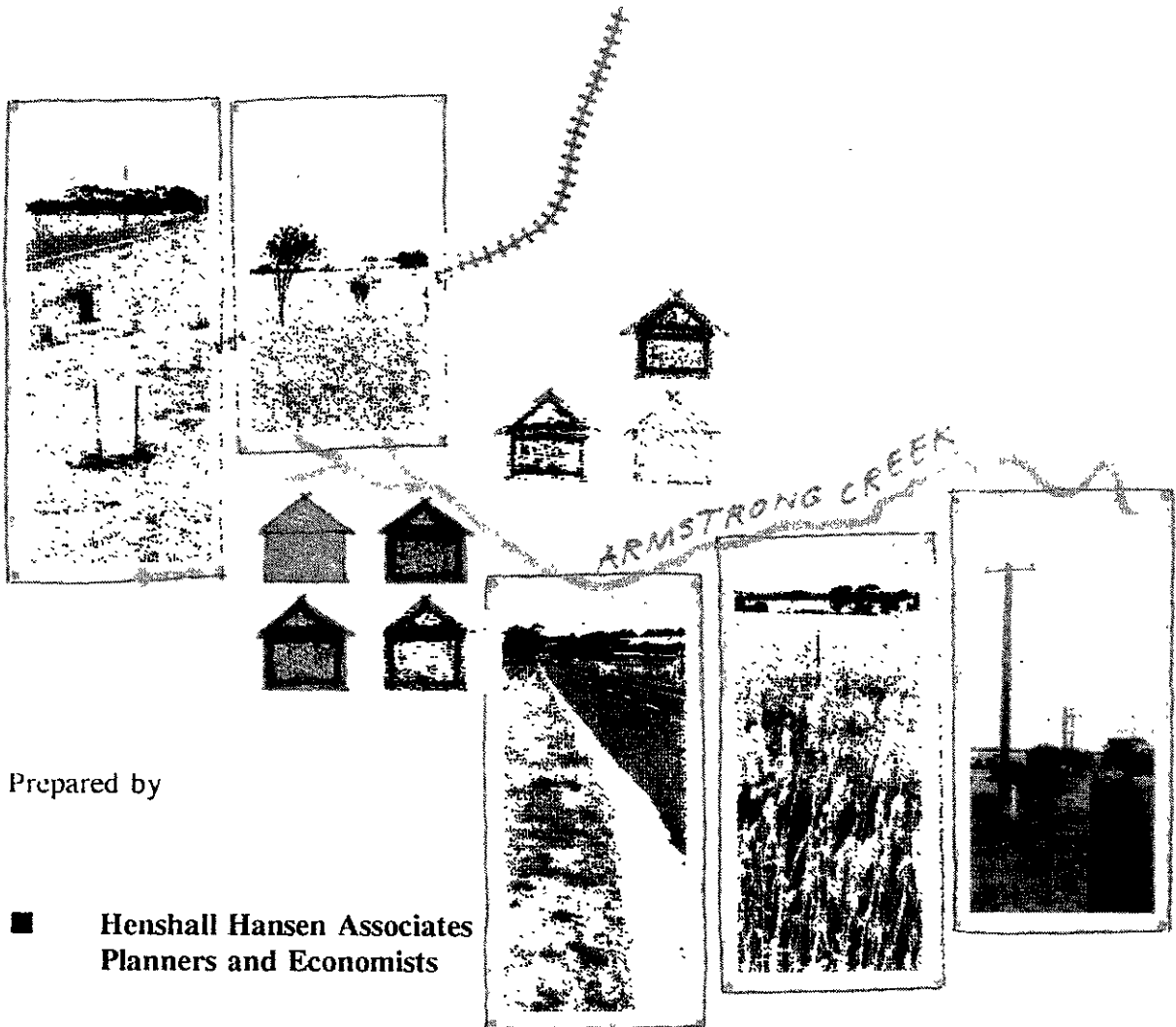


MOUNT DUNEED ARMSTRONG CREEK URBAN DEVELOPMENT STUDY



Prepared by

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for



August 1994

**MOUNT DUNED/ARMSTRONG CREEK URBAN
DEVELOPMENT STUDY 1994**



Prepared by Hanshall Hansen Associates
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CHAPTER 1

THE REGIONAL PERSPECTIVE

Mt Duneed/Armstrong Creek Urban Development Study

1 THE REGIONAL PERSPECTIVE

1.1 An Introduction to the Study

The 1990s is an important planning era in Victoria. The end of the 1980s development boom has forced planners, amongst others, to think more carefully about the ways in which urban areas continue to evolve and how the evolution of our cities and towns should be more closely linked with the sustainability of our environment and the prosperity of local, state and national economies.

During the past decade, the concept of urban consolidation has gained considerable momentum, buoyed by the growing necessity for a wider variety of housing at more affordable prices.

In a general planning sense, however, urban consolidation means two things. First, the need to consolidate existing urban areas already having access to services and infrastructure which are presently underutilised and second, it means slowing the geographic spread of our urban areas while recognising the eventual need for expansion at the fringe. It is also about providing a wider choice in the housing market combined with a more efficient, yet attractive, environment for people to live and work.

As Victoria's largest provincial city, the City of Greater Geelong has a key role to play in accommodating a greater proportion of Victoria's future population growth. As explained in *A Pace to Live*, Geelong

"has by far the largest concentration of population and development activity outside Melbourne and the conditions necessary for sustained urban growth."

With these attributes, it is timely that the City of Greater Geelong review the Geelong Region Development Strategy (GRDS) prepared by the former Geelong Regional Commission in 1988. Importantly, there is already clear recognition by the City that Geelong provides substantial potential to attract more growth, development and employment as it approaches the turn of the century and beyond.

While substantial potential exists, Geelong's historical location on Corio Bay has placed some natural limitations on the city's outward expansion. Key opportunities therefore exist on three primary fronts; these being the north, west and south. With much of the city's growth in past decades having already occurred on the southern edge, it seems relevant that the Mt Duneed/Armstrong Creek area has been continually regarded by policy makers and planners as a medium to long term option for accommodating the future urban settlement.

This study, therefore, seeks to identify the characteristics of land in the Mount Duneed/Armstrong Creek area so that opportunities for, and constraints to, urban development of land are understood. Specifically, its results provide planning and servicing authorities with an indicative picture of the future land use in the area, the way in which this might evolve and likely costs to the community. The results must be used to guide future strategic planning exercises, based on and around the planning and development parameters identified.

1.2 *Where is the Mount Duneed/Armstrong Creek Study Area?*

The location of the Mount Duneed/Armstrong Creek study area is illustrated in Figure 1

The study area is located approximately eight (8) kilometres to the south of Geelong, mid-way between Geelong and Torquay on the Surf Coast. The area is contained within a boundary formed by Geelong-Warrnambool Rail Line and the Barwon River in the north, Mt Duneed and Lower Duneed Road in the south, Ghazeepore Road in the west, and Winklers Road and the western section of Hospital Swamps in the east. It measures approximately 9 kilometres at its widest point and has a total land area of approximately 4300 hectares. The study area is wholly contained within the municipality of the City of Greater Geelong. The southern boundary of the study area abuts the newly formed Surf Coast Shire.

1.3 *The Study Area at a Glance...*

The study as investigated by the consultant team is illustrated in Figure 2.

The northern sections of the study area abuts the urban areas of Grovedale and Marshall. Grovedale, in particular, has established its reputation as a relatively fast growing and attractive urban area offering a variety of new housing opportunities, local and expanding shopping opportunities, local recreation and other community facilities. It is well located to Deakin University on the north side of the Princes Highway.

The central and southern parts of the study area are more isolated from the northern and established areas of urban Geelong. This reflects the boundaries established by urban development policies influencing past, present and future development of the area, and the continuation of farming uses historically present in the area. These portions of the study area are subsequently more isolated from the community services and facilities commonly associated with established urban centres. It is considered that this isolation will have significant implications in

planning future development in the area and heralds the need to provide infrastructure and community services early in the expansion process.

Other characteristics important in forming a picture of the study area include:

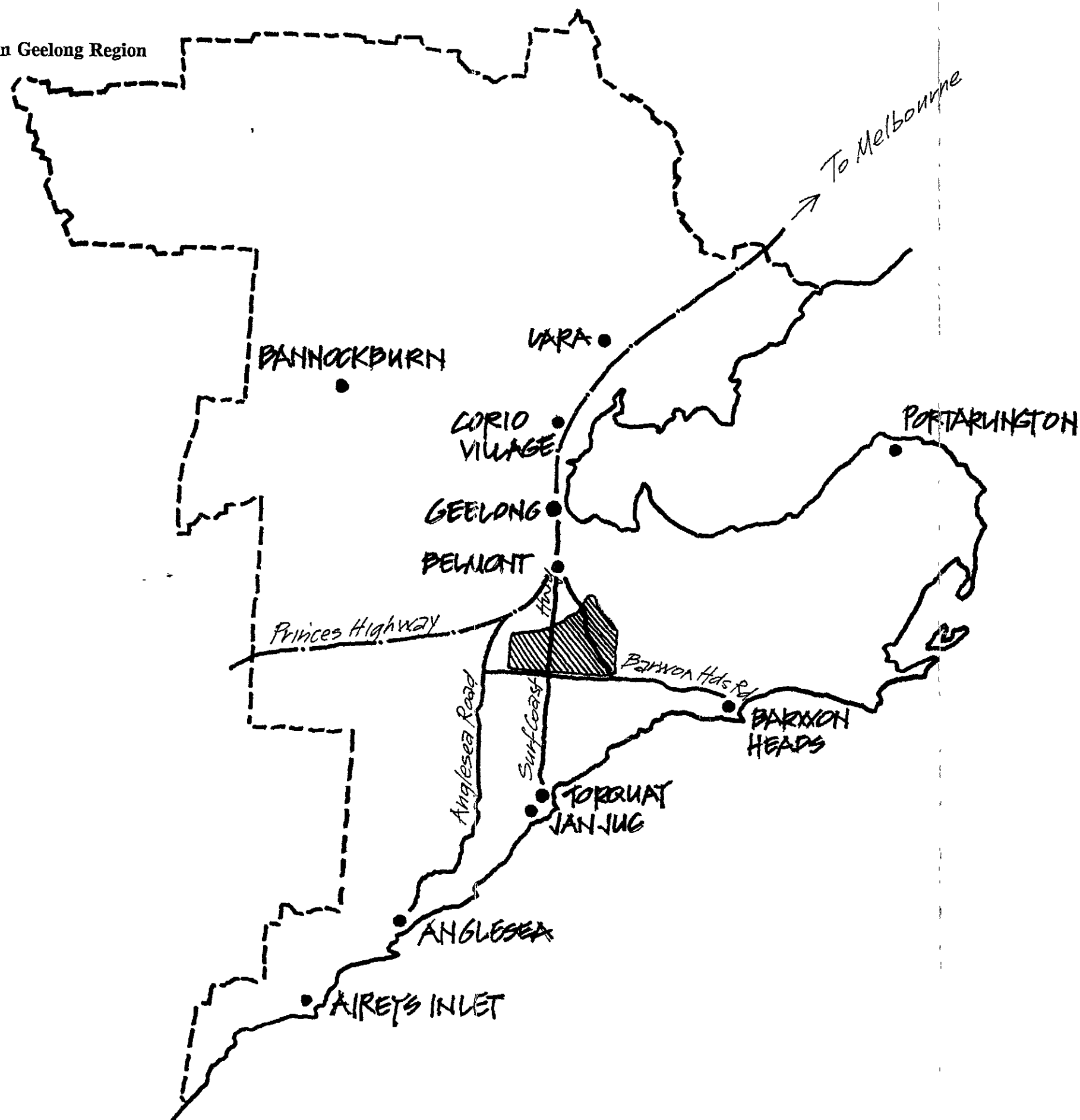
- a natural environment which has been influenced in the same way as many other parts of western Victoria. It is essentially cleared of trees with the exception of isolated pockets of native vegetation along Armstrong Creek and its minor tributaries, roadsides, and nearer Mt Duneed;
- a historical, but continuing dominance of farming and intensive agricultural activities;
- that a large proportion of the study area (approximately 25%) is either low lying or subject to periodic flooding. This area is generally defined as being to the east of the Barwon Heads Road;
- the fact that there is no isolated urban settlement other than minor spill-over associated with the urban development at Grovedale, hence the area is sparsely populated;
- its limited physical and social infrastructure resources; and
- it is well served by north-south traffic routes including the Surf Coast Highway and Barwon Heads Road. Cross movement through the study area is assisted by a reasonably comprehensive "one mile" road grid.

These matters and, indeed, others are discussed in more detail throughout the body of the report. Together, this information will provide land use planners and infrastructure and servicing authorities, in the region, with a more detailed picture of the study area and its potential to accommodate at least part (some might say, a large part) of the future population growth in the Geelong region.

LOCATION OF THE STUDY AREA

LEGEND

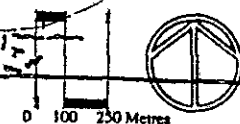
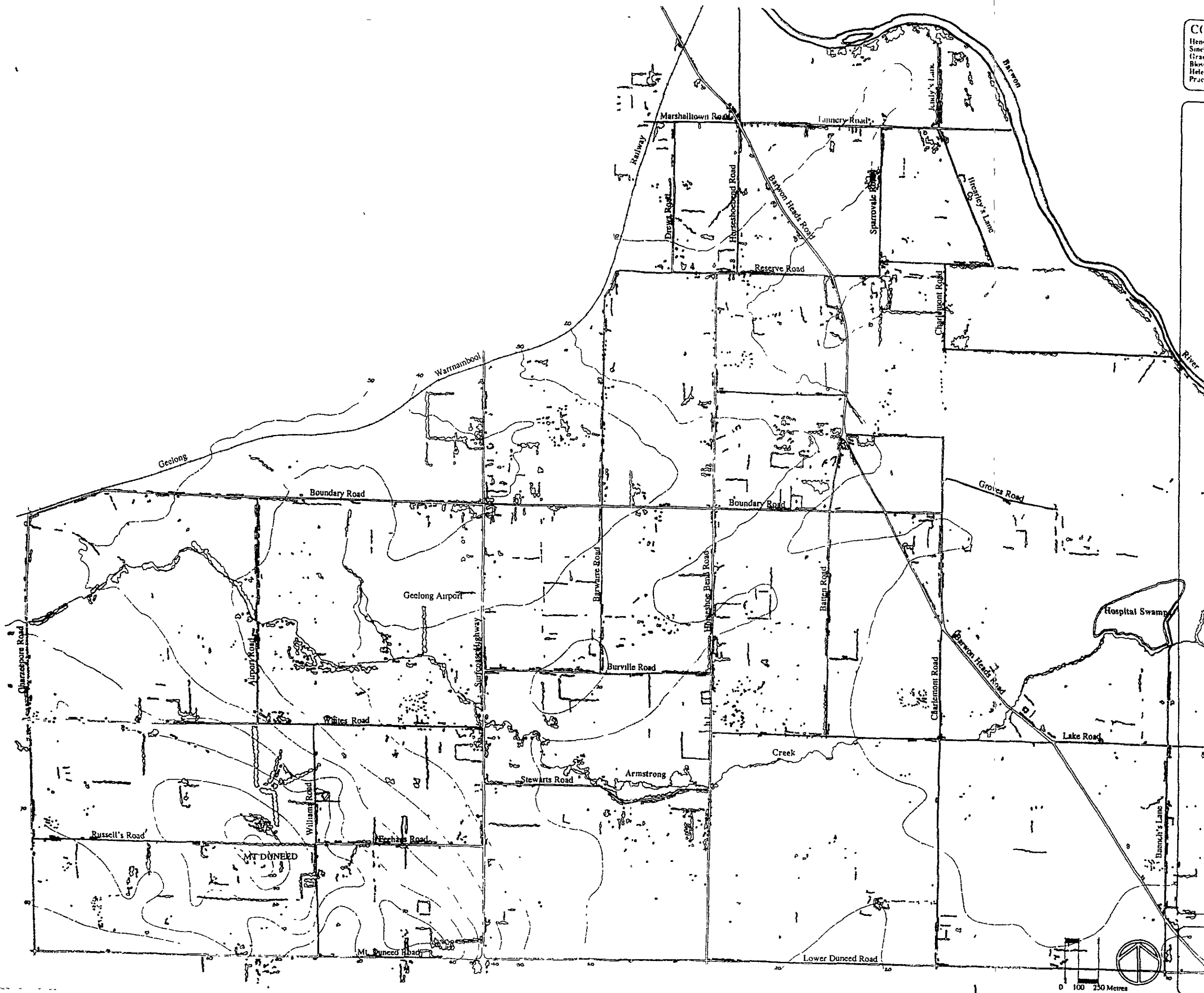
-  Geelong Region as defined in Geelong Region Development Strategy
-  Study Area



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MT. DUNEED STUDY

2



CHAPTER 2

STRATEGIC PLANNING INFLUENCES

Mt Duneed/Armstrong Creek Urban Development Study

2 STRATEGIC PLANNING INFLUENCES

2.1 Strategic Planning Revitalised

Increasing pressure on existing urban areas, rising costs of urban infrastructure, and lengthy and complicated approvals processes are just three of a plethora of factors which have revitalised an interest in strategic planning. This interest is spurred by a growing understanding of its real and tangible benefits for the community.

The Geelong region has a long history of strategic planning which has continued to influence the location and distribution of population in the region. Also relevant to the future planning of Geelong is a growing body of State planning policies focussing on ways of making our cities better places live.

State, regional and local planning policies will influence future planning and development in the Mount Duneed/Armstrong Creek area and these policies are discussed in more detail below.

2.2 State Planning Policies

There is little argument that the impetus of State strategic planning policy has traditionally promoted and concentrated on the growth and development of metropolitan Melbourne. Seemingly little attention, at least until recent times, has focussed on the residential potential of Victoria's provincial centres and other urban settlements

Fortunately, the approach has changed - albeit slowly. The release of *A Place to Live* in the middle 1992 was the culmination of an extensive research and consultation exercise which investigated a series of urban development options for Victoria - a process which springboarded from the release of *Victoria - Trading on Achievement* released back in 1988

A Place to Live - Urban Development 1992-2031, when launched, was believed to be the first long term urban development strategy describing the likely pattern of urban growth in Victoria over the next four decades. Further, the document suggests how Victorians can make the most of the opportunities and challenges Victoria will encounter between now and the year 2031

While there has been a change of government since the strategy's launch, its main objectives continue to be supported. The main objectives of the Strategy outlined in *Shaping Victoria's Future* are:

- to curb the outward sprawl of Melbourne,
- to better use Victoria's regional assets so that regions can accept a substantial proportion of future population growth;
- to make future development in Victoria ecologically sustainable; and
- to better plan Victoria's urban areas to create more livable cities.

The strategy seeks to achieve these objectives by supporting urban consolidation through more efficient use of costly infrastructure and by encouraging higher density development in both established and new urban areas.

A key principle of the strategy is that the northern and western suburbs of Melbourne and the regional centres to the north and west, including Geelong, will become the major focus for development in the State in the future. This replaces the traditional emphasis on the established pattern of development around metropolitan Melbourne. This Central Crescent is described as a future "region of high activity" and pivotal to realisation of the strategy. Importantly, an emphasis on the central crescent has direct implications for Geelong and, further, its fringe areas such as Mt Duneed/Armstrong Creek.

A key reason for promoting the Central Crescent is its apparent attractiveness for development which can occur without major environmental implications normally associated with development to the south east of Melbourne. Consequently, the Central Crescent will be a major focus for development and investment in the medium to long term.

Specifically, the strategy identifies a number of Government sponsored initiatives which are being, or will be, put in place to improve the attractiveness of the area; change the distribution of jobs; and change the traditional patterns of settlement. Initiatives having and impact on Geelong include:

- upgrading the Geelong-Werribee-Melbourne rail link;
- targeting the area for investment through the Better Cities Program;
- completion of the Western Ring Road by the end of this decade;
- servicing by the high voltage National Electricity Grid, and

- spur lines to the standard gauge rail link which will pass through Ballarat.

As the existing urban area of Geelong continues to fill with a growing population, questions about accommodating this population well into the future begin to emerge. Specifically, *A Place to Live* encourages population distribution in the Geelong-Torquay Corridor, a corridor which the strategy identifies as one which can cope with significant expansion without major economic consequences.

2.3 *Regional Planning Policies*

It is important to note that the strategy presented in *Shaping Victoria's future* and subsequent planning documents is looking up to 40 years ahead. While this is important, it is also relevant to note that Geelong has a regional strategy which has been used to guide future population growth and development in the metropolitan area in the short to medium term.

The Geelong Region Development Strategy was completed by the Geelong Regional Commission in 1988. Since that time, it has been the primary force influencing land use and development in the region.

Ostensibly, the Strategy highlights the need for all existing urban zones be developed at, or near, capacity over the life of the strategy with any additional growth being met predominantly in designated new growth areas of South Grovedale, Barrabool Hills and the coastal towns of Drysdale/Clifton Springs, Ocean Grove and Torquay/Jan Juc. This strategy would be assisted by the implementation of urban consolidation policies, led by a revision of the unit code provisions as they apply to the urban area.

In general, the strategy recommends that the South Grovedale/Mt Duneed and Barrabool Hills areas accommodate additional growth, which cannot reasonably be accommodated in the existing urban area, in the proportion of 2:1. Hence, from a strategic point of view the Mt Duneed/Armstrong Creek has a history of being favoured as a likely future urban area. In the wider planning perspective, the push for urban growth in this area and many of the smaller towns further along the coast is completely consistent with the State Government strategy of promoting the Geelong Torquay corridor.

In determining that additional growth be largely distributed in the Mt Duneed/Armstrong Creek area two key actions were identified, these being:

- prepare and implement comprehensive and integrated development plans and staging policies for the new growth areas; and

- make provision for a development progressions from north south along the Surf Coast Highway, with land fronting Anglesea Road being developed at later stages;
- investigate the area north of Whites Road on Armstrong Creek as a potential site for a sub-regional shopping centre,
- develop a linked open space network, utilising Armstrong Creek and the Mt Duneed Reserve, and
- maintain that area between Anglesea and Ghazeepore road as a buffer to Blue Circle cement works

While this study is not intended to specifically address each of these issues, many of these issues are highlighted throughout this report as either an opportunity or constraint to future urban development with a view to providing necessary bank of information to go one step further toward the preparation and implementation of comprehensive development plans consistent with the area's ability to sustain this development in the most cost effective and environmentally sustainable manner.

The strategy to consolidate the existing urban area together with the clear acknowledgment that there will need to be at least some expansion of the urban fringe in the south and the west, is the need to prevent indiscriminate subdivision and development in areas designated non-urban by the maintenance and implementation of statutory planning controls. A primary feature of this part of the strategy is the need to prohibit rural residential subdivision in areas having long term urban development potential. This strategy has been adhered to in the study area, although a rural residential subdivision does abut the southern side of Mt Duneed Road.

In respect of rural residential development the Geelong Regional Commission Geelong Region Rural Residential Living Strategy. During the past ten years, this strategy has guided the provision and location of rural residential development in the Geelong Region.

In 1992 the GRC released a Strategy Review Discussion Document, designed to review the direction and success of the strategy and to revise the demand for this type of residential lifestyle within the region. A final, or revised, document was never released because of the dissolution of the GRC and the Local Government Board's recommendations in respect of new municipal boundaries. The City of Greater Geelong has, however, undertaken some review of this policy and while it has not yet been finalised, it is anticipated the rural residential development will

15,000 people). The area could easily accommodate this level of urban growth, as noted below.

The Mt Duneed study area covers approximately 4,300 ha. The developable area is approximately 2,300 ha. Allowing for an average density of 15 dwellings per hectare, this land could accommodate 34,500 dwellings and a population of around 104,125 people. (based on 3.01 persons per dwelling)

The projected minimum population of 10,000 people could thus easily be accommodated within the study area. Even a projected population of 15,000 people (based on the high growth scenario for the region as a whole), would represent only 14.5% of the total capacity of the area.

It is likely that the availability of well-located residential land in the Mt Duneed area - close to the surf coast and close to central Geelong for services and employment - could attract an even higher share of the region's population growth over the next 20 years given underlying lifestyle factors that are driving many residential location decisions (including the coastal influence), the popularity of the southern areas (such as Grovedale), and the pro-active policies which encourage development of the Geelong-Torquay corridor.

The attractive capacity of Mt Duneed to accommodate a significant amount of Geelong's urban residential growth emphasises the need to suitably stage the development of the study area.

continue to be recognised as a legitimate use of land, however, policy is likely to dictate that it only occur where:

- demand can be properly demonstrated;
- it can be provided in a cost efficient and environmentally sustainable manner;
- it does not remove high quality agricultural land from viable production;
- it is accessible to urban services; and
- where it will not preclude higher density urban development.

A revision of the rural residential policy in this way will ensure complete consistency with the State government's *Guidelines for Rural Residential Development* released in 1991.

2.4 Local Policies

Local policies have traditionally had only a lesser role in the planning of Geelong, primarily because of the importance and influence of the regional planning strategy. In addition, the study area's history as a primarily rural location has meant that local policies have been of little relevance in determining the future planning and development in this area to date.

As urban development proceeds in this area, however, it is anticipated that the preparation of some localised planning policies may be appropriate for dealing with matters of sensitivity.

2.5 Summary

The Geelong-Torquay corridor is a major residential corridor as envisaged in *A Place to Live*, the State Government's key planning and development strategy. In this regard, its role in accommodating a key portion of Geelong's urban growth (in excess of that which can be accommodated in the existing urban area), as defined in the Geelong Region Development Strategy, is reinforced. The Development Strategy has further defined that this development occur in an orderly progression south towards Torquay.

CHAPTER 3

POPULATION GROWTH CONSIDERATIONS

Mt Duneed/Armstrong Creek Urban Development Study

3 POPULATION GROWTH CONSIDERATIONS

3.1 Introduction

When planning for the future urban development of the Mt Duneed area, we need to have an appreciation of regional population growth trends in Geelong, including recent, current and likely future trends

This section considers population growth in the Geelong region and the potential demand for residential development in the Mt Duneed area

It is relevant to note that this study is not a strategic planning exercise aimed at determining the suitability of this area for urban development in a regional context. Rather, the study focuses on the physical opportunities and constraints associated with the urban development of the Mt Duneed/Armstrong area should urban development be seen as strategically desirable. The population figures outlined below are therefore presented as a guide only. For the purposes of this study they illustrate a likely (but not necessarily certain) growth pattern which can then be placed in the context of the land area available for development within the region.

3.2 Past Population Growth

Table 3.1 illustrates past population growth in the Geelong region (including the municipalities of Bannockburn, Barrabool, Bellarine, Corio, Geelong, Geelong West, Newtown, Queenscliff and South Barwon).

Table 3.1: Population Growth in the Geelong Region, 1971 to 1991

Area	1971	1981	1991	Growth 1971-1991
Bannockburn	2080	3070	4260	2180
Barrabool	3490	5960	5550	2060
Bellarine	18900	31380	43620	24720
Corio	40760	52650	58100	17340
Geelong	17940	14980	13300	-4640
Geelong West	17350	15390	13980	-3370
Newtown	11690	10510	10290	-1400
Queenscliff	2820	3200	3280	460
South Barwon	26920	36800	47970	21050
TOTAL	141950	173940	200350	58400

Source ABS, catalogue number 3203.2, various dates

Table 3.1 shows that the Geelong region grew by 58,400 people over the 20 years to 1991, at an average growth rate of 1.74% per year. The Table also shows that the municipality of South Barwon (now defunct), in which Mt Duneed is located, was the area with the second largest population growth in the region. South Barwon grew at an average of 2.93% per year, providing homes for an additional 21,000 people, or 36% of the total population growth of the Geelong region between 1971 and 1991. The municipality with the largest population growth in the period was Bellarine, significantly, also in the south east of the Geelong region. Between them, these two municipalities accounted for 78% of total growth in the Geelong region over the two decades to 1991.

Population growth in the Geelong region has been predominantly in the south and south east part of the region. This trend has been more pronounced during the 1980s than during the 1970s. This growth has been a result of the increasing popularity of the coast for recreation and retirement. The Mt Duneed area is strategically located between the city centre and the resorts of the Surf Coast.

3.2 *Population Forecasts for the Geelong Region*

The Department of Planning and Development is presently recasting population forecast for cities and regions throughout Victoria. At present, however, the Department's figures for the Greater Geelong have not been finalised. The City

With this in mind, the latest available population growth scenarios for the Geelong Region were produced by the ABS for the Geelong Regional Commission in 1992. These provide three potential population outcomes for the region between 1991 and 2011, and are illustrated in Table 3.2.

Table 3.2: Population Growth Scenarios, Geelong Region, 1991 to 2011

Scenario	Regional Population 2011	Population Growth 1991 to 2011
High Growth	251,200	50,850
Medium Growth	247,000	46,650
Low Growth	238,800	38,450

Source: ABS, Population Projection for the Geelong Region, 1992

For the purposes of this report, and in order to demonstrate the need for residential development at Mt Duneed, the low growth scenario is used to demonstrate potential demand for housing in the study area.

Using the low growth scenario, total regional population growth between 1991 and 2011 is estimated at 38,500

If the old municipality of South Barwon, in which Mt Duneed is located, retains the share of regional population growth which it achieved between 1971 and 1991 (ie 36%), growth in South Barwon will be 13,900 people by 2011. Given that Mt Duneed is the main potential development area in the old municipality of South Barwon, it could be expected that Mt Duneed would accommodate most of this growth, amounting to perhaps 10,000 people (with some growth also at Torquay).

The share of regional growth in the area covered by the old municipality of South Barwon could well be more than 36% in the forecast period. Growth in South Barwon consistently outstripped that in the region as a whole in the 20 years to 1991, and the area covered by the municipality is likely to account for an increasing share of regional population

If the south and south-east parts of the Geelong region (the area covered by the former municipalities of Bellarine and South Barwon) retain their share of population growth (78%), the additional population in this part of the region could (conservatively) be 30,000 by 2011. Again, Mt Duneed is one of the main areas able to accommodate residential growth in this part of the region and could be expected to house a substantial proportion of the additional population.

If the high growth scenario for the Geelong region eventuates, growth in the region will be 50,900. If the area covered by the former municipality of South Barwon maintains its share of regional growth (ie 36%), population will increase by 18,000 in the area, and most of these people, perhaps 15,000, are likely to settle in the Mt Duneed area.

The exact proportion of regional population growth accommodated by Mt Duneed will depend on strategic planning by the regional authority and on the quality of residential choices in the region. However, the consultants expect that there will be a likely demand to accommodate in excess of 10,000 people in the Mt Duneed area by 2011 (and being aware that the consultants' forecasts are built on conservatively low assumptions).

By 2011, the consultants expect that household occupancy rates to have declined from the present 3.2 people per household to around 3.0 because of an aging population. If 10,000 people are to be accommodated at Mt Duneed by 2011, this would require the construction of around 3,300 houses (and again, this is a likely to be a conservatively low estimate).

3.3 Potential Role of Mt Duneed Study Area

We estimate that there will be demand to accommodate at least 10,000 people in the Mt Duneed area between the present and 2011 (and possibly as many as

15,000 people). The area could easily accommodate this level of urban growth, as noted below.

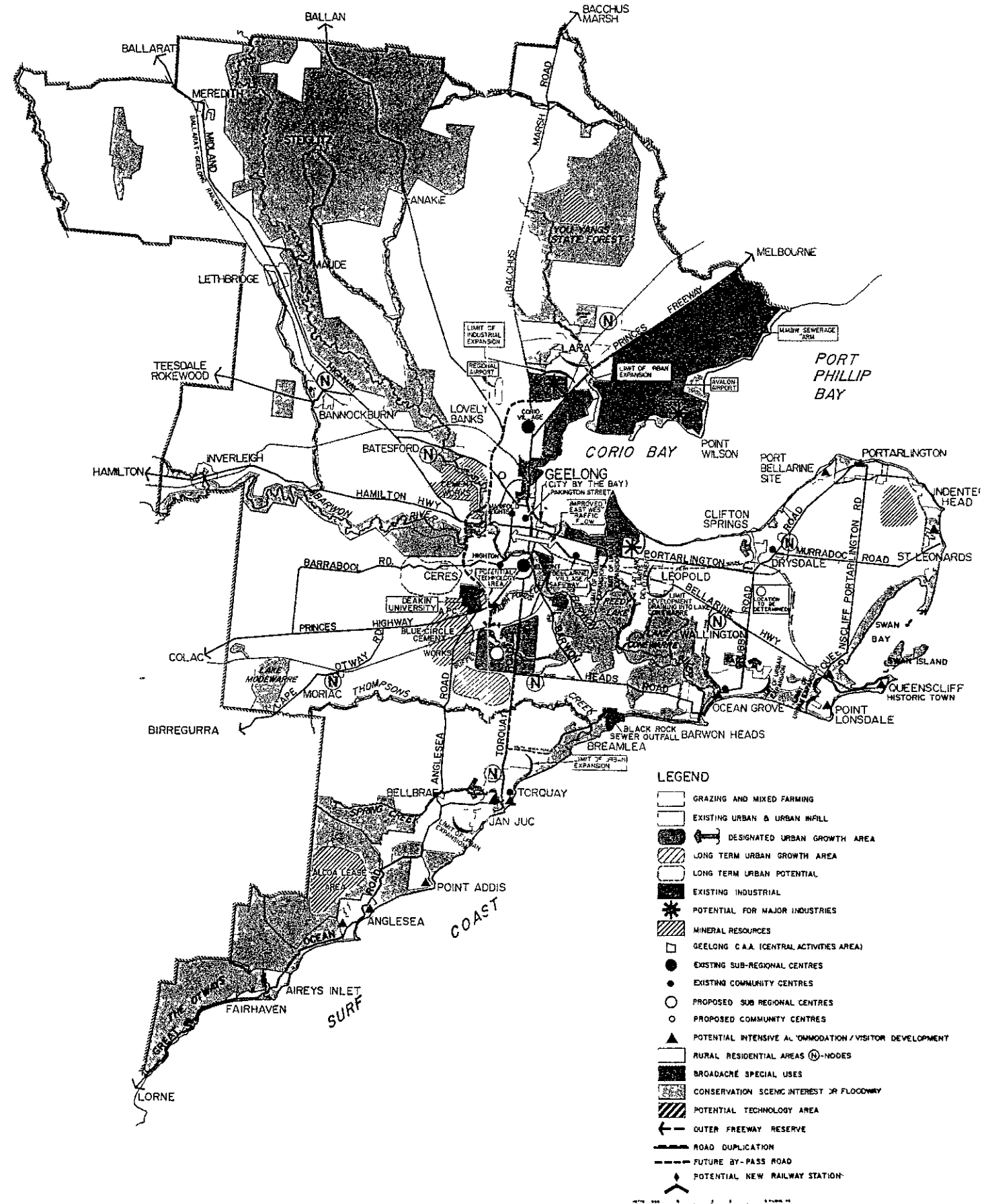
The Mt Duneed study area covers approximately 4,300 ha. The developable area is approximately 2,300 ha. Allowing for an average density of 15 dwellings per hectare, this land could accommodate 34,500 dwellings and a population of around 104,125 people. (based on 3.01 persons per dwelling)

The projected minimum population of 10,000 people could thus easily be accommodated within the study area. Even a projected population of 15,000 people (based on the high growth scenario for the region as a whole), would represent only 14.5% of the total capacity of the area.

It is likely that the availability of well-located residential land in the Mt Duneed area - close to the surf coast and close to central Geelong for services and employment - could attract an even higher share of the region's population growth over the next 20 years given underlying lifestyle factors that are driving many residential location decisions (including the coastal influence), the popularity of the southern areas (such as Grovedale), and the pro-active policies which encourage development of the Geelong-Torquay corridor.

The attractive capacity of Mt Duneed to accommodate a significant amount of Geelong's urban residential growth emphasises the need to suitably stage the development of the study area.

Geelong Region Development Strategy. Physical Framework Plan



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MT. DUNEED STUDY

CHAPTER 4

LAND USE AND DEVELOPMENT

Mt Duneed/Armstrong Creek Urban Development Study

4 *LAND USE AND DEVELOPMENT*

4.1 *Introduction*

This chapter describes the present pattern of land use and development in the study area. It briefly describes the history of settlement in the area which has, in many respects, influenced the type and pattern of land use in the area.

4.2 *Some Historical Notes*

Geelong was one of the first regions to be developed in Victoria and grew as an important port serving the pastoral settlement in much written about Western District, a particularly rich agricultural plain that stretches from Geelong to Hamilton, and between the Great Dividing Range and Otway Ranges.

Improving channels of communications and the opening up of the railways successfully linked this primary wool growing area with the port city and this resulted in the growth in wool related industries establishing along the banks of the Barwon River. During the 19th Century, Geelong quickly emerged as one of the richest agricultural regions in Australia and subsequently enjoyed a period of high population growth

During this century, the city built upon its rural service image and emerged as an important place of manufacturing. Famous names such as the Ford Motor Company and Pilkington still have major manufacturing plants in Geelong. Traditionally, the industrial activity has tended to locate on the north side of Geelong, where its links with Melbourne and its market are closest. The Mt Duneed area is, therefore, all but free of industrial development and tends to have its traditions linked with the pastoral industry, much of the area having been cleared of its indigenous tree cover, to ensure productive grazing and cropping. Grazing and cropping is still evident in the area.

While the restructuring of the agricultural industry has, of itself, changed the nature of farming in the past decade, the nature of land use in the Mt Duneed/Armstrong Creek area finds itself at a type of "cross-road". Put simply, many of the holdings are, increasingly, too small to be viably farmed, and the area's close proximity to urban Geelong constantly heralds the possibility of urban development in the not too distant future.

4.3 Land Use Zoning

The zoning of land in the study area is shown on Figure 4

4.3.1 Within the Study Area

Within the study area, the predominant zonings under the Geelong Regional Planning Scheme are Rural (General Farming), Rural (Floodland) and Rural (Intensive Farming).

Of these, the most predominant zone is **Rural (General Farming)** which accounts for the majority of the study area south of Boundary Road and west of Winklers Road. This zone has proved an effective mechanism for the protection of land for productive rural purposes and has, with considerable success, limited small acre subdivisions and prevented haphazard urban development. Importantly, the zone has ensured the provision of what has previously been described as a "land bank for orderly development in the long term."

Land within the study area zoned **Rural (Floodland)** is largely to the east of Barwon Heads Road and, in the northern part of the study area, part of this zone is specifically recognised as Land Subject to Flooding.

