NARNGULU TO OAKAJEE RAIL ROUTE AND SERVICES CORRIDOR
PROJECT DEFINITION STUDY

Prepared for

LANDCORP
DEPARTMENT OF RESOURCES DEVELOPMENT
and
WESTRAIL

by

WELKER ENVIRONMENTAL CONSULTANCY

October 1997
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EXECUTIVE SUMMARY

Environmental Review

An environmental impact study of the Oakajee-Narngulu rail link and the concept of a services corridor following this alignment was conducted to examine the environmental implications arising from the construction and operation of the railway and to ascertain any environmental constraints for the services corridor concept.

A major component of this study was the implementation of an extensive community consultation program that involved face to face interviews with landowners within 400 m of the rail alignment options. The information gathered from the consultation program, together with the results of the environmental impact study, were used to develop a preferred rail alignment and services corridor location.

An environmental review based on the results of the study was prepared for:

- further landowner consultation; and
- EPA consideration.

Rail Proposal

The rail proposal will involve the construction of a 34 km single narrow gauge rail link from Oakajee Industrial Estate to Mullewa-Geraldton rail line. The line runs north, initially on the eastern side of the Moresby Range and to the west of Narra Tarra Moonyoonooka road. The alignment passes through the Wokatherra Pass and then heads westerly to the Oakajee Industrial Estate, which is approximately 25 km north of Geraldton.

An Feng Kingstream Steel propose to construct a standard gauge from Tallering Peak to the Oakajee Industrial Estate. The standard gauge line will meet the narrow gauge line at a point approximately 10 km east of the North West Coastal Highway. West of this point, the rail link will consist of a dual (three rails) standard/narrow gauge rail line.

The rail reserve is proposed to be 40 m wide to accommodate the rail line, service road, drains and firebreaks. On average, approximately half of the reserve may remain undisturbed.

Initially about 3.6 million tonnes of iron ore may be hauled each year to the Oakajee Industrial Estate along the standard gauge section of the Narngulu to Oakajee rail line by two large locomotives (likely to be S Class). The transport of iron ore will involve a maximum of 10 train movements per day. Options are being considered by An Feng Kingstream Steel to substantially reduce the number of train movements. For the purposes of the environmental review a maximum of 20 train movements per day (the sum of standard and narrow gauge transport) have been assumed for this section of the rail alignment.
Train movements on the remainder of the railway (narrow gauge) are likely to be less than half this number.

**Services Corridor Concept**

An area wider than that required for a rail link has been studied to highlight any environmental factors or "fatal flaws" that may need to be considered for a services corridor. Such a corridor may include pipelines, roads and power lines.

The co-location of services in one corridor is preferable, as it is likely that the social disruption and environmental impact would be substantially less than those resulting from a multitude of separate service routes. The EPA support the use of multiple service corridors to confine potential environmental impact (EPA, 1997).

While there are advantages to the co-location of services, there may be compelling reasons for individual services to co-locate for only part of the length of the railway alignment.

**Overview of Local Environment**

The services corridor and rail alignment pass through rural land used predominantly for cropping and grazing. Most of the route goes through flat to gently undulating farmland east of the Moresby Range and passes through a gap in this Range before crossing the North West Coastal Highway. These areas are designated in the local town planning schemes as having landscape heritage value.

There are a few areas of remnant vegetation along the route containing plant associations of low complexity (except heath) and limited habitat value. This has resulted from grazing by stock and the small area of the remnants.

One A Class Reserve (Reserve 893) for Water Supply and the Conservation of Flora and Fauna is significant, and is avoided by the rail alignment.

Surveys for Aboriginal sites were carried out and sites of varying significance were found. These will not be affected by the preferred rail alignment. European historic and heritage sites were investigated and found to be well away from the alignment.

**Landowner Consultation**

The concerns of landowners ranged widely according to the amenity values they obtained from the local environment and the perceived inconvenience or economic impact of the rail link proposal. Generally landowners in the northern sector of the alignment (west of Wokatherra Pass) felt more concerned about the loss of amenity than landowners over the remainder of the alignment.

Many landowners in the northern sector (and some over the remainder of the alignment) claimed that their reason for residing in this area will be diminished by the presence of a railway. Over the remainder of the alignment the predominant concerns related to impacts on farming activities, property values and subdivision potential.
The following issues of concern were noted from interviews:

- decreased property values (including difficulties in selling properties);
- reduced subdivision potential;
- landscape impacts;
- loss of amenity values;
- disruption to property access;
- noise impact;
- dust impact;
- disruption to farm management practices (such as cropping, stock movements and watering);
- interruption to water supplies; and
- flora and fauna impacts.

Overall the most prominent issues of concern were disruption to farm management practices and water supply, loss of property values, noise and loss of amenity.

**Review of Environmental Factors**

Interactions of the rail link proposal and the services corridor concept with the existing biophysical and social environment will result in changes to these environments. The community consultation program and the environmental studies led to the identification of the following 10 environmental factors requiring review.

- Vegetation
- Rare and Priority Flora
- Specially Protected Fauna
- Noise and Vibration
- Dust
- Water Supply and Drainage
- Aboriginal Heritage and Usage
- European Heritage and Usage
- Dangerous Goods Transport
- Landscape and Visual Amenity.

Of these environmental factors vegetation, noise and vibration, landscape and European heritage and usage are considered to be the most significant.

The review of each factor addressed the relevant EPA objective(s), assessment area, potential impacts, environmental management and commitments.
Environmental Management System

Westrail will prepare and implement an environmental management plan to address environmental matters arising out of the review of environmental factors associated with the construction and operation of the rail link. This plan will be prepared in consultation with the Department of Environmental Protection, Shires of Greenough and Chapman Valley, Department of Aboriginal Affairs and landowners.

The plan will include management plans for construction and landscape impacts.

Vegetation, Flora and Fauna

The railway will result in a small disturbance (about 1.5 ha) to some areas of remnant vegetation of interest in the Moresby Range area and insignificant impacts on significant fauna. Apart from remnant heath all plant associations are of low complexity and richness and occur outside the services corridor. Habitats in the vicinity of the corridor occur elsewhere and it is unlikely that Specially Protected fauna species will occur in the remnants.

The Blue-breasted Fairy-wren was located on the Chapman River and the rail river crossing will be designed to minimise the impact on its habitat. Impediments to the movement of small fauna will be reduced by the use of culverts where practicable in the Wokatherra Pass area.

The EPA endorsed method of Safstrom and Craig (1996) was applied to the evaluation of remnant vegetation on farmland and hills. The remnants were assessed as being of limited value to regional processes, with farmland being of low representational value and very limited viability and hill remnants being moderate representational value and probably viable.

The rail link will not affect any Gazetted Rare Flora. One priority species, Grevillea triloba, was detected in the services corridor but will not be significantly affected as it was found to be extremely common in the area. Further survey work has confirmed the presence of three other Priority species, Stenanthemum (Cryptandra) gracilipes (Priority 1), Scaevola oldfieldii (Priority 3) and Verticordapenicillaris (Priority 4).

These latter three priority species occur in hill crest heath which is mostly avoided by the rail link.

Commitments to minimise impacts on the native vegetation and fauna are:

- avoid as far as practicable the disturbance of native vegetation by refinement of the rail alignment at the detailed design phase and by minimising disturbance during construction.
- promote the restoration of native vegetation in the rail reserve consistent with fire management, safety practices and adjoining land uses.
Noise and Vibration

The passage of freight trains will give rise to noise emissions and vibration. Vibration impacts are likely to be imperceptible more than 15 m from the rail line.

The maximum outdoor noise level ($L_{A_{max}}$) at two residences is anticipated to exceed acceptable levels (80 dB(A)). A further one residence is likely to experience maximum noise levels of 75-80 dB(A) and will require treatment to reduce internal noise levels.

Outdoor noise levels below 75 dB(A) at noise sensitive premises are considered to be acceptable. The only recognised Australian criteria for assessing the acceptability of noise were published by the New South Wales State Pollution Control Council. These criteria suggest that a maximum level of 80 dB(A) is acceptable.

The Department of Environmental Protection has advised that a target for maximum outdoor noise levels from new rail proposals should be 65 dB(A).

The sleep disturbance index is considered to be an indicator of indoor noise levels. For 20 train movements and assuming an internal noise level of 60 dB(A) this index is 0.64. For 10 movements per day (the section between the Wokatherra Pass and the Geraldton-Mullewa railway) the sleep disturbance index decreases to 0.32.

A sleep disturbance index of around 1.5 is considered applicable for rail noise (Buller et al 1996) but for this environmental review an informal acceptability guideline of 1.0 has been applied.

The following measures are proposed in noise affected areas.

1. Where predicted noise level exceeds the $L_{A_{max}}$ of 80 dB(A):
   - offer to purchase existing residences;
   - prevention of future residential development by application of one or more of the following mechanisms:
     - property resumption; or,
     - purchase of any implied residence construction right; or,
     - seek the cooperation of local authorities and the Western Australian Planning Commission to impose restrictions on the construction of dwellings through local town planning schemes and the Geraldton Regional Plan.

2. Where the predicted $L_{A_{max}}$ noise levels from trains are 75 dB(A) to <80 dB(A):
   - offer to compensate for the equivalent to the cost of treatment or provide treatment to existing residences in accordance with Australian Standard 2021-1994; and
   - seek cooperation of local authorities to ensure that building requirements of future residences in the conditional area recognise the predicted noise levels.

In addition the implementation of the services corridor may involve securing up to a 250 m wide corridor against future residential development. The Department of Resources
Development and Ministry for Planning are preparing a strategy to secure the corridor area.

Details of measures to address noise impacts will be provided in the environmental management plan.

**Dust**

Dust emissions from iron ore transport and construction activities will not present any substantial health hazard.

Dust suppression measures such as treatment of fines or covering wagons will be required for the transport of iron ore and other potentially dusty materials. The potential in some areas for dust blow during rail construction is recognised and the Department of Environmental Protection Guidelines for the Prevention of Dust and Smoke from Land Development Sites in Western Australia will be applied.

**Water Supply and Drainage**

The construction of the railway will result in alteration to the drainage system and interruption to the water supplies on some properties. Structures will be designed to minimise adverse interference with the hydrological regime by the use of culverts and drains.

Westrail will make good any farm or domestic supplies (surface or groundwater) that are disrupted by the construction of the railway. Measures to ensure the maintenance of water supply, including the provision of alternative sources or access to water, will be described in the environmental management plan.

**Aboriginal Heritage and Use**

Significant or potential sites that are near the alignment will be avoided by design or by adjustments to the preferred alignment. Westrail will consult with the Department of Aboriginal Affairs on the design of the railway in the vicinity of any sites. Traditional use is usually commensurate with the food providing potential of the area. Along the rail alignment this potential was considered to be very low.

**European Heritage and Usage**

Sites in the Shire of Chapman Valley are some distance away from the proposed rail alignment and the closest (Hanlon's staging post) is about 1 km from the preferred alignment east of Chapman Valley Road. The Shire of Greenough is currently preparing a municipal inventory of European heritage sites. Westrail will liaise closely with the Shires of Greenough and Chapman Valley to maintain an awareness of any new historic sites in the vicinity of the alignment.

In a number of instances fragmentation of properties will result in:

- reduced access to and within the property;
interference with farm management practices;
interference with stock movement and watering; and
disruption to water supplies.

Under the *Public Works Act 1902-1974* procedures are available to address claims for compensation and in addition under these provisions it is normal practice for Westrail to:

- compensate for the value of acquired land;
- maintain or restore stock or domestic access to a water supply that has been affected;
- restore road access to properties where access is disrupted by the rail line; and
- restore internal property access (including stock) for any portion of the property isolated by the railway to minimise impacts on good farm management practices.

**Dangerous Goods Transport**

In the short to medium term the transport of dangerous or hazardous material is anticipated to be insignificant. Nonetheless Westrail will comply with the Australian Code for the Transport of Dangerous Goods by Road or Rail and will develop emergency procedures to respond to any dangerous spills.

**Landscape and Visual Amenity**

The railway will impact on the heritage (landscape) area described in Shires of Greenough and Chapman Valley town planning schemes. The railway will be visible from roads and some residences in the vicinity of the railway. Following community consultation a preferred alignment has been proposed which is further from residences close to the railway.

The retention of the landscape qualities of the assessment area is recognised as being a major consideration in the construction and management of the rail reserve. To help minimise visual impacts the disturbance of native vegetation in the rail reserve will be kept to a minimum.

Westrail will prepare a landscape management plan in consultation with the Shires of Greenough and Chapman Valley, and the Ministry for Planning. This plan will consider the establishment of native vegetation buffers in the rail reserve to enhance the ecological and landscape values of the area.
### TABLE 1: SUMMARY OF THE ENVIRONMENTAL FACTORS AND POTENTIAL MANAGEMENT FOR THE RAIL ALIGNMENT

