

The widespread scarp landform of which this site forms a part is continuous and significantly disturbed by conversion to pasture and retention to Jarrah Marri Forest.

Two hard rock quarries are located nearby, Hanson Byford Quarry and WA Bluemetal Whitby Quarry.

The proposed quarry has the advantage in that it is located wholely on pasture – parkland pasture that is classified as Completely Degraded under Bush Forever Vegetation Condition whilst the other nearby quarries are located on Jarrah – Marri Forest that is required to be cleared.

Stygofauna and Troglofauna

EPA Guidance 54, concentrates on Stygofauna, which occur in caves and “are aquatic subterranean animals, found in a variety of groundwater systems”.

“Troglofauna occur in air chambers in underground caves or smaller voids”.

These type of fauma could only potentially occur on the rocky quarry site and not the access road.

The proposed disturbance is relatively small in consideration of the extent of granite rocks on the Darling Scarp, and underlain by tight hard rock.

Whilst there will be some surface invertebrate species living in surface hollows and under rocks there is no potential for significant or restricted short range endemics of stygofauna or troglofauna on site.

The quarrying will expose much more rock, and as excavation occurs fractures in the rock will open providing increased habitat for ground and soil fauna during and on completion of excavation than currently occurs.

2.3 Wetlands and Riparian Communities

Some frogs and other wetland species will be present associated with the drainage line of Manjedal Brook, although currently there is no riparian vegetation. The pasture goes to the edge of the Brook.

The brook will be protected by buffers and setbacks of 50 metres that are already in place and are the same as used on other hard rock quarries on the Darling Scarp.

A small area of rocky rapids and waterfall lies to the west outside Lot 800. That feature will not be impacted with water from the proposed quarry and processing area being retained in two large detention basins with a total capacity of 20 000 kL combined with a third sediment settlement basin, to provide final water management and sampling and release points.

The release point to Manjedal Brook is 300 metres upstream from the rapids – waterfall. There will be no additional placement of materials closer to the Brook than currently exists.

The fringing and riparian vegetation along Manjedal Brook is in reasonable condition and will be retained. The 50 metre buffer to the Brook will be replanted and re-established to local riparian and forest species matching habitat to species choice, to re-form the original community types.

Figure 6 – 7 Manjedal Brook showing regrowth Marri and Flooded Gum Trees. The buffer is to be planted to local native and riparian species as part of the offsets for the quarry and clearing.

2.4 Clearing

*Clearing is controlled under the **Environmental Protection (Clearing of Native Vegetation) Regulations 2004.** These regulations provide for a number of principles against which clearing is assessed.*

	CLEARING PRINCIPLE *(Schedule 5 Environmental Protection Amendment Act, 1986*
1a	*High Level of diversity*
1b	*Significant fauna habitat*
1c	*Necessary to existence of Rare flora*
1d	*Threatened Ecological Community*
1e	*Significant area of vegetation in an area that has been*

	extensively cleared
1f	*Wetland or watercourse*
1g	*Land degradation*
1h	*Impact on adjacent or nearby conservation areas*
1i	*Deterioration of underground water*
1j	*Increase flooding*

Although the Clearing Principles consider Biodiversity and other conservation issues, they do not specifically address the issues of the metropolitan area or resource needs. Therefore some additional principles need to be added when considering the need for Basic Raw Materials.

The *Environmental Protection ACT 1986 Section 51O* states that the "CEO may take into account other matters that the "CEO considers relevant" (*EP ACT 1986 Section 51O*). Therefore Section 51O of the *Environmental Protection Act 1986* allows the CEO to take planning matters into account when making clearing decisions, such as a State Planning Policy and community need.

The procedures used for vegetation clearing are documented in 5.9.2 Rehabilitation. These were used and are included here in case a small area of additional clearing is applied for to the immediate north of the existing permitted area.

Topsoil and overburden treatment is covered in 5.9 Rehabilitation. All suitable materials will be retained for rehabilitation and directly transferred where possible.

As the quarry area is cleared or has occasional regrowth Marri, a clearing permit will be required for the proposed disturbances.

Principles that have to be satisfied are apparently designed for rural regions and do not adequately address the issues of resource needs. Therefore some additional principles need to be added when considering the need for essential Raw Materials. In an attempt to provide a better balance to the clearing principles those principles have been expanded as listed in the tables below.

The issue of clearing native vegetation and fauna habitat cannot therefore be considered separately but must be considered in terms of community needs and end use of the site.

	ADDITIONAL CLEARING PRINCIPLES – EXTRACTIVE INDUSTRIES
Environmental Protection Act 1984 Section 51O Planning Matters	
1	*Planning Matters*
Environmental Protection Act 1984 Section 51O Relevant Matters	
2a	*Need for the resource*
2b	*Classification of the resource and existing approvals*
2c	*Availability of alternative resources and the impact of their use*
2d	*Proposed final land use*
2e	*Offsite Environmental impacts if the resource is not used*
2f	*Sound environmental management and rehabilitation*

Assessment against the Clearing Principles

	CLEARING PRINCIPLE *(Schedule 5 Environmental Protection Amendment Act, 1986).*	**COMMENT**
1a	High Level of diversity	• The quarry site has been assessed in the flora survey by Landform Research and found to be parkland pasture. • Only three taxa were identified *The proposed clearing is not at variance with this principle.*
1b	Significant fauna habitat	• The small area of scattered trees and the return of local native species on steeper slopes with an increased area of habitat will ensure that there will be no significant loss of habitat. In fact a net gain is likely at the end of excavation. • Revegetation is to be to local native species. • Whilst habitat will be cleared progressively, it will be replaced at the end of excavation by similar and better species composition that will be capable of developing into similar habitat to the pre-mined vegetation. • Assessment of the regrowth Marri trees shows that they are not likely top trigger referral under the EPBC Act 1999 as nesting or roosting habitat for Black Cockatoos, because they are too young, too small and there are larger White trunked Flooded Gum nearby and adjacent. Flooded Gum are preferred for roosting over Marri. that are preferred. • Proposed mining does not generate significant amounts of uncontrolled dust. *The proposed clearing is not at variance with this principle.*
1c	Necessary to existence of Rare flora	• No Threatened (Declared Rare) or Priority Flora was found. *The proposed clearing is not at variance with this principle.*
1d	Threatened Ecological Community	• No Priority or Threatened Ecological Community occurs on the quarry site. *The proposed clearing is not at variance with this principle.*
1e	Significant area of vegetation in an area that has been extensively cleared	• The scatted trees on the quarry site is in contrast to the adjoining State Forest to the east. • Manjedal Brook lies to the north and will be provided with a 50 metre buffer that will be revegetation to local native species to increase the riparian vegetation, wildlife corridors and linkages. *The proposed clearing is not at variance with this principle.*
1f	Wetland or watercourse	• There are no wet areas in the proposed resource or access road footprints. *The proposed clearing not at variance with this principle.*
1g	Land degradation	• The excavation be managed in a manner that does not lead to degradation of the soil and land integrity apart from normal development issues. • Landform values return as the excavated surface is revegetated. *The proposed clearing is partially at variance with this principle.*
1h	Impact on adjacent or nearby conservation areas	• There will be no impact on the adjoining State Forest with no connectivity by water or access. *The proposed clearing is not at variance with this principle*.
1i	Deterioration of underground water	• Hard rock quarrying is one of the few activities permitted in Public Drinking Water Source Areas. • Groundwater flow is westwards and greater than 5 metres below the base of the proposed excavation. • Manjedal Brook lies to the north and will be provided with a 50

		metre buffer that will be revegetated to local native species to increase the riparian vegetation, wildlife corridors and linkages. *The proposed clearing is not at variance with this principle.*
1j	Increase flooding	• The site is high in the landscape and, with a relatively small area of clearing, will have no observable impact on water elevations. • There is no evidence of the access roads impacting on water regimes, flooding or surrounding vegetation. *The proposed clearing is not at variance with this principle.*

