MAIN ROADS
Western Australia

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION

PUBLIC ENVIRONMENTAL REVIEW

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MAIN ROADS WESTERN AUSTRALIA

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JANUARY 1997

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INVITATION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal.

The Public Environmental Review (PER) proposes the establishment of an alignment for the Perth - Bunbury Highway: Peel Deviation section. In accordance with the Environmental Protection Act 1986 a PER has been prepared which describes this proposal and its likely effects on the environment.

The PER is available for public review for up to eight (8) weeks from 11 January closing on 8 March, 1997.

Comments from Government agencies and from the public will assist the EPA to prepare an assessment report in which it will make recommendations to the Government.

Why write a submission?

A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you can suggest ways to improve the proposal.

All submissions received by the EPA will be acknowledged. Submissions will be treated as public documents unless provided and received in confidence subject to the requirements of the Freedom of Information Act, and may be quoted in full or in part in each report.

Why not join a group?

If you prefer not to write your own comments, it may be worthwhile joining with a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the work for an individual or group as well as increasing the pool of ideas and information.

If you form a small group (up to 10 people) please indicate the names of all participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, the general issues included in the PER or the specific proposals. It helps if you give reasons for your conclusions, supported by relevant data. You may make an important contribution by suggesting ways to make the proposal environmentally more acceptable.

When making comments on specific proposals in the review document:

- clearly state your point of view;
- indicate the source of your information or argument if this is applicable;
- suggest recommendations, safeguards or alternatives.

Points to keep in mind

By keeping the following points in mind, you will make it easier for your submission to be analysed:

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the PER;

- if you discuss sections of the PER, keep them distinct and separate, so there is no confusion about which section you are considering;

- attach any factual information you wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- Your name,
- address,
- date, and
- whether you want your submission to be confidential

THE CLOSING DATE FOR SUBMISSIONS IS: **14 MARCH 1997**

Submissions should be addressed to:

The Chairman
Environmental Protection Authority
'Westralia Square'
141 St Georges Terrace
Perth W.A. 6000

Attention: **Mr Ron van Delft**

CONTENTS

SUMMARY

INTRODUCTION

The Peel Deviation proposed by Main Roads Western Australia (MRWA) incorporates an inter-regional road transport route bypassing Mandurah and is located on the eastern side of the Peel - Harvey Estuary. The proposal comprises the staged construction of a freeway/expressway standard road, *i.e.* a dual carriageway with grade separated interchanges and controlled access.

This Public Environmental Review (PER) aims to identify the environmental impacts which may arise from the proposal and to recommend methods of reducing their effect on the environment. The granting of approval to proceed from the Minister for the Environment would allow for the selected alignment to be incorporated into the proposed Peel Region Planning Scheme followed by amendments to the individual town planning schemes of the City of Mandurah, and the Shires of Murray and Waroona. The project area includes the section of the Old Coast Road from where the proposed new road intersects, southwards to Bagieau Road (Figure 1). The duplication of this section of Old Coast Road is likely to occur prior to the construction of the remainder of the route.

For the purposes of this PER, the Peel Deviation section of the Perth - Bunbury Highway is to extend from the future Kwinana Freeway extension north of Mandurah, crossing the Serpentine and Murray Rivers east of the Peel - Harvey Estuary, and joining the existing Perth - Bunbury Highway (Old Coast Road) near the southern end of Lake Clifton, and extending south to Bagieau Road. The length of the Deviation is approximately 60 km and occurs predominantly in the Shire of Murray and Waroona, with the northern and southern ends within the City of Mandurah and Shire of Harvey respectively.

Definition of the Peel Deviation corridor has occurred through assessment of a number of alternative alignments. A total of eight alignment components were considered in the Road Alignment Definition process, which concluded with a preferred alignment which is the subject of this PER.

PROJECT DESCRIPTION AND JUSTIFICATION

Project Description

The Peel Deviation section of the Perth - Bunbury Highway extends for approximately 60 km, and requires the definition and creation of the road reserve for the majority of its length. The median separated dual carriageway project will also involve staged implementation of intersections, alteration to existing road networks, construction of additional service roads, changes to public utilitities, and a road drainage system. The PER seeks approval for the reservation of the road corridor in the first instance, as construction has not been scheduled.

Project Justification

There are currently two major road routes between Perth and the South West of the State; the Perth - Bunbury Highway which provides the coastal route, and the South Western Highway which is located on the base of the Darling Scarp and provides the inland route. The Perth - Bunbury Highway is much more direct and is now firmly established as the primary route.

The ultimate aim is to link the Perth - Bunbury Highway to the Kwinana Freeway Extension north of Mandurah and provide a fast, free flowing facility between Perth and Busselton. This implies a freeway or expressway facility with interchanges at major intersections to avoid traffic signals or roundabouts which impede the flow of through traffic and reduce efficiency.

The requirement for the Peel Deviation essentially arose from the need to provide a total bypass of Mandurah away from the existing coastal route. With dual carriageway works extending up from Bunbury, and the Kwinana Freeway moving south toward Mandurah, there is an obvious bottleneck formed by development along the Mandurah Peninsula which can be overcome by a link to the east of the Peel Inlet.

A study carried out by Uloth and Associates in 1992 for the City of Mandurah made recommendations on the future road network which would be required as a consequence of development in accordance with Mandurah Town Planning Scheme No.3. The study only considered the traffic generated by the development of the Mandurah area and assumed that through traffic would travel via an alternative road east of Peel Inlet/Harvey Estuary. Through-traffic was not included in the traffic forecasts. The following conclusions from the study indicate the impact that the growth of Mandurah will have on the existing main road system.

- A new six lane freeway will be required north of Mandurah.
- The Mandurah Bypass will require six lanes north of Pinjarra Road.
- A six lane road will be required over the northern section of Old Coast Road. However, this may not be sufficient to carry the high traffic flows anticipated to use Old Coast Road between Casuarina Drive and Mandurah Bypass.
- Traffic lights will be required at between 8 and 18 intersections on Old Coast Road and at intersections on Mandurah Bypass leading to the Freeway.

EVALUATION OF ALTERNATIVES

Alternative Alignments

Definition of the Peel Deviation corridor has occurred through assessment of a number of alternative alignments. A total of eight alignment components were considered in the Road Alignment Definition process, which concluded with a preferred alignment. Additional modifications to the preferred alignment were considered following release of the RAD report and discussions with selected interest groups.

The results of the environmental and engineering review, and the public submissions were incorporated into the RAD report which provided a comparative assessment of environmental, social, economic and engineering issues for each section of the Peel section of the Perth - Bunbury Highway. The comparative assessment of options was based upon the predicted level of impact (high, medium, low) of the project on a range of biophysical, human / social, and engineering and economic factors.

No Development Option

The Perth Bunbury Highway Peel Deviation is intended to provide for freight and passenger traffic to and from the south-west region based on diversion of traffic to the east of the Peel - Harvey Inlet to bypass the main residential areas of Mandurah and the Dawesville Peninsula.

The future transport requirements (road, rail, sea and air) for the south-west region have been documented within the Southern Province Transport Strategy - Peel, Great Southern and South West Regions (Department of Transport, 1996). The Stategy is being developed to account for increases in movement of people and of freight. Transport requirements have been assessed according to projections of population growth, tourism activity, industrial activity and rail freight over the next 25 years.

The Peel Deviation is included within this strategy as a requirement to avoid congestion in Mandurah and the Dawesville Peninsula, and to mitigate the problem of heavy vehicle use on the South Western Highway. It is a component of an overall strategy to manage future transport requirements and as such the regional implications of not constructing this route would be significant.

EXISTING ENVIRONMENT

General

The main environmental issue for the Peel Region, is that of the pollution of the Peel Inlet - Harvey Estuary System (Peel - Harvey System) resulting in nuisance weed and algal growth in the system. The scale of the problem resulted in the introduction of environmental management controls in the entire region to control clearing, and to manage land use to minimise nutrients from the regional catchment entering the

Peel - Harvey System. Land use planning and drainage management strategies within the Peel Region are therefore crucial in management of the Peel-Harvey System.

The study area traverses three major physiographic sub-units: Spearwood Dunes, Bassendean Dunes and Pinjarra Plain. The Pinjarra Plain is typified by low relief and the Bassendean Dunes comprise low hills of siliceous sand covered with vegetation. The Spearwood Dunes provide relief in the region, reaching heights of 100 - 150 m.

As part of the Bassendean Dune System, parts of the study area features extremely leached and podzolised white quartz sands with B horizons of iron and organic matter accumulation. The Spearwood dune system is typified by undulating yellow/brown sands overlying limestone found at varying depths. The Spearwood sands have a high calcium carbonate content with good phosphorous retention capability. The Pinjarra Plain is subject to seasonal flooding and is interspersed with swamps and lakes. Low lying areas of the western section of the Pinjarra Plain have fine textured alluvium of mottled duplex soils and yellow-grey clays. Much of this area has been cleared for agriculture.

Hydrology and Hydrogeology
The Peel Deviation project area contains extensive systems of constructed drains, linking agricultural land with natural drainage channels and wetlands. The area is dissected by two major river systems. The Murray River system (including the Serpentine River) and the Harvey River System, both of which discharge into the Peel - Harvey Estuary.

Hydrogeologically, the Peel Region has four major aquifers, these consisting of Superficial Formations, and the Leederville, Cockleshell Gully, and Yarragadee Formations:

The northern and central sections of the study area contain extensive systems of constructed drains, linking agricultural land with natural drainage channels and wetlands. These drains are required due to the flat terrain and high water table causing the eastern Peel Region to be prone to flooding and waterlogging in winter. The southern end of the Peel Deviation is located over the comparatively well drained soils of the Spearwood Dune system.

Vegetation and Flora
The vegetation and flora of the Peel Deviation corridor project area were surveyed for vegetation type, life-form strata, percentage cover, surface soil type, drainage, litter cover, disturbance and the relative abundance of each species present. Thirteen vegetation associations were identified within the Peel Deviation project area. The vegetation associations are:

- Cleared land;
- *Eucalyptus rudis / Melaleuca rhaphiophylla* woodland;
- *Eucalyptus rudis / Melaleuca preissiana* woodland over low shrubs;
- *Casuarina obesa / Melaleuca cuticularis* over *Melaleuca viminea* ;
- *Banksia attenuata / Eucalyptus marginata* woodland;
- *Eucalyptus gomphocephala / Agonis flexuosa* woodland;
- *Eucalyptus calophylla* over *Xanthorrhoea preissii* over mixed heath;
- *Melaleuca pauciflora* heath;
- *Kunzea ericifolia / Jacksonia furcellata* heath;
- *Melaleuca rhaphiophylla / Melaleuca teretifolia* heath;
- Myrtaceous Heath;
- Samphire; and
- Pine plantations.

No Declared Rare Flora were recorded during the field survey, however one Priority 2 flora species, *Lasiopetalum membranaceum,* was identified at the most southern end of the alignment, immediately west of the Old Coast Road, within the *Eucalyptus gomphocephala / Agonis flexuosa* woodland vegetation type.

Fauna
Two species listed on the Wildlife Conservation (Specially Protected Fauna) Notice 1996 as Schedule 1 fauna were recorded during the survey carried out for the Peel Deviation project, these are the Southern Brown Bandicoot and the White Tailed Black Cockatoo. Two individual Southern Brown Bandicoot were recorded within swamp habitats of the Nambeelup Brook system. A White-tailed Black Cockatoo (either Baudins Black Cockatoo *Calyptorhynchus baudinii* or Carnaby's Black Cockatoo *Calyptorhynchus latirostris)* was observed over farmland in the Peel Region. Due to the similarity of both species of White-tailed Black Cockatoos, the individual observed during the survey was unable to be identified to specific level.

No other Schedule fauna species were recorded during the Peel Deviation project biological survey.

Wetlands
The Peel Deviation corridor has been mapped as a flat wetland; predominantly consisting of river floodplains and palusplain. The Peel Deviation study area palusplain is a result of the clay soils impeding infiltration of rainwater. The palusplain would be likely to be classified as a Sustainable Use - Multiple Use wetland. The management objective of these wetlands is that use, development and management should be considered in the context of water (catchment/strategic drainage planning), town (land use) and environmental planning through landcare.

There is in excess of 150 Environmental Protection (Swan Coastal Plain Lakes) Policy (EPP) listed wetlands in a 10 km wide belt surrounding the proposed alignment of the Peel Deviation. None are directly affected by the proposed alignment.

Additional recognition of the environmental value of wetland areas can occur through listing under the Ramsar Convention, which is a convention on wetlands of international importance. The Peel - Yalgorup system has been classified as a Ramsar wetland, and is therefore of international significance. The wetland area of the Peel - Yalgorup system extends to high water mark; the Ramsar area includes the Peel Inlet, Harvey Estuary, the Yalgorup Lakes, Lake McLarty and Lake Mealup.

System 6 Areas And Conservation Reserves
Many of the wetlands and areas of remnant vegetation are affected by System 6 Red Book recommendations The System 6 areas in the vicinity of the proposed Peel Deviation include the Goegrup Lakes (M108), the Peel Inlet (C50), the Harvey Estuary (C51), Lakes McLarty and Mealup (C52), Yalgorup National Park (C54), Clifton Management Priority Area (C55), and McLarty Management Priority Area (C56).

In addition to the areas nominated as System 6 Reserves, the Kooljerrenup Nature Reserve (A↑22756) occurs to the west of the Peel Deviation corridor. Areas of State Forest at the southern end of the alignment, east of Old Coast Road, have been identified as being suitable for inclusion into Yalgorup National Park (CALM, 1995).

Land Use
Land use planning for the area has been undertaken through the Peel Regional Strategy and most recently the Inner Peel Region Structure Plan. The Inner Peel Region Structure Plan indicates that at its northern extent, the Peel Deviation alignment traverses the Future Urban areas of Murray Lakes, and Open Space for Conservation (proposals for inclusion into the Peel Regional Park). The remainder of the alignment traverses land to be zoned as Rural - Broadacre.

Aboriginal Heritage Sites
An archival search was conducted to establish the location and description of previously recorded Aboriginal sites within the vicinity of the survey corridor. The majority of the registered Aboriginal sites of the Peel Region are located around the Harvey Estuary.

Studies into the location of Aboriginal heritage sites by archaeological survey and ethnographic survey were commissioned for the Peel Deviation project. No newly recorded archaeological sites were located during the field survey of the proposed alignment. Consultation with Aboriginal elders highlighted six sites with ethnographic significance within the Peel Deviation project area.

European Heritage Sites
There are two sites and a bridle trail which may be considered of European heritage value. The Heritage Council of Western Australia is aware of Fouracres Cottage (a.k.a. Peppermint Grove Cottage) and has the structure listed as "ruins". The preferred alignment of the Peel Deviation does not impact this site. The second site is Whittakers Mill, which is currently a recreation site on the eastern side of Old Coast Road immediately north of the intersection with Bagieau Road where the study area ends. The proposal will not impact this site.

A bridle trail of heritage value which was utilised historically by the Australian 10th Light Horse Brigade during training exercises occurs within the study area. The trail runs parallel to the Old Coast Road south from the south-western corner of the Harvey Estuary along Southern Estuary, Doman, Centre Break and Runnymeade Roads ending at Wellesley Road. The 60 km trail is currently in use by members of the Yalgorup Recreational Horse Riders Association, and Peel Horseback Adventures; an ecotourism venture.

Visual Amenity
Because of its predominantly rural character, the low-lying nature of the topography, and the relatively small area of impact, the majority of the area traversed by the proposed Peel Deviation route can be regarded as having low to medium landscape value. Areas of high landscape value occur where the alignment crosses or runs adjacent to water bodies or significant stands of native vegetation. The proposed additions to Yalgorup National Park is considered to have high scenic quality according to the management plan for that area.

PUBLIC CONSULTATION

To date, the Public Consultation programme for the Peel Deviation project has occurred in two phases. The first phase was initiated at the commencement of the road alignment definition study and was to assist in the definition of a preferred alignment from the range of options considered. The objective of the second phase was to elicit reaction from the community on the preferred alignment and obtain community input for the preparation of the PER.

The First phase of the consultation programme prompted some 15 verbal and 64 written responses from the newsletter and public information displays. During the Second phase of the programme, the mailout to affected landholders resulted in 18 telephone enquiries. A total of 15 of these enquiries were followed by an on-site meeting with landowners. The public information displays were attended by approximately 36 people. Additionally, a total of 26 written submissions were received (one of which was accompanied by a 35 signature petition). Of these submissions, 20 sought a written response, which was subsequently provided.

ANTICIPATED ENVIRONMENTAL IMPACTS

During the early feasibility stages of the project, and utilising the PER guidelines issued by the EPA, the key topics identified are:

(1) Biophysical
- Terrestrial vegetation (significant vegetation, Declared rare flora, introduced flora, vegetation diseases);
- Terrestrial fauna (Declared rare fauna, significant fauna and habitat);
- Surface and ground water (surface water hydrology, water conservation);
- Wetlands (regionally significant wetlands); and

(2) Pollution Management
- Water quality (surface and ground water quality);
- Air quality (dust); and
- Noise and vibration.

(3) Social Surroundings
- Visual Impacts;
- Risk and Hazard (in reference to transport accidents); and
- Heritage (indigenous and non-indigenous cultures).

ENVIRONMENTAL MANAGEMENT STRATEGY

The aim of the Environmental Management Strategy is to demonstrate that the environmental impacts of the proposal are of an acceptable level and nature according to the assessment process under the Environmental Protection Act 1986.

Construction of the Peel Deviation is not anticipated for some 10 - 20 years, and it is possible that within this time, changes will occur in Government policy relating to aspects of this proposal. It is also likely that alterations to management techniques will occur in the interim. Management techniques in this section are therefore to document the practices currently utilised for projects of this nature, and that the project as described within this PER is environmentally acceptable at the time of approval.

There is considerable precedent to demonstrate that the environmental impacts of road projects can be managed. In order to account for changes in policy and practice over time, and for specific site conditions, a detailed Environmental Management Programme (EMP) will be prepared prior to commencement of construction activities.

The EMP will cover management of the following environmental factors:

Biophysical Factors

- Terrestrial Vegetation. Includes management of clearing, management of regionally and locally significant vegetation (Declared Rare and Priority flora), non-endemic (introduced) vegetation (weed management), and dieback disease.
- Terrestrial Fauna: provision of fauna movement corridors between areas of habitat.
- Surface and Ground Water: maintenance of existing hydrological characteristics through appropriate road design
- Rehabilitation: strategy for rehabilitation following road construction.

Management Of Potential Pollution Impacts

- Water Quality: preventionof pollution of surface and ground water by design of road drainage system.
- Air Quality: management of construction activities to prevent creation of dust nuisance.
- Noise: use of noise amelioration techniques where noise level criteria are exceeded.

Social Surroundings

- Visual Impacts: development of a rehabilitation programme to minimise visual impact from construction.
- Risk and Hazard: road design measures to reduce accident risk.
- Heritage: management measures to minimise impact on heritage sites.

PROPONENT COMMITMENTS

Development Of An Environmental Management Programme
The Perth - Bunbury Highway Peel Deviation is not currently scheduled for construction. It is anticipated that the construction phase of the main component of the project will not occur for another 15 years. However, discrete sections, such as the construction of the second carriageway on the Old Coast Road north of Bagieau Road will occur prior to this time. Consequently, it is proposed that site specific environmental management initiatives be developed in an EMP for separate stages to be prepared in the pre-construction phase of the project. The EMPs will then reflect statutory requirements and Best Practice Management techniques prevalent at the respective times of construction.

Main Roads therefore commits to the preparation of staged EMPs when the sections of the Peel Deviation project are scheduled for construction. Specific commitments have been made in relation to:

- dieback; identification and management;
- vegetation clearing;
- topsoil stockpiling;
- rehabilitation strategy;
- landscape design guidelines;
- stormwater drainage design;
- construction impact management;
- completion criteria for rehabilitation works;
- weed control.

In addition to management techniques, the EMP is to contain identification of monitoring requirements and methodology for satisfying monitoring objectives.

Auditing of the Environmental Management Programme
In order to ensure that the management commitments made within the PER, and that any additional conditions resulting from the assessment process are implemented, the EMP to be prepared for the project is to be subject to an auditing procedure by the Environmental Strategies Branch of Main Roads.

Audit of the PER
Main Roads will undertake auditing of the Conditions and Commitments Schedule of the Minister for the Environment on the PER assessment. Reporting will occur at the completion of each major phase of the project, or an annual basis where any one phase extends over more than 12 months. The report will be in the format of a typical Progress and Compliance Report and will be submitted to the Audit Branch of the DEP for assessment.

CONCLUSION

In conclusion, the planning and consultation for the Peel Deviation project has been extensive. No significant impact on flora, fauna, wetlands or assessed social factors have been identified. The impacts are typical of those resulting from a road project of this nature, for which environmental management practice is well established. With implementation of the project as documented within this PER, there should be no long-term negative impact on the project area.

A summary of key issues and management strategies for the project is provided in the following table.

Summary of key topics

Category	Topics of Concern	Present Status	Proposed Action	Proposed Management	Predicted Outcome
Biophysical	Terrestrial Vegetation • Conservation Reserves • Regionally and locally significant vegetation	The alignment passes through remnant vegetation at river crossings, and vegetation within State Forest and System 6 areas (McLarty and Clifton MPAs). One Priority 2 flora species was located in close proximity to the proposed alignment.	Clearing of vegetation within area required for road construction and earthworks for batter slopes.	Reviewing flora species list prior to construction, for changes in Rare flora listings, with management strategy according to the results. Designation of limit of works for clearance according to limit of site disturbance required for earthworks.	•Avoidance of significant impact on DRF species. •Successful rehabilitation of the road reserve within 5 years. •Vegetation clearance limited to that in the direct impact area of road and earthworks.
	Terrestrial Vegetion •Vegetation Clearing	Vegetation clearing has occurred historically for development of semi-rural and residential land.	Clearing of vegetation within area required for road construction and earthworks for batter slopes.	Designation of limit of works for clearance according to limit of site disturbance required for earthworks.	Vegetation clearance limited to that vegetation occurring within direct impact area of road and earthworks.
	Terrestrial Vegetation • Weeds	Weeds are common within the sections of the alignment that pass through cleared land, but are limited in areas of remnant vegetation and State Forest.	Weed control strategy to prevent the introduction or spread of weeds through areas of remnant vegetation.	Weed management techniques to be included within a Landscape and Rehabilitation plan for the project. Weed control to be included as a component of rehabilitation, and then as ongoing maintenance item.	Prevention of spread of weeds either into, from or throughout the remnant vegetation of the study area.
	Terrestrial Vegetation •Dieback	Study area classified as Not Effectively Quarantined in reference to presence of dieback.	Dieback analysis in study area to confirm any presence and location of dieback within the works area.	Dieback management strategy to be developed according to results of dieback survey. Based upon exclusion from the site and containment within the site, and in accordance with CALM policy and procedures.	Prevention of spread of dieback either into, from or throughout the study area.

Summary of key topics

Category	Topics of Concern	Present Status	Proposed Action	Proposed Management	Predicted Outcome
	Terrestrial Fauna	Areas of remnant vegetation and State Forest form a habitat of native fauna. Swamp areas known to contain the Schedule 1 Southern Brown Bandicoot.	Disruption to habitat due to clearing of vegetation and road construction.	Use of methods such as fencing and underpasses to provide movement corridors and to minimise road deaths.	Movement corridors in areas of remnant vegetation maintained and level of road deaths minimised.
	Surface and Ground Water	The project area contains two major river systems, an extensive system of drains, and a perched water table over winter months.	The Peel Deviation crosses the Murray, Serptentine and Harvey Rivers, and is located on the seasonally inundated Pinjarra Plain.	Appropriate design of bridges and culverts.	Maintenance of existing hydrological characteristics in the project area.
	Wetlands	The project area is essentially all wetland, consisting of a seasonally waterlogged palusplain. No EPP wetlands are directly impacted.	Due to location on palusplain it will be necessary to construct the road on fill, creating a raised platform.	Management of water quality to be addressed through stormwater drainage system.	No direct impact and minimal indirect impact of the project on the region's wetlands.
	Rehabilitation	The road alignment passes through residential and rural areas, and remnant vegetation at river crossings and State Forest/System 6 areas.	Rehabilitation to be implemented following road construction.	Development and implementation of a Landscape and Rehabilitation Plan, using procedures within the Main Roads Environmental Management Manual and draft Roadside Flora Care Manual.	A rehabilitated and stable road reserve, revegetated and landscaped in keeping with the existing character of the region.

Pollution	Water Quality •Contaminants from Stormwater	The Peel-Harvey catchment is subject to policies with specified requirements for management of drainage water, in order to improve water quality in the Peel-Harvey system.	The road drainage system will be designed to incorporate retention / retardation basins for nutrient and contaminant contol. Best practice at the time of construction will be used for the project.	• Water quality protected during construction to prevent erosion during rainfall events in the construction phase.	Prevention of road contaminants directly entering the wetlands, drains and rivers crossed by or adjacent to the Peel Deviation, thereby maintaining existing water quality parameters.
Category	**Topics of Concern**	**Present Status**	**Proposed Action**	**Proposed Management**	**Predicted Outcome**
	Dust Control	Not an issue under normal conditions.	Clearing and roadworks having potential to generate dust.	•Spraying with potable water while construction activities are occurring. •Use of paper mulch if dust nuisance occurs causing complaints from residents.	Limited amount of dust generation during earthworks. No nuisance caused to residents, and no detrimental impact on vegetation.
	Noise	Current background environmental noise levels are low in the Peel Deviation area as rural land use predominates.	Noise monitoring and noise level predication prior to construction to determine whether any residences will be subject to noise increases above MRWA criteria.	Noise bunding of the highway or other techniques (eg noise walls) will be used in front of affected properties.	Increases in noise levels will be mitigated by use of barriers.

Social Surroundings	Visual Amenity	The majority of the area traversed by the Peel Deviation has low-moderate scenic quality. Areas of remnant vegetation (river crossings and State Forest) have moderate-high scenic quality.	Road construction requiring clearing and alteration of levels will alter the visual character of the Peel Deviation alignment.	Landscaping and rehabilitation plan to be developed and implemented based on best practice at the time of rehabilitation.	Road corridor to be revegetated. Areas of remnant vegetation to reflect current aesthetic qualities. Rural sections of the alignment likely to have improved amenity by revegetation programme.
	Risk and Hazard	Due to the absence of a major road in the project area, risk and hazard is not currently an issue.	Design and construction of the Peel Deviation according to Austroads Standards.	Accident risk minimised by design standards required for the road. Protection of water quality and quantity to be addressed by the stormwater system for the project.	Acceptable level of social and environmental risk to be attained by the road design for the project.
Category	**Topics of Concern**	**Present Status**	**Proposed Action**	**Proposed Management**	**Predicted Outcome**
	Heritage • Aboriginal	Six Aboriginal Ethnographic sites have been identified in close proximity to the Peel Deviation alignment. No archaeological sites have been identified as being impacted by the project.	The preferred alignment possibly impacts on two identified ethnographic sites.	Final road design to minimise extent of impact on identified sites. Applications to disturb these sites to be made in accordance with the Aboriginal Heritage Act 1972.	Management of Aboriginal Heritage issues to be to the satisfaction of the Aboriginal Affairs Department.
	Heritage •European	Three European Heritage sites have been identified within the Pee Deviation project area; Fouracres Cottage, Whittakers Mill and the 10th Light Horse Memorial Trail.	The 10th Light Horse Memorial Trail will be severed by the Peel Deviation.	Provision of underpasses on the Peel Deviation as close as possible to the point of severance.	Continuity of the bridle trail will be maintained.

1.0 INTRODUCTION

1.1 BACKGROUND AND OBJECTIVE

The South-West Region of Western Australia encompasses fifteen Local Government Councils which extend from the City of Mandurah and Shire of Murray (which adjoin the southern boundary of the Perth metropolitan area) to the Shire of Manjimup. The region centres on the City of Bunbury, Western Australia's second largest urban area. The Region contributes significantly to the State's economic and social development and is growing strongly. At present the Region accommodates about a third of the State's non-metropolitan population and contributes significantly towards its mineral and primary production and power generation. The South-West Region is also an increasingly popular tourism and recreation destination.

An effective inter-regional road link between Perth and Bunbury is essential to the continued development of the South-West Region. Since the early 1980s, successive State Governments have been committed to this objective through a multi-million dollar programme to upgrade the Perth - Bunbury Highway to a dual carriageway standard. The ultimate highway is intended to be a safe and efficient route that will provide a fast, free-flowing link between Perth and the South-West.

The existing Highway, through and immediately south of Mandurah, is constrained by topography, urban development and sensitive environmental conditions such as the Yalgorup National Park. To overcome these difficulties, the concept of an inter-regional route bypassing Mandurah and located on the eastern side of the Peel - Harvey Estuary has been shown in regional and local plans and strategies since the 1980s. This route has become known as the Peel Deviation.

The Peel Deviation proposed by Main Roads Western Australia (MRWA) incorporates an inter-regional road transport route bypassing Mandurah and is located on the eastern side of the Peel - Harvey Estuary. The proposal comprises the staged construction of a freeway/expressway standard road, *i.e.* a dual carriageway with grade separated interchanges and controlled access. The project area includes the section of the Old Coast Road from where the proposed new road intersects, southwards to Bagieau Road. The duplication of this section of Old Coast Road is likely to occur prior to the construction of the remainder of the route.

This Public Environmental Review (PER) aims to identify the environmental impacts which may arise from the proposal and to recommend methods of reducing their effect on the environment. The granting of approval to proceed from the Minister for the Environment will allow for the selected alignment to be incorporated into the proposed Peel Region Planning Scheme followed by amendments to the individual town planning schemes of the City of Mandurah, and the Shires of Murray and Waroona.

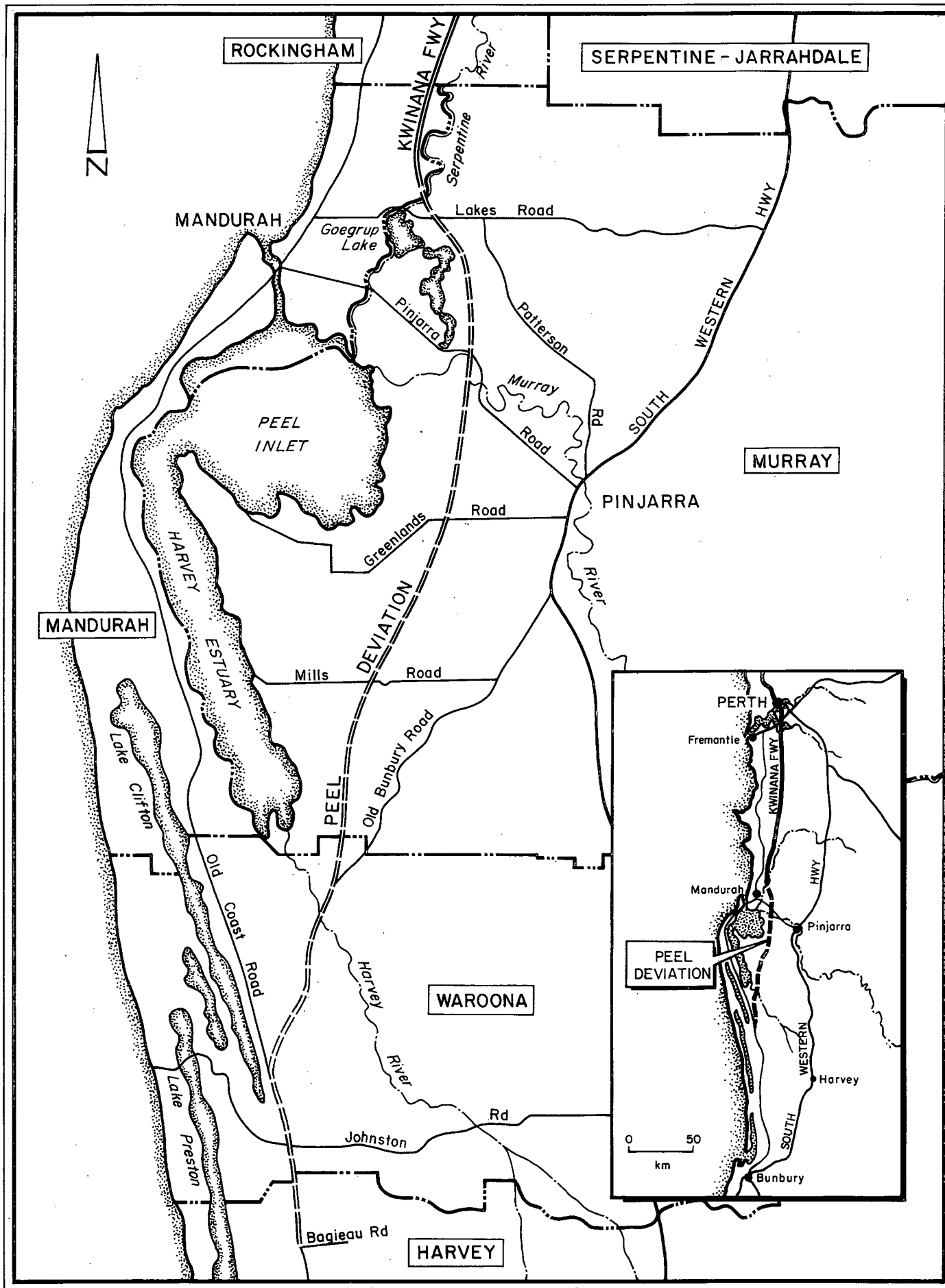
As proposal approvals from the Minister for the Environment designate timeframes over which a project is to be implemented, this PER will also seek an extended approval consistent with the long-term project schedule.

The PER has been prepared in accordance with the guidelines issued by the Environmental Protection Authority (EPA) for the project. The guidelines are included in Appendix A.

1.2 PROJECT LOCATION

For the purposes of this PER, the Peel Deviation section of the Perth - Bunbury Highway is to extend from the future Kwinana Freeway extension north of Mandurah, crossing the Serpentine and Murray Rivers east of the Peel - Harvey Estuary, and joining the existing Perth - Bunbury Highway (Old Coast Road) near the southern end of Lake Clifton, and extending south to Bagieau Road. The length of the Deviation is approximately 60 km and occurs predominantly in the Shire of Murray and Waroona, with the northern and southern ends within the City of Mandurah and Shire of Harvey respectively.

The location of the proposed alignment in respect to municipal boundaries is illustrated in Figure 1.



PERTH – BUNBURY HIGHWAY
Peel Deviation – Location Map

Figure 1

1.3 THE PROPONENT

The proponent for the Perth - Bunbury Highway Peel Deviation is:

Main Roads Western Australia
South West Region
Robertson Drive
Bunbury WA 6230

1.4 APPROVALS PROCESS

The EPA is required to assess all development proposals which may have a significant environmental effect. In this instance, the EPA has decided to formally assess the proposal pursuant to the provisions of Part IV of the Environmental Protection Act 1986.

The EPA's formal environmental impact assessment process allows members of the public to obtain details of the proposal being assessed and to comment on any matters of interest or concern to them. It also enables relevant Government authorities to consider the environmental and social implications of the proposal and provide comments as appropriate to the EPA. In assessing the proposal, the EPA considers all comments received.

In setting the level of formal environmental impact assessment for the proposed Perth - Bunbury Highway: Peel Deviation at PER level, the EPA has required that the document be released for an eight (8) week public review period during which time any interested individual, community group or organisation, or Government agency can peruse the document and lodge a submission on the proposal with the EPA. This PER is a public document and is part of the statutory public environmental impact assessment process established by the Environmental Protection Act 1986.

Following completion of the public review period and receipt of public submissions, the EPA will complete its assessment of the proposal and submit its report to the Minister for the Environment. The EPA's report to the Minister provides advice to the State Government about the environmental acceptability of the proposal.

The Minister will release the EPA's Assessment Report for a two (2) week period during which the public can scrutinise the conclusions and, if considered warranted, appeal to the Minister against the recommendations made about the proposal. The Minister for the Environment will assess any appeals received and ultimately determine whether or not the proposal can proceed. If the Minister determines that the proposal can proceed, legally binding conditions dictating the environmental requirements with which the proponents have to comply will be set pursuant to Section 45 of the Environmental Protection Act 1986.

Thus, in order for the proposed Perth - Bunbury Highway: Peel Deviation project to proceed, the following requirements need to be completed:

- release of this PER for an eight (8) week public review period;
- DEP prepare a summary of submissions received from Government Agencies and members of the public;
- proponents provide the EPA with written responses to all issues raised in submissions received during the public review period. Where appropriate, the proponent may amend the proposal and/or change the management commitments in response to comments raised during the public review period, provided such changes reduce environmental impacts;
- the DEP submits an evaluation of project impacts to the EPA, and any additional requirements to ensure that the proposal would satisfy environmental policies and objectives;

- the EPA provides its advice to Government on the proposal through its Assessment Report made to the Minister for the Environment. The Report and Recommendations are released to the public, and includes a 14 day appeal period;

- the Minister determines any appeals against the EPA's Report and if the proposal is regarded as environmentally acceptable, sets legally binding conditions on the proponent; and

- the project is commenced according to the Ministerial Conditions and Proponent Commitments set out in the Statement that a Proposal may be Implemented (Pursuant to the Provisions of the Environmental Protection Act 1986).

1.5 LEGAL FRAMEWORK

In addition to satisfying the provisions of the Environmental Protection Act 1986, requirements under the following legislation relevant to the proposal have been or will be considered:

Aboriginal Heritage Act 1972

Conservation and Land Management Act 1984

Heritage of Western Australia Act 1990

Land Act 1933

Local Government Act 1960

Main Roads Act 1930

National Trust of Australia Act 1964

Property Law Act 1969

Land Acquisition and Public Works Act 1902

Western Australian Planning Commission Act 1985

Town Planning & Development Act 1928

Wildlife Conservation Act 1950

1.6 MAIN ROADS ENVIRONMENTAL MANAGEMENT PRACTICE

Main Roads in co-operation with Local Government Authorities develops and manages the State's road network. This role includes responsibility for road planning, road construction, maintenance, and management of road reserves associated with State roads.

Main Roads has developed policies and procedures for environmental assessment and management of its activities. This includes an Environmental Management Manual (MRWA, 1996a) which documents:

(i) an Environmental Management Strategy which covers:

- an Environmental Code of Practice;
- Procedures for Environmental Assessment and Management; and
- Environmental Education and Training.

(ii) guidelines for the consideration of significant environmental issues in roadworks, which covers a range of issues including:

- Aboriginal sites;
- Aesthetics;
- Biological surveys;
- Clearing of vegetation;
- Cultural heritage places;
- Dieback;
- Drainage and hydrology;
- Noise;
- Rare flora and fauna;
- Rehabilitation; and
- Social effects.

1.7 SCOPE, PURPOSE AND STRUCTURE OF THE PER

The objective of the PER is to provide the EPA with information about the proposal as a basis for its assessment of the project, and to inform interested parties about the project so that they are in a position to contribute to the environmental impact assessment process if they so wish.

This PER is the second document produced as part of the process of evaluating the environmental acceptability of the Peel Deviation proposal. The first of these documents the Road Alignment Definition (RAD) Report (*ecologia* Environmental Consultants & GB Hill Consulting Engineers, 1996) documented a review of route options based upon a comparative assessment of the environmental, social, engineering and economic factors for a number of alignment options. The RAD report was circulated to State and Local Government agencies and various interest groups in March 1996.

This PER is based on the material presented in the RAD, and from other specialist studies undertaken for the project, including an extensive community consultation programme.

The structure of the PER is as follows:

Chapter 1 provides a background to the project and the environmental assessment process to gain project approval.

Chapter 2 of the PER describes the scope of the project, and the justification for the proposal to proceed, while Chapter 3 describes the existing biological and human environment within the project area. Chapter 4 summarises the public consultation programme undertaken for the Peel Deviation project.

Chapter 5 canvasses potential environmental impacts associated with the proposed route. Chapter 6 details the environmental management plan developed to mitigate these impacts and commitments made by the proponent to ensure the effectiveness of impact amelioration techniques.

2.0 PROJECT DESCRIPTION AND JUSTIFICATION

2.1 PROJECT DESCRIPTION

Some years ago the long-term requirement for an alternative route through Mandurah to serve the needs of through traffic was investigated by Main Roads. North of Mandurah this alternative can readily be provided by an extension of Kwinana Freeway linking it to the Mandurah Bypass. South of Mandurah the option of a parallel road is not possible due to the location of the existing road within a narrow peninsula between the Indian Ocean and the Peel Inlet - Harvey Estuary System.

A concept for a new route east of the Peel Inlet was developed by Main Roads in the early 1980s. Initially the section between the Kwinana Freeway Extension and the Mandurah - Pinjarra Road at Ravenswood was developed in some detail because of development pressure particularly around the Serpentine River and just south of the Murray River. This section was included in the Murray Shire Town Planning Scheme.

South of Ravenswood, a preliminary route was developed but this was seen as very long term and no action was taken to confirm the route with Local Authorities and the general public. However, the route has been depicted on the Land Use Plan of the Peel Regional Plan, prepared by the Department of Planning and Urban Development (DPUD) and released in September 1994.

Proposals for the residential development of land south of the Harvey Estuary in the path of the original route increased the requirement to better define the whole route of the Peel Deviation and its interconnection with the local road network. More detailed planning is therefore required to ensure that future road requirements are integrated into the land use planning and development of the area along the proposed route.

2.2 JUSTIFICATION FOR PEEL DEVIATION

2.2.1 Project History

There are currently two major road routes between Perth and the South West of the State; the Perth - Bunbury Highway which provides the coastal route, and the South Western Highway which is located on the base of the Darling Scarp and provides the inland route. The Perth - Bunbury Highway is much more direct and is now firmly established as the primary route. The planning and development of the main road system servicing the South-West is proceeding on this basis and is now well advanced, as indicated in the Main Roads brochure "Perth to Busselton Coastal Corridor" (MRWA, 1996).

The ultimate aim is to link the Perth - Bunbury Highway to the Kwinana Freeway Extension north of Mandurah and provide a fast, free flowing facility between Perth and Busselton. This implies a freeway or expressway facility with interchanges at major intersections to avoid traffic signals or roundabouts which impede the flow of through traffic and reduce efficiency.

Planning and development of this route in accordance with this ultimate objective includes the following:

- The Australind Bypass, which provides a high standard road around the residential areas of Australind and Eaton. The Bypass has been planned as a future freeway and is currently being upgraded to a dual carriageway.

- Duplication of sections of Old Coast Road north of Bunbury which has been accelerated with the injection of additional funds from the recently introduced State Additional Road Funding Program. It is anticipated that the section between Bunbury and the southern end of the Peel Deviation will be completed by 2000. This represents about two thirds of the distance between Mandurah and Bunbury.

- Definition of the route for the Bunbury Outer Ring Road is nearing completion. This road is being planned as an expressway which when combined with the Australind Bypass, will provide a complete high speed bypass of the greater Bunbury area for through traffic.

- Duplication of the Bussell Highway between Bunbury and Capel is complete.

- A deviation has been constructed around the Ludlow Tuart forest with land set aside for a future second carriageway.

- Detailed design for the second carriageway of the Bussell Highway between the Ludlow Deviation and Busselton is currently underway.

2.2.2 Need for The Proposal

The requirement for the Peel Deviation essentially arose from the need to provide for a total bypass of Mandurah away from the existing coastal route. With the dual carriageway works extending up from Bunbury, and the Kwinana Freeway moving south toward Mandurah, there is an obvious bottleneck formed by development along the Mandurah Peninsula which can be overcome by the creation of a link on the east side of the Peel Inlet.

A study carried out by Uloth and Associates in 1992 for the City of Mandurah made recommendations on the future road network which would be required as a consequence of development in accordance with Mandurah Town Planning Scheme No.3. The study only considered the traffic generated by the development of the Mandurah area and assumed that through traffic would travel via an alternative road east of Peel Inlet/Harvey Estuary. Through-traffic was not included in the traffic forecasts. The following conclusions from the study indicate the impact that the growth of Mandurah will have on the existing main road system.

- A new six lane freeway will be required north of Mandurah.

- The Mandurah Bypass will require six lanes north of Pinjarra Road.

- A six lane road will be required over the northern section of Old Coast Road. However, this may not be sufficient to carry the high traffic flows anticipated to use Old Coast Road between Casuarina Drive and Mandurah Bypass.

- Traffic lights will be required at between 8 and 18 intersections on Old Coast Road and at intersections on Mandurah Bypass leading to the Freeway.

The report commented that: "As long as Old Coast Road provides the only northern and southern access for the Peninsula south of Peelwood Parade there will be traffic congestion at the northern end of the Old Coast Road". This further highlights the problems expected on the existing route.

Delays to through traffic by traffic lights and congestion will become a major problem and it is expected that there will be a demand for an alternative route well before Mandurah becomes developed to the ultimate stage assumed in the study. The existing development of Mandurah, particularly along the Peninsula, essentially precludes the upgrading of the existing road or development of an alternative route which satisfies the ultimate objective of providing a fast, free flowing road link between Perth and Bunbury.

2.2.3 Upgrading the South Western Highway

It has been suggested during the public consultation phase of this study that the upgrading of the South Western Highway should be considered as an alternative to the Peel Deviation. This is clearly not a realistic alternative as the Perth - Bunbury Highway is now firmly established as the primary route between Perth and the South-West.

The following should also be considered in relation to the South Western Highway route.

- The Perth-Bunbury Highway route is significantly shorter, passes through fewer towns and provides the most economical route particularly for the cartage of heavy freight.
- The primary function of the South Western Highway is to provide access to the towns and other developments along the base of the Darling Scarp.
- The South Western Highway does not fit in with the proposed freeway system for Bunbury (which is already planned and substantially developed in the form of the Australind Bypass), or with the freeway north of Mandurah.
- The development of the South Western Highway to a high standard freeway / expressway type facility would be very costly from an economic and social perspective, as land adjacent to this route is much more heavily developed and is considered more valuable as agricultural land than that on the coastal route.

The proposed Peel Deviation is the most practical and economical means of achieving a bypass of Mandurah for the Perth - Bunbury Highway and of satisfying the ultimate State objective of providing a high standard free flowing road link between Perth and Bunbury to service the future development of the South-West.

2.3 EVALUATION OF ALTERNATIVES IN THE PEEL DEVIATION CORRIDOR

2.3.1 Introduction

Definition of the Peel Deviation corridor has occurred through assessment of a number of alternative alignments. A total of eight alignment components were considered in the Road Alignment Definition process, which concluded with a preferred alignment (*ecologia* & GB Hill Consulting Engineers, 1996). Additional modifications to the preferred alignment were considered following release of the RAD report and discussions with selected interest groups.

The rationale for the alignments investigated as part of the Peel Deviation planning study are discussed in this section, and are illustrated in Figure 2.

2.3.2 Alternative Alignments

Northern 1 Option
The Northern 1 option is the route previously selected by earlier studies and is shown on the Peel Regional Strategy Land Use Plan (DPUD, 1994), and included within the Shire of Murray Town Planning Scheme, as the extension of the Kwinana Freeway from the Interchange at Lakelands near Lymon and Stock Roads to Pinjarra Road. Running parallel to Stock Road, the route swings east to cross the Serpentine River 500 m upstream from Stake Hill Bridge on Lakes Rd. The route then swings south-east to cross Nambeelup Brook at Nambeelup Pool and runs approximately parallel with Figirts Road south to Pinjarra Road. New subdivisions in the vicinity of Woodland Parade and Paterson Road have been based on this alignment and Main Roads has purchased land for the Peel Deviation as subdivisions have been developed.

Northern 2 Option
The Northern 2 option was nominated as an alternative alignment to the Northern 1 option due to impact of Northern 1 on the wetland adjacent to Goegrup Lake; Nambeelup Pool. Nambeelup Pool forms part of Nambeelup Brook and is an Environmental Protection Policy (EPP) classified wetland (EPA, 1992). The Northern 2 option crosses the Serpentine River at much the same location as Northern 1, but extends further east before swinging south in an effort to minimise impacts on Nambeelup Brook. It does however, require additional works to accommodate connection to Lakes Road.

