



Melbourne Supply Area—Extractive Industry Interest Areas Review

Geological Survey of Victoria Technical Record 2003/2

A. Olshina & P. Burn



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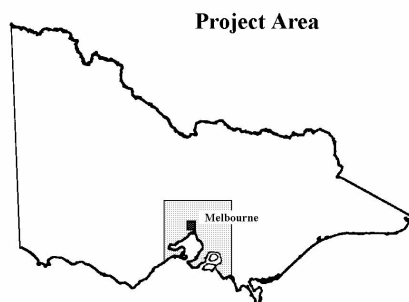
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Hillview quarry, WA 267, Dromana.

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Glossary

DPI	Department of Primary Industries
DSE	Department of Sustainability and Environment
EIDA	Extractive Industry Development Act 1995
EIIA	Extractive Industry Interest Area
EISPIC	Extractive Industries Strategy Plan Interdepartmental Committee
ENRC	Environment and Natural Resources Committee
GSV	Geological Survey of Victoria
MPD	Minerals and Petroleum Division
MSA	Melbourne Supply Area MSS Municipal Strategic Statement
SPPF	State Planning Policy Framework
VPP	Victoria Planning Provisions

Executive Summary

Quarries provide materials that have importance for all members of modern society. Sound management of extractive resources demands a careful balance between competing land use to ensure that sufficient resources remain available for future generations at an affordable cost.

In 1993, the Department of Energy and Minerals released the first report designating the Extractive Industry Interest Areas (EIIAs) in the Melbourne Supply Area (MSA). The first report was reviewed in 1996 to facilitate the protection of stone resources by revising EIIAs within the MSA.

It has become necessary to revise the 1996 report to include:

- changes in land use and zoning that have occurred since 1996,
- changes resulting from the planning reform process,
- new resource and geological information, and
- adjustment of EIIA boundaries resulting from submissions received by the Minerals and Petroleum Division in response to the consultation process undertaken in the preparation of this report.

EIIA designation is applied to land that has been identified as being likely to contain stone resources of sufficient quantity and quality to support commercial extractive industry operations. **This does not mean that a quarry can be established *as-of-right* in these areas, nor does it preclude interested parties from applying for a Work Authority outside the defined EIIAs.**

Significant sand and stone resources often occur outside EIIAs. It should not be argued that quarries be precluded outside EIIAs or that areas not defined by an EIIA contain resources of lesser value or importance. **EIIAs are regarded as areas where extractive industry operations are more likely to be established, both for reasons of resource availability and limited planning constraints.**

Proposals to establish an extractive industry will be considered in the context of the approvals process under the *Planning and Environment Act 1987*. Such proposals will be assessed against appropriate criteria.

The purpose of EIIAs is to:

- provide a basis for the long term protection of sand and stone resources from sterilisation by inappropriate land uses,
- provide a basis for ensuring the long term availability of sand and stone resources for use by the community and at minimal detriment to the environment,
- assist in considering extractive industry values in long term strategic planning and local strategic plans (such as Municipal Strategic Statements),
- ensure that planning or responsible authorities consult with all relevant agencies about land use proposals which may impact on the reduction of sand and stone resources within these areas, and
- create an awareness that extractive industry is a possible land use in these areas.

EIIAs do not:

- provide statutory protection for sand and stone resources,
- allow extractive industry *as-of-right* unless specified by planning schemes,
- imply that future extractive industry will be confined to these areas, or
- preclude the use and development of land for other purposes.

Reference to this report is made in the State Planning Policy Framework (SPPF). To meet the objectives of the SPPF, planning authorities, when preparing planning scheme amendments within the designated EIIAs should consider the impacts that any land use proposal or zoning changes may have on the continuing availability of stone resources and to consult with the Department administering the *Extractive Industries Development Act 1995* on these matters. The SPPF also requires:

- *the long term protection of stone resources in Victoria is to be generally in accordance with:*

- * *provisions and recommendations expressed in Melbourne Supply Area—Extractive Industry Interest Areas, 2003 (the current report), for stone resources in the Melbourne Supply Area, and*
- * *the concept of the Extractive Industry Interest Areas expressed in Melbourne Supply Area—Extractive Industry Interest Areas, for the remainder of Victoria.*

In addition to the SPPF, the Victoria Planning Provisions require that notice of the kinds of application listed below must be given to the Secretary of the Department administering the *Extractive Industries Development Act 1995* in accordance with Section 52(1)(c) of the Act:

- An application which, if a permit is granted, would allow residential land use, rural residential land use or a land use with a substantial residential or rural residential component within an extractive industry interest area.
- An application which, in the opinion of the responsible authority, may materially affect an extractive industry site approved under the *Extractive Industries Development Act 1995* or an extractive industry site in respect of which an application was made under the *Extractive Industries Development Act 1995*.

The above provisions will ensure that any proposed land uses which may reduce the availability of stone resources are considered in accordance with Government policies and that any decision is made in the interest of the whole community.

In addition to the above provisions the Department of Sustainability and Environment agreed, in principle, to create planning scheme overlays for each EIIA in the MSA and to increase protection for existing extractive industry operations. This decision should greatly increase the effectiveness of EIIAs.

The EIIAs are presented as a series of maps, together with written descriptions of the local resource. The maps indicate areas where extractive industries are unlikely to be permitted under current planning provisions and areas of environmental and landscape significance, where additional assessment criteria may apply.

Recommendations:

- Further investigations, including drilling, should be actively encouraged within EIIAs presented in this report in order to further refine the stone potential within these areas. The results of new investigations outside established EIIAs should be noted for future EIIA reviews.
- That EIIAs be identified as overlay controls in planning schemes.
- A review of the effectiveness of the EIIA model should be conducted on an ongoing basis.
- Municipal councils should be encouraged to further integrate the EIIAs into local strategic planning.
- Non-geological criteria used for refining the EIIAs should be regularly reviewed to incorporate improved information and changing community values.
- DPI should develop planning guidelines for EIIAs to protect current extractive industries from incompatible land-uses and to ensure that sand and stone resources within EIIAs are available for the future.
- DSE in conjunction with DPI should update the *Regional Sand Extraction Strategy—Lang Lang to Grantville* study area to reflect changes to the EIIA boundaries.
- DSE in conjunction with DPI should update the Victoria Planning Provisions to reference this revised report.
- DPI and DSE should ensure that the findings of this report are adequately addressed in the implementation of Melbourne 2030.

Abstract

This report aims to facilitate protection of stone resources by identifying Extractive Industry Interest Areas within the Melbourne Supply Area (MSA). This updates the previous 1993 and 1996 studies and was required in order to incorporate significant administrative and policy changes since 1996, as well as feedback from industry groups, municipal councils and other relevant stakeholders.

The purpose of Extractive Industry Interest Areas (EIIAs) is to:

- provide a basis for the long term protection of stone resources from sterilisation by inappropriate land uses,
- provide a basis for ensuring the long term availability of stone resources for use by the community at a minimal detriment to the environment,
- assist in considering extractive industry values in long term strategic planning as well as local strategy plans,
- ensure that planning or responsible authorities consult with all relevant agencies about land use proposals which may impact on the reduction of stone resources within these areas, and
- create an awareness that extractive industry is a potential land use in these areas.

The designation of Extractive Industry Interest Areas does not preclude interested parties from applying for a Work Authority outside the defined areas.

Significant sand and stone resources often occur outside Extractive Industry Interest Areas. It should not be argued that quarries be precluded outside EIIAs or that areas not defined by an EIIA contain resources of lesser value or importance. EIIAs are regarded as areas where extractive industry operations are more likely to be established both for reasons of resource availability and limited planning constraints.

The Extractive Industry Interest Areas are presented as a series of maps, together with written descriptions of the local resource. Areas where extractive industries are unlikely to be permitted under current planning provisions are also indicated.

Reference to this report is made in the State Planning Policy Framework (SPPF). Local government, in assessing planning permit applications and in preparing planning scheme amendments within EIIAs, should consider the impact that land use proposals may have on the availability of sand and stone resources. It is recommended that EIIAs be identified as overlay controls in planning schemes.

1 Introduction

1.1 Aim

This report provides information and makes recommendations to assist municipal councils, government agencies and the community in strategic planning for extractive industry and resource protection. The application of this information and the implementation of the recommendations will ensure the future supply of quarry products at a cost that is acceptable to the community. The information is presented as a series of prospective areas and Extractive Industry Interest Areas (EIIAs), located within the Melbourne Supply Area (MSA). EIIA designation will ensure that planners consider the impact of proposed land use on sand and stone resources and extractive industry operations.

1.2 Definition of Extractive Industry Interest Areas

EIIA designation is applied to land which has been identified as being likely to contain sand and stone resources of sufficient quantity and quality to support commercial extractive industry operations and which has limited environmental and/or social constraints to the establishment of such operations.

The purpose of the EIIA is to:

- provide a basis for the long term protection of sand and stone resources from sterilisation by inappropriate land uses,
- provide a basis for ensuring the long term availability of sand and stone resources for use by the community and at minimal detriment to the environment,
- assist in considering extractive industry values in long term strategic planning and local strategic plans (such as Municipal Strategic Statements),
- ensure that planning or responsible authorities consult with all relevant agencies about land use proposals which may impact on the reduction of sand and stone resources within these areas, and
- create an awareness that extractive industry is a possible land use in these areas.

EIIAs **do not**:

- **provide statutory protection for sand and stone resources,**
- **allow extractive industry as-of-right unless specified by planning schemes,**
- **imply that future extractive industry will be confined to these areas, or**
- **preclude the use and development of land for other purposes.**

Sand and stone resources within an EIIA are identified at a regional scale, or, at best, to an ‘inferred’ level. EIIA boundaries are likely to be refined from time to time in response to planning scheme changes, new geological information and changes in social and/or environmental values. EIIAs should not be regarded as totally inclusive of all attainable sand and stone resources.

Industry can apply to establish extractive industry operations outside designated EIIAs. It should not be assumed that areas outside EIIAs contain resources of limited strategic importance.

Extractive industry is a permit-required use in all rural zones. Proposals must be assessed against appropriate planning criteria, on an individual basis.

Planning schemes are subject to change over time, either as a result of municipal strategic reviews, changes to zones and overlays, changes in local planning policy and/or site specific amendments. Therefore, while planning schemes and decisions based on their provisions are currently valid, future changes are likely and may require future review of this report.

2 Industry overview

Extractive industry refers to the various industrial operations associated with the production, processing and distribution of stone resources such as rock, gravel, sand and clay.

The *Extractive Industries Development Act 1995* defines extractive industry in the following manner:

Extractive industry means the extraction or removal of stone from land if the primary purpose of the extraction or removal is the sale or commercial use of the stone or the use of the stone in construction, building, road or manufacturing works and include:

- a) the treatment of stone or the manufacture of bricks, tiles, pottery or cement products on or adjacent to land from which the stone is extracted; and
- b) any place, operation or class of operation declared by the Minister for Energy and Minerals, by notice published in the *Government Gazette*, to be an extractive industry for the purpose of the *Extractive Industries Development Act 1995*.

The Victoria Planning Provisions define extractive industry as:

- Land used for the extraction or removal of stone from land for commercial use, or to use the stone for building, construction, road or manufacturing works. It includes the treatment of stone or the manufacture of bricks, tiles, pottery, or cement products on, or adjacent to, the land from which the stone is extracted.

2.1 Importance of extractive industries

Extractive industry is an economically important activity in Victoria. Products of extractive industry are essential to modern society—everyone is a consumer of these materials through their use in housing, commercial and industrial buildings, roads, railways, ports and bridges. In 2001/2002 sales of hard and soft rock totalled over \$373 million. Arguably, even more important are the benefits provided to the community from these low-cost industry products.

2.2 Extractive industries

In general terms, extractive industry in Victoria is carried out under two Acts of Parliament; the *Planning and Environment Act 1987* and the *Extractive Industries Development Act 1995*. Safety and operational requirements are controlled by the *Extractive Industries Development Regulations 1996*, and the *Extractive Industries Regulations 1989* (Divisions 3 and 4 of Part 4, and Parts 5 and 6). The main approval mechanism for extractive industry is a planning permit issued by the responsible authority, generally local government. In some cases, the Minister for Planning is the responsible authority.

By nature, stone deposits are fixed in location and are generally worked where they occur. Traditionally, extractive industry operations have been subject to conflict between planning, community, environmental and quarrying interests. In many instances, urban areas have been allowed to expand close to operating quarries or over land with potential for further stone resource development. As a result, many sources of quality stone close to potential markets in the Melbourne metropolitan area are no longer available for extraction. This is particularly important in view of the high weighting of transport costs of quarry products in the price paid for these by the consumer. Due to the on-going competition between various land uses, a clear need is emerging to ensure a continuous supply of construction material to the greater Melbourne area into the future.

2.3 Stone in Melbourne

Stone extracted within the Melbourne region can be grouped into four main categories. These are hard rock, sand, clay, and soft rock and gravel.

Hard rock is rock that is durable and strong and is used in building and road construction. Explosives are necessary to break up the raw material prior to further processing. Hard rock extracted in the Melbourne region comprises basalt, hornfels, granite, rhyolite and rhyodacite some. Melbourne is fortunate in having

large deposits of hard rock situated in the area around Werribee, Melton and Whittlesea in the north and west, Healesville and Yea and in the east and around Berwick and Pakenham in the southeast.

Sand is mostly used in the manufacture of concrete and concrete products. Sand falls into two main categories, depending on grain size: coarse sand, which is usually washed and used in concrete production and fine sand used in the preparation of mortar and other specialised products. Sand deposits are found in the Bacchus Marsh, Heatherton, Cranbourne, Bass and Warragul areas.

Clay is used in the manufacture of bricks, pavers and roofing tiles. Clay deposits are not as plentiful as stone or sand deposits and are found in the Bacchus Marsh and Lilydale areas. This is also referred to as clayshale or 'reef' in the brick making industry and overlaps the definition of 'soft rock' below.

Soft rock and gravel are used for low-grade products such as crushed rock sub-base for unsealed roads. This rock is generally excavated without the use of explosives and can be found in all areas of Melbourne.

Other rock types extracted within the MSA include limestone, scoria and slate. Peat is also extracted in limited amounts, but is not considered to be within the scope of this document.

2.4 Current extractive industry production

Extractive industry production figures fluctuate significantly according to economic circumstances with production decreasing during periods of economic recession and decline in the construction industry.

Total Extractive Industry production within the MSA totalled over 35 million tonnes in 2001/2002. This comprised hard rock production of almost 24 million tonnes and sand and gravel production of almost 10 million tonnes.

Production of the various construction materials within the MSA is summarised by rock type in Figure 1.

As of October 2002, there was a total of 180 extractive industry Work Authorities within the MSA. An additional 22 applications are currently under consideration (Table 1). The type of stone extracted from each operation is presented in Tables 3 to 18 and a complete list of Work Authorities is presented in Appendix 2.

Table 1 Active extractive industry operations in the MSA, October 2002

Rock type extracted	Number of operations
Basalt New/ scoria	21
Basalt Old	9
Clay/ clayshale	29
Granite/ rhyodacite	7
Hornfels	4
Limestone	3
Sand/ gravel	91
Sedimentary/ quartzite	6
Soil/ slate/ peat	10
Total	180

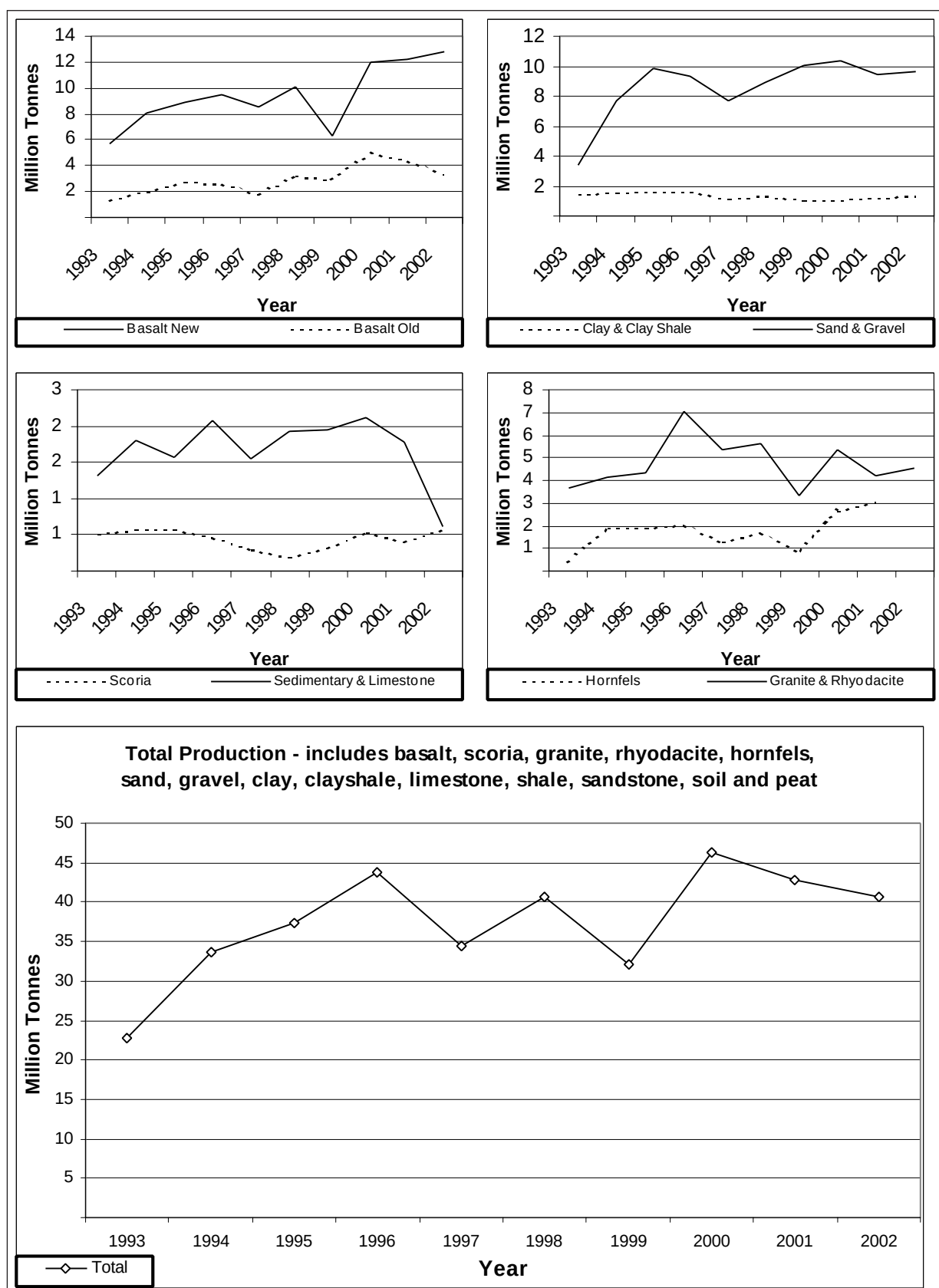


Figure 1 Production statistics for the Melbourne Supply Area, 1993–2002.

2.5 Supply and demand

The supply and demand of hard rock quarry materials in the east of the MSA has been subject to several studies (McHaffie, 1991; Wilson Sayer Core, 1992; Kinhill, 1992; Shire of Pakenham, 1993). Little work has been conducted in the west of the MSA since Buckland & Fielding (1986) and McHaffie (1991). The above has also been summarised in ENRC, 1994, where the usage trends are also discussed in some detail. The studies in the east of the MSA have resulted from the decision by Government at various levels to deal with the expansion of quarries in the area at a strategic level rather than respond to applications for new Work Authorities on an ad hoc basis. This is due to the regional and local implications of establishing medium to large-scale hard rock quarries.

Estimates of extractive industry resources within the MSA have been presented in the past (Olshina & Jiricek, 1996). However, since there is no requirement under the EIDA for operations to provide resource estimates, it is not possible to make meaningful estimates of current resources within the MSA.

3 Methodology

3.1 Study Area

This report is confined to the Melbourne Supply Area (MSA) shown in Figure 2. This area was defined in the draft *Extractive Industries Strategy Plan for Melbourne* (Buckland & Fielding, 1986) and was chosen because it included all major quarries which supplied stone products to Melbourne and its suburbs. Following the restructuring of municipal councils in 1994 and 1995, and the identification of major sand deposits in the Trafalgar area, these boundaries were adjusted, to be more representative and easily defined by natural or man made features (eg. rivers, roads), rather than administrative, features. There were some additional adjustments made to the boundaries of the MSA in the current report. These adjustments were designed to bring the boundaries of the MSA into conformity with the digital corporate databases currently used by DPI and other Government departments. The current MSA is 16 853 km² in area (cf. 16 812 km² for the 1996 version).

3.2 Study approach

2002 modifications to EIIA boundaries

The revision of Olshina and Jiricek, 1996 has become necessary for the following reasons:

- changes in land use and zoning that occurred since 1996,
- changes resulting from the planning reform process,
- additional resource and geological information, and
- readjustment of EIIA boundaries resulting from submissions received by MPD in response to the consultation process undertaken in the preparation of this report.

Land use or zoning changes since 1996

Zoning and land use changes in municipalities since the Olshina and Jiricek (1996) report need to be recognised in the current report. These include changes to the new urban area boundaries around Werribee and Melton. Residential and rural residential development in the Cities of Hume and Casey as well as Mitchell Shire has also been recognised and the necessary adjustments made.

In the Bass region, the modified EIIA boundaries will need to be reflected in the Regional Sand Extraction Strategy, Lang Lang to Grantville. Changes resulting from land use and zoning changes are discussed in detail in Section 7.

Victoria's planning reform process

Following the planning reform process of the mid to late 1990s, a set of principles emerged which underpin the focus and structure of Victoria's planning schemes (DOI 2002). Planning schemes now have a greater policy focus, which aims to express clearly and concisely a strategic vision while allowing more discretion in decision making. The planning reform process also ensures that state-wide provisions apply across Victoria and that site specific provisions are minimised.

The introduction of the Victoria Planning Provisions (VPPs) ensures that a standard set of provisions is applied across the State. Now, all planning schemes include the State Planning Policy Framework (SPPF), a Municipal Strategic Statement (MSS), local planning policies and a strategically allocated selection of zones and overlays (DOI 2002). In preparing this report, MPD has ensured that the greater emphasis on local strategic planning has been adequately addressed.

The study approach used to define EIIs in this report is similar to those used in Buckley *et al.*, 1993 and in Olshina and Jiricek, 1996, and involves the following three major steps:

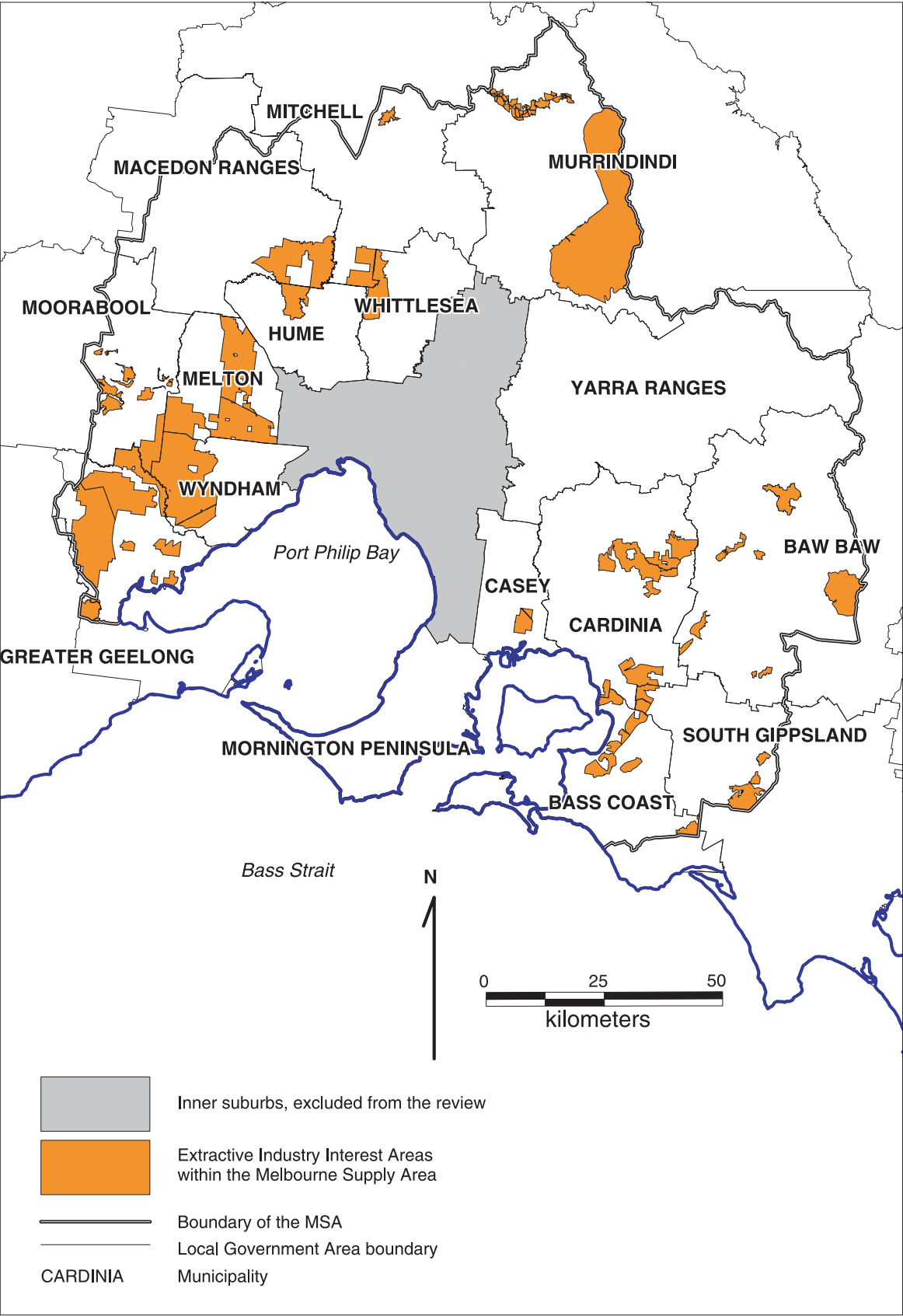


Figure 2 Location map of the Melbourne Supply Area.

1. Interpret each municipality's planning scheme with respect to extractive industry. This step involved discussions with the relevant local councils to identify where extractive industry:
 - either does not require a planning permit or is a permit required use, or
 - areas where extractive industry is a permit required use, but where it is highly unlikely for extractive industry to receive planning permission or is a prohibited use, or
 - is a permit required use in areas of identified environmental or landscape significance and where additional assessment criteria may apply.
2. Analyse the distribution of rock types based on current geological information and MPD drill hole data.
3. View the geology through the "*planning window*" and identify areas where both geology and planning schemes are favourable for extractive industry.