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<th>FACTOR</th>
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<th>POTENTIAL MANAGEMENT</th>
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<td>1. Vegetation</td>
<td>To maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.</td>
<td>Low complexity (except heaths) because of grazing by stock. Non viable and degraded remnants on farmland. Hill remnants (in particular heath areas) probably viable and of greater value. All associations occur outside the corridor area.</td>
<td>Clearing of small area of remnant vegetation of about 1.5 ha in hills area. Very little of the heath remnants will be affected by clearing.</td>
<td>Avoid as far as practicable clearing of native vegetation. Prepare construction management plan. Restore native vegetation in rail reserve.</td>
<td>No significant impact on native vegetation. Opportunity to encourage conservation of native vegetation in rail reserve.</td>
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<td>2. Rare and Priority Flora</td>
<td>To protect declared rare and priority flora consistent with the provisions of the Wildlife Conservation Act 1950.</td>
<td>Species richness is low except in heath remnants. No gazetted rare flora found but four Priority species were located in the vicinity of the rail alignment.</td>
<td>No rare flora affected. One Priority 3 species, which is extremely common in the area, and another three Priority species may potentially be affected.</td>
<td>See 1 above.</td>
<td>No impact on rare flora and no significant impact on priority flora as hill crest area is mostly avoided.</td>
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<td>3. Specially Protected Fauna</td>
<td>To protect Specially Protected (Threatened) Fauna consistent with the provisions of the Wildlife Conservation Act 1950.</td>
<td>Vegetation of limited habitat value because of grazing by stock. No usual habitat types. No gazetted rare or priority fauna recorded during survey. The Blue-breasted Fairy-wren was recorded beneath Eucalypt woodland in the Chapman River bed.</td>
<td>Removal of small amount of habitat (about 1.5 ha). Potential to disturb of Blue-breasted Fairy-wren habitat. Impediment to the movement of small fauna.</td>
<td>See 1 above. Use culverts wherever possible in hills area to reduce impediment to movement of small fauna. Minimise disturbance to Blue-breasted Fairy-wren habitat through design of river crossing.</td>
<td>No impact on specially protected fauna.</td>
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<td>4. Noise and vibration</td>
<td>To protect the amenity of nearby residents from noise and vibration impacts by ensuring noise and vibration meet established criteria.</td>
<td>Residences are in proximity to the rail alignment. Land use is predominantly rural. Maximum noise levels at some residences may exceed established standards. Vibration will be imperceptible at all residences.</td>
<td>Maximum noise levels at some residences may exceed established standards. Vibration will be imperceptible at all residences.</td>
<td>Erect noise barriers in the rail reserve. Offer to purchase those residences that cannot be treated to bring noise levels in line with established standards. Potential residential development will be prevented in areas where noise exceeds 80 dB Lamax. Existing residences in 75-80 dB Lamax area will be offered treatments to reduce noise levels. Future residences in 75-80 dB Lamax area will be required to conform to AS 2021-1994.</td>
<td>Offer to purchase residences in unacceptable noise area and treatment offered to those in the conditional area to ensure noise levels are in accordance with established standards.</td>
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<td>5. Dust</td>
<td>To ensure that dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards.</td>
<td>Residences are in proximity to the rail alignment. Some soils may be subject to dust blow.</td>
<td>Transport of iron ore can potentially give rise to dust emissions. Construction activities under particular conditions and in the hills area can potentially give rise to dust emissions.</td>
<td>Apply Department of Environmental Protection Guidelines during construction. Establish a procedure for dust control for rail transportation of dusty materials. Incorporate dust control in construction management plan.</td>
<td>No significant impact from dust emissions.</td>
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<td><strong>SOCIAL SURROUNDINGS</strong></td>
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<td>6. Water Supply and Drainage</td>
<td>To maintain the quantity of water supply so that existing and potential users are protected. To ensure that alterations to existing drainage patterns by the railway do not unduly affect nearby usage of land.</td>
<td>Rural land uses which include cropping and grazing. Drainage from the Moorsby Range to the Chapman River or Buller River.</td>
<td>Railway may disrupt domestic and stock water supplies. Construction activities under particular conditions and in the hills area can potentially give rise to dust emissions.</td>
<td>Make good disrupted domestic and farm water supplies. Minimise interference with drainage patterns by use of culverts and drains. Incorporate drainage considerations into construction management plan.</td>
<td>Water supplies restored. No significant adverse impacts from alteration to drainage patterns.</td>
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<td>7. Aboriginal Heritage and Use</td>
<td>To ensure the proposal complies with statutory requirements in relation to places and sites of heritage significance. To ensure the proposal does not result in changes to the physical and biological environment, which adversely affects cultural associations with the area.</td>
<td>Heritage sites were established by survey. Food providing potential of the area was considered low.</td>
<td>Potential to disturb Aboriginal sites and usage.</td>
<td>Aboriginal sites will be avoided. Consultation with the Department of Aboriginal Affairs on the design and construction of the railway.</td>
<td>No impact on Aboriginal sites or usage.</td>
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<td>8. European Heritage and Use</td>
<td>To ensure the proposal complies with statutory requirements in relation to places and sites of heritage significance. To ensure the proposal does not result in changes to the physical and biological environment, which adversely affects cultural associations with the area.</td>
<td>Historic sites have been located in the Greenough and Chapman Valley Shires. The area is used for agricultural activities and there are residences in the vicinity of the alignment.</td>
<td>No known sites will be impacted by the railway. Land will be acquired for the rail reserve. Disruption of internal and external access from some properties will occur. Disruption to farm management practices on some properties may occur.</td>
<td>Close liaison with the Shires Of Greenough and Chapman Valley. Establish and implement a procedure for settling compensation claims for acquired land and construction of the railway. Restore internal and external property access. Manage rail reserve so as not to conflict with adjoining land uses.</td>
<td>No impact on historic or heritage sites. Procedure in place to receive and settle compensation claims. Internal and external access is restored. Management of rail reserve is appropriate.</td>
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<td>9. Dangerous Goods Transport</td>
<td>To ensure that the rail transport of potentially dangerous and hazardous goods is consistent with the provisions of the Explosives and Dangerous Goods Act 1961.</td>
<td>Residences are in proximity to the rail alignment. The rail alignment is in the catchment of the Chapman River.</td>
<td>The escape of dangerous materials transported by rail may pose a threat to public safety and the local environment.</td>
<td>Compliance with Australian Code for the transport of Dangerous Goods by Road or Rail. Develop an emergency procedure to respond to spills of dangerous materials.</td>
<td>No significant risk to residences or the environment.</td>
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<td>10. Landscape and Visual Amenity</td>
<td>To ensure that the landscape and visual amenity of the area adjacent to the project is not unduly affected by the proposal.</td>
<td>A portion of the rail alignment passes through the Moresby Range landscape protection area nominated in town planning schemes. The rail alignment is in proximity to residences.</td>
<td>The railway will be visible from major roads and some residences as it passes through the Moresby Range landscape heritage area.</td>
<td>Realignment of the rail route away from residences. Offers to purchase will be made to those residences which are closest to the rail route and experience noise levels above 80 dB Lmax. Prepare and implement a landscape management plan in consultation with landowners, local authorities, Moresby Range Management Committee and Ministry for Planning. Establish native vegetation buffers.</td>
<td>The railway will be visible from some major roads and residences. Landscape and visual amenity will not be unduly affected.</td>
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OTHER

Environmental Management System

Westrail has developed a general environmental policy statement and objectives. A continuous commitment to minimise the environmental impact of its activities. NA

Develop and implement an environmental management plan which includes construction and landscape management plans prepared in consultation with landowners and State and local government agencies.

Ensures the application of best practice environmental management to the proposal.
1. INTRODUCTION

LandCorp, in conjunction with Westrail and the Department of Resources Development, is examining the construction of a rail line and the concept of a general services corridor from Narngulu to Oakajee as part of the Government's investigations into the proposed Oakajee Industrial Estate. An environmental impact study of the corridor and proposed rail alignment options has been conducted by Welker Environmental Consultancy to examine environmental factors associated with the construction and operation of the railway and the services corridor concept.

The study area chosen was larger than that required for a railway to provide a preliminary indication of any major environmental constraints associated with the establishment of the services corridor along the rail alignment.

1.1 ENVIRONMENTAL IMPACT STUDY TEAM

An expert team described in Table 2 below conducted the environmental impact assessment study.

<table>
<thead>
<tr>
<th>Person</th>
<th>Organisation</th>
<th>Expertise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charlie Welker</td>
<td>Welker Environmental Consultancy</td>
<td>Project management, environmental impact assessment and management, community consultation and impacts on social surrounds.</td>
</tr>
<tr>
<td>Val Welker</td>
<td>Welker Environmental Consultancy</td>
<td>European heritage, socioeconomic impacts and land use.</td>
</tr>
<tr>
<td>Lynton Storer</td>
<td>Herring Storer Acoustics</td>
<td>Noise and vibration criteria and impacts</td>
</tr>
<tr>
<td>Gary Quartermaine</td>
<td></td>
<td>Aboriginal Heritage.</td>
</tr>
<tr>
<td>Rory O Connor</td>
<td></td>
<td>Aboriginal Heritage.</td>
</tr>
<tr>
<td>Adrian Peck</td>
<td></td>
<td>Hydrology, erosion, geology and hydrogeology.</td>
</tr>
</tbody>
</table>

The results of this study were considered in the selection of the preferred alignment and formed the basis of this environmental review.

1.2 PURPOSE OF THIS ENVIRONMENTAL REVIEW

1.2.1 EPA Consideration

This environmental review incorporates the results of the environmental impact study and provides details of the proposal and an indication of the environmental factors,
management and commitments that are potentially associated with the rail proposal and the services corridor concept.

This report has also been prepared in the form of a Project Definition Study for the consideration of the Environmental Protection Authority (EPA).

1.2.2 Landowner Consultation

The preparation of this report follows an extensive process of community consultation and liaison with local authorities and Government agencies that enabled a comprehensive scoping of environmental factors and concerns.

This document will be provided to all landowners within 400 m of the alignment to obtain comment before finalising the rail proposal and services corridor concept.

1.3 SUMMARY DESCRIPTION OF THE PROPOSAL

The proposal involves the construction and operation of a rail link about 34 km long between the Oakajee Industrial Estate and Mullewa-Geraldton rail line (Figure 1). An area wider than that required for a railway has been reviewed to highlight any environmental factors that may need to be considered for a services corridor along the rail alignment.

The current proposal addresses only the rail route in detail. Any specific proposals for other services or infrastructure will be referred separately to the EPA for consideration. The Department of Resources Development is seeking strategic advice from the EPA on any potential flaws and environmental requirements associated with the concept of a services corridor that follows the rail route.

The proposed rail line will leave the Mullewa - Geraldton line east of the Nargulu Estate, which is about 5 km south-east of Geraldton (Figure 2). The line runs north, initially on the eastern side of the Moresby Ranges and to the west of Narra Tarra Moonyoonooka Road. The alignment passes through the Wokatherra Pass and then heads westerly to the Oakajee Industrial Estate, which is approximately 25 km north of Geraldton.

Initially about 3.6 million tonnes of iron ore may be hauled over the last 10 km of the rail link to the Oakajee Industrial Estate each year. The transport of iron ore may involve a maximum of 10 train movements per day.

For the purposes of this review a maximum of 20 train movements per day along the last 10 km of the railway have been assumed for the medium to long term. Train movements on the remainder of the railway (narrow gauge section) in the long term are likely to be less than half this number.

1.4 THE PROPOSENT

The proponent for the rail route is Westrail. The Department of Resources Development is developing the concept of a services corridor along the rail alignment.
1.5 RELEVANT LEGISLATION

The Oakajee/Narngulu rail link will be subject to a number of Acts of Parliament and regulations at State and Commonwealth levels. A selection of key legislation is listed below.

- Aboriginal Heritage Act 1972.
- Environmental Protection Act 1986 as amended.
- Heritage of Western Australia Act 1990.
- Town Planning and Development Act 1928
- Iron & Steel (Mid West) Agreement 1997

1.6 KEY AGENCIES

The decision-making authorities (DMAs) and involved authorities which have provided input to this proposal, or will provide input to the implementation include:

1. Environmental Protection Authority (EPA)

   The EPA has prescribed guidelines pursuant to the Environmental Protection Act 1986 for this strategic environmental review and will provide advice to the Minister for the Environment pursuant to Section 44 of the Environmental Protection Act 1986 on environmental factors relevant to the rail route proposal.

2. Department of Environmental Protection (DEP)

   The DEP facilitates the preparation of this environmental review document for the rail route proposal and any subsequent formal assessment of the proposal in accordance with EPA procedures.

3. Department for Resources Development (DRD)

   The DRD is responsible in this instance for the coordination and facilitation of planning initiatives together with the Western Australian Planning Commission to ensure development opportunities for resource industry are optimised.
4. Westrail (Western Australian Government Railways Commission)

Westrail is a statutory authority, which provides freight, passenger and related rail transport services in southern Western Australia. Westrail may design and project manage the construction of new railways as required.

5. Department of Conservation and Land Management (CALM)

CALM protects and manages native flora and fauna and their ecosystems through the provisions of the Conservation and Land Management Act 1984 and the Wildlife Conservation Act 1950. CALM will provide advice on the management of flora and fauna of significance in the area influenced by the rail route and has the responsibility for managing State Forests.

6. The Department of Transport (DOT)

The Department of Transport together with Westrail is responsible for rail transportation policy development and strategic planning.

7. Shires of Chapman Valley and Greenough

The rail alignment passes through the Shires of Chapman Valley and Greenough. Under the Local Government Act 1960, municipal authorities have the power to make by-laws with respect to matters including planning, zoning and land use or environmental controls to the extent that such by-laws are not inconsistent with Commonwealth or State laws.

8. Ministry for Planning

The Ministry for Planning advises and assists the Western Australian Planning Commission in the preparation of regional plans in country and metropolitan areas.
2. COMMUNITY CONSULTATION

Scoping of environmental factors is an integral part of a properly conducted environmental impact assessment.

An extensive community consultation program was undertaken early in the study in order to identify the issues of potential concern to the community, in particular those landowners who are in the vicinity of the proposed rail alignment.

2.1 ORGANISATIONS AND INDIVIDUALS CONSULTED

Discussions have been held with the following organisations and interested persons:

- Shire of Chapman Valley
- Shire of Greenough
- Landowners in the vicinity of the proposed rail alignment
- Government Agencies including the EPA, Department of Environmental Protection, LandCorp, CALM, Department of Mines and Energy and Ministry for Planning.

These discussions provided a substantial amount of information on potential environmental and social issues of concern to the community and decision-making authorities. The cooperation and input of these individuals and organisations is gratefully acknowledged.

2.2 LANDOWNER CONSULTATION

The most important component of the consultation program for this environmental review was consultation with landowners in the vicinity of the alignment. This consultation was undertaken before a decision was made on the preferred rail alignment and services corridor.

For consultation purposes landowners were categorised into two groups:

1. Those owners within 400 m of all rail alignment options; and
2. Those owners within 400-1500 m of all rail alignment options.

2.2.1 Landowners Within 400 m

Landowners within 400 m of the proposed alignment options were contacted and face to face interviews held with each landowner wherever possible. Where this was not possible phone interviews were arranged. A Vietnamese interpreter was engaged to facilitate consultation with some landowners.
The purpose of these interviews was to:

- explain the proposed rail route and the potential services corridor;
- identify landowner concerns; and
- gain information on the potential impact of the alignment on landowner usage of their land.

Following these interviews landowners were advised by mail of the preferred rail alignment.

2.2.2 Landowners Between 400 m and 1500 m

Landowners in this category were sent information by mail on the rail alignment and were encouraged to make contact with the Department of Resources Development if they had any concerns.

2.2.3 Results of Landowner Consultation

The concerns of landowners ranged widely according to the amenity values they gained from the local environment and the perceived inconvenience or economic impact of the rail link proposal. Generally landowners in the northern sector of the alignment (west of Wokatherra Pass) felt more concerned about the loss of amenity than landowners over the remainder of the alignment.

Many landowners in the northern sector (and some over the remainder of the alignment) claimed that their reason for residing in this area will be diminished by the presence of a railway. Over the remainder of the alignment the predominant concerns related to impacts on farming activities, property values and subdivision potential.

The following issues of concern were noted from interviews:

- decreased property values (including difficulties in selling properties);
- reduced subdivision potential;
- landscape impacts;
- loss of amenity values;
- disruption to property access;
- noise impact;
- dust impact;
- disruption to farm management practices (such as cropping, stock movements and watering);
• interruption to water supplies; and
• flora and fauna impacts.

Overall the most prominent issues of concern were disruption to farm management practices and water supply, loss of property values, noise and loss of amenity.

The fragmentation of land and the proximity of residences to the alignment were also determined during interviews and following examination of aerial photography. More details on these aspects are provided in the review of the environmental factor of European heritage and use (refer Section 7.9).

2.2.4 Consultation Following the Completion of this Review

Further community consultation will be undertaken during the public review period of this environmental review by holding an open day in the region. A copy of this review will be provided and comment invited from:

• all landowners within 400 m of the rail alignment;
• local authorities in the region; and
• Department of Environmental Protection, Department of Aboriginal Affairs, Department of Conservation and Land Management and Ministry for Planning.

Copies will be accessible in the libraries of the Shires of Greenough and Chapman Valley and the City of Geraldton and available for purchase ($5) by the general community from Westrail in Geraldton.

The availability of the review will be advertised in the local newspapers in accordance with EPA requirements.

The executive summary will be mailed to all landowners between 400 and 1500 m of the alignment.

Follow up meetings with landowners within 400 m of the alignment will be arranged where requested.

An open day will be held in a shopping centre in the region to provide opportunities for the broader communities to meet and discuss the proposal with the proponent and the Department of Resources Development.
3. DESCRIPTION OF THE PROPOSAL

3.1 POTENTIAL FOR CO-LOCATION OF SERVICES

The proposal involves the construction and operation of a rail link about 34 km long between the Oakajee Industrial Estate and Mullewa-Geraldton rail line (Figure 2). A corridor wider than that required for a railway has been selected for study to highlight any major environmental factors that may prevent additional services being considered for co-location with the rail link. Such a corridor may include pipelines, roads and power lines.

The co-location of services in one corridor is preferable, as it is likely that the social disruption and environmental impacts would be substantially less than those resulting from a multitude of separate service routes. The concept of a single service corridor is preferred from a land use planning point of view and is supported by EPA (EPA, 1997).

While there are advantages to the co-location of services, there may be compelling reasons for individual services (such as high voltage transmission lines in the vicinity of the Geraldton airport) to co-locate for only part of the length of the railway.