ADDITIONAL CLEARING PRINCIPLES – EXTRACTIVE INDUSTRIES		**COMMENT**
Environmental Protection Act 1984 Section 51O Planning Matters		
1	*Planning Matters*	• The identification, protection and use of hard rock is recognised in all Government Policies. • The Geological Survey of WA mapping which identifies Strategically Important Basic Raw Materials recognises the hard rock resources that touch the northern edge of Lot 800 but does not extend onto Lot 800 on the Fremantle – Jarrahdale Sheet Mapsheet. • The *Department of Planning and Urban Development,1993, Darling Scarp Range Regional Park and Landscape Study* in Sectio 4.7 Quarrying listed the site as Site 27. The Darling Escarpment Aggregate Resources Committee (DEAR Committee) identified a total of 29 sites of potential hard rock resource. This site is shown as Site 27 and is given the nomination of 29/19. • For various reasons eight sites were identified with four listed in the Basic Raw Materials Policy of 1992 with the other four requiring additional work to prove their suitability. The proposed pit lies within the buffer of the southern most hard rock quarry area. • The site is listed in the Basic Raw Materials Policy of 1992 as lying within the buffer of the southern most hard rock quarry area. • In the Basic Raw materials Policy of the mid 1980's this site is a site listed to be considered for hard rock quarrying. • The site has therefore been earmarked and identified as a potential quarry site for many years. *The proposed clearing is compatible with this factor.*
Environmental Protection Act 1984 Section 51O Relevant Matters		
2a	*Need for the resource*	• There will be an increasing need for hard rock in the future because of the steriliastion of limestone by urban spread and conservation, the most commonly used road making material. The only alternative to limestone in the next decades is hard rock and the closer that is to the market the better the resource and the more valuable it is to the community. *The proposed clearing is compatible with this factor.*
2b	*Classification of the resource and existing approvals*	• The proposed excavation will support the State need for construction materials over the next decades. *The proposed clearing is compatible with this factor.*
2c	*Availability of alternative resources and the impact of their use*	• There are no real alternative resources. • As noted above there will be an increasing need for hard rock in the future because of the steriliastion of limestone by urban spread and conservation, the most commonly used road making material. The only alternative to limestone in the next decades is

		hard rock and the closer that is to the market the better the resource and the more valuable it is to the community. • The Perth to Peel Draft Green Growth Plan for 3.5 million only protects enough limestone for 30 years and at 2016 proposes to sterilize the rest by conservation. Annually up to 2 million tonnes of limestone are required and that will have to be replaced by the extraction of hard rock from the Darling Scarp. • The amount of clearing is small in relation to the large resource that can be extracted and is a very positive part of the proposed excavation. *The proposed clearing is compatible with this factor.*
2d	*Proposed final land use*	• The proposed final land use is to return the site to local native vegetation. • Whilst the pasture will be cleared progressively, it will be replaced progressively by local native species with much higher species richness and plant density that will be capable of developing into a much better habitat to the pre-mined vegetation. The end result will be an increase of around 16 hectares of local native vegetation. *The proposed clearing is compatible with this factor.*
2e	*Offsite Environmental impacts if the resource is not used*	• Not taking the resource will require material to be taken from much further away. Any alternative area may not offer any better environmental impacts. • Pasture will eventually be replaced progressively by local native species with much higher species richness and plant density that will be capable of developing into a much better habitat to the pre-mined vegetation. The end result will be an increase of around 16 hectares of local native vegetation. *The proposed clearing is compatible with this factor.*
2f	*Sound environmental management and rehabilitation*	• Environmental and rehabilitation management procedures are proposed. Management Plans have been prepared to minimise potential environmental impacts. • Pasture will eventually be replaced progressively by local native species with much higher species richness and plant density that will be capable of developing into a much better habitat to the pre-mined vegetation. The end result will be an increase of around 16 hectares of local native vegetation. *The proposed clearing is compatible with factor.*

2.5 Dieback Management

Phytophthora cinamomi is restricted to the areas greater than the 600 mm rainfall isohyets (EPA 2000 and may occur on this site. There is also potential for other plant pathogens to be brought to the local area. General plant pathogen control principles also assist with weed management and will be implemented.

The aim of a plant pathogen management policy is therefore to minimise the risk of entry of plant pathogens to the site.

In many ways the management of the site for plant pathogens is similar to that for the management of weeds, and the two management practices should be considered together.

The following documents provide guidelines on the management of plant pathogens even though they relate specifically to Dieback.

- *CALM (DPaW) Dieback Hygiene Manual 1992.*

- *CALM (DPaW) Best Practice Guidelines for the Management of Phytophthora cinamomi, draft 2004.*
- *Dieback Working Group 2005, Management of Phytophthora Dieback in Extractive Industries.*

Dieback of vegetation is often attributed to *Phytophthora cinamomi* even though there are other *Phytophthora* species and other diseases such as *Armillaria* that can cause dieback like symptoms.

The existing land surface of the resource grades gently to the west and north from an elevation of 230 metres away from the State Forest.

The Manjedal Brook to the north of the resource, which currently drains State Forest, may be already infected by dieback.

Even though the creekline is possibly infested and capable of carrying spores, it will be protected by setting back the edge of the pit by a buffer of 50 metres that will be replanted to local native vegetation. A bund will be progressively constructed along the eastern side of the operations and with the land contours will prevent any water from flowing to the State Forest.

The State Forest will remain fenced and this will restrict vehicle access in that area.

If some spread of the fungus spores did occur it will be downstream away from forest areas to the east and behind the vegetation of the Scarp to the west. This will take the fungus into areas of cleared farm land where it will be of less importance. However care is taken to prevent spread of the fungus during surface and overburden clearing and rehabilitation.

Dieback management procedures will be used and upgraded as new technology becomes available. As native vegetation on the resource area is removed, dieback could become a more important environmental factor. This will be mitigated by the use of dieback management, which will continue to form an integral part of clearing and revegetation procedures.

The quarry pit is to be self and internally draining and therefore there will be no surface water flow from the pit to the State Forest. The internal drainage of the proposed quarry will tend to inhibit the spread of the fungus to adjoining forest areas. A safety and visual management bund will be progressively constructed around the resource area. This bund will have the effect of preventing any water leaving the pit and travelling to the adjoining vegetation.

The perimeter bund isolates the active working areas from the State Forest and effectively forms a quarantined situation, supported by DER and DPAW policies.

The perimeter bund is created prior to excavation. Clearing is undertaken inside the bund. That is the vegetation is pushed away from the bund and the bund separates the cleared land from the forest. Clearing of vegetation, topsoil and overburden is normally away from the adjoining perimeter vegetation to the centre of the pit, subject to safe excavation practices.

Any topsoil and overburden storage is located in dry areas within the pit perimeter.

Quarry traffic is to be restricted to the designated access roads, pit and stockpile areas apart from clearing land and maintaining fire breaks. As noted above the perimeter bunding is progressively created prior to excavation, and quarantines the State Forest from traffic.

The access road will be sealed and transport trucks will therefore run along the bitumen roads to their destination and return. This run is considered low risk for dieback and trucks will not require cleaning during the transport phase.

Topsoil is cleared according the methods outlined below. Topsoil and overburden are to be stored in separate dumps. Where possible only soil from areas that visually appear to be dieback free will be used for rehabilitation.

Where topsoil cannot be directly transferred, infected and non infected topsoil will be stored separately in dry higher areas within the pit footprint.

As defined by best practice Italia will require vehicles to be used in clearing and removing topsoil, excavation or transport to be clean and free from soil or plant material prior to arriving on site from an area known or thought to be dieback infected. Cleaning is conducted offsite and all drivers and plant operators are made aware of the need to have clean trucks and plant when initially arriving on or accessing the site.

Vehicles, which have been operating in infected areas are to be cleaned, prior to entering site.

Waste from the crushing operation is used for road construction because it is free from dieback.

The site is to be secured from unwanted access with fencing, gates and perimeter bunding. A hygienic site is maintained by not bringing any soil or plant material onto the site except for rehabilitation purposes or from known dieback free areas. All plants, seeds, and other materials used in rehabilitation, are sourced from dieback free areas.

Illegally dumped rubbish or material is not normally an issue but if it is dumped the materials are promptly removed from site.

Significant numbers of species known to be resistant to Jarrah Dieback are to be planted in areas that may be infected.

The following procedures are proposed to be used, although not all potential impacts will apply to all parts of the proposed quarry operations.

- Plant diseases are more likely to be transported under moist soil conditions.
- All vehicles and equipment to be used during land clearing or land reinstatement, will be clean and free from soil or plant material when arriving at site.
- Vehicles accessing the site, whether they be road trucks or light vehicles, will be required to be clean prior to leaving developed areas. Dirty vehicles will not be permitted to enter the site.
- No soil and vegetation will be brought to the site apart from that to be used in rehabilitation.
- Plants and seeds to be used in rehabilitation will be from plant pathogens.
- Vegetated ahead outside the disturbance footprint and ahead of excavation should be quarantined to onsite access.
- Unwanted access to vegetated areas is to be discouraged through track signage and staff education.
- Rehabilitated surfaces are to be free draining and not contain wet or waterlogged conditions.
- Illegally dumped rubbish is to be removed promptly**.**
- When clearing land or firebreaks vehicles will work from the most disturbed to the least disturbed areas.
- Roads will remain free draining and hard surfaced.
- Detention basins will be used to control surface water and provide sediment trapping facilities.
- Compliance with the Weed Management Policy.

2.6 Weed Management Plan

The management of weeds is essentially similar to that for plant diseases. The impact of weeds is really the impact within the local area and the more they are controlled the better. It is desirable that the site does not become a haven for environmental weeds and therefore a management and control program is warranted at all sites.

Weeds can be Declared under the *Agriculture and Related Resources Protection Act 1976* which requires that Declared Weeds are eradicated. Other weeds are not Declared but may be classified as Environmental Weeds because they are well known for impacting on vegetation.

Generally if the actions taken for plant pathogens are applied they will also control weeds. Not all potential impacts will apply to this quarry and the main impacts affecting this site are also listed.

The site consists of pasture with scattered Marri Trees and Flooded Gums in lower elevations.

Cattle are used to graze the land and they control the Cotton Bush which occurs locally.