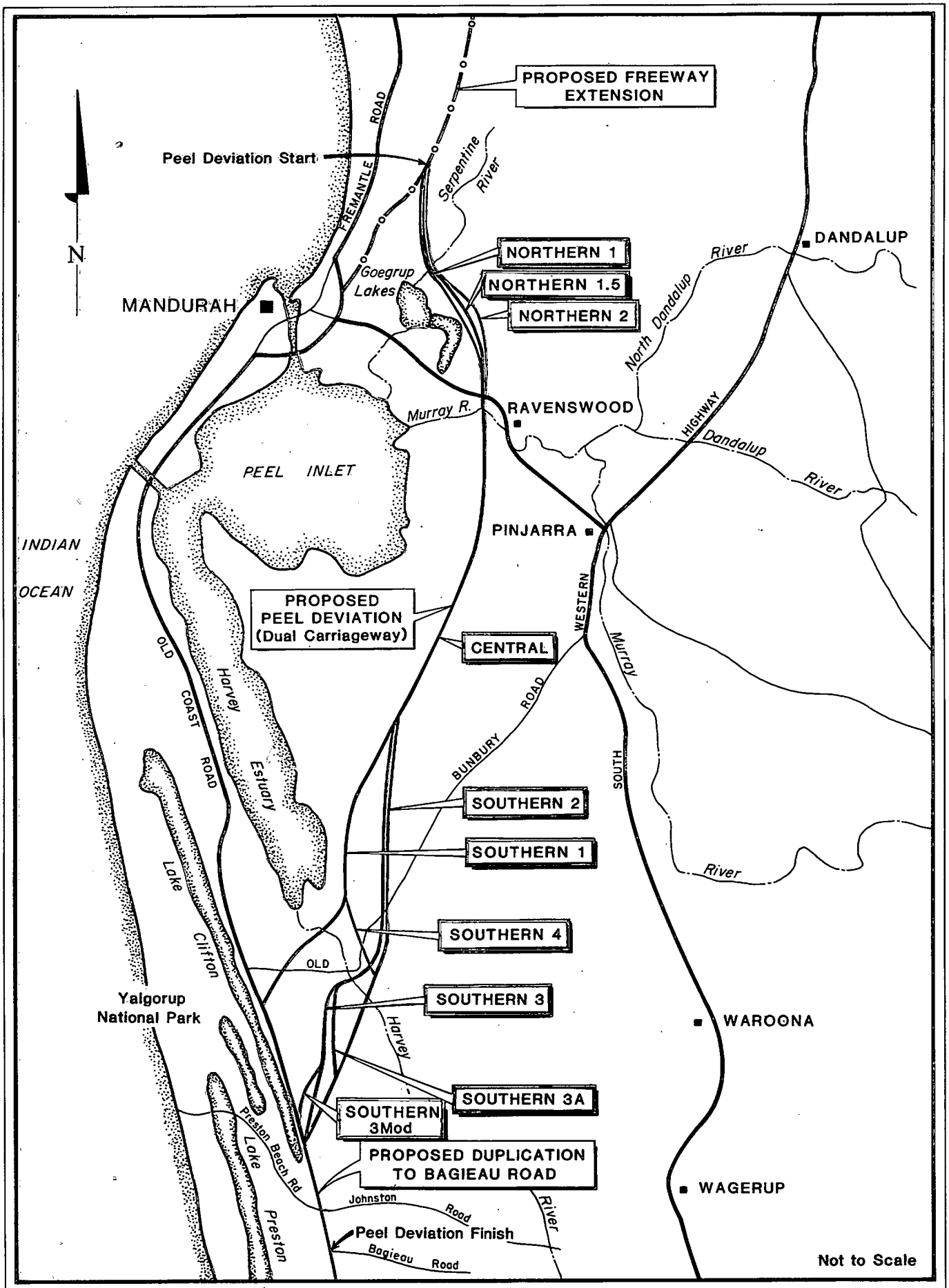


Figure 2: **Perth – Bunbury Highway Peel Deviation Location Map & Preliminary Route Options**

Central Section

The Central Section of the route extends from Pinjarra Road to Birchmont Road. From Pinjarra Road the alignment continues due south across the Murray River to a point 800 m south of Beacham Road, then turns south-west following a major cadastral boundary line. The nominated route minimises the effect on existing properties, by following the cadastral boundaries, and avoids EPP wetlands. The Murray River crossing location was determined by prior studies and is now constrained by development on either side of the alignment.

Other routes for the central section were initially examined including:

- a parallel alignment slightly to the west following the Thompson Road alignment;
- a parallel alignment slightly to the east following the Marsh Road alignment; and
- an eastern alignment incorporating a significant length of the Old Bunbury Road. This alignment ran directly south from the Murray River until intersecting with the Old Bunbury Road. The route then continued along the Old Bunbury Road alignment to the vicinity of the Harvey River.

However, none of the alternative routes were found to have advantages over the nominated route and hence were not pursued. All three routes were eliminated in initial assessments. The Thompson Road alignment offers no advantages and results in a significant increase in private land severance and disruption to local traffic patterns by interruption of Thompson Road. The Marsh Road alignment also results in increased severance, local access impacts, and impacts to stands of remnant vegetation and EPP wetlands in the vicinity of Mills and Birchmont Roads.

The Old Bunbury Road route would result in a high degree of private property severance with the alignment diagonally crossing all affected landholders between Greenlands Road and Old Bunbury Road. The Old Bunbury Road is a major local link road providing access to many properties along its length. To upgrade the Old Bunbury Road route to required design standards would create significant property severance and consequent social impact to existing residents. The need to provide a local road either side of the Freeway to maintain the local road network would also increase land requirements. In addition, the route would involve significant impact to the remnant vegetation corridors along Old Bunbury Road and in the vicinity of Nine Mile Lake Nature Reserve. These factors, along with increased route length and subsequent construction costs, eliminated this route from the selection process.

Southern 1 Option

Southern 1 option is the route previously identified by Main Roads and is shown on the Peel Regional Strategy Land Use Plans (DPUD, 1994). The alignment continues south-west from Birchmont Road until the eastern boundary of Kooljerrenup Nature Reserve. It then follows the boundary south, traversing part of the reserve in the vicinity of the South Coolup Drain. Bordering the nature reserve, the alignment swings south-west to cross Clifton Road near the existing Telstra Microwave Repeater Station and connect to the Old Coast Road near the Clifton Roadhouse. From the junction with the Old Coast Road it is proposed that the existing Highway will be duplicated south to Bagieau Road on the east side of the existing road.

The Southern 1 route option has significant impact on the Kooljerrenup Nature Reserve and State Forest Treasure Block, just south of Clifton Road, which is proposed for addition to Yalgorup National Park. These areas also form part of the Harvey Estuary and Clifton Management Priority System 6 areas. In addition steep grades and a major cutting would be required in the vicinity of a proposed subdivision by Clifton Road.

Southern 2 Option

The Southern 2 option diverges from Southern 1 at Birchmont Road running due south, approximately 1 km east of Southern 1, to Old Bunbury Road. From the point where the alignment crosses the Old Bunbury Road, the alignment runs south-south-west almost directly to Old Coast Road in the vicinity of Peppermint Grove Road. Crossing the Harvey River, the alignment traverses the low-lying open farmland to the east of Doman Road, crossing Coronation Road near the Doman Road junction. The alignment then traverses 1.8

km of State Forest pine plantation and a similar amount of native vegetation which is proposed for addition to Yalgorup National Park.

Southern 3 & 3A Options
These two options are similar to Southern 2 except that from the Old Bunbury Road they diverge to the south-west and follow Doman Road, on the west and east side respectively, before connecting to the Old Coast Road south of Peppermint Grove Road. Both of the Southern 3 options reduce the degree of private property severance and place the route on higher ground than Southern 2.

Southern 3 crosses Williamson Road near the junction with Old Bunbury Road then borders the eastern side of Doman Road until the State Forest. At this point the alignment crosses Doman Road and enters the State Forest to follow the eastern boundary of the pine plantation. To minimise impact to native forest vegetation the alignment would be constructed partially within the pine plantation. In addition Southern 3 crosses an isolated hill just south of Coronation Road which could be used for part of the fill required for the roadworks.

The Southern 3A option reduces impact to State Forest areas by following the eastern side of Doman Road and diverging east to rejoin Southern 2. This alignment produces greater private land severance than Southern 3 and occupies the higher ground within the Doman property. Additionally, the alignment provides less scope for sufficient fill material to be generated directly from the roadworks.

Southern 4 Option
The route option Southern 4 provides an alternative which combines elements of Southern 1 and Southern 2, 3 or 3A. The option incorporates the northern section of Southern 1 adjacent to Kooljerrenup Nature Reserve, follows the eastern boundary of the reserve, then deviates south-east from a point 1.3 km south of the South Coolup Drain to join Southern 2 or 3 just north of the Mayfield Drain. This option avoids the high conservation value areas to the south of the Harvey Estuary and in the State Forest Treasure Block around Clifton Road and reduces impact to the agricultural areas to the east. However, the option still impacts the eastern portion of Kooljerrenup Nature Reserve.

2.3.3 Alignment Variations Subsequent to Release of the RAD Report

Northern 1.5 Option
Subsequent to the release of the RAD, an additional Northern option (Northern 1.5) was proposed due to the impact that both Northern 1 had on Nambeelup Brook and the level of social impact due to land severance resulting from the Northern 2 option. As for Northern 1, this option runs parallel to Stock Road, before swinging east to cross the Serpentine River 500 m upstream from Stake Hill Bridge on Lakes Rd. The alignment then moves east to avoid the Nambeelup Pool, before running southwards in parallel with Figirts Roads. The alignment then meets Pinjarra Road at the Murray River crossing and joins the Central section of the overall alignment. The Northern 1.5 option is considered to balance the environmental and social impacts of the original Northern options for the Peel Deviation.

Southern 3 Option Variations
Following release of the RAD Report, discussions were held with CALM on the impacts of the preferred alignment on pine plantations and the State Forest. As a result of these discussions, modifications to the alignment were proposed which minimised severance of pine plantations and reduced a long length of road through the State Forest. The modified alignment joins Old Coast Road approximately 2.5 km further to the north than the Southern 3 option and locates a future interchange over a disturbed area (limestone quarry). It is expected that the limestone resource will either be exhausted by the time the Peel Deviation is built, or can be purchased for the construction of the road.

2.3.4 Assessment of Alignment Options

The results of the environmental and engineering review, and the public submissions were incorporated into the RAD report which provided a comparative assessment of environmental, social, economic and engineering issues for each section of the Peel section of the Perth - Bunbury Highway.

The comparative assessment of options was based upon the predicted level of impact (high, medium, low) of the project on a range of biophysical, human / social, and engineering and economic factors.

Biophysical Factors
Clearing in reference to habitat loss and impact on rare flora and fauna;
Risk of introduction or spread of dieback disease;
Interruption of regional hydrology;
Intrusion into areas of the conservation estate;
Proximity to wetlands listed under the Environmental Protection (Swan Coastal Plain Lakes) Policy;
Risk of pollution to the environment in the event of Highway accidents;
Intrusion into commercial Pine plantations; and
Pressure on the biophysical environment resulting from improved access.

Human Factors
Proximity to Aboriginal and European Heritage sites;
Impact on residents from noise, dust and vibration;
Alteration to the visual amenity adjacent to the chosen alignment; and
Extent of severance on private land, Crown land, and infrastructure.

Engineering and Economic Factors
Road safety;
Length of road and travel times;
Requirements for foundations and earthworks;
Design criteria to achieve adequate road drainage;
Existence of any special construction requirements;
Public utilities; and
Anticipated construction costs.

Each route option has been ranked in terms of each of these factors from Low to High. The assessment is made on a comparative basis with the ranking of the factors assessed relatively. A Low rank being the lowest level of overall effect and High being the highest for the specific route comparison being made. If a factor does not occur, or no effect is anticipated within the sector being discussed, it is indicated as being Not Applicable (NA). Although such an approach assumes that each of the factors is considered to be of equal importance, it does represent consistent evaluation of the route options and should, therefore, be regarded as an acceptable methodology for selection of the preferred alignment.

This assessment has not been carried out for the Central section of the route due to no alternative alignments with perceived benefits over the original proposal being identified.

The outcome of the comparative assessment process is summarised in Tables 1 and 2.

The preferred Peel Deviation alignment proposed by Main Roads is illustrated in Figure 3. This alignment will be the subject of environmental evaluation through this PER.

2.3.5 No Development Option

The Perth Bunbury Highway Peel Deviation is intended to provide for freight and passenger traffic to and from the south-west region based on diversion of traffic to the east of the Peel - Harvey Inlet to bypass the main residential areas of Mandurah and the Dawesville Peninsula.

The future transport requirements (road, rail, sea and air) for the south-west region have been documented within the Southern Province Transport Strategy - Peel, Great Southern and South West Regions (Department of Transport, 1996). The Strategy is being developed to account for increases in movement of people and of freight. Transport requirements have been assessed according to projections of population growth, tourism activity, industrial activity and rail freight over the next 25 years.

The Peel Deviation is included within this strategy as a requirement to avoid congestion in Mandurah and the Dawesville Peninsula, and to mitigate the problem of heavy vehicle use on the South Western Highway. It is a component of an overall strategy to manage future transport requirements and as such the regional implications of not constructing this route would be significant.

2.4 DESIGN STANDARDS

The geometric design of the Peel Deviation is required to conform with the relevant AUSTROADS guidelines for a four lane divided rural freeway. The major design parameters for the new route will conform to the following:

Design Speed:	Main Alignment	130 km/hr
	Interchange Ramps	100 km/hr at noses to 60 km/hr at intersections
	Turning Roadways	80 km/hr
Minimum Radii:	5000 m	standard cross fall
	1500 m	3% super elevation
	900 m	5% super elevation (maximum)
Carriageways	2 x 3.5 m	traffic lanes and ramps
	4.2 m	single lane ramps
	2.5 m	left shoulder (1.5 m sealed)
	1.5 m	right shoulder (1.0 m sealed)
Median:	40 m desirable maximum, 15.0 m minimum	
Road Reserve:	100 m desirable, minimum 80 m where constrained	
First Stage:	As above, without interchanges	
Vertical Clearance for Bridges over Roads:		5.8 m

The proposed road reservation is generally 100 m wide to accommodate the two carriageways with a 40 m median, and a 20 m wide zone outside each carriageway to allow for possible noise bunds and services.

Table 1: Comparative Assessment of Northern Route Options.

COMPARATIVE ASSESSMENT OF NORTHERN SECTION ALIGNMENT OPTIONS

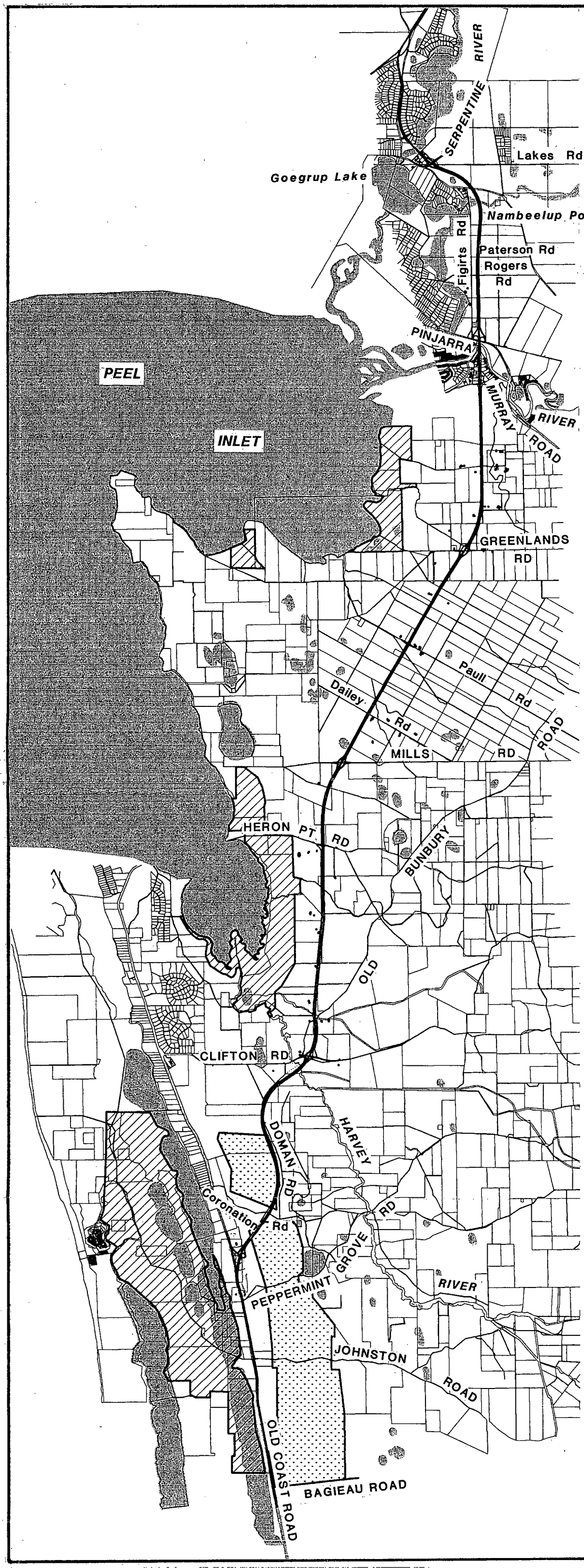
Factor	Northern 1	Northern 1.5*	Northern 2
Biophysical			
- Clearing:			
Habitat loss	High	Medium	Medium
Declared Rare Flora/Fauna	High	Low	Low
- Dieback	Low	Low	Low
- Hydrology	Medium	Medium	Medium
- Conservation estate	High	Medium	Medium
- EPP lakes	High	Medium	Medium
- Pollution risk from accidents	High	High	High
- People pressures	Low	Low	Low
Human			
-Significant Sites			
Aboriginal Heritage sites	Medium	Medium	Medium
European Heritage sites	NA	NA	NA
- Noise, Dust & Vibration	Medium	Medium	Medium
- Amenity	Medium	Medium	Medium
- Severance:			
Private land	Medium	High	High
Crown land	Low	Low	Low
Infrastructure	Low	Medium	Medium
Engineering & Economic			
- Safety	NA	NA	NA
- Length & travel time	Low	Low	Medium
- Foundation & earthworks	Low	Low	Medium
- Drainage	Low	Low	Medium
- Special construction requirements	Medium	Low	Medium
- Public utilities	NA	NA	NA
- Construction cost	Low	Low	Medium

* Component selected for preferred alignment of the Peel Deviation.

Table 2: Comparative Assessment of Southern Route Options.

Factor	Southern 1	Southern 2	Southern 3	Southern 3 modified*	Southern 3 A	Southern 4
	COMPARATIVE ASSESSMENT OF SOUTHERN SECTION ALIGNMENT OPTIONS					
Biophysical						
- clearing: habitat loss	High	Low	Medium	Medium	Medium	High
- clearing: Declared Rare Flora/Fauna	High	Medium	Medium	Medium	Medium	Medium
- dieback	High	Low	Medium	Medium	Medium	Medium
- hydrology	Medium	Medium	Low	Low	Medium	High
- conservation estate	High	Low	Low	Low	Low	High
- EPP lakes	Medium	Low	Low	Low	Low	Low
- pollution risk from accidents	Medium	Medium	Medium	Medium	Medium	Medium
- people pressures	High	Low	Medium	Medium	Medium	High
Human						
-Aboriginal heritage sites	Low	Medium	Medium	Medium	Medium	Medium
-European heritage sites	Medium	NA	NA	NA	NA	NA
- Noise, dust & vibration	High	High	High	High	High	High
- Amenity	Medium	Low	Medium	Medium	Medium	Low/Medium
- Severance:						
private land	High	High	Medium	High	High	High
Crown land	High	Low	Medium	Medium	Medium	High
infrastructure	Low	Medium	Medium	Medium	Medium	Medium
Engineering & Economic						
- Safety	Medium	Low	Low	Low	Low	Low
- Length & travel time	Medium	Low	Medium	Medium	Medium	Medium
- Foundation & earthworks	High	Medium	Low	Low	Low	Low/Medium
- Drainage	Medium	High	Low	Low	Low	Low/High
- Special construction requirements	High	Medium	Low	Low	Low	Low/Medium
- Public utilities	Medium	medium	Medium	Medium	Medium	Medium
- Construction cost	Low	Medium	Medium	Medium	Medium	Medium

* **Component selected for preferred alignment of the Peel Deviation**



N

0 1 5 10km

Scale

LEGEND

CONSERVATION RESERVES

PINE PLANTATION

WETLANDS

PERTH - BUNBURY HIGHWAY

Peel Deviation Preferred Alignment

Figure 3

3.0 EXISTING ENVIRONMENT

3.1 THE PEEL REGION

The broader region of which the study area is a part was first settled in 1830 with the establishment of Peeltown, now Mandurah, from whence settlers moved up the Murray River in search of fertile land for agriculture (DPUD, 1990). Regional development was premised on primary production, Peeltown (Mandurah) being the focus of fishing activity, while farming activity was concentrated on the more fertile and better drained alluvial soils along the Murray River (including around Pinjarra). Agriculture and other forms of primary production (including forestry and mining) have progressively developed throughout the broader region, while Mandurah has developed from its original fishing base to a tourist and retirement settlement in the 1950s and 1960s to its present role as a regional service centre (DPUD, 1990).

The Peel Region incorporates the municipalities of the City of Mandurah, and the Shires of Murray, Waroona and Boddington, with a total area of 4,700 km^2. The Peel Region has a significant agricultural land use component as well as forming a holiday and recreational destination (DPUD, 1994). The Peel Region, and in particular the City of Mandurah, has an increasing residential component as transport linkages with the Perth Metropolitan Area improve.

The main environmental issue for the Peel Region, is that of the pollution of the Peel Inlet - Harvey Estuary System (Peel - Harvey System) resulting in nuisance weed and algal growth in the system. The scale of the problem resulted in the introduction of environmental management controls in the entire region to control clearing, and to manage land use to minimise nutrients from the regional catchment entering the Peel - Harvey System. Land use planning and drainage management strategies within the Peel Region are therefore crucial in management of the Peel-Harvey System (Ministry for Planning, 1996).

3.2 CLIMATE

The climate of the Swan Coastal Plain is equivalent to that found in the Mediterranean Basin with a hot, dry summer and mild wet winter (Seddon, 1972). The area is influenced by alternating high and low pressure systems arising from the south-west and producing winter rainfall systems.

The mean daily maximum temperature ranges from 17.8 °C in July to 30.2 °C in February at Mandurah (Figure 4). August has the lowest mean daily minimum temperature at 9.4 °C while February has the highest at 18.3 °C. Average yearly maximum and minimum temperatures are 23.4 °C and 13.4 °C respectively. Mandurah is the closest centre to the project area which has records of temperature.

The average yearly rainfall at Pinjarra is 951.7 mm from a total of 109 rain days. Major falls occur between May and August and over 90% of the total rainfall occurs between April and October (Figure 4). On average, the wettest month is June (198.4 mm) and the driest month is January (10.6 mm).

The seasonal nature of the rainfall is of biological significance, with ombrothermic (temperature and rainfall) relationships for the Mandurah region indicating a "dry" period between October and March where temperature exceeds precipitation and is considered inadequate for plant growth (Bagnouls and Gaussen, 1957).

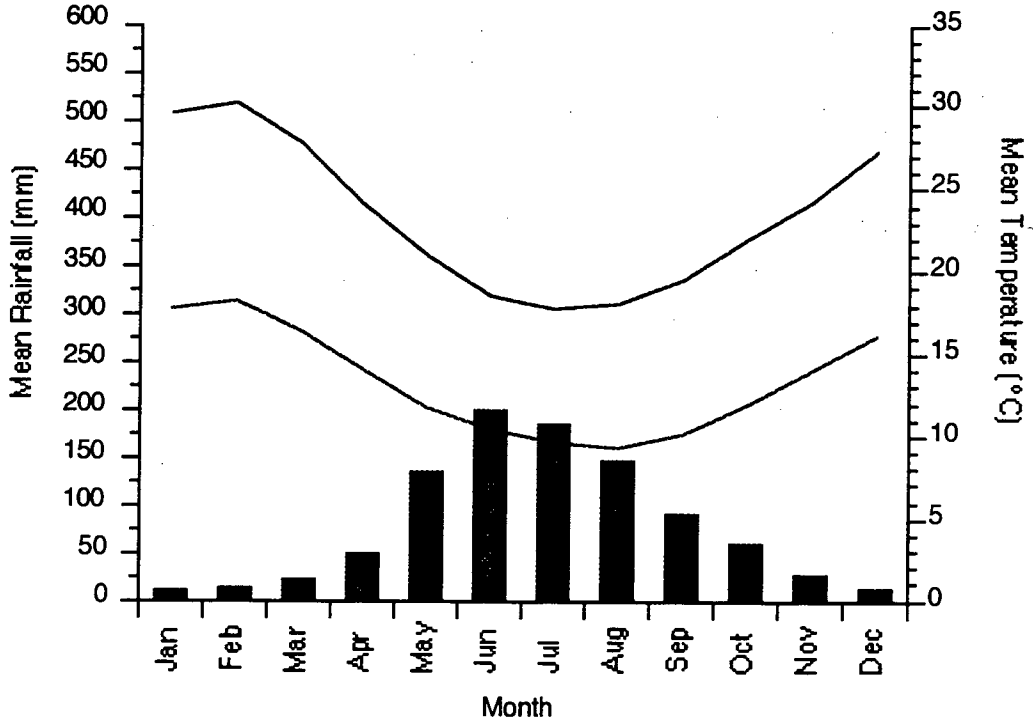


Figure 4 : Mean monthly maximum and minimum temperatures (from Mandurah) and rainfall (from Pinjarra) for the Peel Deviation project area. Data from Bureau of Meteorology.

3.3 SOILS AND LANDFORM

Within the Darling System the geological structure largely determines the physiography of the region. The study area is in the southern part of the Swan Coastal Plain (Beard, 1981), within the South West Physiographic Division (Wilde & Low, 1980). The study area traverses three major physiographic sub-units: Spearwood Dunes, Bassendean Dunes and Pinjarra Plain. A small region at the northern part of the study area, surrounding Goegrup Lake and much of the southern part of the area falls within the Bassendean Dune Division (McArthur & Bettenay, 1974). The Bassendean Dunes are the oldest (Quaternary - Pleistocene) of the Swan Coastal Plain geomorphic units. The western portion of the study area may overlay Tamala Limestone.

The Pinjarra Plain is typified by low relief and the Bassendean Dunes comprise low hills of silicious sand covered with vegetation. The Spearwood Dunes provide relief in the region, reaching heights of 100 - 150 m. The Bassendean Dunes are discontinuous areas, having been isolated into distinct areas by projections of the Pinjarra Plain (Beard, 1981).

As part of the Bassendean Dune System, parts of the study area features extremely leached and podzolised white quartz sands with B horizons of iron and organic matter accumulation (Beard, 1981). Clayey swamps may have cracking clay or hard setting loams. With addition of fertiliser, these soils types support summer pastures. The Spearwood dune system is typified by undulating yellow/brown sands overlying limestone found at varying depths. The sands have a high calcium carbonate content with good phosphorous retention capability (Ministry for Planning, 1996).

The central part of the study area is within the Pinjarra Plain. This alluvial tract (up to 10 km wide) is an extension of the Guildford formation and may be interspersed with recent swamp and lacustrine or alluvium deposits. Several generations of coastal sand dunes may overlay the western portion. The Pinjarra Plain ranges from 6 to 50 m in elevation. Most of this system within the project area is subject to seasonal flooding and is interspersed with swamps and lakes. Much of this area has been cleared for agriculture.

The section of the study area lying within the Pinjarra Plain System comprises alluvial deposits which have been laterised. Much of this soil has been extensively stripped resulting in a soil dominated by meadow podzolic consisting of a sandy surface over a poorly-structured subsoil clay of low permeability developed in the pallid zone (Beard, 1981). Low lying areas of the western section of the Pinjarra Plain have fine textured alluvium of mottled duplex soils and yellow-grey clays. At the junction with the Bassendean Dune System, there is a complex of sand and clay soils which are poorly drained (Ministry for Planning, 1996).

The Murray River and floodplain constitute a separate landform feature. The river has a wide floodplain with a typically flat topography. Soils are alluvial and collectively known as the Swan Association (Ministry for Planning, 1996).

3.4 HYDROLOGY AND HYDROGEOLOGY

The Peel Deviation project area contains extensive systems of constructed drains, linking agricultural land with natural drainage channels and wetlands. The area is dissected by two major river systems. The Murray River system (including the Serpentine River) and the Harvey River System, both of which discharge into the Peel - Harvey Estuary (State Planning Commission, 1988).

The Serpentine River flows into the northern end of Goegrup Lake before entering the Peel Inlet. The Murray River enters the Peel Inlet in the Yunderup area, flowing through a delta containing numerous braided channels. The Harvey River flows into the southern end of the Harvey Estuary, but also discharges to the ocean at Myalup via a diversion drain (State Planning Commission, 1988). All systems have dams upstream and are heavily used for both rural and urban water supplies, altering the natural flooding cycle of the rivers. The extent of drains constructed on the coastal plain catchment has also altered the volume of surface and ground water carried by the river systems.

Hydrogeologically, the Peel Region has four major aquifers, these consisting of Superficial Formations, and the Leederville, Cockleshell Gully, and Yarragadee Formations:

- Superficial Formations: this aquifer is shallow and unconfined, and is recharged directly by rainfall and some inflow from surface streams. Some upward leakage from the Leederville Formation occurs.
- Leederville Formation: this is the main aquifer, underlies and is recharged by the Superficial Formations.
- Cockleshell Gully Formation: this occurs beneath the entire Swan Coastal Plain and varies in depth due to faulting.

The Pinjarra Plain has limited aquifers in beds of gravel, sand and loam. The end of the dry season sees an increase in salinity. A shallow, good quality water table which often reaches the surface is typical of the Bassendean Dune System, hence the multitude of swamps and winter wet depressions in this system. The major aquifer systems drain into the Peel Harvey Estuary.

The Pinjarra Plain is waterlogged in winter and spring due to the presence of clay soils interspersed with sandy soils with a flat topography. Clay impedes the movement of groundwater horizontally and vertically, causing runoff to collect, thereby creating the waterlogged conditions (Balla, 1994).

The northern and central sections of the study area contain extensive systems of constructed drains, linking agricultural land with natural drainage channels and wetlands. These drains are required due to the flat terrain and high water table causing the eastern Peel Region to be prone to flooding and waterlogging in winter (Ministry for Planning, 1996). The southern end of the Peel Deviation is located over the comparatively well drained soils of the Spearwood Dune system.

3.5 VEGETATION AND FLORA

3.5.1 Vegetation Associations

The major vegetation systems of the Pinjarra area have been summarised by Beard (1979). The Bassendean System appears to be a mosaic of vegetation largely controlled by drainage. Near the Peel Deviation project area there is limited *Banksia* low woodland, merging into Jarrah - Marri woodland (*Eucalyptus marginata - E. calophylla*) on moister soils. This varies from an open canopy with a thick *Banksia* understorey to a well developed woodland with scattered *Banksia* and *Casuarina*. Wetland communities are dominated by paperbark *Melaleuca* species with sedges extending into the water.

The Spearwood System consists primarily of eucalypt woodland on ridges of calcarenite mantled with yellow sand. The eucalypt woodland consists of two communities; the *Eucalyptus gomphocephala* (Tuart) and the *E. gomphocephala - Eucalyptus marginata* associations, with the former occurring on limestone ridges. Wetlands and swamps of the Spearwood system are bordered by Melaleuca or Banksia woodlands (Beard, 1979).

Beard (1979) claims that there is no virgin vegetation left on the Pinjarra Plain System. It appears to have been dominated by *Melaleuca* swamps with fringing woodlands of *Eucalyptus* or *Banksia*. The area is now dominated by pasture plants. Due to the extent of clearing, natural vegetation is scarce and therefore has a high priority for conservation (Ministry for Planning, 1996).

In a detailed survey of the vegetation of the southern Swan Coastal Plain, Gibson *et al.* (1994) recognised 43 'community types'. Based on the mapped locations of their survey sites, at least nine community types occur within the Peel Deviation project area. This does not include the cleared farmland which was not surveyed in that report. The nine community types in the study area are:

- *Eucalyptus calophylla - Xanthorrhoea preissii* woodlands and shrublands (Community Type 3c);
- Mixed Shrub damplands (Community Type 5);
- Herb rich saline shrublands in clay pans (Community Type 7);
- Dense shrublands on clay flats (Community Type 9);
- Wet forests and woodlands (Community Type 11);
- *Melaleuca teretifolia* and/or *Astartea* aff. *fascicularis* shrublands (Community Type 12);
- Deeper wetlands on sandy soils (Community Type 14);
- Central *Banksia attenuata - Eucalyptus marginata* woodlands (Community Type 21a); and
- Southern *Eucalyptus gomphocephala - Agonis flexuosa* woodlands (Community Type 25).

The present study has generated a list of 43 Priority Species from the area bounded by Rockingham in the north, Harvey to the south and eastwards to the base of the Darling Scarp, which may be present in the study area (Appendix B). This includes 11 Declared Rare, eight Priority One, 10 Priority Two, seven Priority Three and seven Priority Four species.

The vegetation and flora of the Peel Deviation corridor project area were surveyed for vegetation type, life-form strata, percentage cover, surface soil type, drainage, litter cover, disturbance and the relative abundance of each species present (*ecologia*, 1996). Thirteen vegetation associations were identified within the Peel Deviation project area. The distribution of these vegetation types is illustrated in Figures 5a - 5c. Vegetation association descriptions are included in Appendix C. The vegetation associations are listed below. The community type of Gibson *et al.* (1994) that these associations most closely correspond to follows in brackets.

- Cleared land;
- Pine plantations;

- *Eucalyptus calophylla* over *Xanthorrhoea preissii* over mixed heath (Community Type 3c);
- *Kunzea ericifolia / Jacksonia furcellata* heath (Community Type 5);
- *Casuarina obesa / Melaleuca cuticularis* over *Melaleuca viminea* (Community Type 7);
- Samphire (Community Type 7);
- Myrtaceous Heath (Community Type 9);
- *Eucalyptus rudis / Melaleuca rhaphiophylla* woodland (Community Type 11);
- *Melaleuca rhaphiophylla / Melaleuca teretifolia* heath (Community Type 12);
- *Eucalyptus rudis / Melaleuca preissiana* woodland over low shrubs (Community Type 14);
- *Melaleuca pauciflora* heath (Community Type 14);
- *Banksia attenuata / Eucalyptus marginata* woodland (Community Type 21a); and
- *Eucalyptus gomphocephala / Agonis flexuosa* woodland (Community Type 25).

3.5.2 Results of the Flora Survey

The survey identified 345 species of vascular plants, from 202 genera belonging to 67 families. Thirty of these families were represented by a single species only. The most numerously represented families were the Myrtaceae (33 taxa), Fabaceae (30 taxa) and Poaceae (27 taxa), followed by the Asteraceae, Cyperaceae and Proteaceae (22 taxa each). The most numerous genera were *Melaleuca* (14 taxa), *Lomandra* (nine taxa), *Stylidium* (eight taxa), and *Acacia* and *Leucopogon* (seven taxa each).

The most widely distributed species within the detailed flora survey sites were **Briza maxima* (present at 20 of the 30 sites) (NOTE: *indicates introduced species), **Briza minor* and *Conostylis aculeata* (each recorded from 16 sites), **Lotus suaveolens* (present at 15 sites) and **Aira cupaniana* (collected from 14 sites). Thirteen species were only collected opportunistically (*i.e.* were not present in any of the detailed survey sites). A total of 155 species was recorded from a single survey site, with 14 of these species also recorded opportunistically elsewhere within the survey area.

The number of species collected within the project area compares favourably with surveys in the surrounding region (see for example Dames & Moore (1991)). The damp nature of the soil along much of the proposed alignment meant that many annual species were observed. Of the 345 taxa recorded, 127 were annual or weakly perennial species (approximately 37 %). Seventeen specimens were identified to genus level only and a further eight species were identified to specific level with a degree of uncertainty attached, due to the absence of reproductive material or poorly developed vegetative parts. An additional seven plant specimens were too sterile to identify below family level and were excluded from all analysis. It is probable that some of the partially identified specimens are from taxa already included in the species list, however it is not anticipated that the species number would be reduced by more than 17 species were it possible to fully identify these specimens. The Peel Deviation project area is considered to be floristically rich, in keeping with its location within the South-west region which is well known for its floristic diversity.

Sixty introduced species were recorded from 22 families and 50 genera. The families represented by the greatest number of weed species were the Poaceae (18 taxa), Fabaceae (eight taxa) and Asteraceae (six taxa). Only two sites (Sites 10 and 13) were observed to be free from weeds, while the sites with the greatest number of introduced species were Site 8 (15 taxa), Sites 20 and 27 (12 taxa each), and Sites 2, 14, 19 and 29 (each with 11 taxa).

Due to the extent of clearing and other disturbance within the region it is likely that the entire project area may be infected with "dieback", excluding areas of Tuart/Peppermint woodland within State forest. "Dieback" refers to the expression of root-rot disease caused by a group of soil borne, plant-pathogenic fungi (the most well-known member of which is *Phytophthora cinnamomi).* No definite dieback fronts were noted in the remnant native vegetation within State Forest.

The Tuart/Peppermint woodland occurs on alkaline soils which are not conducive to dieback. The remainder to the project area is almost certain to be dieback infected, even at very low levels, due to the extreme degree of historical disturbance and proximity of transport vectors.

3.5.3 Declared Rare Flora and Priority Species

Priority Species are those species not designated Declared Rare Flora, yet whose conservation status appears to warrant some special legal protection. The priority species are maintained on a "Reserve List" and assigned to one of five priority categories, explained below.

Code:

R: DRF	Declared Rare Flora - Extant Taxa. Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
1: Priority One	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
2: Priority Two	Poorly Known Taxa. Taxa which are known from one or a few (generally <5) population, at least some of which are not believed to be under immediate threat.
3: Priority Three	Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under immediate threat.
4: Priority Four	Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare , are not currently threatened by any identifiable factors.

(From Atkins, 1996)

No Declared Rare Flora were recorded during the field survey, however one Priority 2 flora species, *Lasiopetalum membranaceum,* was identified.

Lasiopetalum membranaceum Priority 2
This low shrub (less than 0.5 m tall) has heart-shaped leaves to 5 cm long by 4 cm wide, on a petiole to 2 cm in length. The leaves and young branchlets have a sparse covering of stellate hairs. As a Priority 2 species, *L. membranaceum* is known from a few populations, at least some of which are not believed to be under immediate threat. This species has a number of collections lodged with the Western Australian Herbarium from Dwellingup, between Lake Clifton and Lake Preston, within Ludlow National Park and south of Ludlow, within the Yanchep and Yalgorup National Parks, Leschenault Inlet, Capel and the Swan River.

Within the project area, a single specimen of *L. membranaceum* was collected from Site 12, where it was noted to occur sparsely (providing less than 2 % cover). Site 12 is at the most southern end of the alignment, immediately west of the Old Coast Road, and lies within the *Eucalyptus gomphocephala / Agonis flexuosa* woodland vegetation type. Given the relatively broad distribution of this vegetation type, this species may be present at other areas along and adjacent to the southern portion of the Peel Deviation.

SWAMPS/WETLANDS

RESERVES

PLANTATIONS

DRAINS

Eucalyptus rudis / Melaleuca rhaphiophylla woodland

Eucalyptus rudis / Melaleuca preissiana woodland over low shrubs

Casuarina obesa / Melaleuca cuticularis over *Melaleuca viminea*

Melaleuca pauciflora heath

Kunzea ericifolia / Jacksonia furcellata heath

Melaleuca rhaphiophylla / Melaleuca teretifolia heath

Banksia attenuata / Eucalyptus marginata woodland

Myrtaceous heath

Samphire

Cleared land

Fauna trapping site

Detailed vegetation survey site

Figure 5a: **Vegetation Associations of the Peel Deviation Preferred Alignment**

Metres 0 500 1000 1500 2000

SCALE 1:50000

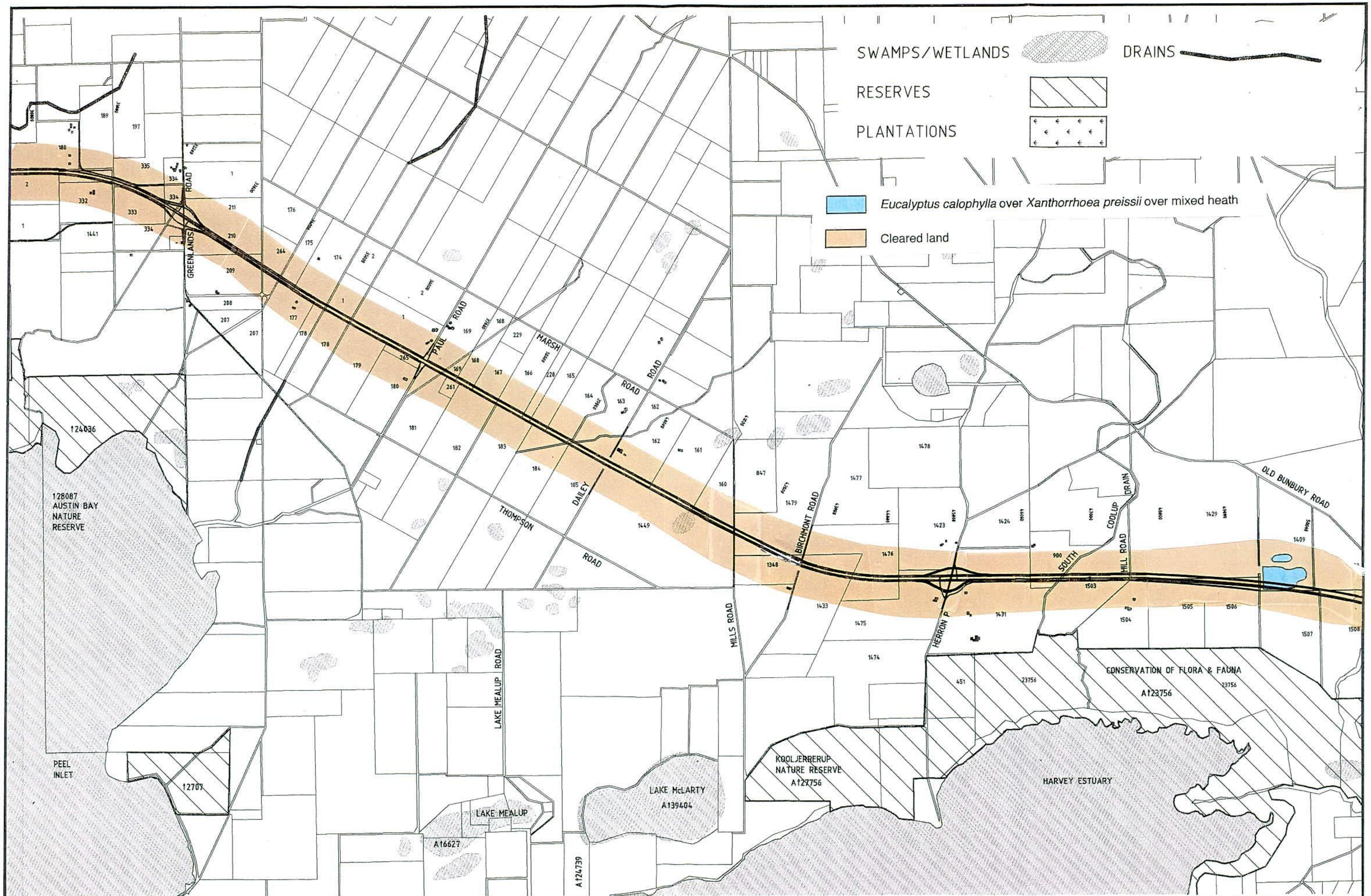


Figure 5b: **Vegetation Associations of the Peel Deviation Preferred Alignment**

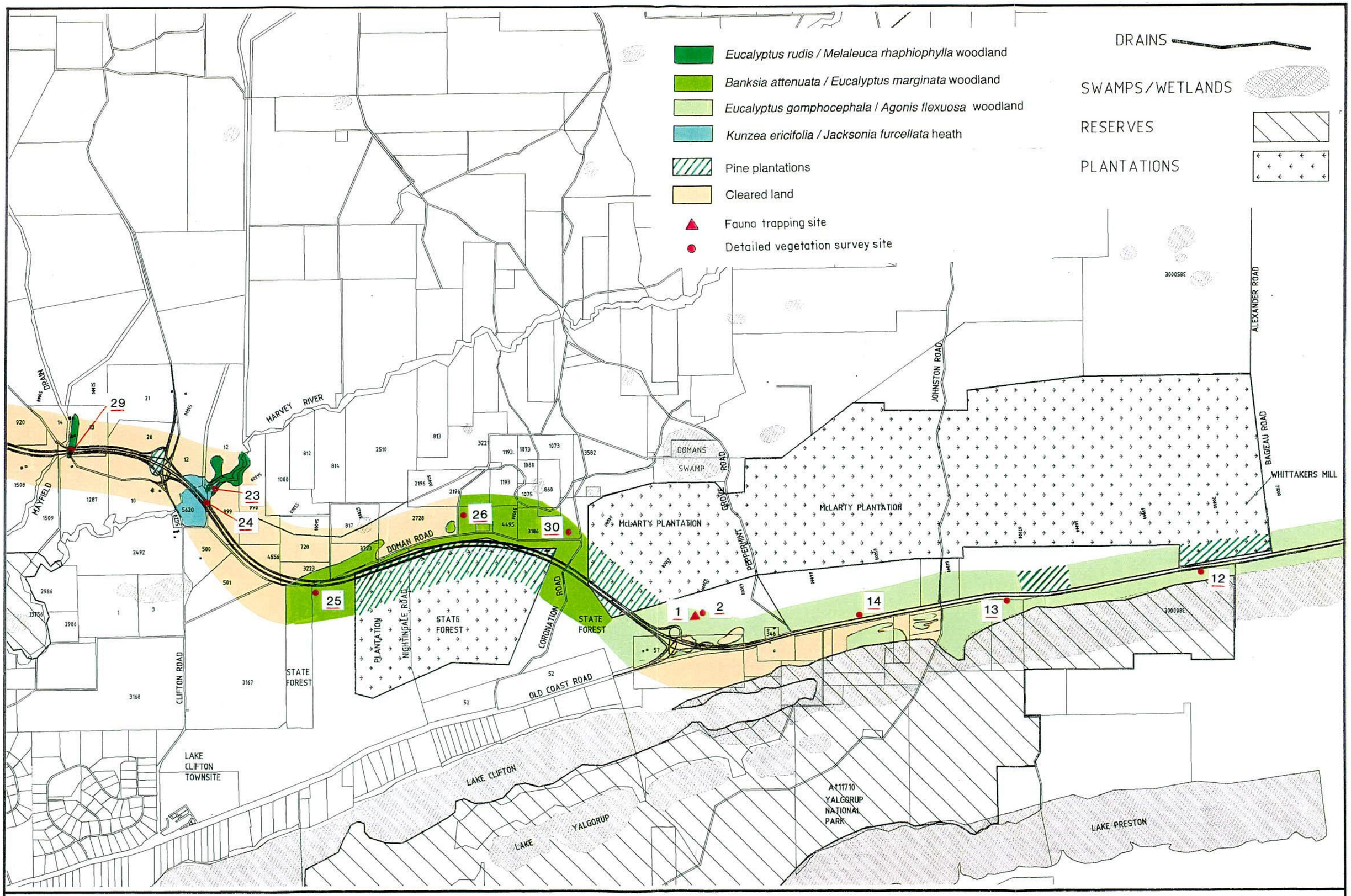


Figure 5c : Vegetation Associations of the Peel Deviation Preferred Alignment

3.6 FAUNA

The fauna of the Peel Deviation corridor project area was surveyed by using a variety of trapping, searching and observational techniques. During the field work, all fauna and secondary evidence of fauna, such as tracks, diggings and scats were recorded. Five trapping quadrats were chosen as being representative of major habitat landforms, and areas of major environmental impact from the proposed development (*ecologia*, 1996).

The project area lies within the boundary of the major zoogeographic region of the mesic South West. The field survey recorded three native and three introduced species of mammal, 73 species of bird, 20 reptile species and three amphibians (Table 3). On the basis of literature searches and known habitat preferences, the project area may potentially support up to 21 native and six introduced mammals, 174 birds, 58 reptiles, 16 frogs and six fishes (Appendix D).

Five main fauna habitats occur within the Peel Deviation project area:

(i)	Open Farmland (OF)	Opportunistic surveys only
(ii)	Samphire Flats (SF)	Opportunistic surveys only
(iii)	Wetlands (WL)	Swamp Fauna Site 4
(iv)	Riverine (RV)	Fauna Site 5 & Vegetation Site 8
(v)	Mixed Woodland (MW)	Fauna Sites 1, 2, 3 & 4

(NB: Fauna survey sites are marked on Figures 5A-C).

Table 3: Summary of vertebrate fauna recorded within the habitats of the Peel Deviation project area. (Abbreviations: OF Open Farmland; SF Samphire Flats; WL Wetlands; RV Riverine; MW Mixed Woodland).

VERTEBRATE GROUP	NUMBER OF FAMILIES	NUMBER OF SPECIES IN:					
		OF	SF	WL	RV	MW	TOTAL
Native Mammals	3	1		1	2	3	7
Introduced Mammals	3	1		1	3	1	6
Birds	33	19		6	31	46	102
Frogs	2	1		2	1	1	5
Reptiles	7	1		4	9	13	27
TOTAL	48	23	0	14	46	64	137

3.6.1 Mammals

Six species of mammal from five families were recorded during the field survey, of which three species were introduced and three native. Literature searches have revealed that up to 21 native and six introduced species of mammal may occur in the Peel Deviation project area (Appendix D1).