Rural (Intensive Farming) in the study area is located solely within the area bounded by Barwon Heads Road, Boundary Road, Surfcoast Highway and the Geelong-Warrnambool Railway

Other zones and reservations in the study area include the following:

- a **Rural (Future Urban)** Zone exists in one location only, immediately south of the intersection of the Geelong Warrnambool Railway and Barwon Heads Road, north of Grove Road
- a **Residential A** Zone abuts the southern boundary of the Rural (Future Urban) Zone described above.
- land zoned **Reserved Industrial** is located in the northern part of the study area
- a **Proposed Arterial Road Reservation** along the Surfcoast Highway south of Boundary Road and along Barwon Heads Road
- **Public Open Space Reservations (Existing)** are located
 - in Russells Road in the south-west of the study area
 - in Stewarts Road the south-east of the Crematorium

- on the western edge of Hospital Swamps
- east of Barwon Heads Road north of Lake Road
- along the north-east section of the Barwon River
- north above Marshall Town Road

The only **Public Open Space Reservation (Proposed)** is along the northern section of the Barwon River

Public Purpose Reservations exist in a number of locations around the study area. The first being the Crematorium and Cemetery located between Burville Road and Stewarts Road, midway between Surfcoast Highway and Horseshoe Bend Road. Another smaller, and considerably older cemetery is located on the crest of Mt Duneed in Williams Road. The other public purpose reservations are for Local Government purposes and these are located on the south-west corner of Russells Road and Mt Duneed Road.

4.3.2 Outside the Study Area

North of the study area is dominated by the existence of urban zones forming the southern edges of the urban area of Geelong. As mentioned above, some of these urban zones have extended south of the railway line.

In the south, the Rural zones dominate because of the long standing need to protect rural land resources and the desire to stop the uncontrolled spread of urban development further toward the Surf Coast. There is however, an area of rural residential development abutting the south side of Mt Duneed Road. The development occupies approximately 130 hectares in this location and new homes continue to be built in this area, although on ground observations indicate that many lots are still available for the construction of dwellings.

Perhaps the most significant zone outside the study area and likely to have some impact on future use and development in the Mt Duneed/Armstrong Creek area is the extensive Extractive Industry Zone facilitating the extraction of local limestone resources as part of the ongoing operations of Blue Circle Cement.

4.4 Current Land Use Activities

The current type and pattern of land use within the study area is illustrated in Figure 5.

As foreshadowed in the earlier historical notes, the study area is primarily used for rural and related purposes with broad acre farming, and intensive agricultural and horticultural uses dominating

4.4.1 Within the Study Area

Most land within the study area is generally used for rural or rural related uses albeit rural activities are less intensive than in times past. Agriculture has undoubtedly wound down over the last decade, or so. Part of this must be attributed to a wider restructuring of the agricultural sector, and at least part could be related to Geelong's general reputation as an area where the use of Dieldrin and DDT was common through the 1970s and 1980s. Department of Agriculture representatives indicate that this reputation has created rather serious marketing problems for local producers over the past decade, and this has eventually been reflected in falling rural land values.

With the scaling down of rural activities in the area, it is suspected that many land holders, particularly those in areas closer to the urban area, could well be anticipating the spread of the urban area south of the railway line. Others have had some success in terms of selling smaller lots for those seeking a rural residential lifestyle. In the north-eastern part of the study area, the land tenure pattern indicates a range of smaller lots (say between 5 and 20 hectares). This tenure pattern now makes amalgamation for productive farming purposes difficult reducing, even further, the area's long term viability for mainstream rural use.

In the south-west part of the study area, land holdings tend to be similar and alternative farming uses are beginning to emerge, although cropping in the area is still evident. In this location, it is relevant to note the winery which has established on the north-eastern slopes of Mt Duneed where it is able to take advantage of a healthy aspect and lime content in the soils.

As the area contains a large Rural (Intensive Farming) Zone it is not surprising to note that vegetable and some limited flower growing is evident in the north of the study area. On ground evidence, however, suggests that this area is not being optimised and ironically, its capability is not as high as the area further to the north-east, which is presently zoned for general industrial purposes, though largely undeveloped after many years now.

The area also has a limited history as a poultry farming area, and this is evident in the existence of a number of ageing and/or obsolete farm establishments. As the southern urban area has moved closer to these establishments, farmers have either made the decision to move, or close down, so as to avoid possible future land use conflicts. Others suggest that the large scale "Happy Hen" operation north of Geelong has been an important factor influencing the demise of ageing poultry operations south of Geelong.

The Geelong Cemetery Trust manages the Geelong Crematorium located in Burville Road. The crematorium commenced operations in April of 1988 has an active burial life in excess of the 60 years. The Crematorium and Cemetery will

therefore be a long term land use within the study area. Importantly, however, the use is one proposing few conflicts to future use and development in the area.

Geelong Airport, operated by the Mahon family, is a medium scale private operation which has been in operation in the area since 1962. Its primary operations are in the area of pilot training, services for recreational users and provision of a scenic flight service along the coast as far as Warrnambool. During the 1970s and 1980s the airport had a major role in transporting Alcoa staff to and from the aluminium smelter at Portland, in Victoria's west. It also used to transport explosives to King Island when shellite was still being mined.

When the airport was established by the Mahon family, it was located distant from the established urban areas of Geelong. In this regard, the small scale of the operations and its distance from residential areas meant that there was little conflict between the airport and residential uses. As urban development gradually moves southward, the potential for conflict grows.

In anticipation of such conflicts, thoughts on the airport moving have been around for some time now, spurred during the late 1980s when the Geelong Regional Development Strategy was released designating the area as having some basic locational suitability for future urban development.

The impact of airports on surrounding land is well documented in Kinhill's *Geelong Airport Environmental Impact Statement*. These impacts include, amongst others, noise and concerns for public safety. This report examined nine different locations for the Geelong Air, with Grovedale and Mt Duneed being identified, at the time, as being the most suitable. While identifying these as the most suitable among the range considered, the report acknowledges that

"a major expansion of the airport would have major detrimental effects at the planning and phase and short term and long term operation phases" adding that it would be

"poor planning to allow an aerodrome to locate in an area where urban development could in the near future surround it." (p89).

Similarly, in respect of a minor expansion, the reports states that

"the presence of an increasingly busy aerodrome would have a detrimental effect on the development of the residential areas to the west and an effect on the property values to the south" (p89)

Importantly, the impact statement documented possible conflicts between the airport and future urban development in this area - acknowledging that highly developed urban areas and airports are not the most desirable of combinations.

While the airport's owner recognises that the urban area is growing closer and closer (where in the 1960s it was virtually isolated), there seems little practical advantage in relocating unless a location with similar access to a major transport corridor (Princes Highway) could be readily identified

In addition, it must be acknowledged that the airport is an established family business and, as such, younger Mahons are likely to continue the business in the future. While, ultimately, the family may be attracted to the higher land values generally accompanying urban development, it has no plans to sell or move the business in the short to medium term.

4.4.2 Surrounding Land Uses

Significant limestone resources and related extractive industry is closely linked to the study area's western boundary. Extraction activities are presently limited to the west of the Anglesea Road and north of the railway line. Recent discussions with Blue Circle management indicate that extraction will eventually commence south of the railway line and move in an anti-clockwise direction over the Anglesea Road and to the north of Whites Road. This program is to occur over the next thirty years or so.

Grovedale and Marshall, border the study area to the north and include a wide range of urban services and activities.

South of the study area continues to be dominated by farming activities.

4.4.3 Contaminated Land

Initial contacts made with the Environment Protection Authority (EPA) indicate that there are no areas of land contaminated, at levels recorded by the Authority, which might threaten or constrain future urban development in the study area. Discussions with the Department of Agriculture indicate that there may be small amounts of Dieldrin residues in the area, but this is only likely to be very minor given a limited history of potato growing in the area. Dieldrin contamination is more prevalent further along the Bellarine Peninsula.

While it is possible to make tentative assessments of contaminated land in the area, no comprehensive testing program has been completed in the area. Hence, areas of contamination may well exist which are yet to be identified. Because of the limited industrial development in the area, any contamination is likely to be associated with agricultural and horticultural uses in the area.

4.5 *Land Use Policies*

Land use and related policies influencing the future planning and development of the study area are essentially derived from regional and state planning policies discussed, in more detail, in Chapter 2 of this report

Other than the 1988 Regional Strategy Plan and associated planning policies which recommends this area for future urban development, numerous policies about the way in which this urban development might occur have been formulated as part of the new government's planning agenda

Of particular relevance to the Mt Duneed area is the government's policies on urban consolidation and the protection of rural land resources. Specifically, the future urban development of the Mt Duneed area will need to carefully consider the best use of available land resources as well as the community's ability to fund the extension of infrastructure.

In relation to urban consolidation policies, it is likely that government will be anticipating a level and density of development which will actively contribute to the containment of urban sprawl and the efficient use of service infrastructure, particularly that for residential purposes. The use of VicCode 1 & 2 will ensure subdivision design and size and dwelling densities which will reinforce urban consolidation principles

In addition, the government's policy on rural land indicates that it would not be wholly supportive of land being lost to rural residential purposes unless it is fully serviced. It will also scrutinise any attempts to withdraw land from productive agricultural use where the soils are of high agricultural quality and where there is limited evidence of demand for this type of residential use exists

4.6 *Summary*

A considerable portion of land in the study area is still held in rural holdings. Although some of these holdings are increasingly small, they do not, of themselves, constrain opportunities for future urban development. While some smaller lot subdivision has occurred in the vicinity of Boundary Road, it has not been to such a degree that it would seriously prejudice the potential for redevelopment of these areas, if required. It would however, necessitate land tenure patterns being investigated as part of strategic planning exercises in the area.

No isolated urban settlement exists within the study area (the former settlement of Mt Duneed was destroyed by the Waurn Ponds fire of 1944). This is important, as any future use and development will not be prejudiced by the existence of existing urban areas beyond Grovedale and the southern urban area located to the north of the study area boundary.

It is considered that the major constraint to development in the area is posed by a combination of factors, some relating to land type, and others relating to land use. Specifically, much of the area east of Horseshoe Bend Road is lowlying and flood prone, severely limiting its capacity for urban development a matter documented in more detail in Chapter 9.

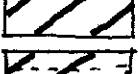
At least part of the area west of Horseshoe Bend Road and, more specifically, land abutting Ghazeepore Road, will be constrained by the quarrying operations presently skirting the western boundary of the study area and set aside for future extraction. Future planning of the area must have regard to the need for appropriate buffers from extractive industry, this having been constantly foreshadowed in the regional planning strategies.

Any future urban development will also be constrained by the operations of the Geelong Airport. In this regard, information about the technical aspects of the operation of the airport, particularly in respect of impacts related to noise and suitable buffer areas etc is required. Future planning of the area will be influenced by the outcomes of such work.

Other land use constraints to future urban development include the SECV high voltage transmission line which traverses the eastern part of the site, although much of the line crosses lowlying and flood prone areas. As such, it is highly unlikely that traditional scale urban development will be present within the immediate environment.

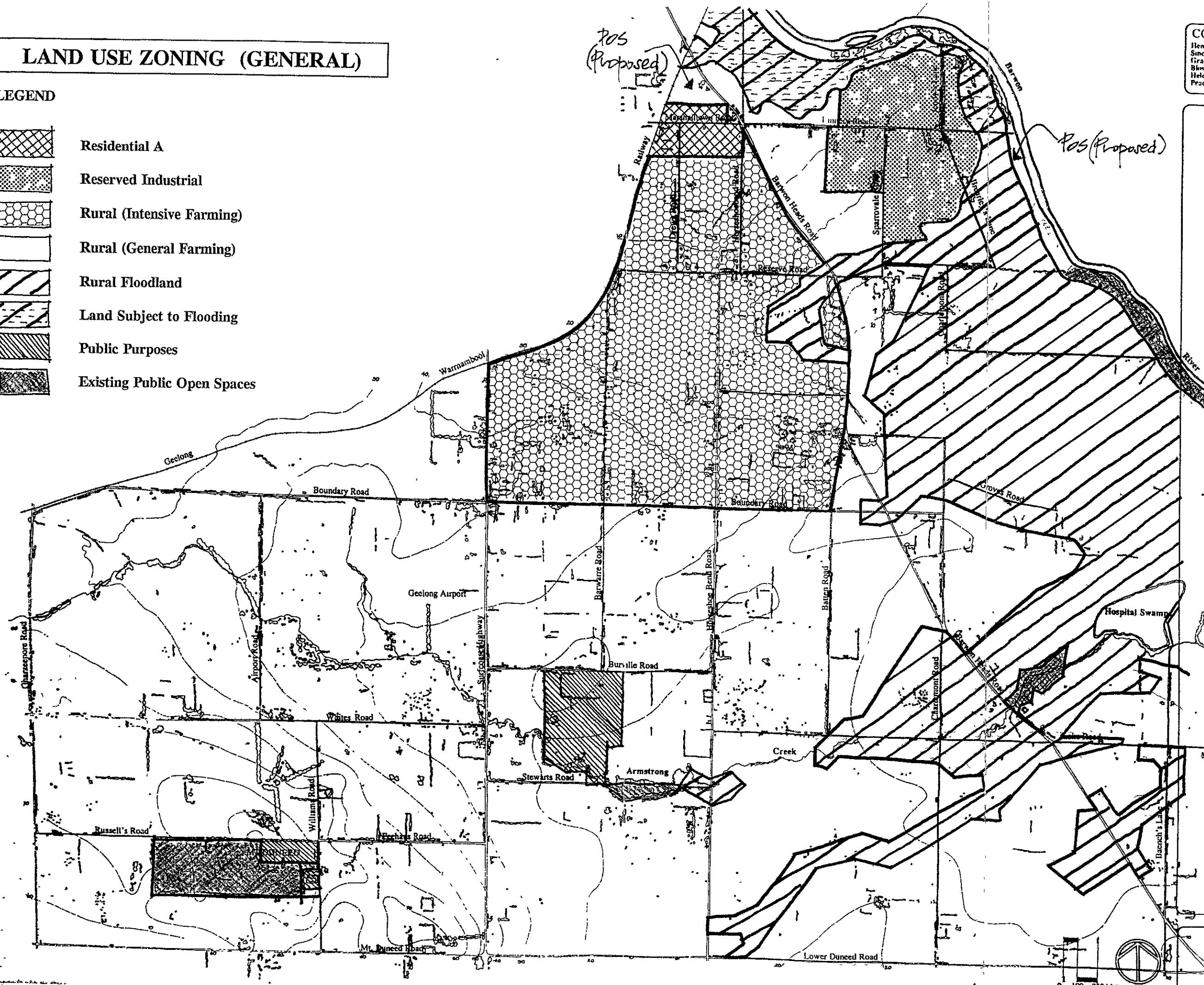
LAND USE ZONING (GENERAL)

LEGEND

-  Residential A
-  Reserved Industrial
-  Rural (Intensive Farming)
-  Rural (General Farming)
-  Rural Floodland
-  Land Subject to Flooding
-  Public Purposes
-  Existing Public Open Spaces

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LAND USE ACTIVITIES

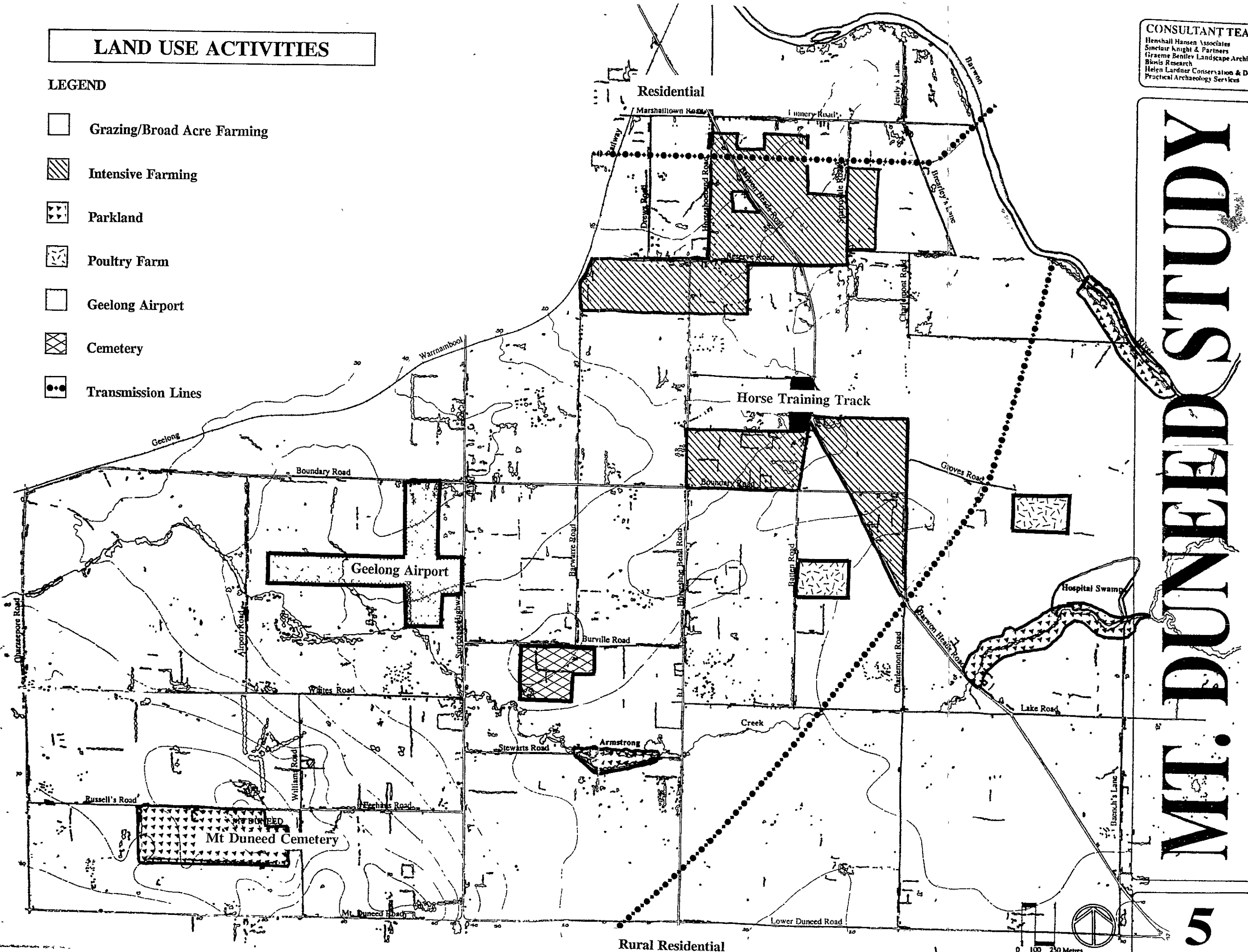
LEGEND

-  Grazing/Broad Acre Farming
-  Intensive Farming
-  Parkland
-  Poultry Farm
-  Geelong Airport
-  Cemetery
-  Transmission Lines

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5



CHAPTER 5

PHYSICAL CHARACTERISTICS

Mt Duneed/Armstrong Creek Urban Development Study

5 *PHYSICAL CHARACTERISTICS*

5.1 *Landform and Topography*

5.1.1 *Existing Conditions*

The dominant landscape feature within the study area is Mt. Duneed, where the ridgeline forms a strong topographic edge across the south-west corner of the study area. The wide, open valley of Armstrong Creek is characterised by gently undulating farmland, which has been largely cleared of vegetation. This area stretches from West to East across the study area. There are several minor ridges and valleys in the central-eastern part of the study area, with obvious knolls and dips, and lesser local rises. The eastern part of the study area is low, flat and open, with minor undulations within the Barwon River plain. There is an appreciable change in landscape character from West to East, which is largely due to the topographic systems and landform features of Mt. Duneed, Armstrong Creek, Barwon River and Lake Connemara.

Landform and topography of the study area is illustrated in Figure 6.

5.1.2 *Key Issues for Development*

Key issues to be considered in the future planning and development of the study area include

- the high visibility of the Mt Duneed area and the natural edge formed by the ridge, which is a natural boundary to future urban growth;
- the creek valley's potential for urban growth with lesser gradients, and the constraints of shallow soils in places;
- the high sensitivity of the creek area itself to any change in hydrological patterns;
- overall, the unsuitability of the river flats area to extensive urban development, with low gradients and drainage problems, as well as its proximity to Lake Connemara State Reserve, which would suffer under any urban development,

5.2 Views and View Corridors

5.2.1 Existing Conditions

The immediate area surrounding the top of Mt. Duneed is highly visible from most parts of the study area, and from the majority of locations it appears as a low ridge. Naturally the views from this area extend over the entire study area and beyond to Geelong, the You Yangs, and towards Anglesea and Barwon Heads. The views of the creek corridor emphasises the connection between remnant indigenous vegetation and the creek itself, and is a recognisable landscape element. Views within the creek corridor are dependent on micro-scale topographic variations and vegetation density. Generally views in this area are between 2km and 5km in length. Along major road reserves, the views are axial and can be very long, (up to 10km) when travelling down a slope. Views are open and framed underneath the SECV transmission lines as most vegetation has been cleared. Within the flatter eastern part of the study area, there are few landscape features to act as a focus to views, apart from the odd glimpse of Mt. Duneed and the You Yangs in the distance.

Views and view corridors are illustrated in Figure 7.

5.2.2 Key Issues for Development

Key issues for future development of the area include:

- the high sensitivity to change of the area immediately surrounding Mt. Duneed, as the visual impact of development on the northern slopes would be easily visible from most parts of the study area;
- the suitability of the greater creek valley (apart from the creek area itself) to development, as it has pockets which are enclosed by vegetation;
- the homogeneous landscape and limited views in the east, mean that future developments in this area would not be apparent from within, or from the other areas due to distance.

5.3 Geology, Soils and Land Capability

5.3.1 Geology

The geology of the land in the southern half of the study area is basalt of the Newer Volcanics Formation, except for a small area of sandstone and limestone (extending north westerly from east of Mt Duneed to near the intersection of

Whites and Williams Roads), known as the Moorabool Viaduct Formation. Phillips (1978) classified these two land types into the Moriac and Other Basalts Land Unit and the Paraparap Land Unit. respectively

The geology of the northern half of the study area is more varied and consists of mainly alluvial deposits. Stream alluvium occurs along the Barwon River floodplain and the Waurn Ponds Creek floodplain at the northern tip of the study area and also along the north western edge of the Armstrong Creek near Boundary Road. These form the Moorabool and Other River Alluvium Land Unit (Phillips, 1976, 1978). A lobe of Waurn Ponds Limestone which is part of the Jan Juc Formation extends eastwards from Grovedale to Barwon Heads Road, together with an adjacent ridge composed of sandstone and limestone from the Moorabool Viaduct Formation. These form the Waurn Ponds District Land Unit (Phillips, 1976, 1978). The area south of Marshall to the intersection of Boundary and Barwon Heads Roads is composed of sands and gravels of the Waurn Ponds Creek alluvial fan. This area forms part of the Moolap Alluvium Land Unit (Phillips, 1976, 1978). The Land Units are shown in Figure 8

5.3.2 Soils

The soils of the Geelong Region were described by Phillips (1976, 1978) and descriptions of soils found in the study area follow. Soils of the Moolap Alluvium Land Unit are variable, being either deep duplex gradational or uniform red-brown or grey silty clay over stratified gravel, clay or silt, or grey-brown clay silt with some sand to 200 mm over red-brown medium textured clay to 900 mm depth. These Moolap Unit soils have a moderate permeability and have established drainage lines. Soils of the Moorabool and Other River Alluvium Land Unit are silty clay loam to grey-brown loams with uniform texture. The Moorabool Unit soils are well drained with a high permeability. Soils of the Waurn Ponds District Land Unit are variable from sandy loams to light clay loams, to uniform dark brown heavy textured clay with calcareous nodules to 0.5 m depth over yellow-grey weathered limestone. Generally shallow gradational soils cover the limestone. The Waurn Ponds Unit soils have moderate to low permeability on the heavy textured clays with high permeability on the sandy loams. Soils of the Moriac and Other Basalts Land Unit are variable with loam to clay texture with uniform dark grey or brown, heavy textured expansive clay with some basalt floaters. In the Mt Duneed to Lake Connewarre the basaltic soils are generally shallow of 150 mm depth, brownish-grey clay loam surface soils overlying grey and yellowish-grey heavy clay subsoils. In the lower lying, poorly drained areas. The soils of the Moriac Unit have low permeability with impeded drainage and high salinity drainage lines. Soils of the Paraparap Land Unit are light grey-brown to light clay loam overlying a gravelly buckshot layer with a mottled grey-brown clay subsoil with a medium to heavy texture. The Paraparap Unit soils have a moderate to high permeability.

5.3.3 *Agricultural Land Capability*

The land units have been previously classified into their agricultural capability by Phillips (1978). The majority of the study area is classified as second quality agricultural land (refer to Figure 8) and includes the Moniac and Other Basalts Unit, and the Moolap Alluvium Unit, which is suitable for mixed farming. The first quality land is the Waurn Ponds District Unit and the Moorabool and Other River Alluvium Unit which is suitable for mixed farming and in some localities intensive uses, whilst the third quality land is the Paraparap Sandy Loams Unit which is generally suitable for grazing. Generally the agricultural potential is limited by the relatively low rainfall and lack of suitable large scale water supplies for irrigation and the poor drainage of the shallow basalt soils and low lying flood prone land, especially in the south-east of the study area in a triangle from Lower Duneed Road to Barwon Heads Road to Horseshoe Bend Road.

However, these classifications are entirely dependant on the physical capability of the land and the present and potential agricultural uses have been significantly limited by the small land tenement sizes throughout the study area. Consequently much of the land is not viable for primary production and is more suitable for hobby farming. However, intensive agriculture mainly irrigated vegetable farming occurs at Marshall on the Moorabool and Other River Alluvium Unit and to a lesser extent on parts of the Moolap Alluvium Unit where irrigation is possible due to the proximity to the Barwon River and Waurn Ponds Creek. This area near Marshall is one of the most valuable rural lands in the Geelong Region and is recognised by its inclusion in the Geelong Regional Planning Scheme's Rural Intensive Farming Zone (Neilson Associates, 1985).

Whilst the agricultural land capability classification (Phillips, 1978) outlines the regional potential for agriculture, there are local opportunities which are based on local topographic slope, aspect and microclimate. On the Paraparap Sandy Loams Unit at Mt Duneed there is an expanding viticulture industry where the slope aspect is north-east and is protected from the prevailing strong south westerly winds. These limestone soils also provide good drainage unlike the basalt soils. The viticulture also can be conducted on smaller land tenement sizes.

In summary it is recommended that the Paraparap Sandy Loam Unit at Mt Duneed and the areas of irrigated intensive agriculture on the Moolap Alluvium Unit and the Moorabool and Other River Alluvium Unit at Marshall be retained as agricultural land in the planning scheme for urban development within the study area.

5.4 *Water Resources, Drainage and Flooding*

5.4.1 *Water Resources*

The general locality of the study area is supplied from the Barwon System which supplies approximately 70% of the total water within the Geelong Region.

The headworks of the system consists of the West Barwon Reservoir near Forrest and diversion weirs on several of the upper tributaries of the Barwon River. Surface water resources can be supplemented by groundwater drawn from deep aquifers on the slopes of the Otway Ranges near Barwon Downs during times of drought. Water from the headworks is transferred to the Wurdee Boluc Reservoir, a major off-river holding storage located near Winchelsea

Water supply to the area will be serviced directly from the Pettavel Service Basin, some 4km west of the study area. The Pettavel Service Basin is fed from the Wurdee Boluc Reservoir

5.4.2 *Drainage and Flooding*

- *Rainfall Characteristics of the Catchment*

Rainfall is variable in the area but can be averaged at 600 mm annual rainfall. Rainfall variability, the level of which is dependant upon total annual rainfall, is a large determinant of flood flows.

The character of the region and rainfall variability causes periodic flooding on the lowland areas within the study area. The extent and intensity of floods is determined by physiography and rainfall.

- *Flooding Within the Study Area*

The boundaries of the rural flood zone were determined using the flood levels from the June 1952 flood. These levels were determined by the identification of known flood points supplied by long-term residents and objectors to the rural zone boundaries.

Flood waters have been identified as coming from:

- the Barwon River and Lake System; and
- local depression areas within each drainage catchment.

Widespread flooding occurs on the low-lying areas adjacent to Reedy Lake and Lake Connemara due to the very slight fall on the land combined with the following two controls:

- the narrow gap between Reedy Lake and Lake Connemara; and
- the tidal breakwater at Barwon Heads which can cause backwatering up to the Lakes System and beyond.

Flooding is sporadic and usually of short duration. Flooding is significant, not in terms of total discharge, but in terms of the capacity of the watercourses. These channels have evolved to cope with limited runoff in a relatively dry area. Historic floods on the Barwon system have been substantial, yet floods of a much greater magnitude are possible.

During periods of heavy rainfall, water crosses several of the roads within the study area cutting road access. This is documented on photographic records taken by the City of Greater Geelong after rainfall on Monday, 1 November 1993. The following road locations are notorious for flooding and are cut to passing traffic on average twice a year:

- Mt Duneed Road east of Ghazepore Road;
- Lower Duneed Road west of Horseshoe Bend Road;
- Lower Duneed Road at Charlemont Road;
- Charlemont Road north of Lower Duneed Road;
- Charlemont Road at Lake Road;
- Barwon Heads Road at Reserve Road;
- Barwon Heads Road at Boundary Road;
- Stewarts Road - eastern section;
- Lake Road at numerous unconstricted sites;
- Batten Road;
- Airport Road; and
- Ghazepore Road at both culvert inverts.

Figure 9 shows the areas liable to flooding and where urban development requires control due to the flood prone nature of the land. The figure also depicts drainage catchment area boundaries as well as the existing main drainage lines within the study area.

- *Drainage Catchment Areas*

The study area falls within the overall Barwon River water catchment system. The drainage system within the study area falls within five main catchments which are represented in Figure 10 and are identified as the catchments of:

- Armstrong Creek

- Sparrowvale
- Sparrowvale (North)
- South-east Grovedale
- Thompson's Creek

Armstrong Creek - The Armstrong Creek catchment covers some 28 square kilometres in area and drains much of the study area with the Armstrong Creek itself forming the major flow line. The creek is relatively shallow and extends from the Mt Duneed region to its outlet in the Hospital Swamps area. East of Horseshoe Bend Road the watercourse is ill-defined and the topography is extremely flat with levels very close to sea level. This low lying area is thus susceptible to flooding.

Flooding on Lake Reedy tends to cause a backwatering effect along Armstrong Creek which contributes to the flooding of these low lying areas. Some low lying areas west of Barwon Heads Road in the vicinity of Lake Road have become salty due to the presence of a continually high water table.

Only areas liable to significant flooding have been identified in the Rural Floodplain Zone although it should be realised that low lying areas are subject to waterlogging during winter months. Some dwellings in the area are subject to some inundation during flood times and caution is required in siting of dwellings in the area especially east of Horseshoe Bend Road.

Sparrowvale - The Sparrowvale catchment consists of a very flat floodplain covering some 4 square kilometres of land which is enclosed by man-made levee banks. The fall on the floodplain is 0.6m over a distance of 2km from the drainage confluence at the intersection of Groves Road and Charlemont Road to the western edge of Lake Connewarre.

Two levee banks have been erected in the catchment area adjacent to the Barwon River and Lake Connewarre. The levee banks were built by the Harbour Trust early this century and prevent inundation of the floodplain during minor and median frequency floods having a frequency which is less than 1 in 10 years. During major storm events the levees are breached and a substantial portion of flood waters from the Barwon River are directed onto this floodplain. During the 1952 flood (an eighty year event), the levee banks were breached and the area was inundated to a depth of 1.5 - 2.0m.

The main drainage paths within this catchment are in the form of very shallow, ill-defined drains which flow towards the outlet point in the eastern part of the catchment area. The level of the floodplain is lower than the top water level in the Barwon River. Thus, drainage waters require pumping out of the impounded floodplain area into the adjacent Hospital Swamps area.

Sparrowvale (North) - This catchment is the smallest drainage catchment in the study area and is located north of the Sparrowvale catchment. North of Boundary Road and east of the Barwon Heads Road development is proceeding on the floodplain.

The outlet to this catchment is at its south-east corner discharging directly to the Barwon River. The Barwon River discharges into Lake Connemara, a shallow estuarine lake system, before draining via the Lower Barwon into Bass Strait.

South East Grovedale - The south east Grovedale drainage catchment area is located in the northern most part of the study area. Urban development is present within this catchment and an urban stormwater drainage system is in service north of the railway line. Stormwater flows in a northerly direction towards the outlet to the Barwon River in the northern most part of the catchment.

Thompson's Creek - A small section of the study area located in the south-west corner falls within the Thompson's Creek drainage system and has not been analysed in this report.

5.5 *Post Contact Cultural Heritage*

5.5.1 *Study Approach and Methodology*

A preliminary survey of post contact cultural heritage (post European settlement) was undertaken in order to obtain an understanding of the physical characteristics of the land in the Mt Duneed/Armstrong Creek area. This survey is a visual analysis which can be used as the basis for identification of likely opportunities and constraints arising from identified places. It should not be seen as complete but rather as an indication of the types of heritage issues which arise in the area.

The cultural heritage survey is based on a visual approach and does not include primary research or a development of the historical settlement themes evident in the area. The survey was undertaken from public roads without entering private property. The rural residential nature of the land means that some places could not be clearly seen from the roads. Hence it was not possible to identify all places of potential archaeological, architectural or historical significance in the area and the list must be seen as preliminary.

The number and type of places identified suggests that a full conservation study of the area is warranted. This should be done in accordance with the guidelines available from Heritage Victoria of the Department of Planning and Development.

5.5.2 Identification of Places

The following places have been identified as good representational examples of the architectural style of their period. They are likely to be of local or greater significance where the buildings are substantially intact. This is because they demonstrate the lifestyle, aspirations and taste of their period. Further historical information could mean that these places are of increased importance. This information could include association with a significant person or group of people or that the buildings on closer examination demonstrate an interesting construction technique or a rare feature. A place which has undergone change so that it now demonstrates a layering of architectural styles can be important for the same reasons. However, it is difficult to identify such places with limited visual access.

The buildings listed below are divided into stylistic groups. The numbering system refers to the accompanying Figure 11 showing places identified on an A3 plan of the study area. Photographs of selected examples are included in Appendix 1.

Victorian c1860-90

- **Residence (1) - North side of Lower Duneed Road between Baench's Lane and Charlemont Road**
Substantially intact weatherboard, corrugated iron roofed residence with Edwardian additions and a number of out buildings
- **Residence (2) - Eastern side of Barwon Heads Road near the northern section of Charlemont Road**
Weatherboard Victorian/Edwardian house with substantial alterations and additions.
- **Ashes Hills (4) - Corner of Barwon Heads and Batten Roads**
Substantial slate roofed weatherboard residence which appears to have Alterations from c1930s.
- **Robantine (6) - Eastern side of Horseshoe Bend Road, north of Burvilles Road intersection**
Mid Victorian weatherboard residence with Edwardian verandah detail.
- **Residence (7) - South side of Boundary Road near Barwarre Road**
Substantially intact weatherboard house with a corrugated iron roof and notable lacework, refer to photograph 4, hard to see bluestone building at rear
- **Residence (8) - Western side of Batten Road, south of Reserve Road**
A large and substantially intact weatherboard house with a corrugated iron roof
- **Residence (10) - East side of Sparrowvale Road, north of the continuation of Reserve Road**
Weatherboard, corrugated iron roofed house with intact lacework, may be threatened by lack of occupancy.

- **Residence (11) - Western side of Brearley's Lane, near Tannery Road**
A large brick and bluestone slate roofed house with a high degree of integrity and many decorative features, notable remnants of garden including plantings and front fence.
- **Greenbanks (12) - Northeast end of Jendes Lane on the Barwon River**
Difficult to see slate roof house with an old out building, requires further investigation.
- **Residence (13) - Northern side of Tannery Road near Sparrowvale Road intersection**
A simple weatherboard house with a corrugated iron roof in derelict condition.
- **Residence (14) - Eastern side of Kings Lane, adjacent to Marshall Pallets**
A simple weatherboard house with a corrugated iron roof in derelict condition
- **Iolanthe (15) - 61 Tannery Road**
Weatherboard house with a corrugated iron roof and decorative details.
- **Residence (16) - South side of Tannery Road, west of Kings Lane intersection**
Weatherboard house with a corrugated iron roof and decorative details.
- **Residence (17) - Eastern side of Barwon Heads Road, near Tannery Road**
Early Victorian tuck pointed bluestone house with slate roof and large slate lintels.
- **Residence (18) - Northern side of Tannery Road, east of Barwon Heads Road**
A simple weatherboard house with a corrugated iron roof and no verandah.
- **Residence (21) - Eastern side of Surf Coast Highway, near intersection with Whites Road**
Weatherboard house with corrugated iron roof and original lacework.
- **Dooliebeal (22) - Southern side of Stewarts Road**
Red brick house with slate roof and hipped verandah.
- **Residence (24) - 50 Whites Road**
A Bluestone house retaining original detailing to the verandah and front facade with alterations and additions to the rear.
- **Hillside (26) - 30 Williams Road**
A Victorian bluestone residence with a slate roof and later Art Nouveau timber verandah, refer to GRC Study Volume 1, Sheet 74 (note that the study gives the property address as Whites Road).
- **Residence (31) - 280 Mt Duneed Road**
A substantial weatherboard Victorian house with an Edwardian bay addition and a corrugated iron roof
- **Uplands (33) - 21 Whites Road**
Weatherboard house with corrugated iron roof and alterations to the rear.

Edwardian c1890-1915

- **Amber Lodge (3) - Batten Road**
Weatherboard residence with some intact features and some alterations.
- **Residence (9) - South side of the continuation of Reserve Road, east of Sparrowvale Road**
A substantially altered Edwardian weatherboard house with large timber and brick sheds to the rear which are visible at a distance, for example from Brearley's Lane

Bungalows c1915-30

- **Residence (5) - East side of Batten Road near Boundary Road**
Substantially intact weatherboard bungalow with alterations to include an attic storey.
- **Bellevue (27) - 60 Mt Duneed Road**
Hard to see bungalow visible at a distance.