Some scattered Cotton Bush plants are present on site and will be treated as part of this weed management program.

The weed management program is summarised below.

- All vehicles and equipment to be used during land clearing or land reinstatement, will be clean and free from soil or plant material when arriving at site.
- Vehicles accessing the site, whether they be road trucks or light vehicles, will be required to be clean prior to leaving developed areas. Dirty vehicles will not be permitted to enter the site.
- No soil and vegetation will be brought to the site apart from that to be used in rehabilitation.
- Plants and seeds to be used in rehabilitation will be free from weeds.
- Vegetated ahead outside the disturbance footprint and ahead of excavation will be quarantined to onsite access.
- Unwanted access to vegetated areas is to be discouraged through track signage and public education
- Weed affected top soils may need to be taken offsite, used in weed affected areas, buried by 500 mm soil/overburden or taken offsite
- Illegally dumped rubbish is the major source of weeds and is to be removed promptly.
- When clearing land or firebreaks vehicles are to work in conjunction with plant pathogen principles and push from areas of better vegetation towards areas of lower quality vegetation.
- Weeds will be sprayed as necessary with broad spectrum spray prior to planting or seeding in weed affected soils.
- Unwanted grasses will be sprayed as necessary with grass selective spray prior to seeding or rehabilitation
- Weed management should work from least affected areas to most affected.
- Declared weeds should be treated promptly by digging out or spraying.

The potential for weeds is less likely to be a problem during excavation.

However, as vehicles will travel to other areas there is potential for weed seeds to be brought to the site within soil adhering to those vehicles. Dirty vehicles are not permitted to enter the site.

Inspections conducted to monitor the presence and introduction of weeds will be carried out on an annual or more frequent basis. On identification, introduced weeds will either be removed, buried, or sprayed with a herbicide.

3.0 CLOSURE OBLIGATIONS AND COMMITMENTS

3.1 Geotechnical

The operations will fall under the supervision of the Department of Mines and Petroleum under the *Mines Safety and Inspection Act 1994*. The site will be regularly inspected by DMP for safety and geotechnical stability during the life of the operation and at closure.

As summary of the geotechnical aspects of the project are included in Attachment 1.

The methods proposed are the same methods used by Roadstone (Part of the Italia Stone Group) during excavation and rehabilitation of the hard rock quarry in Esperance in 2000 - 2003. The removal of material from the Esperance Pit, combined with the reduction in angles of the face and rehabilitation, completely transformed the quarry location in Esperance, and the same methods will be used here.

For their efforts on rehabilitation the Port of Esperance/Roadstone Quarries were a joint winner of the Golden Gecko Award for Environmental Excellence and a winner of the State and National Case Earth Awards for best practice and innovation in Environmental Management and civil construction.

The site will be installed with a safety bund and all rehabilitated faces, benches and slopes that are safe, sustainable and compatible with the *"Guidelines on Safety Bund walls around Abandoned Open Pits",* January 1991.

The guideline is old now and it is more common in quarries to have vertical solid rock faces that are backfilled with overburden and weathered regolith. The backfill is then retained by a low perimeter bund with space left for access. Cut off drains or bunds will be used above the face to ensure stormwater does not flow into the pit or erode the dumped materials.

Contour banks and drains on the sloping weathered material retain water and reduce the potential for erosion. Bunding or a drain at the base of the slopes of unweathered material capture any materials that wash from the banks.

The backfill will provide a substrate for seeding. This method is most commonly used even in the large hard rock quarries in the south west of Western Australia.

For the sound rock, final slopes of up to 45 degrees, when combined with a small bench and a small bund at the toe, will be stable. Any backfill will be stable when placed at a stable face and bench as is completed at all hard rock quarries in the south west of Western Australia.

- ***Proposed Final Contours***

See the Geotechnical aspects at Attachment 1.

- ***Rehabilitation***

The end use will be a return of the quarry to a sloping valley side covered by local native trees and shrubs.

The setback to Manjedal Brook will be re-established to local native riparian and other vegetation, matched to habitat.

The completion criteria are outlined under rehabilitation

3.2 Legal Obligations Register related to Rehabilitation and Closure

Legal Requirement	**Condition**	**Discussion - Requirement**
Conditions placed on the approvals	Compliance with any Shire of Serpentine Jarrahdale Conditions on any approval	
	Compliance with any conditions applied by the Western Australian Planning Commission	
	Compliance with any conditions applied by Department of Environment Conservation Licensing Conditions	
	If the proposed quarry is formally assessed under Part IV of the Environmental Protection Act 1986 compliance with any conditions relating to that assessment and any Ministerial Conditions if applied.	
Mines Safety and Inspection Act 1994	The faces and operations have to be left stable and safe at the end of excavation.	During operations and closure it is proposed to lay back the upper face and make the other faces safe for continued operations. At the end of excavation when the resource is exhausted the whole quarry will be rehabilitated.
	Project Management Plan – SRS System Compliance with the Project Management Plan when it is submitted and approved.	Comply with the plan and any ensuing conditions.
Clearing Permit	Compliance with any conditions of a Clearing Permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* is required *under the Regulations* for the clearing of the scattered trees	A Clearing Permit will be applied for to cover clearing of scattered vegetation if and when the quarry is expanded.
Aboriginal Heritage Act 1972	No sites are listed on Department of Aboriginal Affairs database Any aboriginal heritage found during excavation and any ensuing conditions will be complied with.	If any heritage is found any conditions will be placed on the tenement or closure obligations.

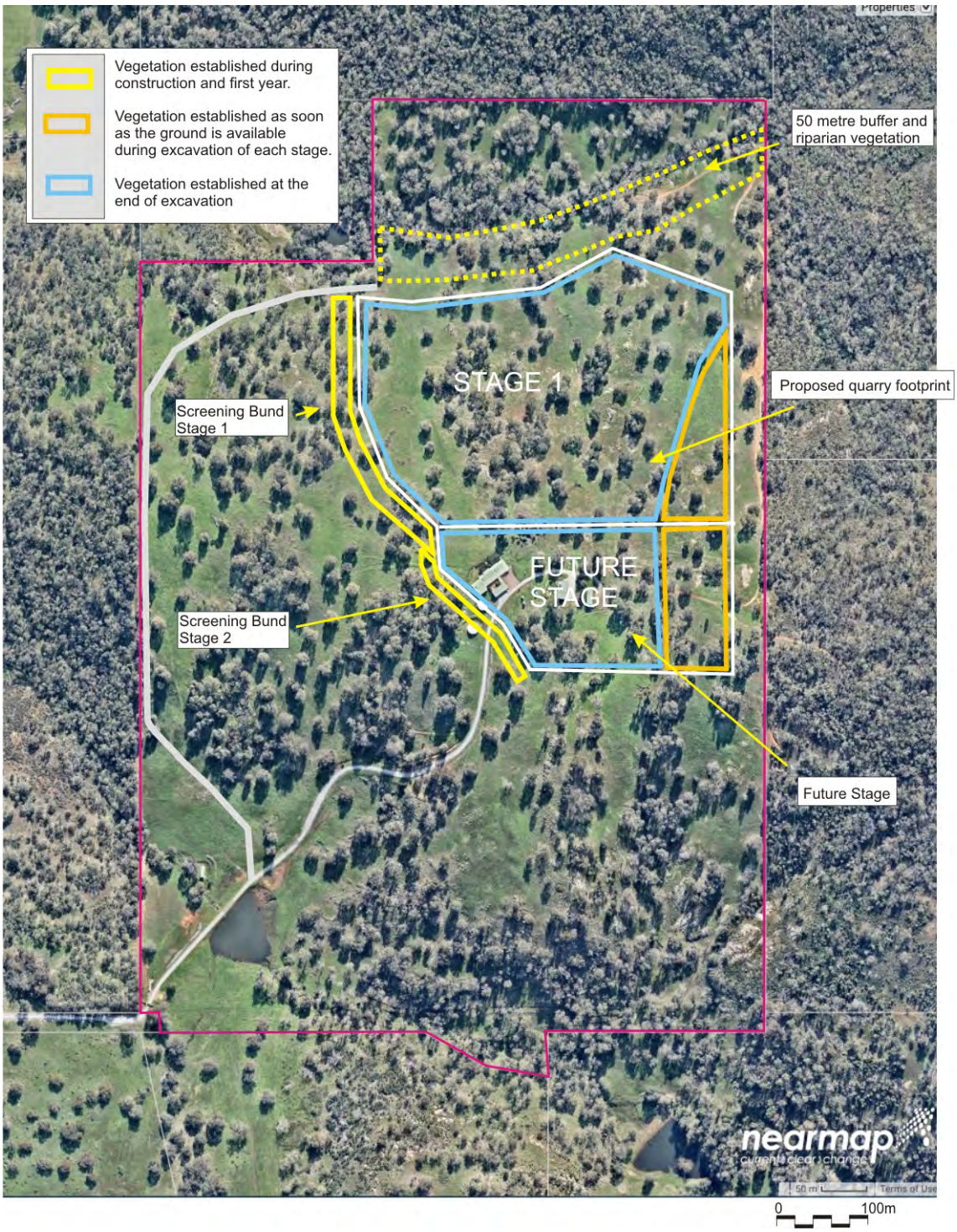

Figure 6 – 8 Proposed rehabilitation

4.0 POST MINING LANDUSE AND PLANNING

4.1 Post Mining Landuse

The closure planning will be updated from time to time as the excavation progresses forwards. This will include both anticipated costs and procedures.

