Blue Hills Quarry

# Market Assessment - Needs Review

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| Mawsons | |
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| | |

GROUNDWORK PLUS
Phone: 1800 GW PLUS (1800 497 587)
Email: info@groundwork.com.au
Website: groundwork.com.au
ABN 13 609 422 791

QLD/NSW
6 Mayneview Street, Milton Qld 4064
PO 1779, Milton BC Qld 4064
Phone: +61 7 3871 0411
Fax: +61 7 3367 3317

SA/WA/NT
2/3 16 Second St, Nuriootpa SA 5355
PO Box 854, Nuriootpa SA 5355
Phone: +61 8 8562 4158

VIC/TAS
PO Box 438, Altona VIC 3018
Phone: 0437 523 282

Geotechnical Laboratory
Unit 78/109 Leitchs Road, Brendale Qld 4500
Phone: 0417 615 217

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# Executive Summary

Groundwork Plus was commissioned to undertake a needs review for the proposed Blue Hills Quarry southwest of Bendigo in order to explain the project metrics of the quarry site in the broader extractive milieu of the region and state. The location of the proposed quarry site is illustrated on Figure 1 - Site Location Plan, while the proposed extractive area along with the aerial photography and local geology is shown on Figure 2 - Site Geology and Proposed Extractive Footprint.

Key documents reviewed as part of this work include:

- Demand and Supply Study, 2015–50 (May 2016) The Department of Economic Development, Jobs, Transport and Resources : Attachment 1
- Extractive Resources in Victoria Summary Sheets 2050 : Attachment 2
- Victoria's infrastructure strategy 2021-2051 Infrastructure Victoria : Attachment 3
- Loddon Campaspe Economic Growth Strategy Loddon Campaspe Regional Partnership Regional Development Australia Loddon Mallee Committee : Attachment 4
- Guidelines for the removal, destruction or lopping of native vegetation Department of Environment, Land, Water and Planning Department of Environment, Land, Water and Planning : Attachment 5
- Planning for Biodiversity Department of Environment, Land, Water and Planning : Attachment 6
- Vic Roads Pavements Geotechnical and Materials (Specifications and Guidelines) :
- Big Build Major Transport Infrastructure Authority (Strategic plans) :
- Regional Geology Map of the Bendigo Region, 1:100,000 Earth Resources Victoria Department of Jobs, Precincts and Regions :
- Cement Concrete and Aggregates Association 30 Year Infrastructure Plan Review : Attachment 7
- Cement Concrete and Aggregates Association Enhancing Australia's Biodiversity : Attachment 8
- Australian Rail Track Corporation Ltd Specifications : and,
- Mawsons Internal Documentation.

Key Findings Geological

- Significant contact metamorphism or hornfels deposits occur in proportionally isolated areas when considered against other environmental, planning, and stakeholder impacts. They are limited by the occurrence of the correct progenitor rock types adjacent to intrusive granite batholiths. The granitic batholiths when intruding into these older sedimentary rocks generally stiffen and strengthen the rocks, changing them from sedimentary to metamorphic rocks provided the geological conditions are amenable to this process. Importantly the process of contact metamorphism is spatially limited and the majority of suitable hornfels deposits i.e., the Lysterfield deposits in Melbourne, are located on the contact or within 500 metres of a granite contact. Further afield from the contact the altering fluids are not as pervasive and material strength and performance commonly decreases away from the contact zone. This commonly reduces the engineering performance of the

rocks and makes them unsuitable at any significant distance from the granite contact as they have not been altered and stiffened by the same degree of silica saturation.

- The hornfels rock which occurs at Blue Hills is not widespread. As shown on Figure 3 - Bendigo Region Work Authority Areas and Regional Geology the coincidence of a suitably isolated area of hornfels with reasonable access to a major road network road, which is suitably distant from nearby neighbours, preferably with minimum 1000 metres exclusion distance, and which is not otherwise constrained, excluding vegetation, is a very rare confluence of circumstances. This contrasts strikingly with the occurrence of the new volcanic basalt terrains which are spatially extensive and very widespread, albeit are of limited thickness. Importantly no other hornfels work authorities are located in the region. Figure 3 illustrates that all the Work Authorities in the region are located on either new volcanics or on sedimentary deposits. No hornfels deposit are recorded by the Victorian Government.

- The hornfels deposits are vertically extensive and when benchmarked against the same extractive footprint as the new volcanics can often yield three to five times the resource for the same area of disturbance. The thickness of the basalt flows can commonly be less than ten metres in many areas of the new volcanics, refer Figure 4 Blue Hills/New Volcanics Typical Pit Cross Section.

- The soil types over much of the new volcanic basalts are classically considered more fertile and more amenable to agricultural pursuits, in contrast to the more skeletal lithosols which occur over the hornfels. This is because basalts being volcanic rocks are enriched in many important trace minerals including calcium, magnesium, potassium, and a host of other desirous trace elements commonly include zeolite. This is in contrast to the soil profile covering the hornfels at Blue Hills which is of a limited thickness in the ridgeline area and has a very low organic and trace element content when considered proportionally against the new volcanics. Being derived from greywacke and siltstone it is not generally enriched to any significant degree in trace elements as the progenitor rock type is a silica, iron, aluminium rich rock.

- The ridgelines of the hornfels are commonly the only economically viable areas of extraction as the degree of weathering and thickness of overburden away from the contact zones and in the lower topographically lying areas often precludes extraction and requires more wastage of the material. This is the case for the Blue Hills site where in the west and lower lying flatter portions of site the thickness of overburden increases up to fifteen metres. This contrasts to the central portion of the proposed quarry area in which the slightly weathered to unweathered rock commonly occurs at a metre or two below the surface. This increases resource utility and efficiency and requires less spoilage or dumping of unusable material. It also has cost benefits for infrastructure projects, refer Figure 5 Cross Sections A-A' to C-C' and Figure 6 Cross Sections D-D' to H-H'.

## Key Findings Engineering Specifications

- The proposed extractive resource at Blue Hills is considered a niche hornfels resource and is differentiated from the other quarries in the Bendigo region by the following key engineering parameters:
  - It has a high Polished Stone Value, (PSV), and skid resistance when compared against the typical new basalt and sedimentary quarries of the region which cannot produce highly skid resistance rocks. This leads directly to safer roads and safer communities.
  - It can produce high quality rail ballast pursuant to Ballast specification CT 147 and the new ARTC specifications, which differentiates the rocks from the new basalt deposits which commonly cannot, if at all, comply with these engineering requirements.
  - It has high durability, strength, and a very good Mill Abrasion index in contrast to the new basalt engineering characteristics. These fundamental engineering parameters are a key issue regarding infrastructure longevity and maintenance costs and provide for a better outcome for the state the tax payer and all stakeholders as proportionally the material is a more durable engineering material.

## Key Findings Economics and Infrastructure

The Victorian Government has completed a plethora of voluminous studies on extractive industry and infrastructure and in précis has highlighted that a looming critical shortage of high quality engineering materials exists in the Greater Bendigo region. These various reports are included in Attachment 1. While the findings of these reports will not be repeated verbatim it is noted that:

- DEDTJR report no Hornfels deposits in the Greater Bendigo or adjacent regions, refer Plate 1.

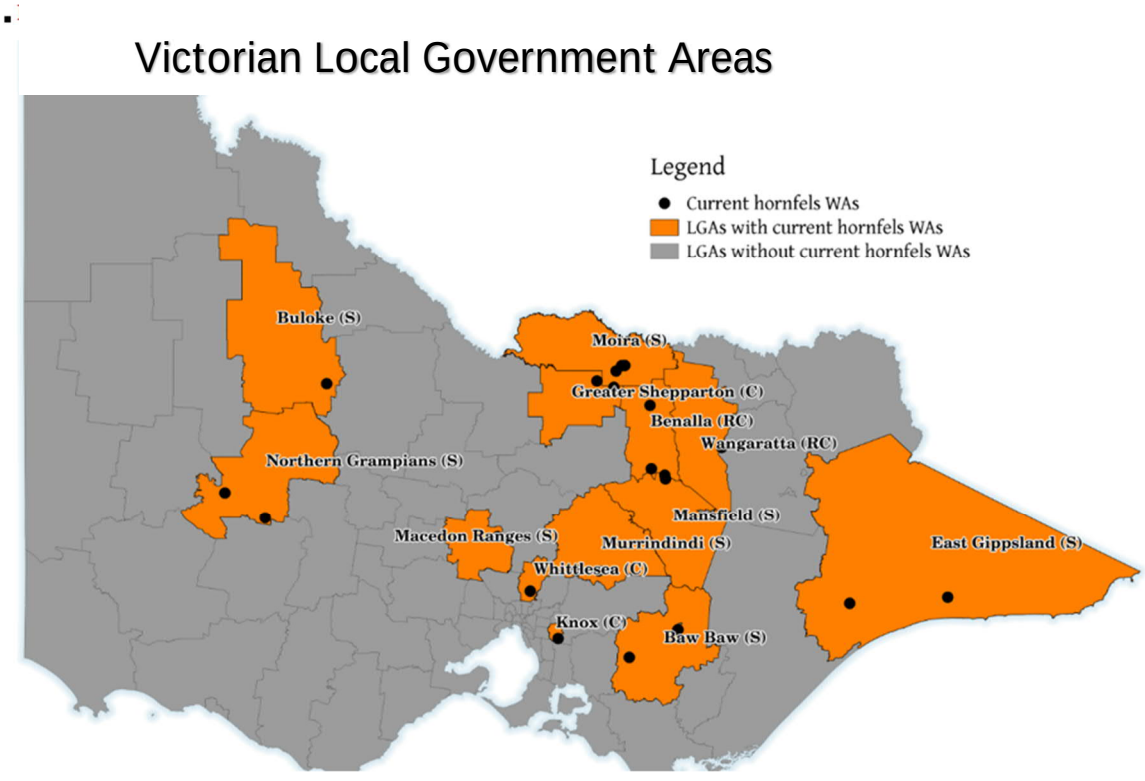

Plate 1: Reproduced courtesy of DEDJTR and which illustrates that there are no hornfels deposits in the Greater Bendigo or surrounding regions. The blue star is the approximate location of the proposed Blue Hills extractive area.