MPD consultation process

The 1996 report was sent to all affected municipalities, relevant statutory authorities, industry and some industry consultants for comments and input. It was also made available to the general public. MPD received over twenty submissions, from municipalities, consultants, industry and industry representatives, community groups and individuals. MPD also met with all affected municipalities in the MSA. Further submissions were received following the exhibition of the draft EIIA maps. The main issues raised during the consultation process relate to:

- strong community opposition to the establishment or expansion of extractive industries on particular sites,
- the removal of sites from EIAs where the merits of extractive industry and other land uses have already been assessed by the planning system,
- areas where industry has identified sand and stone resources,
- concerns with extractive industry occurring in areas of environmental and landscape significance,
- industry concern over the misuse of the report in the planning approvals process;
- the need for greater planning protection for sand and stone resources and extractive industries,
- the identification of areas which have been designated for future urban growth,
- a need to make the interest area maps easier to read, and
- a need to show the interest areas as overlays within planning schemes.
- MPD has evaluated all submissions and made decisions on whether or not to amend individual EIAs. Such changes have been incorporated in this report.

Additional criteria

For the current report the following criteria have also been applied to determine whether areas are included in EIAs:

- EIAs must be of a size that will support more than one extractive industry operation,
- EIAs must be greater than approximately 1 square kilometre in area,
- EIAs as established in the 1996 report, would not be significantly expanded in areas of identified environmental or landscape significance,
- Existing EIAs would be removed from areas where extractive industry is prohibited, and
- Proposed EIAs should not be located in areas of environmental or landscape significance identified by planning schemes.

Areas where extractive industry is prohibited or is highly unlikely to be permitted are shaded grey on the EIIA maps. The 'grey' area represents land that is zoned for residential, mixed-use, business and industrial purposes, where extractive industry is prohibited. Some Special Use and Public Use Zones are also shaded

grey, as is land identified by development plan and public acquisition overlays where appropriate. The public conservation and resource zone and public park and recreation zone have also been shaded grey¹.

Areas of environmental and landscape significance identified by planning schemes are shown in green shading. The 'green' layer identifies land that is covered by the environmental significance, significant landscape and the vegetation protection overlays, where their schedules are appropriate. Extractive industry is **not** prohibited within the green layer (unless the green layer covers grey shaded areas). Additional planning objectives and decision-making criteria may be applied to planning applications in these areas.

¹ It should be noted that extractive industry is a 'permit required' use in the Public Park and Recreation Zone (PPRZ). This zone has been included in the 'grey' layer as it has been applied to some areas of public land where extractive industry is not consistent with the objectives for that land or where extractive industry may be prohibited by other legislation. The maps may show as grey some areas zoned PPRZ where extractive industry could be permitted (subject to land managers consent and planning approval). See 4.4

4 Protection of stone resources

4.1 State Planning Policy Frame Work (SPPF)

The objectives of the SPPF, in relation to extractive industry, is to 'identify and protect stone resources accessible to major markets and to provide consistent planning approvals for extraction, in accordance with acceptable environmental standards.'

In relation to the protection of stone resources, the SPPF includes the following statement:

- *the long term protection of stone resources in Victoria is to be generally in accordance with:*
 - * *provisions and recommendations expressed in Melbourne Supply Area—Extractive Industry Interest Areas, for stone resources in the Melbourne Supply Area, and*
 - * *the concept of the Extractive Industry Interest Areas expressed in Melbourne Supply Area—Extractive Industry Interest Areas, for the remainder of Victoria.*
- *Extractive Industry Interest Areas will be progressively defined across the State by the Department of Natural Resources and Environment, following consultation with local councils, relevant government departments, industry and other appropriate groups, and made available to local councils for consideration in long term strategic planning for their municipalities.*
- *There will be continuing refinement of Extractive Industry Interest Areas resulting from improved geological knowledge, feedback from local councils, industry and other relevant groups.*

It should be noted that EIAs have now been prepared for the Ballarat (Olshina & Jiricek, 1997), Bendigo (Olshina & Jiricek, 1998), Geelong (Olshina & Jiricek, 1999a) and LaTrobe (Olshina & Jiricek, 1999b) supply areas.

Over the last 30 years, the Geological Survey of Victoria (now part of DPI) has carried out significant investigations into sand resources. However, resource protection has been largely the responsibility of individual companies. Only in a few cases have Government agencies been involved in delineating hard rock resources. This approach had led to the present distribution of quarries, which reflects the response of competing companies to their internal requirements and to perceived market demands. In many instances, urban areas have been allowed to expand close to operating quarries or over land with potential for further stone resource development. As a result, many sources of quality stone close to potential markets in the Melbourne metropolitan area are no longer available for extraction. A greater degree of Government involvement in strategic planning has become necessary to ensure that stone resources of importance to the wider community will not be sterilised by decisions reflecting only local interests.

Thus, DPI, together with the planning function of DOI (now included in DSE), were instrumental in developing the SPPF to give effect to the Government's position regarding the protection of stone resources and the development of extractive industry in Victoria.

4.2 Melbourne 2030 – Planning for Sustainable Growth

Most of the MSA is located within the area covered by Melbourne 2030. Melbourne 2030 is a plan for the growth and development of metropolitan Melbourne. The strategy focuses primarily on Melbourne's urban and nearby non-urban areas. It provides a high level overview for the future direction of metropolitan Melbourne, with a clear focus on the management of future growth, land use and infrastructure investment (DOI 2002).

The strategy recognises that sand and stone deposits are important assets for future development. Melbourne 2030 contains the following initiatives, aimed at protecting Melbourne's sand and stone resources:

- Update the mapping of current and potentially productive land resources in the region,
- Identify and safeguard strategic deposits of sand, minerals and stone, to maintain their potential for exploitation, including the provision for buffer areas, and the

- Increased protection for natural resource based industries, industrial land and energy infrastructure against competing and incompatible uses.

The strategy also outlines policies to reduce the proportion of new housing in rural areas, protect 'green wedges' (many of which contain Work Authorities and identified sand and stone deposits) from urban uses and maintain the long term sustainable use and management of existing natural resource attributes.

Tools to implement Melbourne 2030 include the application of an 'Urban Growth Boundary' (UGB) which indicates long-term limits on urban growth. The UGB follows the existing boundary defined by urban zones and growth strategies and has already been incorporated into planning schemes (DOI 2002). The UGB will become permanent once it is finalised by the Minister for Planning.

To protect rural land outside the UGB a 'green wedge' zone is proposed. A purpose of the green wedge zone (as outlined in its draft ordinance) is:

- *To recognise, protect and conserve land that is adjacent to urban areas for its agricultural, environmental, historic, landscape or recreational values or **mineral and stone resources**.*

DPI will continue to work closely with local government and DSE in the implementation of Melbourne 2030.

4.3 Developments to date

Extractive Industries Strategy Plan Interdepartmental Committee (1985)

In 1985, the Minister for Industry, Technology and Resources and the Minister for Planning and Environment established an *Extractive Industries Strategy Plan Interdepartmental Committee* (EISPIC) to prepare a strategy plan for the development of hard rock quarrying over the next 25 years in the MSA. The draft EISPIC report (Buckland & Fielding, 1986) proposed a sequential strategy plan of resource identification followed by planning measures to protect the identified resources. While the recommendations of this committee were not implemented, this draft report has been used as the basis for further investigations into the resource protection and development of extractive industries in the MSA.

Planning Guide for Extractive Industry (1991)

The *Planning Guide for Extractive Industry*, 1991, was produced jointly by the Department of Manufacturing and Industry Development (now DPI) and the Department of Planning and Development (now DSE), and reflects concerns of both Departments that:

- resources should be protected and used wisely for the benefit of all,
- extractive industry should, like any other land use, be subject to the planning process, yet with special attention to future needs due to the finite and fixed nature of the raw material, and
- conflicts between extractive industry and adjacent land uses should be minimised by sensitive site planning and management together with conscientious adherence to good operating practices.

The concept of EIAs developed in Buckley *et al.*, 1993 did not vary significantly to those defined in the above document.

Parliamentary Committees' inquiries into planning issues for extractive industry (1992/1994)

In 1992, the Natural Resources and Environment Committee (NREC), an all-party committee of the Victorian Parliament, conducted an inquiry regarding planning issues that affect extractive industry.

The ENRC report is a comprehensive and detailed document that addresses complex and difficult issues associated with extractive industries. The Committee's recommendations and the Government response to each of these recommendations are included in Appendix 2.

In general terms, the Government strongly endorsed the concept that protection of stone resources should be part of a strategic framework and that the industry should be given certainty concerning its operations, while at the same time recognising the need to protect other natural resources and the environment. The

Government also accepted proposals for a new legislative framework that would utilise planning permits as the primary mechanism for regulating extractive industry. In relation to the separation of extractive industries and other incompatible land uses, the Government accepted that the necessary buffers should be based on the ability of the industry to comply with practical performance standards. The extractive industry operator will then either own, or control, the necessary buffers.

The issue of buffers is now addressed through clause 17.09-2 of the SPPF which states that provision for buffer areas between new extractive industries and sensitive land uses should be determined on the following principles:

- Clearly defined buffer areas appropriate to the nature of the proposed extractive uses, which are to be owned or controlled by the proponent of an extractive industry, are specified in an application for permit.
- Performance standards for the buffer area are set in accordance with requirements of the Extractive Industries Development Regulations 1996 or a work authority or a permit and have regard to the zoning of the land surrounding the extractive industry.
- Activities within land zoned for public use may be taken into consideration in determining the buffer areas.

Provision for buffer areas between existing extractive industries and sensitive land uses should be determined on the following principles:

- The buffer areas are determined so that appropriate limits on effects can be met at the sensitive locations using practical and readily available technology.
- The required buffers are taken into consideration if a change of land use in the vicinity of the extractive industry is proposed.
- Land within the buffer areas may be used for purposes that are not adversely affected by the extractive industry.

DPI is currently preparing guidelines to assist industry, local government and the community in determining appropriate buffers based on performance standards.

Extractive Industry Interest Areas Report (2003) and the planning system

It is envisaged that the maps associated with this report will be incorporated into the planning schemes of all relevant municipalities within the MSA. To meet the objectives of the SPPF, planning authorities, when preparing planning scheme amendments within the designated EIAs should consider the impacts any land use proposal or zoning changes may have on the continuing availability of stone resources and consult with the Department administering the *Extractive Industries Development Act 1995* on these matters.

Clause 52.09-3 of the Victoria Planning Provisions states the following in relation to EIAs:

Notice of the kinds of application listed below must be given to the Secretary of the Department administering the *Extractive Industries Development Act 1995* in accordance with Section 52(1)(c) of the Act:

- An application which, if a permit is granted, would allow residential land use, rural residential land use or a land use with a substantial residential or rural residential component within an extractive industry interest area.
- An application which, in the opinion of the responsible authority, may materially affect an extractive industry site approved under the *Extractive Industries Act 1966* or an extractive industry site in respect of which an application was made under the *Extractive Industries Act 1966*.

The above provisions will ensure that proposed land uses which may reduce the availability of stone resources are considered in accordance with Government policies and that any decision is made in the interest of the whole community.

Recently, DSE agreed, in principle, to create planning scheme overlays for each EIA in the MSA and to increase protection for existing extractive industry operations. This decision should greatly increase the effectiveness of EIAs.

4.4 Planning controls

Planning and Environment Act 1987

The Planning and Environment Act 1987 provides the legal basis for the use and development of land in Victoria. The Act sets out planning objectives and aims to:

- provide for the fair, orderly, economic and sustainable use and development of land,
- provide for the protection of natural and man-made resources and the maintenance of ecological processes and genetic diversity,
- secure a pleasant, efficient and safe working, living and recreational environment for all Victorians and visitors to Victoria,
- conserve and enhance those buildings, areas or other places which are of scientific, aesthetic, architectural or historical interest, or otherwise of special cultural value,
- protect public utilities and other assets and enable the orderly provision and coordination of public utilities and other facilities for the benefit of the community,
- facilitate development in accordance with the objectives set out above, and
- balance the present and future interests of all Victorians.

The Act provides for a planning scheme for each municipality. A planning scheme sets out policies and requirements for the use, development and protection of land. The planning scheme divides the planning area into zones. It sets out for each zone those forms of land use and development of land that may be carried out:

- without any specific approval, with or without conditions (**as of right**),
- those for which a planning permit is required (**consent**) and
- those which may not be carried out at all unless the planning scheme is amended (**prohibited**).

The scheme may also set out areas of special controls, for example land subject to flooding, land that is to be acquired for public purposes or land with specific environmental or landscape values.

The Act also sets out procedures for amending planning schemes, obtaining planning permits, settling disputes and enforcement of planning scheme provisions.

Planning Schemes

Each planning scheme includes:

- the State Planning Policy Framework (SPPF), which is uniform across Victoria and comprises general principles of land use and development and specific policies dealing with settlement, environment, housing, economic development, infrastructure and particular uses and development (DOI, 2001). Planning and responsible authorities must give effect to the general principles and specific policies contained in the SPPF (DOI 2001),
- a Local Planning Policy Framework (LPPF) which comprises the Municipal Strategic Statement (MSS) and Local Planning Policies (LPP),
- MSS is a statement of key strategic planning and land use and development objectives for the municipality. The SPPF and MSS provide the strategic basis for the application of zones and overlays in the planning scheme and for decision making by the responsible authority (DOI 2001)
- LPPs are one of the tools available for the implementation of objectives and strategies contained in the MSS. LPPs provide guidance to decision making on a day-to-day basis where this is not achievable in the VPP zones and overlays.

Zones and overlays are administered to implement the SPPF and LPPF. Zones and Overlays are now standardised for Statewide application and cannot be changed, unless a Statewide amendment is carried out to the VPPs. Schedules apply to some zones and overlays that allow for local circumstances to be addressed.

Schemes use zones to implement strategies and overlays generally apply to single issues (such as heritage) or areas of environmental significance.

More than one overlay can apply to the same parcel of land, but they do not change the intent of the underlying zone. For example a rural zone may allow extractive industry subject to a planning permit and the overlay controls could add another layer of requirements and assessment criteria that need to be addressed prior to any new quarry operation being established.

Amending a planning scheme

As extractive industry is a permit required use in rural zones there should be little need to amend planning schemes in rural areas. However, depending on the long-term use of the land, the need may arise to introduce an alternative zone. In urban areas, if the land is an industrial area and industrial uses are the long-term use of the land, the Industrial 1 Zone or the Industrial 2 Zone designation can be applied. Extractive Industry is a discretionary use in these zones. In a residential area the Special Use Zone may be appropriate.

It should be noted that new format planning schemes do not have site-specific provisions and that permits are the mechanism for regulating extractive industry in planning schemes. If extractive industry is prohibited in a zone the *Planning and Environment Act 1987* now enables the planning authority to simultaneously prepare an amendment to the scheme and give notice of a planning permit application.

Section 19(1)(c) of the *Planning and Environment Act 1987* and its Regulations, require a planning authority to give notice of the preparation of all amendments to the Minister administering the *Mineral Resources Development Act 1990*. A Section 19 notice ensures that prescribed Ministers can input into the amendment process. In the case of the Minister for Resources, MPD will ensure that the extraction of sand and stone will not be detrimentally impacted upon by amendments to planning schemes.

Further details about planning schemes and amendments may be found in the guidelines prepared by the Department of Infrastructure 2001 (*Using Victoria's Planning System*).

Extractive Industry operations on Crown Land

EIIAs also include large areas of public land that are being managed by various Government authorities or statutory agencies. The Department of Sustainability and Environment (DSE) is responsible for the majority of crown land in the MSA, while various water authorities, including Melbourne Water, are responsible for the management of the water catchments. As a rule, extractive industry is not permitted in National and State Parks and Reference Areas. While extractive industry is not prohibited in some Regional Parks or nature reserves, consent from DSE (as land manager) is required either for the establishment of any new quarry operation or to substantially modify an existing operation. Past experience shows that extractive industry in these areas will only be allowed if it does not conflict with values for which the park or reserve were primarily created.

5 Previous Work

Geological maps of the study area include a 1:250 000 series (VandenBerg, 1977a, 1977b, 1977c; 1977d), a 1:63 360 series (Jenkin *et al.*, 1967, Keble *et al.*, 1967, Edwards *et al.*, 1967, Garratt 1977 & 1981 & VandenBerg 1970, 1973 & 1974) and a 1:50 000 series (Bolger, 1980a & b & Roberts 1985 & 1986). From 1969 to 1977 the Geological Survey of Victoria carried out diamond drilling to investigate the resource potential of the basalt plains north and west of Melbourne (*Metropolitan Basalt Survey*, Stewart 1975, 1977 a,b,c). Some 110 holes were drilled through the basalt to the substrate. All cores were logged and a large number of thin sections cut. Analysis of the results concentrated on the identification of individual lava flows and an attempt to correlate flows between bores. The project gave good information on the pre-basaltic surface and stream courses, indicating the trends of thickest basalt.

Areas of basalt in the north and west of the Melbourne Supply Area that warranted further evaluation as potential sources of extractive material were identified in a desk study by Buckland (1985). Twenty-seven areas with “low”, “medium” or “high” potential were identified.

Wylde (1975) undertook a detailed petrological study of the Newer Volcanics basalts of an area west of the Maribyrnong River and between Sunbury and the Western Highway, using cores from the Geological Survey’s *Metropolitan Basalt Study*. Thirty-nine flows were identified, mainly on petrography. The alteration mineralogy of the basalt was described.

Vic Roads investigations for pavement materials in the then Kilmore, Healesville, Whittlesea and Seymour Shires were referred to in this study.

Detailed investigations on hard rock resources in the eastern part of the MSA has been limited to site specific work conducted by individual companies at existing quarries or in areas where an extractive industry licence has been applied for.

Detailed drilling investigations in areas of sand potential have been conducted over the years by the Geological Survey of Victoria. The Springvale–Oakleigh–Clayton area has been subject to several periods of drilling, including Barnes *et al.* (1972) where 168 boreholes defined an additional 20 million tonnes of sand resource. Barnes *et al.* (1972) also describes results of 121 boreholes drilled in sand resource areas in the Cranbourne–Langwarrin areas that delineated 32 million tonnes of sand. McHaffie (1978) reported on 165 bore holes in the Lang Lang area, delineating 190 million tonnes of indicated and inferred sand resources in four resource blocks. Inan (1987) conducted regular grid spaced drilling of bore holes in the Grantville–Gurdies area. A sand resource of 140 million tonnes was indicated in 10 resource blocks covering an area of 800 ha. Finlay (1992) conducted a resistivity geophysical survey over the potential Tertiary sand resource area north of Yarragon and Trafalgar. Drilling at this site has identified a geological resource of 500 million tonnes of sand over an area of 31 km² (Buckley & Faul, 1994). A drilling program by the GSV in Tertiary sediments north of Darnum failed to identify significant construction sand resources (Buckley & Rooney, 1999).

The 1996 review (Olshina & Jiricek, 1996) incorporated adjustments to EIIA boundaries resulting from submissions received in response to the consultation process, major changes in planning regulations and zoning as well as changes to the boundaries of the MSA.

6 Geology

The distribution of rock types within the MSA is presented in Figures 3 to 33. These maps are derived from the 1:250 000 scale geological maps of the Melbourne, Warburton, Warragul and Queenscliff map areas. The map legend (Figure 35, foldout page at the end of the report) has been simplified but the geological details on the maps have been retained to show the geological fabric of the area. More detailed information is available from the 1:250 000 published Geological Survey of Victoria geological maps (VandenBerg, 1977a, 1977b, 1977c; 1977d), from Douglas & Ferguson, 1988 and from other geological maps of various scales and vintages covering the MSA.

The basement rocks in the study area consist predominantly of thin-bedded Ordovician–Silurian–Devonian siltstone, mudstone, shale and minor sandstone and limestone. These sediments have been folded and faulted and subsequently intruded during the Devonian by granitic plutons and associated dykes, which metamorphosed the adjacent country rocks to hornfels. Associated with these intrusions were extensive outpourings of acid (siliceous) volcanics of the Mt Dandenong, Marysville, Macedon and Tolmie igneous complexes. Basement rocks in the South Gippsland region consist of thickly bedded felspathic sandstone of the Lower Cretaceous Strzelecki Group.

These Palaeozoic and Mesozoic rocks are unconformably overlain in some areas by basalt, tuff and associated sediments of the Older Volcanics. Subsequent tectonic movement formed the Port Phillip and Western Port Basins, which have been progressively in-filled by poorly consolidated Tertiary and Quaternary gravel, sand and clay. Extensive volcanism in the Pliocene to Recent has formed the Newer Volcanic basalt plains west and north of Melbourne.

The source rocks that are currently used to provide construction materials in the eastern region of the MSA include basalt, acid volcanics, hornfels, granitic rocks, scoria, sedimentary rocks of varying degrees of hardness and silicification, sand/gravel and clay. A complete list of extractive industry licences and proposed operations within the MSA, as at October 2002, is presented in Appendix 2.

6.1 Basalt

Cainozoic basaltic rocks in Victoria belong to two rock units: the Older Volcanics of Paleocene to early Miocene age (65 to 15 million years old) and the Newer Volcanics of Pliocene to Recent age (younger than 5 million years). The Older Volcanics outcrop mainly in the eastern half of the MSA, but are present in some localities in the west. Newer Volcanics outcrop extensively in the north and west, but are absent in the east.

The Older Volcanics basalts are typically hard, dense, glassy, usually non-vesicular and with pronounced columnar jointing. Specific gravity is 2.8 to 3.1. The basalts have undergone a period of deep weathering resulting in a generally sharp transition between decomposed rocks and clay and the underlying fresh rock. This allows for easy separation of overburden in quarrying.

In many areas, thick sequences of interbasaltic tuffs and volcanogenic sediments occur. So all areas mapped as Older Volcanics do not necessarily contain fresh, hard basalt. Agriculturally productive soils often form over Older Volcanics rocks.

The Older Volcanics have a scattered distribution, outcropping as remnant hilltop cappings or as larger extensive sheets and palaeovalley fill. Small pockets occur at Berwick, Cranbourne, Gembrook, Hoddles Creek and Emerald, while larger sheets occur at Silvan, Flinders–Red Hill, Phillip Island, Neerim North/Jindivick and Drouin/Warragul. Alternative land uses such as residential, intensive agriculture (flower growing and market gardens), tourism and landscape values preclude the establishment of new quarry operations over much of the Older Volcanics areas. Rural agricultural areas such as Neerim North and around Drouin/Warragul are more amenable to extractive industry. In the west of the MSA, Older Volcanics outcrop is limited to some of the deeper valleys northwest of the city and as ancient valley flow remnants now preserved as hilltop cappings at Myrniong, Kilmore East and Broadford, and to the northeast from Bundoora to Kangaroo Ground.

Basalt, possibly of Older Volcanics age, is quarried from a pit on Bulla Road (Consolidated Quarries Ltd WA378) which is situated below the level of the basalt plain on a terrace of Emu Creek. The characteristics of the basalt extracted from the lower quarry levels are closer in character to those of the Older Volcanics than the Newer Volcanics.

The Newer Volcanics basalt covers some 2,000 km² of the MSA. A line of hills along Mickleham Road and Deep Creek creates a major bedrock divide. The Newer Volcanics form gently undulating plains on which there are volcanic cones with surrounding aprons forming relatively elevated hills above the plains. Mount Cotterill and Mount Atkinson are considered the major sources for much of the basalt in the Werribee Plains. The Rocky Range near Romsey produced lava streams that flowed south as far as Bulla. At the eastern edge of the Newer Volcanics, Hayes Hill and Mount Fraser were major sources of lava.

Newer Volcanics basalts are generally grey or blue-grey in colour when unweathered, porous, commonly vesicular, and generally display coarse columnar jointing. Specific gravity is generally 2.7 to 2.9.

Mineralogically, the plains basalts are dominantly tholeiitic whereas the basalt found at the eruption centres tends to be moderately to strongly alkalic.

The Newer Volcanics basalt is prone to mineralogical alteration, commonly referred to as green discolouration. This occurs where some minerals have been altered in reducing conditions below the relict water table, to green montmorillonitic clays (also known as smectite). The basalt also tends to be subject to deuteritic alteration as well as alteration under oxidising conditions. *Green basalt* can be dense and hard and appears to be fresh, but breaks down rapidly due to the swelling of the montmorillonite clays when exposed to moisture. Other types of mineral alteration also occur, as listed in Table 2. The degree of alteration is measured by counting the proportion of secondary minerals in thin section.

There is very little information available on secondary mineral alteration in the borehole logs, however a large number of thin section slides were available from the *Metropolitan Basalt Survey*. These were examined and the secondary mineral content was qualitatively assessed. The results showed a generally low degree of alteration in the top 20 to 25 m of basalt, a high proportion of alteration minerals between 25 and 40 m, and then low alteration below that. Occasionally, low secondary mineral content appeared to extend from the surface to about 50 m depth.

Table 2 Secondary minerals in Newer Volcanics basalt

Main secondary minerals	Replaced minerals	Comments
Iddingsite	Olivine	forms a rim around or may replace olivine in part or in full formed by deuteritic alteration and/or weathering under oxidising conditions
Clay minerals mainly smectite (montmorillonite); green	Olivine and volcanic glass & filling vesicles	formed under reducing conditions and found in the lower flows below groundwater table (GWT)
Carbonate and silica minerals calcite, dolomite, siderite, ankerite, magnesite, chalcedony, zeolite	filling vesicles, lining cavities	may be found above and below GWT

Individual flows can be identified within the basalt by differences in vesicularity and composition, and preserved soil profiles. In the west of the MSA, between 2 and 39 flows were identified from borehole data, ranging from a few metres to 30 m thick. At the surface, the youngest flows are often preserved topographically as tongues and ridges. Where these have been identified they are marked on the smaller scale geological maps referred to above. These ridges are often referred to as *stony rises* and usually contain fresher, less altered basalt.

Even in the stony rises there can be localised pockets of altered and weathered basalt, formed where water was ponded in depressions in the original lava surface as it was cooling. These pockets can often be located by surface conductivity surveys and colour aerial photography.

Plotting of the bore database information indicates the basalt is up to about 80 m thick between the Hume Highway and Epping Road, where an approximately north–south trending valley was in-filled. Another deeply in-filled valley lies between the Lancefield Road and Deep Creek, close to the course of Emu Creek,

where it is up to 130 m thick. In the thickest basalt follows a north–south trend from Diggers Rest to Werribee, reaching a thickness of around 140 m.

Borehole logs give some indication of the quality of the basalt in terms of weathered, unconsolidated and consolidated material. Borehole data is available from the DPI database, as are the results of research carried out since the 1996 report.

Areas of thick overburden, as calculated from the bore records, occur in the restricted valley flows north of Wallan (up to 80 m deep) and in the Romsey area west of Brock Hill (up to 50 m deep). These areas were excluded from possible EIAs.