This proposal does not attempt to examine in detail the potential environmental implications that may arise from the construction and operation of other infrastructure or services along the rail alignment. These proposals will be referred separately to the EPA for its consideration.

The implementation of the services corridor concept will involve securing an approximately 250 m wide strip of land from future incompatible development. This will require the cooperation of local authorities and the Ministry for Planning to implement appropriate amendments to town planning schemes and region plans. In parallel with this process agreements may be made with landowners to prevent incompatible development.

3.2 SELECTION OF A PREFERRED RAIL ALIGNMENT

A rail alignment for large freight trains should avoid river crossings and should preferably be located on relatively flat ground to minimise costly engineering works such as cutting and filling (which may also be disruptive to the environment). Ideally an effective grade of 1:150 is the design target for railways carrying freight trains hauling large loads of materials such as iron ore. Consequently railways are often located along river valleys or in flat country to take advantage of desirable natural grades.

Other considerations that are important in the construction and location of a railway are:

- avoidance of small landholdings and property fragmentation to minimise disruption to land use;
- avoidance of existing or potential areas of intensive land uses such as horticulture and urban and existing industrial areas;
achieving a balance between cut and fill requirements along the alignment to minimise the use of external sources (quarries or borrow pits) to the alignment for foundation material;

- favourable geotechnical conditions;

- location along existing road reserves; and

- avoidance of areas of environmental and heritage significance.

Following consideration of all the above location factors the most desirable rail alignment is east of the Moresby range and following generally the Narra Tarra Moonyoonooka Road until diverging to pass through the Wokatherra Pass and then onto the Oakajee Industrial Estate (Figures 3, 4 & 5). This Pass is the only practicable means of crossing the Moresby Range to enter the Industrial Estate and is a major constraint on the choice of alternative alignments.

3.2.1 Alternative Rail alignments

Three alignment options (Figure 5), north, central and south, from the Wokatherra Pass to the Oakajee Industrial Estate were considered in detail. These options were evaluated on the basis of the following criteria:

- environmental considerations arising from the environmental impact study including remnant vegetation, heritage and usage of land;

- potential operating requirements such as grade considerations to and from the Oakajee Port;

- construction costs; and

- the requirements of the Iron and Steel (Mid West) Agreement Act 1997.

The relative environmental and operational advantages of each of these alignments were compared (Table 3) and the central option chosen as the preferred alignment.

<table>
<thead>
<tr>
<th>Option</th>
<th>Remnant Vegetation</th>
<th>Aboriginal Heritage</th>
<th>Human Land Usage</th>
<th>Operational Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td>Central</td>
<td>L</td>
<td>L</td>
<td>E*</td>
<td>I</td>
</tr>
<tr>
<td>South</td>
<td>L</td>
<td>I</td>
<td>E*</td>
<td>H</td>
</tr>
</tbody>
</table>

H-Major, I-Intermediate, L-Low impact

*Roughly equivalent but the central option has one less residence within 150m.

Welker Environmental Consultancy
The preferred alignment south of the Wokatherra Pass to the Mullewa-Geraldton railway passes mainly through farmland. This route was finalised after consideration of all the above factors, adjustments to avoid the Conservation Reserve 893 and to increase, wherever practicable, the distance from residences.

The preferred alignment for the rail route and general services corridor is shown in detail in Figures 3, 4 & 5.

3.3 RAIL DESIGN

From Narngulu to a point approximately 10 km east of the North West Coastal Highway, the rail link will consist of a narrow gauge track in a 40 metre rail reserve (Figure 6). West of this point the rail link will consist of a dual (three rails) standard/narrow gauge rail line in a rail reserve of the same size.

The narrow gauge track and sleepers will be layed on a formation of bulk fill common material overlain by a topping of 230 mm of gravel. Drains will be constructed on each side of the formation and a one lane access road may be constructed on the far side of one drain. The remainder of the reserve may contain any remaining native vegetation with a 3 m firebreak on each edge of the reserve. Figure 6 illustrates the appearance of a narrow gauge railway over flat land and in a side embankment cutting.

The top of the formation is always six metres wide and the outside slope is at a grade of 1:1.5 (Figure 6). In areas where fill is required to raise the rail track the width of the base of the formation will increase in proportion to its height.

The railway will cross the North West Coastal about 8m above grade and will go under the Geraldton - Mt Magnet Road flyover about 4m below grade. The exact details of these crossings will be developed during the detailed design of the railway.

3.4 TRAIN CHARACTERISTICS AND MOVEMENTS

Train operations along the narrow gauge section of the line will be the responsibility of a private rail operator or Westrail. In either case Westrail is likely to retain ownership of the rail infrastructure and reserve and will be in a position to enforce conditions on rail operators.

The narrow gauge section of the line will not be constructed until Westrail considers there is sufficient freight to warrant its construction. This is likely to be some time in the future. The level of train movements along the narrow gauge is not precisely known but is likely to be less than 10 train movements per day.

Construction of the standard gauge section of the rail link is likely to commence in 1998. The standard gauge link east of the point where it leaves the narrow gauge line will be the subject of a separate referral to the EPA and environmental impact assessment.

In the short to medium term the use of the dual standard/narrow gauge section is likely to be dominated by the transport of iron ore. When the demand is large enough the remainder of the rail link will be constructed and used to transport general freight to the
Estate. Iron ore trains are expected to consist of two S class locomotives hauling a total of
2000-3000 tonnes. The rail wagons will either be covered or the fines treated with a
crusting agent to prevent dust emissions (Alan Tingay and Associates, 1997).

Iron ore trains will be backloaded with any slag and other inert solid wastes (up to 500,000
tonnes per year) from the Geraldton Steel Plant requiring disposal in the Tallering Peak
mine waste dump.

The movement of iron ore will involve a maximum of 10 train movements per day in the
long term. An Feng Kingstream Steel is investigating options to substantially reduce the
number of daily train movements and to lower noise emissions from locomotives on the
standard gauge line.

The speed of the loaded train on the rail link is anticipated to be 60 km per hour loaded
and 70 km for unloaded or with partially loaded trains.

For the purposes of this assessment the following train movements have been assumed in
the medium to long term:

- a maximum of 20 per day along the dual standard/narrow gauge section of the rail line;
  and

- less than 10 per day on the remainder of the rail link (narrow gauge).
4. EXISTING BIOPHYSICAL ENVIRONMENT

4.1 REGIONAL CLIMATE

Geraldton's climate may be classified "extra dry Mediterranean" because there are normally seven or eight dry months per year.

Maximum temperatures near the coast are mild, with monthly averages rarely rising above 30°C. The area experiences cool winter conditions, with monthly minima as low as 8°C.

Rainfall is low (about 470 mm/year in coastal areas), with most falling between May and August. There are long periods without rain during the summer (a mean of two rain days per month). Rainfall at this time is sporadic, with thunderstorms sometimes causing heavy falls in small areas and tropical cyclones occasionally bringing heavy rain to the region generally.

Geraldton has an annual evaporation rate of 2464 mm, with evaporation exceeding rainfall for every month except June and July. Net evaporation is 1995 mm.

The area is noted for its windy conditions, with winds predominantly from south-south west to easterly sectors. The general seasonal wind pattern is highly influenced by a land/sea breeze system, which causes variations over a period of a day. Summer winds are mainly from the east-south east and south in the morning, with strong sea breezes from the south-south west and south in the afternoon. The winter pattern is more variable and wind speeds are generally lower.

Comprehensive wind data was collected from a weather monitoring station, which operated behind the escarpment near Coronation Beach for several years. Wind roses constructed from this data at Coronation Beach and Geraldton are presented Figure 7.

4.2 GEOLOGY AND SOILS

The geology of the route is featured in Plate 7 of Playford et al (1976) and the Geraldton Sheet of the 1:250 000 Geological Series of maps. In summary, the proposed route lies over areas of sedimentary sequences of the Perth Basin, and fractured rocks of the Northampton Complex.

The proposed services corridor route lies well to the west of the Darling Fault and east of the Geraldton Fault. Most of the route crosses Mesozoic and Proterozoic rocks of the Northampton Block, the exceptions being Quaternary alluvium along the valley of the Chapman River, and Quaternary limestone at the Oakajee terminal.

The Northampton block is cut by a dense swarm of dolerite dykes that strike north-north east and are usually steeply dipping. However, no dykes are mapped along the proposed route.

Starting at Nargulu, the southern section of the proposed route including part of the valley of the Chapman River, traverses Quaternary alluvium, colluvium and undifferentiated soils described as quartz sand, clay and loam.
At a point south-east of The Brothers, and shortly after crossing Ego Creek, the underlying geology changes to Proterozoic granulites that are generally highly weathered and in part blanketed by Pleistocene or Late Tertiary laterite and quartz sand. These metasedimentary rocks are eroded to form characteristically rounded hills.

Near Mount Sommer the proposed services corridor swings more to the north-west where Lower Jurassic sedimentary rocks of the Chapman Group overlie the older rocks. The Chapman Group includes Greenough Sandstone (variable thickness up to 94 m) and younger Moonyoonooka Sandstone (usually about 30 m thick). Flat-topped remnants of the Victoria Plateau (mesas with laterite capping of the Jurassic sediments) give the area a characteristic topography.

North-west of Wokatherra Pass the route traverses another area of Proterozoic granulites before terminating on Quaternary Tamala limestone west of the North West Coastal Highway.

4.2.1 Erosion Potential

Agriculture WA has reported on the potential for wind and water erosion of soils in the Geraldton area (Rogers, 1996). This assessment is summarised below. A further discussion of soil erodibility, based on vegetation classification is presented in Muir Environmental (1997a).

Alluvium of the Chapman River valley (Greenough Alluvium Landform) is part of the Bowes soil series that is classified as having a low risk of erosion by water or wind. The proposed rail line is expected to disturb areas of this soil type.

Soil series developed on the granulite (Sugarloaf landform) are Kojarena, Northern Gully, Rock Outcrop and an un-named soil developed on dolerite dykes (none of which are mapped in the area of the proposed rail line).

The Kojarena soil unit is developed on mid to lower slopes. It is classified as having a moderate risk of erosion by water, and a low risk of erosion by wind. The proposed rail line is expected to disturb this soil type.

The Northern Gully soil unit is developed on hillcrests and ridges. It has a moderate risk of erosion by water or wind. The proposed rail line is not expected to affect this soil unit.

Soil series developed on the Chapman Group of rocks (Moresby Landform) are Rennie, Nabbeja, Euronga, Mount Scratch and Heaton.

The Rennie soil unit is developed on a level to gently undulating surface. It is classified as having a moderate risk of erosion by water, and a low risk of erosion by wind. The proposed rail line is expected to disturb areas of this soil type.

The Nabbeja and Euronga soil units are developed on summits and the edges of summits. These units are classified as having low risk of erosion by water and high risk of erosion by wind. The proposed rail line is not expected to disturb this soil type.
The Mount Scratch soil unit is developed on undulation summits. This is classified as having a moderate risk of erosion by water and a low risk of erosion by wind. However, it is not expected to be disturbed by the proposed rail line.

The soil erosion risks are summarised in Table 4.

**TABLE 4**

**EROSION OF SOILS ALONG THE ROUTE OF THE PROPOSED RAIL LINE**

<table>
<thead>
<tr>
<th>Rock Type</th>
<th>Soil Unit</th>
<th>Risk of Water Erosion</th>
<th>Risk of Wind Erosion</th>
<th>Probability of Disturbance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alluvium</td>
<td>Greenough</td>
<td>M</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Alluvium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granulite</td>
<td>Kojareena</td>
<td>M</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Northern Gully</td>
<td>M</td>
<td>M</td>
<td>L</td>
</tr>
<tr>
<td>Chapman</td>
<td>Rennie</td>
<td>M</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td></td>
<td>Nabbeja</td>
<td>L</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Euronga</td>
<td>L</td>
<td>H</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Mt Scratch</td>
<td>M</td>
<td>L</td>
<td>L</td>
</tr>
<tr>
<td></td>
<td>Heaton</td>
<td>L</td>
<td>M</td>
<td>L</td>
</tr>
</tbody>
</table>

H = high; M = medium; L = low

The proposed rail line is expected to disturb areas of Kojareena and Rennie soil units that have a moderate risk of erosion by water. The Rennie soil unit also has a moderate risk of erosion by wind.

**4.3 HYDROLOGY**

**4.3.1 Surface Water**

None of the streams in the Geraldton area flow permanently, but the geological maps show several springs in areas of Proterozoic granulite.

The largest stream crossed by the proposed services corridor is the Chapman River. This stream probably gains small amounts of water from local aquifers. Through much of the year the discharges of groundwater will be lost by evaporation from pools and shallow water tables, and transpiration by riparian vegetation.

The Water and Rivers Commission operates a stream gauging station on the Chapman River at Utakarra (station number 701 007 at AMG grid 272 250 mE, 6 815 900 mN). The total catchment area above this gauging station is 1160 km². Flow data for the Utakarra station have been processed for the period 1977 to 1995 in which the maximum instantaneous discharge was 146 m³/s in 1986. Figure 8 is the streamflow hydrograph for that year. This station is about 5 km (direct) downstream of the location of the proposed crossing of the Chapman River. The area of catchment between the proposed crossing and the Utakarra gauging station is about 15 km², but rainfall in this area is likely to be above
the average for the whole catchment. On this basis, maximum flow at the site of the proposed bridge over the period 1977 to 1995 is estimated to be about 140 m³/s.

The Utakarra streamflow hydrographs show that peak flows are normally in the period June to August when Geraldton rainfall is from frontal systems. However, in 1979 and 1984 peak flows were in March and May respectively, presumably in response to cyclonic rainfall systems.

The Main Roads Department advise that their 20 year and 50 year recurrence interval flows for the road bridge across the Chapman River at Narra Tarra (about 9 km upstream of the proposed rail bridge) are 160 and 320 m³/s respectively.

The route of the proposed services corridor crosses Ego Creek and several smaller drainage lines that are marked but not named on the geological maps. There are no flow data for these smaller creeks. Engineering design of culverts and minor bridges for the rail line will require estimation of flow in these creeks.

4.3.2 Groundwater

Water supplies for towns and many farms in the Geraldton area are obtained from bores. The Northampton town supply is obtained from bores in granulites similar to those crossed by part of the proposed rail route. Small supplies have been obtained from sandstones of the Chapman Group, but salinities are commonly high.

Along most of the proposed services corridor route, groundwater flow is expected to be east towards the Chapman River. The Nargulu area is likely to be close to a major groundwater divide with flow possibly being south west towards Rudds Bully and/or the ocean north of the mouth of the Greenough River. The rail line is expected to cross a second major groundwater divide close to the surface water divide in the northern sector of the proposed route. Groundwater flow to the west of this divide will be westwards to the coast, possibly with minor deviations towards discharge areas along the beds of more deeply incised gullies.

The Water and Rivers Commission groundwater database (AQWAbase) lists 29 farm bores in the vicinity of the proposed route. These bores are used for stock water supplies. Alternate supplies are earth dams, many of which are shown on the Geraldton Sheet of the 1:100 000 Topographic Survey series of maps.

The depth of these bores ranges from 2.7 to 20.4 m with a median value of 12.6 m, whilst depths to water range from 1.5 to 6.1 m with a median value of 5.6 m. Water salinity ranges from 925 to 11 700 mg/L with a median value of 5800 mg/L whilst yields range from 0.05 to 13.6 kL/d with median value of 8.9 kL/d.

In summary, only one of the farm bores along the proposed route of the rail line yields water suitable for domestic use, and the water from eight of them exceeds salinity standards for stock.
Narngulu to Oakajee Rail and Services Corridor
Project Definition Study

Water quality data reported by Hirshberg and Appleyard (1996) indicates that NaCl is expected to contribute 75 to 80% of total dissolved solids (TDS salinity). Concentrations of nitrate up to 10 mg/L may be found in the groundwater, and an elevated ratio of sulphate to chloride in groundwater of the Narngulu area suggests contamination by industrial or agricultural activity.