Several of these expected species are considered very unlikely to be recorded for the area, but the possibility cannot be ignored. This is highlighted by the discovery of two Southern Brown Bandicoots, *Isoodon obesulus fusciventer*, one in a small wetland that was surveyed and named Swamp Site 4 and the other in the adjacent mixed woodland of Site 4. The habitat is only marginally suitable for the Chuditch

Dasyurus geoffroii, Western Ringtail Possum *Pseudocheirus occidentalis* and Honey-possum *Tarsipes rostratus* (Strahan, 1995). Similarly, the bats occur with such irregularity that it is unlikely that the full compliment of eight bats would occur at any one time. They are however, all likely to be present at some time.

The habitats comprising the Riverine and Mixed Woodland potentially support the richest mammal communities with 25 and 24 species respectively (Appendix D1). These habitats would provide the most cover for many of the mammals, and are also the least disturbed by agriculture. The less vegetated habitats of Open Farmland and Wetlands have 19 potential species each, while the Samphire Flats may support 17 species. Twelve of the native mammals, and all of the introduced species (except the Brown Rat *Rattus norvegicus)* are expected in all five habitats. This includes all of the bats.

3.6.2 Birds

Bird surveys of the project area recorded 73 species; 33 passerine and 40 non-passerine species. An expected list of 172 bird species from 47 families has been generated for the Peel Deviation project area (Appendix D2). This comprises 112 non-passerines and 60 passerines. The expected species list was generated from the following references: Blakers *et al.*, 1984; Pizzey, 1988; Simpson & Day, 1993; Slater *et al.*, 1991.

Many of the species listed as potentially occurring within the project area are unlikely to be found, however like some of the mammals, they cannot be ignored. Among the species unlikely to occur are the Australasian Bittern *Botaurus poiciloptilus,* Freckled Duck *Stictonetta naevosa,* Masked Owl *Tyto novaehollandiae* and Red-eared Firetail *Stagonopleura oculata.* In most cases these species are sufficiently rare, or the habitat is not really suitable (Blakers *et al.*, 1984).

The Wetlands and Riverine habitats have the potential to support the richest bird communities with 111 and 116 species respectively (Appendix D2). This is largely due to the abundance of waterbirds (including waders, ducks, herons *etc.)* in these diverse communities. The Mixed Woodland has a variety of microhabitats and niches and also has a reasonably large potential avifauna community of some 101 species. The less vegetated, and more disturbed Open Farmland and Samphire Flats habitats have less rich potential bird communities, with 86 and 68 species respectively. Twenty seven bird species potentially occur within all five habitat types. This includes all of the predominantly aerial raptors, swifts, swallows and martins.

Only one Scheduled bird species was observed, the White-tailed Black Cockatoo, *Calyptorhynchus baudinii* or *Calyptorhynchus latirostris.* This bird is discussed in more detail in Section 5.6.

3.6.3 Reptiles and Amphibians

Pit trapping and opportunistic collecting yielded 20 reptile and three frog species from the project area. A potential species list of 15 frogs (from two families) and 58 reptile species (from nine families) was generated for the Peel Deviation project area (Appendix D3). The reptilian fauna comprised 41 lizards (five families), 16 snakes (three families) and one tortoise.

Over the duration of the survey, several of the trapping grids yielded species which were thought unlikely to be collected. Examples of this were the juvenile Rosenberg's Monitor, *Varanus rosenbergi,* caught in an Elliott trap in the Riverine habitat (Site 5), and the skink *Ctenotus impar,* again recorded from Site 5. Some other species listed in Appendix D3 are relatively rare or usually exist in habitats dissimilar to those of the project area, however they have been included as specimens have been recorded in the area before. The Carpet Python *Morelia spilota imbricata* is an example.

The Wetlands and Riverine habitats potentially support rich herptile communities, largely due to the variety of frog species which may occur in these damp habitats (Appendix D3). The Mixed Woodland also has a large potential herpetofauna community with some 55 species. The disturbed Open Farmland habitat may

have around half the number of herptiles as the previous habitats, while the Samphire Flats are likely to be suitable habitat for only 16 species. Twelve reptile species potentially occur in all five habitat types. This includes predominantly mobile predators (monitors Varanus species, Tiger Snake *Notechis ater*, Dugite *Pseudonaja affinis*) and common species such as *Cryptoblepharus plagiocephalus* and Bobtail *Trachydosaurus rugosus*.

3.6.4 Fishes

There are six species of fishes (from six families) likely to be encountered in the waterbodies of the Peel Deviation project area (Allen, 1989) (Appendix D4). One of these, the Mosquitofish *Gambusia affinis*, is introduced. All species are expected to be found in the Riverine habitat (RV), and the Swan River Goby *Pseudogobius olorum* and *Gambusia affinis* may also occur in the still waters of the Wetlands (WL) habitat.

3.6.5 Rare And Specially Protected Fauna

Fauna species which have been formally recognised as rare, threatened with extinction or as having high conservation value are protected by law under the Western Australian Wildlife Conservation Act 1950. Classification of rare and endangered fauna under the Wildlife Conservation (Specially Protected Fauna) Notice 1996 recognises four distinct schedules;

(a) Schedule 1 "are fauna which is rare or are likely to become extinct, are declared to be fauna in need of special protection";

(b) Schedule 2 "are fauna which is presumed to be extinct, are declared to be fauna that is in need of special protection";

(c) Schedule 3 "are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection"; and

(d) "Schedule 4 are declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned in paragraphs (a), (b) and (c)."

Schedule 1
Six Schedule 1 species potentially occur in the Peel Deviation study area and two of these, the Southern Brown Bandicoot and a White Tailed Black Cockatoo, were recorded during the field survey.

Southern Brown Bandicoot *Isoodon obesulus fusciventer*. The Southern Brown Bandicoot has undergone a range contraction due to land clearance and introduced predators such as the fox (Strahan, 1995). The species prefers scrubby habitats or areas with low ground cover that are burnt relatively frequently as this promotes an abundant supply of insect food.

Two individuals of this species were found during the study period. The first individual was captured in a Tomahawk trap in Swamp Site 4 and the second was captured in an Elliott trap in the mixed woodland of Site 4. The Northern 1.5 alignment does not directly impact on the Nambeelup Brook site, secondary impacts are discussed in Section 5.2.2.

White-tailed Black Cockatoo: Baudins Black Cockatoo *Calyptorhynchus baudinii* and Carnaby's Black Cockatoo *Calyptorhynchus latirostris*. White-tailed Black Cockatoos have diminished in range since European settlement but are unlikely to become rare. Both species are endemic to the South-west of Western Australia. Baudins Black Cockatoo breeds in country with a mean annual rainfall exceeding 750 mm, however Carnaby's Black Cockatoo prefers to breed in regions with rainfall less than 750 mm. Both species are known to inhabit the Peel region. Due to the similarity of both species of White-tailed Black Cockatoos, the individual observed during the survey was unable to be identified to specific level. This species is not expected to be affected by the proposed development.

The remaining four species which potentially occur, but were not recorded during the survey are:

(i) Chuditch *Dasyurus geoffroii.* It is generally quite uncommon throughout the remainder of its range and unlikely (although possible) to be encountered in the project area.

(ii) Australasian Bittern *Botaurus poiciloptilus.* This bird is extremely uncommon in the South-west and habitats within the Peel Deviation are probably not optimal.

(iii) Freckled Duck *Stictonetta naevosa.* It is uncommon in the South-west and habitats within the Peel Deviation are probably not optimal.

(iv) Western Long-billed Corella *Cacatua pastinator pastinator.* It may be an uncommon visitor to the study area.

Schedule 2
No Schedule 2 species potentially occur in the Peel Deviation study area.

Schedule 3
No Schedule 3 species are expected to occur in the Peel Deviation study area.

Schedule 4
Two Schedule 4 species potentially occur in the Peel Deviation study area. None of these species were recorded, and they are not expected to be affected by the proposed development.

Peregrine Falcon *Falco peregrinus.* The Peregrine Falcon is uncommon but widespread throughout Australia.

Carpet Python *Morelia spilota imbricata.* Although no specimens were recorded during the survey, local farmers residing in the Lake Clifton area, adjacent to Site 1, have reported sightings in the State forest and on their own properties (Tyler, pers. comm.).

A range of migratory species are protected under various international agreements, including the Japan and Australia Migratory Bird Agreement (JAMBA), the China and Australia Migratory Bird Agreement (CAMBA), and the Australian New Zealand Environment and Conservation Council (ANZECC) List of Endangered Vertebrate Fauna. These include Cattle Egret *Ardeola ibis,* Great Egret *Ardea alba*, Glossy Ibis *Plegadis falcinellus*, Grey Plover *Pluvialis squatarola*, Hooded Plover *Charadrius rubricollis*, Wood Sandpiper *Tringa glareola*, Common Sandpiper *Actitis hypoleucos*, Greenshank *Tringa nebularia*, Marsh Sandpiper *Tringa stagnatilis*, Sharp-tailed Sandpiper *Calidris acuminata*, Red-necked Stint *Calidris ruficollis*, Long-toed Stint *Calidris subminuta*, Curlew Sandpiper *Calidris ferruginea*, Oriental Pratincole *Glareola maldivarum*, Fork-tailed Swift *Apus pacificus*, Rainbow Bee-eater *Merops ornatus.* Most of these species are waders which use the nearby Lake McLarty, and may stop briefly in the swampy areas. These and other possible (unlisted) species are visitors which would not be greatly affected by the proposed deviation.

3.7 WETLANDS AND EPP LAKES

The wetlands of the Swan Coastal Plain have been mapped by the Water and Rivers Commission, based on the Geomorphic Wetland Classification System developed by Semeniuk (1987). Four main wetland categories have been defined:

(i) Basin wetlands; includes lakes, swamplands, damplands and artificial basins;

(ii) Flat wetlands; such as floodplains and palusplain;

(iii) Channel wetlands; rivers, creeks and drains; and

(iv) Estuary wetlands; estuarine water body and peripheral marshes.

The Pinjarra Plain has been referred to as one large wetland (EPA, 1993a) and consequently, the Peel Deviation corridor has been mapped as a flat wetland; predominantly consisting of river floodplains and palusplain (Semeniuk, 1987). A palusplain is an area that is seasonally waterlogged, while a floodplain is seasonally inundated.

The Peel Deviation study area palusplain is a result of the clay soils impeding infiltration of rainwater. The waterlogging is rain dependant, and therefore the palusplains dry out soon after winter rains cease (Balla, 1994). The region has not been allocated a management category under the evaluation system of the Water and Rivers Commission, however due to the extent of clearing and level of agricultural use, the palusplain would be likely to be classified as a Sustainable Use - Multiple Use wetland. The management objective of these wetlands is that use, development and management should be considered in the context of water (catchment/strategic drainage planning), town (land use) and environmental planning through landcare.

Wetlands on the Swan Coastal Plain may also be classified under the Environmental Protection (Swan Coastal Plain Lakes) Policy to afford protection of the environment as a habitat. The purpose of the policy (EPA, 1992) is to protect the environmental value of lakes on the Swan Coastal Plain. The policy designates beneficial uses, and prohibits activities which may cause adverse environmental impact to these areas without the approval of the EPA. There is in excess of 150 EPP listed wetlands in a 10 km wide belt surrounding the proposed alignment of the Peel Deviation. EPP lakes in close proximity to the preferred alignment for the Peel Deviation are illustrated in Figures 6A - 6C.

Additional recognition of the environmental value of wetland areas can occur through listing under the Ramsar Convention, which is a convention on wetlands of international importance. The objective of the Ramsar Convention is to promote wetland conservation, monitoring, management and use. The Peel - Yalgorup system has been classified as a Ramsar wetland, and is therefore of international significance. The wetland area of the Peel - Yalgorup system extends to high water mark; the Ramsar area includes the Peel Inlet, Harvey Estuary, the Yalgorup Lakes, Lake McLarty and Lake Mealup (Department of Conservation and Land Management, 1990).

3.8 SYSTEM 6 AREAS AND CONSERVATION RESERVES

Many of the wetlands and areas of remnant vegetation are affected by System 6 Red Book recommendations (Department of Conservation & Environment, 1983). The System 6 study identified areas considered to have conservation value and provided specific recommendations on issues of land ownership and reserve vesting, land use, and ongoing management for all nominated sites.

The System 6 areas in the vicinity of the proposed Peel Deviation include the Goegrup Lakes (M108), the Peel Inlet (C50), the Harvey Estuary (C51), Lakes McLarty and Mealup (C52), Yalgorup National Park (C54), Clifton Management Priority Area (C55), and McLarty Management Priority Area (C56). The Peel Deviation alignment will cross or be adjacent to the following System 6 areas, as described in the System 6 Recommendations (Department of Conservation and Environment, 1983; EPA, 1993b):

(i) Goegrup Lakes (M108)
The Goegrup Lakes area contains reserves vested for public recreation. It is noted as a habitat for water fowl and breeding ground for aquatic fauna. The area is noted as being open space of regional significance due to its high conservation and recreation values. The System 6 report noted the potential for impact from the Perth - Bunbury Highway.

(ii) Clifton Management Priority Area (C55)
The management priority designated by CALM for the Clifton Management Priority Area (MPA) is for conservation of flora, fauna and landscape. The requirement for widening of Old Coast Road was acknowledged as a pressure for this area. The Clifton MPA is noted for the Tuart (*Eucalyptus gomphocephala*) and Peppermint (*Agonis flexuosa*) woodland. The System 6 areas C54, C55, and C56 are the only areas where this woodland is reserved for conservation in the Darling System.

(iii) McLarty Management Priority Area (C56)
The McLarty MPA is also managed for the conservation of flora, fauna and landscape, and contains extensive stands of Tuart/peppermint woodland suitable for reservation.

(iv) Yalgorup National Park (C54)
Yalgorup National Park consists of reserve for National Parks and recreation. It was noted for its populations of grey kangaroos, emus and brush wallabies. The potential for the Perth - Bunbury Highway and widening of the Old Coast Road were acknowledged as pressures for this area. The Park represents significant regional open space due to high conservation and recreation values.

In addition to the areas nominated at System 6 Reserves, the Kooljerrenup Nature Reserve (A↑22756) occurs to the west of the Peel Deviation corridor. Areas of State Forest at the southern end of the alignment, east of Old Coast Road, have been identified as being suitable for inclusion into Yalgorup National Park (CALM, 1995).

Locations of System 6 and Conservation Reserves are illustrated in Figures 6A - 6C.

3.9 LAND USE

Land use planning for the area has been undertaken through the Peel Regional Strategy (Department of Planning & Urban Development [DPUD], 1994) and most recently the Inner Peel Region Structure Plan (Ministry for Planning, 1996). Land use proposed under the Structure Plan is shown in Figure 6. As can be seen, rural land use predominates. Areas of existing and / or proposed more intense human settlement (*i.e.* residential, special rural and tourist/recreational development) focus upon the following areas;

- effectively all of the City of Mandurah north of the Florida-Melros localities;
- localities extending from Dawesville to Point Repose along the western shore of the Harvey Estuary;
- the north-western extremity of the Shire of Murray (encompassing the localities of Parklands, Barragup, Furnissdale, North and South Yunderup and Ravenswood);
- Pinjarra;
- Point Grey; and
- lands at the southern extremity of Harvey Estuary within the Shire of Waroona.

Conservation is also a significant land use within the study area, the principal features in this context being:

- the proposed Peel Regional Park encompassing the lower reaches of the Serpentine River, much of Goegrup Lake, all of Black Lake, Lakes Mealup and McLarty and the Peel - Harvey Estuary;
- proposed Regional Open Space encompassing the lower reaches of the Serpentine River;
- proposed Regional Open Space and various Land Act Reserves along the eastern shores of the Peel - Harvey Estuary;
- the Nine Mile Lake Nature Reserve; and
- Yalgorup National Park (and the proposed additions thereto).

The Inner Peel Region Structure Plan indicates that at its northern extent, the Peel Deviation alignment traverses the Future Urban areas of Murray Lakes, and Open Space for Conservation (proposals for inclusion into the Peel Regional Park). The remainder of the alignment traverses land to be zoned as Rural - Broadacre.

3.10 POLICY AND PLANNING STRATEGIES

3.10.1 Peel Regional Strategy

The Peel Regional Strategy was finalised and released in September 1994 (DPUD, 1994) with the aim of assisting the Peel Region in the management of economic and social development and the sustainable use of natural resources. The Perth-Bunbury Highway constitutes a Regional Matter under this Strategy as it affects more than one local authority.

The Primary Environmental Objective specified under the Peel Regional Strategy, which is directly applicable to the Peel Deviation project is: "to conserve the natural systems, resources and special features of the Peel Region and to enhance its landscape values.". This objective incorporates maintenance of species diversity, maintenance or improvement of water quality, soil conservation, protection of landscape features and maintenance of atmospheric quality.

The Peel Regional Strategy also documents regional objectives for transport. An objective of the strategy was to select a route and prepare the required environmental reports for the extension of the Perth - Bunbury Highway in consultation with other agencies and local government in the region. The RAD and this PER independently form the documentation for this objective of the Peel Regional Strategy.

3.10.2 Inner Peel Region Structure Plan

The Inner Peel Region (Draft) Structure Plan (Ministry for Planning, 1996) covers the Mandurah - Pinjarra and Point Grey areas within the Peel Region (Figure 7). The Structure Plan consists of a review of the Peel Regional Strategy and Draft Peel Regional Park Report (DPUD,1993a) and will effectively supersede the Peel Regional Strategy when finalised. The Structure Plan represents a move towards more precise planning in terms of future land use as opposed to the more conceptual level of planning provided by a strategy. The Inner Peel Region includes the study area for the Peel Deviation proposal.

One of the main objectives of the Structure Plan is to: "Identify and define land requirements for major infrastructure corridors, including regional open space required within the area in the future." The Structure Plan is one of a number of studies contributing to the long-term planning of major transportation routes.

The Inner Peel Region Structure Plan incorporated an indicative alignment for the Peel Deviation as proposed within the RAD Report (*ecologia*, 1996). The alignment subject to assessment within this PER supercedes the alignment illustrated within the Structure Plan.

The Structure Plan discusses three options for future urban development in the Peel Region. In relation to the land use proposed surrounding the Peel Deviation, the predominant land use remains rural under each of the three options. The Peel Deviation would pass through the proposed Peel Regional Park, incorporating the Yalgorup National Park, at its southern extremity. One additional area of Future Urban land is allowed for at Murray Lakes under the highest population scenario for the region. The northern section of the Peel Deviation is allocated as Greenbelt Rural Living, and the area around Lakes Road, to the east of the Peel Deviation is classified industrial (existing and future).

The Inner Peel Region Structure Plan concludes that the topography and soils to the east of the Peel - Harvey System are not suited for urban development, especially in relation to drainage and sewerage requirements under SPP No 2 (Refer to Section 3.10.3). The Structure Plan also recommends avoidance of fragmentation of agricultural areas through subdivision. It is anticipated that future urban development is to be concentrated to the west of the Peel - Harvey System, and possibly in the Amarillo area.

EPP Wetlands

Conservation Reserve

System 6 Areas

DRAINS

Aboriginal Ethnographic Site

Barragup/Furnisdale Bridle Trail

M108

C50

PATERSON ROAD

ROGERS ROAD

OLD MANDURAH ROAD

PINJARRA ROAD

GREY ROAD

FIEGIRTS ROAD

LAKES ROAD

STOCK ROUTE ROAD

NAMBEELUP BROOK

SERPENTINE RIVER

MURRAY RIVER

STAKE HILL BRIDGE

GOEGRUP LAKE

PEEL INLET

126351

14990

128087 AUSTIN NATURE RESERVE

Figure 6a: Areas of Biophysical and Social Significance in the Peel Deviation Project Area

Metres

0 500 1000 1500 2000

SCALE 1:50000

EPP Wetlands

Conservation Reserve

System 6 Areas

DRAINS

10th Light Horse Memorial Bridle Trail

GREEN ANDS ROAD

PAUL ROAD

MARSH ROAD

ROAD

DAILEY ROAD

THOMPSON ROAD

BIRCHMONT ROAD

OLD BUNBURY ROAD

COOLUP DRAIN

SOUTH HILL ROAD

HERRON PT RD

MILLS ROAD

LAKE MEALUP ROAD

124036

128087
AUSTIN BAY
NATURE
RESERVE

C50

C51

C52

PEEL
INLET

12707

LAKE MEALUP
A16627

LAKE McLARTY
A139404

A124739

KOOLJERRERUP
NATURE RESERVE
A123756

CONSERVATION OF FLORA & FAUNA
A123756

HARVEY ESTUARY

Figure 6b: Areas of Biophysical and Social Significance in the Peel Deviation Project Area

Metres
0 500 1000 1500 2000

SCALE 1:50000

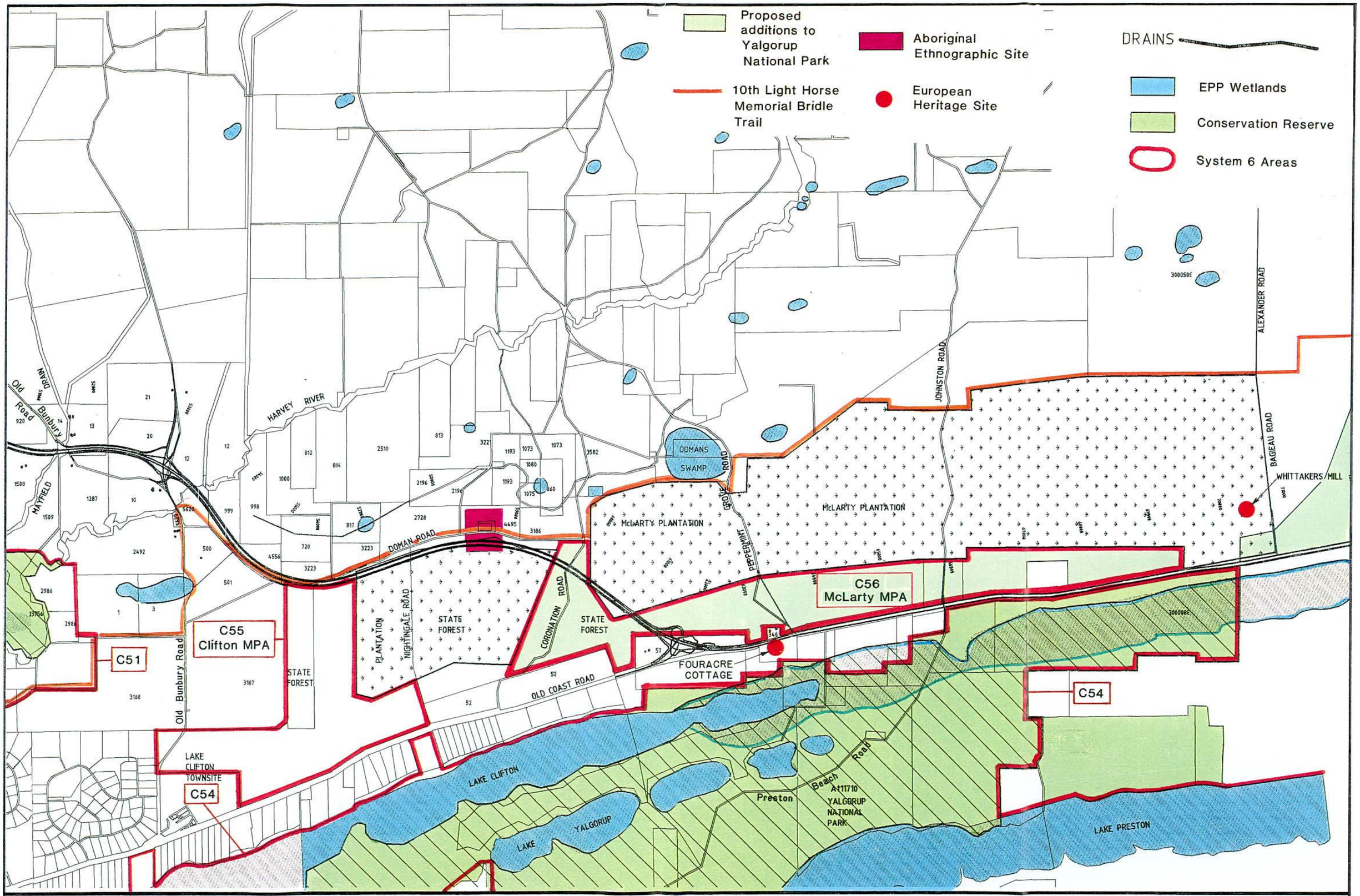


Figure 6c: Areas of Biophysical and Social Significance in the Peel Deviation Project Area

Metres
0 500 1000 1500 2000

SCALE 1:50000

The Structure Plan provides the basis for formulating and promulgating a regional town planning scheme for the Peel Region under recent amendments to the Town Planning and Development Act 1928, which allow such regional town planning schemes be developed. The Peel Deviation will therefore be indicated within the Peel Region Scheme in addition to inclusion within local Town Planning Schemes. The Peel Region Scheme will be subject to environmental assessment under recent amendments to the planning legislation and the Environmental Protection Act 1986.

3.10.3 Statement Of Planning Policy (Peel - Harvey Coastal Plain Catchment) 1992

The Statement of Planning Policy No. 2 (SPP No. 2) The Peel - Harvey Coastal Plain Catchment was declared in 1992 under the Town Planning and Development Act 1928. The policy applies to all residential, commercial, industrial, rural and recreation land uses and public sector undertakings within the Peel catchment located on the Swan Coastal Plain (Figure 8). An overall policy objective is to improve the social, economic, ecological, aesthetic, and recreational potential of the Peel-Harvey Coastal Plain Catchment.
General policy provisions apply to changes in land use and construction of buildings in the policy area. Provisions under SPP No. 2 relate to vegetation clearing, requirements for sewerage, site drainage and water supply. The content of the policy is most applicable to regulating urban development to prevent input of nutrients into the Peel - Harvey System.

The drainage management requirements of this policy are relevant to the Peel Deviation proposal in respect to the system developed to manage road runoff.

3.10.4 Environmental Protection Policy (Peel - Harvey Estuarine System) 1992

The Environmental Protection Policy (Peel - Harvey Estuarine System) 1992 (EPP) is enacted under the Environmental Protection Act 1986, with the purpose of setting out and achieving environmental quality objectives concerning nutrient loading of the Peel - Harvey system. The EPP enforces the provisions of SPP No. 2.

3.11 CULTURAL HERITAGE

3.11.1 Aboriginal Heritage Sites

An archival search was conducted to establish the location and description of previously recorded Aboriginal sites within the vicinity of the survey corridor. This involved a search of the Culture and Heritage Division of the Aboriginal Affairs Department's Aboriginal Site Register and a study of relevant files and survey reports. The majority of the registered Aboriginal sites of the Peel Region are located around the Harvey Estuary. Of these, most comprise stone artefact scatters (O'Connor *et al.*, 1985; O'Connor *et al.*, 1988).

Studies into the location of Aboriginal heritage sites by archaeological survey (Quartermaine Consultants, 1995) and ethnographic survey (O'Connor, 1995) were commissioned for the Peel Deviation project.

The closest sites to the survey area are S0185 Stake Hill Bridge artefact scatter and S0328 Lake Clifton artefact scatter located along the Old Coast Road. These sites were recorded in the mid 1970s and have probably either been collected or disturbed by development. No newly recorded archaeological sites were located during the field survey of the proposed alignment (Quartermaine Consultants, 1995).

In terms of ethnographic significance, only two sites were located within the vicinity of the Peel Deviation; Sites S2844 and S2226 are near Barragup and Goegrup Lakes respectively.

Consultation with Aboriginal elders has highlighted six other sites with ethnographic significance (O'Connor, 1995, O'Connor, 1996).

(1) Fiegirts Road: Fiegirts Road Camp and Water-source occurs approximately 200 metres east of the proposed route and is an area which was used by the Pinjarra people as a camping ground and water reserve.

(2) Murray River: The Yunderup Aboriginal Site occurs near where the proposed alignment crosses the Murray River and a swampy region is separated from the 'mainland' by a small creek. This area was a favoured Black Bream fishing hole of the Ravenswood people.

(3) Doman Road: The Doman Road Camp and Water-source occurs 1.5 km north of the intersection with Coronation Road. The site was a water reserve and camping area

(4) Scorpion Camp: Scorpion Camp is a former camping area, located 700 m south-west of the point where the Peel Deviation will cross the Harvey River.

(5) Tuart Tree: A large unusually shaped Tuart tree is located approximately 500 m north-west of the Coronation Road/Doman Road junction. The tree and the grove of peppermint trees surrounding it constitute an area of spiritual significance, as a site of meditation.

(6) Cave Site: A cave site is located north of Peppermint Grove Road and 700 m east of the proposed alignment, and is considered to be of historical significance as a place of concealment and refuge.

3.11.2 European Heritage Sites

There are two sites and a bridle trail which may be considered of European heritage value.

The Heritage Council of Western Australia is aware of Fouracres Cottage (a.k.a. Peppermint Grove Cottage) and has the structure listed as "ruins" (Figure 6C). The site is now included on the Shire of Waroona's Municipal Inventory Register. The preferred alignment of the Peel Deviation does not impact this site.

The second site is Whittakers Mill, which is currently a recreation site on the eastern side of Old Coast Road immediately north of the intersection with Bagieau Road where the study area ends (Figure 6C). Duplication of the Old Coast Road will not impinge on this site.

A bridle trail of heritage value which was utilised historically by the Australian 10th Light Horse Brigade during training exercises occurs within the study area. The trail runs parallel to the Old Coast Road south from the south-western corner of the Harvey Estuary along Southern Estuary, Doman, Centre Break and Runnymeade Roads ending at Wellesley Road (Figures 6B & 6C). The 60 km trail is currently in use by members of the Yalgorup Recreational Horse Riders Association, and Peel Horseback Adventures; an ecotourism venture.

3.11.3 Recreation Activities

Horse riding is a significant pursuit within the Peel Region, leading to the formation of two interest groups. The Peel Equestrian Association and the Yalgorup Recreational Horse Riders Association Incorporated. These groups have supplied information on bridle trails in the project area which are used by local horse riders, as well as for tourism-based trail rides.

Bridle trails within the area are shown on Figures 6A - 6C.

3.11.4 Visual Amenity

The study area falls within the Coastal Plain Landscape Character Type. Allocation of scenic quality occurs according to specified criteria according to landform, vegetation and waterform criteria developed by the (DPUD 1993b). As scenic quality is relative, the assessment criteria are based on a value judgement that scenic worth (quality) increases:

- with ruggedness and relative landscape relief;
- with the presence of water forms, water edges and water areas;
- as vegetative patterns become more diverse;
- as natural and agricultural landscapes increase; and
- as human-made landscapes decrease.

The criteria are separated into categories of High, Moderate or Low Scenic Quality. Although the alignment can be categorised on the basic criteria, scenic quality also varies according to the distance from which the affected site is viewed, public perception of alteration to the landscape, and the nature of the proposed alteration to the landscape.

Because of its predominantly rural character, the low-lying nature of the topography, and the relatively small area of impact, the majority of the area traversed by the proposed Peel Deviation route can be regarded as having low to medium landscape value. Areas of high landscape value occur where the alignment crosses or runs adjacent to water bodies or significant stands of native vegetation. The proposed additions to Yalgorup National Park is considered to have high scenic quality according to the management plan for that area (CALM, 1995).

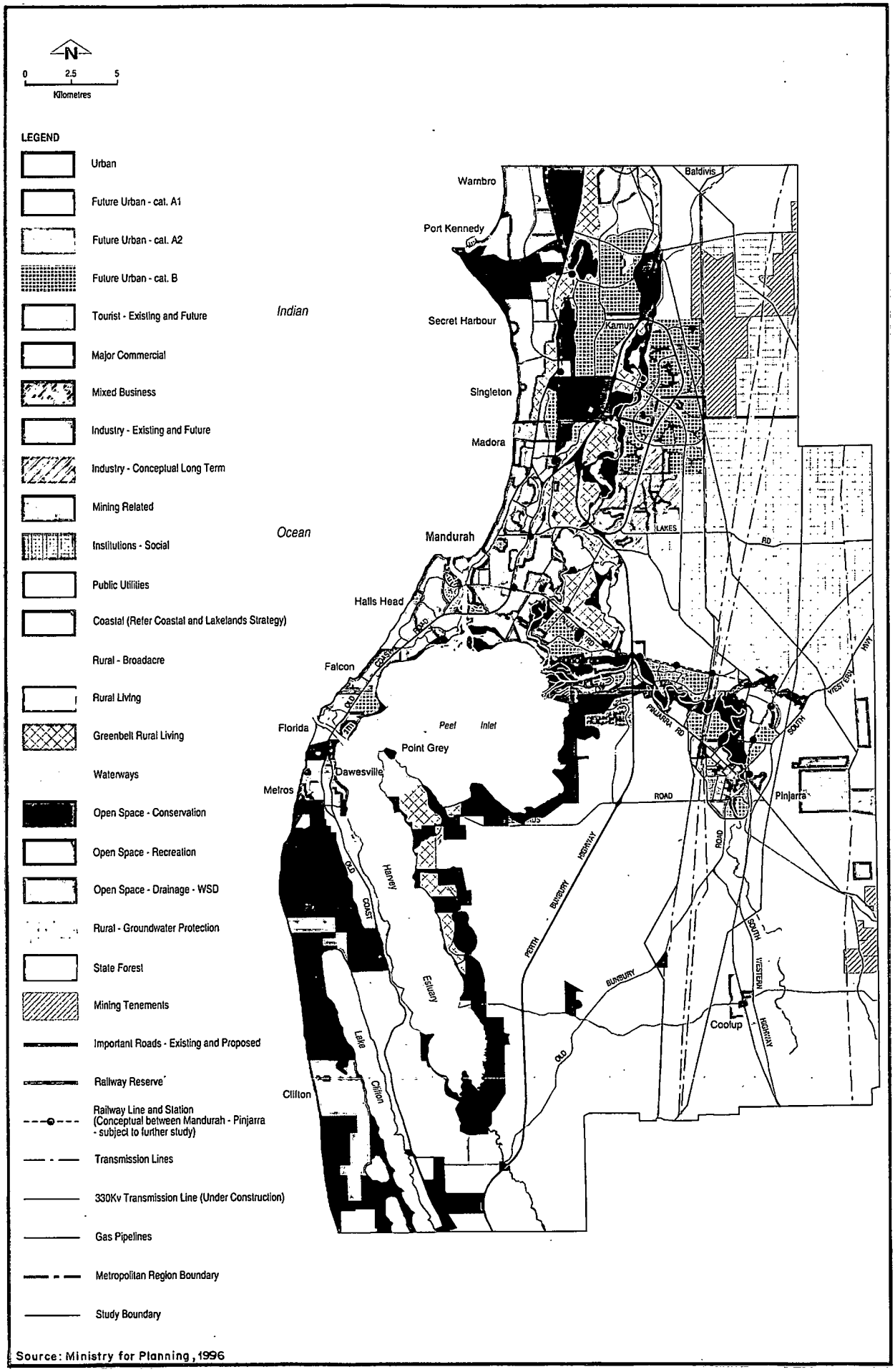
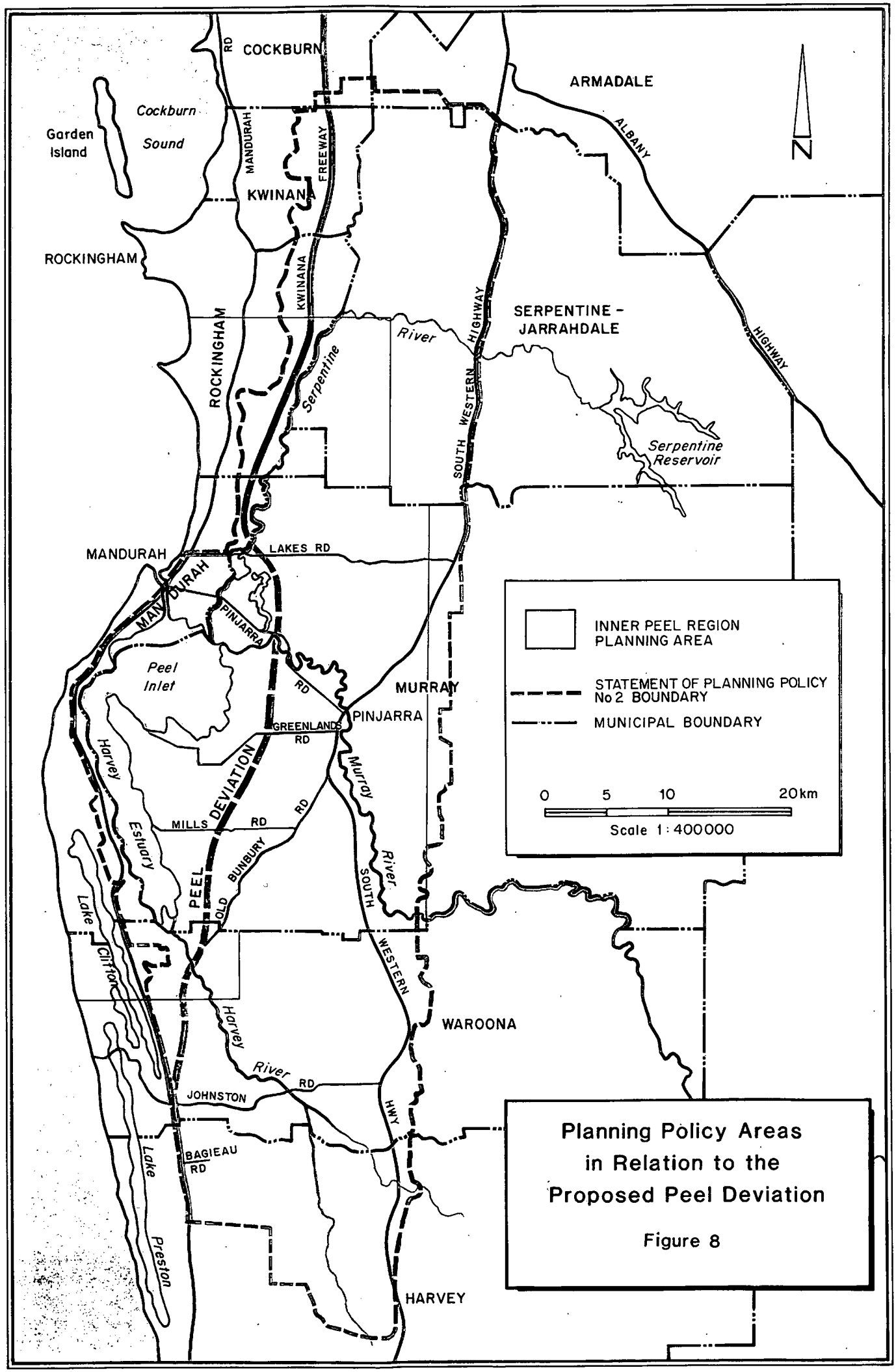


Figure 7: **Inner Peel Region Structure Plan**



Planning Policy Areas in Relation to the Proposed Peel Deviation

Figure 8

4.0 PUBLIC CONSULTATION

4.1 OBJECTIVE

To date, the Public Consultation programme for the Peel Deviation project has occurred in two phases. The first phase was initiated at the commencement of the road alignment definition study and was to assist in the definition of a preferred alignment from the range of options considered. The objective of the second phase was to elicit reaction from the community on the preferred alignment and obtain community input for the preparation of the PER.

4.2 PHASE 1 CONSULTATION

4.2.1 Aims

The aims of the first phase of the consultation process were to:

- liaise with State and Local Government agencies potentially affected by the Peel Deviation;
- maintain contact with affected landowners;
- provide information to the community regarding progress of the Peel Deviation study; and
- identify the impacts of the proposed route.

4.2.2 Method

The first phase of consultation process comprised:

- establishment of a Consultative Liaison Group (CLG) comprising State and Local Government agencies, and representatives of community groups, to facilitate the transfer of information;
- regular meetings of the CLG to discuss the overall project;
- distribution of an information brochure to affected landowners and other relevant individuals and community based groups;
- personal contact with affected landholders to obtain local knowledge on opportunities and constraints;
- utilisation of the local press to disseminate information about the study; and
- presentation of a public information display within the study area, including unstaffed displays of a week's duration in Waroona and Pinjarra (the final day of the display in Pinjarra was also staffed), followed by a staffed display of one day's duration in Mandurah.

4.2.3 Results

The initial phase of the consultation programme prompted some 15 verbal and 64 written responses. Issues raised in the responses received and the number of respondents raising these issues are summarised in Table 4.

The responses received demonstrated a degree of support for the Peel Deviation route. However comment questioning the proposed route alignments was predominant. The main issues raised by members of the public during the initial phase of the consultation process were:

- a preference for upgrading of the South Western Highway and Old Coast Road route rather than the development of a new road corridor;
- desire for a modified alignment to be located east of the Serpentine River, to run through Amarillo;

- concern over the impact of the Peel Deviation on wetlands listed either under the Ramsar convention, or classified as EPP wetlands;
- concern over potential impact on species of flora and fauna within the road alignment;
- severance and disruption of existing farming activities, and intrusion upon farm buildings;
- traffic noise generated and resultant impact on nearby residents; and
- concern that the Peel Deviation would lead to further development on the eastern side of the Peel - Harvey Inlet.

The local environmental groups were among those expressing opposition to the Peel Deviation route (essentially for the reasons outlined above) and indicated their intention to lobby the broader environmental community to also oppose the proposed route.

Concerns about the proposed route have been raised by residents in the Parklands and Murray Lakes areas (wherein the reserve for the proposed route has been created through surrounding subdivisions) in relation to noise impact. Comments in this regard include claims that prospective purchasers were not made aware of the proposed route's existence. However, other comment received during the consultation process suggests that landowners were made aware of the route at the time of seeking a licence to construct a building on their property.

4.3 PHASE 2 CONSULTATION

4.3.1 Aims

The objective of the second phase of the community consultation process was to provide information about the preferred alignment selected for the Peel Deviation and seek comment on it, particularly from directly affected landholders, but also from the general public. The intention in so doing was to obtain feedback that would assist in the development of design and management strategies to ameliorate consequent impacts.

4.3.2 Methods

The second phase of the consultation process commenced in December 1995, but its duration was extended due to protracted investigations to refine the northern and southern extremities of the preferred alignment.

In addition to continuing the CLG meetings, and ongoing information dissemination and interaction with affected individuals, community groups, Local and State Government bodies, and other interested parties, this phase of the consultation programme also included:

- general distribution of an information brochure (with reply paid response proforma);
- specific correspondence with landowners whose properties were directly affected by the preferred alignment;
- follow-up site meetings with landowners if requested;
- public information displays at Mandurah, Waroona and Pinjarra libraries; and
- written replies to submissions received as requested.

Table 4: Summary of issues from First Phase of Consultation.

ISSUE	NUMBER OF TIMES RAISED
Preferred Route Option	
Northern 1	0
Northern 2	1
Central	1
Southern 1	2
Southern 2	3
Southern 3	2
Southern 3A	0
Southern 4	0
Upgrade SW Highway/Old Coast Road	28
Suggested modified alignment	25
Endorse but no option specified	4
Opposed but no option specified	3
No preference specified	7
Social Issues	
Problem of increased traffic through Pinjarra	4
Effect on private property	14
Reduction in farming land	6
Effect on existing community	8
Devaluation of land/businesses	5
Other land resumption issues	5
Disruption to current planning	3
Environmental Issues	
Impact on wetlands/international significance	32
Further attrition of System 6 Estate	1
Impact on wildlife and flora	19
Effect of consequent development	10
Effect on past/current revegetation	11
Additional pollution	7
Risk from haulage of toxic chemicals	4
Possible damage to stromatolites	3
Other environmental damage	14
Hydrocarbon runoff and drainage problems	5
Swampland can encourage vermin/disease	1
Other	
Upgrade will be more cost/resource efficient	7
Additional bridge unnecessary	5
Additional road unnecessary	3
Concern over limited response time/consultation	3
Concern over 2 stage development	2
No guarantee of freeway construction in 50 yrs	1
Greater tourism appeal if wetlands protected	1
Importance of more efficient highways	1
Requests for further information only	5
Request to be added to mailing list only	4

4.3.3 Results

The mailout to affected landholders resulted in 18 telephone enquiries. A total of 15 of these enquiries were followed by an on-site meeting with landowners.

The public information displays were attended by approximately 36 people. Additionally, a total of 26 written submissions were received (one of which was accompanied by a 35 signature petition). Of these submissions, 20 sought a written response, which was subsequently provided.

Issues raised during the information displays, the site meetings with landowners, and in the written submissions received are summarised in Table 5. The number of times a particular issue was raised in indicated in the table. It is to be noted that most people who provided comment (either through the information displays, site meetings or written submissions) raised multiple issues. It also needs to be noted that a number of people provided input through more than one of the available mechanisms.

4.4 DISCUSSION

A comparison of Tables 4 & 5 indicates the similarity of issues raised during both phases of the consultation process. Many of the issues raised during the second phase of consultation have in fact been addressed in assessing the various route options considered in selection of the preferred alignment.

Although the expressions of support for the proposed route are a valid comment on the proposal, other than noting them, little of significance can be inferred in terms of the overall study. While there are seven clear statements of support, most of the remaining submissions indicated some degree of negativity towards the proposal. This is however understandable, in that consultation was intentionally (and appropriately) focused to those most directly affected by the preferred alignment.

Benefits arising from the proposed route will accrue essentially to the broader (regional) communities and it is therefore likely than an expanded consultation area would have identified a greater level of support for the project. However, doing so would diminish the validity of the consultation process. The purpose of the process was to provide opportunities for those most directly affected by the proposal to contribute towards selection of the preferred alignment and to identify issues / concerns that need to be addressed in managing the direct impacts of the proposal on local landowners.

While issues relating to the need and / or justification for the proposed Peel Deviation were raised in comments received during the second phase of consultation, these were substantially more prominent in submissions from the earlier phase of the consultation process. This is understandable given that the earlier phase of consultation served as part of the preferred alignment selection process.

Table 5: Summary of Issues From Second Phase Consultation.

ISSUE	NUMBER OF TIMES RAISED			
	Information Displays	Site Meeting	Written Comment	TOTAL
1.0 General Attitude Towards Peel Deviation				
1.1 General Support		1	2	3
1.2 Qualified Support			4	4
1.3 General Opposition		3	2	5
1.4 Qualified Opposition			2	2
2.0 *Need For Proposed New Route*				
2.1 Justification Questioned		2		2
2.2 Alternatives				
• upgrade existing N-S routes	1	3	3	7
• upgrade/provide rail/public transport services			3	3
• localised realignment suggested		4	5	9
• general			1	1
3.0 *Biological Impacts*				
3.1 Flora/Fauna		1	9	10
3.2 Wetlands	2		4	6
3.3 Increased Access will Promote Development, Compounding (Biological) Impacts			2	2
3.4 Environment takes Precedence over People		3		3
4.0 *Severance Impacts*				
4.1 Disruption of Local Areas				
• road network/movement patterns	4	7	8	19
• bridle trails		1	7*	8
4.2 Disruption of Existing Land Use				
• direct loss of land	2	4	4	10
• loss of high ground/potential building sites	1		1	2
• loss of subdivision potential		1		1
• severance of farm lands/farming operations		8	3	11
• dislocation of farming infrastructure	2	3	2	7
• sterilisation of basic raw materials		2	2	4
• diminished economic viability	2	5	4	11
• reduced land values		3	1	4
• separate titles for "defacto" lots		2		2
5.0 *Spillover Effects From Proposed Route*				
5.1 Noise/Dust/Fumes/Vibration	1	1	8	10
5.2 Diminished Amenity	1	2	2	5
5.3 Visual Impact			1	1
6.0 *Compensation*				
6.1 Adequacy of Payment		2		2
6.2 Timing of Payment		2		2
6.3 General		5		5
7.0 *Other Issues*				
7.1 Use of Existing Road Reserve no Longer Required			1	1
7.2 Adequacy of Information Available to Community			2	2
7.3 Intrusion Upon Aboriginal Site(s)			2	2
	17	**66**	**87**	**170**

* Letter accompanied by 35 signature petition treated as one submission.

5.0 ANTICIPATED ENVIRONMENTAL IMPACTS

5.1 GENERAL

During the early feasibility stages of the project, and utilising the PER guidelines issued by the EPA, the key topics identified are:

(1) Biophysical
- Terrestrial vegetation (significant vegetation, Declared rare flora, introduced flora, vegetation diseases);
- Terrestrial fauna (Declared rare fauna, significant fauna and habitat);
- Surface and ground water (surface water hydrology, water conservation);
- Wetlands (regionally significant wetlands); and

(2) Pollution Management
- Water quality (surface and ground water quality);
- Air quality (dust); and
- Noise and vibration.

(3) Social Surroundings
- Visual Impacts;
- Risk and Hazard (in reference to transport accidents); and
- Heritage (indigenous and non-indigenous cultures).

In addition to the key topics, a number of additional aspects of impact to the social environment are discussed, although they may fall outside the scope of the definition of environment under the Environmental Protection Act 1986. These topics relate to recreation, and social impacts arising from construction activities, and are provided as extra information on project management for members of the public as opposed to environmental topics requiring assessment by the EPA.