- Hornfels is considered a threatened rock type, refer Section 5.4 of the PWC and DEDJTR 2016 review, which will be exhausted within the time frame that was assessed by the state government review.
- The state government has predicted that the Greater Bendigo region has a looming shortfall of construction materials, which will become critical by 2050.
- It is noted by PWC in the 2016 extractive industry review that work authority approvals can take up to fifteen years, (eight years on average), from genesis to full approval given the complexity and difficulty of these types of projects.

## Key Findings General

- Community environmental and general stakeholder issues are forcing extractive industry further afield from major urban centres and it is increasingly difficult to find a site with proportionally few sensitive receptors. This is because new extractive industry approvals generally have a minimum buffer distance of 1000 meters to any occupied dwelling. This buffer distance generally ensures that on site impacts can be suitably managed and mitigated.

Plate 2: While vegetation will unfortunately require clearing it is noted that much of the vegetation is new regrowth and the area has been extensively logged. One of the favourable characteristics of the site is visible in this image, in that the rock appears at surface over much of the proposed quarry area, which limits the amount of topsoil and weathered rock requiring storage.

## Summary

In summary the occurrence of a viable hornfels quarry site requires the coincidence of a host of project permutations which include favourable topography, (helping shield the quarry from stakeholders), suitable rock mass engineering performance and degree of weathering of the rock mass, suitable buffer distances of commonly a minimum of 1000 metres to any sensitive receptor, refer Figure 7 Nearest Sensitive Receptors, proximal access to roads, lack of substantial watercourses, and in so far as is practicable, a minimal impact on flora and fauna.

When project economics, rock mass engineering requirements, capital risk, local, state, and federal planning schemes, environmental impacts, and all other relevant constraints are considered, clearly finding a new extractive industry site is difficult and requires a balanced consideration of all impacts. That said, in review of this site, it is submitted and indeed is demonstrable that in so far as is achievable, all impacts can be suitably managed by:

- Implementing staged clearing over the pit area :
- Providing adjacent areas for offset :
- Completing habitat maintenance and enhancement on other portions of vegetation on site :
- Modifying the pit design to limit the impacts on significant trees :
- Avoiding the majority of significant waterways and riparian corridors :
- Retaining the top soil and seedbank for rehabilitation purposes :
- Ongoing management of prickly pear and other invasive weeds : and,
- Implementing other niche vegetation management practices and strategies as considered relevant.
- Rigorously managing off site traffic impact by enforcement of Mawsons Transport Protocols and Traffic Management Plan and implementation of a one strike policy regarding road and safety rules and off site traffic management.

Finally, without society even being generally cognisant of extractive material usage, the following points are noted:

- It is estimated that extractive materials comprise approximately one third of Australia's infrastructure costs, which is graphically illustrated in Plate 3. They also consist of a lessor, however still significant portion of ongoing maintenance costs, which are estimated to range between be 20 and 25% of sustaining capital. It is also noted that when globally benchmarked against other countries Australia's cost of infrastructure development is 2-3 time that of other developed western nations. While these comparatively larger costs are partly due to the geographic size and low density of population they are intrinsically related to the Australia's lack of acceptance of extractive industry as being a fundamental corner stone of developing a nation.

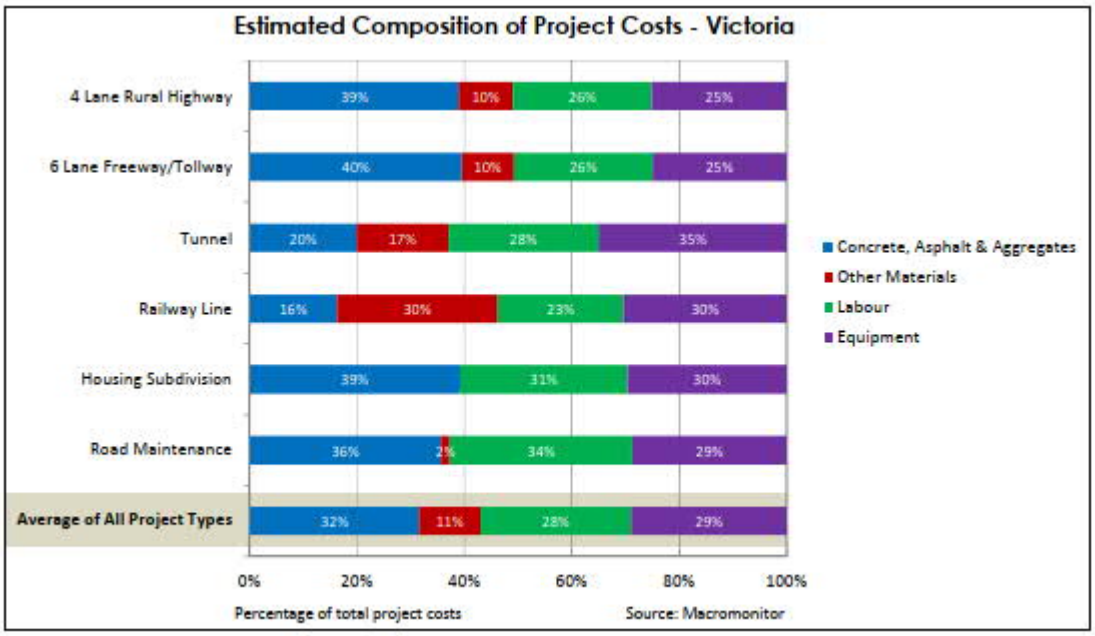


Plate 3: The estimated composition of costs on infrastructure development in Victoria.

- Development of a typical new volcanic basalts resource in Victoria yield a lower quality construction material and commonly require a footprint 3 to 4 times the size of the deposit type at Blue Hills to extract the same volume of construction materials, refer Figures 4 Blue Hills/New Volcanics Typical Pit Design Comparison and Figure 5 Blue Hills/New Volcanics Typical Pit Cross Section. In considering the new volcanic deposit thickness it is noted that the basalt flows can vary between 5 and 25 metres however in most deposits they are a one bench operation i.e., 12-15 metres with the deposits around Wollert, Rockbank and Werribee considered to provide a typical thickness of the new volcanics flows.

- Extractive industry materials, including concrete, are by volume the second most consumed material, after water, by humanity. Resultantly use of high volume low value local products is aligned with sustainability and is considered a preferred outcome. Haulage of extractive materials large distances increases the carbon footprint of a project, damages road networks and increases significantly the cost of infrastructure to the taxpayer.

- History has numerous examples of where society failed because a cost effective, sustainable or proximal source of suitable construction materials could not be found. Good examples of this contributory effect are the early civilisations of Mesopotamia or the Anasazi Indians of North America.

- Aleppo in Syria one of the oldest, if not the oldest, continuously inhabited cities in the world was once called Halab, and which to this day has survived as the current Arabic name of the city. Ḥalab means 'white', and now also means milk however this usage is understood to derive from the name of the white marble rock found in Aleppo. The centre of Aleppo was a quarry, as was the Rocks in Sydney the iconic Kangaroo Point Cliffs in Brisbane, Staten Island in New York or Edinburgh Castle.

- Mawsons have owned the land for twenty years and in that time have been good custodians of the land in managing prickly pear and other declared weed species. They have also integrated into the rural community by retaining large areas of native vegetation. This extractive proposal will use less than 12% of the total surface area of the site (less than 40 of the total 347 Hectares), with much of the land retained as green space and a biodiversity corridor. Because extractive industry requires proportionally large buffer distances to suitably manage impacts, these buffer zones are commonly areas of high retention of native vegetation within the overall palette of a rural landscape.

# 1 Introduction

## 1.1 Object and Scope

The Scope of Work Groundwork was commissioned on was to complete a needs and market assessment of the proposed Blue Hills Quarry, near Maldon, Victoria. The primary objectives of this review are to:

- Assess relevant documentation on extractive industry supply and demand in Victoria as drafted by the State Government and other relevant bodies;
- Assess the material quality and quantum and benchmark against relevant Vic Roads and Australian Rail Track Corporation (ARTC) specifications;
- Assess rock type distributions within the greater Bendigo area focusing on Hornfels;
- Provide a background to extractive industry management and material usage;
- Assess the general suitability of this site and its potential to host extractive industry given the constraints acting on the site; and
- Review internal documentation and financial modelling regarding project justification, initial and sustaining capital requirements along with an assessment on operational costs.

