SHIRE OF SERPENTINE JARRAHDALE

ENVIRONMENTAL STUDY FOR MUNDIJONG/WHITBY DISTRICT STRUCTURE PLAN

FINAL REPORT

April 2009

SMEC

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1 Executive Summary

The environmental study of the Mundijong Whitby (MW) Cell identified a series of potential environmental impacts associated with the proposed development of the cell (Table 1), as well as a series of broad management recommendations (Tables 2). These impacts and more detailed management recommendations are discussed in detail in the later sections of this report.

TABLE 1. POTENTIAL ENVIRONMENTAL IMPACTS OF IDENTIFIED LAND USES

Land Use	Environmental Aspect	Potential Environmental Impacts
Urban Development (housing)	Flora	1. Loss of vegetation and habitat 2. Loss of significant flora (DRF and TECs) 3. Introduction of weeds and diseases
	Fauna	1. Loss of significant fauna
	Landscape and Landform	1. Loss of visual amenity
	Land degradation	1. Increased phosphorous export 2. Increased water logging
	Wetlands, linear watercourses and groundwater dependant ecosystems	1. Degradation of EPP Wetlands 2. Loss of aquatic habitat 3. Changes in hydrology
	Surface and ground water quality	1. Increased stormwater run off 2. Decreased groundwater level 3. Increased phosphorous export
	Contamination	1. Delays in planning approval due to contaminates located on some sites
	Odour	1. Odour emissions received at odour sensitive sites
	Noise	1. Noise emissions received at noise sensitive sites
	Aboriginal heritage	1. Loss of aboriginal heritage values
Bores	Wetlands, linear watercourses and groundwater dependant ecosystems	1. Loss of groundwater dependant ecosystems
	Surface and groundwater quality	1. Lowering of groundwater
	Acid Sulphate Soils	1. Disturbance of acid sulphate soils
Stormwater Drainage System	Land degradation	1. Increased phosphorous export
	Wetlands, linear watercourses and groundwater dependant ecosystems	1. Erosion of existing waterways 2. Loss of aquatic habitat
	Contamination	1. Contaminants entering watercourse and the Peel Harvey Estuary 2. Contaminants entering groundwater and affecting human, fauna and flora health
	Surface and groundwater quality	1. Decrease in surface water quality
Linear Infrastructure (e.g. roads, power, water mains and sewers)	Flora	1. Loss of vegetation and habitat 2. Loss of significant flora (DRF and TECs) 3. Introduction of weeds and diseases
	Fauna	
	Landscape and Landform	1. Loss of visual amenity
	Wetlands, linear watercourses and groundwater dependant ecosystems	1. Degradation of EPP Wetlands 2. Loss of aquatic habitat 3. Changes in hydrology
	Acid Sulphate Soils	1. Disturbance of acid sulphate soils
	Aboriginal heritage	1. Loss of aboriginal heritage values

TABLE 2. FACTORS RELEVANT TO THE DSP AND LATER PLANNING STAGES

Environmental Factor	Management Actions
Flora and Habitat Preservation	1. Where possible development should be located within existing cleared land to minimise the impact on remnant vegetation. 2. Where native vegetation is to be cleared, detailed floristic surveys should be undertaken prior to subdivision. These surveys should focus on declared rare and priority flora, vegetation structure, proximity to and connectivity with, other vegetation and a discussion of linkage values at a local and regional context. 3. The clearing of native vegetation should be prohibited unless authorised by a DEC Clearing Permit or is exempt under Schedule 6 of the *Environmental Protection Act 1986* or Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. 4. When undertaking subdivision building envelopes should be pegged for each proposed lot to ensure that the impact on remnant vegetation is minimised. 5. The following should be used to minimise inadvertent impacts during constructions: • use of clear signage; • provision of operator information; • fencing, where necessary; and • rehabilitation and stabilization of areas disturbed during construction 6. Roads and firebreaks are located such that fragmentation of remnant vegetation is prevented. 7. A Vegetation Management Plan should be prepared that details: • protected areas within the Cell • management practices for each area of remnant vegetation • details the ecological linkages within the cell • contains an approved planting list for gardens and public open space • offset requirements should native vegetation require clearing • weed management requirements for the Cell • hygiene requirements for soil imported into the cell.
Fauna Preservation	1. Prior to commencing work in areas of remnant vegetation, field investigations for Specially Protected (Threatened) Fauna should be undertaken in accordance with the EPA Guidance Statement No. 54, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*. If identified these species should be protected in accordance with the *Wildlife Protection Act 1950*. This should be addressed in a Fauna Management Plan. 2. Fauna Management Plans should be required when clearing areas of remnant vegetation. The plan should include provisions for retaining habitat trees where possible and the relocation of fauna species if necessary. 3. A comprehensive Fox Management Plan should be formulated by Shire of Serpentine-Jarrahdale in association with the development of MW Cell; 4. Consideration should be given to developing a Shire Pet Policy that could include: • prohibiting domestic cats and dogs from entering natural area reserves; • establishes buffer zones (e.g. cat buffer zones) around key natural assets; • limit the number of cats per household and/or • require cat owners to register their cat with the Shire.
Loss of Visual Amenity	1. Landscape Management Plans (LMP's) should be submitted to and approved by the Shire for all development within areas covered by the Shires Local Planning Policy 8 - Landscape Protection Area, then implemented prior to development. LMP's should contain provisions for minimising clearing, building heights, lot sizes, planting of fringing vegetation, building envelopes, adequate building setbacks and provision of public open space.
Wetlands and Water Courses	1. No development should occur within EPP Wetlands or their buffers. New subdivisions should ensure that Lot boundaries do not intersect EPP wetlands or their buffers and prospective purchasers of land containing an EPP Wetlands and/or it buffer should be made aware of development restrictions. 2. Where future subdivision has the potential to impact of Manjedal Brook a Foreshore Management Plan should be prepared by the sub-divider for approval by the WAPC. 3. All remnant vegetation, fringing vegetation and ecological linkages associated with the

Environmental Factor	Management Actions
	Cell's wetlands and water courses should be maintained. 4. Access to wetlands should be controlled/restricted by using paths, fences and gates. The exact nature of these measures should be determined during local structure planning. 5. There is to be no fill, fertiliser or chemical application, groundwater or wetland water abstraction, no waste disposal, excavation, or drainage into or out of EPP wetlands. Discharge of stormwater may be permitted into the wetland provided a Storm Water Management Plan is approved by the DoW. 6. Stormwater management plans should be produced at the Local Structure Planning Stage to ensure that any existing inappropriate stormwater disposal to wetlands or water courses are replaced and that stormwater management at the site is in accordance with the DoW's *Stormwater Management Manual* (DoE, 2004). 7. Where development is proposed near a wetland a Wetland Management plan should be prepared that details: • the wetland's buffer distance; • the proposed management of stormwater run-off into the wetlands; • the management of groundwater recharge; • any approved groundwater abstraction allowances; • any required rehabilitation of the wetland(s) • site monitoring; and • the management of Acid Sulphate Soils (where necessary).
Noise	1. Noise issues associated with the South Western Highway and the north-south railway should be addresses at the Local Structure Planning Stage. Prior to the redevelopment of areas adjacent to these transport corridors the sub-divider should provide a written undertaking to the WAPC that the purchaser will be notified of requirements to undertake noise studies and install measures to reduce noise impacts for any sensitive premises built within 200m. A similar requirement could be expected fro properties adjacent to the proposed Tonkin Highway extension.

2 Introduction

2.1 Background

The Shire of Serpentine-Jarrahdale (the Shire) is located 45km south east of the Perth Central Business District (CBD) and covers an area 905 km^2. The Shire is presently experiencing a period of significant growth with its population expected to increase from approximately 13,500 to 60,000 by 2037 (Shire of Serpentine-Jarrahdale, 2006). While the Shire is a predominantly rural Local Government Area (LGA), specific cells such as the Mundijong-Whitby Cell (MW Cell) have been set aside to accommodate the projected growth.

The MW Cell covers an area of approximately 1,800 hectares (Figure 1) and is expected to accommodate about approximately 30,000 people by 2037. Most of this population will be in a series of neighbourhoods, each comprising up to 5000 people (Shire of Serpentine-Jarrahdale, 2006). The Mundijong Whitby District Structure Plan (MWDSP) is being developed to enable the Shire to protect and enhance its rural character and environment by accommodating the projected growth principally within the existing urban footprint. The MWDSP aims to maximise the beneficial impacts of growth, while containing potential adverse impacts by providing broad guidance on the types of land use that may be permitted. When complete the MWDSP will be used to guide the development of the MW Cell.

SMEC Australia Pty Ltd was commissioned to undertake the environmental study, one of ten components of the MWDSP.

2.2 Project Purpose

The purpose of this report is to provide the baseline environmental data for the MWDSP and identify the known and potential environmental impacts associated with the plan.

This report builds upon the MWDSP Environmental Scoping Paper (Land Insights, 2007) by:

- Identifying and assessing the factors relevant to the district structure plan and later planning stages;
- Describing in detail how the existing environment can be protected from development impacts; and
- Identifying recommendations for management actions and further investigations.

The key outcomes of this report include:

1. The identification of, and protection measures for, areas within the DSP with the greatest conservation value;
2. The identification of land uses that may be permitted within the DSP without the need for further environmental approvals;
3. The identification of potential environmental impacts of the identified potential land uses; and
4. Provisions for managing identified impacts to an acceptable level within the DSP.

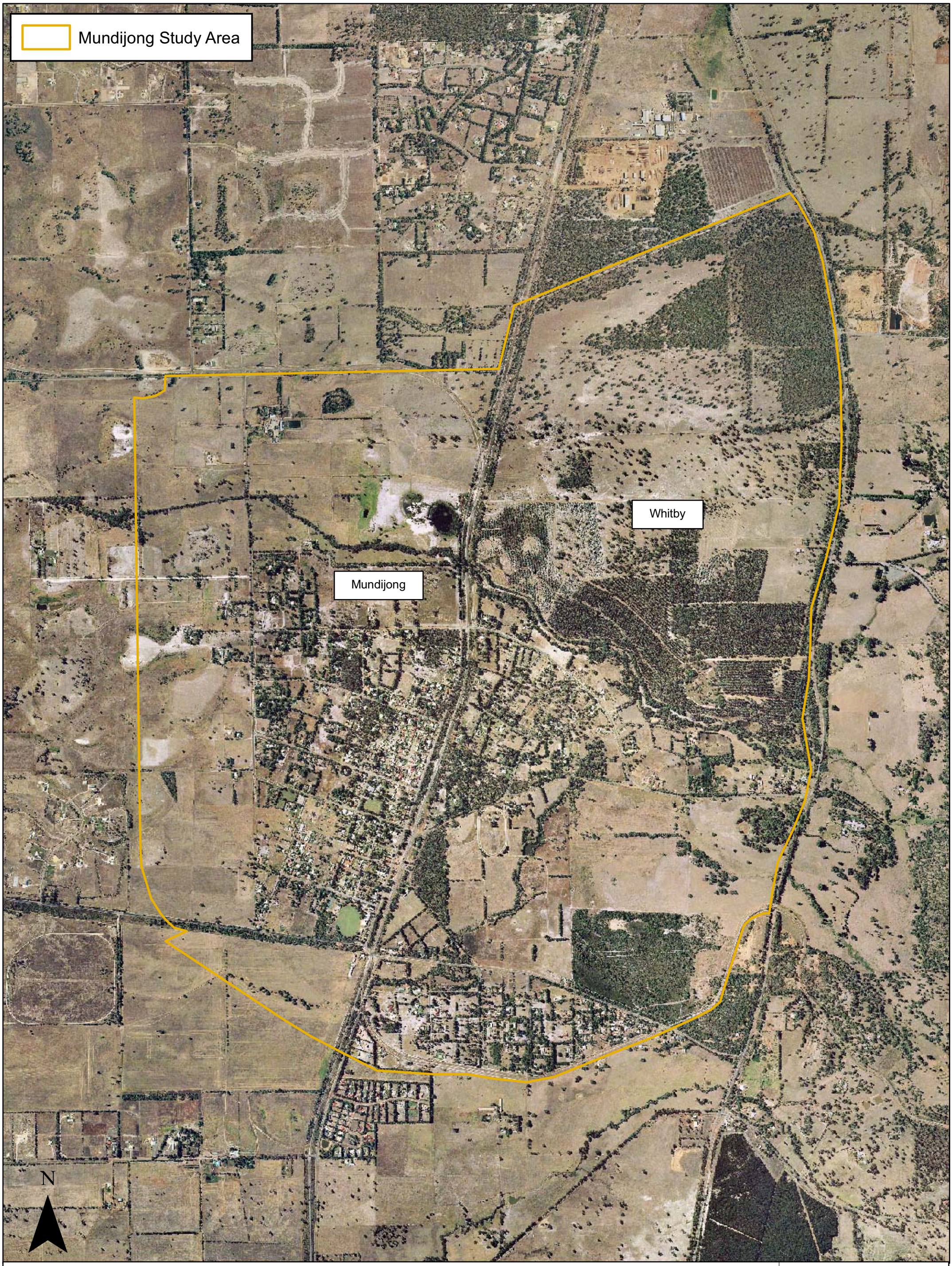
2.3 Stage One: Local Biodiversity Strategy

Local Biodiversity Strategies are non-statutory documents which set long-term targets and short-term actions to protect significant natural areas across public and private lands. The *Serpentine Jarrahdale Shire Stage One: Local Biodiversity Strategy* (Ironbark Environmental and Sustainable Development, 2007) identifies a series of proposed local biodiversity targets for the Shire. The following proposed targets are of particular relevance to the MWDSP:

1. Protection of verified Local Natural Areas (LNA's) of the following vegetation complexes:
    a. Guildford vegetation complex;
    b. Beermullah vegetation complex; and
    c. Forrestfield vegetation complex.

2. Retention of all verified LNA's within the Shire;
3. Protection of the following specific biodiversity features in order to maintain, or to form, resilient ecologically viable natural areas:
    a. Declared Rare Flora (DRF), Specially Protected Fauna and Priority Species;
    b. Threatened Ecological communities (TEC's);
    c. Wetlands and wetland vegetation;
    d. Waterways;
    e. Ecological linkages;
    f. Locally Characteristic Fauna and Flora.

The key outcomes presented in this report are constant with the proposed targets of the local biodiversity strategy.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Mundijong Whitby Celll	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 1	SCALE	1 : 20 000		
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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3 Methodology

The description of the existing environment within the Mundijong Whitby District Structure Plan required the review and assessment of the following environmental factors.

1. Terrestrial flora;
2. Terrestrial fauna;
3. Landscape and landform;
4. Land degradation;
5. Wetlands, linear watercourses and groundwater dependant ecosystems;
6. Surface and ground water quality;
7. Site contamination;
8. Acid sulfate soils;
9. Odour;
10. Noise;
11. Aboriginal heritage; and
12. Non-indigenous heritage.

The methodologies employed for assessing each of these environmental factors are detailed in Appendix 1.

4 Overall Environmental State

4.1 State of the Environment Affected by the DSP

The Mundijong Whitby Cell (the Cell) covers an area of approximately 1,800 hectares (Figure 1) and is expected to accommodate about approximately 30,000 people by 2037. The Cell sits within the Swan Coastal Plain Bioregion and is dominated by vegetation of the Pinjarra Plain and Bassendean System, comprised of the Beermullah, Guildford and Forrestfield vegetation complexes. Due to the clearing of the Cell only remnants of the Guildford and Forrestfield vegetation complexes remain. These complexes are considered to be significant as there is currently less than 10 percent of their original extent remaining on the Swan Coastal Plain.

The Cell also contains 5 State listed Threatened Ecological Communities (TEC's), 2 of which are also protected under the EPBC Act (Table 18, Figure 4) (Appendix 4 and 5). These TEC's are located within the 4 Bush Forever Sites located within the Cell. These sites provide important ecological links and habitats for the remaining flora and fauna of the cell. Four water courses flow through the cell (Figure 18) and a total of 11 Environmental Protection Policy (EPP) wetlands occur. This report investigates the environmental aspects of the Cell and where necessary contains management actions and recommendations for further studies to minimise the effect of the DSP on the Cell's environment.

4.2 Factors Relevant to the DSP and Later Planning Stages

The five factors have been identified as being relevant to the DSP and later planning stages (Table 3).

TABLE 3. FACTORS RELEVANT TO THE DSP AND LATER PLANNING STAGES

Environmental Factor	Management Actions
Flora and Habitat Preservation	1. Where possible development should be located within existing cleared land to minimise the impact on remnant vegetation. 2. Where native vegetation is to be cleared, detailed floristic surveys should be undertaken prior to subdivision. These surveys should focus on declared rare and priority flora, vegetation structure, proximity to and connectivity with, other vegetation and a discussion of linkage values at a local and regional context. 3. The clearing of native vegetation should be prohibited unless authorised by a DEC Clearing Permit or is exempt under Schedule 6 of the *Environmental Protection Act 1986* or Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. 4. When undertaking subdivision building envelopes should be pegged for each proposed lot to ensure that the impact on remnant vegetation is minimised. 5. The following should be used to minimise inadvertent impacts during constructions: • use of clear signage; • provision of operator information; • fencing, where necessary; and • rehabilitation and stabilization of areas disturbed during construction 6. Roads and firebreaks are located such that fragmentation of remnant vegetation is prevented. 7. A Vegetation Management Plan should be prepared that details: • protected areas within the Cell • management practices for each area of remnant vegetation • details the ecological linkages within the cell • contains an approved planting list for gardens and public open space • offset requirements should native vegetation require clearing • weed management requirements for the Cell • hygiene requirements for soil imported into the cell.
Fauna Preservation	1. Prior to commencing work in areas of remnant vegetation, field investigations for Specially Protected (Threatened) Fauna should be undertaken in accordance with the EPA Guidance Statement No. 54, *Terrestrial Fauna Surveys for Environmental Impact*

Environmental Factor	Management Actions
	Assessment in Western Australia. If identified these species should be protected in accordance with the *Wildlife Protection Act 1950*. This should be addressed in a Fauna Management Plan. 2. Fauna Management Plans should be required when clearing areas of remnant vegetation. The plan should include provisions for retaining habitat trees where possible and the relocation of fauna species if necessary. 3. A comprehensive Fox Management Plan should be formulated by Shire of Serpentine-Jarrahdale in association with the development of MW Cell; 4. Consideration should be given to developing a Shire Pet Policy that could include: • prohibiting domestic cats and dogs from entering natural area reserves; • establishes buffer zones (e.g. cat buffer zones) around key natural assets; • limit the number of cats per household and/or • require cat owners to register their cat with the Shire.
Loss of Visual Amenity	1. Landscape Management Plans (LMP's) should be submitted to and approved by the Shire for all development within areas covered by the Shires Local Planning Policy 8 - Landscape Protection Area, then implemented prior to development. LMP's should contain provisions for minimising clearing, building heights, lot sizes, planting of fringing vegetation, building envelopes, adequate building setbacks and provision of public open space.
Wetlands and Water Courses	1. No development should occur within EPP Wetlands or their buffers. New subdivisions should ensure that Lot boundaries do not intersect EPP wetlands or their buffers and prospective purchasers of land containing an EPP Wetlands and/or it buffer should be made aware of development restrictions. 2. Where future subdivision has the potential to impact of Manjedal Brook a Foreshore Management Plan should be prepared by the sub-divider for approval by the WAPC. 3. All remnant vegetation, fringing vegetation and ecological linkages associated with the Cell's wetlands and water courses should be maintained. 4. Access to wetlands should be controlled/restricted by using paths, fences and gates. The exact nature of these measures should be determined during local structure planning. 5. There is to be no fill, fertiliser or chemical application, groundwater or wetland water abstraction, no waste disposal, excavation, or drainage into or out of EPP wetlands. Discharge of stormwater may be permitted into the wetland provided a Storm Water Management Plan is approved by the DoW. 6. Stormwater management plans should be produced at the Local Structure Planning Stage to ensure that any existing inappropriate stormwater disposal to wetlands or water courses are replaced and that stormwater management at the site is in accordance with the DoW's *Stormwater Management Manual* (DoE, 2004). 7. Where development is proposed near a wetland a Wetland Management plan should be prepared that details: • the wetland's buffer distance; • the proposed management of stormwater run-off into the wetlands; • the management of groundwater recharge; • any approved groundwater abstraction allowances; • any required rehabilitation of the wetland(s) • site monitoring; and • the management of Acid Sulphate Soils (where necessary).
Noise	1. Noise issues associated with the South Western Highway and the north-south railway should be addresses at the Local Structure Planning Stage. Prior to the redevelopment of areas adjacent to these transport corridors the sub-divider should provide a written undertaking to the WAPC that the purchaser will be notified of requirements to undertake noise studies and install measures to reduce noise impacts for any sensitive premises built within 200m. A similar requirement could be expected fro properties adjacent to the proposed Tonkin Highway extension.

4.3 Protecting the Environment from Development

The environmental factors relevant to the DSP and later planning Stages can be broken down into three groups:

1. Potential "Show Stoppers"
2. Factors that will require careful management; and
3. Localised factors that can be easily avoided.

4.3.1 Potential "Show Stoppers"

Potential "Show Stoppers" associated with the project include:

- Rare and priority flora
- Rare fauna
- Threatened Ecological Communities
- Wetlands and watercourses
- Acid Sulphate Soils; and
- Land Degradation Impacts

These factors have been overlaid on the land capability assessment for the Cell to identify areas where development can occur with little or no further development approvals (Figure 2). It is recommended that no development occurs in those areas where potential "show stopping" environmental factors occur.

4.3.2 Factors Requiring Careful Management

Factors requiring careful management that are associated with the project include:

- Impacts on Landscape and Landform
- Surface and groundwater quality
- Odour
- Noise
- Contaminated Sites

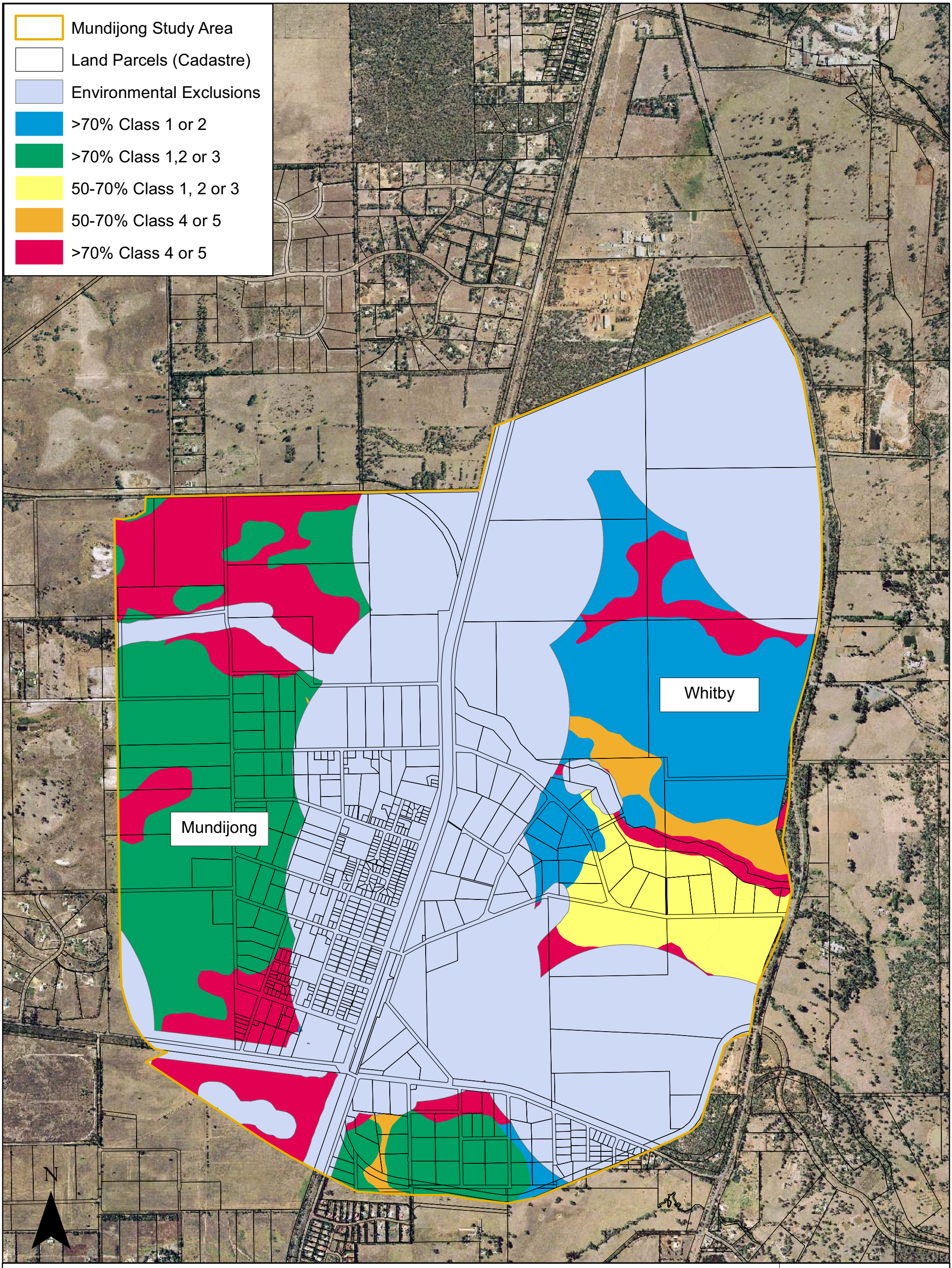
These factors and their management actions are discussed in the relevant sections of the report.

4.3.3 Easily Avoided Localised Factors

Localised factors that can be easily avoided include:

- Aboriginal Heritage
- Non-Indigenous Heritage

It is recommended that no development occur at heritage sites or heritage properties without first undertaking consultation with the Shire, Heritage Council of WA and/or the Department of Indigenous Affairs.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Land Capability and Environmental Exclusions	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 2	SCALE	1 : 20 000	SOURCE	Dept. of Conservation & Environment (2007)
DATE	18/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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4.4 Recommendations for Management and Further Studies

4.4.1 Management Actions

TABLE 4. MANAGEMENT OF IDENTIFIED IMPACTS ON FLORA

Impact	Management Actions
Loss of vegetation and habitat	1. Close Nornman Road and rehabilitate to join Bush Forever Sites 354 and 361 to create a significant conservation area. 2. No clearing of vegetation should occur within Bush Forever Sites 350, 354, 360, 362 and 365. Should clearing be required approval should be obtained from the relevant State and or Federal Government Department prior to clearing. 3. No changes should be made to the existing Bush Forever boundaries. 4. Offsets should be provided for all remnant vegetation that is cleared 5. Bush Forever sites 354, 360 (Watkins Road Bushland only) and 362 should remain fenced to prevent vehicle access. Where necessary fences should be upgraded. 6. To discourage the collection of firewood from bushland within the MW Cell the use of wood heaters in new properties constructed within the cell should be restricted or prohibited. 7. Ensure that firebreaks are established around all areas of remnant vegetation. 8. Erect signs to advise residents where to report any dumping they have observed. 9. Inspect road reserves on a regular basis and remove all dumped waste ASAP. 10. Fence off areas on the road reserve (where possible) where dumping reoccurs. 11. Once the ecological linkages within the MW Cell are finalised they should be incorporated into the local structure plan (LSP) by: a. identifying the areas of ecological linkages that occur in each the LSP; and b. outlining the specific management requirement that are required for these areas.
Loss of significant flora (DRF and TECs)	1. A flora survey should be undertaken prior to clearing any vegetation near known DRF populations. 2. Where possible, no vegetation should be cleared in TEC's or near known populations of DRF. Should clearing be required approval should be obtained from the relevant State and or Federal Government Department prior to clearing. If development is planned near a TEC, ground truthing is required to confirm the TEC boundary
Introduction of weeds and diseases	1. Establish an approved list of plant species for gardens within the MW Cell 2. Where possible, plants used in gardens and particularly median strips should at best be species native to the Swan Coastal Plain and at worst non-invasive exotic species. 3. Weed management within the cell should be integrated with vegetation rehabilitation for effective weed management results. Currently, weed management of declared plants such as the Arum Lily and Cottonbush are currently actively being carried out in the Shire of Serpentine and is set to continue. 4. All fill imported into the cell should be certified free of *Phytophthora cinnamomi*.

TABLE 5. MANAGEMENT OF IDENTIFIED IMPACTS ON FAUNA

Impact	Management Actions
Loss of significant fauna	2. Minimise habitat fragmentation by: • managing internal dynamics such as the disturbance regime (fire and weed invasion) and population dynamics of key organisms for the Bush Forever site on Norman Rd and Watkins Nature Reserve; and • focusing on managing external threatening processes and disturbance factors in other areas of remnant vegetation. 3. Maintain and rehabilitate vegetation corridors within the cell. 4. Where possible, significant hollow bearing trees located in cleared pasture land adjacent to Norman Rd Bushland should be preserved to facilitate the movement of fauna across the landscape and provide breeding and shelter resources for significant fauna. 5. A comprehensive fox management plan should be formulated by Shire of Serpentine-Jarrahdale in association with the development of MW Cell; 6. Consideration should be given to developing a Shire Pet Policy that could include: • prohibiting domestic cats and dogs from entering natural area reserves; • establishes buffer zones (e.g. cat buffer zones) around key natural assets; • limit the number of cats per household and/or • require cat owners to register their cat with the Shire.

TABLE 6. MANAGEMENT OF IDENTIFIED IMPACTS ON LANDSCAPE AND LANDFORM

Impact	Management Actions
Loss of visual amenity	1. Ensure that all developments within the Landscape Protection Area comply with Local Planning Policy 8 - Landscape Protection. 2. Ensure a Landscape Management Plan is submitted to and approved by the Shire for all areas within the Landscape Protection Area, prior to development and implemented. 3. Use larger Lot sizes and identify adequate setbacks and building envelopes during the local structure planning stage. 4. Preserve all fringing vegetation along railroads, roads, highways and the Landscape Protection Area. 5. Were possible plant fringing vegetation to shield new houses from existing railroads, roads and highways. 6. Plant trees/fringing vegetation to block the view to housing developments and maintain the view of the Darling Scarp. 7. Undertake a weed eradication program along road verges and rail tracks where practical. 8. Ensure that the current watercourses are maintained. 9. Ensure that the only modification of the cell's waterways is to rehabilitate them as living streams.

TABLE 7. MANAGEMENT OF IDENTIFIED LAND DEGRADATION IMPACTS

Impact	Management Actions
Increased phosphorous export	1. Any fill brought into the project area should maximise phosphorous retention time.
Increased risk of water erosion	2. Drainage should be designed to minimise the risk of erosion.
Increased risk of water logging	3. Any development must ensure that suitable fill material and drainage is established to prevent water logging from occurring.

TABLE 8. MANAGEMENT OF IDENTIFIED IMPACTS ON WETLANDS, LINEAR WATERCOURSES AND GROUNDWATER DEPENDANT ECOSYSTEMS

Impact	Management Actions
Degradation of EPP wetlands	1. If fill is to be imported it should: • have a high nutrient retention rate (where possible); and • maintain the appropriate permeability. 2. Residents should be educated in the use of slow release fertilisers. 3. Native vegetation should be encouraged in all new developments.
Loss of aquatic habitat	1. No vegetation should be cleared around wetlands or watercourses. 2. Wetlands or watercourses should be rehabilitated to restore them to living streams.
Changes in Hydrology	1. Determine the acceptable level of groundwater abstraction and hence the number of bores permitted and their abstraction rate. 2. Design all new developments to ensure maximum recharge of groundwater. 3. Rehabilitate existing watercourses and use them as living streams to remove stormwater from the area in accordance with the Department of Environment and Conservation (DEC's) Stormwater Management Manual and its revisions upon release.

TABLE 9. MANAGEMENT OF IDENTIFIED IMPACTS ON SURFACE AND GROUND WATER QUALITY

Impact	Management Actions
Increased stormwater run off	1. Develop a District/Local Water Management Strategy that complies with the *Peel-Harvey Coastal Catchment Water Sensitive Urban Design Technical Guidelines* (Peel Development Commission, 2006a) and *Stormwater Management Manual for Western Australia* (DoE, 2004) 2. Ensure the development design of the MW Cell to: • maximise the infiltration of stormwater; and • ensure unit discharge is representative of pre-development levels
Erosion of existing waterways	1. Drainage should be designed to minimise the risk of water erosion. 2. Rehabilitate the existing waterways within the cell and convert them to "living streams". 3. Maintain pre-development discharge rates.
Decrease in surface water quality	1. Develop a District/Local Water Management Strategy that complies with the *Peel-Harvey Coastal Catchment Water Sensitive Urban Design Technical Guidelines* (Peel Development Commission, 2006a) and *Stormwater Management Manual for Western Australia* (DoE, 2004) and its revision's upon release. 2. Rehabilitate the existing waterways within the cell and convert them to "living streams".
Decreased Groundwater Levels	1. Determine the acceptable level of groundwater abstraction and hence the number of bores permitted and their abstraction rate; 2. Design all new developments within the cell to ensure maximum recharge of groundwater. 3. Limit bore use within the MW Cell such that the acceptable groundwater abstraction rate is not exceeded.

TABLE 10. MANAGEMENT OF IDENTIFIED IMPACTS OF CONTAMINATION

Impact	Management Actions
Delays in planning approval due to contaminates located on some sites	1. Undertake a detailed site investigations for the Council Depot, decommissioned landfill and the Timber Mill and Plant should land uses changes be proposed for these sites. 2. Prior to development, further site investigations should be undertaken for the storage sheds associated with the Stockfeeds to determine the nature of any chemical storage and the extent of any potential contamination. 3. Further detailed investigations should be undertaken down gradient of the decommissioned mine on Lot 5 to identify potential contaminates and their impact of groundwater within the MW Cell.
Contaminants entering watercourse and the Peel Harvey Estuary	1. Prior to development further site investigations should be undertaken for the storage sheds associated with the Stockfeeds to determine the nature of any chemical storage and the extent of any potential contamination.
Contaminants entering groundwater and affecting human, fauna and flora health	1. Further detailed investigations should be undertaken down gradient of the mine to identify potential contaminates and their impact of groundwater within the MW Cell.

TABLE 11. MANAGEMENT OF IDENTIFIED IMPACTS OF ACID SULFATE SOILS

Impact	Management Actions
Disturbance of Potential or Actual Acid Sulphate Soils	1. Should excavation be required in the vicinity of the wetlands on Soldiers Road (Wetlands B and C) a further ASS investigation should be undertaken. 2. Should excavations deeper than 3 m be required further ASS investigations should be conducted in these areas. 3. Any groundwater abstraction from the cell should not be exceed levels that would result in the exposure of PASS or ASS.

TABLE 12. MANAGEMENT OF IDENTIFIED IMPACTS OF ODOUR

Impact	Management Actions
Odour emissions received at odour sensitive sites	1. No odour sensitive development should occur within the buffer zones of existing odour emitting premises. 2. No new odour emitting premises should be constructed such that existing odour sensitive premises are within the buffer zone. 3. Any new properties requiring the addition/inclusion of stables will need to submit a Land Management Plan to the Shire.

TABLE 13. MANAGEMENT OF IDENTIFIED IMPACTS OF NOISE

Impact	Management Actions
Noise emissions received at noise sensitive sites	1. No noise sensitive development should occur within the buffer zones of existing noise emitting premises. 2. No new noise emitting premises should be constructed such that existing noise sensitive premises are within the buffer zone.

TABLE 14. MANAGEMENT OF IDENTIFIED IMPACTS ON ABORIGINAL HERITAGE

Impact	Management Actions
Loss of aboriginal heritage values	1. Should any of the Aboriginal heritage sites identified in this report be subject to disturbance as a result of MWDSP, the Shire should undertake consultation with the South West Land & Sea Council (SWLASC) and Department of Indigenous Affairs (DIA). 2. Should the southeast of the study area be subject to development under MWDSP further ethnographical and archaeological surveys.

TABLE 15. MANAGEMENT OF IDENTIFIED IMPACTS ON NON-INDIGENOUS HERITAGE

Impact	Management Actions
Loss of non-indigenous heritage values	To prevent the loss of non-indigenous heritage within the MW Cell the following actions should be undertaken: 1. Refer the following sites to the Heritage Council for possible inclusion in the Heritage Register: a. Whitby Falls Coach House b. Manjedal School 2. Update the TPS to include the following sites: a. Manjedal School b. Masonic Hall c. Mundijong Uniting Church d. Railway Cottage e. Road Board Building 3. Incorporate the following properties into a heritage precinct within the TPS: a. Residence (Mundijong Rd cnr Adonis Rd) b. Whollogan's Bakers 4. Any development applications for properties listed or recommended for listing in the TPS should be considered by the Council.

4.4.2 Recommendations for Further Investigations

Ten recommendations for further investigations within the MW Cell have been identified. It should be noted that most of these investigations will not be required prior to the development of the cell, except under specific circumstances.

1. A flora survey should be undertaken prior to clearing any vegetation near known DRF populations;
2. If development is planned near a TEC, ground truthing is required to confirm the TEC boundary;
3. A groundwater study should be undertaken to determine the acceptable level of groundwater abstraction and hence the number of bores permitted within the MW Cell and their abstraction rate;
4. Undertake detailed site investigations for the Council Depot, decommissioned landfill and the Timber Mill and Treatment Plant should land uses changes be proposed for these sites;
5. Prior to development further site investigations should be undertaken for the storage sheds associated with the Stockfeeds to determine the nature of any chemical storage and the extent of any potential contamination;
6. Further detailed investigations should be undertaken down gradient of the decommissioned mine on Lot 5 to identify potential contaminates and their impact of groundwater within the MW Cell;
7. Should excavation be required in the vicinity of the wetlands on Soldiers Road (Wetlands B and C) a further ASS investigation should be undertaken;
8. Should excavations deeper than 3 m be required further ASS investigations should be conducted in these areas;
9. Should any of the Aboriginal heritage sites identified in this report be subject to disturbance as a result of MWDSP, the Shire should undertake consultation with the South West Land & Sea Council (SWLASC); and
10. Should the southeast of the study area be subject to development under MWDSP further ethnographical and archaeological surveys.

5 Terrestrial Flora

5.1 Background

The Cell is part of the Southwest Botanical Province which is considered a global biodiversity hotspot (DEC, 2006d). The Cell sits within the Swan Coastal Plain Bioregion and is dominated by vegetation of the Pinjarra Plain and Bassendean System. Vegetation of the Pinjarra Plain in the study site is represented by *Corymbia calophylla* (marri) open forest and the Bassendean System by banksia low woodland, generally *Banksia attenuata* (slender banksias), *Banksia menziesii* (firewood banksias), *Banksia ilicifolia* (holly leaf banksias), *Eucalyptus todtiana* (coastal blackbutt) and *Nuytsia floribunda* (Christmas tree).

Based on a desktop review of flora and vegetation surveys conducted within the study area from Department of Environmental Protection (DEP), 1995; Cardno BSD, 2006a; Cardno BSD 2006a; Maunsell, 2006; Syrinx, 2006; Keighery, 1996; and Keighery and Trudgen, 1992 a comprehensive list of taxa within the study site was compiled (Appendix 2).

The flora surveys identified 393 taxa, comprising 55 families and 183 genera within the MW Cell. The cell is represented mainly by species of families typical of the Swan Coastal Plain Subdistrict (Beard, 1981), namely Proteaceae (Proteas), Poaceae (Grasses) and Myrtaceae (Myrtles) and Papilionaceae (legume) families. A total of 59 introduced (weed) species were identified which were dominated by the Poaceae (grasses) and Asteraceae (daisies) families.

The MW Cell has been extensively surveyed with sufficient data collected to permit a comprehensive desktop review of the cell, without the need of a detailed spring survey. The comprehensive desktop review was supported by opportunistic flora surveys conducted during field visits on the 17th and 30th of October, and the 4th of December, 2007.

5.1.1 Gaps in Data

The following information gaps in flora data were identified:

1. Vegetation Condition

There is a lack of up to date information to describe vegetation and condition. An up to date description was not available for the entire Study Site. For the purposes of this study vegetation condition was based on surveys conducted in the study area (Keighery and Trudgen 1992, Keighery 1996) and a visit to each area of remnant vegetation (Figure 7).

The Shire is currently in the process of addressing this gap through implementing its Local Biodiversity Strategy. Local Natural Areas and selected Bush Forever sites will be assessed by aerial photography and /or site visit to determine if a sufficient understorey is present to be deemed a Verified Natural Area. In addition, all reserves with natural areas in the Shire will be assessed using the Natural Area Initial Assessment (NAIA) templates; however, this is unlikely to be completed until 2008 (pers com., Chris Portlock, 2007).

After completion of the NAIA templates, the following information will be obtained:

- Vegetation extent by planning category
- Percentage remnants of each complex within the study area as compared to the Shire and the SCP
- Vegetation condition

This should then be used to review the protection priority for all remnant vegetation within the MW Cell.

2. Weeds

There are presently no maps of invasive or declared environmental weeds within the MW Cell. This data is necessary to prepare a weed management plan for the cell.

5.2 Rare and Priority Flora

Threats of species extinction are recognised at two levels:

1. Commonwealth – Flora is protected under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act*, 1999 which is administered by the Department of Environment Water, Heritage and the Arts (DEWHA); and
2. State – Flora is protected under the *Wildlife Protection Act, 1950* which is administered by the Department of Environment and Conservation (DEC).

The *EPBC Act and the Wildlife Protection Act* both identify a series of categories of threatened flora (Appendix 3).

An EPBC Act Protected Matters Report (DEWHA, 2007a; Appendix 4) and a DEC Declared Rare and Priority Flora Search (DEC, 2007b; Appendix 5) identified a total of 13 species of threatened flora with the potential to occur within the MW Cell (Table 16).

TABLE 16. THREATENED FLORA SPECIES WITH THE POTENTIAL TO OCCUR WITHIN THE MW CELL

Species	DEC Declared Rare and Priority list	EPBC Act Listing
Verticordia plumose var. *pleiobotrya* A.S.George	DRF	Endangered
Centrolepis caespitosa	4	Endangered
Tetraria australiensis C.B.Clarke	DRF	Vulnerable
Acacia lasiocarpa var. *bracteolata long, peduncle variant* (GJ Keighery 5026)	1	N/A
Schoenus pennisetis	1	N/A
Synaphea odocoileops	1	N/A
Synaphea sp. *Pinjarra plain* (AS George 17182)	1	N/A
Johnsonia pubescens subsp. *cygnorum*	2	N/A
Aotus cordifolia	3	N/A
Caladenia huegelii	DRF	Endangered
Drakaea elastica	DRF	Endangered
Drakaea micrantha Hopper & A.P.Brown nom. inval	DRF	Vulnerable
Lasiopetalum pterocarpum	DRF	Endangered
Lepidosperma rostratum	DRF	Endangered
Thelymitra stellata	DRF	Endangered

A total of three DRF and one Priority Flora species were identified in the MW Cell (Table F2, Figure 3). The DEC search (Appendix 5) identified the locations of 3 DRF species (*Verticordia plumosa* var. *pleiobotrya*, *Tetraria australiensis*, *Drakea elastica*) and 1 Priority 3 species (*Baeckea* sp. Perth Region)) within the study site (Figure 3).

TABLE 17. THREATENED FLORA SPECIES KNOWN TO OCCUR WITHIN THE MW CELL

Species	DEC Declared Rare and Priority list	EPBC Act Listing
Verticordia plumosa var. *pleiobotrya* A.S.George	DRF	Endangered
Tetraria australiensis C.B.Clarke	DRF	Vulnerable
Drakea elastica	DRF	Endangered
Baeckea sp. (Perth Region)	Priority 3	N/A

The desktop review also noted that the DRF *Calectasia cyanea* R.Br. (blue tinsel lily) was recorded in surveys by Keighery and Trudgen, 1992 and Keighery 1996. Historically *Calectasia cyanea* was

thought to be widespread throughout south-west Western Australia as it was mistaken for *Calectasia narragara*. It is now known that true blue tinsel lily (*Calectasia cyanea*) is confined to a small area south of Albany (DEWHA, 2008) and does not occur in the MW Cell.

The WA Herbarium list was not used in the mapping of DRF locations as the recorded sightings were opportunistic and have not been confirmed. The WA Herbarium list was therefore not considered sturdy data (pers com. Bridgette Long, DEC, 2007).

5.3 Threatened Ecological Communities (TEC's)

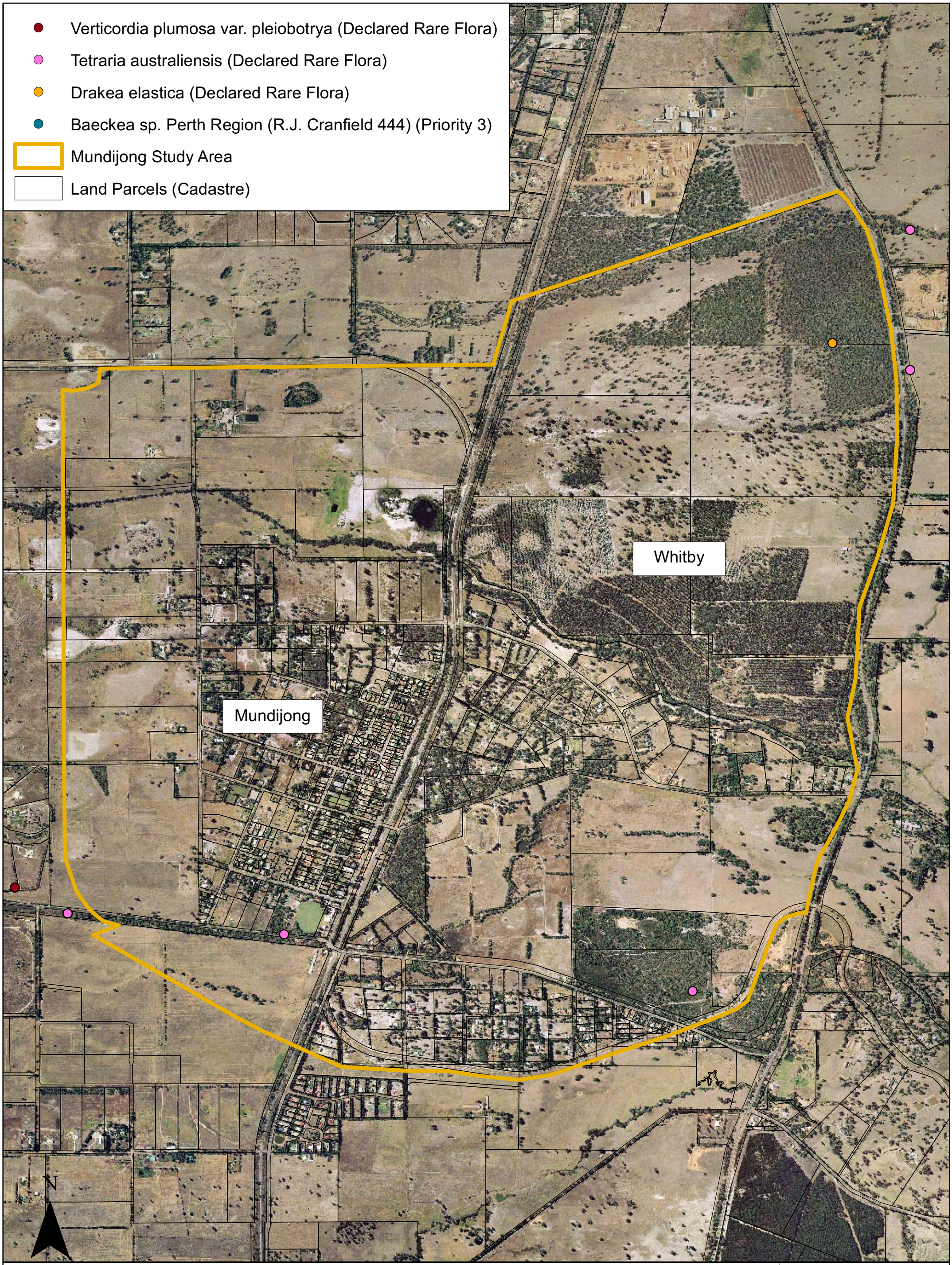
Threatened Ecological Communities (TECs) and their associated threat category are assessed by the DEC (Appendix 6). TEC's are identified by the floristic community type (FTC) classification which has been identified and classified based on species composition across the Swan Coastal Plain (Gibson et al. 1994). TEC's are considered to be "environmentally sensitive areas" and are protected under the *Environmental Protection Act,* 1986 (WA). Scheduled TEC's can also be further protected at the Commonwealth level under the EPBC Act.