5.2 POTENTIAL IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

5.2.1 Terrestrial Vegetation

Vegetation in existing conservation estate

The Peel Deviation can be considered to impact on vegetation in existing conservation estate where it crosses System 6 areas. Vegetation types impacted are discussed below. The length of vegetation type impacted by the Peel Deviation is shown in brackets.

(i) Serpentine River crossing: The Serpentine River itself is a nominated System 6 area in its own right, with the classification being independent of conservation issues relating to vegetation. However, the fringing vegetation associations include small areas of *Melaleuca pauciflora* heath (150 m), samphire (100 m), *Kunzea ericifolia / Jacksonia furcellata* heath (50 m), and *Casuarina obesa / Melaleuca cuticularia* over *Melaleuca viminea* (100 m). A secondary impact on these vegetation types would be that of extent of shading provided by the bridge.

(ii) Clifton MPA: The Clifton MPA is designated for management for flora, fauna and landscape. It is noted for the Tuart / Peppermint woodland. The alignment of the proposed Peel Deviation runs adjacent to, or impinges on, the System 6 boundary for approximately 1 km. The vegetation type at this edge of the MPA is Banksia *attenuata /Eucalyptus marginata* woodland

(iii) McLarty MPA: The McLarty MPA is designated for management for flora, fauna and landscape. It is noted for the Tuart / Peppermint woodland. The alignment crosses approximately 750 m of *Banksia attenuata /Eucalyptus marginata* woodland. The duplication of Old Coast Road to Bagieau Road will occur to the east of the existing road, and will therefore encroach on the western boundary of the

McClarty MPA which contains *Eucalyptus gomphocephala/Agonis flexuosa* woodland. The southern portion of the alignment will affect a 5.6 km strip of this vegetation association.

Liaison with CALM has occurred in reference to the Peel Deviation alignment, and formal agreement has been received from the Department allowing for widening of the road reserve to allow construction of the second carriageway though the McLarty MPA, thus avoiding any direct impact on the existing Yalgorup National Park.

Regionally Significant Vegetation

Assessment of the significance of vegetation associations is determined through reference to the Reservation and Conservation status of Community Types defined by Gibson *et al.* (1994), and summarised in Table 6.

Table 6: Reservation and Conservation Status of Community Types in the Peel Deviation project area.

Community Type	Reservation Status	Conservation Status
3c	Well Reserved	Vulnerable
5	Well Reserved	Low Risk
7	Well Reserved	Vulnerable
9	Well Reserved	Vulnerable
11	Well Reserved	Low Risk
12	Well Reserved	Low Risk
14	Unreserved	Insufficiently Known
21a	Well Reserved	Low Risk
25	Poorly Reserved	Susceptible

Reservation Status is based upon the following definitions:

- Well Reserved: known from 2 or more A class National parks or Nature Reserves.
- Poorly Reserved: known from a single A class National park or Nature Reserve.
- Unreserved: not known to occur in any A class National park or Nature Reserve.

Conservation Status is based upon a ranking system, ranging from Presumed Destroyed to Insufficiently known:

- Presumed destroyed;
- Critical;
- Endangered;
- Vulnerable;
- Susceptible;
- Low Risk; and
- Insufficiently Known.

Based upon this classification, there are two Community Types which are either unreserved or poorly reserved, and which have a susceptible or insufficiently known conservation status. These occur as the Tuart / Peppermint woodland and the Eucalyptus and Paperbark associations at the river crossings and near Nambeelup Brook.

The Tuart / Peppermint woodland (Community Type 25) in the southern section of the project area may be considered to be regionally significant. This interpretation is based on the recommendation for the McClarty and Clifton MPAs to be included within the Yalgorup National Park on the basis that these are the only areas where this woodland is reserved for conservation in the System 6 (Darling System). This is discussed in the previous section concerning vegetation within the existing conservation estate. No other vegetation of regional significance is considered to occur within the proposed Peel Deviation corridor.

Locally Significant Vegetation

The loss of vegetation through clearing activities constitutes the principal biophysical impact from the construction of the proposed Peel Deviation project. The majority of the project area comprises land which has already been cleared of most natural vegetation, or has been significantly disturbed. Any remnant vegetation can therefore be classified as being locally significant. The impact of vegetation clearing is regarded as an impact on locally significant vegetation and is therefore an environmental factor requiring evaluation in assessment of this project.

Areas of remnant vegetation to be disturbed consist of vegetation associations that are generally well represented in the project area. The vegetation associations are represented within the System 6 areas, Yalgorup National Park and Kooljerrenup Nature Reserve. Areas that would be impacted by the construction of the preferred alignment for the Peel Deviation are summarised in Table 7. This table presents a worst case scenario of clearing of the whole road reserve, set at 100 m for the purposes of this analysis.

Table 7: Area of vegetation impacted by the Peel Deviation proposal.

Vegetation Associations	km Affected	Total Area (ha)
Cleared Land	41.9	439
Pine plantation	4.65	46.5
Eucalyptus calophylla over *Xanthorrhoea preissii* over mixed heath (C3c)	0.95	9.5
Kunzea ericifolia/Jacksonia furcellata heath (C 5)	1.06	10.6
Samphire (C 7)	0.10	1.0
Casuarina obesa/Melaleuca cuticularis over *Melaleuca viminea* (C 7)	0.12	1.2
Myrtaceous Heath (C 9)	0.12	1.2
Eucalyptus rudis/Melaleuca rhaphiophylla woodland (C 11)	0.82	8.2
Melaleuca rhaphiophylla/Melaleuca teretifolia heath (C 12)	0.40	4.0
Melaleuca pauciflora heath (C 14)	0.05	0.5
Banksia attenuata/Eucalyptus marginata woodland (C21a)	5.05	50.5
Eucalyptus gomphocephala/Agonis flexuosa woodland (C 25)	6.30	63.0

(C = Community Type Gibson *et. al* 1994)

A particular species has been highlighted by the WA Orchid Society as occurring within the road reserve of Old Coast Road at the southern extent of the project area. The orchid is the Tuart Rufous Greenhead (*Pterosylis* aff. *picta*) which is found only in the coastal strip between Mandurah and Bunbury under scattered Tuart and Peppermint, often in association with blackboys (Hoffman & Brown, 1992). The species occurs to the west and the east of the road. Populations to the east of the road may be impacted by the proposal.

Declared Rare Flora
The Priority 2 *Lasiopetalum membranaceum* was recorded within the *Eucalyptus gomphocephala / Agonis flexuosa* woodland vegetation type which is typical of the most southern portion of the Peel Deviation alignment. Development of this section of the alignment will involve duplication of the existing Old Coast Road. The single site at which *L. membranaceum* was recorded was located to the west of the Old Coast Road. As construction of the second carriageway is proposed on the east of the current road, no impact is anticipated to this species.

Non-endemic (Introduced) Vegetation
Construction activities within the project area have the potential to introduce and spread weed species between sites, particularly from areas of cleared farmland (which typically have an abundance of introduced species) to areas of native vegetation (which generally have lower levels of weed infestation). In this respect the areas of remnant vegetation most likely to be impacted include the vegetation at the Serpentine River crossing, and the southern extent of the deviation, where the alignment passes through State Forest.

Dieback Disease
It is likely that the northern and central sections of the Peel Deviation route are dieback infected due to the extent of clearing and the presence of dieback transport vectors. Introduction of dieback into the apparently dieback-free remnant vegetation between Doman Road and Old Coast Road has the potential to significantly alter the composition of the vegetation structure and therefore habitat types, as a result of the death of dieback susceptible species.

5.2.2 Terrestrial Fauna

The impact to fauna is generally secondary. There will be local impacts initially with loss of habitat and relocation of mobile species into adjacent habitats. The alignment predominantly occurs through pasture and is therefore not a habitat for regionally or locally significant fauna.

The construction of a new road can also sever movement corridors between areas of formerly contiguous vegetation. This may occur at the Serpentine River, Nambeelup Brook and Harvey River crossings - the extent of severance will depend upon the nature of the bridges at this location. Severance of movement corridors will also occur where the alignment crosses the eastern edges of the Clifton and McLarty MPAs. The proposed alignment will create a narrow isolated strip of remnant vegetation between the Peel Deviation and Doman Road. The alignment will also sever the McLarty MPA from the remaining State Forest to the north of the intersection of the Peel Deviation with Old Coast Road.

Increased traffic may cause localised death of larger mobile species, predominantly kangaroos and snakes. This is likely to be the main impact on fauna currently present in the study area.

Declared Rare Fauna
No direct impact to Scheduled rare fauna is expected from the Peel Deviation proposal. However, two fauna species protected under the Wildlife Conservation Act 1950 were recorded within the project area. The Schedule 1 Southern Brown Bandicoot was trapped at a swampy site (typical habitat for this species), associated with Nambeelup Brook. This area would have been impacted by development of the Northern 1 route option. The Northern 1.5 option will not impact on the core population area, however it is possible that the alignment may create a barrier to any movement along the fringing vegetation of Nambeelup Brook. This movement is likely to be occasional only.

A single Schedule 1 White-tailed Black Cockatoo was recorded from an area of Open Farmland, a habitat which is already significantly disturbed and largely cleared of natural vegetation.

Bird species protected under the JAMBA, CAMBA and the ANZECC List of Endangered Vertebrate Fauna are noted from the study area. Most of these species are waders which use the nearby Lake McLarty, and may stop briefly in the swampy areas. These species are visitors which would not be greatly affected by the proposed deviation.

5.2.3 Surface and Ground Water

Surface water within the study area includes the rivers, wetlands and drains. The palusplain or seasonally inundated character of the Pinjarra Plain may be considered to be surface water, or alternatively an unconfined perched aquifer related to the groundwater regime of the region. The impermeable clays within the typical soil profile impedes infiltration of winter rains, with the flat topography minimising overland flow and discharge into the river and drain systems.

The requirement for bridge construction over the Serpentine, Murray and Harvey Rivers will create short-term construction impacts, primarily that of sediment disturbance. A number of established drains will also be intercepted by the proposed alignment. Without road design accounting for hydrological characteristics, alterations to the flow regimes in natural channels can impact on fringing vegetation by increasing or decreasing submergence patterns or availability of permanent water. All drainage structures, culverts, bridges will need to be designed to ensure that no significant alteration to the surface water drainage pattern will result from the project.

The construction of the Peel Deviation will require placement of fill to raise the road surface above the level of seasonal inundation. Construction requirements will therefore have a localised impact on water ponding and infiltration due to the barrier created by the road formation. As the alignment lies predominantly within cleared farmland, the clearing of vegetation is not likely to result in an increased volume or runoff.

5.2.4 Wetlands

Regionally Significant Wetlands

The preferred alignment for the Peel Deviation does not impact on the Peel-Yalgorup system area listed under the Ramsar convention. The project will impact on the Serpentine River System 6 area due to the requirement for a bridge crossing. This impact will be localised and related to site disturbance during construction. The alignment does not directly impact on other wetlands listed under the System 6 or EPP for Swan Coastal Plain Lakes.

The alignment proposed for the Peel Deviation passes through a region predominantly classified as palusplain (Hill *et al*, 1996). The natural attributes and ecological functions of vegetated portions of the palusplain form the focus for management of such areas. Consequently the role of the vegetated segments as habitat, and importance of surface water for avifauna are the primary biological features. These factors are discussed in Sections 5.3.1 and 5.3.2. In reference to the palusplain as a whole, management strategies focus on maintenance of hydrological characteristics. This aspect is discussed in Section 5.2.3.

5.3 POTENTIAL POLLUTION IMPACT FROM THE PROPOSAL

5.3.1 Water Quality

Surface and Ground Water Quality

Potential exists for any road project to create a pollution impact on the adjacent environment, although runoff from rural highways with traffic volumes less than 30,000 vehicles per day is considered to have a low potential to cause adverse effects (Muestra *et al.*, 1985). The issue of water quality in the project area is of relevance due to the ultimate discharge of surface and groundwater into the Peel - Harvey System. There

are two aspects to construction of a road which could create a negative impact on surface and ground water quality; road runoff and spills of contaminants from road accidents.

Without provision of specific drainage structures, road runoff or accidental spills would discharge into the palusplain / perched aquifer and drain system in the region. However, it is Main Roads practice that uncontrolled or untreated discharge of storm water not be discharged into wetlands and the road drainage system will incorporate compensation / retention basins with nutrient / pollutant retaining features.

In reference to water quantity, runoff from the paved road surface will have little impact on the overall water balance for the area.

5.3.2 Air Quality

Dust

The impact of dust generation in residential areas is primarily a social impact, causing nuisance in the form of dust settling on cars, laundry and outdoor furniture. In high volumes, dust may also have implications for human health; particularly in reference to respiratory complaints and eye irritations. Dust may also impact vegetation adjacent to works areas, where it settles on leaves and hinders biological function.

Dust will be generated during the construction phase of the project due to ground disturbance from earthworks. The potential for dust generation from the site will continue until the land rehabilitation is successfully implemented.

5.3.3 Noise

There are two aspects of the proposed Peel Deviation that will alter the noise levels for residents. These are the noise generated by construction activities, and the noise generated from vehicle use of the completed route. The former is a temporary impact, while the latter will cause a permanent alteration to the existing noise levels in the area adjacent to the proposed alignment.

As rural land uses predominate throughout much of the area traversed by the proposed route, current background environmental noise levels are low. The more densely developed areas at Lakelands and Murray Lakes estates are considered to currently have a moderate noise environment. Establishing an inter-regional route that will carry heavy traffic volumes will inevitably change the noise environment in areas adjacent to the road.

The most common way of describing traffic noise is by the L_{10}(18 hour) level. By definition the L_{10}(18 hour) descriptor is the mean level of noise exceeded for 10 % of the period between 6 am and midnight. This is a statistical measure and can be explained as the average of the upper levels of noise which occur during the eighteen hour period. The units for traffic noise are dB(A), which is the abbreviation for decibels A-weighted. For new road construction, Main Roads uses a design goal of 63 dB(A) L_{10}(18 hour) at residential buildings.

In addition to the distance from the noise source, traffic noise at adjacent properties is dependent on a number of factors including; road cross-section, traffic volume, percentage of heavy vehicles, the speed zone, the road surface and the road gradient. Using values typical of the proposed Peel Deviation for these factors, modelling was undertaken (Limb, 1996) to determine an indicative distance at which the design goal noise level would not be exceeded at adjacent properties. This modelling showed that residences further away than 135 m from the road reserve boundary would meet the required noise level goal once the road carries high traffic volumes.

The current alignment will have the most significant noise impact on the Lakelands and Murray Lakes estates. At present, there are approximately 14 and 22 houses respectively within these residential areas. There are nine residential properties located within the 135 m zone along the remainder of the alignment.

The noise level at existing residences within the 135 m zone could be reduced by incorporating noise amelioration measures such as bunds and / or a quieter road surfacing. Main Roads policy (MRWA,1992b) requires investigation for noise reduction options should L10 (18 hour) traffic noise at dwellings be measured in excess of 63 dB(A).

5.4 SOCIAL SURROUNDINGS

5.4.1 Visual Amenity

The visual amenity of the area traversed by the Peel Deviation will be altered by the road project. This alteration will be most evident to the current residents and road users as the road, bridges and intersection lighting will form additional visible infrastructure in the project area.

The most significant impact will be in those sections where clearance of remnant vegetation is required. The main area of impact on vegetation is where the alignment traverses the hill west of Doman Road. The angle of the approach of the Peel Deviation to Old Coast Road is such that the visual impact of clearing in State Forest, will be less visible from the coastal plain.

The impact of clearing will however be a short-term one, as land rehabilitation and revegetation will be instigated to mitigate the evident alteration, and for much of the route will improve the visual amenity.

5.4.2 Risk and Hazard

The Perth Bunbury Highway will be utilised by freight traffic which may include the transport of hazardous materials. The risk therefore exists for accidents to occur causing the release of such materials to the road and adjacent areas. The main impact of this in environmental terms would be the pollution risk to the surface and ground water systems along the Peel Deviation alignment.

Risk and hazard are issues related to the properties of the materials being transported. Regulations for transport and emergency response procedures for hazardous goods are the responsibility of the transporter under the Dangerous Goods Regulations 1992 (set under the Explosives and Dangerous Goods Act 1961) in accordance with the Australian Code for the Transport of Dangerous Goods by Road and Rail. The Regulations specify labelling and packaging of materials, licensing and inspection of transport vehicles and the emergency procedures for response to accidents.

The road design will be in accordance with the alignment standards specified by Austroads, which will minimise the risk of accidents occurring. Landscape planting will also account for sight requirements to maximise safety. The remaining possibility for minimising risk and hazard in reference to the biophysical environment and in respect to pollution events will be to incorporate retention mechanisms into the drainage system.

The drainage system to be incorporated into the Peel Deviation project will form an improvement on existing routes, where there are not currently any measures to control accidental spills.

5.4.3 Heritage

Aboriginal (Indigenous) Heritage

The closest archaeological sites to the survey area are S0185 Stake Hill Bridge artefact scatter and S0328 Lake Clifton artefact scatter located along the Old Coast Road. Two registered ethnographic sites are located near Barragup and Goegrup Lakes respectively. The alignment of the Peel Deviation does not directly impact these sites.

If reference to sites with ethnographic significance identified during the 1995 survey, the alignment will occur in close proximity to the Yunderup Aboriginal Site at the Murray River crossing. The extent of impact on this site will depend on the final bridge design at this location. The preferred alignment crosses through the eastern portion of the site nominated as the Doman Road Camp and Water Source. The alignment is to be located within pine plantation as much as possible to avoid impact to the native vegetation, which is of primary concern to the Winjan Aboriginal Progress Association.

The Fiegirts Road, Scorpion Camp, Tuart tree and Cave sites are not directly impacted by the proposal.

European Heritage

The preferred alignment does not affect Fouracre Cottage or Whittakers Mill. The 10th Light Horse Memorial Bridle Trail follows Clifton Road in the north, through Reserve 5620, follows Doman Road to Coronation Road before heading away to the south-east. The Peel Deviation alignment will however sever the trail in the location of Coronation Road.

5.5 OTHER MISCELLANEOUS FACTORS

5.5.1 Land Acquisition and Severance

A total of 44 land holders with a total of 67 lots will be impacted by the preferred alignment proposal for the Peel Deviation. State Forest and pine plantations are also impacted by the preferred alignment.

Some properties will be bisected by the route, causing interference to the movement of stock and machinery. The alignment may also create small severed areas of land which due to their reduced size may no longer be commercially or operationally viable for the current owner. The preferred alignment for the Peel Deviation also impacts on farm infrastructure such as stockyards, watering points, windmills *etc.*

5.5.2 Access and Severance to Farming Properties

The creation of a new road corridor will impact existing access to properties traversed by the alignment, as well as altering local road networks.

Stock Road, Lakes Road, and Fiegirts Road in the northern section will continue as feeder roads for local and regional traffic. Fiegirts Road will have a cul-de-sac at the Pinjarra Road end and will connect with Patterson Road. Rogers Road and Fowler Road will be severed and will require service roads to maintain traffic patterns. A total of approximately 6 km of service roads will be required in the northern section of the Peel Deviation, including re-alignment of Fiegirts Road.

In the central section, Greenlands Road will be the main connection to the Peel Deviation, and an overpass is proposed at Paull Road. A total of 10 km of service roads will be required for the central section, including alterations to access to Greenlands Road to ensure properties adjacent to the route can still be accessed.

Herron Point Road will be the main connection point in the southern section, resulting in restriction of access on Mills Road. Doman Road is severed by the Peel Deviation and a service road parallel to the freeway is proposed to maintain access with affected properties.

5.5.3 Material Sourcing

Construction material sources have not been identified as this stage of the Peel Deviation project. It is proposed, however, to obtain some construction materials from the alignment at the southern end of the project. It will be necessary to ensure that construction materials are sourced from appropriate locations to prevent the introduction of dieback to any areas which remain free of the disease.

5.5.4 Recreation

The main impact that the Peel Deviation will have on existing recreation activities in the area results from the interruption of bridle trails located in the region. The importance of horse riding in the Peel area is demonstrated through the membership of the Peel Equine Task Force, the Yalgorup Recreational Horse Riders Association Inc., and the Peel Equestrian Association.

From submissions supplied by these groups, it is evident that the 10th Light Horse Memorial Trail and the Barragup/Furnissdale Bridle Trail are well used horse trails within the project area. The 10th Light Horse Memorial Trail will be intersected at the junction of Doman Road with the Clifton MPA. The Barragup/Furnissdale Bridle Trail will be intercepted at the points where the Peel Deviation crosses Paterson and Pinjarra Roads. The Peel Deviation also impacts on a property located on the Harvey River which is currently used for camping associated with use of the 10th Light Horse Memorial Trail.

6.0 ENVIRONMENTAL MANAGEMENT STRATEGY

6.1 AIM

The aim of this section is to document environmental management strategies to be applied to the Peel Deviation proposal, to demonstrate that the environmental impacts of the proposal are of an acceptable level and nature according to the assessment process under the Environmental Protection Act 1986.

It must be noted however that construction of the Peel Deviation is not anticipated for some 10 - 20 years. It is possible that within this time, changes will occur in Government policy relating to aspects of this proposal. It is also likely that alterations to management techniques will occur in the interim. Management techniques in this section are therefore to document the practices currently utilised for projects of this nature, and that the project as described within this PER is environmentally acceptable at the time of approval.

There is considerable precedent to demonstrate that the environmental impacts of road projects can be managed. This section provides the general principles for management of potential impacts in the context of prevailing policy and practice. In order to account for the changes in policy and practice over time, and for specific site conditions, a detailed Environmental Management Programme (EMP) will be prepared prior to commencement of construction activities.

As construction will occur in stages, management commitments made by Main Roads will apply to all sections. Commitments made by Main Roads for this project are made under discussion of each environmental factor, and the agency to whose satisfaction each commitment will be implemented. The commitments are summarised in Table 8.

6.2 ENVIRONMENTAL MANAGEMENT PROGRAMME

The Perth - Bunbury Highway Peel Deviation is not currently scheduled for construction. It is anticipated that the construction phase of the main component of the project will not occur for another 15 years. However, discrete sections, such as the construction of the second carriageway on the Old Coast Road north of Bagieau Road will occur prior to this time.

Consequently, it is proposed that site specific environmental management initiatives be developed in an EMP for separate stages to be prepared in the pre-construction phase of the project. The EMPs will then reflect statutory requirements and Best Practice Management techniques prevalent at the respective times of construction.

Main Roads therefore commits to the preparation of staged EMPs when the sections of the Peel Deviation project are scheduled for construction. The EMPs will cover:

- dieback; identification and management;
- vegetation clearing;
- topsoil stockpiling;
- rehabilitation strategy;
- landscape design guidelines;
- stormwater drainage design;
- construction impact management;
- completion criteria for rehabilitation works;
- weed control.

In addition to management techniques, the EMP is to contain identification of monitoring requirements and methodology for satisfying monitoring objectives.

6.2.1 Auditing of the Environmental Management Programme

The environmental management strategies outlined within this section, document the means to minimise the impact of the Peel Deviation proposal. In order to ensure that the management commitments made within the PER, and that any additional conditions resulting from the assessment process are implemented, the EMP to be prepared for the project is to be subject to an auditing procedure by the Environmental Strategies Branch of Main Roads.

6.2.2 Audit of the PER

Main Roads will undertake auditing of the Conditions and Commitments Schedule of the Minister for the Environment on the PER assessment. Reporting will occur at the completion of each major phase of the project, or an annual basis where any one phase extends over more than 12 months. The report will be in the format of a typical Progress and Compliance Report and will be submitted to the Audit Branch of the DEP for assessment.

Commitment

(1) Preparation an EMP prior to commencement of construction, addressing, but not limited to dieback identification and management, vegetation clearing, rehabilitation strategy, landscape design, stormwater drainage design, construction impact management *etc.* The EMP will be prepared to the satisfaction of the DEP and CALM.

(2) Implementation of the EMP as approved by DEP and CALM

6.3 MANAGEMENT OF POTENTIAL BIOPHYSICAL IMPACTS

6.3.1 Terrestrial Vegetation

Management of Clearing

As discussed within Section 5.0, the primary impact on vegetation will occur due to clearing of the area required for construction purposes. Discussion of management for vegetation within existing Conservation Reserves, regionally and locally significant vegetation will therefore be consistent throughout the study area.

Impacts shall be minimised by undertaking clearing as each stage of roadworks is to commence, limiting clearing to that which is absolutely essential (demarcation of a limit-of works), and limiting road and track development. Areas with intact vegetation beyond the limit of works shall not be disturbed. Large trees close to the limit of works shall be identified and clearly marked to avoid accidental damage.

Suitable vegetative material and topsoil required to be removed as a result of construction will be used in the land rehabilitation process. Techniques to be employed are discussed below.

Vegetation is only to be cleared in areas directly required for roadworks. Vegetation less than 150 mm in diameter will be chipped or mulched and spread over any site that requires rehabilitation. Chipped and mulched vegetation is to be re-applied to approximately the same area as it was collected from. Where an excess of material occurs in a given area it is to only be used in areas of the same vegetation association, as defined by vegetation mapping undertaken for the Peel Deviation project.

Any vegetation not required for rehabilitation, or which has a high proportion of weeds, is to be taken off-site to a pit area designated by the local authorities.

Commitment

(3) Clearing and stockpiling of vegetation shall occur in accordance with the procedures designated within the MRWA Environment Management Manual and Roadside Flora Care Manual. These factors will be incorporated into an EMP specifically prepared for the project prior to construction, to the satisfaction of the DEP.

(4) During construction, road verges shall not be cleared by Main Roads beyond the corridor required for the construction of the road formation and earthworks, with the exception of horizontal curves required to maintain minimum sight distance consistent with Austroads standards. This commitment will be implemented to the satisfaction of the DEP.

(5) If required by CALM, restrictions to public access to internal forest roads shall be installed by Main Roads in areas of State Forest where these are intersected by the construction of the new road. This commitment will be implemented to the satisfaction of CALM.

Regionally and Locally Significant Vegetation

The WA Orchid Society has indicated that relocation of the orchid *Pterostylis aff. picta* is possible. Relocation of plants taken during road construction will be considered as a management option for this species, and if feasible be implemented prior to construction occurring in the Peppermint Grove Road to Bagieau Road section of the Peel Deviation project.

The Priority 2 flora species *Lasiopetalum membranaceum* was found at the southern end of the study area, and will possibly occur within the impact area of the Old Coast Road Duplication. Confirmation of the extent to which this species does occur is required prior to the development of a management strategy. Any impact on this species will occur in consultation with and to the requirements of CALM.

Due to the probability that classifications of Declared Rare and Priority Flora will change by the time construction is initiated a review of the vegetation species list will be required. Additional surveys for Declared Rare and Priority Flora and appropriate management strategies may be required in the future according to additions, alterations and deletions from the Declared Rare and Priority Flora list.

Commitment

(6) A review of the vegetation mapping and species list shall occur prior to construction at river crossings and System 6 Area C56. Action will be dependent on the Declared Rare and Priority Flora list current at the time of construction. This commitment will be implemented to the satisfaction of the DEP and CALM.

Non-endemic (Introduced) Vegetation

Due to historical land use, weeds are prevalent along the Peel Deviation alignment, and complete control of weeds through cleared land and pastures will not be possible. The potential for introduction or spread of weeds through remnant vegetation and conservation reserves is to be minimised by management techniques. During and following the construction phase, weed control will need to be incorporated into the rehabilitation strategy to maximise success of the revegetation programme. Details of weed management techniques will be included in the Landscape and Rehabilitation Plan to be developed for the project at a time closer to construction, and to be included within the project EMP.

Commitment

(7) Weed management shall be included in the Landscape and Rehabilitation Plan (See Commitment 14) and implemented in areas of remnant vegetation. This is to focus on the Serpentine River

crossing (System 6 area M108), and the southern end of the alignment where it passes through System 6 areas C55 (Clifton MPA) and C56 (McLarty MPA). Weed management will be addressed to the satisfaction of CALM.

(8) Weed control shall be included as a component of the rehabilitation strategy (see Commitment 14) developed for the project and form an ongoing component of road reserve management. Implementation will be to the satisfaction of the DEP and CALM.

Dieback Disease

Due to the high level of historical disturbance, the area may be contaminated with dieback. In order to determine the presence and location of dieback within native remnant vegetation a Dieback Survey shall be undertaken prior to construction commencing. A Dieback Management Plan shall be prepared based on the results of the dieback survey. The management strategy will be based upon ensuring that no soil movement will occur between infected and non-infected areas of remnant vegetation within the project area.

The Dieback Management Programme will be prepared in accordance with dieback hygiene procedures developed by CALM and MRWA. Strategies to be included in the dieback procedures may include:

- selection of appropriate road construction materials;
- cleaning down of machinery prior to delivery to the site, to ensure all soil and root material is removed, using a brush and/or compressed air in dry soil conditions, or washdown with dieback-free water in wet soil conditions;
- where practicable, construction activities to occur during summer to minimise risk of spreading of dieback;
- education of construction and operations staff in procedures of dieback hygiene.

Commitment

(9) Prior to construction, a Dieback Management Programme shall be developed to the requirements of CALM and implemented in areas of remnant vegetation at river crossings and within System 6 Area C56.

6.3.2 Terrestrial Fauna

The minimisation of fauna road fatalities shall be a management objective in the design of the Peel Deviation project. A combination of fencing and underpasses will be utilised to achieve this, in order to restrict fauna access to the road reserve and allow access between the remaining habitat patches on either side of the new alignment. Management techniques shall be developed in consultation with CALM.

Appropriate fencing along the road reserve may be necessary in some locations to remove the threat of road fatalities. To help facilitate seasonal movements and access to all available habitats, suitable passageways crossing the road may need to be constructed. Access via underpasses potentially facilitates the maintenance of the integrity of the local populations, however sufficient data is lacking to enable judgement on the effectiveness of this strategy.

Underpass length is to be the minimum possible consistent with safe road design practices. The objective is to install culverts of minimum length to encourage utilisation. While Kangaroos and other medium size fauna are highly mobile it is widely acknowledged that the longer the underpass, the lower the level of utilisation.

The culvert underpasses require a base to be constructed from earth and rock fill to provide a natural substrate. Vegetation debris, rocks and small logs are to be placed within the culvert both, on the base and the raised bench, to provide shelter from predators and a more secure natural passageway.

The bridges at the Serpentine River and Nambeelup Brook shall be designed to provide for fauna movement along the stream banks by the provision of adequate freeboard.

The area of direct impact between Doman Road and Old Coast Road where the alignment passes through State Forest should be encompassed by exclusion fencing or alternative exclusion measures. Isolation exclusion fencing is required on both sides of the road reserve.

Main Roads are currently undertaking trials on Wildlife Warning Reflectors (headlights causing optical warning fences), and the use of lengthy exclusion fences (1.8 m chain mesh fencing), large underpasses (2m x 2m), and Roo Guards (high frequency sound emission systems) in efforts to manage kangaroo movement across road reserves. When trial results have been analysed, the most effective method for preventing road deaths will be utilised for the Peel Deviation project.

Commitment

(10) In areas of remnant vegetation (river crossings and System 6 Area C56) Main Roads will incorporate into the road design techniques found to be most effective in managing fauna movement across road reserves. This commitment will be implemented to the satisfaction of the DEP and CALM.

(11) Suitable fauna migration pathways in swamp areas (Nambeelup Brook) and within State forest and (System 6 Area C56) shall be provided by Main Roads, to the satisfaction of CALM.

6.3.3 Surface and Ground Water

The potential impact of the road construction on surface and groundwater is the creation of a physical barrier to water movement patterns in the area. It is necessary therefore that road and bridge design account for this factor and incorporate design detail to mitigate interruption of water flow. A series of culverts will be allowed for, in order to maintain the existing drainage pattern of the area. This includes existing drains and surface water from seasonal inundation.

Construction activities will cause a short-term increase turbidity in the river systems due to sediment disturbance. Where practicable, construction shall occur in the drier months to avoid increased erosion of disturbed area and sediment suspension from rainfall events.

Commitment

(12) Culverts and appropriate bridge design, shall be provided to maintain surface hydrology characteristics within the study area. This commitment shall be implemented to the satisfaction of the DEP and the WRC.

6.3.4 Wetlands

The main issue in relation to wetlands of the study area (essentially the palusplain through which the alignment crosses) is in reference to water (surface and ground water) quality. Protection of water availability and water quality will be addressed through management of road runoff and containment measures for accidental spills (Refer to sections 6.3.3 and 6.4.1).

The majority of palusplain wetlands classified by the Water & Rivers Commission (Hill *et al.*, 1996) were evaluated under the EPA Bulletin methodology as falling into the Multiple Use category for management goals. Given the extent of modification to the Pinjarra Plain area the management category "Sustainable

Use - Multiple Use wetlands. The management objective of these wetlands is that use, development and management should be considered in the context of water (catchment/strategic drainage planning), town (land use) and environmental planning through landcare (Hill *et al.*, 1996). The EPA management objectives within Bulletin 686 (EPA, 1993) adds that sections of extensive wetlands may only have a hydrological function and hence management is based on water management and off-site impacts.

Commitment

(13) The objectives for wetland management of the Water & Rivers Commission and the EPA will be incorporated into a Drainage Management Plan (DMP) for the project (Commitment 16). The requirement for liaison with the Pinjarra Community Catchment Centre will be incorporated into this plan. The DMP will be prepared to satisfy the requirements of the WRC.

6.3.5 Rehabilitation

All areas disturbed as a result of construction of the proposed road shall be rehabilitated. Topsoil management will form an important component of the rehabilitation process. Topsoil management recommendations have been adapted from draft guidelines produced by MRWA (1995). The topsoil in areas of remnant vegetation will contain a seed source for rehabilitation. The topsoil and the overlying litter layer are to be stockpiled for rehabilitation, within areas of remnant vegetation. An assessment of the suitability of topsoil taken from cleared land for rehabilitation is to form a component of developing a specific rehabilitation strategy for the project.

Topsoil shall be removed following clearing of vegetation to a depth of between 50 to 100 mm. The topsoil is to be retained for a minimum amount of time in order to maximise the viability of the seed store within the material. Topsoil shall be respread dry to a maximum depth of 50 mm.

Topsoil cleared from the works site should be stockpiled in windrows (no higher than 1.5 m) on site and respread over approximately the same area as it was collected from after completion of works.

In areas where topsoil is significantly infected with weeds, the soil is to be scalped, and disposed of in a pit located remote from any native vegetation, or is to be buried under a minimum cover of 300 mm of weed free soil. Due to the potential for spread of dieback, no topsoil is to be removed from the project area for use elsewhere. It is however suitable for re-application in its area of origin.

Commitment

(14) A Landscape and Rehabilitation Plan shall be prepared and incorporated into the EMP prior to construction commencing. The strategy is to be based upon procedures designated within the MRWA Environment Management Manual and the Roadside Flora Care Manual. Alternatively, best practice at the time of construction is to be utilised. The EMP will be prepared to satisfy the requirements of the DEP and CALM

(15) On completion of construction, all borrow pits on private or public lands shall be reinstated in accordance with Main Roads policy, and in consultation with the owners on private and / or CALM and other authorities on public lands. This commitment will be implemented to the satisfaction of the DEP.

6.4 MANAGEMENT OF POTENTIAL POLLUTION IMPACTS

6.4.1 Water Quality

Surface and Ground Water Quality
The Inner Peel Region Structure Plan addresses the issue of drainage in the palusplain areas east of the Peel - Harvey system. The basic guiding principle is to restrict the rate of discharge into drains which discharge into the Serpentine or Murray Rivers, or into the Peel Inlet. The recommended stormwater strategy is retention of water as close as possible to its source by detention basins and/or artificial wetlands accommodated in a series of wide multiple-use corridors encompassing the main drainage lines (Ministry for Planning, 1996).

The Peel Deviation project will require the preparation of a project specific Drainage Management Plan, with the objective of containing stormwater within the road reserve and maintenance of existing hydrological characteristics.

The drainage system for control of road runoff will account for water volumes and water quality, and will be designed to the criteria prevalent at the time of construction, to achieve appropriate retention times to reduce water volumes and improve water quality of road runoff. Any culverts or pipe outlets will be positioned and designed to prevent erosion.

Commitment

(16) Main Roads shall undertake design for road drainage according to best practice at the time of construction. Water quality issues will be addressed in the Drainage Management Plan. This commitment will be implemented to the satisfaction of the DEP and WRC.

(17) Main Roads shall incorporate erosion control measures in the drainage channel design as necessary, to Austroads standards. This commitment will be implemented to the satisfaction of the DEP.

(18) Specific design measures, including retardation basins shall be incorporated in the design in order to prevent direct drainage to wetlands and rivers.

6.4.2 Air Quality

Dust
Dust created during road construction shall be controlled through repeated spraying of earthworks with water.

There is also potential for dust generation between completion of sections of roadworks and initiating rehabilitation. If complaints are received from residents, then a paper mulch may be sprayed on problem areas to stabilise the surface until permanent stabilisation can be achieved.

Commitment

(19) Roadworks shall be sprayed with water to minimise dust generation. Rehabilitation will be undertaken as soon as practicable after road construction to ensure surface stabilisation. This commitment will be implemented to the satisfaction of the respective Local Authorities.

6.4.3 Noise

Noise

Construction activities will be programmed to comply with the Noise Abatement (Neighbourhood Annoyance) Regulations 1979 enforceable under the Environmental Protection Act 1986. The project will conform to relevant Regulations in force at the time of construction should they be altered in the interim.

In reference to ongoing noise generated by traffic flow, a noise impact assessment will be carried out prior to construction, to encompass:

(i) noise prediction;

(ii) noise measurement; and

(iii) noise control measures.

The Peel Deviation project will be designed such that private homes are not exposed to noise levels in excess of 63 dB(A) L_{10} (18 hour), or relevant Main Roads criteria, with noise mitigation techniques employed where necessary to meet this criteria.

Commitment

(20) Noise impact assessment will be carried out prior to construction. Noise mitigation techniques shall be determined for residences where the predicted noise level is above the designated criteria of 63 dB(A) L_{10} (18 hour), or relevant Main Roads criteria. This commitment will be implemented to the satisfaction of the DEP.

(21) Post-construction noise monitoring to gauge the effectiveness of noise amelioration measures shall be carried out by Main Roads. Results will be made available to interested parties. This commitment will be implemented to the satisfaction of the DEP.

6.5 SOCIAL SURROUNDINGS

6.5.1 Visual Impacts

Visual impacts will be managed by the development and implementation of a Landscaping and Rehabilitation Concept Plan. The low-medium landscape value will allow for categorisation into landscape management zones, resulting in determination of strategies to minimise the apparent landscape alteration possible from the road construction.

According to the Visual Resource Management System previously utilised by the Department of Planning and Urban Development, classification into management zones is based upon the extent to which a site should be affected by development. The categories are Inevident, Apparent and Dominant Alteration landscape management zones (DPUD, 1993). The objectives are:

(i) Inevident alteration: high priority to maintain existing character and to render development visually inevident to temporarily apparent. After five years from initial alteration, the visual impact should be minimised as far as possible. Development should utilise natural features and blend with natural form, line, colour and texture of the landscape.

(ii) Apparent alteration: moderate priority to maintain existing character. Alteration may be visually apparent after five years, but not dominant. Development should comply with natural form, line, colour and texture of the landscape.

(iii) Dominant alteration: low priority to maintain existing character. Development may be visually dominant but reflect naturally established form, line, colour and texture. Alterations may have high visual impact, but retain landscape integrity.

The majority of the study area would fall into the Dominant and Apparent alteration landscape management zones. The section of the alignment passing through proposed additions to Yalgorup National Park would fall within the Inevident alteration category.

Commitment

(22) The Landscape and Rehabilitation Plan will incorporate the objective of reducing apparent landscape alteration resulting from the Peel Deviation within five years of completion of construction. This commitment will be implemented to the satisfaction of the Ministry for Planning and CALM.

6.5.2 Risk and Hazard

The main issue in relation to risk and hazard is in reference to water (surface and ground water) quality. Protection of water availability and water quality will be addressed through management of road runoff (Refer to sections 6.3.3 and 6.4.1).

The risk and hazard for human use of the Peel Deviation is firstly accounted for in road design and construction that satisfies Austroads Standards. In addition, road maintenance and monitoring of conditions is a standard component of Main Roads functions.

Commitment

(23) The Drainage Management Plan will address the potential for containment of accidental spills of hazardous goods. This aspect of the DMP will be resolved to the satisfaction of the DEP, WRC and Main Roads.

(24) Road accident statistics for the route will be kept by Main Roads as part of its standard accident database.

(25) Main Roads shall monitor road safety, and monitor and maintain pavement conditions, drainage facilities and road signs consistent with standard practice.

6.5.3 Heritage

Aboriginal Heritage

The impact of the Peel Deviation on the Yunderup Aboriginal ethnographic sites on the Murray River will be accurately determined once the bridge design has been finalised. Any impact to Aboriginal ethnographic sites shall be kept to the minimum possible. Permission will be sought under Section 18 of the Aboriginal Heritage Act 1972 to disturb the Doman Road and if necessary the Yunderup Aboriginal ethnographic sites prior to construction activities commencing. Consultation is ongoing with the local Winjan Aboriginal Progress Association and the Murray Districts Aboriginal Progress Association, in order to minimise impact to nominated sites.

Should any archaeological material be uncovered during road construction activities work in the immediate area shall be stopped and the Aboriginal Affairs Department notified.

Commitment

(26) Clearance will be sought under Section 18 of the Aboriginal Heritage Act 1972 to disturb the ethnographic sites impacted by the Peel Deviation. This commitment will be implemented to the satisfaction of the Aboriginal Affairs Department.

European Heritage

The major impact on European Heritage is that of severance of the 10th Light Horse Bridle Trail. A method for ensuring continuation of the trail will be determined during detailed design for the Peel Deviation project. The possibility of using an underpass which will allow passage of horses and riders will be considered as one option to provide trail continuity.

Commitment

(27) A method for maintaining the 10th Light Horse Bridle Trail will be determined prior to construction commencing. This commitment will be implemented to the satisfaction of the Shires of Murray and Waroona.

6.6 OTHER MISCELLANEOUS ISSUES

6.6.1 Land Acquisition

The planning phase for the Peel Deviation project has resulted in recommendations for the land requirements for the road reserve. Design plans of the proposed road reserve are included in Appendix E.

Land acquisition is not proposed until a time closer to construction, however early purchase may be considered if landowners can demonstrate hardship as a direct result of the proposed alignment.

The process of land acquisition will be carried out by Main Roads, in accordance with the provisions of the Land Acquisition and Public Works Act 1902. The Act provides for compensation for, or purchase of, land to be based on market value as assessed by qualified land valuers.

Commitment

(28) If requested by the owners of severed properties or small holdings, Main Roads shall consider the purchase of part or all of the holding.

(29) Land required for the road reserve shall be acquired in accordance with the Land Acquisition and Public Works Act 1902.

6.6.2 Access and Severance

Where the Peel Deviation requires removal of, or severs access to farm management structures (eg. tanks, bores, yards or sheds etc.) the provision of replacement structures will be provided by Main Roads. Alternatively, the cost of replacement may be included in the compensation package for the loss of land.

The provision of underpasses shall be considered in the road design at strategic locations, to allow landholders whose properties are severed by the Peel Deviation to maintain connectivity between the severed portions.

Commitment

(30) The construction programme shall be managed by Main Roads to maintain current access on local roads.

(31) Prior to construction, Main Roads shall provide, in consultation with owners, appropriate means for stock and equipment movement between severed portions of properties.

6.6.3 Material Sourcing

Material sources have not been defined for construction of the Peel Deviation section of the Perth - Bunbury Highway. An appropriate location for construction materials will need to be located, to ensure that materials do not form a source of dieback or weed contamination. Acquisition of construction materials from sites away from the alignment will be subject to appropriate environmental assessment and management procedures commonly implemented for such sites.

Commitment

(32) Sites utilised for acquisition of construction materials will be subject to appropriate environmental assessment and management procedures commonly implemented for such sites. This commitment will be implemented to the satisfaction of the DEP.

Table 8: Summary of Proponent Commitments

FACTOR	OBJECTIVE	NUMBER	COMMITMENT	PHASE	TO SATISFY
Environmental Management Programme (EMP)	Address the commitments	1	Prepare an EMP addressing, but not limited to: dieback identification and management, vegetation clearing, rehabilitation strategy, landscape design, stormwater drainage design, construction impact management etc.	Pre-construction	DEP & CALM
		2	Implement the approved EMP	All Phases	DEP & CALM
BIOPHYSICAL ENVIRONMENT					
Terrestrial Vegetation					
Management of clearing	Minimise clearing of remnant vegetation within the road reserve during construction	3	Clearing and stockpiling of vegetation shall occur in accordance with the procedures designated within the MRWA Environmental Management Manual and Roadside Flora Care Manual, and incorporated into the project EMP.	Construction	DEP
		4	During construction, road verges shall not be cleared by beyond the corridor required for the road formation and earthworks with the exception of horizontal curves required to maintain minimum sight distance consistent with Austroads standards.	Construction	DEP
		5	If required by CALM, restrictions to public access to internal forest roads shall be installed by Main Roads in areas of State Forest where these are intersected by the construction of the new road.	Construction	CALM
• Vegetation within existing conservation reserves • Regionally significant vegetation • Locally significant vegetation	Minimise impact on Declared Rare and Priority Flora and locally significant flora and vegetation.	6	A review of the vegetation mapping and species list shall occur at river crossings and System 6 Area C56. Action will be dependent on the Declared Rare and Priority Flora List current at the time of construction.	Pre-construction	DEP & CALM
• Weeds	Prevent the introduction and spread of weeds.	7	Weed management shall be included in the Landscape and Rehabilitation Plan (see Commitment 14) and implemented in areas of remnant vegetation, focussing on river crossings and System 6 Area C56.	Pre-construction and Construction	CALM
		8	Weed control shall be included as a component of the rehabilitation strategy (see Commitment 14) developed for the project and form an ongoing component of road reserve management.	Construction and Post-construction	CALM & DEP

Table 8: Summary of Proponent Commitments

• Dieback	Prevent the introduction and/or spread of dieback.	9	A Dieback Management Programme shall be developed to the requirements of CALM and implemented in areas of remnant vegetation at river crossings and within System 6 Area C56 .	Pre-construction and Construction	CALM
Terrestrial Fauna	Minimise disturbance to fauna.	10	In areas of remnant vegetation (river crossings and System 6 Area C56) Main Roads will incorporate into the road design techniques found to be most effective in managing fauna movement across the road reserve.	Pre-construction and Construction	DEP & CALM
		11	Suitable fauna migration pathways in swamp areas (Nambeelup Brook) and within State Forest (System 6 Area C56) shall be provided by Main Roads.	Pre-construction and Construction	CALM
Surface & Ground Water	Minimise the impact on existing drainage patterns.	12	Culverts and appropriate bridge design shall be provided to maintain surface hydrology characteristics within the study area.	Pre-construction and Construction	DEP & WRC
Wetlands	Maintenance of wetland function and characteristics	13	The objectives for wetland management of the WRC and EPA will be incorporated into a Drainage Management Plan for the project (Commitment 16).	Pre-construction	WRC
Rehabilitation	Develop and implement rehabilitation works to all areas disturbed by construction activity as soon as possible.	14	A Landscape and Rehabilitation Plan shall be prepared and incorporated into the EMP, based on the MRWA Environmental Management Manual and Roadside Flora Care Manual. Alternatively, best practice at the time of construction is to be utilised.	Pre-construction	DEP & CALM
		15	On completion of construction, all borrow pits on private or public lands shall be reinstated, in accordance with Main Roads policy and in consultation with owners or management agencies.	Post-construction	DEP
POLLUTION IMPACTS					
Water Quality	To prevent deleterious impact on water (surface and ground water) quality from the Peel Deviation project.	16	Main Roads shall undertake design for road drainage according to best practice at the time of construction. Water quality issues will be addressed in the Drainage Management Plan.	Pre-construction	DEP & WRC
		17	Main Roads shall incorporate erosion control measures in the drainage channel design as necessary, to Austroad standards.	Pre-construction	DEP
		18	Specific design meaures, including retardation basins shall be incorporated in the design in order to prevent direct drainage to wetlands and rivers.	Pre-construction	DEP

Table 8: Summary of Proponent Commitments

Air Quality	To prevent atmospheric pollution resulting from the Peel Deviation project	19	Roadworks shall be sprayed with water to minimise dust generation. Rehabilitation will be undertaken as soon as practicable after road construction to ensure surface stabilisation.	Construction	Local Authorities
Noise	To ensure that residents are not unduly affected by noise from construction or use of the Peel Deviation.	20	Noise impact assessment will be carried out. Noise mitigation techniques shall be determined for residences where the predicted noise level is above the designated criteria of 63 dB(A) L10 (18 hour) or relevant Main Roads criteria.	Pre-construction and Construction	DEP
		21	Post-construction noise monitoring to guage the effectiveness of noise amelioration measures. Results will be made available to interested parties.	Post-construction	DEP
SOCIAL SURROUNDINGS					
Visual Impacts	To minimise the impact of the proposal on visual amenity within the project area.	22	The Landscape and Rehabilitation Plan will incorporate the objective of reducing apparant landscape alteration resulting from the Peel Deviation within five years of completion of construction.	Pre-construction	MfP and CALM
Risk and Hazard	To minimise environmenal and social risk and hazard resulting from use of the Peel Deviation	23	The Drainage Management Plan will address containment provisions for accidental spills of hazardous goods.	Pre-construction	Main Roads, DEP & WRC
		24	Road accident statistics for the route will be kept by Main Roads as part of its standard accident database.	Post-construction	Main Roads
		25	Main Roads shall monitor road safety, and monitor and maintain pavement conditions, drainage facilities and road signs consistent with standard practice.	Post-construction	Main Roads
Heritage					
•Aboriginal Heritage	Avoid disturbance to Aboriginal archaeological and ethnographic sites wherever possible	26	Clearance will be sought under Section 18 of the Aboriginal Heritage Act 1972 to disturb the ethnographic sites impacted by the Peel Deviation.	Pre-construction	Aboriginal Affairs Department
•European Heritage	Avoid disturbance to European heritage sites wherever possible.	27	A method for maintaining the 10th Light Horse Bridle Trail will be determined prior to construction commencing.	Pre-construction	Shires of Murray & Waroona
OTHER ISSUES					
Land Acquisition	To avoid causing hardship to impacted landowners.	28	If requested by the owners of severed properties or small holdings, Main Roads shall consider the purchase of part or all of the holding.	Pre-construction	Main Roads

Table 8: Summary of Proponent Commitments

	To ensure equity in acquisition of required land.	29	Land required for the road reserve shall be acquired in accordance with the Land Acquisition and Public Works Act 1902	Pre-construction	Main Roads
Access and Severance	To avoid undue disruption to local traffic movements.	30	The construction programme shall be managed by Main Roads to maintain current access on local roads.	Construction	Main Roads and Local Authorities
	To maintain as far as possible existing patterns of land use.	31	Prior to construction, Main Roads shall provide, in consultation with owners, appropriate means for stock and equipment movement between severed portions of properties.	Pre-construciton	Main Roads
Material sourcing	To ensure than material source sites are subject to appropriate levels of environmental management.	32	Sites utilised for acquisiton of construction materials will be subject to appropriate environmental assessment and management prcedures commonly implemented for such sites	Post-construction	DEP

STUDY TEAM

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1. GB Hill Consulting Engineers provided information on engineering design for the Perth Bunbury Highway Peel Deviation Public Environmental Review.