Appleyard (1993) has reported an assessment of the vulnerability to contamination of groundwater in the Perth Basin.

The Quaternary alluvial sediments of the Narngulu area and the lower valley of the Chapman River are classified 3b2 - moderately vulnerable.

The Mesozoic Chapman Group and older rocks are classified 4a2 - low vulnerability.

4.4 FLORA AND VEGETATION

The services corridor falls within the Irwin Botanical District in the South West Botanical Province (Beard, 1980). The study area has been extensively cleared with small vegetation remnants adjoining the Chapman river, on slopes and creek lines in the vicinity of Wokatherra Pass and in a reserve.

Field surveys were undertaken by Muir Environmental (1997a & 1997b) to determine:

- the occurrence, structure, and health of vegetation;
- flora richness and occurrence of rare or priority flora; and
- faunal habitat and the likelihood of any rare or endangered fauna species in the area.

4.4.1 Vegetation

Vegetation was described using the method defined by Muir (1977) for the wheatbelt and goldfields. This method is suitable for the study area. Twenty-five areas of vegetation were examined in detail but detailed floristic records were obtained at only five locations because the rest had been heavily grazed and most of the understorey removed.

The following vegetation types were located in the services corridor area (Muir Environmental, 1997a):

- *Eucalyptus camaldulensis* Woodland - ungrazed (EWU);
- *Eucalyptus camaldulensis* Woodland - grazed (EWG) with almost no understorey;
- *Eucalyptus loxophleba* Woodland/Tree Mallee (ELW) which has been heavily grazed;
- *Acacia* Shrubland/Low Woodland- Type 1 (AS1) which has been heavily grazed;
- *Acacia* Shrubland/Low Woodland- Type 2 (AS2) may represent small remnants of sandplain which may have once covered the peneplain;
- Mixed Heath (MH) mostly on high ground and hill slopes;
- Plateau and Hill Crest Health (PHC) occupies the highest ground in hilly areas;
- *Dryandra fraseri* var. *ashbyi* Heath (DH)

The structure and health of each of the seven vegetation types described was examined and the results are summarised in Table 5 below.

### TABLE 5
**VEGETATION STRUCTURE AND HEALTH ALONG THE RAIL ALIGNMENT**

<table>
<thead>
<tr>
<th>Character</th>
<th>EWU</th>
<th>EWG</th>
<th>ELW</th>
<th>AS&lt;sub&gt;1,2&lt;/sub&gt;</th>
<th>MH</th>
<th>PHH</th>
<th>DH</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stratum 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life-form</td>
<td>T</td>
<td>T</td>
<td>T/TM</td>
<td>T/S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Canopy Height (m)</td>
<td>12</td>
<td>12</td>
<td>6</td>
<td>6-9</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Canopy Thickness (m)</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>0.5</td>
<td>1</td>
</tr>
<tr>
<td>Canopy Cover (%)</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>20-50</td>
<td>80</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>Average Foliage Density (%)</td>
<td>70</td>
<td>70</td>
<td>60</td>
<td>50</td>
<td>70</td>
<td>30</td>
<td>40</td>
</tr>
<tr>
<td>Health</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Stratum 2</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Life-form</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td></td>
<td></td>
<td>S</td>
</tr>
<tr>
<td>Canopy Height (m)</td>
<td>3</td>
<td>1</td>
<td>1-4</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopy Thickness (m)</td>
<td>3</td>
<td>1</td>
<td>1-4</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canopy Cover (%)</td>
<td>100</td>
<td>5</td>
<td>5-20</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Foliage Density (%)</td>
<td>60</td>
<td>30</td>
<td>40</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Muir Environmental (1997a)*

#### 4.4.2 Flora

A total of 86 native taxa were recorded in the services corridor area with a conspicuous low abundance of ephemeral species (Muir Environmental, 1997a). The lack of ephemeral species was probably due to the timing of fieldwork and the effects of past grazing. The results of this work prompted further survey work (Muir Environmental, 1997b) to confirm the presence of priority and rare ephemeral species.

Heaths were found to be the most floristically rich and no unusual assemblages of species were found. No Gazetted rare species were located.
Four priority plant species were found (Figure 9):

- *Stenanthemum (Cryptandra) gracilipes* (Priority 1) in hill crests in Location G;

- *Grevillea triloba* (Priority 2) which was found to be extremely common in the *Acacia* shrublands, in the heaths in the hills and on roadsides and numerous other areas both near and well away from the service corridor;

- *Scaevola oldfieldii* (Priority 3) in hill crest heath on the extreme northern edge of location F; and

- *Verticordia penicillaris* (Priority 4) in hill crest heath in location F.

4.5 FAUNA

4.5.1 Faunal Habitat

Vegetation in the vicinity of the services corridor is very homogenous, consisting of only a single primary habitat - cleared farmland (Muir Environmental, 1997a). The hilltops of the Moresby Range are mainly uncleared and fauna habitats which occur on them are similar to the heath types occurring on the rail route. Thus, these habitats in the study area are widespread.

Faunal habitats surveyed by Muir Environmental (1997a) were classified into three basic types:

- heaths of the hills and slopes of the nearby Moresby Range;

- tall *Acacia* shrubland of the sandy plains; and

- *Eucalyptus* woodland of the drainage lines and low-lying land.

This survey found that there were no unusual habitat types in the services corridor though ungrazed woodland at one location (G) is poorly represented elsewhere.

An evaluation of fauna habitat was undertaken (Muir Environmental, 1997b) using the Muir Rapid Habitat Assessment System (MRHAS). This evaluation indicated that with the exception of the ungrazed *Eucalyptus camaldulensis* woodland, faunal habitat along the rail route is of average value.

4.5.2 Specially Protected Fauna

Opportunistic recording of fauna was undertaken by Muir Environmental (1997a) in the general services corridor area. Birds were examined in detail because of the greater ease of sampling.

Twenty-nine species of birds were recorded in the remnant vegetation. The only significant species recorded (but not considered rare) was the Blue-Breasted Fairy-wren (*Malurus pulcherrimus*) in relatively dense understorey near the Chapman River crossing.
(Figure 2). This species is sedentary and is considered by Storr (1991) to be extinct in much of the wheatbelt and of patchy distribution elsewhere.

It is highly likely that this species occurs elsewhere along the Chapman River where the understorey is in tact. A follow up survey by Muir Environmental (1997b) may have located another small group of Fairy wrens upstream from the Moonyoonooka Narra Tarra Road.

The following Specially Protected species may occur in the region of the services corridor.

- Carnaby's cockatoo (*Calyptorhynchus funereus latirostris*) was not recorded in the survey of the corridor area. It may use the area periodically but is unlikely to be dependent on it because of the absence of Banksia;

- Peregrine Falcon (*Falco peregrinis*) was not recorded in the survey of the corridor area and ranges widely over most of Australia;

- A species of native bush cricket (*Psacodonodonotus seriatus*) may occur within the vicinity of the corridor but is unlikely to be present because of the highly modified habitat;

- Woma (or Ramsey's Python) (*Aspidites ramsayi*) ranges over a large area from Shark Bay to Boddington and to Rawlinna to the east. It was not recorded in the survey of the corridor area; and

- Carpet Python (*Morelia spilota imbricata*) ranges over a wide area of the south west and other areas of Western Australia. It was not recorded in the survey of the corridor area.

There are two lizard Priority Taxa:

- *Pletholax gracilis gracilis* (P4) occupies low coastal heaths none of which are in the area; and

- *Cyclodomorphus brachialis* (P2) which occurs along watercourses little of which is affected by the rail link.
5. SOCIAL SURROUNDINGS

The proposed services corridor passes primarily through agricultural land in the Shires of Greenough and Chapman Valley.

5.1 SOCIAL SETTING

The nearest population centre to the rail link is Moonyoonooka with Geraldton being a nearby regional centre. Geraldton is the service centre for the Mid West region and has an estimated resident population of about 21,700 (Ministry for Planning, Research Branch Projections). Geraldton has excellent community services and facilities.

The Shire of Greenough has a resident population of about 11,300 and has experienced substantial growth owing to the development of new suburbs around Geraldton. Any future urban expansion in the Shires of Greenough and Chapman Valley will rely heavily on the services and facilities of Geraldton.

However, the rail proposal is a relatively small development and is unlikely to significantly increase the demand on community services and facilities, and housing. The proposal will create additional opportunities for employment.

5.2 LAND USE

5.2.1 Rural

Land for the services corridor along the northern portion of the proposed route is predominantly zoned for rural (general farming) purposes with potential for rezoning for "Special Rural" or hobby farming purposes, south of White Peak Road. Land zoning north of White Peak Road may also be reviewed by Chapman Valley Shire to allow for future subdivision (Environmental Capability, 1994).

Along the central portion of the proposed route land is zoned rural and is used mainly for cropping and grazing. Soils in this area are generally good quality and the preferred land use scenario is for broad-acre agricultural use.

It is generally recognised that viable broad acre agriculture farming enterprises in the region need to be about 2,000 ha. However, many farming properties in the vicinity of the alignment are considerably less in area. A number of smaller lots in the area are attractive for hobby farming.

Many landowners, particularly in the White Peak Road area, have settled there because of the attractive countryside and the relatively isolated rural lifestyle and tranquillity.

5.2.2 Geraldton Airport

At the southern end of the rail alignment is the Geraldton Airport, which is owned and operated by the Shire of Greenough. The airport is expected to expand in the future by the construction of an additional runway. The rail alignment is about 750 m to the east of the main runway. A recent study by Westralia Airports Corporation showed that a railway
cutting (with road overpass) on the Geraldton Mt Magnet Road crossing would ensure appropriate safety standards.

5.2.3 Conservation

There are two conservation reserves in the vicinity of the proposed alignment (Figures 3 & 5). One is on the extreme western end of the northern option adjacent to the North West Coastal Highway. This is reserve 16200 (C Class) of 17.0676 ha and for the purpose of Water Supply and Conservation of Flora and Fauna. This reserve is not on the route of the services corridor.

The other conservation reserve is Reserve 893 of 15.0221 ha for the Conservation of Flora and Fauna and is vested in the Department of Conservation and Land Management. The west side of the Narra Tarra Moonyoonooka Road consists of *Acacia* Shrubland/Low Woodland - Type 1 (AS₁) with some *Acacia* Shrubland/Low Woodland - Type 2 (AS₂) on the north side, and a small area of *Dryandra fraseri* var. *ashbyi* Heath. On the east side of the road are some *Acacia* Shrubland/Low Woodland - Type 1 on the slopes and a dense stand of *Eucalyptus camaldulensis* Woodland - Grazed (EWG) but the canopy is in good condition.

While the reserve vegetation is degraded by weeds and grasses, it is the only area noted with (AS₁) and (AS₂) with nearly intact understoreys. All other similar associations had been heavily grazed. Damage to this reserve would be a considerable loss to the Conservation Estate as there are very few reserves in the area. The alignment of the rail line has been adjusted to avoid this reserve.

There also exists a strip of reserved vegetation along the Chapman River (Reserve 42462 for Foreshore Protection). This reserve is not affected by the rail link.

5.3 LANDSCAPE

The importance of protecting the landscape character of the Moresby range was raised in the 1989 Draft Region Plan. Subsequently the Moresby Range Management Committee was established in 1996 to examine the management requirements for the Range. A land management strategy for the Range is currently being prepared. This strategy aims to determine the extent and regional significance of the Range and to define a system of land management for the Range.

The services corridor is along the eastern edge of the Moresby Range landscape protection area (Geraldton Region Plan, in prep) and passes through this area in the vicinity of the Wokatherra Pass.

5.4 HERITAGE

5.4.1 Aboriginal

An archaeological survey for possible Aboriginal sites was undertaken in the services corridor (Quartermaine, 1997). This survey involved an investigation of previous research...
in the area, a field survey of the corridor and the recording of archaeological material located.

No previously recorded sites are within the proposed corridor however two sites were identified during the field survey.

- one site of low archaeological significance but not on the preferred corridor alignment; and

- one site of greater significance because of its stratigraphic potential was located adjoining the rail alignment.

One spring in the area is believed to be of high archaeological potential but will not be affected by the preferred rail alignment. In this survey the scientific definition of archaeological site was used because the Aboriginal Material Committee determines whether a site is a site under Section 5 of the Aboriginal Heritage Act (1972-95).

Five archaeological sites have been recorded with the Culture and Heritage Division of the Aboriginal Affairs Department within three kilometres of the proposed alignment (Quartermaine, 1997). Of these sites, two are located close to the development but not within the corridor.

An ethnographic survey of the study area was conducted (O'Connor, 1997) and one site was recorded, which may be a site within the meaning of Section 5 of the Aboriginal Heritage Act (1972-95). This site is not located on the preferred services corridor route.

Traditional use is usually commensurate with the food providing potential of the area. Along the services corridor this potential was considered to be very low.

5.4.2 European

Chapman Valley Shire

The Shire has designated a heritage area in its town planning scheme centred on the Moresby Range, associated valleys and the Lower Chapman River. The town planning scheme also lists places of heritage significance. These and other sites of heritage value form part of the Chapman Valley Heritage Trail, which follows Chapman Valley Road. Heritage sites and the unique landforms and floristic diversity of the Moresby Range are important values for tourism in the region.

A European heritage site survey commissioned by LandCorp (Suba & Callow, 1993) identified several sites (Figures 4 & 5) in the vicinity of the proposed services corridor. The sites identified include:

- **Site 1: Narra Tarra Homestead and Outbuildings** - The Narra Tarra homestead was the home of Mr Joseph Green and his family who were early settlers in the region. The site comprises a homestead, several outbuildings (some of which are falling down or have been demolished) and a shearing shed. This site has been recommended for further
assessment for consideration of entry into the State Register for the Heritage Council of Western Australia.

- **Site 2: Narra Tarra Cemetery** - Located on the Narra Tarra estate on the banks of the Chapman River, the private cemetery was the burial ground for several members of pioneering families. The cemetery has been closed to burials for many years. This site has been recommended for further assessment for consideration of entry into the State Register for the Heritage Council of Western Australia.

- **Site 3: White Peak Homestead** - The White Peak Homestead was one of five original pastoral leases in the district and was built by John Drummond, a pioneer pastoralist in the region. The site consists of the homestead and several outbuildings. Some of the outbuildings have been demolished or are falling down and stone ruins are evident on the site.

- **Site 4: White Peak Quarry** - Stone from the quarry was used in many of the buildings in Chapman Valley and Geraldton and also in the Geraldton harbour.

- **Site 5: Hanlons' Staging Post** - A staging post was set up by the Hanlon family possibly providing food, drink and shelter to travellers and to enable them to change horses. Little if anything remains of the staging post (S Green pers comm).

- **Site 6: Hangman's Valley** - Hangman's valley is the site where several prisoners were hanged while being taken to Geraldton by a policeman and an Aboriginal tracker. It appears that the prisoners were hanged while left in the charge of the tracker. There are no remains on the site.

Sites 1, 2 & 3 are recommended for the highest protection on the Municipal Inventory of the Shire of Chapman Valley (Suba & Callow, 1993).

All of these sites are some distance away from the proposed rail alignment. The closest site - Hanlon's staging post - is approximately 1 km from the rail alignment east of Chapman Valley Road.

**Greenough Shire**

Greenough Shire is currently preparing a municipal inventory of European heritage sites and consequently precise details of the location of sites are not yet available. However, discussions with heritage consultant Tanya Suba and local historian Stan Gratte have indicated the presence of following sites (Figure 3) in the vicinity of the proposed alignment:

- **Site 7: Eastern Valley Hotel Ruins** - The hotel and nearby stables were probably built in ca 1880 to service horse teams (S Gratte, pers comm).