There are 5 State listed TEC's within the MW Cell, 2 of which are also protected under the EPBC Act (Table 18, Figure 4) (Appendix 4 and 5). The DEC has allocated a buffer distance to each occurrence of a TEC (Table 18, Figure 4). Buffers are the minimum outermost point in the TEC occurrence. Where the TEC is a wetland, the buffer distance incorporates the minimum area to protect the wetland from developments with potential to impact hydrology (pers com. Val English, DEC). Calculating buffers required to protect wetlands is a complex exercise and is further complicated by other factors, primarily on the intended land use. The boundaries of TEC's (Figure 4) are approximated from DEC's database. For most cases, the boundaries are derived from field checking, satellite imagery, soil and vegetation maps (pers com. Val English and Monica Hunter, DEC, 2007). However, if development is planned near a TEC, ground truthing is required to confirm the TEC boundary.

All TEC's in the MW Cell are located in Bush Forever sites. Bush Forever sites are protected at the State level under the *State Planning Policy 2.8 Bushland Policy for the Perth Metropolitan Region (Draft) (WAPC, 2004)*. TEC's are defined as "environmentally sensitive areas" under then *Environmental Protection (Clearing of Native Vegetation) Regulations, 2004* (Clearing Regulations). Any clearing proposals for an environmentally sensitive area (Figure 5) will need to be prepared under a specific permit and environmental impact assessment (EIA) may be required (DEC, 2007a).

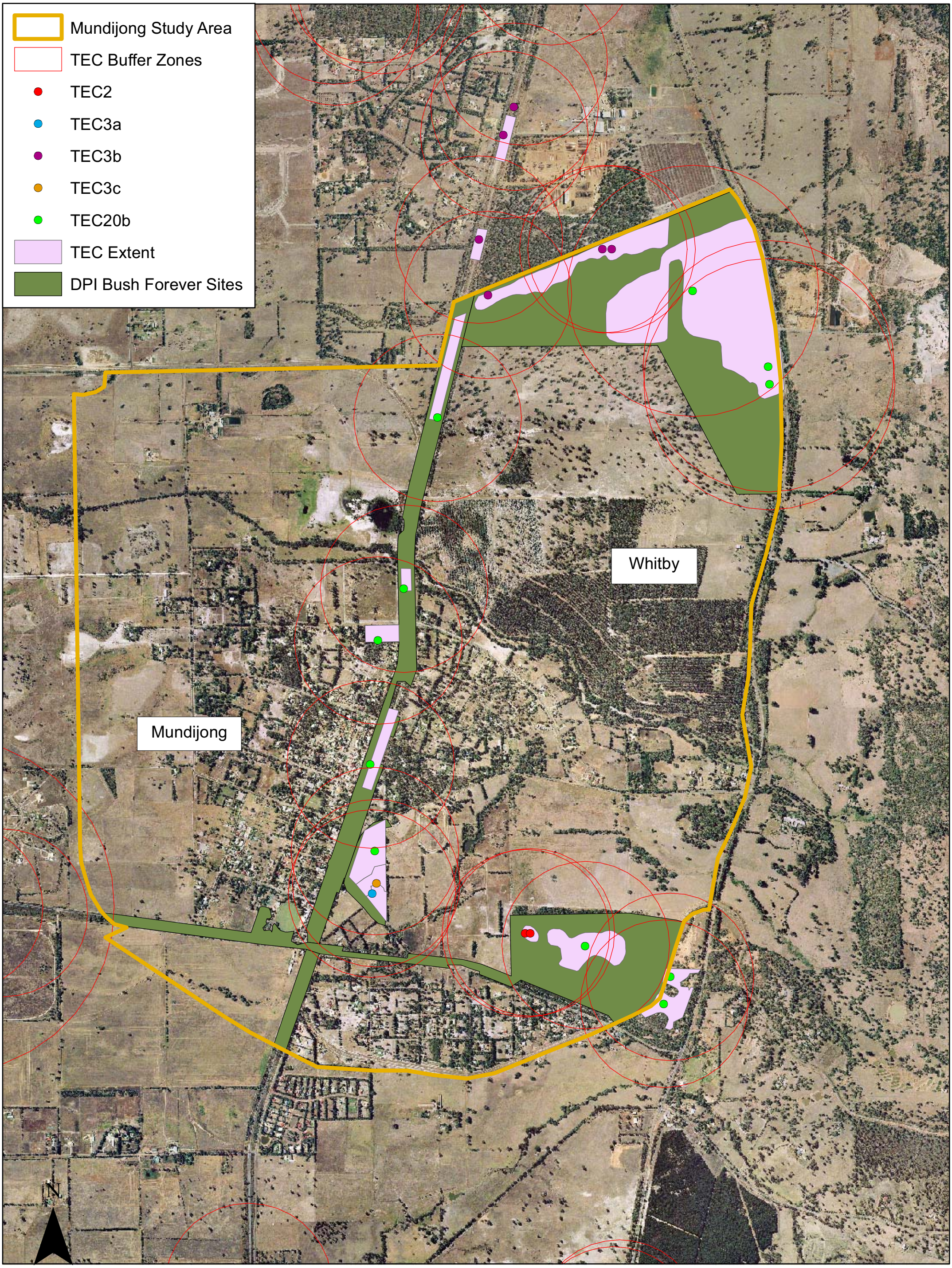
TABLE 18. TEC'S WITHIN THE MW CELL

Floristic Community Type	TEC Description (Gibson et al, 1994)	DEC Ranking	EPBC Ranking	DEC Occurrence Number	Required Buffer
2	Southern wet shrublands, Swan Coastal Plain	Endangered	N/A	27	500m
3a	*Corymbia calophylla - Kingia australis* woodlands on heavy soils of the Swan Coastal Plain	Critically Endangered	Endangered	11	500m
3b	*Corymbia calophylla - Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain	Vulnerable	N/A	13, 14, 22	500m
3c	*Corymbia calophylla-Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain	Critically Endangered	Endangered	8	500m
20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain	Endangered	N/A	7, 8, 9, 10, 11, 25, 26	500m



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Rare & Priority Flora	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	Luc M Cotte
FIGURE No.	Figure 3	SCALE	1 : 20,000	SOURCE	Dept. of Environment & Conservation (2007)
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	TEC's, Buffers & Bush Forever Sites	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 4	SCALE	1 : 20 000	SOURCE	Dept. of Environment & Conservation (2007)
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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Mundijong Study Area

Land Parcels (Cadastre)

Environmentally Sensitive Areas

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	DEC - Environmentally Sensitive Areas	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 5	SCALE	1 : 20 000	SOURCE	Dept. of Conservation & Environment (2007)
DATE	19/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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5.4 Weed species

A total of 59 species recorded are weeds, four of these, *Echium plantagineum* (Paterson's Curse), *Gomphocarpus fruticosus* (Narrow Leaf Cottonbush), *Moraea flaccida* (Cape Tulip) and *Zantedeschia aethiopica* (Arum Lily) are Declared Plants under the *Agriculture and Related Resources Act 1976.* Under the act, landholders are required to prevent the spread of declared weeds through control measures. Recommended control measures are described in Appendix 7. Currently, weed management of declared plants such as the Arum Lily and Cottonbush are currently actively being carried out in the Shire of Serpentine and is set to continue (Appendix 8).

5.5 Vegetation Complexes

The MW Cell originally contained the Beermullah, Guildford and Forrestfield vegetation complexes. However due to the clearing of the site there are only remnants of the Guildford and Forrestfield vegetation complexes remaining within the cell (Table 19, Figure 6).

TABLE 19. VEGETATION COMPLEXES WITHIN THE STUDY AREA (WAPC, 2000)

Vegetation Complex	Description (Heddle at al, 1980)
Forrestfield	Vegetation ranges from open forest of *E. calophylla – E. wandoo – E. marginata* to open forest of E. *marginata – E. calophylla – C. fraseriana – Banksia* species. Fringing woodland of *E. rudis* in the gullies that dissect this landform.
Guildford	A mixture of open forest to tall open forest of *E. calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components included *E. rudis – M. rhaphiophylla*. Swan Complex: Fringing woodland of *E. rudis – M. rhaphiophylla*.

Vegetation complexes are considered to be significant if there is currently less than 10 percent (current extent / original extent) x 100) remaining. Any developments that are likely to impact on significant vegetation complexes will trigger the formal EIA process under the *Environmental Protection Act, 1986* as outlined in *EPA Guidance Statement No. 10* (Environmental Protection Authority (EPA), 2003a).

5.5.1 Forrestfield Vegetation Complex

The Forrestfield complex is significant as only 9 percent remains on the Swan Coastal Plain and only 3 percent of the original extant remains within the Shire (Table 20). The MW Cell contains approximately 59 percent (Calculated by: Current Extent in Study Area / Current Extent in Shire (ha) [% current extent x original extent]) of the Shire's Forrestfield Complex, most of which is contained within Bush Forever sites and EPP wetlands. This represents a significant area of the Forrestfield vegetation complex within the Shire.

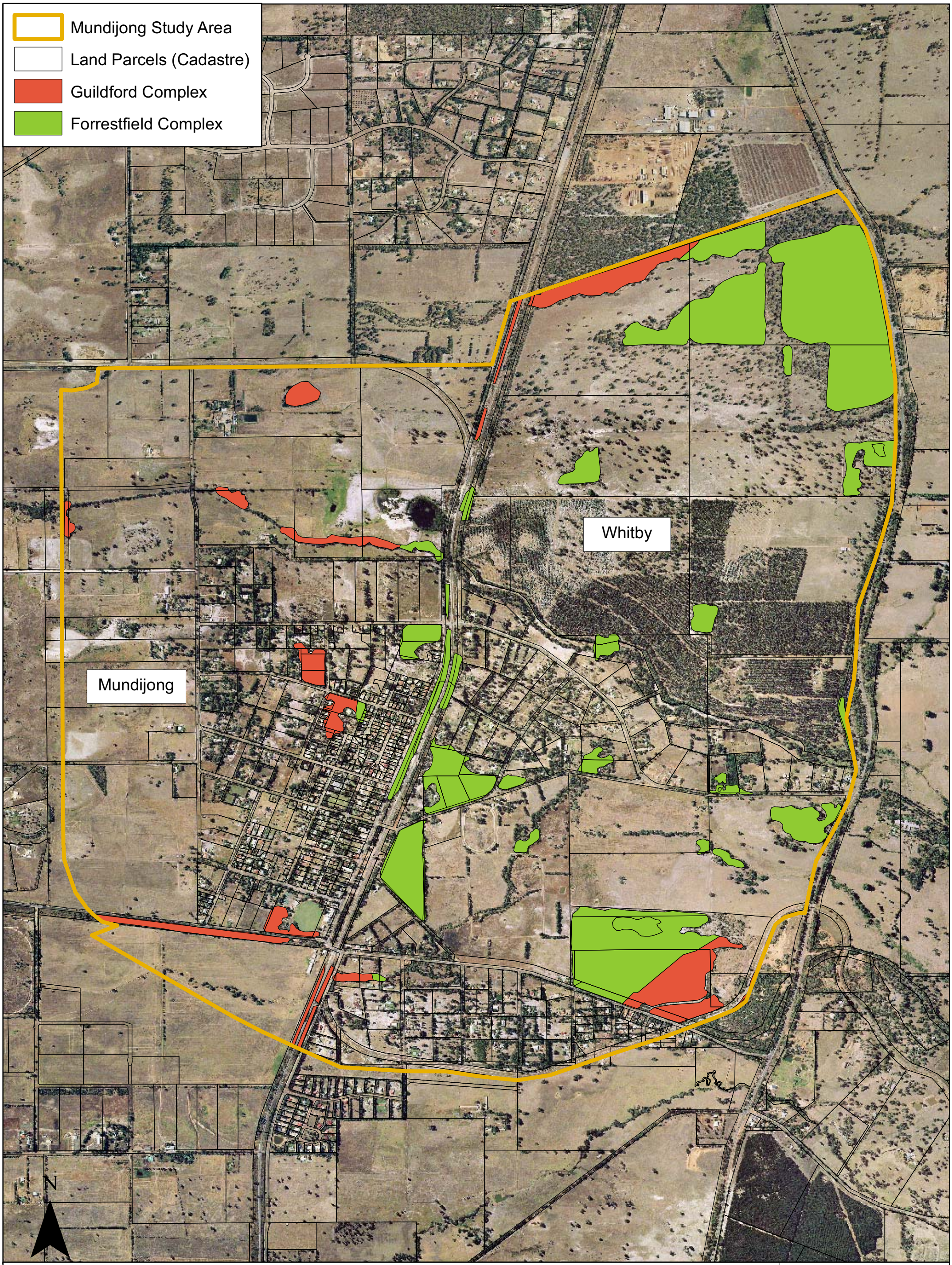
5.5.2 Guildford Vegetation Complex

The Guildford complex is significant as only 6 percent remains on the Swan Coastal Plain and only 5 percent of the original extant remains within the Shire (Table 20). The MW Cell contains approximately 6.3 percent of the Shire's Guildford Complex, most of which is contained within Bush Forever sites and EPP wetlands. This represents a significant area of the Guildford vegetation complex within the Shire.

TABLE 20. CURRENT AREAS AND PROTECTION OF VEGETATION COMPLEX IN THE MW CELL

Vegetation Complex	Extent Remaining on the Swan Coastal Plain[a]	Original extent in Shire[b]	Present Extent in Shire[b]	Extent currently protected in the Shire[b]	Shire's proposed protection target[b]	Current extent in the Study Area 2006[c]
Forrestfield	9%	4,128ha	248ha (3%)	145ha (2%)	101ha (70%)	147ha (59.3%)
Guildford	6%	13,244ha	662ha (5%)	347ha (3%)	96ha (27%)	42ha (6.3%)

Source: [a]WAPC, 2000; [b]Ironbark Environmental, 2007; [c]Area each remnant vegetation complex in the cell.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Vegetation Complexes	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 6	SCALE	1 : 20 000	SOURCE	Perth Biodiversity Project (2001)
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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5.6 Remnant Vegetation and Condition

The Cell contains approximately 189 ha of remnant native vegetation made up of the Forrestfield and Guildford vegetation complexes. Based on previous vegetation surveys 13 Floristic Community Types (FCT) have been identified within the MW Cell (Table 21).

With approximately 88.7 percent of the Study Area cleared, all remnant vegetation regardless of condition is significant. The remnant vegetation remaining in the Study Site is generally restricted to Bush Forever sites, namely sites 354, 350, 362 and 360 (Figure 4). The vegetation condition for these sites is mostly good to excellent condition. Remnant vegetation outside of the Bush Forever sites is generally in a degraded or completely degraded condition (Figure 7). The vegetation condition classification used is per Keighery 1996 (Appendix 9).

A proposed Local Biodiversity Action item (Shire of Serpentine Jarrahdale, 2007b) is to assess all 28 reserves with natural areas using the Natural Area Initial Assessment (NAIA) templates. In the interim, based on surveys conducted in the study area (Keighery and Trudgen 1992, Keighery 1996) and a visit to each area of remnant vegetation, a description area and vegetation condition was made (Figure 7). As these surveys were conducted in the early to mid nineties, it is likely that changes in vegetation condition have occurred, most likely deleteriously as noted in a 2006 flora survey conducted by Maunsell (Maunsell, 2006).

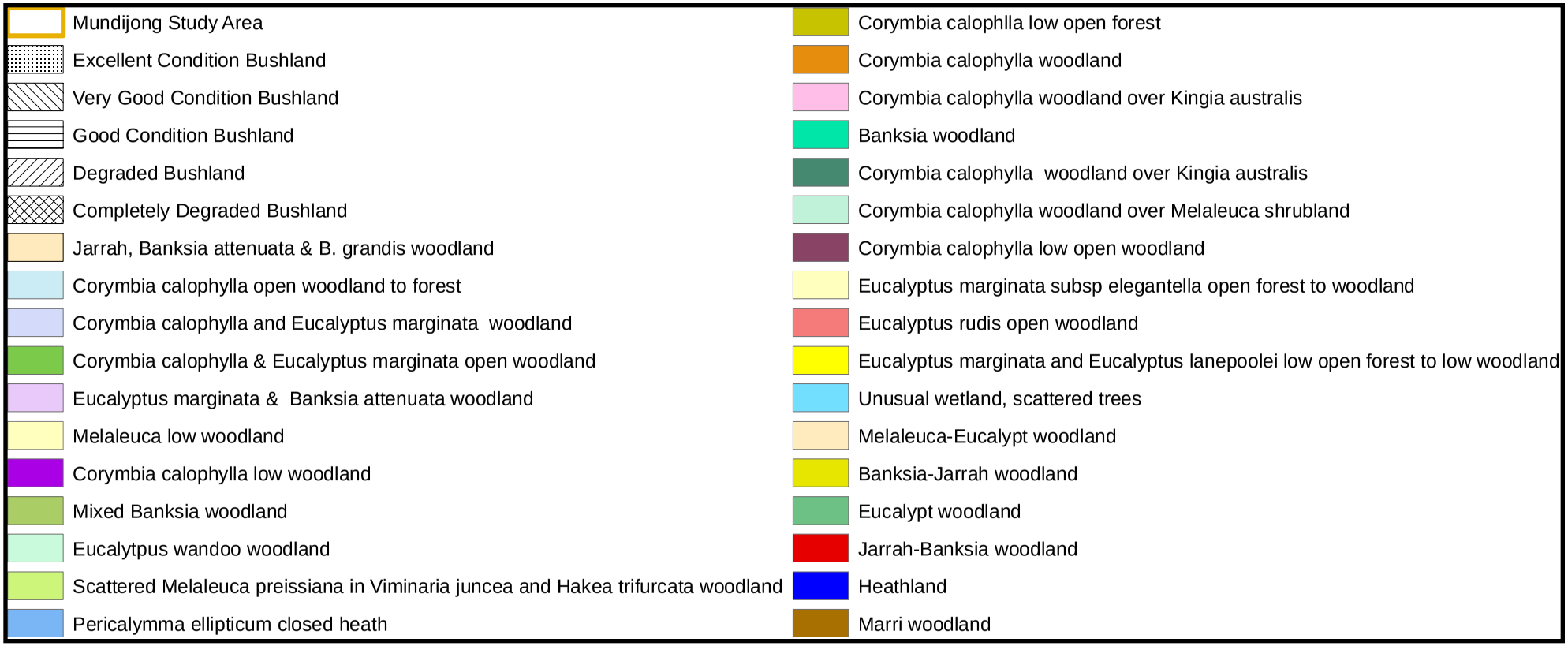
TABLE 21. FLORISTIC COMMUNITIES WITHIN THE MW CELL

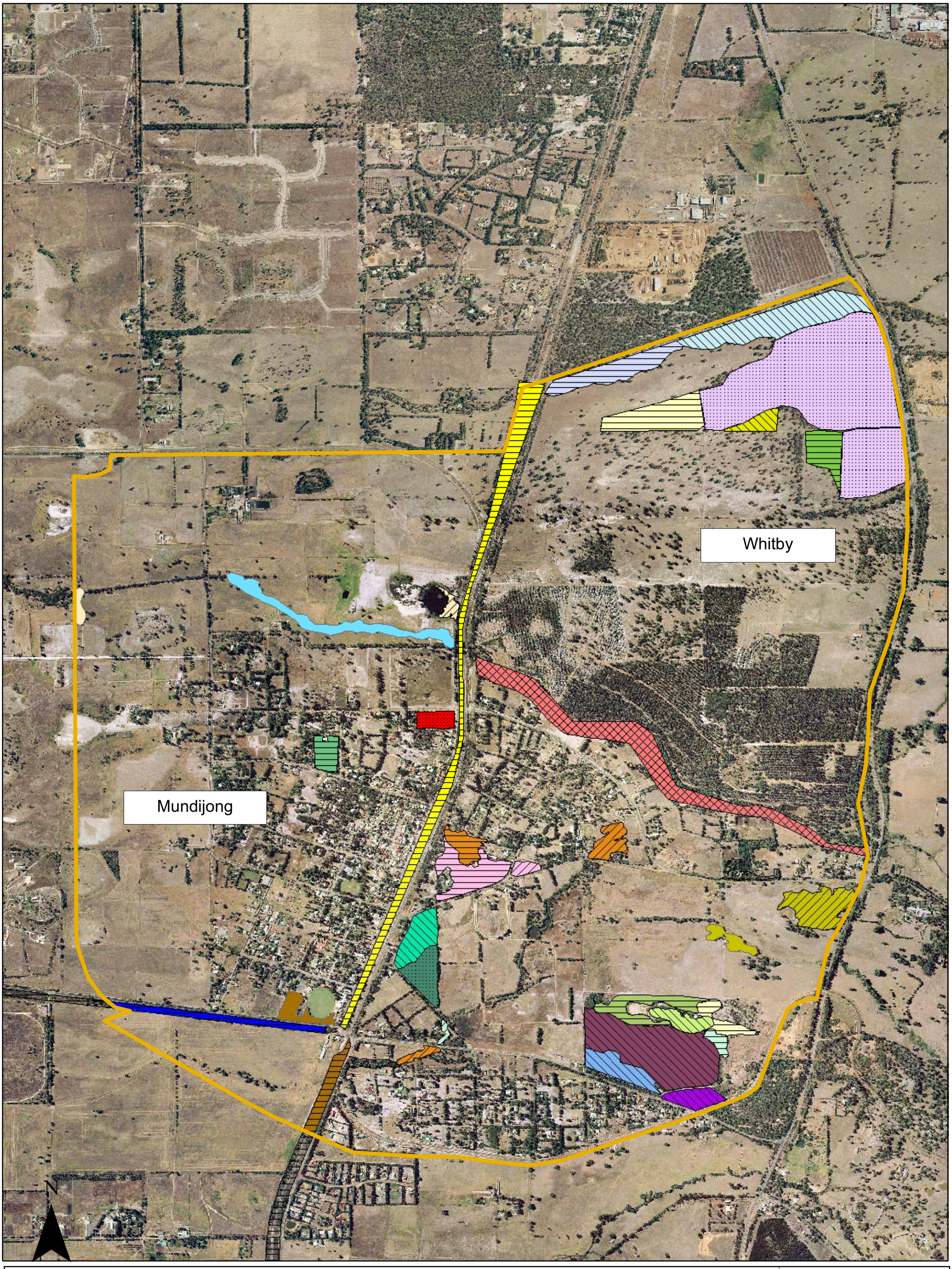
Floristic Community Type	Description (WAPC, 2000)
2	Southern wet shrublands, Swan Coastal Plain
3a	*Corymbia calophylla* - *Kingia australis* woodlands on heavy soils of the Swan Coastal Plain
3b	*Corymbia calophylla* - *Eucalyptus marginata* woodlands on sandy clay soils of the southern Swan Coastal Plain
3c	*Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands, Swan Coastal Plain
8	Herb rich shrublands in clay pans
S8	*Eucalyptus wandoo* woodlands (Scarp)
9	Dense scrublands on clay flats
10a	Shrublands on dry clay flats
11	Wet forests and woodlands
20b	*Banksia attenuata* and/or *Eucalyptus marginata* woodlands of the eastern side of the Swan Coastal Plain
20c	Eastern Shrublands and woodlands
21a	Central *Banksia attenuata – Eucalyptus marginata* woodlands
23a	Central *Banksia attenuata – Banksia menziessii* woodlands

5.6.1 Regionally Significant Natural Areas

Regionally Significant Natural Areas in the Study Site are identified as Bush Forever Sites (Figure 4). Bush Forever Sites are identified as bushland of a vegetation complex with only 400 hectares or less than 10 percent (whichever is the greater) remaining in the Bush Forever Study Area WA Planning Commission (WAPC, 2000). It should be noted that other natural areas of regional significance have not been formally identified by the State Government within the Bush Forever Study Area.

The principal objective of Bush Forever is to provide a guide for landowners, developer and the community to implement protection to lots that have been clearly distinguished as a Bush Forever site. The statutory policy framework that oversees Bush Forever is a Statement of Planning Policy (SPP) under the *Planning and Development Act 2005*.


Mundijong Study Area
Excellent Condition Bushland
Very Good Condition Bushland
Good Condition Bushland
Degraded Bushland
Completely Degraded Bushland
Jarrah, Banksia attenuata & B. grandis woodland
Corymbia calophylla open woodland to forest
Corymbia calophylla and Eucalyptus marginata woodland
Corymbia calophylla & Eucalyptus marginata open woodland
Eucalyptus marginata & Banksia attenuata woodland
Melaleuca low woodland
Corymbia calophylla low woodland
Mixed Banksia woodland
Eucalytpus wandoo woodland
Scattered Melaleuca preissiana in Viminaria juncea and Hakea trifurcata woodland
Pericalymma ellipticum closed heath
Corymbia calophlla low open forest
Corymbia calophylla woodland
Corymbia calophylla woodland over Kingia australis
Banksia woodland
Corymbia calophylla woodland over Kingia australis
Corymbia calophylla woodland over Melaleuca shrubland
Corymbia calophylla low open woodland
Eucalyptus marginata subsp elegantella open forest to woodland
Eucalyptus rudis open woodland
Eucalyptus marginata and Eucalyptus lanepoolei low open forest to low woodland
Unusual wetland, scattered trees
Melaleuca-Eucalypt woodland
Banksia-Jarrah woodland
Eucalypt woodland
Jarrah-Banksia woodland
Heathland
Marri woodland



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Vegetation Communities & Bushland Condition	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 7	SCALE	1 : 20 000	SOURCE	Shire of Serpentine-Jarrahdale (2007)
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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Bush Forever Site 350
One of the most significant areas of remnant vegetation, recognised by the Shire of Serpentine-Jarrahdale is the Soldiers Road flora road (Shire of Serpentine-Jarrahdale 1992, Keighery 1996c cited from WAPC, 2000). With Bella Cumming Reserve this flora road forms Bush Forever Site 350. The flora road is a significant vegetation asset as it contains a north-south transact of plant communities which is representative of the eastern side of the Swan Coastal Plain (WAPC, 2000). Bush Forever Site 350 also contains 3 TECs (Figure 4).

The vegetation condition along Soldiers Road ranges from 50 percent excellent to very good, to 50 percent good to completely degraded, with areas of localised disturbance (Keighery, 1996, cited from WAPC, 2000). The vegetation for the Bella Cumming Reserve was considered excellent to very good (Figure 7).

Bush Forever Site 354
Bush Forever Site 354 contains 2 TECs (Figure 4). The condition of the vegetation was found to be 90 percent excellent to very good and 10 percent good (Keighery and Trudgen 1992, cited from WAPC 2000).

The boundary of Bush Forever Site 354 has been successfully renegotiated with the WAPC (Bush Forever branch) by Urban Pacific, despite a separate opposing assessment commissioned the Shire of Serpentine Jarrahdale (Syrinx, 2006). The renegotiation has resulted in a 16.5 percent reduction to the site's original area, primarily within the buffer of TEC 20b. The potential exists combine this site with Bush Forever Site 361 by closing and rehabilitating Norman Road. This would result in the creation of a very significant conservation within the North of the Cell.

Bush Forever Site 360
Bush Forever site 360 contains plant communities representative of the eastern side of the Swan Coastal Plain that are considered to be regionally significant (WAPC, 2000) and 4 TECs (Figure 4).

The vegetation condition of the site is considered to be 50 percent excellent to very good and 50 percent good to completely degraded (Figure 7) with areas of severe localized disturbance (Keighery 1996 and Keighery et al 1997 cited from WAPC, 2000).

Recently, DEC's attention to improving the management of Bush Forever sites has been drawn and included weed eradication programs and general on-ground management.

On the 18th December 2007 the Watkins Road Nature Reserve (located within Bush Forever Site 360) was allocated funding from the State Government's *Saving our Species* Initiative (Appendix 8). This funding is for priority conservation management measures within the reserve included weed removal, removal of illegally dumped rubbish, closure of unused tracks, vegetation rehabilitation and installation of signage and fencing to prevent disturbance by four wheel drive vehicles on unauthorized tracks.

Bush Forever Site 362
Bush Forever Site 362 contains plant communities representative of the eastern side of the Swan Coastal Plain (WAPC, 2000) and 3 TECs (Figure 4). The condition of the vegetation was found to be 90 percent very good to good and 10 degraded (Keighery and Trudgen, 1992; cited from WAPC, 2000).

5.6.2 Locally Natural and Significant Areas

Natural areas are any physical area that contains native species or ecological communities in a relative natural state and hence contains biodiversity (Perth Biodiversity Program (PBP, 2004). Local Natural Area (LNAs) are natural areas that are outside DEC Managed Estates, Regional Parks and Bush Forever sites. Locally Significant Natural Areas (LSNAs) are verified Local Natural Areas that fulfill one or more ecological criteria for local significance. LSNAs are verified by undertaking a field assessment of the site.

At the time of preparing this report, the Shire's Local Biodiversity Strategy (Ironbark Environmental and Sustainable Development, 2007) was at the discussion paper stage. As a result LSNAs had not yet been identified or confirmed. The final LSNA's for the Cell should include Bush Forever Sites 350, 354, 360 and 362 (Figure 4); and those areas of the Cell protected under the Shire's Local Planning Policy 8 - Landscape Protection (Figure 10).

5.6.3 Ecological linkages

Ecological linkages or corridors are natural areas with varying degrees of fragmentation that assist in the movement of fauna and flora. Ecological linkages are achieved when small natural areas are used to connect larger natural areas by forming "stepping stones" to assist the movement of organisms between the larger areas over time. Regional ecological linkages, identified at the State level, and local ecological linkages, described by the Shire, are important to improve the viability of vegetation communities that would normally be too small to be viable if it remained isolated (WALGA & PBP Guidelines, 2004).

Ecological linkages are important as they allow for the movement of wildlife between isolated patches of bushland, particularly movement across the Swan Coastal Plain in an east-west or north-south direction. This provides greater access to potential breeding partners, new habitats and food sources. The movement of animals from one area of remnant of bushland to another also helps maintain genetic diversity in plant communities through distribution of pollen and seed.

Corridors also play a part in reducing the impact of multiple disturbances, such as fire; weed invasion; rubbish dumping; feral animals and climate change (Ironbark Environmental and Sustainable Development, 2007); by minimising isolation of the remnant bushland. A relatively new environmental threat, climate change will see predicted movement of the climate belt in southerly direction with ecological linkages likely play a significant role in facilitating the movement of flora and fauna (Hobbs and Hopkins 1991, cited from Tingay 1998a).

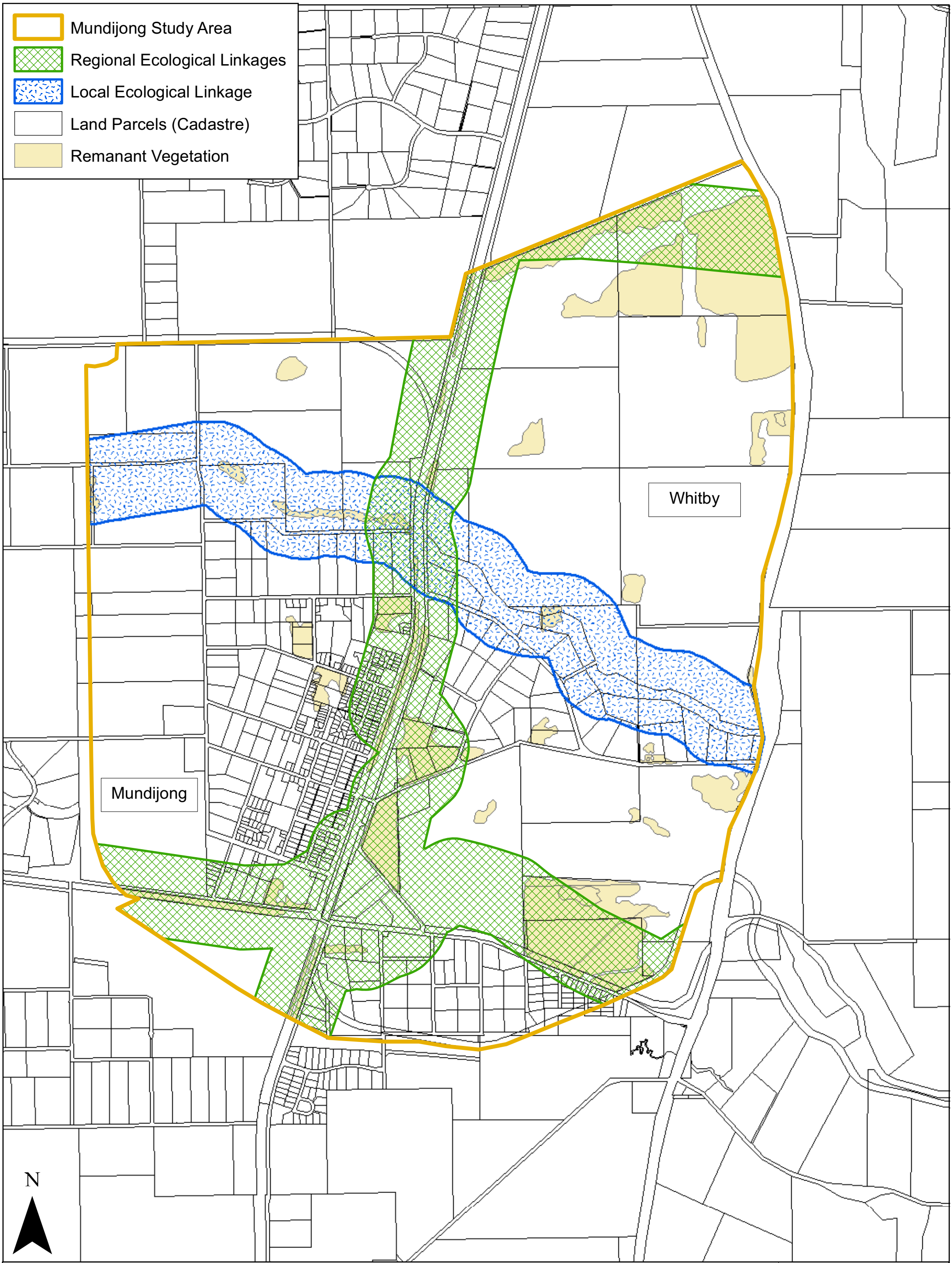
Whilst ecological linkages have a largely beneficial role, they may also have a negative impact. If corridors are not designed properly, fauna may be encouraged into areas which could lead to increased mortality (e.g. roads) and promote movement of predators into habitat areas. Due to the large edge to area ratio of linear corridors, they are particularly susceptible to impacts from surrounding landscapes. This may include deleterious effects of temperature, wind, spray drift, increased nutrients and water (Tingay, 1998a).

Regional linkages in the Cell (Figure 8) reflect the greenways proposed by the "Strategic Plan for Perth's Greenways" (Tingay 1998a). Greenways links bushland remnants, usually associated with wildlife corridors (actual or potential). Greenways are defined as "networks of land containing linear elements that are planned, designed and managed for multiple purposes including ecological, recreational, cultural, aesthetic, or other purposes compatible with the concept of sustainable land use. Wetlands and waterways networks also play a significant, often overlooked role in the linkage of bushland areas (Tingay, 1998a). In general, the four Bush Forever sites form the basis of the regional ecological linkages in the MW Cell (Table 22).

The Shire has not designated local ecological linkages but has developed a shire-wide system of multi-use trials in *Local Planning Policy No. 9 – Multiple-Use Trails within the Shire of Serpentine-Jarrahdale* and the *Local Planning Policy 8 - Landscape Protection*. These policies are considered of limited usefulness for the movement of fauna around the landscape especially mammals, amphibian and reptile species which are more sedentary or habitat restricted (Ironbark Environmental and Sustainable Development, 2007). A Green Towns Study (Hocking Planning and Architecture, 1995) developed for the Shire of Serpentine-Jarrahdale developed a Green Town plan for Mundijong (Appendix 10).

The Green Town plan recommends planning of several local linkages based mostly on water ways which include (from north to south) Cardup Brook, Gingagup Brook, Manjedal Brook and 'Stream A'. While requiring substantial effort, rehabilitation of these waterways for use as "living streams" will permit the corridor movement of fauna throughout the MW Cell. The development of living streams within the MW Cell is further discussed in Section 8.

The Cell's recommended local ecological linkages (Figure 8) should be reviewed following the completion of surveys conducted for the South West Biodiversity Program.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Regional and Local Ecological Linkages	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 8	SCALE	1 : 20 000	SOURCE	South West Biodiversity Project
DATE	11/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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TABLE 22. REGIONAL AND LOCAL ECOLOGICAL LINKAGES IN THE MW CELL

Linkage Type	Site	Significance	Greenways (Tingay 1998)
Regional	Bush Forever Site 350	Linkage to adjacent Bush Forever Sites 361, 354, 362 & 371 and, to the west, Sites 321, 352 & 371. With Bush Forever Site 365 is part of a regionally significant fragmented bushland/wetland linkage.	Forms part of Greenways 61, 62, 63, 64, 65, 66 & 106
Regional	Bush Forever Site 354	N/A	Part of Greenways 77 & 106
Regional	Bush Forever Site 362	Linkage adjacent Bush Forever Site 350 to the north and west. Is part of a regionally significant fragmented bushland/wetland linkage.	Part of Greenway 106
Regional	Bush Forever Site 360	Linkage adjacent Bush Forever Site 350 to the north and Site 365 to the south and east. Is part of regionally significant fragmented bushland/wetland linkage Provides a fragmented bushland/canopy linkage east to the Darling Range Regional Park.	Part of Greenways 66, 87, 88, 129
Local	Manjedal Brook	Provides an east-west ecological linkage across the Cell. The brook is protected under the Shire's *Local Planning Policy 8 - Landscape Protection* from the South-Western Highway to Soldier's Road and by as an Environmentally Sensitive Area under the *Environmental Protection (Clearing of Native Vegetation) Regulations*, 2004 from the west of Soldier's Road.	N/A

5.6.4 Ecological Linkage within Local Structure Plans

The final ecological linkages should be determined as part of the Shire's Biodiversity Strategy. Once the ecological linkages within the MW Cell are finalised they can be incorporated into the Local Structure Plan (LSP) by:

- Identifying the areas of ecological linkages that occur in each the LSP; and
- Outlining the specific management requirement that are required for these areas.

Specific management requirements should include (where possible):

- Enhancing any remnant vegetation within designated ecological linkages within the LSP;
- Delivering environmental offsets within the designated ecological linkages to compensate for clearing elsewhere within the LSP;
- Development of an approved planting list for designated ecological linkages within the LSP; and
- Establishment of public open space that has been planted with species native to the area within the LSP designated ecological linkages.

5.7 Effect of Hydrology on Native Vegetation

The DEWHA identifies one groundwater ecosystem (Swan Coastal Plain damplands and sumplands with paperbark and Banksia woodlands) within the MW Cell (Table 23). This ecosystem is highly dependant on groundwater. A site visit to the MW Cell identified where groundwater dependant ecosystems occurred by observing the presence of *Banksia litoralis*, *Melaleuca rhaphiophylla*, *Melaleuca preissianna* and *Eucalyptus rudis* (Figure 9).

TABLE 23. GROUNDWATER DEPENDANT ECOSYSTEMS – THREATS, RISKS, VALUES AND IMPORTANCE

Groundwater Dependant Ecosystem	Threat to ecosystem		Vulnerability	Risk	Value	Importance
	Process	Groundwater attribute	Impact if threat realised	Likelihood of threat being realised	Conservation value of ecosystem	Risk x Vulnerability x Value
Swan Coastal Plain damplands and sumplands with paperbark and Banksia woodlands	Water resources, urban & commercial	Level, quality	High	High	Moderate	High

Source: DEWHA (2007b) *Indicator: IW-45 Groundwater management plans that consider groundwater dependent ecosystems*

Any change to the groundwater abstraction or recharge rates near these ecosystems can have a serious detrimental effect, potentially resulting in the death of the groundwater dependant vegetation. To ensure that the development of the MW Cell has a minimal impact on the groundwater dependant ecosystems within and surrounding the cell, the following strategies should be implemented:

1. Determine the acceptable level of groundwater abstraction and hence the number of bores permitted and their specified abstraction rate; and
2. Design all new developments within the cell to ensure maximum recharge of groundwater; and
3. Establish unit discharge that is representative of pre-development levels

5.8 Preliminary Prioritisation of Natural Areas

The current extent of remnant vegetation in the Shire is currently less than 10 percent of each of the original vegetation complexes. This is considerably lower than the recommended 30 percent mark based on the first principle for local biodiversity planning and conservation (PBP, 2004) which proposes "retention of at least 30% of the pre-European extent of each ecological community". Thus the retention of existing vegetation is a high priority.

Before protection and management of natural areas and allocating priority can occur, baseline information on Local Natural Areas needs to be collected. This will involved the assessment of all reserves with natural areas to determine if they are Verified Natural Areas (VNAs), are Locally Significant Natural Areas (LSNA) and ecologically viable using Natural Area Initial Assessment (NAIA). This should then be used to prioritise the protection and management of those areas with the highest biodiversity value.

As this information is not yet available a preliminary prioritization of natural areas within the MW Cell has been undertaken using the information currently available (Table 24). This table should be reviewed and updated on completion of the Shire's biodiversity assessment.

TABLE 24. PRELIMINARY PRIORITISATION OF NATURAL AREAS WITHIN THE MW CELL

Natural Area	Location	Is the site a natural area	Is the site locally significant	Is the area ecologically viable	Does the area contain DRF, rare fauna or TECs	Protection and Management Priority
Bush Forever Site 350	Figure 4	✓	✓	X	✓	High
Bush Forever Site 354	Figure 4	✓	✓	✓	✓	Very High
Bush Forever Site 360	Figure 4	✓	✓	✓	✓	Very High
Bush Forever Site 362	Figure 4	✓	✓	✓	✓	Very High
Bush Forever Site 365	Figure 4	✓	✓	X	X	High
Wetland B	Figure 18	✓	✓	✓	✓	Very High
Wetlands C	Figure 18	✓	✓	✓	✓	Very High
Wetland D	Figure 18	✓	✓	X	X	Medium
Wetland E	Figure 18	✓	X	X	X	Low
Wetland G	Figure 18	✓	X	X	X	Low
Wetland I	Figure 18	✓	X	X	X	Low
Wetland M	Figure 18	✓	X	X	✓	Medium
Manjedal Brook	Figure 18	✓	✓	X	✓	High
Gingagup Brook	Figure 18	X	X	X	✓	Low
Stream A	Figure 18	X	X	X	X	Very Low

Mundijong Study Area

Land Parcels (Cadastre)

Groundwater Dependent Ecosystem

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Groundwater Dependent Ecosystems	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 9	SCALE	1 : 20 000	SOURCE	Dept. of Conservation & Environment (2007)
DATE	11/06/2008	PROJECT No.	3006110	0 120 240 480 720 960 Meters	

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5.9 Urban Development Activities with Potentially Significant Impacts on Flora

5.9.1 Clearing and Habitat Fragmentation

In order for the development of the Cell it will be necessary for some of the remnant vegetation within the cell to be cleared. Clearing will be necessary to construct new infrastructure (e.g. housing) and the upgrade existing infrastructure (e.g. widening existing roads).

Removal of remnant vegetation will result in habitat fragmentation for fauna and flora species. Fragmented habitats restrict species dispersal, which limits their ability to recolonise disturbed areas. This poses a threat for species survival should any further disturbances occur. Species also become more sensitive to impact of surrounding area such as weed infestations, traffic and introduced predators (e.g. cats).

5.9.2 Increased Visitation to Conservation Reserves

Increased population leads to increased visitation to conservation areas. Human activities which include access to sites with DRF, recreational activities (i.e. four wheel driving), collection of flora and firewood collection contribute to the disturbance of vegetation. These activities can result in erosion, introduction of weeds and diseases and removal of habitats.

5.9.3 Waste Dumping in Conservation Reserves

In addition to being unsightly dumping of domestic, garden and commercial waste leads to increased disturbance and can potentially introduce disease and weeds. Habitats can also become contaminated by commercial waste (e.g. asbestos, petroleum products).

5.9.4 Fire Regimes

Fire regimes can significantly alter the structure, density and floristic composition of natural areas. Fires that occur too frequently will have a significant impact on fire sensitive plant species and fauna, as periods after fire are insufficient for species/habitat recovery.

5.9.5 Introduction and/or Spread of Weeds

Weeds compete and displace local native plant species and therefore are a significant threat to natural areas. Weeds displace native species by out competing them for essential resources including space, light and water. As weeds overtake native species, fauna are also affected as suitable habitats are no longer available.

The conversion of pasture to urban infrastructure has the potential to introduce new weeds into the cell in the form of garden plants (e.g. Lantana).

5.9.6 Disease

Diseases such as *Phytophthora cinnamomi* (Dieback) is a soil borne pathogen that can have a significant effect of native plant species resulting in species loss and habitat destruction.

5.9.7 Alteration to Surface and Ground Water Hydrology

Urban development is also likely to result in changes in surface water and groundwater hydrology. This has the potential to pose a significant threat to flora within the cell. See Section 9 for further information on possible impacts urban development may have on surface and groundwater hydrology.

Many flora and vegetation communities are strongly influenced by water availability caused by modified water regimes and hydrological imbalances. Wetlands are particularly vulnerable to water regime changes as well as upland vegetation such as banksias which are sensitive to lowering ground water tables.

Urban development can result in:

- Increased volumes and velocity of stormwater runoff;
- Decreased stormwater infiltration; and
- A reduction in groundwater recharge.

Groundwater levels can be further reduced should garden bores be established in the cell.

5.10 Impacts of Urban Cell Development on Significant Flora and Vegetation Communities

Excluding portions of Bush Forever Sites 364 and 360 (zoned as reserved land (parks and recreation) or urban deferred), the entire MW Cell has been zoned as urban development (WAPC, 2007). The development of the MW Cell will therefore potentially have a significant impact on the Cell's flora and vegetation. With exception of remnant vegetation protected as Parks and Recreation (Bush Forever Site 360, Watkins Road Nature Reserve and Site 364), almost half of the remaining remnant vegetation (based of area of native vegetation minus the area of protected vegetation) will be influenced by development of the urban cell.