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APPENDIX A

EPA Guidelines for the Preparation of the Public Environmental Review

PROPOSED PERTH TO BUNBURY HIGHWAY, FROM THE SOUTH OF THE METROPOLITAN REGION TO BAGIEAU ROAD - PEEL BYPASS

PUBLIC ENVIRONMENTAL REVIEW GUIDELINES

Overview

In Western Australia all environmental reviews are about protecting the environment. The fundamental requirement is for the proponent to describe what they propose to do, to discuss the potential environmental impacts of the proposal, and then to describe how those environmental impacts are going to be managed so that the environment is protected.

If the proponent can demonstrate that the environment will be protected then the proposal will be found environmentally acceptable; if the proponent cannot show that the environment would be protected then the Environmental Protection Authority (EPA) would recommend against the proposal.

Throughout the process it is the aim of the EPA to advise and assist the proponent to improve or modify the proposal in such a way that the environment is protected. Nonetheless, the environmental review in Western Australia is proponent driven, and it is up to the proponent to identify the potential environmental impacts and design and implement proposals which protect the environment.

For this proposal, protecting the environment means that the natural and social values associated with wetlands, particularly Environmental Protection Policy Lakes, the Peel-Harvey estuary, System 6 areas, various water courses, and associated flora and fauna, are protected. Where they cannot be protected, proposals to mitigate the impacts are required.

Purpose of an PER

The primary function of an PER is to provide the basis for the EPA to provide advice to Government on protecting the environment. An additional function is to communicate clearly with the public so that EPA can obtain informed public comment. As such, environmental impact assessment is quite deliberately a public process. The PER should set out the series of decisions taken to develop this proposal at this place and time and why.

Objectives of the review

The Public Environmental Review should have the following objectives:

- to place this project in the context of the regional environment;

  to explain the issues and decisions which led to the choice of this project at this place at this time;

- to set out the environmental impacts that the project may have; and

- for each impact, to describe any environmental management steps the proponent believes would avoid, mitigate or ameliorate that impact.

The PER should focus on the major issues for the area and anticipate the questions that members of the public will raise. Data describing the environment should be directly related to the discussion of the potential impacts of the proposal. Both should then relate directly to the actions proposed to manage those impacts.

Key issues

The critical issues for the proposal are likely to be the impact on wetlands, particularly Environmental Protection Policy Lakes, the Peel-Harvey estuary, System 6 and other conservation areas, various water courses, and the associated flora and fauna. It is critical therefore that the PER shows a detailed understanding of conservation, landscape and social values in the area, and whether they are represented elsewhere. The conservation values of areas to be disturbed should he examined in detail.

The key issues for this project should be clearly identified and the content of succeeding sections determined by their relevance to these issues.

In this case the key issues should include:

- the reasons for selection of the preferred alignment for the highway, including a detailed analysis of the alternatives considered and why they were not selected;
- wetlands likely to be impacted, particularly those identified for protection under the Environmental Protection (Swan Coastal Plain Lakes) Policy;
- impact on System 6 and other conservation areas;
- impact on the major water courses where the highway will cross over;
- flora, fauna and ecosystems along the alignment:
  - major vegetation communities
  - land units;
  - rare and poorly known flora, fauna and communities, shown on distribution maps;
  - inter-relationships of the biota and environment;
- feral fauna, weed, access and fire control;
- landscape and recreation values;
- impact on farming, recreational and tourist users;
- on-going noise impacts
- cultural impact on Aboriginal people with traditional affiliation to the land;
- water management issues:
  - management of off-road stormwater within the context of the moratorium on drainage into the Peel-Harvey estuary
  - maintenance of surface water drainage patterns
  - impact on subsurface and groundwater hydrology;
- construction phase management issues:
  - dust and noise control;
  - overburden and topsoil management
  - rehabilitation of easement and spoil pits; and
  - contingency plans for accidents such as fuel spills.etc.
- where the environment is to be impacted, details of impact monitoring programme(s).

plus any other key issues raised during the preparation of the report.

Public participation and consultation

A description should be provided of the public participation and consultation activities undertaken by the proponent in preparing the PER. It should describe the activities undertaken, the dates, the groups and individuals involved and the objectives of the activities. Cross reference should be made with the description of environmental management for the proposal which should clearly indicate how community concerns have been addressed. Where these concerns are dealt with via other departments or procedures, outside the EPA process, these can be noted and referenced here.

Detailed list of environmental commitments

The commitments being made by the proponent to protect the environment should be clearly defined and separately listed. Where an environmental problem has the potential to occur, there should be a commitment to rectify it. They should be numbered and take the form of:

a who will do the work;

b what the work is;

c when the work will be carried out; and

d to whose satisfaction the work will be carried out.

- All actionable and auditable commitments made in the body of the document should be numbered and summarised in this list.

APPENDIX B

Declared Rare and Priority Flora Species found within the Peel Deviation Study Area.

Appendix B: Declared Rare and Priority Flora in the Peel Region

Species	Conservation Code	Nearest Collection
Anthocercis gracilis	R	Dandalup
Aponogeton hexatepalus	R	Perth*
Caladenia huegelli	R	Perth*
Diurus drummondii	R	Pinjarra
Diurus micrantha	R	Yalgorup
Diurus purdiei	R	Pinjarra
Drakaea elastica	R	Perth*
Drakaea micrantha ms.	R	Perth*
Schoenus natans	R	Pinjarra
Tetraria australiensis	R	Serpentine Rv.
Verticordia plumosa var. *ananeotes*	R	Serpentine
Acacia lasiocarpa var. *bracteolata* (long peduncle)	1	North Dandalup
Amperea simulans	1	Waroona
Aristida ramosa	1	Waroona
Caladenia longicauda subsp. *clivola* ms.	1	Harvey
Caladenia uliginosa subsp. *patulens* ms.	1	Harvey
Eryngium pinnatifidium subsp. *palustre* ms.	1	Serpentine
Eryngium subdecumbens ms.	1	Perth*
Eucalyptus marginata subsp. *elegantella*	1	Serpentine
Acacia oncinophylla subsp. *patulifolia* ms.	2	North Dandalup
Grevillea manglesii subsp. *ornithopoda*	2	Pinjarra
Haloragis aculeotata	2	Yalgorup NP
Isolepis hookeriana	2	Waroona
Lasiopetalum membranaceum	2	Yalgorup
Leptocarpus ceramophilus ms.	2	Yarloop
Leptomaria lehmannii	2	Yalgorup
Parsonia diaphanophleba	2	Murray Rv.
Platysace sp. Yalgorup [aff. *xerophila*]	2	Yalgorup
Senecio leucoglossus	2	Harvey
Acacia horridula	3	Serpentine
Acacia oncinophylla subsp. *oncinophylla*	3	Serpentine
Hibbertia spicata subsp. *leptotheca*	3	Yalgorup
Jacksonia sericea	3	Pinjarra
Lasiopetalum glabratum	3	Serpentine
Rhodanthe pyrethrum	3	Harvey
Stylidium sp. Yalgorup	3	Yalgorup
Anthotium junciforme	4	Serpentine
Banksia meisneri var. *ascendens*	4	Mandurah
Caladenia speciosa ms.	4	Yarloop
Conostylis pauciflora subsp. *pauciflora*	4	Yalgorup NP
Drosera occidentalis subsp. *occidentalis*	4	Pinjarra
Hibbertia silvestris	4	Waroona
Verticordia lindleyi subsp. *lindleyi*	4	Murray Rv.

* species which, whilst not having been collected within the Peel Region, appear to have ranges that encompass this region.

Sources: Atkins (1995); Dames & Moore (1991); Gibson *et al.* (1994)

APPENDIX C

Description of Vegetation Associations in the Peel Deviation Corridor

APPENDIX C: Description of Vegetation Associations in the Peel Deviation Corridor

Association 1: Cleared land.
This category, which comprises the majority of the proposed alignments, has been defined to include farmland, housing estates and other developments in which the natural vegetation has been largely or completely removed. Cleared land was generally characterised by an overstorey of scattered trees such as *Agonis flexuosa, Eucalyptus calophylla, Eucalyptus gomphocephala, Eucalyptus marginata* or *Melaleuca rhaphiophylla,* representing remnants of the original vegetation. The pasture understorey was typically dominated by introduced grasses and herbs, although occasional shrubs or patches of shrubland included species such as *Macrozamia riedlei.*

Association 2: Pine plantations.
Dense stands of pine trees occurred in plantations along the southern end of the alignment. They consisted of dense tall forests of **Pinus radiata* over an open to dense cover of herbs and grasses, including numerous introduced species such as **Briza maxima* and **Briza minor.*

Association 3: *Eucalyptus calophylla* over *Xanthorrhoea preissii* over mixed heath (Sites 15, 18 & 20).
This vegetation occurred along the section of alignment adjacent to and traversing Kooljerrenup Nature Reserve. Where a tree overstorey occurred, this strata was dominated by *Eucalyptus calophylla,* with lesser amounts of various species such as *Banksia attenuata, Eucalyptus marginata, Melaleuca preissiana* and *Nuytsia floribunda.* The generally open cover of shrubs greater than 1 m tall was dominated by a variety of species including *Xanthorrhoea preissii,* with lesser amounts of species such as *Acacia saligna, Hakea prostrata* and *Jacksonia furcellata.* The open to moderately dense 0.5 to 1 m tall shrub stratum was dominated by a variety of species including *Acacia pulchella, Hakea varia, Hypocalymma robustum, Jacksonia furcellata* and *Pericalymma ellipticum* var. *ellipticum.* The open to moderately dense low shrub layer (< 0.5 m tall) was generally dominated by *Conostylis aculeata* and *Patersonia occidentalis, Hakea varia, Hypocalymma robustum,* with species such as *Dasypogon bromeliifolius, Dryandra nivea, Hemiandra pungens* and *Hibbertia* species contributing sparse cover.

Association 4: *Kunzea ericifolia / Jacksonia furcellata* heath (Sites 5, 6, 11 and 24).
This vegetation occurred on patches of sandy soil associated with creek systems. Where a tree overstorey was present, the open cover was generally dominated by Eucalyptus species such as *E. calophylla, E. marginata* and *E. rudis,* with scattered trees of species such as *Banksia attenuata, Banksia menziesii, E* and *Nuytsia floribunda.* The dense heath greater than 2 m tall was generally dominated by *Kunzea ericifolia* and *Jacksonia furcellata*, with lesser amounts of *Adenanthos sericeus* subsp. *sericeus.* Lower shrub layers generally provided an open cover and were dominated by *Bossiaea ornata, Conostylis aculeata, Dasypogon bromeliifolius* and *Phlebocarya ciliata,* together with *Xanthorrhoea preissii* or *Pteridium esculentum* in places. Other species contributing sparse amounts of cover were *Acacia huegelii, Acacia pulchella, Gompholobium tomentosum, Leucopogon australis* and *Macrozamia riedlei.* At ground level there was a sparse cover of herbs including *Burchardia umbellata, Drosera stolonifera* and **Ursinia anthemoides.* A sparse to open cover of sedge-like plants included a variety of species such as *Lomandra integra, Loxocarya flexuosa* and *Lyginia barbata.* Grasses were sparse or absent; where present, this strata included **Aira cupaniana, *Avena barbata, *Briza maxima* and **Ehrharta calycina.*

Association 5: *Casuarina obesa / Melaleuca cuticularis* over *Melaleuca viminea* (Site 10).
This vegetation occurred in a narrow band fringing the Serpentine River in the most northern part of the project area. The dense tree overstorey was dominated by *Casuarina obesa* and *Melaleuca cuticularis,* with a lesser amount of cover provided by *Melaleuca rhaphiophylla.* A moderately dense cover of *Melaleuca viminea* shrubs greater than 2 m in height occurred above the sparse mid-height shrub layers which included species such as *Kunzea ericifolia, Melaleuca lateritia* and *Regelia ciliata.* An open cover of low

shrubs (< 2 m tall) contained a single species, *Halosarcia pergranulata*. The sparse cover of herbs included *Cassytha racemosa* and *Comesperma virgatum*. The dense cover of sedges was dominated by *Juncus kraussii*, and also included *Baumea juncea*, *Gahnia ancistrophylla* and *Leptocarpus coangustatus*. No grasses were collected from this association.

Association 6: Samphire (Site 1).
This association occurred in two small patches on seasonally wet clay soil adjacent to the Serpentine River. The sparse overstorey consisted of occasional trees of *Casuarina obesa* over scattered tall shrubs of *Melaleuca cuticularis*, and occurred as fringing vegetation around the central patch of samphire. The dense low shrubland (generally < 1 m tall) was dominated by *Halosarcia halocnemoides* and *Halosarcia pergranulata*, and included lesser amounts of *Halosarcia indica* subsp. *bidens*. At ground level there was a sparse cover of herbs dominated by chenopods such as **Chenopodium glaucum*, **Chenopodium album* and *Suaeda australis* and also including the daisy *Cotula coronopifolia*. The rush *Juncus pauciflorus* provided less than 2 % cover.

Association 7: Myrtaceous Heath (Site 16).
This vegetation occurred in a small patch of damp clayey loam. Occasional *Eucalyptus calophylla* trees occurred above sparse tall (> 2 m) shrubs of *Melaleuca viminea* and *Viminaria juncea*. The moderately dense to dense shrub layers from 0.5 to 2 m in height were dominated by *Pericalymma ellipticum* var. *ellipticum* over *Melaleuca lateritia* and *Melaleuca pauciflora*. Other shrubs occurring as sparse densities included *Astartea fascicularis*, *Calothamnus lateralis*, *Nemcia reticulata*, *Hakea sulcata*, *Hakea varia* and *Xanthorrhoea preissii*. The open cover of shrubs less than 0.5 m tall included *Boronia juncea*, *Conostylis aculeata* and *Kunzea recurva*. At ground level there was a sparse cover of herbs including *Anigozanthus manglesii*, *Dampiera linearis*, *Haemodorum paniculatum* and *Patersonia occidentalis*, and a sparse cover of grasses dominated by **Briza minor*. A relatively open (10 - 20 %) cover of sedges was dominated by *Leptocarpus scariosus*, while *Mesomelaena tetragona* occurred sparsely.

Association 8: *Eucalyptus rudis / Melaleuca rhaphiophylla* woodland (Sites 7, 8, 21, 23, 28 & 29).
This vegetation occurred adjacent to creeklines and in seasonally wet areas within the survey area. The moderately dense to dense tall woodland was dominated by *Eucalyptus rudis* over *Melaleuca rhaphiophylla*, with species such as *Casuarina obesa* and *Melaleuca preissiana* providing a lesser amount of cover. Beneath the tree canopy, tall shrub layers ranged from sparse to moderately dense, and were dominated by a variety of species such as *Astartea fascicularis*, *Kunzea ericifolia*, *Melaleuca lateritia* and *Melaleuca viminea*. Other species occurring at lesser densities included *Astartea fascicularis*, *Hakea prostrata*, *Kunzea ericifolia* and *Pteridium esculentum*. Lower shrubs (< 1 m in height) were generally sparse and included *Patersonia occidentalis*, *Callistachys lanceolata* and *Eutaxia virgata*. At ground level, herbs provided an open to dense cover and included *Centella asiatica*, *Lobelia alata*, **Lotus suaveolens*, **Lotus uliginosus*, **Mentha pulegium* and **Rumex conglomeratus*. The cover of sedges was typically dense and included a variety of species such as **Cyperus eragrostis*, *Gahnia ancistrophylla*, *Isolepis cyperoides*, *Juncus pallidus*, *Juncus pauciflorus*, *Lepidosperma effusum* and **Typha domingensis*. The open to moderately dense cover of grasses was typically dominated by introduced grasses such as **Avena barbata*, **Briza maxima*, **Briza minor* and **Ehrharta calycina*.

Association 9: *Melaleuca rhaphiophylla / Melaleuca teretifolia* heath (Site 27).
This vegetation occurred on a small area of damp land which may be seasonally wet. A large number of introduced species were recorded due to the location within a rural holding. The sparse tree overstorey comprised clumps of *Melaleuca rhaphiophylla*, with occasional *Eucalyptus rudis* and *Melaleuca preissiana*. The dense cover of shrubs greater than 1 m tall included only two species, *Melaleuca rhaphiophylla* and *Melaleuca teretifolia*, with the latter being dominant. The open cover of lower shrubs (< 1 m tall) again included only two species, *Melaleuca teretifolia* and *Melaleuca lateritia*. The moderately dense cover of herbs was dominated by the clover **Lotus suaveolens* and to a lesser extent the daisy *Cotula coronopifolia*, and also included lesser amounts of **Arctotheca calendula*, *Caladenia longicauda* subsp. *longicauda*, *Cassytha*

racemosa, **Hypochaeris glabra*, **Ornithopus compressus* and **Trifolium campestre*. A sparse cover of sedges included *Isolepis marginata*, *Juncus kraussii* and *Juncus pallidus*. The grass layer contributed a dense cover and was dominated by **Anthoxanthum odoratum*. Other grass species occurring at lesser densities were *Agrostis avenacea*, **Briza maxima*, **Briza minor* and **Holcus setiger*.

Association 10: *Eucalyptus rudis / Melaleuca preissiana* woodland over low shrubs.
This vegetation was similar to Association 2, occurring in a single patch on a slightly drier area and having a more open cover. The open to moderately dense tree overstorey was dominated by *Eucalyptus rudis* over *Melaleuca preissiana*. The moderately dense cover of shrubs was dominated by *Xanthorrhoea preissii* over *Patersonia occidentalis* and *Dasypogon bromeliifolius*. At ground level, the sparse to open cover of herbs and grasses included **Lotus suaveolens*. Sedges were sparse to absent.

Association 11: *Melaleuca pauciflora* heath (Site 9).
This vegetation occurred on a single patch of sandy ground at the most northern end of the project area, north of the Serpentine River. The sparse tree overstorey included a single species, *Casuarina obesa*. The moderately dense to dense heath greater than 1 m tall was dominated by *Melaleuca pauciflora* with lesser amounts of *Acacia saligna*, *Hakea varia*, *Jacksonia sternbergiana* and *Kunzea ericifolia*. The moderately dense cover of shrubs 0.5 to 1 m in height was dominated by *Pericalymma ellipticum* var. *ellipticum* and *Regelia ciliata*, while the moderately dense cover of low shrubs (<0.5 m) was dominated by *Patersonia occidentalis*, with other species occurring at lesser densities including *Dryandra nivea*, *Dasypogon bromeliifolius*, *Phlebocarya ciliata* and *Stirlingia latifolia*. At ground level there was a sparse cover of herbs including *Corynotheca micrantha*, *Cotula coronopifolia* and *Dampiera linearis*, and a sparse cover of grasses such as **Aira cupaniana*, **Briza maxima*, **Briza minor* and **Ehrharta calycina*. These strata were largely obscured by the dense cover of sedge-like plants dominated by *Lepidosperma squamatum*, with lesser amounts of *Baumea juncea*, *Lepyrodia glauca*, *Lomandra hermaphrodita* and *Loxocarya flexuosa*.

Association 12: *Banksia attenuata / Eucalyptus marginata* woodland (Sites 3, 4, 25, 26 & 30).
This vegetation occurred on relatively dry, sandy soils along the southern portion of the alignment. The moderately dense to dense cover of trees was generally dominated by *Eucalyptus marginata* over *Banksia attenuata*, with lesser amounts of species such as *Allocasuarina fraseriana*, *Banksia grandis*, *Banksia ilicifolia*, *Eucalyptus calophylla* and *Eucalyptus gomphocephala*. The open cover of shrubs greater than 1 m in height was generally dominated by *Acacia pulchella* and included a variety of other species such as *Kunzea ericifolia*, *Macrozamia riedlei* and *Melaleuca thymoides*. The open to moderately dense cover of shrubs less than 1 m tall was dominated by *Hibbertia hypericoides* and included lesser amounts of *Bossiaea eriocarpa*, *Conostylis aculeata*, *Hibbertia racemosa*, *Leucopogon striatus* and *Petrophile linearis*. At ground level there was generally a sparse cover of herbs including a diverse mix of species such as *Asteridea athrixioides*, *Drosera stolonifera*, *Hardenbergia comptoniana*, **Hypochaeris glabra*, *Lobelia heterophylla*, *Lobelia tenuior*, *Trachymene pilosa* and **Ursinia anthemoides*. The sparse cover of sedge-like plants included *Lepidosperma angustatum*, *Lomandra caespitosa*, *Lomandra sonderi*, *Loxocarya fasciculata*, *Loxocarya flexuosa* and *Lyginia barbata*. The sparse cover of grasses was typically dominated by the introduced grasses **Aira cupaniana*, **Briza maxima* and **Briza minor*.

Association 13: *Eucalyptus gomphocephala / Agonis flexuosa* woodland (Sites 2, 12, 13 & 14).
This vegetation type also occurred on sandy soils in the most southern portion of the project area. The moderately dense tree overstorey was dominated by *Eucalyptus gomphocephala* over *Agonis flexuosa*. Other species occurring at lesser densities within the overstorey layer included *Banksia attenuata*, *Banksia grandis* and *Eucalyptus marginata*. Shrubs greater than 1 m in height generally provided a sparse to open cover, dominated by a variety of species such as *Acacia pulchella*, *Acacia saligna*, *Dryandra sessilis*, *Leucopogon australis*, *Leucopogon propinquus*, *Templetonia retusa* and *Xanthorrhoea preissii*. The sparse to moderately dense cover of lower shrubs was dominated by a mixture of species including *Conostylis aculeata*, *Hibbertia hypericoides*, *Hibbertia racemosa*, *Leucopogon australis* and *Dryandra nivea*. The sparse to open cover of herbs included a diverse mix of species such as **Anagallis arvensis*, *Asteridea*

*athrixioides, Dianella revoluta, Hardenbergia comptoniana, *Hypochaeris glabra, Lagenifera huegelii, Pelargonium australe, Rhodanthe* sp. 1, *Trachymene pilosa* and **Trifolium campestre.* There was typically a sparse cover of various species of sedge-like plants such as *Lepidosperma angustatum, Lomandra hermaphrodita, Lomandra integra, Lomandra preissii, Loxocarya cinerea, Loxocarya fasciculata* and *Loxocarya flexuosa.* The sparse to open cover of grasses included **Briza maxima, *Briza minor, *Holcus setiger* and **Vulpia myuros.*

APPENDIX D

Fauna recorded or potentially occurring in the Peel Deviation project area

ABBREVIATIONS

OF	Open Farmland
SF	Samphire Flats
WL - Swamp Fauna S4	Wetlands
RV - Fauna S5 & Vege. S8	Riverine
MW - Fauna S1, S2, S3 & S4	Mixed Woodland

\+ fauna potentially occurring within the project area
X fauna collected or observed within the project area
• mostly aerial species
Int. introduced species

Appendix D1: Mammals observed or potentially occurring within the Peel Deviation project area.

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
TACHYGLOSSIDAE						
Tachyglossus aculeatus	Echidna				+	+
DASYURIDAE						
Dasyurus geoffroii	Chuditch				+	+
Sminthopsis crassicaudata	Fat-tailed Dunnart	+	+	+	+	+
Sminthopsis murina	Common Dunnart	+	+	+	+	+
PERAMELIDAE						
Isoodon obesulus	Southern Brown Bandicoot			X	+	X
PETAURIDAE						
Pseudocheirus peregrinus	Common Ringtail Possum				+	
PHALANGERIDAE						
Trichosurus vulpecula	Common Brushtail Possum	+		+	X	X
BURRAMYIDAE						
Cercartetus concinnus	Western Pygmy-possum					+
TARSIPEDIDAE						
Tarsipes rostratus	Honey-possum					+
MACROPODIDAE						
Macropus fuliginosus	Western Grey Kangaroo	X	+	+	X	X
Macropus irma	Western Brush Wallaby	+	+	+	+	+
MOLOSSIDAE						
Mormopterus planiceps	Little Mastiff-bat	+	+	+	+	+
Nyctinomus australis	White-striped Mastiff Bat	+	+	+	+	+
VESPERTILIONIDAE						
Chalinolobus gouldii	Gould's Wattled Bat	+	+	+	+	+
Chalinolobus morio	Chocolate Wattled Bat	+	+	+	+	+
Eptesicus regulus	King River Eptesicus	+	+	+	+	+
Nyctophilus geoffroyi	Lesser Long-eared Bat	+	+	+	+	+
Nyctophilus gouldii	Gould's Long-eared Bat	+	+	+	+	+
Nyctophilus timoriensis	Greater Long-eared Bat	+	+	+	+	+
MURIDAE						
Hydromys chrysogaster	Water Rat				+	
Rattus fuscipes	Bush Rat			+	+	+
INTRODUCED MAMMALS						
Felis catus	Feral Cat [int.]	+	+	+	+	+
Mus musculus	House Mouse [int.]	+	+	X	X	+
Oryctolagus cuniculus	European Rabbit [int.]	X	+	+	X	X
Rattus norvegicus	Brown Rat [int.]	+			+	
Rattus rattus	Black Rat [int.]	+	+		X	+
Vulpes vulpes	Fox [int.]	+	+	+	+	+
	TOTAL	19	17	19	25	24

Appendix D2: Birds observed or potentially occurring within the Peel Deviation project area.

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
CASUARIDAE						
Dromaius novaehollandiae	Emu	+	+	+	+	X
PODICIPEDIDAE						
Podiceps cristatus	Great Crested Grebe			+	+	
Poliocephalus poliocephalus	Hoary-headed Grebe			+	+	
Tachybaptus novahollandiae	Australasian Grebe	X		+	+	
PELECANIDAE						
Pelecanus conspicillatus	Australian Pelican	X		+	+	
ANHINGIDAE						
Anhinga melanogaster	Darter			+	X	X
PHALACROCORACIDAE						
Phalacrocorax carbo	Great Cormorant			+	+	
Phalacrocorax sulcirostris	Little Black Cormorant			+	X	
Phalacrocorax melanoleucos	Little Pied Cormorant			+	X	
ARDEIDAE						
Ardea pacifica	Pacific Heron		+	X	+	
Egretta novaehollandiae	White-faced Heron	X	+	X	+	
Ardeola ibis	Cattle Egret	+	+	+	+	
Ardea alba	Great Egret	+	+	+	X	
Egretta garzetta	Little Egret		+	+	+	
Nycticorax caledonicus	Nankeen Night Heron			+	+	
Ixobrychus minutus	Little Bittern			+	+	
Botaurus poiciloptilus	Australasian Bittern			+	+	
THRESKIORNITHIDAE						
Plegadis falcinellus	Glossy Ibis	+	+	+	+	
Threskiornis aethiopica	Sacred Ibis	X	+	X	+	
Threskiornis spinicollis	Straw-necked Ibis	X	+	X	+	
Platalea regia	Royal Spoonbill		+	+	+	
Platalea flavipes	Yellow-billed Spoonbill	X	+	X	+	
ANATIDAE						
Cygnus atratus	Black Swan			+	+	
Stictonetta naevosa	Freckled Duck			+	+	
Tadorna tadornoides	Australian Shelduck			+	+	
Anas superciliosa	Pacific Black Duck	+	+	+	X	
Anas gracilis	Grey Teal	X	+	+	+	
Anas castanea	Chestnut Teal			+	+	
Anas rhynchotis	Australasian Shoveller			+	+	
Malacorhynchus membranaceus	Pink-eared Duck			+	+	
Aythya australis	Hardhead			+	+	
Chenonetta jubata	Maned Duck	+	+	+	+	
Oxyura australis	Blue-billed Duck			+	+	
Biziura lobata	Musk Duck			+	+	
ACCIPITIRIDAE						
Pandion haliaetus	Osprey				X	
Elanus axillaris	Black-shouldered Kite	X	+	+	+	+
Lophoictinia isura	Square-tailed Kite	+	+	+	+	+
Haliastur sphenurus	Whistling Kite	+	+	+	+	X
Accipiter fasciatus	Brown Goshawk	+	+	+	+	+
Accipiter cirrhocephalus	Collared Sparrowhawk	+	+	+	+	+

Appendix D2: continued

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
ACCIPITIRIDAE continued						
Aquila audax	Wedge-tailed Eagle*	+	+	+	+	X
Hieraaetus morphnoides	Little Eagle*	+	+	+	+	+
Circus assimilis	Spotted Harrier*	+	+	+	+	+
Circus aeruginosus	Swamp Harrier*	X	+	+	+	+
FALCONIDAE						
Falco peregrinus	Peregrine Falcon*	+	+	+	+	+
Falco longipennis	Australian Hobby*	+	+	+	+	+
Falco berigora	Brown Falcon*	X	+	+	+	+
Falco cenchroides	Australian Kestrel*	+	+	+	+	X
PHASIANIDAE						
Coturnix pectoralis	Stubble Quail	+				+
Coturnix australis	Brown Quail			+	+	X
TURNICIDAE						
Turnix varia	Painted Button-quail				+	+
RALLIDAE						
Gallirallus philippensis	Banded Land Rail	+		+	+	
Porzana pusilla	Baillon's Crake			+		
Porzana fluminea	Australian Crake		+	X		
Porzana tabuensis	Spotless Crake		+	+	+	
Gallinula ventralis	Black-tailed Native Hen			+	+	
Gallinula tenebrosa	Dusky Moorhen	X		+	+	
Porphyrio porphyrio	Purple Swamphen	+		+	+	
Fulica atra	Eurasian Coot	+		+	+	
CHARADRIIDAE						
Vanellus tricolor	Banded Lapwing	+	+	+		
Pluvialis squatarola	Grey Plover		+	+		
Erythrogonys cinctus	Red-kneed Dotterel		+	+		
Thinornis rubricollis	Hooded Plover		+	+		
Charadrius ruficapillus	Red-capped Plover		+	+		
Elseyornis melanops	Black-fronted Plover		+	+		
RECURVIROSTRIDAE						
Cladorhynchus leucocephalus	Banded Stilt		+	+		
Himantopus himantopus	Black-winged Stilt		+	+		
Recurvirostra novaehollandiae	Red-necked Avocet		+	+		
SCOLOPACIDAE						
Tringa glareola	Wood Sandpiper[m]		+	+		
Actitis hypoleucos	Common Sandpiper[m]		+	+	+	
Tringa nebulari	Greenshank[m]		+	+		
Tringa stagnatilis	Marsh Sandpiper[m]		+	+		
Calidris acuminata	Sharp-tailed Sandpiper[m]		+	+		
Calidris ruficollis	Red-necked Stint[m]		+	+		
Calidris subminuta	Long-toed Stint[m]		+	+		
Calidris ferruginea	Curlew Sandpiper[m]		+	+		
GLAREOLIDAE						
Glareola maldivarum	Oriental Pratincole[m]		+	+		
LARIDAE						
Larus novaehollandiae	Silver Gull	+	+	+	X	
Chlidonias hybridus	Whiskered Tern		+	+		
Sterna nilotica	Gull-billed Tern		+	+		
Hydroprogne caspia	Caspian Tern	X				

Appendix D2: continued

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
COLUMBIDAE						
Columba livia	Feral Pigeon[int.]	+				
Streptopelia chinensis	Spotted Turtle-dove[int.]	+				
Streptopelia senegalensis	Laughing Turtle-dove[int.]	+			X	X
Phaps chalcoptera	Common Bronzewing	X			+	X
Phaps elegans	Brush Bronzewing	+			+	X
Ocyphaps lophotes	Crested Pigeon	X			+	X
CACATUIDAE						
Calyptorhynchus banksii	Red-tailed Black Cockatoo	+			+	X
Calyptorhynchus baudinii	White-tailed Black Cockatoo	X			+	+
Calyptorhynchus latirostris	Carnaby's Black Cockatoo	+			+	+
Cacatua roseicapilla	Galah	+	+	+	+	+
Cacatua pastinator	Long-billed Corella	+			+	
Cacatua sanguinea	Little Corella	+				+
PSITTACIDAE						
Glossopsitta porphyrocephala	Purple-crowned Lorikeet					+
Polytelis anthopeplus	Regent Parrot	+			X	+
Purpureicephalus spurius	Red-capped Parrot	+				X
Platycercus icterotis	Western Rosella	+				+
Barnardius zonarius	Port Lincoln Ringneck	+			X	X
Neophema elegans	Elegant Parrot	+				+
CUCULIDAE						
Cuculus pallidus	Pallid Cuckoo	+		+	+	+
Cacomantis flabelliformis	Fan-tailed Cuckoo			+		+
Chrysococcyx basalis	Horsefield's Bronze Cuckoo	+		+	+	X
Chrysococcyx lucidus	Shining Bronze-cuckoo				X	+
STRIGIDAE						
Ninox novaeseelandiae	Southern Boobook	X		+	+	+
Ninox connivens	Barking Owl				+	
TYTONIDAE						
Tyto alba	Barn Owl	+			+	+
Tyto novaehollandiae	Masked Owl	+			+	+
PODARGIDAE						
Podargus strigoides	Tawny Frogmouth	+			+	+
AEGOTHELIDAE						
Aegotheles cristatus	Owlet-nightjar	+			+	+
CAPRIMULGIDAE						
Eurostopodus argus	Spotted Nightjar	+			+	+
APODIDAE						
Apus pacificus	Fork-tailed Swift[m.]	+	+	+	+	+
ALCEDINIDAE						
Dacelo novaeguineae	Laughing Kookaburra[int.]	+			X	X
Todiramphus sanctus	Sacred Kingfisher			+	X	X
MEROPIDAE						
Merops ornatus	Rainbow Bee-eater[m.]	+	+	+	+	X
HIRUNDINIDAE						
Hirundo neoxena	Welcome Swallow	+	+	+	X	X
Hirundo nigricans	Tree Martin	+	+	+	+	X
Cheramoeca leucosternum	White-backed Swallow	+	+	+	+	+
Hirundo ariel	Fairy Martin	+	+	+	+	+

Appendix D2: continued

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
MOTACILLIDAE						
Anthus novaeseelandiae	Richard's Pipit	X	+			
CAMPEPHAGIDAE						
Coracina novaehollandiae	Black-faced Cuckoo-shrike	+	+	+	X	X
Lalage sueurii	White-winged Triller	+				X
PETROICIDAE						
Petroica multicolor	Scarlet Robin					X
Petroica goodenovii	Red Capped Robin	+		+	+	+
Melanodryas cucullata	Hooded Robin					+
Microeca fascinans	Jacky Winter					+
PACHYCEPHALIDAE						
Pachycephala *pectoralis*	Golden Whistler			+	X	X
Pachycephalus *rufiventris*	Rufous Whistler			+	+	+
Colluricincla harmonica	Grey Shrike-Thrush	+		+	+	X
DICRURIDAE						
Myiagra inquieta	Restless Flycatcher					
Rhipidura fuliginosa	Grey Fantail				X	X
Rhipidura leucophrys	Willie Wagtail	+	+	+	X	X
Grallina cycanoleuca	Australian Magpie-lark	+	+	+	X	X
SYLVIIDAE						
Acrocephalus stentoreus	Clamorous Reed-Warbler			+	+	
Megalurus gramineus	Little Grassbird			+	+	
Cinclorhamphus mathewsi	Rufous Songlark	+				+
Cinclorhamphus cruralis	Brown Songlark	+				+
MALURIDAE						
Malurus splendens	Splendid Fairy-wren			+	X	X
Malurus elegans	Red-winged Fairy-wren			+	+	
Stipiturus malachurus	Southern Emu-wren		+	+	+	+
PARDALOTIDAE						
Sericornis frontalis	White-browed Scrub-wren		+	+	X	X
Calamanthus fuliginosus	Striated Calamanthus		+	+	+	+
Sericornis brevirostris	Weebill				X	X
Gerygone fusca	Western Gerygone				X	X
Acanthiza apicalis	Inland Thornbill				X	X
Acanthiza inornata	Western Thornbill	+				X
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					X
Pardalotus punctatus	Spotted Pardalote					+
Pardalotus striatus	Striated Pardalote					X
NEOSITTIDAE						
Daphoenositta chrysoptera	Varied Sittella					X
CLIMACTERIDAE						
Climacteris rufa	Rufous Treecreeper					+
MELIPHAGIDAE						
Anthochaera carunculata	Red Wattlebird	+			X	X
Anthochaera chrysoptera	Little Wattlebird					+
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					+
Manorina flavigula	Yellow-throated Miner	X				X
Lichenostomus virescens	Singing Honeyeater	+		+	X	+
Melithreptus brevirostris	Brown-headed Honeyeater					+
Melithreptus lunatus	White-naped Honeyeater					+

Appendix D2: continued

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
MELIPHAGIDAE continued						
Lichmera indistincta	Brown Honeyeater	+	+	+	X	X
Phylidonyris novaehollandiae	New Holland Honeyeater				X	+
Phylidonyris nigra	White-cheeked Honeyeater					+
Phylidonyris melanops	Tawny-crowned Honeyeater					+
Acanthorhynchus superciliosus	Western Spinebill				X	X
Ephithianura albifrons	White-fronted Chat	+		+	+	
DICAEIDAE						
Dicaeum hirundinaceum	Mistletoe Bird				+	+
ZOSTEROPIDAE						
Zosterops lateralis	Silvereye			+	+	X
PASSERIDAE						
Stagonopleura oculata	Red-eared Firetail			+	+	
ARTAMIDAE						
Artamus personatus	Masked Woodswallow					X
Artamus cinereus	Black-faced Woodswallow					X
Artamus cyanopterus	Dusky Woodswallow					+
Cracticus torquatus	Grey Butcherbird	+				X
Cracticus nigrogularis	Pied Butcherbird					+
Gymnorhina tibicen	Australian Magpie	+	+	+	X	X
Strepera versicolor	Grey Currawong					X
CORVIDAE						
Corvus bennetti	Little Crow	+	+	+	+	+
Corvus coronoides	Australian Raven	+	+	+	X	X
	TOTAL	85	68	111	116	101

Appendix D3: Amphibians and reptiles observed or potentially occurring within the Peel Deviation project area.

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
MYOBATRACHIDAE						
Crinia georgiana	Quacking Frog			+	+	
Crinia glauerti	Glauert's Froglet			+	+	
Crinia insignifera	Squelching Froglet			+		
Crinia parainsignifera				X		
Geocrinia leai	Lea's Frog			+	+	
Heleioporus albopunctatus	Western Spotted Frog			+	+	
Heleioporus barycragus	Western Marsh Frog			+	+	
Heleioporus eyrei	Moaning Frog	X		X	X	X
Heleioporus inornatus	Plain Frog			+	+	
Heleioporus psammophilus	Sand Frog	+		+	+	+
Limnodynastes dorsalis	Banjo Frog			+	+	
Myobatrachus gouldii	Turtle Frog	+		+	+	+
Neobatrachus pelobatoides	Humming Frog	+		+		
Pseudophryne guentheri	Günther's Toadlet			+	+	
HYLIDAE						
Litoria adelaidensis	Slender Tree Frog			+	+	
Litoria moorei	Bell Frog			X	+	
CHELIDAE						
Chelodina oblonga	Long-necked Tortoise				X	
GEKKONIDAE						
Phyllodactylus marmoratus	Marbled Gecko	+				X
Diplodactylus granariensis						+
Diplodactylus polyophthalmus						+
Diplodactylus spinigerus	Western Spiny Tailed Gecko					+
Underwoodisaurus milii	Thick-tailed Gecko	+		+	+	+
PYGOPIDIDAE						
Aprasia repens	Fry's worm lizard	+		+		+
Delma fraseri						+
Delma grayii						+
Lialis burtonis	Burton's Snake Lizard	+	+	+	X	+
Pygopus lepidopodus	Common Scaly-foot	+	+	+	+	+
AGAMIDAE						
Pogona minima	Western Bearded Dragon	+	+	+	+	+
SCINCIDAE						
Cryptoblepharus plagiocephalus	Fence Skink	+	+	+	+	X
Ctenotus australis				+		+
Ctenotus fallens		+	+	+	+	+
Ctenotus gemmula				+		+
Ctenotus impar				+	X	+
Ctenotus labillardieri						+
Ctenotus lesueurii					X	X
Egernia kingii	King's Skink		+	+	+	
Egernia luctuosa				+	+	
Egernia napoleonis				+	X	+
Egernia pulchra			+	+		+

Appendix D3: continued

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
SCINCIDAE continued						
Hemiergis initialis				+	+	+
Hemiergis peronii				+	+	
Hemiergis quadrilineatum					X	X
Lerista distinguenda				+		X
Lerista elegans		+		+		+
Lerista lineata				+		+
Lerista lineopunctulata			+			
Lerista microtis				+		+
Lerista praepedita				+		+
Menetia greyii	Grey's Skink	+	+	+	+	X
Morethia butleri						X
Morethia lineoocellata		+		+	+	+
Morethia obscura				+		X
Pseudemoia trilineata				+	+	+
Tiliqua occipitalis	West. Blue-tongued Lizard	+	+	+	+	+
Trachydosaurus rugosus	Bobtail	+	+	+	X	X
VARANIDAE						
Varanus gouldii	Gould's Monitor	+	+	+	+	+
Varanus rosenbergi	Rosenberg's Monitor	+	+	X	X	+
Varanus tristis	Black-headed Monitor					X
TYPHLOPIDAE						
Rhamphotyphlops australis		+			+	X
Rhamphotyphlops pinguis		+			+	+
Rhamphotyphlops waitii		+			+	+
BOIDAE						
Morelia spilota	Carpet Python	+			+	+
ELAPIDAE						
Acanthophis antarcticus	Common Death-adder				+	+
Demansia psammophis	Yellow-faced Whipsnake	+		+	+	+
Drysdalia coronata	Crowned Snake			+		+
Echiopsis curta	Bardick			+		
Notechis ater	Tiger Snake	+	+	X	+	+
Pseudonaja affinis	Dugite	X	+	X	X	X
Simoselaps bertholdi	Jan's Banded Snake				+	+
Simoselaps bimaculatus	Black-naped Snake			+		+
Simoselaps calonotus	Black-striped Snake			+		+
Simoselaps semifasciatus	Southn Shovel-nosed Snake		+	+	+	+
Suta gouldii	Black-headed Snake			+	+	X
Suta nigriceps	Black-backed Snake					+
	TOTAL	26	16	54	46	55

Appendix D4: Fishes potentially occurring in the streams and wetlands within the Peel Deviation project area.