## 1.2 Extractive Industry Background

Extractive resources underpin all urban and infrastructure development as they are the primary source of materials used for building future roads, bridges, railways, factories, hospitals, schools, homes, etc. They are vital in satisfying society's growing requirements in constructing our built environment. It is clearly evident that the projected population growth, the resulting demand for housing and the need for major infrastructure and resource-related projects proposed for the surrounding Greater Bendigo Region are set to continue the high level of demand for extractive resources.

The availability of quarried products is essential for the welfare of modern communities. Quarried products are essential materials for providing infrastructure and shelter.

Since quarried products are low cost, bulky materials, transport costs are usually a major component of the end user's cost. The cost of extraction and processing of quarried products depends on many factors such as material type, environmental setting, access, topography and other engineering and development constraints. However, the range of production costs between efficient and inefficient producers is highly variable for similar operations. Unit production costs are generally most affected by the rate of production with high volume production rates generally achieving lower unit production costs.

A competitive supply of quarried products is required not only to ensure competitive prices to the consumer, but also choice, service, and convenience.

Choice ensures that a full range of quarried product types are available for particular needs. Thus, the availability of low strength road base material may be essential for farming communities whereas the availability of high strength road sealing aggregates will be essential for State Road authorities or road construction companies. The availability of a range of aggregates of different colour, surface texture and density also improve the choice and availability for the consumer for particular engineering and architectural applications. Additionally, different suppliers may have different credit arrangements which may be important, particularly for small landscaping and building firms.

For a particular market area, a balance needs to be struck for the distribution of supply sources, capital investments, operating costs, transport costs, land disturbance and protection of environmental values to achieve an optimum for convenient and economical supplies of quarried product.

The market for extractive materials is therefore known as a 'derived' demand. Demand is 'derived' by the demand for the goods or services that aggregates or quarry products provide. As the majority of aggregates and roadbase materials are used as inputs into construction materials for building and construction, their demand is driven largely by population growth, economic activity and specific purpose funding for major projects (e.g., highway works, residential, trade and commercial precincts, airport developments etc.). Given that demand for extractive materials is driven by demand for construction materials as inputs into building and construction, which itself is strongly influenced by population growth (either actual or anticipated), it is a useful approach to estimate future demand for aggregates by reference to per capita consumption and population growth.

This is the generally accepted method used in Victoria for forecasting demand for extractive materials. Such forecasts generally take the form of a time-series approach, based on historical production patterns for aggregates and projected population levels. Over the shorter term, consumption can be volatile, varying with the level of local economic growth and building and infrastructure development. However, these effects are smoothed by the estimation of average demand over longer time periods such as 10 to 20 years.

## 1.3 Material Use and Industry Benchmarks

The following information is derived from the Cement Concrete and Aggregate Association of Australia refer Attachment 7. In their research they note the quantum of extractive resources required for the construction of major infrastructure and urban development:

a) 1 kilometre of highway requires approximately 25,000 tonnes of crushed rock;
b) 1 kilometre of suburban road requires approximately 5,000 tonnes of crushed rock, 750 tonnes of 313m3 of concrete for footpaths, kerbs and gutters, and about 450 tonnes of asphalt for road surfacing;
c) 1 kilometre of railway requires approximately 2,000 tonnes of aggregate;
d) A high-rise building can utilise up to 1,000 tonnes of aggregate per floor; and
e) The construction of a typical house (including driveway and landscaping) uses about 100 tonnes of aggregate.
f) per capita usage of aggregates in Australia has historically ranged between 8-10 tonnes per person per annum.

## 1.4 Market Area and Competitors

Quarry market areas are dynamic and depend on a number of factors including integrated investments, product characteristics, competition, access, physical constraints, infrastructure development, population distribution, customer preference and construction project requirements.

Although the market area for any particular source is complex and ever changing, in broad terms the market area may be considered to comprise a primary market area and a secondary market area. The primary market area is defined as the area into which the majority of sales are delivered. The secondary

market area surrounds the primary market and is the area where bids are less successful due to competition, although sales of special products and high value products may also be successful.

The principal market area for the project would encompass the greater Maldon area, in a radius of approximately 50 to 60 kilometres from the site, whilst the secondary market area is most likely encompassed within a market radius of approximately 60 to 100 kilometres from the quarry site. Because regional quarries are more isolated, they generally have larger market areas than metropolitan quarries.

Importantly the inability to secure the supply of locally extracted resources would negatively impact the sustainability and affordability of future growth within the Greater Bendigo Region, and many of the attached documents consider the use of social, economic and ecological implications of using alternative sources should the development of extractive industry within the area be limited restricted or prevented. These impacts commonly include:

a) Increased costs of extractive materials for building construction and infrastructure;
b) Increased pollution levels from increased exhaust emissions;
c) Increased road maintenance costs;
d) Increased transport costs for extractive industry; and
e) Reduced transport safety and efficiency.

All these issues while tangible to government at all levels, are generally considered intangibles by most stakeholders as they do not have a direct economic impact on most users and the impacts manifest as :

Reduced development of infrastructure being roads schools, hospitals, footpaths, sewerage and piping networks etc:

- Expensive maintenance and upkeep of infrastructure, and
- Increased costs of upkeep of the current infrastructure network.

As identified by the Victorian State Government more than one billion dollars is to be invested by major projects and infrastructure across this broader region of Victoria. It is acknowledged that there would be a number of ‘secondary’ infrastructure projects to complement these major projects, which are currently unaccounted for within these estimates.

# 2 The Quarry Proposal

The proposed operation at Blue Hills will aim to achieve a benchmark in environmental management for extractive industry within Victoria. Consideration of environmental values has been integral to the design process. Potential impacts upon the environment have been identified and appropriate safeguards and offsets put in place to ensure that the overall site biodiversity and environmental values remain intact and are maintained, in so far as is practical. Additionally, to minimise the impact on the environmental values of the site, quarrying is deliberately focused on a low-lying portion of the land which is well shielded by large topographic features to the immediate north of the proposed quarry area shield the operation to the nearest sensitive receptors. Importantly the operation will not be visible to the nearest sensitive receptors.

Cognisant of the impact of extractive operations on the community, Mawsons will implement a large buffer zone around the quarry periphery with this buffer land to function as a large environmental corridor. Community and environmental considerations have been integral to the design of the proposed development and in particular, conservation issues have exerted a large influence on the quarry design, with the proposed quarry development occurring in an area which for the most part has been previously cleared of native vegetation and while regrowth has occurred the bulk of old growth trees will be avoided in the design.

The proposed quarry development area accounts for less than 12% of the land at approximately 39.5 Hectares. The balance of the land holdings of approximately 307 hectares or, slightly greater than 88% of the land, will be utilised as environmental buffer land with habitat maintenance and enhancement works planned to occur over the site. Additionally, a large wildlife corridor will be retained in the buffer zone of the project. These key design features highlight the cognisance and emphasis placed on consideration of the environmental values of the area and illustrate that industry and nature conservation can be synergistic, and mutually inclusive to the benefit of all stakeholders.

## 2.1 Summary of Environmental Issues

Consideration of environmental issues has been integral to the planning and design of the proposed quarry development. The location, layout and staging of the proposed development has to a large extent, been predicated by consideration of environmental issues. Issues of particular concern have been the protection of flora and fauna, protection of both surface and ground water quality, minimisation of the impact on visual amenity as well as mitigation of potential dust, noise and vibration emissions. Specifically, the following issues have been addressed:

Acoustic and dust emissions will be managed by:

- Frequent watering of the haul road at a rate of around 2 litres/$m^2$/hour
- Water sprays used on the processing plant
- Rock drills to use appropriate dust extraction systems
- Partial enclosure of the primary crusher and screens as needed
- Wheel washer used for heavy vehicles leaving the quarry
- Progressive rehabilitation of the site occurring synchronous with development

Surface water will be managed through a comprehensive stormwater harvesting and management system involving grit traps, velocity retarders, silt fences, bench detention basins and ultimately a series of settlement ponds. A large capacity sump will also be developed in the floor of the lowest quarry bench with this sump having a design capacity to capture and hold a significant AEP event. Progressive and sequenced landform rehabilitation will occur contemporaneous with extraction to ensure only a limited and manageable area is exposed at any one time to erosion and sediment run off. Clean stormwater, where practicable, will be diverted away from the quarry workings. Ultimately the intent of the site is to be zero discharge and ultimately self-sustaining in regard to water usage.

- No significant impact upon groundwater is expected resultant of the quarry development as all drilling completed to date has yet to intersect significant volumes of groundwater. Geologically given the massive, nature of the hornfels the area is not expected to host significant volumes of groundwater.

- Blasting will generally be carried out twice per month with each blast event lasting less than a few seconds. Vibration and airblast from blasting activities will be controlled by the application of industry standard control measures. Blasting will be undertaken by specialist contract blasting organisations and will be conducted in compliance with local environmental and operational constraints and within accepted limits for ground vibration and airblast. To ensure compliance with the relevant guidelines a comprehensive Blast Management Plan has been developed.