- **Site 8: Ruins** - The ruins of an old cottage can be seen on the bank of the Chapman River.
- **Site 9: Ruins** - The ruins of an old house and possibly bones.

These sites should not be affected by the railway.
6. ENVIRONMENTAL MANAGEMENT SYSTEM

Westrail has adopted the following general environmental policy statement:

*Westrail's policy is to provide effective freight and passenger transport services, which are consistent with safety and environmental protection, as part of an efficient transport system for the public benefit.*

In support of this general statement a number of policy objectives have been developed for the following:

- laws, regulations and standards;
- environmental management;
- communications;
- discharges and wastes;
- site rehabilitation and contaminated sites;
- acquisitions and divestments; and
- landscape, heritage and social values.

A key component of Westrail's environmental strategy to give effect to environmental objectives is a voluntary and continuous commitment to minimise the environmental impact of all its activities.

Consistent with this management approach Westrail intends to prepare an environmental management plan to address matters that arise out of the consideration of environmental factors addressed later in this review.

*Environmental Management Approach Commitment*

1. Prepare and implement an environmental management plan which will include construction and landscape management plans in consultation with the Department of Environmental Protection, Shires of Greenough and Chapman Valley, Department of Aboriginal Affairs and land owners. This plan will address the environmental matters relating to environmental factors that arise out of construction and operation of the railway.

Other services and infrastructure that locate within the services corridor will be required to commit to an environmental management approach based on best practice environmental management.
7. REVIEW OF ENVIRONMENTAL FACTORS

7.1 IDENTIFICATION OF FACTORS

Interactions of the rail link proposal and the location of the services corridor concept with the existing biophysical and social environment will result in changes to these environments. The scoping of the environmental implications of these changes has lead to the identification of the following 10 environmental factors.

- Vegetation
- Rare and Priority Flora
- Specially Protected Fauna
- Noise and Vibration
- Dust
- Water Supply and Drainage
- Aboriginal Heritage and Usage
- European Heritage and Usage
- Dangerous Goods Transport
- Landscape and Visual Amenity.

Of these environmental factors vegetation, noise and vibration, landscape and visual amenity and European heritage and usage are considered to be the most significant. These factors all contribute to the amenity that a number of landowners valued from the local environment.

The following sections address the EPA objectives, assessment area, potential impacts, management, commitments and criteria that relate to each of the above environmental factors. The goal of the assessment of factors is to ascertain whether EPA objectives can be achieved for all environmental factors by the design of the proposal, location of the services corridor and commitments for environmental management.

A. BIOPHYSICAL ENVIRONMENT

7.2 VEGETATION

EPA Objective

To maintain the abundance, species diversity, geographic distribution and productivity of vegetation communities.
7.2.1 Applicable Assessment Standards or Procedures

The method of Safstrom and Craig (1996) was developed for the EPA to assess the removal of native vegetation on agricultural lands. This method involves the evaluation of remnant vegetation on the basis of three evaluation principles:

- region processes (e.g., waterlogging, erosion);
- representation (e.g., species richness, threatened plant communities); and
- viability (survival of the values over the next fifty years).

The method provides criteria for these principles in order to determine whether a vegetation remnant should not be cleared.

Vegetation was described using the method defined by Muir (1977) for wheatbelt and goldfields.

7.2.2 Assessment and Management

The area considered for the assessment of this relevant environmental factor is the Geraldton Sandplain Interim Biographical Region (Thackway and Cresswell, 1995).

Westrail has established a set of principles for the management of biological conservation on its reserves and land (refer Appendix 1). Under these principles, objectives have been established for rare flora, rare fauna, weeds, feral animals, drainage, dieback and burning.

Owing to grazing and the small areas of the remnants, plant associations present along the corridor generally have low vegetation complexity and species richness was relatively low (except for remnant heath at Locations F, G and H which are on private land and are shown in Figure 9). All plant associations observed occur both inside and outside the area of the services corridor (Muir Environmental, 1997a).

The rail alignment corridor will go through the mostly grazed or cleared portion of location F and H and skirts along the edge of the Location G remnant (Figure 9). The amount of these remnants disturbed by the rail alignment will be small (refer Table 6).

<table>
<thead>
<tr>
<th>Remnant Location</th>
<th>Vegetation Types of Interest</th>
<th>Area of Remnant Vegetation (approx ha)*</th>
<th>Area Cleared (approx ha)+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location G</td>
<td>EWU</td>
<td>10</td>
<td>0.2</td>
</tr>
<tr>
<td>Location H</td>
<td>AS2</td>
<td>12</td>
<td>0.3</td>
</tr>
<tr>
<td>Location F</td>
<td>AS1, MH, PHC, ELW</td>
<td>&gt;&gt;100</td>
<td>1 (PHC)</td>
</tr>
</tbody>
</table>

*Area in or immediately adjoining study area.
+ based on clearing an average of 60% of the rail reserve

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The creation of a rail reserve may provide for greater protection and the potential for rehabilitation of remnants than is currently afforded by private ownership.

The rail alignment will be designed to avoid, as far as practicable, the removal of native vegetation. In addition the restoration of native vegetation will be promoted within the rail reserve consistent with fire management, safety practices and adjoining land uses.

An A Class Reserve 893 (about 15 ha) for the Conservation of Flora and Fauna and vested with the Department of Conservation and Land Management is near the preferred rail alignment (Figure 3). While weeds and grasses degrade the Reserve, it has regional value because there are few reserves in the area (Muir Environmental, 1997a). There were no rare species located, but Grevillea triloba (Priority Two) was present in the Reserve.

The rail alignment was adjusted to avoid the Reserve altogether. Substantial cost penalties have been incurred in avoiding the Reserve.

The method of Safstrom and Craig (1996) was applied to the evaluation of the vegetation remnants on farmland and in the hills in the vicinity of Wokatherra Pass. The remnants were assessed as being of limited value to regional processes; with farmland being of low representational value and very limited viability and hill remnants had moderate representational value and are probably viable (Muir Environmental, 1997a).

Westrail will ensure that the clearing of vegetation will be minimised and appropriate vegetation protection and management practices are followed. Westrail will prepare a construction management plan incorporating these considerations in consultation with the Shires of Greenough and Chapman Valley and CALM.

<table>
<thead>
<tr>
<th>Vegetation commitments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Avoid as far as practicable the clearing of native vegetation by refinement of the rail alignment at the detailed design phase and minimising clearing during construction.</td>
</tr>
<tr>
<td>3. Include details of measures to minimise the disturbance of native vegetation in the construction management plan for the railway.</td>
</tr>
<tr>
<td>4. Promote the restoration of native vegetation in the rail reserve consistent with fire management, safety practices and adjoining land uses.</td>
</tr>
</tbody>
</table>

Given the above management measures and commitments, the EPA's objective for this environmental factor is unlikely to be compromised.

7.3 RARE AND PRIORITY FLORA

**EPA Objective**

To protect declared rare and priority flora consistent with the provisions of the *Wildlife Conservation Act 1950.*
7.3.1 Applicable Assessment Standards or Procedures

The preservation and conservation of flora is covered by the *Wildlife Conservation Act 1950*. In addition the *Commonwealth Endangered Species Protection Act 1992* provides for the protection of endangered and vulnerable species.

Australia is a signatory to the International Convention on Biodiversity and Western Australia is signatory to the National Strategy for the Conservation of Australia's Biological Diversity.

7.3.2 Assessment and Management

The area for the assessment of this environmental factor is in the vicinity of the rail alignment within the broader Geraldton Sandplain Biogeographical Region (Thackway and Cresswell, 1995).

Westrail has established a set of principles for the management of biological conservation on its reserves and land (refer Appendix 1). Under these principles, objectives have been established for rare flora, rare fauna, weeds, feral animals, drainage and dieback and burning.

No gazetted rare flora were found during surveys (Muir Environmental, 1997a & 1997b) of remnant vegetation.

One Priority 1 species *Stenanthemum (Cryptandra) gracilipes* was recorded in one vegetation remnant at location G (Figure 9). The rail alignment skirts along the edge of location G and avoids any significant clearing of remnant vegetation in this location. *Grevillea triloba* (Priority 2) was found to be extremely common in the heaths of the hills and on roadsides and numerous other areas both near and well away from the service corridor. It will not be significantly affected by the rail line because of its wide range and abundance.

The May 1997 survey (Muir Environmental, 1997a) was carried out at a time when it is not easy to recognise the presence of priority or rare ephemeral species.

A follow up survey in August 1997 (Muir Environmental, 1997b) located two other priority species *Scaevola oldfieldii* (Priority 3) and *Verticordia penicillaris* (Priority 4) in hill crest heath areas. These areas will be mostly avoided by the preferred route (Figure 9).

As mentioned previously, Westrail is committed to minimising the disturbance and promoting the restoration of native vegetation (commitments 2 & 3).

Given the above management measures and commitments, the EPA's objective is unlikely to be compromised.
7.4 SPECIALLY PROTECTED FAUNA

EPA Objective

To protect Specially Protected (Threatened) Fauna consistent with the provisions of the Wildlife Conservation Act 1950.

7.4.1 Applicable Assessment Standards or Procedures


Australia is a signatory to the International Convention on Biodiversity and Western Australia is signatory to the National Strategy for the Conservation of Australia's Biological Diversity.

Westrail has established a set of principles for the management of biological conservation on its reserves and land (refer Appendix 1). Under these principles objectives have been established for rare flora, rare fauna, weeds, feral animals, drainage and dieback and burning.

7.4.2 Assessment and Management

The area for the assessment of this environmental factor is the Geraldton Sandplain Biogeographical Region (Thackway and Cresswell, 1995).

Habitats in the vicinity of the services corridor are represented elsewhere. Many of the Specially Protected Fauna that may occur in the region of the rail link are unlikely to be present exclusively in the study area because of the lack of a suitable habitat.

In places where appropriate habitat occurs, the range of the Specially Protected species, or the degraded nature of the habitat makes it unlikely that Specially Protected species will be affected (Muir Environmental, 1997a).

In the Wokatherra Pass the railway may impede the movement of small fauna. In this area the use of culverts to assist the passage of small fauna will be considered in the detailed design of the railway.

No Specially Protected or Priority Fauna were recorded either within or adjoining the corridor area during the survey by Muir Environmental (1997a). One significant bird species (but not considered rare), the Blue-breasted Fairy-wren (Malurus pulcherrimus), was recorded in the relatively dense understorey vegetation beneath Eucalyptus woodland in the Chapman River bed near the river crossing of the railway.

This species is likely to occur elsewhere along the Chapman River where the understorey is in tact. In a follow up survey in August 1997 (Muir Environmental, 1997b) a further group of Fairy-wrens may have been located upstream from Moonyoonooka Narra Tarra Road.

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The avoidance of this habitat will be a major criterion in the design of the rail bridge across the Chapman River. As indicated in previous commitments (commitments 2 and 3 above) clearing of native vegetation will be minimised and restoration of native vegetation will be promoted. These considerations will be addressed in the construction management plan.

**Specially Protected Fauna Commitments**

- 5. Reduce the impediment to the movement of small fauna by the use of culverts, where practicable in the Wokatherra Pass area.
- 6. Minimise disturbance of the habitat of the Blue-breasted Fairy-wren through the design of Chapman River crossing and during construction.
- 7. Describe the measures to minimise disturbance of the Blue-breasted Fairy-wren habitat in the construction management plan.

Given the above management measures and commitments, the EPA's objective is unlikely to be compromised.

**B. POLLUTION PREVENTION**

7.5 NOISE AND VIBRATION

**EPA Objective**

To protect the amenity of nearby residents from noise and vibration impacts by ensuring noise and vibration meet established criteria.

**7.5.1 Applicable Assessment Standards or Procedures**

Criteria used in this assessment for vibration from trains are taken from the Australian Standard AS2670 - Part 1990 (refer Figure 10).

**Acceptable Outdoor Noise Levels**

The only recognised Australian criteria for assessing the acceptability of outdoor rail noise were published by the NSW State Pollution Control Council in the "Environmental Noise Control Manual". These standards are as follows:

- Maximum Level, \( L_{\text{Amax}} \) = 80 dB(A)
- Average Level, \( L_{\text{Aeq 24 hours}} \) = 55 dB(A)

These criteria are planning levels and maximum levels are considered to be 5 dB(A) higher.

The outdoor noise criteria, for urban passenger railway services, cited in the Westrail "Environmental Management Manual" are provided in Table 7 below.

Welker Environmental Consultancy
TABLE 7
WESTRAIL OUTDOOR NOISE CRITERIA FOR URBAN PASSENGER SERVICES

<table>
<thead>
<tr>
<th>Period</th>
<th>$L_{Aeq}^*\text{ dB(A)}$</th>
<th>$L_{Amax}^*\text{ dB(A)}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime (0600-2000 hrs)</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>Nightime (2000-0600 hrs)</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

*These would be the arithmetic average of the $L_{Aeq}$ (1 hr) for the period stated, when received at residential premises and at a minimum distance of 25 m from the track centre line.

The Department of Environmental Protection endorses the above criteria (Herring Storer Acoustics, 1997) but in addition recommends a target level for planning purposes of 65 dB(A) outdoors. This level is to be considered in the assessment of new proposals and is more relevant to sleep disturbance (see below) and consequently more applicable to the indoor environment.

The Australian Standard 2021-1994 "Acoustics - Aircraft Noise Intrusion - Building Siting and Construction" can also be used as a guide for noise disturbance from rail noise. This standard indicates that noise levels up to $L_{Amax}$ of 75 dB(A) are acceptable in an outdoor environment. Further this standard provides guidance on the measures to reduce internal noise by treatment of dwellings.

**Indoor Noise Assessment**

For the indoor noise level environment, sleep disturbance is considered to be a better guide to transport noise impact (Herring Storer Acoustics, 1997). A sleep disturbance index (SDI) has been proposed for transport noise and an index of around 1.5 is considered applicable for rail noise (Bullen et al, 1996). For the purposes of this environmental review an informal guideline of 1.0 for the sleep disturbance index has been adopted as an indicator of acceptable indoor noise from rail transport.

The sleep disturbance index is based on:

- the number of noise events during a nighttime (or daytime) period;
- the maximum noise level at the noise sensitive premises; and
- house attenuation of noise.

The formula for the calculation of a sleep disturbance index is as follows:

$$SDI = N \times W(L_{max})/100$$

$N$ is the number of events per night.

$L_{max}$ is the maximum internal noise level of any event.
W(L_{\text{max}}) is the weighting factor for a noise level of L calculate from:
W(L_{\text{max}})=0.142(L-45) + 0.00473(L-45)^2 if L>45 dB(A) where L<45 dB(A) then L(L_{\text{max}})=0

After considering all the above, the assessment criteria used in this environmental review for noise sensitive premises are described in Table 8 below.

Noise modelling was conducted using the ENM computer program.

**TABLE 8**
CRITERIA FOR NOISE SENSITIVE PREMISES

<table>
<thead>
<tr>
<th>Area</th>
<th>Noise Level Criteria</th>
<th>Sleep Disturbance Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unacceptable for noise sensitive premises (residential)</td>
<td>&gt;80 dB $L_{\text{Amax}}$ &amp; 55 $L_{\text{Aeq}}$ 24 hr</td>
<td>&gt;1.5</td>
</tr>
<tr>
<td>Conditional - treatment of existing residences or special building requirements for new residences may be required</td>
<td>75 to 80 dB $L_{\text{Amax}}$ &amp; &gt;55 $L_{\text{Aeq}}$ 24 hr</td>
<td>1-1.5</td>
</tr>
<tr>
<td>Acceptable</td>
<td>&lt;75 dB $L_{\text{Amax}}$ &amp; 55 $L_{\text{Aeq}}$ 24 hr</td>
<td>&lt;1.0</td>
</tr>
</tbody>
</table>

7.5.2 Assessment and Management

**Impact**

Noise levels and vibration from single locomotives with 45 wagons were measured and extrapolated to S class double header, 65 carriage trains for noise modelling purposes by Herring Storer Acoustics (1997) (Appendix 2). For the purposes of this assessment 10 and 20 train movements per day have been assumed on the narrow and dual gauge sections of the rail link respectively.