SPECIES	COMMON NAME	OF	SF	WL	RV	MW
GALAXIIDAE						
Galaxius occidentalis	Western Galaxius				+	
ATHERINIDAE						
Atherinosoma wallacei	Western Hardyhead				+	
PERCICHTHYIDAE						
Bostockia porosa	Nightfish				+	
NANNOPERCIDAE						
Edelia vittata	Western Pygmy Perch				+	
GOBIIDAE						
Pseudogobius olorum	Swan River Goby			+	+	
POECILIIDAE						
Gambusia affinis	Mosquitofish[int.]			+	+	
	TOTAL	0	0	2	6	0

APPENDIX E

Preliminary Concept Drawings

MAIN ROADS WESTERN AUSTRALIA

PEEL DEVIATION
PRELIMINARY CONCEPT DRAWINGS

SECTION : CHA. 10000 - CHA. 71500

SOUTH WEST REGION

SHIRE OF MURRAY
SHIRE OF WAROONA

REDUCED DRAWINGS
NOT TO BE SCALED

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TELEPHONE. (09) 322 5990 FAX (09) 321 6385
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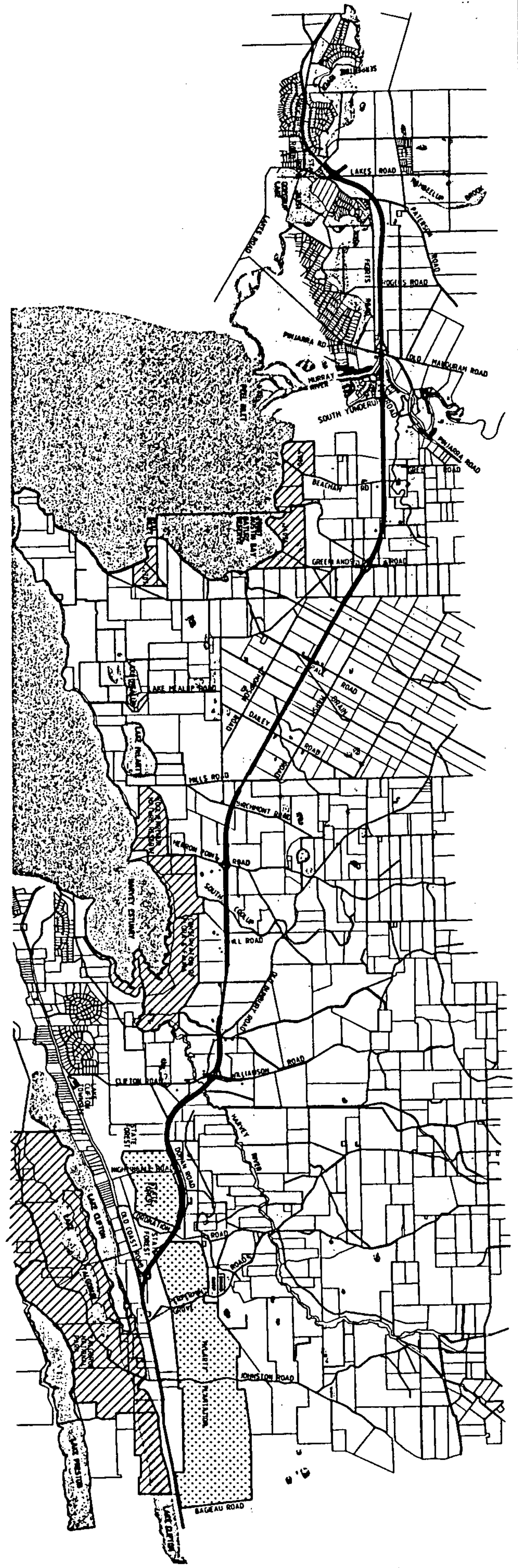
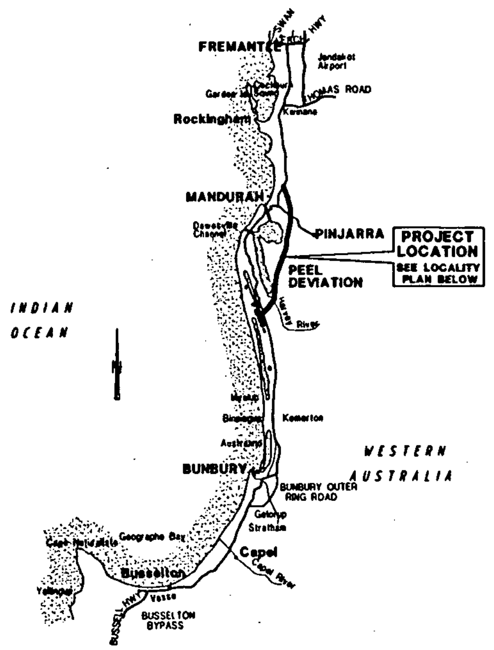


LOCALITY PLAN



KEY PLAN

INDEX OF PRELIMINARY CONCEPT DRAWINGS

ROAD DETAILS

9602-1102	PLAN / PROFILE (CHA. 10000 - 13000)
9602-1103	PLAN / PROFILE (CHA. 13000 - 16000)
9602-1104	PLAN / PROFILE (CHA. 16000 - 19000)
9602-1105	PLAN / PROFILE (CHA. 19000 - 22000)
9602-1106	PLAN / PROFILE (CHA. 22000 - 25000)
9602-1107	PLAN / PROFILE (CHA. 25000 - 28000)
9602-1108	PLAN / PROFILE (CHA. 28000 - 31000)
9602-1109	PLAN / PROFILE (CHA. 31000 - 34000)
9602-1110	PLAN / PROFILE (CHA. 34000 - 37000)
9602-1111	PLAN / PROFILE (CHA. 37000 - 40000)
9602-1112	PLAN / PROFILE (CHA. 40000 - 43000)
9602-1113	PLAN / PROFILE (CHA. 43000 - 46000)
9602-1114	PLAN / PROFILE (CHA. 46000 - 49000)
9602-1115	PLAN / PROFILE (CHA. 49000 - 52000)
9602-1116	PLAN / PROFILE (CHA. 52000 - 55000)
9602-1117	PLAN / PROFILE (CHA. 55000 - 58000)
9602-1118	PLAN / PROFILE (CHA. 58000 - 61000)
9602-1119	PLAN / PROFILE (CHA. 61000 - 64000)
9602-1120	PLAN / PROFILE (CHA. 64000 - 67000)
9602-1121	PLAN / PROFILE (CHA. 67000 - 70000)
9602-1122	PLAN / PROFILE (CHA. 70000 - 71500)
9602-1123	TYPICAL ROAD CROSS-SECTION DETAILS

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED [signature] 23/12/96

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APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

SCALE NOT TO SCALE

MAIN ROADS
Western Australia

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
INDEX OF PRELIMINARY CONCEPT DRAWINGS
CHA. 10000 - 71500

LOCAL AUTHORITY SHIRE OF MURRAY (215) SHIRE OF WAROONA (209)

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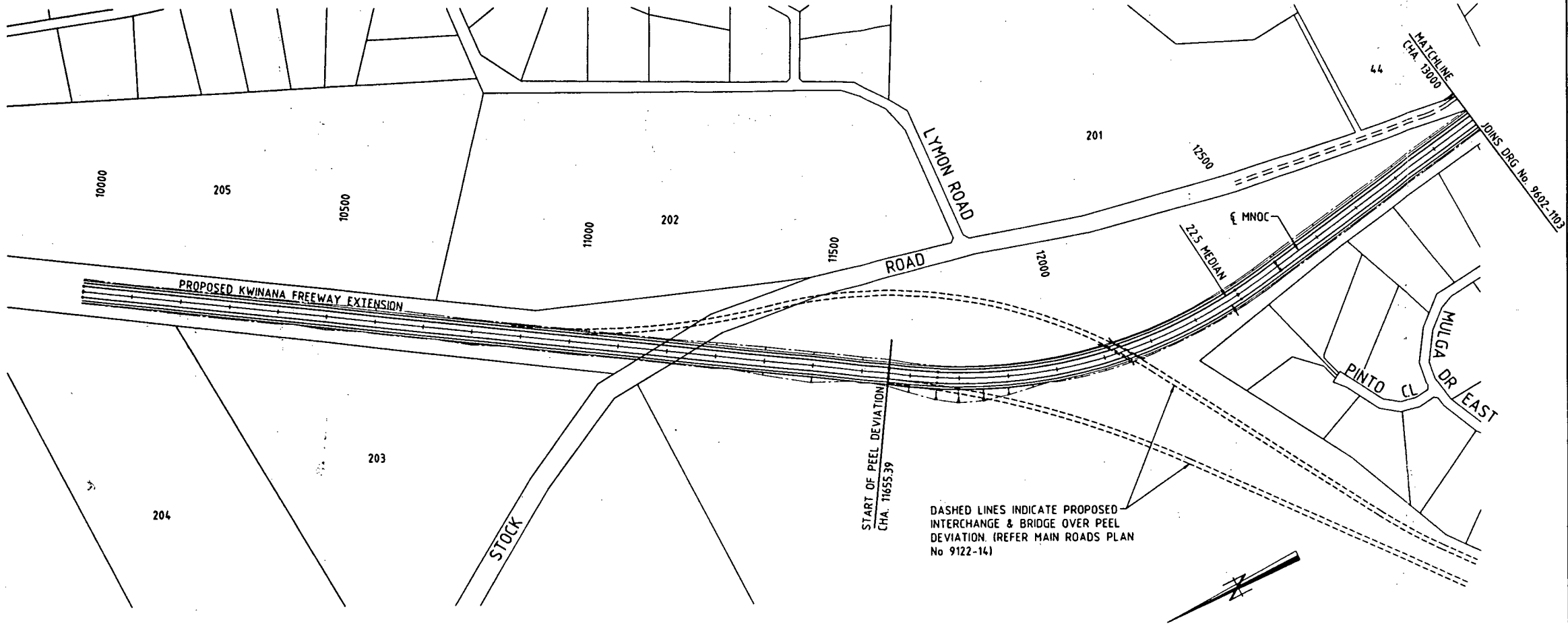

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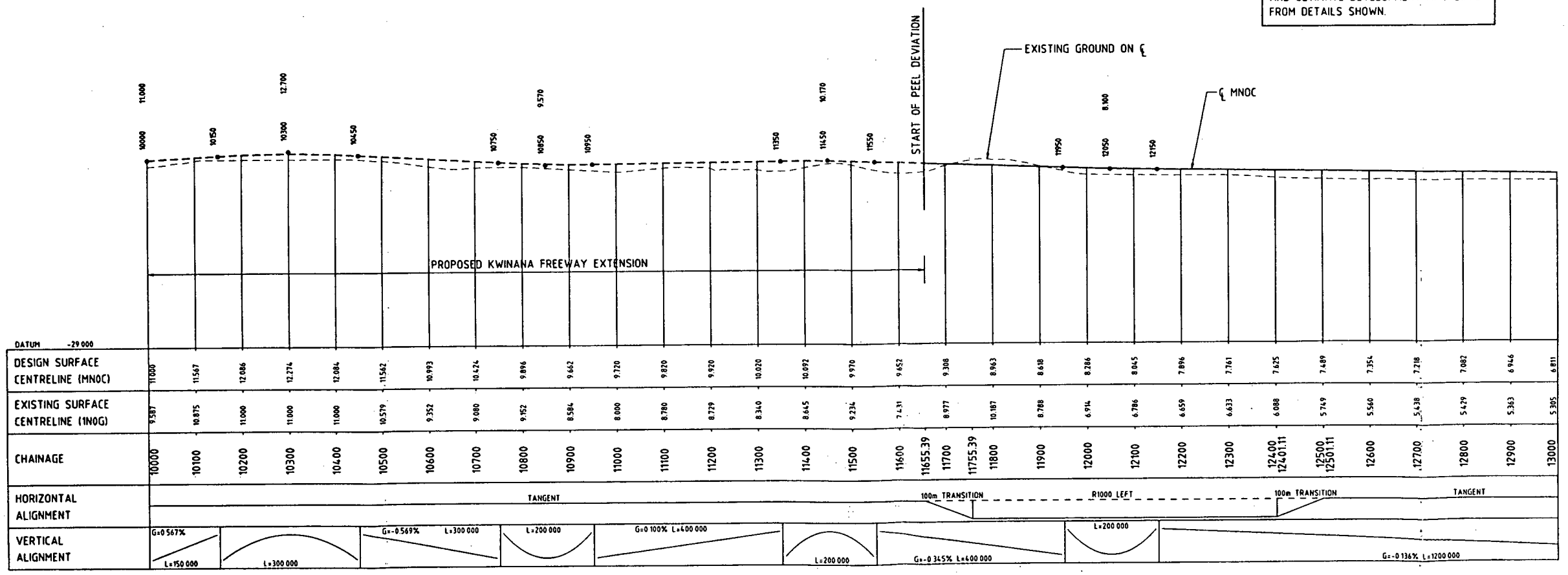

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500 A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 10000 - 13000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

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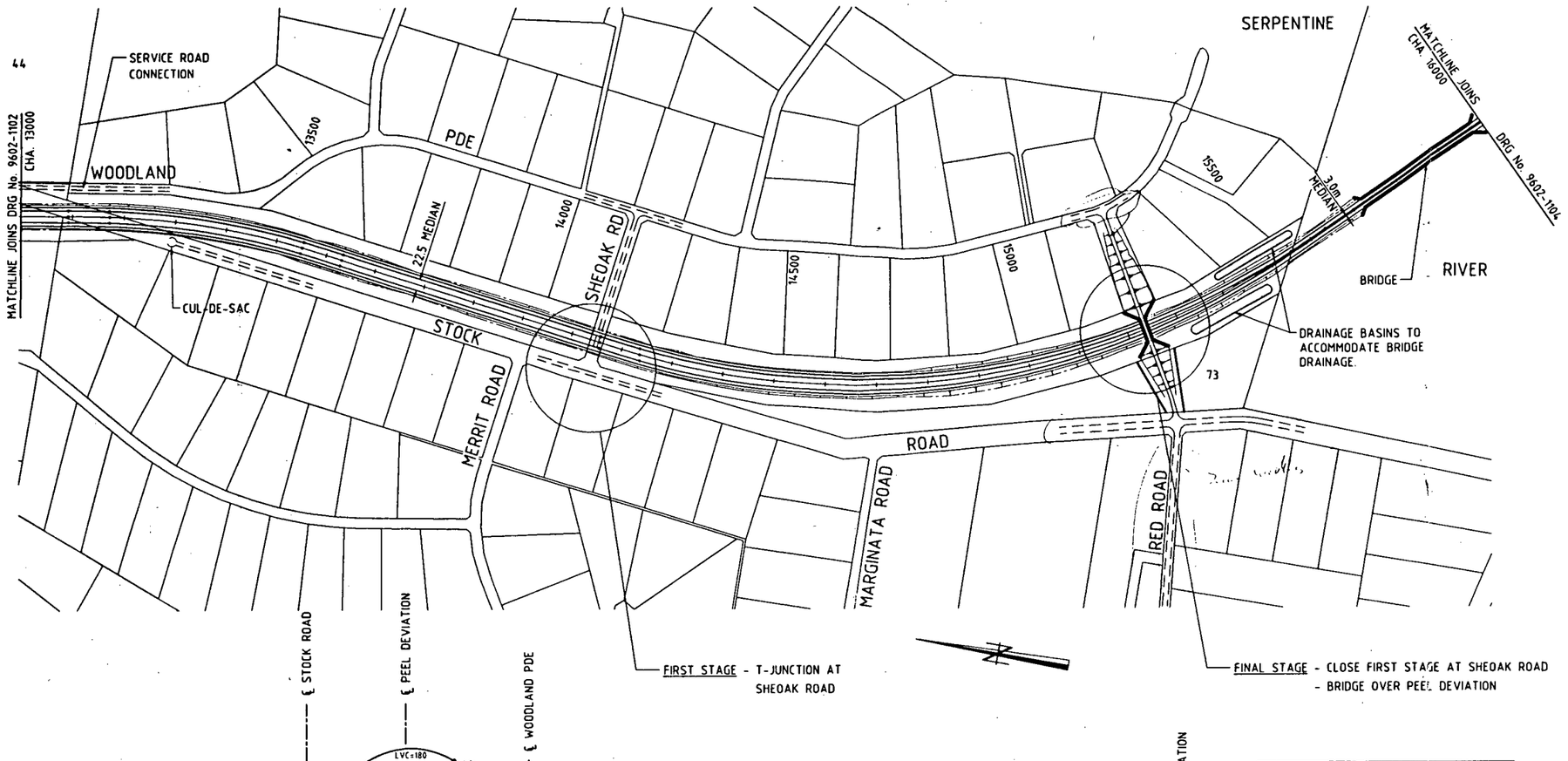

PROFILE OF RED ROAD (HEADING EAST)

H 1:5000
V 1:500

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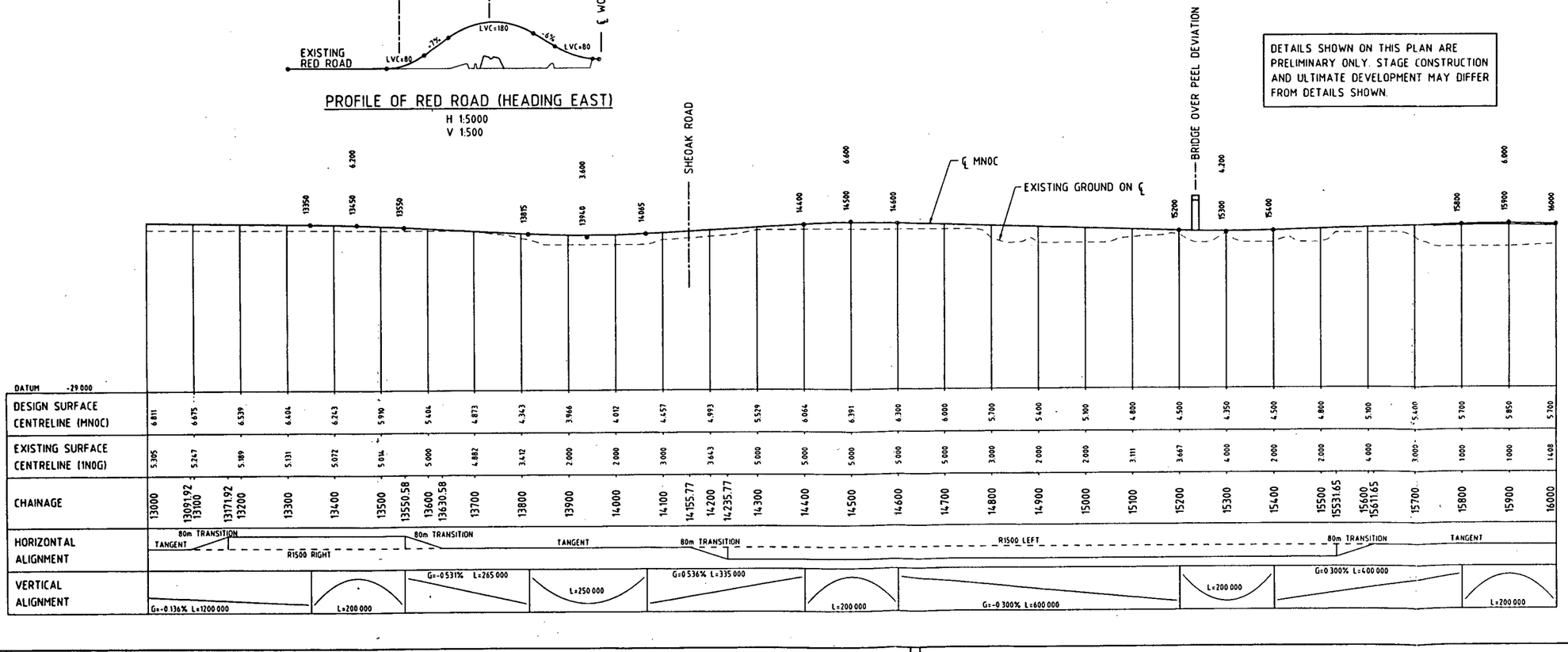

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.IMP
ACAD PROJECT	/ard/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 13000 - 16000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
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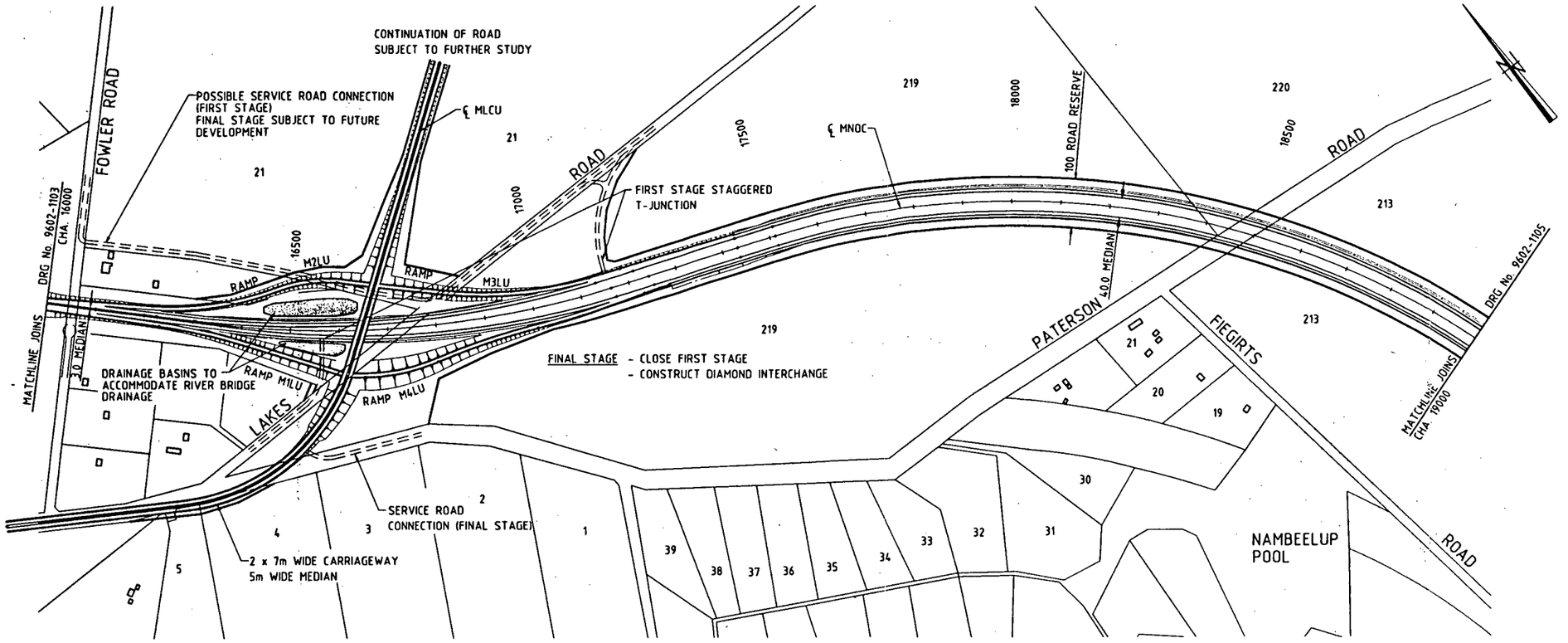

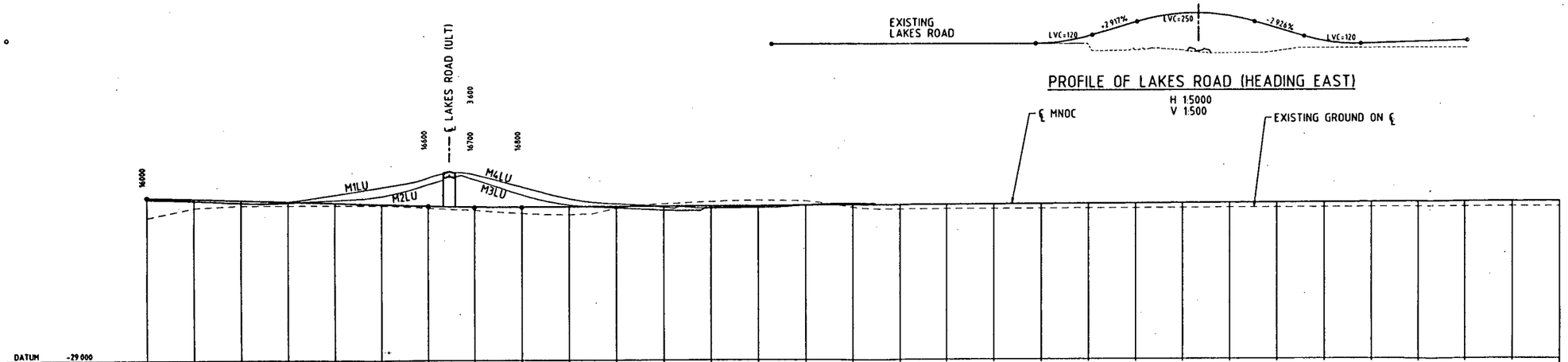

DESIGN SURFACE CENTRELINE (MNOC)	5.700	5.400	5.100	4.800	4.500	4.200	3.900	3.685	3.640	3.680	3.720	3.760	3.800	3.840	3.880	3.920	3.960	4.000	4.040	4.080	4.120	4.160	4.200	4.240	4.280	4.320	4.360	4.400	4.440	4.480	4.520
EXISTING SURFACE CENTRELINE (1NOG)	1.408	3.506	4.000	4.000	4.000	4.000	3.480	3.000	2.319	2.000	3.325	4.263	4.723	5.000	4.820	3.396	3.022	3.050	3.078	3.106	3.134	3.162	3.191	3.219	3.247	3.275	3.303	3.331	3.360	3.388	3.416
CHAINAGE	16000	16100	16200	16279.41 16300	16359.41 16400	16500	16600	16700	16800	16900	17000	17100	17162.99 17200	17242.99 17300	17400 17431.60	17500 17511.60	17600	17700	17800	17900	18000	18100	18200	18300	18400	18500	18600	18700	18800	18900	19000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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GB HILL & PARTNERS PTY LTD EST 1958 ACN 009 031 661

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 22/12/96

APPROVED

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Robertson Drive Bunbury 6230
Telephone (097) 25 5477 Fax (097) 25 4913

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

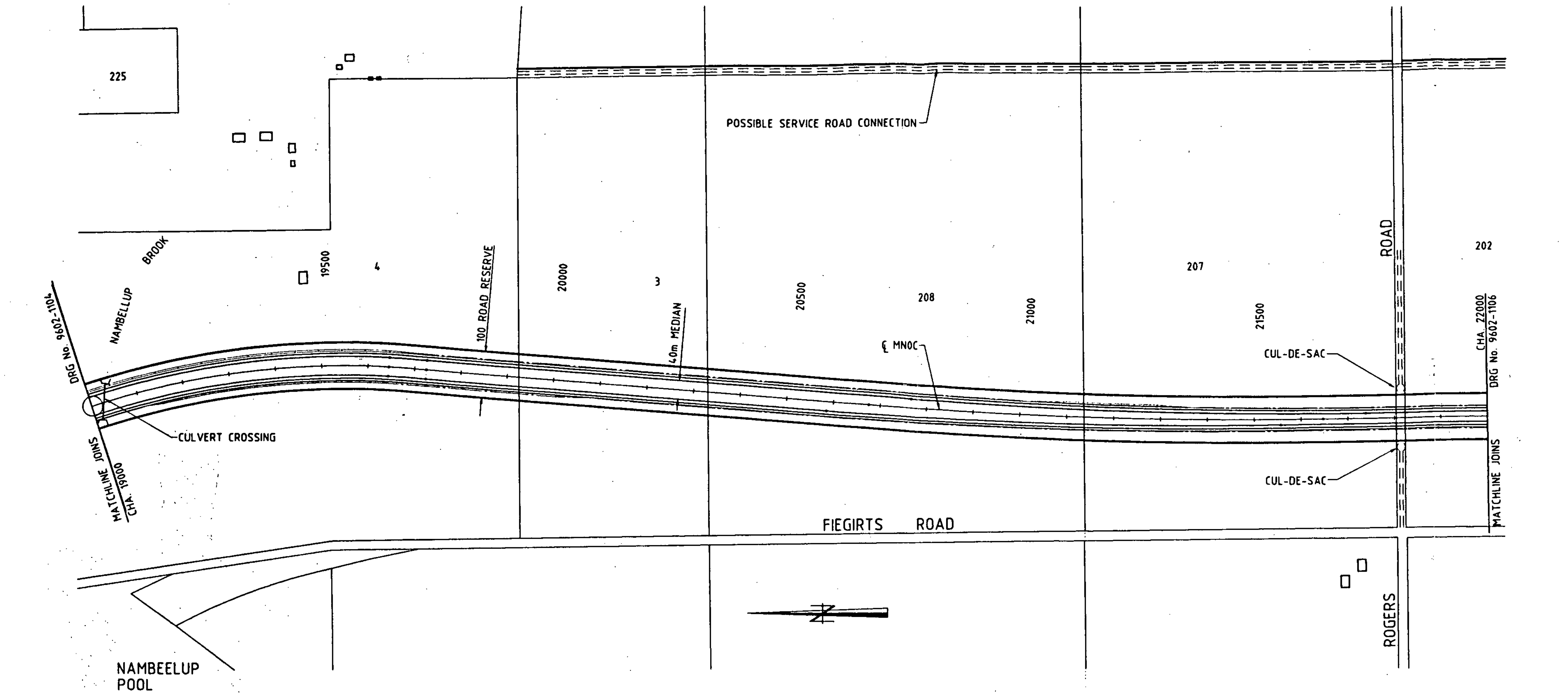
MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500 A1

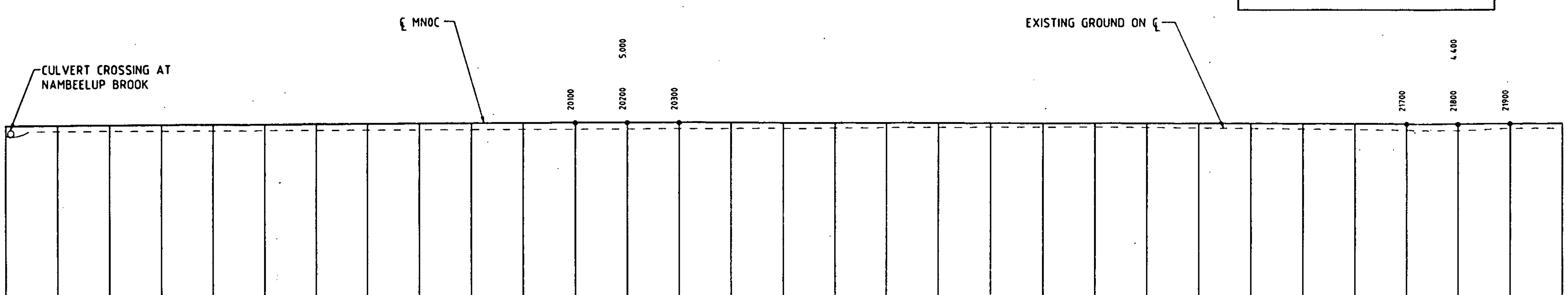
PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 16000 - 19000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
04:06	9602-1104	



DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -29.000

DESIGN SURFACE CENTRELINE (MNOC)	4.520	4.560	4.600	4.640	4.680	4.720	4.760	4.800	4.840	4.880	4.920	4.960	4.981	4.962	4.925
EXISTING SURFACE CENTRELINE (1NOG)	3.416	3.444	3.472	3.501	3.529	3.557	3.585	3.613	3.641	3.670	3.698	3.726	3.754	3.782	3.810
CHAINAGE	19000	19100	19200	19300	19400	19500	19600 19644.78	19700 19724.78	19800	19900	20000	20100	20200	20300	20400

DESIGN SURFACE CENTRELINE (MNOC)	4.887	4.850	4.812	4.775	4.737	4.700	4.663	4.625	4.587	4.550	4.512	4.475	4.437	4.429	4.479	4.557
EXISTING SURFACE CENTRELINE (1NOG)	3.839	3.867	3.895	3.923	3.951	3.980	3.966	3.844	3.721	3.598	3.475	3.352	3.230	3.107	3.563	3.655
CHAINAGE	20500	20600	20675.75 20700	20800	20900	21000	21100	21200	21300	21400	21500	21600 21647.68	21700	21800	21900	22000

HORIZONTAL ALIGNMENT: R1700 RIGHT — 80m TRANSITION — TANGENT — R10000 LEFT — TANGENT

VERTICAL ALIGNMENT: G=0.040% L=3300.000 — L=200.000 — G=-0.038% L=1400.000 — L=200.000 — G=0.079% L=1200.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND
- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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DESIGNED/DRAWN J. H. GRAY W. B. RUDDY
VERIFIED [signature] 23/12/96
APPROVED

SOUTH WEST REGION
Robertson Drive, Bunbury 6230
Telephone (097) 25 5477 Fax (097) 25 4013

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS Western Australia

SCALE: VERTICAL 1:500 — HORIZONTAL 1:5000 — A1

PERTH - BUNBURY HIGHWAY PEEL DEVIATION PLAN/PROFILE CHA. 19000 - 22000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
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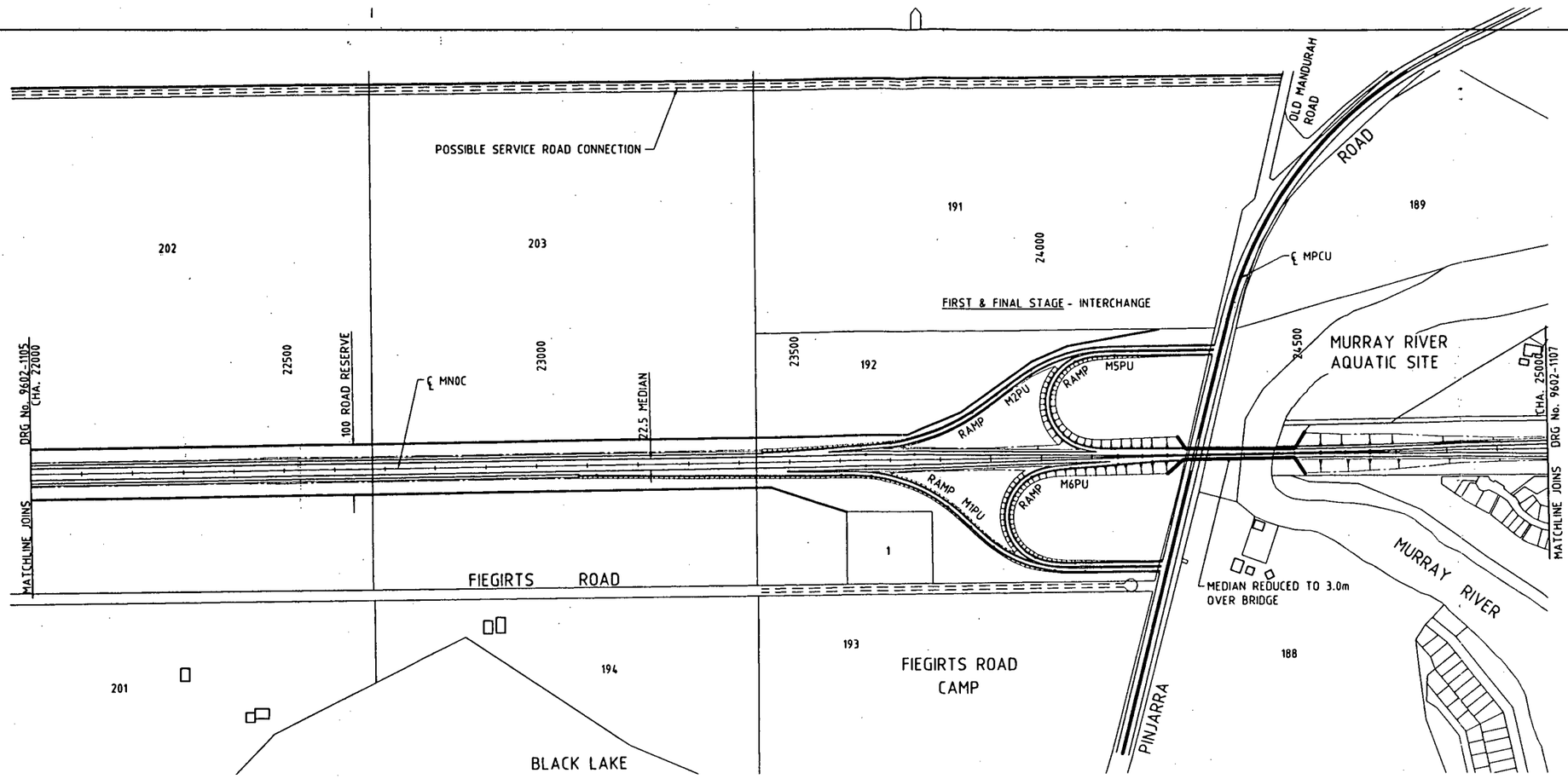

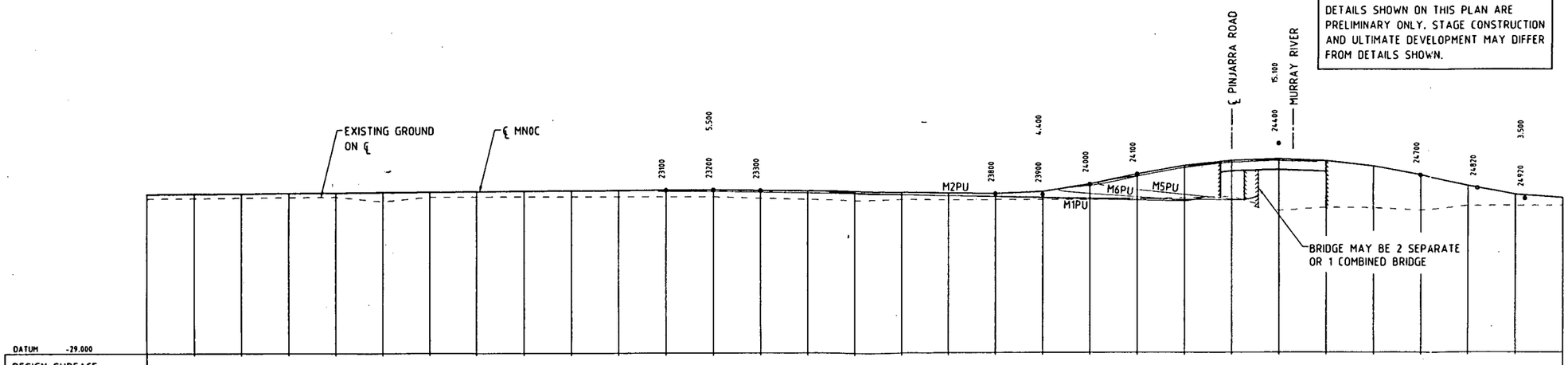

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.

DATUM -29.000

DESIGN SURFACE CENTRELINE (MNOC)	4.557	4.636	4.714	4.793	4.871	4.950	5.029	5.107	5.186	5.264	5.343	5.421	5.441	5.343	5.186	5.029	4.871	4.714	4.557	4.974	6.540	8.680	10.456	11.503	11.822	11.412	10.274	8.408	6.177	4.319	3.605
EXISTING SURFACE CENTRELINE (1NOG)	3.655	3.747	3.839	3.931	4.000	3.028	4.000	4.000	4.000	4.000	4.000	4.000	4.000	3.698	3.396	3.094	3.382	3.258	3.271	3.285	3.298	3.466	3.666	3.866	1.000	1.611	1.461	1.000	2.000	2.000	2.000
CHAINAGE	22000	22100	22200	22300	22400	22500	22600	22700	22800	22900	23000	23100	23200	23300	23400	23500	23600	23700	23800	23900	24000	24100	24200	24300	24400	24500	24600	24700	24800	24900	25000
HORIZONTAL ALIGNMENT	TANGENT																														
VERTICAL ALIGNMENT	G=0.079% L=1200.000											L=200.000		G=-0.157% L=500.000			L=200.000	G=2.140%	L=100.000	L=600.000							G=-2.231%	L=120.000	L=200.000		

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS
- AREA OF ABORIGINAL SIGNIFICANCE

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONES0
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/2/96

APPROVED

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APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500 — A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 22000 - 25000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
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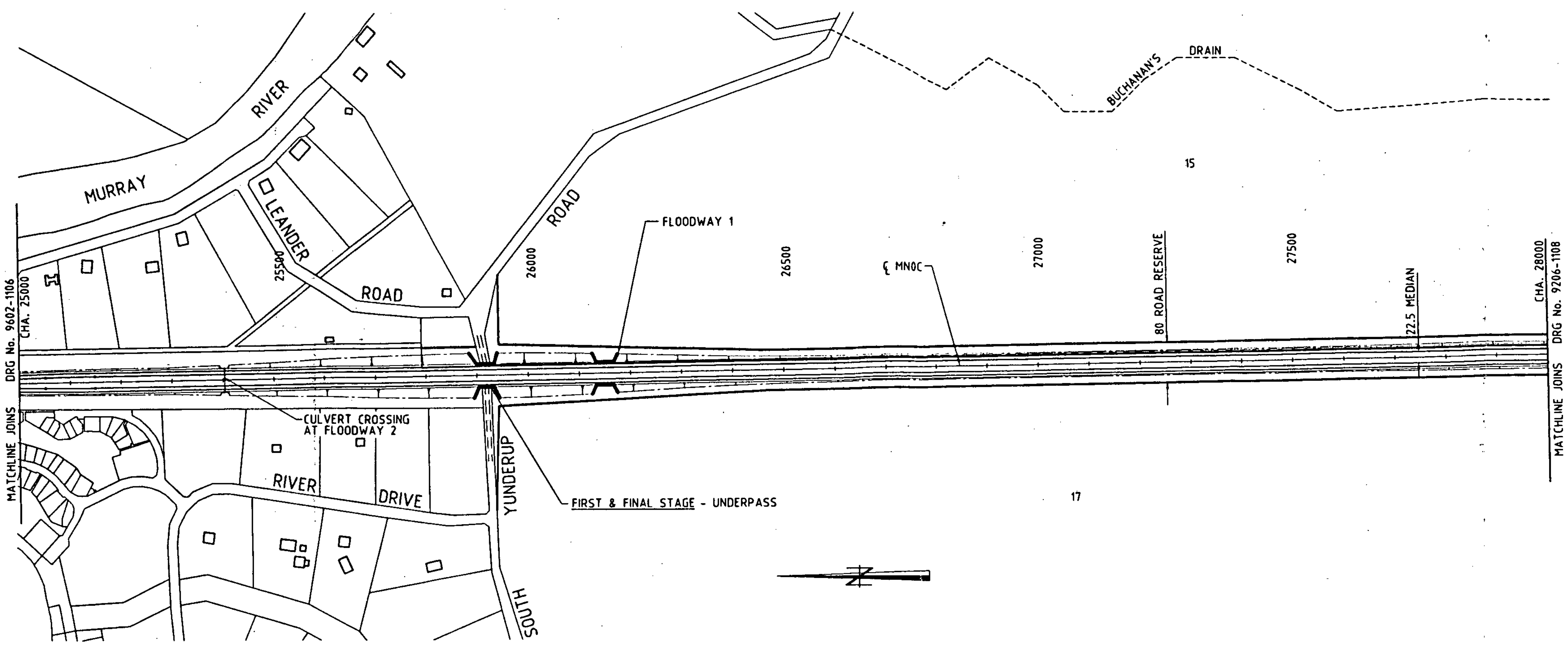
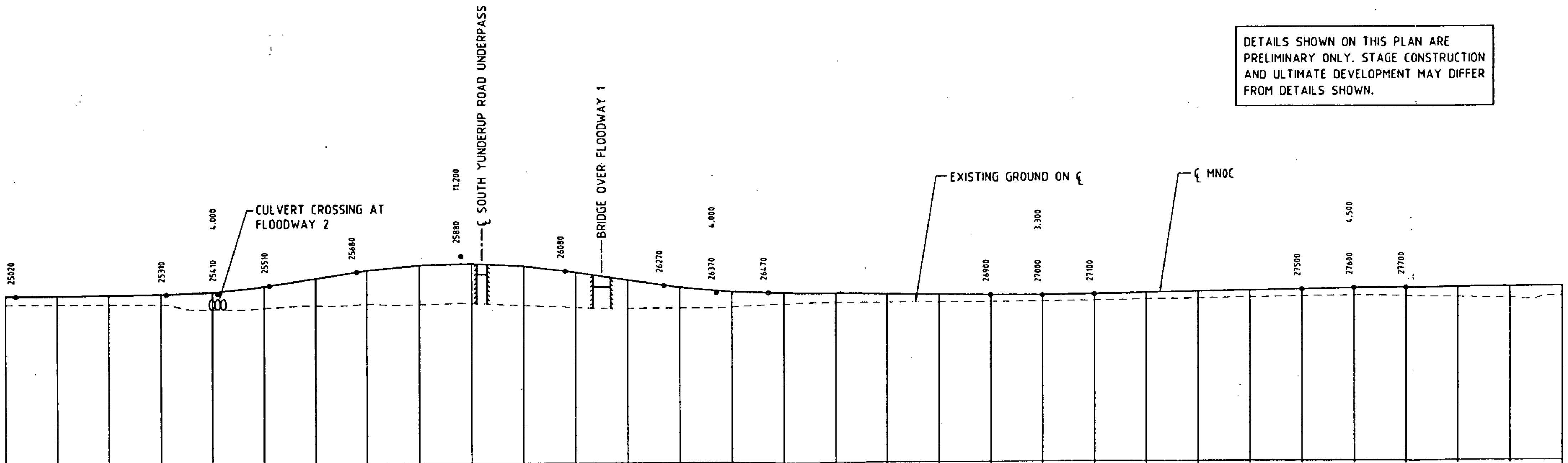


DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -29.000

DESIGN SURFACE CENTRELINE (MNOC)	3.605	3.684	3.786	3.888	4.279	5.382	6.911	8.428	9.434	9.691	9.197	7.967	6.498	5.059	4.133	3.856	3.744	3.633	3.522	3.411	3.378	3.500	3.700	3.900	4.100	4.300	4.474	4.595	4.689	4.784	4.879
EXISTING SURFACE CENTRELINE (1NOG)	2.000	2.000	2.000	2.000	1.000	1.228	1.693	2.000	1.883	2.000	1.662	1.237	1.000	1.078	1.231	1.756	2.000	2.000	2.000	2.076	2.152	2.303	2.463	2.624	2.784	2.945	3.000	2.937	2.727	2.516	3.000
CHAINAGE	25000	25100	25200	25300	25400	25500	25600	25700	25800	25900	26000	26100	26200	26300	26400	26500	26600	26700	26800	26900	27000	27100	27200	27300	27400	27500	27600	27700	27800	27900	28000

HORIZONTAL ALIGNMENT: TANGENT

VERTICAL ALIGNMENT: G=0.102% L=290.000 | L=200.000 | G=1.532% L=170.000 | L=400.000 | L=190.000 G=-1.469% | L=200.000 | G=-0.111% L=430.000 | L=200.000 | G=0.200% L=400.000 | L=200.000 | G=0.095% L=1700.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/12/96

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Telephone (097) 25 5477 Fax (097) 25 4013

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS Western Australia

SCALE: HORIZONTAL 1:5000, VERTICAL 1:500

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 25000 - 28000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
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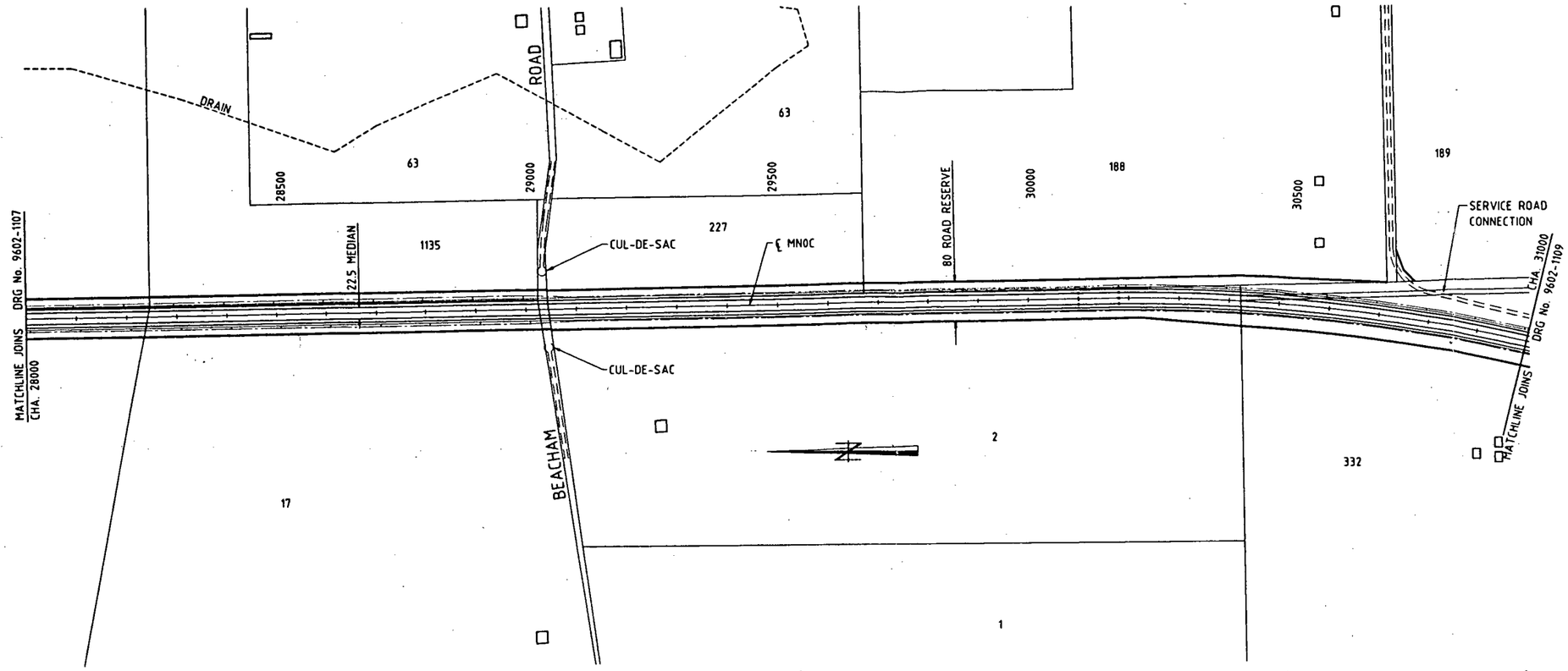

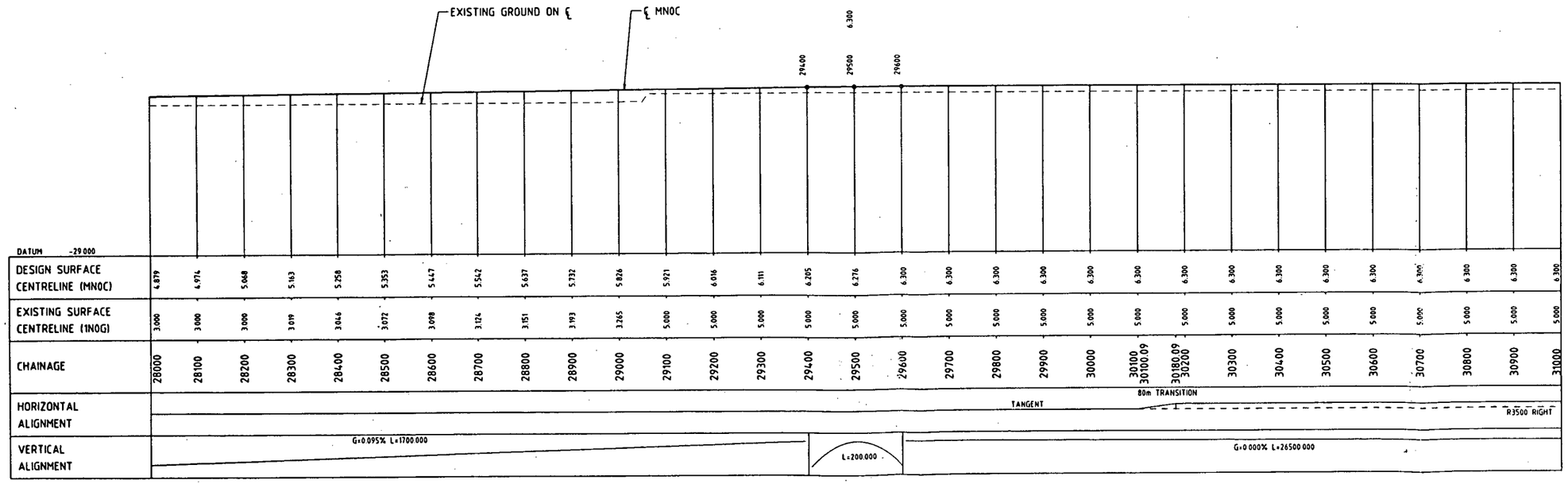

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.