5.10.1 Impacts on Rare and Priority Flora

***Verticordia plumose* var. *pleiobotrya* A.S.George**
The only know occurrence of this species lies just outside the MW Cell (Figure 3). As this species lies outside the cell it is unlikely that it will be directly impacted by activities within the MW Cell. There are 3 potential indirect threats facing this species as a result of activities within the MW Cell:

1. Introduction of weeds;
2. Fire regimes; and
3. Introduction of Dieback (Phillimore & Evans, 2003).

Tetraria australiensis C.B.Clarke
Clearing of roadside vegetation for the widening of roads has the potential to significantly impact on the DRF species *Tetraria australiensis* as four of its five known locations in or surrounding the cell lie within road reserves (Figure 3).

Drakea elastica
The development of the MW Cell poses no threat to *Drakea elastica* provided that there is no further modification of the boundaries, or clearing within, Bush Forever Site 354 (Figure 3).

Baeckea sp. Perth Region
The development of the MW Cell poses no threat to *Baeckea sp. Perth Region* as this species lies well outside the MW Cell (Figure 3).

5.10.2 Impacts on TECs

All TEC's within the MW Cell (Figure 4) are under threat from the development of the MW Cell (Table 25). With an increase in the cell's population there is the risk that more people will use the reserves containing TEC's for activities including:

- Recreational activities;
- Collection of firewood;
- Accidental/deliberate lighting of fires; and
- Illegal dumping of waste.

These activities can result in the introduction of weeds, disease and removal of habitats.

A field survey conducted on 4th December 2007 noted that illegal dumping of domestic waste has occurred within Bush Forever Sites 350 and 365. An increase in population within the MW Cell is likely to result in an increase in illegal dumping of waste.

TABLE 25. THREATS TO TEC'S WITHIN THE MW CELL

TEC FCT	Identified Threat								
	Vegetation Clearing	Widening of Existing Roads	Recreational Activities	Firewood Collection	Fire Regimes	Dumping of waste	Introduction / spread of weeds	Introduction of Dieback	Changes in Hydrology
2			✓	✓	✓	✓	✓	✓	
3a			✓	✓	✓	✓	✓	✓	
3b	✓	✓	✓	✓	✓	✓	✓	✓	
3c			✓	✓	✓	✓	✓	✓	
20b	✓	✓	✓	✓	✓	✓	✓	✓	✓

5.11 Management Strategies to Prevent Loss of Significant Flora

Management strategies have been developed to prevent the loss of significant flora within the MW Cell as a result of urban development (Table 26). These strategies should be incorporated into local structure plans where appropriate.

5.11.1 Existing Management Strategies to Prevent the Loss of Significant Flora

Regionally significant remnant vegetation (Bush Forever sites and TECs) are afforded protection at the State and/or Commonwealth level. Development in the vicinity and within the TEC or Bush Forever site requires assessments of the impact of an application to clear vegetation and must refer proposals to the EPA.

DRF are also protected at the State and Commonwealth level and regulations are enforced by the DEC to conserve DRF species and populations.

5.11.2 Recommended Management Strategies to Prevent the Loss of Significant Flora

Seven broad management actions to prevent the loss of significant flora as a result of development within the Cell:

1. Where possible development should be located within existing cleared land to minimise the impact on remnant vegetation.
2. Where native vegetation is to be cleared, detailed floristic surveys should be undertaken prior to subdivision. These surveys should focus on declared rare and priority flora, vegetation structure, proximity to and connectivity with, other vegetation and a discussion of linkage values at a local and regional context.
3. The clearing of native vegetation should be prohibited unless authorised by a DEC Clearing Permit or is exempt under Schedule 6 of the *Environmental Protection Act 1986* or Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.
4. When undertaking subdivision building envelopes should be pegged for each proposed lot to ensure that the impact on remnant vegetation is minimised.
5. The following should be used to minimise inadvertent impacts during constructions:
   - use of clear signage;
   - provision of operator information;
   - fencing, where necessary; and
   - rehabilitation and stabilization of areas disturbed during construction
6. Roads and firebreaks are located such that fragmentation of remnant vegetation is prevented.
7. A Vegetation Management Plan should be prepared that details:
   - protected areas within the Cell
   - management practices for each area of remnant vegetation
   - details the ecological linkages within the cell

- contains an approved planting list for gardens and public open space
- offset requirements should native vegetation require clearing
- weed management requirements for the Cell
- hygiene requirements for soil imported into the cell.

Specific management strategies have also been developed to address potentially significant impacts the development of the Cell may have on significant flora and vegetation types (Table 26).

TABLE 26. RECOMMENDED MANAGEMENT STRATEGIES TO PREVENT THE LOSS OF SIGNIFICANT FLORA

Threats to Significant Flora	Significant Flora Affected	Methods to Attenuate the Identified Threat
Clearing of vegetation	**DRF** *Tetraria australiensis* **TEC** FCT 2, 3a, 3b, 3c, 20b	1. A flora survey should be undertaken prior to clearing any vegetation near known DRF populations. 2. Where possible no vegetation should be cleared in TEC's or near known populations of DRF. Should clearing be required, approval should be obtained from the relevant State and or Federal Government Department prior to clearing. 3. No clearing of vegetation should occur within Bush Forever Sites 350, 354, 360, 362 and 365. Should clearing be required, approval should be obtained from the relevant State and or Federal Government Department prior to clearing. 4. No changes should be made to the existing Bush Forever boundaries. 5. Offsets should be provided for all remnant vegetation that is cleared
Recreational activities	**TEC** FCT 2, 3a, 3b, 3c, 20b	1. Bush Forever sites 354, 360 (Watkins Road Bushland only) and 362 should remain fenced to prevent vehicle access. Where necessary fences should be upgraded.
Collection of firewood	**TEC** FCT 2, 3a, 3b, 3c, 20b	1. Bush Forever sites 354, 360 (Watkins Road Bushland only) and 362 should remain fenced to prevent vehicle access. Where necessary fences should be upgraded. 2. Restrict or prohibit the use of wood heaters in new properties constructed within the MW Cell.
Inappropriate fire regimes	**DRF** *Verticordia plumose var. pleiobotrya* **TEC** FCT 2, 3a, 3b, 3c, 20b	1. Ensure that firebreaks are established around all areas of remnant vegetation.
Illegal dumping of waste	**TEC** FCT 2, 3a, 3b, 3c, 20b	1. Erect signs to advise residents where to report any dumping they have observed. 2. Inspect road reserves on a regular basis and remove all dumped waste ASAP. 3. Fence off areas on the road reserve (where possible) where dumping reoccurs.
Introduction or spread of weeds	**DRF** *Verticordia plumose var. pleiobotrya* **TEC** FCT 2, 3a, 3b, 3c, 20b	1. Establish an approved list of plant species for gardens within the MW Cell 2. Where possible plants used in gardens and particularly median strips should at best be species native to the Swan Coastal Plain and at worst non-invasive exotic species. 3. Weed management within the cell should be integrated with vegetation rehabilitation for effective weed management results.
Introduction of Dieback	**DRF** *Verticordia plumose var. pleiobotrya* **TEC** FCT 2, 3a, 3b, 3c, 20b	1. All fill imported into the cell should be certified free of *Phytophthora cinnamomi*.
Changes in hydrology	**TEC** FCT 20b	1. Ensure the development design of the MW Cell maximises the infiltration of stormwater. 2. Ensure discharge rates inline with pre-development levels 3. Rehabilitate the existing waterways within the cell and convert them to "living streams". 4. Limit bore use within the MW Cell such that the acceptable groundwater abstraction rate is not exceeded

6 Terrestrial Fauna

6.1 Background

Despite the region's rich agricultural history, increasing urbanisation and the impacts of land-clearing in reducing the extent of contiguous native vegetation units on this portion of the Swan Coastal Plain (SCP), large tracts of remnant vegetation still occur within the study area. Several studies pertaining to the fauna of the eastern side of the SCP suggest a rich and diverse suite of faunal assemblages still exists.

The significant environmental values of bushland within the study area are recognised in numerous studies (Shire of Serpentine-Jarrahdale 1992; Keighery, BJ & Trudgen 1992; Gibson et al. 1994; Keighery, BJ 1996; and Harvey et al. 1996) and have subsequently been listed on the Department for Planning and Infrastructure's Bush Forever Sites Register (Government of Western Australia, 2000). The most significant bushland areas are situated in the north-eastern corner adjacent to Norman Road and South-west Highway, and the south-eastern corner on Watkins Road, and along the road and rail reserves of Mundijong Road and Paterson Road. They are known as:

- Bush Forever Site 354 – Norman Road Bushland (Whitby/Cardup);
- Bush Forever Site 350, 365 & 375 – Byford to Serpentine rail/road reserves and adjacent Bushland; and
- Bush Forever Site 360 – Mundijong and Watkins Road Bushland (Mundijong/Peel Estate).

Further protection is also afforded to Bella Cumming Reserve and Watkins Nature Reserve, which are vested in the Shire of Serpentine-Jarrahdale as local government reserves under the Shire's Town Planning Scheme (TPS).

Given that each of these remnants is fairly large in size and in relatively good condition (Section 4), each of these sites were, for the purposes of this Environmental Study, considered potentially significant fauna habitats worthy of further investigation.

SMEC's desktop survey found that the habitat values of these sites and fauna assemblages have been sufficiently defined by Syrinx (2006), Harvey, et al (1996). Supplementary data was collected through opportunistic surveys of Norman Rd Bushland and Watkins Nature Reserve and site visits to Bella Cumming Reserve and the road reserves of Mundijong Rd and Paterson Rd.

6.2 Fauna Habitats

The most significant bushland remnants occur in the northeast and southeast portions of the study area and are approximately 114ha and 28ha respectively. A description of the various fauna habitats is provided Table 27 while a comprehensive description of the vegetation is provided in Section 4.

A total of four native mammal and 2 introduced mammal species, six amphibians, 12 reptiles and 24 birds have been recorded at sites within the study area (Appendix 11).

6.3 Significant Fauna

The *Wildlife Conservation Act 1950* is the primary legislative instrument concerned with the protection of native fauna in Western Australia. The Act infers on the Minister the authority to specially protect native fauna species at risk of extinction through provisions which enable threatened species to be listed under a series of schedules (Appendix 3). A list of threatened fauna in the Mundijong region is provided in Table 28.

The *Environmental Protection & Biodiversity Conservation Act 2000* is a federal legislative instrument that aims to protect threatened native fauna on a national scale. Species listed under this section of the Act are considered to be matters of National Environmental Significant (NES).

TABLE 27. DESCRIPTION OF FAUNA HABITATS WITHIN STUDY AREA (ALSO CITED CARDNO BSD 2005)

Habitat	Description
Banksia Woodland	A low woodland dominated by *Banksia attenuata*, with associations of Jarrah (*Eucalyptus marginata*) and Sheoak (*Allocasuarina fraseriana*), comprising approximately one third of the vegetation at Norman Rd bushland. The understorey various considerably from degraded or non-existent to dense. Fallen logs are rare, as are hollow-bearing trees, however some significant sized hollows are present. Banksia species may be an important food resource for Baudin's Black Cockatoo.
Jarrah Woodland	An open forest to woodland dominated by Jarrah makes up a significant portion of the bushland at Norman Rd. Ground cover also varies from non-existent to dense, with extrusions of laterite cap-rock present in the upland areas of the bushland. Marri occurs sporadically throughout this vegetation type with Wandoo present along stream banks. Some She-oak and Banksia are also present.
Marri Woodland	An open forest to woodland dominated by Marri occurs along the northern border of Norman Rd and is bounded by a creek line to the south. Numerous fresh Quenda diggings are evident throughout and large Marri trees provide excellent hollows for a range of birds, bats and arboreal mammals. The understorey is dominated by *Xanthorhorrea preissii* , with occasional emergent *Nuystia floribunda*.
Jarrah-Marri Open Forest	Present as a small remnant on the eastern boundary of the study area. In association with the Jarrah and Marri are Sheoak and Banksia species. A dense understorey exists for much of its extent.
She-oak Woodland	Present in two small patches. Most easterly occurrence has emergent Marri and southern occurrence is associated with Banksia sp. Both have been subject to intensive grazing pressures resulting in a degraded understorey.
Plantations	Large timber plantations occur to the south of Norman Rd Bushland adjacent to Manjedal Brook. Within these are some large isolated native trees along with patches of remnant vegetation with a cleared understorey, predominantly Marri and Jarrah, and occasional She-oak. Some trees contain significant terminal and secondary hollows.
Cleared Pasture with Scattered Trees	Cleared farmland with a mixture of introduced pasture grasses, clovers, weeds, degraded sedgelands and creek lines. Some areas are subject to seasonal waterlogging and may provide occasional feeding grounds for water birds and breeding habitat for frogs.
Creek Lines	Three creek lines traverse the northeast and central eastern flank of the study area. The northern creek line that runs through Norman Road Bushland is in best condition and has very good condition riparian vegetation on both banks for much of its length. The creek line that abuts the southern portion of Norman Road Bushland has largely been cleared of understorey vegetation with some large trees remaining. As this creek line travels further west, all native vegetation has been cleared. Remaining vegetation consists of Flooded Gum *(Eucalyptus rudis*) and Marri. While it appears these creek lines support only seasonal flows, Western Minnow (*Galaxias occidentalis*) has been previously observed in the northern watercourse closest to Norman Road.

TABLE 28. THREATENED FAUNA OF WESTERN AUSTRALIA IN THE MUNDIJONG REGION

Schedule 1	Fauna that is Rare or Likely to Become Extinct
Chuditch (*Dasyurus geoffroii*)	The Chuditch is a medium sized carnivorous marsupial that occupies large home ranges, is highly mobile and appears to utilise bushland remnants and corridors.
Brush-tailed Phascogale (*Phascogale tapoatafa*)	The Brush-tailed Phascogale is a reasonably small arboreal marsupial which occurs in forest and woodland where suitable hollow-bearing trees are available. Populations fluctuate greatly in response to the availability of invertebrate prey.
Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*)	This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the southwest. It requires tree hollows to nest and breed and is totally dependent on Jarrah (*Eucalyptus marginata*) – Marri (*Corymbia calophylla*) forest.
Baudin's Black Cockatoo (*Calyptorhyncus baudinii*)	This species is a seasonal visitor to the northern forests and adjacent eastern edge of the coastal plain, feeding on the seeds of eucalypts and various proteaceous species. It breeds in spring/summer in the southern forests, nesting in tree hollows (primarily in Marri).
Priority One	**Taxa with Few, Poorly Known Populations on Threatened Lands**
Arbinitus inornata	This species of trapdoor spider is found on the Darling Range escarpment between the Brockman and Serpentine Rivers south to the Murray River system. Small isolated populations also occur on the Swan Coastal Plain. This species is under threat from land development.
Priority Five	**Taxa in Need of Monitoring (Conservation Dependent)**
Quenda (*Isoodon obesulus fusciventor*)	This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses, that provides ample protection from predators.

6.3.1 Matters of National Environmental Significance

The *EPBC Act 2000* defines a 'significant impact' as an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts (DEH 2007).

In the likelihood that a proposed action may impact upon a Matter of National Environmental Significance as listed under the *EPBC Act*, the Act requires referral to the Minister where any of the following considerations are deemed to relate to that proposed action.

Should significant clearing of remnant vegetation occur within the Cell it is probable that this would trigger a referral under the EPBC Act, particularly should the vegetation cleared provide nesting or feeding grounds for the Baudin's Black Cockatoo.

6.3.2 Considerations for Referral to the Minister

1. Are there any matters of national environmental significance located in the area of the proposed action (noting that 'the area of the proposed action' is broader than the immediate location where the action is undertaken; consider also whether there are any matters of national environmental significance adjacent to or downstream from the immediate location that may potentially be impacted)?
2. Considering the proposed action at its broadest scope (that is, considering all stages and components of the action, and all related activities and infrastructure), is there potential for impacts, including indirect impacts, on matters of national environmental significance?
3. Are there any proposed measures to avoid or reduce impacts on matters of national environmental significance (and if so, is the effectiveness of these measures certain enough to reduce the level of impact below the 'significant impact' threshold)?

4. Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts (important, notable, or of consequence, having regard to their context or intensity)?

6.4 Key Fauna

6.4.1 Brushtail Possum

Brushtail Possums are found in forests and woodlands that provide an adequate number of quality refuge hollows in mature eucalypts with a trunk girth in excess of 70cm (diameter at breast height). They are also known to utilise ground hollows and other refugia in the absence of foxes. Fox predation, along with the loss of hollow-bearing trees, are therefore considered as key threatening processes (DEC, 2006).

Three brushtail possums were observed during an opportunistic survey of the Jarrah forest at Norman Rd Bushland

6.4.2 Brush-tailed Phascogale

The distribution of this species has constricted by as much as 50% since European colonisation and is thought to be predominantly caused by gross habitat alteration including land clearing and fragmentation. Brush-tailed Phascogales prefer dry sclerophyll forests and woodlands that contain hollow-bearing tress, although they do occur in wetter forests at lower densities. The loss of hollow-bearing trees is considered a key threatening process as too is predation from foxes and cats, and reproductively viable populations are unlikely to persist in suitable habitats areas smaller than thousands of hectares (DEC, 1996).

A search of Norman Rd Bushland and Watkins Nature reserve failed to locate any Brush-tailed Phascogales despite a dead specimen being found in 2003 (DEC, 2007)

6.4.3 Chuditch

It is widely thought that prior to European settlement Chuditch inhabited over 70% of the Australian mainland (DEC, 1994). Today, there may only be as few as 6000 individuals surviving in the southwest of Western Australia. Chuditch can survive in a range of habitats, including forest, woodland and desert, although the densest populations tend to occur in riparian forests with adequate hollow and den sites.

There are no recent records of Chuditch in the study area, however, they are relatively common in Jarrah forests of the Darling Range and may opportunistically utilise remnant vegetation and corridors in the study area as a means of dispersal to establish new home ranges.

6.4.4 Western Grey Kangaroo

The Western Grey Kangaroo is considered common and abundant in Western Australia Several Western Grey Kangaroos were observed in bushland remnants at Watkins Nature Reserve and Norman Rd Bushland, and were observed feeding in adjacent cleared areas.

6.4.5 Trapdoor Spider

This species of Trapdoor spider, *Arnibitus inornatus* is a priority one species that is believed to be relatively common in the Jarrah forests of the Darling Range but rare on the Swan Coastal Plain. No evidence of this species was found during this survey, however, Syrinx (2006) located spider holes in the southern creek line of the brook adjacent to Norman Rd Bushland, which are believed to contain *Arnibitus inornatus*.

This population is considered significant as other populations of this species near Jarrahdale occur on a roadside and over the years and has apparently suffered as a result. With respect to the population at Mundijong a critical disturbance factor may be increased water flow caused by changes in stream hydrology through increased urbanisation of surrounding areas (Syrnix, 2006). Increased visitation by local residents may also impact negatively on this species

6.5 Management Strategies to Prevent the Loss of Significant Fauna

6.5.1 Additional Fauna Surveys

It is recommended that should clearing of native vegetation be required, that prior to commencing work, field investigations for Specially Protected (Threatened) Fauna should be undertaken in accordance with the EPA Guidance Statement No. 54, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. If identified these species should be protected in accordance with the Wildlife Protection Act 1950. This should be addressed in a Fauna Management Plan.

6.5.2 Fauna Management Plans

It is recommended that a fauna management plans are prepared at the local structure planning stage to address the loss of habitat were native vegetation is to be cleared. The plan should include the requirements to minimise clearing, retain regional and local ecological linkages and the relocation of fauna where necessary.

6.5.3 Fragmentation

The long-term viability of extant faunal assemblages within the study area depends largely on the manner in which the fragmented ecosystems that remain are managed in the future. This primarily relates to the management of the natural system or internal dynamics of the remnant areas, as well as external influences on the natural system. In relation to the larger remnants, such as the Bush Forever site on Norman Rd and Watkins Nature Reserve, the emphasis should be on managing internal dynamics such as the disturbance regime (fire and weed invasion) and population dynamics of key organisms. With respect to the small remnants and corridors, the focus should be placed specifically on managing external threatening processes, disturbance factors and other management issues (Saunders *et al* 1991). It should be noted, however, that external influences can be equally important for larger remnants as they are for smaller ones.

6.5.4 Corridors

Remnant vegetation located in the road reserves of Mundijong Road and Paterson Road presently ensures connectivity between the larger reserves of Norman Rd Bushland, Bella Cumming Reserve and Watkins Nature Reserve. Given that these sites facilitate the movement of fauna from adjacent bushland through bushland corridors, it is paramount that sufficient value is placed on these areas and their principle environmental value, in terms of fauna conservation, as ecological linkages are preserved.

Certain sections of these corridors are heavily degraded by weed invasion and rubbish dumping and consequently threaten to reduce the native vegetation cover. This is particularly relevant in regards to the understorey vegetation, which is essential to encourage dispersal through corridors and colonisation of surrounding bushland remnants by small ground mammals, reptiles and birds.

6.5.5 Maintain Hollow-bearing Trees in the Landscape

Hollow-bearing trees provide important shelter and breeding habitats for a range of fauna including Black Cockatoos, Brushtail Possums and Brush-tailed Phascogales. Numerous hollow-bearing trees are reserved at Norman Rd Bushland and Watkins Nature Reserve, while many isolated specimens of Jarrah and Marri remain in the cleared pastoral areas in the northeast of the study area. Black cockatoos were observed roosting in some of these trees, indicating that they have some value as habitat for this species in particular.

SMEC therefore recommends that, where possible, significant hollow bearing trees located in cleared pasture land adjacent to Norman Rd Bushland be preserved to facilitate the movement of fauna across the landscape and to provide breeding and shelter resources for significant fauna.

6.5.6 Feral Animals – Foxes, Cats and Dogs

High densities of Quenda diggings at Norman Road indicate that this species is flourishing in this part of the study area, despite their susceptibility to predation from introduced predators such as foxes, dogs and cats.

Inactive fox dens were observed during this study suggesting foxes inhabited the area previously, although, no evidence was found to indicate foxes presently occur at Norman Road Bushland. SMEC was unable to confirm that a fox baiting program has been undertaken by Shire of Serpentine-Jarrahdale or DEC, and although it may not be possible to completely rid this reserve of foxes indefinitely, controlling their populations and maintaining them at low densities will assist to ensure the long-term survival of Quenda in the study area.

A strategic approach to managing foxes is imperative in order to facilitate positive environmental outcomes with respect to the management of native mammals, and other fauna in the study area. SMEC therefore recommends that a comprehensive fox management plan be formulated by the Shire of Serpentine-Jarrahdale in association with the development of Mundijong Proposed Urban Village. Such a plan should include:

- Description of the potential ecological effects of fox predation on native animals within the study area;
- Recording and mapping of the locations of all fox dens, sightings and other records of fox habitation of reserves within the study area;
- A detailed study to determine whether foxes are still present at Norman Road Bushland, Watkins Nature Reserve and Bella Cumming Reserve, and if so, an estimate of their abundance;
- Control options for fox populations within the study area;
- Identification of priority areas for fox control within the study area;
- A monitoring program to measure the effectiveness of control strategies.

No dogs or cats were observed in any natural areas within the study area, however it is anticipated that as adjacent land is developed around the remaining natural areas, ecological pressures associated with incursions from domestic dogs and cats may negatively impact native fauna.

These issues may, in part, be addressed through the adoption by the Shire of a policy that prohibits domestic cats and dogs from entering natural area reserves. Other options include:

- Buffer zones (e.g. cat buffer zones) around key natural assets that limit the number of cats per household; and
- requiring owners to register their cat(s) with the Shire of Serpentine-Jarrahdale.

Such a policy could also incorporate curfews that require cat owners to ensure that their cats are kept indoors at night. This approach has been implemented by the City of Stirling for areas abutting significant wetlands such as Lake Gwelup Reserve and has proven to be quite successful at educating local residents about native fauna at their local reserves and the impacts dogs and cats can have on those species residing within the reserves. (pers. comm Daniel Rajah, City of Stirling, 2007).

7 Landscape and Landform

7.1 Background

7.1.1 Dominant Landforms

There are three dominant land forms surrounding the MW cell. These are the Darling Plateau, the Darling Scarp and the Swan Coastal Plain.

The Darling Plateau lies to the east of the area the Cell and provides no real influence to the study area.

The Darling Scarp is the most prominent physiographic feature within the South West of Western Australia. The Scarps main influence within the MW Cell is the effect of developments on views of the Scarp.

The Swan coastal Plain lies to the west of the Darling Scarp and is the dominant landform within the MW Cell. The Plain is predominantly low-lying with a gently undulating to flat surface.

7.1.2 Vegetation Features

There are three vegetation complexes within the MW Cell: Forrestfield, Guildford and Beermullah (Figure 6).

The Forrestfield Vegetation Complex ranges from open forest of *Corymbia calophylla, Eucalyptus wandoo, Eucalyptus marginata* to open forest of *E. marginata, C. calophylla, Casuarina fraseriana* and *Banksia* species. Fringing woodlands of *Eucalyptus rudis* occur in the gullies that dissect this complex (Bush Forever, 2000b).

The Guildford Vegetation Complex is a mixture of open forest to tall open forest of *C. calophylla, E. wandoo, E. marginarta* and woodland of *E. wandoo* (with rare occurrences of Eucalyptus lane-poolei). Some minor components of this complex also include *E. rudis* and *Melaleuca rhaphiophylla* (Bush Forever, 2000b).

The Beermullah Vegetation Complex is a mixture of low open forest of *Casuarina obesa* and open woodland of *C. calophylla, E. wandoo* and *E. marginarta*. Some minor components of the complex include closed scrub of *Melaleuca* species and occurrences of *Actinostrobus pyramidalis* (Bush Forever, 2000b).

While a majority of the site has been cleared there are some larger areas of remnant vegetation including five TEC's (Section 4). The main vegetation features within the MW Cell are:

- Bush Forever Sites 350, 354 360 362 and 365;
- Manjedal Brook;
- Gingagup Brook;
- Cardup Brook;
- Norman Road;
- Manjedal wetland.

7.1.3 Community Values

There are six community values that have been identified within the MW Cell:

- Aboriginal Heritage Sites;
- Rural area/lifestyle;
- Bush Forever;
- Darling Scarp Views;
- Flora Roads; and
- Reserves and wetlands.

7.1.4 Serpentine Jarrahdale Shire Local Planning Policy 8 - Landscape Protection

The Local Planning Policy 8 - Landscape Protection (Serpentine-Jarrahdale Shire, 2004a) has five objectives:

1. To preserve the amenity deriving from the scenic value of the Darling Scarp;
2. To maintain the integrity of landscapes within the Landscape Protection Area;
3. To protect and enhance the landscape, scenic and townscape values through design, building materials and siting of development and land uses rather than prohibition of development and land use as such;
4. To maintain the integrity of landscapes in the line of sight, view corridors identified as scenic routes in the Shire, including but not limited to the South-Western Highway, Nettleton Road, Jarrahdale Road, Admiral Road, Kingsbury Drive and both the South and East-West Railway lines and natural water courses; and
5. To provide developers and landowners with a policy that describes the requirements for subdivision and development within the Landscape Protection Area.

This policy targets areas of high landscape value and aims to maintain the integrity of significant landscape areas and features. In particular, such areas occur all along the escarpment between the railway line and the top of the escarpment in a line of sight ("viewshed") from the South-Western Highway and along some major watercourses.

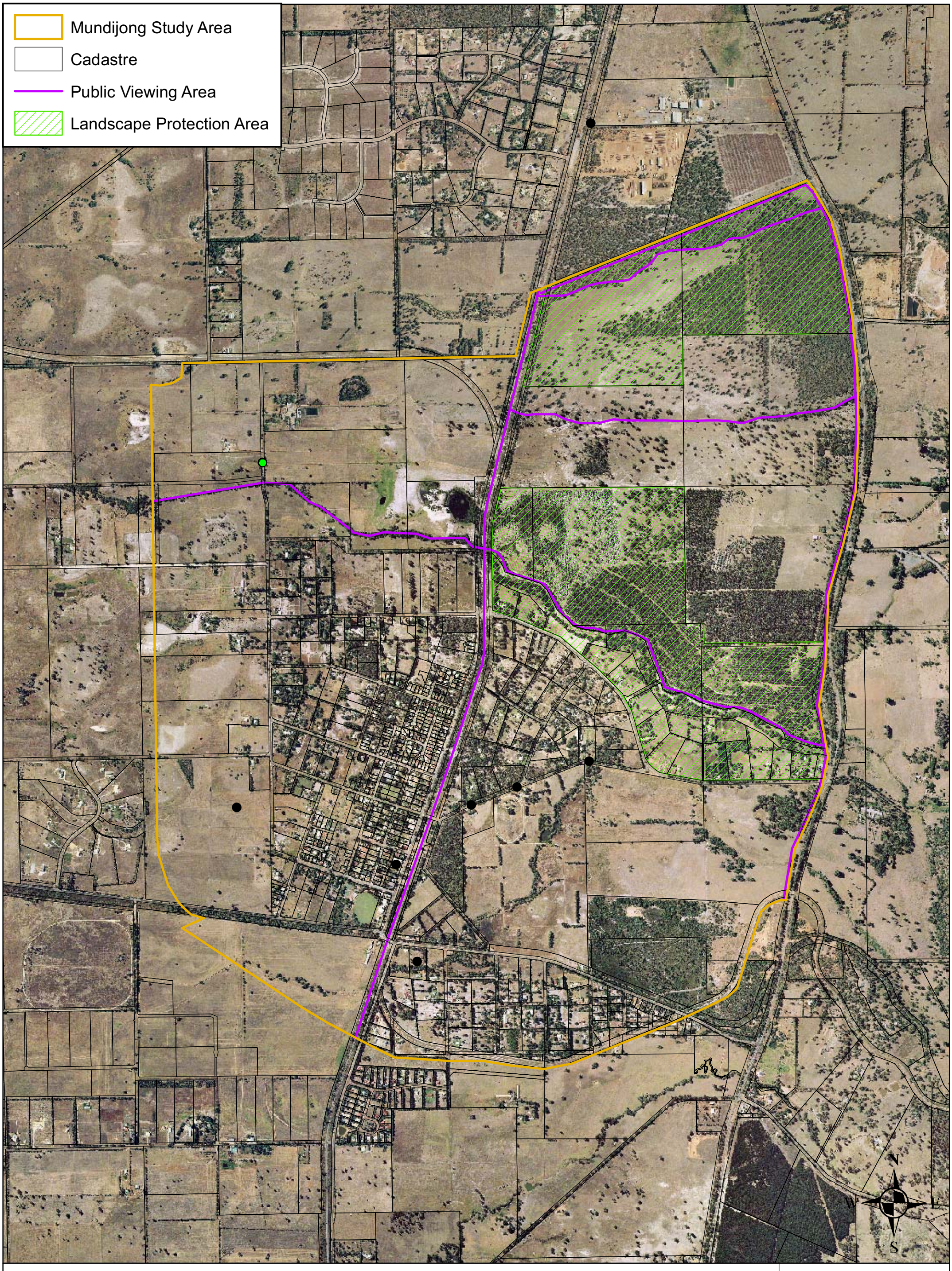
Planning approval will not be given by Council for the development of any allotment which lies wholly or partly within the Landscape Protection Area unless:

1. Council is satisfied that the landscape value of the area is going to be protected;
2. Any buildings or works are carefully designed and sited so as to blend with the landscape in the opinion of Council.

7.2 Key Public Viewing Areas

The following key public viewing areas have been identified within the MW Cell (Figure 10):

- South-Western Highway;
- Norman Road;
- Taylor Road;
- North–South Railway line;
- Manjedal Brook;
- Cardup Brook;
- Gingagup Brook.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Landscape Protection Zones & Public Viewing Areas	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 10	SCALE	1 : 20 000		
DATE	06/06/2008	PROJECT No.	3006110	0 135 270 540 810 1,080 Meters	

SMEC

7.2.1 South West Highway

Name	South-Western Highway
Location	From MGA Zone 50 407043E 6427006N to 407053E 6430257N. See Figure 10
Dominant Landform	Darling Scarp and Plateau to the East Swan Coastal Plain to the West.
Vegetation Features	While a majority of the native vegetation has been cleared to the west of the South-Western Highway the remnant vegetation is predominantly Forestfield Vegetation Complex (Bush Forever Sites 354, Manjedal Brook, Gingagup Brook), with Guildford Vegetation Complex located at the southern end of the MW Cell area at Bush Forever Site 360.
Community Values	Rural area/lifestyle Bush Forever Darling Scarp Views Reserves and wetlands
Type of View	The MW Cell can be viewed from the western side of the South-Western Highway. The present views consist of a strip of fringing vegetation separating open farm land from the road (Photograph 1). Bush Forever sites mark the beginning and end of the stretch of South West Highway that forms the eastern boundary of the MW Cell.
Local Planning Policy Requirements	1. The Landscape Protection Area (Figure 10) defined by Local Planning Policy 8 - Landscape Protection can be viewed to the east of the South-Western Highway. The following requirements must be met for any developments within the Landscape Protection Area (Figure 10): • Creek banks to be stabilised to prevent erosion. • Buildings must not exceed 9m in height. • Trees/vegetation to be retained where possible. • Clearing limited to 30m around buildings. • Landscape management plan may be required. • Driveways to be tree lined. • An application must be lodged for all developments within the Landscape Protection Area. The application must include a: ▪ Provision of revegetation; ▪ Schedule of colours and finishes of external materials and other design criteria; ▪ Site access plan; and ▪ Map of vegetation to be removed.
Potential Impacts of Land Development	1. Pasture land converted to housing estates on the western side of the South-Western Highway between the two Bush Forever Sites. 2. Fringing vegetation cleared along the western side of the South-Western Highway creating a view of the new urban development.
Recommendations to Maintain and Enhance Views	1. Ensure that all developments within the Landscape Protection Area comply with *Local Planning Policy 8 - Landscape Protection* (Serpentine-Jarrahdale Shire, 2004a). 2. Ensure a Landscape Management Plan is submitted to and approved by the Shire for all areas within the Landscape Protection Area, prior to commencement of any development. 3. Preserve all fringing vegetation along the South West Highway and wherever possible, increase the vegetation to shield houses from the road.

Photograph 1: Point 1 (Figure 10) Looking south at fringing vegetation along the South West Highway

7.2.2 Norman Road

Name	Norman Road
Location	From MGA Zone 50 406880E 6430388N to 405283E 6429788N See Figure 10
Dominant Landform	Swan Coastal Plain
Vegetation Features	Forestfield Vegetation Complex from the eastern end of Norman road to the mid-point of the road and Guildford Vegetation Complex from the mid-point to the western end of the road. Norman Road is bounded by Bush Forever Site 354 to the south, 361 to the north and 350 to the west.
Community Values	Registered Flora Road Bush Forever
Type of View	There are limited views of the MW Cell from Norman Road as a majority of the area is blocked by the roads fringing vegetation and by Bush Forever Site 354 to the south (Figure 10: Photograph 2). The road provides a wonderful viewing opportunity for people wishing to look at the Bush Forever sites to the North, South and West and has a profusion of wildflowers resulting in it being identified as a DEC Flora Road.
Local Planning Policy Requirements	1. Norman Road lies completely within the Landscape Protection Area (Figure 10) defined by Local Planning Policy 8 - Landscape Protection. 2. Clearing within the Bush Forever site would require approval from the WAPC.
Potential Impacts of Land Development	1. Widening of the road to incorporate higher traffic volumes. 2. Introduction/spread of weed species due to increased traffic. 3. Loss of fringing vegetation resulting in a destruction of the valued views. 4. Clearing of Bush Forever Sites
Recommendations to Maintain and Enhance Views	1. Retain the use of the road for low traffic volumes, rather than as a main arterial route. 2. Undertake weed eradication programs where practical. 3. Maintain road fringing vegetation.

Photograph 2: Point 2 (Figure 10) Looking west at fringing vegetation along Norman Road

7.2.3 Taylor Road

Name	Taylor Road
Location	From MGA Zone 50 406880E 6430388N to 405283E 6429788N See Figure 10
Dominant Landform	Located on the Swan Coastal Plain, but has an excellent view of the Darling Scarp to the east (Photograph V3)
Vegetation Features	While a majority of the native vegetation has been cleared along Taylor Road the remnant vegetation belongs to the Guildford Vegetation Complex, with views to the east of some remnants of the Forrestfield Vegetation Complex.
Community Values	Rural area/lifestyle Darling Scarp Views
Type of View	There is an excellent view of the north of the MW Cell and the Darling Scarp from Taylor Road (Photograph 3). The road provides a wonderful viewing opportunity for people wishing to look at the Darling Scarp to the east.
Local Planning Policy Requirements	1. The Landscape Protection Area (Figure 10) defined by Local Planning Policy 8 - Landscape Protection (Serpentine-Jarrahdale Shire, 2004a) can be viewed to the south east and north east of Taylor Road. The following requirements must be met for any developments within the Landscape Protection Area (Figure 10): • Creek banks to be stabilised to prevent erosion. • Buildings must not exceed 9m in height. • Trees/vegetation to be retained where possible. • Clearing limited to 30m around buildings. • Landscape management plan may be required. • Driveways to be tree lined. • An application must be lodged for all developments within the Landscape Protection Area. The application must include a: ▪ Provision of revegetation; ▪ Schedule of colours and finishes of external materials and other design criteria; ▪ Site access plan; and ▪ Map of vegetation to be removed.
Potential Impacts of Land Development	1. Loss/change of views of the Darling Scarp
Recommendations to Maintain and Enhance Views	1. Maintain fringing vegetation along Patterson Street/Soldiers Road. 2. Plant trees to block housing development and maintain the view of the Darling Scarp.

Photograph 3: Point 3 (Figure 10) Looking east from Taylor Road to the Darling Scarp

7.2.4 North–South Railway Line

Name	North–South Railway Line
Location	From MGA Zone 50 404264E 6425437N to 405283E 6429788N See Figure 10
Dominant Landform	Swan Coastal Plain Some views of the Darling Scarp to the East
Vegetation Features	The strip of vegetation either side of the North–South Railway is a Threatened Ecological Community (TEC) and is made up of Bush Forever Sites 365 and 350. A majority of this area retains its original overstorey with a highly degraded understorey. A majority of the rail-line passes through the Forrestfield Vegetation Complex with a small section of the north and south falling within the Guildford Vegetation Complex.
Community Values	Bush Forever Darling Scarp Views Flora Road Reserves and wetlands
Type of View	The North–South Railway provides a excellent view of the MW Cell, the Darling Scarp and of the regions remnant vegetation (Photograph 4)
Local Planning Policy Requirements	1. The North–South Railway lies on the western boundary of the Landscape Protection Area (Figure 10) defined by Local Planning Policy 8 - Landscape Protection (Serpentine-Jarrahdale Shire, 2004a). The following requirements must be met for any developments within the Landscape Protection Area (Figure 10): • Creek banks to be stabilised to prevent erosion. • Buildings must not exceed 9m in height. • Trees/vegetation to be retained where possible. • Clearing limited to 30m around buildings. • Landscape management plan may be required. • Driveways to be tree lined. • An application must be lodged for all developments within the Landscape Protection Area. The application must include a: ▪ Provision of revegetation; ▪ Schedule of colours and finishes of external materials and other design criteria; ▪ Site access plan; and ▪ Map of vegetation to be removed. 2. Clearing within the Bush Forever site would require approval from the WAPC.
Potential Impacts of Land Development	1. Widening of the road to incorporate higher traffic volumes. 2. Introduction/spread of weed species due to increased traffic. 3. Loss of fringing vegetation resulting in a destruction of the valued views. 4. Clearing of Bush Forever Sites
Recommendations to Maintain and Enhance Views	1. Retain the use of the road for current traffic volumes, rather than as a main arterial route. 2. Undertake weed eradication programs where practical. 3. Maintain road fringing vegetation.

Photograph 4: Point 4 (Figure 10) Looking north along the North-South Railway Line towards Mundijong

7.2.5 Manjedal Brook

Name	Manjedal Brook
Location	From MGA Zone 50 to See Figure 10
Dominant Landform	Swan Coastal Plain Some views of the Darling Scarp to the East
Vegetation Features	While a majority of the native vegetation has been cleared either side of the Brook the remnant vegetation along the Brook belongs to the Guildford Vegetation to the East of Patterson Road and the Forrestfield Vegetation Complex from Patterson road to the South-Western Highway.
Community Values	Aboriginal Heritage Sites Rural area/lifestyle Reserves and wetlands
Type of View	Manjedal Brook provides a strip of remnant vegetation across the entire MW Cell.
Local Planning Policy Requirements	1. Manjedal Brook lies completely within the Landscape Protection Area (Figure 10) defined by Local Planning Policy 8 - Landscape Protection (Serpentine-Jarrahdale Shire, 2004a). The following requirements must be met for any developments within the Landscape Protection Area (Figure 10): • Creek banks to be stabilised to prevent erosion. • Buildings must not exceed 9m in height. • Trees/vegetation to be retained where possible. • Clearing limited to 30m around buildings. • Landscape management plan may be required. • Driveways to be tree lined. • An application must be lodged for all developments within the Landscape Protection Area. The application must include a: ▪ Provision of revegetation; ▪ Schedule of colours and finishes of external materials and other design criteria; ▪ Site access plan; and ▪ Map of vegetation to be removed. 2. Sections of the Brook are registered as an Environmental Protection Policy (EPP) wetland. This means that: • no development can occur within 50m of the EPP section of the Brook; • no water can be extracted from the wetland; and • no water can be discharged to the wetland.
Potential Impacts of Land Development	1. Use of Manjedal Brook as a stormwater drainage system; 2. Loss of fringing vegetation resulting in a destruction of the valued views.
Recommendations to Maintain and Enhance Views	1. Ensure that the course of the Manjedal Brook is not modified during development; 2. Ensure no fringing vegetation is cleared during development; 3. Maintain Pre-development flows within Manjedal Brook.

Photograph 5: Point 5 (Figure 10) Looking east along Manjedal Brook from Taylor Road

7.2.6 Cardup Brook

Name	Cardup Brook
Location	From MGA Zone 50 407053E 6430257N to 405314E 6429679N See Figure 10
Dominant Landform	Swan Coastal Plain
Vegetation Features	Cardup Brook runs through Bush Forever Site 354. The eastern end of the brook is located in the Forrestfield Vegetation Complex, while the western end is located in the Guildford Vegetation.
Community Values	Bush Forever Flora Roads Reserves and wetlands
Type of View	There are limited views of Cardup Brook, as it is blocked from view by the Bush Forever Site 354.
Local Planning Policy Requirements	1. Cardup Brook lies completely within the Landscape Protection Area (Figure 10) defined by Local Planning Policy 8 - Landscape Protection (Serpentine-Jarrahdale Shire, 2004a). The following requirements must be met for any developments within the Landscape Protection Area (Figure 10): • Creek banks to be stabilised to prevent erosion. • Buildings must not exceed 9m in height. • Trees/vegetation to be retained where possible. • Clearing limited to 30m around buildings. • Landscape management plan may be required. • Driveways to be tree lined. • An application must be lodged for all developments within the Landscape Protection Area. The application must include a: ▪ Provision of revegetation; ▪ Schedule of colours and finishes of external materials and other design criteria; ▪ Site access plan; and ▪ Map of vegetation to be removed. 2. Clearing within the Bush Forever site would require approval from the WAPC.
Potential Impacts of Land Development	1. Use of Cardup Brook as a stormwater drainage system; 2. Loss of fringing vegetation resulting in a destruction of the valued views.
Recommendations to Maintain and Enhance Views	1. Ensure that the course of the Cardup Brook is not modified during development; 2. Ensure no fringing vegetation is cleared during development; 3. Maintain Pre-development flows within Cardup Brook.

Photograph 7: Point 7 (Figure 10) Looking east along Cardup Brook

7.2.7 Gingagup Brook

Name	Gingagup Brook
Location	From MGA Zone 50 407079E 6429072N See Figure 10
Dominant Landform	Swan Coastal Plain Some views of the Darling Scarp to the east
Vegetation Features	While a majority of the native vegetation has been cleared either side of the Brook the remnant vegetation along the Brook belongs to the Forrestfield Vegetation Complex.
Community Values	Rural area/lifestyle Reserves and wetlands
Type of View	Gingagup Brook provides a strip of remnant vegetation across the north-west of the MW Cell.
Local Planning Policy Requirements	Nil
Potential Impacts of Land Development	1. Use of Gingagup Brook as a stormwater drainage system; 2. Loss of fringing vegetation resulting in a destruction of the valued views.
Recommendations to Maintain and Enhance Views	1. Ensure that the course of the Gingagup Brook is not modified during development; 2. Ensure no fringing vegetation is cleared during development; 3. Maintain Pre-development flows within Gingagup Brook.

Photograph 6: Point 6 (Figure 10) Looking west along Gingagup Brook

7.3 Summary of Development Impacts on Views

The following impacts and potential impacts on landscape and landform (Table 29) have been identified:

TABLE 29. IMPACTS AND POTENTIAL IMPACTS OF DEVELOPMENT ON KEY VIEWING AREAS

Impact	Key Viewing Area						
	South-West Highway	Norman Road	Taylor Road	North South Railway	Manjedal Brook	Gingagup Brook	Cardup Brook
Pasture land converted to housing estates	✓		✓	✓			
Loss of fringing vegetation from roads, wetlands and/or watercourses	✓	✓		✓	✓	✓	✓
Damage to EPP Wetlands				✓	✓		
Widening of roads		✓		✓			
Introduction/spread of weeds		✓		✓			
Clearing of Bush Forever Sites		✓		✓			
Loss/change of views of the Darling Scarp			✓	✓	✓	✓	
Loss of Flora Roads		✓		✓			

7.4 Summary of Recommendations to Maintain and Enhance Views

The following recommendations have been made to minimise the impacts and potential impacts of the development of the MW Cell on the regions landscape and landform:

1. Ensure that all developments within the Landscape Protection Area comply with Local Planning Policy 8 - Landscape Protection;
2. Ensure a Landscape Management Plan is submitted to and approved by the Shire for all areas within the Landscape Protection Area, prior to commencement of any development;
3. Use larger Lot sizes and identify adequate setbacks and building envelopes during the local structure planning stage.
4. Preserve all fringing vegetation along railroads, roads and highways;
5. Where possible plant fringing vegetation to shield new houses from existing railroads, roads and highways;
6. Plant trees/fringing vegetation to block the view to housing developments and maintain the view of the Darling Scarp;
7. Retain the use of Norman Road for low traffic volumes;
8. Undertake a weed eradication program along road verges and rail tracks where practical;
9. Ensure that the course of the Manjedal Brook is not modified during development; and
10. Ensure that where possible the course of any other waterways is not modified during development
11. Ensure pre-development flows are maintained within all watercourses, brooks and drains.

8 Land Degradation

8.1 Existing Land Management Issues

There are three (3) soil complexes located within the project area each containing six (6) sub-soils:

1. Forrestfield (F2a, F2b, F2c, F3, F4, F5);
2. Pinjarra (B1, B1a, B2, B2a, B3, B6; and
3. Bassendean (B1, P1b, P1d, P1e, P2, P3).