Other Places

- **Mt Duneed Cemetery (32) - Western side of Williams Road**
A local cemetery with monuments and surrounds dating from Victorian times to the present, planting and a gatehouse contribute to this landmark, refer to photographs 20, 21 & 22 Refer to the GRC Study Volume 1, Sheet 72

Potential Places

- **Mystic Park (34) - Eastern side of Charlemont Road near Lower Duneed Road**
Hard to see, perhaps a stone wall and stone shed.
- **Residence (35) - 1330 Lake Road**
Substantially altered house, perhaps with an older section behind.
- **The Old Hill (36) - 1455 Charlemont Road**
Weatherboard Victorian house, substantially altered including tiled roof.
- **Residence (37) - Western side of Horseshoe Bend Road, north of Boundary Road**
A substantially intact simple weatherboard 1930s house.
- **Residence (38) - South side of Reserve Road, east of Horseshoe Bend Road**
A substantially intact simple weatherboard bungalow.
- **Barwonside (39) - Eastern side of Kings Lane on Barwon River**
Hard to see appears to be an altered Victorian.

- **Residence (19) - 28 Marshall Town Road**
Interesting roof line and remnant plantings, appears to be substantially altered
- **Residence (20) - 365 Surfcoast Highway**
A simple weatherboard Edwardian house.
- **Residence (23) - Eastern side of Surfcoast Highway, near Mt Duneed Road**
Hard to see bungalow with woven wire fence.
- **Former residence? (25) - Northern side of Whites Road near Airport Road**
A small weatherboard and corrugated iron structure that appears to have the entry facing east and a bluestone, slate roofed service wing addition to the street.
- **Calder Park (28) - 20 Mt Duneed Road**
Hard to see, long low bluestone buildings with slate roof and a weatherboard section which appears to face Surfcoast Highway.
- **Hall? (29) - 40 Mt Duneed Road**
A half timber and cement sheet building which appears to be a hall.
- **Cedar Lodge (30) - 260 Mt Duneed Road**
Appears to be an old corrugated iron roof line but the building is difficult to see.

5.6 *Pre-Contact Heritage*

5.6.1 *The Windscreen Survey*

A windscreen survey was undertaken over one and a half days, and covered every road and track within the study area. During this survey, areas were noted which covered the following topics.

Historic Archaeological Sites

- Historic archaeological sites
- Potential Historic archaeological sites
- Locations which indicated that Historic archaeological material or sites could be present

Aboriginal Archaeological Sites

- Areas which provided good ground surface visibility for Aboriginal cultural material (eg. ploughed or cultivated paddocks)
- Areas where Eucalypts of considerable age are present, (these might contain bark removal scars).

Only a few areas were examined on foot. These areas included:

- the recreation reserve at the end of Russells Road,
- the summit of Mt. Duneed,
- the recreation reserve on Stewart Road,
- the northern extension of Baenschs Lane
- a section of Kings Lane

5.6.2 *Aboriginal Archaeological Sites*

No Aboriginal archaeological sites were located during the windscreen survey, however several areas with great potential for stone artefact sites or scarred trees, were noted for further work.

Stone artefact sites are usually isolated stone artefacts or scatters of stone artefacts. These sites can occur on most landscapes, usually within a reasonable distance from water or on elevated or high points of the landscape. Therefore, stone artefact sites could occur on Mt Duneed or on the undulating plains towards Lake Connewarre which are latticed with small streams.

Stone artefact sites are easily located in areas of good ground surface visibility. The best ground surface visibility is gained from ploughed or cultivated paddocks, dirt vehicle tracks and stock tracks.

Based on the results of the windscreen survey, several ploughed or cultivated paddocks were identified across the study areas (Figure 12). Such exceptional ground surface visibility would require several days of intensive foot surveying in transects, if permission was granted by the owners.

Bark removal scars are usually located on old Eucalypts. There are numerous areas noted during the windscreen survey where suitably old Eucalypts, dead and alive, are present (Figure 12).

5.6.3 *Historic Archaeological Sites*

Six Historic archaeological sites were noted during the windscreen survey (Figure 13). These sites consist of three domestic bluestone quarries, one dry-stone fenceline, one vegetation driveway of Cypress Pines and Sugar Gums, and one homestead complex which has been partly removed.

1	Mt Duneed Road 1	Bluestone Quarry
2.	Russells Road 1	Dry-stone wall
3	Williams Road 1	Vegetation Driveway
4.	Williams Road 2	Bluestone Quarry

5.	Horseshow Bend Road 1	Homestead Complex
6	Manooka 1	Bluestone Quarry

Several areas which could yield Historic archaeological sites or material, were also noted during the windscreen survey (Figure 13). There areas are as follows:

- A Stone ruin at rear of "Wongara" property buildings, H Dekker 80 Russells Road.
- B Cypress Pine windbreak at eastern end of Russells Road.
- C Cypress Pine windbreak at "Tallandale" property, Mt. Duneed Road.
- D Basalt ridgeline to west of "Tallandale" property
- E The old Mt. Duneed township area, around Williams, Feehans, Torquay and Stewart Roads.
- F Buildings etc, of considerable age attached to property at 140 Whites Road.
- G Property on south side of Boundary Road, between Barwarre and Horseshoe Bend Roads.
- H "Dooliebeal" Property, Stewart Road.
- I Old house, Lower Mt. Duneed Road
- J Hall, and Cypress lined property, 40 Mt. Duneed Road.
- K Possible dry-stone wall remains, along elevated banks of Lake Connnewarre, and Barwon River
- L Gravel pit, east side of Charlemont Road.
- M Old Bluestone building and outbuildings, corner of Tannery Road and Barwon Heads Road
- N "Barwonside" property at northern end of Kings Lane
- O Timber house on Kings Lane.
- P Deserted timber house north side Tannery Road.
- Q "Greenbanks" property, Jendies Lane.
- R "Sunnyside" and property, corner Brearleys Lane and Tannery Road.
- S Old abandoned timber house and outbuildings, off Sparrowvale Road.
- T "Sparrowvale. and outbuildings, Sparrowvale Road.
- U "Calder Park", No 20 Mt. Duneed Road
- V Former Yarborough Hotel site, corner of Stewarts Road and Torquay Road

5.6.4 Discussion

The results of this windscreen survey have established that Aboriginal archaeological sites are difficult to locate and record under these circumstances. Areas which could provide optimum survey conditions, such as good ground surface visibility and suitably old Eucalypts, can be identified under these circumstances

The location of Aboriginal Archaeological sites recorded away from the coast line of the Bellarine Peninsula, suggests that ploughed or cultivated paddocks can reveal Aboriginal stone tools (Rhoads 1985)

Evidence of the location of Aboriginal archaeological sites elsewhere in Victoria, suggests that high points of the landscape were used as mythological sites, vantage points and base camps by Aboriginal people. This could well be the history of European settlement and current land use, has not enabled a good examination of the summit or slopes for Aboriginal archaeological material.

The problem of extensive grass cover was encountered throughout the Study Area. Even the banks of Armstrong Creek and the Barwon River had poor ground surface or profile visibility. This does not suggest that Aboriginal archaeological materials or sites are not present. It merely suggests that the presence of the Aboriginal archaeological material or sites should not be discounted until such time that these area can be thoroughly examined

In terms of the Historic archaeology of the Study Area, the results of the windscreen survey suggest that there are a significant number of Historic sites and a corresponding number of areas which have the potential to yield Historic archaeological sites. Some of these sites were easily identified during the windscreen survey, however many more require additional time to survey and research than was possible during this project

Historic archaeological sites are not only piles of bricks or bluestone which once formed a house, but can consist of fencelines, outbuildings, wells, houses, huts or the remains thereof, bridges, fords, drains, tunnel, abandoned railway stations, early roads, early European plantings such as orchards, gardens, driveways and windbreaks

Historic archaeological sites also consist of sub-surface remains of past human activity, where there are no longer extant structures. Historic archaeology can yield information about buildings and areas which can verify or refute written records, or bring to light information unavailable in written records.

In the event that urban development proceeds within the Mt Duneed/Armstrong Creek area, a great deal of the heritage of pre-settlements and early settlement of this western section of the Bellarine Peninsula could be lost without a more detailed archaeological survey. This heritage should be given consideration in any future strategic planning studies undertaken within the area

5.7 *Open Space and Recreation*

5.7.1 *Existing Conditions*

As the study area is still largely rural, there are no active and passive recreation reserves provided, apart from the football oval near Mt. Duneed, and the picnic area at Stewart's Reserve. The creek area itself, and the land beneath the SECV transmission lines have remained as open space linkages which traverse the study area. Open areas adjacent to the Barwon River are periodically inundated, or require mechanical pumping to overcome chronic drainage problems.

Current recreation and open space opportunities are illustrated in Figure 14.

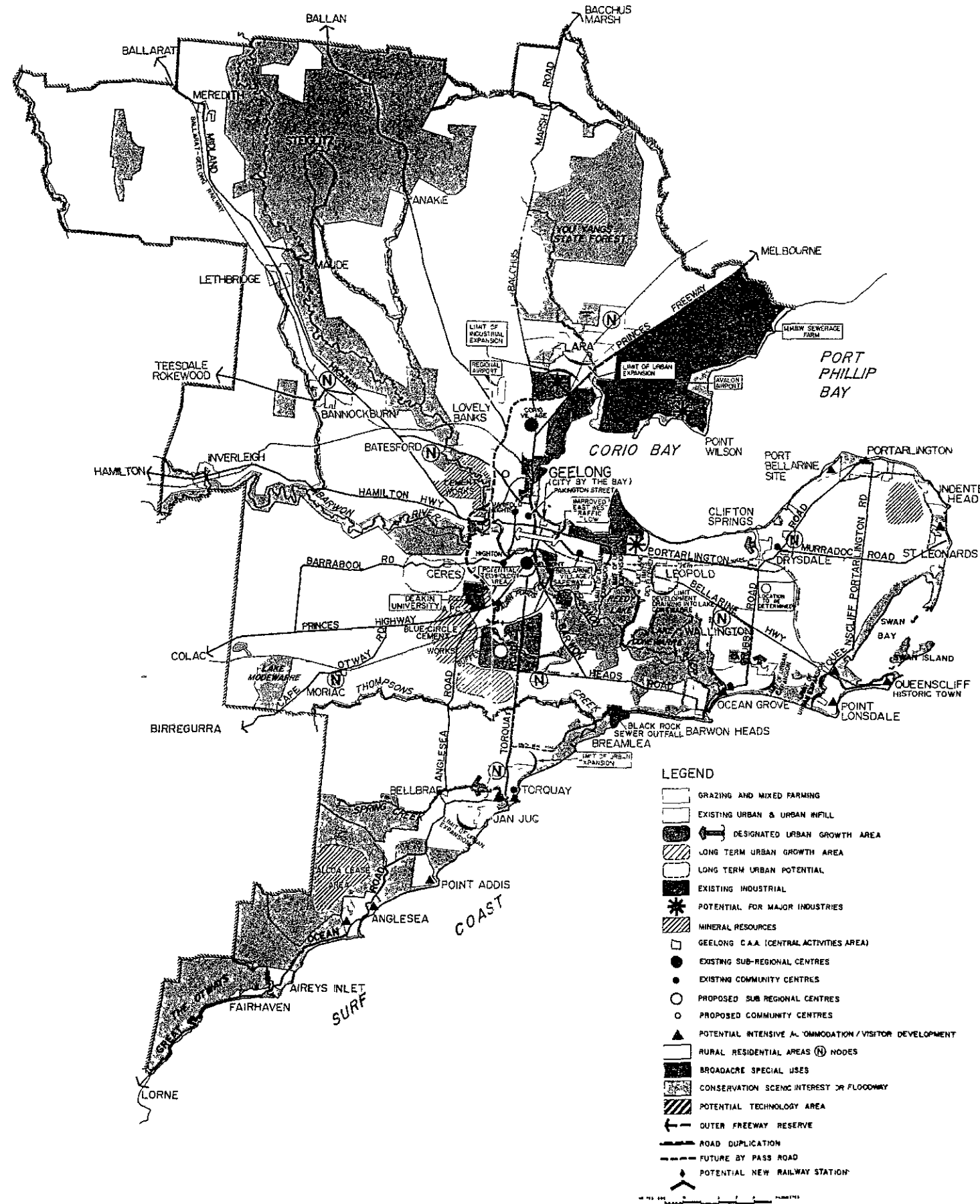
5.7.2 *Key Issues for Development*

Key issues which will need to be addressed in any future planning of this area will include

- adequate provision for open space and community recreation facilities within any urban development to meet the needs of future residents;
- the potential role of the open space under major SECV easements, and natural areas of open space which are relatively intact, like Armstrong Creek, as linear parks/bicycle path networks/open space corridors, to ensure the preservation of these areas within future developments;
- the need to integrate future open space/recreation areas into existing open space systems directly to the North;
- the careful development of flood prone areas as part of open space networks and community access methods;
- the protection and management of ecologically significant areas, like Lake Connewarre, by incorporation into/with open space reserves and public land,
- the advisability of further investigation into the importance of landscape features and vegetation as habitat runs and vegetative webs which support fauna, to ensure optimal flora and fauna conservation;
- the possible augmentation of natural systems within recreation/open space areas, by combining services easements and the establishment of building envelope set-backs in future industrial and commercial areas.

Geelong Region Development Strategy. Physical Framework Plan

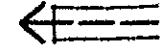
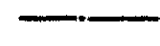
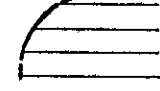
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MT. DUNEED STUDY

RECREATION & OPEN SPACE

LEGEND

- A** Active Recreation Area
- P** Passive Recreation Area
-  Creek Corridor
-  Airport Runway / Flight Path
-  SECV Transmission Line
-  Area of periodic, ill-defined flooding
(once every 1 - 2 years, below Horseshoe Bend Road)
-  Area of periodic flooding
(once every 1 - 2 years, below Barwon Heads Road)

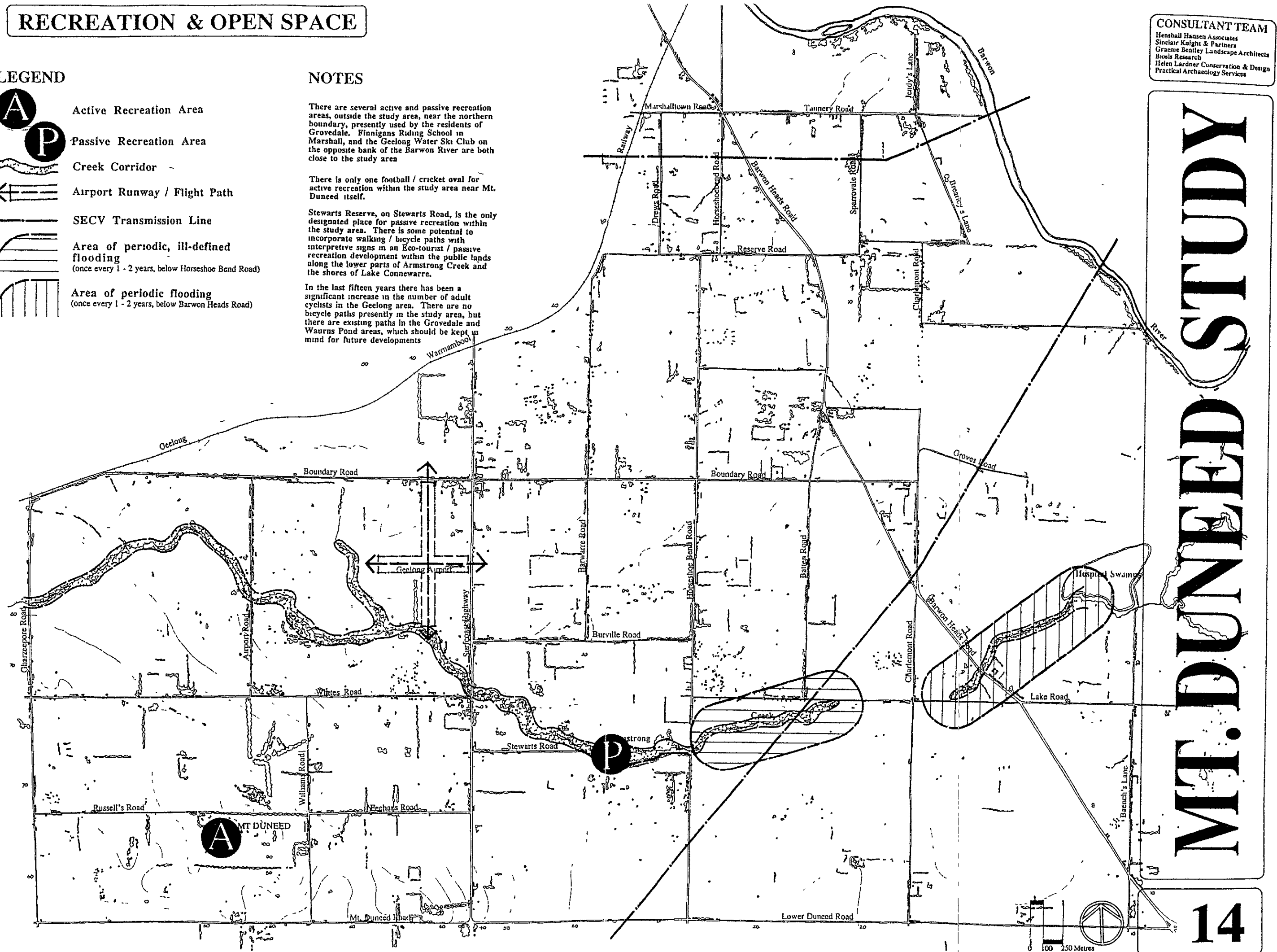
NOTES

There are several active and passive recreation areas, outside the study area, near the northern boundary, presently used by the residents of Grovedale. Finnigans Riding School in Marshall, and the Geelong Water Ski Club on the opposite bank of the Barwon River are both close to the study area

There is only one football / cricket oval for active recreation within the study area near Mt. Duneed itself.

Stewarts Reserve, on Stewarts Road, is the only designated place for passive recreation within the study area. There is some potential to incorporate walking / bicycle paths with interpretive signs in an Eco-tourist / passive recreation development within the public lands along the lower parts of Armstrong Creek and the shores of Lake Connewarre.

In the last fifteen years there has been a significant increase in the number of adult cyclists in the Geelong area. There are no bicycle paths presently in the study area, but there are existing paths in the Grovedale and Waurms Pond areas, which should be kept in mind for future developments

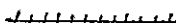
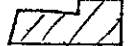


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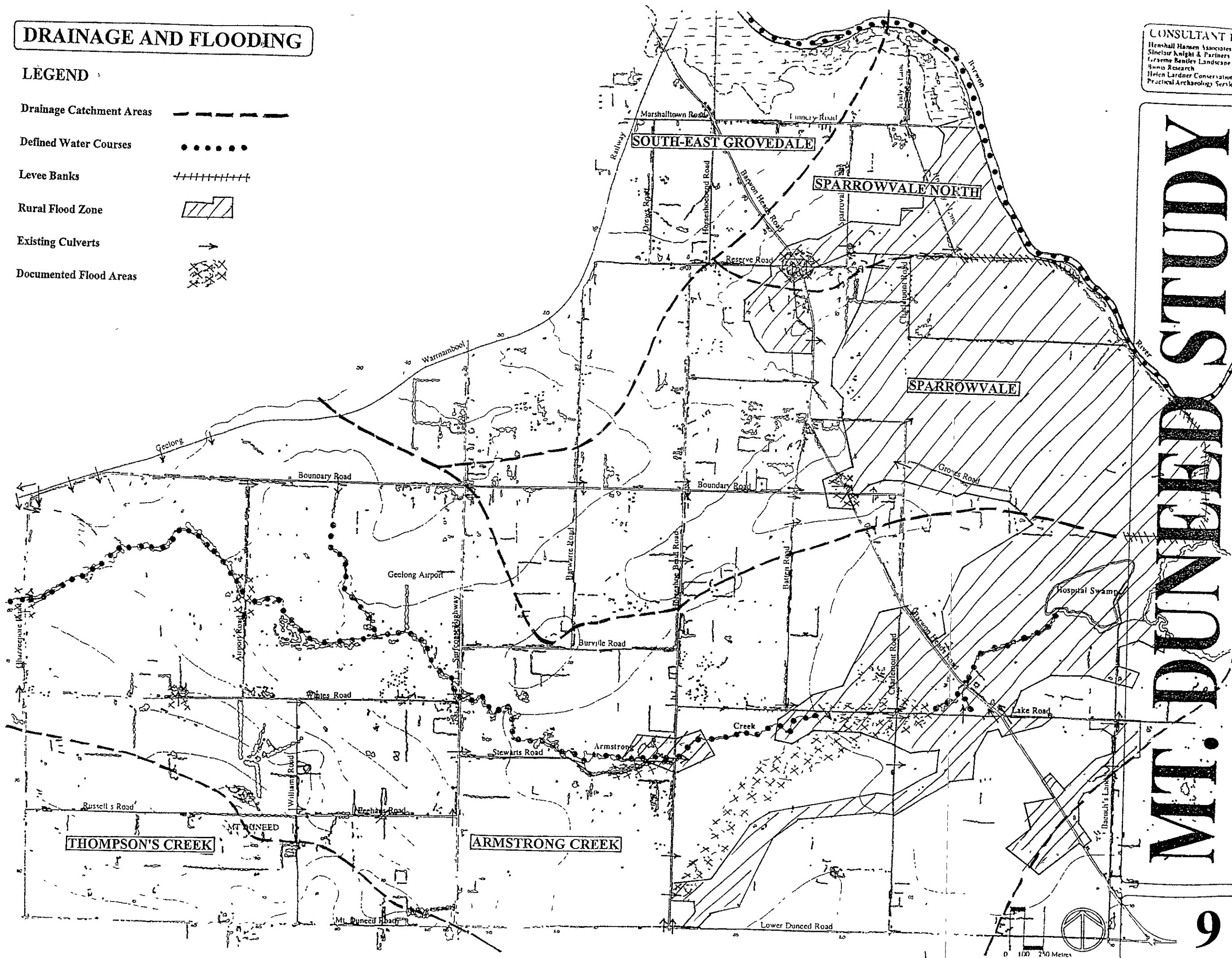
MT. DUNEED STUDY

DRAINAGE AND FLOODING

LEGEND

- Drainage Catchment Areas 
- Defined Water Courses 
- Levee Banks 
- Rural Flood Zone 
- Existing Culverts 
- Documented Flood Areas 

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MT. DUNEED STUDY

LAND UNITS AND AGRICULTURAL LAND CAPABILITY

LEGEND



Land Unit Boundary



First Class Agricultural Land



Second Class Agricultural Land



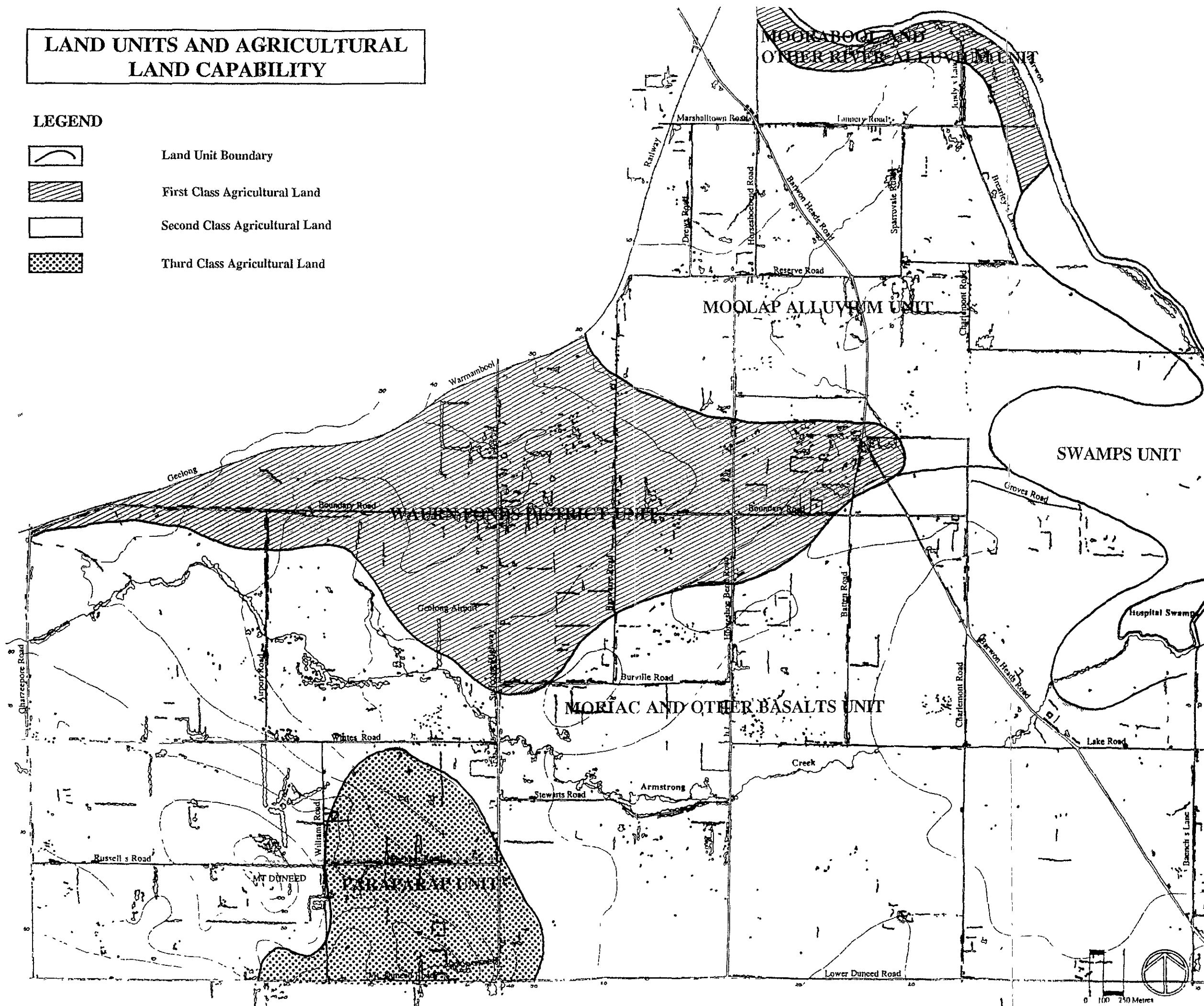
Third Class Agricultural Land

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MT. DUNEED STUDY

8

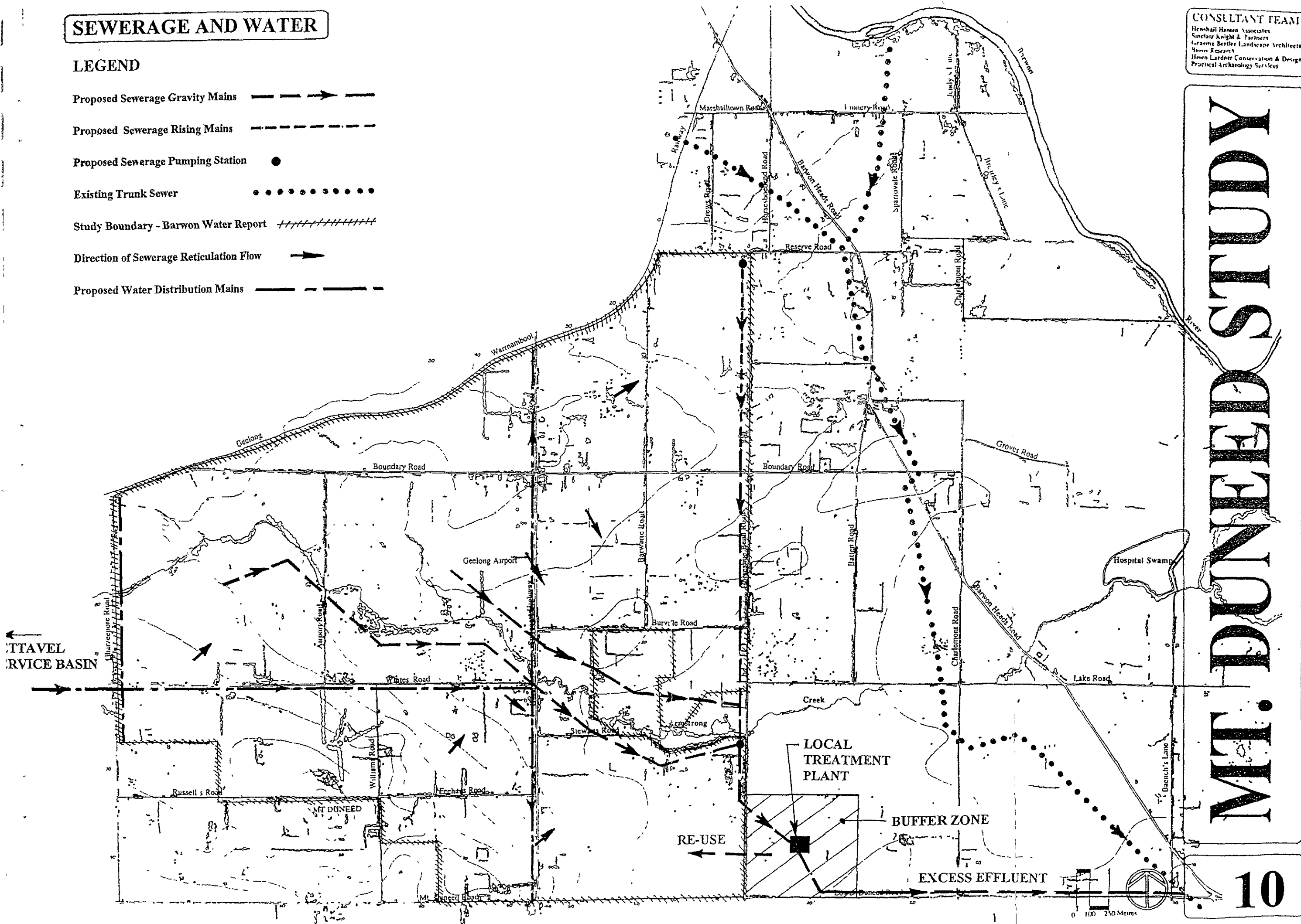


SEWERAGE AND WATER

LEGEND

- Proposed Sewerage Gravity Mains** ————→————
- Proposed Sewerage Rising Mains** - - - - -
- Proposed Sewerage Pumping Station** ●
- Existing Trunk Sewer** ● ● ● ● ● ● ● ● ● ●
- Study Boundary - Barwon Water Report** ++++++
- Direction of Sewerage Reticulation Flow** →
- Proposed Water Distribution Mains** ————

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MT. PLENNER STUDY

10

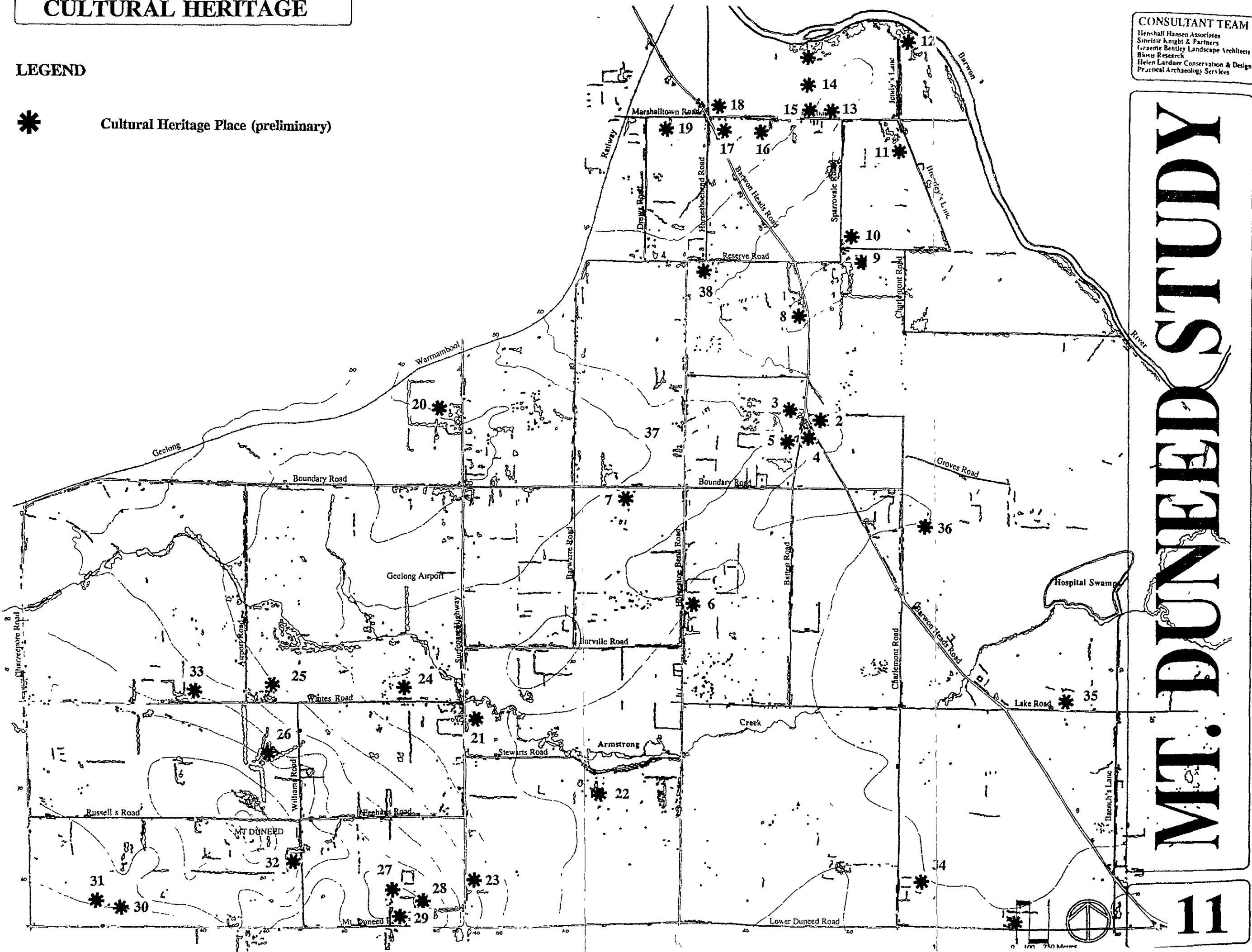
CULTURAL HERITAGE

LEGEND



Cultural Heritage Place (preliminary)

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MT. DUNEED STUDY

ABORIGINAL ARCHAEOLOGICAL SITES

LEGEND

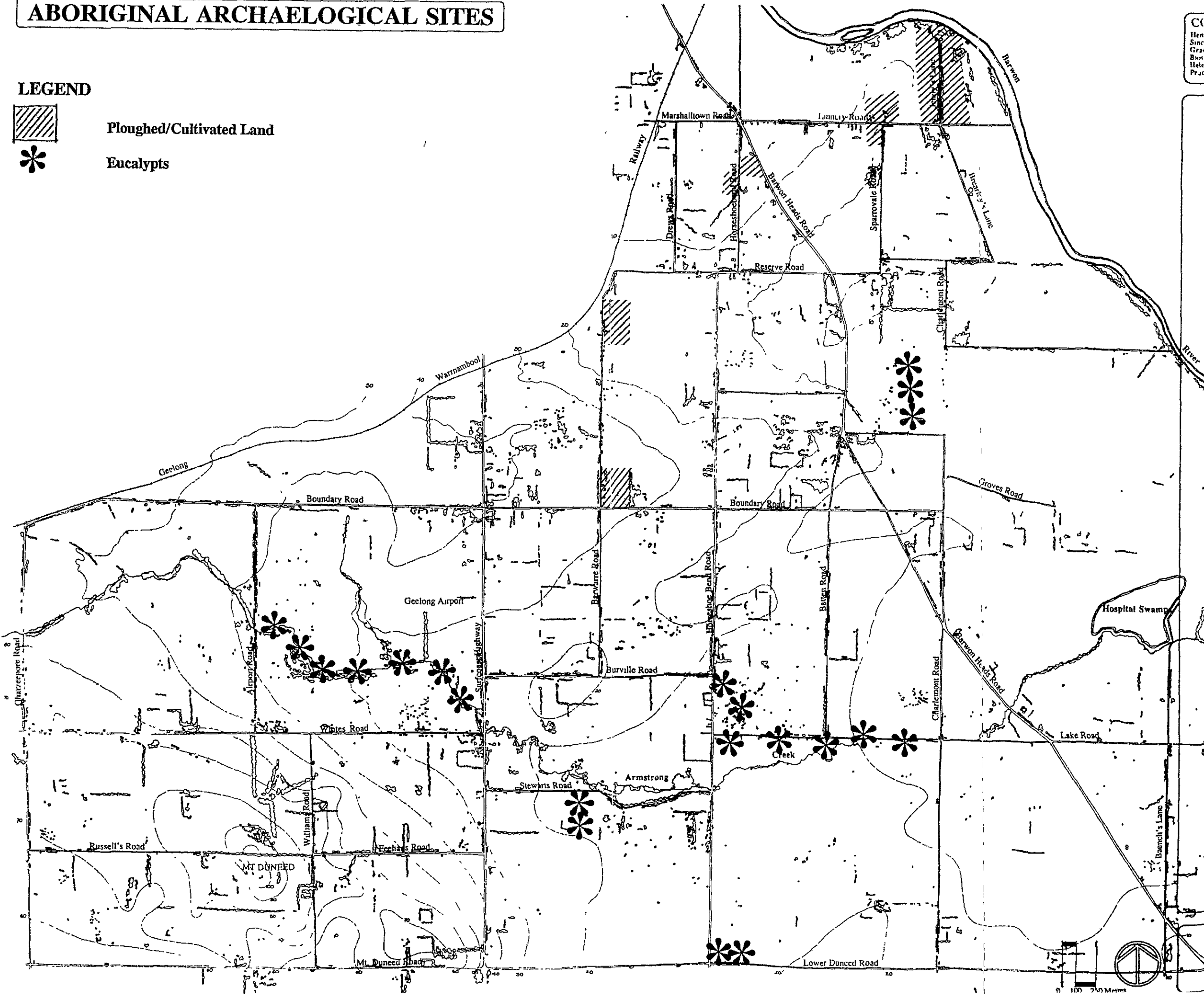


Ploughed/Cultivated Land



Eucalypts

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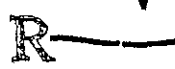
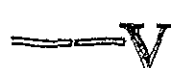


MT. DUNEED STUDY

12

LANDFORM & TOPOGRAPHY

LEGEND

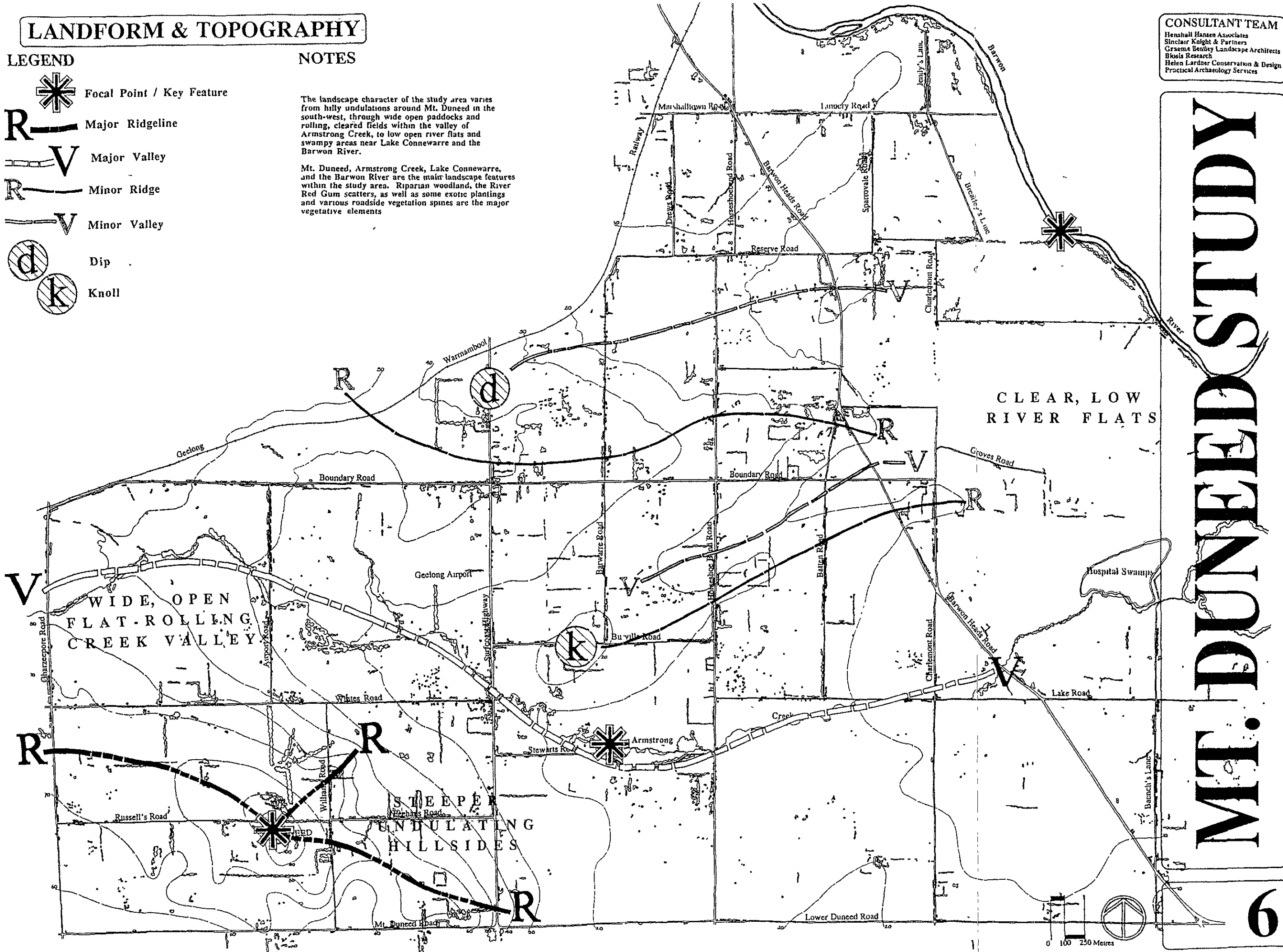
-  Focal Point / Key Feature
-  Major Ridgeline
-  Major Valley
-  Minor Ridge
-  Minor Valley
-  Dip
-  Knoll

NOTES

The landscape character of the study area varies from hilly undulations around Mt. Duneed in the south-west, through wide open paddocks and rolling, cleared fields within the valley of Armstrong Creek, to low open river flats and swampy areas near Lake Connewarre and the Barwon River.