In the Newer Volcanics, quarrying over the past 20 years has tended to concentrate on the stony rises, where generally there has been less secondary mineral alteration.

In the west of the MSA, the CSR quarry at Werribee (WA184) is situated on a low stony ridge of high quality basalt, overlying a more altered lower flow. There are a number of Newer Volcanics basalt quarries at Epping and Wollert, including WA381 and WA393 (Pioneer Construction Materials P/L) and WA117 (Nubrik P/L), east of the Hume Highway, in an area of stony rises formed from late stage flows from Mount Fraser and Hayes Hill. McHaffie Sculpting executes works on commission using fine-grained, unweathered Older Volcanics basalt.

The quality of basalt can vary greatly over short distances horizontally and vertically. An area of good quality basalt can only really be established by a closely spaced investigation using a number of techniques. The EIAs in basalt, proposed in this report, are necessarily based on fairly generalised regional patterns.

6.2 Granitic rocks

Granitic rocks include granite and granodiorite and outcrop in a large mountainous belt east of Dandenong and north of the Princes Highway. Small intrusions are present on the Mornington Peninsula at Mount Eliza, Mount Martha, Arthurs Seat as well as Cape Woolamai. Granitic rocks form the You Yangs, Mount Disappointment, Cobaw and Strathbogie Ranges, Gellibrand Hill (Bulla), Black Range and other areas near Healesville. Granitic rocks are pink to light grey and dark grey in colour. Whilst granitic rocks can be worked to a great depth, the properties of the fresh rock can vary widely with rock composition and texture. However, the finer to medium grained granites provide hard, durable rock for most uses. Specific gravity is 2.6 to 2.7. Depth and degree of weathering are also variable, depending on such factors as joint patterns and topographic aspect. Granitic rocks represent a huge potential resource but due to conflicting land use, the window of opportunity for quarrying is very limited.

Major, multi-level granitic quarries occur in the Eastern Region at Lysterfield (Pioneer, WA385), Tynong North (Astec Quarries P/L, WA25), Garfield North (CSR Ltd, WA182) and Arthurs Seat, Dromana (Hillview Quarries P/L, WA267 and WA380). The CSR quarry at Oaklands Junction, near Bulla (WA176), is the only granite quarry in the remainder of the MSA. It is strategically placed in the Gellibrand Hill granite with good access to the Hume Highway. Much of the Mount Disappointment granite is covered by planning constraints. A Vic Roads investigation failed to find an area that was not deeply weathered, outside the water catchment area.

6.3 Hornfels

Hornfels is formed by the thermal alteration of sedimentary rocks in the metamorphic aureole surrounding granitic rocks. In the unweathered state, hornfels is a hard, grey, fine grained rock. Variations in rock quality may occur as interbedded sediments of different type react differently to metamorphism and subsequent weathering. The quartz rich varieties of hornfels derived from sandstones tend to be more resistant to weathering than the cordierite hornfels derived from clay rich sediments. Variations in quality may also occur due to hydrothermal alteration generated by the nearby intrusive rocks.

In the east of the MSA, the distribution of hornfels is restricted to a belt around granitic intrusions that is best developed in the Lysterfield, Harkaway, Upper Beaconsfield, Cockatoo, Gembrook, Warburton, Upper Yarra and Noojee areas. Apart from Noojee, current planning schemes in these areas restrict the establishment of new quarries. In the north of the MSA, hornfels occurs around the granitic intrusions at

Bulla, Quarry Hill (Mernda), Mount Disappointment, the Cobaw granodiorite, Strathbogie Range, and a large area around the Black Range north of Healesville.

The hornfels quarries in the east include the large Boral quarry at Lysterfield (WA99) and the Pioneer Lysterfield granite/hornfels operation (WA385, see previous section). In the west, hornfels as well as granite is quarried from the CSR Oaklands Junction quarry (WA176) and hornfels at Quarry Hill, Mernda (WA102, Boral). In both these quarries the metamorphosed sedimentary rocks are the more siliceous members of the Palaeozoic formations. There is also a large area of hornfels aureole around the Black Range granite. This hornfels is quarried near Castella (Phillips, WA522).

6.4 Acid volcanics

The acid volcanic rocks are fine to medium grained siliceous rocks which include rhyolite, rhyodacite and dacite. The thick volcanic layers offer the potential for development of relatively deep quarries. The unweathered acid volcanic rocks are generally tough and compact, although depth of weathering is highly variable depending on rock type and degree of fracturing. Specific Gravity is 2.6 to 2.7.

Acid volcanics are limited in distribution within the MSA to the Dandenong Ranges, Mount Macedon and the Acheron Cauldron, in the Lake Mountain–Rubicon area. Planning guidelines restrict the establishment of new quarry operations in the Dandenong Ranges, although an area near Kallista (Yarra Ranges Shire), lying within the Kalorama Rhyodacite, is indicated as an EIIA.

Acid volcanic quarries are relatively large, with Boral operations at Coldstream (WA96) and Montrose (WA100).

6.5 Scoria

Scoria is formed when volcanoes explosively eject sprays of liquid or fragments of solid material (pyroclastics) which build up in a cone around the vent.

There are a number of scoria cones associated with the Newer Volcanics in MSA, notable ones including Mount Fraser at Beveridge, Bald Hill at Kalkallo, and Mount Aitken, She Oak Hill and Mount Kororoit west of the Calder Highway.

Scoria consists of fragments of highly vesicular basalt, generally in the 4 to 32 mm size range. It is easily excavated by ripping because of its friable nature. The bulk density of scoria ranges from 0.75 tonnes per cubic metre to around 1.3 tonnes per cubic metre. The primary use for scoria is as a low grade road material used for road sub-base, shoulders and standing areas. In addition, scoria aggregate has a number of specialised uses including skid resistant surfacing on major roads, ornamental and horticultural uses.

There are approximately 25 scoria cones in the MSA. Scoria is quarried from the Mount Anakie area near Geelong (Aerolite Quarries, WA225 and WA9), She Oak Hill west of Digger's Rest (Excel Quarries P/L WA343) and at Rockbank (Quarries P/L WA346, Stella Farm P/L WA440).

Scoria deposits are highly localised, being restricted to the volcanic cones and immediate surrounds. A number of the proposed EIIs over basalt also include scoria deposits. The ability to site a pit out of view of the neighbouring countryside is an important factor in considering utilising scoria resources. As Guerin (1992) provides a review of scoria and tuff resources and extraction in Victoria, these resources are not considered further here.

6.6 Sedimentary rocks

The consolidated sediments of Palaeozoic age and, to a lesser extent, Lower Cretaceous age, represent generally rippable, and hence cheap, sources of relatively low quality road making material. In general they do not have the mechanical strength of the igneous and metamorphic rocks, and therefore have a more limited use. The harder, more massive sandstones and siltstones are of prime interest as sources of aggregate for the sub-base course of road pavements. They are commonly used by councils for local rural roads. Unlike the Palaeozoic rocks, the Lower Cretaceous sandstones have a higher feldspar content and a chloritic cement,

reducing the mechanical strength of the material. Care must be taken in the selection of source rock to ensure the material is suitable for the required purpose.

Palaeozoic sediments outcrop over much of the MSA, with most of the central sector sterilised from quarrying by residential development. Potential resource areas include Kinglake, Whittlesea, Wallan–Wandong, Gruyere–Healesville, Wonga Park–Croydon–Bayswater, Drouin–Jindivick West and Langwarrin. Thick sandstone beds within the generally argillaceous (sandy) Silurian–Devonian sequence were outlined in Olshina and Jiricek, 1996. These sandstone units are a cheap, rippable material suitable for use as road sub-base. As such, they have potential value as a stone resource, but not sufficient to support a medium–large scale operation that would suggest the declaration of an EIIA on the basis of the sandstone resource only. Where sandstone occurs in conjunction with other potential hard rock resources, EIIs have been declared, eg. the Castella EIIA. The southeast of the MSA consists largely of Mesozoic sandstone with cleared agricultural land over hilly countryside.

Several quarries extract siliceous Palaeozoic mudstone, sandstone and quartzite. They are relatively small operations, producing less than 10% of the crushed rock products that the larger granite/acid volcanic/basalt quarries produce. The main current operations include the Graham quarry at Langwarrin (WA241), Rockleigh Engineering P/L quarry, Balnarring (WA159), Hornsfield Resources, Launching Place (WA375), Woodyhill Extractive Industries P/L, south of Beveridge (WA492) and the Nubrik P/L quarries at Craigieburn (WA110, WA117). Macedon Ranges Shire, Romsey, (WA416) and Newnham (WA361) extract Cambrian cherts and siliceous shales for local use.

6.7 Sand and gravel

In the west of the MSA, the bulk of the sand is extracted from the Tertiary Werribee Formation at Bacchus Marsh and Quaternary colluvium/alluvium deposits at the You Yangs. These areas have been included in EIIs even in cases where the size of the outcrop is small, due to their strategic location in an area with relatively sand resource sites.

Good quality Tertiary sand and gravel occurs to the north of Bacchus Marsh. The sand deposit is over 30m thick and consists predominantly of medium to coarse sand and fine gravel with rare clay lenses (Roberts, 1984). The deposit is currently being worked by Barro Properties P/L (WA93 and WA35), Boral Resources (WA92), Excel Quarries (WA342), Burgin (WA273), Pioneer Construction Materials P/L (WA377). A minor gravel deposit located near Bullengarook is worked by Newnham (WA360).

Fine-grained, near-pure silica sand and silt occurs as interbeds in the Werribee Formation in the Bacchus Marsh area. This deposit was formerly worked by Silverstein (old LIC 1508) west of Anthony's Cutting where a 12 m thick sand occurs. This site is currently undergoing rehabilitation after cessation of operations. There are similar sand bodies within a few kilometres of this site.

Quaternary sand overlying decomposed and friable granite occurs at the You Yangs, near Anakie and along Sutherland Creek. The sand is poorly sorted and consists of angular quartz and feldspar (Bolger, 1977). The coarse fraction has a high percentage of K-feldspar, but the finer fractions contain little feldspar and make good concrete sand. At the You Yangs, sand is extracted by Transwest Haulage (WA453), Davegale P/L (WA437 and WA188) and Excel Quarries P/L (WA347).

In the eastern part of the MSA, sand is extracted from extensive Quaternary aeolian sand dune sheets and alluvium as well as from Tertiary fluvial sources that contain interbedded gravels. The fluvial sands were generally deposited in braided stream environments where sediment eroded from the uplifted ranges was deposited on plains within the Port Phillip and Western Port basins. The sand dune sheets were formed by the prevailing southwest winds and were deposited on the windward side of basement highs and fault scarps. Sand thickness reaches a maximum of 30 m at the crests of the major dunes, but is generally less than 15 m. These high ridges grade laterally into thin sand sheets. The sand dune sheets tend to be finer grained and more uniform in grain size than the fluvial sediments, with variable clay content throughout. Details of size grading at various locations are presented in Brown (1992) and Inan (1992).

Tertiary/Quaternary sand and gravel extends over Melbourne's suburbs south of Oakleigh Dandenong, and much of the area south of the Princes Highway between Dandenong and the Bunyip River. Large sand sheets also occur north of Trafalgar and from Leongatha South to Inverloch. Much of the area close to Melbourne has been sterilised from additional extractive industry by the encroachment of housing developments over

prospective resources. The sand resources further away from Melbourne are generally in rural areas of large lot size.

In the past (Olshina & Jiricek, 1996), attention has been drawn to potential resources of coarse sand available in offshore waters along the east coast of Port Phillip Bay and along the Western Entrance Channel of Western Port. However, in the current planning environment it is unlikely that such material will be available for exploitation in most cases (Z. Toogood, Department of Sustainability and Environment, *pers. comm.*).

There are numerous small sand and gravel pits that are worked intermittently, but the largest operations with significant resources include Moorabbin (Grosvenor Lodge P/L WA166, Pioneer WA383), Cranbourne (CSR Ltd WA170), Lang Lang (Unimin Australia Ltd, WA2) and Langwarrin (Amatek Ltd WA13).

6.8 Clay

Most of the structural clay extracted in the MSA and used in brick, paver and roofing tile manufacture is derived from the deep weathering profiles of Palaeozoic sedimentary rocks. During the late Cretaceous / early Tertiary and mid Tertiary periods, weathering profiles were developed to considerable depths (commonly up to 30 m around Melbourne) under hot, humid conditions (McHaffie, 1992).

A generalised, full profile displays the following zones from top to bottom:

- ferruginous zone
- mottled zone
- pallid (white, kaolinitised) zone
- brown oxidised bedrock (reef) zone

The partial or complete removal of these zones by erosion, and the cumulative effect of weathering at different times, has produced a complex distribution of clay types. Clays from the *deep brown weathering zone* constitute most of the brick clay mixes in Victoria. They are essentially kaolinitic, and impart low drying shrinkage (due to the low content of fine particles) and high fired strength to the bodies. A *pallid zone* was particularly well developed in the early Tertiary period and remnants of it exist in some of the eastern and northern suburbs of Melbourne. Extraction of white firing clays from this zone is now restricted to sites at Campbellfield and Craigieburn, north of the city. Pallid zone material preserved over the Lysterfield Granite at Hallam has been used as a source of fireclay and for cream and pink brick and roofing tile manufacture (McHaffie, 1992). The pallid zones of the mid-Tertiary weathering period were thinner than the earlier ones, but the upper ferruginous and mottled zones were well developed. In passing upwards into the *mottled zone*, kaolinitic clays give way to finer and more plastic kaolinitic / illitic clays. This zone is of particular value in the manufacture of extruded bricks (eg at Scoresby), and roofing tiles (eg. near Lilydale).

Useful deposits of alluvial clay were formed at various times in the Cainozoic Era. Many of the early Cainozoic clays were formed by erosion of material from the older pallid zones, with re-deposition in stream, lake and basin environments. They are therefore enriched in kaolinite and are commonly white burning and refractory. An example of a relatively small fluvial deposit may be found at Campbellfield. More extensive, white clay beds are exposed along the valley of the Parwan Creek near Rowsley. These “semi-ball” clays are predominantly siliceous, with up to 40% kaolinite and 15% coarse mica, but there are lenses of kaolin with higher grade and plasticity (Olshina & Hiew, 1995).

The late Cainozoic alluvial clays generally contain a higher proportion of illitic and mixed-layer clay minerals than the earlier ones. Montmorillonite is present where drainage was poor. Their iron content makes most of them red-burning. However, such deposits are widespread, and often sufficiently plastic to make them useful in mixes for structural products.

The clay brick and paver industry in Victoria is dominated by two companies, Nubrik P/L, and Boral Bricks (Vic) P/L with the former also producing roofing tiles. The most important brick making centres are at Campbellfield (Nubrik P/L WA109; Boral WA68) and Craigieburn (Nubrik WA110 and WA117) to the north, and Scoresby (Boral Bricks (Vic) P/L WA67) to the southeast, of Melbourne.

Clays with a good range in plasticity and fired colour to meet specific company blending requirements have been readily available close to these city brick making centres, providing the bulk of their needs. Whilst red

firing reef material can be supplied from existing areas for at least 20 years, there is an increasing need to supply plastic white-firing clays and short white clays from more remote areas. White plastic clays have been imported to Melbourne from Axedale, Enfield, Hallora and Rowsley. With the depletion of reserves at existing sites, and the spread of urban development, there will probably be a need for new brick making centres to be established to the southeast or west of Melbourne as reserves run down.

Melbourne-based manufacturers have a sound resource base for most of their long term needs of the remaining major clay types. Monier Redland is a major producer of terra cotta roofing tiles at its recently upgraded plant at Vermont, fed mainly by plastic clay from its Coldstream site (CSR Construction Materials, WA350). Daniel Robertson Pty. Ltd, with reserves at Ferntree Gully, Nunawading and Cranbourne (WA190, WA191 and WA192), has established an important niche in the elite brick and paver market. In addition, there are small producers of tiles and pottery ware utilising clay resources near Melbourne. These are geologically similar to those used by the larger industries. An example is the Bayport Industries (WA28) site at Somerville (reef and plastic clay).

7 Melbourne Supply Area Extractive Industry Interest Areas

VicMine numbers are used to identify mines, deposits, prospects and mineral occurrences within Victoria. The VicMine numbers referred to below are those used to identify individual EIAs in the DPI corporate VicMine database.

7.1 Bass Coast Shire within the MSA

There are 11 current extractive industry operations and 5 proposed operations this part of the shire, most targeting sand and gravel (see Figures 3 and 4 and Table 3).

The Gurdies (VicMine Site ID 883999), Grantville (VicMine Site ID 883998), Nyora (VicMine Site ID 884121)

Rock type: sand and gravel.

Topography: undulating.

Transport: direct access from the quarry operation to the Bass or South Gippsland Highways is available for most of the area. The northern section is serviced by MacDonalds Track, a sealed road, and by the South Gippsland railway line.

Geology: Tertiary sediments have been deposited along the Heath Hill Fault scarp forming a linear belt from south of Grantville to west of Nyora. They consist of the basal, relatively thin Childers Formation that contains red to brown gravels with green plastic clay interbeds. This is overlain by the main economic sands of the Yallock Formation. This includes a basal clayey coarse sand unit with a variable thickness of overlying, cleaner, fine to coarse sand. Fine sand is thickest in the Grantville area.

Existing extractive industry: a total of eight sand and gravel operations occur within these EIAs in Bass Coast Shire. An additional four operators have applied for Work Authorities for sand and gravel in this area.

Rationale: **The Gurdies** (VicMine Site ID 883999)–**Grantville** (VicMine Site ID 883998)–**Nyora** (VicMine Site ID 884121) EIAs have been investigated by widely spaced drilling (Inan, 1987). Similar to the Lang Lang area, the Grantville–Gurdies–Nyora belt has the potential to be a major supplier of sand to the Melbourne area. The area north of The Gurdies and south of the railway line has not been fully assessed by drilling and needs further investigation to determine the full sand resource potential. Since the 1996 review (Olshina & Jiricek, 1996), the EIA 3 km southwest of Coronet Bay (VicMine Site ID 883997) has been removed. This is because it is located in an area of subdued topography near sea level, the supporting borehole information was considered inadequate to support its status as an EIA and no current or previous records of operations in this area. In the event that further investigation identifies a useful resource, this area may be reinstated.

The boundaries of the Grantville, The Gurdies and Nyora EIAs were adjusted to conform to geological, cadastral and road boundaries with consideration given to borehole information. The boundary of the portion of the **Jam Jerrup** (VicMine Site ID 883996) EIA within Bass Coast Shire (see below under Cardinia Shire) was adjusted to conform to cadastral and road bases, and to incorporate new resource information provided by Bell Cochrane & Associates (*pers. comm.*). These EIAs were chosen due to favourable geology and a long-established history of sand extraction which has been recognised in the Regional Sand Extraction Strategy, Lang Lang to Grantville (AGC Woodward - Clyde Pty Ltd., 1996). Existing Work Authorities and drill holes indicate the large sand resource that is available in the area.

Kernot (VicMine Site ID 884000)

Rock type: sand, gravel.

Topography: undulating.

Transport: good roads provide access to the Bass Highway, 6 km from the EIA.

Geology: Tertiary sands and gravels occur in this area, similar to the Grantville region.

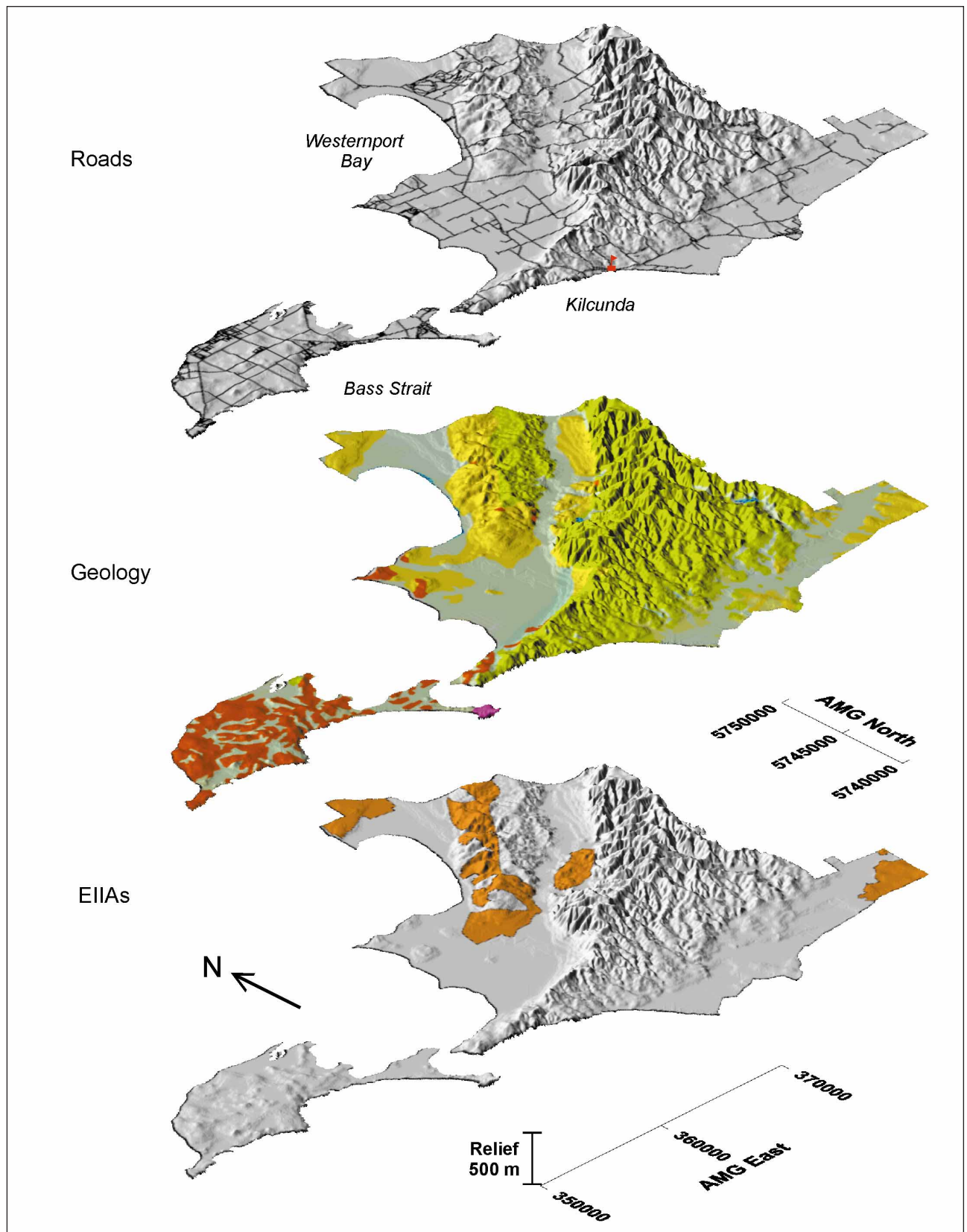


Figure 3 Stacked 3-D diagrams of the roads, geology and EIAs for Bass Coast Shire within the MSA.

Existing extractive industry: the small, intermittently worked Scheppers sand quarry (WA424) is the only operation within the EIIA.

Rationale: Geophysical surveys by Inan (1987) indicated potential for viable sand resources within the EIIA, but were never tested by drilling. However some boreholes drilled in this general location (eg. Corinella 56 & 57) indicate the presence of sand in areas other than the current operation. The extent of this area was increased slightly to conform to the geological boundaries of the two patches of Haunted Hills Gravel previously only partially included (VandenBerg, 1997d, Olshina & Jiricek, 1996). The 1996 EIIA boundary was modified to better conform to the geological boundaries of the two patches of Haunted Hills Gravel previously (Olshina & Jiricek, 1996) only partially included. The boundary of the **Leongatha South** (VicMine Site ID 883993) EIIA portion within Bass Coast Shire was adjusted to conform to the geological boundary of the Haunted Hills Gravel (see section on South Gippsland Shire for full description).

Table 3 Extractive Industry Tenements within Bass Coast Shire, MSA

Licence	Product	Operator	Status
ESP 177	Clay/clayshale	Lebony P/L	Application Received but not Granted
WA 40	Sand/gravel	Barro Group P/L	Currently Active
WA 210	Sand/gravel	Donmix (Proprietor: Lebony P/L)	Currently Active
WA 211	Basalt old	Defor P/L	Currently Active
WA 283	Sand/gravel	Nola M Johnson	Currently Active
WA 358	Sand/gravel	G A & K F Morrison P/L	Currently Active
WA 424	Sand/gravel	P F Scheppers	Currently Active
WA 469	Sand/gravel	CSR Construction Materials	Currently Active
WA 470	Sand/gravel	CSR Construction Materials	Currently Active
WA 512	Sand/gravel	Pioneer Construction Materials P/L	Proposal for an Application
WA 513	Sand/gravel	Barro Group P/L	Proposal for an Application
WA 520	Sand/gravel	Umberto Viglietti	Currently Active
WA 532	Sand/gravel	Edward W Hill	Proposal for an Application
WA 538	Sand/gravel	Blue Metal Concrete P/L	Proposal for an Application
WA 784	Sand/gravel	Bass Coast Shire Council	Currently Active
WA 970	Sand/gravel	Umberto Viglietti	Currently Active
WA 983	Sand/gravel	A T Massaro	Proposal for an Application

7.2 Baw Baw Shire within the MSA

There are 19 current extractive industry operations within this part of the shire, targeting hard rock, sand, gravel, clay and peat (see Figures 5 and 6 and Table 4).

Labertouche (VicMine Site ID 884005)

Rock type: granite, sand, gravel.

Topography: undulating to mountainous.

Transport: the existing road network within the State Forest is limited in its potential to provide access by quarry vehicles. Access to the Princes Highway from the EIIA would have to be carefully planned to minimise the impact on rural residential lots and small hobby farms scattered along potential truck access routes.

Geology: granite occurs throughout the EIIA, with granitic sands and gravels occurring as colluvium on the lower slopes of the Bunyip Valley. Sound rock would be expected to continue at depth, with local areas exhibiting minimum overburden.

Existing extractive industry: Baw Baw Shire operates a gravel pit in the EIIA (WA129).

Rationale: this EIIA was chosen for its favourable geology and limited planning restrictions. The boundary of this EIIA was modified to better conform to geological and cadastral boundaries, as well as incorporating new resource information provided by Bell Cochrane & Associates (*pers. comm.*).

Jindivick (VicMine Site ID 884006)

Rock type: Older Volcanics basalt.

Topography: undulating.

Transport: a reasonable road network provides good access throughout the area. There is good access to potential market areas, with the shortest route of 9 km to the Princes Highway.

Geology: this EIIA covers an area of Older Volcanics basalt that extends between Jindivick and Tarago. As with other Older Volcanic regions, the exact locations of areas where hard rock occurs close to the surface with minimal overburden are not precisely known.

Existing extractive industry: There are no current operations in this area. The last application (old LIC1317), which was withdrawn in 1995, targeted basalt.