Land Use Policies

The relevant State and Local land use policies can be summarised as;

- Maintain the integrity of the Darling Scarp
- Minimise visual impacts on the Darling Scarp
- Return the disturbed areas to a compatible local community of native vegetation.

The design of the operations and the proposed closure are designed to comply with the relevant policies.

End Use

The extraction of granite hard rock is seen as an interim use of the land followed by an end use of local native vegetation.

Final Contours

The final contours are to a sloping land surface in compliance with the *Mines Safety and Inspection Act 1994* and DMP *Mine Closure Guidelines*.

See Attachment 1.

4.2 Mine Closure Considerations

The hard rock quarry is anticipated to provide a long term resource over many years, therefore the methods of rehabilitation for closure will be used for any ground that is not required, during the life of the operation, such as completed faces and benches and screening bunds.

However it is possible that closure could occur either temporarily or at the end of the approval time and a contingency is required for that purpose.

The main closure issues relate to the reformed slopes that need to be formed to be resistant to erosion combined with visual management in addition to making the pit safe.

There will be no tailings, adverse soil or other materials or features on site and none are proposed during future excavations.

There will be some dumps of subgrade rock and overburden, which will be used for rehabilitation.

The pit is to be excavated to a series of benched faces in the north that will be rehabilitated to a steeper rocky slope of about 1 : 2 which will match the rocky local areas.

The current and pre-excavation land use is pasture with several scattered trees.

The site is elevated and cannot be seen from main roads but the top of the eastern slope may be viewed from a small area to the west – north west.

Post mining landuse will be to return the excavated and disturbed areas to local native trees and shrubs.

4.3 Research

Italia Stone Group are experienced in hard rock quarry restoration and operation even though this has not been their core business.

The same methods used by Roadstone (Part of the Italia Stone Group) during excavation and rehabilitation of the hard rock quarry in Esperance in 2000 – 2003 will be used at this site. The removal of material from the Esperance Pit combined with the reduction in angles of the face and rehabilitation, completely transformed the quarry location in Esperance, and the same methods will be used here.

For their efforts on rehabilitation the Port of Esperance/Roadstone Quarries were a joint winner of the Golden Gecko Award for Environmental Excellence and a winner of the State and National Case Earth Awards for best practice and innovation in Environmental Management and civil construction.

Landform Research provided advice on the Esperance quarry rehabilitation.

Photographs of the rehabilitation of the Esperance Port Quarry are located in Attachment 4.

4.4 Visual Landscape

The key aim of rehabilitation and landscape management has been to minimise visual impact, maintain site security, quarantine the State Forest to the east as well as provide rehabilitation of any disturbed areas.

The operation is located just back from the brow of the Darling Scarp protected by a north south spur along the western side of the proposed pit.

The Darling Scarp is identified either formally through documentation and policies or informally by the community as having high aesthetic values that are desirable to protect.

The quarry is located on a north facing slope on the southern side of the Manjedal Brook, facing along the scarp, rather than west to the Swan Coastal Plain.

The Darling Scarp is listed as a significant landscape feature in State and Local Government Planning as it is a prominent feature, visible from the Swan Coastal Plain. Community concern, rightly so is for no visual impact from hard rock quarries on the Darling Scarp and to this end the older quarries have all been modified to minimise existing and future visual impacts.

Visual Management is considered in Attachment 4.

Every opportunity is to be taken to minimise visual impact through the construction of new banks and the use of rehabilitation.

Annually, a summary of the success of the rehabilitation and visual management is proposed, the planting and seeding undertaken in the previous year documented, and the proposed work for the following year listed. A photographic record of these activities has been included in the annual reports.

The methods of rehabilitation proposed are similar to those used at other hard rock quarries under advice from Landform Research, that have been proven to be successful.

The visual manaegement has been designed in combination with the rehabilitation of the faces, benches and disturbed land to minimise and mitigate visual impacts.

The location and pit design has been chosen to minimise or mitigate the visual impacts from the Swan Coastal Plain and sensitive premises. A visual analysis shows that the site is not visible from South Western Highway because of the extensive tree growth along the road verge of the highway.

The only location where the top of the upper eastern slope of the pit footprint will be visible through two small windows where Manjedal Brook crosses South Western Highway. These two small windows are so small in a 110 kph zone that it is doubtful anyone would be able to see the top of the eastern face of the pit. The visible section will be rehabilitated at the earliest opportunity during construction and operation.

It is proposed to rehabilitate the top face as soon as practicable to reduce the visual impacts.

Therefore, in addition to species indigenous to the area other species, which are fast growing, are proposed to be used.

The landscape banks have been constructed on previously pastured areas on the western side of the quarry. The most essential aspect of this revegetation was to provide fast visual screening. Therefore, whilst many local indigenous species in addition to some other native but non local species included for their;

- rapid growth
- deep or fibrous root system to increase the structural stability of the overburden and resistance to erosion.
- good screening potential
- ability to provide habitat and food resources for fauna
- species resistant to dieback disease.

Non local species are not used any more because the revegetation is largely adjacent to native vegetation and is higher up the Scarp.

The construction of a 4 metre visual screening and noise management bund was proposed and considered in the planning and design to minimise potential visual impacts from the north west and west.

The screening bund is proposed to be planted with tall trees to mitigate the risk of the top of the eastern face being visible.

Residences to the south behind the southern face out of the view shed are protected by landform.

A visual analysis shows that the site is not visible from South Western Highway because of the extensive tree growth along the road verge of the highway

4.5 Hydrology

The pit lies on the southern valley side of Manjedal Brook that drains west to the Swan Coastal Plain.

Other hard rock quarries have been excavated near watercourses with no impacts on the water quality through the use of detention basins, bunding and water management. Hanson Red Hill Quarry sits near Susannah Brook and has been approved with a 50 metre setback to the brook, although the pit does not approach as close as that.

Boral Orange Grove Pit has a creek to the north which is also provided with a setback of 50 – 100 metres. A drainage line runs through the approved pit and stockpile areas and drains to a constructed detention basin before release of excess water downstream.

WA Bluemetal Quarry at Whitby also lies near a significant watercourse. Water collects in the pit and processing area, is directed to three detention basins with the overflow directed to Manjedal Brook. A setback of approximately 100 metres is applied to Manjedal Brook from WA Bluemetal operations.

Hard rock is tight and has some fractures. The elevation of the proposed pit is well above creek elevation so the water table will not be intersected. There may be some minor perched or trapped water occurring in fractures of the hard rock.

Sediment trapping basins are proposed to manage water during and at the end of quarrying and operations. See Attachment 2 Water management Plan.

The water management features will be left in place at the end of operations together with any additional features that may be required to manage the final slopes. See Attachment 1 Overview of Geotechnical Factors and Water Management Attachment 2.

4.6 Revegetation

A most important aspect of revegetation is that the planting and seeding must be completed within the first year of placement of the topsoil, and that planting in compacted ground reduces the success greatly. Therefore there is only one real chance to achieve high quality revegetation. If vegetation established on landscape banks was highly susceptible to dieback disease or local predators, then the vegetation, although establish successfully, could conceivably be denuded or defoliated through disease and grazing, and the visual screening significantly devalued.

The planting of too many trees, without shrubs, can also lead to many deaths and thinning of the visual screen, as the plants grow or are subject to drought stress.

The methods of revegetation, which have proved successful in the past are proposed to continue. The list of species used has been refined over the years. Included are species shown to be particularly useful in past rehabilitation either for stability or visual screening,

A definitive time for seeding and the planting of tube stock should not be prescribed, but rather a commitment to establish the vegetation within the first autumn/winter following placement of the overburden/topsoil.

Seeding and planting is undertaken at the most suitable time and can vary greatly depending on individual site conditions and the season. For example planting tube plants early in a dry winter year can lead to their probable failure because of a lack of early rains. Seeding with heat treated seed is not normally suitable for late summer, but scarified seed can be spread in late summer. North facing banks, are planted earlier than south facing banks which are better planted in August. All seeds are now subjected to smoke pre-treatment.

Monitoring of rehabilitation is continued until the vegetation provides effective screening and meets the completion criteria, with the most emphasis being placed on the vegetation cover and screening.

The rehabilitation program must be tied to the end use of the quarry. However the end use of the quarry cannot be defined in absolute terms because excavation is not expected to be completed for about 100 years. In the working life of the quarry, excavation methods may change and the development of the surrounding land can only be estimated. The South-East Corridor Plan envisages that the area east from South West Highway will be open space, recreation or special use for public purposes.

Therefore the quarry will be rehabilitated to local native vegetation in a manner consistent with several possible future land uses of an essentially recreational nature.