- Diesel and hydrocarbons will be stored on site in hard stand areas which will be bunded pursuant to Australian Standard 1940 Storage and Handling of Flammable and Combustible Liquids. Hydrocarbon waste products will be removed from site via a certified waste removal company.

- No acid mine drainage or associated chemical runoff will be produced from the resource. The rocks on site are geochemically inert and suitable for use as non-reactive engineering/construction materials.

## 2.2 Extraction and Quarry Development Issues

Prior to commencement of extraction, environmental controls will be established, access and haul roads will be developed, and topsoil stripping and stockpiling will be completed over the stage one development area. Construction of site infrastructure i.e., office, weigh bridge, wheel washers, motor vehicle workshop will also occur at this juncture. Once the required environmental controls are implemented stage 1 of extraction will commence by dozer ripping followed by conventional drill and blast. Processing on site will occur initially by mobile plant and when established a combination of fixed and mobile plant.

The extraction methodology used on site will involve initially stripping and stockpiling of the residual soil profile, with this campaign followed by the removal of the top one to three metres of extremely to distinctly weathered material by either dozer ripping or drill and blast methodologies. Material will be transported to a primary bin and feeder and transferred to the primary crusher located within the workings of the proposed quarry. Crushed rock will be transported by rubber conveyors to the downstream crushing and screening operations. The crushing and screening plant that has been selected for the proposal will be configured to optimise crushing of the rock and environmental controls. It will

have the latest technological developments for dust and noise suppression. Material will be processed into a wide range of quarried products and stockpiled adjacent to the processing plant. This overburden material will be suitable for use as fill for site pad construction or for the production of lower quality road bases and engineered fills. The material between three and eight metres, if scalped, or otherwise beneficiated, may be suitable for the production of most higher quality products i.e., concrete aggregates and higher quality road bases. Below eight metres the material will generally be suitable for the production of most high quality quarried products. Conventional drill and blast methodologies will be used to break the rock below three metres depth as the rock is very strong, hard and durable.

## 2.3 Quarry Development Summary

In summary the objectives of this quarry development are to:

- Present a balanced outcome for the project in terms of utilisation of the material in an environmentally sustainable, practical and sensible fashion;
- Minimise any potential environmental, (dust, noise, water, vibration and visual), impact associated with the operation;
- Preserve and enhance remnant vegetation buffers outside of proposed quarry development areas;
- Provide a supply of construction materials for use by the local and wider community;
- Provide employment, education and training for the local workforce;
- Implement “better than best practice” environmental management;
- Ensure that the operations are carried out in an orderly and efficient fashion;
- Provide further choice in a market dominated by multinational companies;
- Rehabilitate and enhance the land conservation value post quarry production, and
- Return a profit on funds and efforts employed.

In conclusion the proposed quarry development at Blue Hills provides an excellent opportunity to utilise a strategically important quarry resource in conjunction with enhancing and maintaining wildlife habitat, and wildlife corridors. Consideration of environmental and, in particular, conservation issues has exerted a large influence on the final quarry design. In particular this quarry has been designed, in so far as is practicable, to co-exist and minimise disruption to wildlife, which may occur on site. The proposed quarry design highlights the fact that development and conservation can be mutually inclusive and coexist.

# 3 Mawsons Background

## 3.1 Mawsons Philosophy of Community Partnership

Operating within and as a part of the community Mawson has several key philosophies which are integrated into their business model. While engagement with stakeholder at all levels is critical a few of the internal philosophies include

- "We aim to steadily grow our business. Excelling in customer service and innovation while building strong partnerships with our valued customers, staff and suppliers"

- Our vision is to be able to supply a complete range of construction materials to the strongly growing central Victorian region and have identified resources which are sustainable for many decades into the future provides security for all of our partners and in particular for the local community.

- The ability to develop a greenfield quarry enables us to design every aspect of the project to meet all requirements relating to community needs and demonstrate environmental best practice as well as operational needs.

## 3.2 Local Competition and Market

- The central region of Victoria is serviced by several quarries of which Mawson operates two. Mawsons Lake Cooper quarry on the northeast side of Bendigo services that part of the region very successfully however the opposite side, where Blue Hills is located, is less well serviced by A Grade stone suppliers. There are competitor's facilities at Maryborough and Ballarat however these are further from Bendigo and approximately equidistant into Melbourne which is approximately 100 km to the southeast.

- Volumes of road base and aggregate materials for construction projects are expected to grow strongly over the medium to long term with an expectation that 500,000 tonnes per annum would be achievable within 10 years and growth to 1+ million tonnes per annum a potential outcome within 10-20 years as Melbourne grows to the north and west. With Bendigo projecting population growth from ~120,000 currently to 200,000 by 2050, demand for housing and infrastructure will need high quality construction materials supply over the long term

- Blue Hills is well placed to service the region given its central location and being located quite close to the Calder Highway which links to the Loddon Valley Highway to the north and Midland Highway to the south. The Wimmera Highway also provides good access to the western region which all means that Blue Hills is very well placed to service a large market area.

- Bendigo itself is only some 30km to the north east and is one of the fastest growing large towns in Australia and is recognised as the 'Regional Capital' of central Victoria.

## 3.3 Growth of Regional Towns in the Bendigo Region and Mount Alexander Shire

The Loddon Campaspe region covers a population base of some 250,000 people and Gross Regional Product of $13 billion. Population is projected to grow to 280,000 by 2031 (Loddon Campaspe Economic Growth Strategy, 20191) with annual population growth rate at 1.25%.


Plate 4: *The Lodden Campaspe Regional Partnership*

The proposed Blue Hills quarry is located in the northern part of the Mount Alexander Shire only 30 km from the city of Bendigo.

Key sectors by output include:

1. Manufacturing
2. Construction
3. Financial & Insurance Services

Health care, retail and manufacturing are the top employers in the region.

The region is characterised by vibrant agriculture, retail, health and manufacturing sectors and the partnership between the regional shires has committed to an Economic Growth Strategy Framework with a key pillar of Infrastructure Development as below.

The targeted investment areas of the growth strategy include a strong focus on capital for 'Regional Infrastructure Investment' as part of the 'Built' component of that strategy.

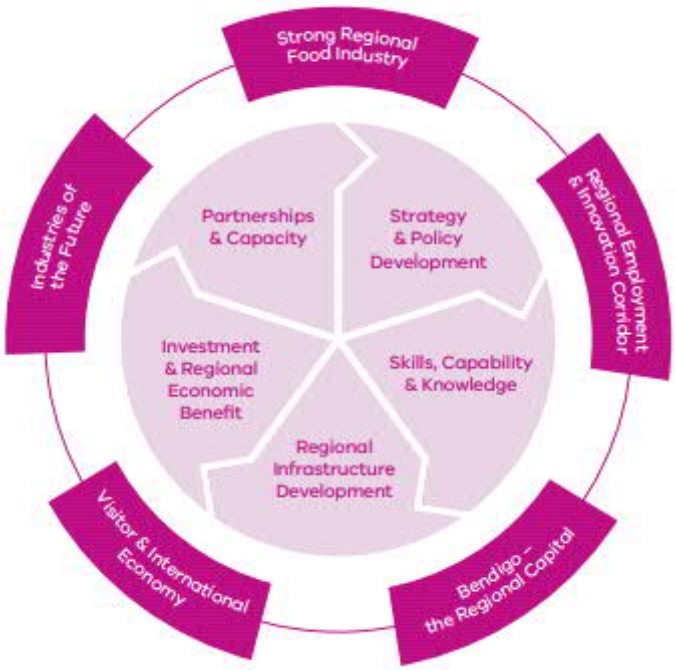


Plate 5: Regional Economic Grouth Framework

Economic priorities such as the Bendigo Airport, business land development, cultural assets and Bendigo 'metro' rail are all projects identified within the regional growth strategy. There are also infrastructure renewal projects identified such as water/fire management, power and gas impediments as well as a future vision of upgraded bike networks, walking paths and landscape restoration. All of these projects require a significant ongoing and economical supply of quality construction materials from local supply sources.

# 4 Transport Networks

Freight improvement is also identified as a key need in the regional strategy as part of the Goulburn Murray Irrigation District which links with the strong food production industry and employment future for the area. With 'stock and domestic' water pipelines currently being installed there is a serious commitment to the 'food industry' pillar of the regional growth strategy.

The map below provides a good diagram of how the highway network spreads from the node which is Bendigo at its centre with our proposed quarry marked on the inner west side of that system. This makes Blue Hills a key part of the future of the region and complements Mawsons Lake Cooper quarry which is located on the opposite NE side of the City of Bendigo on the Shepparton link (Midland Highway).