Rationale: this area of Older Volcanics basalt was considered to have additional potential for future operations. The boundary of this EIIA was adjusted to conform to geological, cadastral, road and planning boundaries.

Neerim (VicMine Site ID 884007)

Rock type: Older Volcanics basalt.

Topography: undulating, broadly dissected plateau.

Transport: a reasonable road network provides good access throughout the area. Access to potential market areas is more limited, with the shortest route of 24 km to the Princes Highway passing through Neerim South. The area is well placed to cater for any upgrading of road access or facilities at Mount Baw Baw.

Geology: this EIIA covers part of the broadly dissected plateau of Older Volcanics basalt that extends south to Neerim South. As with other Older Volcanic regions, the exact locations of areas where hard rock occurs close to the surface with minimal overburden are not precisely known.

Existing extractive industry: There are no current operations in this area. The last operation (WA175), which was surrendered in 2000, extracted basalt and was situated on the eastern edge of the plateau. The material extracted was considered to be of good quality and a substantial resource remains in this EIIA (L. Street, CSR, *pers. comm.*).

Rationale: the northern section of the Neerim Older Volcanics basalt plateau was assigned EIIA status as the area consists of broad agricultural farming lots compared to the Neerim South area, where there are relatively more small, hobby farm type allotments. The boundary of this EIIA was adjusted to conform to geology, cadastral, road and planning boundaries and avoids Special Water Supply Catchment Areas.

Trafalgar North (VicMine Site ID 884123)

Rock type: Sand, gravel derived from Tertiary sediments (Haunted Hills Gravel).

Topography: gently sloping with occasional dissected creeks.

Transport: a reasonable road network within the area provides good access to the nearby transport corridor of the Princes Highway.

Geology: this EIIA covers the Tertiary outwash alluvial fan area north of Yarragon and Trafalgar. The fan has formed at the base of the ranges between the Moe and Latrobe rivers and consists of interbedded sand, gravel and clay. Drilling conducted by GSV has outlined extensive prospective sections within the EIIA (Buckley & Faul, 1994).

Existing extractive industry: several sand and gravel operations currently operate within the area including Ashdown (WA23), Deane (WA204) and Trevally Farms (WA454). Two additional operations in the application stage in 1996 have now been granted and are currently active (WA521 and WA523).

Rationale: this is a broad agricultural farming area located adjacent to the main Princes Highway transport corridor so that any appropriately located quarry operation will have minimal impact on existing infrastructure. GSV drilling results indicate favourable intersections of sand with size grading suitable for concrete manufacture.

The EIIA boundary was adjusted to conform to geological boundaries (especially that of the Haunted Hills Gravel) where appropriate. It was also extended slightly to encompass a prospective area south of original southern boundary as delineated by roads, as per Buckley & Faul, 1994. There was also an adjustment to the western boundary as per Buckley & Faul, 1994.

Most of this EIIA is also covered by a planning scheme overlay that highlights the significance of the Trafalgar sand resource.

Ellinbank (VicMine Site ID 883995)

Rock type: sand, gravel.

Topography: hilly.

Transport: reasonable roads provide access to the Princes Highway at Warragul, 11 km to the North.

Geology: this EIIA covers outliers of Childers Formation where the overlying Older Volcanics basalt has been eroded away. The quarries extract sand up to 20 m thick and there is potential to exploit additional sandy Childers Formation from the immediate vicinity. In the broader regional context, the clay content within the Childers Formation can be appreciable, limiting the areas where sand extraction is feasible.

Existing extractive industry: there are three operations in the EIIA, with the Hammill quarry (WA162) being the largest operation. Adjacent to this pit there is a current Work Authority to quarry sand (WA19, Willanders) and the Jeffrey operation (WA281) further to the west.

Rationale: this is a broad-acre farming area with few planning restrictions to extractive industry. There is potential for additional sand resources to be extracted. The boundary of this EIIA was adjusted to conform to planning, cadastral and geological boundaries.

Tetoora (VicMine Site ID 884002)

Rock type: sand, gravel.

Topography: hilly.

Existing extractive industry: there are no current operations in this EIIA.

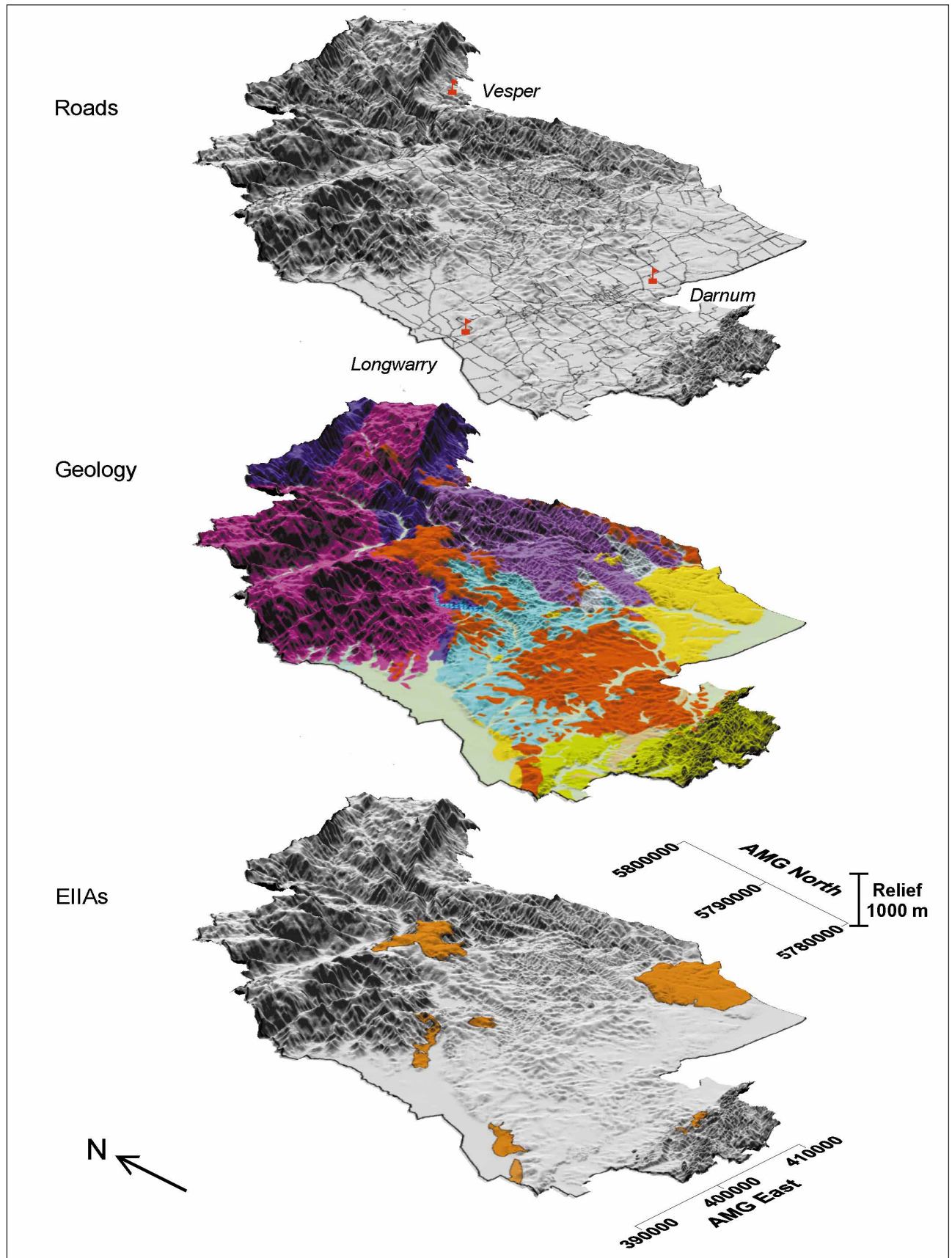


Figure 5 Stacked 3-D diagrams of the roads, geology and EIAs for Baw Baw Shire within the MSA.

Transport: reasonable roads provide access to the Princes Highway at Warragul, 11 km to the North.

Geology: this EIIA covers outliers of Childers Formation where the overlying Older Volcanics basalt has been eroded away.

Rationale: this is a broad-acre farming area with few planning restrictions to extractive industry. There is potential for additional sand resources to be extracted. The boundary of this EIIA was adjusted to conform to planning, cadastral and geological boundaries.

Heath Hill (VicMine Site ID 915190)

Rock type: sand.

Topography: flat to undulating.

Transport: reasonable roads provide access to the Princes Highway and Gippsland Highway.

Geology: this EIIA covers a Tertiary sand body adjacent to the Heath Hill Fault.

Existing extractive industry: there are no current operations in this EIIA.

Rationale: This EIIA was defined on the basis of new resource information provided by Bell Cochrane & Associates (*pers. comm.*). The boundary of this EIIA was defined by geological boundaries.

Ripplebrook (VicMine Site ID 915191)

Rock type: sand.

Topography: flat to undulating.

Transport: reasonable roads provide access to the Princes Highway and Gippsland Highway.

Geology: this EIIA covers a Tertiary sand body adjacent to the Heath Hill Fault.

Existing extractive industry: there are no current operations in this EIIA.

Rationale: This EIIA was defined on the basis of new resource information provided by Bell Cochrane & Associates (*pers. comm.*). The boundary of this EIIA was defined by geological boundaries.

Table 4 Extractive Industry Tenements within Baw Baw Shire, MSA

Licence	Product	Operator	Status
WA 19	Sand/gravel	Wilanders P/L	Currently Active
WA 23	Sand/gravel	Phillip Ashdown	Currently Active
WA 64	Clay/clayshale	Boral Bricks (Vic) P/L	Currently Active
WA 103	Sand/gravel	Irene P Bourke	Currently Active
WA 112	Clay/clayshale	Nubrik P/L	Currently Active
WA 128	Basalt old	Baw Baw Shire	Currently Active
WA 129	Sand/gravel	Baw Baw Shire	Currently Active
WA 162	Sand/gravel	James A Hammill	Currently Active
WA 189	Hornfels	J H Cuthbertson P/L	Currently Active
WA 204	Sand/gravel	Lionel T Deane	Currently Active
WA 237	Basalt old	Eileen E Gourley	Currently Active
WA 281	Sand/gravel	Peter Jeffrey	Currently Active
WA 298	Sand/gravel	Ernest B Kincaid	Currently Active
WA 406	Sand/gravel	Donald S Clarke	Currently Active
WA 454	Sand/gravel	Travalley Farms P/L	Currently Active
WA 462	Peat	Tweddle Estates P/L	Currently Active
WA 521	Sand/gravel	D G L Abel	Currently Active
WA 523	Sand/gravel	D G L Abel	Currently Active
WA 779	Basalt old	Dept of NRE	Currently Active

7.3 Cardinia Shire

There are 12 current extractive industry operations and 4 proposed operations within the shire, most targeting sand and gravel (see Figures 7 and 8 and Table 5).

Jam Jerrup (VicMine Site ID 883996) and Lang Lang (VicMine Site ID 884122)

Rock type: sand and gravel.

Topography: level to gently undulating.

Transport: a good road network in the area provides access to the nearby South Gippsland Highway. The South Gippsland railway line also runs close to the EIIA.

Geology: Tertiary/Quaternary sand resources within the EIIA were defined on the basis of drilling conducted by McHaffie (1978). The Tertiary economic sand unit belongs to the Baxter Formation and represents braided river deposits that roughly correspond to the present Lang Lang and Little Lang Lang Rivers. Fine to coarse sand is present together with minor interbedded clay. Palynological analysis of one of the bores indicates that the sediments are mid Eocene to early Oligocene in age. The Tertiary deposits are overlain by Quaternary aeolian dune ridges trending northwest to southeast and high level river terraces. These deposits are thickest where they bank up against the Wellington Fault.

Existing extractive industry: there are no current operations in the Jam Jerrup EIIA, whereas the Lang Lang EIIA hosts three current sand/gravel operations and three proposals. In addition, there are two current operations and one application to the immediate west of the EIIA boundary.

Rationale: the large sand deposits in the Lang Lang region have already been recognised as a future major source of sand to the MSA with the declaration of the *Regional Sand Extraction Strategy, Lang Lang to Grantville*. Declaring this EIIA ensures the ongoing protection of resources. The EIIA boundary was adjusted to better conform to currently available cadastral and planning boundaries, roads and geological boundaries and incorporated new resource information provided by Bell Cochrane & Associates (*pers. comm.*).

Tonimbuk (VicMine Site ID 884124)

Rock type: Granite, sand and gravel.

Topography: partly cleared foothills.

Transport: this EIIA is close to the major Princes Highway transport corridor and to established truck routes to current quarry operations.

Geology: Tynong Granite, Quaternary fluvial and colluvial sand and gravel.

Existing extractive industry: there is one current operation extracting sand/gravel from Quaternary fluvial sediments to the southeast of Tonimbuk, at the eastern edge of this EIIA (WA476).

Rationale: This EIIA was chosen due to favourable geology and limited planning restrictions. Granite occurs throughout this EIIA, with quarries in the adjacent Garfield North and Maryknoll EIIs, which are areas of similar geology, indicating the minimal overburden and continuation of sound rock at depth. Granitic sands and gravels occur as colluvium on the lower slopes of the hills or as alluvium within the valleys. The granite produces valued crushed rock products whilst the sand in the area has the potential for use in concrete manufacture. The EIIA is largely agricultural, unlike the valued landscape and conservation areas to the west. This may result in a concentration of hard rock quarries in the one general area. The boundary of this EIIA was adjusted to conform to geological, planning and cadastral boundaries, and to include all of the area of WA476.

Garfield North (VicMine Site ID 884127)

Rock type: Granite, sand and gravel.

Topography: undulating.

Transport: this EIIA is close to the major Princes Highway transport corridor and to established truck routes to current quarry operations.

Geology: Tynong Granite, Quaternary fluvial and colluvial sand and gravel.

Existing extractive industry: there is one current operation extracting granite to the west of Garfield North (WA182).

Rationale: This EIIA was chosen due to favourable geology and limited planning restrictions. Granite occurs throughout this EIIA, with quarries in the adjacent Garfield North and Maryknoll EIIs, which are areas of similar geology, indicating the minimal overburden and continuation of sound rock at depth. Granitic sands and gravels occur as colluvium on the lower slopes of the hills or as alluvium within the valleys. The granite produces valued crushed rock products whilst the sand in the area has the potential for use in concrete manufacture. The EIIA is largely agricultural, unlike the valued landscape and conservation areas to the west. This may result in a concentration of hard rock quarries in the one general area. The boundary of this EIIA was adjusted to conform to geological, planning and cadastral boundaries.

Maryknoll (VicMine Site ID 884125)

Rock type: Granite, sand and gravel.

Topography: undulating.

Geology: Tynong Granite, Quaternary fluvial and colluvial sand and gravel.

Existing extractive industry: there is one current operation extracting granite to the north of Tynong (WA25).

Rationale: This EIIA was chosen due to favourable geology and limited planning restrictions. Granite occurs throughout this EIIA, with quarries here and in the adjacent Garfield North EIIA, an area of similar geology, indicating the minimal overburden and continuation of sound rock at depth. The granite produces valued crushed rock products. The EIIA is largely agricultural, unlike the valued landscape and conservation areas to the west. The boundary of this EIIA around Maryknoll was adjusted to conform to small subdivision areas and areas where extractive industry is prohibited by the planning scheme. Elsewhere, the EIIA was adjusted to better conform to geological and cadastral boundaries. The previous EIIA north of Cornucopia (Olshina & Jiricek, 1996), which hosts no current operations, was deleted following a submission from a local community group which indicated that previous attempts to establish extractive industry operations in this area had failed following extensive community consultation.

Nar Nar Goon (VicMine Site ID 884003)

Rock type: Granite, basalt, sand and gravel.

Topography: undulating.

Transport: this EIIA is close to the major Princes Highway transport corridor and to established truck routes to current quarry operations.

Geology: granite (Tynong Granite) ridges capped by Older Volcanics basalt in the Mt Ararat region, with Quaternary fluvial sediments between the ridges

Existing extractive industry: there are no current operations in this area.

Rationale: This EIIA was chosen due to favourable geology and limited planning restrictions. The granite and Older Volcanics basalt produces valued crushed rock products whilst the sand in the area has the potential for use in concrete manufacture. The EIIA is largely agricultural, unlike the valued landscape and conservation areas to the West. The boundary of this the EIIA was adjusted to better conform to geological and cadastral boundaries. The EIIA surrounding WA896 was deleted in accordance with current policy on small EIIs surrounding single operations.

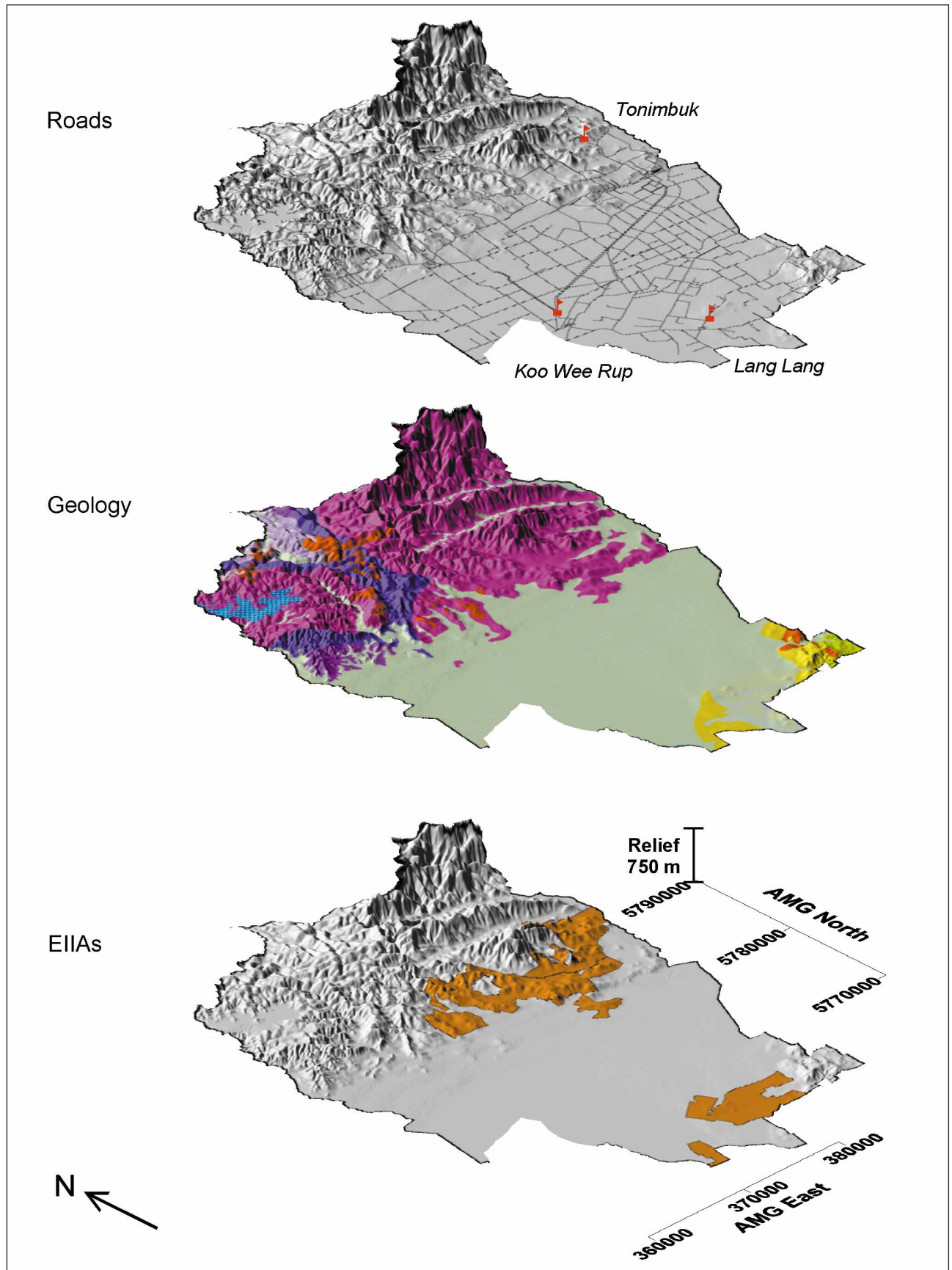


Figure 7 Stacked 3-D diagrams of the roads, geology and EIAs for Cardinia Shire.

Table 5 Extractive Industry Tenements within Cardinia Shire

Licence	Product	Operator	Status
WA 25	Granite	Astec P/L	Currently Active
WA 65	Clay/clayshale	Glen Iris Brick Holdings Ltd	Currently Active
WA 127	Sand/gravel	Pioneer Construction Materials P/L	Currently Active
WA 174	Basalt old	CSR Ltd	Currently Active
WA 182	Granite	CSR Ltd	Currently Active
WA 238	Sand/gravel	Aidan J Graham P/L	Currently Active
WA 265	Clay/clayshale	James Hicks P/L	Currently Active
WA 338	Sand/gravel	Ian D McLeod	Currently Active
WA 455	Sand/gravel	Emidio Tribuzi	Currently Active
WA 456	Sand/gravel	Emidio Tribuzi	Currently Active
WA 476	Sand/gravel	Alan L Forte	Currently Active
WA 511	Sand/gravel	Tygtand P/L	Proposal for an Application
WA 531	Sand/gravel	P D'Alberto	Proposal for an Application
WA 836	Sand/gravel	Rocla Quarry Products Application	Received but not Granted
WA 896	Hornfels	Hillview Quarries P/L Application	Received but not Granted
WA 1005	Sand/gravel	John Brian	Currently Active
WA 1029	Sand/gravel	Lang Lang Industries	Proposal for an Application
WA 1159	Granite	Lodge Bros P/L	Proposal for an Application

7.4 City of Casey

There are 12 current extractive industry operations within the shire, targeting sand, gravel, basalt and clay (see Figures 9 and 10 and Table 6).

Fiveways (VicMine Site ID 883992)

Rock type: Sand, gravel derived from Tertiary sediments.

Topography: flat.

Transport: roads in the area provide ready access to the adjacent South Gippsland Highway.

Geology: this EIIA has been defined on the basis of scattered bore hole data which indicate the presence of economically viable sand intersections up to 10 m thick within the Tertiary/Quaternary sequence. More closely spaced drill holes would be required to define a specific economic sand resource.

Existing extractive industry: none.

Rationale: there is the potential for a sand resource to occur within the EIIA. Such a resource would be valuable as it is much closer to potential markets than other new EIAs at Lang Lang and Grantville. Identifying this EIIA may restrict further development that has the potential to sterilise this potentially valuable resource. The boundary of this EIIA was adjusted to conform to road and cadastral boundaries, likely planning constraints and incorporates new resource information provided by Bell Cochrane & Associates (*pers. comm.*). The previous EIIA to the southwest of Cranbourne (Olshina & Jiricek, 1996), was removed because of its small size (it formerly hosted only one EI operation), proximity to areas of likely urban expansion and lack of current activity.

Table 6 Extractive Industry Tenements within Casey City

Licence	Product	Operator	Status
WA 18	Sand/gravel	CSR Ltd	Currently Active
WA 111	Clay/clayshale	Nubrik P/L	Currently Active
WA 113	Clay/clayshale	Nubrik P/L	Currently Active
WA 121	Sand/gravel	Brompton Lodge P/L	Currently Active
WA 145	Sand/gravel	Unimim Australia Ltd	Currently Active
WA 170	Sand/gravel	CSR Ltd	Currently Active
WA 190	Clay/clayshale	Daniel Robertson P/L	Currently Active
WA 277	Sand/gravel	Kenneth J Huxtable	Currently Active
WA 382	Basalt old	Pioneer Construction Materials P/L	Currently Active
WA 388	Basalt old	Pioneer Construction Materials P/L	Currently Active
WA 441	Clay/clayshale	Stevenson Bros Industries P/L	Currently Active
WA 444	Clay/clayshale	Darley Refractories P/L	Currently Active

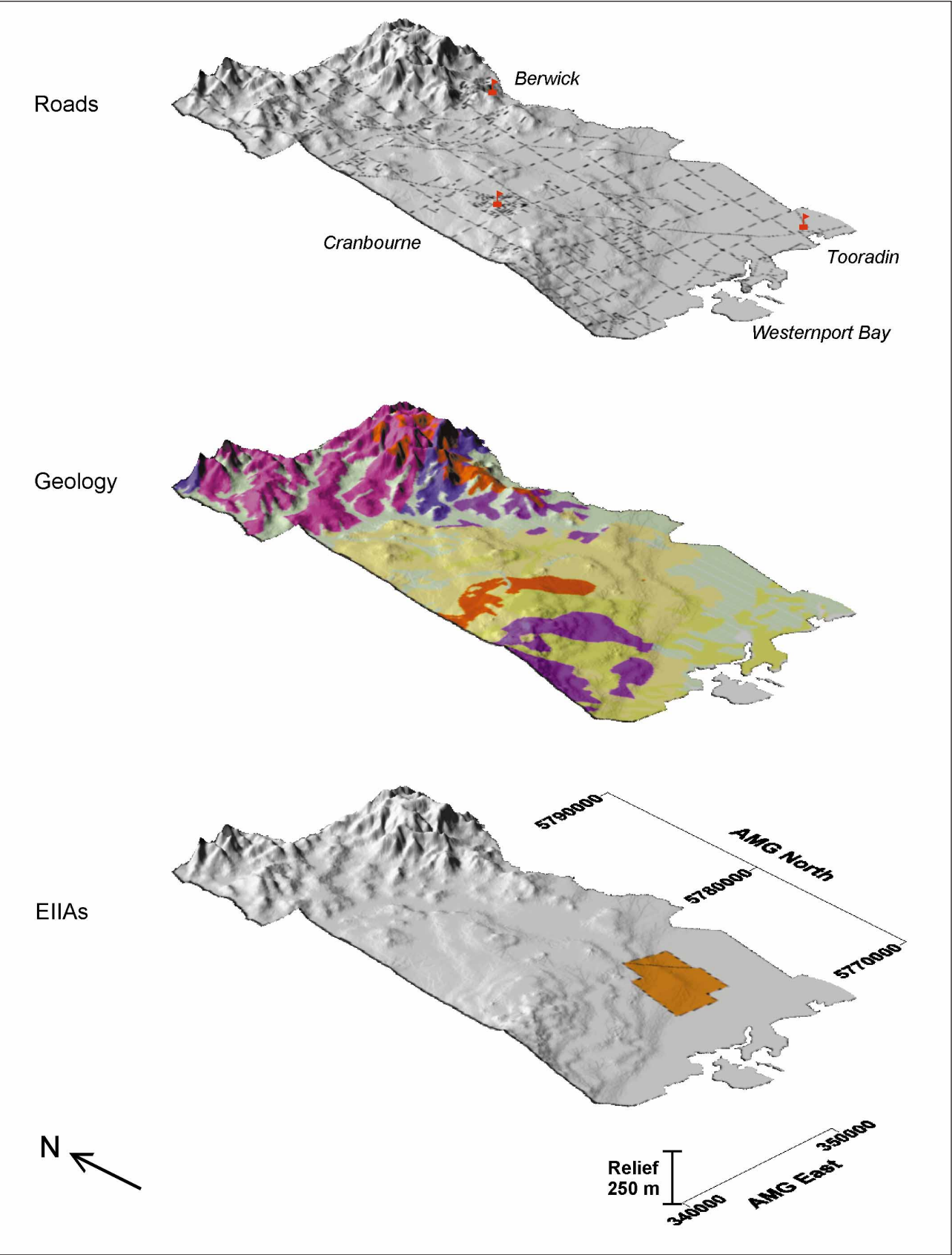


Figure 9 Stacked 3-D diagrams of the roads, geology and EIAs for Casey City.