The planned rehabilitation program will aim to produce a landscape visually similar to the existing landscape.

4.7 Closure Objectives

Rehabilitation will utilise best practice and be directed towards achieving a sustainable cover of local native vegetation on a safe rehabilitated quarry face and operational areas.

- Stable post-mining landscape, and the minimisation of wind and water erosion.
- Provide for the protection of the local groundwater resource and Manjedal Brook in terms of both quality and quantity.
- Achieve weed species at levels not likely to threaten the vegetation.
- Changes may be made to the completion criteria for the location, depending on the decisions to be made on the end use of the completed floor and quarry faces.

4.8 Closure Risk

The environmental risk of closure has been examined and is summarised in the table below.

Closure Objective	Un-managed Risk	Indicative Completion Criteria	Completion Criteria	Measurement Tool and Assessment activities	Managed Risk
All legally binding conditions and commitments relevant to mine closure and rehabilitation will be met.	High Potential High impact	Comply with all legally binding conditions.	• All conditions of approval from any agency will be complied with.	• Review the latest documentation and assess compliance. • Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. • Visually audit against all conditions by establishing an Environmental Management System to AS standards.	Low
All plant, foreign materials, buildings and other matter associated with mining will be removed from the completed areas.	High Potential moderate impact	The site will be cleaned, structures and non natural materials will be removed. The access roads are to be retained. Water management features and detention basins are to be retained.	• No non natural structures will be retained on site. • All hardstand and road making materials and non natural inert materials are to be removed or buried. • All non inert materials are to be removed from site. • All ground once occupied by structures are deep ripped and soils reconstructed.	• Audit of completed ground, to verify compliance.	Low
The disturbed land will be made safe and in compliance with the *Mines Safety and Inspection Act 1994* and DMP *Mine Closure Guidelines*.	Moderate Potential High impact	Surfaces will be formed to DMP Guidelines and match natural ground. Holes, sumps drains, ditches and the like will be filled and removed and faces reduced and	• Faces and the landform are to comply with DMP Guidelines and be safe and stable for the long term. • The land surface is to have a stepped landform with some rocky outcrops and similar to the natural form.	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.	Low

		backfilled.			
The reformed land surface will be internally draining and draining to small infiltration basins and pools.	Moderate Potential Moderate impact	Drainage will be internal or the ground sufficiently permeable to minimise or negate runoff.	• Slopes are to drain to detention basins to allow water to settle prior to release to Manjedal Brook.	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.	Low
The land surface will be resistant to wind and water erosion.	Moderate Potential moderate impact	Slopes are to be stable and free from erosion.	• Slopes are to be stable and free from erosion.	• Visual observations of the landforms.	Low
Rehabilitation vegetation will be a cover of local native vegetation to improve the pre-excavation habitat.	High Potential high impact	The vegetation composition of rehabilitation will be capable of forming a native habitat over time.	• All species used in rehabilitation are to be local provenance species suited to local loam soils and sloping sites. • A plant density that is variable but with an average plant density of 50 plants per 100 m^2 in locations where topsoil is available and 30 plants per 100 m^2 in other locations. • Species richness of 5 species per 100 m^2 in all areas.	• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation as required. • Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off. • Maintain ongoing records.	Low
Rehabilitated areas will form a sustainable habitat that will be capable of improving with time as vegetation growth continues.	High Potential high impact	Over time there will be an increase in habitat values.	• Habitat values that are capable of increasing with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches.	• Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records. • Maintain ongoing records.	Low
The rehabilitated vegetation will have similar resilience to the adjoining local vegetation.	High Potential high impact	The rehabilitated vegetation will be resilient to fire impacts, seasonal changes and longer term variable weather impacts.	• The vegetation is to include a mixture of species that grow in local, soil substrates and be resilient to fire or readily regenerate following fire.	• Annually conduct an on site audit of completed rehabilitation for species richness, resilience. • Inspect revegetation to determine its long term survival from environmental and fire impacts. • Until sign off inspect	Low

				vegetation re-establishment following fire.	
Soil properties will be appropriate to sustaining revegetated local native species.	Moderate Potential moderate impact	Soil properties will be appropriate to sustaining revegetated local native species.	• The soils are to be constructed from overburden overlain by topsoil where available, leaf litter, vegetation fragments as available in areas of native vegetation.	• Prior to rehabilitating land before vacating. • Annually check rehabilitated areas. • Undertake to mitigate rehabilitation areas that are deficient or not capable of becoming compliant with the completion criteria.	Low
Revegetation will be free from Declared or Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation.	High Potential high impact	Revegetation will be free from Declared or Environmental weeds that could compromise the success of the revegetation or spread into adjoining native vegetation.	• Absence of Declared or Environmental weeds that could compromise the success of revegetation. • Exotic species to be no greater richness or density than adjoining vegetation.	• Provide annual inspections at the appropriate time of the year.	Low

4.9 Completion Criteria

The post mined land surface is proposed to have a form that is compatible with the surrounding geomorphology of a north facing hillside.

The rehabilitated surface is proposed to provide a better habitat and ecological function of local native vegetation, to the pre- mined habitat that is pasture.

Local native species will be used in the restoration of the rehabilitation of the pit faces and disturbed areas. The use of topsoil which contains pasture species will make revegetation to local native vegetation more difficult but is achievable.

The best means of revegetation on the disturbed areas is to use;

- Vegetation and topsoil recovered from clearing where available.
- Brush cut from adjoining vegetation, where available
- Providing seed of local provenance species as necessary, the methods used for the restoration of the Esperance Port hard rock quarry for example.

The Completion Criteria will be adjusted as necessary during the life of the project based on stakeholder input, data collected on the existing environment and the continued success of the rehabilitation. This will be done at the required three year review.

- ***Completion Criteria***

The Completion Criteria are identified below as auditable tasks developed from the Closure Objectives.

These will be adjusted as necessary during the life of the project based on stakeholder input, data collected on the existing environment and the continued success of the rehabilitation as the Mine Closure Plan is reviewed.

Assessment of species and success.

- All species used in rehabilitation of the pit slopes are to be local provenance species suited to the local regolith.
- Species are to mimic the local communities.
- In some key screening areas non local native species may be used to provide rapid visual protection.
- A plant density that is variable but with an average plant density of 50 plants per 100 m^2 in locations where topsoil is available and 30 plants per 100 m^2 in other locations.
- Species richness of 5 species per 100 m^2 in all areas.

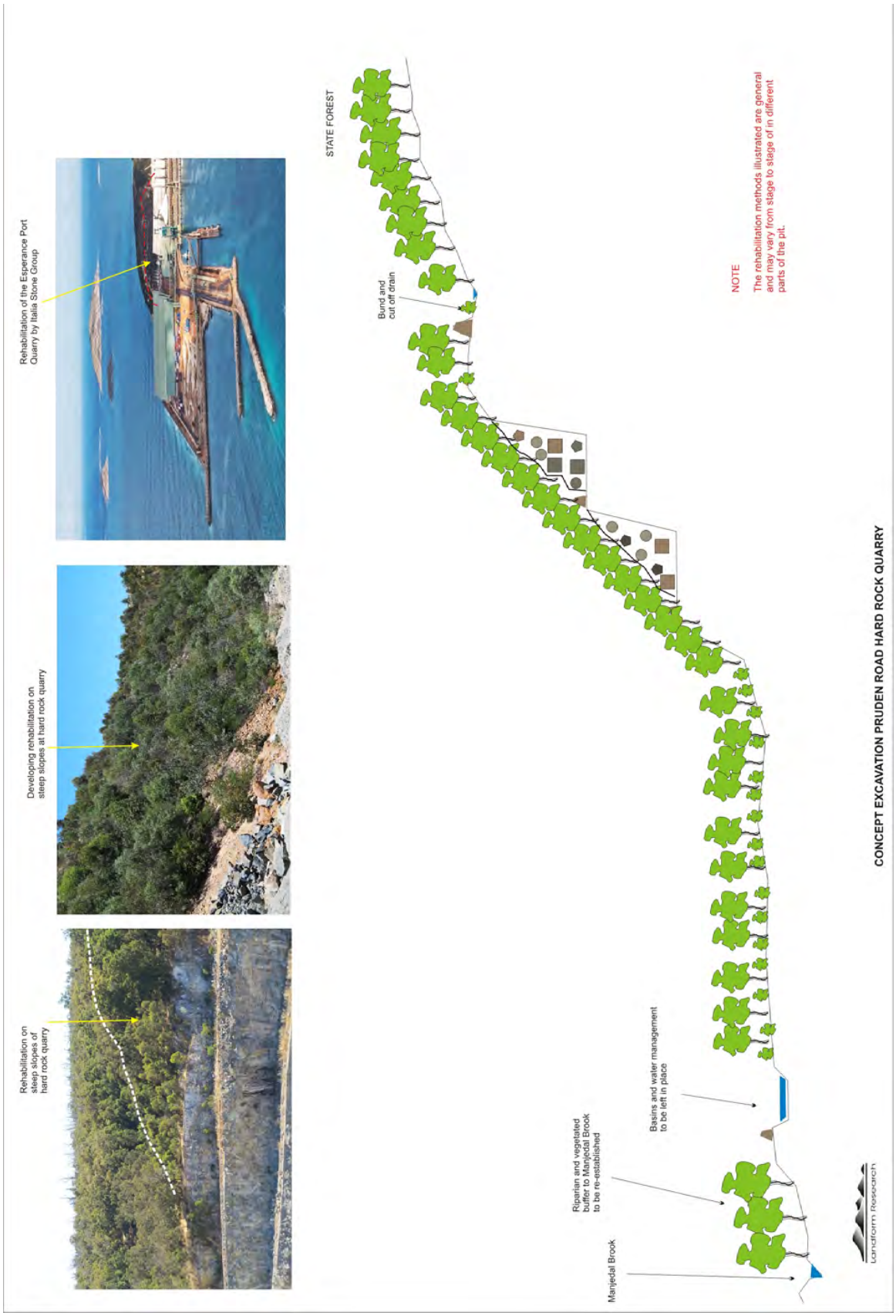

Figure 6 - 9 Concept and sketch rehabilitation

5.0 CLOSURE IMPLEMENTATION

5.1 Closure of any ground under Rehabilitation

The closure of completed areas of the operations will be progressive with closure of all remaining ground at the end of operations.