Each of these soils has a range of associated land management issues (Table 30).

TABLE 30. SUMMARY OF LAND MANAGEMENT ISSUES WITHIN THE MW CELL

Soil Landscape Unit	Land Management Issue							
	Phase	Phosphorus Export	Existing salinity	Salinity risk	Water erosion	Water logging	Wind erosion	ASS
Forrestfield	F2a							NA[1]
	F2b							NA
	F2c							NA
	F3					✓		NA
	F4	✓			✓	✓		NA
	F5	✓			✓	✓		NA
Bassendean	B1	✓				✓	✓	✓
	B1a						✓	NA
	B2	✓				✓	✓	✓
	B2a	✓					✓	NA
	B3	✓			✓	✓		NA
	B6	✓				✓	✓	NA
Pinjarra	B1	✓				✓	✓	NA
	P1b	✓				✓	✓	✓
	P1d		✓	✓		✓		✓
	P1e					✓		✓
	P2		✓	✓		✓		✓
	P3	✓			✓	✓		✓

[1]NA = Not Assessed

8.1.1 Phosphorus Export

Urban development is likely to increase the risk of phosphorous export from the MW Cell (Department of Agriculture and Food (DAF), 2000). Increased phosphorous export from the project area is likely to contribute to the eutrophication of waterways and wetlands within the area and downstream watercourses, including the Peel-Harvey estuary. The percentage risk of phosphorous export occurring within the project area (Table 31, Figure 11) will only be increased by urbanisation of the cell. To reduce this risk any fill brought into the project area should maximise phosphorous retention time. This can be achieved by only importing soils with a low phosphorous export risk or by mixing high Phosphorous fixing materials (e.g. alkaloam) to soils with a high risk of phosphorous leaching. Typical costs of products such as alkaloam are $14 per ton with an application of 5 tons per hectare every ten years (DAF, 2004).

Areas with a high phosphate risk are also likely to be unsuitable for the use of Biomax water treatment systems. Any proposed development in high risk areas will require the soil to be tested to determine its Phosphorous Retention Index (PRI). Where the soil's PRI is less than 20 Biomax systems are not suitable without soil treatment and ongoing testing. In these areas connection to the sewer may be the most suitable, or in some cases only, option.

TABLE 31. PERCENTAGE RISK OF PHOSPHOROUS EXPORT

Soil Landscape Unit	Land Management Issue		
	Phase	Risk Description	Percentage risk of occurrence[2]
Forrestfield	F4	High, very high and extreme hazard	100
	F5	High, very high and extreme hazard	100
Bassendean	B1	High, very high and extreme hazard	5
	B2	High, very high and extreme hazard	70
	B2a	High, very high and extreme hazard	15
	B3	High, very high and extreme hazard	100
	B6	High, very high and extreme hazard	90
Pinjarra	B1	High, very high and extreme hazard	5
	P1b	High, very high and extreme hazard	5
	P3	High, very high and extreme hazard	15

8.1.2 Existing and Potential Salinity

All areas identified with existing or potentially saline characteristics are situated in locations where groundwater depth exceeds 30m (Tables 30 & 31, Figure 12). Urban development is unlikely to pose a threat to salinity in the areas identified.

TABLE 32. PERCENTAGE RISK OF EXISITNG SALINITY

Soil Landscape Unit	Land Management Issue		
	Phase	Risk Description	Percentage
Pinjarra	P1d	Percentage presently saline (ECe >400mS/m)	5
	P2	Percentage presently saline (ECe >400mS/m)	25

TABLE 33. PERCENTAGE RISK OF FURTHER SALINITY

Soil Landscape Unit	Land Management Issue		
	Phase	Risk Description	Percentage risk of occurrence
Pinjarra	P1d	Moderate risk, high risk and presently saline	45
	P2	Moderate risk, high risk and presently saline	35

[2] Only those soil phases with a percentage risk are shown.

Mundijong Study Area
Land Parcels (Cadastre)
5% Phosphorous Export Risk
15% Phosphorous Export Risk
70% Phosphorous Export Risk
90% Phosphorous Export Risk
100% Phosphorous Export Risk

Bassendean B1
Bassendean B1a
Bassendean B2
Bassendean 2a
Bassendean B3
Bassendean B6
Forrestfield F2a

Forrestfield F2b
Forrestfield F2c
Forrestfield F3
Forrestfield F4
Forrestfield F5
Pinjarra B1
Pinjarra P1b

Pinjarra P1d
Pinjarra P1e
Pinjarra P2
Pinjarra P3

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Risk of Phosphorous Export	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 11	SCALE	1 : 20 000		
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

Mundijong Study Area
Land Parcels (Cadastre)
45% Risk of Occurrence

Bassendean B1
Bassendean B1a
Bassendean B2
Bassendean 2a
Bassendean B3
Bassendean B6
Forrestfield F2a
Forrestfield F2b
Forrestfield F2c
Forrestfield F3
Forrestfield F4
Forrestfield F5
Pinjarra B1
Pinjarra P1b
Pinjarra P1d
Pinjarra P1e
Pinjarra P2
Pinjarra P3

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Salinity Risk	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 12	SCALE	1 : 20 000		
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

8.1.3 Water erosion

TABLE 34. PERCENTAGE RISK OF WATER EROSION

Soil Landscape Unit	Land Management Issue		
	Phase	Risk Description	Percentage risk of occurrence
Forrestfield	F4	High, very high and extreme hazard	75
	F5	High, very high and extreme hazard	85
Bassendean	B3	High, very high and extreme hazard	40
Pinjarra	P3	High, very high and extreme hazard	15

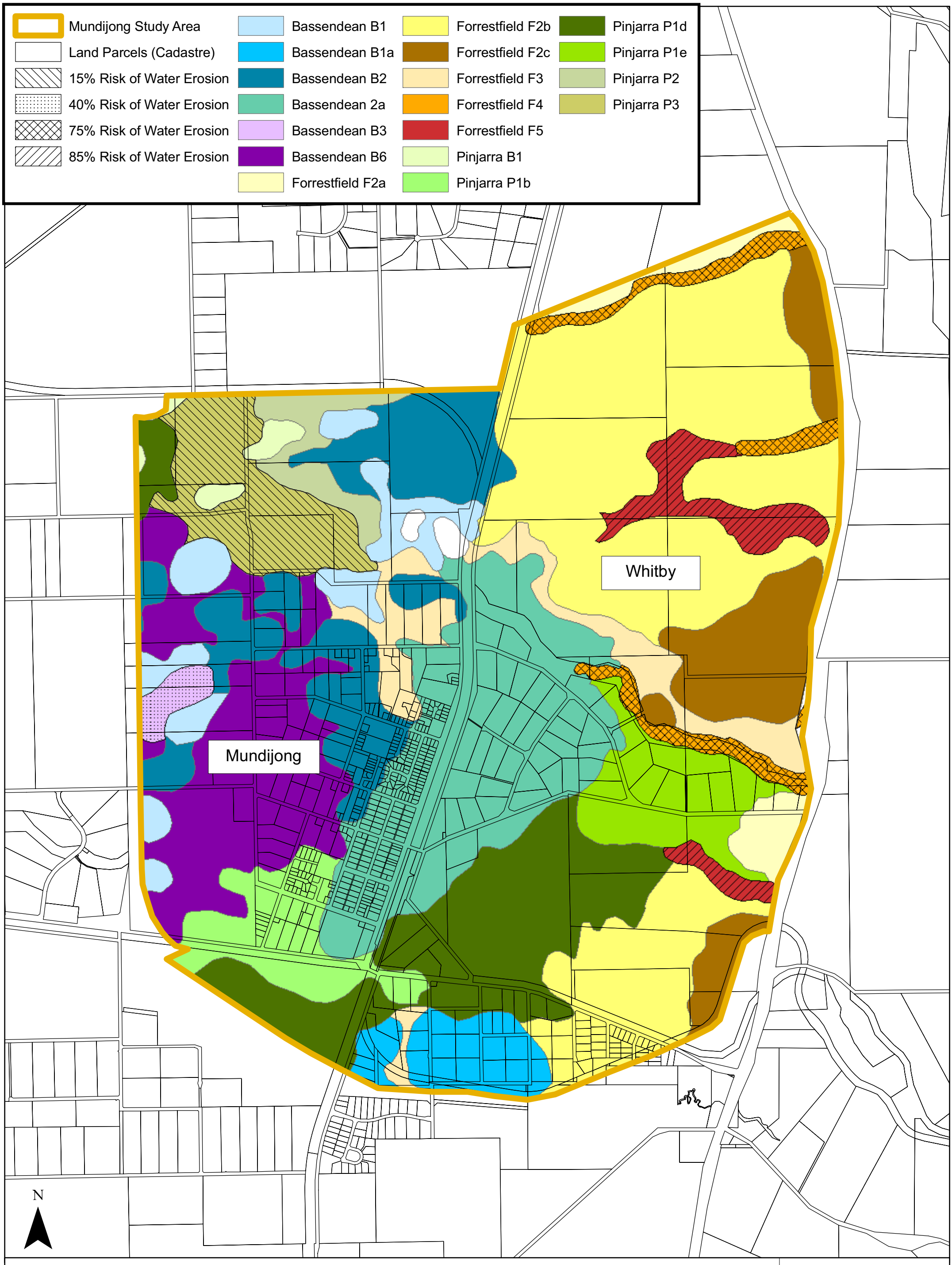
The major risks of water erosion within the MW Cell occur along the existing creek lines between Patterson Road and the South-Western Highway (Table 34, Figure 13). Should these areas be used as part of a drainage system for any urban development, increased flow rates during storm events are likely increase water erosion in these areas.

8.1.4 Water logging

TABLE 35. PERCENTAGE RISK OF WATER EROSION

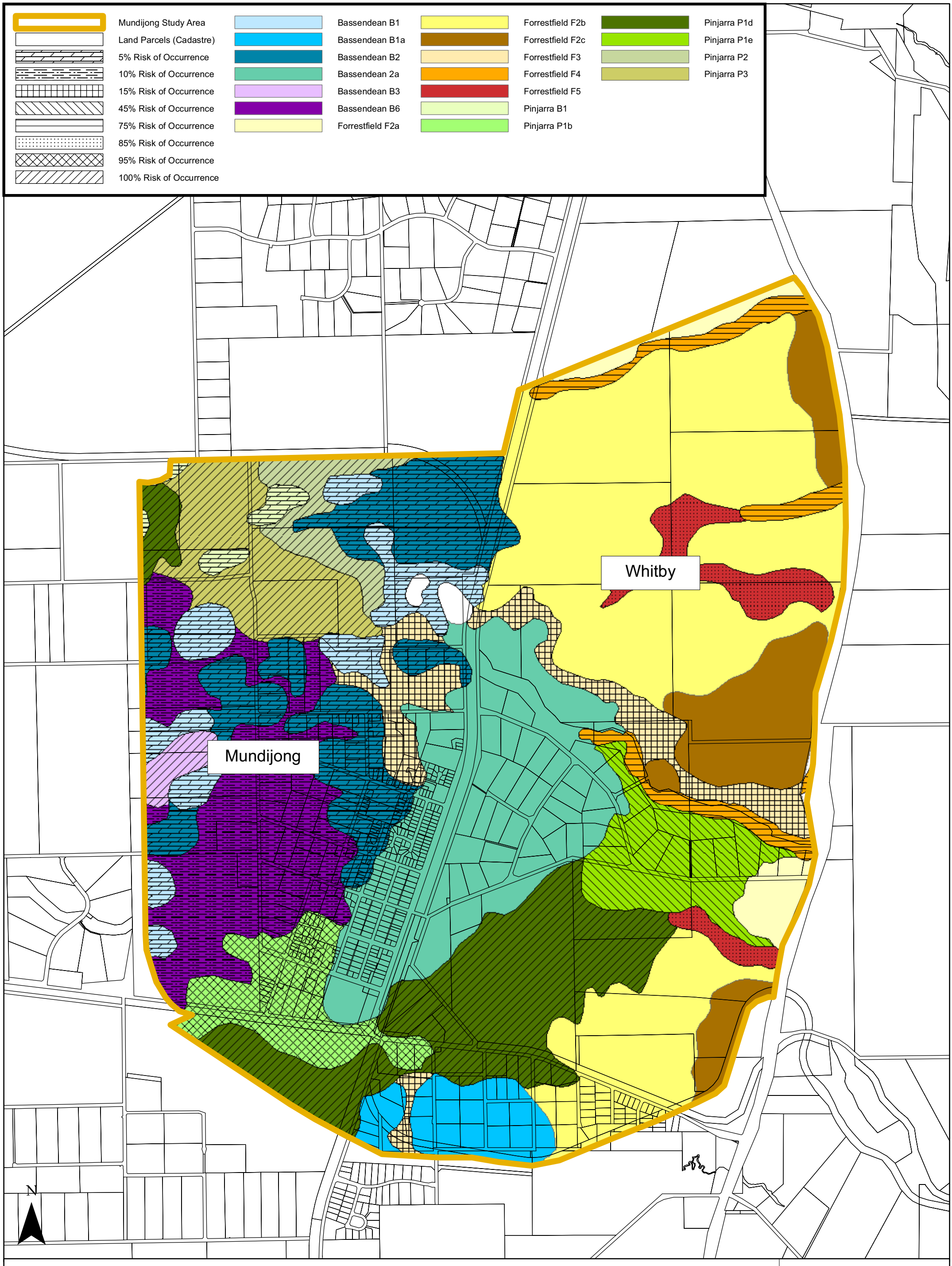
Soil Landscape Unit	Land Management Issue				
	Phase	Risk Description	Percentage risk of occurrence	Risk Description	Percentage risk of occurrence
Forrestfield	F3	Moderate, high and very high risk	15	High and very high risk	0
	F4	Moderate, high and very high risk	75	High and very high risk	55
	F5	Moderate, high and very high risk	85	High and very high risk	85
Bassendean	B1	Moderate, high and very high risk	5	High and very high risk	0
	B2	Moderate, high and very high risk	5	High and very high risk	0
	B3	Moderate, high and very high risk	100	High and very high risk	85
	B6	Moderate, high and very high risk	10	High and very high risk	0
Pinjarra	B1	Moderate, high and very high risk	5	High and very high risk	0
	P1b	Moderate, high and very high risk	95	High and very high risk	30
	P1d	Moderate, high and very high risk	100	High and very high risk	85
	P1e	Moderate, high and very high risk	45	High and very high risk	0
	P2	Moderate, high and very high risk	100	High and very high risk	85
	P3	Moderate, high and very high risk	100	High and very high risk	80

There is a substantial risk of waterlogging occurring in areas of the MW Cell (Table 35, Figure 14 & 15). Any development in these areas should be avoided where possible. Should development occur in high risk areas any fill material should allow for rapid infiltration of water and a detailed drainage investigation undertaken to mitigate the risks of water logging..



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Risk of Water Erosion	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 13	SCALE	1 : 20 000		
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Moderate, High and Very High Risk of Water Logging	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 14	SCALE	1 : 20 000		
DATE	06/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

Mundijong Study Area
Land Parcels (Cadastre)
30% Risk of Occurrence
55% Risk of Occurrence
80% Risk of Occurrence
85% Risk of Occurrence
Bassendean B1
Bassendean B1a
Bassendean B2
Bassendean 2a
Bassendean B3
Bassendean B6
Forrestfield F2a
Forrestfield F2b
Forrestfield F2c
Forrestfield F3
Forrestfield F4
Forrestfield F5
Pinjarra B1
Pinjarra P1b
Pinjarra P1d
Pinjarra P1e
Pinjarra P2
Pinjarra P3

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	High, Very High and Extreme Hazard Percentage Risk of Water Logging	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 15	SCALE	1 : 20 000		
DATE	09/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

8.1.5 Wind erosion

TABLE 36. PERCENTAGE RISK OF WIND EROSION

Soil Landscape Unit	Land Management Issue		
	Phase	Risk Description	Percentage risk of occurrence
Bassendean	B1	Very high and extreme hazard	35
	B1a	Very high and extreme hazard	30
	B2	Very high and extreme hazard	15
	B2a	Very high and extreme hazard	15
	B6	Very high and extreme hazard	35
Pinjarra	B1	Very high and extreme hazard	35
	P1b	Very high and extreme hazard	5

Urban development is likely to reduce the impacts of wind erosion within the MW Cell as areas with wind erosion potential will be covered by infrastructure and gardens. This change in land use will reduce the wind exposure of sensitive soils and hence act to stabilise sensitive areas (Table 36, Figure 16).

8.1.6 Acid Sulphate Soils

Land degradation issues associated with acid sulphate soils (ASS) have been addressed in Section 12.

8.1.7 Land Compatibility Classification

Land compatibility classifications identify the suitability of each soil phase for an identified land use based on the associated land management issues. Five land use classifications are used:

Class 1 – Very High: Very few physical limitations present and are easily overcome. Risk of land degradation is negligible.

Class 2 – High: Some physical limitations affecting either productive land use or risk of land degradation. Limitations overcome by careful planning.

Class 3 – Fair: Moderate physical limitations significantly affecting productive land use or risk of land degradation. Careful planning and conservation measures required.

Class 4 – Low: High degree of physical limitations not easily overcome by standard development techniques and/or resulting in a high risk of land degradation. Extensive conservation requirements.

Class 5 – Very Low: Severity of physical limitations is such that its use is usually prohibitive in terms of either development costs or the associated risk of land degradation.

The land compatibility classification for urban development has been based on the compatibility classification for perennial agriculture (DAF, 2000). Modifications to the perennial agriculture classifications have been suggested to reflect the fact that urban developments:

1. are a more intensive land use;
2. often have a large amount of capital investment meaning that engineering solutions are used more cost effective, particularly in large developments; and
3. may be restricted by extensive land degradation problems (e.g. wetland eutrophication).

A revised land capability classification for the MW Cell has been suggested based on the fact that:

1. wind and water erosion problems can often be improved by urbanisation as the change in land use may result in reducing the expose of sensitive soils to wind or water resulting in the stabilisation of sensitive areas. For example covering an area of soil susceptible to

wind erosion with lawn will reduce wind erosion as the soil is no longer exposed to wind.; and

2. phosphorous export is a high risk in urban areas irrespective of soil type.

While some areas may presently be less suitable for urban development this can be overcome by addressing the associated impacts identified above.

TABLE 37. LAND COMPATIBILITY CLASSIFICATION

Soil Landscape Unit	Phase	Land Capability Classification[3] (perennial agriculture)	Land Capability Classification (urban)	Land Capability Suitability for urban development
Forrestfield	F2a	50-70% Class 1, 2 or 3.	>70% Class 1 or 2.	High
	F2b	>70% Class 1 or 2.	>70% Class 1 or 2.	High
	F2c	>70% Class 1 or 2.	>70% Class 1 or 2.	High
	F3	50-70% Class 4 or 5.	50-70% Class 4 or 5.	Low
	F4	>70% Class 4 or 5.	>70% Class 4 or 5.	Low
	F5	>70% Class 4 or 5.	>70% Class 4 or 5.	Low
Bassendean	B1	>70% Class 1, 2 or 3.	>70% Class 1, 2 or 3.	Fair
	B1a	>70% Class 1, 2 or 3.	>70% Class 1 or 2.	High
	B2	>70% Class 1, 2 or 3.	>70% Class 1, 2 or 3.	Fair
	B2a	>70% Class 1 or 2.	>70% Class 1 or 2.	High
	B3	>70% Class 4 or 5.	>70% Class 4 or 5.	Low
	B6	>70% Class 1, 2 or 3.	>70% Class 1, 2 or 3.	Fair
Pinjarra	B1	>70% Class 1, 2 or 3.	>70% Class 1, 2 or 3.	Fair
	P1b	>70% Class 4 or 5.	>70% Class 4 or 5.	Low
	P1d	>70% Class 4 or 5.	>70% Class 4 or 5.	Low
	P1e	50-70% Class 1, 2 or 3.	50-70% Class 1, 2 or 3.	Fair
	P2	>70% Class 4 or 5.	>70% Class 4 or 5.	Low
	P3	>70% Class 4 or 5.	>70% Class 4 or 5.	Low

The land capability suitability for urban development (Table 37, Figure 17) has been developed following a review of the Land Capability Classification for perennial agriculture (DAF, 2005) and the associated impacts and benefits of urbanisation. While this map details areas of the MW Cell with a low suitability for urbanisation, many of these areas could become suitable if the associated potential impacts are correctly managed. The outcomes of the Land Capability Classification have been overlaid with all the environmental constraints identified in the study to produce a map of areas suitable for urban development within the Cell (Section 15, Figure 2).

8.2 Review of Impacts of Importing Fill into Byford

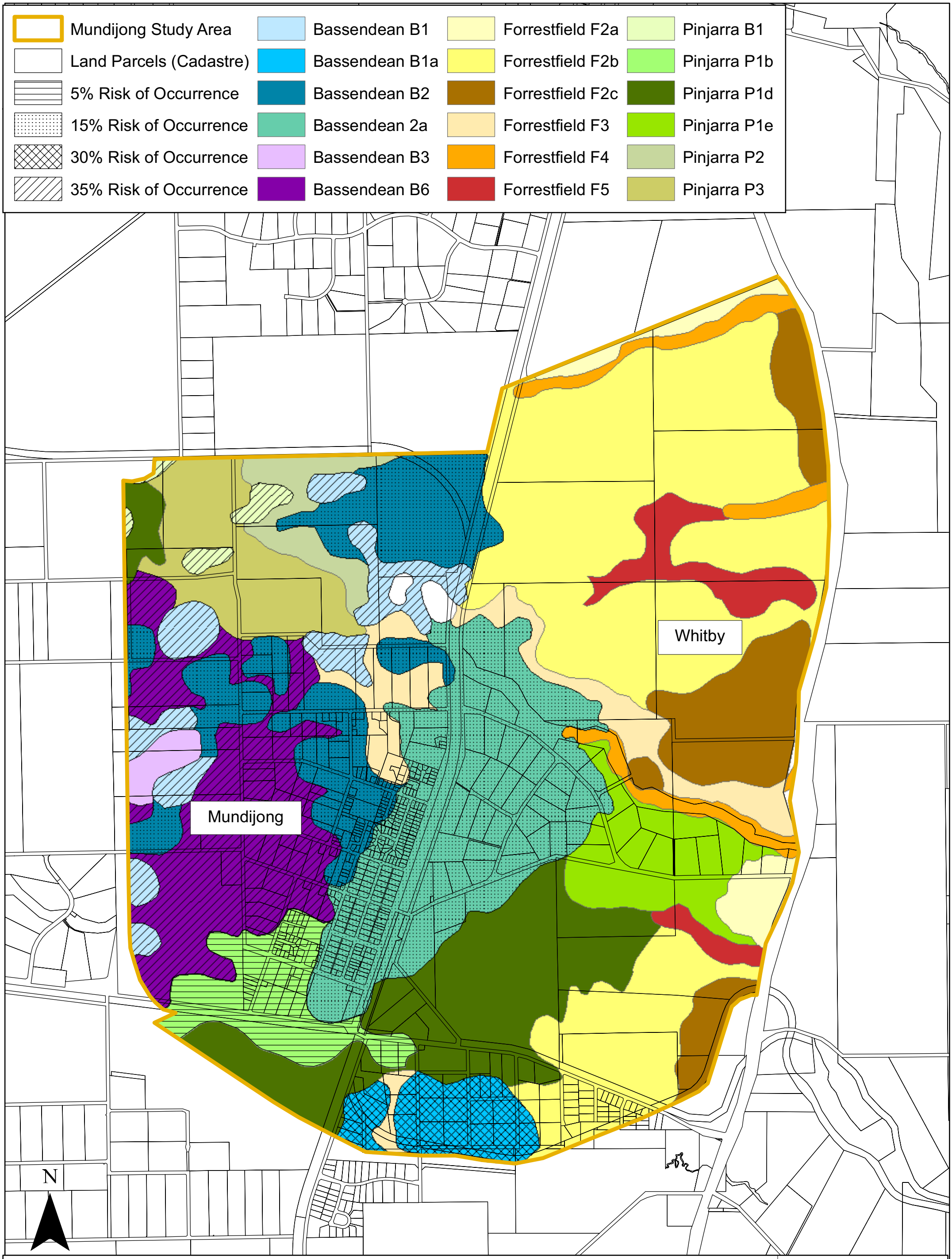
At present there have been no investigations or studies into the effects of importing fill into Byford (Richard Morup, pers comm.).

Any importation of fill to a new development poses a number of potential impacts. These include:

- Increased potential for phosphorous export;
- Importation or spread of weeds and/or disease;
- Change in soil hydrology; and
- Increased risk of water and wind erosion

To minimise these impacts it is essential that any fill imported to the Cell should be certified weed and disease free, have a low risk of phosphate export (Section 7.1.1) and be placed in accordance with the sites water sensitive urban design plan.

[3] Capability class has been determined using the Perennial Horticulture classifications (DAF, 2000a)



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Very High and Extreme Hazard Percentage Risk of Wind Erosion	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 16	SCALE	1 : 20 000		
DATE	09/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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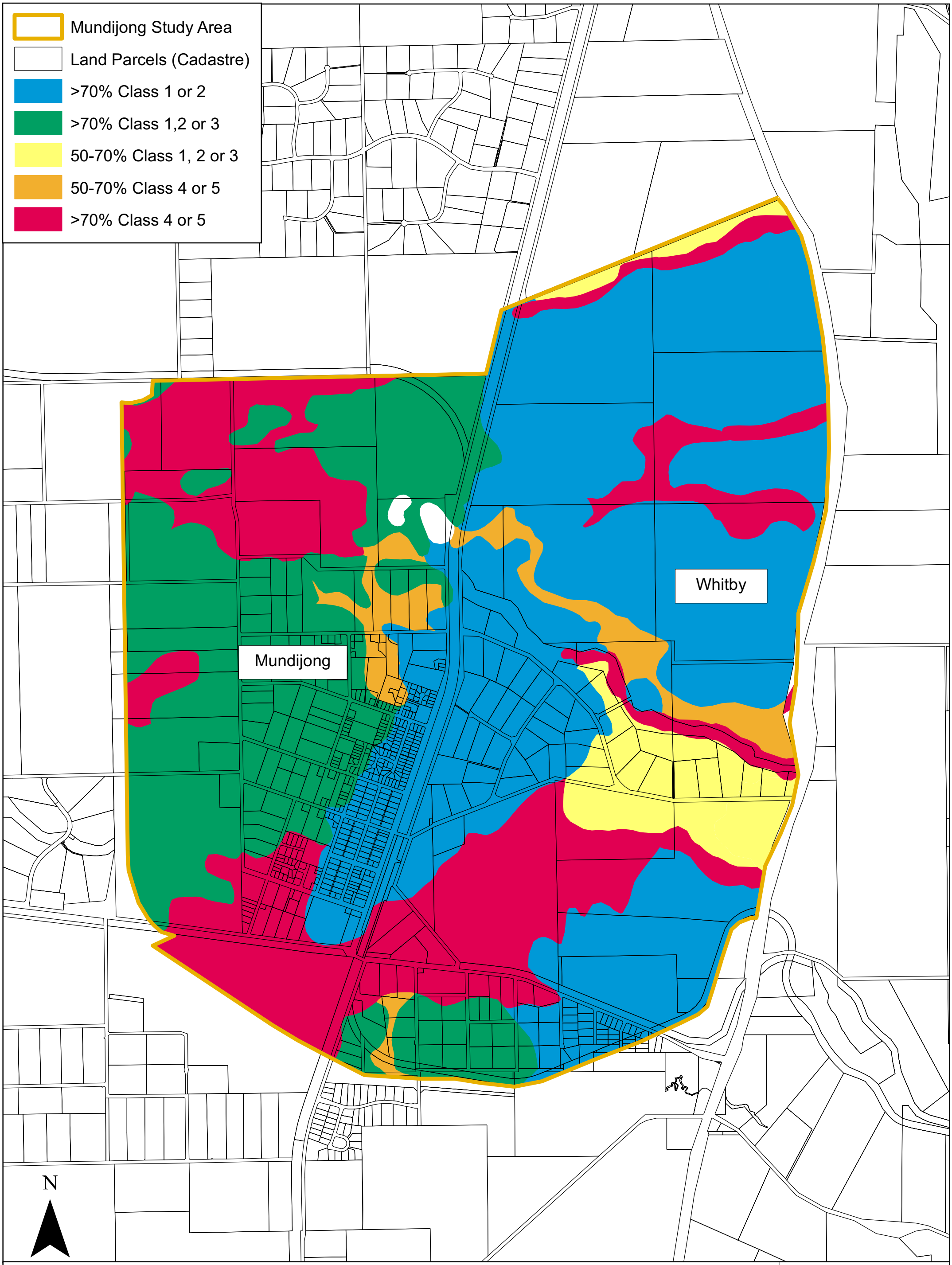

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Land Capability Classification (Perrenial Agriculture)	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 17	SCALE	1 : 20 000		
DATE	09/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

9 Wetlands, Linear Watercourses and Groundwater Dependant Ecosystems

9.1 Background

There are three types of geomorphic wetland within the MW Cell. These are:

1. Palusplain (a seasonally waterlogged flat);
2. Sumplands (a seasonally inundated basin of variable size and shape); and
3. Creeks (a seasonally inundated channel) (Semeniuk & Semeniuk, 1995).

These are further broken into three classifications:

1. Conservation wetlands – Wetlands which support high levels of attributes and functions;
2. Resource Enhancement wetlands – Wetlands which have been partly modified but still support substantial functions and attributes; and
3. Multiple Use wetlands – Wetlands with few attributes which still provide important wetland functions (Hill, et al, 1996).

In addition to these three categories the *Environmental Protection (Swan Coastal Plains Lakes) Policy, 1992* protects all lakes shown in green on *Miscellaneous Plan No. 1815* (EPP wetlands) from degradation or destruction including the:

- Filling in of lakes with materials;
- Carrying out excavation or mining operations in lakes;
- Discharge or disposal of effluent into lakes; and
- Drainage of water into or out of a lake.

Unless authorised under the *Environmental Protection Act, 1986* a person may not construct or alter any system for the drainage of water into or out of a lake or within a fifty (50) m buffer zone around the lake.

9.2 Wetlands within the MW Cell

Wetland Name	A[5]	B	C	D	E	F	G	H	I	J	K	L	M	Mundijong[4]
Category	EPP	EPP	EPP	EPP	EPP	EPP	EPP	EPP	EPP	EPP	EPP	R[6]	M[7]	M
Location (MGA Zone 50) (Figure 18)	405244E 6429315N	404833E 6428480N	404102E 6428350N	405913E 6427720N	405529E 6426762N	406033E 6426027N	404571E 6425706N	404064E 6424100N	403787E 6425667N	400825E 6426316N	404788E 6427710N	404802E 6426231N	404623E 6428570N	397614E 6415444N
Description														
Geomorphic class	Palusplain	Sumpland	Palusplain	Sumpland	Palusplain	Sumpland	Palusplain	Palusplain	Palusplain	Palusplain	Palusplain	Palusplain	Sumpland	Palusplain
Approximate Area (ha)	1.8	2	13.1	7.7	1.4	0.8	0.9	16	1.5	17.7	2.5	2.3	1.2	188.8
Approximate Perimeter (m)	1004	539	2184	1090	585	359	426	3689	649	3114	887	911	398	20476
Fringing Vegetation Condition[8]	5	4	5	5	5	4	5	5	5	4	3	4	5	6
Upland Vegetation Condition	D	D	P	D	D	G	D	D	D	D	D	D	D	D
Visual Water Quality	Clear	Clear with tadpoles, fish & tortoise	Clear	Clear with tadpoles and mussels	No water	Clear, brown algae, brown sediment	No water	No water	No water	No water	No water	No water	Clear with tadpoles, fish & tortoise	No water
Groundwater Dependant Ecosystems (Figure 9)	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No	Yes	No
Weeds	*Gladiolus caryophyllaceus* (Gladioli)	Pasture grasses	Gladioli *Briza maxima*	Gladioli *Briza maxima*	Gladioli	Gladioli	Pasture grasses	Gladioli	Pasture grasses	Gladioli	N/A	Gladioli	Pasture grasses	Pasture grasses
Biodiversity[9]														
Mammals	1x Priority 3 3x Priority 5	1x Priority 3 3x Priority 5	1x Priority 3 3x Priority 5	1x Priority 3 3x Priority 5	1x Priority 3 2x Priority 5	1x Priority 3 2x Priority 5	1x Priority 3 2x Priority 5	1x Priority 3 10x Priority 5	1x Priority 3 1x Priority 5	3x Schedule 1 1x Priority 3 4x Priority 4 1x Priority 5	1x Priority 3 3x Priority 5	1x Priority 3 2x Priority 5	1x Priority 3 3x Priority 5	8x Schedule 1 1x Priority 3 5x Priority 4 25x Priority 5
Birds	1x Schedule 1	1x Schedule 1	1x Schedule 1	1x Schedule 1				1x Schedule 4			1x Schedule 1		1x Schedule 1	4x Schedule 1 1x Schedule 4 8x Priority 4
Flora						1x DRF	1x DRF	1x DRF	3x DRF	4x DRF 1x Priority 3 2x Priority 4		1x DRF		29x DRF 2x Priority 1 17x Priority 3 12x Priority 4
No. of TEC	11	5	6	5	9	6	6	6	6	11	7	7	4	62
Required Buffer Zone	50m	50m	50m	50m	50m	50m	50m	50m	50m	50m	50m	50m	N/A	N/A
Potential Development Impacts														
Groundwater abstraction		✓	✓	✓		✓	✓	✓	✓				✓	
Changes in Stormwater drainage/run off	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	
Acid Sulphate Soils		✓	✓										✓	
Eutrophication		✓		✓	✓	✓	✓		✓				✓	
Vegetation Clearance	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Associated Land Management Issues														
Phosphorous export			✓✓	✓✓✓			✓			✓	✓✓✓			✓✓✓
Salinity					✓✓		✓✓	✓✓	✓✓			✓✓		✓
Water erosion			✓	✓✓✓										✓
Water logging			✓✓✓	✓✓✓	✓✓✓		✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓	✓✓✓		✓✓✓

Wetland Name	A[5]	B	C	D	E	F	G	H	I	J	K	L	M	Mundijong[4]
Wind erosion			✓✓	✓✓	✓		✓✓	✓	✓	✓✓	✓✓✓	✓		✓✓✓
ASS	✓✓	✓✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓✓	✓✓
Likely to be impacted by future development	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	No	Yes	Yes

Key:	Unlikely	✓	Possible	✓✓	Probable	✓✓✓	Highly Probable

[4] The DEC's WetlandBase identifies a number of wetlands within this region. As they are all palusplain multiple use wetlands they have been grouped together. Approximately half of the project area is occupied by the Mundijong Wetland.
[5] EPP = Environmental Protection Policy Wetland
[6] Resource Enhancement Wetland
[7] Multiple Use Wetland
[8] Refer to Appendix 9 for a description of vegetation conditions.

[9] All references refer to records within 1km of the wetland.

Land Parcels (Cadastre)
Mundijong Study Area
Mandejal Brook
Cardup Brook
Gingagup Brook
Stream A
Wetland Buffer
Resource Enhancement Wetlands
Conservation Wetlands
Multiple Use Wetlands

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Wetlands within the Mundijong Whitby Cell	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 18	SCALE	1 : 20 000	SOURCE	Dept. of Conservation & Environment (2007)
DATE	12/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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9.3 Water Courses within the MW Cell

Wetland Name	Manjedal Brook	Cardup Brook	Gingagup Brook	Stream A
Location	Figure 18	Figure 18	Figure 18	Figure 18
Description				
Geomorphic class	Creek	Creek	Creek	Creek
Fringing Vegetation condition	6	5 – (Eastern End) 4 – (Center) 5 – (Western End)	6	5
Groundwater Dependant Ecosystem (Figure 9)	Yes	No	Yes	Yes
Weeds	Gladioli *Briza maxima*	*Gomphocarpus fruticosus* (Cottonbush) infestation at eastern end Gladioli at western end	Pasture grasses	Pasture grasses
Evidence of erosion	No	Evidence of significant erosion (undercutting of banks) at eastern end to the centre of the site.	Some evidence of erosion along riverbanks	No
Aquatic habitats	Perennial stream dry in summer months	Perennial stream dry in summer months	Perennial stream dry in summer months	Perennial stream dry in summer months
Water quality (visual)	Excellent – freshwater mussels and tadpoles	Clear	Good – tadpoles present, but trace of oil scum	No water
Nutrient stripping potential	Western End: >70% high to extreme risk Eastern End: 10-30% high to extreme risk	>70% high to extreme risk	>70% high to extreme risk	No risk of nutrient stripping (See Figure 11)
Required Buffer Zone	50m (in places)	No legally required buffer zone	No legally required buffer zone	50m (in places)
Potential Development Impacts				
Groundwater abstraction	✓		✓	✓
Changes in Stormwater drainage/run off	✓	✓	✓	✓
Acid Sulphate Soils	✓			✓
Eutrophication	✓	✓	✓	✓
Vegetation Clearance	✓		✓	✓

Wetland Name	Manjedal Brook	Cardup Brook	Gingagup Brook	Stream A
Associated Land Management Issues				
Phosphorous export	✓✓	✓✓✓	✓✓✓	✓
Salinity				✓
Water erosion	✓✓✓	✓✓✓	✓✓✓	✓
Water logging	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Wind erosion	✓✓			✓
ASS	✓✓			✓✓
Likely to be impacted by future development in the Cell	Yes	No (Cardup Brook lies to the north of Bush Forever Site 354 and will not be impacted by Cell development)	Yes	Yes

Key:	Unlikely	✓	Possible	✓✓	Probable	✓✓✓	Highly Probable

9.4 Karst Formations within the MW Cell

A Karst formation is the name given to a type of topography where the landscape has been shaped by the action of water dissolving carbonate rocks (typically limestone, dolomite and marble). These types of formations are very specific to certain geologies. None of the soil types found within the MW Cell are associated with Karst formations (DAF, 2000) and no evidence was found of Karst formations during site visits.

9.5 Potential Development Impacts and Strategies for their Reduction

Potential Impact	Details of Potential Impact	Affected Wetlands	Strategies to Reduce Impacts
Groundwater abstraction	Groundwater abstraction can have a serious detrimental effect on groundwater dependant ecosystems, potentially resulting in the death of groundwater dependant vegetation.	**Wetlands** B,C,D,F,G,H,I,M **Watercourses** Stream A, Manjedal and Gingagup Brooks	1. Determine the acceptable level of groundwater abstraction and hence the number of bores permitted and their abstraction rate. 2. Design all new developments to ensure maximum recharge of groundwater.
Stormwater drainage/run off	Stormwater drainage into existing wetlands and water courses has a number of potential impacts including: • increased water turbidity; • eutrophication; • sedimentation; • erosion; • increased salinity; • increased micro-organisms; • increased pollutants (e.g. hydrocarbons, pesticides, acids and heavy metals); • increased gross pollutants (e.g. litter and debris); and • increased water temperature.	**Wetlands** A,B,C,D,E,F,G,H,I,J,K,M **Watercourses** Stream A, Manjedal, Cardup and Gingagup Brooks	1. Design all new developments to ensure maximum recharge of groundwater. 2. Rehabilitate existing watercourses and use them as living streams to remove stormwater from the area in accordance with the Department of Environments (DoE's) *Stormwater Management Manua* and subsequent publications (DoW, 2007)
Acid Sulphate Soils	The disturbance of ASS or PASS has the potential to acidify wetlands resulting in the destruction of aquatic habitat, fringing vegetation and two associated TEC's.	**Wetlands** B,C,M **Watercourses** Stream A and Manjedal Brook	1. Determine depths to groundwater near PASS and ASS. 2. Developers to undertake ASS assessments prior to development. 3. Ensure groundwater abstraction is managed.
Eutrophication	Eutrophication can cause an increased algal blooms resulting in an increase the oxygen demand and toxins in the water. This can result in the death of aquatic fauna.	**Wetlands** B,C,D,E,F,G,I,M **Watercourses** Stream A, Manjedal, Cardup and Gingagup Brooks	1. If fill is to be imported it should have a high nutrient retention rate (where possible). 2. Residents should be educated in the use of slow release fertilisers. 3. Native vegetation should be encouraged in all new developments.
Vegetation clearance	Clearing of vegetation has the potential to result in: • increased erosion • loss of habitat; • loss of rare flora; • loss of rare fauna; and • introduction/spread of invasive weeds.	**Wetlands** A,B,C,D,E,F,G,H,I,J,K,M, Mundijong **Watercourses** Stream A, Manjedal, Cardup and Gingagup Brooks	1. All vegetation clearance should be kept to a minimum. 2. No vegetation should be cleared around wetlands or watercourses. 3. Wetlands or watercourses should be rehabilitated to restore them to living streams.

9.6 Potential for Watercourse inclusion into Drainage Systems

Stormwater is water flowing over ground surfaces and in natural streams and drains as a direct result of rainfall over a catchment. Stormwater in Western Australia is managed in accordance with the DoW's (previously the DoE) *Stormwater Management Manua*l under consideration of the following hierarchy:

1. Retention and restoration of existing valuable elements of the natural drainage system, including waterways, wetlands and groundwater features and processes.
2. Implementation of non-structural source controls to minimise pollutant inputs principally via planning, organisational and behavioural techniques to minimise the amount of pollution entering the drainage system.
3. Minimisation of runoff by infiltrating or re-using rainfall as high in the catchment as possible and the installation of structural controls at or near the source to minimise pollutant inputs and the volume of stormwater.
4. Utilisation of in-system management measures including vegetative measures, such as swales and riparian zones, and structural quality improvement, devices such as gross pollutant traps (DoE, 2004).

The protection of existing waterways and the rehabilitation of degraded waterways into living streams in urban areas is an important technique for improving stormwater management. Changes to the catchment due to urbanisation can impact the health of waterways in a number of ways, including:

- An increase in flow rates resulting in changes to the size and shape of the channel;
- The erosion of the channel to accommodate increased flows, resulting in vegetation loss, smothering of habitat, loss of river pools and increased turbidity; and
- Changes to water quality, due to contaminants delivered by poorly managed stormwater, such as metals that are toxic to aquatic fauna and nutrients which potentially fuel excessive algal growth leading to the depletion of dissolved oxygen within the water column (DoE, 2004).

In urban areas, such as the MW Cell, utilisation of living streams can facilitate nutrients and contaminants sequestration, improve water quality and help mitigate erosional forces through the reduction flow rates.

While the four watercourses within the MW Cell are suitable for inclusion as living streams into the stormwater management system, there are a number of limitations on their use:

1. The DEC requires that there shall be no new constructed stormwater infrastructure within Conservation category wetlands and their buffers, or other conservation value wetlands and their buffers (e.g. no pipes or constructed channels within these wetlands and their buffers), unless authorised by the DoE or the Environmental Protection Authority (DoE and (Swan River Trust) SRT, 2005). At a minimum this means that no water can be discharged within 50 metres of EPP wetlands (Figure 18);
2. All wetlands and watercourses within the MW Cell (Figure 18) contain at least one sensitive receiving environment. Sensitive receiving environments include EPP wetlands, DRF, Priority Species, TEC's, Threatened Fauna Habitat and vegetation identified in Bush Forever (DoE and SRT, 2005). Any stormwater management system with the potential to impact on sensitive receiving environments may be subject to additional design and performance requirements, particularly with respect to nutrient leaching;
3. The watercourses within the MW Cell undergo restoration in accordance with the *River Restoration Manual* (Water and Rivers Commission (WRC), 1999-2003); and
4. Any stormwater management systems should be designed in accordance with the Stormwater Management Manual for Western Australia (DoE, 2004).

5. Where future subdivision has the potential to impact of Manjedal Brook a Foreshore Management Plan should be prepared by the sub-divider for approval by the WAPC.

While the DEC prefers living streams to be used where possible, given the sensitive nature of watercourses within the MW Cell, discussion should be undertaken with the DEC at the Local Structure Planning Stage to achieve a stormwater management system that meets with their approval.

10 Surface and Groundwater Quality

10.1 Background

10.1.1 Surface Water

The Cell is located in the lower Serpentine sub-catchment of the Murray River Basin within the Peel Harvey Catchment (Peel Harvey Catchment Council, 2005). Surface water in the Shire of Serpentine-Jarrahdale drains to the Serpentine River and ultimately the Peel Harvey Estuary. Surface hydrology in the Mundijong project area has four surface flows:

1. Manjedal Brook traversing the site from east-southeast to west-northwest;
2. Cardup Brook flowing east-northeast to west-southwest;
3. Gingagup Brook flowing east to west; and
4. a smaller unnamed ephemeral streamline (Stream A) flowing north-northeast to south-southwest.

None of these brooks are considered regionally significant (Peel Harvey Catchment Council, 2005). Generally surface water at the site flows from the Darling Scarp towards the Serpentine River.

Stream flows have not previously been gauged, however previous investigations have estimated flow for Manjedal Brook as approximately 8.3ML/day in winter and 1.6ML/day in Summer (Collins and Rosair as cited in Cardno BSD Pty Ltd, 2006b).

Baseline surface water quality data for the Whitby area has previously been recorded in June 2006 by Cardno BSD, however sampling was limited due to low rainfall and subsequent low flow. Sampling parameters for physical in-situ measurements and nutrients for this investigation were undertaken in parallel with Cardno BSD's report for comparison of results (2006b).

10.1.2 Groundwater

The cell overlies three aquifer systems; the Byford Area Superficial Aquifer unit (Davidson, 1995), the Leederville formation and Cattamarra Coal Measures. The Cell falls within the Serpentine Groundwater area of the northern Perth Basin and overlaps the Archaean terrain of the Yilgarn Shield. Groundwater flow was determined to be generally westward with some localised inflections towards Manjedal Brook.

While there appear to be bore and groundwater wells currently installed within the cell, consultation with the DEC indicated there are no groundwater abstraction licenses and groundwater allocations associated with these bores (Cardno BSD, 2006b).

No information is currently available regarding groundwater recharge rates within the MW Cell.

10.1.3 The Peel-Harvey Estuary

The Peel-Harvey Estuarine system is a valuable water resource under stress from nutrients, particularly phosphorus, draining from the catchment area. Phosphorus is considered the critical nutrient for eutrophication causing algal blooms in the Peel-Harvey Estuary. Current average nutrients for the Peel-Harvey Inlet are estimated at a rate of 15kg of phosphorus/ha per annum and 150kg of nitrogen/ha per annum (Peel-Harvey WSUD Local Planning Policy, 2006). The Estuary has a long history of nutrient enrichment and algal blooms which are a major environmental concern in the region (Ecological Engineering et al, 2005).

10.2 Surface Water Monitoring

Samples were collected on the 30th October 2007 from seven surface flow locations around the site; two from Cardup Brook, four from Manjedal Brook, and one from a sump located on Soldier's Road (Figure 19). Rainfall for October was slightly below average; however, over the winter months prior to sampling (July-September 2007) rainfall was above average at the Perth Airport Monitoring Station (Bureau of Meteorology, 2007).