7.5 City of Greater Geelong within the MSA

There are 12 current extractive industry operations within this part of the shire, targeting sand, gravel, basalt and limestone (see Figures 11 and 12 and Table 7). The EIAs within City of Greater Geelong have also been covered by a previous study (Olshina & Jiricek, 1999a), now superseded in part by the current report.

Batesford (VicMine Site ID 884076)

Rock type: basalt, granite, sand, clay, limestone.

Topography: undulating.

Transport: this area is located near the Princes, Midland and Hamilton Highways.

Existing extractive industry: there are two current operations in this area – Adelaide Brighton Cement Ltd's WA3 (currently being wound down) and CSR Ltd (WA165) producing basalt.

Geology: Newer Volcanics basalt, granite (Dog Rocks Granite) and Tertiary limestone, sand and clay.

Rationale: this EIA contains economic resources of Newer Volcanics basalt and possible sand, clay, granite and perhaps additional limestone resources outside the already quarried area. General parameters of sound basalt greater than 10 m thick, and overburden less than 5 m thick, were used to delineate basalt EIAs. These are relatively elevated areas with good outcrop and include stony rises. The boundary of this EIA was adjusted to conform to cadastral and current planning boundaries.

Anakie (VicMine Site ID 884086)

Rock type: basalt.

Topography: flat to undulating.

Transport: this area is located near the Geelong–Ballan Road, with access to the Princes Highway.

Geology: this EIA contains substantial long-term economic resources of Newer Volcanics basalt and scoria

Existing extractive industry: there are three current operations producing basalt and scoria in this area – WA9, WA225 and WA278.

Rationale: general parameters of sound basalt greater than 10 m thick, and overburden less than 5 m thick, were used to delineate basalt EIAs. These are relatively elevated areas with good outcrop and include stony rises. The boundary of this EIA was adjusted to conform to road, cadastral and current planning boundaries.

You Yangs (VicMine Site ID 884082)

Rock type: granite, sand and gravel.

Topography: flat to undulating.

Transport: this area has good access to Princes Highway.

Geology: granite, quartz gravel derived from weathered granite; gravel, sand and silt derived from Tertiary and Quaternary sediments.

Existing extractive industry: there are seven quarries grouped in four current operations producing sand and gravel in this area (WAs 188, 347, 437 and 453), all in the vicinity of the You Yangs.

Rationale: there is a long-established history of sand and gravel extraction from this area, with additional potential to the north and west of the current centre of operations. In addition, there is potential for relatively unweathered granite as a source of hard rock. The boundary of this EIA was adjusted to conform to road, geological, cadastral and current planning boundaries.

Balliang (VicMine Site ID 884081)

Rock type: basalt.

Topography: flat.

Transport: this area is located near the Geelong–Ballan Road.

Geology: this EIIA covers an area of potential for economic resources of Newer Volcanics basalt.

Existing extractive industry: there are no current operations in this area.

Rationale: general parameters of sound basalt greater than 10 m thick, and overburden less than 5 m thick, were used to delineate basalt EIAs. The boundary of this EIIA was adjusted to conform to road, cadastral and current planning boundaries.

Rothwell (VicMine Site ID 884083)

Rock type: basalt.

Topography: flat.

Transport: this area has good access to Princes Highway.

Geology: this EIIA covers an area of potential for economic resources of Newer Volcanics basalt.

Existing extractive industry: there is currently one operation in this area (WA980) extracting Newer Volcanics basalt.

Rationale: general parameters of sound basalt greater than 10 m thick, and overburden less than 5 m thick, were used to delineate basalt EIAs. The boundary of this EIIA was adjusted to conform to road, cadastral and current planning boundaries.

Lara (VicMine Site ID 884080)

Rock type: limestone.

Topography: flat.

Transport: this area has good access to Princes Highway.

Geology: Lara limestone (laucustrine).

Existing extractive industry: there is currently one operation in this area (WA198) producing limestone for agricultural applications.

Rationale: there is considerable potential to extend the area of current operations in the future, in addition to some additional potential for sand and gravel. This is an important source of agricultural limestone within the western half of the MSA. The boundary of this EIIA was adjusted to conform to road, cadastral, geological and current planning boundaries.

Point Wilson (VicMine Site ID 884084)

Rock type: basalt.

Topography: flat.

Transport: this area has good access to Princes Highway.

Geology: this EIIA covers an area of potential for economic resources of Newer Volcanics basalt.

Existing extractive industry: there is currently one operation in this area (WA41) extracting Newer Volcanics basalt.

Rationale: general parameters of sound basalt greater than 10 m thick, and overburden less than 5 m thick, were used to delineate basalt EIAs. The boundary of this EIIA was adjusted to conform to road, cadastral and current planning boundaries and incorporated new resource information provided by Bell Cochrane & Associates, (pers. comm.).

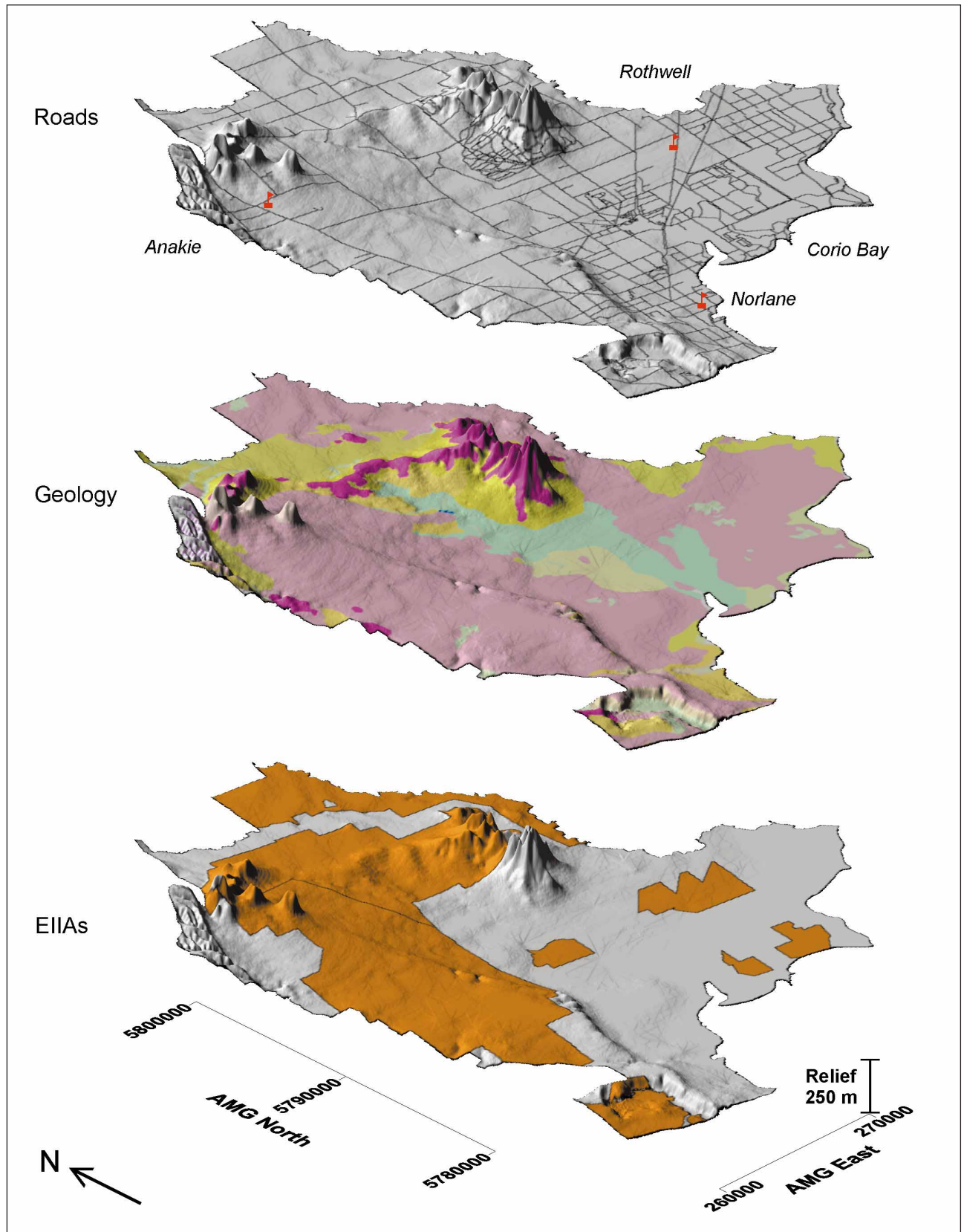


Figure 11 Stacked 3-D diagrams of the roads, geology and EIAs for Greater Geelong City within the MSA.

Table 7 Extractive Industry Tenements within Greater Geelong City, MSA

Licence	Product	Operator	Status
WA 3	Limestone	Adelaide Brighton Cement Ltd	Currently Active
WA 9	Scoria	Delacom P/L	Currently Active
WA 41	Basalt new	Barro Group P/L	Currently Active
WA 165	Basalt new	CSR Ltd	Currently Active
WA 188	Sand/gravel	Davegale P/L	Currently Active
WA 198	Limestone	Lara Lime P/L	Currently Active
WA 225	Scoria	Aerolite Quarries P/L	Currently Active
WA 278	Basalt new	Jalna Nominees P/L	Currently Active
WA 347	Sand/gravel	Excel Quarries P/L	Currently Active
WA 437	Sand/gravel	Davegale P/L	Currently Active
WA 453	Sand/gravel	Transwest Haulage P/L	Currently Active
WA 980	Basalt new	Kesselhill P/L	Currently Active

7.6 Hume City

There are 5 current extractive industry operations within the shire, targeting clay, hard rock and soil (see Figures 13 and 14 and Table 8).

Clarkefield (VicMine Site ID 884010)

Rock type: basalt.

Topography: elevated plateau.

Transport: access to Lancefield Road is restricted by the deep valley of Emu Creek in Hume City. Access to the Hume Highway is restricted by Deep Creek.

Geology: Newer Volcanics basalt. The overburden (calculated from borehole log information) is thin. However, some bores in Hume City contained up to 20 m of highly fractured basalt. Borehole 2174/00002 (Bollinda 2; AMG zone 55, 305171E 5841261N), contains 90 m of grey basalt, although the top 20 m is highly fractured and weathered. Thin sections from 10 boreholes in Hume City were available, indicating the grey, surface basalt extends to between 25 and 40 m depth.

Existing extractive industry: there are no current operations in this EIIA in Hume City.

Rationale: the area has thick basalt with evidence that the basalt could have low secondary mineral content to considerable depth. The generally wide, flat areas are not overlooked from nearby hills, minimising the potential visual impact of any quarries. It is generally poor farming land, with many areas of stony ground, suggesting hard rock close to the surface. The existing quarries are probably extracting basalt that has come from the same volcanic sources as represented here, but have the advantage of strategic siting (overburden removed by creeks and a better transport situation). The boundary of this EIIA was adjusted to conform to geological and planning boundaries. The previous small EIIA to the northeast of Bulla (Olshina & Jiricek, 1996) was deleted due to its small size and lack of current operations.

Table 8 Extractive Industry Tenements within Hume City

Licence	Product	Operator	Status
WA 44	Clay/clayshale	Malcolm Sinclair	Currently Active
WA 109	Clay/clayshale	Nubrik P/L	Currently Active
WA 176	Granite	CSR Construction Materials	Currently Active
WA 806	Sedimentary	Bairlea P/L Trading as T & M Bulla	Proposal for an Application
WA 1012	Soil	Hnj Holdings P/L	Currently Active
WA 1013	Soil	John M Ower	Currently Active
WA 1046	Soil	George Duncan	Proposal for an Application
WA 1123	Sand/gravel	Pinnacle Investments Pty Ltd	Proposal for an Application
WA 578	Basalt new	Whitsunday Crushers Pty Ltd	Proposal for an Application

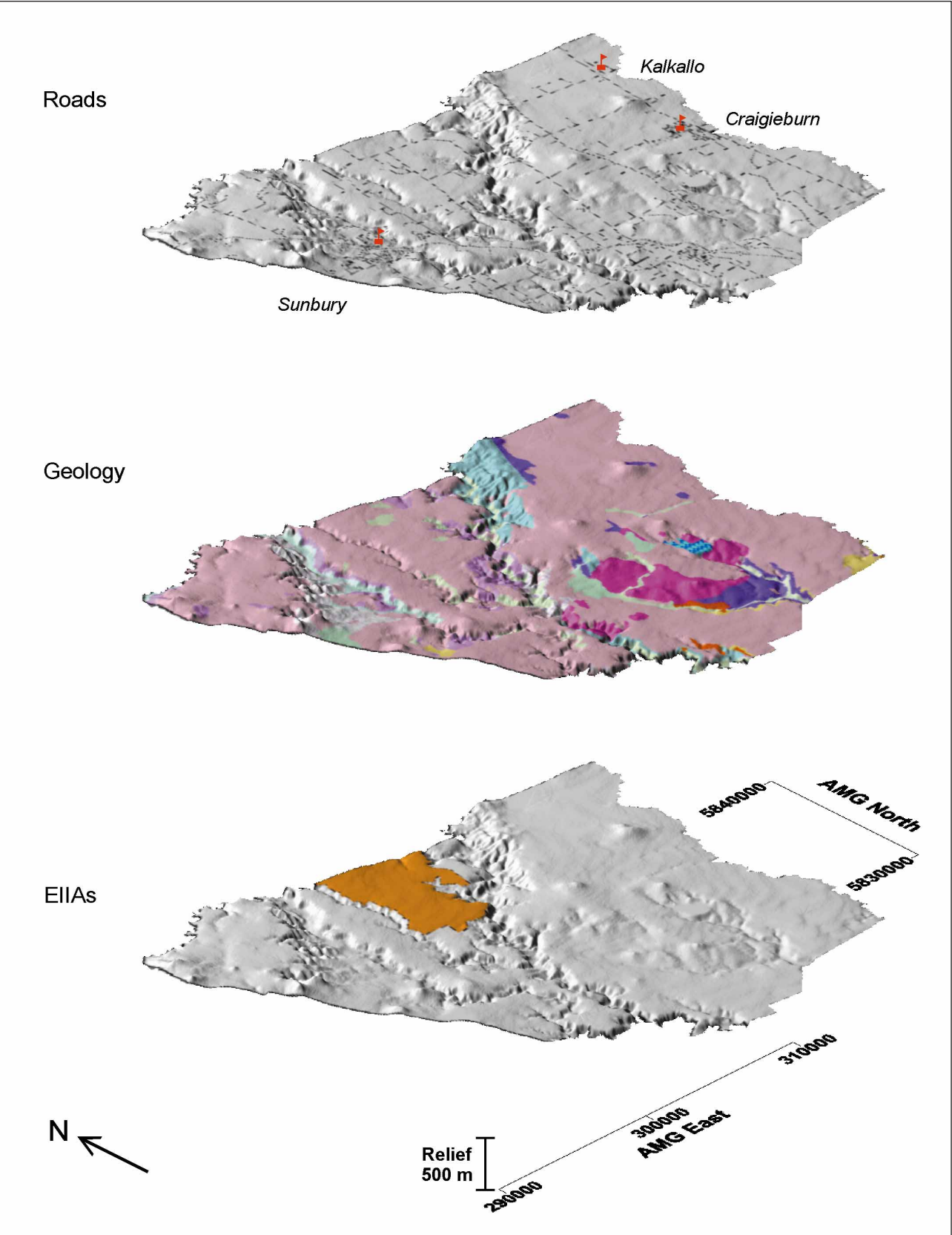


Figure 13 Stacked 3-D diagrams of the roads, geology and EIAs for Hume City.

7.7 Macedon Ranges Shire within the MSA

There are 4 current extractive industry operations and 2 proposed operations within this part of the shire, targeting sand, gravel, hard rock and soil (see Figures 15 and 16 and Table 9).

Clarkefield (VicMine Site ID 884010)

Rock type: basalt.

Topography: elevated plateau.

Transport: access to the Hume Highway is restricted by Deep Creek.

Geology: includes a major infilled valley with basalt up to 130 m deep on the west side of the area. The lower portion of this is possibly Older Volcanics. The overburden (calculated from borehole log information) is thin. Basalt flows can be seen close to Fenton Hill and near Deep Creek, indicating likely areas where fresh basalt is close to the surface.

Existing extractive industry: two operations producing soil (both under WA699) on the banks of the Maribyrnong River.

Rationale: the area has thick basalt with evidence that the basalt could have low secondary mineral content to considerable depth. The generally wide, flat areas are not overlooked from nearby hills, minimising the potential visual impact of any quarries. It is generally poor farming land, with many areas of stony ground, suggesting hard rock close to the surface. There are no current operations extracting basalt in this EIIA. The boundaries of this EIIA were adjusted to conform to cadastral, geological and planning boundaries.

Two small previous EIIs between Bullengarook and Gisborne (Olshina & Jiricek, 1996) were removed due to their size, their proximity to Rosslynne Reservoir and their location within Special Water Supply Catchment Areas with restrictive planning controls.

Table 9 Extractive Industry Tenements within Macedon Ranges Shire, MSA

Licence	Product	Operator	Status
WA 360	Sand/gravel	Kenneth Newnham	Currently Active
WA 361	Sand/gravel	Kenneth Newnham	Currently Active
WA 416	Sedimentary	Macedon Ranges Shire (Romsey)	Currently Active
WA 699	Soil	John M Ower	Currently Active
WA 816	Basalt new	Vic Roads Application	Received but not Granted
WA 969	Hornfels	Graeme J Wright	Proposal for an Application

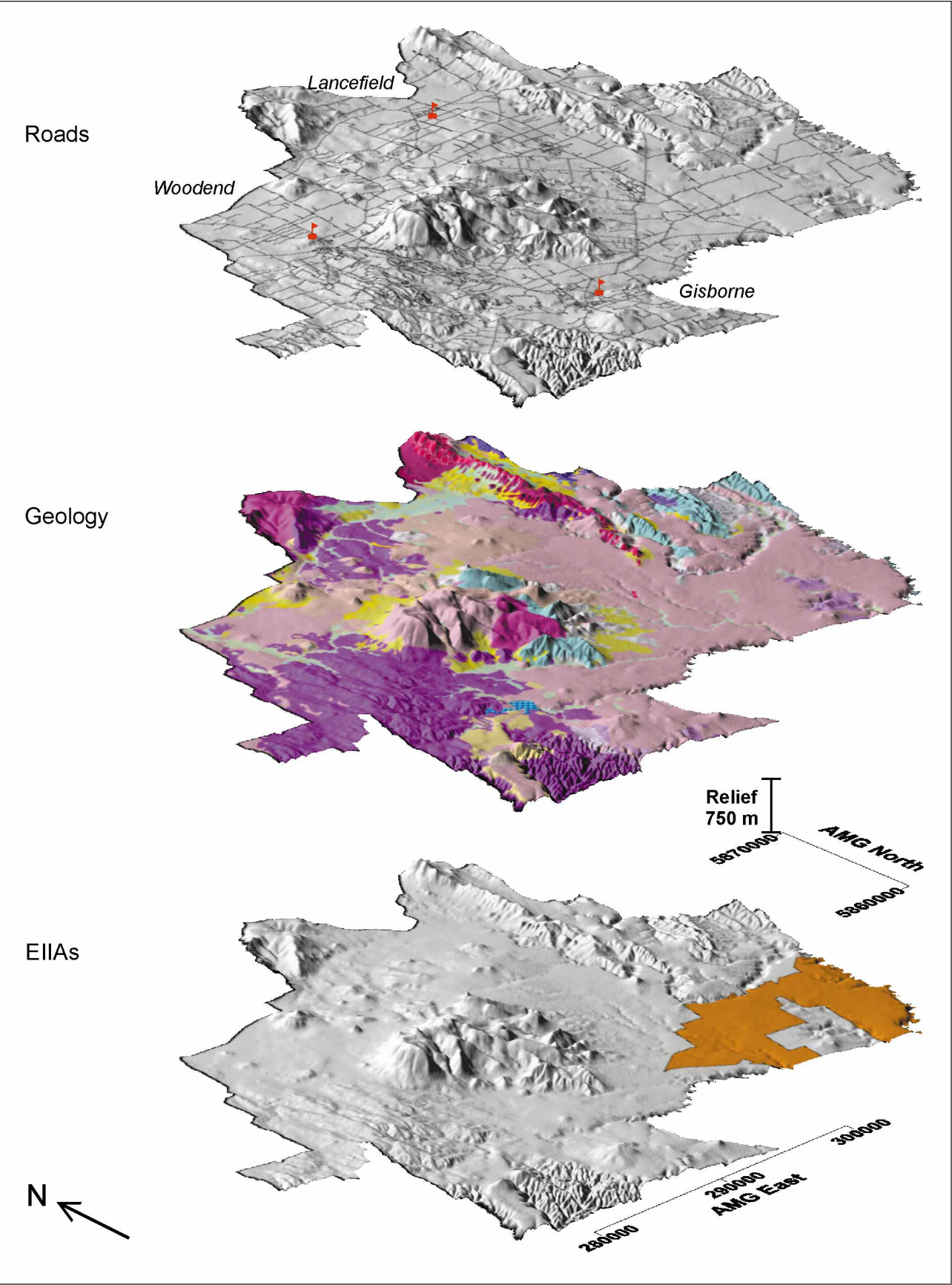


Figure 15 Stacked 3-D diagrams of the roads, geology and EIAs for Macedon Ranges Shire within the MSA.

7.8 Melton Shire

There are 5 current extractive industry operations and 2 proposed operation within the shire, targeting basalt (see Figures 17 and 18 and Table 10).

Rockbank (VicMine Site ID 884025)

Rock type: basalt.

Topography: flat to undulating.

Transport: this area has good access to Princes Highway.

Geology: Newer Volcanics basalt.

Existing extractive industry: there are five current operations and one proposed operation in this area, all targeting basalt and scoria.

Rationale: this EIIA contains substantial resources of Newer Volcanics basalt with established operations. General parameters of sound basalt include greater than 10 m thickness and overburden less than 5 m thick, were used to delineate basalt EIAs. The EIIA boundary was adjusted to conform to current planning, road and cadastral boundaries.

Little River (VicMine Site ID 884085)

Rock type: basalt.

Topography: flat to undulating.

Transport: this area has good access to Princes Highway.

Geology: Newer Volcanics basalt.

Existing extractive industry: there are no current operations within the portion of the Little River EIIA within Melton Shire.

Rationale: this EIIA contains substantial resources of Newer Volcanics basalt. General parameters of sound basalt include greater than 10 m thickness and overburden less than 5 m thick, were used to delineate basalt EIAs. The EIIA boundary was adjusted to conform to current planning, road and cadastral boundaries.

Table 10 Extractive Industry Tenements within Melton Shire

Licence	Product	Operator	Status
WA 97	Basalt new	Boral Resources (Vic) P/L	Currently Active
WA 343	Scoria	Excel Quarries P/L	Currently Active
WA 346	Basalt new	Excel Quarries P/L	Currently Active
WA 440	Basalt new	Stella Farm P/L	Currently Active
WA 507	Scoria	Fraser Mining & Construction P/L	Proposal for an Application
WA 515	Basalt old	Excel Quarries P/L	Currently Active
WA 659	Basalt old	Paul Galea	Proposal for an Application

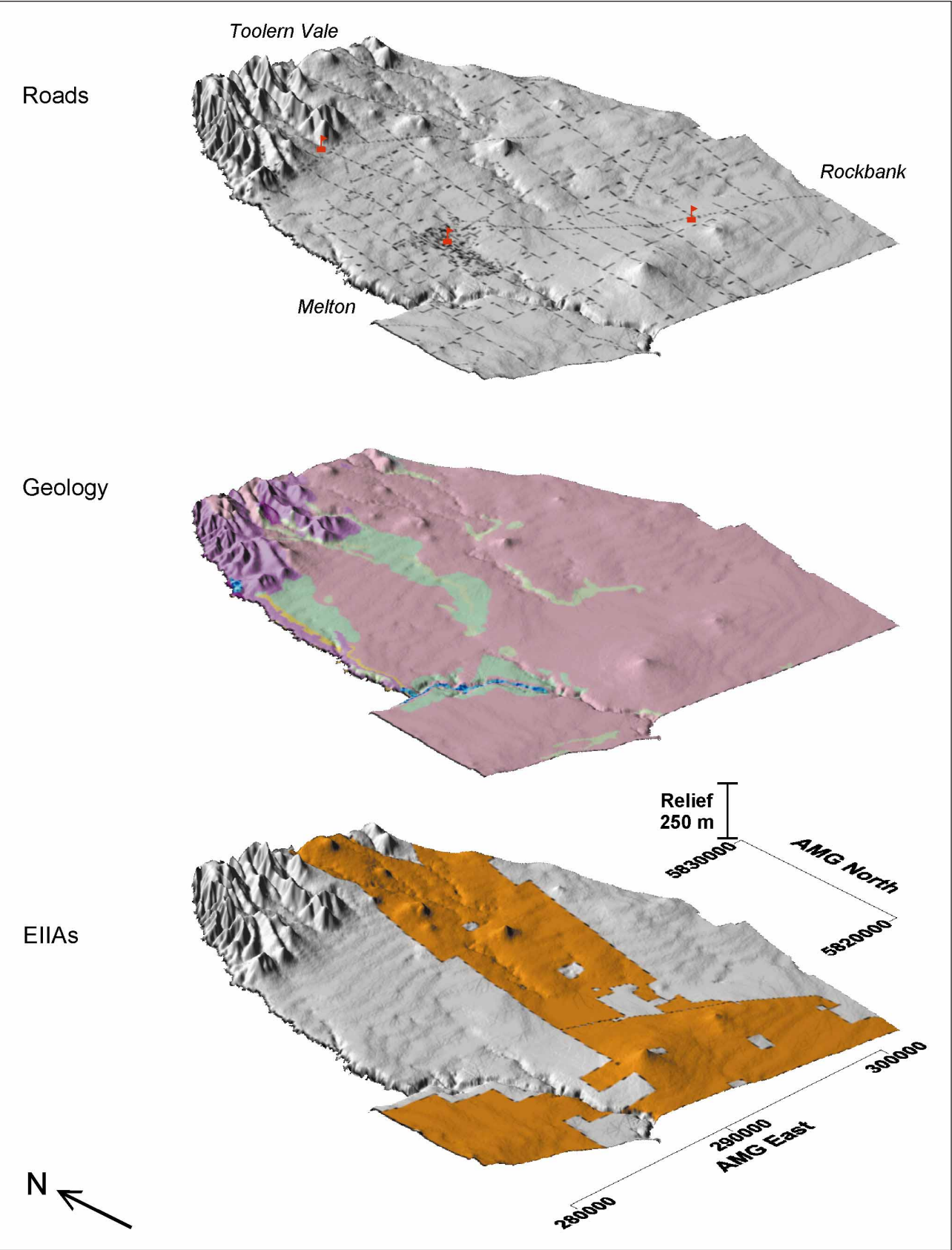


Figure 17 Stacked 3-D diagrams of the roads, geology and EIAs for Melton Shire.