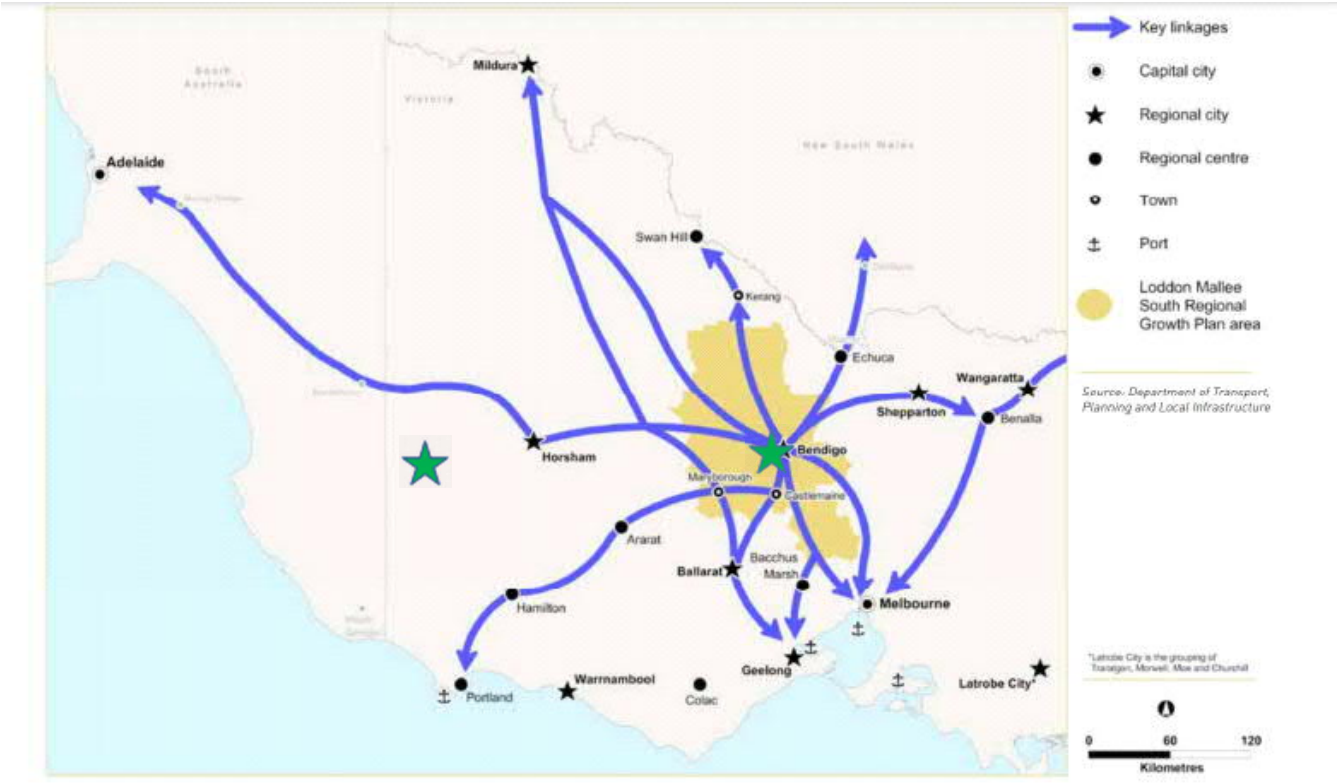


Plate 6: Links to Surrounding Regions

The Calder road and rail corridor is the key transport spine in the region providing access to and from Melbourne in the south and Mildura in the north west. Upgrades to the Calder Freeway and the Bendigo rail line over the past decade have helped support strong growth in the movement of people and goods along this important transport corridor. Other key road links include the Northern and Sunraysia highways, which provide strategic routes to intra-regional cities such as Ballarat and Geelong; and the Midland Highway, which provides a north-south orbital link between the Hume Freeway and the Port of Geelong via Benalla, Shepparton, Bendigo and Ballarat. The Bendigo rail line has experienced strong growth in patronage following recent upgrades. This includes high levels of commuting from Bendigo to Melbourne on a daily basis. Commuter growth is expected to continue and is critical for businesses in and outside the region. Different solutions are required for the movement of people and the

movement of freight. The future directions in this strategy provide some guidance to help ensure the transport network supports changes to the economy, settlement patterns and demographic changes.'

The transport network in the region is being supported with Commonwealth and State Government funding to cater for population and business growth.

## 4.1 Importance of Calder Corridor and Regional Highways

The majority of Loddon Campaspe produce for export and domestic markets is generally transported along the region's highways to domestic markets in Melbourne or export through the Ports of Melbourne, Portland or Geelong. There are a number of freight transporters that use the Calder Highway to transport goods from NSW and throughout the broader Murray Basin region, through the Loddon Campaspe Region and on to ports.

Within the Loddon Campaspe Region it is more efficient to move freight to processing facilities and markets by road rather than rail. In part this is due to the region's proximity to Melbourne and short distances between farm gate and local processing facilities. The Calder Highway, Northern and Midland Highways, the Pyrenees Highway and the Wimmera Highway are critical in enabling efficient freight movement.

In total there are 6 major highway corridors within the region which require high quality crushed rock and sealing aggregate products to meet construction and maintenance requirements:

- Calder Highway
- Midland Highway
- Northern Highway
- Wimmera Highway
- Pyrenees Highway
- Sunraysia Highway

## 4.2 Proximity to Melbourne

The regional centre of Bendigo and other major towns along the Calder corridor (including Castlemaine, Gisborne, Kyneton and Woodend, refer Plate 7) are readily accessible to Melbourne via rail and road transport links, which enables daily or regular commuting to Melbourne for employment or business. This has implications for the movement of people and goods and the interrelationship of employment and tourism. The continued growth and peri-urban expansion of Melbourne is going to have an effect on the operating of transport networks. As well as this, the employment and market opportunities for the region are inherently linked to the opportunities and impacts of Melbourne. It will be important to continue to 'Support State initiatives that continue improvements to the Calder corridor as the key transport corridor in the region' and 'State actions to improve the frequency, reliability, amenity and comfort of train services in the Melbourne to Bendigo corridor'

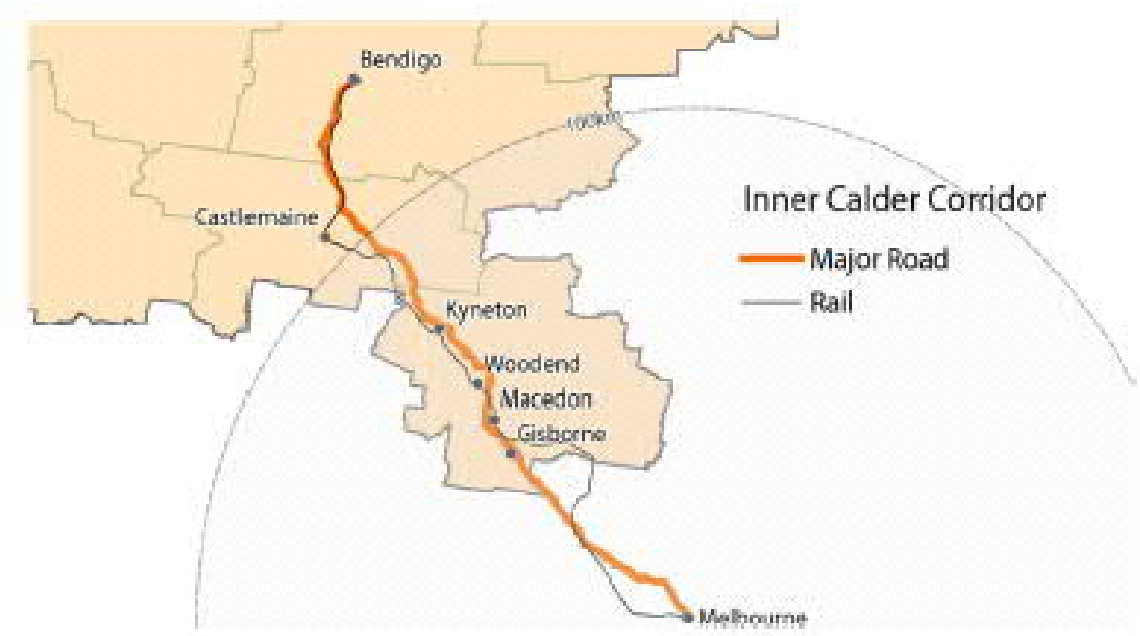


Plate 7: Proximity and Route to Melbourne

# 5 Agricultural and Horticultural Assessment

The Loddon Campaspe region is a major contributor to the Victorian economy, contributing over 10% of the respective overall output for the state of Victoria. Campaspe and Loddon Councils lead regional exports in agriculture supporting large areas of irrigation. The Loddon Shire produces over 42% of Victoria's olive output. Tomato production for processing from the Loddon-Campaspe region represents over 96% of the state total and these farms are implicitly linked to major processing and cannery operations in the Campaspe and neighbouring Shepparton districts. Exports from the region comprise around 70% by value of Victoria's grain exports and around 15% of Australia's grain exports. Grain exports are typically either Victoria's top or second largest export item by value.

Livestock, dairy cattle, poultry and pigs are also strong agricultural sectors in Loddon Campaspe region. Large poultry and pig processing facilities are located in Bendigo and Castlemaine, with recent investment and expansion at these processing facilities. The pig industry in Loddon Campaspe region represents over 40% of Victoria's pig industry production. The Loddon Campaspe region is also home to one of the largest integrated poultry processors. Expansions and investment at this facility, located outside of Bendigo, continue. Poultry processing, hen eggs and day old chicks contribute a significant proportion of the total Victorian poultry industry. The northern Victoria dairy industry is one of three Victorian dairy production regions. The other regions being, south west and Gippsland. Sheep in Loddon Campaspe region comprise around 12% of the Victorian flock.