Surface Water Sampling Sites

Mundijong Study Area

Whitby

Mundijong

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Surface Water Sampling Locations	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 19	SCALE	1 : 20 000		
DATE	10/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

pH measured in situ was recorded within limits ranging from 6.89-8.25. Electrical Conductivity ranged from 343 – 1150us/cm and salinity ranged from 0.14 – 0.58 ppt, indicating fresh to slightly brackish water. Lower conductivity values are often associated with seasonal rainfall. Turbidity ranged from 5.30 – 25.8 Nephelometric Turbidity Unit (NTU). Oxidation Reduction Potential (ORP) ranged from 170-286mV and Dissolved Oxygen ranged from 82.7 – 138.6%. Dissolved oxygen should avoid falling below 5mg/L to avoid stress to aquatic species (Appendix 19).

Although some heavy metals, such as copper and zinc, are important trace elements for aquatic life, they can be toxic at higher concentrations. Metals analysed from the MW Cell were all within Australian and New Zealand Environment Conservation Council (ANZECC) Drinking Water Guideline Values 2004 and ANZECC Fresh and Marine Water Quality 2000.

Phosphorus is usually the most significant nutrient in freshwater ecosystems and has been targeted as the main contributor of eutrophication in the Peel Harvey Estuary. When present in excess it can cause algal blooms in rivers, ponds and lakes. Total Phosphorus includes dissolved, particulate and organically bound phosphorus. Total Phosphorus recorded at the MW Cell ranged from 0.01mg/L to 0.03mg/L and Reactive Phosphorus was generally recorded below the limits of reporting (>0.01mg/L). Total Phosphorus results recorded within the cell were below the water quality target (0.1mg/L) set in the Peel Harvey Water Quality Improvement Plan (2007a)

Total Nitrogen averaged 0.35mg/L however one sample, SW11 (Appendix 17) recorded a concentration of 2.1mg/L, nearly twice the freshwater and marine trigger value (ANZECC, 2000). Total Kjeldahl Nitrogen (TKN) is a measure of organically bound forms and includes organic nitrogen and ammonia nitrogen. TKN concentrations ranged from 0.2 – 0.7mg/L. Ammonia is a bioavailable nutrient and very soluble in water. Depending on the pH and temperature, a fraction of the total ammonia exists as an undissociated form (NH_3). Ammonia concentrations were recorded above trigger values ranging from 0.105 – 0.118 mg/L. As pH increases and as temperature increases, the fraction will decrease (ECO Management Services, 2001). Oxidised nitrogen including nitrite and nitrate nitrogen, are dissolved bioavailable forms of nutrients. Nitrite and Nitrate (NOx) averaged concentrations below the trigger value except in two samples; SW2 recorded a NOx concentration of 0.176mg/L and SW11 recorded 1.38mg/L (Appendix 17). Generally these results are indicative of a slightly disturbed ecosystem with elevations in nutrients (ANZECC 2000).

10.3 Groundwater Monitoring

The data for the assessment of potential impacts on groundwater within the cell was sourced from a Department of Water (DoW) "Water Study". SMEC is currently awaiting the outcomes of this study. At present this study has not commenced, therefore the identified potential impacts on groundwater are based on the:

- Mundijong Deposit Investigation of Shallow Groundwater Resources (URS, 2001b);
- Whitby Surface and Groundwater Monitoring Program (Cardno BSD, 2006b);
- DoW Bore data (DoW, 2007a); and
- Perth Groundwater Atlas (DoW, 2007b).

10.4 Potential Impacts of Urban Development on Surface Water within the MW Cell

The conversion of a rural landscape to an urban cell increases the proportion of land that is impermeable to water (e.g. hard surfaced roads, footpaths, car parks etc), which in turn increases the volume and velocity of stormwater. The increase of stormwater velocity and volume has two major effects:

1. It increases the potential for the transport of solid materials resulting in:
    a. Increased water turbidity;
    b. Increased sedimentation;

c. Increased erosion;
d. Increased level of waterborne micro-organisms (including pathogens);
e. Increased amounts of gross pollutants entering the cell's water courses and wetlands (e.g. litter and debris); and
f. Increased water temperature.

2. It increases the potential for the transport of chemical compounds, resulting in:
   a. Increased nutrient export;
   b. Increased salinity; and
   c. Increased amounts of pollutants entering the cell's water courses and wetlands (e.g. hydrocarbons, pesticides, acids and heavy metals).

10.4.1 Solid Transport Potential

Rapid flowing water contains more energy than slower moving water. Greater energy means the water is able to collect and retain more suspended particles and gross pollutants (e.g. litter) than a slower moving stream. Should fast flowing stormwater enter the existing waterways within the Cell, there is a very high risk that it would result in the erosion of stream banks and increase water turbidity potentially resulting in the destruction of freshwater habitat and fringing vegetation. In addition, when the water slows and looses energy, the transported solid material will be deposited. This is most likely to occur in pools and wider areas of streams.

An increase in water turbidity facilitates greater heat absorption from the sun resulting in an increase in water temperature. Rising water temperatures can cause:

1. A decrease in the dissolved oxygen (DO) levels as warmer water absorbs less oxygen;
2. A decrease in light penetration reducing algae photosynthesis, further reducing DO levels; and
3. An increase in bacteria numbers, as they reproduce more rapidly at higher temperatures.

A decrease in the DO levels of watercourses and wetlands in the MW Cell could result in a loss of aquatic habitats and aquatic fauna.

10.4.2 Chemical Transport Potential

Large volumes of water moving at a high velocity have a very high chemical transport potential, as they are able to dissolve or directly transport these chemicals into waterways. The conversion of the MW Cell from a rural to an urban landscape is likely to increase the risk of chemical pollutants, such as hydrocarbons, being transported from road surfaces into the cell's waterways. The transport of significant levels of these pollutants over time is likely to result in the degradation of freshwater habitats, the loss of fringing vegetation and the loss of aquatic fauna.

Much of the MW Cell has a very high risk of nutrient export (Figure 28). It is possible that the amount of nutrients, particularly phosphorous applied to land within the cell may increase with urbanisation. There is also the potential for incorrectly applied fertilisers from urban gardens to be washed directly into the cell's water courses, resulting in the eutrophication of wetlands and water ways within the cell and the loss of aquatic fauna.

Similarly, urbanisation will increase the quantity of chemical pollutants (e.g. hydrocarbons, herbicides and pesticides) within the cell. Stormwater runoff will transport these chemical pollutants into the surrounding waterways and wetlands, resulting in the degradation and possible destruction of fringing vegetation, aquatic habitat and the loss of aquatic fauna within and downstream of the MW Cell.

10.5 Potential Impacts of Urban Development on Groundwater within the MW Cell

The development of the MW Cell is likely to result in an increase in stormwater runoff resulting in less water infiltrating the ground within the cell reducing groundwater recharge and lowering groundwater levels. Groundwater levels will be lowered further should groundwater abstraction increase within the MW cell (e.g. private garden bores are established).

There are potentially two major effects of lowering groundwater levels within the MW Cell:

1. The loss of groundwater dependant ecosystems; and
2. The exposure of Potential Acids Sulphate Soils (PASS) and Acid Sulphate Soils (ASS).

The Cell contains 11 areas where groundwater dependant ecosystems occur (Figure 9). Should the groundwater levels in these areas be lowered beyond the reach of the root systems these vegetation communities will become stressed and possibly die, resulting in a loss of habitat and potentially the loss of significant flora and fauna.

If the water table is lowered to an extent that PASS and ASS soils are exposed to oxygen, sulphur based chemicals (e.g. pyrite) within the soils could react to form sulphuric acid. This acid can then leach into the groundwater, as well as watercourses and wetlands, resulting in groundwater degradation/pollution and vegetation loss. This is particularly likely in areas of high risk of PASS and ASS (Appendix 18). The risks associated with PASS and ASS within the MW Cell are discussed further in Section 11.

There are two ways in which groundwater can be contaminated:

1. Point source contamination; and
2. Diffuse source contamination.

Point source contamination results from a localised/single chemical spill or leak and is often the most severe form of contamination. When a point source contamination event occurs, the contaminant interacts with the groundwater and the soil and spreads out to form a plume moving in the direction as the groundwater.

Diffuse source contamination occurs where there are a number of contaminate sources over a wide area. Urban runoff can be highly polluted by fertilisers, animal droppings, oil, petrol, tyre rubber and pesticides, resulting in the diffuse contamination of groundwater. Diffuse contamination may have a greater environmental impact than contamination from a point source because it affects a much larger volume of water.

Contamination of groundwater may result in bores being unsuitable for use and the damage or destruction to local ecosystems, such as groundwater dependant ecosystems, wetlands and watercourses.

To determine appropriate mitigation measures for the potential impacts discussed above the DoW will conduct investigations into the groundwater recharge rates. The use of production bores in the cell should be restricted and licences obtained where necessary to ensure that groundwater levels are not significantly reduced.

10.6 Groundwater Recharge Rates

Groundwater recharge rates are to be determined by the DoW Hydrogeological Investigations, which is yet to be undertaken.

10.7 Nutrient Sources within and surrounding the MW Cell

The water quality sampling results indicate the main environmental concern is nutrient loading from current and surrounding land uses, including:

- Dairies;
- Animal feedlots;
- Poultry farms;

- Sale yards and sheds;
- Waste disposal facilities;
- Septic tanks; and
- other agriculture uses (e.g. pasture).

Surface water sampling showed that nutrient concentrations for SW11 at Cardup Brook (Figure 19) significantly exceeded ANZECC trigger values for slightly disturbed fresh water ecosystems (ANZECC 2000). SW11 is located in the northeast corner of the MW cell adjacent and downstream of South West Highway, South Cardup Landfill Facility and agricultural activities (e.g. pasture). These results suggest that following seasonal rain, runoff from upstream has transported significant quantities of nutrients into Cardup Brook. However, SW12 downstream of SW11 recorded much reduced levels of nutrients, indicating those quantities of nutrient inputs, excluding ammonia, were filtered on site rather than being exported from the site.

SW2 at Manjedal Brook (Figure 19), located at the eastern edge of the site, exceeded NOx and ammonia trigger values but downstream concentrations of NOx at SW4 did not exceed trigger values. This suggests that those nutrients from upstream (agricultural lands) are entering the site most likely via run-off and filtering within the site.

Generally ammonia levels across the site moderately exceeded trigger values (on average by 0.4mg/L). Ammonia is used commercially in animal feeds, fertilisers and the manufacture of fibres, plastics and explosives. The site has a significant number of hobby farms and equine facilities which could account for the wide spread source of ammonia. Following significant rainfall events it can be expected that runoff from these areas will transport ammonia into all four waterways.

Results from SMEC's surface water investigation vary slightly from the samples undertaken by Cardno BSD. The 2006 results recorded exceedances in NOx only (Cardno BSD, 2006). This investigation recorded exceedances in NOx, Total Nitrogen and Ammonia (SMEC 2007). These differences can be attributed to seasonal variation. June 2006 received lower than average rainfall and less run-off which led to no water flow leaving the site. The 2007 samples were collected in October after a higher than average seasonal (winter) rainfall, which increased surface flows and runoff and subsequent transport of nutrients.

10.8 Pollutant Sources within and surrounding the MW Cell

There are 7 existing potential pollutant sources (excluding nutrients) within or surrounding the MW Cell (Figure 21):

- Council depot;
- Cardup landfill;
- Decommissioned landfill;
- Decommissioned mine;
- Timber mill and treatment;
- Stock feed suppliers; and
- Rubbish pile.

These potential pollutant sources are discussed in further detail in Section 10.

10.9 Actions required to meet Peel Harvey Water Quality Improvement Plan and ANZECC Water Quality Guidelines

Nutrient modeling undertaken for the Peel Harvey Catchment and suburb of Byford have made recommendations for nutrient loads leaving the site. To reduce nutrient inputs into the Serpentine River, the Peel Harvey Catchment Council's *Natural Resources Management Plan* recommends that Total Nitrogen should not exceed 235 tonnes/year (Peel Harvey Catchment Council, 2005).

The environmental objective of the *Environmental Protection (Peel Inlet-Harvey Estuary) Policy 1992* states that Total Phosphorus flowing into the estuary from the Serpentine River should not exceed 21 tonnes/year (EPA 1992). The *Urban Stormwater Management Strategy for Byford* (Ecological Engineering Holdings & Parsons Brinkerhoff, 2005) modeled nutrient inputs leaving the suburb. The strategy recommended Total Nitrogen leaving the site should not exceed the ANZECC default trigger values of 1.2mg/L and Total Phosphorus 0.065mg/L (Ecological Engineering Holdings & Parsons Brinkerhoff, 2005).

More recently the *Peel Harvey Water Quality Improvement Plan (Draft)* has developed water quality objectives to reduce the Total Phosphorus load causing algal blooms entering the estuary from the Serpentine, Murray and Harvey Rivers. The maximum pollutant load of Total Phosphorus has been calculated at a Winter Mean Target of 0.1mg/L (Environmental Protection Authority 2007). The results of the surface water sampling indicate the Total Phosphorus pollutant load leaving the cell is well below the Winter Mean Target.

The *State Planning Policy 2.9*: *Water Resources* (WAPC, 2006) states that nutrient export levels should be reduced into receiving waters to a lower level than that of the existing land use. Human activities can impact waterways on site via pollution from industrial, urban, mining and agricultural sources; including infrastructure development (road building), clearance of vegetation, particularly stream bank vegetation, habitat destruction and eutrophication.

Any development likely to result in a catchment nutrient input rate above the current average estimated rate of 15kg/phosphorus/ha per annum or 150kg/nitrogen/ha per annum into the Peel Harvey estuary is considered environmentally unacceptable and shall be referred to the EPA, unless appropriate and acceptable information is provided to demonstrate that the development will achieve relevant environment criteria (Peel Development Commission, 2006a).

Urbanisation of the site is expected to increase the amount of runoff entering the waterways and thus pollutants from impervious surfaces. However the reduction in hobby farms and sources of nutrients may reduce the nutrient loads generated on site and transported to the waterways by run-off.

10.9.1 Recommendations

It is recommended that a District/Local Water Management Strategy is developed in compliance with the *Peel-Harvey Coastal Catchment Water Sensitive Urban Design Technical Guidelines* (Peel Development Commission, 2006a) and *Stormwater Management Manual for Western Australia* (DoE, 2004). These guidelines are in support of the *Draft Peel-Harvey Water Sensitive Urban Design Local Planning Policy* (Peel Development Commission, 2006b) and the objectives of the *Draft Peel-Harvey Water Quality Improvement Plan* (EPA, 2007a). In terms of project planning, the opportunities and constraints of the site have been defined and the Strategy/plan can be developed. The Strategy as a minimum should:

- Include commitments to best practice planning, design and construction (discuss conceptual Best Planning Practices such as Water Sensitive Urban Design (Gross pollutant Traps, Swales, Natural Channel Designs etc), better managing agricultural land (slow release fertilizers and phosphorus binding soil agents), urban and rural effluent management, and reafforestation (nutrient stripping)) ;
- Refine land use scenario and identify major constraints;
- Identify water sources for drinking and other uses, consistent with fit-for-purpose use;
- Refine water quantity management strategy including land for flood protection; and
- Identify any issues to be addressed at later planning stages.

The Strategy should then be developed into a Plan that presents:

- Commitments to compliance with stated Design Objectives via future Urban Water Management Plan (UWMP);
- A Site Water Balance;
- A Fit-for-purpose water use strategy including conservation;

- Management Strategies for environmental assets and site conditions;
- Further refining of the urban water management system to quantify land required to meet design objectives;
- Suite of proposed best management practices and best practice plans (treatment train approach) – depicted in diagrams;
- Recommended monitoring framework: and
- Identify requirements of UWMP (sub-divisional applications) (Peel Development Commission, 2006b).

11 Site Contamination

11.1 Introduction

A Preliminary Site Investigation (PSI) of potentially contaminated sites within the MW Cell was undertaken as part of the Environmental Study for the Mundijong Whitby District Structure Plan. Potentially contaminated sites were identified based on consultation with the Shire of Serpentine-Jarrahdale and a review of previous environmental studies. The sites investigated for this PSI included: Dairies (Lots 2/11 Taylor Rd, a Poultry (Lot 2 Adamson St), a Garden Hire Business (Lot 410 Watkins Rd), Lots 100/101 (Keirnan Rd - Stockfeeds), Reserve 37149 (Adjacent to Lots 4396, 139 Watkins Rd – old landfill), Lots 48/50/221/222 (Butcher St - Council Depot), Lot 180 (Shanley Rd – Telecom Tower), Lots 200/201 (Shale Rd – Cardup Landfill), Lots 2/20/21/60 (Norman Rd - Timber mill), Reserve 7125 (South Western Highway – Motorcross track), Lots 4396/139 (Bush forever site 360 - Mundijong Rubbish Tip Road – Old Landfill), Decommissioned mine Lot 5 and Reserve 37149 (Watkins Rd - Council pound). All of the sites are located within or in close proximity to the MW Cell.

The investigation was carried out in accordance with the DEC Contaminated Sites Guidelines, which is part of the *Contaminated Sites Management Series: Reporting on Site Assessments 2001.*

The *Contaminated Sites Act 2003* (Act) defines contamination as a substance present on land, water or site at levels above background concentrations and at high enough concentrations, such that it presents, or has the potential to present, a risk to human health, the environment or any environmental value. Under the *Act* it is a requirement for people to report sites they know, or suspect, are contaminated to the DEC.

The objectives of the PSI are to:

1. Assess identified potentially contaminated sites, within or adjacent to the Cell, probable contaminants and their possible locations;
2. Identify potential sources of impact, transport mediums, preferential pathways and sensitive receptors;
3. Assess if potential contamination poses an actual or potential risk to human health and/or the environment; and
4. Provide recommendations in accordance with DEC guidelines.

Risk Assessment is an integral part of all contaminated site investigations. All sites assessed in this PSI have been considered with respect to their risk potential. The DEC states, for a site to be considered "contaminated" there needs to be a risk (i.e. a source, pathway and receptor) that has either materialised or has the potential to materialise (DEC, 2006a). The conclusions provided for each site have been developed based on the risk potential.

11.1.1 Legislation and Land Use Planning

The investigation, assessment and remediation of contaminated land is governed by the *Contaminated Sites Act 2003.* The *Act* is the most important mechanism for identifying and managing known and suspected contaminated sites; however, the land use planning process plays a crucial role for the identification and subsequent management of unknown contaminated sites.

In essence, the land use planning process operates in parallel to the *Contaminated Sites Act 2003.* The level of consideration and detail paid to contamination issues varies depending on the level of planning at which the proposal is being assessed (e.g. strategic plans, structure plans, scheme amendments to subdivision and development) (DEC, 2006b). The DEC recommends that, before making a determination on a proposal, planning authorities take into account that contamination in most cases is manageable and, in terms of subdivision and development applications, issues can commonly be mitigated by the application of appropriate conditions. Potential soil and/or groundwater contamination must, however, be identified and managed or remediated, if necessary, prior to any development activities.

11.2 Site Conditions and Surrounding Environment

11.2.1 Topography

Ground elevations at the site slope from the western boundary to the north-west point of the site from approximately 25 mAHD to 75 mAHD, reaching a high point of 96mAHD along the eastern boundary (South-Western Hwy).

11.2.2 Geology and Soils

The Swan Coastal Plain is a part of a deep linear trough of sedimentary rocks called the Perth Basin, which extends north-south, parallel to the coastline, for about 1000 km (Wade, 2006). The MW Cell consists of three soil types: Forrestfield, Pinjarra and Bassendean.

The Forrestfield soils are situated along the undulating foothills of the Darling Scarp. The formation of the soils results from a mixture of colluvium and ancient shoreline deposits (Wade, 2006). They are predominantly duplex sandy gravels, pale deep sands and deep sandy duplexes, susceptible to water erosion and phosphorus export, particularly in drainage channels and on the steeper slopes (Wade, 2006).

The formation of the Pinjarra soils is attributed to alluvial materials deposited across the plain extending from north to south adjacent to the Forrestfield group, including through the centre of the Shire to its western boundary (Wade, 2006).

In isolated pockets, the alluvial soils are overlain by wind blown sand typical of the Bassendean System. These areas are prone to wind erosion, but only minor areas of the remainder of the flats are susceptible to either wind or water erosion (Wade, 2006). Most of the low lying heavy soils are susceptible to water logging and substantial areas have some risk of developing secondary salinity (Wade, 2006).

11.2.3 Surface Hydrology

Surface water in the Shire of Serpentine-Jarrahdale drains to the Serpentine River and ultimately the Peel Harvey Estuary. Surface hydrology in the Mundijong project area has four surface flows:

1. Manjedal Brook traversing the site from east-southeast to west-northwest;
2. Cardup Brook flowing east-northeast to west-southwest;
3. Gingagup Brook flowing east to west; and
4. A smaller unnamed ephemeral streamline (Stream A) flowing north-northeast to south-southwest.

Stream flows have not previously been gauged; however, previous investigations have estimated flow for Manjedal Brook as approximately 8.3ML/day in winter and 1.6ML/day in summer (Collins and Rosair as cited in Cardno BSD Pty Ltd, 2006).

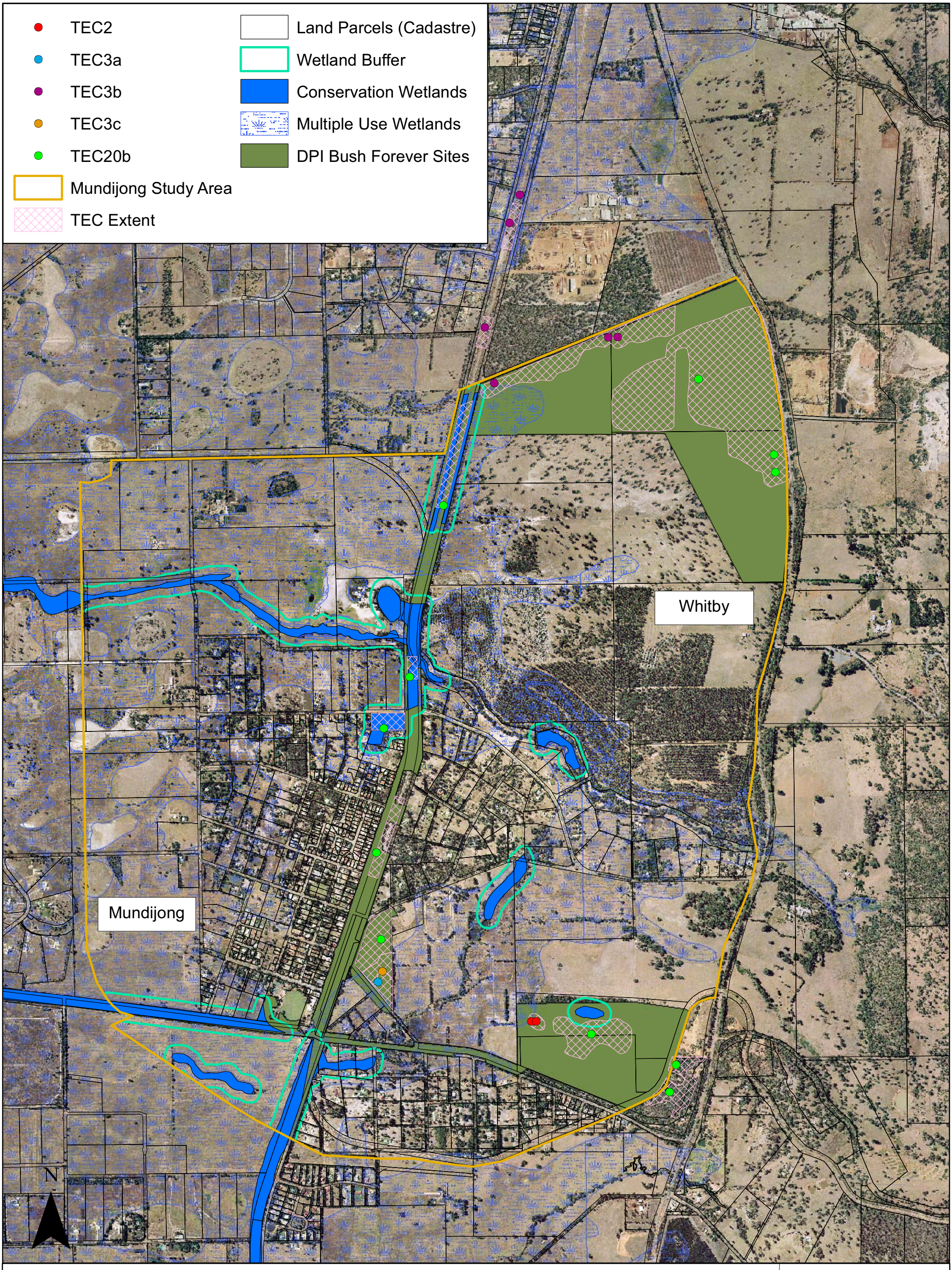
11.2.4 Sensitive Environmental Receptors

There are five major sensitive environmental receptors within the Cell (Figure 20):

1. Shallow superficial groundwater tables occurring slighting north-east of centre of the cell;
2. Wetlands and watercourse occurring within the project area;
3. TECs;
4. DRF; and
5. Bush Forever sites).

11.3 Regulatory Agency and Records Search

A search conducted on the 4th December 2007 of the DEC records of known or suspected contaminated sites; the Public Database of Confirmed Contaminated Sites (under development) and the Perth Ground Water Atlas identified one area (2 Jarrahdale Rd) as "contaminated remediation required". This site is situated outside of the cell to the south east and not a significant concern for the Cell (Appendix 16).



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Sensitive Environmental Receptors	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 20	SCALE	1 : 20 000	SOURCE	Dept. of Conservation & Environment (2007)
DATE	11/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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11.4 Property Description

11.4.1 Title Description

The sites investigated as part of this study are presently owned by various sources, including private, Government and the Shire (Table 38). Copies of the Certificates of Title are included (Appendix 13).

TABLE 38. CERTIFICATES OF TITLE

Address	Certificate of Title	Present Owner(s)
Lots 200* & 201 Shale Rd	Volume 2053 Folio 524 & Volume 2107 Folio 678	Pioneer Construction Materials Pty Ltd Pioneer Australia Waste Management Pty Ltd SITA-BFI Waste Services Pty Ltd
Lots 48, 50, 221 & 222 Butcher St	Volume 914 Folio 13 & Volume 2198 Folio 804 & Volume 2198 Folio 805 & Volume 2198 Folio 806	Serpentine Jarrahdale Road Board of Mundijong Shire of Serpentine Jarrahdale
Lot 11 Taylor Rd	Volume 2052 Folio 559	Wellstrand Pty Ltd
Lot 4396 Mundijong Rubbish Tip Rd	Volume LR3111 Folio 72	Crown Land (State of Western Australia)
Lot 5 South-Western Hwy	Volume 2199 Folio 537	Meelia Pty Ltd
Lots 2*, 20, 60 & 21 Norman Rd	Volume 1863 Folio 686 & Volume 2672 Folio 275 & Volume 2672 Folio 276	Silvagold Corporation Pty Ltd Kandalee Pty Ltd Mecca Holdings Pty Ltd

*caveat on land parcel

11.4.2 Land Use Zoning

Under the MRS (WAPC, 2007) all investigated sites are zoned “urban” except the:

- Decommissioned Landfill on Mundijong Rubbish Tip Rd (zoned “parks & recreation”);
- Cardup Landfill (zoned public purposes “special uses”); and
- Timber Treatment Mill (zoned “rural”).

Under the TPS No. 2 (Serpentine Jarrahdale Shire, 2004b) the zoning for all sites is listed below;

- Dairy Lots 2 & 11 zoned, “urban development”;
- Poultry Lot 2, (outside the Cell) zoned “rural”;
- Council Depot Lots 48, 50, 221, 222, classed under local schemes reserves as for ‘public and community purposes’;
- Garden & Hire Business Lot 410 zoned, “urban development”;
- Decommissioned Landfill adjacent to Lots 4396, 139, classed within metropolitan scheme reserves as “parks and recreation”;
- Telecommunications Tower (Lot 180) (outside Cell), zoned as “rural”;
- Decommissioned Mine (Lot 5) (outside Cell), zoned as “rural”;
- Stockfeeds (Lot 100, 101), zoned “additional uses” and “rural” with additional zoning on northern boundary as an “area of natural beauty”;
- Motorcross track Reserve 7125, zoned “rural”;
- Cardup Landfill (Lot 200, 201), zoned special use “Extraction of Hardrock/Landfill” and “Extraction/Storage Shale & Clay/Landfill”;
- Timber Mill and Treatment (Lots 2, 20, 60 and 21), zoned special use “Manufacture/Distribution of Timber”; and

- Council Pound (Reserve 37149) classed under local schemes reserves as for 'public and community purposes'.

11.4.3 Surrounding Land Uses

Location with respect to the MW Cell	Land Use
North	The northern boundary of the Cell is Norman/Bishop Rd. Beyond this boundary is approximately 500 m of remnant bush and a recent plantation timber allotment to the north east. Further north is the PERMApole Timber Treatment Plant. To the northeast is Cardup Metro Brickworks and the Byford Rifle Range.
East	Immediately east of the Cell is South-Western Hwy. Beyond the Highway are several industrial commercial properties which were assessed as part of this PSI, including South Cardup Landfill, Henley Park Motorcross Track and the decommissioned mine.
South	South of Mundijong/Watkins Rd the area is predominantly residential and comprises rural allotments (including a Dairy, Poultry and Horse Racing Track). Towards the eastern end of Watkins Rd is a significant area of remnant vegetation (adjacently south of Jarrahdale Rd).
West	Beyond the western boundary of the Cell the land is predominantly rural properties. The general topography for the area slopes from east to west and as such west of the Cell is a large palusplain wetland. The DEC wetland base named this wetland as the Mundijong Wetland.

11.5 Site History

11.5.1 Overall State for Mundijong/Whitby Cell

A historical search was undertaken by Landgate that included search of historical titles and aerial photographs. In addition, a historical search of the Shire of Serpentine Jarrahdale records was conducted to ascertain any changes in land use that may potentially impact, or have impacted, on the sites.

A review of historical aerial photos of the study site from 1953 until 2006 was undertaken to provide insight into possible significant land use changes within the Cell (Table 39). Aerials for approximately each decade since 1953 are provided (Appendix 14).

TABLE 39. HISTORICAL AERIAL REVIEW

1953	The 1953 aerial shows the Mundijong/Whitby Cell is predominantly low density agriculture with some residential developments along the south of Paterson St. A significant distinguishing feature from more recent aerials is there no vegetation had been cleared for the landfill located at Bush Forever site 360, and due to this there is more vegetation in the south east corner of the Cell.
1965	The overall state of the Cell relatively unchanged from the previous decade with the dominant land use remaining as agriculture. One notable feature is a cleared area adjacent to the South-Western Hwy in the south east corner of the Cell just outside Cell boundary. This is thought to be for the now decommissioned landfill situated on Bush Forever site 360.
1972	The Cell remains similar to previous aerial from 1965 no noteworthy features were visible, the only significant change is an expansion of residential housing along Paterson St.
1985	The aerial image from 1985 of the Cell marks the first appearance of pine plantations located towards the centre middle of the Cell on the eastern boundary, north of Kiernan St and east of the South-Western Hwy.
1997	The overall state of the Cell remains relatively unchanged from the 1985 aerial, with the only visible feature being some more land cleared for landfill in south-east corner of the Cell.
2007	The overall state of the Cell differs from the decade previous, with more residential housing, and miscellaneous building east and west of Paterson St.

11.5.2 Potential Contamination on Agricultural Land

A significant portion of the MW Cell is agricultural land. The DEC has documented a number of potential causes of contamination that are commonly associated with rural activities (DEC, 2004c), including:

- Current or historical arsenic-based sheep or cattle dips - especially if they were unlined or sludge/residue was disposed of on-site;
- Uncontrolled landfills and rubbish dumps - particularly sites where unused chemicals were disposed of on-site and leachate from landfills may enter surface water or groundwater;
- Areas of land where fertilisers, pesticides or herbicides were not applied in accordance with manufacturer recommendations and therefore elevated concentrations may be present in the soil;
- Large spillages of hazardous chemicals or fuels which have impacted soil and may impact groundwater and surface water; and
- Storage of disused chemicals, particularly where these have the potential to leak into the soil, surface water or groundwater.

11.6 Potentially Contaminated Sites within the Cell

The *Mundijong Whitby District Structure Plan Environmental Scoping Paper* (Land Insights, 2006) identified a number of sites within the MW Cell considered to contain potentially contaminating activities and requiring further investigation. An inspection of these sites and others identified through consultation with the Shire of Serpentine- Jarrahdale was conducted on 17th October 2007 to produce a list of the sites identified for inclusion in this assessment (Table 40).

11.7 Previous Studies

11.7.1 Environmental Scoping Study

As part of the *Mundijong Whitby District Structure Plan Environmental Scoping Paper* (Land Insights, 2006) preliminary investigations were undertaken to identify potential contaminated sites within the Cell. The list of potentially contaminated sites identified in this study was incorporated as the baseline data for this Preliminary Site Investigation (PSI) (Table 40, Figure 21).

11.7.2 PSI for Lots 22 to 27, 29 and 45 South West Hwy and Lots 302 and 399 Reilly Rd Mundijong

Golder Associates Pty Ltd undertook a PSI for the north east section of the Mundijong/Whitby Cell in 2005 (Golder, 2005). The parcel of land considered in this PSI included ten adjoining Lots between South Western Hwy, Norman Rd, Soldiers Rd and Manjedal Brook (north of Kiernan Rd). The PSI included Lots 22 to 27, 29 and 45 South Western Hwy and Lots 302 and 399 Reilly Rd.

Various zoning classifications applied to the allotments parcels of land. The area is currently owned by Iluka Resources and leased to various parties for residential and agricultural purposes. The PSI determined there were no environmental concerns with the majority of the site. However, nine areas of potential site contamination were identified (Table 41).

The study concluded that given the past and present use of the Site, it is unlikely that the potential sources of contamination detected will have resulted in significant soil or groundwater impacts. However, it is recommended that further investigations (including sampling) be undertaken to confirm this.

TABLE 40. LIST OF POTENTIALLY CONTAMINATED SITES WITHIN OR SURROUNDING THE PROJECT AREA

Site/Location (s)	Proximity to Cell	DEC Classification	Possible Contaminants
Dairy Lot 11 (S 32°16'15.1 E 115°58'50.3)	Within cell	Intensive Agriculture	Nutrients, pesticides and nitrates.
Dairy Lot 2 (S 32°16'14.8 E 115°59'03.2)	Within cell	Intensive Agriculture	Nutrients, pesticides and nitrates.
Poultry (S 32°18'28.6 E 115°59'17.8)	>500 m south of southern boundary	Intensive Agriculture	Nutrients, pesticides and nitrates.
Council Depot (32°17'42.83 S 115°59'0.76 E)	Within cell	Not Listed/ Classified	Carbamates, pesticides, herbicides, fungicides and hydrocarbons.
Cardup Landfill (S 32 16 00.4 E 116 01 07.0)	On boundary of north east point of site	Landfill	Dependent on landfill type and waste disposed; Polychlorinated biphenyls (PCB), Alkanes, Sulphides, Metals, Organic acids, Nutrients (e.g. nitrogen, phosphorus), Total petroleum hydrocarbons (TPH), Polycyclic aromatic hydrocarbons (PAH), Ammonia, Landfill gas (e.g. methane), Total Dissolved Solids (TDS), Monocyclic aromatic hydrocarbon.
Decommissioned Landfill (S 32°18' 06.9 E 116°00' 18.2)	South east corner of site.	Landfill	Dependent on landfill type and waste disposed; PCB, Alkanes, Sulphides, Metals, Organic acids, Nutrients (e.g. nitrogen, phosphorus), TPH, PAH, Ammonia, Landfill gas (e.g. methane), TDS, Monocyclic aromatic hydrocarbon.
Timber Mill and Treatment (S 32°15'21.5 E 115°59'52.4)	>1km north of northern site boundary	Timber preserving/ saw mills/ wood storage	• Chlorinated hydrocarbons (e.g. pentachlorophenol); • Polycyclic aromatic hydrocarbons (e.g. creosote, naphthalene); • Organochlorine pesticides; • Metals (e.g. arsenic, copper, chromium); and • Ammonia.
Stockfeeds (S 32°17'26.9 E 116°00' 44.8)	Within cell	Not Listed/ Classified	Nutrients and chemicals.
Telecommunications Tower (S 32°18'40.1 E 115°59'57.1)	>1km south of south eastern boundary	Not Listed/ Classified	Fuel and chemicals.
Council Pound (S 32°18'06.5 E 115°59'18.7)	Within cell	Not Listed/ Classified	Nutrients and pesticides.
Decommissioned Mine (S 32°18'21.2 E 116°00'30.1)	>1km south east of cell	Mining and Extractive Industries	Acids, Alkalis, TDS, Organic flocculants (e.g. sulphate, cyanide), Metals (e.g. arsenic, copper, iron, mercury), TPH, Monocyclic aromatic hydrocarbons (e.g. benzene, toluene, ethylbenzene & xylene).
Motorcross Track (S 32°15'55.4 E 116°00'53.9)	On north eastern boundary (eastern side of South Western Hwy)	Not Listed/ Classified	Hydrocarbons and chemicals.
Garden & Hire Business (S 32°18'03.6 E 115°59'11.0)	Within cell	Not Listed/ Classified	Nutrients, pesticides and chemicals.
Horse Racetrack S32 18 00.9 E115 58 03.7	700m south west of the cell	Not Listed/ Classified	Nutrients and pesticides.

Potential Contaminated Sites

Mundijong Study Area

Land Parcels (Cadastre)

Timber Mill & Treatment

Cardup Landfill

Motorcross Track

Dairy Lot 11

Dairy Lot 2

Equipment Sheds

Rubbish Pile

Shearing Sheds

Dead Trees

Toolshed

Sheep Yards

Septic Tank

Stock Feed Suppliers

Council Depot

Council Pound

Decommissioned Landfill

Decommissioned Mine

Poultry Farm

Telecommunications Tower

N

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Potential Contaminated Sites	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 21	SCALE	1 : 20 000		
DATE	10/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

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TABLE 41. POTENTIALLY CONTAMINATING SITES/ACTIVITIES IN WHITBY IDENTIFIED BY GOLDER ASSOCIATES IN 2005

Site	Justification for Contamination Potential
Equipment shed, Lot 23	The cement fibre roofing on the equipment shed potentially contains asbestos and was used for storage of chemicals and hydrocarbon products therefore rating the potential for soil contamination moderate to low.
Tool shed, Lot 23	There is potential for soil/groundwater contamination from DDT, sheep dip and hydrocarbons.
Fire damaged area, Lot 24	Limited regrowth suggest the area may contain contaminants in soil/groundwater.
Septic tank systems	A septic tank was observed at Lot 302 and is believed to also be present adjacent to dwellings on Lots 23 & 24. There may be potential for soil and groundwater contamination if hydrocarbons or chemicals were discharged in tanks.
Shearing shed, Lot 23	Regular use of chemicals and hydrocarbon based products and nutrients in this area and hence potential for soil/groundwater contamination.
Rubbish pile, Lot 23	There is potential for soil contamination surrounding the rubbish pile due to the storage of chemical and hydrocarbon containers and waste metal.
Sheep yards. Lot 24	Visual soil contamination was evident from drums of hydrocarbon products and hence potential for groundwater contamination.
Lot 302	Aerial photograph indicates several structures on the property, which warrant further investigation.
Cleared grazing areas	No obvious indication of contamination but significant potential exists for contamination in this area.

11.7.3 Groundwater Use

The DoW identified two boreholes within the MW Cell, with another two monitoring sites in close proximity (Table 42). The DoW records of ground water level measurements since 1978 (Appendix 15) show a significant decline groundwater levels. This decline suggests that existing bore use is impacting on groundwater within the cell.

There are nearly 300 registered bore licenses for the area, with a majority registered for domestic use with an allocation of up to 1500kL/annum for house, garden and stock water. While many of these domestic bores are licensed to the superficial aquifer, it is likely that the majority of these are actually drawing from the Leederville aquifer (pers comm., Kym Del Casale, DoW, 2007). The DoW is in the process of trying to amend these smaller licenses.

TABLE 42. WIN DATABASE MONITORING BORES IN OR NEAR THE MW CELL

WIN Site ID	Reference	Location	Elevation (mAHD)	Ground Water Levels			
				Drilled Depth (mAHD)	Converted Level (mAHD)	Stored Reading (mAHD)	Borehole water supply (m3/day)
3441	61415041	South west of the cell close to Lot 410	34.697	351	22.357	12.34	21.6
3442	61415042	South west of the cell	34.416	85	31.616	3.56	-
3113	61410151	500m west of the cell	17.271	18.99	15.501	1.77	65.5
3454	61415054	500m north of the cell.	30.662	87	26.014	5.36	-

Note: Detailed WIN data is provided (Appendix 15).

11.8 Site Inspection

A site visit conducted 17th October 2007 entailed an inspection of each site identified in Table 40. Each site inspection (Table 43) included a walkover to:

- Verify all relevant information gathered during the various database searches;
- Visually identify any potentially contaminating activities;
- Assess the need for soil and water sampling; and
- Obtain photographic evidence of the site (Appendix 17).

11.9 Conclusions of the PSI

Based on the likely contaminates, the expected level of remediation and relevant site history the possible land uses for the cell requires careful consideration. The PSI identified five (5) potentially contaminating activities warranting further investigation, particularly in light of any proposed change in land use for the sites (Table 44). The remaining sites are not expected to require further investigation given the low risk of contamination and as such do not pose any constraints on development within the Cell.

For each of the five (5) sites identified as requiring detailed site investigations (DSI), the following will need to be undertaken to inform potential residential and commercial developers:

- Undertake a DSI according to the DEC's Contaminated Sites Guidelines (DEC, 2004a; DEC, 2004b; DEC, 2004c; DEC, 2006a; DEC 2006b); and
- Should contamination be identified on site a Site Remediation and Validation Report will be required in compliance with DEC guidelines (DEC, 2006b) prior to development approval.

TABLE 43. SUMMARY OF SITE INSPECTIONS

Site/Location (s)	Site Inspection
Dairy Lot 11	The site visit confirmed the Dairy on Taylor/Bishop Roads (Lot 11) remains in operation with approximately 10-20 cattle present in the area at the time of inspection. There was an unsealed access track within the Dairy and housing in the adjacent Lot south of the area.
Dairy Lot 2	The site visit confirmed the Dairy on Taylor/Bishop Roads (Lot 2) remains in operation with approximately 20 cattle present in the area at the time of inspection.
Poultry	It appears the farm is not currently in operation. Two large grain silos were situated to the eastern and western end of the Poultry. There was also two tin sheds located on the area and miscellaneous rubbish, including old cars. The structure was likely a cement fibre building.
Council Depot	The site walkover showed indications of potentially contaminating activities and materials. A summary of potential significant contaminants is listed below: • 44 gallon diesel drums; • Trucks, front end loader and vehicles; • Constructions materials e.g. blue metal, bricks; • Piles of soils and sand; • Tin storage sheds; and • Old car batteries. Of significance with regards to the storage sheds was the lack of concrete footings and therefore possibility of spillages leaching through directly to the ground.
Cardup Landfill	The site inspection confirmed the presence of the landfill. The Cardup landfill site receives various wastes including; non hazardous inert (type 1 and 2), putrescible, commercial/industrial, low hazardous wastes special waste (type 1 and 2), asbestos, clinical and related wastes, clean fill uncontaminated soil, contaminated soil (special purpose fill), and low level contaminated soil.
Decommissioned Landfill	The site investigation confirmed the area is presently a decommissioned landfill. Various items e.g. old tyres, construction materials, general household wastes and concrete water piping were evident on the site, which suggests contamination is likely.
Timber Mill and Treatment	The site visit confirmed the presence of the timber mill and treatment facilities, which was essentially large sheds with exhaust vents. Also present at the site were timber preserving areas, saw mills and wood storage.
Stockfeeds	The site investigation of the Stockfeeds confirmed the presence of a shed storing various forms of animal feed and some small machinery. At the time of the site visit no animals were observed on the site; however, there was evidence that stock were handled on site with associated infrastructure including holding pens and gates.
Telecommunications Tower	The site visit confirmed the presence of the telecommunications tower; however, no other obvious or significant contaminants were visible in the area.
Council Pound	There was no evidence of the Council Pound being in operation during the site inspection. A sign on the property described the land as an animal exercise area. The site was overgrown with vegetation, cleared areas, a water body in the south west corner and a drainage channel in the north-west corner (not connected to the water body).
Decommissioned Mine	Site visit confirmed the presence of the mine which was not in operation. The mine site was partly re-vegetated but there were obvious areas of limited regrowth
Motorcross Track	The Motorcross track site inspection confirmed the presence of the track and also a number of fuel storage drums and old tyres.
Garden & Hire Business	A site inspection of the Garden and Hire business on Watkins road identified that large amounts of fertilizers and various other chemicals were stored on site. The sheds were in good condition with solid concrete flooring.
Horse Track	Located approximately 1 km south west of the Cell boundary, no potential point sources were identified from the site inspection. Considering the nature of the landscape and groundwater flow, it is very unlikely contaminants would be dispersed into the Cell. Based on all information available, this site does not warrant any further investigation for the redevelopment of the Mundijong/Whitby Cell.

TABLE 44. PSI SUMMARY RECOMMENDATIONS AND EXPECTED DEVLOPMENT RESTRICTIONS

Site/Location (s)	Conclusion	Recommendation	Development Restrictions Expected
Dairy Lot 11 & Lot 2	The Dairy Farm on Taylor/Bishop Rd remains in operation with approximately 10-20 cattle present in the area at the time of the site inspection. Attempts to contact the land owners failed to identify the use and/or storage of chemicals on site. Should the landowners be contacted and evidence of chemicals are or have been used on site, a revised Preliminary Site Investigation may be required. Any changes in land use would see a decline in the level of nutrients on site, reducing the risk to future end users, therefore no further investigations are deemed necessary.	No further investigations required unless site owners can be contacted to provide evidence of chemical use on site.	Monitoring of nutrients levels prior to residential development (DoW).
Poultry	The Poultry farm is not currently in operation and is also located outside the Cell. There were two large grain silos, tin sheds and miscellaneous rubbish including old cars on the allotment. The soil and possibly localised surface water and groundwater have the potential to have high nutrient levels. This is not expected to be a significant concern for rezoning/redevelopment of the Cell due to the location of the poultry. The risk of contamination within the Cell resulting from the site is considered low to nil. However, should the area be included in any rezoning schemes it is recommended further investigations be carried out to assess possible high nutrient levels and identify any other contaminants.	No further investigations required.	Not expected to pose any constraints for the Cell.
Council Depot	The Council Depot showed indications of potentially contaminating activities. A number of potentially contaminating materials were identified on the site such as fuel storage drums, chemical storage sheds, and used car batteries. Some of the machinery storage sheds lacked concrete flooring, making these areas susceptible to soil contamination. The site inspection did not identify any spills or contamination. However considering the high risk of contamination and condition of the chemical storage area, should a changing land use be proposed, further investigations are warranted for these allotments.	Further investigations required, should changing land use be proposed.	Expected to pose constraints on development due to contamination potential.
Cardup Landfill	The site inspection confirmed the presence of a landfill which is situated east of the eastern boundary of the Cell. The landfill site receives various wastes, including non hazardous inert (type 1 and 2), putrescible, commercial/industrial, low hazardous wastes special waste (type 1 and 2), asbestos, clinical and related wastes, clean fill uncontaminated soil, contaminated soil (special purpose fill), and low level contaminated soil. This site is not considered a significant issue for the redevelopment of the Cell assuming the present land uses for the site remains. The site is situated outside of the Cell, east of South Western Hwy and the landfill has a clay underlining, primary lining membrane and covering protective fabric (Koltasz-Smith, 2006). The lining alleviates the risk of leachate entering the soil and groundwater below the landfill, which suggests the risk of possible contamination down gradient into the Cell is low to nil	No further investigations required.	Not expected to pose any constraints for the Cell.