7.9 Mitchell Shire within the MSA

There are 4 current extractive industry operations and 1 proposed operation within this part of the shire, mostly targeting basalt (see Figures 19 and 20 and Table 11).

Broadford (VicMine Site ID 884013)

Rock type: basalt.

Topography: undulating.

Transport: good access to Hume Highway.

Geology: Round Hill is a basalt eruption point in the approximate centre of this EIIA. This basalt outcrop is entirely surrounded by Palaeozoic rocks.

Existing extractive industry: there are no current operations in this area

Rationale: the area covers a basalt outcrop located close to Broadford. The boundary of this EIIA was adjusted to conform to geological and planning boundaries.

Beveridge (VicMine Site ID 884011)

Rock type: basalt, scoria

Topography: undulating.

Transport: good access to Hume Highway.

Geology: Mt Fraser is a Newer Volcanics basalt eruption point north of Beveridge, and is surrounded by a basalt plain with Palaeozoic hornfels and sedimentary inliers.

Existing extractive industry: there is one current operation, the long-established WA147 extracting scoria from the flanks of Mt Fraser, and one application in this area

Rationale: there is possibly a good resource of scoria in the gently sloping pediments of Mount Fraser and Bald Hill, in particular the area west of Mount Fraser and the Hume Highway, as well as basalt in the general area. In addition, a small hill of hornfels occurs along the Hume Highway southwest of Mount Fraser (see Map 7). VandenBerg (1991) describes it as fine, blue-black and dense. There is a small disused pit on the west flank of this hill. Presumably granite occurs in the vicinity, buried under basalt. The boundary of this EIIA was adjusted to conform to geological and planning boundaries.

The previous EIIA northeast of Kilmore (Olshina & Jiricek, 1996), was deleted because the entire area of basalt outcrop is covered by current operations (WA384 and WA400) and there is no additional future potential for this rock type in the immediate vicinity.

Table 11 Extractive Industry Tenements within Mitchell Shire, MSA

Licence	Product	Operator	Status
WA 80	Basalt new	Adelaide Quarry Industries Ltd	Application Received but not Granted
WA 147	Scoria	Conundrum Holdings P/L	Currently Active
WA 384	Basalt old	Pioneer Construction Materials P/L	Currently Active
WA 400	Basalt new	Galli Quarries P/L	Currently Active
WA 1049	Sand/gravel	Chris Ryan	Currently Active

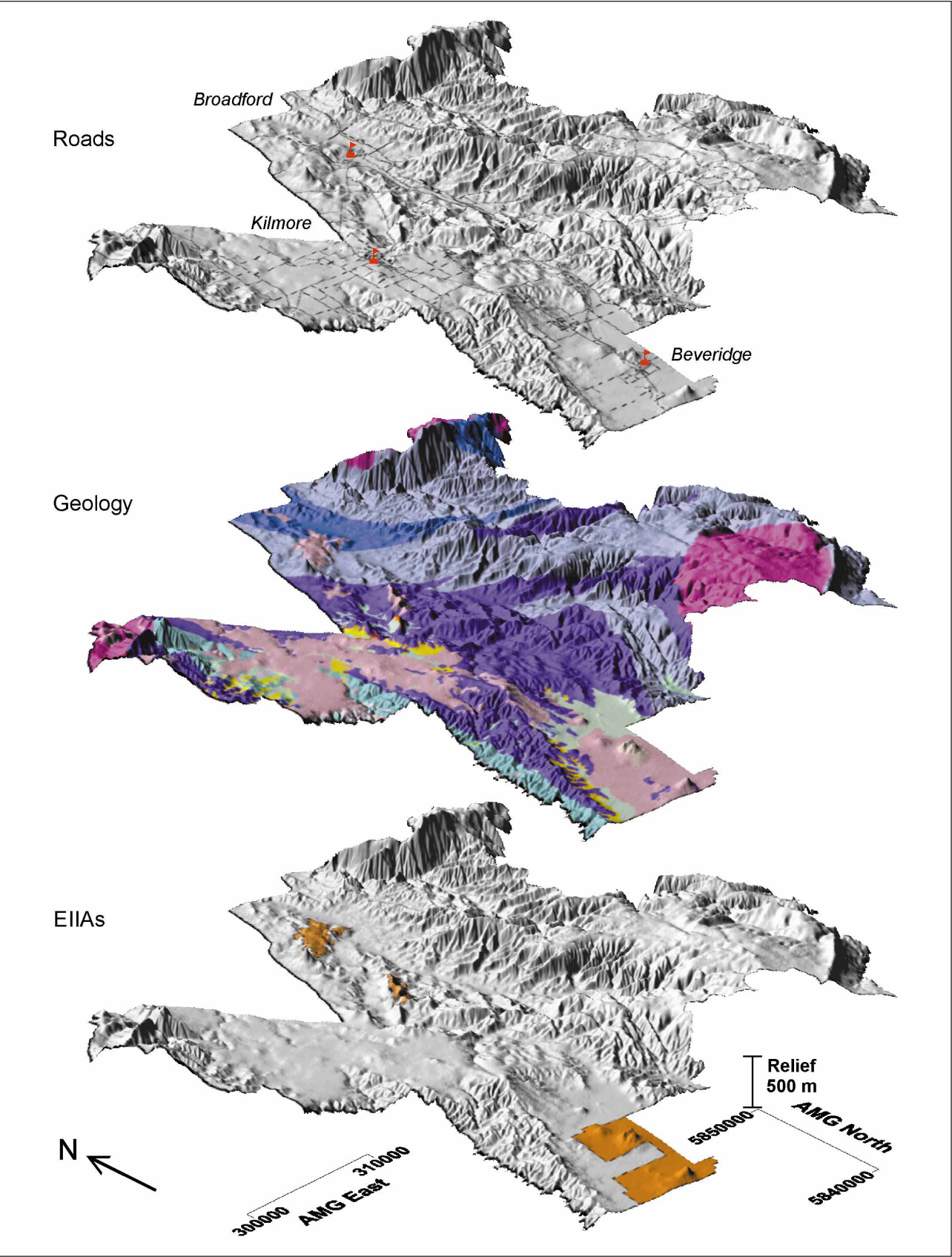


Figure 19 Stacked 3-D diagrams of the roads, geology and EIAs for Mitchell Shire within the MSA.

7.10 Moorabool Shire within the MSA

There are 13 current extractive industry operations and 1 proposed operation within this part of the shire, targeting sand, gravel and clay (see Figures 21 and 22 and Table 12).

Myrniong (VicMine Site ID 884015)

Rock type: sand and gravel.

Topography: flat to undulating.

Transport: indirect access to Western Freeway.

Geology: Tertiary fluvial sand and gravel.

Existing extractive industry: there are three current operations producing sand and gravel – WAs 273, 425 and 859.

Rationale: this EIIA contains three separate outcrops of sand and gravel with potential for future production. The sand deposit is over 30m thick and consists predominantly of medium to coarse sand and fine gravel with rare clay lenses (Roberts, 1984). The EIIA boundary was adjusted to conform to the geological boundary of this unit.

Parwan Valley North (VicMine Site ID 884018)

Rock type: Clay and sand.

Topography: undulating.

Transport: Bacchus Marsh–Geelong Road and indirect access to Western Freeway.

Geology: Tertiary Werribee Formation clay and sand.

Existing extractive industry: there are no current operations in this area, but ceramic grade clay has been extracted from this area in the past (Olshina & Hiew, 1995).

Rationale: this EIIA contains clay suitable for the production of bricks and ceramics and has additional potential for sand and gravel. The EIIA boundary was adjusted to conform to the boundary of this geological unit.

Parwan Valley South (VicMine Site ID 884024)

Rock type: Clay, sand.

Topography: undulating.

Transport: Bacchus Marsh–Geelong Road and indirect access to Western Freeway.

Geology: Tertiary clay and sand.

Existing extractive industry: there are three current operations producing clay for ceramics and brick making in this area

Rationale: this EIIA contains clay suitable for the production of bricks and ceramics and has additional potential for sand and gravel (Olshina & Hiew, 1995). The EIIA boundary was adjusted to conform to the boundary of this geological unit.

Bacchus Marsh West (VicMine Site ID 884016)

Rock type: Clay, sand.

Topography: undulating.

Transport: Access to Bacchus Marsh and indirect access to the Western Freeway.

Geology: Tertiary clay and sand.

Existing extractive industry: there are no current operations in this area

Rationale: this EIIA has potential for clay suitable for the production of bricks and ceramics and has additional potential for sand and gravel. The EIIA boundary was adjusted to conform to the boundary of this geological unit.

Bacchus Marsh (VicMine Site ID 884017)

Rock type: coal, basalt.

Topography: undulating.

Transport: Bacchus Marsh–Geelong Road and access to Western Freeway.

Geology: Newer Volcanics basalt, Tertiary brown coal.

Existing extractive industry: this area hosts an operation under the *Mineral Resources Development Act 1990* – MIN4701, extracting brown coal.

Rationale: this EIIA hosts the Maddingley brown coal deposit, which includes overburden basalt which could be utilised in the southern portion of this area. The EIIA boundary was adjusted to conform to cadastral and road boundaries.

Darley 1 (VicMine Site ID 884022)

Rock type: sand, gravel.

Topography: undulating.

Transport: Bacchus Marsh–Geelong Road and access to Western Freeway.

Geology: Tertiary sand and gravel.

Existing extractive industry: no current extractive industry.

Rationale: this EIIA hosts potential sand deposits. The EIIA boundary was adjusted to conform to geological boundaries.

Darley 2 (VicMine Site ID 884021)

Rock type: sand, gravel.

Transport: Bacchus Marsh–Geelong Road and access to Western Freeway.

Topography: undulating.

Geology: Tertiary sand and gravel.

Existing extractive industry: no current operations.

Rationale: this EIIA hosts potential sand deposits. The EIIA boundary was adjusted to conform to geological boundaries.

Darley 3 (VicMine Site ID 884023)

Rock type: sand, gravel.

Topography: undulating.

Transport: Bacchus Marsh–Geelong Road and access to Western Freeway.

Geology: Quaternary sand and gravel.

Existing extractive industry: no current extractive industry.

Rationale: this EIIA hosts potential sand deposits. The EIIA boundary was adjusted to conform to geological and cadastral boundaries.

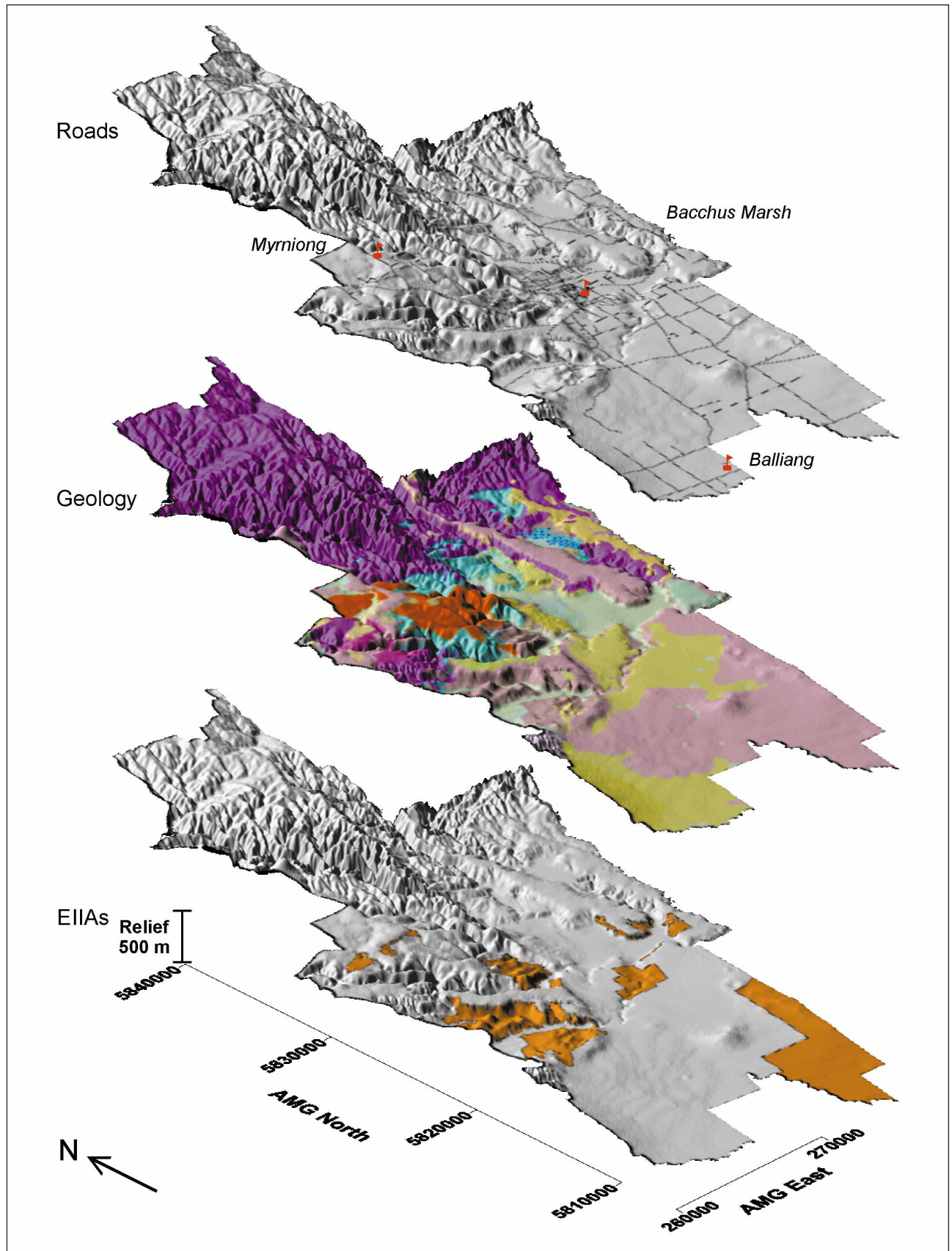


Figure 21 Stacked 3-D diagrams of the roads, geology and EIAs for Moorabool Shire within the MSA.

Little River (VicMine Site ID 884085)

Rock type: basalt.

Topography: flat to undulating.

Transport: Bacchus Marsh–Werribee Road and access to Princes Highway.

Geology: Newer Volcanics basalt.

Existing extractive industry: there are no current operations within the portion of the Little River EIIA within Moorabool Shire.

Rationale: this EIIA contains substantial resources of Newer Volcanics basalt. General parameters of sound basalt include greater than 10 meters thickness and overburden less than 5 m thick, were used to delineate basalt EIIs. The EIIA boundary was adjusted to conform to road and cadastral boundaries.

Table 12 Extractive Industry Tenements within Moorabool Shire, MSA

Licence	Product	Operator	Status
WA 35	Sand/gravel	Barro Properties P/L	Currently Active
WA 66	Clay/clayshale	Glen Iris Brick Holdings Ltd	Currently Active
WA 92	Sand/gravel	Boral Resources (Vic) P/L	Currently Active
WA 93	Sand/gravel	Barro Properties P/L	Currently Active
WA 268	Clay/clayshale	Colin Hine	Currently Active
WA 269	Clay/clayshale	Hine Bros P/L	Currently Active
WA 273	Sand/gravel	Stephen Burgin	Currently Active
WA 342	Sand/gravel	Excel Quarries P/L	Currently Active
WA 377	Sand/gravel	Pioneer Construction Materials P/L	Currently Active
WA 425	Sand/gravel	Robert J Scott	Currently Active
WA 505	Clay/clayshale	John Huntly	Currently Active
WA 859	Sand/gravel	Shire of Moorabool	Currently Active
WA 903	Sand/gravel	Cremona Nominees Application	Received but not Granted
WA 1144	Sand/gravel	Barro Properties P/L	Currently Active

7.11 Mornington Peninsula Shire

There are 11 current extractive industry operations and 1 proposed operation within the shire, mostly targeting sand, gravel, granite and clay (see Figures 23 and 24 and Table 13).

No EIAs were declared on the Mornington Peninsula even though extensive granite and sand resources occur here. Existing boreholes in the Older Volcanics basalt from Cape Schanck to Merricks North indicate a deep soil profile has developed over the area. This down-grades the potential for the establishment of a hard rock quarry in the region.

The Arthurs Seat–Mount Martha granites are the primary hard rock resource here. Arthurs Seat is a sensitive area from a visual amenity perspective and much of the Mount Martha resource has been sterilised through the expansion of housing and other land uses. Consequently, existing operations are assigned long-term planning permits rather than new Work Authorities being granted in new areas. It is unlikely that planning permits will be granted for new quarry operations.

This may have ramifications in the longer term. Currently, Hillview Quarries (WA380 and WA267) is the only local supplier of good quality crushed rock products. This may have implications for the supply of crushed rock products at a competitive price to Mornington Peninsula consumers in the future.

Currently there is no source of washed concrete sand on the Mornington Peninsula, this being derived from the Cranbourne–Langwarrin area. With the limited resource of the Cranbourne Langwarrin area in the longer term, alternative sources of concrete sand for the Mornington Peninsula will have to be investigated. Given that the closest major future sand resources are in the Lang Lang–Grantville region, the extra haulage distance from these sources to the Mornington Peninsula is likely to increase the cost to Peninsula customers.

In the longer term, increased cost of stone supplies to Mornington Peninsula customers may occur if no alternative hard rock and/or sand resource was developed locally. Geologically this is feasible, but current planning constraints make this unlikely.

Table 13 Extractive Industry Tenements within Mornington Peninsula Shire

Licence	Product	Operator	Status
WA 28	Clay/clayshale	Bayport Industries P/L	Currently Active
WA 159	Quartzite	Rockleigh Engineering P/L	Currently Active
WA 258	Sand/gravel	Barry R Hawkes	Currently Active
WA 267	Granite	Hillview Quarries P/L	Currently Active
WA 282	Sand/gravel	Clarrie Jennings & Sons P/L	Currently Active
WA 380	Granite	Hillview Quarries P/L	Currently Active
WA 965	Sand/gravel	Mornington Peninsula Shire Council	Currently Active
WA 1039	Clay/clayshale	Gavin Perry	Currently Active
WA 1043	Sand/gravel	Allan John Bond	Currently Active
WA 1093	Soil	D H Industries	Currently Active
WA 1117	Clay/clayshale	Select Contractors P/L	Proposal for an Application
WA 1162	Clay/clayshale	Grosvenor Lodge P/L	Currently Active

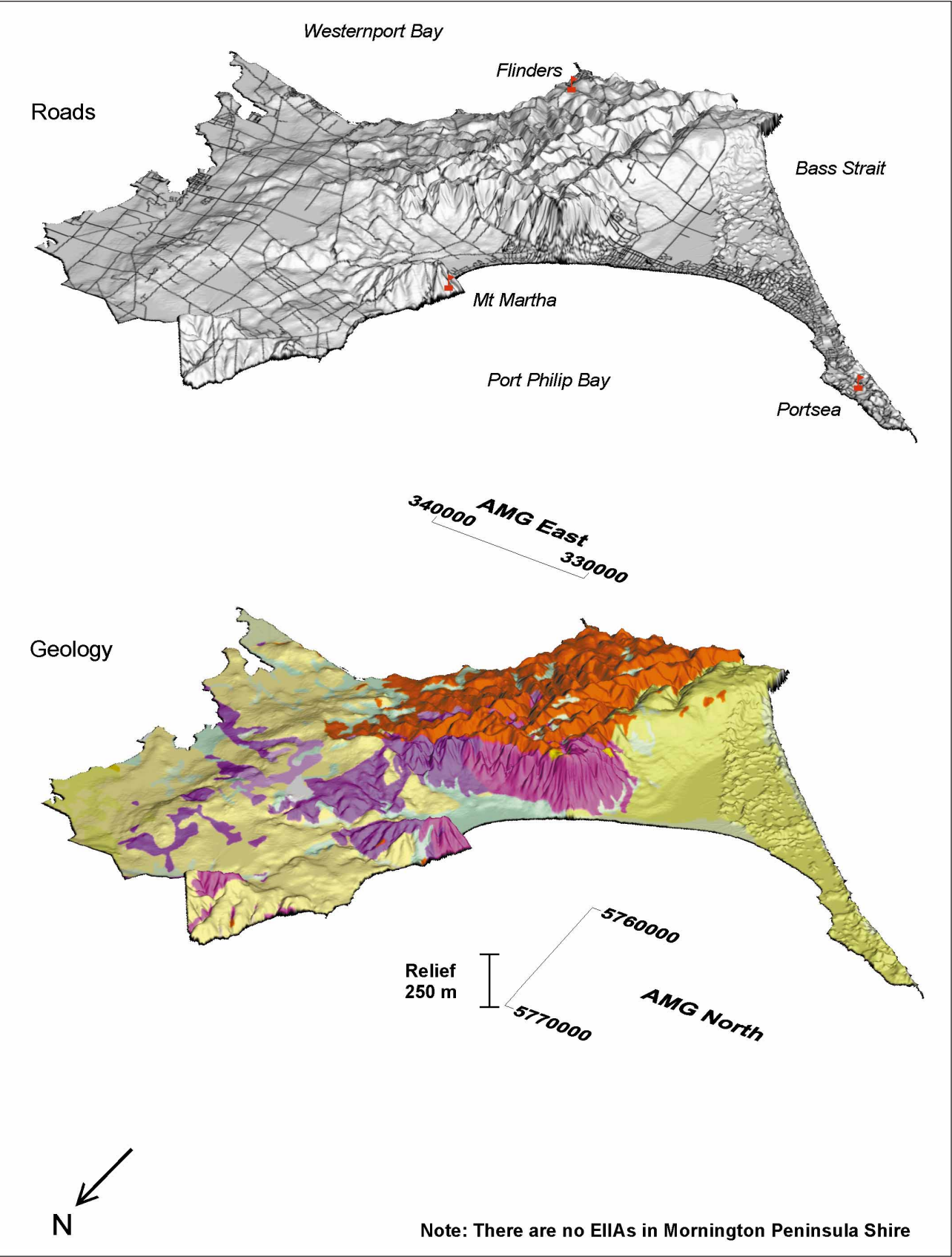


Figure 23 Stacked 3-D diagrams of the roads, geology and EIAs for Mornington Peninsula Shire.

7.12 Murrindindi Shire within the MSA

There are 7 current extractive industry operations and 2 proposed operations within this part of the shire, targeting sand, gravel and hard rock (see Figures 25 and 26 and Table 14).

Castella (VicMine Site ID 884128)

Rock types: hornfels, slate, granodiorite, rhyolite/rhyodacite, sandstone, sand and gravel.

Topography: mountainous.

Transport: main road is the Melba Highway.

Geology: Black Range Granodiorite, Rubicon Rhyolite and the surrounding metamorphic aureole. Includes some Quaternary alluvial valley fill.

Existing extractive industry: hornfels is extracted from a quarry (WA522) near Castella on the Melba Highway, about 18 km north of Yarra Glen. Sand and gravel is extracted from WA732 (about 12 km east of Yea).

Rationale: the area has potentially good hard rock resources and is large because there are few planning constraints in this mountainous, sparsely developed region. Too little is known about the rock quality to refine the area further, although airborne geophysical information acquired since the 1996 report was published, as well as information provided by A. VandenBerg and M. Garratt (*pers. comm.*), has allowed some adjustment to be made to the boundary of this area in the vicinity of Glenburn. The development of these resources is constrained by access and transport distance. Areas close to the main highways have already been targeted by industry ie, the hornfels quarry and application on the Melba Highway near Castella. The boundaries of the EIAs have also been adjusted to better conform to currently available cadastral boundaries, roads and geological boundaries.

Goulburn River Valley (VicMine Site ID 884009)

Rock types: sand and gravel.

Topography: flat.

Transport: main road is the Goulburn Valley Highway, with access to the Melba Highway.

Geology: Quaternary alluvial valley fill.

Existing extractive industry: Sand and gravel is extracted from WA45, WA516 and WA141 in the valley of the Goulburn River north of Yea.

Rationale: this EIA was significantly expanded following new resource information provided by Bell Cochrane & Associates (*pers. comm.*), which indicates that the Goulburn River floodplain may have greater potential for sand and gravel than previously recognised, which may be an important local resource for the future. The boundaries of this EIA have been defined by cadastral boundaries, roads and geological boundaries.

The previous EIA surrounding WA200 was removed in accordance with current criteria for determining EIAs surrounding single operations.