In terms of agricultural trends, land use is slowly changing from broad acre sheep and cropping to more intensive land uses to supply the processing facilities, for example pigs, poultry and irrigated horticulture. This land use change is changing the nature of transport requirements and future needs of the transport network.

Well established industries have developed in the region over long periods of time and as such processing plants, abattoirs and storage facilities have been built in close proximity to the respective industry centres to maximise efficiency in freight and logistics. Internal movements between farms and storage or processing facilities tend to be over shorter distances but may occur in more compressed time frames to coincide with harvest periods, leading to significant numbers of heavy vehicles accessing a small area over a short period, such as grain trucks accessing silos.

Transporting these commodities to Melbourne and the ports of Port Melbourne, Geelong and Portland increasingly require road transit using heavy vehicles, B-Doubles or rail transport travelling through the region from the north to the south. Development of rail infrastructure, extension and addition of heavy rail lines and greater interconnectivity between lines is aimed at increasing the volume of export product using rail, reducing the dependence on road transport and relieving heavy vehicle traffic loads.

# 6 Regional Employment & Innovation Corridor

Plate 8 provided courtesy of from the Loddon Campaspe Economic Growth Strategy of 2019. Linked efficiently by both road and rail systems, the movement of people and employment up and down this corridor is a constant flow, both in between towns and from Melbourne through to the major centres in the north. The proposed quarry will support large parts of the infrastructure and growth plans for this region over the long term.

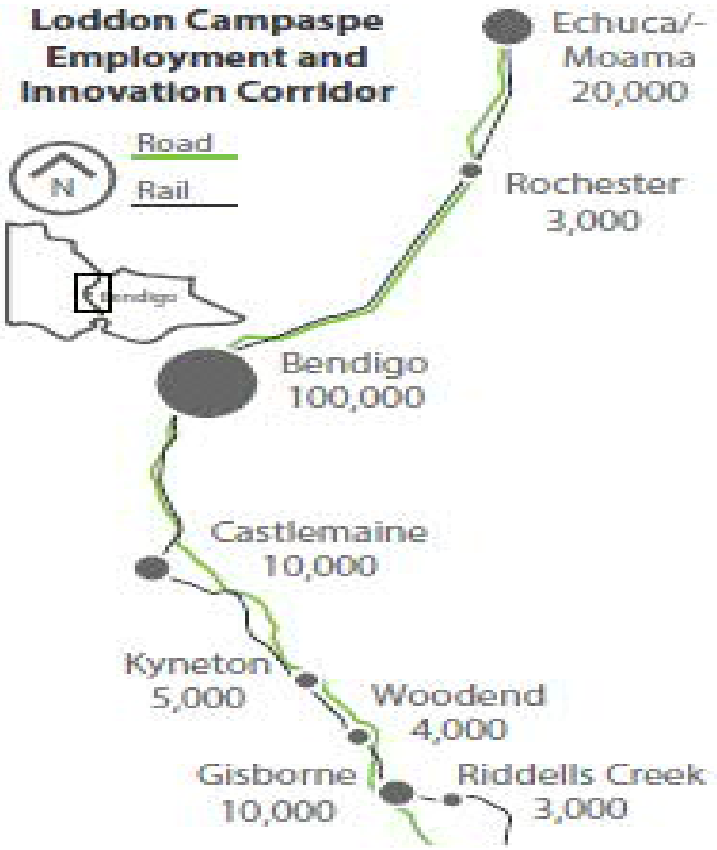


Plate 8: Links to Surrounding Regions

# 7 Commonwealth/State/Local Government Area Projects

## 7.1 Infrastructure

Quarry products from Blue Hills quarry will be of high quality, and perfectly positioned to service Government projects and private sector needs in the central region.

Infrastructure spending can be defined as follows:

- Commonwealth funded projects
- Victorian Government funded projects
- Local Government projects

Commonwealth funded projects current

- Inland Rail through ARTC
- North East Rail Line (NERL)

Victorian Government Funded Projects and other bodies

- Major Projects Victoria
  - Hume Highway
  - Shepperton Bypass
- Regional Roads Victoria
  - Road construction/reconstruction
  - Road resurfacing and micro-surfacing
- VicRoads
  - Infrastructure projects such as barriers/signal improvements
- North East Water
- Goulburn Murray Water
- Local Land Services (NSW)

Main Local Government Areas to be serviced in Hume region

- City of Greater Bendigo
- Loddon Shire
- Campaspe Shire
- Central Goldfields Shire
- Mt Alexander Shire
- Macedon Ranges Shire

Local Government Projects

- Road construction and Resheeting
- Resealing of roads
- Drainage
- Stabilising and rock armouring dams and river banks

Private sector projects

- Commercial building
- Housing
- Subdivision roads and drainage
- On farm works

# 8 Other Considerations – Environmental and Social

## 8.1 Transport Distances

Blue Hills' central Victorian location means that it can efficiently supply projects to all points of the compass. Access to the large population centres of Bendigo (30km), Ballarat (90km) and Melbourne (120km) means that Blue Hills has significant transport advantages for supply to projects within that radius. Inevitably, given Victoria's poor rail network capability, this delivery is likely to be made by road transport so access to main highways is critical. Blue Hills is within 20km of the Calder Highway/Freeway to the East which means excellent access to markets to the south and northwest of the quarry as well as the Pyrenees Highway to the west. Once on the Calder Freeway other markets to the east of the quarry are easily reached via connecting roads from the Calder.

## 8.2 Environmental

The proposed Blue Hills Quarry is located within a regrowth forest on a concealed ridgeline which is shielded to the north by significant larger ridgelines. The hornfels deposit is relatively deep meaning that the quarry can have a modest footprint when compared to a basalt flow deposit. Whilst it will require the removal of an area of regrowth, the remaining trees will provide an excellent buffer for visual, noise and dust emissions. Combined with bunding as required, this quarry will have minimal visual impact to neighbours or visitors to the region. Indeed, it is the very philosophy of the quarry design to remain out of site to all stakeholders apart from trucks entering and exiting the site.

## 8.3 Social

The relatively remote location of Blue Hills will mean minimal neighborhood disturbance. There are only 4 houses within a 2 km radius of the quarry and whilst it is 13km from Maldon, the majority of the delivery transport will bypass the central portion of the township. It is anticipated that the quarry operations will grow over the next 5-10 years and are likely to employ upwards of 10 staff plus contractors from the surrounding area.

## 8.4 Estimated Production

In completing a market review, sales volumes in the order of 500, 000 tonnes per annum are likely within the first ten years of operation with growth to around one million tonnes per annum considered possible within a 10-20 year timeframe.

# 9 References

Australian Rail Track Corporation Ltd Technical Specification Sheets

Big Build Major Transport Infrastructure Authority (Strategic plans) :

Cement Concrete and Aggregates Association 30 Year Infrastructure Plan Review

Cement Concrete and Aggregates Association Enhancing Australia's Biodiversity

Department of Economic Development, Jobs, Transport and Resources : Demand and Supply Study, 2015–50 (May 2016)

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Earth Resources Victoria Department of Jobs, Precincts and Regions : Regional Geology Map of the Bendigo Region, 1:100,000

Extractive Resources in Victoria Summary Sheets 2050 :

Loddon Campaspe Integrated Transport Strategy, December 2015

Loddon Campaspe Economic Growth Strategy, August 2019

Loddon Campaspe Economic Growth Strategy Loddon Campaspe Regional Partnership Regional Development Australia Loddon Mallee Committee 2020

Infrastructure Victoria: Victoria's infrastructure strategy 2021-2051

Vic Roads Pavements Geotechnical and Materials Manuals and Specifications Various

# FIGURES

Bendigo
Site Location
Maldon
Maryborough
Castlemaine
Ballarat
Melbourne
E 255600 m
E 305600 m
E 355600 m
N 5917200 m
N 5867200 m
N 5817200 m
Sydney
Canberra
Site
Melbourne

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CREATED: 27 September 2021 JOB SUB #

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**Data Sources:**
Photography: © 2021 Microsoft Corporation; © 2021 Maxar; © CNES (2021) Distribution Airbus
Topography:
Cadastre:
Ecosystem:
Other:



Legend:
- Site Location

PROJECT: Blue Hills
CLIENT: Mawsons

TITLE: Figure 1: Site Location Plan

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DATE: 27 September 2021 | DRAWN: JHV
PRINTED: 27 September 2021 | CHECKED: RH
DATUM: HORIZONTAL / VERTICAL / ZONE
GDA94 / MGA / AHD / 55

## Geology Legend:

**GS90** — Harcourt Granodiorite (G290):
Biotite granodiorite: medium grained, pale grey; equigranular to weakly porphyritic in plagioclase, quartz and K-feldspar; numerous enclaves; nonmagnetic; reduced; I-type

**G293** — Baringhup Granodiorite (G293):
Biotite granodiorite; fine to medium grained, grey; slightly porphyritic; leucocratic, minor mafic enclaves: magnetic oxidised I-type

**Na** — Incised alluvium (Na):
Gravel, sand, silt, minor ferricrete; variably incised.

**Nc1** — Incised colluvium (Nc1):
Silt, sand, gravel: generally poorly sorted and poorly rounded except within channels cut into colluvial material; dissected to variable degrees

**Nc4** — Dissected granite-derived colluvium (Nc4):
Quartz and feldspar sand and gravel: well sorted, fine to medium grained; derived from granite

**Neo** — Newer Volcanic Group - basalt flows (Neo):
Olivine tholeiite, quartz tholeiite, basanite, basaltic icelandite, hawaiite, mugearite, minor scoria and ash, fluvial sediments: tholeiitic to alkaline; includes sheet flows and valley flows and intercalated gravel, sand, clay

**Nws** — Shepparton Formation (Nws):
Clay, sand, silt, pooly-sorted lenticular gravel. Dissected flood plain alluvium: terraces 1-10 metres above present river channels; well developed soil 2-3 m thick.