Site/Location (s)	Conclusion	Recommendation	Development Restrictions Expected
Decommissioned Landfill	The site investigation confirmed the area is presently a decommissioned landfill. Various construction materials were evident on the site. Considering the previous land usage and high risk of contamination of both soil and groundwater, this area would require a DSI prior to any land use changes. The area would likely require significant remediation. The site is recommended to remain zoned as 'parks and recreation' due to the high probability of extensive contamination. Furthermore, this area also includes significant environmental conservation values (Bush Forever 360) which are recommended to be preserved.	Further investigations required, should changing land use be proposed.	Expected to pose constraints on development due to contamination potential.
Timber Mill and Treatment	The Timber Mill and Treatment Facilities are not located within the Cell and are approximately 500 m to the north. Considering the use and storage of toxic/carcinogenic chemicals at the mill, there is potential for spills and contamination. Typical chemicals associated with mills include chlorinated hydrocarbons, polycyclic aromatic hydrocarbons, organochlorine pesticides, metals (e.g. arsenic, copper, chromium) and ammonia. The premises of the mill and treatment facilities are situated within the EPA sanctioned buffer zone for sensitive land uses, such as residential developments. The required separation distance for timber milling is 500-1000 m and for timber preserving premises 300-500 m, dependent on size of facility. The redevelopment of the Cell needs to ensure the required separation distances are maintained from any sensitive land uses. There appears to be a moderate to low risk of contamination of the Cell from the mill as the Cell is up gradient of the facilities. As this area of the Cell also has significant environmental conservation values (Bush Forever 350), it is recommended this area be preserved as such.	Further investigations required should, changing land use be proposed for Bush Forever Site 350, 354.	Maintain EPA buffer (EPA, 2005b) between sensitive receptors (residential lots) and Timber Mill.
Stockfeeds	The significant features on this parcel of land were a shed storing various forms of animal feed and some small machinery. At the time of the site visit no animals were on the site, however there was evidence that stock have been or are handled on site with associated infrastructure including holding pens and gates. Potential contamination on site would be limited to chemical storage areas (sheds) which considering their good condition including concrete footing suggests the risk of contamination of soil and groundwater would be low.	Further investigations recommended for storage sheds.	May pose constraints on development depending on detailed investigations of areas with high risk of contamination.
Tele-communications Tower	No obvious or significant contaminants were visible in the area. This is not expected to be a significant concern for rezoning/redevelopment of the Cell as the tower is situated outside of the Cell boundaries and the risk of contaminants entering the Cell is considered to be low to nil.	No further investigations required.	Not expected to pose any constraints for the Cell.

Site/Location (s)	Conclusion	Recommendation	Development Restrictions Expected
Council Pound	Based on the preliminary investigation and site inspection this site is predicted to have a low risk of contamination and no further investigations are recommended.	No further investigations required.	Not expected to pose any constraints for the Cell.
Decommissioned Mine	There exists potential for contamination of soil, groundwater and surface waters within the decommissioned mine area given the previous land use. This is highlighted by the limited regrowth of vegetation at the site. The old mine is situated approximately 100 m from the eastern boundary of the Cell. The nature of the landscape contours indicates potential contaminants sourced from the mine would be dispersed towards the Cell via leachate, suggesting more detailed investigations should be undertaken within the Cell, down gradient of the mine.	Further investigations are recommended down gradient of the mine.	High likelihood of constraints on development due to contamination potential.
Motorcross Track	The Motorcross Track site inspection confirmed the presence of the track and also a number of fuels storage drums and old tyres. The Motorcross track has a low risk for localised hydrocarbon contamination through spills and storage. The closest down gradient area within the Cell is the adjacent Bush Forever Site 354. Should the area become rezoned for development, further investigations are recommended. However, the likelihood of potential hydrocarbon contamination down gradient of the motorcross track is considered low to nil, not requiring further investigation within the Cell.	No further investigations required.	Not expected to pose any constraints for the Cell.
Garden & Hire Business	The Garden and Hire Business stored significant quantities of fertilizers and various other chemicals on site. There were no visible signs of contamination. Further investigations are not required considering the potential for spills/discharge of chemicals permeating soil and groundwater is low, given the good condition of the storage sheds which all had concrete flooring. Based on the site inspection and review of relevant information, this site is expected to require some remediation after the DSI although this is not predicted to pose any development constraints.	Conduct a DSI. Undertake remediation activities as required following further investigation.	Not expected to pose any constraints for the Cell.
Horse Track	Located south west of the Cell boundary, no potential point sources were identified from the site inspection. There is a low to nil risk of contaminants entering the Cell, considering the nature of landscape and groundwater flow. Based on all information available, this site does not warrant any further investigation for the redevelopment of the Mundijong/Whitby Cell.	No further investigations required.	Not expected to pose any constraints for the Cell.

11.10 Remediation

For the sites requiring further investigations to assess potential contamination, appropriate remediation options, are possible should these sites be found to be contaminated. The remediation options are dependent on the nature and extent of contamination identified from detailed investigations. The DEC and EPA advises on a number of remediation strategies and relevant features of the EPA Guidance Statement with regards to achieving appropriate remediation of contaminated land are summarised below.

11.10.1 EPA Guidance Statement

The EPA has outlined guidelines to achieve appropriate remediation of contaminated land. The guidelines are based on two principles:

1. "Contaminated material shall preferably be either treated on-site and the contaminants reduced to acceptable levels, or be treated off-site and returned for reuse after the contaminants have been reduced to acceptable levels; and
2. Disposal of contaminated material to an approved waste disposal facility or landfill or 'cap and contain' management options will only be considered if:
    a. Treatment of the contaminated material is shown or demonstrated not to be practicable;
    b. The options to dispose to landfill or 'cap and contain' are undertaken in an environmentally acceptable manner; and
    c. The risk of disturbance of the contaminant exceeds the risk of leaving it undisturbed and contained on site."(EPA, 2000).

The EPA specifies that while the Guidance Statement only relates to remediation of contaminated land, water resources cannot be discounted with respect to identifying a suitable remediation option (DEC, 2004a). This is of particular relevance where there are extensive groundwater resources that are at high risk of contamination from surface land uses.

The Guidance Statement states that maintaining the environmental integrity of groundwater resources after remediation has stopped, is very important and, as such, the levels of contaminants in any soil that has been treated and/or replaced must be sufficiently low to ensure groundwater will not continue to be contaminated (DEC, 2004b).

12 Acid Sulphate Soils

12.1 Background

Acid Sulfate Soils (ASS) occur naturally in soils, sediments or organic substrates (e.g. peat). They are formed in substrates inundated with water that contain iron sulfide minerals, predominantly as the mineral pyrite or their oxidation products (DEC, 2006c). When exposed to air, due to the lowering of the water table through activities such as dewatering, groundwater abstraction, drainage and/or excavation, the sulfides in these soils readily oxidise, releasing sulfuric acid and iron into the soil and groundwater supplies. The release of these harmful substances can often occur in quantities that seriously compromise environmental values and risk human health as the acid in turn can release aluminium, nutrients and heavy metals (including arsenic) held within the soil matrix (DEC, 2006c). Once mobilised, the acid metals and nutrients can seep into surface waterways, impacting on aquatic organisms and vegetation, and degrade concrete, steel piping and structures to the point of failure (DEC, 2006c).

A distinction is made between Potential Acid Sulfate Soils (PASS) and Actual Acid Sulfate Soils (AASS). PASS occur where iron sulfides are contained in a layer of waterlogged soil. This layer can be clay, loam or sand, and is usually dark grey and soft. The water prevents oxygen in the air reacting with the iron sulfides. This layer is commonly known as potential acid sulfate soil because it has the potential to oxidise to sulfuric acid (Sammut, 2000). AASS are coastal sedimentary material that once contained or does contain iron pyrites which have been exposed to air causing pyrite to oxidise and leading to the formation of sulphuric acid (Thomas *et al*., 2003).

A regulatory framework has been initiated for the development of ASS risk mapping for Western Australia. The ASS risk mapping published in the Western Australian Planning Commission (WAPC) Planning Bulletin No.64 is formed from a collaboration between the DEC and the WAPC. The DEC has published a series of guideline documents namely the '*Acid Sulfate Guideline Series*', developed to assist in the identification, assessment and management of ASS in Western Australia.

12.2 ASS Environments

In general, ASS can be found in the following areas:

- Areas depicted on geology/geomorphological maps as geologically recent, including shallow tidal flats/lakes, shallow estuarine/marine deposits, stranded beach ridges and adjacent swales, interdune swales or coastal sand dunes, coastal alluvial valleys, wetlands, floodplain, waterlogged areas, scalded areas, sump land, marshes and swamps;
- Areas depicted in vegetation mapping as mangroves, wetland dependent vegetation such as reeds and paperbarks (*Melaleuca sp*.), areas where the dominant vegetation is tolerant of salt, acid and/or waterlogging conditions e.g. mangroves, saltcouch, swamp-tolerant reeds, rushes, paperbarks and swamp oak (*Casuarina sp*.);
- Areas identified in geological descriptions or in maps as bearing acid sulfide minerals, former marine or estuarine shales and sediments, coal deposits and mineral sand deposits;
- Areas known to contain peat or a build up of organic material;
- Areas where the highest known watertable level is within three (3) metres of the surface;
- Land with elevation less than 5 metres above Australian Height Datum (AHD); and
- Any areas in Western Australia (including inland areas) where a combination of all the following pre-disposing factors exist: organic matter, iron minerals, waterlogged conditions or a high watertable, sulfidic minerals, deep estuarine sediments below ground surface.

Experience within Western Australia has found a strong correlation with soil profile consisting of pale grey (to white) sands of rich organic cemented sands (coffee rock),that may contain stored acid potential in a variety of forms (DEC, 2006c).

12.3 ASS Regulations and Guidelines

WAPC Planning Bulletin No.64 provides preliminary ASS risk mapping. The maps are developed using various soil/landform characteristics such as soil type, wetland locations and surface elevation, providing a preliminary assessment of the risk of ASS within the shallow soil profile. The maps produced provide sufficient detail to indicate the presence of ASS within an area, however the scale of mapping is insufficient to provide the necessary detail on a site specific basis. For a complete assessment of ASS potential the maps need to be complemented with detailed site specific information.

The WAPC ASS maps (Appendix 18) showed that most of the area of the cell is classed as having "Moderate to Low Risk of ASS and PASS generally occurring at depths less than three metres". The wetlands on the western side of Paterson Street/Soldiers Road and a wetland adjacent to Manjedal Brook, east of Roberstson Road and north of Evelyn Street are classified as having a "High to Moderate Risk of ASS and PASS generally occurring at depths >3m". Along the eastern boundary of the Cell a significant area is mapped as having "no known risk of ASS occurring within three metres of natural soil surface or deeper".

12.3.1 Acid Sulphate Soils and the Contaminated Sites Act 2003

Sites will be classified as a contaminated site under the *Contaminated Sites Act 2003*, where ASS disturbance has resulted in concentrations of contaminants and/or a level of acidity within soils, sediments and waters that are above background concentrations and present, or have the potential to present, a risk of harm to human health, the environment or any environmental value (DEC, 2007d). It is important to note the DEC does not consider sites, where naturally occurring ASS persist in an undisturbed state as "contaminated".

In terms of the responsibility for remediation of a site where contamination has been caused by the disturbance of ASS, the DEC states that where a site is contaminated as a result of ASS disturbance, if the contamination is sufficiently severe that the site is classified as *contaminated – remediation required*, the determination of the responsibility for remediation of the site under the *Act* will take into account all potential factors that may have contributed to the disturbance (DEC, 2007d).

The DEC does not require a site to be reported under the *Contaminated Site Act 2003* where a site has naturally occurring ASS which are undisturbed, assuming there are no other substances present in or on that site exceeding background concentrations that present, or have the potential to present, risk to human health or any environmental value (DEC, 2007d).

12.4 Landform and Soils

Most of the low lying heavy soils within the Cell are susceptible to water logging and as such represent areas suitable for the formation of ASS materials. Typically soil units were of Pleistocene age. The exception was the Clayey Sandy Silt in the central region of the Cell derived from the Holocene period. This is significant, as they are associated with the occurrence of ASS (Cardno, 2007). A complete description of soil units is provided (Table 30).

12.5 Surface Hydrology and Wetlands

Wetlands are strongly associated with the occurrence of ASS, as they present the ideal waterlogged carbon rich conditions necessary for the formation of ASS. A complete list of wetlands within the boundaries of the Cell is provided (Section 8). A significant portion of the Cell is either cleared parkland and used for agriculture or cleared for tree plantations. Remnant native vegetation remaining to indicate the presence of shallow groundwater levels and wetland dependent vegetation is limited. A complete list is provided (Section 8).

12.6 Groundwater

In the north-eastern section of the Cell, Cardno (2007) measured groundwater elevation to vary from ~20mBGS in the vicinity of the eastern boundary (central eastern to south-eastern) of the Cell decreasing to less than 5mBGS along the central region adjacent to Soldiers Road. Cardno (2007) identified some water levels around the later region to less than 2m depth. The recorded depths to groundwater suggest that the development of ASS within the shallow surface profile is restricted to the region adjacent and east to south-east of Soldiers Road, with a high risk for ASS development within the shallow soil profile (<3m) in a small wetland area east of Roberstson Road and north of Evelyn Street also apparent (Cardno, 2007).

The Cardno ASS investigation (2007) concluded that it was probable iron persists in the groundwater due to the presence of ferruginous gravel soils to the east of the Cell and hydraulically up gradient from these areas. The presence of a potential source of sulfate for reduction is not known, however the extended use of surrounding areas for agricultural purposes is likely to provide an anthropogenic source of sulfate in groundwater in the area. This study also noted area most suitable for ASS development are likely linked hydraulically to the wetlands west of Soldiers Road, based on a review of historical aerials to assess depositional areas within the Cell. The connection between these surface features was thought to be disjointed during the construction of the railway line and adjacent roads (Cardno 2007).

12.7 Site Investigation

A site investigation was conducted for the high risk ASS regions identified within the Cell from the WAPC ASS risk maps in October 2007. The wetlands west of Soldiers road had a number of attributes making the area suitable for the formation of ASS, including the waterlogged soil identified as pale grey sands derived from the Bassendean formation. Another notable feature was the presence of an oily bacterial surface scum. Although oily surface scums are often indicative of hydrocarbon pollution, the rust coloured staining of the wetland, coupled with the fact the scum separated when disturbed, suggest it is more likely to be related to presence of ASS. The oily bacterial scum and rust coloured iron stains are shown below (Photograph 7). A by-product of the oxidation of ASS is the production of rust-coloured iron stains and oily looking bacterial scums. When acid water mixes with water of a higher pH, the dissolved iron in the water precipitates as a rust-red scum, which can smother and kill vegetation and aquatic organisms (NRW, 2006).

Photograph 7: Oily Bacterial Surface Scum and Rust Colouring at the Wetland West of Soldiers Road

During the site investigation access to the remaining high risk ASS area within the Cell was not possible as this was private property. As there is a high risk of ASS formation and occurrence in this area, any excavation or similar works should not be undertaken prior to further investigations.

12.8 Cardno Preliminary ASS Investigation

Soil boring, installed to assess soil units, particularly wetlands and regions of wetland dependent vegetation, revealed:

- The comparatively low change in soil pH, following oxidation coupled with the low reaction strengths observed during the oxidation, suggesting ASS are not present within the soil profiles;
- Most of the soils within the borings were slightly acidic which Cardno (2007) concluded was not related to the historical oxidation of ASS. Furthermore, the laboratory analysis undertaken on selected samples suggests the level of existing acidity are below the DEC's treatment criteria; and
- Of the samples tested, none indicated the presence of pyrite confirming for the samples tested, the lowered pH was not a consequence of the release of acid by the oxidation of pyrite.

Cardno (2007) acknowledged that despite the possibility of ASS occurrence within the other soil borings, this would be limited to the soil zones in the immediate vicinity of the water table. As such, for these areas activities which may disrupt the deeper soil profile are not recommended. Furthermore, although the risk of ASS within 3mBGS is low across much for the north east corner of the Cell, significantly deeper excavation works, particularly around the eastern boundary of the site, will require further investigations. Overall Cardno (2007) concluded that should such deep excavation works or dewatering be proposed, further studies should be undertaken to assess the potential for ASS deeper within the soil profile prior to commencement of such activities or proposed land use changes which may impact on the deeper soil profile (<3.0mBGS).

12.9 Conclusions and Recommendations

The possible occurrence and distribution of ASS within the shallow soil surface profile was assessed for the Mundijong/Whitby Cell. The ASS investigation comprised a review of information from all available sources including the WAPC, DEC and the Shire, followed by a site investigation for the identified areas with high risk of ASS. The assessment was also undertaken in consideration of landform, soil and hydrological features. Geomorphic and landscape characters are important due to their strong association with the formation and distribution of PASS and AASS.

SMEC's investigation has revealed that overall within the shallow soil profile (3.0mBGS) the high risk regions for the development of ASS are restricted to three relatively small areas within the Cell. These areas are wetlands west of Soldiers Road and a wetland east of Roberstson Road and north of Evelyn Street adjacent to Manjedal Brook. A site investigation confirmed that at the wetlands west of Soldiers Road suitable conditions persist for ASS development. There was also evidence of ASS oxidation with the presence of an oily bacterial scum and rust-staining. This was thought to result from acidic water mixing with water of a higher pH, precipitating a rust-red scum containing iron. As similarly concluded by Cardno (2007), it is possible ASS are located within 3.0m of the natural soil surface in this area.

The risk of ASS within 3.0mBGS for the remainder of the Cell based on the WAPC ASS risk maps is predominantly medium to low risk of ASS within shallow soil surface profile. Much of the north-east corner of the Cell and further south along the eastern boundary is classed as no know risk of ASS within 3.0m of natural soil surface or deeper". The Cardno (2007) ASS investigation identified the depth of the water table for the majority of the north-east corner of the Cell is greater than 3.0m below existing ground surface. Consequently ASS may persist deeper in the soil profile (>3.0m) which is unlikely to be disturbed by shallow surface works. Should deeper excavation

works be proposed further investigations should be undertaken to assess the risk of disturbing ASS material.

Overall the distribution and extent of ASS within the Mundijong/Whitby Cell is limited to wetlands generally situated in the central part of the Cell. Significantly SMEC did not assess potential ASS deeper than 3.0m of the natural soil surface and as such, should deep excavations or dewatering be proposed within the Cell, further more detailed investigations are recommended.

13 Odour and Noise

13.1 Background

13.1.1 Odour

The assessment of the impacts of odour emitting land uses within Western Australia is governed by the *Interim Guidance on Odour as a Relevant Environmental Factor* (EPA, 2005a), in conjunction with the *Odour Methodology Guideline* (DEC, 2002). The Interim Guidance sets out the generic buffer criteria that apply for volume sources (e.g. poultry sheds), large area sources (e.g. effluent treatment ponds), or strongly wake-affected plumes. The generic buffer criteria are detailed in Appendix 1 of the *Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses* (EPA, 2005b).

While the generic buffer criteria are not intended to be applied where the surrounding land has not yet been zoned for urban use, they have been applied within the scope of this study for the following reasons:

1. No other generic buffer criteria have been defined by the EPA;
2. The land within the MW Cell is likely to be rezoned, following the district structure plan and the preparation of local structure plans; and
3. Any sensitive premises constructed in the area will need to comply with the Interim Guidance.

Proposals for sensitive land use developments (e.g. housing development) near existing odour sources will need to assess the suitability of established management procedures currently in use, prior to commencement of any development. Where the generic buffer criteria are met and a proposed facility is designed for "best practice" emission control, then no further assessment of odour is required (EPA, 2003b).

13.1.2 Noise

The *Environmental Protection (Noise) Regulations 1997*, sets out the allowable noise emissions for the State. This regulation is supported by *Draft Guidance Statement No. 8 – Environmental Noise* (EPA 2007b), *Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses* (EPA, 2005b), and *Statement of Planning Policy: Road and Rail Transport Noise* (WAPC, 2005a).

Noise Screening Procedure

The draft guidance statement details a five question screening process that should be undertaken, when assessing the noise impacts associated with a development proposal. If any of the questions return a "Yes", then a detailed noise assessment is required.

Screening Questions

1. Is the proposal particularly sensitive within the community?
2. Are there any noise-sensitive premises within the buffer distances indicated in Guidance Statement No. 3 (EPA, 2005b) for this type of proposal?
3. Is operational noise likely to be above the relevant screening criterion?
4. Is construction noise likely to be above the relevant screening criterion?
5. Is the proposal likely to involve blasting?

These screening questions have been applied to each site listed in Section 12.3 to determine the potential for noise to affect sensitive land areas within the MW Cell.

Detailed Noise Assessment

Where the noise screening procedure indicates a detailed assessment is required, this should be conducted by a person competent in environmental noise assessment, such as, a member of the Australian Acoustical Society or the Australian Association of Acoustical Consultants.

13.2 Known or Potential Odours and/or Noise Producing Sites

TABLE 45. KNOWN OR POTENTIAL ODOURS AND/OR NOISE PRODUCING SITES

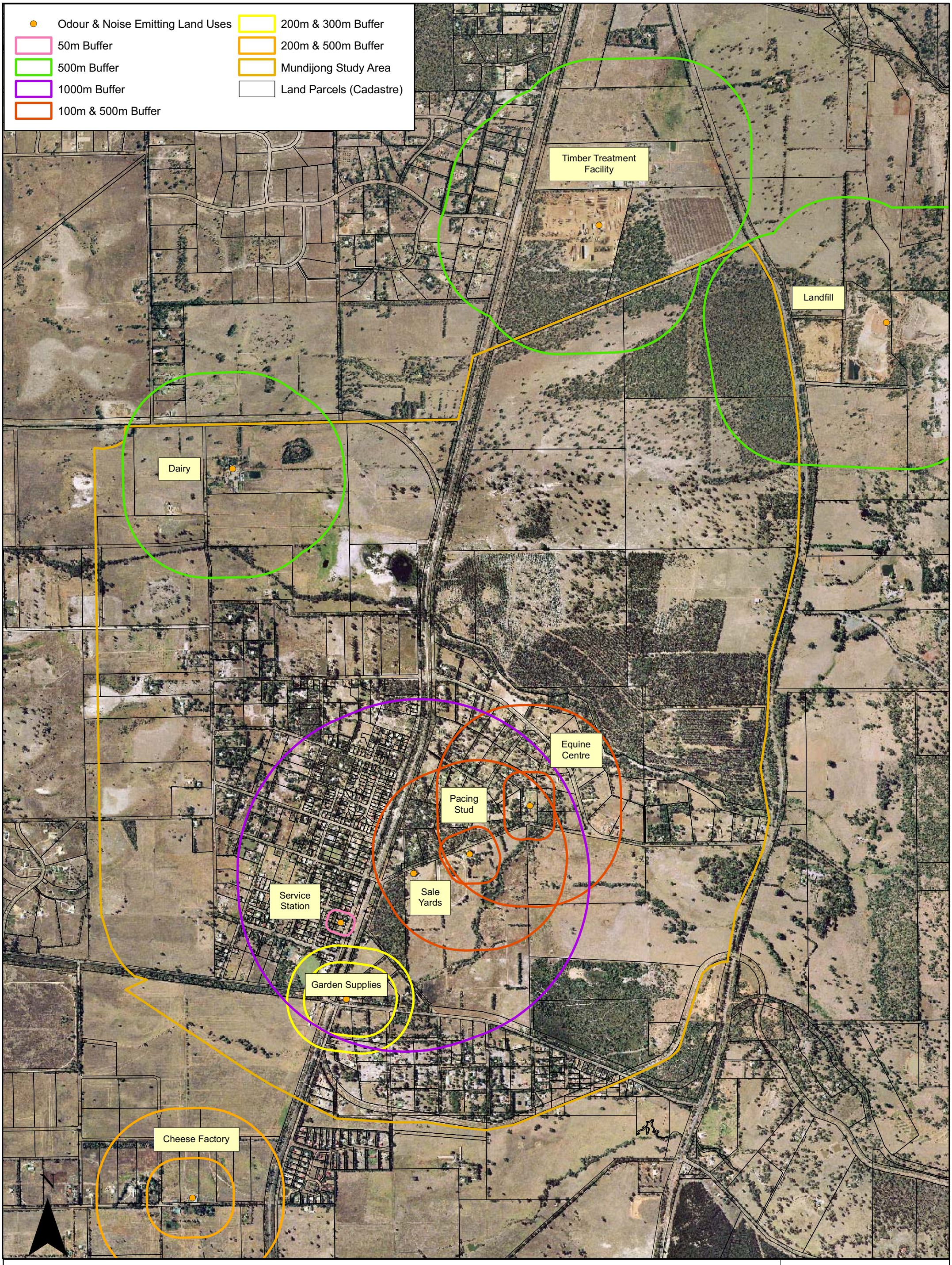
Site	Odour	Noise	Assessment Required	Justification
South Cardup Landfill	Yes	Yes	Yes	Within buffer distances specified by the EPA
Bett E & S J & Son (Dairy)	Yes	Yes	Yes	Within buffer distances specified by the EPA
Mundijong Store & Deli (Service Station)	Yes	Yes	Yes	Within buffer distances specified by the EPA
Mundella Foods (Yogurt/Cheese Factory)	Yes	Yes	Yes	Within buffer distances specified by the EPA
Mundijong Garden Supply and Hire (Chemical Storage)	Yes	Yes	Yes	Within buffer distances specified by the EPA
Mundijong Sale Yards	Yes	Yes	Yes	Within buffer distances specified by the EPA
Off Road Track	No	Yes	Yes	Buffer distances are set on a case by case basis by the EPA.
Whitby Falls Pacing Stud	Yes	Yes	Yes	Within buffer distances specified by the EPA
Topline Equine Center	Yes	Yes	Yes	Within buffer distances specified by the EPA
Perma Poles	Yes	Yes	Yes	Suitable EPA buffer exists following development
Old Tip	Yes	No	No	Site no longer in use
Egg/Poultry Farm (closed)	No	No	No	Site no longer in use
Sepentine-Jarrahdale Shire Depot	No	Yes	No	No EPA buffer distance specified for this land use Operates within normal business hours

13.3 Odour and Noise Site Assessments

Site Name	South Cardup Landfill
Location	MGA Zone 50 407570E 6429571N (Figure 22)
Site Use	Class II Putrescible Landfill
Odour	Yes
Noise	Yes
Minimum Buffer Distance	500m for sensitive uses (e.g. subdivisions); 150m for single residences; and 35m internal buffer from boundary.
Management of Odour Emissions	1. Waste is compacted to minimise odour release. 2. The area of active call face is limited to ensure that deposited waste is covered daily with 150mm of soil to minimise exposed putrescible material 3. Completed areas are capped to trap Landfill Gas (LFG) and prevent odours from being released to the atmosphere.
Management of Noise Emissions	1. The distance to the Site boundary acts as a suitable buffer for the site.
Potential impacts on the MW Cell	Provided the noise and odour management strategies outlined in the South Cardup Development Application are complied with, there should be no impacts on the development of the MW Cell.

Site Name	Bett E & S J & Son
Location	MGA 50 403846E 6429333N (Figure 22) 52 Taylor Rd, Mundijong
Site Use	Dairy
Odour	Yes
Noise	Yes
Minimum Buffer Distance	500m
Management of Odour Emissions	Existing buffer is currently sufficient provided no odour sensitive properties are constructed within the buffer zone.
Management of Noise Emissions	Existing buffer is currently sufficient provided no noise sensitive properties are constructed within the buffer zone.
Potential impacts on the MW Cell	While this area has been rezoned as Urban Development, until the dairy is closed no odour sensitive properties should be constructed within the buffer zone.

Site Name	Mundijong Store & Deli
Location	MGA 50 404446E 6426327N (Figure 22) 20 Paterson Street, Mundijong
Site Use	Service Station
Odour	Unlikely to be an odour producer
Noise	Unlikely to be an noise producer
Minimum Buffer Distance	50m in normal hours
Management of Odour Emissions	Tanks are presently underground and sealed to prevent escape of odours.
Management of Noise Emissions	Nil
Potential impact on the MW Cell	There is presently only one property within the 50m buffer zone. No other properties should be constructed within this zone.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Noise & Odour Emitting Land Uses	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 22	SCALE	1 : 20 000		
DATE	19/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

Site Name	Mundella Foods Pty Ltd
Location	MGA 50 403494E 6424667N (Figure 22) 46 Randell Road, Mundijong
Site Use	Dairy and Yogurt/Cheese Factory
Odour	No
Noise	Yes
Minimum Buffer Distance	Dairy: 500m Yogurt/Cheese Factory: 200m – 500m, depending on size, wastewater treatment and disposal system
Management of Odour Emissions	No emission control required
Management of Noise Emissions	Noise levels received at the sites of the proposed residences around the cheese factory and dairy, comply with the requirements of the *Environmental Protection (Noise) Regulations 1997*, and no additional noise amelioration is required (Herring Storer Acoustics, 2005).
Potential impact on the MW Cell	Nil

Site Name	Mundijong Garden Supply and Hire
Location	MGA 50 404571E 6425749N (Figure 22) Lot 410 Watkins Rd, Mundijong
Site Use	Garden Hire
Odour	Yes
Noise	Yes
Minimum Buffer Distance	Chemical Storage (non-bulk) 200m – 300m
Management of Odour Emissions	Chemicals are stored in bags within the building.
Management of Noise Emissions	Work conducted within normal business hours.
Potential impact on the MW Cell	Depending on the types of chemicals stored on site there may be a restriction required on the development of sensitive properties within the 200m buffer zone.

Site Name	Mundijong Sale Yards
Location	MGA 50 404895E 6426683N (Figure 22) Cnr Evelyn & Roman Road, Mundijong
Site Use	Sale yards (cattle, sheep, horses, pigs & poultry)
Odours	Yes
Noise	Yes
Minimum Buffer Distance	At least 1000m, depending on size
Management of Odour Emissions	Nil
Management of Noise Emissions	Nil
Potential impact on the MW Cell	As long as the sale yards remain in operation no odour sensitive properties should be constructed within the 1000m buffer zone.

Site Name	Hedley Park Motocrosse
Location	MGA 50 407226E 6429722N (Figure 22) Cnr Shale Rd and South-Western Highway
Site Use	Off Road Motorbikes
Odours	No
Noise	Yes
Minimum Buffer Distance	Buffer distances are set on a case by case basis by the EPA.
Management of Odour Emissions	N/A
Management of Noise Emissions	The operating hours of the track and the extent of bushland and screening materials surrounding the track should reduce the impact of noise emitted from the site.
Potential impact on the MW Cell	Any changes to the site's operating hours or the clearing of nearby vegetation may result in noise from this site becoming a significant issue.

Site Name	Whitby Falls Pacing Stud
Location	MGA 50 405167E 6426789N (Figure 22) Evelyn Road, Mundijong
Site Use	Horse stud and training track
Odours	Yes
Noise	Yes
Minimum Buffer Distance	100-500, depending on size
Management of Odour Emissions	Nil
Management of Noise Emissions	Nil
Potential impact on the MW Cell	As long as the stud remains in operation no odour sensitive properties should be constructed within the 100m buffer zone. New properties requiring the addition/inclusion of stables will need to submit a Land Management Plan to the Shire.

Site Name	Topline Equine Center
Location	MGA 50 405597E 6426944N (Figure 22) Galvin Road, Mundijong
Site Use	Horse Agistment Facility
Odours	Yes
Noise	Yes
Minimum Buffer Distance	100m – 500m, depending on size
Management of Odour Emissions	Nil
Management of Noise Emissions	Nil
Potential impact on the MW Cell	As long as the stud remains in operation no odour sensitive properties should be constructed within the 100m buffer zone. New properties requiring the addition/inclusion of stables will need to submit a Land Management Plan to the Shire.

Site Name	Perma Pole
Location	MGA 50 405607E 6430751N (Figure 22) Robertson Road, Mundijong
Site Use	Timber Milling and CCA Treatment
Odour	Yes
Noise	Yes
Minimum Buffer Distance	500m – 1000m, depending on size.
Management of Odour Emissions	Existing 300m buffer should be suitable as no odour was detectable and the NPI report indicates minimal emissions.
Management of Noise Emissions	Existing 300m buffer should be suitable.
Potential impact on the MW Cell	Nil.

13.4 Odour Policy Framework

13.4.1 Introduction

The policy framework detailed below is based on the *Interim Guidance on odour as a relevant environmental factor* (EPA, 2005a), the *Odour Methodology Guideline* (DEP 2002), *Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses* (EPA, 2005b) and, *Guidance Statement No. 55 – Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process* (EPA, 2003b). The framework applies only to sources that may be classified as "volume sources" (e.g. poultry sheds), "large area sources" (e.g. effluent treatment ponds) or strongly wake-affected plumes.

13.4.2 Odour Sources and Generic Buffers

A number of potential odour producing land uses within the MW Cell and the surrounding area have been identified (Table 46). The generic buffer distances for each identified land use was then determined.

13.4.3 Assessing proposals with the potential to produce odour

The following process should be used when assessing new proposals or expansions with the potential to cause odour impacts on existing sensitive land uses:

1. Where the generic buffer distance is met and the proposed facility is designed for "best practice" emission control, then no further assessment of odour is required; or
2. Where the generic buffer distance is not met and/or the proposed facility is not designed for "best practice" emission control, a more detailed assessment of odour is required.

13.4.4 Assessing new developments near existing odour sources

The following process should be used when assessing new developments near existing odour sources:

1. Where the generic buffer distance is met and the proposed facility is designed for "best practice" emission control, then no further assessment of odour is required; and
2. Where a proposal for a sensitive land use development is within the generic buffer zone of existing odour source a more detailed assessment of the level of management in place at the nearby source will be required.

13.4.5 Land uses not covered in this policy with the potential to cause odour

Where a land use is not covered in Table 46, yet has the potential to cause odour it should be referred to the council for further assessment.

TABLE 46. ODOUR SOURCES AND GENERIC BUFFERS

Land Use	Generic Buffer Distance
Abattoir	500m – 1000m, depending on size.
Animal feedlot	1000m – 2000m. depending on size.
Automotive spray painting	200m
Bakeries (daytime operations)	100-200m, depending on size.
Composting facility – outdoor uncovered, regularly turned windrows	1000m for manures, mixed food/putrescible & vegetative food waste; 500m for biosolids; and 150m for green waste.
Composting facility – outdoor covered, turned windrows	750m for manures, mixed food/putrescible & vegetative food waste; 250m for biosolids; and 150m for green waste.
Composting facility – outdoor covered windrows with continuous aeration	500m for manures, mixed food/putrescible & vegetative food waste; 250m for biosolids; and 150m for green waste.
Composting facility – enclosed windrows with odour control	250m for manures, mixed food/putrescible & vegetative food waste; 150 for biosolids.
Composting facility – in-vessel composting with odour control	150m for manures, mixed food/putrescible & vegetative food waste; 150 for biosolids.
Chemicals storage – minor	200m – 300m
Dairies	500m
Dry-cleaners	100m
Horse stables	100m – 500m, depending on size.
Joinery & wood working premises	100-300m, depending on size.
Livestock sale-yard or holding pen	At least 1000m, depending on size.
Milk processing	200m – 500m, depending on size, wastewater treatment & disposal system.
Motor body works	200m
Poultry industry	300m – 1000m, depending on size.
Service stations, involving vehicle cleaning/ detailing facilities & the retailing of spare parts & foodstuffs (normal business hours)	50m
Service stations, involving vehicle cleaning/ detailing facilities & the retailing of spare parts & foodstuffs (24 hours)	200m
Timber preserving premises	300m – 500m, depending on size.
Waste disposal putrescible landfill site (Class 2 & 3)	500m for sensitive uses (subdivisions); 150m for single residences; and an internal buffer of 35m from boundary.

13.5 Noise Policy Framework

13.5.1 Introduction

The policy framework detailed below is based on the *Environmental Protection (Noise) Regulations, 1997*; *Draft Guidance Statement No. 8 – Environmental Noise* (EPA, 2007b), and *Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses* (EPA, 2005b) for fixed point sources, and *Statement of Planning Policy: Road and Rail Transport*

Noise (WAPC, 2005a), and *Statement of Planning Policy: Metropolitan Freight Network (Draft)*, (WAPC 2005b) for transport noise.

13.5.2 Generic Buffers for Fixed Noise Sources

A number of potential noise producing land uses within the MW Cell and the surrounding area have been identified (Table 47). The generic buffer distances for each identified land use was then determined.

13.5.3 Criteria to be used in developing the MW Cell for fixed point noise sources

All new proposals with the potential to produce noise should undergo an initial noise assessment. A detailed assessment should be made when indicated by the initial assessment.

Initial assessment of proposals with the potential to produce noise
The initial assessment of the noise impacts associated with any new proposal should be undertaken by completing the Noise Assessment Worksheet, taken from the *Draft Guidance Statement No. 8 – Environmental Noise* (EPA, 2007b) (see Section 12.1.2).

TABLE 47. NOISE SOURCES AND GENERIC BUFFERS

Land Use	Generic Buffer Distance
Abattoir	500m – 1000m, depending on size.
Animal feedlot	1000m – 2000m, depending on size.
Automotive spray painting	200m
Bakeries (daytime operations)	100-200m, depending on size.
Composting facility – outdoor uncovered, regularly turned windrows	1000m for manures, mixed food/putrescible & vegetative food waste; 500m for biosolids; and 150m for green waste.
Composting facility – outdoor covered, turned windrows	750m for manures, mixed food/putrescible & vegetative food waste; 250m for biosolids; and 150m for green waste.
Composting facility – outdoor covered windrows with continuous aeration	500m for manures, mixed food/putrescible & vegetative food waste; 250m for biosolids; and 150m for green waste.
Composting facility – enclosed windrows with odour control	250m for manures, mixed food/putrescible & vegetative food waste; 150 for biosolids.
Composting facility – in-vessel composting with odour control	150m for manures, mixed food/putrescible & vegetative food waste; 150 for biosolids.
Dairies	500m
Dry-cleaners	100m
Extractive industries – hard rock, Darling Scarp	1000m
Horse stables	100m – 500m, depending on size.
Joinery & wood working premises	100-300m, depending on size.
Livestock sale-yard or holding pen	At least 1000m, depending on size.
Milk processing	200m – 500m, depending on size, wastewater treatment & disposal system.
Motor body works	200m
Nurseries	100m
Poultry industry	300m – 1000m, depending on size.

Service stations, involving vehicle cleaning/ detailing facilities & the retailing of spare parts & foodstuffs (normal business hours)	50m
Service stations, involving vehicle cleaning/ detailing facilities & the retailing of spare parts & foodstuffs (24 hours)	200m
Timber preserving premises	300m – 500m, depending on size.
Sawmill	500m – 1000m, depending on size.
Waste disposal putrescible landfill site (Class 2 & 3)	500m for sensitive uses (subdivisions); 150m for single residences; and an internal buffer of 35m from boundary.
Wreckers (automotive)	300m

Noise Assessment Worksheet

1. Community Concern

   Is the proposal particularly sensitive within the community? .....

2. Buffer distances

   a. Buffer distance for this type of operation (from Guidance No. 3) …….m

   b. Distance to nearest residence .....m

   c. Is distance (a) greater than distance (b)? …….

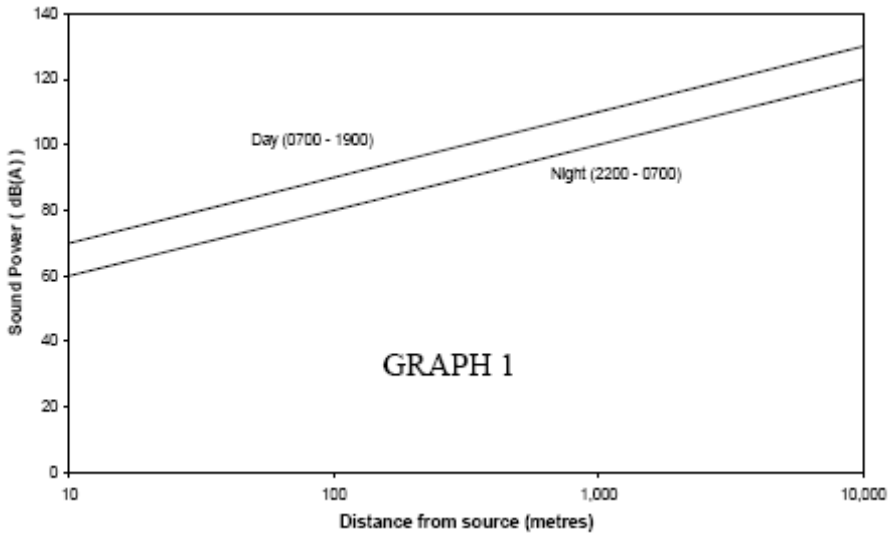
3. Operational noise

   a. Estimated total sound power for all sources on site

      - daytime ….....dB(A)
      - nighttime ...……...dB(A)

   b. Distance to nearest residence ……..…..m

   c. Plot the two points (a) against (b) on Graph 1 below



   d. Is operational noise above the relevant line in Graph 1?

4. Construction activities on site

   4.1 Where construction activity is likely to take place within the hours 7.00 am to 7.00 pm Monday to Saturday -

   Are particularly noisy activities such as impact piling envisaged? .....

   4.2 Where construction activity is likely to take place outside the hours 7.00 am to 7.00 pm Monday to Saturday –

   a. Estimate total sound power for all sources on site –

      - daytime .....dB(A)
      - nighttime .....dB(A)

   b. Distance to nearest residence .....m

   c. Plot (a) against (b) on Graph 1 above.

   d. Is construction noise above either line in Graph 1? .....

5. Blasting

   a. Is the construction/operation likely to involve blasting? .....

13.5.4 Criteria to be used in developing the MW cell for transport noise sources

The criteria outlined below should be used when assessing traffic noise impacts associated with:

- New primary or district distributor roads in the vicinity of noise sensitive land uses;
- New rail infrastructure in the vicinity of noise-sensitive land uses;
- Major upgrading of existing roads or rail infrastructure which is likely to result in a significant increase in capacity and/or noise, in the vicinity of noise sensitive land uses;
- Rezoning of land for noise-sensitive land uses in the vicinity of an existing or proposed primary or district distributor road or a railway;
- Subdivision of land for a noise-sensitive land uses in the vicinity of an existing or proposed primary or district distributor road, or a railway; and
- New noise sensitive development in the vicinity of an existing or proposed primary or district distributor road, or railway.

The criteria do not apply to pre-existing developments along existing roads and railways.

Exposure criteria for outdoor noise levels

The noise exposure level should be determined by noise monitoring at a point 1 metre from the edge of the site or building façade that is the most exposed to traffic noise and at a height of 1.5m from the ground level at that point. The assessment should also reflect the impact of any future growth in road and rail traffic, based on a 20 year forecast period (WAPC, 2005a).

Once the noise level at a sensitive land use area has been identified the noise exposure level should be determined using the External Noise Exposure Level Criteria (Table 48).

TABLE 48. EXTERNAL NOISE EXPOSURE LEVEL CRITERIA

Time Period	External Noise Exposure Level Criteria (dB)		
	Exposure level 1 (Target)	Exposure level 2	Exposure level 3
Day (6.00am – 10.00pm)	Less than LAeq55	LAeq55-60	Above LAeq60
Night (10.00pm – 6.00am)	Less than LAeq50	LAeq50-55	Above LAeq55
Additional criteria for railways	Less than LA Max75	LA Max 75-80	Above LA Max80

Exposure Level 1

Exposure level 1 is the level of outdoor noise considered a desirable target for noise-sensitive developments. No noise reduction measures are required for noise-sensitive developments within an area with an Exposure Level 1.

Exposure Level 2

Exposure Level 2 represents the maximum noise exposure for proposed new road or rail infrastructure and noise-sensitive development adjacent to such infrastructure. New noise sensitive developments in areas with an Exposure Level 2 should be designed and constructed to meet:

- Exposure Level 1 for outdoor living areas; and
- The 'satisfactory' criteria under *AS 2107, 2000: Acoustics – Recommended design sound levels and reverberation times for building interiors*, for indoor areas.

Exposure Level 2 may not be practicable for many existing major road and rail corridors.

Exposure Level 3

Exposure Level 3 is the level of outdoor noise exposure that is not generally regarded as acceptable for noise-sensitive developments.

Noise management measures are mandatory for new or upgraded roads and railways near noise-sensitive sites with predicted noise levels in Exposure Level 3. The objective of the noise

management measures should be to achieve Exposure Level 2 or better. New noise sensitive developments within an Exposure Level 3 area should be designed and constructed to meet:

- Exposure Level 1 for outdoor living areas; and
- The 'satisfactory' criteria under *AS 2107, 2000: Acoustics – Recommended design sound levels and reverberation times for building interiors*, for indoor areas.

While it may not always be practicable to achieve the above criteria, special attention should be given to meeting the indoor noise standards.

Measures for reducing road and rail noise

Measures have been identified for reducing roads and rail noise within the MW Cell (Table 49). These measures should be implemented, where practical, when the exposure criteria for outdoor noise areas have not been met.

TABLE 49. MEASURES FOR REDUCING ROAD AND RAIL NOISE

Measures for Reducing Road and Rail Noise	Circumstances where these measures are required	Method
Separation of noise-sensitive development from noise source.	Major freight corridors, or where major transport corridors traverse rural areas.	Setbacks to housing and other noise-sensitive development with the aim to meet the Exposure Level 1, for the development site.
Infrastructure design and management.	Near proposed major road and rail infrastructure with established or planned noise-sensitive uses.	Noise control at the source including operational controls, traffic management and the use of low-noise surfaces.
		Constructing the road or rail infrastructure in a cut where the topography is suitable.
		Noise walls
		Combinations of earth mounding and landscaping can reduce the scale and visual impact of noise walls and barriers.
Building design.	Where noise levels impacting a noise-sensitive premises still exceed the 'target' level criteria set out in Table 48 after separation and infrastructure design and management.	Use of materials and construction of buildings to limit noise entry by upgraded glazing, ceiling insulation and sealing of air gaps.
		Walls designed to screen part or all of the affected property.
		Outdoor living areas located to maximise the screening effects of buildings and barrier walls.
		Locate the most noise-sensitive areas (bedrooms, living, entertainment, kitchen and dining) furthest away from the noise source.
		Placing service areas (bathrooms, hallways, stairways, storage rooms and garages) between the noise source and more noise-sensitive activity areas so as to act as a noise barrier.
		Limiting the size and height of openings to habitable rooms, in a direct line-of-sight to the noise source so as to maximise the screening effect of any noise barrier.