Maintenance and monitoring will be conducted until completion criteria is met.

Unexpected or early closure will be completed in the same way as permanent closure below but the full rehabilitation will be completed as one operation.

Progressive Closure of completed Stages of the Pit

Completion Criteria	**Activity** *To be completed as soon as site activities have been completed on any area and that area will not be required for future operations.*
• All conditions of approval from any agency will be complied with.	Prior to undertaking permanent closure. • Review the latest documentation and assess compliance requirements. • Design the rehabilitation to comply with, and be able to achieve the completion criteria and commitments. • Review the latest documentation and assess compliance. • Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off. • Visually audit against all conditions.
• No non natural structures will be retained on site. • All hardstand and road making materials and non natural inert materials are to be removed or buried. • All non inert materials are to be removed from site. • All ground once occupied by structures are deep ripped and soils reconstructed.	Prior to earthworks and rehabilitation; • Remove any plant or non natural materials and structures. • Remove all hydrocarbons and other fluids. • Audit of completed ground, to verify compliance. • Remove all non inert products. • Some concrete and other inert products may be removed or buried at depth and covered by overburden.
• Faces and the landform are to comply with DMP Guidelines and be safe and stable for the long term. • The land surface is to have a stepped landform with some rocky outcrops and similar to the natural form.	Prior to rehabilitation; • Complete activities to make the site safe. • Ensure that the batters are formed to comply with the requirements. • Ensure the floor is completed and formed to the proposed final contours. • Match the landform to the adjoining excavated and non excavated surfaces. • Deep rip the floors and batter slopes along contour. • Spread the overburden followed by topsoil. • Use weed treatment and dieback principles as required. • Spread any local native vegetation removed from ahead of excavation. • Provide fences, bunding and warning signs above faces as required. • Provide locked gates or access restraints as required.

	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.
• Slopes are to drain to detention basins to allow water to settle prior to release to Manjedal Brook.	Prior to rehabilitation and during audits; • Inspect batter slopes, access points, pools and other features and inspect drainage and provide infiltration areas as necessary. • Form small internal sumps and detention basins to ensure all water is retained on site. • Provide specific fauna habitat, such as logs, uneven land surface and recovered vegetation to provide a habitat suitable for local native fauna. • Audit of completed ground, to verify compliance. • Visual observations of the landforms.
• Slopes are to be stable and free from erosion.	Prior to rehabilitation and during audits; • Inspect all areas and ensure the land surfaces and access points, are stable to erosion from wind and water. • Check the slope angles for compliance. • Visual observations of the landforms.
• All species used in rehabilitation are to be local provenance species suited to local loam soils and sloping sites. • A plant density that is variable but with an average plant density of 50 plants per 100 m^2 in locations where topsoil is available and 30 plants per 100 m^2 in other locations. • Species richness of 5 species per 100 m^2 in all areas.	Prior to rehabilitation; • Provide additional topsoil or seed to increase the number and diversity of plants. • Spread vegetation fragments or harvested branches capable of providing seed sources from brushing where available. • Review the vegetation and add seed or additional tube plants as required.
• Habitat values that are capable of increasing with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches.	During rehabilitation; • Ensure rehabilitation is conducted at a suitable time to achieve success. • If timing is not suitable undertake remediation earthworks such as re-ripping. • Use Dieback and Weed prevention methods. • Collect seeds from native vegetation well in advance and retain for rehabilitation. • Complete pre-rehabilitation weed control, normally in autumn. • Undertake rehabilitation within the first year following ground preparation (Normally within 6 months). • Determine the replanting and seed rates that are likely to achieve the Completion Criteria with an allowance for deaths (Normally 20%). • Determine whether plant protection devices are required and install as necessary. • Provide additional topsoil or seed to increase the number and diversity of plants. • Spread vegetation fragments or harvested branches capable of providing seed sources from brushing. • Add additional species as seed for those that do not germinate readily from top soil such as Proteaceous and *Eucalyptus* species.

	• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation and adjoining vegetation. • Check for predators such as rabbit and goat impacts and treat accordingly through control, fencing, additional planting or other measures. • Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off. • Maintain ongoing records.
• The vegetation is to include a mixture of species that grow in local, soil substrates and be resilient to fire or readily regenerate following fire.	Prior to and During Rehabilitation; • Ensure that the species selected and rehabilitation techniques are chosen to provide species that are suitable for the soil conditions and will in time be able to regenerate after fire and become self sustaining. • Adjust species and rehabilitation methods to enable the completion criteria to be reached.
• The soils are to be constructed from overburden overlain by topsoil where available, leaf litter, vegetation fragments as available in areas of native vegetation. •	Prior to vacating and during annual inspections. • Applies to the revegetated river banks • Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation and adjoining vegetation. • Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records. • Maintain ongoing records. • Improve existing rehabilitated areas as necessary using additional seeding, tube planting and weed control. • Check damage by predators or disease and take remedial action. • Maintain ongoing records.
• Absence of Declared or Environmental weeds that could compromise the success of revegetation. • Exotic species to be no greater richness or density than adjoining vegetation.	This applies to all areas. • Add topsoil or vegetation fragments by brushing and other means or by transferring material from areas being cleared. • Monitor and allow time to naturally develop and transition through initial rehabilitation to a mature habitat.
• All conditions of approval from any agency will be complied with.	Annually; • Remove or spray environmental or declared weeds. • Provide annual inspections at the appropriate time of the year. • Provide annual follow up inspections and treatment at the appropriate time of the year.

6.0 CLOSURE ACTIONS

The closure planning will be updated from time to time as the excavation progresses forwards. This will include both anticipated costs and procedures.

The following procedures will be used for final closure and rehabilitation.

6.1 Land Clearing

Tree Removal

1. The trees will be progressively removed ahead of each stage of clearing.

2. Useful timber is used for local firewood subject to safety considerations.

Limited clearing will be required where new areas are opened. A Clearing Permit will be required to take the regrowth Marri trees. The loss of these trees will be compensated for by the planting of many more trees on site when the disturbed land is returned to local native vegetation.

Vegetation clearing requires that all topsoil and any overburden is to be recovered as ground is cleared and spread directly onto an area to be rehabilitated or retained for use in rehabilitation. The topsoil is stored separately from the overburden.

A Clearing Permit under the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* is required under the Regulations for the clearing of the scattered trees, and will be applied for.

None of the Clearing Principles are likely to be compromised by the excavation of resource from the scattered vegetation surrounding the pit.

Topsoil and Overburden Removal

Clearing and soil management will vary from area to area because of variations in the quality and quantity of top soil and the areas to be rehabilitated. The aim will be for best practise rehabilitation of each area, although the actual methods could change from year to year or stage to stage. For example clearing of one stage could occur in summer but the next might be required in winter. Similarly the depth of topsoil and overburden will vary as will the extent of dieback within the soil.

1. Vegetation will be cleared ahead of excavation. The vegetation will be pushed into windrows. Where possible useable eucalypt timber will be offered to a suitable party for cutting into firewood subject to safety and liability issues.

2. Topsoil will then be stripped from the area under development and where possible spread directly onto an area to be rehabilitated. This can be undertaken at any time but needs to be balanced against the potential for dieback spread.

   Summer clearing can generate dust, and winter clearing can lead to the spread of dieback through water moving spores. Dust is a highly visible issue and it is likely to be easier to manage surface runoff than dust. Therefore it is proposed, where possible, to clear during wetter months using water management procedures to prevent run off from flowing into the creekline, onto State Forest, or areas that are likely to be dieback free.

3. Machinery will work in stages to try and separate the areas of higher dieback risk from those dieback free areas. The different risk soils will then be used in areas according to the quality of the vegetation adjoining the rehabilitation areas. This will involve pushing soils from areas of lower risk or better vegetation condition, to areas of higher risk to assist protecting the better vegetation for future revegetation.