Vibration levels from the passage of trains are low enough so as to be imperceptible greater than 15 m from the rail line (Figure 10).

The detailed results of noise modelling are presented in Appendix 2 and noise contours for sound pressure levels in the vicinity of the proposed rail line are illustrated in Figures 3, 4 & 5. For the level of activity on the dual and narrow gauge sections of the rail link the maximum noise criteria ($L_{\text{Amax}}$) and not the average noise criteria ($L_{\text{Aeq}}$) determine the acceptable noise levels at noise sensitive premises. For average noise levels to be critical, train movements would have to exceed 30 per day.

The sleep disturbance index for 20 movements (dual gauge section) and an internal noise level of 60 dB(A) (corresponding to an external noise of 75 dB(A)) is 0.64 (Table 9 below). For 10 movements per day (narrow gauge section) the sleep disturbance index would decrease to 0.32.
TABLE 9
SLEEP DISTURBANCE INDICES CORRESPONDING TO NOISE LEVELS (LA_{MAX}) AND TRAIN MOVEMENTS

<table>
<thead>
<tr>
<th>Outdoor Noise Level (LA_{max})</th>
<th>Sleep Disturbance Index*</th>
<th>20 Train Movements</th>
<th>10 Train Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>0.95</td>
<td>0.49</td>
<td></td>
</tr>
<tr>
<td>75</td>
<td>0.64</td>
<td></td>
<td>0.32</td>
</tr>
<tr>
<td>65</td>
<td>0.38</td>
<td></td>
<td>0.19</td>
</tr>
</tbody>
</table>

*Based on inside level 15 dB(A) less than maximum outdoor level.

The maximum distance that the 80, 75, and 65 dB(A) contour occurs from the rail line is 50, 90, and 240 m respectively on normal flat ground or ground falling away from the rail line. The distance to these contours would be increased in down wind conditions but this effect would be intermittent and would vary according to location.

The number of residential dwellings potentially within the modelled contours is presented in Table 10 below.

TABLE 10
RESIDENCES POTENTIALLY WITHIN NOISE AFFECTED AREAS

<table>
<thead>
<tr>
<th>Noise Affected Area</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 to &lt;75</td>
<td>75 to 80</td>
</tr>
<tr>
<td>No. of Residences</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
</tbody>
</table>

Noise barriers greater than 2 m in height will be required to significantly reduce noise levels. The effect of barrier heights in reducing the distance to the 80, 75 and 65 dB(A) contours over flat ground is provided in Table 11 below. A railway cutting of equivalent depth to barrier height can be as effective in reducing noise levels.

TABLE 11
EFFECT OF BARRIER HEIGHTS ON REDUCTION OF NOISE

<table>
<thead>
<tr>
<th>Barrier Height (m)</th>
<th>80</th>
<th>75</th>
<th>65</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>50</td>
<td>90</td>
<td>240</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>70</td>
<td>210</td>
</tr>
<tr>
<td>4</td>
<td>36</td>
<td>52</td>
<td>164</td>
</tr>
<tr>
<td>5</td>
<td>31</td>
<td>44</td>
<td>128</td>
</tr>
</tbody>
</table>

Adapted from Herring Storer Acoustics, 1997

Welker Environmental Consultancy
Noise from the construction and operation of the line is not expected to have any significant long term impact on fauna in the area, as the area is already highly disturbed. Experience in other areas has shown that some animals quickly become unconcerned about noise and move rapidly back into the habitat. Species likely to be sensitive to disturbance are probably already gone from the region as a result of human activity (Muir Environmental, 1997a).

Management of Noise Affected Areas

In the area where the predicted noise level from trains exceeds the $L_{A\text{max}}$ of 80 dB(A) criterion (termed the unacceptable area) the following measures will be implemented:

- offer to purchase existing residences;
- prevention of future residential development by application of one of more of the following mechanisms:
  - property purchase; or,
  - purchase of any implied residence construction right; or,
  - seek the cooperation of local authorities and the Western Australian Planning Commission to prepare strategies to prevent the construction of dwellings through local town planning schemes and the Geraldton Regional Plan.

In the area where the predicted $L_{A\text{max}}$ noise levels from trains are 75 dB(A) to 80 dB(A) (termed the conditional area) the following measures will be implemented:

- offers to compensate for the equivalent to the cost of treatment or provide treatment to existing residences in accordance with Australian Standard 2021-1994; and
- seek cooperation of local authorities to ensure that building requirements of future residences in the conditional area recognise the predicted noise levels.

In addition the implementation of the services corridor will involve securing a 250 m wide corridor against future residential development.

**Noise and Vibration Commitments**

8. Reduce as far as practicable noise levels at noise sensitive premises by use of barriers and refinement of the rail alignment.

9. Establish a procedure for the purchase of existing residences and to prevent the construction of new dwellings where predicted $L_{A\text{max}}$ exceeds 80 dB(A).

10. Establish a procedure to provide treatment (or the equivalent in compensation) of existing dwellings and promote the application of building standards in accordance with Australian Standard 2021-1994 in areas where predicted $L_{A\text{max}}$ is 75 dB(A) to 80 dB(A).
Given the above management measures and commitments, the EPA's objective for this environmental factor is unlikely to be compromised.

7.6 DUST

**EPA Objective**

To ensure that dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems, by meeting statutory requirements and acceptable standards

7.6.1 Applicable Standards or Procedure

Dust potentially generated from iron ore transport and construction activities will predominantly consist of particles much greater than 10 µm in diameter and consequently will not present any substantial health hazard. However, excessive dust emissions may be visible and may potentially give rise to a nuisance or impact vegetation.

The Department of Environmental Protection Guidelines for the Prevention of Dust and Smoke Pollution from Land Development sites in Western Australia is applicable to the control of dust from construction activities. Given the anticipated particle size range of dust emissions, the particulate standards in the Environmental Protection Policy (Atmospheric wastes) Kwinana are not applicable.

7.6.2 Assessment and Management

The area considered in the assessment of this environmental factor is the immediate surroundings of the rail reserve including any neighbouring residences.

Some areas along the alignment may be susceptible to dust blow under dry and windy conditions (Muir Environmental, 1997a).

Iron ore will be transported in covered wagons or the fines in the ore will be treated with a crusting agent to prevent dust generation (Alan Tingay & Associates, 1997). Westrail will require the control of dust from the rail transportation of any material to be in accordance with best practice and Westrail's environmental policy and objectives.

Dust generated during construction of the railway will be minimised by the application of DEP Guidelines and best practice in dust suppression (including watering surfaces and rehabilitation of disturbed areas) in sensitive areas. The amount of land disturbed will be kept to a minimum and disturbed areas will be stabilised and rehabilitated.

Particular emphasis will be placed on the control of dust under dry windy conditions. A construction management plan will be prepared incorporating dust management and rehabilitation procedures. Dust suppression will be undertaken in accordance with the requirements of the Department of Environmental Protection.
Dust Commitments

11. Apply Department of Environmental Protection Guidelines for the Prevention of Dust and Smoke Pollution from Land Development sites in Western Australia during construction of the railway.

12. Establish and implement a procedure to require the suppression of dust from rail transportation. This procedure will be detailed in the environmental management plan.

13. Detail dust suppression procedures in the construction management plan for areas where dust blow may occur.

Given the above management measures and commitments the EPA's dust objective is unlikely to be compromised.

C. SOCIAL SURROUNDS

7.7 WATER SUPPLY AND DRAINAGE

EPA Objective

To maintain the quantity of water supply so that existing and potential users are protected.

To ensure that alterations to existing drainage patterns by the railway do not unduly affect nearby usage of land.

7.7.1 Applicable Assessment Procedure

The Public Works Act 1902-1974 has established procedures that enable the impact of the construction of the railway on water supplies of landowners to be addressed.

7.7.2 Assessment and Management

The area considered in the assessment of this environmental factor is the immediate surroundings of the rail reserve including any neighbouring properties.

The construction of the railway will result in alteration to the drainage system and interruption to the water supplies on some properties. Interviews with landowners have provided indications of the likely impact of the railway on farm and domestic water supplies (refer Section 2.2).

Alterations to drainage may also affect the hydrological environment of remnant vegetation.

During detailed design, surface drainage patterns, groundwater recharge areas and user requirements will be ascertained in consultation with the Shires of Greenough and Chapman Valley and landowners. Structures will be designed to minimise adverse interference with the hydrological regime by the use of culverts and drains.
Westrail will make good any farm or domestic supplies (surface or groundwater) that are disrupted by the construction of the railway. Measures to ensure the maintenance of water supply include providing alternative sources or ensuring access is provided to water.

Drainage considerations will be incorporated into the construction management plan, which will be prepared in consultation with the Shires and the Water and Rivers Commission.

Water Supply and Drainage Commitments

14. Make good any farm or domestic supplies disrupted by the construction of the railway.

15. Minimise adverse interference with the hydrological regime by design considerations including culvert and drains in consultation with landowners and the Water and Rivers Commission.

16. Incorporate water supply and drainage considerations into the construction management plan.

Given the above management measures and commitments, the EPA's objective for this environmental factor is unlikely to be compromised.

7.8 ABORIGINAL HERITAGE AND USE

EPA Objectives

To ensure the proposal complies with statutory requirements in relation to places and sites of heritage significance.

To ensure the proposal does not result in changes to the physical and biological environment, which adversely affects cultural associations with the area.

7.8.1 Applicable Procedure

The Western Australian Aboriginal Heritage Act 1972 and amendments in 1980 and 1995 make provision for the recording and preservation of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants or associated therewith, and for other purposes incidental thereto. Unauthorised interference with Aboriginal sites is an offence under this Act.

7.8.2 Assessment and Management

The area considered in the assessment of this environmental factor is the rail reserve and adjoining areas.

Ethnographic and archaeological surveys of an area 250 m either side of the rail alignment options were recently undertaken (Quatermaine Consultants, 1997 and R O'Connor & Associates, 1997). Two significant sites were located on the non-preferred north and
south alignment options and one significant archaeological site and one site of high archaeological potential near the preferred alignment.

Significant or potential sites that are near the alignment will be avoided by design of the railway or adjustments to the preferred alignment. Westrail will consult with the Department of Aboriginal Affairs on any necessary adjustment to the alignment or design of the railway in the vicinity of these sites.

The Mullewa Wadjari group have lodged an application for the Determination of Native Title with the National Native Title Tribunal over an area that includes the rail alignment. The private land in the vicinity of the alignment will not be affected by the application but it may have implications for vacant crown land and reserves in the area.

Traditional use is usually commensurate with the food providing potential of the area. This potential was considered to be very low along the rail alignment.

<table>
<thead>
<tr>
<th>Aboriginal Heritage and Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>17. Design and realign the rail route to avoid Aboriginal sites.</td>
</tr>
<tr>
<td>18. Liaise with the Department of Aboriginal Affairs on measures to avoid disturbance of any Aboriginal sites in the vicinity of the rail route.</td>
</tr>
</tbody>
</table>

Given the above management measures and commitments the EPA's objectives are unlikely to be compromised.

7.9 EUROPEAN HERITAGE AND USE

EPA Objectives

To ensure the proposal complies with statutory requirements in relation to places and sites of heritage significance.

To ensure the proposal does not result in changes to the physical and biological environment, which adversely affects cultural associations with the area.

7.9.1 Applicable Standards and Procedure

The Western Australian Heritage Act 1972 protects European Sites.

The Government Railways Act 1904-1982 and Public Works Act 1902-1974 provides the power to the Commissioner of Railways to acquire land for the rail link.

Under the Public Works Act 1902-1972 procedures are available to address claims for compensation arising out of the construction of the rail link and the creation of the rail reserve.
7.9.2 Assessment and Management

The area considered in the assessment of this environmental factor is the rail reserve and adjoining areas.

Heritage

A European site survey commissioned by LandCorp (Suba & Callow, 1993) identified several sites in the Shires of Chapman Valley. All of these sites are some distance away from the proposed rail alignment and the closest (Hanlon’s staging post) is 1 km from the preferred alignment east of Chapman Valley Road (Figure 4).

The Shire of Greenough is currently preparing a municipal inventory of European heritage sites. At this stage the precise location details of a number of sites are unavailable. However, discussions with local historian Stan Gratte and historian Tanya Suba have indicated several sites (Figure 3) which are located away from the preferred alignment.

Westrail will liaise with the Shires of Greenough and Chapman Valley to maintain an awareness of any new historic sites in the vicinity of the alignment.

Use

An inspection of the proposed route, examination of aerial photography and interviews with each landowner were held to ascertain impacts on water supplies and the owner's usage of the land. The number of permanent residences within 250 m of the preferred and optional alignments was recorded and a qualitative scale was developed to provide a relative indication of the degree of fragmentation of land (Table 12).

Fragmentation of land may provide an indication (depending the size of the land parcel) of the degree to which the usage of a land parcel may be affected. In a number of instances fragmentation will result in:

- reduced access within the property;
- interference with farm management practices;
- interference with stock movement and watering; and
- disruption to water supplies.

Road access to a number of properties will also be affected by the preferred alignment.

The results of landowner interviews and investigations were considered in the choice of the preferred alignment.
### TABLE 12
PROPERTY FRAGMENTATION AND RESIDENCES NEAR THE PREFERRED ALIGNMENT

<table>
<thead>
<tr>
<th>Residences</th>
<th>Land Fragmentation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Up to 150</td>
<td>17</td>
</tr>
<tr>
<td>150-250</td>
<td>6</td>
</tr>
</tbody>
</table>

Under the acquisition provisions of the *Public Works Act 1902-1974* it is normal practice for Westrail to:

- maintain or restore stock or domestic access to a water supply that has been affected;
- restore road access to properties where access is disrupted by the rail. Level crossings with gates will be provided to ensure road access; and
- restore internal property access (including stock) of any portion of the property isolated by the railway to minimise impacts on good farm management practices. This may be achieved by providing rails crossings (with gates) or underpasses where the railway is sufficiently elevated above the surrounding land.

The value of land resumed for the rail reserve may be the subject of compensation claims.

Westrail will detail management measures in the environmental management plan to ensure that the management of the rail reserve is consistent with adjoining land uses.

**European Heritage and Use Commitments**

19. Restore road access to properties where disrupted by the rail.

20. Provide access (including stock) to any areas within a property which are isolated by the railway.

21. Establish, implement and inform landowners of a procedure based on the provisions of the *Public Works Act 1902-1974* for the submission and settling of compensation claims arising out of the resumption of land and the construction of the railway.

22. Implement measures to manage the rail reserve so as to not conflict with adjoining land uses in consultation with landowners and the Shires of Greenough and Chapman Valley. These measures will be described in the environmental management plan.

Given the above management measures and commitments, the EPA's objectives for this environmental factor are unlikely to be compromised.
7.10 DANGEROUS GOODS TRANSPORT

**EPA Objective**

To ensure that the rail transport of potentially dangerous and hazardous goods is consistent with the provisions of the *Explosives and Dangerous Goods Act 1961*.

**7.10.1 Applicable Standards and Procedures**

The carriage of dangerous goods by rail is subject to the provisions of the *Explosives and Dangerous Goods Act 1961*, *Dangerous Goods (Transport) Regulations 1983* and the conditions of the Australian Code for the Transport of Dangerous Goods by Road and Rail. This code has requirements for the packaging, labelling, storage and documentation of consignments.

**7.10.2 Assessment and Management**

The area considered in the assessment of this environmental factor is the surroundings of the rail reserve including any neighbouring residences.