Mt. Duneed, Armstrong Creek, Lake Connewarre, and the Barwon River are the main landscape features within the study area. Riparian woodland, the River Red Gum scatters, as well as some exotic plantings and various roadside vegetation spines are the major vegetative elements

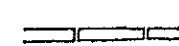
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Practical Archaeology Services



MT. DUNEED STUDY

VIEWS & VIEW CORRIDORS

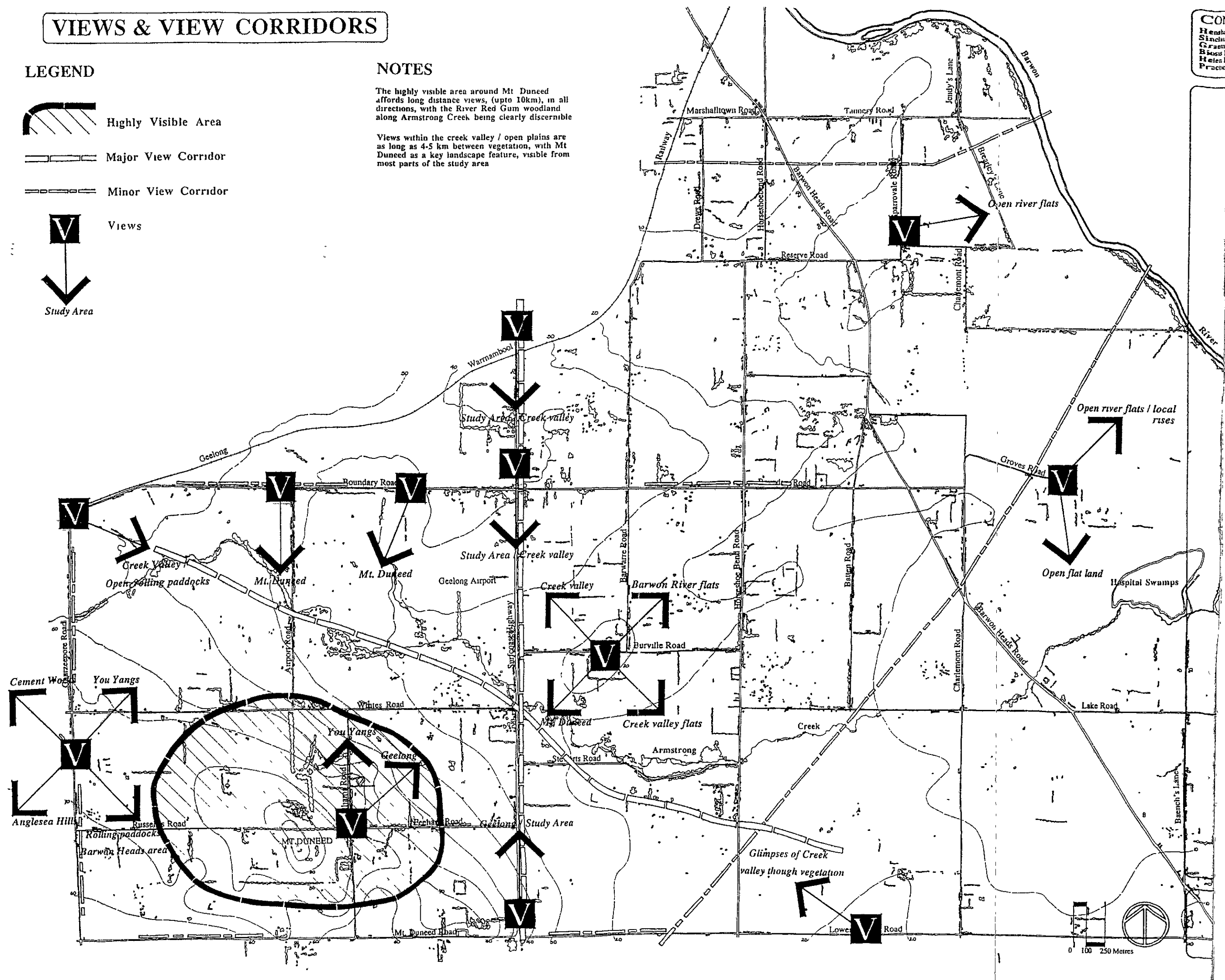
LEGEND

-  Highly Visible Area
-  Major View Corridor
-  Minor View Corridor
-  Views
-  Study Area

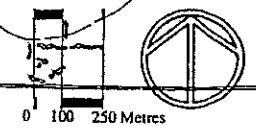
NOTES

The highly visible area around Mt Duneed affords long distance views, (upto 10km), in all directions, with the River Red Gum woodland along Armstrong Creek being clearly discernible

Views within the creek valley / open plains are as long as 4-5 km between vegetation, with Mt Duneed as a key landscape feature, visible from most parts of the study area



CON
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Graham
Bosch
Helen L.
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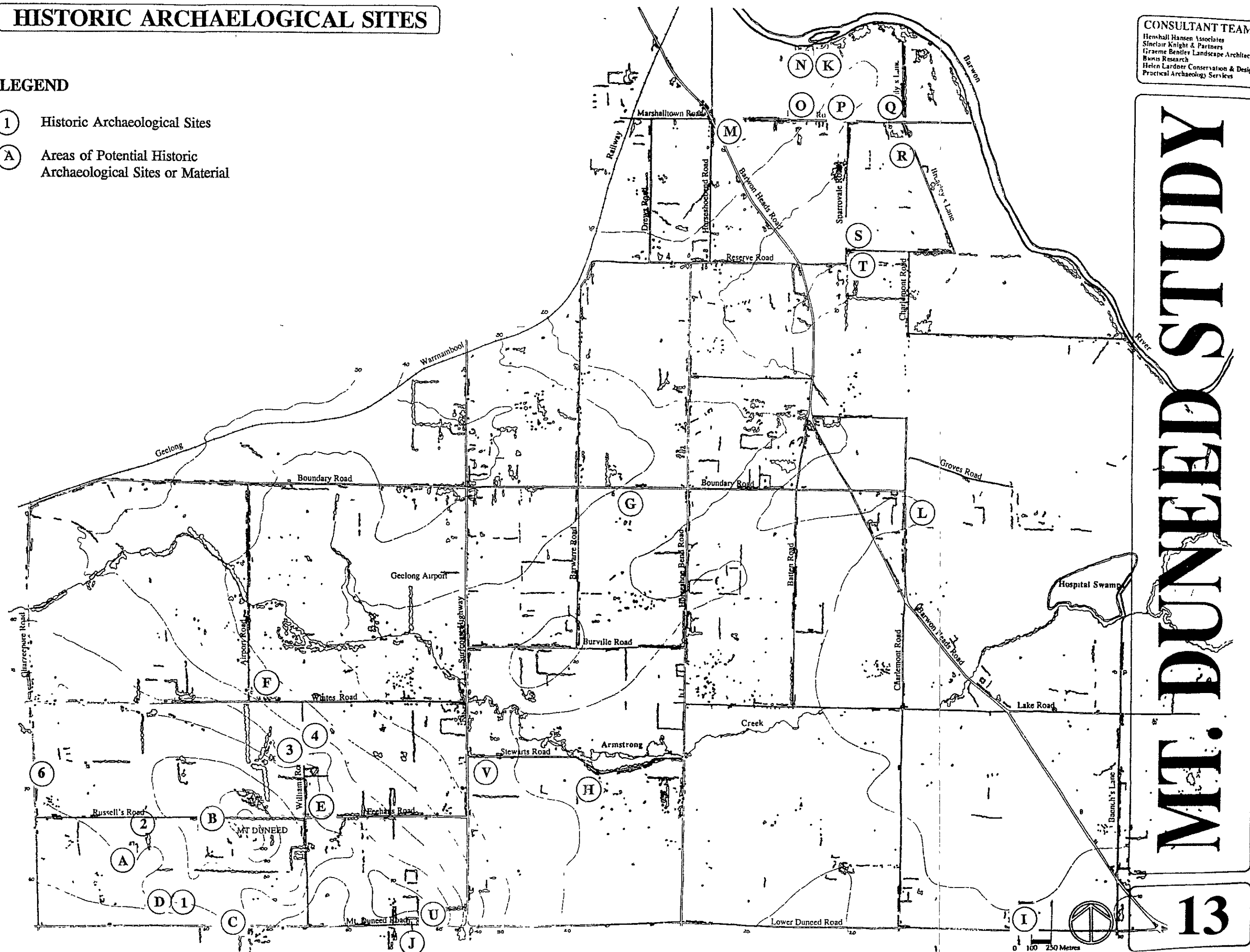


HISTORIC ARCHAEOLOGICAL SITES

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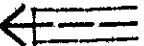
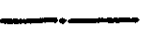
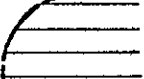
LEGEND

- ① Historic Archaeological Sites
- Ⓐ Areas of Potential Historic Archaeological Sites or Material



RECREATION & OPEN SPACE

LEGEND

- A** Active Recreation Area
- P** Passive Recreation Area
-  Creek Corridor
-  Airport Runway / Flight Path
-  SECV Transmission Line
-  Area of periodic, ill-defined flooding
(once every 1 - 2 years, below Horseshoe Bend Road)
-  Area of periodic flooding
(once every 1 - 2 years, below Barwon Heads Road)

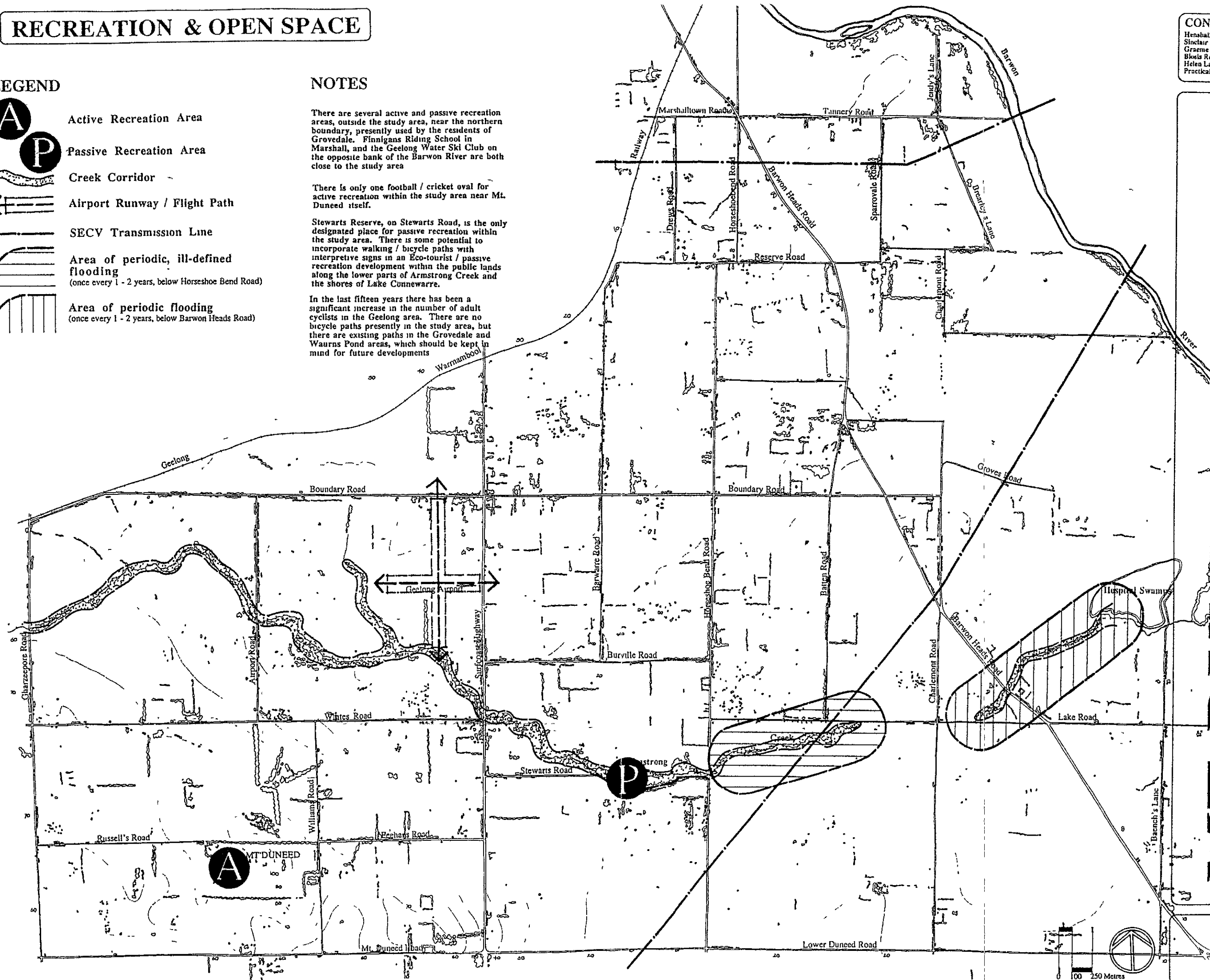
NOTES

There are several active and passive recreation areas, outside the study area, near the northern boundary, presently used by the residents of Grovedale. Finnigans Riding School in Marshall, and the Geelong Water Ski Club on the opposite bank of the Barwon River are both close to the study area.

There is only one football / cricket oval for active recreation within the study area near Mt. Duneed itself.

Stewarts Reserve, on Stewarts Road, is the only designated place for passive recreation within the study area. There is some potential to incorporate walking / bicycle paths with interpretive signs in an Eco-tourist / passive recreation development within the public lands along the lower parts of Armstrong Creek and the shores of Lake Connewarre.

In the last fifteen years there has been a significant increase in the number of adult cyclists in the Geelong area. There are no bicycle paths presently in the study area, but there are existing paths in the Grovedale and Waurms Pond areas, which should be kept in mind for future developments.



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CHAPTER 6 ***NATURAL ENVIRONMENT CHARACTERISTICS***

Mt Duneed/Armstrong Creek Urban Development Study

6 NATURAL ENVIRONMENT CHARACTERISTICS

6.1 Flora and Fauna

Vegetation communities and fauna habitat are combined in the following section to simplify the discussion of natural environment features of the study area at a reconnaissance level

The following information is based on a reconnaissance level survey of the study area by vehicle, and an analysis of available literature which discusses roadside vegetation (Dilena 1994), indigenous vegetation in the City of South Barwon (Pescott 1991), the vegetation of the lower reaches of Armstrong Creek and Stewart's Reserve (Pescott 1993). Records from the Atlas of Victorian Wildlife were consulted to determine the characteristic fauna for the study area. The condition and composition of representative accessible remnant native flora (ie on roadsides and reserves) was briefly assessed. However access to vegetation on private land was not possible and this vegetation was visually assessed from the nearest road vantage point.

Most of the study area is cleared and used for farming. Remnants of native woodland vegetation occur throughout the study area; as a riparian fringe along Armstrong Creek, in stands on private property, and along most roads. Native vegetation without tree cover is not readily apparent from air photo interpretation and is likely to have been underestimated. This may include both areas of naturally treeless vegetation (wetlands for example) as well as some of the cleared farming land which supports semi-improved pasture including a substantial component of native plant species, depending on the intensity of past land use.

The composition and condition of woodland vegetation on private land cannot be determined at the level of survey undertaken. As previously discussed, it is likely that additional areas of cleared or treeless native vegetation and of wetland occur within the study area and would be detected by a more intensive survey. Flora and fauna habitat types found in the study area are discussed below.

Woodland, often dominated by River Red Gum *Eucalyptus camaldulensis*, and with understorey shrubs commonly including Drooping Sheoke *Allocasuarina verticillata*, Hedge Wattle *Acacia paradoxa*, and Black Wattle *Acacia mearnsii* occurs throughout the study area. The understorey of most stands observed is highly modified by disturbance, especially on road reserves, but there are native species in the ground layer, including Kangaroo Grass *Themeda triandra*, wallaby-grasses *Danthonia* species and spear-grasses *Stipa* species.

This habitat type is of medium to low quality for fauna, depending on the presence of understorey vegetation and the degree of connectivity with other remnants. No

significant fauna are expected to occur in these areas. Woodland bird species would represent the most prominent element of the fauna community in this habitat. Common groups present include parrots, raptors, some honeyeaters, magpies, pardalotes and thornbills. No amphibian and few reptile species are likely to occur. Common Brushtail Possums and up to ten species of bats are likely to occur in the Red Gum woodlands.

Riparian Vegetation is mostly woodland dominated by River Red Gum. It occurs in patches along the Barwon River and fringes much of Armstrong Creek, with semi-aquatic species including Rush Sedge *Carex tereticaulis* fringing the channel. Manna Gum *Eucalyptus viminalis* is also present in Stewart's Reserve (Pescott 1993) and at other sites along Armstrong Creek (L. Conole pers. comm.). The riparian vegetation along the creek which was inspected during field work is highly disturbed as a result of clearing and grazing, and has little remaining understorey vegetation, except in Stewart's Reserve. There are dense stands of Water Couch *Paspalum distichum* in some reaches of the creek.

Riparian vegetation represents the best fauna habitat of the study area. Mammal fauna would include bats (as for woodland habitat), Water Rats, Common Brushtail Possums (and Common Ringtail Possums where intact shrub understorey occurs), Koalas, and Eastern Grey Kangaroos along the creek. Typical woodland bird species would also occur but with higher species richness than in the non-riparian woodland habitat. Vagrant waterbirds and waders may appear in swampy areas associated with the creek, and roosting waterbirds may use eucalypts along the creek. All frog species recorded from the study area could potentially occur or breed along the creek and associated swamps. Reptiles (Blue tongue Lizard, Garden and Grass skinks and Tiger Snakes) would be expected in the ground and litter layers of the riparian vegetation. There are potentially 2-3 significant fish species in the creek, which have been recorded from Waurm Ponds Creek and the Barwon River.

Wetland vegetation, including Rushes *Juncus* species, Water Ribbons *Triglochin procerum* sensu Willis 1990, Cumbungi *Typha* sp., Common Reed *Phragmites australis* and Common Spike-sedge *Eleocharis acuta* occurs in swampy sections of the creek and on seasonally wet sites throughout the study area. Sub saline to saline wetlands supporting salt tolerant vegetation occupy the lower reaches of Armstrong Creek, and parts of the Barwon River flood plain. The largest and most intact wetland in the study area is at the western edge of Hospital Swamp and on the Barwon River floodplain north of Hospital Swamp. It is likely that the vegetation composition of these wetlands reflects small elevation changes and hence subtle differences in the seasonal input of freshwater run-off, groundwater discharge and estuarine water.

Wetlands are of high faunal habitat quality. These areas provide significant breeding sites for many amphibian species, and would also support Water Rat.

populations. Many of the waders and waterbirds that occur in the Lake Connewarre/Barwon River system would utilise these peripheral wetland areas.

Grassland, including exotic and native species, occupies much of the study area. It is not possible at this level of survey to identify areas of predominantly native species, however these are considered likely to be cleared remnants of woodland vegetation, rather than naturally treeless.

This is low quality fauna habitat. Except for Eastern Grey Kangaroos, only introduced mammal species would be expected. A rich amphibian fauna may occur, possibly dominated by Striped and Spotted Marsh Frogs and Common Froglets. Low numbers of reptiles could be present, depending on the quality of grassland and availability of sheltering sites and basking features. Bird species would be restricted to introduced species, and those native species that prefer disturbed sites, including magpies, ravens bushlarks and pipits.

Rock outcrops are restricted to the upper slopes of Mt Duneed, and support remnants of native grasses and a sparse, low shrub layer. The values of this habitat are uncertain. It has the potential for a rich reptile and amphibian fauna.

The assessment of the fauna species present, their distribution within the study area and the quality of the habitat is purely preliminary. Only secondary sources were accessed and no field survey was conducted to evaluate habitat and record species presence. In this case, the conclusions are only indicative of what species, significant species and habitat types are present in the study area. It is likely that further direct survey may reveal a higher species and habitat richness and a higher number of significant species.

6.2 *Significant Fauna Species*

Five FFG (Flora and Fauna Guarantee) listed species are recorded by the Atlas of Victorian Wildlife, although the area covered by the search is larger than the study area. Only three of these species (Freckled Duck, Yarra Pygmy Perch and the Spotted Galaxias) could possibly occur within the study area. The Yarra Pygmy Perch and the Spotted Galaxia have been recorded in the Waurin Ponds Creek/Barwon River and may occur in Armstrong Creek.

Using Atlas data only, there are no mammals, amphibians or reptiles, of conservation significance recorded in the study area, apart from an old (40 year) record of Growling Grass Frog from the area that needs confirmation. Seventeen bird species for the area are of high conservation status, and twelve Camba/Jamba listed bird species are recorded for the area. These are all associated with wetlands, the Barwon River and the Lake Connewarre system, however it is likely that many may occur in the wetland and creek habitat in the study area.

It is clear that further direct survey is needed to adequately assess the presence of all fauna species and habitat types within the area proposed for development. Survey experience at other sites within the region indicate that current sources of fauna records from the study area underestimate the total species (including species of regional and local significance) present in each taxonomic group. Further survey would allow a clearer evaluation of the presence of significant species within the study area and the contribution it makes towards the conservation of these species within the region

6.3 Areas of Natural Significance

Remnant areas of natural significance that appear to retain high flora and/or fauna values, are depicted in Figure 15, together with those areas within roadside reserves. Key areas are described below:

6.3.1 Roadside Reserves

Roadside reserves throughout the study area include valuable remnants of the original vegetation, and have an important role in connecting areas of fauna habitat. A detailed survey of roadside flora has been undertaken for the City of Greater Geelong (Dilena 1994), that includes species lists and rates the conservation value of each stretch of road in the study area

6.3.2 Armstrong Creek

Armstrong Creek supports valuable remnants of riparian woodland, freshwater and saline wetland, and functions as a wildlife corridor. The most intact riparian vegetation occurs along the reaches between Ghazeepore and Horseshoe Bend Roads. The most degraded sections of the creek lie between Horseshoe Bend Road and Barwon Heads Road, and downstream of Barwon Heads Road.

The eastern end of Armstrong Creek, adjacent to Hospital Swamps supports wetland vegetation, and includes excellent waterbird habitat (Pescott 1993). A preliminary bird list has been compiled (Pescott 1993).

6.3.3 Barwon River Flood Plain

The Barwon River floodplain which forms the eastern boundary of the study area, was not inspected during the reconnaissance field work. Some remnants of riparian vegetation and wetland areas on the flood plain are apparent from aerial photo interpretation. The extent of remnant riparian and wetland vegetation is not known.

6.3.4 *Remnant Stands on Private Land*

Remnant native vegetation on private land, especially large remnants, is potentially of significance for flora conservation and fauna habitat, depending on the extent of grazing, clearing and weed invasion. The condition and conservation value of these stands, and the implications for planning and development of the study area is not known without further survey.

Large patches of remnant vegetation on private land occur at the following locations (some of these have also been listed in Pescott (1991):

- South of Reserve Road, east of Barwarre Road
- North of Boundary Road, west of Barwarre Road
- North of Boundary Road, west of Batten Road
- North of Burville Road, east of Barwarre Road
- North of Lake Road, east of Horseshoe Bend Road
- North of Lake Road, west of Charlemont Road
- North of Whites Road, west of the Surf Coast Highway
- South of Russells Road, on the western slopes of Mt Duneed
- South of Russells Road, east of Ghazeepore Road (possible wetland)
- South of Stewarts Road, west of Horseshoe Bend Road.

6.3.5 *Stewarts Reserve*

Stewarts reserve is an area of 4 ha on Armstrong Creek, north of Stewarts Road, between Horseshoe Bend Road and the Surf Coast Highway. The reserve supports a valuable remnant of woodland vegetation. A plant species list has been compiled for the reserve (Dilena 1992, Pescott 1993) and a management plan is in preparation (M. Trengove pers. comm.)

6.4 *Areas of Geomorphological and Geological Significance*

The Mt Duneed hill is composed of scoriaceous basalt and is an eroded volcanic eruption point of the Newer Volcanics. The feature is the major landform on the landscape between Torquay and Grovedale rising up from the Thompson Creek floodplain to the south and the Barwon coastal plain to the east. About 600 m to the west of the summit of Mt Duneed on its south west slope is a small explosion cone or crater forming a shallow perched wetland. Lava from the eruption point flowed radially to Armstrong Creek, Thompson's Creek and to Lake Connemawarre forming an extensive sheet of basalt. The Mt Duneed hill is of regional significance.

6.5 Policy Considerations

The State Government's Conservation Strategy (1987) sets out the broad policy framework for conservation planning in Victoria. Aims of the strategy that are relevant to planning for natural environment conservation in the study area include

- protection of indigenous flora and fauna
- revival of rivers, waterways and wetlands
- protection and enhancement of urban open space
- improvement of environmental education and community involvement

More detailed policies, programs and acts have been initiated within the State Conservation Strategy, and include the following

- *Flora and Fauna Guarantee Act (1988)*
The Act aims to protect and conserve all native species. It includes a process for the listing of species or communities in danger of extinction and identification of potentially threatening processes. Controls have been introduced that can protect habitats critical to the survival of threatened flora and fauna.
- *Draft Flora and Fauna Guarantee Strategy: conservation of Victoria's biodiversity (DCE 1992)*
This strategy provides guidelines for the future direction of flora and fauna conservation in the state
- *Wetlands Conservation Program for Victoria (1988)*
This program recognises that large areas of wetland have been lost from the state, and provides principles and a detailed course of action for the conservation of those that remain, however supporting legislation is not yet in place
- *Native Vegetation Clearing Controls (Amendment S16)*
An amendment has been made to the state sections of all Victorian planning schemes, that inserts statewide controls on the clearing of native vegetation on areas greater than 0.4 hectare.

These policies emphasise the importance of preserving and enhancing natural values in the planning process. They advocate the identification and conservation of sites of significance for flora and fauna, the rehabilitation of vegetation communities and fauna habitats and the revival and protection of wetlands and waterways.

Acknowledgments

Mr Laurie Conole, Geelong, provided unpublished records of flora and fauna for Stewart's Reserve, and information about the natural environment of the study area.

References

- Dilena R. 1994. *City of Greater Geelong - South Barwon District Roadside Flora Assessment Report*. Report to City of Greater Geelong.
- Pescott T. 1991. *Report on indigenous vegetation in City of South Barwon* report to City of South Barwon
- Pescott T. 1993. *Report on sites for possible inclusion in 'Ecotour'*. Submission to Alcoa Australia for inclusion in their LandCare program.

6.6 Preliminary Notes on Constraints and Opportunities

There are a number of constraints to urban development within the study area if the significant natural environmental values are to be maintained. Key habitat areas, and the associated opportunities and constraints to development associated with each are discussed below.

6.6.1 Armstrong Creek

Armstrong Creek has high value in the remnants of riparian vegetation, and associated faunal habitat, and as a wildlife corridor to the Lake Connewarre system. Potential adverse impacts resulting from development of the study area which must be addressed include:

- alteration in water flows, ie quantity and flood regime - effects on channel stability, vegetation condition, especially viability of River Red Gum, and direct impacts on aquatic flora and fauna,
- reduction in water quality - including changes to salinity, input of nutrients, urban litter from stormwater discharge, and pollutants including hydrocarbons;
- increased direct effects from human activities (trampling, disturbance to wildlife, rubbish dumping) and predation from domestic pets

Opportunities resulting from development include:

- the opportunity to create a linear open space and conservation reserve for the whole length of the creek;

- rehabilitation of the waterway and associated flora and fauna, through management to encourage natural regeneration and revegetation (where appropriate) in the riparian corridor,
- the opportunity for community involvement in developing and implementing such activities,
- the opportunity to incorporate stormwater screening and detention systems that improve the present quality of water flows to the creek, and minimise adverse effects on the creek hydrology; and
- recreational opportunities associated with the creek, provided that nature conservation remains the primary management aim. This requires careful placement of access tracks and facilities and controlled levels of use, consistent with the flora and fauna values of the creek corridor.

6.6.2 Barwon River Frontage and Flood Plain

Similar opportunities and constraints apply to this part of the study area, with additional possibilities for wetland habitat creation/enhancement on the flood plain. The river is already used for recreation in this part of the study area (including Torquay Waterski Club). In view of the high degree of disturbance and existing use of the river for recreation, the opportunities for management of this area for nature conservation are less than for Armstrong Creek.

6.6.3 Remnant Privately Owned Bushland

Patches of bushland, some apparently with native understorey remnants, others comprising overstorey trees over predominantly exotic species, are found throughout the study area. These are important remnants of the original flora and constitute habitat for some fauna species. It is desirable that they should be retained and managed appropriately, as part of any development, however management of such areas, because of their small size, will be difficult.

6.6.4 Wetlands

The swamp at the eastern end of Armstrong Creek is of high value for wildlife conservation. This area should be managed in conjunction with the adjoining Lake Connewarre Reserve primarily for wildlife conservation and passive recreation.

6.6.5 Stewarts Reserve

Stewarts Reserve is a valuable remnant of Riparian Woodland that could be improved by weed control and rehabilitation of disturbed areas. The picnic area, vehicle tracks and car park occupy a large part of the reserve, which is only 4 ha in area. The location and size of these facilities are not compatible with the management of the reserve for flora and fauna conservation. Opportunities exist to:

- to rehabilitate and manage this reserve for conservation, as part of a linear reserve along the entire length of Armstrong Creek; and
- relocate public facilities to a less sensitive site.

6.6.6 Roadside Reserves

Most road reserves throughout the study area contain valuable remnants, and their protection should be planned as part of any development. They are vulnerable to incremental loss as a result of road works, fire prevention activities by public authorities and adjoining landholders, weed invasion and lack of regeneration. Opportunities exist for:

- conservation management of existing remnants, especially those that include understorey species; and
- appropriate revegetation of roadsides where necessary to link existing stands and improve the continuity of wildlife corridors.

6.6.7 Off-site Effects

Although the Lake Connemara State Game reserve is outside the study area, the effects of large-scale urban development in the catchment must be considered, viz. changes in water quality and quantity, predation, and increased disturbance.

6.7 Implications for Development

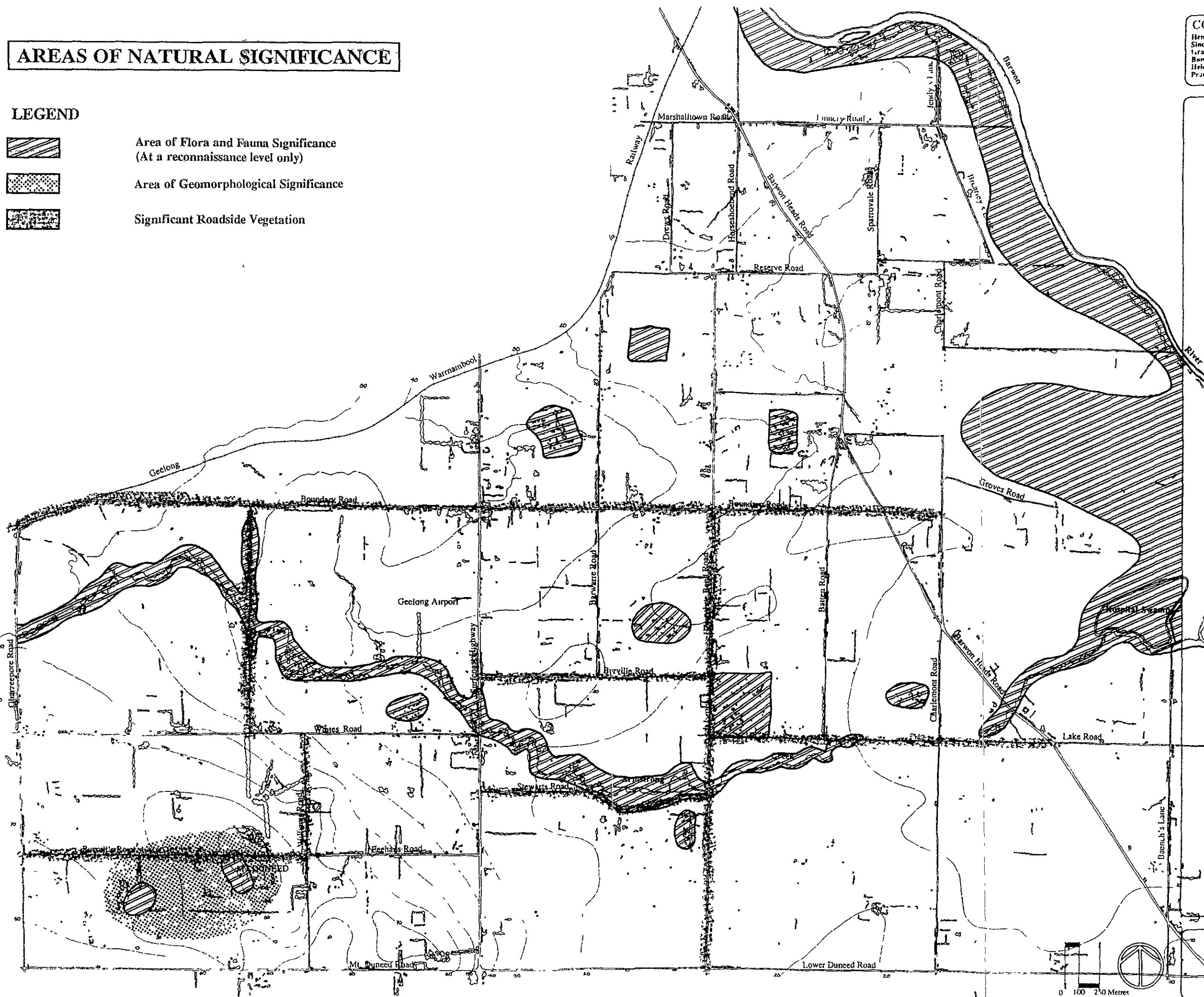
The implications for development of areas identified as of existing or potential value for flora and fauna cannot be adequately assessed without further survey work. Subject to further survey, it appears that the main areas that potentially constrain development because of natural environment considerations are the riparian corridors along the Barwon River and Armstrong Creek, including the wetland at the eastern end of Armstrong Creek. There are numerous vegetation remnants in the central third of the study area, that require further survey, and should be considered during the planning process. Two areas have few remaining natural values and offer little constraint to development:

- that part of the study area west of the Surf Coast Highway, (except for the creek corridor); and
- the southern part of the area, bounded by Burville Road, Lake Road and the Surf Coast Highway, (except for the creek corridor).

AREAS OF NATURAL SIGNIFICANCE

LEGEND

-  Area of Flora and Fauna Significance
(At a reconnaissance level only)
-  Area of Geomorphological Significance
-  Significant Roadside Vegetation



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MT. DUNEED STUDY

CHAPTER 7 ECONOMIC AND EMPLOYMENT CHARACTERISTICS

Mt Duned/Armstrong Creek Urban Development Study

7 ECONOMIC AND EMPLOYMENT CONSIDERATIONS

7.1 Introduction

By the year 2011, it is likely that Mt Duneed could comfortably accommodate 10,000-15,000 new residents, assuming this southern part of Geelong continues to achieve its share of Geelong's urban population growth. Clearly, there is potential to accommodate even higher numbers, as the residential capacity of the study area is estimated to be around 104,125 people (as noted in Section 3.5, but prior to any detailed evaluation of physical opportunities and constraints).