4. When stored topsoil is used it may be diluted and mixed with fresh topsoil.

5. Overburden will then be pushed westwards for use in rehabilitation and/or the construction of landscape banks. Overburden can also be stored in low dumps ready for future use in rehabilitation of benches. These dumps will be stable and located in areas where any runoff can be controlled.

6. Overburden will consist of gravel, duricrust, and the underlying gibbsite and kaolin rich layers. It may be possible to utilise some of this material for road products or for lining and covering clays at the adjoining landfill site when excess is available. Some storage of overburden will be required to enable rehabilitation of the last stage.

7. The floor of the pit will be internally draining to a basal sump in later stages of excavation.

6.2 Land Restoration

The following procedures have been used in the past to restore the disturbed ground whether at the end of excavation, as part of ongoing rehabilitation or during premature closure. In summary the methods are;

- Rehabilitation is to occur as soon as possible following the end of excavation and other activities or as soon as a part of the operation is completed or no longer required.

- Where possible any disturbed areas that are no longer required will be rehabilitated using the methods described above within 12 months of becoming available.

- Runoff will significantly reduce as a result of rehabilitation of the excavated land. The form of the concept final land surface has taken account of the runoff and has been designed to minimise runoff from storm events and therefore manage erosion risk. It also aims to maximise infiltration of smaller rainfall events.

Pit faces – Geotechnical

- All buildings, plant and any other foreign materials will be removed from site.

- The pit will be prepared by pushing down, reducing and backfilling the active face with a loader and bulldozer. Blasting will be used as required to knock the crest down, with the rock being used for backfill.

- The quarry benches will be left in place. Benches will be back filled with overburden with the brow remaining as a rocky outcrop. This will give the overall appearance of a steep slope broken by rocky outcrops. In some locations the brow of the benches will be broken by blasting to give the appearance of hill slopes. This final landform will provide a visually similar appearance to other parts of the Darling Scarp when viewed from a distance such as South Western Highway.

- As a result of past research and experience it has been found that the best method of backfill is to include a substantial proportion of rock and stone to assist stability and to leave the surface rough. This is particularly important where the overburden has a high clay content. Where the surface is smooth the surface will be worked where possible to form channels, furrows or small banks or rough areas to encourage the penetration of precipitation and reduce surface runoff. Seepage under the placed materials is to be prevented to minimise the risk of subsurface erosion.

- These methods have been used on landscape banks which have been in place for 20 years and show no sign of instability at other quarries. Their bases are dry and well drained, minimising any subsurface moisture increases or movement.

- The upper bench will be laid back to the northern boundary during excavation to reduce the visual impact and make the face safe.

- The lower quarry benches will be partially left in place. Benches will be back filled with overburden with the brow remaining as a rocky outcrop in places but knocked off in others. This will give the overall appearance of a steep slope broken by rocky outcrops. In some locations the brow of the benches will be broken by blasting to give the appearance of hill slopes. This final landform will provide similar habitat to the local landform.

- No natural soil or weathered regolith slope or batter will be greater than 1 : 3 to vertical to horizontal. Pit slopes in hard rock will be retained at safe vertical faces or slopes at 1 : 1 to 1 : 2 vertical to horizontal in compliance with the *Mines Safety and Inspection Act 1994* and DMP *Mine Closure Guidelines*.

- The floor will be formed to be internally draining, and will retain rainfall or drain to the detention basins which will be retained at the end of excavation.

- Areas of the pit floor to be vegetated will be deep ripped.

- Overburden followed by topsoil will be spread directly from an area being cleared or from overburden stockpiles and placed over the land surface being restored. Any vegetation fragments will be either spread on top of the topsoil or spread with the topsoil.

- The backfilled materials will be track rolled by bulldozer where possible and covered by 600 mm of overburden to ensure that all inert and non – natural materials are covered. Some parts of faces and boulders will be retained to provide fauna habitat.

Hardstand, roads and other such areas of the processing area

- All buildings, plant and any other foreign materials will be removed from site.

- Roadbase, hardstand and any other inert materials left over from the site operations will be scraped and picked up and will be used to backfill the pit faces. Note that the access road will be retained for future access.

- Steep or vertical slopes will be pushed down, although the batter slopes that form the level areas will be retained for future use.

- Where backfill is not required, used hardstand will be scraped up and placed in the pit with the inert materials

- The ex-hardstand, processing, access roads, stockpile areas and other compacted ground will be deep ripped by bulldozer at intervals of 1 – 2 metres, which will rip up the subsoils that remain in those locations.

- Ripping is preferred after the spreading of overburden/topsoil, provided ripping of the base floor material can achieve the required 1 metre.

- A minimum of 300 mm of overburden will be spread over the surface where available to provide a substrate for revegetation.

- The floor and slopes will be left with a rough surface along contour as this reduces run off and encourages plant growth.

- The steeper slopes will be installed with contour banks or structures to slow the flow of surface water.

- Any materials which may have been displaced during storm events will be picked up and used for fill.

- Where possible, overburden, followed by topsoil and recovered vegetation, will be spread directly from an area being cleared to an area being rehabilitated to minimise the potential for seed loss.

- Overburden from areas of thin soil, which contains topsoil and included seed load, will be spread across the surface.

- Where separate topsoil is available it will be spread across the overburden.

- Topsoil will be spread evenly across the rehabilitated areas in summer or early autumn prior to the winter rains. Stored topsoil rapidly loses seed viability and could be expected to be less than 50% effective if stored through one winter.

Stormwater Management

- As the quarry is mainly to produce large rock for coastal work and not aggregates the amount of water management required is reduced.

- Water from disturbed areas will be directed to sumps in the base of the pit and around disturbed areas to provide control of water flow rates and sediment trapping facilities. The water trapping facilities will be designed to retain the 1 in 10 year storm event and release large flows to the environment through protected water ways.

- When additional water is required it will be brought to site as required.

- The management of water, and the risk to it, is discussed in the attached Water Management Plan. The plan is currently being revised and will be finalised when a site survey is available and the mine planning completed.

Erosion Control

- Soil erosion occurs when soil is exposed and disturbed by wind or water. For this site the loam/clay soils will be resistant to wind erosion.

- Water erosion on the steeper slopes will be reduced by leaving the surface soft, rough and undulating, with the undulations running along contour. The final machinery run should be along contour and not down slope. In most cases any backfill will be pushed perpendicular to the face rather than pushed along contour.

- For rehabilitation areas, revegetation will take place as soon as possible following landform and soil reconstruction.

- The gently sloping pasture areas will assist in reducing runoff as will the planting of trees and shrubs on the steeper slopes.

6.3 Revegetation

- Topsoil will be transferred directly from an area being cleared and spread across the surface to provide seed sources and habitats wherever possible.

- Weed and Plant Disease Management Plans are included below.

- Any weeds likely to significantly impact on the rehabilitation will be sprayed with Roundup or similar herbicide or grubbed out, depending on the species involved. Weed affected topsoil and overburden will be buried.

- The Weed Management Plan will form the basis of weed treatment. Depending on the nature of the planting substrate, a broad spectrum spraying program may be used. In areas where grass only is a potential problem grass specific sprays will be used. In some areas where topsoil from cleared native vegetation is available no spraying may be required.

- Rehabilitation is to be carried out progressively during the first available winter months following the restoration earth works. Leaving the completed earth works for one season reduces the success of rehabilitation by at least 50%, due to compaction effects.

- Pre-seeding weed control is only likely to be required where topsoils are used that contain weed species.

- If required this is normally only conducted after overburden and topsoil have been spread and any seeds have been allowed to germinate. Broad scale weed treatment can be detrimental to the germination and growth of native and some pasture species but may be required if the weed load is to be reduced.

- Rehabilitation is carried out during the first available winter months following the restoration earth works. Leaving the completed earth works for one season reduces the success of rehabilitation by at least 50%, due to compaction effects.

- Trees are to be planted as tube plants in winter, (June to August) installed with 10 g fertiliser tree tablet next to each plant. Prior to planting, the ground is deep ripped and the competition from pasture species removed through spraying or mechanical removal.

- Species will be selected predominantly from local species with the addition of fast growing screening species in visually sensitive areas. Seed species list below.

- Seeding and planting should be undertaken at the most suitable time and can vary greatly depending on individual site conditions and the season. The commitment is therefore to establish the vegetation within the first autumn/winter following placement of the overburden/topsoil.

- Tube plants are established in low undulations and not on the high points of furrowed soil. The planting rate is to be sufficient, after allowing for deaths to achieve the completion criteria.

- A decision to use additional fertiliser will be made on a site specific basis. It has been demonstrated that fertiliser is not required when planting into kaolin and gibbsite overburden with the inclusion of nitrogen fixing species. On the other hand planting into gravel overburden will require fertiliser at the rate of up to 200 kg per hectare, best applied in spring and split over two years. The recommended fertiliser is superphosphate containing trace elements Cu, Zn and Mo. A proportion of rock dust or fines will increase mineral trace elements.

- The vegetation will be fenced to exclude stock, or stock will not be introduced until the vegetation is sufficiently established.

- A local native plant species list is provided below.