In the short to medium term, the transport of dangerous or hazardous material is not anticipated to be significant. Nonetheless Westrail has developed safe working practices for the transport of dangerous materials that often makes rail the safest mode for transport of these goods.

Westrail is involved with the Western Australian Hazardous Materials Emergency Management Scheme (WAHMEMS) and will continue to develop its own emergency procedures and expertise to respond to any dangerous spills that may occur.

**Dangerous Goods Transport Commitments**

23. Ensure compliance with the Australian Code for the Transport of Dangerous Goods by Road or Rail.

24. Develop an emergency procedure to respond to any dangerous spills from rail transport.

Given the above management measures and commitments, the EPA's objective is unlikely to be compromised.

**7.11 LANDSCAPE AND VISUAL AMENITY**

**EPA objective**

To ensure that the landscape and visual amenity of the area adjacent to the project is not unduly affected by the proposal.
7.11.1 Applicable Standards and Procedure

The Shire of Chapman Valley has designated an area of heritage (landscape) value in its town planning scheme centred on the Moresby Range, associated valleys and the Lower Chapman River.

The 1989 Draft Region Plan outlined the need to protect the landscape of the Moresby Range. The Moresby Range Management Committee was established in 1996 to examine land management requirements for the Range. This Committee is currently preparing a land management strategy for the Range.

7.11.2 Assessment and Management

The area for the assessment of this environmental factor is the vicinity of the rail alignment and heritage (landscape) area described in Town Planning Scheme No.1, Appendix 5A of the Shire of Chapman Valley and the Town Planning Scheme of the Shire of Greenough.

Viewscape impacts were evaluated by Muir Environmental (1997a) by field observations from areas where the rail link or trains may be visible. This assessment found that:

- the houses most affected were near locations F and G (Figure 9).
- from long distances the railway will be relatively inconspicuous because the landscape is relatively flat and the height of track or trains above the landscape will be small.
- the railway will be visible from the Narra Tarra - Moonyoonooka Road for about 8 km of its length and in the distance from parts of White Peak Road and the North West Coastal Highway.
- The railway will cross Chapman Valley Road at one point.

Locations F and G are within the heritage (landscape) area in the Shire of Chapman Valley town planning scheme.

Since this assessment was completed the rail alignment was amended and the central option at the northern end of the alignment was chosen as the preferred alignment.

This adjustment of the alignment and choice of the central option has resulted in the following:

- one house near location F is about 150 m north of the preferred alignment and in this vicinity the train will be in a cutting at a lower elevation and should be less intrusive. The other house near location F is likely to be exposed to noise levels in excess of 80 dB(A) and consequently an offer to purchase the residence will be made.
- The house at location G is about 250 m from the preferred alignment and at this point the railway is in a cutting and should be less obtrusive.
Adjustment of the alignment in the vicinity of Chapman Valley Road before it crosses the Chapman River, shifted the railway a further 400 m to the west away from houses. However, the railway while distant, may still be visible from Chapman Valley Road.

The railway will cross the North West Coastal Highway about 8 m above the level of the highway. The elevated crossing cannot be avoided because of grade considerations into and leaving the Oakajee Industrial Estate. The railway at this point will be visible for some distance along the North West Coastal Highway and areas to the east towards Wokatherra Pass.

The retention of the landscape qualities of the assessment area is recognised as being a major consideration in the construction and management of the rail reserve. One of Westrail's environmental policy objectives is to minimise the impact of rail reserves on visual amenity.

To help minimise visual impacts the clearing of vegetation in the rail reserve and crossing heights over major roads will be kept to a minimum. In addition the Department of Resources Development and Ministry for Planning are developing a strategy to prevent further residential development in the services corridor.

Westrail will prepare a landscape management plan during the detail design of the rail link. This plan will be prepared and implemented in consultation with the Shires of Greenough and Chapman Valley, and the Ministry for Planning. This plan will consider the establishment of native vegetation buffers in the rail reserve to enhance the ecological and landscape values of the area.

<table>
<thead>
<tr>
<th>Landscape and Amenity Commitments</th>
</tr>
</thead>
<tbody>
<tr>
<td>25. Prepare and implement a landscape management plan (as a component of the environmental management plan) in consultation with landowners, Shires of Greenough and Chapman Valley, Ministry for Planning and the Moresby Range Management Committee.</td>
</tr>
<tr>
<td>26. Establish native vegetation buffers in the rail reserve particularly in areas of high landscape sensitivity.</td>
</tr>
</tbody>
</table>

Given the above management measures and commitments the EPA's objective for this environmental factor is unlikely to be compromised.
8. LIST OF COMMITMENTS

Environmental Management Approach

1. Prepare and implement an environmental management plan which will include construction and landscape management plans in consultation with the Department of Environmental Protection, Shires of Greenough and Chapman Valley, Department of Aboriginal Affairs and land owners. This plan will address the environmental matters relating to environmental factors that arise out of construction and operation of the railway.

Vegetation

2. Avoid as far as practicable the clearing of native vegetation by refinement of the rail alignment at the detailed design phase and minimising clearing during construction.

3. Include details of measures to minimise the disturbance of native vegetation in the construction management plan for the railway.

4. Promote the restoration of native vegetation in the rail reserve consistent with fire management, safety practices and adjoining land uses.

Specially Protected Fauna

5. Reduce the impediment to the movement of small fauna by the use of culverts, where practicable, in the Wokatherra Pass area.

6. Minimise disturbance of the habitat of the Blue-breasted Fairy-wren through the design of river crossing and during construction.

7. Describe the measures to minimise disturbance of the Blue-breasted Fairy-wren habitat in the construction management plan.

Noise and Vibration

8. Reduce as far as practicable noise levels at noise sensitive premises by use of barriers and refinement of the rail alignment.

9. Establish a procedure for the purchase of existing residences and to prevent the construction of new dwellings where predicted $L_{A_{max}}$ exceeds 80 dB(A).

10. Establish a procedure to provide treatment (or the equivalent in compensation) of existing dwellings and promote the application of building standards in accordance with Australian Standard 2021-1994 in areas where predicted $L_{A_{max}}$ is 75 dB(A) to 80 dB(A).
Dust Commitments

11. Apply Department of Environmental Protection Guidelines for the Prevention of Dust and Smoke Pollution from Land Development sites in Western Australia during construction of the railway.

12. Establish and implement a procedure to require the suppression of dust from rail transportation. This procedure will be detailed in the environmental management plan.

13. Detail dust suppression procedures in the construction management plan for areas where dust blow may occur.

Water Supply and Drainage Commitments

14. Make good any farm or domestic supplies disrupted by the construction of the railway.

15. Minimise adverse interference with the hydrological regime by design considerations including culvert and drains in consultation with landowners and the Water and Rivers Commission.

16. Incorporate water supply and drainage considerations into the construction management plan.

Aboriginal Heritage and Use

17. Design and realign the rail route to avoid Aboriginal sites.

18. Liaise with the Department of Aboriginal Affairs on measures to avoid disturbance of any Aboriginal sites in the vicinity of the rail route.

European Heritage and Use Commitments

19. Restore road access to properties where disrupted by the rail.

20. Provide access (including stock) to any areas within a property which are isolated by the railway.

21. Establish, implement and inform landowners of a procedure based on the provisions of the Public Works Act 1902-1974 for the submission and settling of compensation claims arising out of the resumption of land and the construction of the railway.

22. Implement measures to manage the rail reserve so as to not conflict with adjoining land uses in consultation with landowners and the Shires of Greenough and Chapman Valley. These measures will be described in the environmental management plan.

Dangerous Goods Transport Commitments

23. Ensure compliance with the Australian Code for the Transport of Dangerous Goods by Road or Rail.
24. Develop an emergency procedure to respond to any dangerous spills from rail transport.

**Landscape and Amenity Commitments**

25. Prepare and implement a landscape management plan (as a component of the environmental management plan) in consultation with landowners, Shires of Greenough and Chapman Valley, Ministry for Planning and the Moresby Range Management Committee.

26. Establish native vegetation buffers in the rail reserve particularly in areas of high landscape sensitivity.
9. REFERENCES


Safstrom, R and Craig, G F (1996). *Environmental Evaluation of Native Vegetation in the Wheatbelt of Western Australia*. Prepared for Western Australian Department of Environmental Protection


W. A. Heritage Committee. *Chapman Valley Heritage Trail*
FIGURES
FIGURE 2

Proposed rail route options
Preferred rail alignment

- 65 dB(A)
- 75 dB(A)
- 80 dB(A)

- Heritage Site
- Residences in proximity to proposed rail alignment

LandCorp
PROPOSED RAIL LINK - OAKAJEE
PROPOSED RAIL ALIGNMENT
SOUTHERN PORTION
REFERENCE

- Preferred rail alignment
- 65 dB(A)
- 75 dB(A)
- 80 dB(A)
- Heritage Site
- Residences in proximity to proposed rail alignment

Land Corp
PROPOSED RAIL LINK - OAKAJEE
PROPOSED RAIL ALIGNMENT
NORTHERN PORTION
TYPICAL SECTION FOR SINGLE TRACK SIDE EMBANKMENT CUTTING IN ROCK

Benching to be provided in cuts of 9m depth or greater

3m minimum

Maximum batter 1:4

TYPICAL SECTION OF RAILWAY RESERVE ON FLAT LAND

Standing trees and ground cover to remain except for safety reasons where trees may be removed on curves and level crossings.

Standing trees and ground cover to remain except for safety reasons where trees may be removed on curves and level crossings.

LandCorp
PROPOSED RAIL LINK - OAKAJEE
TYPICAL SECTIONS

FIGURE 6
FIGURE 7: WINDROSES FROM OAKAJEE INDUSTRIAL ESTATE
for the period July 1, 1990 to June 30, 1991
(Source: Steedman Science & Engineering, 1991)
FIGURE 8: STEAMFLOW FOR CHAPMAN RIVER AT UTAKARRA STATION
Figure 10: Rail Groundborne Vibration
Bauxite Train vs Effects
Appendix 1

Westrail Principles for Management of Reserves
2.0 Environmental Policy

2.1 Introduction

Environment is the total stock of all our surroundings. It is living things as well as the interactions between their:

- biological;
- social; and
- physical surroundings.

Rail and railway operations are part of the environment. They are relied upon for transport, communication and commerce.

Westrail appreciates that development and maintenance of the rail network must recognise and include a commitment to environmental protection, in addition to consideration of the factors of safety, practicality, community expectation and commercial viability.

Westrail recognises that its commitment to environmental protection must be maintained as an integral part of its culture and decision making. To achieve these objectives Westrail has developed this Manual as a foundation and a clear statement of its intent for the future.
2.2 Environmental Policy Statement

Westrail’s policy is to provide effective freight and passenger transport services, which are consistent with safety and environmental protection, as part of an efficient transport system for the public benefit.

Specifically, it is Westrail’s policy to:

- comply with all applicable, laws, regulations and standards,
- conduct its business professionally and in a way which promotes a strong, corporate environmental ethic as well as sound environmental practices;
- communicate with the community and the government on environmental issues, and contribute to the development of policies, legislation and regulations that may affect Westrail;
- recognise the importance of public consultation when planning activities which have a potential to adversely impact the physical, biological, social or cultural environments;
- ensure that its clients, employees, contractors, subcontractors and suppliers of goods and services are aware of Westrail’s environmental policy, and of the obligations which arise from the policy.
- institute environmental management systems and procedures to identify, assess, control and monitor environmental risks arising from its operations, designs and services;
- be aware of and, where appropriate, contribute to studies which are pertinent to Westrail’s operations and which are expected to reduce pollution, enhance fuel conservation, minimise waste, or improve processes or technologies that will protect the environment.
- audit environmental performance to ensure compliance with Westrail policy.
2.3 Environmental Policy Objectives

The Environmental Policy Statement describes in overall terms the philosophy by which Westrail undertakes its operations. The policy statement is the cornerstone for the development of specific initiatives, management of environmental issues, standards of operation and procedures.

The following notes provide a guide to Westrail’s environmental commitment and aim to complement and expand upon Westrail’s stated Environmental Policy’s objectives.

---

**Environmental Policy - Laws, Regulations and Standards**

**Compliance**
Westrail will comply with all environmental laws, codes of practice and regulations that govern its operations and will always seek to uphold the spirit of the law.

**Performance Standards**
Where environmental risks are identified that are not covered by existing laws or regulations, or where in Westrail’s judgement the requirements of law or regulation do not offer sufficient protection to the environment, Westrail will apply environmental performance standards based on:

- an assessment of environmental impacts of its operations;
- relevant international standards and good transport practices; and
- environmental risk management principles.

**Development of Policies, Legislation and Regulation**
Westrail will participate in the formulation of environmental policies, legislation and regulations that relate to its business.

Westrail will work with appropriate government authorities and industry groups to achieve timely, reasonable and cost effective solutions to environmental issues.

**Self Regulation**
By establishing a record of sound environmental performance and management practices in its operations, Westrail intends to be recognised as an effective self-regulator on environmental matters.

**Satisfying Future Requirements**
New plant, equipment and processes will be designed or selected taking into account any likely changes in environmental standards which may evolve in the future.
Environmental Policy - Environmental Management

**Environmental Responsibility**
Westrail will incorporate environmental management as an integral part of its business practice.

Westrail employees at all levels of the organisation will be encouraged to demonstrate a commitment to care for the environment and to observe the objectives of the Environmental Policy.

**Training**
Westrail employees will receive education and training on relevant environmental matters.

**Accountability**
Implementation of Westrail's Environmental Policy will be a key management performance criterion; environmental responsibilities will be identified and employees will be accountable for their performance in this regard.

**Structures and Systems**
Westrail will ensure that organisation structures and management systems support the Environmental Policy.

These systems will include planning, auditing and reporting to ensure that:

- environmental management forms an integral part of the business planning process;
- Westrail operations are subject to periodic environmental audits; and
- Westrail's environmental performance is reported regularly to senior management and the Commission.

**Standard Operating Procedures**
Westrail will develop, implement and maintain standard operating procedures which include all regulatory and practical environmental procedures.

**Emergency Response**
Westrail aims to identify potential environmental risks and hazards and will minimise the risk of their occurrence through design, procedural controls and employee training. Westrail will develop emergency response plans and confirm response capability through drills.
Environmental Policy - Communications

**Strategy**
Communication of environmental matters will be handled as part of an integrated communications strategy. Key elements of the strategy will include:

- establishing lines of communication;
- open and frequent communications;
- developing credibility and trust;
- promotion of relevant achievements and capabilities;
- the initiation of and participation in discussions on relevant environmental issues; and
- the implementation and testing of crisis communication procedures in line with emergency response plans.

Environmental Policy - Discharges and Wastes

**Waste Minimisation**
Westrail aims to reduce or eliminate its waste streams through sound waste minimisation and recycling programs.

**Destruction, Containment and Disposal**
Where it is not technically or economically feasible to eliminate wastes, these will be destroyed, contained or disposed of in a manner that minimises the effects on the environment.

**Monitoring, Discharges and Effects**
Where noise or any discharges of gases, liquids or solids may have a potentially deleterious effect on the environment, the discharges and their effects on the environment will be monitored and corrective action taken if required.

**Ozone Depleting Substances**
Westrail aims to eliminate the release of stratospheric ozone depleting substances into the atmosphere by employing only products that use safe, economic alternatives and by recovering and recycling ozone depleting substances in systems where alternatives are not currently available.

**Greenhouses Gases**
In response to this global issue Westrail aims to reduce emissions of Greenhouse Gases per unit of production (in particular, carbon dioxide) through increased energy efficiencies and more efficient use of fossil fuels in its transportation and production operations and other activities, where these programs are technically and economically viable.
Environmental Policy - Site Rehabilitation and Contaminated Sites

Rehabilitation
Rehabilitation of sites disturbed as a result of Westrail's operations will be an integral part of Westrail's operating responsibilities.