Table 14 Extractive Industry Tenements within Murrindindi Shire, MSA

Licence	Product	Operator	Status
WA 45	Sand/gravel	Yea Sand & Gravel P/L	Currently Active
WA 141	Sand/gravel	Killingworth Quarries P/L	Currently Active
WA 200	Slate	Charles Davis	Currently Active
WA 214	Sand/gravel	D A Drysdale	Currently Active
WA 516	Sand/gravel	Charles Davis	Currently Active
WA 522	Hornfels	Frank Phillips	Currently Active
WA 732	Sand/gravel	Ray Cooper	Currently Active
WA 913	Sedimentary	Hancock Victorian Plantations P/L	Application Received but not Granted
WA 1138	Sedimentary	Shire of Murrindindi	Proposal for an Application
WA 1114	Sedimentary	DNRE	Proposal for an Application

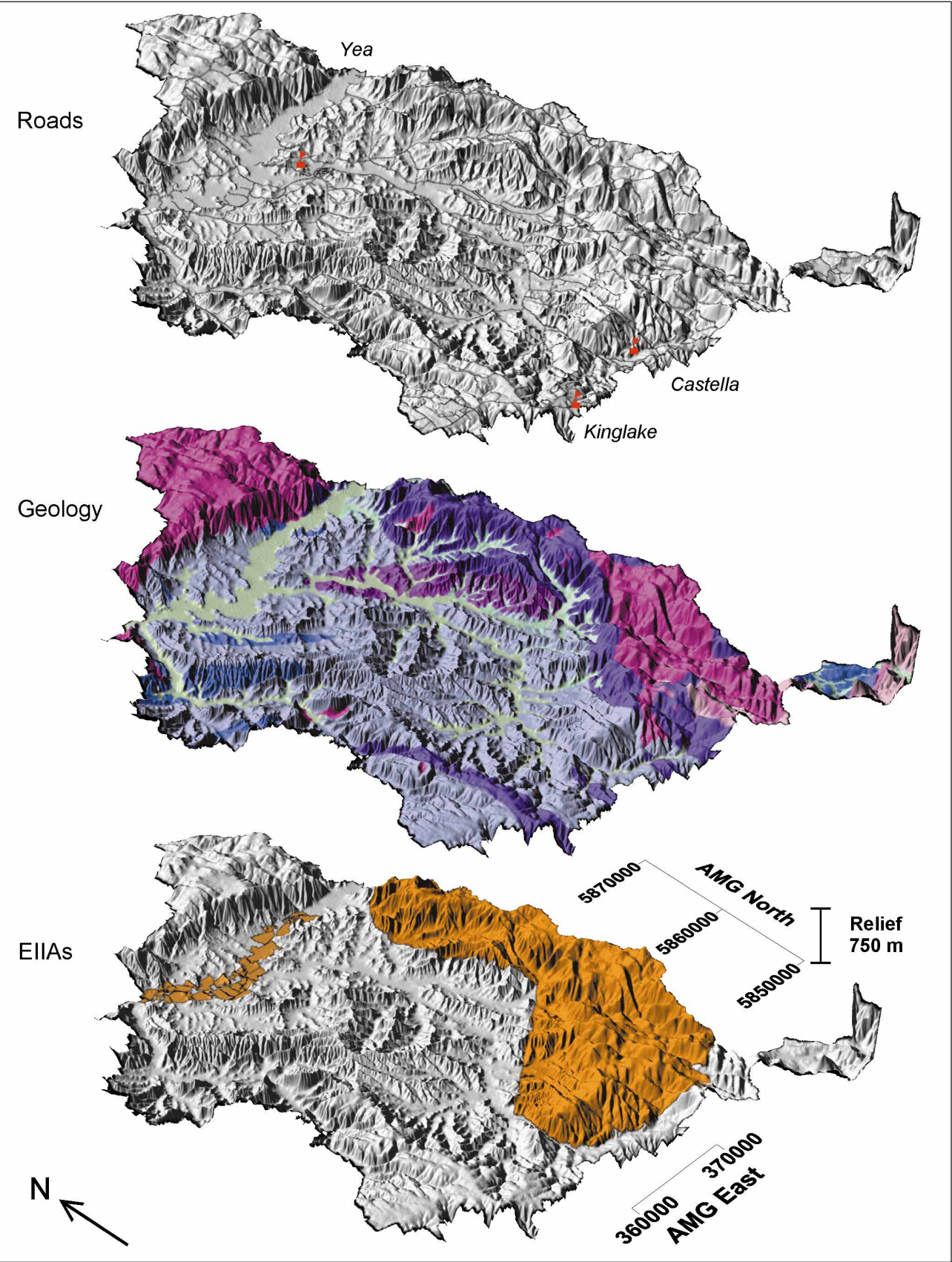


Figure 25 Stacked 3-D diagrams of the roads, geology and EIAs for Murrindindi Shire within the MSA.

7.13 South Gippsland Shire within the MSA

There are 5 current extractive industry operations and 1 proposed operation within this part of the shire, most targeting sand and gravel (see Figures 27 and 28 and Table 15).

Leongatha South (VicMine Site ID 883993)

Rock type: sand, gravel, basalt.

Topography: level and gently undulating.

Transport: reasonable roads provide access to the EIIA. The region is a relatively long distance from Melbourne, 160 km via Leongatha or 145 km via Wonthaggi. This long haul distance will inhibit large scale utilisation of this resource in the short to medium term.

Geology: extensive Tertiary sand sheets extend from Leongatha South to Inverloch. Only broadly spaced boreholes have been drilled over the area, so there is little detailed knowledge of the total available sand resource. Some small areas of Older Volcanics basalt were also included.

Existing extractive industry: none.

Rationale: the large area of favourable geology makes this an area with potential for sand resources. The boundary of the EIIA portion within South Gippsland Shire was adjusted to conform to the geological boundary of the Haunted Hills Gravel.

Ruby (VicMine Site ID 884001)

Rock type: basalt.

Topography: undulating.

Transport: easy access to the South Gippsland Highway. This long haul distance will inhibit large scale utilisation of this resource in the short to medium term, for other than local use.

Geology: Older Volcanics basalt.

Existing extractive industry: none.

Rationale: this area has potential for hard rock near a major transport corridor. The boundary of the EIIA was adjusted to conform to cadastral boundaries.

Lang Lang (VicMine Site ID 884122)

Rock type: sand and gravel.

Topography: level to gently undulating.

Transport: a good road network in the area provides access to the nearby South Gippsland Highway. The South Gippsland railway line also runs close to the EIIA.

Geology: Tertiary/Quaternary sand resources within the EIIA were defined on the basis of drilling conducted by McHaffie (1978). The Tertiary economic sand unit belongs to the Baxter Formation and represents braided river deposits that roughly correspond to the present Lang Lang and Little Lang Lang Rivers. Fine to coarse sand is present together with minor interbedded clay. Palynological analysis of one of the bores indicates that the sediments are mid Eocene to early Oligocene in age. The Tertiary deposits are overlain by Quaternary aeolian dune ridges trending northwest to southeast and high level river terraces. These deposits are thickest where they bank up against the Wellington Fault.

Existing extractive industry: there are three current operations extracting sand and gravel in the Lang Lang EIIA within South Gippsland shire, including that of ACI Operations P/L (WA2) and Unimin Australia Ltd (WA423).

Rationale: the large sand deposits in the Lang Lang region have already been recognised as a future major source of sand to the MSA with the declaration of the *Regional Sand Extraction Strategy – Lang Lang to*

Grantville and the change in the planning scheme to allow extractive industry with the consent of the responsible authority. Declaring this EIIA ensures uniformity of protection of resources. The EIIA boundary was adjusted to better conform to currently available cadastral and planning boundaries, roads and geological boundaries and incorporated new resource information provided by Bell Cochrane & Associates (*pers. comm.*).

Nyora (VicMine Site ID 884121)

Rock type: sand and gravel.

Topography: level to gently undulating.

Transport: a good road network in the area provides access to the nearby South Gippsland Highway. The South Gippsland railway line also runs close to the EIIA.

Geology: Tertiary/Quaternary sand resources within the EIIA were defined on the basis of drilling conducted by McHaffie (1978). The Tertiary economic sand unit belongs to the Baxter Formation and represents braided river deposits that roughly correspond to the present Lang Lang and Little Lang Lang Rivers. Fine to coarse sand is present together with minor interbedded clay. Palynological analysis of one of the bores indicates that the sediments are mid Eocene to early Oligocene in age. The Tertiary deposits are overlain by Quaternary aeolian dune ridges trending northwest to southeast and high level river terraces. These deposits are thickest where they bank up against the Wellington Fault.

Existing extractive industry: there are two current operations extracting sand and gravel in the Nyora EIIA within South Gippsland shire—WA157 and WA1102. In addition there is one Extractive Search Permit and one proposal for a Work Authority in the South Gippsland portion of this EIIA.

Rationale: the large sand deposits in the Lang Lang region have already been recognised as a future major source of sand to the MSA with the declaration of the *Regional Sand Extraction Strategy, Lang Lang to Grantville*. Declaring this EIIA ensures resources are available for the future. The EIIA boundary was adjusted to better conform to currently available cadastral and planning boundaries, roads and geological boundaries and incorporated new resource information provided by Bell Cochrane & Associates (*pers. comm.*).

Table 15 Extractive Industry Tenements within South Gippsland Shire, MSA

Licence	Product	Operator	Status
ESP 176	Sand/gravel	G A & K F Morrison P/L Application	Received but not Granted
WA 2	Sand/gravel	ACI Operations P/L	Currently Active
WA 157	Sand/gravel	Gary A Morrison	Currently Active
WA 333	Sand/gravel	Glenister McGregor	Currently Active
WA 423	Sand/gravel	Unimim Australia Ltd	Currently Active
WA 1102	Soil	G A & K F Morrison P/L	Currently Active
WA 1104	Sand/gravel	Railway Sand Supplies Pty Ltd	Proposal for an Application

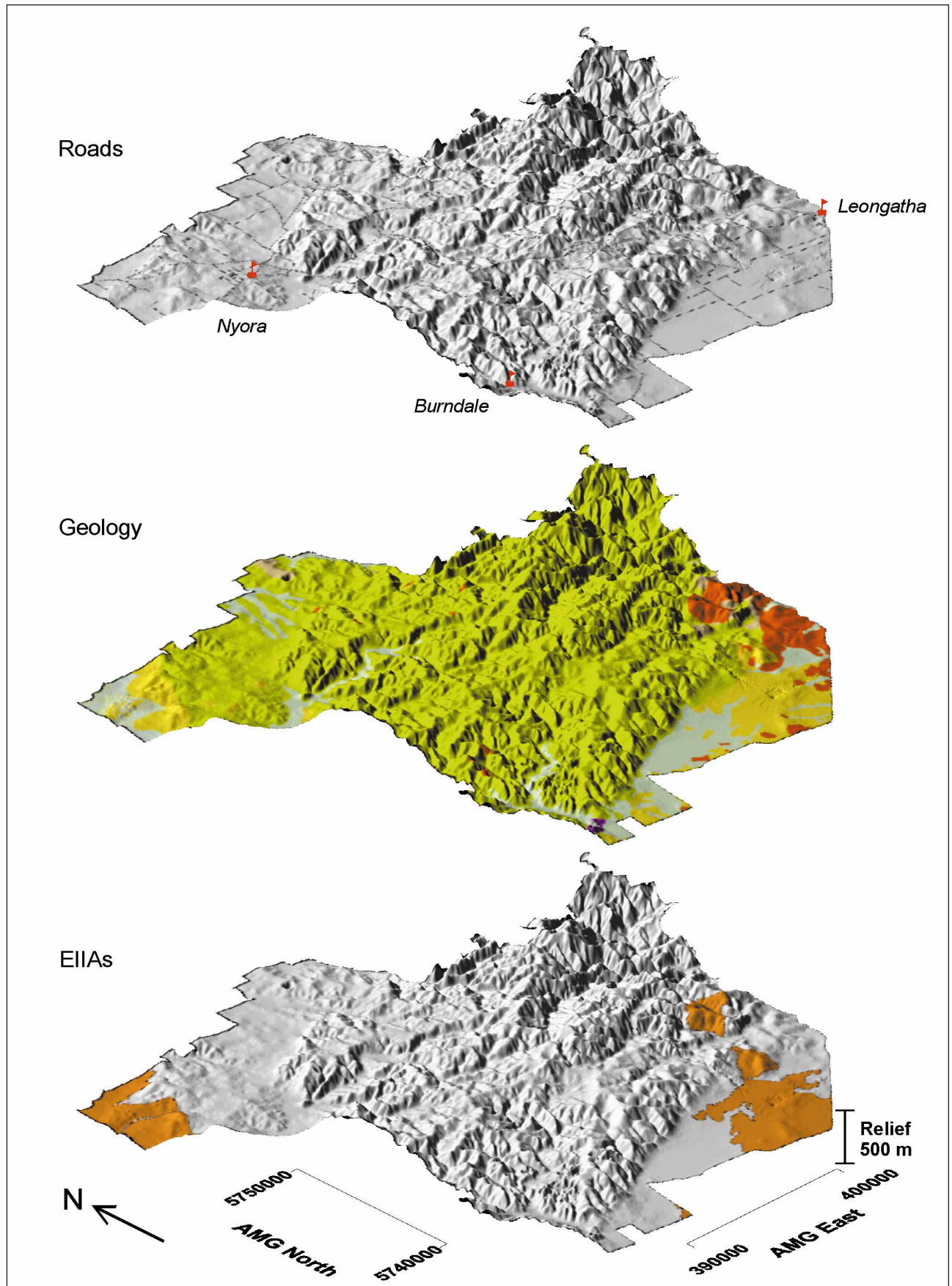


Figure 27 Stacked 3-D diagrams of the roads, geology and EIAs for South Gippsland Shire within the MSA.

7.14 Whittlesea City

There are 11 current extractive industry operations and 2 proposed operations within the shire, mostly targeting basalt and clay (see Figures 29 and 30 and Table 16).

Beveridge (VicMine Site ID 884011)

Rock type: basalt, scoria, sedimentary rock.

Topography: undulating.

Transport: good access to Hume Highway.

Geology: Newer Volcanics basalt and Palaeozoic sedimentary rocks.

Existing extractive industry: there are two current operations, the Woody Hill (WA192) Palaeozoic sedimentary rock, mainly for use as road base and WA160, which produces basalt.

Rationale: there is potential for the production of basalt from this area for the long term, to replace that currently being produced in the operations to the south of this EIIA. The boundary of this EIIA was adjusted to conform to geological, cadastral and planning boundaries.

Table 16 Extractive Industry Tenements within Whittlesea City

Licence	Product	Operator	Status
WA 68	Clay/clayshale	Boral Bricks (Vic) P/L	Currently Active
WA 102	Hornfels	Boral Resources (Vic) P/L	Currently Active
WA 110	Clay/clayshale	Nubrik P/L	Currently Active
WA 117	Clay/clayshale	Nubrik P/L	Currently Active
WA 149	Basalt new	Conundrum Holdings P/L	Currently Active
WA 160	Basalt new	CSR Ltd	Currently Active
WA 381	Basalt new	Pioneer Construction Materials P/L	Currently Active
WA 393	Basalt new	Pioneer Construction Materials P/L	Currently Active
WA 445	Basalt new	Conundrum Holdings P/L	Currently Active
WA 492	Sedimentary	Woodyhill Extractive Industries P/L	Currently Active
WA 600	Soil	Ken Junor	Currently Active
WA 658	Basalt old	Tom Love	Proposal for an Application
WA 1106	Sedimentary	City of Whittlesea	Proposal for an Application

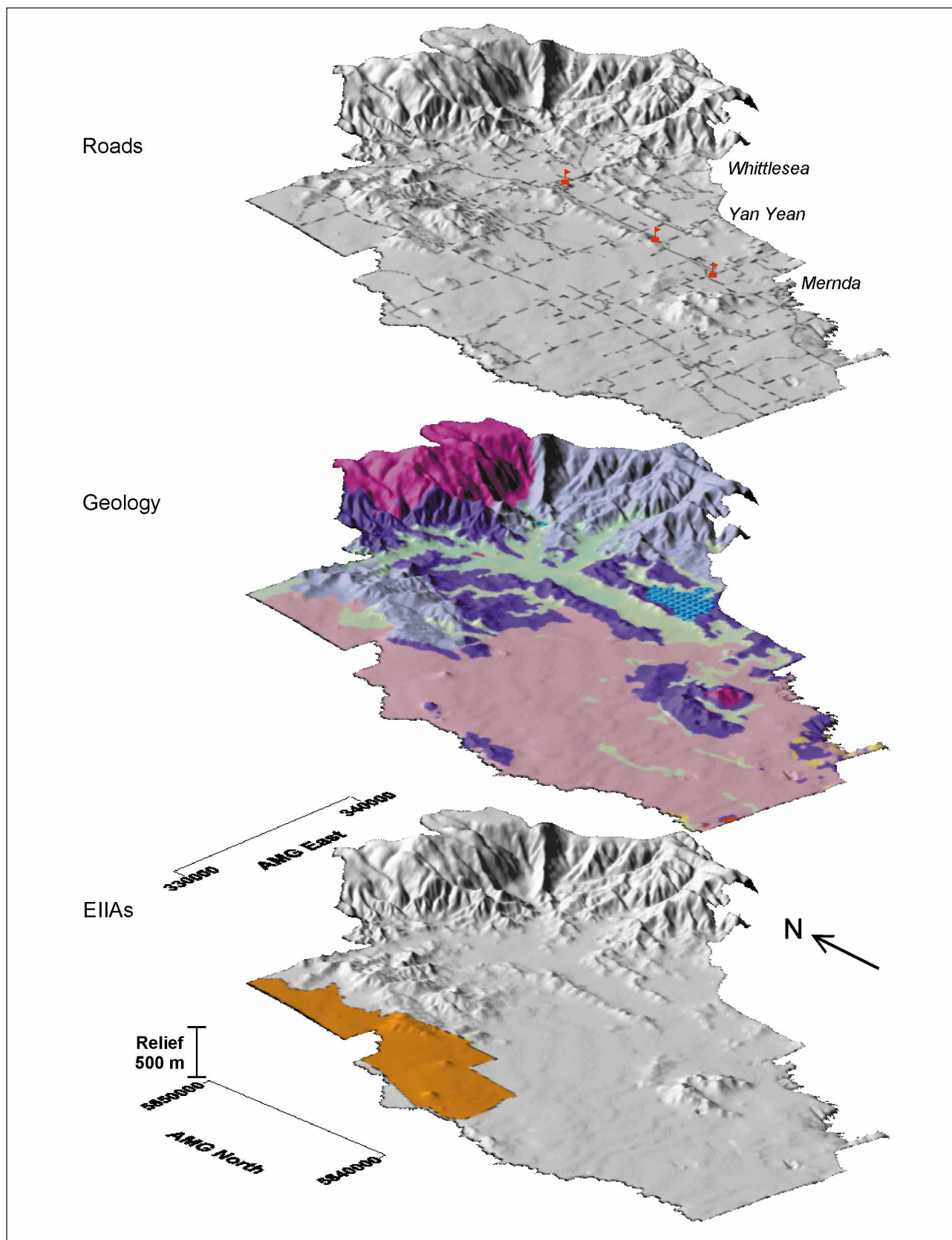


Figure 29 Stacked 3-D diagrams of the roads, geology and EIAs for Whittlesea City.

7.15 Wyndham City

There are 6 current extractive industry operations and 1 proposed operation within the shire, targeting basalt and soil (see Figures 31 and 32 and Table 17).

Little River (VicMine Site ID 884085)

Rock type: basalt.

Topography: flat to undulating.

Transport: Bacchus Marsh–Werribee Road and access to Princes Highway.

Geology: Newer Volcanics basalt.

Existing extractive industry: there are five current operations and one proposal within the portion of the Little River EIIA within Wyndham Shire, all targeting Newer Volcanics basalt.

Rationale: this EIIA contains substantial resources of Newer Volcanics basalt. General parameters of sound basalt include greater than 10 m thickness and overburden less than 5 m thick, were used to delineate basalt EIAs. The EIIA boundary was adjusted to conform to road, planning and cadastral boundaries. The land to the south of Princes Highway is Melbourne Water's Werribee Treatment Plant. This area is zoned Special Use Zone 1 (SUZ1). While the SUZ does not prohibit extractive industry, it is extremely unlikely that extractive industry would be permitted in this area. This SUZ extends north of the highway, where it is included in the EIIA. This part of the SUZ has not been included in the prohibited layer.

Table 17 Extractive Industry Tenements within Wyndham City

Licence	Product	Operator	Status
WA 43	Basalt new	Barro Group P/L	Currently Active
WA 184	Basalt new	CSR Ltd	Currently Active
WA 186	Basalt new	Barro Group P/L	Currently Active
WA 297	Soil	John M Kilpatrick	Currently Active
WA 420	Basalt new	CSR	Construction Materials Currently Active
WA 509	Basalt new	Pioneer Construction Materials P/L	Proposal for an Application
WA 610	Soil	Robert Emmins	Currently Active

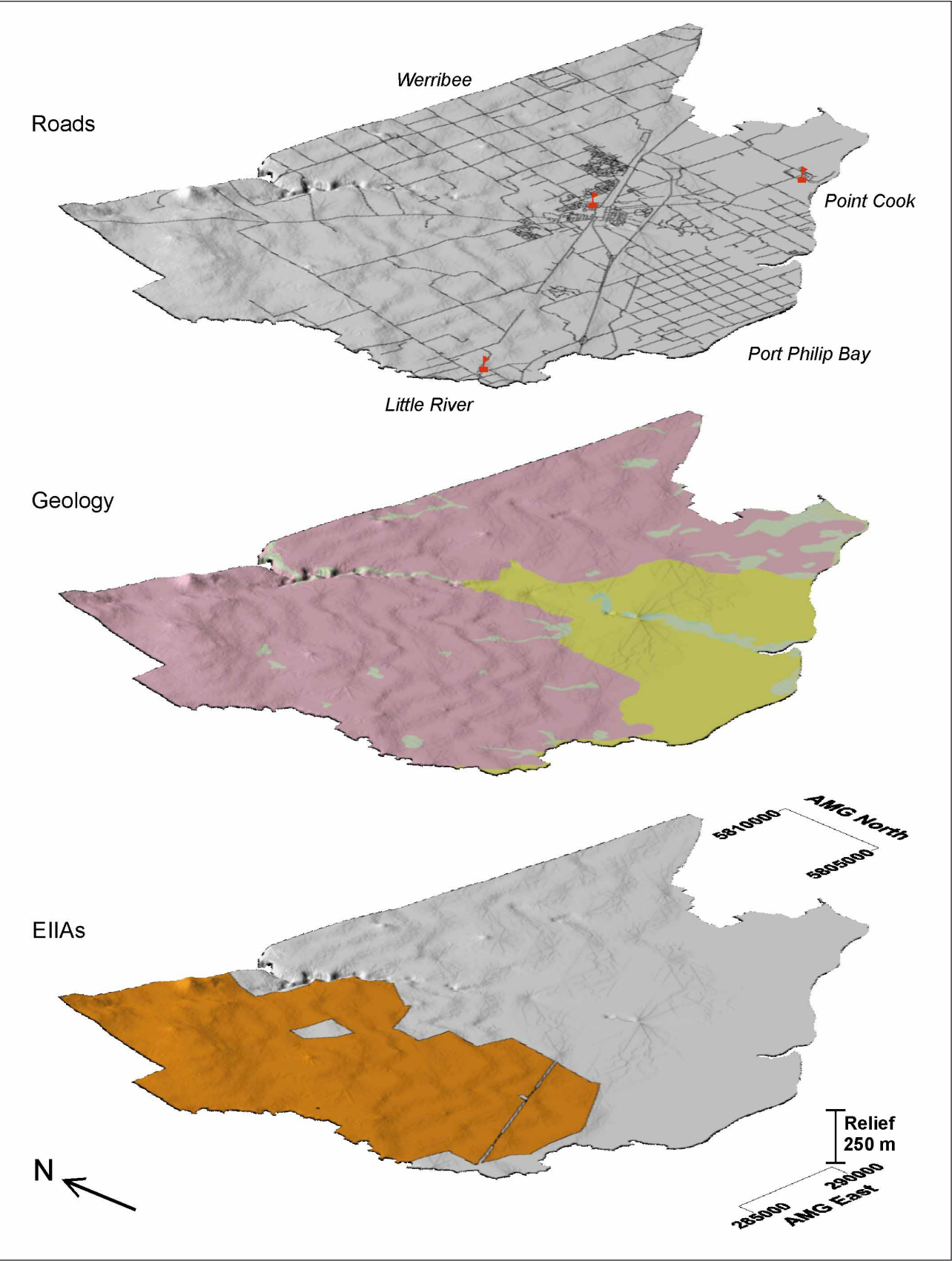


Figure 31 Stacked 3-D diagrams of the roads, geology and EIAs for Wyndham City.

7.16 Yarra Ranges Shire within the MSA

There are 5 current extractive industry operations and one proposed operation within this part of the shire, targeting hard rock, limestone and clay (see Figures 33 and 34 and Table 18).

An area near Kallista was identified by Bell Cochrane & Associates (*pers. comm.*) as having potential for hard rock resources. However, this area also contains significant landscape and environmental values. Much of Yarra Ranges Shire is covered by a Regional Strategy Plan that specifically directs planning controls to recognise the environmental values of the area. As a result, no EIAs have been declared for Yarra Ranges Shire.

Table 18 Extractive Industry Tenements within Yarra Ranges Shire, MSA

Licence	Product	Operator	Status
WA 96	Clay/clayshale	Boral Resources (Vic) P/L	Currently Active
WA 100	Rhyodacite	Boral Resources (Vic) P/L	Currently Active
WA 199	Limestone	David Mitchell (Victoria) P/L	Currently Active
WA 350	Clay/clayshale	CSR Construction Materials	Currently Active
WA 375	Quartzite	Hornfeld Resources P/L	Currently Active
WA 1100	Sand/gravel	A & J Bond	Proposal for an Application

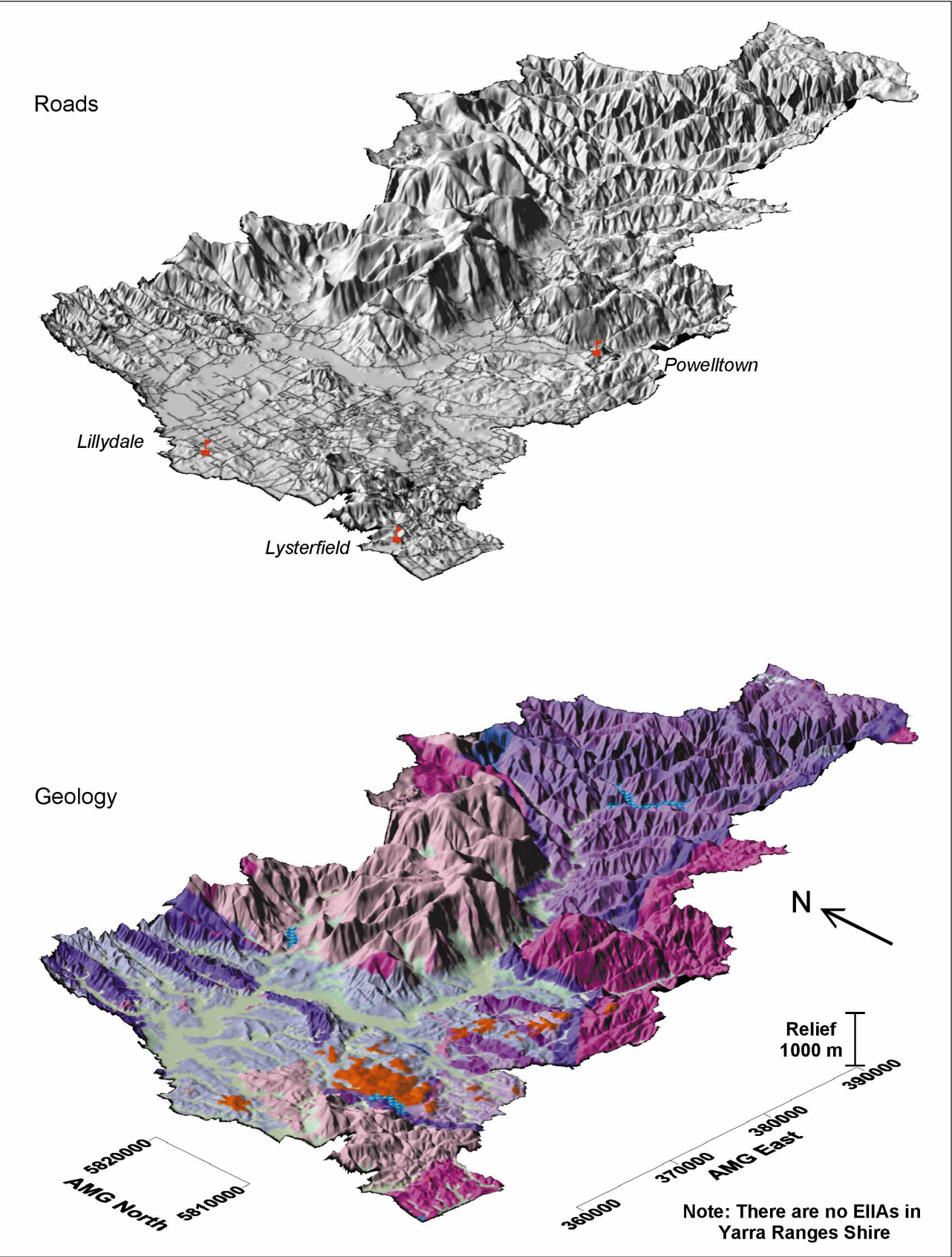


Figure 33 Stacked 3-D diagrams of the roads, geology and EIAs for Yarra Ranges Shire within the MSA.