W	Suitable for wet sites
T	Tree
L	Legume or nitrogen fixing
S	Best species for providing rapid screening cover
#	Suitable for seeding and normally introduced from seed

Local species to be used in rehabilitation

Local species to be used in rehabilitation

Acacia celastrifolia	LS#	
Acacia extensa	L#	
Acacia latericola	L#	
Acacia pulchella	L#	
Acacia saligna	LS#W	can be affected by insects
Acacia urophylla	L#	
Allocasuarina fraseriana	L#	
Baknsia grandis		
Banksia littoralis	W	
Callistemon phoeniceus	SW	
Calothamnus quadrifidus	S#	
Calothamnus rupestris	S	
Calothamnus sanguineus	S	
Clematis pubescens	#	
Eucalyptus accedens	T	slow but good in hard clay sites
Eucalyptus calophylla	TS	
Eucalyptus laeliae		
Eucalyptus megacarpa	TSW	
Eucalyptus patens	TSW	
Eucalyptus rudis	TSW	affected by insects
Eucalyptus wandoo	T	slow but good in hard clay sites
Gastrolobium ebracteolatum	W	
Grevillea diversifolia	W	
Hakea lissocarpha		
Hakea petiolaris		
Hakea trifurcata		
Hardenbergia comptoniana	L#	
Kennedia coccinea	L#	
Kennedia prostrata	L#	
Kunzea recurva		

Labichea lanceolata	W
Leptospermum erubscens	
Melaleuc lateritia	W
Melaleuca preissiana	SW
Melaleuca radula	
Melaleuca rhaphiophylla	W
Melaleuca scabra	
Mirbelia dilatata	
Paraserianthes lophantha	LS#W
Sollya heterophylla	
Taxandria linearifolia	W
Trymalium ledifolium	W
Viminaria juncea	LSW#

Irrigation

- Rehabilitation of local quarries and revegetated areas has shown that when completed well there is no need for irrigation of the rehabilitation when the revegetation is completed at the appropriate time of the year.

Erosion Control

1. Water erosion is the most likely issue, rather than wind erosion, because of the loam nature of the soils.

2. The main method to manage potential soil erosion on sloping banks is by leaving the banks rough to enable infiltration of moisture. However this is not always possible because the infiltration of water can lead to resduced bank stability and there may be safety considerations at some locations which dictate the surface treatment of the bunds and banks.

3. Contour banks are also used, but the most effective management is revegetation in the first year when the soils are soft.

4. Planting and revegetation is completed within the first winter following placement of the soils.

5. Contour banks and drains are used at the base of some landscape banks to collect any runnoff water and capture any sediment that moves from the banks on the western edge of the operations near adjoining land to the west. Where surface water runs into vegetation the vegetation provides efficient sediment trapping and a contour bank would just require the clearing of additional vegetation for no effective environmental gain.

6. The soils are to be rehabilitated as soon as practicable.

6.4 Monitoring and Remediation

The revegetation will be monitored at least twice annually that is before and at the end of each excavation campaign, to determine what work needs to be undertaken and to ensure that the required work is completed.

A weed monitoring and management program will be continued annually during operations and following closure to identify and control significant environmental weeds.

The revegetation will be monitored for 3 – 10 years post closure of each part of the pit or until completion criteria are achieved.

1. During late summer an assessment of the success of the rehabilitation will be made to determine the rehabilitation requirements for the following winter. This will be undertaken to the completion criteria listed above.

2. Monitoring will include visual assessments to determine the success of the rehabilitation and restoration, as follows;

    - pasture density
    - species diversity
    - plant growth
    - plant deaths
    - regeneration
    - insect attack and disease
    - weed infestation

3. As necessary steps will be taken to correct any deficiencies in the vegetation.

4. Rehabilitation of each stage will be monitored for a period of three years to ensure that the revegetation meets the completion criteria of providing self sustaining indigenous shrub vegetation.

A table summarising the remediation in the event of rehabilitation not achieving the aims an functions is included below.

Completion Works	**Measurement Tool and Assessment activities**	**Timing**	**Remediation Techniques to be Used as Required.**
• All conditions of approval from any agency will be complied with.	• Review the latest documentation and assess compliance. • Visually audit against all conditions.	Prior to land restoration activities and on completion of rehabilitation.	• Undertake liaison and adjust the land reconstruction and rehabilitation to bring into compliance. • Repeat or undertake required activities.
• Closure and rehabilitation is consistent with all conditions of the tenement. • *Note that currently there are no tenement conditions.*	• Review the latest documentation and assess compliance. • Compile an audit table of all conditions and commitments that relate to closure and conduct an audit of those items upon the completion of each stage of rehabilitation and annually until sign off.	Prior to land restoration activities and on completion of rehabilitation.	• Undertake liaison and adjust the land reconstruction and rehabilitation to bring into compliance. • Repeat or undertake required activities.
• No non natural structures will be retained on site. • All hardstand and road making materials and non natural inert materials are to be removed or buried. • All non inert materials are to be removed from site. • All ground once occupied by structures are deep ripped and soils reconstructed.	• Audit of completed ground, to verify compliance.	Prior to spreading with topsoil.	• Remove any foreign or other non natural materials. • Deep rip any areas that have not been adequately prepared. • Check that all hardstand and roads that are no longer required are closed and prepared for rehabilitation.
• Faces and the landform are to comply with DMP Guidelines and be safe and stable for the long term. • The land surface is to have a stepped landform with some rocky outcrops and similar to the natural form. •	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.	Prior to spreading with topsoil.	• Complete remediation earthworks. • Undertake any earthworks required to bring the land surfaces into compliance with the end use and completion criteria. • Smooth out any non natural looking slopes and features. • Make any non compliant faces safe and in compliance to DMP Guidelines.

• Slopes are to drain to detention basins to allow water to settle prior to release to Manjedal Brook.	• Audit of completed ground, to verify compliance. • Visual observations of the landforms.	Prior to spreading overburden and topsoil.	• Complete or revise the remediation earthworks. • Ensure the ground is free draining and the detention basins can contain the predicted rainfall events. • Ensure that the basins are stable in the long term and comply with the Water Management Plan
• Slopes are to be stable and free from erosion. •	• Visual observations of the landforms.	Annually	• Undertake additional planting or seeding. • Provide additional earthworks or brushing. • Provide temporary wind breaks. • Bring any non compliant faces into compliance by backfill, or pushing down.
• All species used in rehabilitation are to be local provenance species suited to local loam soils and sloping sites. • A plant density that is variable but with an average plant density of 50 plants per 100 m^2 in locations where topsoil is available and 30 plants per 100 m^2 in other locations. • Species richness of 5 species per 100 m^2 in all areas.	• Conduct an on site audit of completed rehabilitation for species richness, diversity and structure using standard 100m^2 plots of rehabilitation and adjoining vegetation. • Conduct audits of the completion criteria upon the completion of each stage of rehabilitation and annually until sign off. • Maintain ongoing records.	During site audits.	• Ensure rehabilitation is conducted at a suitable time to achieve success. • If timing is not suitable undertake remediation earthworks such as re-ripping. • Program additional rehabilitation work and ensure that it is implemented. • Undertake any non complying or neglected steps in the rehabilitation program. • Add tube plants, topsoil or seeds as required to increase the species richness and density.
• Habitat values increase that are capable of increasing with time, measured by soil development, soil litter increases, increased plant matter, cover, vegetation, structure and habitat niches.	• Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records. • Maintain ongoing records.	Annually Continue monitoring for 3 years or until signed off.	• Complete revegetation of completed areas prior to vacating. • Provide specific fauna habitat, such as logs, uneven land surface and recovered vegetation to provide a habitat suitable for local native fauna. • Improve existing rehabilitated areas as necessary.
• The vegetation is to include a mixture of species that grow in local, soil substrates and be resilient to fire or readily regenerate following fire.	• Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records. • Maintain ongoing	Annually Continue monitoring for 3 years or until signed off.	• Complete revegetation of completed areas prior to vacating. • Improve existing rehabilitated areas as necessary including changes to species mixes as necessary.

	records.		
• The soils are to be constructed from overburden overlain by topsoil where available, leaf litter, vegetation fragments as available in areas of native vegetation. •	• Conduct audits of the key indicators upon the completion of each stage of rehabilitation and annually until sign off, using lists and photographic records. • Maintain ongoing records.	Annually Continue monitoring for 3 years or until signed off.	• Normally would be completed at rehabilitation and would apply to flood damage or instability. • Reinstate and make stable as necessary to increase ground habitat
• Absence of Declared or Environmental weeds that could compromise the success of revegetation. • Exotic species to be no greater richness or density than adjoining vegetation.	• Annually conduct an on site audit of completed rehabilitation for species richness, resilience. • Inspect revegetation to determine its long term survival from environmental and fire impacts. • Until sign off inspect vegetation re-establishment following fire.	Annually Continue monitoring for 3 years or until signed off. Inspect vegetation re-establishment following fire.	• Undertake additional weed control measures using spray or mechanical means. • Treat grass impacts with Fusilade and general weeds with glyphosate or similar. • Treat when appropriate.

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