**Ocl** — Castlemaine Group - Lancefieldian( Ocl): hornfels
Cordierite hornfels, biotite hornfels, calc-silicate hornfels.

**Qa1** — Alluvium( Qa1):
Gravel, sand, silt: variably sorted and rounded; generally unconsolidated; includes deposits of low terraces; alluvial floodplain deposits

**Qc1** — Colluvium( Qc1):
Diamictite, gravel, sand, silt, clay, rubble: sorting variable, usually poor; generally poorly rounded; clasts locally sourced; includes channel deposits with better rounding and sorting

**Qc4** — Granite-derived colluvium (Qc4):
Quartz and feldspar sand: well sorted, fine to medium grained; derived from granite

E 230200 m · E 234200 m · E 238200 m
N 5911900 m · N 5907900 m

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JOB SUB #:
CREATED: 27 September 2021

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**Data Sources:**
Photography: © 2021 Microsoft Corporation; © 2021 Maxar; © CNES (2021) Distribution Airbus
Topography:
Cadastre:
Ecosystem:
Other: © State Government of Victoria 2021, Victoria Seamless Geology 2014 (50k)



Legend:
- Site Boundary
- Cadastral Boundary
- Pit Boundary

PROJECT: Blue Hills
CLIENT: Mawsons

TITLE: Figure 2: Site Geology and Proposed Extractive Footprint

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DATE: 27 September 2021 — DRAWN: JHV
PRINTED: 30 September 2021 — CHECKED: RH
DATUM: HORIZONTAL / VERTICAL / ZONE: GDA94 / MGA / AHD / 55

E 215100 m
E 240100 m
E 265100 m
E 290100 m
N 5903000 m

Inglewood
Newbridge
Bendigo
Axedale
Heathcote
Dunolly
Maldon
Tooborac
Maryborough
Castlemaine

## Geology Legend:

**GS90** Harcourt Granodiorite (G290):
Biotite granodiorite: medium grained, pale grey; equigranular to weakly porphyritic in plagioclase, quartz and K-feldspar; numerous enclaves; nonmagnetic; reduced; I-type

**G293** Baringhup Granodiorite (G293):
Biotite granodiorite; fine to medium grained, grey; slightly porphyritic; leucocratic, minor mafic enclaves: magnetic oxidised I-type

**Na** Incised alluvium (Na):
Gravel, sand, silt, minor ferricrete; variably incised.

**Nc1** Incised colluvium (Nc1):
Silt, sand, gravel: generally poorly sorted and poorly rounded except within channels cut into colluvial material; dissected to variable degrees

**Nc4** Dissected granite-derived colluvium (Nc4):
Quartz and feldspar sand and gravel: well sorted, fine to medium grained; derived from granite

**Neo** Newer Volcanic Group - basalt flows (Neo):
Olivine tholeiite, quartz tholeiite, basanite, basaltic icelandite, hawaiite, mugearite, minor scoria and ash, fluvial sediments: tholeiitic to alkaline; includes sheet flows and valley flows and intercalated gravel, sand, clay

**G283** Pyalong Granite (G283):
Igneous (Intrusive (Granite Unassigned))

**Ocl** Castlemaine Group - Lancefieldian( Ocl): hornfels
Cordierite hornfels, biotite hornfels, calc-silicate hornfels.

**Qa1** Alluvium( Qa1):
Gravel, sand, silt: variably sorted and rounded; generally unconsolidated; includes deposits of low terraces; alluvial floodplain deposits

**Qc1** Colluvium( Qc1):
Diamictite, gravel, sand, silt, clay, rubble: sorting variable, usually poor; generally poorly rounded; clasts locally sourced; includes channel deposits with better rounding and sorting

**Qn** Extrusive: (Qn):
Tholeiitic to alkaline basalts, minor scoria and ash

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JOB SUB #:
CREATED: 27 September 2021

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Data Sources:
Photography: © 2021 Microsoft Corporation; © 2021 Maxar; © CNES (2021) Distribution Airbus
Topography:
Cadastre:
Ecosystem:
Other: © State Government of Victoria 2021, Victoria Seamless Geology 2014 (50k)



Legend:
Site Boundary
Current Extractive Industry Work Authorities

PROJECT: Blue Hills
CLIENT: Mawsons

TITLE: Figure 3: Bendigo Region Work Authority Areas and Regional Geology

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JOB SUB #:
CREATED: 3 December 2021

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Topography: © Commonwealth of Australia (Geoscience Australia) 2008, LIDAR 10m
Cadastre: © The State Government of Victoria (DELWP) 2020
Ecosystem:
Other:



Legend:
- Mawsons Owned Land
- Cadastral Boundary
- Extraction Boundary
- Sensitive Receptor

PROJECT: Blue Hills

CLIENT: Mawsons

TITLE: Figure 4: Blue Hills New Volcanics Typical Pit Cross Sections

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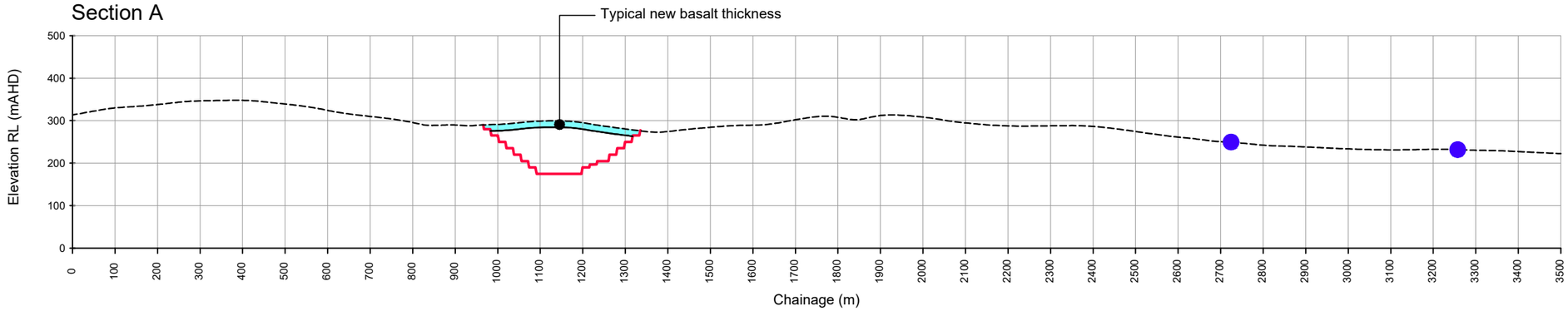


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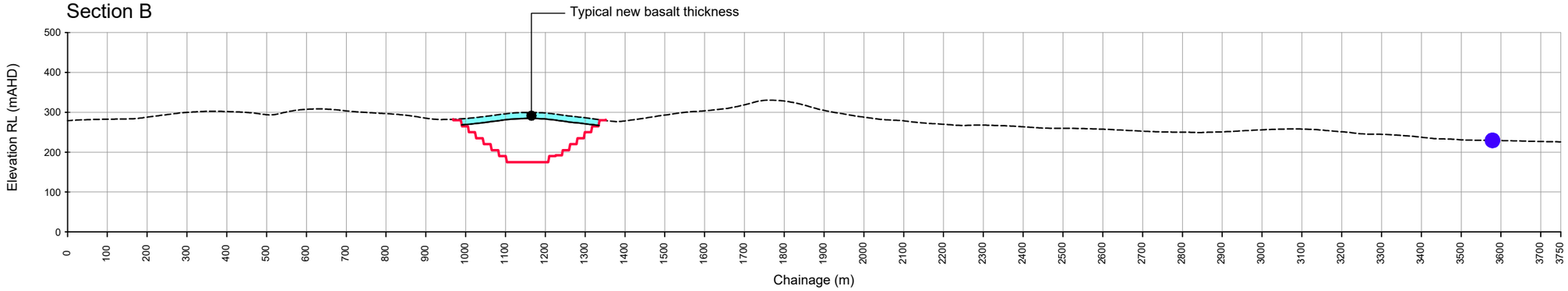