8 Recommendations

- Further investigations, including drilling, should be actively encouraged within EIAs presented in this report in order to further refine the stone potential within these areas. The results of new investigations outside established EIAs should be noted for future EIA reviews.
- That EIAs be identified as overlay controls in planning schemes.
- A review of the effectiveness of the EIA model should be conducted on an ongoing basis.
- Municipal councils should be encouraged to further integrate the EIAs into local strategic planning.
- Non-geological criteria used for refining the EIAs should be regularly reviewed to incorporate improved information and changing community values.
- DPI should develop planning guidelines for EIAs to protect current extractive industries from incompatible land-uses and to ensure that sand and stone resources within EIAs are available for the future.
- DSE in conjunction with DPI should update the *Regional Sand Extraction Strategy – Lang Lang to Grantville* study area to reflect changes to the EIA boundaries.
- DSE in conjunction with DPI should update the Victoria Planning Provisions to reference this revised report.
- DPI and DSE should ensure that the findings of this report are adequately addressed in the implementation of Melbourne 2030.

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Appendix 1

List of Contributors

Contributor	Organisation
Mr Richard Perry, Planning Manager	Bass Coast Shire
Mr Syd Deam, Town Planner	Baw Baw Shire Council
Mr Basil Natoli	Bell, Cochrane & Associates
Mr Philip Walton, Manager Strategic Planning	Cardinia Shire Council
Mr Halvard Delheim, Planning Manager	Casey City Council
Ms Susan Williamson, Urban Planner	City of Greater Geelong
Mr Chris De Silva, Manager Strategic Planning and Mr Darren Jackson, Strategic Planner	City of Whittlesea
Mr Basil Natoli, for	Construction Material Processors Association
Mr Peter Allen, Ms Alison Harris and Ms Paula O'Byrne, Planning Systems Unit	Department of Sustainability and Environment
Mr Douglas Browning, Secretary	Extractive Industries Association of Victoria Inc
Mr Philip Westwood	Friends of Bass Valley Group
Ms Joy Carberry, President	Friends of RJ Chambers Flora and Fauna Reserve Inc
Mr Michael Sharp, Planning Manager	Hume City Council
Mr Tom Love, Principal	Love Pastoral Industries
Ms Coral Young, Senior Planner	Macedon Ranges Shire Council
Mr Luke Shannon, Town Planner and Mr Robert Szymanski, Senior Town Planner	Melton Shire Council
Mr Ian Scholes, Planning Manager	Mitchell Shire Council
Mr Jack Green, Shire Development Officer and Mr Jason Taylor, Town Planner	Moorabool Shire Council
Ms Karen Girvan, Town Planner	Murrindindi Shire Council
Mr David Grace, Senior Statutory Planner	Port Phillip Region, Department of Sustainability and Environment
Mr Fedir Woskoboenko, President	Quarry Impact Association
Mr Garth Monseair, Secretary	Quarry Impact Association
Mr Leigh Street, Business Development Manager	Readymix Holdings Pty Ltd
Mr Don Petty	Resident – Pakenham
Mr & Mrs Waterhouse	Residents – Pakenham
Ms Sue Robinson, Secretary	Save the Valley Committee
Mr Kris Hansen, Strategic Planner and Mr Ian Gibson, Director of Sustainability	Shire of Yarra Ranges
Mr Rob Hutchinson, Town Planner and Ms Julianne Hill, Town Planner	South Gippsland Shire
Ms Kerry Hart, President	Toomuc Land Care
Mr Anthony Hooper, President	Tynong North Community Affairs Inc
Mrs L Levens, Secretary	Upper Beaconsfield Conservation Group
Mr Peter Van Til, Manager Town Planning	Wyndham City Council

Appendix 2

Extractive industry tenements, Melbourne Supply Area, October, 2002

Ordered by product type

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 41	133.3	Basalt new	Currently Active	Greater Geelong City	Barro Group P/L
WA 43	250.1	Basalt new	Currently Active	Wyndham City	Barro Group P/L
WA 80	104.0	Basalt new	Application Received but not Granted	Mitchell Shire	Adelaide Quarry Industries Ltd
WA 97	1104.7	Basalt new	Currently Active	Melton Shire	Boral Resources (Vic) P/L
WA 149	40.2	Basalt new	Currently Active	Whittlesea City	Conundrum Holdings P/L
WA 160	212.3	Basalt new	Currently Active	Whittlesea City	CSR Ltd
WA 165	110.7	Basalt new	Currently Active	Greater Geelong City	CSR Ltd
WA 184	178.0	Basalt new	Currently Active	Wyndham City	CSR Ltd
WA 186	173.1	Basalt new	Currently Active	Wyndham City	Barro Group P/L
WA 278	158.3	Basalt new	Currently Active	Greater Geelong City	Jalna Nominees P/L
WA 346	43.8	Basalt new	Currently Active	Melton Shire	Excel Quarries P/L
WA 381	293.7	Basalt new	Currently Active	Whittlesea City	Pioneer Construction Materials P/L
WA 393	327.0	Basalt new	Currently Active	Whittlesea City	Pioneer Construction Materials P/L
WA 400	504.0	Basalt new	Currently Active	Mitchell Shire	Galli Quarries P/L
WA 420	253.0	Basalt new	Currently Active	Wyndham City	CSR Construction Materials
WA 440	84.1	Basalt new	Currently Active	Melton Shire	Stella Farm P/L
WA 445	38.7	Basalt new	Currently Active	Whittlesea City	Conundrum Holdings P/L
WA 509	382.9	Basalt new	Proposal for an Application	Wyndham City	Pioneer Construction Materials P/L
WA 578		Basalt new	Proposal for an Application	Hume City	Whitsunday Crushers Pty Ltd
WA 816	0.0	Basalt new	Application Received but not Granted	Macedon Ranges Shire	Vic Roads
WA 980	8.0	Basalt new	Currently Active	Greater Geelong City	Kesselhill P/L
WA 128	46.0	Basalt old	Currently Active	Baw Baw Shire	Baw Baw Shire
WA 174	75.8	Basalt old	Currently Active	Cardinia Shire	CSR Ltd
WA 211	8.5	Basalt old	Currently Active	Bass Coast Shire	Defor P/L
WA 237	7.4	Basalt old	Currently Active	Baw Baw Shire	Eileen E Gourley
WA 382	59.6	Basalt old	Currently Active	Casey City	Pioneer Construction Materials P/L
WA 384	456.6	Basalt old	Currently Active	Mitchell Shire	Pioneer Construction Materials P/L

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 388	38.3	Basalt old	Currently Active	Casey City	Pioneer Construction Materials P/L
WA 515	81.3	Basalt old	Currently Active	Melton Shire	Excel Quarries P/L
WA 658	145.0	Basalt old	Proposal for an Application	Whittlesea City	Tom Love
WA 659		Basalt old	Proposal for an Application	Melton Shire	Paul Galea
WA 779	16.5	Basalt old	Currently Active	Baw Baw Shire	Dept of NRE
ESP 177	53.4	Clay/clayshale	Application Received but not Granted	Bass Coast Shire	Lebony P/L
WA 28	28.5	Clay/clayshale	Currently Active	Mornington Peninsula Shire	Bayport Industries P/L
WA 44	11.5	Clay/clayshale	Currently Active	Hume City	Malcolm Sinclair
WA 64	31.2	Clay/clayshale	Currently Active	Baw Baw Shire	Boral Bricks (Vic) P/L
WA 65	36.5	Clay/clayshale	Currently Active	Cardinia Shire	Glen Iris Brick Holdings Ltd
WA 66	115.6	Clay/clayshale	Currently Active	Moorabool Shire	Glen Iris Brick Holdings Ltd
WA 67	172.7	Clay/clayshale	Currently Active	Knox City	Boral Bricks (Vic) P/L
WA 68	42.1	Clay/clayshale	Currently Active	Whittlesea City	Boral Bricks (Vic) P/L
WA 96	31.3	Clay/clayshale	Currently Active	Yarra Ranges Shire	Boral Resources (Vic) P/L
WA 108	18.9	Clay/clayshale	Currently Active	Whitehorse City	Reading Properties P/L
WA 109	19.4	Clay/clayshale	Currently Active	Hume City	Nubrik P/L
WA 110	262.4	Clay/clayshale	Currently Active	Whittlesea City	Nubrik P/L
WA 111	38.9	Clay/clayshale	Currently Active	Casey City	Nubrik P/L
WA 112	37.2	Clay/clayshale	Currently Active	Baw Baw Shire	Nubrik P/L
WA 113	20.2	Clay/clayshale	Currently Active	Casey City	Nubrik P/L
WA 115	23.9	Clay/clayshale	Currently Active	Knox City	Nubrik P/L
WA 116	56.0	Clay/clayshale	Currently Active	Knox City	Nubrik P/L
WA 117	276.7	Clay/clayshale	Currently Active	Whittlesea City	Nubrik P/L
WA 190	62.6	Clay/clayshale	Currently Active	Casey City	Daniel Robertson P/L
WA 191	8.9	Clay/clayshale	Currently Active	Knox City	Robertson Industries P/L
WA 192	4.7	Clay/clayshale	Currently Active	Whitehorse City	Daniel Robertson P/L

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 265	4.8	Clay/clayshale	Currently Active	Cardinia Shire	James Hicks P/L
WA 268	7.1	Clay/clayshale	Currently Active	Moorabool Shire	Colin Hine
WA 269	72.8	Clay/clayshale	Currently Active	Moorabool Shire	Hine Bros P/L
WA 350	82.2	Clay/clayshale	Currently Active	Yarra Ranges Shire	CSR Construction Materials
WA 441	62.7	Clay/clayshale	Currently Active	Casey City	Stevenson Bros Industries P/L
WA 444	9.4	Clay/clayshale	Currently Active	Casey City	Darley Refractories P/L
WA 505	19.3	Clay/clayshale	Currently Active	Moorabool Shire	John Huntly
WA 1039	23.0	Clay/clayshale	Currently Active	Mornington Peninsula Shire	Gavin Perry
WA 1117	1.5	Clay/clayshale	Proposal for an Application	Mornington Peninsula Shire	Select Contractors P/L
WA 1162	12.0	Clay/clayshale	Currently Active	Mornington Peninsula Shire	Grosvenor Lodge P/L
WA 25	250.1	Granite	Currently Active	Cardinia Shire	Astec P/L
WA 176	315.7	Granite	Currently Active	Hume City	CSR Construction Materials
WA 182	43.8	Granite	Currently Active	Cardinia Shire	CSR Ltd
WA 267	68.1	Granite	Currently Active	Mornington Peninsula Shire	Hillview Quarries P/L
WA 380	18.1	Granite	Currently Active	Mornington Peninsula Shire	Hillview Quarries P/L
WA 385	76.5	Granite	Currently Active	Knox City	Pioneer Construction Materials P/L
WA 1159	4.9	Granite	Proposal for an Application	Cardinia Shire	Lodge Bros P/L
WA 99	78.5	Hornfels	Currently Active	Knox City	Boral Resources (Vic) P/L
WA 102	100.0	Hornfels	Currently Active	Whittlesea City	Boral Resources (Vic) P/L
WA 189	31.1	Hornfels	Currently Active	Baw Baw Shire	J H Cuthbertson P/L
WA 522	91.6	Hornfels	Currently Active	Murrindindi Shire	Frank Phillips
WA 896	0.0	Hornfels	Application Received but not Granted	Cardinia Shire	Hillview Quarries P/L
WA 969		Hornfels	Proposal for an Application	Macedon Ranges Shire	Graeme J Wright
WA 3	902.6	Limestone	Currently Active	Greater Geelong City	Adelaide Brighton Cement Ltd
WA 198	32.6	Limestone	Currently Active	Greater Geelong City	Lara Lime P/L
WA 199	123.6	Limestone	Currently Active	Yarra Ranges Shire	David Mitchell (Victoria) P/L

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 462	180.5	Peat	Currently Active	Baw Baw Shire	Tweddle Estates P/L
WA 159	5.6	Quartzite	Currently Active	Mornington Peninsula Shire	Rockleigh Engineering P/L
WA 209	15.6	Quartzite	Currently Active	Manningham City	City of Manningham
WA 375	90.1	Quartzite	Currently Active	Yarra Ranges Shire	Hornsfield Resources P/L
WA 100	57.6	Rhyodacite	Currently Active	Yarra Ranges Shire	Boral Resources (Vic) P/L
ESP 176	210.9	Sand/gravel	Application Received but not Granted	South Gippsland Shire	G A & K F Morrison P/L
WA 2	255.8	Sand/gravel	Currently Active	South Gippsland Shire	ACI Operations P/L
WA 7	16.9	Sand/gravel	Currently Active	Kingston City	A J Baxter P/L
WA 8	3.9	Sand/gravel	Currently Active	Kingston City	Allied Sand Nominees P/L
WA 13	48.9	Sand/gravel	Currently Active	Frankston City	Amatek Ltd
WA 14	10.1	Sand/gravel	Currently Active	Kingston City	A J Baxter P/L
WA 18	77.8	Sand/gravel	Currently Active	Casey City	CSR Ltd
WA 19	8.8	Sand/gravel	Currently Active	Baw Baw Shire	Wilanders P/L
WA 23	9.6	Sand/gravel	Currently Active	Baw Baw Shire	Phillip Ashdown
WA 30	96.3	Sand/gravel	Currently Active	Frankston City	Ballarto Pastoral P/L
WA 35	69.2	Sand/gravel	Currently Active	Moorabool Shire	Barro Properties P/L
WA 40	26.5	Sand/gravel	Currently Active	Bass Coast Shire	Barro Group P/L
WA 45	39.2	Sand/gravel	Currently Active	Murrindindi Shire	Yea Sand & Gravel P/L
WA 92	190.8	Sand/gravel	Currently Active	Moorabool Shire	Boral Resources (Vic) P/L
WA 93	33.0	Sand/gravel	Currently Active	Moorabool Shire	Barro Properties P/L
WA 103	4.3	Sand/gravel	Currently Active	Baw Baw Shire	Irene P Bourke
WA 121	33.4	Sand/gravel	Currently Active	Casey City	Brompton Lodge P/L
WA 127	26.6	Sand/gravel	Currently Active	Cardinia Shire	Pioneer Construction Materials P/L
WA 129	19.7	Sand/gravel	Currently Active	Baw Baw Shire	Baw Baw Shire
WA 132	23.8	Sand/gravel	Currently Active	Kingston City	City of Boroondara
WA 137	6.2	Sand/gravel	Currently Active	Monash City	Fabcot P/L

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 141	23.5	Sand/gravel	Currently Active	Murrindindi Shire	Killingworth Quarries P/L
WA 145	51.3	Sand/gravel	Currently Active	Casey City	Unimim Australia Ltd
WA 157	38.0	Sand/gravel	Currently Active	South Gippsland Shire	Gary A Morrison
WA 162	14.1	Sand/gravel	Currently Active	Baw Baw Shire	James A Hammill
WA 166	63.6	Sand/gravel	Currently Active	Kingston City	Grosvenor Lodge P/L
WA 170	92.3	Sand/gravel	Currently Active	Casey City	CSR Ltd
WA 188	230.0	Sand/gravel	Currently Active	Greater Geelong City	Davegale P/L
WA 204	20.1	Sand/gravel	Currently Active	Baw Baw Shire	Lionel T Deane
WA 210	16.3	Sand/gravel	Currently Active	Bass Coast Shire	Donmix (Proprietor: Lebony P/L)
WA 214	3.3	Sand/gravel	Currently Active	Murrindindi Shire	D A Drysdale
WA 238	17.7	Sand/gravel	Currently Active	Cardinia Shire	Aidan J Graham P/L
WA 239	65.0	Sand/gravel	Currently Active	Frankston City	Aidan J Graham P/L
WA 240	13.5	Sand/gravel	Currently Active	Frankston City	Aidan J Graham P/L
WA 241	26.1	Sand/gravel	Currently Active	Frankston City	Aidan J Graham P/L
WA 242	22.7	Sand/gravel	Currently Active	Frankston City	Aidan J Graham P/L
WA 246	22.7	Sand/gravel	Currently Active	Greater Dandenong City	Thomas C Greensmith
WA 258	16.6	Sand/gravel	Currently Active	Mornington Peninsula Shire	Barry R Hawkes
WA 273	12.8	Sand/gravel	Currently Active	Moorabool Shire	Stephen Burgin
WA 277	19.6	Sand/gravel	Currently Active	Casey City	Kenneth J Huxtable
WA 281	4.6	Sand/gravel	Currently Active	Baw Baw Shire	Peter Jeffrey
WA 282	36.5	Sand/gravel	Currently Active	Mornington Peninsula Shire	Clarrie Jennings & Sons P/L
WA 283	9.6	Sand/gravel	Currently Active	Bass Coast Shire	Nola M Johnson
WA 298	5.3	Sand/gravel	Currently Active	Baw Baw Shire	Ernest B Kincaid
WA 309	3.3	Sand/gravel	Currently Active	Kingston City	Lofts Quarry & Sand Supplies
WA 310	3.0	Sand/gravel	Currently Active	Greater Dandenong City	Lyndcadle P/L
WA 331	52.6	Sand/gravel	Currently Active	Frankston City	Aidan J Graham P/L

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 332	101.5	Sand/gravel	Currently Active	Frankston City	Burdett Nominees P/L
WA 333	67.7	Sand/gravel	Currently Active	South Gippsland Shire	Glenister McGregor
WA 338	57.5	Sand/gravel	Currently Active	Cardinia Shire	Ian D McLeod
WA 342	115.4	Sand/gravel	Currently Active	Moorabool Shire	Excel Quarries P/L
WA 347	144.1	Sand/gravel	Currently Active	Greater Geelong City	Excel Quarries P/L
WA 358	31.0	Sand/gravel	Currently Active	Bass Coast Shire	G A & K F Morrison P/L
WA 360	9.1	Sand/gravel	Currently Active	Macedon Ranges Shire	Kenneth Newnham
WA 361	78.2	Sand/gravel	Currently Active	Macedon Ranges Shire	Kenneth Newnham
WA 377	216.0	Sand/gravel	Currently Active	Moorabool Shire	Pioneer Construction Materials P/L
WA 383	59.7	Sand/gravel	Currently Active	Kingston City	Pioneer Construction Materials P/L
WA 389	6.6	Sand/gravel	Currently Active	Monash City	Pioneer Construction Materials P/L
WA 398	1.4	Sand/gravel	Currently Active	Kingston City	Praznovszky Carriers P/L
WA 401	2.6	Sand/gravel	Currently Active	Kingston City	A J Baxter P/L
WA 406	12.6	Sand/gravel	Currently Active	Baw Baw Shire	Donald S Clarke
WA 412	4.1	Sand/gravel	Currently Active	Brimbank City	The Estate of Frank Cuartero
WA 423	24.9	Sand/gravel	Currently Active	South Gippsland Shire	Unimim Australia Ltd
WA 424	8.9	Sand/gravel	Currently Active	Bass Coast Shire	P F Scheppers
WA 425	59.5	Sand/gravel	Currently Active	Moorabool Shire	Robert J Scott
WA 434	27.9	Sand/gravel	Currently Active	Kingston City	Ernest Smith Contractors P/L
WA 437	282.2	Sand/gravel	Currently Active	Greater Geelong City	Davegale P/L
WA 453	395.6	Sand/gravel	Currently Active	Greater Geelong City	Transwest Haulage P/L
WA 454	13.3	Sand/gravel	Currently Active	Baw Baw Shire	Travalley Farms P/L
WA 455	10.6	Sand/gravel	Currently Active	Cardinia Shire	Emidio Tribuzi
WA 456	6.0	Sand/gravel	Currently Active	Cardinia Shire	Emidio Tribuzi
WA 469	34.3	Sand/gravel	Currently Active	Bass Coast Shire	CSR Construction Materials
WA 470	56.7	Sand/gravel	Currently Active	Bass Coast Shire	CSR Construction Materials

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 476	145.7	Sand/gravel	Currently Active	Cardinia Shire	Alan L Forte
WA 506	21.8	Sand/gravel	Currently Active	Kingston City	Pioneer Construction Materials P/L
WA 511	32.5	Sand/gravel	Proposal for an Application	Cardinia Shire	Tygtand P/L
WA 512	1.8	Sand/gravel	Proposal for an Application	Bass Coast Shire	Pioneer Construction Materials P/L
WA 513	72.6	Sand/gravel	Proposal for an Application	Bass Coast Shire	Barro Group P/L
WA 516	100.0	Sand/gravel	Currently Active	Murrindindi Shire	Charles Davis
WA 519	27.4	Sand/gravel	Currently Active	Frankston City	Burdett Sands P/L
WA 520	12.2	Sand/gravel	Currently Active	Bass Coast Shire	Umberto Viglietti
WA 521	186.8	Sand/gravel	Currently Active	Baw Baw Shire	D G L Abel
WA 523	62.9	Sand/gravel	Currently Active	Baw Baw Shire	D G L Abel
WA 531	119.1	Sand/gravel	Proposal for an Application	Cardinia Shire	P D'Alberto
WA 532	36.5	Sand/gravel	Proposal for an Application	Bass Coast Shire	Edward W Hill
WA 538	9.0	Sand/gravel	Proposal for an Application	Bass Coast Shire	Blue Metal Concrete P/L
WA 560	21.2	Sand/gravel	Currently Active	Kingston City	CSR Construction Materials
WA 657	10.3	Sand/gravel	Currently Active	Brimbank City	Highfield Quarries P/L
WA 681	3.0	Sand/gravel	Currently Active	Kingston City	F Siciliano
WA 732	2.0	Sand/gravel	Currently Active	Murrindindi Shire	Ray Cooper
WA 784	20.2	Sand/gravel	Currently Active	Bass Coast Shire	Bass Coast Shire Council
WA 836	38.0	Sand/gravel	Application Received but not Granted	Cardinia Shire	Rocla Quarry Products
WA 859	20.0	Sand/gravel	Currently Active	Moorabool Shire	Shire of Moorabool
WA 903	0.0	Sand/gravel	Application Received but not Granted	Moorabool Shire	Cremona Nominees
WA 965	4.6	Sand/gravel	Currently Active	Mornington Peninsula Shire	Mornington Peninsula Shire
WA 970	61.4	Sand/gravel	Currently Active	Bass Coast Shire	Umberto Viglietti
WA 983	0.0	Sand/gravel	Proposal for an Application	Bass Coast Shire	A T Massaro
WA 1004	50.0	Sand/gravel	Proposal for an Application	Bass Coast Shire	Railway Sand Supplies Pty Ltd
WA 1005	40.4	Sand/gravel	Currently Active	Cardinia Shire	John Brian

Licence	Current Area (Ha)	Product	Status	Shire	Operator
WA 1029	150.0	Sand/gravel	Proposal for an Application	Cardinia Shire	Lang Lang Industries
WA 1043	16.7	Sand/gravel	Currently Active	Mornington Peninsula Shire	Allan John Bond
WA 1049	4.9	Sand/gravel	Currently Active	Mitchell Shire	Chris Ryan
WA 1100	29.0	Sand/gravel	Proposal for an Application	Yarra Ranges Shire	A & J Bond
WA 1123	20.0	Sand/gravel	Proposal for an Application	Hume City	Pinnacle Investments Pty Ltd
WA 1144	3.2	Sand/gravel	Currently Active	Moorabool Shire	Barro Properties P/L
WA 9	24.6	Scoria	Currently Active	Greater Geelong City	Delacom P/L
WA 147	11.5	Scoria	Currently Active	Mitchell Shire	Conundrum Holdings P/L
WA 225	94.4	Scoria	Currently Active	Greater Geelong City	Aerolite Quarries P/L
WA 343	122.7	Scoria	Currently Active	Melton Shire	Excel Quarries P/L
WA 507	35.6	Scoria	Proposal for an Application	Melton Shire	Fraser Mining & Construction P/L
WA 234	1.6	Sedimentary	Currently Active	Frankston City	C/ M Glen
WA 416	24.1	Sedimentary	Currently Active	Macedon Ranges Shire	Macedon Ranges Shire (Romsey)
WA 492	42.5	Sedimentary	Currently Active	Whittlesea City	Woodyhill Extractive Industries P/L
WA 806	0.0	Sedimentary	Proposal for an Application	Hume City	Bairlea P/L Trading as T & M Bulla
WA 913	1.3	Sedimentary	Application Received but not Granted	Murrindindi Shire	Hancock Victorian Plantations P/L
WA 1106		Sedimentary	Proposal for an Application	Whittlesea City	City of Whittlesea
WA 1114		Sedimentary	Proposal for an Application	Murrindindi Shire	DNRE
WA 1138	0.0	Sedimentary	Proposal for an Application	Murrindindi Shire	Shire of Murrindindi
WA 200	10.2	Slate	Currently Active	Murrindindi Shire	Charles Davis
WA 297	3.6	Soil	Currently Active	Wyndham City	John M Kilpatrick
WA 600	2.3	Soil	Currently Active	Whittlesea City	Ken Junor
WA 610	0.5	Soil	Currently Active	Wyndham City	Robert Emmins
WA 699	4.0	Soil	Currently Active	Macedon Ranges Shire	John M Ower
WA 1012	3.0	Soil	Currently Active	Hume City	Hnj Holdings P/L
WA 1013	2.0	Soil	Currently Active	Hume City	John M Ower