While these numbers of people could be accommodated in a physical sense, we need to have consideration of the economic implications, especially regarding employment access. This chapter looks at these economic implications associated with Mt Duneed's urban development.

7.2 Labour Force Numbers and Access to Jobs

Assuming that Mt Duneed accommodates at least the 10,000 residents that could be expected under existing regional population trends, the locality will have a resident labour force of approximately 4,500 people.

These people will need access to jobs.

Job locations in urban Geelong tend to focus on the following locations:

- central Geelong - for retail, commercial and other regional services, as well as the port area;
- town centres or smaller settlements - for local services, service industry, etc;
- industrial areas - largely located in northern parts of Geelong for employment in manufacturing, service industry, etc; and
- coastal areas - for employment in tourism, recreation and leisure activities.

These existing job locations are expected to remain as the foci for employment into the foreseeable future. This raises a number of implications for Mt Duneed as a residential location.

7.3 *Regional Employment Context*

As noted above, most of Geelong's employment base is located in central Geelong, in the port area and in the industrial areas to the north.

We also note from the Geelong Strategy Plan that a considerable share of new urban growth over the next two decades is planned to take place in the Geelong - Torquay corridor and in the Bellarine Peninsula. In other words, much of the new resident labour force is planned to live in localities that are situated some distance from the region's employment centres

In a strategic sense, there is a need to carefully examine the implications which arise from this planned location of new residential areas in the context of established employment centres

One implication is the need to ensure adequate transport links within the region, involving (possibly) freeways and arterial roads, and appropriate public transport services

Of course, there are costs involved in providing and maintaining this intra-regional transport infrastructure; these costs are incurred at both the individual household level (eg. the cost of one's journey to work, car ownership, operation and maintenance etc) and at the wider community level (eg via the taxes necessary to pay for and maintain the transport infrastructure and services).

Having regard for these transport-related costs, it will be important in the Mt Duneed case (and others) to ensure that - wherever possible - there are efforts to provide employment opportunities close to where people live.

7.4 *Implications for Mt Duneed*

In further considering the urban development of the Mt Duneed/Armstrong Creek study area, the following implications are relevant

- Mt Duneed, as a residential settlement, will need to provide for local employment as well as relying on existing employment foci in the wider Geelong region. Local job opportunities will be found in Mt Duneed's shopping facilities, education and health facilities, and in local service businesses and service industries.
- For a population of around 10,000 people (as a first stage), Mt Duneed would have a neighbourhood shopping centre and this would provide an estimated 200 jobs in retailing, plus possibly another 200 working in

personal, professional and community facilities and services (local school, health clinic, accountant, travel agent, etc).

- Employment in locally-based service businesses and service industry could provide another 100-200 jobs, depending on the extent to which the plan allows for employment locations (eg local activity zones to accommodate small workshops, depots, etc).
- In total, the Mt Duneed area could possibly generate at least some 500 local jobs, accounting for 10% of the employment need. Even so, some of these 500 locally-based jobs are likely to be held by people who live *outside* the Mt Duneed area. Thus, at least 90% of the resident labour force will need to travel outside the Mt Duneed area to work each day, and this is expected to involve around 4,000 residents.
- Mt Duneed will need to have appropriate transport links - including public transport - to the central Geelong area as this is where many of the new residents will be working.
- Where possible, effort should be made to develop employment opportunities at nearby existing employment centres, such as the Deakin University campus, as well as develop new opportunities that will generate more employment, such as technology and other potential activities linked with the Deakin campus. Development of tourism and related activities in recreation and leisure along the south coast and on the Bellarine Peninsula are other examples of the potential to provide employment closer to where people live, rather than having to travel into and beyond central Geelong.
- The structure planning process for Mt Duneed will need to provide opportunities to reserve and develop areas for:
 - a shopping centre in Stage 1, and this will also need to involve provision for a hierarchy of activity centres to accommodate the area's full potential of at least 100,000 people;
 - locations for schools, facilities and other community infrastructure and services (again, allowing for wider provision of such facilities for the ultimate population to be accommodated);
 - locations for small service industry and service business activities, principally focused on meeting the requirements of the Mt Duneed area, but also allowing for the accommodation of those businesses that could meet wider, regional markets;
 - the identification of possible "greenfields" or freestanding sites that

might be suitable to accommodate one-off activities, such as a large educational institution or other enterprise that is seeking a suitable location in this popular southern part of the Geelong region.

- With provision for accommodating these employment-generating activities in the Mt Duneed area, the study area - as it reaches full development - should be well-placed to provide a range of employment opportunities for its residents, in addition to having important links with established employment foci located elsewhere in Geelong and beyond.

Also relevant when considering economic and employment aspects associated with growth in the region, are the gradual changes which are occurring in working patterns. Continued research of the relationship between home, work and service provision as changes in the processes of production and distribution occur is important.

As we move towards the technologies of a new century, it is likely that growing numbers of people will choose to work from home, relying on fast and sophisticated means of telecommunication. Growth in this employment area will inevitably have implications for regional transit links between residential locations and employment nodes.

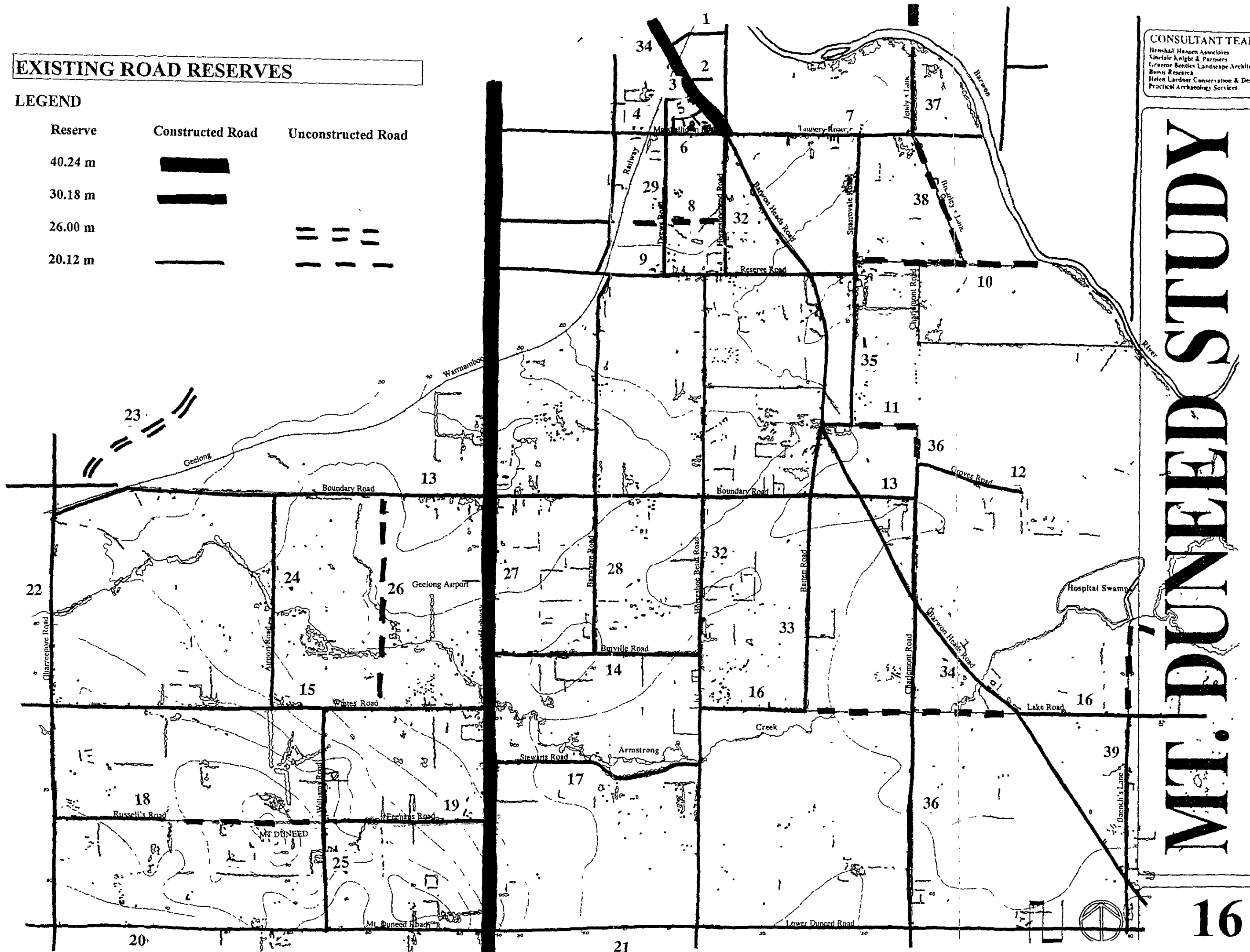
In the short to medium terms however, attention could focus on discouraging large numbers of car users travelling through Geelong by the introduction of suitable transportation systems. This could well mean the introduction of a rail station in the Grovedale/Mt Duneed area whereby trains could become a preferred transit method, rather than encouraging a continuing and heavy reliance on car travel.

Many of these aspects should be considered in ongoing strategic and neighbourhood planning in the area over the next twenty or so years.

EXISTING ROAD RESERVES

LEGEND

Reserve	Constructed Road	Unconstructed Road
40.24 m		
30.18 m		
26.00 m		
20.12 m		



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MT. DUNEED STUDY

CHAPTER 8

TRANSPORT, CIRCULATION AND ACCESS

Mt Duned/Armstrong Creek Urban Development Study

8 TRANSPORT, CIRCULATION AND ACCESS

8.1 Road Network

There are two aspects to be considered in the existing road network:

- constructed roads
- road reserves specified in the Geelong Planning Scheme

There are 39 road reserves in the study area, predominantly based around a one mile grid system oriented north-south and east-west. Barwon Heads Road runs diagonally from north-west to south-east across the study area and connects Geelong with Barwon Heads. The other major road in the study area is Surf Coast Highway which runs north-south and links Geelong with the Geelong Airport, Torquay and Great Ocean Rd. The existing Geelong Outer Fwy reserve terminates immediately outside the north-west corner of the study area.

The existing road network is described in Table 5 and indicated in Figure 16.

Table 5: Existing Road Network

Ref	Road	Orient- ation	Reserve (m)	Road Cross-section	Constructed Road Width (m) (to be confirmed)
1	Woolscour La	e-w	20 12	2 lane undivided	8
2	Norcott Rd	e-w	20 12	2 lane undivided	8
3	Grove Rd	e-w	20.12	2 lane undivided	8
4	Inala Ct	e-w	20 12	2 lane undivided	8
5	Tamala Av	e-w	20 12	2 lane undivided	8
6	Marshalltown Rd	e-w	20 12	2 lane undivided	8
7	Tannery Rd	e-w	20.12	2 lane undivided	8
8	Smith St	e-w	20 12	unconstructed	
9	Reserve Rd	e-w	20.12	2 lane undivided	8
10	unnamed	e-w	20 12	unconstructed	
11	Charlemont Rd	e-w	20 12	2 lane undivided	8
12	Goves Rd	e-w	20 12	2 lane undivided	8
13	Boundary Rd	e-w	20 12	2 lane undivided	8
14	Burville Rd	e-w	20 12	2 lane undivided	8

15	Whites Rd	e-w	20 12	2 lane undivided	8
16	Lake Rd	e-w	20 12	2 lane undivided	8
17	Stewarts Rd	e-w	20 12	2 lane undivided	8
18	Russells Rd	e-w	20 12	2 lane undivided	8
19	Peehars Rd	e-w	20 12	2 lane undivided	8
20	Mt Duneed Rd	e-w	20 12	2 lane undivided	8
21	Lwr Duneed Rd	e-w	20 12	2 lane undivided	8
22	Ghazeepore Rd	n-s	20 12	2 lane undivided	8
23	Geelong Outer Fwy	n-s	26 00	unconstructed	
24	Airfield Rd	n-s	20 12	2 lane undivided	8
25	William Rd	n-s	20 12	2 lane undivided	8
26	unnamed	n-s	20 12	unconstructed	
27	Surf Coast Highway	n-s	40 24	4 lane divided	24
28	Barwarre Rd	n-s	20 12	2 lane undivided	8
29	Drews Rd	n-s	20.12	2 lane undivided	8
30	Minka Ct	n-s	20 12	2 lane undivided	8
31	Field Ct	n-s	20.12	2 lane undivided	8
32	Horseshoe Bend Rd	n-s	20.12	2 lane undivided	8
33	Batten Rd	n-s	20 12	2 lane undivided	8
34	Barwon Heads Rd	n-s	20 12	2 lane undivided	8
35	Sparrowvale Rd	n-s	20 12	2 lane undivided	8
36	Charlemont Rd	n-s	20.12	2 lane undivided	8
37	Jendes La	n-s	20.12	2 lane undivided	8
38	Brearleys La	n-s	20 12	unconstructed	
39	Winklers Rd	n-s	20 12	2 lane undivided	8

Source. City of Greater Geelong

8.2 *Traffic Volumes*

Historical traffic volume data has been provided by VicRoads, City of Greater Geelong and Shire of Barrabool and is indicated in Appendix 2.

The traffic volumes in the study area vary greatly by month of year, due to the tourist attractions lying south (Great Ocean Road) and west (Bellarine Peninsula) of the study area. VicRoads have recorded volumes on Surf Coast Highway by month of year. The 1991 annual average daily traffic volume (AADT) was 8,000 vpd, which corresponded to the average weekday daily traffic volume (ADT) for October. Volumes are highest in December, with around 10,500 - 11,000 vpd (ADT), or 1.3 times the AADT. In January the volumes are around 9,000 vpd (ADT), dropping off in February (to around 7,500 vpd) and rising again in March and April (school holidays and Easter still with warm weather) to around 8,500 - 9,000 vpd and dropping off between May and September to between 6,500 - 7,500 vpd (ADT).

Based on the historical traffic volumes presented in Appendix 1 the existing 24 hour traffic volumes for a weekday in mid October have been estimated and are presented in Figure 17 and are represented in diagrammatical format in Figure 18.

Surfcoast Highway and Barwon Heads Rd are the major through routes in the study area which serve other population centres and holiday/tourist traffic. Other roads essentially provide for local traffic and therefore the volumes on these roads would effectively be replaced by local traffic generated by urban development. The through traffic volumes on Surf Coast Highway and Barwon Heads Rd can be expected to increase with time and this should be catered for in the planning for the area.

8.3 *Public Transport Services*

The study area is not well served by public transport in line with its existing rural nature. The study area is bounded to the north by the Geelong-Warrnambool railway line. This connects to the Geelong CBD and Melbourne via Werribee. It is understood there has been some discussion regarding the provision of a new railway station on this line between Ghazeepore Rd and Surf Coast Highway, but no definite plans have been made at this time.

There are two bus services in the study area:

- Geelong to Apollo Bay
- Geelong to Barwon Heads

These are routed along Surf Coast Highway and Barwon Heads Rd respectively.

The National Rail Corporation will not be using the Geelong-Warrnambool railway line as the route for the standard gauge line under the One Nation program.

Public transport services are indicated in Figure 19.

8.4 *Travel Patterns*

Road-based trip generation for urban areas has generally been found to be 1.0 vehicle movement per dwelling over the am and pm peak hour periods. This is made up of various trip types, but predominantly four types can be assumed for initial planning purposes:

- home-work
- home-school
- home-shopping
- home-entertainment

The Australian Bureau of Statistics 1991 Census included questions on home-work travel. Data is available on mode of travel to work by origin and destination zones. The following modes have been investigated:

- car as driver plus taxi (work-related traffic generation)
- train (work-related train demand)
- bus (work-related bus demand)
- train and car as driver (park and ride demand)
- train and car as passenger (railway station drop off)

The data is available for eight regions within the urban area of Geelong. The South Barwon urban area is adjacent to the study area and in fact includes a large part of it and home-work travel patterns for the South Barwon area are therefore considered appropriate for the study area. The population of the South Barwon area is 35,530 which is equivalent to the upper limit of the population for urban development in the study area. The number of persons per dwelling is 2.63 for South Barwon. The total car home-work generation rate for the area is 0.73 vehicles per dwelling on the day of the 1991 Census. Not all these home-work trips are generated over the am and pm peak hours, as this would assume all people left for work in the am and returned from work in the pm periods. The assumed generation rates by trip type are indicated in Table 6.

Table 6: Assumed Vehicle Generation Rates by Trip Type for Study Area

Trip Type	Generation Rate (vehicles/household)	
	AM Peak Hour	PM Peak Hour
Home-work	0.70	0.60
Home-school	0.20	
Home-shopping	0.10	0.25
Home-entertainment		0.15
Total	1.00	1.00

Based on the 1991 Census data the trip distribution for home-work trips for the study area has been estimated. Trip distributions for the other trip types have been estimated using gravity models. Car trip distributions are presented in Table 7.

Table 7: Car Trip Distribution by Trip Type

Direction		Car Distribution by Trip Type			
		Home-work	Home-school	Home-shopping	Home-entertainment
North					
	Metropolitan Melbourne	8%	1%	10%	10%
	Geelong	33%	2%	30%	30%
	Corio - urban	18%	6%	3%	10%
	Corio - rural	1%			
	Geelong West	5%	3%	4%	5%
	Newtown	3%	6%	6%	5%
	Total	68%	18%	53%	60%
North-West					
	Barrabool - urban	3%	1%	1%	
	South Barwon - urban	4%			
	Total	7%	1%	1%	
North-East					

	Bellarine - urban	4%	1%	1%	
	Bellarine - rural	1%			
	Total	5%	1%	1%	
South-West					
	Barrabool - rural	1%			
South-East					
	South Barwon - rural	1%			
Internal		18%	80%	45%	40%
Total		100%	100%	100%	100%

The weighted combined distributions for the am and pm peak periods are given in Table 8.

Table 8: Car Directional Distribution

Direction	Distribution	
	AM Peak Hour	PM Peak Hour
North	56%	63%
North-west	5%	4%
North-east	4%	3%
South-west	1%	1%
South-east	1%	1%
Internal	33%	28%
Total	100%	100%

The predominant movement on the road network is therefore north-bound, into Geelong and beyond, with a significant proportion of trips internal to the study area.

Public transport and bicycle trip generation rates have been estimated based on the 1991 Census data:

- train 0 0116 patrons/dwelling
- bus 0 0135 patrons/dwelling
- bicycle 0 0127 bicycles/dwelling

Park and ride generation for the study area is estimated to be 0.0091 cars/dwelling.

The home-work generation for these modes is very low, due to the low level of existing services in the South Barwon region of Geelong

8.5 *Traffic Growth*

Annual traffic growth on Surf Coast Highway appears to have been relatively low since it was made the main link from Geelong to the Great Ocean Rd, however it does carry additional traffic over December and April (in the order of 1.3 and 1.1 times greater the AADT, which corresponds to volumes in October, respectively) due to the holiday and tourist traffic. Barwon Heads Rd has similar January traffic increases

Traffic growth on Princes Highway (north of the study area) has been in the order of 3.6% p.a., which is consistent with traffic growth rates in urban areas. The seasonal peak in January is similar to that observed on Surf Coast Highway.

Traffic growth on the other roads in the study area appears to be negligible, again with seasonal peaks being the major consideration.

8.6 *Arterial Road Spacing*

The arterial road network services large traffic movements along principal avenues of communication. They provide a high level of **mobility** between land uses, generally for long trips across a metropolitan area. Generally it is considered desirable to ensure they will allow a large volume of traffic to travel at high speed travel with minimal delays, which requires an appropriate traffic carrying capacity to be provided.

As the traffic volume on a road increases from zero to above the road's capacity, the operational conditions of the traffic flow, or traffic performance, will gradually reduce. Performance includes speed, travel time, freedom to manoeuvre, interruption to traffic flow, comfort, convenience and safety. These are measured by level of service (los) and this has been found to be divided into 6 main levels:

- **Level of Service A:**

Free flow with high speeds and low traffic volumes. Drivers can hold their desired speeds without delays.

Example: Geelong freeway at 4:00 am.

- **Level of Service B:**

Stable flow where drivers have reasonable freedom to select their speed.

Example Geelong Fwy on a weekday afternoon

- **Level of Service C:**

Stable flow where most drivers are restricted in their freedom to select their own speed or change lanes, overtake, etc.

Example: Operating speeds are still reasonable.

- **Level of Service D:**

Approaching unstable flow with nearly all drivers restricted. Comfort and convenience are low but may be tolerated for short periods. Fluctuations in conditions cause substantial drops in speed. This level of service corresponds to tolerable capacity.

Example: Geelong Fwy in the weekday peak periods.

- **Level of Service E:**

Traffic volumes are near of at capacity. Flow is unstable and there may be momentary stoppages.

Example. Geelong Fwy on a busy weekend

- **Level of Service F:**

Forced flow operation at low speeds caused by demand exceeding capacity. There is stop-start operation with long queues and delays. In the extreme both speed and volume can drop to zero. This level also occurs when the road is acting as a storage area upstream from a bottleneck.

Example: South Eastern Arterial near AFL Park after a football game.

The capacity of a road is a function of its cross section, as indicated in Table 9

Table 9: Road Capacity for Various Cross-Sections

Road Cross-Section		Road Capacity (vph)
2 Lane Road		
	undivided with occasional parking	600
	undivided with no parking	900
4 Lane Road		
	undivided with occasional parking	1,500
	undivided with clearways	1,800
	divided with clearways	1,900

6 Lane Road		
	undivided with occasional parking	2,400
	divided with clearways	2,900
Freeways		
	4 lane	4,000
	6 lane	6,000

Source: Traffic Studies Manual, Department of Main Roads NSW

Road cross-section and hence reserve width is therefore a function of the following variables:

- arterial road spacing (size of enclosed residential cell)
- residential density (lots per cell)
- peak hour traffic generation rates
- proportion of internal trips
- directional traffic split (in/out)
- directional traffic distribution (north/south/east/west)
- usage of arterial roads (east/west and north/south)
- proportion of through traffic across each cell
- number of cells in each direction
- road cross section
- desired level of service

Guidelines for the specification of arterial road cross-sections has been based on the findings of research conducted in America in the 1950s, as presented in Table 10.

Table 10: Traditional Arterial Road Spacing Guidelines

Population Density (persons/km ²)	Typical Example	Road Grid Spacing (km)	
		4 lane	6 lane
1,600	urban fringe	2.5 - 3.0	3.5 - 4.0
3,200	suburban	1.0 - 1.3	1.6 - 2.0
4,600	inner urban	0.8 - 1.0	1.0 - 1.3

Source: Traffic Engineering Practice (4th Ed)/
Chicago Area Transportation Study, 1959

This determines the arterial road reservation locations and widths that need be specified in the planning scheme/structure plan. It is important to provide adequate road capacity to minimise congestion due to the cost of travel time, particularly for the export exposed manufacturing sector however unnecessarily large road reserves result in an opportunity cost of the land "locked-up" for roads which is then not available for other land uses or difficult to develop.

Typical suburban development requires 4 lane arterial roads spaced at around one kilometre or 6 lane arterial roads spaced at around one mile (1.6 km). To test the recommendations in Table 4 an Arterial Road Reserve model has been developed which determines arterial road reservation widths for specified values of the variables listed above. The model allows the road infrastructure implications of a range of development scenarios to be tested.

VicCode recommends arterial road spacing of around 1.6 km with a north-south/east-west orientation and the existing road network matches this pattern, as discussed above. There are some discontinuities in the existing road network and these are indicated in Figure 20.

8.7 Arterial Road Reserves

Arterial road reserve widths are based on the road cross-sections. VicRoads has developed guidelines for the desirable minimum width of the various elements of a road.

•	footways (footpath and nature strip)	4.0 m
•	traffic lanes	3.5 m
		(plus 0.5 m for kerb-side lanes)
•	medians	5.5 m
•	parking lanes	2.5 m
•	bicycle lanes	1.5 m
•	service road separators	5.5 m

and the combination of these determines the road cross-section and hence reserve width. Typical road cross-sections are summarised in Table 11.

It should be noted some of the elements above can be reduced in width, particularly separators and medians. Absolute minimums for these are 1.5 m and 4.5 m respectively.

Table 11: Typical Road Cross-Sections

Road Cross-Section	Road Reserve Width (m)		Example
	Desirable Minimum	Absolute Minimum	
2 lane undivided	23.0	23.0	Glen Iris Rd
4 lane undivided	30.0	23.0	Toorak Rd
4 lane divided	35.5	34.5	Warrigal
4 lane divided with service roads	54.5	45.5	-
6 lane divided	42.5	41.5	Burwood Highway
6 lane divided with service roads	61.5	52.5	Springvale Rd

This indicates road reserves should be in the order of 30 m to 60 m (depending on spacing of the roads). It is probable therefore in the longer term that the existing 20 m road reserves in the Geelong Planning Scheme could prove inadequate.

8.8 Public Transport Provision

The estimated level of public transport usage for the study area is relatively low, however this is due to the low level of service currently available in the South Barwon region of Geelong. If services were improved it is likely a higher level of public transport usage would occur.

The feasibility of providing public transport depends on the level of urban development (density and extent) in the study area. It should be noted the current trend of private bus operators is towards smaller buses with more frequent services, with the target market being the "off-peak" market of school children and shoppers. Therefore urban planning in the area will have a significant impact on the viability of bus services - particularly relating to retail and entertainment facilities.

A public transport reserve to be used by either heavy or light rail or bus through the study area could be considered, again depending on the level of urban development. It is likely heavy rail would only be viable if the Grovedale residential area was included in the catchment in some form - either through park and ride facilities or distributor bus feeding passengers to a railway station.

8.9 *Bicycle Planning*

Bicycle planning guidelines for new subdivisions are covered in detail in relevant documents. It is considered important that bicycle users be regarded as legitimate road users in the planning of urban development in the study area.

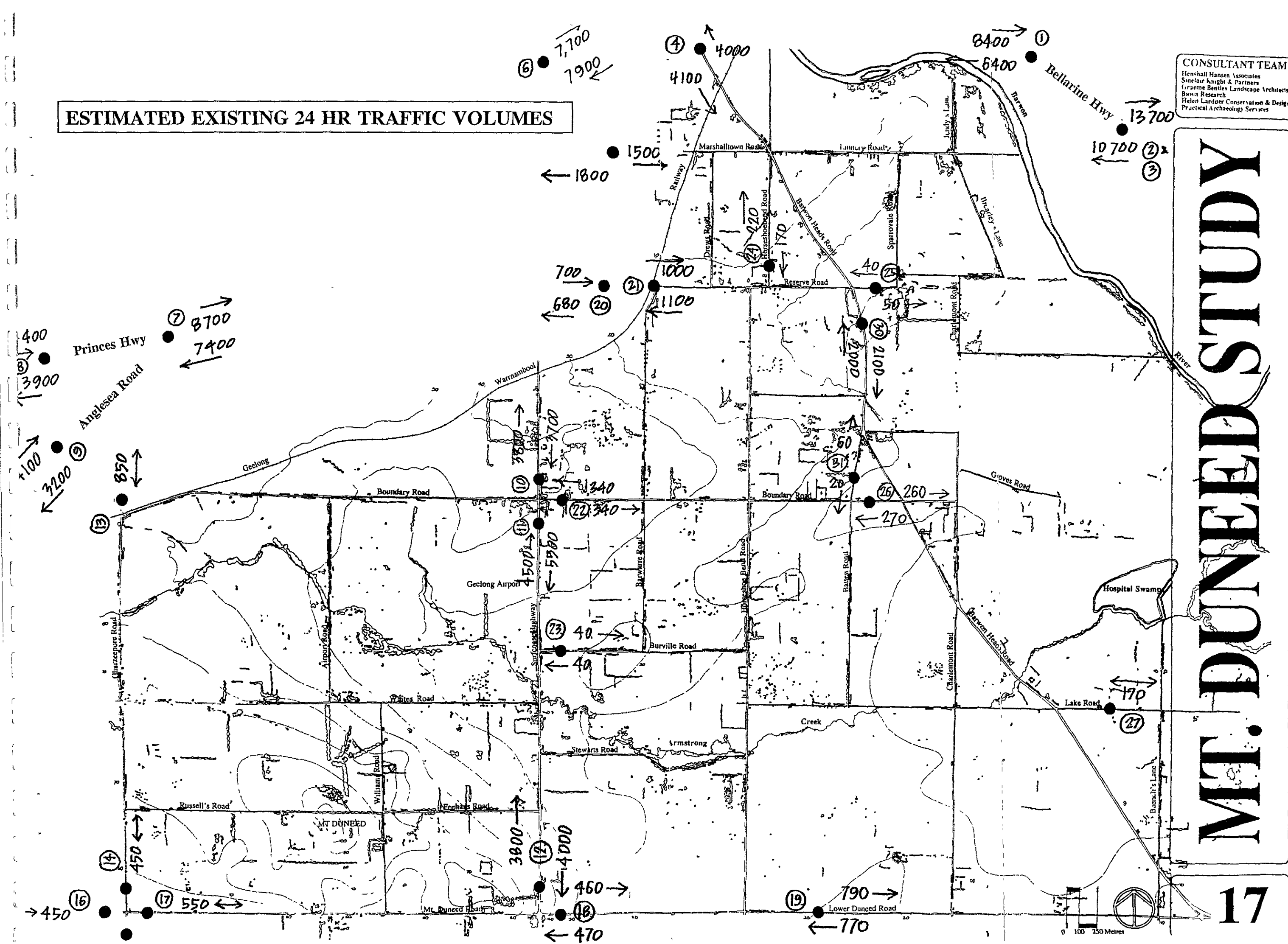
ESTIMATED EXISTING 24 HR TRAFFIC VOLUMES

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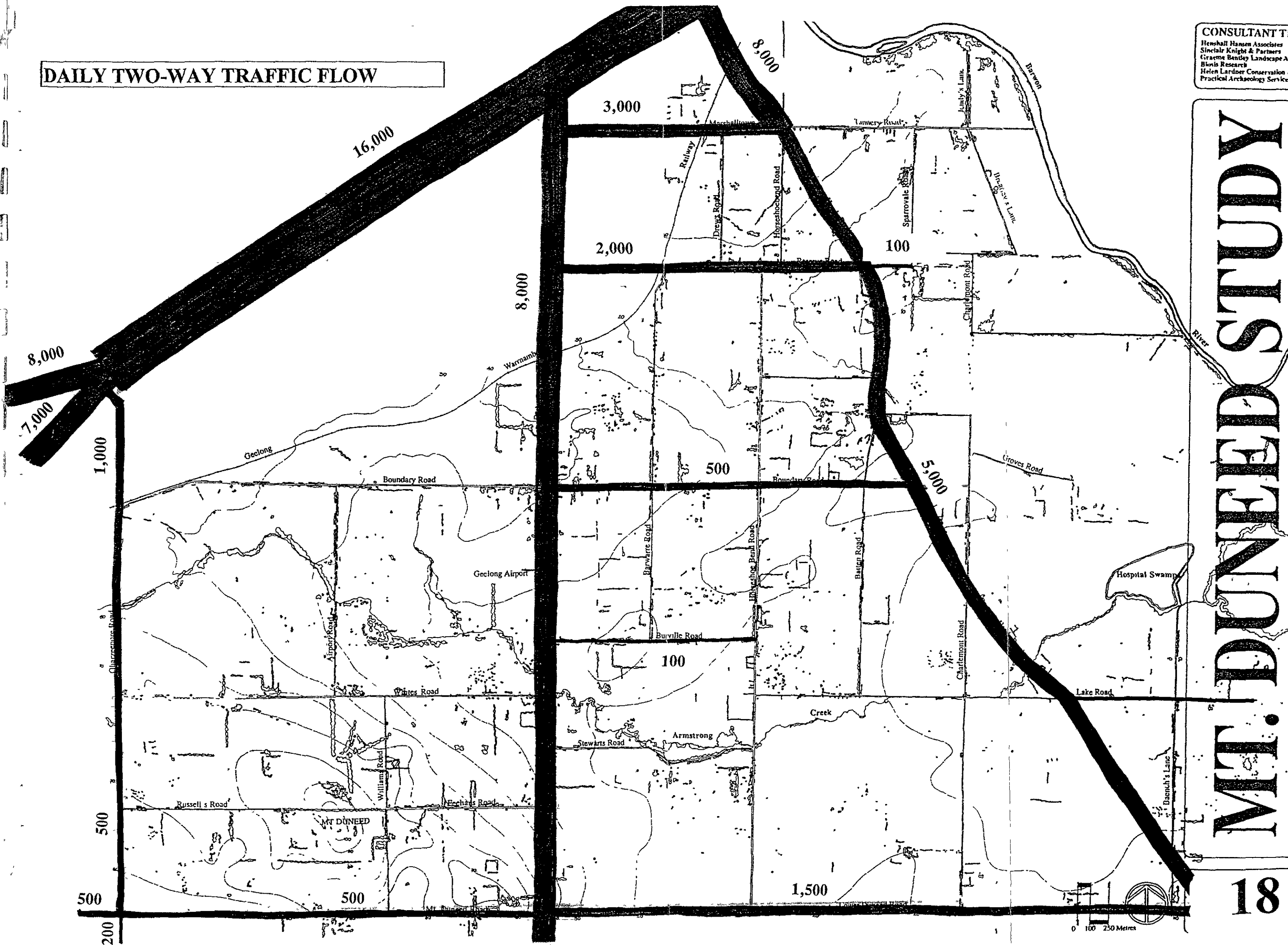
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17



DAILY TWO-WAY TRAFFIC FLOW

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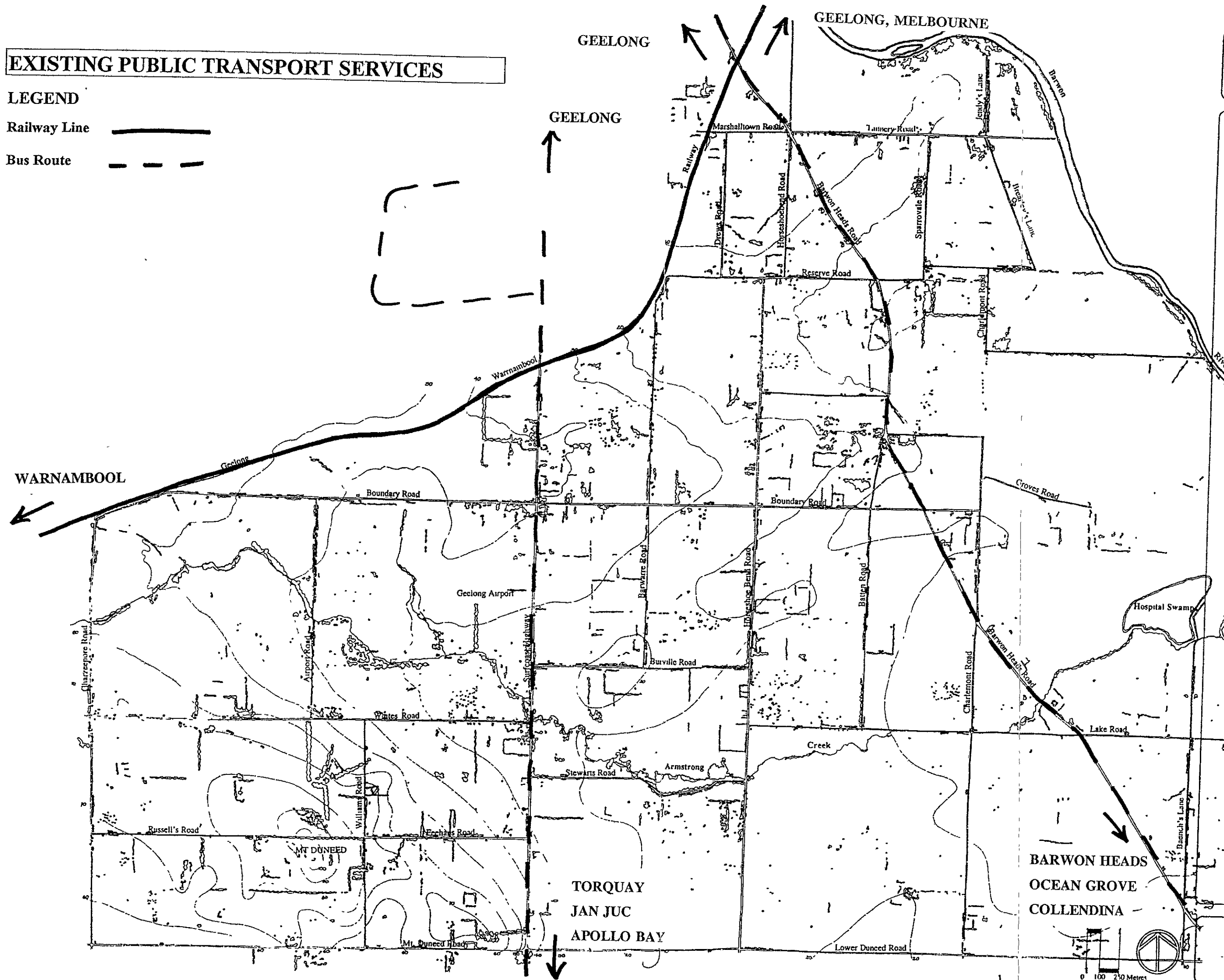
EXISTING PUBLIC TRANSPORT SERVICES

LEGEND

Railway Line 

Bus Route 

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BARWON HEADS
OCEAN GROVE
COLLENDINA

EXISTING ROAD NETWORK'S MATCH TO VICCODE GUIDELINES

LEGEND

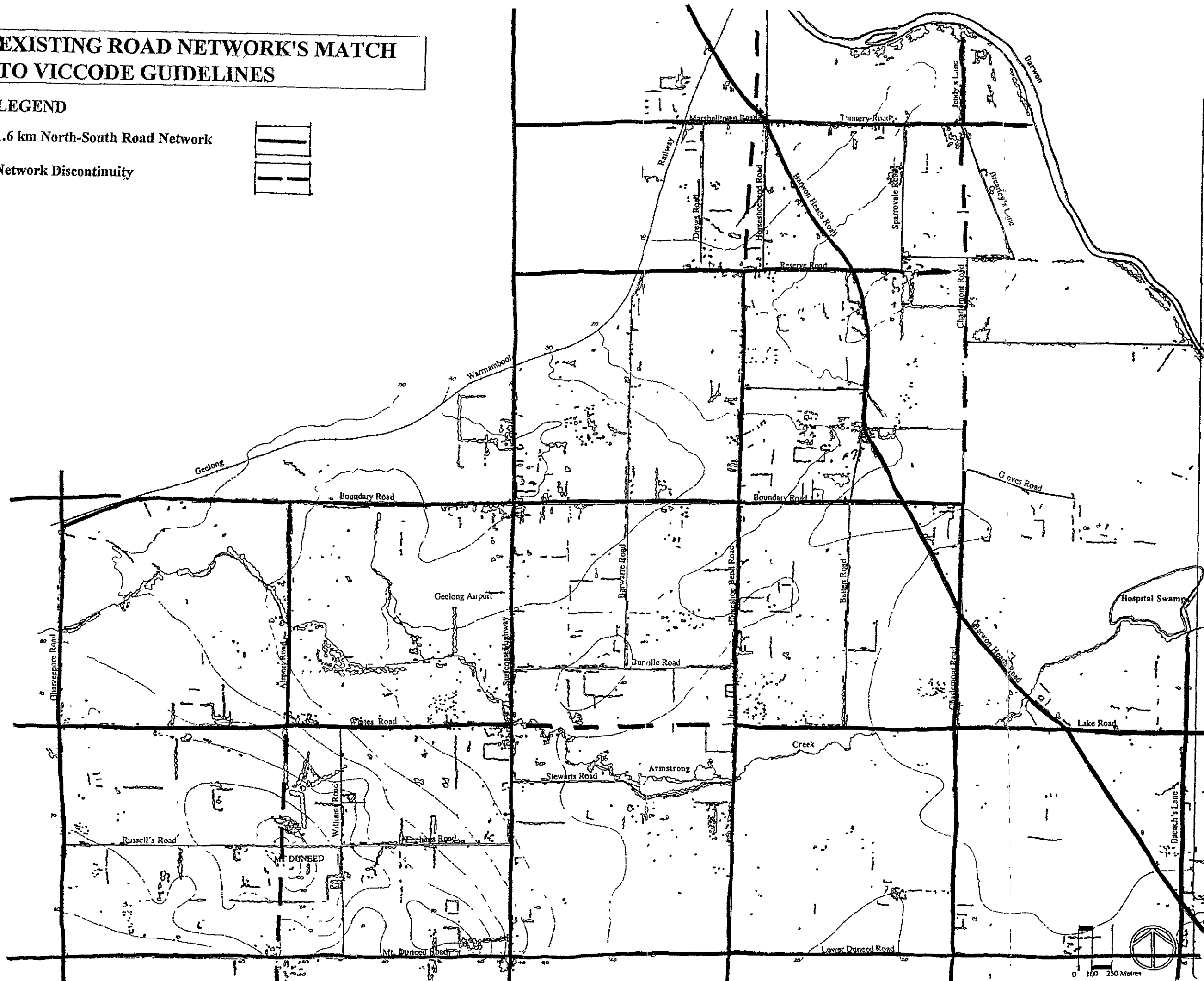
1.6 km North-South Road Network

Network Discontinuity



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MT. DUNEED STUDY



CHAPTER 9

PHYSICAL INFRASTRUCTURE

Mt Duneed/Armstrong Creek Urban Development Study

9 PHYSICAL INFRASTRUCTURE

9.1 Sewerage

Wastewater from the Geelong region is transferred to the ocean outfall located at Black Rock via a trunk sewer which travels through the study area following an alignment which is roughly parallel to the Barwon Heads Road. The Black Rock facility is currently being upgraded to incorporate a secondary treatment plant.