13.5.5 Compatible Land Uses near existing and proposed linear infrastructure

There are four main components of the freight network that are within, or form a boundary to, the Cell (Figure 22). These are the:

- South Western Highway: a primary freight road within MRWA jurisdiction;
- Mundijong Road: a primary freight road within jurisdiction;
- North South Rail line: a freight rail line; and
- Proposed Tonkin Highway extension: a primary freight road within MRWA jurisdiction.

The area of influence associated with these routes should be determined using the exposure criteria for outdoor noise levels identified in *Statement of Planning Policy: Road and Rail Transport Noise* (WAPC, 2005b). Noise modelling of predicted noise levels should be undertaken to determine if it is possible for these criteria to be met. Where modeling suggests the criteria can be met the noise sensitive land uses should be permitted. Where modeling suggests the criteria for noise sensitive premises can not be met, land uses such as light industry and certain commercial developments (service industries) may be appropriate.

Potentially compatible land uses have been identified for the areas abutting the four identified freight routes (Table 50). Further noise modelling of predicted noise levels will be required to confirm these identified land use compatibilities.

TABLE 50. POTENTIALLY COMPATABLE LAND USES NEAR FREIGHT CORRIDORS

Compatible Land Use	Acceptable land use based on minimum possible exposure level		
	Exposure level 1	Exposure level 2	Exposure level 3
Residential housing	✓	✓*	X
Caravan park	✓	✓*	X
Camping ground	✓	✓*	X
Educational establishment	✓	✓*	X
Child care premises	✓	✓*	X
Hospital	✓	✓*	X
Nursing home	✓	✓*	X
House of worship	✓	✓*	X
Light industry	✓	✓	✓
Service industry	✓	✓	✓

*noise exposure should be acceptable, subject to appropriate measures to ameliorate noise impact.

Noise issues associated with the South Western Highway and the north-south railway should be addresses at the Local Structure Planning Stage. Prior to the redevelopment of areas adjacent to these transport corridors the sub-divider should provide a written undertaking to the WAPC that the purchaser will be notified of requirements to undertake noise studies and install measures to reduce noise impacts for any sensitive premises built within 200m. A similar requirement could be expected fro properties adjacent to the proposed Tonkin Highway extension.

13.5.6 Definitions

Term	Definition
A-weighted	An A-weighted sound level includes the 'A' frequency weighting in the measurement of a sound, to approximate the frequency response of the normal human ear (WAPC, 2005a).
LAeq	The equivalent steady-state, A-weighted sound level ('equal energy') which in a specified time period contains the same acoustic energy as the time varying level during the same period (WAPC, 2005a).
LAmax	The specified A-weighted noise level (slow) which is not to be exceeded at any time (WAPC, 2005a).
Light industry	An industry: ▪ In which the processes carried on, the machinery used, and the goods and commodities carried to and from the premises will not cause any injury to, or will not adversely affect the amenity of the locality by reason of the emission of light, noise, vibration, smell, fumes, smoke, vapour, steam, soot, ash, dust, waste water or other waste products; and ▪ The establishment of which will not, or the conduct of which does not, impose and undue load on any existing or projected service for the supply or provision of water, gas, electricity, sewerage facilities, or any like services (WAPC, 1997).
Service industry	A light industry carried out on land or in buildings which may have a retail shop front and from which goods manufactured on the premises may be sold; or land and buildings having a retail shop front and used as a depot for receiving goods to be serviced (WAPC, 1997).

14 Aboriginal Heritage

14.1 Background

Evidence taken from various sites across the Swan Coastal Plain suggest that Aboriginal groups have occupied the south-west corner of Western Australia for at least 40 000 years (Edwards & Macdonald, 1999). According to Blockley & Greenfield (1995), Aboriginal people in the south-west of the state lived in 13 distinct socio-dialectical groups, all of which are now recognised as a grouping or cultural block known as Nyungar, meaning 'man' or 'person'. Nyungar language was spoken by Aboriginal people living westward of a line extending from immediately south of Geraldton to the southern edge of the Great Australian Bight, east of Esperance (Blockley & Greenfield, 1995).

With respect to Aboriginal use of the lands surrounding the Study Area, Tiller (1983) contends that the area formed part of the traditional lands of the Whadjuk people, a large territory that is bounded by the Swan River and it's northern and eastern tributaries extending inland beyond Mount Helena to Kalamunda, Armadale, Victoria Plains and within the western vicinity of York. At Perth, the traditional lands of the Whadjuk stretch as far south as Pinjarra.

14.2 The Aboriginal Heritage Act

The *Aboriginal Heritage Act 1972* provides for the preservation, on behalf of the community, of places and objects customarily used by, or traditional to, the Aboriginal people of Western Australia.

Under section 17 of the Act, a person who excavates, destroys, damages, conceals or in any way alters any Aboriginal site commits an offence. It is also an offence to alter, damage, remove, destroy, conceal , deal with, or assume possession of any object on, or under, a site.

It is the role of the Aboriginal Cultural Materials Committee (ACMC) to consider applications under Section 18 of the Act by landowners to use land, on which Aboriginal sites or objects are located, and recommending to the Minister for Indigenous Affairs whether consent should be given to the use of the land for the purpose sought.

After considering the recommendations of the ACMC and having regard to the "general interest of the community", the Minister may either consent to the use of the land for the purpose sought, or refuse to consent. If the Minister consents, he may attach conditions to the use of the land.

14.3 Section 18 Notice

Section 18 of the Act provides the mechanism to seek the consent of the Minister to use the land upon which an Aboriginal site exists or might exist for a nominated purpose. The purpose of the s18 Guidelines is to help proponents prepare a Notice which provides complete and relevant information to the ACMC.

With regard to a Section 18 Notice, the proponent is required to provide the ACMC with the following information:

- Statement of Notice;
- Land owners name (Name of Applicant);
- Contact details of owner / agent;
- Key contact persons for the Notice;
- A description of the Land the subject of the Notice;
- Maps of the Land and the location of known Aboriginal heritage sites in relation to the Land;
- A project description indicating the purpose of the use of the land;
- Summary of proponent consultation with relevant Aboriginal people and other stakeholders;
- Summary of potential effects on Aboriginal sites and possible management responses; and
- Recommendations.

The Department of Indigenous Affairs can assist proponents with any queries in relation to preparing a Section 18 Notice.

14.4 Aboriginal Heritage Sites

A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register and Enquiry System (Appendix 21) identified 12 Aboriginal heritage sites within the Study Area and confirmed the presence of the Aboriginal heritage sites mentioned in the Environmental Scoping Paper – Mundijong/Whitby District Structure Plan (Land Insight 2007).

Under the general licensing agreement for access to the Aboriginal Sites Register, public disclosure of detailed information regarding Aboriginal Sites is not permitted. A list of sites and a brief description of the site type is provided in Table 51. The approximate location of sites is provided in Figure 23.

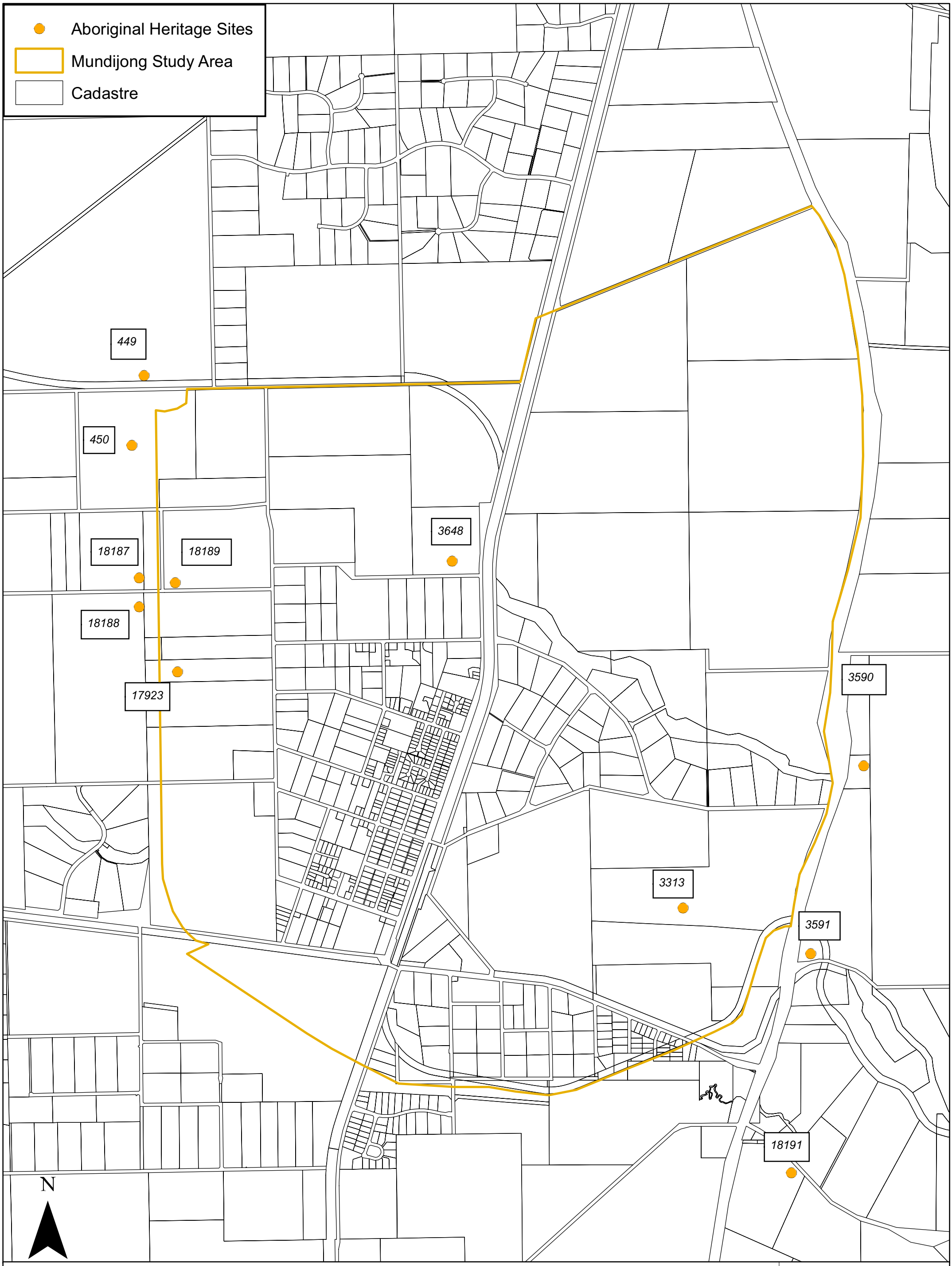
TABLE 51. ABORIGINAL HERITAGE SITES AT MUNDIJONG AND WHITBY

Site ID	Site Name	Site Type
449	South-East Corridor 02	Artifacts/Scatter
450	South-East Corridor 03	Artifacts/Scatter
3313	Mundijong	Artifacts/Scatter
3590	Whitby	Artifacts/Scatter
3591	Yarrabah	Artifacts/Scatter
3648	Soldiers Rd, Mundijong	Artifacts/Scatter
17923	If No 2	Artifacts/Scatter
18187	Tonkin Highway – Mundijong Rd Scatter No 11	Artifacts/Scatter
18188	Tonkin Highway – Mundijong Rd Scatter No 12	Artifacts/Scatter
18189	Tonkin Highway – Mundijong Rd Scatter No 13	Artifacts/Scatter
18190	Tonkin Highway – Mundijong Rd Scatter No 14	Artifacts/Scatter
18190	Tonkin Highway – Mundijong Rd Scatter No 15	Artifacts/Scatter

The sites listed in the table are concentrated along the western flank of the study area and have been the subject of numerous cultural heritage surveys and reports, all of which are held by the Department of Indigenous Affairs and were reviewed for the purposes of this Study. Of the 12 known sites within the Study Area, detailed site information, a description of the condition of the site and an analysis of its significance is available for eight of the sites listed in Table 51, while Blockley & Greenfield, 1995) were unable to locate site 3313 in what is referred to in their report as the Mundijong Proposed Urban Village, as a result of the dense vegetation cover.

Detailed heritage surveys of the north-east sector of the Study Area between the South-Western Highway and Reilly Road, carried out on behalf of Cardno BSD (Robert Day, 2005), found no Aboriginal heritage sites in the area. Therefore, it is not expected that Aboriginal heritage issues are likely to constrain any proposed development in that area.

The significance of each Aboriginal heritage site has been described by the Blockley and Greenfield (1995), O'Connor & Quatermaine (1989) and Blockley (1996). Site SO2329, on Soldiers Rd is a stratified archaeological site that conforms to the general pattern and nature of other sites located on the Swan Coastal Plain, suggesting that Aboriginal habitation of the Swan Coastal Plain was mainly concentrated along the eastern interface with the Darling Scarp.



JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	Aboriginal Heritage Sites	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 24	SCALE	1 : 20 000		
DATE	10/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

14.5 Protection of Aboriginal Heritage Sites

The EPA is required to report under section 44 (1) of the *Environmental Protection Act 1986* (EP Act), on the environmental factors relevant to a proposal (i.e. the *relevant environmental factors*). In recent years the EPA has had cause to reconsider its position within the scope of the EP Act in relation to Aboriginal heritage matters. The broad definition of environment in the EP Act clearly encompasses the physical environment including heritage matters. Given the overlap with the *Aboriginal Heritage Act 1972* (AH Act), the EPA has developed a guidance statement to reduce duplication of requirements for information and to make them as complementary as possible.

As part of the formal EIA process (i.e. where it has been determined that a proposal will be subject to formal assessment), proponents and the community could expect that the EPA will:

- Where Aboriginal heritage is likely to be important, identify it as an issue to be addressed by the proponent (this is a reminder to the proponent to provide information so that the EPA can consider whether or not Aboriginal heritage is a *relevant environmental factor*);
- On the basis of information provided to it in the environmental review document and submissions, consider whether Aboriginal heritage is a *relevant environmental factor*; and
- Where Aboriginal heritage is a *relevant environmental factor*, report on the implementation of the proposal in relation to resulting changes to physical and biological attributes of the environment which may impact on the heritage significance of those attributes to Aboriginal people.

Where it is possible that Aboriginal heritage is a *relevant environmental factor*, the proponent should demonstrate that the relevant Aboriginal heritage issues have or will be identified (to the satisfaction of the DIA) and that the proponent has properly considered how to minimise any adverse impact by the proposal on heritage values.

The EPA *Guidance Statement 41: Assessment of Aboriginal Heritage* outlines actions which may be pertinent to the factor of Aboriginal heritage. They are:

- Consult with staff of the DIA and review any site records (desk-top review) in accordance with the AH Act;
- Undertake an Aboriginal heritage survey (if it is noted from a desk-top review that an adequate survey has not been undertaken for an area to be developed) which should include both consultation with appropriate Aboriginal people, which may include an anthropological survey, and, if necessary, an archaeological survey;
- Inform the relevant Aboriginal people about details of the proposed development, including potential environmental impacts;
- Consult with relevant Aboriginal people to enable them to make known to the proponent their concerns in regard to environmental impacts as they affect heritage matters; and
- Demonstrate that any concerns raised by Aboriginal people have been adequately considered by the proponent in its management of environmental impacts, and any changes as a result of this process are made known to the relevant Aboriginal people.

14.6 Recommendations

SMEC recommends that Shire of Serpentine-Jarrahdale consult with the South West Land & Sea Council (SWLASC) in relation to all matters pertaining to Aboriginal heritage sites identified in this report should they be subject to disturbance as a result of Mundijong/Whitby District Structure Plan. The Swan Catchment Council (SCC) has developed a 'one-stop shop' to help simplify the Aboriginal consultation process to ensure that all the requirements of a Section 18 Notice are met by the proponents. Such an approach will ensure that the proponent has consulted with the appropriate representatives of the relevant Aboriginal people and in turn, reduce the prospect of impediments that may slow the consultation process.

The Department of Indigenous Affairs, SWLASC and SCC can also recommend archaeologists and ethnographers who play a very important function in facilitating communications between the proponent and the traditional owners. This is very important because these professionals are familiar with the cultural sensitivities that may concern certain Aboriginal heritage sites.

SMEC also recommends that further ethnographical and archaeological surveys are undertaken in the south-east of the study area, should this area be subject to development under that Structure Plan, as previous surveys were unable to locate this site and assess its significance.

15 Non-Indigenous Heritage

15.1 Non-Indigenous Heritage within the MW Cell

Non-indigenous heritage is protected under the *Heritage of Western Australia Act 1990* (Heritage Act). This Act sets out the requirements for:

- Heritage sites to be recorded in the Register of Heritage Places; and
- Local Governments to establish and maintain an inventory of buildings (Municipal Inventory) within its district which in its opinion are, or may become, of cultural heritage significance.

15.1.1 Register of Heritage Places

The State Register provides official recognition of a place's cultural heritage significance to Western Australia and assists the Heritage Council to identify, provide for, and encourage the conservation of heritage places (Heritage Council of Western Australia, 2007a). The State Register legally protects a site's significant cultural heritage from any changes. Any development proposals regarding a registered place must be referred to the Heritage Council for advice.

There are no sites currently listed in the Register of Heritage Places within the MW Cell.

15.1.2 Municipal Inventory

A Municipal Inventory is a list of buildings which in the opinion of the local government are, or may become, of local cultural heritage significance. Local governments are required under Section 45 of the Heritage of Western Australia Act 1990 to prepare such a list (Heritage Council of Western Australia, 2007b).

The objective of the Local government heritage inventories is to assist local governments to:

- Provide a cultural and historic record of the local district;
- Determine local government conservation policies; and
- Provide information about local heritage that may be required under a town planning scheme for that district.

Places entered in a Municipal Inventory do not have legal protection unless they are listed in a separate Heritage List linked to the local Town Planning Scheme, or are already entered in the State Register of Heritage Places

There are thirteen (13) sites within the MW Cell that are listed on the Shire of Serpentine-Jarrahdale's Municipal Heritage Inventory (Figure 24). Eight (8) of these sites are all linked to the Serpentine Jarrahdale Town Planning Scheme No. 2 and, as such are legally protected.

15.1.3 Other Registers

There are four (4) other heritage sites within the MW Cell that are recorded on other registers (Figure 24):

- Anglican Church Inventory (1 site);
- Statewide War Memorial Survey (1 site); and
- Serpentine Jarrahdale Town Planning Scheme No. 2 (2 sites).

Only those sites listed on the Town Planning Scheme have any legal protection under the Heritage Act.

JOB TITLE	Environmental Study - Mundijong/Whitby District Structure Plan				
FIGURE TITLE	European Heritage Sites	REFERENCE	Shire of Serpentine Jarrahdale	AUTHOR	J Levett
FIGURE No.	Figure 24	SCALE	1 : 20 000	SOURCE	WA Heritage Commision & Shire of Serpentine-Jarrahdale
DATE	10/06/2008	PROJECT No.	3006110	0 125 250 500 750 1,000 Meters	

SMEC

15.2 Non-Indigenous Heritage Sites within the MW Cell and their Associated Protection Obligations

Reference Number	Name/Place	Address	Reserve / Lot #	Cultural Heritage Significance	Management Category[10]	Listed in the TPS 2007	Obligations / Recommendations
11582	Anglican Rectory	86 Paterson St, Mundijong 32°17'19.63"S 115°59'17.37""E	Lot 17	Anglican Church[11]	N/A	No	Nil
08605 SJ13-02	Jarrahdale Inn (fmr) / Whitby Falls Coach House	Cnr South-Western Hwy & Kiernan St, Mundijong 32°17'27.17"S 116°00'42.70"E	Lot 100	Former inn has social and historical significance being an early licensed premises in the area and established for the timber workers, and in its continued use as a public (licensed) facility. Its prominent corner location and pleasing aesthetic give the inn landmark value[12].	Category 1A-2 Conservation Essential - Highly recommended	Yes	1. Refer the site to the Heritage Council for possible inclusion on the Heritage Register. 2. Provide maximum encouragement to owner(s) to conserve the sites significance.
08615 SJ9-08	Manjedal School (fmr)	12 Paterson St, Mundijong 32°17'50.78"S 115°59'3.56"E	Reserve 32180 Lot 218	Former Mundijong school has high historic and social significance being the oldest surviving school building in the Shire of Serpentine-Jarrahdale. It may also be one of the earliest timber school complexes still existing in the State. Despite its new use it remains a relatively intact example of an early school, in its building design and layout[12].	Category 1A Conservation Essential	No	1. Refer the site to the Heritage Council for possible inclusion on the Heritage Register. 2. Site should be listed in the TPS. 3. Provide maximum encouragement to owner(s) to conserve the sites significance.
03922 SJ9-09	Masonic Hall	32 Butcher St, Mundijong 32°17'29.50"S 115°59'0.93"E	Lot 502	The Masonic Hall is the only surviving purpose build lodge in the shire. Its good condition and pleasing design give the hall aesthetic value. Some of the heritage value has been compromised by the relocation, although the hall has remained intact and in good condition and is still used for its original purpose. The relocation of the hall to Mundijong is representative of the growth and stability of the Mundijong locality as opposed to Jarrahdale[12].	Category 2 Conservation highly recommended	No	1. Site should be listed in the TPS. 2. All development applications to be considered by Council. 3. Provide maximum encouragement to owner(s) to conserve the sites significance.
14042	Mundijong Honour Roll, Mundijong Community Hall	Paterson St, Mundijong	Not available	War memorial[11]	N/A	No	Nil
02365 SJ9-03	Mundijong Hotel/Tavern	32 Paterson St, Mundijong 32°17'40.45"S 115°59'9.18"E	Lot 6	Social significance as a meeting place, and as a place of employment. Historic significance in its association with Antoni Szczecinski, Mundijong's first publican. Important as part of the group of early buildings along Paterson Street[12].	Category 2 Conservation highly recommended	Yes	1. All development applications to be considered by Council. 2. Provide maximum encouragement to owner(s) to conserve the sites significance.
08621 SJ9-10	Mundijong Post Office (fmr Dot's Teagarden)	26 Paterson St, Mundijong 32°17'43.16"S 115°59'7.63"E	Lot 1	The former Post Office retains some historic and social significance, despite its new use and alterations, as the site of the first purpose build post office in Mundijong[12].	Category 5 Historic Site of Significant vegetation	No	Nil
03129 SJ9-06	Mundijong Railway Station	Paterson St, Mundijong 32°17'41.0"S 115°59'11.6"E	Railway Reserve	The railway buildings are a tangible reminder of the significant impact of the railway on industry in the area – particularly the timber and dairy industries. Although the relocation of the station buildings has diminished some of their integrity the buildings still retain a level of historic and social significance, particularly as they are the only railway station buildings in the shire. Relocation has also resulted in greater exposure and public access to the buildings, bring them within the main precinct of older buildings[12].	Category 2 Conservation highly recommended	Yes	1. All development applications to be considered by Council. 2. Provide maximum encouragement to owner(s) to conserve the sites significance.
02366 SJ9-01	Mundijong Uniting Church	18 Paterson St, Mundijong 32°17'46.40"S 115°59'06.20"E	Reserve 3863 Lot 11 Pt Lot 208	Significant in its association with the development of the town after the railway came through in the late 1890's, and the presence of Methodist/Uniting community. Important as part of the group of early buildings along Paterson Street and the only Church in Mundijong townsite[12].	Category 2 Conservation Highly Recommended	No	1. Site should be listed in the TPS. 2. All development applications to be considered by Council. 3. Provide maximum encouragement to owner(s) to conserve the sites significance.
08497 SJ9-04	Old Mundijong Hotel	Cnr Paterson St & Mundijong Rd 32°18'00.4"S 115°59'04.1"E	C S Loc. 499	Social significance as a meeting place, and as a place of employment. Historic significance in its association with Antoni Szczecinski, Mundijong's first publican. Aesthetically the house has landmark value in its pleasing form and proximity to the railway line junction. Important as part of a group of early buildings along Paterson Street[12].	Category 2 Conservation Highly Recommended	Yes	1. All development applications to be considered by Council. 2. Provide maximum encouragement to owner(s) to conserve the sites significance.

Reference Number	Name/Place	Address	Reserve / Lot #	Cultural Heritage Significance	Management Category[10]	Listed in the TPS 2007	Obligations / Recommendations
08624 SJ9-12	Railway Cottage (fmr)	Roman Rd, Mundijong 32°17'38.1"S 115°59'14.7"E	Lot 1839	High level of historical significance and rarity value at the local level, being the only cottage remaining of the original 4, built for the workers at the station. Some integrity has been lost owing to the relocation of the Railway Station buildings to the other side of the railway line, severing the association between the two places to some degree[12].	Category 2 Conservation Highly Recommended	No	1. Site should be listed in the TPS. 2. All development applications to be considered by Council. 3. Provide maximum encouragement to owner(s) to conserve the sites significance.
08623 SJ9-11	Residence	Mundijong Rd cnr Adonis Rd, Mundijong 32°17'54.4"S 115°58'43.8"E	Lot 8	The residence and barn on Hall Street, is an example of an early residence and small farm in the Mundijong area[12].	Retain & conserve if possible Category 4 Conservation Desirable	No	1. Incorporate into a heritage precinct within the TPS.
08617 SJ9-07	Road Board Building (fmr Library)	10 Paterson St, Mundijong 32°17'50.78"S 115°59'3.56"E	Lot 58	Historic and social value being the only former administrative centre still existing in the shire, and the first purpose built centre. With the new offices located next door, and the old agricultural hall once located nearby, the site has continued its function as the administrative part of town and where people involved in the council and general community have traditionally met and interacted. Its prominent corner location give the place some aesthetic value[12].	Category 2 Conservation highly recommended	No	1. Site should be listed in the TPS. 2. All development applications to be considered by Council. 3. Provide maximum encouragement to owner(s) to conserve the sites significance.
08498 SJ9-05	The Nook / Szczecinski's Cottage	Roman Rd, Mundijong 32°17'43.4S 115°59'12.4E	Lot 1 Cockburn Sound Loc 548	Historic significance in its association with Antoni Szczecinski, Mundijong's first publican and well known identity of the district and as an early residence in Mundijong[12].	Category 3 Conservation encouraged.	Yes	Nil
08496 SJ9-02	Whollogan's Bakers	50 Paterson St, Mundijong 32°17'34.1"S 115°59'10.9"E	Lot 80	Important as part of the group of early buildings along Paterson Street and as a remnant of the baking industry in the shire[12].	Category 3 Conservation encouraged.	No	1. Incorporate into a heritage precinct within the TPS.
No. 37 (TPS)	Flora roads[13]	Soldiers Rd/Paterson St (Turner Rd to Mundijong Rd and Mundijong Rd from Paterson St to Lightbody Rd)	Not Available	Not available	Category 5 Historic Site of Significant vegetation	Yes	Nil
No. 33 (TPS)	Manjedal Brook[13]	From its source East of Nettleton Road along its length to Kargotich Road.	Not Available	Not available	Category 5 Historic Site of Significant vegetation	Yes	Nil

[10] Refer to Appendix 20 for definition of Heritage Management Categories

[11] Heritage Council of Western Australia Database, 2007c

[12] Source: Municipal Heritage Inventory Shire of Serpentine-Jarrahdale Parts 1, 2 and 3, 2000

[13] Source Serpentine Jarrahdale Shire Town Planning Scheme No. 2, 2007

16 Conclusions

The outcomes of the Land Capability Classification (Section 8) have been overlaid with all the environmental constraints identified in the study to produce a map of areas suitable for urban development within the Cell (Section 4, Figure 2).

Development outside the areas of environmental constraint are unlikely to require any further approvals. Development within the areas of environmental constraint face a number of potential approval requirements ranging from Shire Approval for developments in Landscape Protection Areas, to State and even Federal approvals should the development be likely to affect Threatened Ecological Communities.

The impacts of development within the areas of environmental constraint can be minimised by applying a series of management actions to address the relevant environmental factors (Table 52).

TABLE 52. MANAGEMENT ACTIONS FOR SIGNIFCANT ENVIRONMENTAL FACTORS

Environmental Factor	Management Actions
Flora and Habitat Preservation	1. Where possible development should be located within existing cleared land to minimise the impact on remnant vegetation. 2. Where native vegetation is to be cleared, detailed floristic surveys should be undertaken prior to subdivision. These surveys should focus on declared rare and priority flora, vegetation structure, proximity to and connectivity with, other vegetation and a discussion of linkage values at a local and regional context. 3. The clearing of native vegetation should be prohibited unless authorised by a DEC Clearing Permit or is exempt under Schedule 6 of the *Environmental Protection Act 1986* or Regulation 5 of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. 4. When undertaking subdivision building envelopes should be pegged for each proposed lot to ensure that the impact on remnant vegetation is minimised. 5. The following should be used to minimise inadvertent impacts during constructions: • use of clear signage; • provision of operator information; • fencing, where necessary; and • rehabilitation and stabilization of areas disturbed during construction 6. Roads and firebreaks are located such that fragmentation of remnant vegetation is prevented. 7. A Vegetation Management Plan should be prepared that details: • protected areas within the Cell • management practices for each area of remnant vegetation • details the ecological linkages within the cell • contains an approved planting list for gardens and public open space • offset requirements should native vegetation require clearing • weed management requirements for the Cell • hygiene requirements for soil imported into the cell.
Fauna Preservation	1. Prior to commencing work in areas of remnant vegetation, field investigations for Specially Protected (Threatened) Fauna should be undertaken in accordance with the EPA Guidance Statement No. 54, *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*. If identified these species should be protected in accordance with the *Wildlife Protection Act 1950*. This should be addressed in a Fauna Management Plan. 2. Fauna Management Plans should be required when clearing areas of remnant vegetation. The plan should include provisions for retaining habitat trees where possible and the relocation of fauna species if necessary. 3. A comprehensive Fox Management Plan should be formulated by Shire of Serpentine-Jarrahdale in association with the development of MW Cell; 4. Consideration should be given to developing a Shire Pet Policy that could include: • prohibiting domestic cats and dogs from entering natural area reserves; • establishes buffer zones (e.g. cat buffer zones) around key natural assets;

Environmental Factor	Management Actions
	• limit the number of cats per household and/or • require cat owners to register their cat with the Shire.
Loss of Visual Amenity	1. Landscape Management Plans (LMP's) should be submitted to and approved by the Shire for all development within areas covered by the Shires Local Planning Policy 8 - Landscape Protection Area, then implemented prior to development. LMP's should contain provisions for minimising clearing, building heights, lot sizes, planting of fringing vegetation, building envelopes, adequate building setbacks and provision of public open space.
Wetlands and Water Courses	1. No development should occur within EPP Wetlands or their buffers. New subdivisions should ensure that Lot boundaries do not intersect EPP wetlands or their buffers and prospective purchasers of land containing an EPP Wetlands and/or it buffer should be made aware of development restrictions. 2. Where future subdivision has the potential to impact of Manjedal Brook a Foreshore Management Plan should be prepared by the sub-divider for approval by the WAPC. 3. All remnant vegetation, fringing vegetation and ecological linkages associated with the Cell's wetlands and water courses should be maintained. 4. Access to wetlands should be controlled/restricted by using paths, fences and gates. The exact nature of these measures should be determined during local structure planning. 5. There is to be no fill, fertiliser or chemical application, groundwater or wetland water abstraction, no waste disposal, excavation, or drainage into or out of EPP wetlands. Discharge of stormwater may be permitted into the wetland provided a Storm Water Management Plan is approved by the DoW. 6. Stormwater management plans should be produced at the Local Structure Planning Stage to ensure that any existing inappropriate stormwater disposal to wetlands or water courses are replaced and that stormwater management at the site is in accordance with the DoW's *Stormwater Management Manual* (DoE, 2004). 7. Where development is proposed near a wetland a Wetland Management plan should be prepared that details: • the wetland's buffer distance; • the proposed management of stormwater run-off into the wetlands; • the management of groundwater recharge; • any approved groundwater abstraction allowances; • any required rehabilitation of the wetland(s) • site monitoring; and • the management of Acid Sulphate Soils (where necessary).
Noise	1. Noise issues associated with the South Western Highway and the north-south railway should be addresses at the Local Structure Planning Stage. Prior to the redevelopment of areas adjacent to these transport corridors the sub-divider should provide a written undertaking to the WAPC that the purchaser will be notified of requirements to undertake noise studies and install measures to reduce noise impacts for any sensitive premises built within 200m. A similar requirement could be expected fro properties adjacent to the proposed Tonkin Highway extension.

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APPENDIX 1 : Methodology

Terrestrial Flora

A desktop investigation on the Study Site's flora and vegetation assets was conducted by:

- Reviewing
  - all flora and vegetation surveys conducted within the study area:
    - DEP, 1995 from Cardno BSD, 2005;
    - Cardno BSD 2006a;
    - Maunsell, 2006;
    - Syrinx, 2006; and
    - Keighery 1996, and Keighery and Trudgen, 1992
  - previous environmental studies conducted by Land Insights (2006);
  - the Shire's Environmental Scoping documents Environmental Services Rolling Five Year Management Plan (Shire of Serpentine-Jarrahdale, 2007); and
  - the Local Biodiversity Strategy (Ironbark Environmental and Sustainable Development, 2007);
- Conducting searches for threatened flora and ecological communities at the Commonwealth and State levels which included an EPBC Protected Matters Search and DEC database enquiry.

The flora data collected and reviewed for the MW Cell was significantly detailed that detailed flora survey of the cell was not required; however opportunistic flora surveys were undertaken during each site visit.

Based on this review, the following outcomes were derived:

- Gaps in information identified;
- Maps and descriptions on a range of flora and vegetation features;
- Description and analysis of threats and issues associated with the development of the urban cell;
- Description of the relationship between the distribution of vegetation types and hydrology
- Values and significance of vegetation communities;
- Discussion on how ecological linkages should be reflected in the Local Structure Plans; and
- Discussion on the potential impact of the development of the urban cell on significant flora and proposed management strategy to prevent loss of significant flora.

Terrestrial Fauna

A desktop review of previous studies was undertaken in order to compile a comprehensive list of fauna that has previously been recorded and is likely to occur within and in close proximity to the study area, and to identify any threatened or significant fauna whose conservation requirements may need to be considered further as part of the development of the Mundijong/Whitby District Structure Plan.

The desktop survey comprised a search of:

- EPBC Protected Matters Search Database (Appendix F3);
- DEC Threatened and Priority Fauna Database (Appendix 12);
- Environmental Scoping Document – Mundijong/Whitby District Structure Plan (Land Insights 2007); and
- Previous fauna surveys of the study area.

The desktop survey aimed to determine whether any gaps exist in within the body of data pertaining to faunal assemblages within the study area and surrounding landscape.

In addition a site inspection of all prospective fauna habitat areas was conducted within the Study Area, constituting a level 1 survey under the Environmental Protection Authority's (EPA) Guidance Statement 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.

Landscape and Landform

The identification and description of the existing landscapes, landforms and public viewing areas within the MW Cell was prepared by conducting:

- a review of the following documents:
    - Local Planning Policy 8 - Landscape Protection (Shire of Serpentine Jarrahdale 2004a);
    - MWDSP Environmental Scoping Paper (Land Insights, 2007); and
    - Bush Forever – Volume 2: Directory of Bush Forever Sites (DEP, 2000b).
- a site visit to the project area.

The potential development impacts on each public viewing location was then assessed based on how the views of the MW Cell would be altered following the development of the area. Recommendations were then developed to maintain or enhance the viewing experience.

Land Degradation

The existing land management issues within the MW Cell were identified using AGMaps Land Manager (DAF, 2005). The land management issues associated with each soil type occurring in the MW Cell were identified and mapped. The effect of urban development on each land management issue was assessed to determine the Land Capability Suitability for urban development.

Wetlands, Linear Watercourses and Groundwater Dependant Ecosystems

The identification and description of wetlands, linear watercourses, groundwater dependant ecosystems and Karst formations within the MW Cell was prepared by conducting:

- a review of the following documents:
    - MW Cell Environmental Scoping Paper (Land Insights, 2007);
    - Environmental Protection (Swan Coastal Plains Lakes) Policy, 1992;
    - Bush Forever – Volume 2: Directory of Bush Forever Sites (DEP, 2000b);
    - A geomorphic approach to global classification for inland wetlands (Semeniuk & Semeniuk, 1995);
    - Wetlands of the Swan Coastal Plain Volume 2b – Wetland Mapping, Classification and Evaluation, Wetland Atlas (Hill et al, 1996);
    - WetlandBase;
    - Stocking Rate Guidelines for Rural Small Holdings (van Gool, et al, 2000);
    - Stormwater Management Manual;
    - Decision Process for Stormwater Management in WA (DoE, 2004);
    - River Restoration Manual (WRC, 1999-2003).
- a site visit to each wetland and linear water course within the MW Cell.

The boundaries of each wetland and associated fringing vegetation were then mapped and the information collected used to:

- Identify land management issues associated with each wetland; and
- Identify and assess potential development impacts upon each wetland; and
- Develop strategies for minimising potential impacts.

Each linear watercourse within the MW Cell was assessed to determine its suitability for inclusion in the stormwater system by identifying any:

- Associated conservation values;
- Groundwater dependant ecosystems;
- Vegetation condition; and
- Land management issues (eg erosion or nutrient export potential).

Surface and Groundwater Quality

Surface water Quality

Surface water sampling and analysis was undertaken in accordance with the following documents:

- Contaminated Sites Management Series – Department of Environment and Conservation;
- National Environment Protection (Assessment of Site Contamination) Measure 1999 – National Environment Protection Council;
- ANZECC (2000) – Australian & New Zealand Guidelines for Fresh & Marine Water Quality, Vol 1, The Guidelines (Chapters 1-7);
- Environmental Health Risk Assessment – Health Council; and
- Contaminated Sites Act 2003 and Contaminated Sites Regulations 2006 – Parliament of WA.

Surface samples were collected in accordance with:

- Australian Guidelines for Water Quality Monitoring and Reporting 2000;
- Australian Standard AS/NZS 5667.1-1998: Water Quality Sampling Part 1 - Guidance on the Design of Sampling Programs Sampling Techniques and the Preservation and Handling of Samples;
- DEC Contaminated Sites Management Series Guideline – Development of Sampling and Analysis Programs, December 2001; and
- NEPM (Assessment of Site Contamination) 1999: Schedule B (2) - Guideline on Data Collection, Sample Design and Reporting.

Field monitoring and pumping equipment was decontaminated between sampling sites as follows:

- Removal of solids;
- Wash and scrub in phosphate free detergent (Decon 90); and
- Rinse with deionised water.

The following physical parameters were measured in the field for surface water using a Yeo-Kal Data Logging Water Quality Analyser:

- Temperature (°C);
- Oxidation Reduction Potential (mV);
- Turbidity (NTU);
- Dissolved oxygen (mg/L and % saturation);
- Salinity (mg/L);
- pH; and
- Electrical Conductivity (µS/cm).

Water samples were collected in appropriate preservation containers (supplied by ALS Environmental) at each of the sampling sites for lab analysis. ALS Environmental Analytical Laboratories were used to the water samples for the selected laboratory analytes. ALS Environmental is NATA registered and as such has undertaken a number of QA/QC measures. These include laboratory duplicates (DUP), method blanks (MB) and laboratory controls samples (LCS), matrix spikes (MS), recovery and acceptance limit checks, and surrogate control limit checks.

One (1) field blank samples were included in the water samples for each month of sampling submitted to the laboratory. Field samples were placed on ice in a cool box immediately, labeled and chilled before being transported to ALS Environmental testing laboratory. Chain of Custody (COC) documentation accompanied the delivery of laboratory samples for field QA/QC verification.

All surface water samples were analysed for the following parameters:

- Metals (As, Cd, Cr, Cu, Hg, Ni, Pb, Zn);
- Major Nutrients (Ammonia, NOx, TKN, Total N and Total Phosphorus);

The results of the sampling were compared to previous reports from the MW Cell and recommendations for the maintenance and enhancement for the surface water quality within the MW Cell were prepared.

Groundwater Quality

The data for the assessment of potential impacts on groundwater within the cell was to have been sourced from a DoW "Water Study". At present this study has not commenced so the identified potential impacts on groundwater are based on the:

- Mundijong Deposit Investigation of Shallow Groundwater Resources (URS, 2001);
- Whitby Surface and Groundwater Monitoring Program (Cardno BSD, 2006b);
- DoW Bore data (DoW, 2007a); and
- Perth Groundwater Atlas (DoW, 2007b).

Site Contamination

The PSI for the MW Cell scope involved:

1. A site history review including historical titles and historical aerials;
2. Review of geology, hydrogeology, hydrology and topography of the project area;
3. Review of all other relevant information from Shire of Serpentine-Jarrahdale and other relevant sources e.g. Government Departments;
4. Site inspection; and
5. Preparation of a report summarising the results of the PSI in accordance DEC guidelines.

The data required to undertake this investigation was obtained from the following sources:

- Shire of Serpentine-Jarrahdale;
- Landgate: Historical Certificates of Title/Aerial photographs;
- Environmental Scoping Study – Mundijong/Whitby District Structure Plan (prepared by Land InSights);
- Phase 1 Environmental Site Assessment Lots 22 to 27, 29 and 45 South West Hwy and Lots 302 and 399 Reilly Rd Mundijong (Prepared by Golder Associated Pty Ltd 2005);
- Metropolitan Regional Scheme;
- Shire Town Planning Scheme No. 2;
- Submission to lift MRS 'Urban Deferred' Zoning (prepared by Roberts Day Town Planning + Design, Cardno BSD, Gilbert Rose Consulting Pty Ltd, Transcore Pty Ltd, McMullen Nolan & Partners);

- Environmental Protection Authority (EPA) – Guidance Statement for Remediation Hierarchy for Contaminated Land No. 17 2000;
- DEC: *Contaminated Site Management Series*;
- DEC: records of known or suspected contaminated sites, the Public Database of Confirmed Contaminated Sites (under development), the Perth Ground Water Atlas; and
- Department of Water – Bore Monitoring and Records.

Acid Sulfate Soils

The ASS investigation initially involved a desktop study undertaken to identify the regions where conditions are favourable for formation of ASS. These areas represent the highest risk for exposure of ASS materials and the array of associated problems. The desktop study was complemented by a field assessment to determine the site's specific characteristics, and identify any possible indicators of ASS symptoms, such as iron staining.

Odour

An odour policy framework for the assessment and mitigation of odour emitting land uses within the MW Cell by:

- Conducting a review of the following documents:
  - MW Cell Environmental Scoping Study (Land Insights, 2007);
  - Interim Guidance on odour as a relevant environmental factor (EPA, 2005a);
  - Odour Methodology Guideline (DEP 2002);
  - Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005b); and
  - Guidance Statement No. 55 – Implementing Best Practice in proposals submitted to the Environmental Impact Assessment process (EPA, 2003).
- Preparing a list of potential odour causing sites within and surrounding the MW Cell.
- Conducting a site visit to:
  - Confirm the land use at each identified site: and
  - Determine if there were any previously unidentified odour or potential odour producing sites within or surrounding the MW Cell.
- Determining the necessary buffers for each identified land use.
- Compiling the relevant information into framework that identifies:
  - identifies odour producing land uses and their generic buffers;
  - outlines odour assessment methods; and
  - outlines various processes and procedures for dealing with development proposals that do not meet the MW Cell odour requirements.

Noise

A noise policy framework for the assessment and mitigation of noise emitting land uses within the MW Cell by:

- Conducting a review of the following documents:
  - Environmental Protection (Noise) Regulations, 1997;
  - Draft Guidance Statement No. 8 – Environmental Noise (EPA, 2007);
  - Guidance Statement No. 3 – Separation Distances between Industrial and Sensitive Land Uses (EPA, 2005b);
  - Statement of Planning Policy: Road and Rail Transport Noise (WAPC, 2005a); and

    - Statement of Planning Policy: Metropolitan Freight Network (Draft), (WAPC 2005b).
- Preparing a list of potential noise emitting sites within and surrounding the MW Cell;
- Conducting a site visit to:
    - Confirm the land use at each identified site; and
    - Determine if there were any previously unidentified noise or potential noise emitting sites within or surrounding the MW Cell.
- Determining the necessary buffers for each identified noise emitting land use;
- Compiling the relevant information into framework that identifies:
    - Identifies noise emitting land uses
    - The generic buffers for fixed point noise sources;
    - How to assess of fixed point noise sources;
    - Criteria for managing transport noise sources;
    - Measures for reducing noise exposure; and
    - Compatible land uses along the major freight road and rail networks within the MW Cell.

Aboriginal Heritage

A search of the Department of Indigenous Affairs Aboriginal Heritage Sites Register and Enquiry System was undertaken (Appendix 21) to identify all Aboriginal heritage sites within the Study Area. These were compared with the presence of the Aboriginal heritage sites mentioned in the Environmental Scoping Paper – Mundijong/Whitby District Structure Plan (Land Insight 2007).

The DIA was contacted regarding the exact location and mapping requirements for the identified sites.

Non-Indigenous Heritage

A list and description of non-indigenous cultural heritage sites within the MW Cell was prepared by:

- Conducting a review of the following documents:
    - Heritage of Western Australia Act, 1990;
    - Municipal Heritage Inventory Shire of Serpentine-Jarrahdale Parts 1, 2 and 3, (Burgess, 2000); and
    - Town Planning Scheme No. 2, (Serpentine Jarrahdale Shire, 2004b).
- Undertaking a search of the Heritage Council of Western Australia's databases (http://www.heritage.wa.gov.au/).

The shires obligations and recommendations for management were then determined.