Contaminated Sites
Westrail will ensure that company controlled sites contaminated as a result of its operations will be managed so as to protect the health of the community and the environment.

Site management, including remediation efforts, will ensure public health and environment risks are acceptable.

Leasees and Consignors
Leasees who have rights on Westrail sites will be bound by contractual conditions to meet Westrail's specified requirements with respect to maintenance of site health and to rehabilitation of the site.

Consignors of goods will be liable for decontamination and rehabilitation after any leakage, spillage or accident.

Environmental Policy - Acquisitions and Divestments

Application of Policy
Westrail Environmental Policy will apply to businesses for which Westrail has operating responsibility.

Westrail will also endeavour to ensure that in those businesses where it does not have operating responsibility, comparable environmental policies will be applied.

Due Diligence
Investigations will be undertaken to determine Westrail's potential environmental liabilities before any contracts, acquisitions or divestments are effected, to ensure compliance with legislation and good industry standards, or to appraise the costs and actions necessary to ensure compliance.
Environmental Policy - Landscape, Heritage and Social Values

Landforms, Flora and Fauna
Westrail recognises the importance of the landforms, the flora and fauna that compose the landscape as well as features of importance to the social and economic well-being of the community.

Westrail will take such actions as are necessary to provide appropriate knowledge on those features of the landscape and heritage, so as to devise ways for keeping the impacts of its operations within manageable limits.
Appendix 2

Geraldton Oakajee Rail
Acoustic Assessment
GERALDTON OAKAJEE RAIL

ACOUSTIC ASSESSMENT

FOR

WELKER ENVIRONMENTAL

AUGUST 1997

REFERENCE: 5608-97060-528
CONTENTS

1.0 INTRODUCTION
2.0 CONCLUSION
3.0 METHOD
4.0 CRITERIA
   4.1 VIBRATION
   4.2 NOISE CRITERIA
5.0 RESULTS
6.0 DISCUSSION

APPENDICES

APPENDIX A MEASURED TRAIN NOISE LEVELS
APPENDIX B GRAPH SHOWING TRAIN VIBRATION
1.0 INTRODUCTION

A rail freight line is proposed to service the developing Oakajee Industrial Estate linking it to the Port of Geraldton line.

A study has been made of the noise and vibration level emission from freight trains that would ply this line. The average and maximum instantaneous noise levels have been determined based on the class, composition and operating conditions of the locomotive systems that are proposed for use on this line. The resultant data has been used to assess the impact on existing or potential noise sensitive premises adjacent to the preferred route of the line. The line would be constructed and operated by the Western Australian Government Railways Commission (WESTRAIL).

There are no regulatory criteria in Western Australia for governing noise and vibration level emissions for transport systems such as rail and hence recognized acceptable data and Westrail's "Environmental Management Manual" guidelines are used for assessment purposes. Other indices are explored such as 'sleep disturbance' based on indices that have recently been put forward for transport noise.

This report presents the results of noise level measurements, methods of determining noise propagation, applicable criteria for the assessment of impact and recommendations for managing noise emissions to noise sensitive premises.

2.0 CONCLUSION

It is the conclusion of this report that any land encompassed by an 80 dB(A) contour associated with noise from the rail system will be unfit for residential or other noise sensitive uses.

It is the recommendation of this study that any residences within the 80 dB(A) zone be resumed and where applicable development rights be purchased to prevent any residential development. Alternatively noise control in the form of barriers can be considered to reduce the 80 dB(A) contour to within an affected premises.

It is also a recommendation of this study that land within the 75 to 80 dB(A) noise level contours be made conditional for residential use by planning authorities.

The 80 dB(A) contour can be up to 50 metres from the line and the 75 dB(A) contour up to 90 metres from the line.
3.0 METHOD

Noise and vibration levels were recorded of 'P' Class locomotives with 45 carriages travelling at 70kph on the Pinjarra to Kwinana line. Both maximum and $L_{Aeq}$ dB(A) levels were recorded at distances of 15, 30 and 60 metres. These recordings allowed delineation of absolute levels as well as the rate of attenuation with respect to distance, particularly for the $L_{Aeq}$ values. The measured noise level data was extrapolated to represent the double header (2 locomotives) and 65 carriages systems that would be used at Oakajee. An addition of 3 dB(A) was made to the maximum level on the basis that the locomotive is the source of maximum noise and that an extra locomotive represents a doubling of acoustic energy. The $L_{Aeq}$ value was extrapolated based on the level versus time history of the passing train and extending the time for the increase of 45 to 65 carriages and increasing the maximum levels by 3 dB(A).

Having determined sound power levels, a computer program (ENM) was employed to develop noise level contours along the proposed route, taking into account varying topography.

4.0 CRITERIA

4.1 VIBRATION

Vibration levels from trains is relatively low, in fact often imperceptible at 20 metres from the line. The exception can occur from a locomotive sitting idling for any length of time and if there is reasonable connecting medium such as rock. Also travelling trains can cause perceptible vibrations due to imperfection in rail joints or crossing points.

The criteria used for assessment is taken from AS2670 - Part 2 1990, the most critical of which is 'perception criteria'. Also used is the criteria for possible structural damage.

4.2 NOISE CRITERIA

The only documented and utilised criteria for outdoor rail noise acceptability is taken from the New South Wales State Pollution Control Commission "Environmental Noise Control Manual" which cites the following:

- Maximum Level, ($L_{Amax}$) = 80 dB(A)
- Average Level, ($L_{Aeq\ 24\ hours}$) = 55 dB(A)

The above criteria are planning levels for noise sensitive premises associated with existing rail systems. The reported maximum acceptable levels are 5 dB(A) above these levels.
The Westrail “Environmental Management Manual” cites the following as acceptable criteria for urban passenger railway services:

<table>
<thead>
<tr>
<th>Period</th>
<th>$L_{Aeq}$ $*$ dB(A)</th>
<th>$L_{Amax}$ $*$ dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daytime (0600-2000hrs)</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>Nighttime (2000-0600hrs)</td>
<td>60</td>
<td>80</td>
</tr>
</tbody>
</table>

* These would be:
  - the arithmetic average of the $L_{Aeq}$ (1 hour) for the period stated; and
  - when received at residential premises and at a minimum distance of 25 metres from the centre line of the track.

The Department of Environmental Protection endorse the above criteria, however, in addition recommend a target level for planning purposes of 65 dB $L_{Amax}$. This level is considered in the assessment of new rail proposals. It is also considered to be more relevant to sleep disturbance and hence, although an outdoor level, is more applicable to the in-house environment.

For the indoor noise level environment sleep disturbance, has long been mooted as a better guide to transport noise impact assessment. In recent times a sleep disturbance index (S.D.I.) has been put forward (reference R. Bullen E.R.M.M.M. Pty Ltd) as an index for assessing transport noise impact. Although no fixed criteria has been set down, an index around 1.5 is put forward as applicable for rail noise; in this instance an S.D.I. of less than 1.0 is considered appropriate.

The sleep disturbance index is based on the number of events during a night time (or day time) period, the maximum noise level at the noise sensitive premises and the house attenuation. Sleep disturbance is relative to internal noise levels and number of events and therefore Australian Standard 2021-1994 “Acoustics - Aircraft Noise Intrusion - Building Siting and Construction” can also be used for guidance. In particular Table 3.3 “Indoor Design Sound Levels for Aircraft Noise Reduction Assessment” which indicates the maximum acceptable indoor noise levels for intermittent high noise level events.

AS2021 also cites a level of up to an $L_{Amax}$ of 75 dB(A) as acceptable for the outdoor environment.

Further, this standard is useful in determining the extent of noise reduction required for ‘conditional sites’ (i.e. noise levels above 75 dB $L_{Amax}$) and the type of building construction required to achieve a given noise reduction.

Considering all of the above the following criteria has been adopted in this assessment:

Unacceptable $>$80 dB $L_{Amax}$ and $>$55 $L_{Aeq}$ 24 hour and S.D.I.$>$1.5
Conditional 75 to 80 dB $L_{Amax}$ and $>$55 $L_{Aeq}$ 24 hour and S.D.I. 1.0 to 1.5
Acceptable $<$75 dB $L_{Amax}$ and 55 $L_{Aeq}$ 24 hour and S.D.I. $<$1.0
5.0 RESULTS

The various measured noise level data from the Kwinana Line, single locomotives and 45 wagon tests are given in Appendix A.

In summary, the $L_{\text{Amax}}$ and $L_{\text{Aeq 1 min}}$ at 15 metres are as follows:

- $L_{\text{Amax}}$ (15 metres) $\quad 91$ dB(A)
- $L_{\text{Aeq 1 min}}$ (15 metres) $\quad 79$ dB(A)

Recorded vibration levels at 15 metres are shown in graphical form in Figure 1. This data is compared to building damage and perception criteria. The measured data is shown in Appendix B.

FIGURE 1

![Graph showing rail groundborne vibration](image)

Trains using 'S' class locomotives and 65 carriages are intended to be used on the route. Based on the measured 'P' class train systems, noise levels have been extrapolated for the 'S' class system as follows:

- $L_{\text{Amax}}$ (15 metres) $\quad 91$ dB(A)
- $L_{\text{Aeq 1 min}}$ (15 metres) $\quad 78$ dB(A)
- $L_{\text{Aeq 24 hour}}$ (15 metres) 1 train (35 dB(A) ambient) $\quad 47$ dB(A)
The determined sound power level of a double headed ‘S’ class locomotive and 65 wagons is given in Table 1.

**TABLE 1**

<table>
<thead>
<tr>
<th>OCTAVE BAND CENTRE FREQUENCY Hz</th>
<th>31.5</th>
<th>63</th>
<th>125</th>
<th>250</th>
<th>500</th>
<th>1K</th>
<th>2K</th>
<th>4K</th>
<th>dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOUND POWER LEVEL dB re 10^{-12} watts</td>
<td>129</td>
<td>133</td>
<td>134</td>
<td>123</td>
<td>121</td>
<td>117</td>
<td>116</td>
<td>115</td>
<td>124</td>
</tr>
</tbody>
</table>

The acoustic centre or source height is taken as 3 metres above the rail line. Based on flat surrounding ground the modelled results of sound pressure level versus distance is shown in Table 2 for both ‘P’ and ‘S’ class systems.

**TABLE 2**

<table>
<thead>
<tr>
<th>NOISE CONTOUR LEVELS VERSUS LOCO TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTANCE (METRES)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LOCO TYPE</th>
<th>SOUND PRESSURE LEVEL dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>82</td>
</tr>
<tr>
<td>‘P’ CLASS SINGLE</td>
<td>40</td>
</tr>
<tr>
<td>‘P’ CLASS DOUBLE</td>
<td>60</td>
</tr>
<tr>
<td>‘S’ CLASS SINGLE</td>
<td>30</td>
</tr>
<tr>
<td>‘S’ CLASS DOUBLE</td>
<td>40</td>
</tr>
</tbody>
</table>

The effect of barrier height (such as formed by a cutting) on noise level contour locations is shown in Table 3.

**TABLE 3**

<table>
<thead>
<tr>
<th>NOISE CONTOUR LEVEL VERSUS HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DISTANCE (METRES)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BARRIER HEIGHT (m)</th>
<th>SOUND PRESSURE LEVEL dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80</td>
</tr>
<tr>
<td>0</td>
<td>50</td>
</tr>
<tr>
<td>+1</td>
<td>50</td>
</tr>
<tr>
<td>+2</td>
<td>50</td>
</tr>
<tr>
<td>+3</td>
<td>41</td>
</tr>
<tr>
<td>+4</td>
<td>36</td>
</tr>
<tr>
<td>+5</td>
<td>31</td>
</tr>
</tbody>
</table>
The 80, 75 and 65 dB(A) noise level contours are shown plotted on to an area map. These contours take into account various topography including areas of cut or fill along the route.

The distance from the track for the $L_{eq}$ 55 dB(A) value versus number of train movements is shown below in Table 4.

**TABLE 4**

$L_{eq}$ 55 dB(A) CONTOUR DISTANCE VERSUS NUMBER OF MOVEMENTS

<table>
<thead>
<tr>
<th>No. Train Movements</th>
<th>Distance (metres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>23</td>
</tr>
<tr>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>46</td>
</tr>
</tbody>
</table>

6.0 DISCUSSION

Vibration levels are low enough so as that they are generally imperceptible even within the rail reserve itself (20 metres from the line). Impact from vibrations is therefore a non issue.

It is the maximum noise level criteria that determines the acceptable limits for noise sensitive premises adjacent to the line. It would require more than 30 trains per day for the $L_{eq}$ 24 hour criteria of 55 dB(A) to become a determining factor. Also it would require outdoor noise levels over 80 dB(A) and 20 movements per day for the S.D.I. to become a determining factor. Based on the proposed train movements, in this instance of up to 20 per day, and an outdoor noise level of 75 dB(A) the S.D.I. is well less than the 1.0 criteria.

The actual S.D.I. for various scenarios is shown in Table 5.

**TABLE 5: SLEEP DISTURBANCE INDEX**

<table>
<thead>
<tr>
<th>OUTDOOR NOISE LEVEL $L_{MAX}$</th>
<th>NUMBER OF MOVEMENTS PER DAY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td>80 dB(A)</td>
<td>0.95</td>
</tr>
<tr>
<td>75 dB(A)</td>
<td>0.64</td>
</tr>
<tr>
<td>65 dB(A)</td>
<td>0.38</td>
</tr>
</tbody>
</table>
Typically, the 80 dB(A) contour falls at 50 metres from the line with normal flat ground or ground falling away from the line. Therefore this is the maximum distance the 80 dB(A) contour will occur except if there were acoustically reflective surfaces between the line and the receiver point i.e. water. The distance would be increased under down wind conditions, however, due to the intermittent nature of winds and the coincidence of a train passing, this effect will be very inconsistent.

The 80 dB(A) contour will come as close as 30 metres to the line when the barrier effect due to cuttings is up to 5 metres high. This contour, the 75 dB(A) and 65 dB(A) contours are plotted in the layout plans in Appendix C. It is these plot lines that determine the location of the unacceptable, conditional and acceptable zones for any noise sensitive premises existing or proposed along the route. Hence on this basis determination can be made to resume, rezone or treat noise sensitive locations.

for HERRING STORER ACOUSTICS

Lynton Storer

25 September 1997
APPENDIX A

MEASURED TRAIN NOISE LEVELS
## APPENDIX A

### LEVELS MEASURED OF PASSING TRAINS ON THE PINJARRA TO KWINANA LINE

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>OCTAVE BAND CENTRE FREQUENCIES, Hz</th>
<th>dB(A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>31.5</td>
<td>63</td>
</tr>
<tr>
<td>70kph Unloaded Single Header @15m dB(max)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 kph P Class Unloaded Single Header @15m dB(max)</td>
<td>90</td>
<td>94</td>
</tr>
<tr>
<td>70 kph Loaded Single Header @30m dB(max)</td>
<td>89</td>
<td>93</td>
</tr>
<tr>
<td>60 kph P Class Unloaded Single Header @30m dB(max)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 kph P Class Unloaded Single Header @60m dB(max)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 kph P Class Unloaded Single Header @30m Leq(1:00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 kph P Class Unloaded Single Header @60m Leq(1:00)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>70 kph Unloaded Single Header @15m Leq(1:05)</td>
<td>84</td>
<td>83</td>
</tr>
<tr>
<td>70 kph Loaded Single Header @30m Leq(1:10)</td>
<td>79</td>
<td>82</td>
</tr>
<tr>
<td>60 kph Unloaded Single Header @60m Leq(1:00)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Weighted Measurement of P Class Single Header Train at 70km/hr
APPENDIX B

GRAPH SHOWING TRAIN VIBRATION