DATUM -29.000

CHAINAGE	DESIGN SURFACE CENTRELINE (MNOC)	EXISTING SURFACE CENTRELINE (1NOG)
28000	4.879	3.000
28100	4.974	3.000
28200	5.068	3.000
28300	5.163	3.019
28400	5.258	3.046
28500	5.353	3.072
28600	5.447	3.098
28700	5.542	3.124
28800	5.637	3.151
28900	5.732	3.193
29000	5.826	3.265
29100	5.921	5.000
29200	6.016	5.000
29300	6.111	5.000
29400	6.205	5.000
29500	6.276	5.000
29600	6.300	5.000
29700	6.300	5.000
29800	6.300	5.000
29900	6.300	5.000
30000	6.300	5.000
30100	6.300	5.000
30100.09		
30180.09	6.300	5.000
30200		
30300	6.300	5.000
30400	6.300	5.000
30500	6.300	5.000
30600	6.300	5.000
30700	6.300	5.000
30800	6.300	5.000
30900	6.300	5.000
31000	6.300	5.000

HORIZONTAL ALIGNMENT: 80m TRANSITION; TANGENT; R3500 RIGHT

VERTICAL ALIGNMENT: G=0.095% L=1700.000; L=200.000; G=0.000% L=26500.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONES0
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

G B HILL
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GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 031 661

DESIGNED/DRAWN J. H. GRAY W. B RUDDY

VERIFIED 23/12/96

APPROVED

SOUTH WEST REGION
Robertson Drive, Bunbury 6230
Telephone (097) 25 5477 Fax (097) 25 6813

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

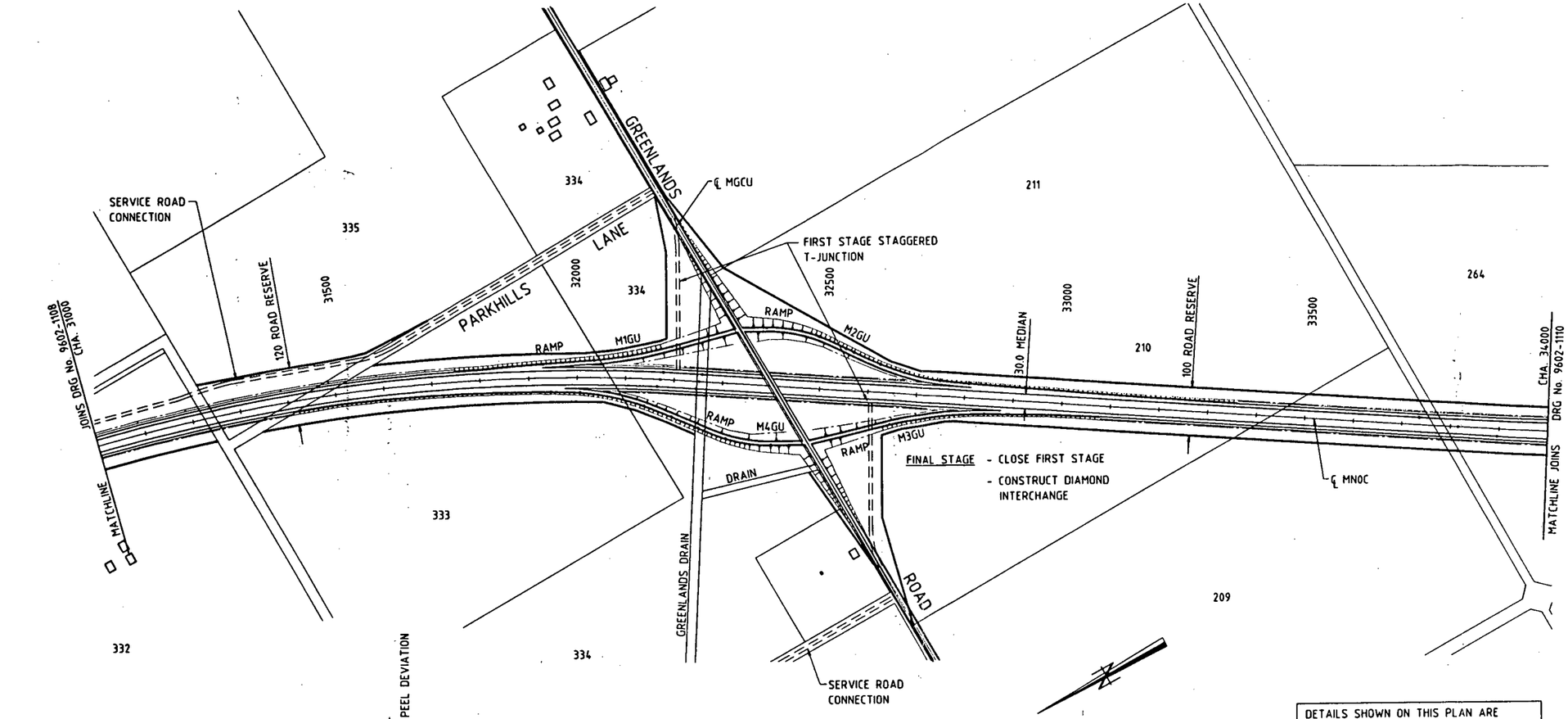
PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 28000 - 31000

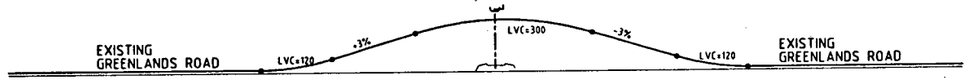
LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
04:06	9602-1108	

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

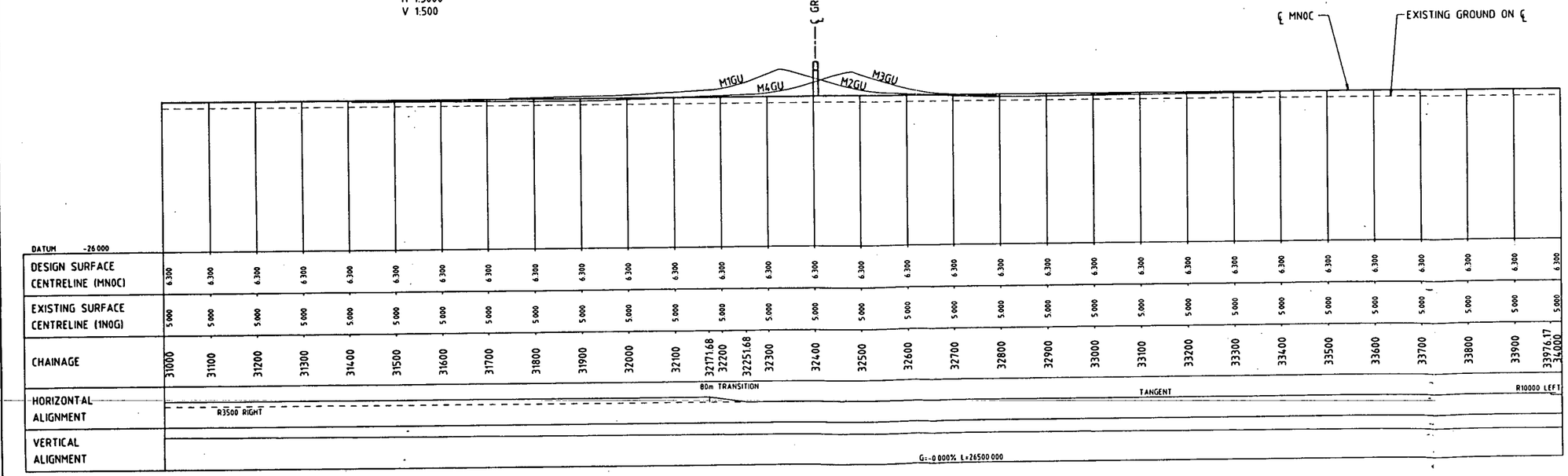
A1





PROFILE OF GREENLANDS ROAD (HEADING EAST)

H 1:5000
V 1:500



DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.MP
ACAD PROJECT	/era/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

G B HILL
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GB HILL & PARTNERS PTY LTD EST 1955 ACN 008 031 681

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/12/96

APPROVED

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Telephone (097) 25 5477 Fax (097) 25 6813

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

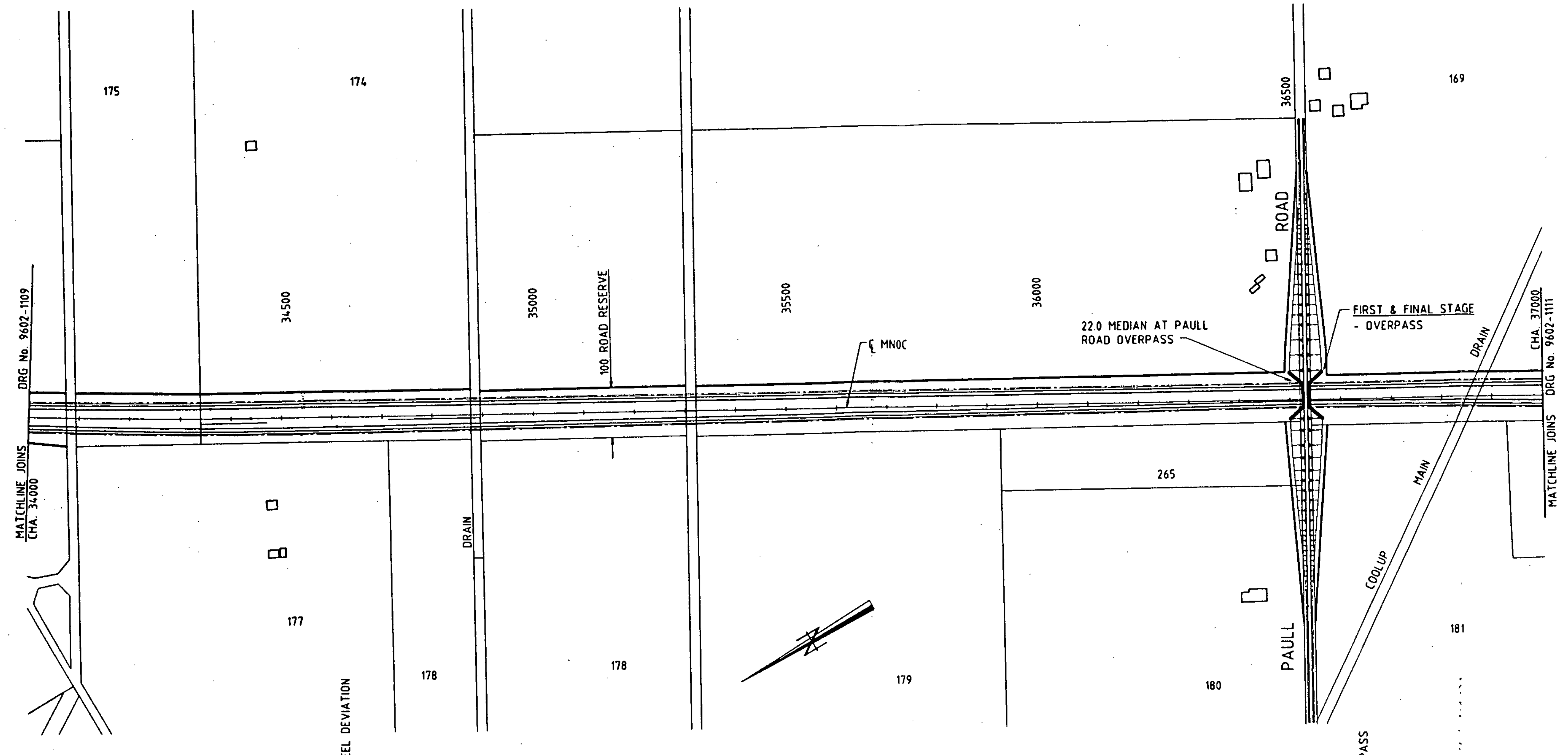
SCALE HORIZONTAL 1:5000 VERTICAL 1:500

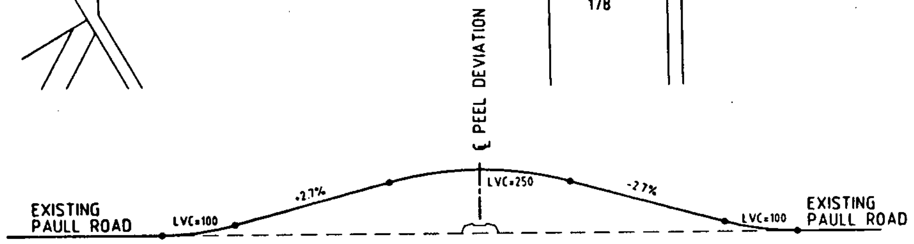
A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 31000 - 34000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
04:06	9602-1109	

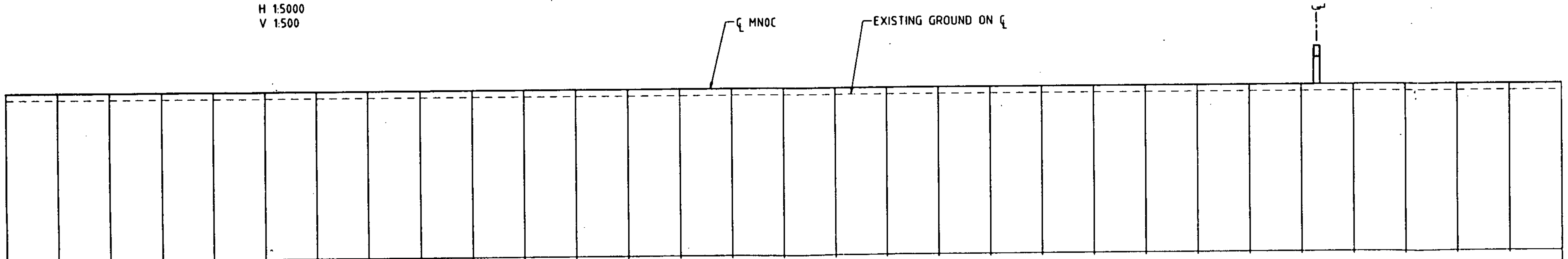




PROFILE OF PAULL ROAD (HEADING EAST)

H 1:5000
V 1:500

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -26.000

CHAINAGE	DESIGN SURFACE CENTRELINE (MNOC)	EXISTING SURFACE CENTRELINE (1NOG)
34000	6.300	5.000
34100	6.300	5.000
34200	6.300	5.000
34300	6.300	5.000
34400	6.300	5.000
34438.87		
34500	6.300	5.000
34600	6.300	5.000
34700	6.300	5.000
34800	6.300	5.000
34900	6.300	5.000
35000	6.300	5.000
35100	6.300	5.000
35200	6.300	5.000
35300	6.300	5.000
35400	6.300	5.000
35500	6.300	5.000
35600	6.300	5.000
35700	6.300	5.000
35800	6.300	5.000
35900	6.300	5.000
36000	6.300	5.000
36100	6.300	5.000
36200	6.300	5.000
36300	6.300	5.000
36400	6.300	5.000
36500	6.300	5.000
36600	6.300	5.000
36700	6.300	5.000
36800	6.300	5.000
36900	6.300	5.000
37000	6.300	5.000

HORIZONTAL ALIGNMENT: R10000 LEFT; TANGENT

VERTICAL ALIGNMENT: P=-0.000% L=26500.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND
- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

G B HILL
CONSULTING ENGINEERS
62 COLIN STREET PO BOX 1142 WEST PERTH WA 6872
TELEPHONE (09) 322 5990 FAX (09) 321 6385
GB HILL & PARTNERS PTY LTD EST 1959 ACN 008 031 681

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY
VERIFIED [signature] 23/12/96
APPROVED

SOUTH WEST REGION
Robertson Drive, Bunbury 6230
Telephone (097) 25 5677 Fax (097) 25 4813

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS Western Australia

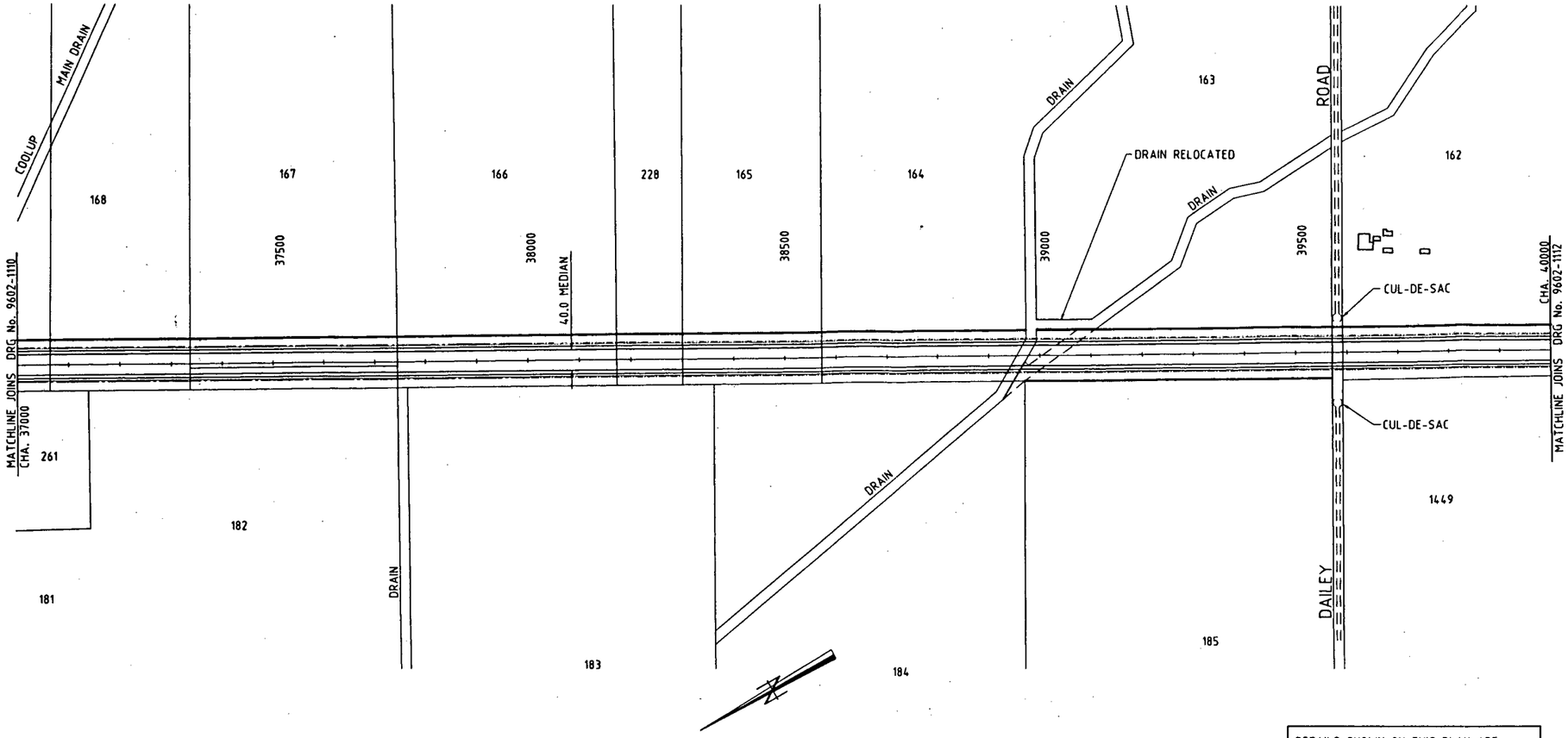
SCALE: VERTICAL 1:500 / HORIZONTAL 1:5000

A1

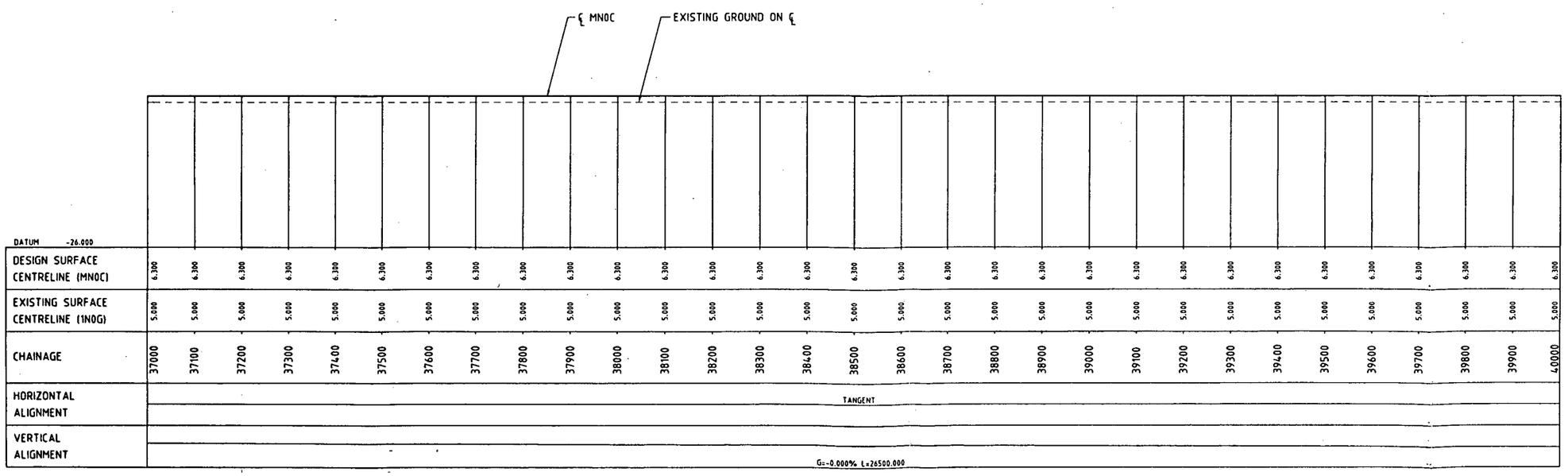
PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 34000 - 37000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE 04:06 | DRAWING NUMBER 9602-1110 | AMEND



DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.DWP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

GB HILL
CONSULTING ENGINEERS
62 COLIN STREET PO BOX 1142 WEST PERTH, WA 6872
TELEPHONE (09) 322 5000 FAX (09) 321 6365
GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 031 861

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 27/12/96

APPROVED

SOUTH WEST REGION
Robertson Drive Bunbury 6230
Telephone (097) 25 5677 Fax (097) 25 4013

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

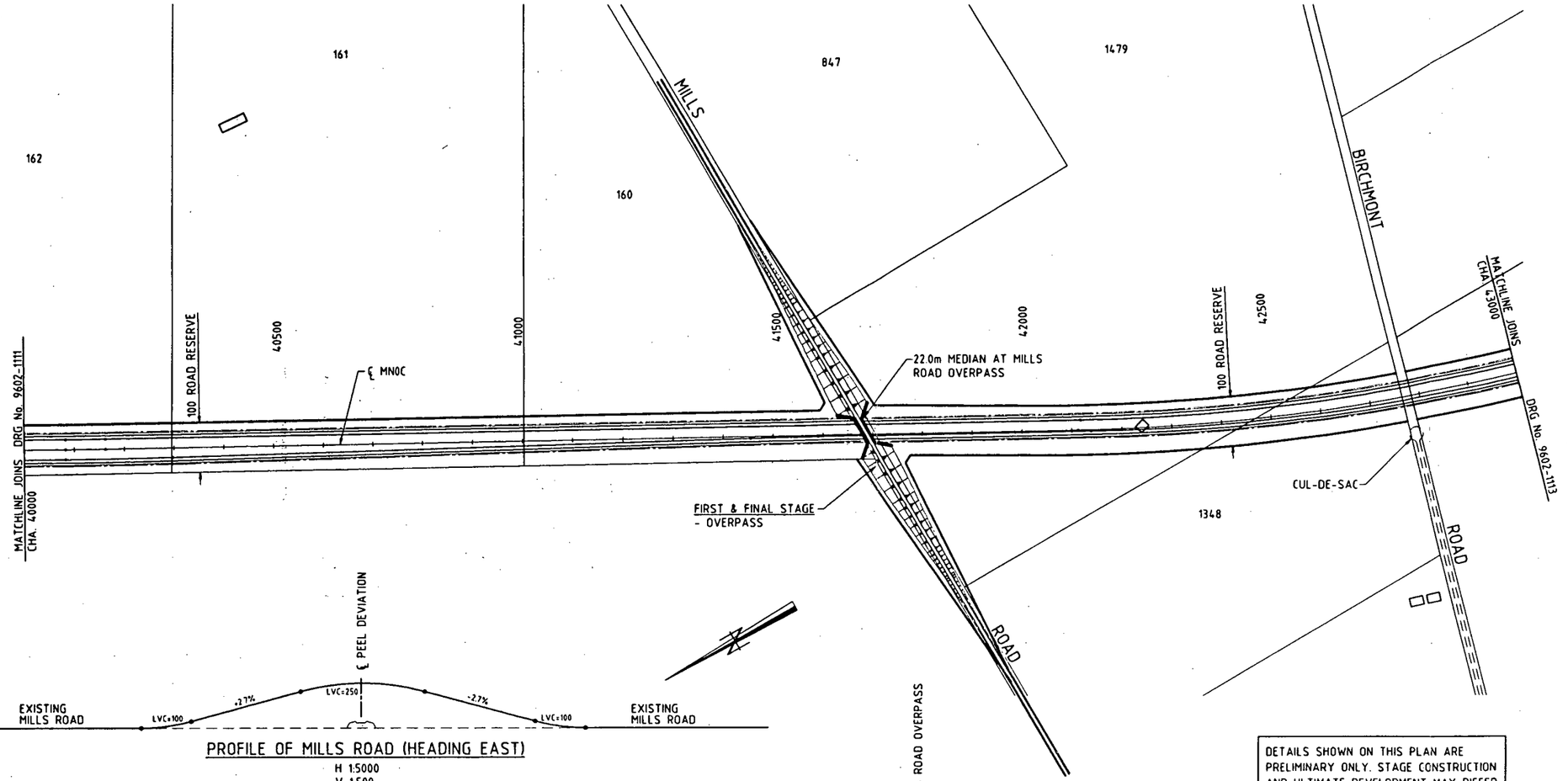
MAIN ROADS
Western Australia

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 37000 - 40000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

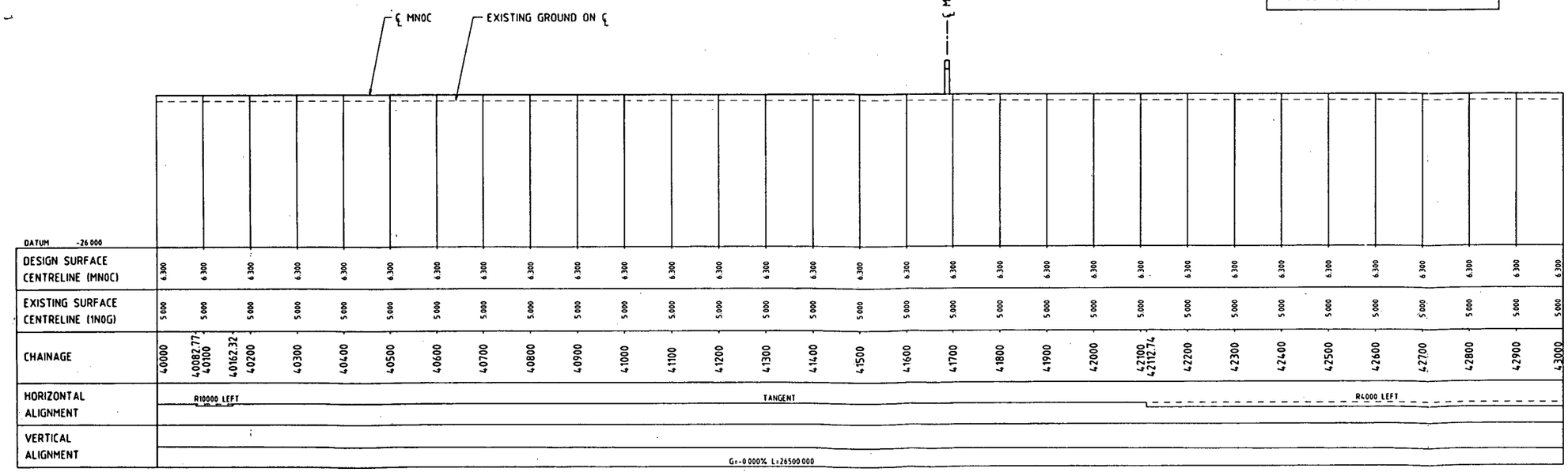
DRAWING TYPE	DRAWING NUMBER	AMEND
04:06	9602-1111	

SCALE HORIZONTAL 1:5000 VERTICAL 1:500 A1



PROFILE OF MILLS ROAD (HEADING EAST)

H 1:5000
V 1:500



DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.DGP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONES0
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 031 681

DESIGNED/DRAWN J. H GRAY W. B. RUDDY

VERIFIED 23/12/96

APPROVED

SOUTH WEST REGION
Robertson Drive Bunbury 6230
Telephone (097) 25 5477 Fax (097) 25 6413

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

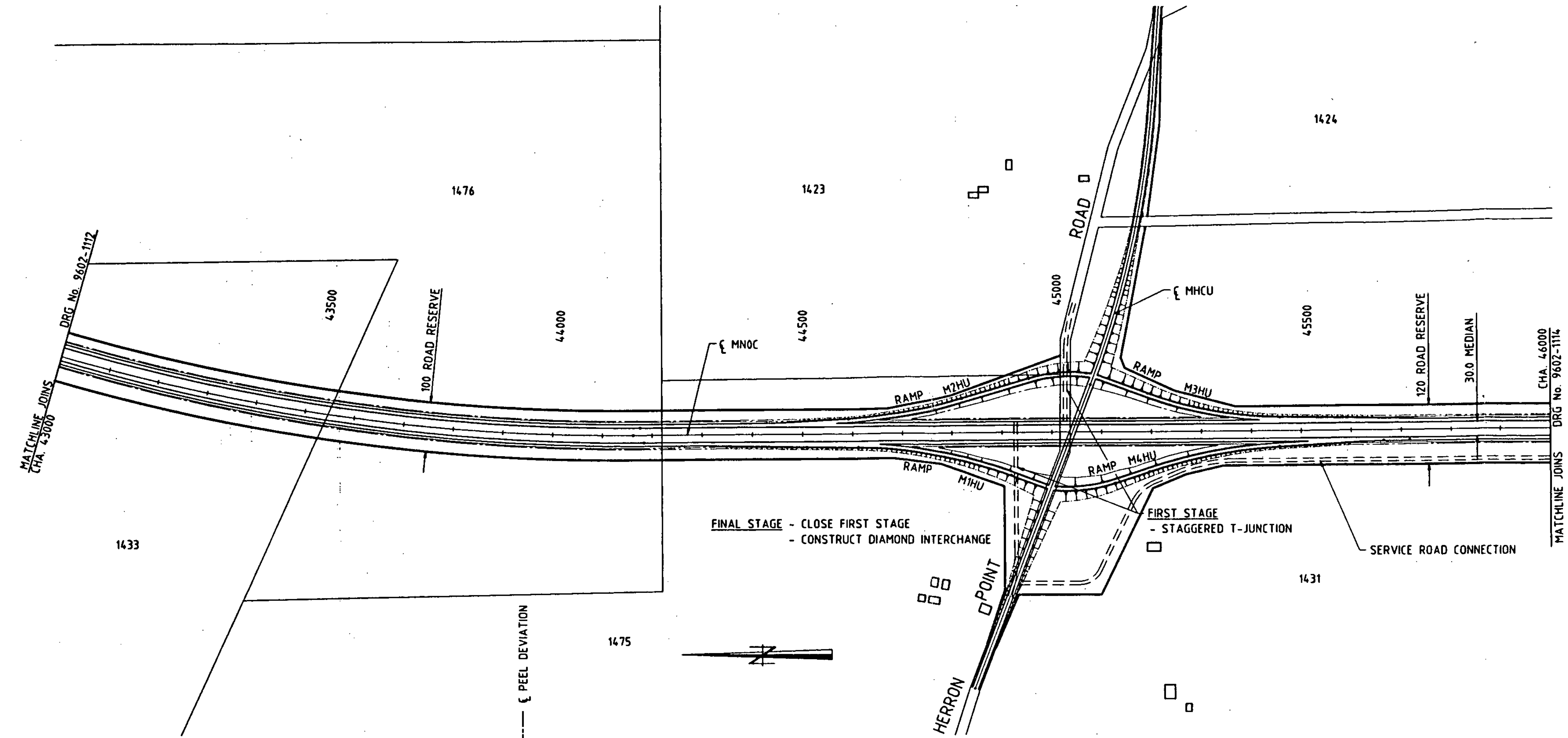
MAIN ROADS
Western Australia

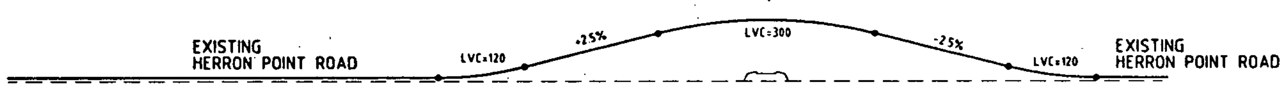
PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 40000 - 43000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
04:06	9602-1112	

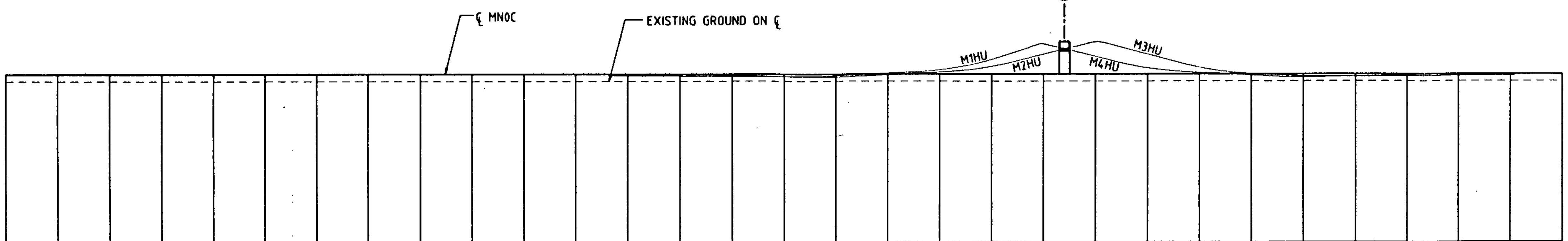
VERTICAL 1:500
HORIZONTAL 1:5000
SCALE
A1





PROFILE OF HERRON POINT ROAD (HEADING WEST)
H 1:5000
V 1:500

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -26 000

DESIGN SURFACE CENTRELINE (MNOC)	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300		6.300	6.300	6.300
EXISTING SURFACE CENTRELINE (1NOG)	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000		5.000	5.000	5.000
CHAINAGE	43000	43100	43200	43300	43400	43500	43600	43700	43800	43900	44000	44100	44161.85	44200	44300	44400

DESIGN SURFACE CENTRELINE (MNOC)	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300	6.300
EXISTING SURFACE CENTRELINE (1NOG)	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000	5.000
CHAINAGE	44500	44600	44700	44800	44900	45000	45100	45200	45300	45400	45500	45600	45700	45800	45900	46000

HORIZONTAL ALIGNMENT	R4000 LEFT (43000 – 44161.85); TANGENT (44161.85 – 46000)
VERTICAL ALIGNMENT	G=-0.000% L=26500 000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND
- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/erd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONES0
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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DESIGNED/DRAWN J. H. GRAY W. B. RUDDY
VERIFIED [signature] 23/12/96
APPROVED

SOUTH WEST REGION
Robertson Drive Bunbury 6230
Telephone (097) 25 5677 Fax (097) 25 4613

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE
VERTICAL 1:500
HORIZONTAL 1:5000
A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 43000 - 46000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
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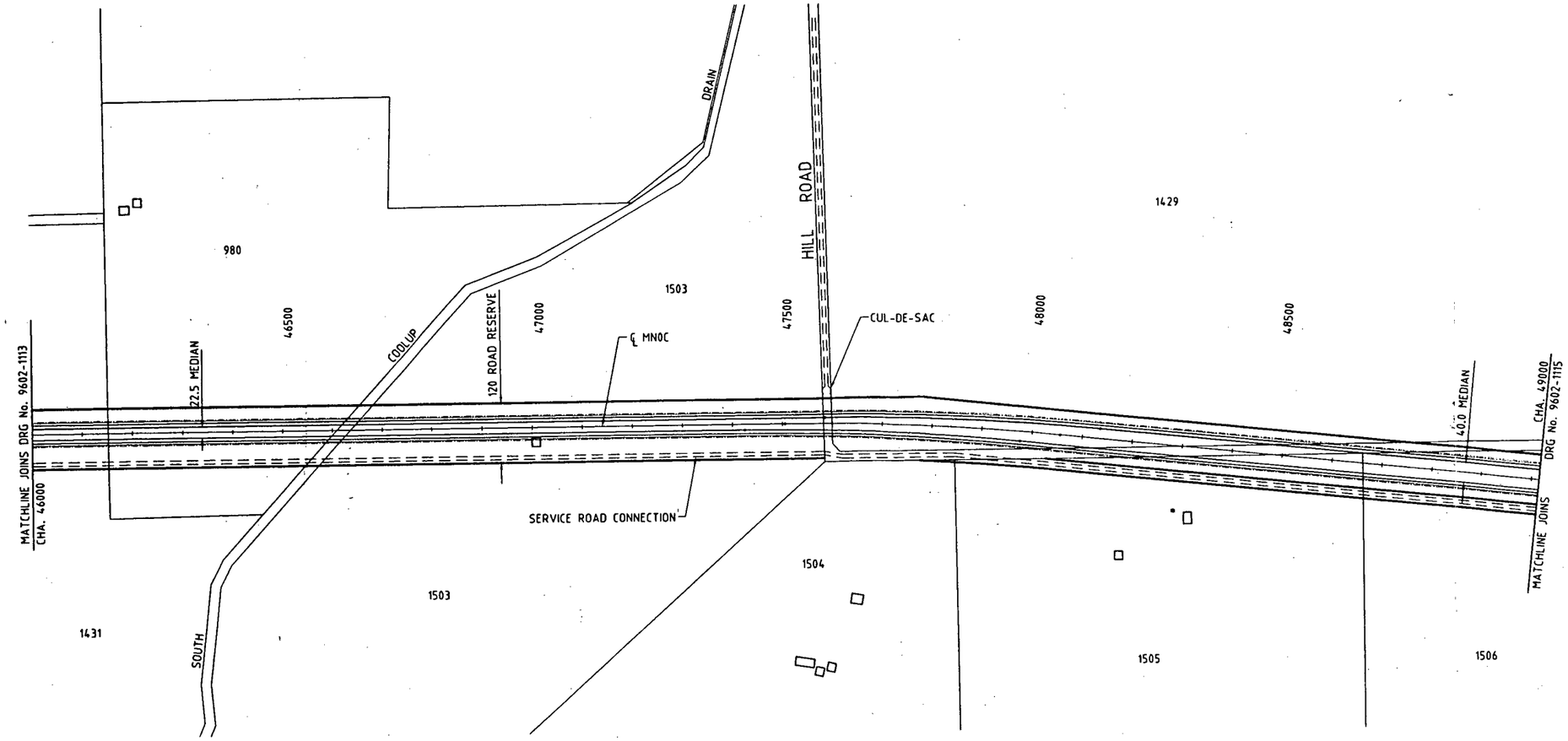
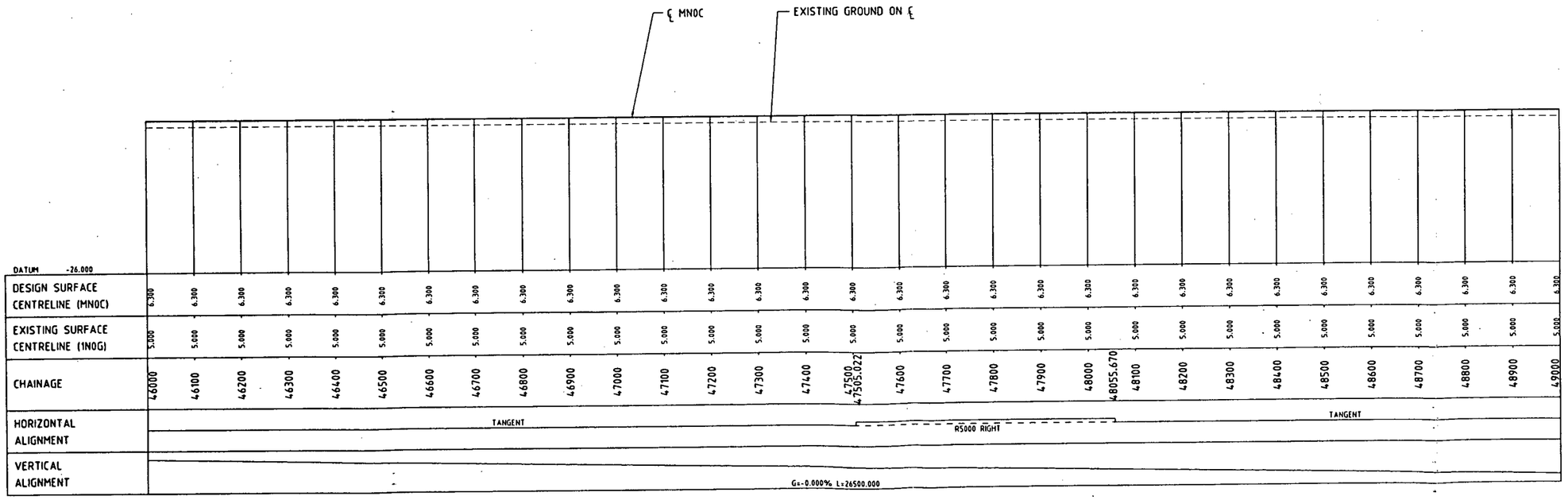


DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.IMP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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62 COLIN STREET,PO BOX 1142,WEST PERTH, WA 6872
TELEPHONE (08) 322 5900 FAX (08) 321 6385
GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 031 661

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/12/96

APPROVED

SOUTH WEST REGION
Robertson Drive Bunbury 6230
Telephone (097) 25 5477 Fax (097) 25 4813

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 46000 - 49000

LOCAL AUTHORITY SHIRE OF MURRAY (215)

DRAWING TYPE	DRAWING NUMBER	AMEND
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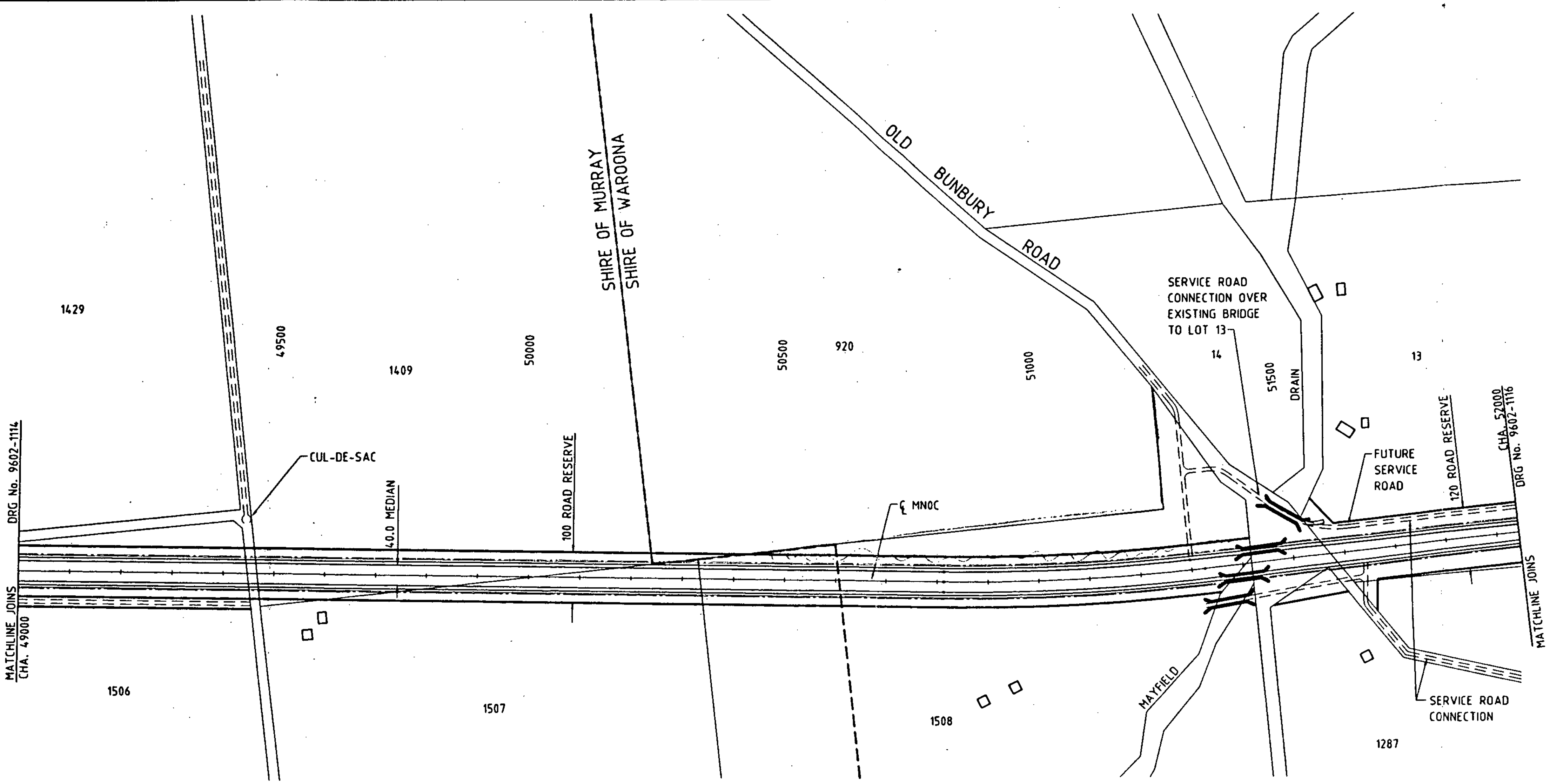
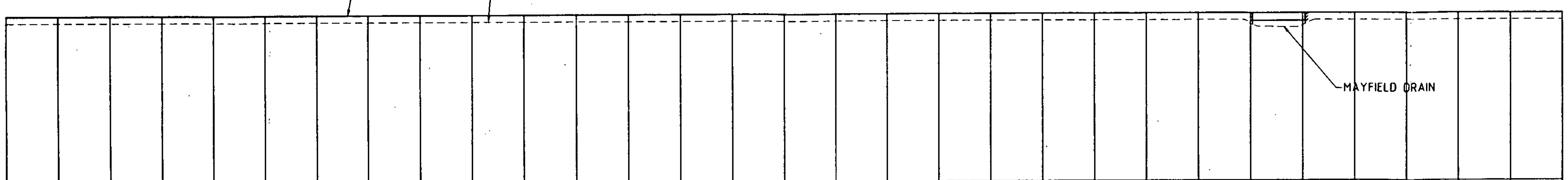


DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -26.000

CHAINAGE	DESIGN SURFACE CENTRELINE (MNOC)	EXISTING SURFACE CENTRELINE (1NOG)
49000	6.300	5.000
49100	6.300	5.000
49200	6.300	5.000
49300	6.300	5.000
49400	6.300	5.000
49500	6.300	5.000
49600	6.300	5.000
49700	6.300	5.000
49800	6.300	5.000
49900	6.300	5.000
50000	6.300	5.000
50100	6.300	5.000
50200	6.300	5.000
50300	6.300	5.000
50400	6.300	5.000
50500	6.300	5.000
50600	6.300	5.000
50700	6.300	5.000
50800 50813.08	6.300	5.000
50900	6.300	5.000
51000	6.300	5.000
51100	6.300	5.000
51200	6.300	5.000
51300 51325.70	6.300	5.000
51400	6.300	5.000
51500	6.300	5.000
51600	6.300	5.000
51700	6.300	5.000
51800	6.300	5.000
51900	6.300	5.000
51993.93 52000	6.300	5.000

HORIZONTAL ALIGNMENT: TANGENT — R4000 LEFT — TANGENT

VERTICAL ALIGNMENT: G=-0.000% L=26500.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 031 881

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED [signature] 23/12/96

APPROVED

SOUTH WEST REGION
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Telephone (097) 25 5677 Fax (097) 25 4013