Barwon Water has identified a strategy for the provision of sewerage services to the study area for the purpose of residential development which is documented in a report entitled *Water Supply & Wastewater Services for Possible Development at Lovely Banks & Armstrong Creek/Mt Duneed* prepared by Systems Planning Branch of Barwon Water and dated June 1993.

The study area identified by Barwon Water encompasses some 1500ha to the west of Horseshoe Bend Road and is located close to the trunk sewer which runs from Geelong to Black Rock. Two densities of development were considered:

- medium density was adopted as 10 dwellings/ha with an average wastewater flow of 10Ml/day
- high density was adopted as 15 dwellings/ha with an average wastewater flow of 15Ml/day

The trunk sewer will not have the spare capacity to cater for sewerage flows during periods of peak wet weather flows once the area is fully developed. The following two options are available for treatment of sewerage from the study area:

- local treatment plant and partial reuse of effluent; and
- augmentation of 7km of trunk sewer from the study area to Black Rock

Considering the first of these two options, namely provision of a local treatment plant and reuse, it appears that the most suitable location for the treatment plant is on the north-eastern side of the Lower Duneed Road and Horseshoe Bend Road intersection on the outskirts of the study area. This area is susceptible to flooding and is not as suitable for residential development as other areas within the study area. It is intended that a 300m wide buffer zone surrounds the treatment plant. This buffer zone area would be used for storage of treated effluent prior to disposal. Possibilities for re-use of treated wastewater include:

- private gardens in residential areas which would have the advantage of reducing the potable water consumption but may not be considered cost effective in the long term due to the requirement for provision of a dual water reticulation system,

- watering of public parks and golf courses within in the urban area;
- irrigation of crops on nearby rural land; and
- treatment of the wastewater to potable water standard and returning it to the water supply system.

These effluent reuse options would not utilise all of the wastewater generated by a residential development. Local treatment enables the treated wastewater to be stored for extended periods so that the effluent which is not reused can be discharged into the existing trunk sewer at times of low flow in order to maximise Barwon Water's infrastructure and not affect the size or operating costs of the Black Rock treatment plant

The second of the two options involves upgrading the site of the existing trunk sewer for a length of 7km to cater for the extra capacity generated by the development in the study area

Two prominent ridge lines are evident within the study area and effect the configuration of the reticulated system. The reticulated system can drain by gravity towards Armstrong Creek and then in an easterly direction along the line of the creek to a pumping station in the vicinity of Horseshoe Bend Road and Stewarts Road. The northern section of the study area, which lies to the north of the ridge line, drains towards the north to a pumping station located near Reserve Road and Horseshoe Bend Road from where it is pumped to the top of the ridge line via a rising main and then flows by gravity to the Armstrong Creek pumping station. From the Armstrong Creek pumping station the sewerage would be pumped to the local treatment plant or the trunk sewer.

If development were to proceed on the eastern side of Horseshoe Bend Road, a sewerage system could be provided to cater for the development. One alternative is use of a vacuum sewer system which is suitable for low lying, low density development areas. This system employs a central vacuum source which draws flows from individual properties via service and collector lines to a central collection tank. When sufficient sewage has accumulated, a pump is activated to deliver the sewage to a treatment plant.

9.2 Water

Barwon Water has identified a strategy for the provision of water supply services to the study area for the purpose of residential development which is documented in a report entitled *Water Supply and Wastewater Services for Possible Development at Lovely Banks and Armstrong Creek/Mt Duneed* prepared by Systems Planning Branch of Barwon Water and dated June 1993.

A study area encompassing some 1500ha to the west of Horseshoe Bend Road was again adopted by Barwon Water. Two development densities were considered.

- Medium density was adopted as 10 dwellings/ha with an average water consumption of 13.5Ml/day; and
- High density was adopted as 15 dwellings/ha with an average water consumption of 20Ml/day.

This area can be readily serviced by water drawn from the Barwon System. Construction of a 4km transfer main along Whites Road from Pettavel Service Basin to the study area and construction of distribution mains within the area is required. Augmentation of the Pettavel Basin may be required.

It appears unlikely that the high development densities of this order will be achieved. Consequently, if development were to proceed on the east side of Horseshoe Bend Road then properties could still be supplied with water.

9.3 *Drainage*

With any increase in urban development, it will be necessary to cater for a greater volume of run-off from peak storm events. It is anticipated that run-off will increase by approximately 150-200% depending on development densities. Development of the area will need to include adequate provision for self drainage of lots and reserves through appropriate land forming as well as the large scale transfer of stormwater flows.

The Armstrong Creek, Sparrowvale and Sparrowvale north drainage catchments each have flood prone areas within them. Development of the drainage system within each catchment should be such that the duration, severity and frequency of flooding in the its downstream reaches is not significantly increased.

One way of controlling flooding in the downstream areas of a catchment is to establish on-site retention basins in its upper reaches to store flow from the increased run-off. Due to flat nature of the catchments in the study area, these on-site retention basins may be permanently wet. Appropriately located retarding basins can reduce peak flows to be transferred from the catchment, but they do not reduce the total run-off volume.

Development on or near the floodplains requires careful regulation. It is intended that development should occur generally above the 1% probability flood level, although methods exist by which some owners may opt to accept a greater risk of flooding.

In order to satisfy drainage objectives, development of any new area to retain as many natural features (in terms of vegetation, infiltration capacity, etc) as possible and thus minimise the increase in run-off is desirable. The provision of a drainage system which permits natural self drainage is advantageous.

9.3.1 Preliminary Assessment of Drainage Catchments

Preliminary assessment of the three main drainage catchments is set out in the following:

Armstrong Creek Catchment Area

Armstrong Creek would still form the major flow line within the catchment, however the use of on-site retention is proposed to limit peak flows. In order to accommodate the expected higher flows, the creek could be upgraded in one of the following ways:

- it could be developed as an open waterway having a capacity to transfer unstored run-off from a 1% storm; or
- it could constitute the secondary drainage system (floodway) to compliment a primary system comprising an underground pipeline having a capacity to accommodate run-off from a 1 in 5 year storm. The total capacity of the combined system would cater for the unstored run-off from a 1% storm.

One possible way of providing on-site retention within the catchment could be to increase the extent of the Hospital Swamps area.

Sparrowvale Catchment Area

This catchment drains into the Hospital Swamps area. The formation of definite drainage lines is required to effectively drain this area. The use of on-site retention could be considered to restrict flows to the outlet.

Sparrowvale North Catchment Area

This catchment drains directly into the Barwon River. Again, the formation of definite drainage lines is required to achieve an effective drainage system.

In general terms, due to the flood prone nature of the area, it is not desirable to develop land to the east of Horseshoe Bend Road for residential purposes.

Further drainage studies are required to determine the accurate extent of flooding due to backwatering effects on the complicated lake hydraulic systems.

9.4 *Electricity*

Electricity Services Victoria (SEC) advise there are some existing assets in the study area. SEC are currently investigating the capacity of these for urban development.

9.5 *Gas*

The Gas and Fuel Corporation (GFC) advise there is no existing reticulation in the study area. They have recently been investigating providing reticulation to Torquay but this is not yet viable. The most likely route for this service would be along Ghazeepore Rd and any development in the study area would assist in the viability of this service.

9.6 *Telecommunications*

Telecom advise there are some existing cables within the study area and are currently reviewing the capacity of these for urban development.

Optus advise their optical fibre cable is located north of the Barwon River and is therefore not a consideration in the study area.

9.7 *Refuse Disposal*

City of Greater Geelong advise they have recently completed a waste disposal strategy for the entire Geelong region. This identifies a tip site north of the city with ample capacity to provide refuse disposal for Geelong and any level of urban development in the study area. Refuse disposal is therefore not a limiting factor for development.

9.8 *Policy Influences*

9.8.1 *Drainage*

Constraints to development within the Rural Flood Zone exist at present. One cannot build, carry out earthworks, remove or place soil within the zone without the consent of the governing drainage authority. In this case it is the Rural Water Corporation and the Greater City of Geelong. However, development is not totally ruled out and where practical alternatives to drainage are available the legislation is flexible to allow development within the flood zone.

9.8.2 Sewerage and Water

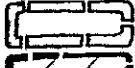
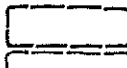
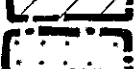
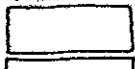
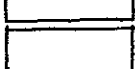
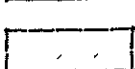
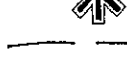
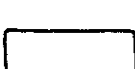
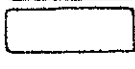
Barwon Water have produced a report on the provision of Water Supply and Wastewater Services for possible development at Lovely Banks and Armstrong Creek/Mt. Duneed regions dated June 1993. At this stage the Board has not adopted any water supply or wastewater options for either development area

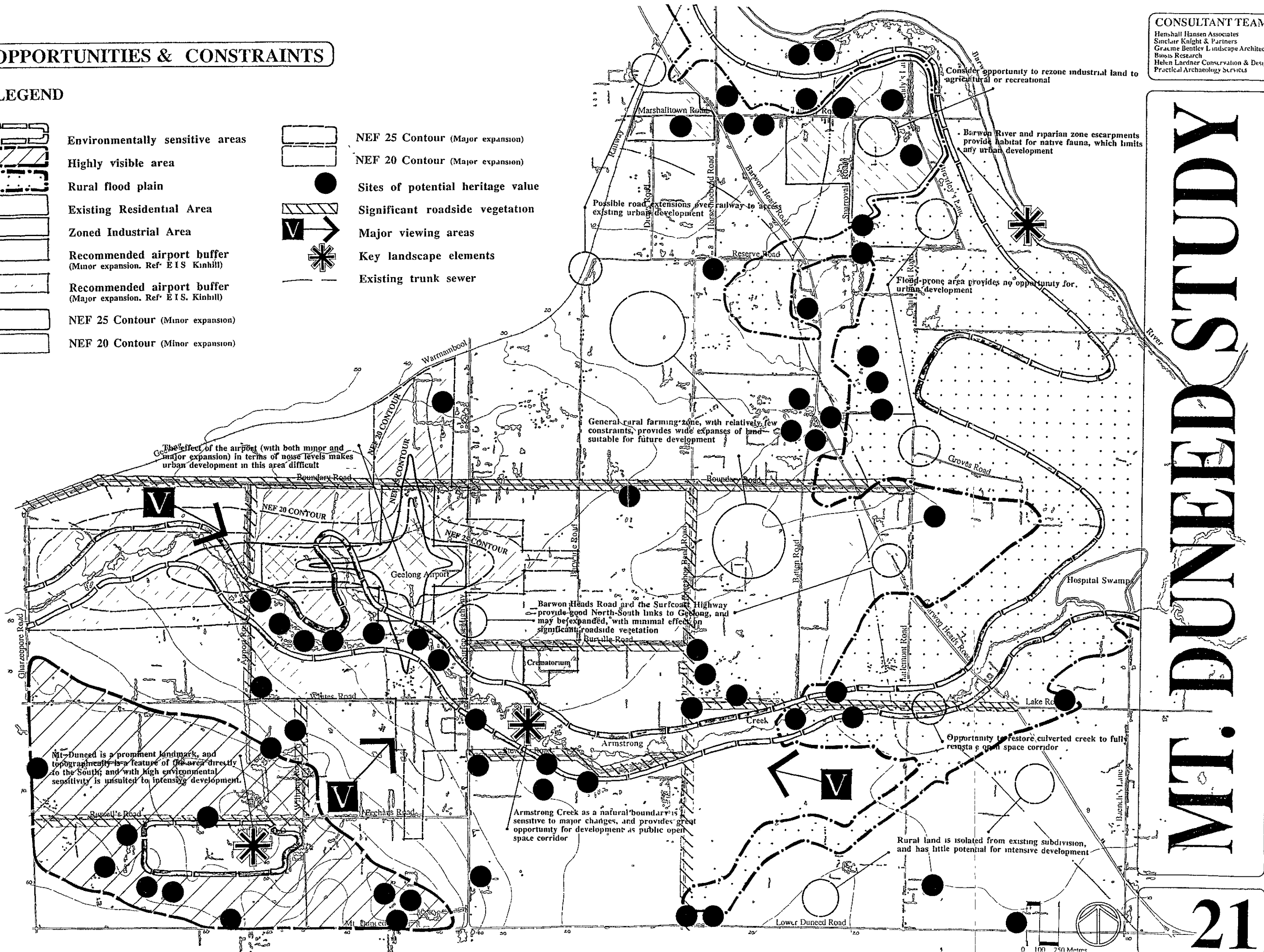
The Geelong Region Wastewater Strategy was adopted by Barwon Water in 1991. The strategy details the two following items:

- upgrade of the existing facility at Black Rock to a secondary treatment plant
- investigation of opportunities for local treatment and reuse of wastewater in situations where this is achievable.

OPPORTUNITIES & CONSTRAINTS

LEGEND

- | | | | |
|---|--|---|-----------------------------------|
|  | Environmentally sensitive areas |  | NEF 25 Contour (Major expansion) |
|  | Highly visible area |  | NEF 20 Contour (Major expansion) |
|  | Rural flood plain |  | Sites of potential heritage value |
|  | Existing Residential Area |  | Significant roadside vegetation |
|  | Zoned Industrial Area |  | Major viewing areas |
|  | Recommended airport buffer (Minor expansion, Ref. EIS Kinhill) |  | Key landscape elements |
|  | Recommended airport buffer (Major expansion, Ref. EIS Kinhill) |  | Existing trunk sewer |
|  | NEF 25 Contour (Minor expansion) | | |
|  | NEF 20 Contour (Minor expansion) | | |



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MT. DUNEED STUDY

CHAPTER 10
A SUMMARY OF THE CONSTRAINTS AND OPPORTUNITIES

Mt Duneed/Armstrong Creek Urban Development Study

10 A SUMMARY OF THE CONSTRAINTS AND OPPORTUNITIES

10.1 Introduction

Earlier sections of this report describe the existing features and characteristics of the study area compiled from the information sources which are presently available. This section of the report summarises that information and presents it in the form of potential opportunities and constraints to future urban development. A visual representation of these constraints and opportunities appear in Figure 21.

It is important to note that the information presented is based on the preliminary information which is available at this time. Where there have been gaps in this information, particularly in respect of flora, fauna and cultural heritage, the consultant team has been able to undertake reconnaissance surveys as a means of alerting planners and other key decision makers to the existence of issues of potential concern in the future planning of the area. More detailed constraints analysis will need to be undertaken to provide a comprehensive and complete data base for the area, and much of this work could be undertaken when more detailed planning of the urban areas commence. To assist local planning authorities, the report identifies likely additional information requirements in Chapter 11.

While there are numerous interpretations of what constitutes a constraint to urban development the consultants, for the purpose of this report, understand it to mean the following:

a factor (or combination of factors) which limit or restrict the potential for land to be used and developed for primarily urban purposes, or which requires specific consideration and attention in the planning of future urban areas in order to recognise or successfully respond to this factor.

As with most planning matters, the identification of constraints to urban development is reliant, to a certain degree, on the judgement and individual interests of those making the assessment. In short, the degree to which different features and characteristics pose a constraint to urban development depends on the values of the person, or persons, considering the issues.

In the Mount Duneed/Armstrong Creek area, for example, many would agree that the low lying land, subject to periodic flooding, is a *constraint* to urban development. In this example, flooding will impact on the potential for future urban drainage problems and, in doing so, would generally favour an approach where such land is ruled out for urban purposes. Similarly, many would agree

that the continued existence of the Geelong Airport in its present location is a substantial *constraint* to urban development. Not only does it occupy considerable areas of land which might otherwise be used for urban purposes, but it also has off site effects which can extend well beyond the boundaries of the site. Others may see the existence of remnant native vegetation as a *constraint*, yet others may argue that such a feature contributes to the environmental quality and character of the area, as well as its conservation significance.

The approach taken by the consultants when preparing this report is based on an underlying planning principle which demands that future urban development should be

sympathetic to the local environmental and cultural features of the area and, at the same time, strive to be socially and economically sustainable.

This principle seeks to sensitively integrate the characteristics and features of the study area which present opportunities for creating an attractive, well designed urban environment which has a "sense of place" - building on the environmental and existing attributes of the area.

Some may suggest that this a "greener" approach to the planning of our urban areas. The consultants, however, believe it to be an ecologically sustainable approach - an approach which has gained considerable acceptance in the past decade at all levels of government. One thing is certain, however, this approach is in sharp contrast to the way in which development of urban areas has been undertaken in the past, where the environmental values of an area were often unduly compromised or forsaken for the spatial needs of growing urban communities.

10.2 Land Use Planning

As described in Chapter 4, the study area essentially comprises broadacre farming uses and the land use and ownership patterns generally reflect rural, agricultural and horticultural activities. In a general sense, this suggests few land use constraints to urban development. Indeed, current land use in the area has largely ensured the provision of a "land bank for orderly development in the long term.

There are a limited number of important exceptions to this general situation which have been critical in the development of the three development scenarios described in the Section 10.5. These are summarised as follows

10.2.1 The Geelong Airport

When the airport was established by the Mahon family in 1962, it is fair to say that it was located distant from the established urban areas of Geelong. In this regard, the small scale of operations and their distance from the then residential area meant that there was little conflict between the airport and residential uses. In short, adequate buffers prevailed

However, since establishment in 1962, urban development south of Geelong has progressed as one of the region's most significant growth corridors partly fostered by the capability of this area for urban development as well as the increasing popularity and access to the Surf Coast townships and the lifestyle choice which they offer new residents

In the wider planning perspective, the pressure for urban growth in the study area, and many of the smaller towns further along the coast, is completely consistent with the State Government's strategy of promoting the Geelong/Torquay Corridor within the context of future growth in Victoria.

The extension of urban development into areas such as Grovedale highlights the popularity of the southern areas of Geelong. It also highlights the growing potential for conflict between residential and non-residential uses

The impacts of airports on surrounding land is well documented as a result of very real concerns of public safety and noise pollution associated with this activity. Such conflicts in land use are well understood in Metropolitan Melbourne, where Essendon Airport continues to be a focus for resident concerns in respect of noise and dangers associated with aircraft ascending or landing. As most would realise, Essendon Airport has, for many years now, distinctly lacked buffer areas. This continues to be a cause for community concerns as accidents, and loss of life, in surrounding urban areas are always a possibility.

In addition, buffers can be considered as luxuries when located near to, or central to, intensely developed urban areas. In normal urban development scenarios, this land would be used for higher and better purposes. Thus, for as long as urban development is not desirable or permitted in these areas, the longer the development opportunity is foregone. This is particularly relevant in a time when the State Government actively promotes urban consolidation as the most effective and efficient means of developing our communities.

Inevitably, if the Mt Duneed/Armstrong Creek area is to become the location for a significant proportion of Geelong's future urban population, the conflict between residential land use and airport activities will undoubtedly intensify. The Essendon Airport experience tells us this. This fact was also highlighted in the

Geelong Airport - Environmental Impact Statement prepared by Kinhill. This report, stated that

"Adverse impacts on urban development would be highest under Option 2 (Grovedale - Major expansion) Given that Grovedale is located near existing urban development to the north of the rail line and that there is strong expectation of major urban development in the vicinity of the aerodrome, then the development of Grovedale as a municipal aerodrome would have a negative effect on urban expansion." (p.103)

In respect of a minor expansion of the airport the reports states that

"under the do nothing option (Grovedale - Minor expansion) the effects on urban development would be less marked than under Option 2. Nevertheless, the presence of an increasingly busy aerodrome would have a detrimental effect on the development of the residential areas to the west and an effect on the property values to the north " (p.89)

While there is a need to update the information regarding environmental effects, it is clear that the airport at its current or expanded levels of operation will represent a substantial *constraint* to urban development in the Mt Duneed/Armstrong Creek area. Based on the information provided in the Kinhill Report, these constraints are identified as follows

1. Retaining the airport at its current scale of operations, (with some minor expansion of services, such as the soon to be introduced King Island Tourist Flights) will necessitate the severe limitation of urban development within the 20-25 Noise Exposure Forecast contours. This essentially removes a rectangular area of land between Boundary and Whites Roads extending from the east side of Ghazeepore Road to the Surf Coast Highway. This would leave a small area available for urban development between Boundary Road and the Geelong-Warrnambool Railway Line. This western part of the study has considerable drainage difficulties which would ultimately require substantial drainage infrastructure if the structure of the catchment and the significance of Armstrong Creek is to be retained Under this option, infrastructure planners must begin to consider the cost-benefit of these works if development cannot extend further south
2. A major expansion of the airport, would necessitate additional land being removed from the potential bank of future urban land. Increased frequency of flights, noise and public safety issues ultimately necessitate

much of the area bound by boundary, Ghazeepore and Whites Road Surf Coast Highway, together with a section of land extending to the west side of Burwarre Road, being removed from the land bank. This would represent a substantial blight on land in the area - land which is increasingly unviable for productive farming purposes, yet having the basic potential for urban development over the next twenty years, subject to the introduction of suitable drainage infrastructure.

A third option also needs to be raised for the purposes of comprehensive evaluation of the broad development options being prepared as part of this study. This option envisages that the airport be relocated and is premised on the basis that the long term sustainability of the area for urban development purposes should not be prejudiced or undermined by a single land use, namely the airport. This option could ultimately see the development of the area between the Geelong-Warrnambool Railway Line and Armstrong Creek, subject to suitable drainage of the area

Clearly the role of the airport as a regional facility needs to be taken into consideration in terms of its long term development and planning. Any discussion about expansion of the facility in light of the area's potential as a future growth area should therefore be the subject of careful consideration. Further, it should be stated that if the area's urban capacity is to be maximised (both in terms of quantity and quality) then any expansion of the airport must be seriously questioned.

Put simply, times have changed. Urban development is all but knocking at the airport's door so, rather than supporting the incremental expansion of the airport's infrastructure and its intensity of use, the consultants recommend that the City of Greater Geelong should undertake, as a matter of priority, further investigations to identify an appropriate site for relocating the airport, thus ensuring expansion over time, with minimal impacts on its surrounds and maximum certainty for the operator.

10.2.2 Extractive Industry

Extractive industry also poses *constraints* to urban development. While quarrying activities remain some distance from the western boundary of the Mt Duneed/Armstrong Creek area, it is Blue Circle's intention to extract significant limestone resources on land as far east as Ghazeepore Road. While extraction of resources on the western boundary of the study area is still some time away, planners must be mindful of the need for suitable buffer areas to protect future residents from excessive noise and limestone dust residues.

It is expected that Blue Circle would provide these buffers within the confines of its own land. These buffers would be assisted, however, by ensuring low density residential development on the western boundary of the study area.

Future mineral extraction activities are therefore considered a *constraint* to urban development which must be acknowledged in any future strategic, structure or neighbourhood planning exercises.

10.2.3 Intensive Agricultural Activity

The high quality of the soil in the northern portion of the study area (refer to discussions in Chapter 5 of this report) indicates suitability for agricultural purposes even though few productive intensive farming activities exist today. As the northern most section of the study area, it is likely that it will be the first area subjected to urban growth pressures.

Continued occupation of this area, for farming purposes is, therefore, considered as a *constraint* to urban development. It is likely that farming will ultimately be forced out because of rising land values brought about by growing urban development pressures. In this regard, other areas, like those at Sparrowvale, which are less suited to urban development may prove popular as higher intensity agricultural areas.

10.3 Land Capability

There are a number of land capability issues worthy of note, some representing constraints to urban development and these have been discussed throughout the report.

Land east of Barwon Heads Road is generally low lying and subject to periodic flooding, thus presenting substantial difficulties in terms of drainage. Land west of the Surf Coast Highway is also an area with substantial drainage issues which would need to be resolved prior to the commencement of urban development. While drainage solutions are possible, they may prove expensive and will undoubtedly necessitate solutions such that the duration, severity and frequency of flooding in the downstream reaches of Armstrong Creek is not significantly increased. This is important if the natural qualities of the Creek are to be maintained.

As indicated above, the highest quality agricultural soils fall almost directly within the path of the natural extension of urban development. In terms of land capability it is State Government policy to maintain these areas for soil based agricultural activities given the relative scarcity of the soil resource.

Aside from the issues outlined above, the study area is reasonably typical of the southern part of Geelong and, land of not dissimilar capability, has successfully been developed for urban purposes elsewhere. Caution should, however, be exercised in respect of soil quality and the grade and orientation of slopes around Mt Duneed as the area does indicate physical qualities most suited to viticulture, as well as representing a prominent land form visible from many vantage points within and beyond the boundaries of the study area.

10.4 Important Visual Characteristics

While the majority of the landscape in the area could be described as being unremarkable, some individual features stand out as being worthy of protection and enhancement in the future planning of the area. Future planning needs to ensure these features are sensitively integrated into the urban form as key character components

These individual features include the steep and undulating hillsides of Mt Duneed and wide open flat-rolling creek valley - a valley which extends from west to east across the study boundary. Aside from its environmental significance (discussed below) the creek is a signature for the area and, as such, is an important feature for consideration in any future urban development.

Similarly, the area contains remnants of what would have been substantial vegetation. Some of the more botanically significant areas although limited and isolated in nature could, in many instances, be readily incorporated into subdivision design and more particularly, the development of the area's regional open space network. Given that farming practices in the area have removed much of the riparian vegetation, what remains warrants special attention and protection.

10.5 Provision of Reticulated Urban Services

Provision of infrastructure services will ultimately be the most significant of the planning considerations relating to the development of the area. A combination of topographical characteristics pose considerable constraints in respect of staging of development and, subsequently, accommodating the needs of a new population in the Mt Duneed/Armstrong Creek area

A detailed discussion regarding the provision of reticulated services and the most practical methods of achieving this are outlined in the following chapter

10.6 *Transportation and Access*

The existing road network presently meets the requirements of the area. However, significant population increases in the years ahead are likely to be the catalyst for a number of changes to ensure the safe free flow of traffic and movement around and throughout the study area.

Consideration will need to be given to the provision of upgraded transportation and access services and facilities. Like the provision of reticulated urban services, these matters are discussed in more detail in Chapter 11.

10.7 *Protection of Natural Environmental Assets*

The major natural environment assets to be protected within the planning for staged urban development of the study area are

- the Armstrong Creek, (including Stewart's Reserve), which is of high conservation value due to its remnant riparian vegetation and its associated faunal habitat and wildlife corridor to Lake Connemara.
- Armstrong Creek also is the major natural channelised drainage system in the Study area.
- remnant stands of bushland with high conservation value located on private land throughout the proposed Stage 1 and 2 areas.
- roadside reserves containing valuable remnant vegetation along Boundary Road, Burville Road, and Horseshoe Bend Road within the proposed Stage 1, 2 and 3 areas
- wetlands of high conservation value at the downstream edge of the Armstrong Creek and in the Lake Connemara system immediately outside the study area.

The major threats to the conservation of these significant natural assets are vegetation clearance, loss of stand and habitat integrity, the adverse effects of feral animals on the native fauna, weed invasions, changes to the hydrological regime, in particular increased inundation along Armstrong Creek, and decreased water quality from urban runoff.

If the planning process requires the prioritisation of which natural assets are the most important to retain, the consultants strongly suggest that the most

consideration be directed towards the protection of the Armstrong Creek corridor and the remnant bushland on private blocks. It is mandatory under the following Victorian Government's legislation to protect such natural assets

- Flora and Fauna Guarantee Act (1988);
- Draft Flora and Fauna Guarantee Strategy: Conservation of Victoria's Biodiversity (DCE 1992),
- Native Vegetation Clearing Controls (Amendment S16).

During the neighbourhood planning stages of the planning process detailed flora and fauna surveys would be required under these statutory requirements to ascertain the species distribution and composition, and the occurrence and level of significant flora and fauna which would require special conservation measures established. Consequently, subdivisions will need to be designed around significant stands to maintain their value and integrity.

In addition, Armstrong Creek is a narrow and shallow waterway which has evolved carrying relatively small flows. It is imperative to restrict/retard urban run-off into the creek from those proposed urban areas which would naturally drain into the Armstrong Creek catchment, being the south-western corner of the proposed Stage 2 and Stage 3 areas. It is not recommended to conduct any earthworks to the channel nor to excavate and construct a stormwater pipe adjacent to either bank as this would have detrimental impact on the integrity of the creek's natural values.

Retarding basins with artificial wetlands to delay intense runoff and filter the quality of the urban runoff from development within the proposed Stage 3 area would be required upstream of flow into Armstrong Creek. This would reduce the impact due to scouring under high flows and minimise the impact of siltation, nutrification and weed growth. It would also minimise the impact of the proposed urban development on the downstream wetlands and conservation reserves.

It is also important to minimise the need for road widening in order to protect the remnant roadside vegetation from clearance as this constitutes a major proportion of the total remnant vegetation and habitat within the study area.

10.8 Heritage Planning Issues

With further investigation, some of the places identified as having potential for heritage or archaeological significance, may prove to be of a level of significance worthy of protection. Depending on significance, these sites may well be a *constraint* to future urban development. However, with sensible planning these sites could well be incorporated into a new urban area and serve to remind new

communities of their past, thus strengthening the sense of place and overall character of the urban environment.

The windscreen survey of post contact cultural heritage identified 21 Victorian, 2 Edwardian, 2 Bungalow era places and the Mt Duneed cemetery as likely to be of cultural significance. Another 13 places were identified as potentially important. Given the limitations of the field work undertaken, and the lack of an historic framework for consideration of places, it is probable that the preliminary survey list may alter. However, a sufficient number of places has been identified to suggest that a full conservation study of the area is warranted. The identification, evaluation and documentation of places of post-contact archaeological significance would be included in such a study

The outcomes from a conservation study of the Mt Duneed/Armstrong Creek area would be

- the establishment of an historic framework which reflects the development themes visible in the area,
- the identification of places of cultural significance with a clear statement for each place as to why it is significant and the level of significance;
- the identification of precincts, if any, where the existing cultural heritage character should be retained and enhanced;
- the protection, if appropriate, of individual places and precincts through an amendment to the planning scheme,
- the nomination of places of significance to the appropriate registers, such as the Register of the National Estate and the Historic Buildings Register; and
- the identification of actions to encourage the retention of cultural significance and enhance the special qualities of the area.

This last outcome is of particular importance given the likely expansion of urban development into part of the Mt Duneed/Armstrong Creek area. Clear guidelines should be developed to assist owners of identified places to make appropriate changes and undertake conservation works. The guidelines should also cover urban design issues to ensure that the qualities of the precincts and individual places are retained, and enhanced, by the new development. Some of the guideline issues, although not those relating directly to conservation works, may be covered in the outcomes of the Residential Review currently underway in the City of Greater Geelong.

Education and encouragement is a key component of heritage management in the region. Access to the technical expertise of Council's Heritage Advisor and the low interest loan scheme for conservation works should be provided to owners of places identified as significant. Community education activities, such as heritage walks and heritage awards, should be encouraged. All of these services currently operate in the parts of the City of Greater Geelong which are covered by heritage studies. These are Geelong City, Geelong West, Newtown and those properties identified in the Geelong Regional Commission study. In addition, Bellarine is beginning a conservation study this year. In this context, the same level of heritage services should be available in the Mt Duneed/Armstrong Creek area after a conservation study has been done

As with the area's post-contact heritage, there is a need to make a closer examination of those areas where urban development has the potential to destroy Aboriginal archaeological sites. More specifically, this means an examination of:

- all cultivated/ploughed paddocks;
- all areas containing old Eucalypts;
- all raised ground around the margins of Reedy Lake, Hospital Swamp, Lake Connewarre, and southern bank of the Barwon River;
- the length of Armstrong Creek
- Mount Duneed.

Studies such as those outlined above will undoubtedly lead to additional sites of significance being discovered in the future. Depending on their heritage value, these may influence future subdivision design and, at a more detailed level, will challenge urban designers to determine creative solutions whereby aboriginal and cultural heritage values can be integrated with the demands of the modern urban lifestyle.

10.9 Social and Economic Issues

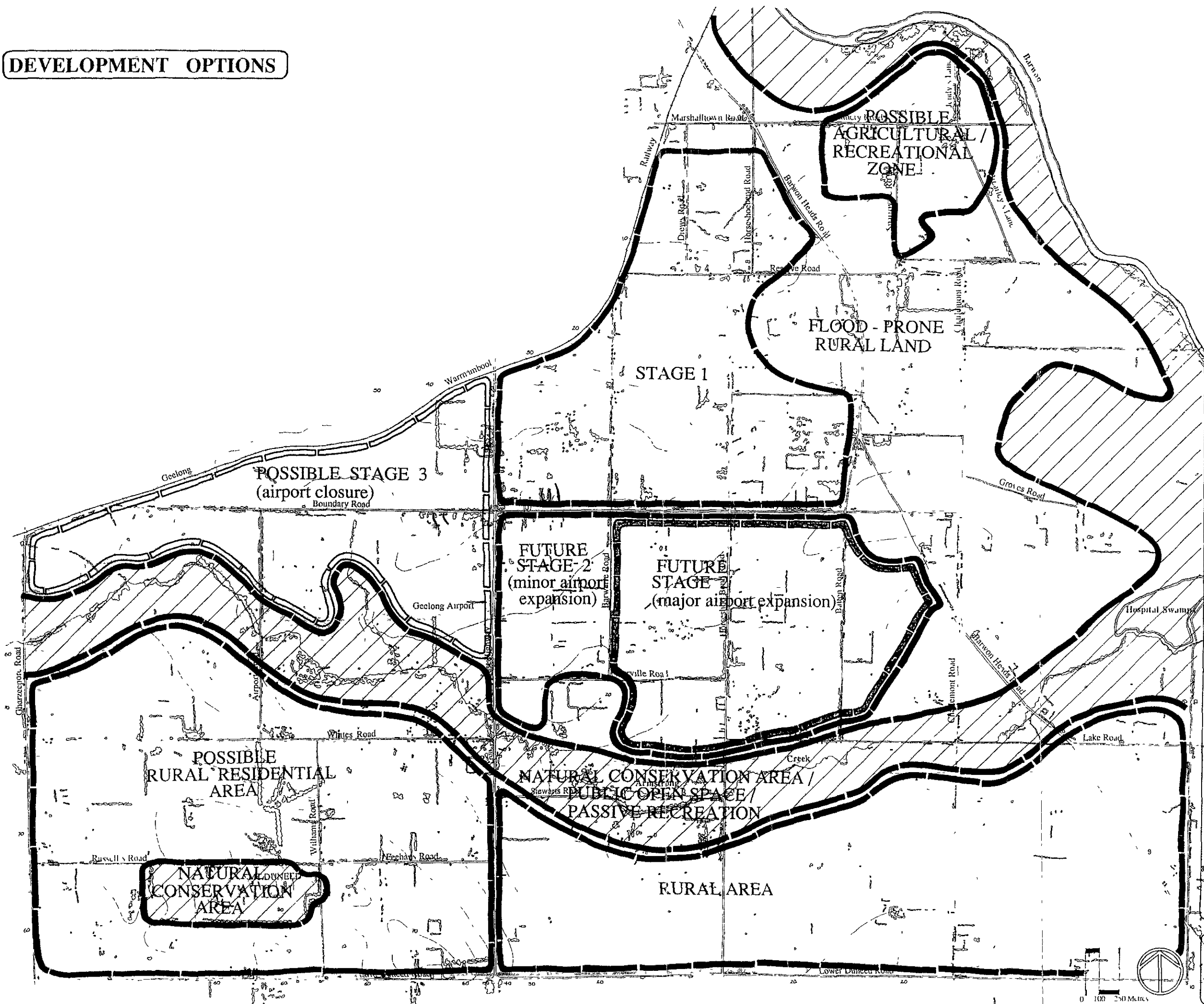
While an extension of the existing urban area of Geelong, development within the Mount Duneed/Armstrong Creek area, will be the beginning of a new community in an essentially greenfields location with its own demands for an extensive range of urban and community services. This is likely to include a full range of human services and facilities, education, public transport, as well as shops, entertainment facilities and employment opportunities.