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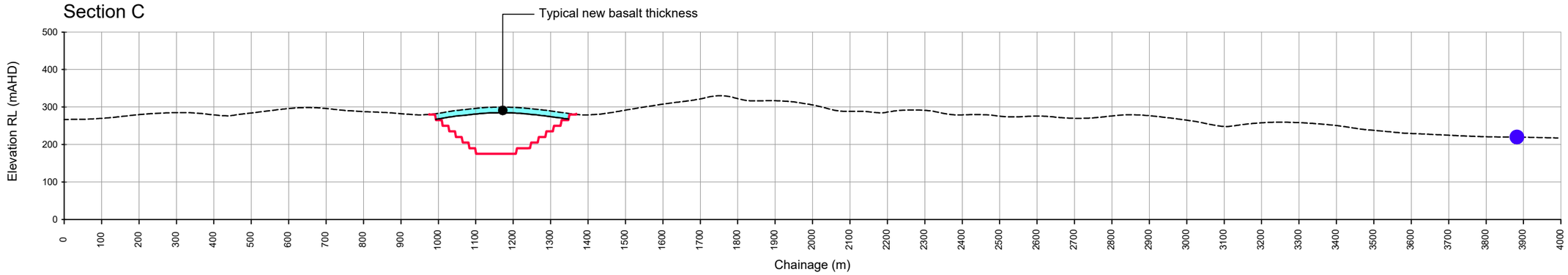


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Topography: © Commonwealth of Australia (Geoscience Australia) 2008, LiDAR 10m
Cadastre:
Ecosystem:
Other:



Legend:
- Existing Ground Surface
- Blue Hills Pit Design Surface
- Sensitive Receptors

PROJECT: Blue Hills

CLIENT: Mawsons

TITLE: Figure 5: Cross Sections A-A to C-C

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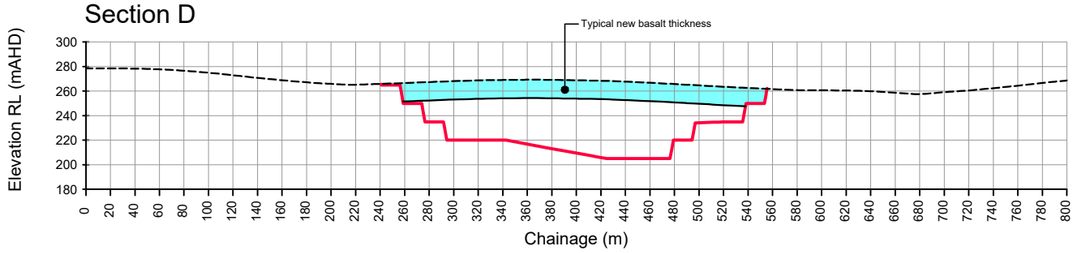


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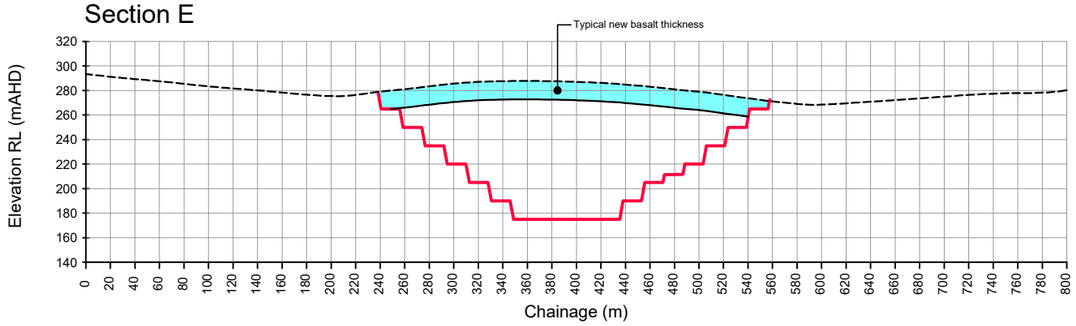


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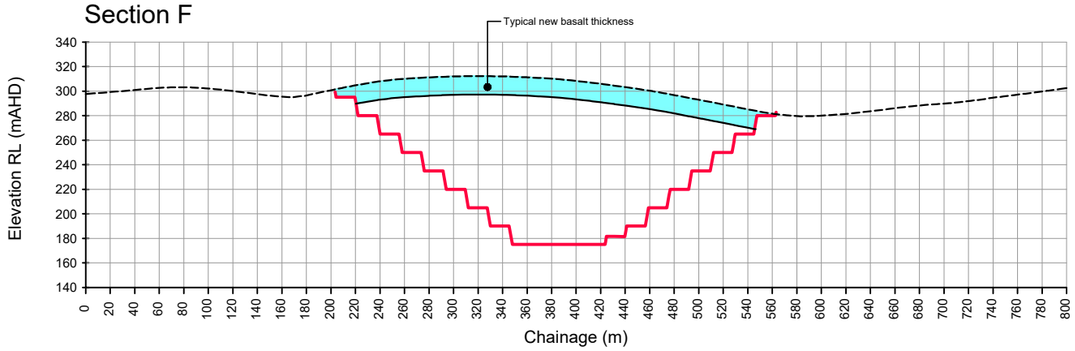


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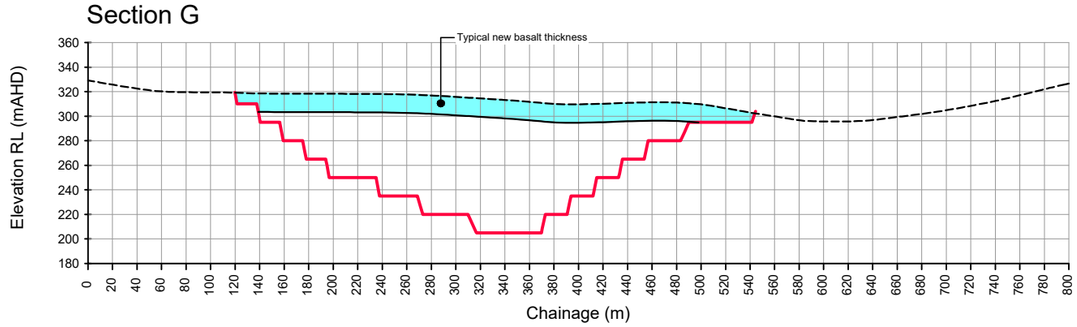


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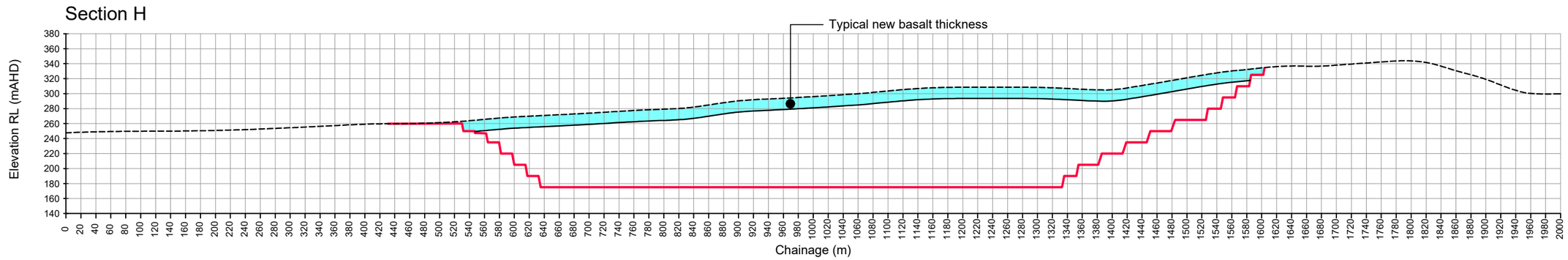


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Topography: © Commonwealth of Australia (Geoscience Australia) 2008, LiDAR 10m
Cadastre:
Ecosystem:
Other:



Legend:
- Existing Ground Surface
- Blue Hills Pit Design Surface
- Sensitive Receptors

PROJECT: Blue Hills

CLIENT: Mawsons

TITLE: Figure 6: Cross Sections D-D to H-H

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DRAWING NUMBER: 5016.DRG.015B
REVISION:
DATE: 3 December 2021 | DRAWN: JHV
PRINTED: 3 December 2021 | CHECKED: RH
DATUM: HORIZONTAL / VERTICAL / ZONE
GDA94 / MGA / AHD / 55

E 232300 m
E 234800 m
E 237300 m
N 5912700 m
N 5910200 m
N 5907700 m
3km
2km
1km
Bells Ln
Lakeys Rd
Shelbourne Rd
Bridgewater Maldon Rd
Bradford Rd
Maldon-Shelbourne Rd
1360m
2386m
1km
2km
3km
4km

FILE NAME: F:\Jobs\SA\50005016 Mawsons Blue Hills\Drawings\5016.DRG.014 - Nearest Sensitive Receptors.dwg
JOB SUB #:
CREATED: 3 December 2021

| REV | DESCRIPTION | DATE | BY |
|---|---|---|---|
| | | | |

Data Sources:
Photography: © 2021 Microsoft Corporation; © 2021 Maxar; © CNES (2021) Distribution Airbus
Topography: © Commonwealth of Australia (Geoscience Australia) 2008, LIDAR 10m
Cadastre: © The State Government of Victoria (DELWP) 2020
Ecosystem:
Other:



Legend:
- Mawsons Owned Land
- Cadastral Boundary
- Extraction Boundary
- Sensitive Receptor

PROJECT: Blue Hills

CLIENT: Mawsons

TITLE: Figure 7: Nearest Sensitive Receptors

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SCALE: 1:25,000 When Printed On A3 — 0 — 500m
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