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 49000 - 52000

LOCAL AUTHORITY SHIRE OF MURRAY (215) SHIRE OF WAROONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
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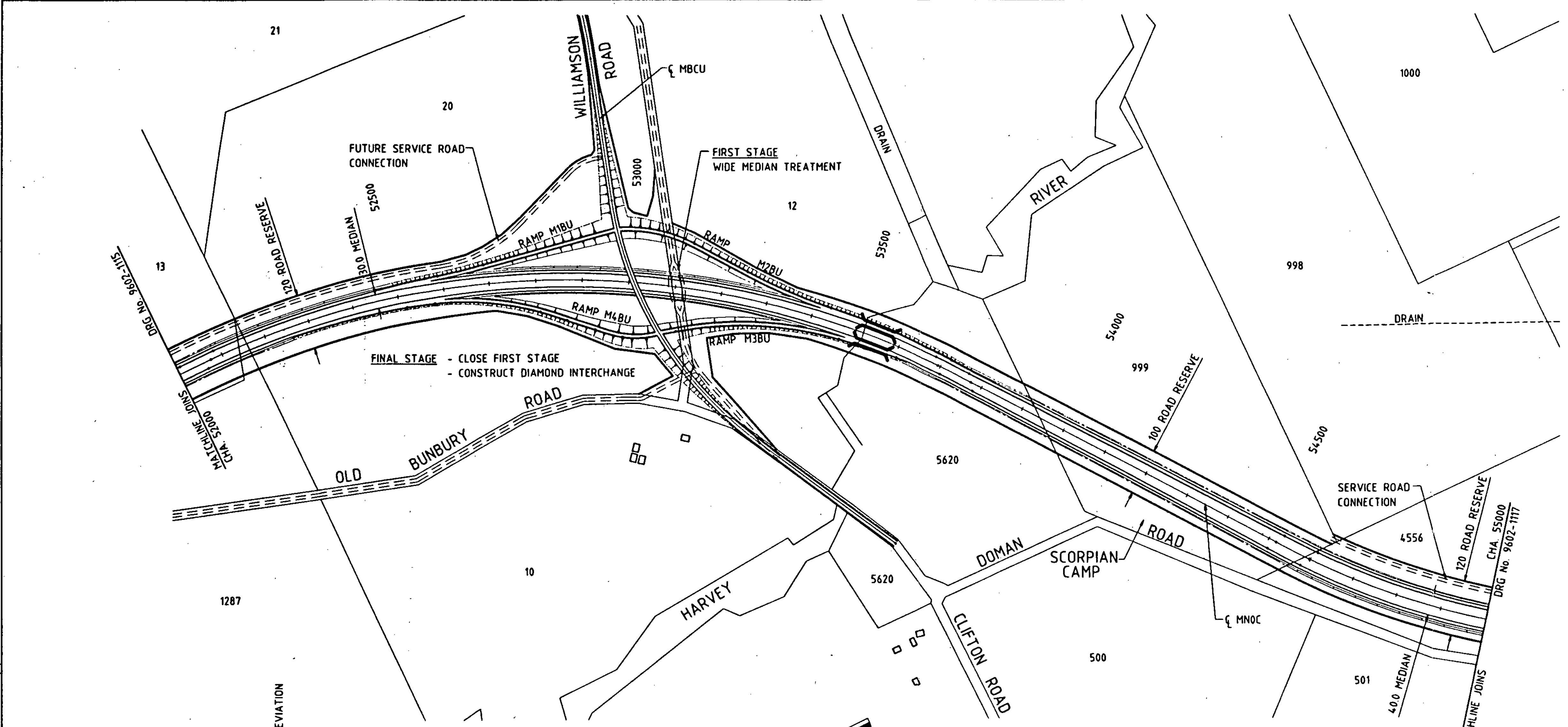
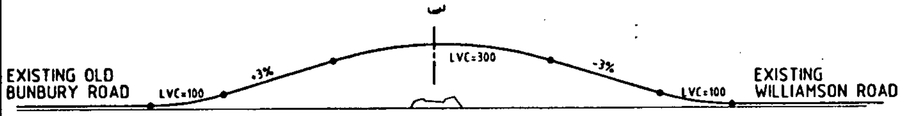
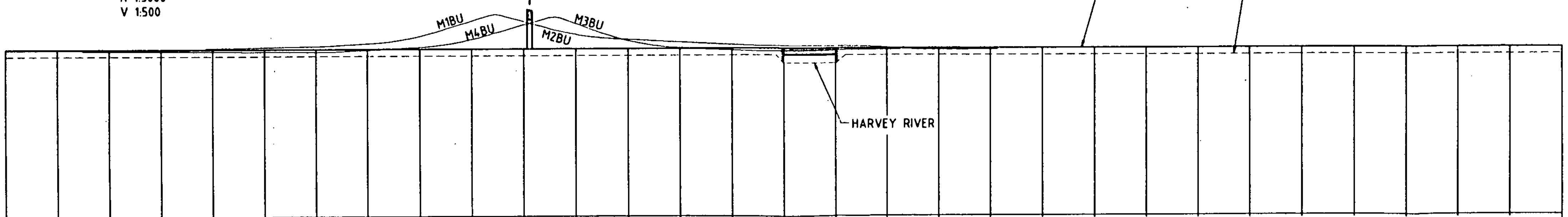




PROFILE OF WILLIAMSON ROAD (HEADING EAST)

H 1:5000
V 1:500

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -26.000

CHAINAGE	DESIGN SURFACE CENTRELINE (MNOC)	EXISTING SURFACE CENTRELINE (1NOG)
52000	6.300	5.000
52073.93 / 52100	6.300	5.000
52200	6.300	5.000
52300	6.300	5.000
52400	6.300	5.000
52500	6.300	5.000
52600	6.300	5.000
52700	6.300	5.000
52800	6.300	5.000
52900	6.300	5.000
53000	6.300	5.000
53100	6.300	5.000
53200	6.300	5.000
53300	6.300	5.000
53400	6.300	5.000
53500	6.300	5.000
53600	6.300	5.000
53694.14 / 53700	6.300	5.000
53774.14 / 53800	6.300	5.000
53900	6.300	5.000
54000	6.300	5.000
54100	6.300	5.000
54200	6.300	5.000
54300	6.300	5.000
54400	6.300	5.000
54500 / 54517.57	6.300	5.000
54597.57 / 54600	6.300	5.000
54700	6.300	5.000
54800	6.300	5.000
54900	6.300	5.000
55000	6.300	5.000

HORIZONTAL ALIGNMENT: 80m TRANS — R1800 RIGHT — 80m TRANS — TANGENT — 80m TRANS — R1600 LEFT

VERTICAL ALIGNMENT: G=0.000% L=26500.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS
- AREA OF ABORIGINAL SIGNIFICANCE

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

VERTICAL 1:500
HORIZONTAL 1:5000

G B HILL
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GB HILL & PARTNERS PTY LTD EST 1965 ACN 009 031 681

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY
VERIFIED [signature] 23/12/96
APPROVED

SOUTH WEST REGION
Robertson Drive, Bunbury 6230
Telephone (097) 25 5477 Fax (097) 25 4013

APPROVED FOR IMPLEMENTATION

AUTHORISED	
RECOMMENDED	
APPROVED	

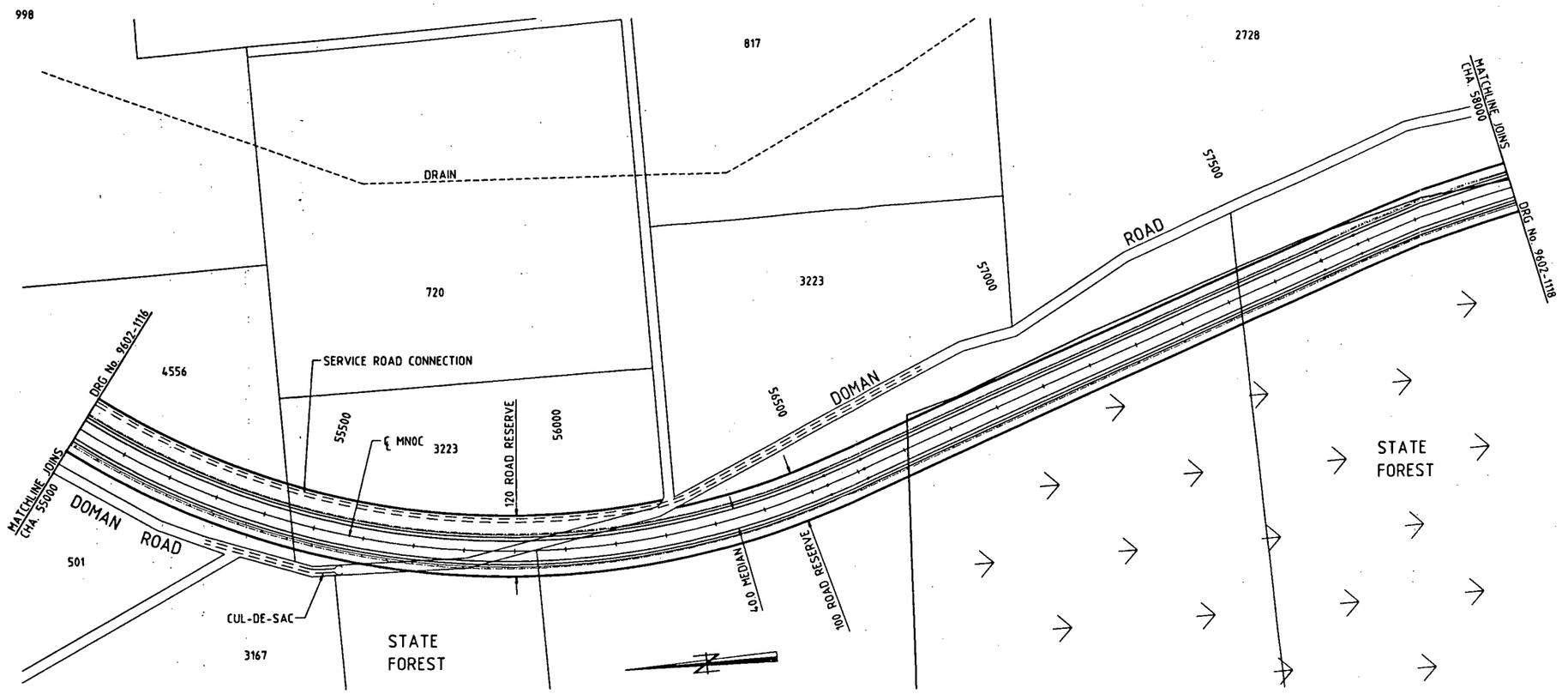
MAIN ROADS Western Australia

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 52000 - 55000

LOCAL AUTHORITY SHIRE OF WAROONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
04:06	9602-1116	



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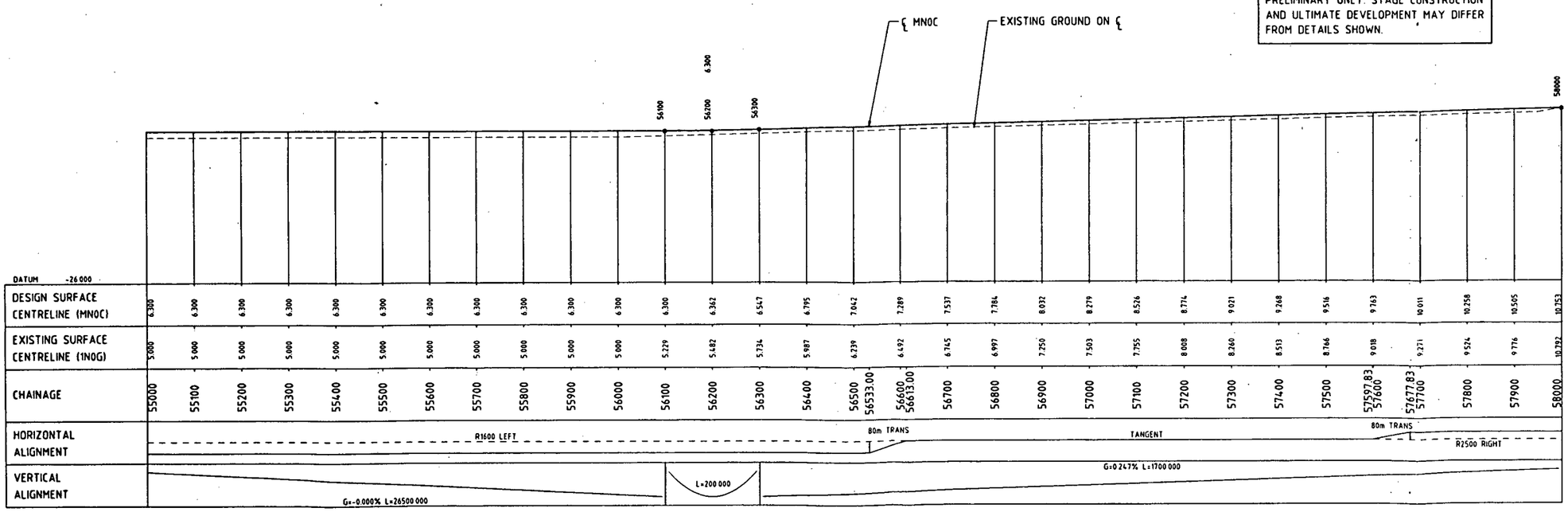

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/dcad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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TELEPHONE (09) 322 5890 FAX (09) 321 8385
GB HILL & PARTNERS PTY LTD EST 1965 ACN 008 031 681

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/12/96

APPROVED

SOUTH WEST REGION
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Telephone (097) 25 5677 Fax (097) 25 4813

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500 A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 55000 - 58000

LOCAL AUTHORITY SHIRE OF WAROONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
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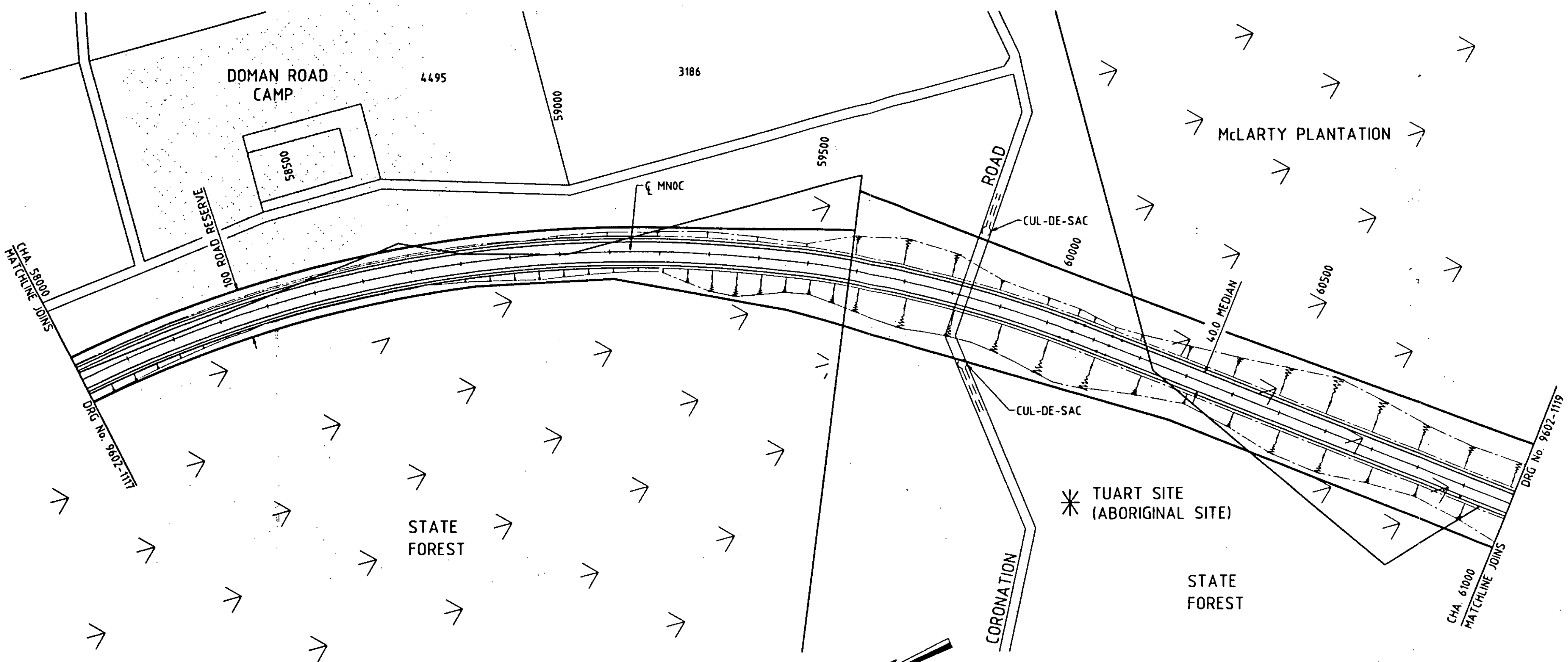
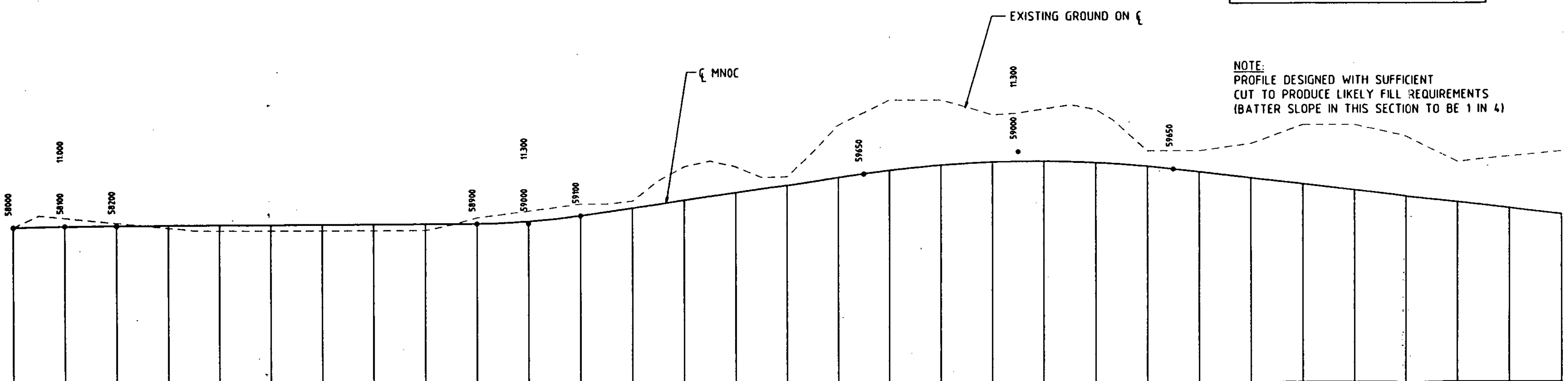


DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.

NOTE:
PROFILE DESIGNED WITH SUFFICIENT CUT TO PRODUCE LIKELY FILL REQUIREMENTS (BATTER SLOPE IN THIS SECTION TO BE 1 IN 4)



DATUM -20.000

CHAINAGE	DESIGN SURFACE CENTRELINE (MNOC)	EXISTING SURFACE CENTRELINE (1NOG)
58000	10.753	10.792
58100	10.946	12.557
58200	11.033	11.570
58300	11.067	10.584
58400	11.100	10.000
58500	11.133	10.000
58600	11.167	10.000
58700	11.200	10.000
58800	11.233	10.000
58900	11.267	12.428
59000	11.652	13.714
59100	12.742	15.000
59200	14.184	15.540
59300	15.626	22.147
59400	17.068	22.082
59500	18.511	20.213
59600	19.953	30.177
59700	21.340	35.000
59800	22.344	35.000
59900	22.911	32.175
60000	23.040	33.313
60052.74		
60100	22.732	33.102
60132.74		
60200	21.985	25.000
60300	20.856	25.000
60400	19.672	26.403
60500	18.488	30.000
60600	17.304	30.000
60700	16.120	27.808
60800	14.936	22.773
60900	13.752	23.817
61000	12.568	24.860

HORIZONTAL ALIGNMENT: R2500 RIGHT; 80m TRANS; TAN

VERTICAL ALIGNMENT: L=200.000; G=0.033% L=700.000; L=200.000; G=1.442% L=550.000; L=600.000; G=-1.184% L=800.000

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND
- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS
- AREA OF ABORIGINAL SIGNIFICANCE

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/ard/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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GB HILL & PARTNERS PTY LTD EST 1955 ACN 008 031 661

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY
VERIFIED [signature] 23/12/96
APPROVED

SOUTH WEST REGION
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Telephone (097) 25 5677 Fax (097) 25 4413

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 58000 - 61000

LOCAL AUTHORITY SHIRE OF WAROONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
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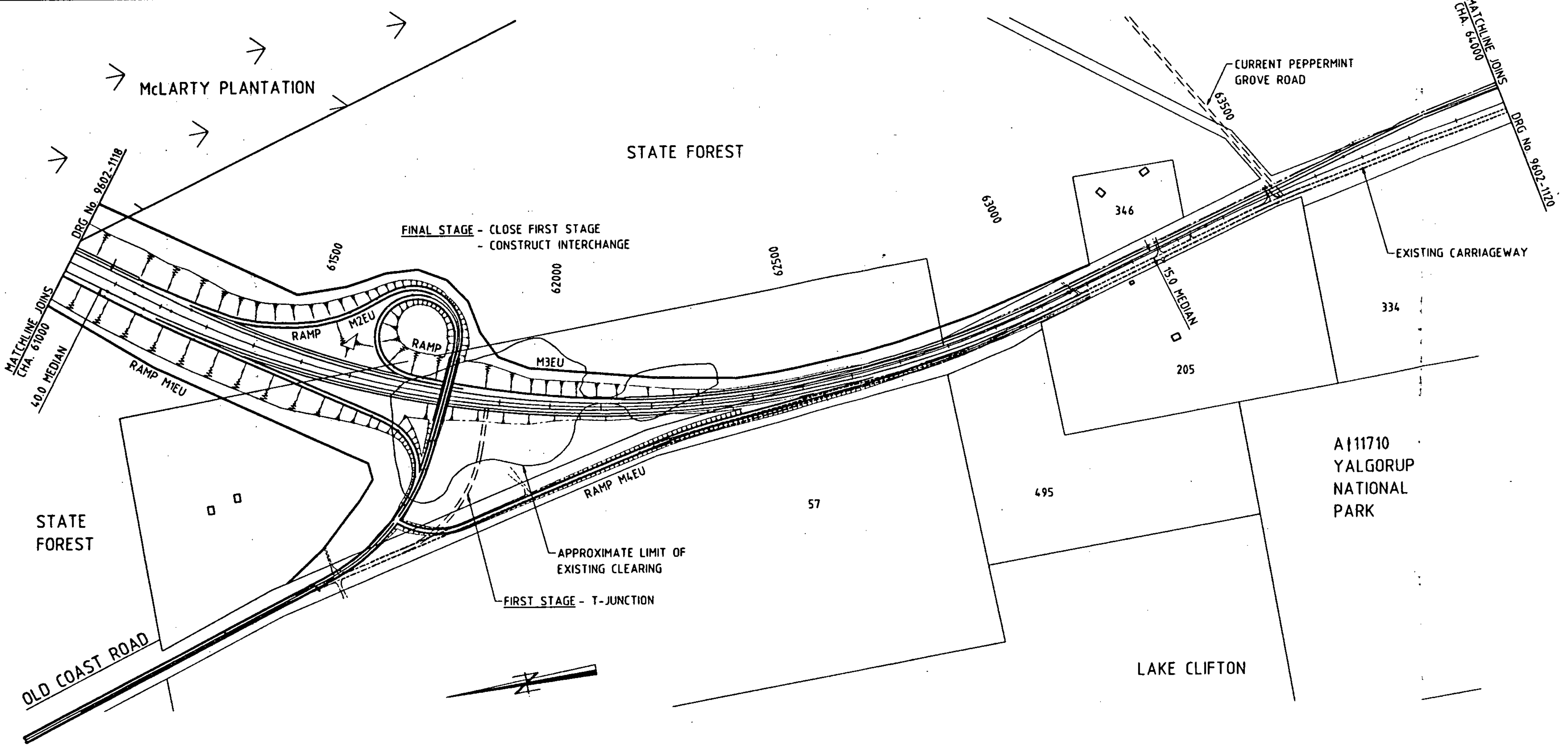
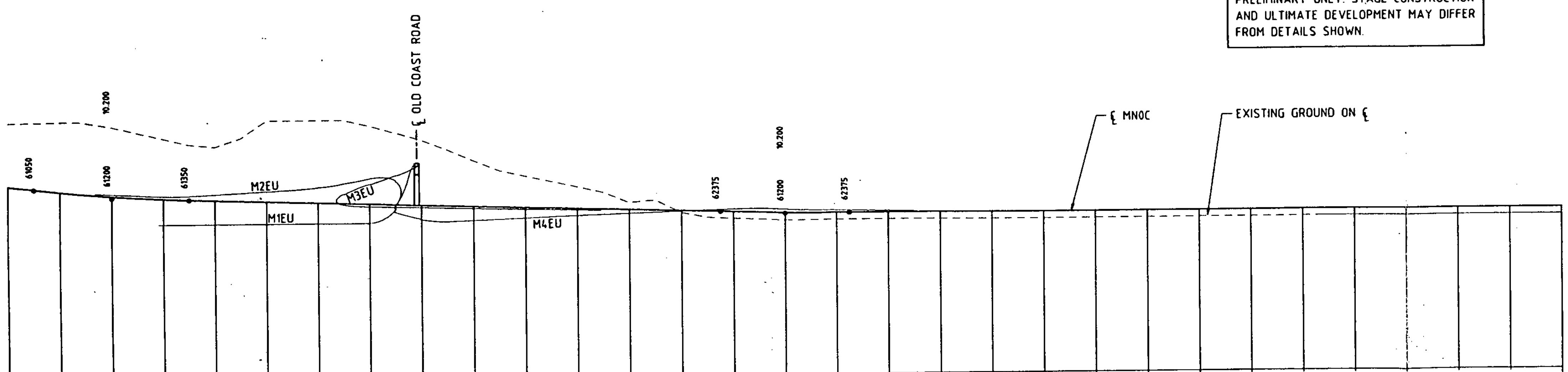


DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



DATUM -25 000

CHAINAGE	DESIGN SURFACE CENTRELINE (MNOC)	EXISTING SURFACE CENTRELINE (1NOG)
61000	12.568	24.860
61100	11.421	25.000
61142.66		
61200	10.532	23.990
61222.66		
61300	9.937	21.639
61400	9.600	20.000
61500	9.300	25.000
61600	9.000	25.000
61700	8.700	23.852
61800	8.400	21.035
61900	8.100	16.996
62000	7.800	13.901
62100	7.500	11.702
62200	7.200	8.558
62300	6.900	6.496
62400	6.604	5.281
62500	6.394	5.000
62600	6.304	5.000
62700	6.300	5.000
62800	6.300	5.000
62900	6.300	5.000
62981.90		
63000	6.300	5.000
63061.90		
63100	6.300	5.000
63200	6.300	5.000
63300	6.300	5.000
63361.81		
63400	6.300	5.000
63500	6.300	5.000
63600	6.300	5.000
63700	6.300	5.000
63727.12		
63800	6.300	5.000
63900	6.300	5.000
64000	6.300	5.000

HORIZONTAL ALIGNMENT: TANGENT — 80m TRANS — R2000 LEFT — 80m TRANS — TANGENT — R4000 RIGHT — TANGENT

VERTICAL ALIGNMENT: G=1.184% L=800 — L=300 000 — G=-0 300% L=1025 000 — L=250 000 — G=0 000% L=11352 495

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND
- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 031 641

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY
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APPROVED FOR IMPLEMENTATION

AUTHORISED	
RECOMMENDED	
APPROVED	

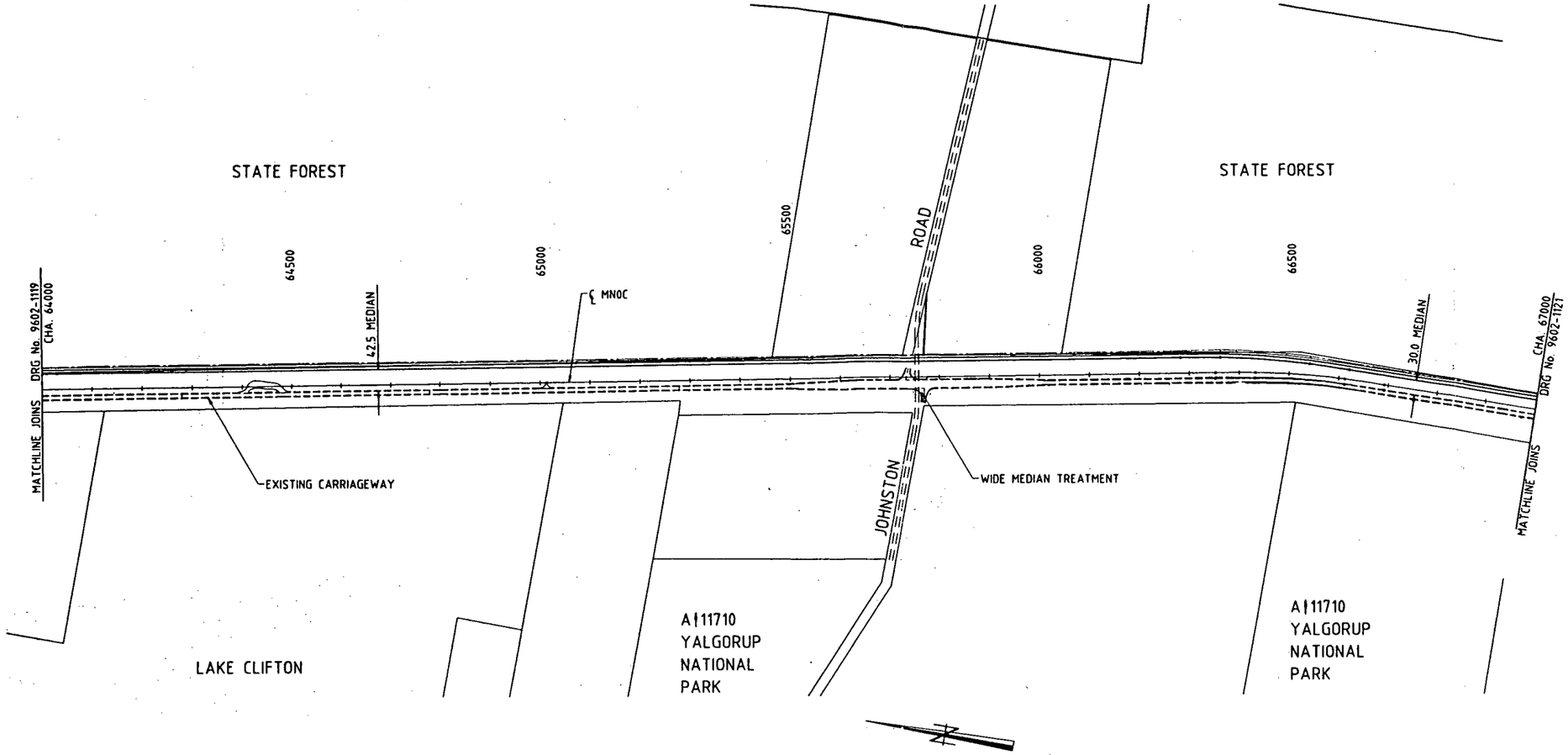
MAIN ROADS Western Australia

SCALE: VERTICAL 1:500 / HORIZONTAL 1:5000 — A1

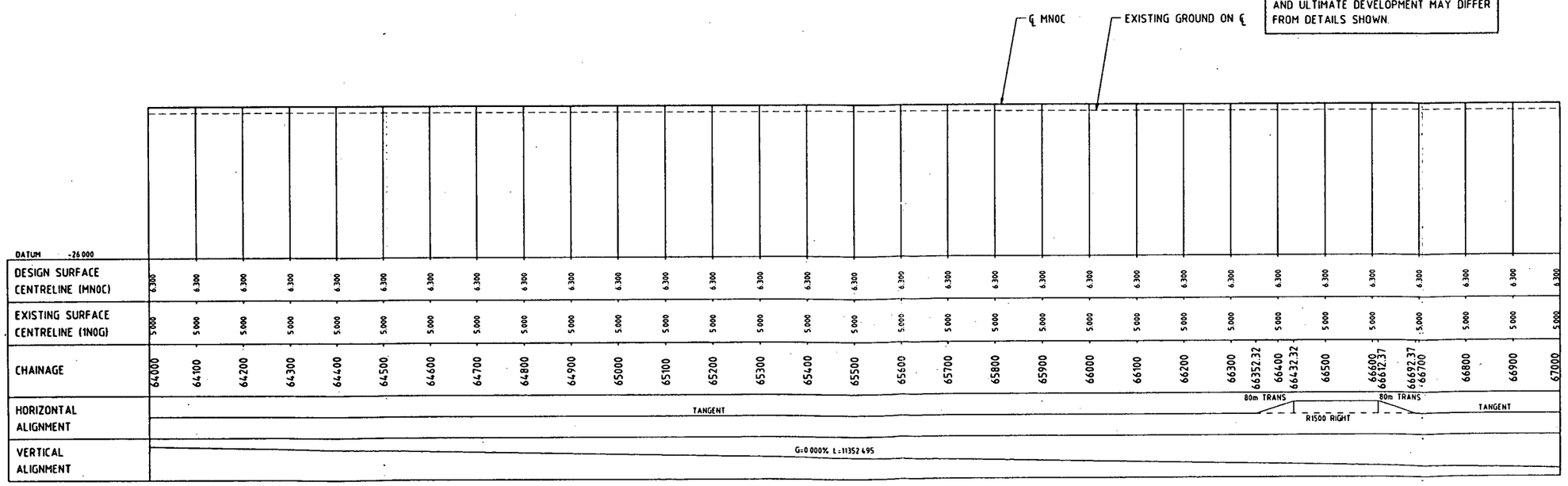
PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 61000 - 64000

LOCAL AUTHORITY: SHIRE OF WAROONA (209)

DRAWING TYPE: 04:06 | DRAWING NUMBER: 9602-1119 | AMEND



DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.INP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONE50
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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GB HILL & PARTNERS PTY LTD EST 1956 ACN 008 031 661

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/2/98

APPROVED

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Telephone (097) 25 5477 Fax (097) 25 4413

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

A 1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 64000 - 67000

LOCAL AUTHORITY SHIRE OF WARDONA (2091)

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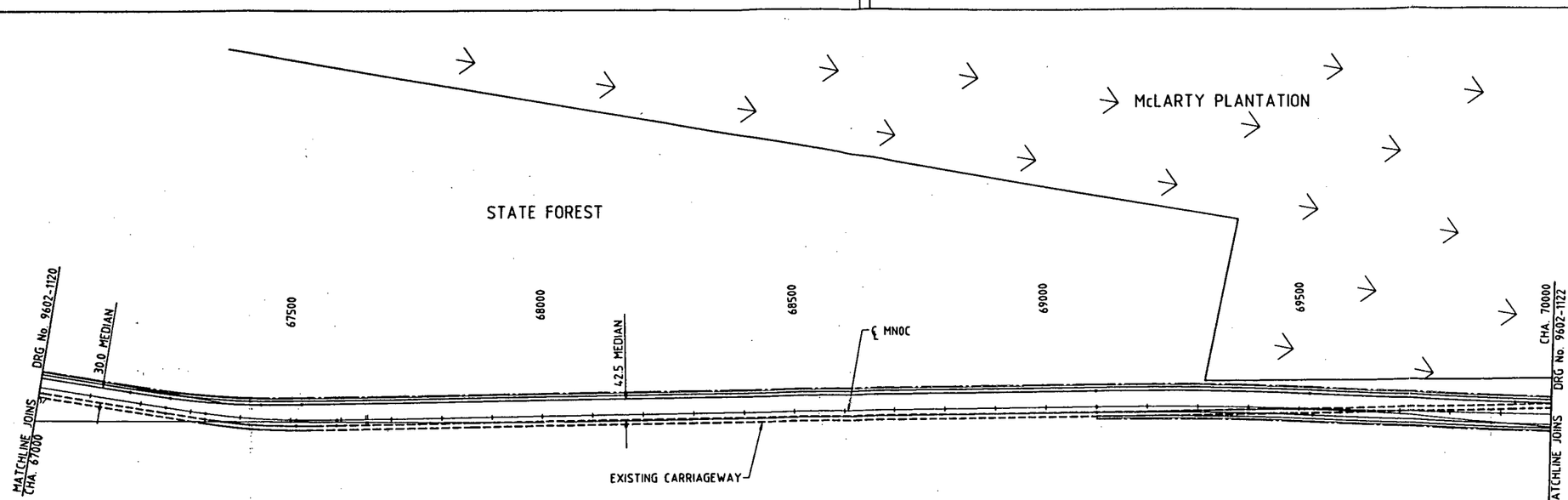
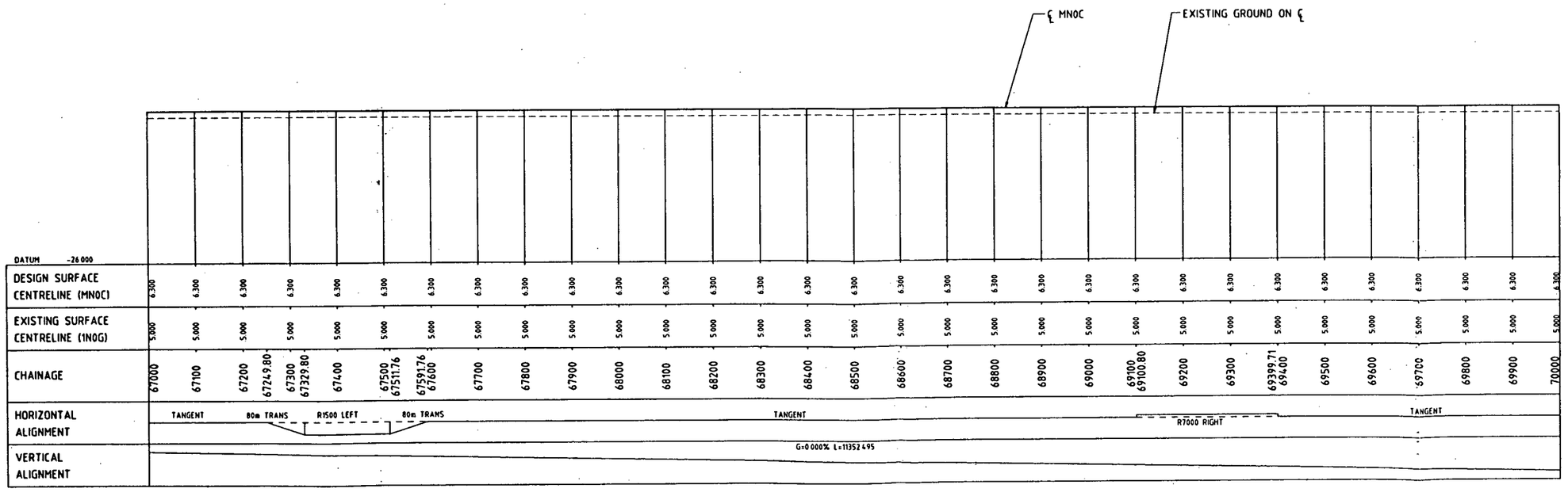


A11710
YALGORUP
NATIONAL
PARK

DETAILS SHOWN ON THIS PLAN ARE PRELIMINARY ONLY. STAGE CONSTRUCTION AND ULTIMATE DEVELOPMENT MAY DIFFER FROM DETAILS SHOWN.



AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

LEGEND

- SWAMPS / WETLANDS
- PROPOSED LAND RESUMPTION BOUNDARIES
- EXISTING BUILDINGS

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.DWP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONES0
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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82 COLIN STREET,PO BOX 1142,WEST PERTH, WA 6872
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GB HILL & PARTNERS PTY LTD EST 1955 ACN 009 091 881

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 23/1/96

APPROVED

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Telephone (097) 25 5677 Fax (097) 25 4813

APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500 — A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 67000 - 70000

LOCAL AUTHORITY SHIRE OF WAROONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
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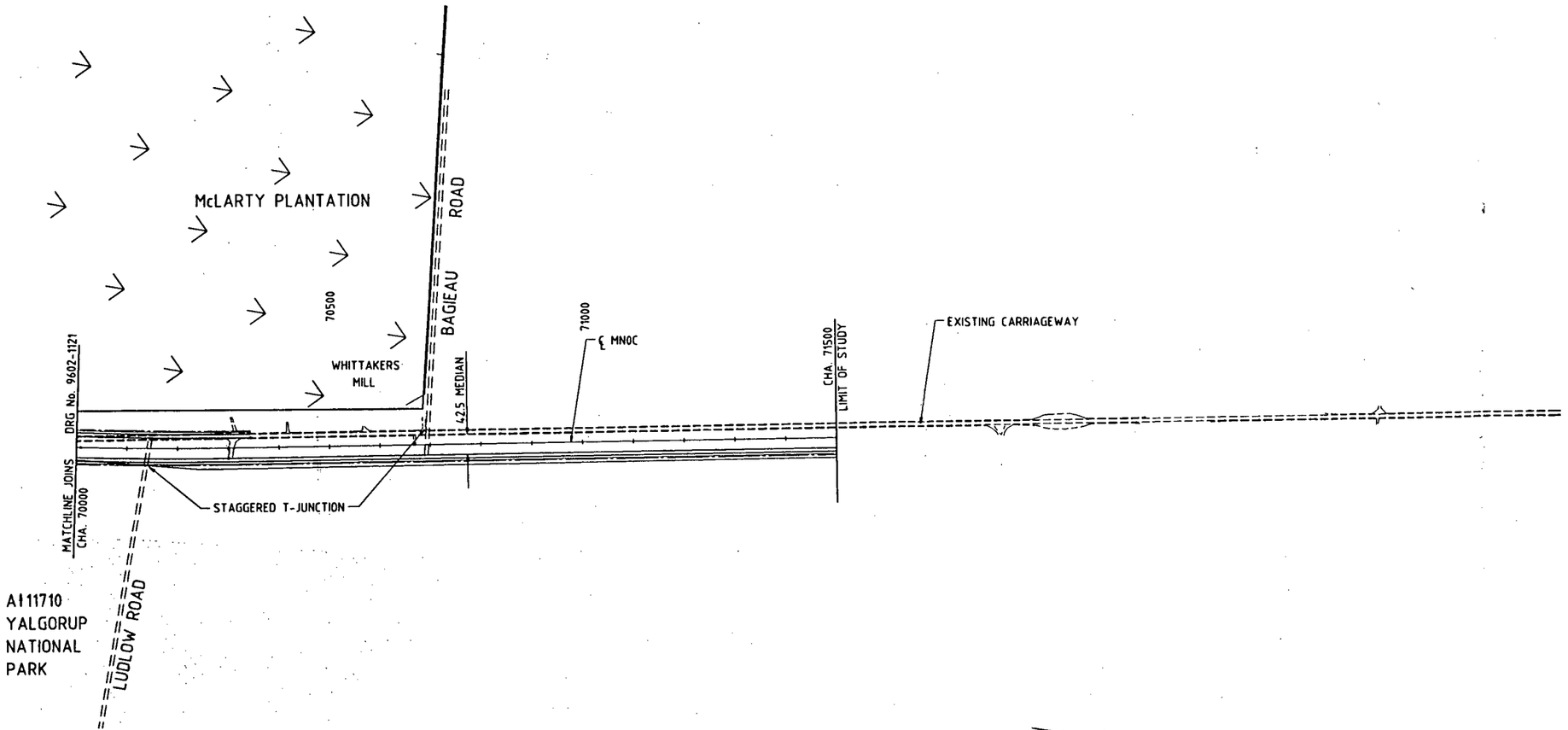

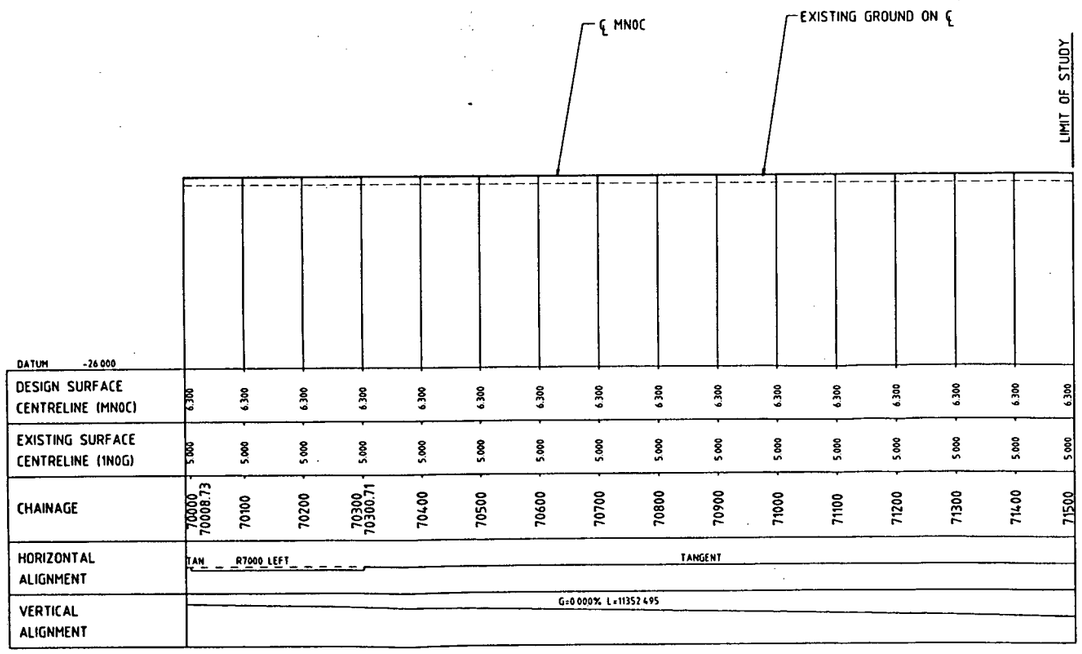

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AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

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SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

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82 COLIN STREET,PO BOX 1142,WEST PERTH, WA 6872
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GB HILL & PARTNERS PTY LTD EST 1955 ACN 008 091 861

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VERIFIED 23/12/96

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Robertson Drive Bunbury 6230
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APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE HORIZONTAL 1:5000 VERTICAL 1:500

A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
PLAN/PROFILE
CHA. 70000 - 71500

LOCAL AUTHORITY SHIRE OF WAROONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
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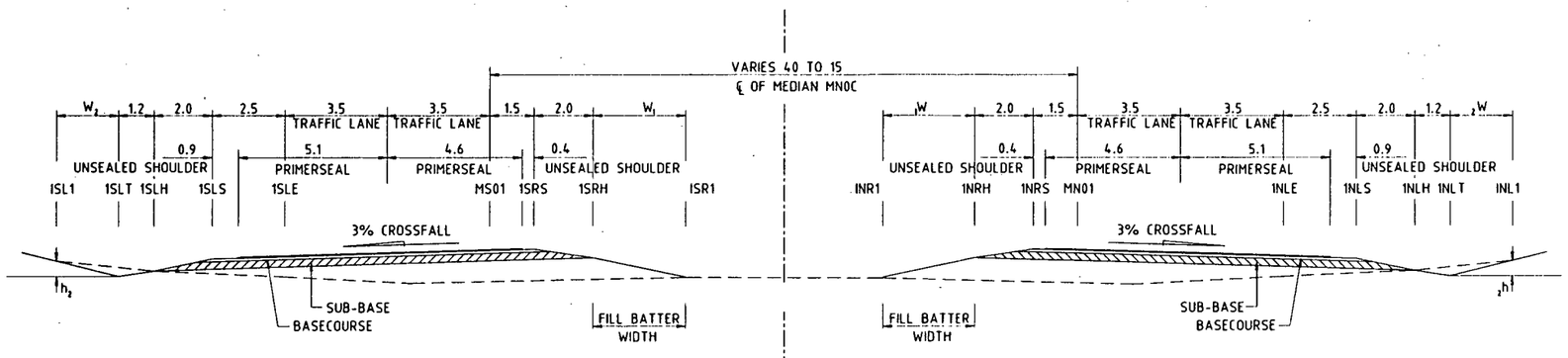

SOUTHBOUND CARRIAGEWAY

NORTHBOUND CARRIAGEWAY

TYPICAL CROSS SECTION

H_2	BATTER SLOPE	W_2
H_2<1.0	VARIES	3.0
H_2>1.0	1:3	VARIES

CUT BATTERS

H_1	BATTER SLOPE	W_1
H_1<0.2	BATTER SLOPE	1.2
0.2<H_1<0.4	1:6	VARIES
0.4<H_1<0.8	VARIES	2.4
H>0.8	1:3	VARIES

FILL BATTERS

AMENDMENTS

No.	DATE	DESCRIPTION	AUTHORISED

NOTES

REFERENCES

MOSS PROJECT	
MOSS DESIGN MODEL	DESIGN97
MOSS DRAW FILE	DRAW.DWP
ACAD PROJECT	/mrd/acad/1996
SURVEYOR	MRWA
SURVEY DATE	1992
SURVEY JOB NUMBER	
SURVEY MODEL	PEEL CONTOURS, PEEL DEV ZONES9
SURVEY DATUM	A.H.D.
SURVEY GRID	ZONE 50

GB HILL
CONSULTING ENGINEERS
GB HILL & PARTNERS PTY LTD EST 1953 ACN 009 039 881

DESIGNED/DRAWN J. H. GRAY W. B. RUDDY

VERIFIED 27/12/96

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APPROVED FOR IMPLEMENTATION

AUTHORISED		
RECOMMENDED		
APPROVED		

MAIN ROADS
Western Australia

SCALE 1:100 A1

PERTH - BUNBURY HIGHWAY
PEEL DEVIATION
TYPICAL CROSS SECTION

LOCAL AUTHORITY SHIRE OF WARDONA (209)

DRAWING TYPE	DRAWING NUMBER	AMEND
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