The extent of the services facilities required to meet the needs of a new population in this area and their likely costs may, ultimately, be a constraint to urban

development although careful planning and appropriate use of developer contributions could ease the burden on the wider community. Future planning of the area, particularly in structure and neighbourhood planning phases, cannot ignore the social and economic consequences of a new urban population.

DEVELOPMENT OPTIONS

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MT. DUNEED STUDY

CHAPTER 11

URBAN DEVELOPMENT OPTIONS

Mt Duneed/Armstrong Creek Urban Development Study

11 URBAN DEVELOPMENT OPTIONS

11.1 Introduction

This section of the report outlines what the consultants believe to be the three primary options for urban development within the Mt Duneed/Armstrong Creek Designated Urban Growth Area as described in the Geelong Region Development Strategy completed by the Geelong Regional Commission in 1988.

It is important to note that the options developed assume that there will be urban development in this area, noting that it has not been the purpose of this study to assess the appropriateness of this development in a regional strategic planning context. More particularly, it has not been the purpose of this study to evaluate the Mt Duneed/Armstrong Creek area in the context of other future urban areas around the perimeter of urban Geelong.

In stating this, however, it is relevant to note that there are substantial constraints to large scale development of the Mt Duneed/Armstrong Creek area and that these constraints may ultimately encourage strategic planners to review and/or modify their expectations regarding the area's ability to accommodate urban development over the next twenty years. Hence the area's future as an extension to the urban area of Greater Geelong could be placed in a revised planning context.

It is also relevant to note that the staging approach discussed in the following chapters has been proposed as it represents an orderly and proper approach to planning for new communities which takes account of a range of physical, environmental and social issues. In this regard, no one consideration (eg cost of infrastructure, presence of roadside vegetation etc) has dominated the opportunities and constraints analysis.

As indicated in the previous chapter, Figure 21 presents a composite picture of the constraints which have been outlined in the report. Figure 22 illustrates possible staging of future development of the Mt Duneed/Armstrong Creek area. Three development options have been prepared because of the uncertainty surrounding the future size and operations of the Geelong Airport.

The Airport, is the single use in the area which has the greatest ability to impact on future development. The impact of airport activities extends well beyond the boundaries of the site itself and, hence, there is a range of land use conflicts, including public safety and noise issues, which must be resolved and, in cases where this is not possible, the impacts must be well shielded from residential development.

While planners can foreshadow what may be the likely impacts of urban development on the study area, it is difficult to anticipate the full impacts without the benefit of knowing the precise detail about where development will take place, to what extent it take place, how quickly it will take place etc.

To this end, this report is primarily about posing a series of possible options, and to raise an awareness of the constraints which have influenced the development of these options.

11.2 *Urban Limits Identified*

As indicated in Chapter 10, much of the assessment of urban development constraints and opportunities and their impact in determining possible future development options is, by nature, subjective. The consultants have been mindful of this and have, through a series of team meetings, defined an approach to urban development which is seen as realistic within the physical capacity of the land, economic in respect of community costs and respectful, wherever possible, of the inherent environmental characteristics of the land.

With these factors in mind the staging option illustrated in Figure 22 is summarised as follows:

Stage	Area	No Dwellings	No Persons
Stage 1	450 ha	6750	20250
Stage 2	425 ha	6375	19125
Stage 3	440 ha	6600	19800
Total	12750 ha	19725	59175

These stages are defined within the following limits:

A. *Southern Boundary - Armstrong Creek*

Armstrong Creek has high value in the remnants of riparian vegetation, and associated, faunal habitat, and as a wildlife corridor to the Lake Connnewarre system. In addition it forms a natural geographical boundary past which, the next phase of urban development should not extend. Aside from its habitat and natural boundary qualities, the Creek would form a strong urban edge, hence curbing the uncontrolled spread of the urban area and the maintenance of

greenfields which would continue to ensure that Greater Geelong remains separate from the Surfcoast towns.

It is therefore recommended that Armstrong Creek forms the southern boundary of Stage 2 and Stage 3, if the airport was to be relocated.

B. Eastern Boundary - Barwon Heads Road

The area east of Barwon Heads Road is dominated by land with flooding characteristics. In addition, the swamp at the eastern end of Armstrong Creek is of high wildlife conservation value. In the northern most part of the study area there exists a substantial area of land zoned for industrial purposes portions of which are being used for intensive horticultural purposes. It is the fundamentally low lying nature of the majority of this area, and the extensive and expensive drainage requirements of it, which suggests that Barwon Heads Road forms an appropriate eastern boundary for urban development.

It is therefore recommended that Barwon Heads Road, with minor exception relating to floodprone areas, form the eastern boundary of Stage 1 and Stage 2.

C. Western Boundary - Surfcoast Highway

The Surf Coast Highway has been identified as the line around which a western boundary to urban development could be identified. The precise alignment of the boundary could be either east or west of the Highway depending on the future size and intensity of airport operations. These boundary variations are outlined in the description of the development options which are described below. In addition, the area west of the Highway is another area having fundamental drainage problems, which if not handled sensitively, could have a severe impact on the quality and significance of Armstrong Creek as one of the region's environmental assets.

It is therefore recommended that the Surfcoast Highway form the western boundary of Stage 1, and possibly Stage 2 (depending on updated information in respect of NEF levels), if the airport was to remain in its current location. In the event that the airport remains in its current location, it may be more prudent to move this boundary east to Buwarre Road.

11.3 Provision and Possible Staging of Reticulated Urban Services

11.3.1 Drainage

**OPTION 1: AIRPORT STATUS QUO
URBAN DEVELOPMENT STAGES 1 & 2**

A development area of some 875ha would require drainage services if Option 1 were to evolve.

STAGE 1

Stage 1 of urban development would include collection of drainage waters from within the South-East Grovedale drainage catchment and the Sparrowvale drainage catchment.

A. South-East Grovedale Drainage Catchment

The drainage waters from within this catchment drain towards the north and discharge to Barwon River at an outlet point north of Tannery Road and east of Horseshoe Bend Road. The area of this catchment which is located within the Stage 1 development boundary is approximately 230ha.

If full development of the catchment were to occur a drainage collection system which collects stormwater runoff from all allotments would require installation. Any overflow from the drainage collection network would be directed towards the major drainage system which flows towards the discharge point.

The major drainage system should have the capacity to control stormwater flows to cater for a 1 in 100 year ARI storm. The major drainage system would follow the natural depressions in the land, where possible, within the collection system and flow under gravity from the upper most reaches of the catchment to the outlet at Barwon River. From the intersection of Horseshoe Bend Road and Barwon Heads Road floodwaters could be contained within large pipes laid east along the alignment of Tannery Road for a distance of 400m from where an open channel could be employed to carry floodwaters a further 600m to the north along an existing illdefined drainage line to the outlet at Barwon River.

Indicative costs for providing drainage services to the South-East Grovedale drainage catchment area which lies within the Stage 1 development zone are:

- drainage collection network = \$6,900,000
- major drainage system east of Barwon Heads Road to outlet = \$1,000,000

B. Sparrowvale Catchment Area

Stormwater runoff from the Sparrowvale drainage catchment drains towards the floodplain east of Barwon Heads Road. The floodplain is very flat and illdefined drainage paths are apparent on the floodplain. The natural level of the land is actually lower than the water level in the Barwon River, being reclaimed land which is protected from inundation by levee bank structures. A pumping arrangement currently exists whereby stormwater flows are pumped into the Barwon River.

The drainage requirements for full development of this catchment would also be undertaken using a drainage collection system and a major drainage network.

Since sections of the Sparrowvale catchment area are located within both Stage 1 and Stage 2 development boundaries an allowance for drainage waters from future Stage 2 works are required during Stage 1 works for the major drainage network system.

The Sparrowvale catchment area can be viewed as three sub-catchment areas for simplicity, these being:

- northern section west of Barwon Heads Road
- southern section west of Barwon Heads Road
- Sparrowvale farm area east of Barwon Heads Road.

Drainage waters from the 2 sub-catchments west of Barwon Heads Road would be directed towards the Barwon Heads Road and concentrated in two areas:

- The northern sub-catchment drainage waters crosses the Barwon Heads Road approximately 500 m north of Cavor Road. From the Barwon Heads Road flow can be diverted into an open channel which roughly follows the existing drainage line flowing into a retarding basin located north of Groves Road and on the east side of Charlemont Road. The northern sub-catchment area is approximately 190ha.
- Drainage waters from the southern sub-catchment cross the Barwon Heads Road at Boundary Road. An open channel could carry the waters from Barwon Heads Road in an easterly direction discharging to the retarding basin at the corner of Groves Road and Charlemont Road. The southern sub-catchment area is estimated as approximately 180ha of which 30ha is located within stage 1.

The proposed retarding basin would be capable of holding 205,200 cumecs of water. From the retarding basin an outlet pipe in the order of 1500 mm diameter in size would take the water to the existing pumping point from where drainage waters are pumped to the Barwon River.

The drainage water collection system from the Sparrowvale farm area east of Barwon Heads Road (approximately 520ha) would continue to operate as it presently does with an outlet to Lake Conewarre and a diesel pump to the Barwon River. With regulation of stormwater from upstream areas and provision of a retarding storage, flows from most storm events should be less than currently occur to the Sparrowvale farm area catchment.

Indicative costs for providing drainage services to the Sparrowvale catchment area which is located within the stage 1 development boundary is as follows:

- drainage collection network = \$6,600,000
- major drainage system east of Barwon Heads Road = \$1,950,000

STAGE 2

Stage 2 of the proposed development would include collection of drainage waters from within the Sparrowvale Catchment Area and the Armstrong Creek Catchment area.

A. Sparrowvale Catchment Area

As described above the operation of the Sparrowvale catchment area would remain unchanged when Stage 2 development progressed with provision for drainage waters to drain to the major system having been allowed for in Stage 1 works. The area contributing to Stage 2 is approximately 150ha.

The cost of drainage works within Stage 2 originating from the Sparrowvale catchment is as follows:

- drainage collection network = \$4,500,000

B. Armstrong Creek Catchment Area

The drainage waters from within the Armstrong Creek Catchment flow towards Armstrong Creek which is used to carry the flow to the Hospital Flats area outlet east of Barwon Heads Road. The portion of Armstrong Creek catchment contributing to development in Stage 2 is approximately 275ha.

A number of alternative drainage arrangements exist for the successful drainage of the Armstrong Creek catchment when development occurs. Some of the options available are described as follows:

- Armstrong Creek could constitute the secondary drainage system to compliment a primary system comprising an underground pipeline having a capacity to accommodate runoff from a 1 in 5 ARI storm. The total capacity of the combined system would cater for the unstored runoff from a 1 in 100 ARI storm. The use of a system of retarding basins located through the catchment can help in controlling the amount of discharge to the creek. These retarding basins would normally be dry and useable as parks and recreation facilities.
- Armstrong Creek could be developed as an open waterway having a capacity to transfer unstored runoff from a 1 in 100 ARI storm.
- Underground Armstrong Creek completely leaving more open space available for use.

Drainage and land use objectives need to be set in order to ultimately determine the exact method of drainage within the catchment. Management of the Armstrong Creek would involve a drainage solution to the creek which satisfies the community and fits in with the environment but is technologically sound and an economically feasible solution.

For costing purposes, the following major drainage system catering for developed land within the Armstrong Creek catchment contributing to stage 2 has been adopted:

- A retarding basin located east of Barwon Heads Road immediately west of the outlet to the Hospital Swamps area with a basin capacity in the order of 550,000 cumecs. An outlet from the retarding basin would be provided to hospital swamps.
- Drainage upgrade works along Armstrong Creek, including widening and shaping of the existing channel, would be required between Surf Coast Highway and Barwon Heads Road. It is envisaged that natural engineering techniques be adopted in undertaking the drainage upgrade works.

The indicative cost of drainage works within stage 2 contributing from the Armstrong Creek catchment area is as follows:

- drainage collection network = \$8,250,000
- major drainage system including upgrade of Armstrong Creek between Surf Coast Highway and Barwon Heads Road and construction of retarding basin east of Barwon Heads Road = \$900,000

**OPTION 2: AIRPORT MAJOR EXPANSION
URBAN DEVELOPMENT STAGE 1 & STAGE 2
(WESTERN BOUNDARY AT BURWARRE ROAD)**

Option 2 encompasses an area of some 850ha which require drainage services.

The drainage arrangement for Stage 1 and Stage 2 is the same as described previously for Option 1 although a slightly smaller discharge occurs in Stage 2 development to Armstrong Creek catchment area.

Similar costings are apparent for the major drainage system. For the drainage collection system the costs will be less than those stated in Option 1 for the Stage 2 development as less area requires servicing.

**OPTION 3: AIRPORT CLOSURE
URBAN DEVELOPMENT STAGE 1, 2 & 3**

The drainage system outlined for Stages 1 and Stage 2 under Option 1 remain unchanged for development of Option 3. However, Stage 3 must be catered for and falls almost entirely within the Armstrong Creek catchment. Development of Stage 3 would most likely necessitate an upgrade of Armstrong Creek.

Stormwater drainage from within Stage 3 would drain towards Armstrong Creek which would carry the flows to a retarding basin with a capacity in the order of 730,000 cumecs located on the east side of Barwon Heads Road prior to reaching the Hospital Swamps area. The retarding basin could effectively increase the extent of the Hospital Swamps area.

Indicative costs for providing drainage services to Armstrong Creek Catchment area which lies within Stage 3 development zone are:

- drainage collection network = \$8,250,000
- major drainage system including upgrade of Armstrong Creek between Ghazeeopore Road and Surf Coast Highway = \$400,000

A. Short Term - 10 Year Drainage Requirement

As outlined in Chapter 3 of this report the expected realistic population requiring services in the next 10 years is in the order of 10,000 people. This population people would fit within the Stage 1 development boundary. From a drainage servicing point the staging of development is best undertaken all within the South-East Grovedale drainage catchment area which is located parallel to the railway line. Drainage of this catchment area has previously been described under Option 1.

B. Drainage Servicing Costs

The cost per lot for the drainage collection network was determined from similar urban developments in the Melbourne area calculated at 1994 costs. Any charges required by the Greater City of Geelong for drainage works has not been included in any costing.

To determine the cost of the major drainage system some very broad assumptions were made as to the actual workings of the drainage system and these costs can only be used as a guide to indicate the magnitude of costs involved. Accurate costings would require a much more detailed drainage study to be undertaken of the area.

A summary of indicative costs for each stage of development relating to drainage services are summarised in Table 12.

Table 12: Indicative Costs of Staged Development

Development Stage	Contributing Catchment	Collection Network	Major Network	Total Cost
Stage 1	SE Grovedale	\$ 6,900,000	\$ 1,000,000	
Stage 2	Sparrowvale	\$ 6,600,000	\$ 1,950,000	
TOTAL		\$13,500,000	\$2,950,000	\$16,450,00
Stage 2	Sparrowvale	\$ 4,500,000		
Stage 2	Armstrong Creek	\$ 8,250,000		
TOTAL		\$12,750,000	\$ 400,000	\$13,650,000
Stage 3	Armstrong Creek	\$ 8,250,000	\$ 400,000	
TOTAL		\$ 8,250,000	\$ 400,000	\$ 8 650,000

Figure 23 shows the drainage strategy adopted in order to estimate the above costs. Drainage flow lines for the major drainage system for each catchment within each stage of development are shown.

11.3.2 Sewerage

The Stage 1 development area is situated in close proximity to the trunk sewer, which takes sewerage to the Black Rock Treatment Plant, and is ideally situated for servicing the wastewater requirements of the Stage 1 development. However, the trunk sewer is currently near capacity during wet weather flow and would thus not be able to cater for full development of Stage 1.

The following options are some of the options available for treatment of sewerage from the study area:

- local treatment plant and partial reuse of effluent
- augmentation of 7km of trunk sewer from the study area to Black Rock
- discharging sewerage into the existing trunk sewer during dry weather flows and provision of suitable facilities for a flow balancing storage or retarding arrangement to cater for wet weather flows. This option would only be viable for an estimated population of up to around 10,000 persons which is predicted to cater for approximately half of the stage 1 development.

If a local treatment plant and reuse system were to be implemented it could be sized to cater for all stages of development. The location of the local area treatment plant is flexible and a study to determine its best siting should be undertaken. One possible location for the local area treatment plant is located south of the Stage 1 development, east of Barwon Heads road and south of Groves Road. This area is not in the residential development zone and is not in the floodplain, and reuse options in this vicinity could include irrigation to agricultural land.

The majority of the reticulated system of the Stage 2 and 3 development areas can drain by gravity towards Armstrong Creek and then in an easterly direction along the line of the creek to the Armstrong Creek Pumping Station at Battern Road. The reticulation system in the northern section of Stage 1 can drain towards the north to a pumping station located near Reserve Road and Horseshoe Bend Road from where it would be pumped to the top of the ridge line via a rising main and then flow by gravity along the alignment of Boundary Road and Battern Road to the Armstrong Creek Pumping Station. From the Armstrong Creek pumping station the sewerage would be pumped to the local area treatment plant or the trunk sewer.

Figure 24 shows the provision of sewerage services for the developments.

The second of the three options listed above involves upgrading the site of the existing trunk sewer for a length of 7km to the Black Rock Treatment Plant to cater for the extra capacity generated by the development in the study area.

The third of the three options caters for an initial development of approximately 10,000 persons. The trunk sewer would be used to discharge flows and this can be achieved successfully during dry weather flows. Provision of a flow balancing storage would be required to cater for wet weather flows ensure the trunk sewer is not over full during wet weather flow conditions. The provision of a flow balancing storage would fit in with the strategy of Barwon Water in using flow balancing storages to alleviate sewerage overflows in the Geelong area.

A. Estimated Wastewater Requirements

Considering a density of 15 dwellings/ha and a dwelling occupancy rate of 3 persons/dwelling the estimated wastewater supply requirement for each stage of development are outlined in Table 13.

Table 13: Estimated Wastewater Supply Requirements

Stage	Area	No. Dwellings	No. Persons	Ave. Wastewater Flow
Stage 1 Option 1, 2 & 3	450 ha	6750	20,250	4.46ML/day
Stage 2 Option 1 & 3	425 ha	6375	19,125	4.2ML/day
Stage 3 Option 3	440 ha	6600	19,800	4.4ML/day
10yr development Stage 1	220 ha	3300	9,000	2.2ML/day
Stage 2 Option 2	400 ha	6000	18,000	3.96ML/day

B. Sewerage Servicing Costs

The costings for the provision of sewerage services to the development areas are based on the figures presented in Barwon Water's report entitled *Water Supply & Wastewater Services for Possible Development at Lovely Banks & Armstrong Creek/Mt. Duneed* prepared by Systems Planning Branch of Barwon Water and dated June 1993.

A wastewater capital works charge is required to be paid by developers for connection to the wastewater system. Based on the assumptions outlined in the Barwon Water report the average wastewater capital works charge would be approximately \$17,000/ha. If the local wastewater treatment and reuse option were to be adopted the capital works charge may be reduced.

Reticulation sewers within the developed areas would be constructed at the developer's cost. The Barwon Water report nominates an average cost of sewer reticulation to be approximately \$30,000/ha.

An estimated cost to purchase land and construct a high grade wastewater treatment plant at Armstrong Creek including effluent storage ponds and connection to existing trunk sewer is \$22,250,000 as outlined in Barwon Water's report. This plant will service a population of up to 67,500 people. Construction of at least 2 pumping stations would be required to obtain the full development proposed. The estimated cost of each pumping station is \$250,000.

Based on the information given above the estimated costs to provide wastewater services to the development at Armstrong Creek is as follows:

Table 14: Estimated Wastewater Costs

Stage	Capital Works Charge	Reticulation Sewer	Treatment Plant - Effluent Storage	PS Rising Main & Gravity Sewer	Total
Stage 1 Option 1, 2 & 3	7,875,000	13,500,000	15,000,000	4,285,000	41,160,000
Stage 2 Option 1 & 3	7,437,5000	12,750,000	15,500,000	1,250,000	36,937,500
Stage 3 Option 3	7,700,000	13,200,000	22,250,000	500,000	43,650,000
10yr development Stage 1	3,850,000	6,600,000	15,500,000	3,335,000	29,285,000
Stage 2 Option 2	7,000,000	12,000,000	22,250,000	1,250,000	35,750,000

11.3.3 Water**A. Estimated Water Supply Requirements**

If one considers a density of development of 15 dwellings/ha and a dwelling occupancy rate of 3 persons/dwelling the estimated water supply requirements for each stage of development is as follows:

Stage	Area	No. Dwellings	No. Persons	Ave. Wastewater Flow
Stage 1 Option 1, 2 & 3	450 ha	6750	20,250	6.08ML/day
Stage 2 Option 1 & 3	425 ha	6375	19,125	5.74ML/day
Stage 3 Option 3	440 ha	6600	19,800	5.94ML/day
10yr development Stage 1	220 ha	3300	9,000	2.97 ML/day
Stage 2 Option 2	400 ha	6000	18,000	5.4ML/day

B. Water Supply Options

The staging of the development areas is ideal for the provision of sewerage services but is at the wrong end as far as development of water services.

The proposal to construct a 4km transfer main along Whites Road from Pettavel Service Basin to the Armstrong Creek development does not seem all that relevant to stage 1 of the development. There is the possibility that limited capacity is available in the water mains in the Grovedale Area which could be used to service initial development in Stage 1. Barwon Water would need to undertake a thorough examination of the supply area to determine what effects servicing of the Armstrong Creek development would have on water supply to the Grovedale area. In order to service stage 1 some augmentation of the existing Grovedale area would be required. It is unlikely that the existing system could supply an estimated 10 year population of 10,000 persons. As development extends augmentation from Pettavel Service Basin would be required.

A new transfer main at the western end of the development area along Ghazeepore Road is currently being planned to supply the township of Torquay. This main is due to be constructed during the next 6-12 month period. Most of the Armstrong Creek/Mt Duneed area could be supplied by the Ghazeepore Road transfer main.

It is difficult to estimate the costs involved in determining the transfer and distribution mains as there is a possibility of many different development scenarios and a number of different water supply options associated with each scenario. A detail study is required to be undertaken in order to explore these options and recommend the most suitable water servicing arrangement. An example of possible options is as follows:

STAGE 1

- initial supply from existing distribution mains in Grovedale area
- construction of a distribution main from Ghazeepore Road along Boundary Road to Surf Coast Highway (approximate distance of 3.25km) to the stage 1 development in order to service 10,000 people
- construction of a distribution main from Ghazeepore Road to the stage 1 development to service 20,000 people.

STAGE 2

- augmentation of the distribution main constructed for the stage 1 development from Ghazeepore Road to Surf Coast Highway along Boundary Road to service a further 19,000 people

- provision of a new main from Ghazeepore Road to Surf Coast Highway along Boundary Road to service 39,000 people

STAGE 3

- construction of a 4 km long transfer main from Pettavel Service Basin to Ghazeepore Road to service a further 20,000 people predicted to obtain the full development of stage 3.

C. Water Servicing Costs

The costings for the provision of water services to the development areas are based on the figures presented in Barwon Water's report entitled *Water Supply & Wastewater Services for Possible Development at Lovely Banks & Armstrong Creek/Mt Duneed* prepared by Systems Planning Branch of Barwon Water and dated June 1993.

A water supply capital works charge is required to be paid by developers for connection to the water supply system. Following the assumptions outlined in the Barwon Water report the average water supply capital works charge would be approximately \$9,000/ha.

Reticulation mains within the development areas would be constructed at the developers' cost. The Barwon Water report nominates an average cost of water reticulation to be approximately \$12,000/ha.

As previously stated it is difficult to estimate accurately costing for supply of water services to the area. However, based on the above information the estimated costs to provide water supply services to the development at Armstrong Creek are outlined in Table 15.

Table 15: Estimated Costs of Water Supply Provision

Stage	Capital Works Charge/Stage	Reticulation Mains	Transfer Main Distribution Mains	Total
Stage 1 Option 1, 2 & 3	4,050,000	5,400,000	4,000,000	13,450,000
Stage 2 Option 1 & 3	3,825,000	5,100,000	4,000,000	12,925,000
Stage 3 Option 3	3,960,000	5,280,000	4,500,000	13,740,00
10yr development Stage 1	1,980,000	2,640,000	3300	9,000
Stage 2 Option 2	3,600,000	4,800,000	6000	18,000

11.3.4 Preliminary Costings for Staging of Development

A summary of preliminary costs for each stage of the development is given below:

Table 16: Preliminary Costings for Staged Development

Stage	Area ha	Drainage Services	Sewerage Services	Water Services	Total
Stage 1 Option 1, 2 & 3	450ha	\$36,600/ha	\$91,500/ha	\$29,900/ha	\$158,000/ha
Stage 2 Option 1 & 3	425ha	\$32,200/ha	\$87,000/ha	\$30,500/ha	\$149,700/ha
Stage 3 Option 3	440ha	\$19,700/ha	\$99,250/ha	\$31,300/ha	\$150,250/ha
10yr development Stage 1	220ha	\$9,000/ha	\$12,000/ha	\$39,200/ha	\$60,200/ha
Stage 2 Option 2	400ha	\$9,000/ha	\$12,000/ha	\$31,000/ha	\$52,000/ha

11.4 Transportation and Access Implications

11.4.1 Road Network

Three development scenarios have been investigated, as described above. Stage 1 is common to all scenarios and takes in the area bounded by Barwon Heads Road, Boundary Road, Surf Coast Highway and the Geelong-Warrnambool railway line, of which the northern-most triangle has already been developed. Stage 1 has an area of approximately 400 ha.

Surf Coast Highway and Barwon Heads Road are existing secondary arterial roads and serve a regional access function, linking to the Great Ocean Road and the Bellarine Peninsula respectively. At the northern end of the study area they have a separation of around 1.6 km (although Surf Coast Highway is outside the study area), the arterial road spacing recommended in VicCode. Therefore it is desirable to utilise both of these as arterial roads in the urban development of the study area. Horseshoe Bend Road is an existing north-south road traversing the study area and ending at an intersection with Barwon Heads Road. It has a 20 m (1 chain) reservation in the Geelong Planning Scheme and a discontinuity at Reserve Road.

The east-west roads in the Stage 1 area are:

- **Marshalltown Road**
An existing east-west secondary arterial road linking Surf Coast Highway and Barwon Heads Road at the northern end of the study area.
- **Reserve Road**
Currently a local road also linking Surf Coast Highway and Barwon Heads Road, located approximately 1 km south of Marshalltown Road. It has a 20 m reserve in the Geelong Planning Scheme.
- **Boundary Road**
A road with a 20 m reserve in the Geelong Planning Scheme located 1.6 km south of Reserve Road and running from Charlemont Road, crossing Barwon Heads Road, to Gharzeepore Road (the western boundary of the study area).

These north-south and east-west roads form a grid which can become the arterial road network for Stage 1. There are no environmental constraints on these roads. Actions required to allow for adequate level of service are:

- realignment of Horseshoe Bend Road at Reserve Road to create a cross intersection rather than the existing staggered-t arrangement

- widening of the road reserves in the Geelong Planning Scheme and resumption of the land for the following roads:
 - Barwon Heads Road
 - Horseshoe Bend Road between Barwon Heads Road and Boundary Road
 - Marshalltown Road between Surf Coast Highway and Barwon Heads Road
 - Reserve Road between Surf Coast Highway and Barwon Heads Road

It is envisaged that the intersections of the arterial road network will ultimately be signalised. Other existing roads within this arterial road grid can be used as local or collector roads within residential subdivisions and other urban development. The collector or sub-arterial road network is determined at the local structure plan stage, however, this can lead to disjointed road networks depending on the ownership and development pattern of the land. Therefore it is recommended the sub-arterial network is further investigated with a view to specifying the sub-arterial road network, purchasing the land and reserving it in the Geelong Planning Scheme and this expenditure could be recouped as part of the developer levies as the land is subdivided.

The recommended arterial road network is indicated in Figure 25.

For Option 1, Stage 2 is approximately defined by Boundary Road, Barwon Heads Road, Lake Road, Burville Road and Surf Coast Highway, again an area of around 400 ha. In addition, it has been recommended Armstrong Creek be the limit of urban development to the southward. Therefore the road network has to provide only for Stage 2 development and not allow for additional urban development further south. It is recommended Horseshoe Bend Road be designated as a secondary arterial road between Boundary Road and Lake Road and remain a local road south of Lake Road. Horseshoe Bend Road and Barwon Heads Road are approximately 1.6 km apart at Armstrong Creek and this completes the arterial road network for Stage 2, as indicated in Figure 25.

This arterial road network allows for Stage 2 of Options 2 and 3, that is less development in Stage 2 and more development in Stage 2 respectively. It is therefore recommended the following road reserves are widened in the Geelong Planning Scheme and the appropriate land be resumed:

- Boundary Road between Surf Coast Highway and Barwon Heads Road
- Barwon Heads Road south of Boundary Road
- Horseshoe Bend Road between Boundary Road and Lake Road

Option 3 added Stage 3 on the assumption Geelong Airport is relocated. It is assumed for road planning purposes that Stage 3 would include the entire area defined by Armstrong Creek, Ghazeepore Road, Geelong-Warrnambool Railway Line and Surf Coast Highway. Boundary Road would provide the east-west arterial to serve this area. The existing urban development north of the railway line cannot link into Boundary Road due to the lack of crossings and the subdivision layout. Therefore it is considered that there is no need for another north-south arterial within the study area, as Boundary Road between Ghazeepore Road and Surf Coast Highway will provide adequate capacity. Land west of Ghazeepore Road is to be used as a quarry, therefore urban development will not extend beyond Ghazeepore Road.

There is a need for a north-south arterial link between Boundary Road and Princes Highway. The urban development extending 2 km west of Surf Coast Highway does not allow for a road link however there are two options at the western end of this development:

- Ghazeepore Road
- Geelong Western Bypass reserve

Ghazeepore Road intersects with Anglesea Road just south of Princes Highway and the intersection arrangement has downgraded Ghazeepore Road. The geometry of this three road intersection is not considered satisfactory for Ghazeepore Road to act as an arterial road although there is an existing railway level crossing in Ghazeepore Road. It is recommended the Geelong Western Bypass reserve be used as the arterial link to Princes Highway from Boundary Road. This will also allow two connections from the residential subdivision to the north of the railway line.

It is therefore recommended the following road reserves are widened in the Geelong Planning Scheme and the appropriate land be resumed:

- Boundary Road between Ghazeepore Road and Surf Coast Highway
- Geelong Western Bypass reserve

In addition it is recommended:

- a railway crossing at the end of the Geelong Western Bypass reserve be investigated and appropriate agreements from Public Transport Corporation be obtained
- the intersection treatment of Boundary Road/Geelong Western Bypass be investigated and appropriate land be reserved in the Geelong Planning Scheme and resumed.

The ArtRdNet model has been used to determine the required road cross-sections to provide acceptable levels of service on the arterial road network. VicCode specifies level of service D in peak hours as being an appropriate design guideline. Based on existing traffic generation and distribution determined above the model indicates 2 lane roads will be adequate for the east-west arterials but 6 lane divided roads are required for the north-south arterials. Based on VicRoads guidelines for footway, lane, median, separator, parking and bicycle lane widths (as outlined above), the arterial road reserves should be:

- east-west arterials 30 m
- north-south arterials 60 m

the roads specified above for Options 1, 2 and 3 should therefore be widened to these values.

11.4.2 Public Transport

Based on the ABS census data presented earlier in this report the estimated demand for public transport for home - work trips for each scenario is presented in Table 17 - Work Public Transport Demand.

Table 17: Home-Work Public Transport Demand

Options	1	2	3
Train passengers	120	90	160
Bus passengers	130	100	180
Park & Ride Cars	100	70	130

It should be noted Table 17 does not include demand generated north of the study area which could be attracted to a railway station or bus service/s for the study area.

Table 17 indicates sufficient demand to further investigate the possibility of a railway station on the Geelong-Warrnambool line between Surf Coast Highway and Reserve Road with substantial commuter parking provided, particularly when the potential catchment of Torquay and beyond and railway patronage for other trip types are added. A possible location is identified in Figure 25, that this is some distance east of the location previously discussed. For planning purposes, the proposed location is more centrally located to its catchment

population, particularly if Stage 3 is delayed as a result of airport expansion. Grades in this area need to be considered further, to ensure suitability for the PTC purposed. A suitable and centralised location could also be the springboard for a local light rail system as the population grows over the next few decades.

Bus services should be provided on the arterial road network and on collector and/or local roads within each subdivision. The route is dependent on subdivision layout and should be considered by developers and council when local structure plans are being prepared.

11.4.3 Bicycles

The ABS census data presented in earlier sections of this report indicates potential home - work bicycle usage of 130, 100 and 180 trips for scenarios 1, 2 and 3 respectively. Therefore bicycle facilities such as dedicated off-street paths, parking racks, showers, etc should be encouraged and considered by developers and council at the local structure plan stage. The original Geelong Bicycle Plan was a seminal study which founded bicycle planning in this country.

11.5 Conclusions

The consultants have, by way of a sieving process, determined that less than half of the study area will be suitable for conventional urban development. Further, it has been determined using development density averages, that the available area could accommodate up to 60,000 people. If the Geelong Airport is to remain in the area, and possibly expand, regard for public safety and residential amenity may ultimately limit the area's capacity to less than 40,000 people. These capacities are particularly important, as ABS census information indicates that it is likely that between 10,000 (conservative) and 15,000 people may move into the area over the next 10-15 years. Based on the Development Options presented in the chapter, this new population could be successfully contained within Stage 1, as proposed.

Thus the future of Stages 2 and 3 (if appropriate and possible) could be reassessed in the longer term as part of ongoing strategic planning processes. On the basis of information available to date, it would appear that much of the area designated as having basic suitability for urban development should continue to be held as a "land bank" for future urban development in much the same way as it has in the past until such time that population figures indicate the necessity for future urban zones or similar.

In addition, anticipated long lead times may well have implications for the current review of the regional strategy, the basis and future direction of which, has not been within the ambit of this study.

In the event that the City of Greater Geelong is keen to pursue urban development in the area generally described as Stage 1, consideration should be given to rezoning land for future urban use, or similar, and further investigations regarding the provision of physical infrastructure in line with the servicing information provided as part of Chapter 11 must be undertaken.

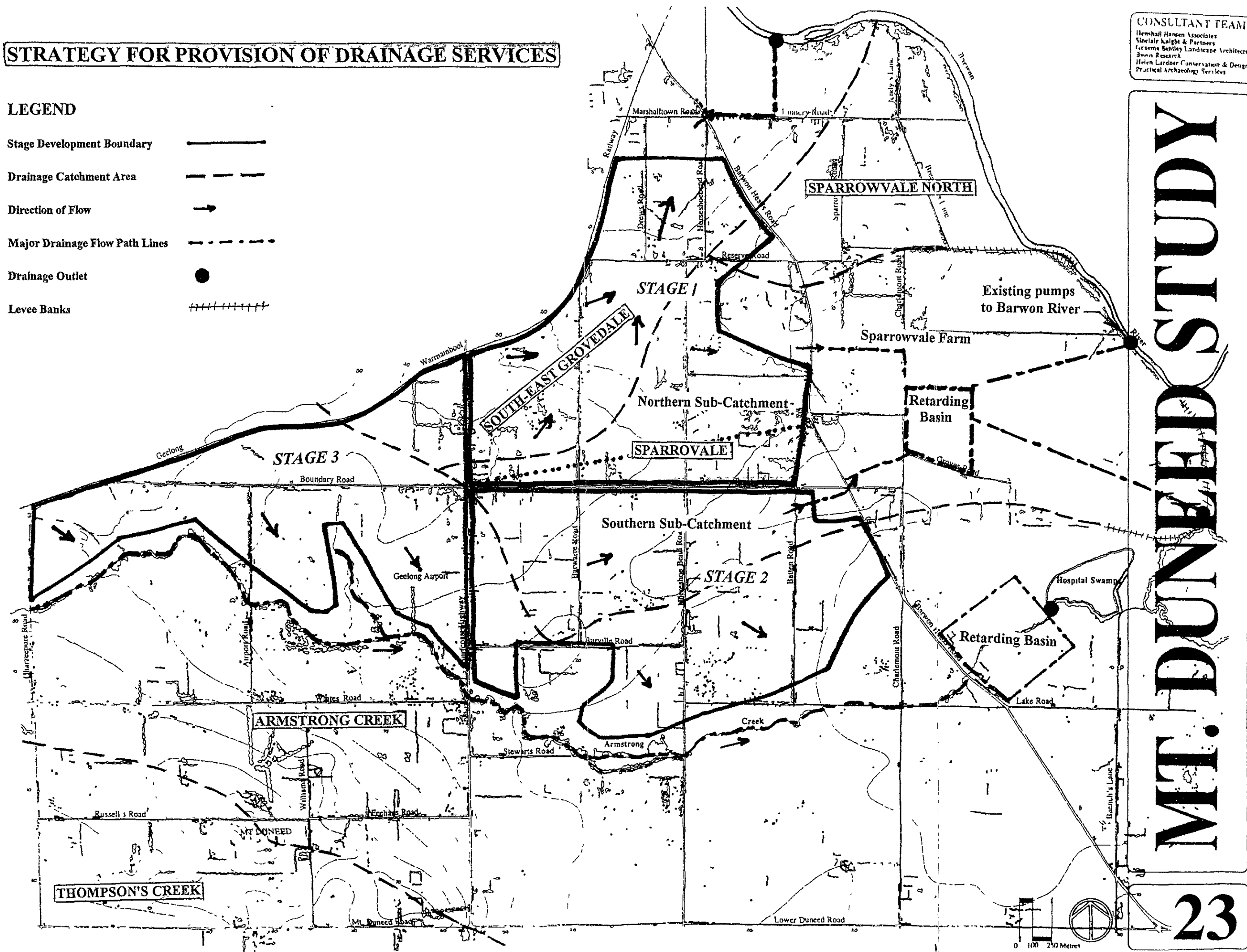
While much of the focus of this study has been on the physical opportunities and constraints to development in the area, there are matters which the City of Greater Geelong will need to consider when planning for a new population. New urban areas are not simply places to live. They are places where people work, shop, develop social networks and participate in recreation. These aspects of the urban planning process should not be neglected and it is important that structure and neighbourhood planning exercises aim to optimise land use and development, while simultaneously ensuring the efficient and effective provision of infrastructure and of a range of human services and facilities.

CONSULTANT TEAM
 Hemmell Hansen Associates
 Sinclair Knight & Partners
 Geosoma Bentley Landscape Architects
 Brown Research
 Helen Lardner Conservation & Design
 Practical Archaeology Services

STRATEGY FOR PROVISION OF DRAINAGE SERVICES

LEGEND

- Stage Development Boundary ———
- Drainage Catchment Area - - - - -
- Direction of Flow →
- Major Drainage Flow Path Lines - . - . - .
- Drainage Outlet ●
- Levee Banks + + + + +



MT. DUNEED STUDY

PROVISION OF SEWERAGE SERVICES

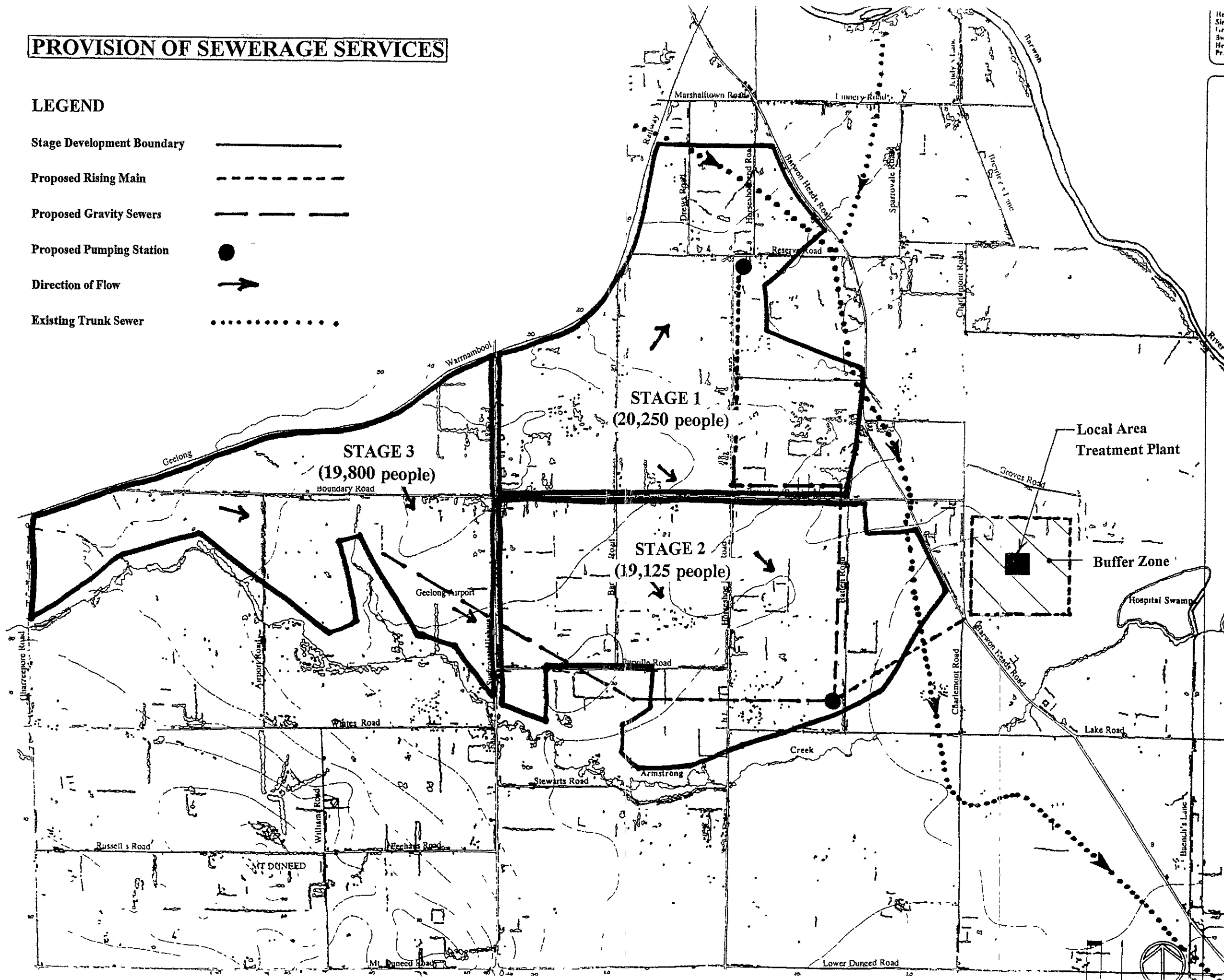
LEGEND

- Stage Development Boundary —————
- Proposed Rising Main - - - - -
- Proposed Gravity Sewers — — — — —
- Proposed Pumping Station ●
- Direction of Flow →
- Existing Trunk Sewer ·······

Henshall Hansen Associates
Sivell Knight & Partners
Graeme Bentley Landscape Architect
Bunn Research
Helen Lardner Conservation & Design
Practical Archaeology Services

MT. DUNEED STUDY

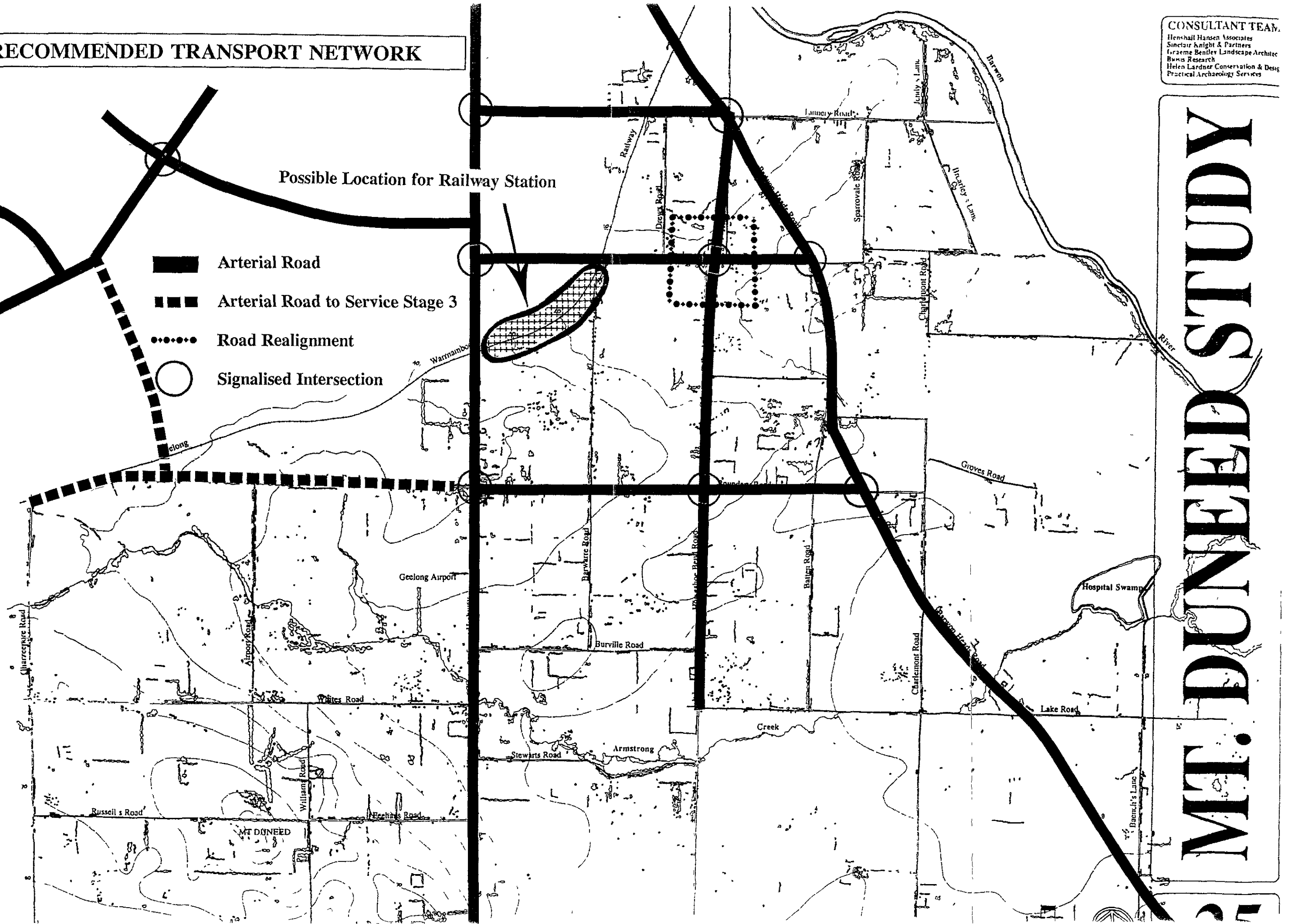
24



RECOMMENDED TRANSPORT NETWORK

Possible Location for Railway Station

-  Arterial Road
-  Arterial Road to Service Stage 3
-  Road Realignment
-  Signalised Intersection



CONSULTANT TEAM
 Henshall Hansen Associates
 Sinclair Knight & Partners
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 Buxton Research
 Helen Lardner Conservation & Design
 Practical Archaeology Services

MT. DUNEED STUDY

CHAPTER 12

FURTHER INFORMATION REQUIREMENTS

Mt Duneed/Armstrong Creek Urban Development Study

12 FURTHER INFORMATION REQUIREMENTS

12.1 Introduction

Planning studies such as this, and the success of them, inevitably rely on the availability of an extensive range of information. However, the ongoing search for information can be such that the focus of the study becomes lost in the collection of detail - detail which forms part of the strategic planning of the future urban areas broadly identified in Chapter 11. This is relevant in the Mt Duneed/Armstrong Creek Area where the potential exists for a significant level of new urban development and where the overall aim is to at least attempt to recognise, protect and enhance the significant physical and natural characteristics of an area and, where possible, integrate them as important elements into the overall planning of this designated urban growth area.

How, for example, is it possible to know whether grassland should be protected, if we are unsure of its environmental value? Is it appropriate to insist on the retention of those "older" elements of the physical environment if the value or significance of these places has not been determined? These are just two examples of planning dilemmas which face professionals and the community, where a full body of information is not available

As has been mentioned already, this study has been undertaken using existing sources of information, most of which has been provided by the City of Greater Geelong. Original research has, necessarily been limited. Field work, also has been limited to that at a reconnaissance levels because of inherent difficulties associated with gaining access to private property and the limitations imposed by the study budget. Accordingly, this section of the report identifies a number of what are described as information deficiencies and further work which is required to be undertaken to ensure that strategic planning in the area proceeds with the access to the greatest amount of information possible. These information requirements are summarised in the following sections.

12.2 Land Use Planning Constraints

Prior to any major new urban development in the Mt Duneed/Armstrong Creek area, planners would benefit from further information in the following areas:

- an update of the Environmental Impact Statement on the Geelong Airport. As indicated throughout the report, the airport is the single land use in the area having the greatest potential to impact on the extent and staging of development. In this regard, planners must have access to up-to-date

information on noise exposure forecasts and minimum buffer areas to ensure that new residents in the area are exposed to minimum noise levels and maximum public safety.

- the long term future of industrial land in the north eastern corner of the study. If this area is not ideally suited to longer term industrial development, then serious consideration should be given to alternative zoning provisions. The consultants have tentatively recommended that this area may have a longer term future for intensive farming purposes, other rural use or, possibly, recreation.
- an open space strategy using Armstrong Creek. An open space strategy which incorporates the Creek is believed to be an ideal way of preserving its natural and significant environmental characteristics, as well as providing an outstanding part of what would ultimately be extensive open space and recreation requirements associated with a new urban population in this area.

12.3 Provision of Reticulated Urban Services

Within the limits of this study it has not been possible to determine precise stormwater flow figures for each drainage catchment. In light of this, it is recommended that:

- a more detailed drainage study be undertaken to determine the magnitude of stormwater discharges from new subdivisions which may need to be constructed in the near future. The flows thus determined could then be used by planners and engineers at the Greater City of Geelong in determining sizes of new culverts and drainage structures and discharges from new subdivisions which may need to be constructed in the immediate future, and progressively, as the area develops.

In addition, future planning of the area would benefit from:

- a more detailed analysis of the water supply to the development areas undertaken by Barwon Water. This would assist in determining more precisely the most economical method of supply

12.4 The Natural Environment

The flora and fauna field survey investigations conducted during this overview study were conducted at a reconnaissance level to provide a base level of information on the likely areas of remnant vegetation and habitat. However:

- a detailed flora and fauna study will need to be carried out for at least each stage area of the proposed urban development and/or at the neighbourhood planning level.

It is recommended that these surveys are undertaken by professional consultants and that they are conducted during the summer months when a thorough identification is possible.

These field survey investigations could also evaluate mature exotic plantings on private land, as visual landscape elements in an area which is relatively exposed. They may also coincide with old properties and farm boundaries, possibly having some heritage value

12.5 Heritage Planning

In respect of heritage matters, future planning of the Mt Duneed/Armstrong Creek area would benefit from:

- a comprehensive study of Cultural Heritage (post-contact).
- a comprehensive Archaeological Survey of Aboriginal Heritage.

For advice on undertaking pre and post-contact conservation studies, and possible funding opportunities through the National Estate Grants Scheme of the Australian Heritage Commission. The Council should contact Heritage Victoria at the Department of Planning and Development

12.6 Social and Economic Issues

If planning is to proceed in the Mt Duneed/Armstrong Creek area in the next few years, planners will need to begin consideration of requirements in respect of the provision and delivery of human services and facilities, recreation and employment opportunities.

Specifically consideration should be given to

- whether the existing availability and capacity of human and community services in the Grovedale region can play a role in servicing the initial stage of development in the area,
- the human and community service requirements of new communities which are likely to establish in this area;
- the responsibilities of government and the private sector, in meeting the human and community service requirements of the new communities which are likely to establish in this area;
- the determination of developer contribution principles, based on guideline reports already prepared by the former Department of Planning and Housing,
- the active and passive recreation needs of the future residents need to be considered and ways in which these needs can be incorporated into an overall public open space network,
- generation of local employment opportunities and the role that these opportunities will play in the economic development of greater Geelong; and
- the need for shopping and service facilities as part of the development of new urban communities

12.7 Conclusions

The City of Greater Geelong will have an important role to play in the co-ordination and assessment of additional information in an effort to ensure that a comprehensive range of information is available to facilitate successful planning and development in the Mt Duneed/Armstrong Creek area. Importantly, many of the matters outlined above will enable planners, engineers and other in the planning and development process to balance pressure for urban develop with the preservation and enhancement of the natural and heritage values of the area.

APPENDIX 1
PLACES OF POTENTIAL CULTURAL SIGNIFICANCE

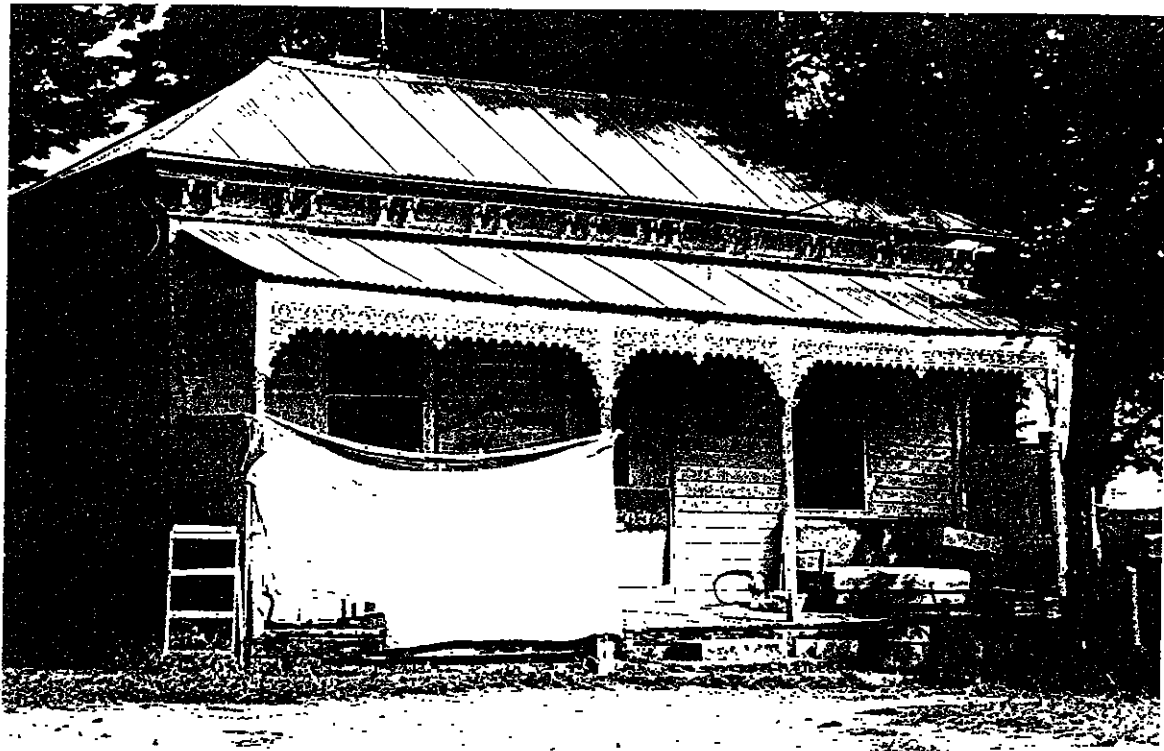
Mt Duneed/Armstrong Creek Urban Development Study



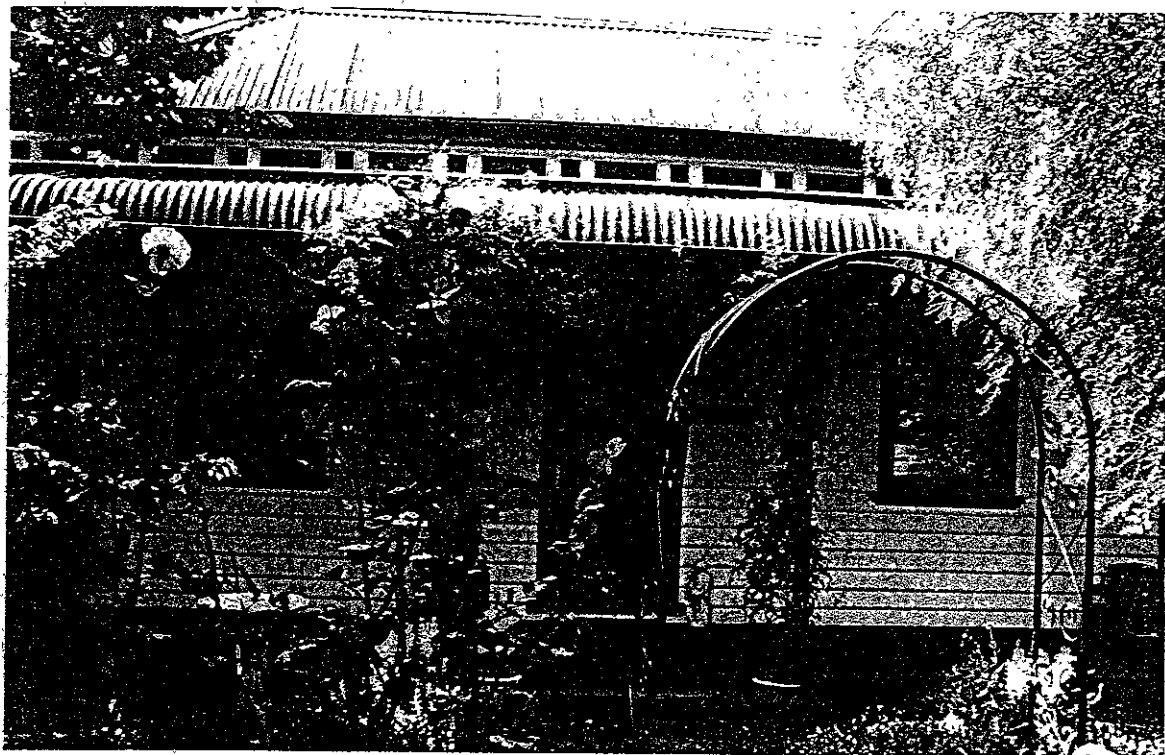
Residence (21)



Residence (24) 50 Whites Road



Residence (16)



Residence (15)



Residence (13)



Residence (17)



Residence (II)



Residence (II)



Residence (14)



Residence (18)



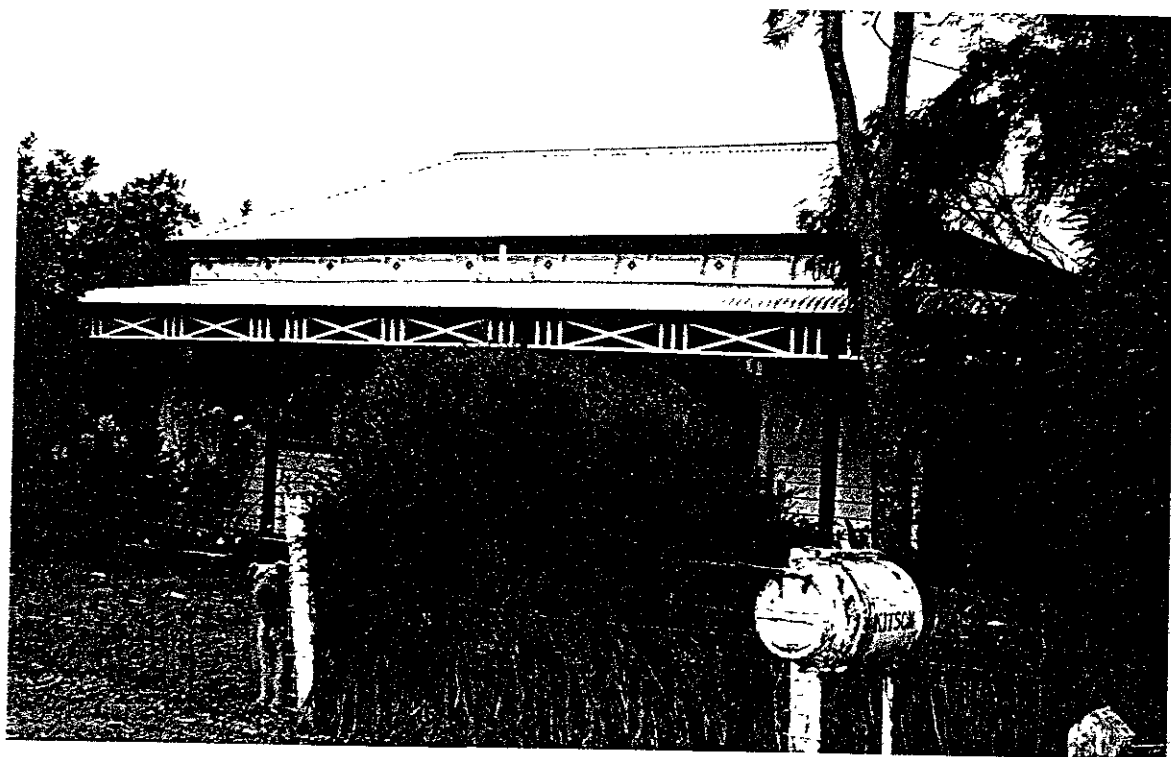
Residence (7)



Residence (10)



"Ashes Hills"



"Robantine"



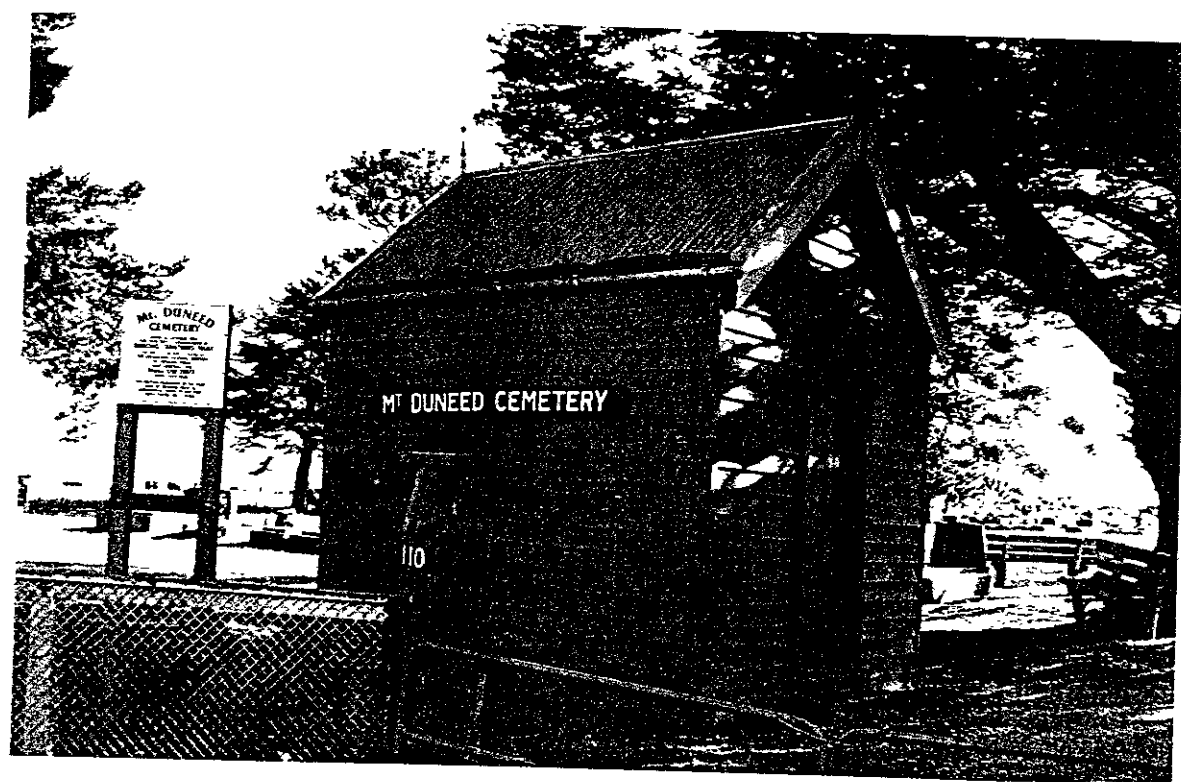
Mt. Duweed Cemetery



Mt. Duweed Cemetery



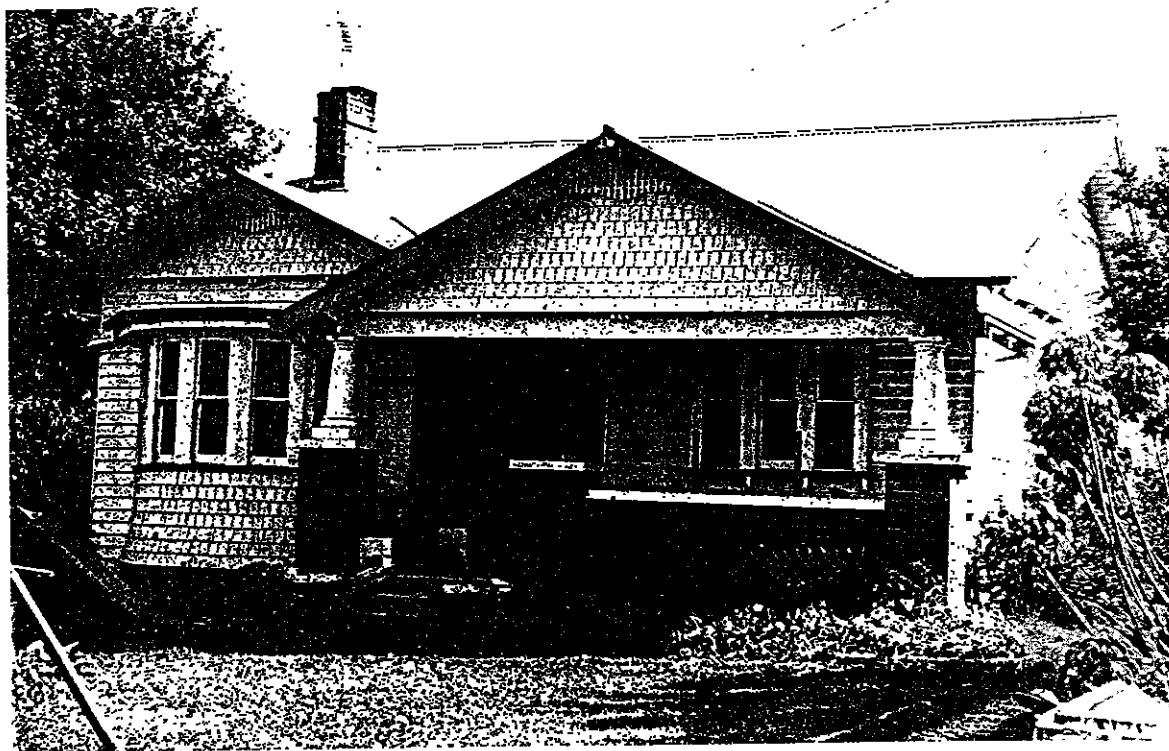
Former Residence (25)



Mt. Duneed Cemetery



Residence (31)



Residence (5)



Residence (9)



Outbuildings (9)



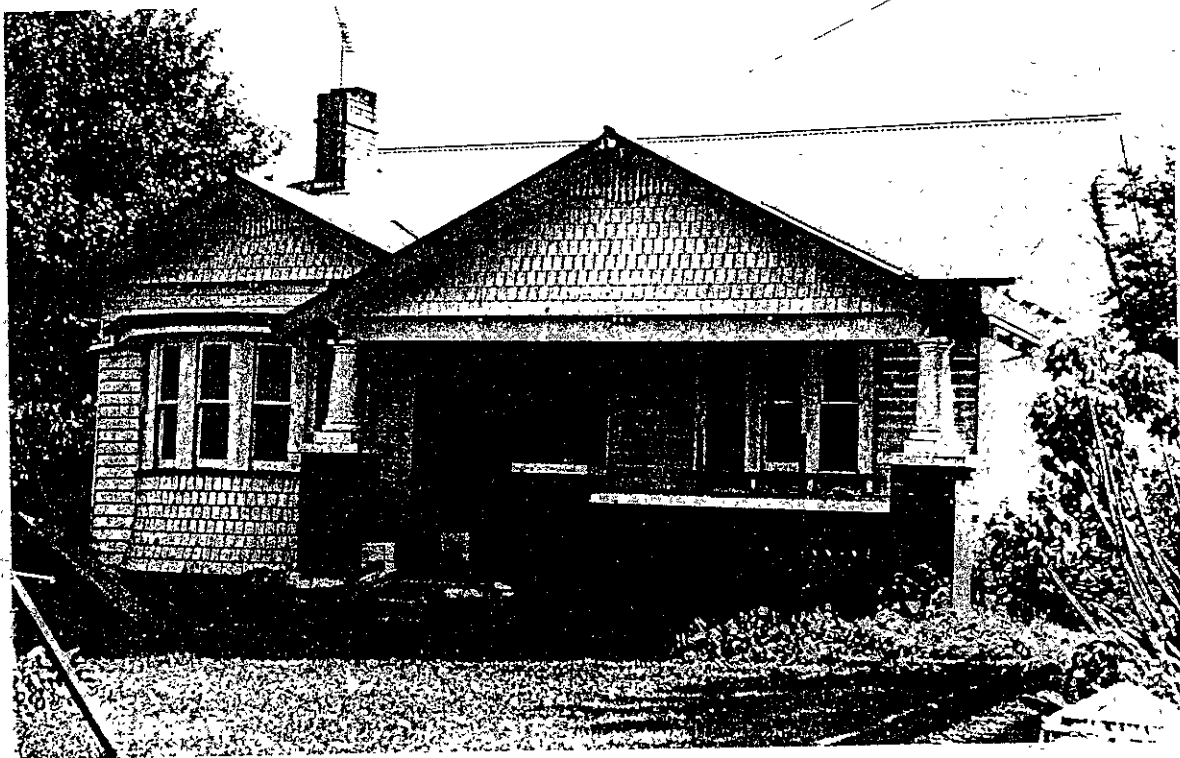
Residencia (31)



Residencia (5)



Residence (31)



Residence (5)



Residencia (31)



Residencia (5)

APPENDIX 2
HISTORICAL TRAFFIC VOLUMES

Mt Duneed/Armstrong Creek Urban Development Study

Appendix1: Historical Traffic Volumes

[illegible]

	west of Surf Coast Hwy	6	17-Mar-93	23-Mar-93	weekday 24 hr ADT	7,851	7,675	15,526			VicRoads
	east of Anglesea Rd	7	18-Jan-91	30-Jan-91	weekday 24 hr ADT	6,892	8,116	15,008			VicRoads
	west of Anglesea Rd	8	01-Jan-90	06-Jan-90	weekday 24 hr ADT	3,770	3,732	7,502			VicRoads
			18-Jan-91	30-Jan-91	weekday 24 hr ADT	3,664	4,111	7,775			VicRoads
Anglesea Rd											
	south of Princes Hwy	9	18-Jan-91	30-Jan-91	weekday 24 hr ADT	3,851	2,947	6,798			VicRoads
Surf Coast Hwy											
	north of Boundary Rd	10	Oct-88		24 hour ADT	8,464	3,685	12,149			Greater Geelong
	south of Boundary Rd	11	Dec-89		24 hour ADT	4,682	6,494	11,176			Greater Geelong
	north of Lower Duneed Rd	12	22-Dec-89	01-Jan-90	weekday 24 hr ADT	5,420	5,906	11,326			VicRoads
			11-Feb-91	01-Dec-91	weekday 24 hr ADT			8,026			VicRoads
			09-May-91	31-May-91	weekday 24 hr ADT			6,768			VicRoads
			02-Jun-91	29-Jun-91	weekday 24 hr ADT			6,685			VicRoads
			01-Jul-91	01-Aug-91	weekday 24 hr ADT			6,912			VicRoads
			01-Aug-91	31-Aug-91	weekday 24 hr ADT			6,724			VicRoads
			01-Sept-91	30-Sept-91	weekday 24 hr ADT			7,127			VicRoads
			01-Oct-91	01-Nov-91	weekday 24 hr ADT			7,845			VicRoads
			01-Dec-91	01-Jan-92	weekday 24 hr ADT			8,792			VicRoads
			02-Jan-92	01-Feb-92	weekday 24 hr ADT			10,321			VicRoads

			01-Feb-92	01-Mar-92	weekday 24 hr ADT			8,813			VicRoads
			01-Mar-92	28-Mar-92	weekday 24 hr ADT			7,600			VicRoads
			01-Mar-92	01-Apr-92	weekday 24 hr ADT			8,832			VicRoads
			01-Apr-92	01-May-92	weekday 24 hr ADT			8,618			VicRoads
			02-Jun-92	01-Jul-92	weekday 24 hr ADT			7,472			VicRoads
			01-Jul-92	31-Jul-92	weekday 24 hr ADT			7,416			VicRoads
			01-Aug-92	01-Sept-92	weekday 24 hr ADT			6,923			VicRoads
			01-Nov-92	01-Dec-92	weekday 24 hr ADT			8,128			VicRoads
			15-Aug-93	21-Aug-93	weekday 24 hr ADT	3,812	3,951	7,763			VicRoads
Ghazeepore Rd											
	100m north of railway line	13	07-Oct-92	08-Oct-92	24 hr ATD			877			Barrabool Shire
			08-Oct-92	09-Oct-92	24 hr ATD			801			Barrabool Shire
	300m north of Mt Duneed Rd	14	18-Jun-90	19-Jun-90	24 hr ATD			459			Barrabool Shire
			19-Jun-90	20-Jun-90	24 hr ATD			509			Barrabool Shire
			21-Jun-90	22-Jun-90	24 hr ATD			432			Barrabool Shire
			22-Jun-90	23-Jun-90	24 hr ATD			475			Barrabool Shire
			24-Jun-90	25-Jun-90	24 hr ATD			370			Barrabool Shire

	250m south of Mt Duneed Rd	15	08-Jun-90	12-Jun-90	24 hr ATD			235			Barrabool Shire
			12-Jun-90	13-Jun-90	24 hr ATD			204			Barrabool Shire
			13-Jun-90	14-Jun-90	24 hr ATD			147			Barrabool Shire
			14-Jun-90	18-Jun-90	24 hr ATD			190			Barrabool Shire
Mt Duneed Rd											
	200m west of Ghazeepore Rd	16	08-Jun-90	12-Jun-90	24 hr ATD			560			Barrabool Shire
			12-Jun-90	13-Jun-90	24 hr ATD			435			Barrabool Shire
			13-Jun-90	14-Jun-90	24 hr ATD			260			Barrabool Shire
			14-Jun-90	18-Jun-90	24 hr ATD			405			Barrabool Shire
	100m east of Ghazeepore Rd	17	18-Jun-90	19-Jun-90	24 hr ATD			507			Barrabool Shire
			19-Jun-90	20-Jun-90	24 hr ATD			541			Barrabool Shire
			20-Jun-90	21-Jun-90	24 hr ATD			484			Barrabool Shire
			21-Jun-90	22-Jun-90	24 hr ATD			571			Barrabool Shire
			22-Jun-90	25-Jun-90	24 hr ATD			546			Barrabool Shire

Lower Duneed Rd										
	east of Surf Coast Hwy	18	Jul-92		24 hour ADT	465	457	922		Greater Geelong
	bet Horseshoe Bend Rd & Charlemont Rd	19	Jan-94		24 hour ADT	768	780	1,548		Greater Geelong
Reserve Rd										
	west of Railway Line	20	Jun-93		24 hour ADT	685	688	1,373		Greater Geelong
	on Level Crossing	21	Oct-92		24 hour ADT	1,084	1,015	2,099		Greater Geelong
	east of Barwon Heads Rd	25	May-91		24 hour ADT	53	42	95		Greater Geelong
Boundary Rd										
	east of Surf Coast Hwy	22	Oct-92		24 hour ADT	341	341	682		Greater Geelong
	west of Barwon Heads Rd	26	Jun-93		24 hour ADT	269	264	533		Greater Geelong
Burville Rd										
	east of Surf Coast Hwy	23	Jun-93		24 hour ADT	41	36	77		Greater Geelong
Lake Rd										
	east of Barwon Heads Rd	27	Mar-88		24 hour ADT			167		Greater Geelong
Horseshoe Bend Rd										
	north of Reserve Rd	24	Oct-92		24 hour ADT	218	170	388		Greater Geelong

Batten Rd										
north of Boundary Rd	31	Apr-89		24 hour ADT	65	30	95			Greater Geelong