APPENDIX 2 : Flora Species List for the MW Cell

Family	*Species*	Weed
Amaranthaceae	*Ptilotus manglesii*	
Amaranthaceae	*Ptilotus polystachyus*	
Amaranthaceae	*Ptilotus sp*	
Anthericaceae	*Agrostocrinum scabrum*	
Anthericaceae	*Borya sphaerocephala*	
Anthericaceae	*Caesia micrantha*	
Anthericaceae	*Caesia occidentalis*	
Anthericaceae	*Chamaescilla corymbosa*	
Anthericaceae	*Chamaescilla corymbosa* var. *corymbosa*	
Anthericaceae	*Johnsonia pubescens* subsp. *cygnorum*	
Anthericaceae	*Johnsonia pubescens* subsp. *pubescns*	
Anthericaceae	*Laxmannia sessiliflora*	
Anthericaceae	*Laxmannia sessilliflora* subsp. *australis*	
Anthericaceae	*Laxmannia squarrosa*	
Anthericaceae	*Laxmannia squarrosa* subsp. *squarrosa*	
Anthericaceae	*Sowerbaeae laxiflora*	
Anthericaceae	*Thysanotus arenarius*	
Anthericaceae	*Thysanotus manglesianus*	
Anthericaceae	*Thysanotus manglesianus/patersonii* complex	
Anthericaceae	*Thysanotus sparteus*	
Anthericaceae	*Thysanotus tenellus*	
Anthericaceae	*Thysanotus thyrsoideus*	
Anthericaceae	*Thysanotus triandrus*	
Anthericaceae	*Tricoryne elatior*	
Anthericaceae	*Tricoryne humilis*	
Anthericaceae	*Tricoryne tenella*	
Apiaceae	*Homalosciadium homalocarpum*	
Apiaceae	*Hydrocotyle callicarpa*	
Apiaceae	*Hydrocotyle* sp.	*
Apiaceae	*Pentapeltis peltigera*	
Apiaceae	*Trachymene pilosa*	
Apiaceae	*Xanthosia huegelii*	
Apiaceae	*Xanthosia huegelii subsp. huegelii MS*	
Apiaceae	*Xanthosia pusilla*	
Araceae	*Zantedeschia aethiopica*	*
Asclepidaceae	*Gomphocarpus fruticosus*	*
Asteraceae	*Amblysperma spathulata*	
Asteraceae	*Arcotheca calendula*	*
Asteraceae	*Carduus ?tenuiflorus*	*
Asteraceae	*Carthamus lanatus*	*
Asteraceae	*Cotula australis*	*
Asteraceae	*Filago gallica*	*
Asteraceae	*Hyalosperma cotula*	*
Asteraceae	*Hypochaeris glabra*	*
Asteraceae	*Hypochaeris radicata*	*
Asteraceae	*Podotheca angustifolia*	
Asteraceae	*Pseudognaphalium luteoalbum*	*
Asteraceae	*Pterochaeta paniculata*	
Asteraceae	*Quinetia urvillei*	
Asteraceae	*Silocerus humifusus*	

Family	*Species*	Weed
Asteraceae	*Sonchus asper*	*
Asteraceae	*Trichocline spathulata*	
Asteraceae	*Ursinia anthemoides*	*
Asteraceae	*Waitzia suaveolens*	
Asteraceae	*Waitzia suaveolens* var.*suaveolens*	
Boraginaceae	*Echium plantagineum*	*
Boryaceae	*Borya sphaerocephala*	
Brassicaceae	*Brassica napus*	*
Caesalpiniaceae	*Labichea punctata*	
Caesalpiniaceae	*Labichea punctata*	
Campanulaceae	*Wahlenbergia capensis*	*
Campanulaceae	*Wahlenbergia preissii*	
Casuarinaceae	*Allocasuarina fraseriana*	
Casuarinaceae	*Allocasuarina humilis*	
Centrolepidaceae	*Aphelia cyperoides*	
Centrolepidaceae	*Centrolepis aristata*	
Centrolepidaceae	*Centrolepis drummondiana*	
Centrolepidaceae	*Centrolepis mutica*	
Colchicacaea	*Burchardia umbellata*	
Colchicaceae	*Burchardia congesta*	
Colchicaceae	*Burchardia multiflora*	
Crassulaceae	*Crassula colorata* var. *colorata*	
Cyperaceae	*Cyathochaeta avenaceae*	
Cyperaceae	*Cyathochaeta equitans*	
Cyperaceae	*Gahnia ancistrophylla*	
Cyperaceae	*Lepidosperma angustatum*	
Cyperaceae	*Lepidosperma leptostachyum*	
Cyperaceae	*Lepidosperma longnitudinale*	
Cyperaceae	*Lepidosperma scabrum*	
Cyperaceae	*Lepidosperma squamatum*	
Cyperaceae	*Lepidosperma tenue*	
Cyperaceae	*Mesomelaena pseudostygia*	
Cyperaceae	*Mesomelaena stygia* subsp. *stygia*	
Cyperaceae	*Mesomelaena tetragona*	
Cyperaceae	*Restio sunuosus*	
Cyperaceae	*Schoenus bifidus*	
Cyperaceae	*Schoenus clandestinus*	
Cyperaceae	*Schoenus humilis*	
Cyperaceae	*Schoenus subbarbatus*	
Cyperaceae	*Schoenus subflavus* subsp. *subflavus*	
Cyperaceae	*Tetraria australiensis*	
Cyperaceae	*Tetraria octandra*	
Cyperaceae	*Tricostularia neesii*	
Cyperaceae	*Tricostularia neesii* var. *neesii*	
Dasypogonaceae	*Calectasia cyanea*	
Dasypogonaceae	*Dasypogon bromeliifolius*	
Dasypogonaceae	*Dichopogon capillipes*	
Dasypogonaceae	*Kingia australis*	
Dasypogonaceae	*Lomandra brittanii*	
Dasypogonaceae	*Lomandra caespitosa*	
Dasypogonaceae	*Lomandra hermaphrodita*	
Dasypogonaceae	*Lomandra nigricans*	
Dasypogonaceae	*Lomandra preissii*	

Family	*Species*	Weed
Dasypogonaceae	*Lomandra sericea*	
Dasypogonaceae	*Lomandra sonderi*	
Dasypogonaceae	*Lomandra spartea*	
Dilleniaceae	*Hibbertia aurea*	
Dilleniaceae	*Hibbertia commutata*	
Dilleniaceae	*Hibbertia huegelii*	
Dilleniaceae	*Hibbertia hypercoides*	
Dilleniaceae	*Hibbertia pachyrrhiza*	
Dilleniaceae	*Hibbertia subvaginata*	
Droseraceae	*Drosera erythrorhiza*	
Droseraceae	*Drosera erythrorhiza* subsp. *erythrorhiza*	
Droseraceae	*Drosera gigantea*	
Droseraceae	*Drosera gigantea* subsp. *gigantea*	
Droseraceae	*Drosera macrantha*	
Droseraceae	*Drosera macrantha* subsp. *macrantha*	
Droseraceae	*Drosera menziesii* subsp. *menziessii*	
Droseraceae	*Drosera menziesii* subsp. *penicillaris*	
Droseraceae	*Drosera paleacea* subsp. *paleacea*	
Droseraceae	*Drosera pallida*	
Droseraceae	*Drosera pallidum*	
Droseraceae	*Drosera stolonifera*	
Epacridaceae	*Astroloma pallidum*	
Epacridaceae	*Astroloma stomarrhena*	
Epacridaceae	*Conostephium pendulum*	
Epacridaceae	*Conostephium preissii*	
Epacridaceae	*Lysinema ciliatum*	
Epacridaceae	*Styphelia tenuiflora*	
Euphorbiaceae	*Monotaxis grandiflora*	
Euphorbiaceae	*Phyllanthus calycinus*	
Euphorbiaceae	*Poranthera microphylla*	
Euphorbiaceae	*Stachystemon vermicularis*	
Geraniaceae	*Erodium moschatum*	*
Goodeniaceae	*Dampiera alata*	
Goodeniaceae	*Dampiera linearis*	
Goodeniaceae	*Goodenia caerulea*	
Goodeniaceae	*Goodenia micrantha*	
Goodeniaceae	*Lechnenaultia biloba*	
Goodeniaceae	*Leschenaultia floribunda*	
Goodeniaceae	*Scaevola phlebopetala*	
Goodeniaceae	*Scaevola repens*	
Haemodoraceae	*Anigozanthos humilis* subsp. *humilis*	
Haemodoraceae	*Anigozanthos manglesii*	
Haemodoraceae	*Anigozanthos viridis*	
Haemodoraceae	*Anigozanthos viridis* subsp. *viridis*	
Haemodoraceae	*Conostylis aculeata* subsp. *aculeata*	
Haemodoraceae	*Conostylis juncea*	
Haemodoraceae	*Conostylis serrulata*	
Haemodoraceae	*Conostylis setigera*	
Haemodoraceae	*Conostylis setigera* subsp. *setigera*	
Haemodoraceae	*Conostylis setosa*	
Haemodoraceae	*Haemodorum laxum*	
Haemodoraceae	*Haemodorum spicatum*	
Haemodoraceae	*Phlebocarya ciliata*	

Family	*Species*	Weed
Haemodoraceae	*Tribonanthes brachypetala*	
Halorgaceae	*Gonocarpus pithyoides*	
Iridaceae	*Chasmanthe floribunda*	*
Iridaceae	*Gladiolus caryophyllaceus*	*
Iridaceae	*Moraea flaccida*	*
Iridaceae	*Patersonia babianoides*	
Iridaceae	*Patersonia juncea*	
Iridaceae	*Patersonia occidentalis*	
Iridaceae	*Patersonia pygmaea*	
Iridaceae	*Patersonia rudis* subsp. *rudis*	
Iridaceae	*Romulea rosea*	*
Iridaceae	*Watsonia bulbillifera*	*
Iridaceae	*Watsonia meriana*	*
Juncaceae	*Juncus subsecundus*	
Lauraceae	*Cassytha glabella*	
Lobeliaceae	*Lobelia tenuior*	
Loganiaceae	*Mitrasacme paradoxa*	
Loganiaceae	*Phyllangium paradoxum*	
Loranthaceae	*Nuytsia floribunda*	
Mimosaceae	*Acacia alata*	
Mimosaceae	*Acacia applanata*	
Mimosaceae	*Acacia barbinervis* subsp. *barbinervis*	
Mimosaceae	*Acacia dentifera*	
Mimosaceae	*Acacia lateriticola*	
Mimosaceae	*Acacia nervosa*	
Mimosaceae	*Acacia podalyriifolia*	*
Mimosaceae	*Acacia pulchella*	
Mimosaceae	*Acacia saligna*	
Mimosaceae	*Acacia sessilis*	
Mimosaceae	*Acacia stenoptera*	
Mimosaceae	*Acacia teretifolia*	
Mimosaceae	*Acacia urophylla*	
Myrtaceae	*Agonis linearfolia*	
Myrtaceae	*Astartea fascicularis*	
Myrtaceae	*Baeckea camphorosmae*	
Myrtaceae	*Beaufortia macrostemon*	
Myrtaceae	*Calothamnus lateralis*	
Myrtaceae	*Chaemelaucium uncinatum*	*
Myrtaceae	*Corymbia calophylla*	
Myrtaceae	*Eremaeae pauciflora*	
Myrtaceae	*Eremaeae pauciflora* subsp. *pauciflora*	
Myrtaceae	*Eremeae pauciflora* var. *calyptra*	
Myrtaceae	*Eucalyptus calophylla*	
Myrtaceae	*Eucalyptus lanepoolei*	
Myrtaceae	*Eucalyptus marginata*	
Myrtaceae	*Eucalyptus marginata* subsp. *marginata* (previously *elegantella)*	
Myrtaceae	*Eucalyptus rudis*	
Myrtaceae	*Eucalyptus wandoo*	
Myrtaceae	*Hypocallymma ?cordiflolium*	
Myrtaceae	*Hypocallymma angustifolium*	
Myrtaceae	*Hypocallymma ericifolia* subsp. *ericifolia*	
Myrtaceae	*Hypocalymma robustum*	
Myrtaceae	*Kunzea recurva*	

Family	*Species*	Weed
Myrtaceae	*Leptospermum laevigatum*	*
Myrtaceae	*Melaleuca ?scabra*	
Myrtaceae	*Melaleuca aff. trichophylla*	
Myrtaceae	*Melaleuca incana*	
Myrtaceae	*Melaleuca lateriflora*	
Myrtaceae	*Melaleuca preissiana*	
Myrtaceae	*Melaleuca rhaphiophylla*	
Myrtaceae	*Melaleuca trichophylla*	
Myrtaceae	*Melaleuca viminea* subssp *viminea*	
Myrtaceae	*Pericalymma ellipticum*	
Myrtaceae	*Regilia ciliata*	
Myrtaceae	*Scholtzia paniflora*	
Myrtaceae	*Verticordia acerosa subsp. acerosa*	
Myrtaceae	*Verticordia densiflora*	
Myrtaceae	*Verticordia hueglii var. huegelii*	
Oleaceae	*Olea europea*	*
Orchidaceae	*Caladenia flava subsp. flava*	
Orchidaceae	*Caledenia flava*	
Orchidaceae	*Diuris ?longifolia*	
Orchidaceae	*Elythranthera brunonis*	
Orchidaceae	*Pyrochis nigricans*	
Orchidaceae	*Thelymitra ?crinita*	
Orchideaceae	*Pyrorchis nigricans*	
Orobanchaceae	*Orobanche minor*	*
Oxalidaceae	*Oxalis glabra*	*
Oxalidaceae	*Oxalis pes-caprae*	*
Oxalidaceae	*Oxalis purpurea*	*
Papilionaceae	*Bossiaea eriocarpa*	
Papilionaceae	*Bossiaea ornata*	
Papilionaceae	*Chamaecytisus palmensis*	*
Papilionaceae	*Cytisiss prolifera*	*
Papilionaceae	*Daviesia ?decurrens*	
Papilionaceae	*Daviesia decurrens subsp. decurrens MS*	
Papilionaceae	*Daviesia divaricata*	
Papilionaceae	*Daviesia incrassata*	
Papilionaceae	*Daviesia nudiflora*	
Papilionaceae	*Daviesia physodes*	
Papilionaceae	*Daviesia preissii*	
Papilionaceae	*Daviesia triflora*	
Papilionaceae	*Gastrolobium pauciflorum*	
Papilionaceae	*Gompholobium knightianum*	
Papilionaceae	*Gompholobium marginatum*	
Papilionaceae	*Gompholobium polymorphum*	
Papilionaceae	*Gompholobium tomentosum*	
Papilionaceae	*Hovea chorizemifolia*	
Papilionaceae	*Hovea trisperma*	
Papilionaceae	*Hovea trisperma var. grandiflora*	
Papilionaceae	*Jacksonia restioides*	
Papilionaceae	*Jacksonia sternbergiana*	
Papilionaceae	*Kennedia coccinea*	
Papilionaceae	*Kennedia prostrata*	
Papilionaceae	*Lotus angustissimus*	*
Papilionaceae	*Sphaerolobium medium*	

Family	*Species*	Weed
Papilionaceae	*Trifolium arvense*	*
Papilionaceae	*Trifolium campestre*	*
Papilionaceae	*Trifolium repens var. repens*	*
Papilionaceae	*Trifolium subterraneum*	*
Papilionaceae	*Viminaria juncea*	
Phormiaceae	*Stypandra glauca*	
Pittosporaceae	*Pronaya fraseri*	
Poaceae	*Aira caryophyllea*	*
Poaceae	*Amphipogon debilis*	
Poaceae	*Aristada ramosa*	
Poaceae	*Austrodanthonia occidentalis*	
Poaceae	*Austrodanthonia pilosa*	
Poaceae	*Austrostipa compressa*	
Poaceae	*Austrostipa nitida*	
Poaceae	*Austrostipa semibarbata group (Gibson et al. 1994)*	
Poaceae	*Austrostipa trichophylla*	
Poaceae	*Avena barbata*	*
Poaceae	*Briza maxima*	*
Poaceae	*Briza minor*	*
Poaceae	*Bromus diandrus*	*
Poaceae	*Cynodon dactylon*	*
Poaceae	*Danthonia occidentalis*	
Poaceae	*Ehrharta longiflora*	*
Poaceae	*Eragrostis curvula*	*
Poaceae	*Eragrostis elongata*	
Poaceae	*Eragrostis leptocarpa*	*
Poaceae	*Erharta calycina*	*
Poaceae	*Holcus lanatus*	*
Poaceae	*Lagurus ovatus*	*
Poaceae	*Neurachne alopecuroidea*	
Poaceae	*Neurachne alopecuroidea*	
Poaceae	*Pennisetum clandestinum*	*
Poaceae	*Pentaschistis airoides*	*
Poaceae	*Poa sp.*	
Poaceae	*Stipa campylachne*	
Poaceae	*Stipa compressa*	
Poaceae	*Stipa tenuifolia*	
Poaceae	*Themeda triandra*	
Poaceae	*Vulpia bromoides*	*
Poaceae	*Vulpia myuros var. myuros*	*
Primulaceae	*Anagallis arvensis*	*
Proteaceae	*Adenanthos meisneri*	
Proteaceae	*Astroloma pallidum*	
Proteaceae	*Banksia attenuata*	
Proteaceae	*Banksia grandis*	
Proteaceae	*Banksia menziesii*	
Proteaceae	*Conospermum diffusum*	
Proteaceae	*Conospermum stoechadis*	
Proteaceae	*Conospermum stoechadis subsp. stoechadis*	
Proteaceae	*Cryptandra arbutiflora*	
Proteaceae	*Dryandra armata*	
Proteaceae	*Dryandra armata var.armata*	
Proteaceae	*Dryandra bipinnatifida subsp. multifida*	

Family	*Species*	Weed
Proteaceae	*Dryandra kippistiana*	
Proteaceae	*Dryandra lindleyana*	
Proteaceae	*Dryandra nivea*	
Proteaceae	*Dryandra sessilis*	
Proteaceae	*Dryandra sessilis var. sessilis*	
Proteaceae	*Dryandra squarrosa*	
Proteaceae	*Grevillea bipinnatifida*	
Proteaceae	*Grevillea bipinnatifida subsp. bipinnatifida*	
Proteaceae	*Grevillea pilulifera*	
Proteaceae	*Grevillea vestita*	
Proteaceae	*Grevillea wilsonii*	
Proteaceae	*Hakea auriculata*	
Proteaceae	*Hakea ceratophylla*	
Proteaceae	*Hakea corymbosa*	
Proteaceae	*Hakea cyclocarpa*	
Proteaceae	*Hakea elliptica*	
Proteaceae	*Hakea incrassata*	
Proteaceae	*Hakea lissocarpha*	
Proteaceae	*Hakea prostata*	
Proteaceae	*Hakea ruscifolia*	
Proteaceae	*Hakea spathulata*	
Proteaceae	*Hakea stenocarpa*	
Proteaceae	*Hakea trifurcata*	
Proteaceae	*Hakea undulata*	
Proteaceae	*Hakea varia*	
Proteaceae	*Lambertia multiflora var.darlingensis*	
Proteaceae	*Persoonia comata*	
Proteaceae	*Persoonia elliptica*	
Proteaceae	*Persoonia longifolia*	
Proteaceae	*Petrophile linearis*	
Proteaceae	*Petrophile macrostachya*	
Proteaceae	*Petrophile seminuda*	
Proteaceae	*Petrophile striata*	
Proteaceae	*Stirlingia latifolia*	
Proteaceae	*Stirlingia sp.*	
Proteaceae	*Synaphea gracillima*	
Proteaceae	*Synaphea petiolaris*	
Proteaceae	*Xylomelum occidentale*	
Restionaceae	*Cytogonidium leptocarpoides*	
Restionaceae	*Desmocladus fasciculatus*	
Restionaceae	*Desmocladus flexuosus*	
Restionaceae	*Harperia lateriflora*	
Restionaceae	*Hypolaena exsulca*	
Restionaceae	*Loxocarya fasciculata*	
Restionaceae	*Lyginia barbata*	
Restionaceae	*Meeboldina cana*	
Restionaceae	*Restio sinuosus*	
Rhamnaceae	*Trymalium floribundum*	
Rhamnaceae	*Trymalium floribundum subsp. Trifidum*	
Rubiaceae	*Opercularia vaginata*	
Rutaceae	*Eriostemon spicatus*	
Rutaceae	*Philotheca spicata*	
Scorphulariaceae	*Parentucellia viscosa*	*

Family	*Species*	Weed
Solanaceae	*Solanum nigrum*	*
Stylidiaceae	*Levenhookia pusila*	
Stylidiaceae	*Levenhookia stipitata*	
Stylidiaceae	*Stylidium adpressum*	
Stylidiaceae	*Stylidium breviscapum*	
Stylidiaceae	*Stylidium brunonianum*	
Stylidiaceae	*Stylidium brunonianum subsp. brunonianum*	
Stylidiaceae	*Stylidium bulbiferum*	
Stylidiaceae	*Stylidium carnosum*	
Stylidiaceae	*Stylidium ecorne*	
Stylidiaceae	*Stylidium pilferum subsp. junceum*	
Stylidiaceae	*Stylidium piliferum*	
Stylidiaceae	*Stylidium pycnostachyum*	
Stylidiaceae	*Stylidium repens*	
Thymelaeaceae	*Pimelea suaveolens subsp. suaveolens*	
Thymeleaeceae	*Baeckea camphorosmae*	
Thymeleaeceae	*Pimelea imbricata var piligera*	
Thymeleaeceae	*Pimelea piliferum*	
Tremandraceae	*Tetratheca hirsuta*	
Tremandraceae	*Tetratheca nuda*	
Violaceae	*Hybanthus calycinus*	
Xanthorrhoeaceae	*Xanthorrhoea acanthostachya*	
Xanthorrhoeaceae	*Xanthorrhoea gracilis*	
Xanthorrhoeaceae	*Xanthorrhoea preissii*	
Zamiaceae	*Macrozamia riedlei*	

APPENDIX 3 : Threatened Flora and Fauna Categories of the EPBC & Wildlife Protection Acts

Categories of Threatened Flora and Fauna Species (EPBC Act, 1999)

Conservation Code	Category
Ex	**Extinct** "Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died."
ExW	**Extinct in the Wild** "Taxa which is known only to survive in cultivation, in captivity or as a naturalized population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form."
CE	**Critically Endangered** "Taxa which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria."
E	**Endangered** "Taxa which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as described in accordance with the prescribed criteria."
V	**Vulnerable** "Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria."
CD	**Conservation Dependent** "Taxa which at a particular time if, at that time, the species is the focus of a specific conservation programme, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years."

Categories of Rare and Priority Flora Species (DEC, 2007)

Conservation Code	Category
R	**Declared Rare Flora - Extant Taxa** "Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such."
X	**Declared Rare Flora - Presumed Extinct Taxa** "Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such."
1	**Priority One - Poorly known Taxa** "Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
2	**Priority Two - Poorly Known Taxa** "Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey."
3	**Priority Three - Poorly Known Taxa** "Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey."
4	**Priority Four - Rare Taxa** "Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years."

Note: the need for further survey of poorly known taxa is prioritised into the three categories depending on the perceived urgency for determining the conservation status of those taxa, as indicated by the apparent degree of threat to the taxa based on the current information."

Western Australia Threatened Fauna Categories (DEC, 2007)

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct
Schedule 2	S2	Fauna which is presumed extinct
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia & Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction
Schedule 4	S4	Fauna that is otherwise in need of special protection

APPENDIX 4 : EPBC Act Protected Matters Search

Australian Government
Department of the Environment and Water Resources

Protected Matters Search Tool

16 October 2007 18:17

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

You may wish to print this report for reference before moving to other pages or websites.

The Australian Natural Resources Atlas at http://www.environment.gov.au/atlas may provide further environmental information relevant to your selected area. Information about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

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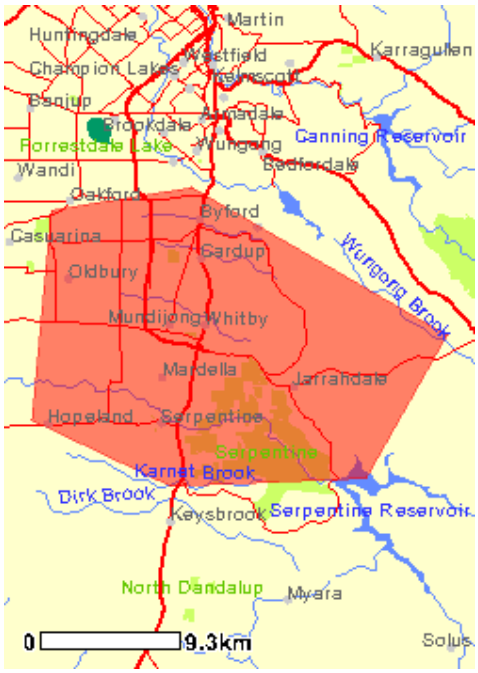

Search Type: Area

Buffer: 0.5 km

Coordinates: -32.20041,116.00234, -32.21624,115.90418, -32.36269,115.89072, -32.40860,115.98730, -32.40306,116.12346, -32.3033,116.17966

Report Contents:

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Significance: **(Ramsar Sites)**	3
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	2
Threatened Species:	13
Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html.

Please note that the current dataset on Commonwealth land is not complete. Further information on Commonwealth land would need to be obtained from relevant sources including Commonwealth agencies, local agencies, and land tenure maps.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of

a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.au/epbc/permits/index.html.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Places on the RNE:	8
Listed Marine Species:	5
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	8
Other Commonwealth Reserves:	None
Regional Forest Agreements:	1

Details

Matters of National Environmental Significance

Wetlands of International Significance [Dataset Information] (Ramsar Sites)	
BECHER POINT WETLANDS	Within same catchment as Ramsar site
FORRESTDALE & THOMSONS LAKES	Within 10 km of Ramsar site
PEEL-YALGORUP SYSTEM	Within same catchment as Ramsar site

Threatened Ecological Communities [Dataset Information]	Status	Type of Presence
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain	Endangered	Community known to occur within area
Corymbia calophylla - Xanthorrhoea preissii woodlands and shrublands of	Endangered	Community known to occur within area

the Swan Coastal Plain

Threatened Species [Dataset Information]	Status	Type of Presence
Birds		
Calyptorhynchus baudinii * Baudin's Black-Cockatoo, Long-billed Black-Cockatoo	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris * Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo	Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii * Chuditch, Western Quoll	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura * Red-tailed Phascogale	Endangered	Species or species habitat may occur within area
Setonix brachyurus * Quokka	Vulnerable	Species or species habitat may occur within area
Plants		
Caladenia huegelii * King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa *	Endangered	Species or species habitat likely to occur within area
Drakaea elastica * Glossy-leaved Hammer-orchid, Praying Virgin	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Hopper & A.P.Brown nom. inval. * Dwarf Hammer-orchid	Vulnerable	Species or species habitat likely to occur within area
Lasiopetalum sp. Serpentine (S.Paust 1103A) WA Herbarium * Wing-fruited Lasiopetalum	Endangered	Species or species habitat likely to occur within area
Lepidosperma rostratum * Beaked Lepidosperma	Endangered	Species or species habitat likely to occur within area
Thelymitra stellata * Star Sun-orchid	Endangered	Species or species habitat likely to occur within area
*Verticordia plumosa var. pleiobotrya** Narrow-petalled Featherflower	Endangered	Species or species habitat likely to occur within area
Migratory Species [Dataset Information]	Status	Type of Presence
Migratory Terrestrial Species		

Birds		
Haliaeetus leucogaster White-bellied Sea-Eagle	Migratory	Species or species habitat likely to occur within area
Merops ornatus * Rainbow Bee-eater	Migratory	Species or species habitat may occur within area
Migratory Wetland Species		
Birds		
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift	Migratory	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Migratory	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Migratory	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Dataset Information]	Status	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift	Listed - overfly marine area	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	Listed - overfly marine area	Species or species habitat may occur within area
Ardea ibis Cattle Egret	Listed - overfly marine area	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	Listed	Species or species habitat likely to occur within area
Merops ornatus *	Listed	Species or species habitat may

Rainbow Bee-eater	- overfly marine area	occur within area

Commonwealth Lands [Dataset Information]

Unknown

Places on the RNE [Dataset Information]
Note that not all Indigenous sites may be listed.

Historic

Lowlands WA

Spencers Cottage WA

Natural

Brickwood Bushland WA

Cardup Bushland WA

Karnet Nature Reserve WA

Lowlands and Riverlea Bushland WA

Reserve 23012 WA

Serpentine National Park WA

Extra Information

State and Territory Reserves [Dataset Information]

Cardup Nature Reserve, WA

Gooralong Conservation Park, WA

Karnet Nature Reserve, WA

Lambkin Nature Reserve, WA

Modong Nature Reserve, WA

Serpentine National Park, WA

Un-named (No. 23012) Nature Reserve, WA

Un-named (No. 46587) Nature Reserve, WA

Regional Forest Agreements [Dataset Information]
Note that all RFA areas including those still under consideration have been included.

South-west WA RFA, Western Australia

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the *Environment Protection and Biodiversity Conservation Act 1999*. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under "type of presence". For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the migratory and marine provisions of the Act have been mapped.

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites;

- seals which have only been mapped for breeding sites near the Australian continent.

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgments

This database has been compiled from a range of data sources. The Department acknowledges the following custodians who have contributed valuable data and advice:

- New South Wales National Parks and Wildlife Service
- Department of Sustainability and Environment, Victoria
- Department of Primary Industries, Water and Environment, Tasmania
- Department of Environment and Heritage, South Australia Planning SA
- Parks and Wildlife Commission of the Northern Territory
- Environmental Protection Agency, Queensland
- Birds Australia
- Australian Bird and Bat Banding Scheme
- Australian National Wildlife Collection
- Natural history museums of Australia
- Queensland Herbarium
- National Herbarium of NSW
- Royal Botanic Gardens and National Herbarium of Victoria
- Tasmanian Herbarium
- State Herbarium of South Australia
- Northern Territory Herbarium
- Western Australian Herbarium
- Australian National Herbarium, Atherton and Canberra
- University of New England
- Other groups and individuals

ANUCliM Version 1.8, Centre for Resource and Environmental Studies, Australian National University was used extensively for the production of draft maps of species distribution. Environment Australia is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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Telephone: +61 (0)2 6274 1111

APPENDIX 5 : DEC Searches for DRF, Priority Flora and TECs

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
DECLARED RARE AND PRIORITY FLORA LIST
21 December 2006

SPECIES / TAXON	CONS CODE	CALM REGION	DISTRIBUTION	FLOWER PERIOD
Acacia lasiocarpa var. bracteolata long peduncle variant (GJ Keighery 5026)	1	SW	North Dandalup, Mundijong, Gosnells, Jandakot	My,Aug
Aotus cordifolia	3	SR,SW	Red Hill, Byford, Witchcliffe, Upper Swan, Dwellingup, Helena Valley, Forrestdale, Dunsborough, Jarrahdale, Banjup	Aug-Dec
Centrolepis caespitosa	4	SC,SW,WB	South Stirling, Pearce, Meckering, (Byford), Youngs Siding, Narrikup, Orange Grove	Nov
Johnsonia pubescens subsp. cygnorum	2	SW	Serpentine, Cardup, Lowlands	Sep-Nov
Schoenus pennisetis	1	SW,WB	Cannington, Byford, Kenwick, Wongan Hills	Aug-Dec
Synaphea odocoileops	1	SW,SR	Serpentine, Elgin, Byford, Wagerup	Aug-Oct
Synaphea sp. Pinjarra plain (AS George 17182)	1	SW	Mundijong	Oct
Tetraria australiensis	R	SW,SR	Mundijong, Busselton, (Cannington, Serpentine River)	Dec
Verticordia plumosa var. pleiobotrya	R	SW	Mundijong West Road, Bullsbrook NR	Nov

Total No. of Records = 18

Species Name	Cons. Code	Status	Pop ID	No. Plants	Latitude	Longitude	Purpose	Vest
Anthotium junciforme	4		4	44	32^17'54.6"	115^57'11.4"	Road Verge	SHI
			5	299	32^17'43.6"	115^57'02.4"	Road Verge	SHI
Baeckea sp. Perth Region (R.J. Cranfield 444)	3		2		32^14'55.6"	115^57'05.4"	Road Verge	SHI
			4		32^17'49.6"	115^57'54.4"	Road Verge	SHI
Drakaea elastica	R		22	0	32^16'02.6"	116^00'40.4"		PRI
Johnsonia pubescens subsp. cygnorum	2		1		32^14'38.0"	115^59'20.0"	Conservation Of Flora & Fauna	CC
Millotia tenuifolia var. laevis	2		2		32^16'48.0"	116^02'11.9"		UNK
Pithocarpa corymbulosa	2		8		32^17'39.9"	116^01'56.8"	Unknown	UNK
Tetraria australiensis	R		1	1000	32^18'07.6"	116^00'13.4"	Conservation Of Flora & Fauna	CC
			5A	100	32^16'07.6"	116^00'55.4"		PRI
			5B	100	32^15'40.6"	116^00'55.4"		PRI
			8		32^17'56.6"	115^58'54.4"	Unknown	UNK
			10	50	32^17'52.5"	115^58'12.5"	Road Verge	SHI
Verticordia plumosa var. pleiobotrya	R		1	0	32^18'16.6"	115^57'12.4"	Road Verge	SHI
			2	326	32^17'47.6"	115^58'02.4"	Road Verge	SHI
			3	0	32^18'45.6"	115^57'12.4"	Road Verge	SHI
			7A	30	32^14'55.6"	115^57'15.4"	Drain	SHI
			7B	30	32^14'55.6"	115^57'15.4"		PRI

WAHERB SPECIMEN DATABASE GENERAL ENQUIRY

Anthotium junciforme
(de Vriese) D.A.Morrison (Goodeniaceae)
CONSERVATION STATUS:P4
Coll.: A. Kelly & A. Spooner 90/124 Date: 04 12 1990 (PERTH 02391996)
LOCALITY SE side of Mundijong Road, Kargotich Road junction, Mundijong, population extends E along road reserve for 50 metres WA
LAT 32 Deg 17 Min 59.000 Sec S LONG 115 Deg 57 Min 6.000 Sec E
Perennial herb with flowers deep purple to light mauve. Brown sandy clay, drainage line.
In mixed low heath D over Leptocarpus canus low sedges and grasses.

Anthotium junciforme
(de Vriese) D.A.Morrison (Goodeniaceae)
CONSERVATION STATUS:P4
Coll.: A. Kelly & A. Spooner 90/123 Date: 04 12 1990 (PERTH 02392011)
LOCALITY 200 metres W of Kargotich Road on Mundijong Road, Peel Estate, S side of road WA
LAT 32 Deg 17 Min 48.000 Sec S LONG 115 Deg 56 Min 57.000 Sec E
Glabrous perennial herb. Leaves linear to terete. Flowers deep purple. Brown clay, drainage line and low lying flat.
Melaleuca lateritica low heath C/heath B and Leptocarpus sp. low sedges.
Abundance: 300+ plants.

Baeckea sp. Perth Region (R.J. Cranfield 444) PN (Myrtaceae)
CONSERVATION STATUS:P3
Coll.: R.J. Cranfield 1679 Date: 23 03 1981 (PERTH 03377962)
LOCALITY Abernethy Road, Oakford WA
LAT 32 Deg 15 Min Sec S LONG 115 Deg 57 Min Sec E
Erect open shrub, 40 cm high. Flowers white and pink centres. Dry summer swamp. Sandy white clay soil.
Heath type vegetation.
Previous det.: Baeckea tenuifolia (Turcz.)Domin

Diuris purdiei
Diels (Orchidaceae)
CONSERVATION STATUS:R
Coll.: C. Andrews s.n. Date: 09 1903 (PERTH 1096478)
LOCALITY Mundijong. WA
LAT 32 Deg 18 Min Sec S LONG 115 Deg 59 Min Sec E
Sand.
Previous det.: Diuris laevis

Johnsonia pubescens
subsp. cygnorum Keighery (Anthericaceae)
CONSERVATION STATUS:P2
Coll.: C.A. Gardner 2014 Date: 09 10 1923 (PERTH 01969625)
LOCALITY Whitby Falls near Mundijong, WA
LAT 32 Deg 17 Min 48.000 Sec S LONG 115 Deg 58 Min 54.000 Sec E
Previous det.: Johnsonia pubescens Lindl.

Johnsonia pubescens
subsp. cygnorum Keighery (Anthericaceae)
CONSERVATION STATUS:P2
Coll.: R.H. Underwood 49/88 Date: 21 09 1988 (PERTH 01969528)
LOCALITY Cardup Nature Reserve WA
LAT 32 Deg 14 Min 48.000 Sec S LONG 115 Deg 59 Min 42.000 Sec E
Dwarf, caespitose shrub 15 cm tall, flowers green-white. Yellow sand. In open low woodland A with Jarrah and Banksia.
Previous det.: Johnsonia pubescens Lindl.

Millotia tenuifolia
var. laevis P.S.Short (Asteraceae)
CONSERVATION STATUS:P2
Coll.: C. Hancock 25 Date: 18 10 2005 (PERTH 07414803)
LOCALITY WA Bluemetal Quarry Survey Area, Serpentine WA
LAT 32 Deg 16 Min 48.000 Sec S LONG 116 Deg 2 Min 11.900 Sec E
Herb. Slope. Sand-gravel-laterite.
Dryandra lindleya, Hypocalymma angustifolia, Trichocline spathulata, Gompholobium knightianum.

Millotia tenuifolia
var. laevis P.S.Short (Asteraceae)
CONSERVATION STATUS:P2
Coll.: L. Dalgliesh 599 Date: 18 10 2005 (PERTH 07414811)
LOCALITY WA Bluemetal Quarry Survey Area, Serpentine WA
LAT 32 Deg 16 Min 22.800 Sec S LONG 116 Deg 2 Min 27.600 Sec E
Herb. Outcrop. Sand, gravel.
Lomandra hermaphrodita, Stylidium piliferum, Macrozamia riedlei, Platysace compressa, Tetraria capillaris.

Pithocarpa corymbulosa
Lindl. (Asteraceae)
CONSERVATION STATUS:P2
Coll.: C. Hancock 54 Date: 20 10 2005 (PERTH 07414854)

LOCALITY WA Bluemetal Quarry Survey area, Serpentine WA
LAT 32 Deg 17 Min 39.900 Sec S LONG 116 Deg 1 Min 56.800 Sec E
Herb. Slope. Sand-loam-gravel-laterite. Eucalyptus marginata, Corymbia calophylla, Baeckea camphorosmae, Conostylis setosa.

Synaphea sp. Pinjarra Plain (A.S. George 17182)
PN (Proteaceae)
CONSERVATION STATUS:P1
Coll.: A.S. George 17182 Date: 25 10 1993 (PERTH 05125820)
LOCALITY Just N of Mundijong, in Paterson Road, WA
LAT 32 Deg 17 Min Sec S LONG 115 Deg 59 Min Sec E
Stems clumped, flowers mid-yellow. In sandy loam. In Jarrah - Marri woodland on road verges.
Previous det.: Synaphea sp.

Synaphea sp. Pinjarra Plain (A.S. George 17182)
PN (Proteaceae)
CONSERVATION STATUS:P1
Coll.: R. Butcher RB 814 Date: 26 10 1999 (PERTH 07463693)
LOCALITY Mundijong Road, 2 km W of South West Highway WA
LAT 32 Deg 17 Min Sec S LONG 115 Deg 58 Min Sec E
Shrub 80 cm x 1 m. Flowers opening narrowly. Stigma transversely lunate.
Inflorescence greatly exceeding leaves. Leaves with oblanceolate ultimate lobes.
Seasonally wet area. Brown loam. Shrubland. Sedges, grasses, Xanthorrhoea, Allocasuarina, Jacksonia, Calothamnus.
Frequency:infrequent, 5 plants seen.

Synaphea sp. Pinjarra Plain (A.S. George 17182)
PN (Proteaceae)
CONSERVATION STATUS:P1
Coll.: R. Butcher RB 1117 Date: 29 10 2003 (PERTH 07463723)
LOCALITY 4.65 km S of Abernathy Road rail crossing on Soldiers Road, S of Cardup siding WA
LAT 32 Deg 15 Min 46.000 Sec S LONG 115 Deg 59 Min 42.000 Sec E
Clumped sub-shrub. Inflorescences greatly exceeding leaves; mid to late
flowering stage with numerous fruits on plant. Flowers dorsiventrally compressed; stigma lunate. Thinner leaf lobes than RB 1116.
Brown, moist clay loam. Area between road and rail. Shrubland with Xanthorrhoea preissii, Kingia australis, Dryandra nivea, Conospermum huegelii, Synaphea petiolaris, Mesomelaena tetragona, Gompholobium marginatum, Conostylis, Laxmannia, Drosera, Restionaceae spp. and weeds -
Aira cupaniana, Ursinia anthemoides, Briza maxima, B. minor, Ehrharta calycina. No overstorey at this collection site.
Frequency:infrequent.

Synaphea sp. Pinjarra Plain (A.S. George 17182)
PN (Proteaceae)
CONSERVATION STATUS:P1
Coll.: R. Butcher RB 1077 Date: 18 10 2003 (PERTH 07463758)
LOCALITY 2.1 km W of rail crossing at Mundijong on Mundijong Road; W of Mundijong WA
LAT 32 Deg 17 Min 48.000 Sec S LONG 115 Deg 57 Min 42.000 Sec E
Large leaves with oblanceolate ultimate lobes. Flowers glabrous, dorsiventrally compressed.
Flora Road reserve. Moist brown clay loam. Open Hakea and Melaleuca shrubland on edge of Corymbia calophylla remnant
woodland. Associated species: Synaphea petiolaris (RB 1075), S. sp. Serpentine (G.R. Brand 103) (RB 1076), 3 x Verticordia spp., Pimelea, Xanthorrhoea
preissii, Kingia australis, Calothamnus, Thysanotus, Acacia, Conostylis, Dillwynia, Restionaceae spp. and Neurachne alopecuroidea.
Frequency:scattered.

Synaphea sp. Pinjarra Plain (A.S. George 17182)
PN (Proteaceae)
CONSERVATION STATUS:P1
Coll.: R. Butcher RB 1116 Date: 29 10 2003 (PERTH 07463871)
LOCALITY 4.65 km S of Abernathy Road rail crossing on Soldiers Road, S of Cardup siding WA
LAT 32 Deg 15 Min 41.600 Sec S LONG 115 Deg 59 Min 47.400 Sec E
Clumped sub-shrub. Leaves variable in length across population but ultimate
lobes always oblanceolate. Leaves frequently folded. Inflorescences greatly
exceeding leaves. Flowers dorsiventrally compressed. Fruits coarse, no well defined neck.
Brown, moist clay loam. Area between road and rail. Shrubland with Xanthorrhoea preissii, Kingia australis, Dryandra nivea,

Conospermum huegelii, Synaphea petiolaris, Mesomelaena tetragona, Gompholobium marginatum, Conostylis, Laxmannia, Drosera, Restionaceae spp. and weeds -
Aira cupaniana, Ursinia anthemoides, Briza maxima, B. minor, Ehrharta calycina. No overstorey at this collection site.
Frequency:infrequent.

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: P. Brown & B. Keighery s.n. Date: 03 12 2001 (PERTH 05899133)
LOCALITY Mundijong Road, Mundijong, 150-250 m E of Webb Road on the southern side of Mundijong Road within flora/road reserve, Serpentine/Jarrahdale Shire, WA
LAT 32 Deg 17 Min Sec S LONG 115 Deg 58 Min Sec E
Leaves hairy at base. No prominent midrib. No enlargement at base leaves.
Low plain. Moist sand-loam. New highway extension. Marri/Kingias TEC 3a.
Condition of population: moderate.
Previous det.: Tetraria australiensis C.B.Clarke
Frequency:50+ plants.

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: G.J. Keighery 12792 Date: 04 01 1993 (PERTH 04164911)
LOCALITY 2 km E of Mundijong WA
LAT 32 Deg 18 Min Sec S LONG 115 Deg 57 Min Sec E
Rhizamatous perennial herb, to 70 cm. In early seed. Winter wet flats. Grey sand over clay.
Sedgeland and edging Marri woodland.
Abundant in area burnt ca 2 years before.

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: G.J. Keighery 14376 Date: 23 06 1996 (PERTH 05039274)
LOCALITY Mundijong townsite, beside Mundijong Road by tennis courts WA
LAT 32 Deg 17 Min 48.000 Sec S LONG 115 Deg 58 Min 54.000 Sec E
Rhizomatous perennial herb 50-70 cm high, 30-40 cm wide. Gentle slope, winter damp, brown clayey sand.
Eucalyptus calophylla woodland over sedges.
Flowered last summer.
Frequency:locally common in burnt woodland.

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: B.J. Keighery 2197 Date: 01 11 1995 (PERTH 06427669)
LOCALITY Private property in Norman Road Bushland (Bush Forever Site 354) South Western Highway, Whitby/Cardup, in System 6 Update quadrat norm02 WA
LAT 32 Deg 16 Min 12.200 Sec S LONG 116 Deg 0 Min 46.400 Sec E
Tufted perennial herb. Dune Ridge, gentle slope, W aspect, dark brown clayey sand over orange clayey sand, well drained.
Associated species: Eucalyptus marginata.
Previous det.: Tetraria australiensis C.B.Clarke

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: B.J. Keighery 2385 Date: 20 02 1996 (PERTH 06513328)
LOCALITY Watkins Road Reserve on N boundary between fire break and fence line. Watkins Road E of Mundijong (Bush Forever Site 360)
WA
LAT 32 Deg 18 Min 9.600 Sec S LONG 116 Deg 0 Min 5.400 Sec E
Erect sedge to 1.2 m by 0.6 m. Low dune, white and grey sand.
Scattered Eucalyptus calophylla over Banksia menziesii and Banksia attenuata Low Woodland over Tetraria australiensis Tall Sedges.
Previous det.: Tetraria australiensis C.B.Clarke
Frequency:plants abundant, principal component of understorey. Fire probably '94/'95 summer. All plants flowering in '96 summer, remains flower heads present.

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: B.J. Keighery 2365 a Date: 20 02 1996 (PERTH 06532888)
LOCALITY Private property adjacent to N boundary of Watkins Road Reserve, Mundijong (Bush Forever Site 360) WA
LAT 32 Deg 18 Min 5.600 Sec S LONG 116 Deg 0 Min 5.400 Sec E
Erect sedge to 1 m by 0.5 m. Low sand dune above a sumpland with exposed ironstone, grey sand.
Scattered Marri over Banksia menziesii and Banksia attenuata Low Woodland.
Grazed, reduced in understorey div & dens, inv by grasses, adj

wetland excavated, fire ?'94/'95 summer, all plants flowering in '96 summer.
Previous det.: Tetraria australiensis C.B.Clarke

Tetraria australiensis
C.B.Clarke (Cyperaceae)
CONSERVATION STATUS:R
Coll.: B.J. Keighery 2384 Date: 26 02 1996 (PERTH 06532993)
LOCALITY Watkins Road Reserve (on the low sandy rise to the NW of the original population), Mundijong (Bush Forever Site 360) WA
LAT 32 Deg 18 Min 5.600 Sec S LONG 116 Deg 0 Min 5.400 Sec E
Erect tufted sedge to 0.4 m by 0.1 m, leaves brown in overlapping section at base, young leaves and lower green sections of the leaves pubescent, base plant fan shaped compared to T. octandra which is 'bulbous'. Dune flat, grey sand over sandy clay.
Mixed Low Heath D over Open Herbs and Low Sedges.a attenuata Low Woodland.
Previous det.: Tetraria australiensis C.B.Clarke
Frequency:common but difficult to locate when not flowering.

Verticordia lindleyi
Schauer subsp. lindleyi (Myrtaceae)
CONSERVATION STATUS:P4
Coll.: R.J. Cranfield 1680 Date: 23 03 1981 (PERTH 1057251)
LOCALITY Abernethy Road, Oakford WA
LAT 32 Deg 15 Min Sec S LONG 115 Deg 57 Min Sec E
Compact erect shrub, 36 cm high, flowers pink. Dry summer swamp. Sandy white clay soil. Heath type.
Previous det.: Verticordia lindleyi Schau.

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: B.J. Keighery & N. Gibson 989 Date: 25 10 1992 (PERTH 04521099)
LOCALITY Roadside remnant Mundijong Rd, 2 km W of Mundijong (plot mud-9). WA
LAT 32 Deg 17 Min 47.600 Sec S LONG 115 Deg 57 Min 41.400 Sec E
Erect shrub 0.8m. Soil: Orange brown clay. Topography/drainage: Seasonally wet poorly drained flat. Geomorphology: Guildford formation (pinjarra plain). Vegetation: Melalueca uncinata Open Scrub over Verticordia plumosa Dwarf Scrub D over mixed Open Herbs over Leptocarpus canus, Chorizandra enodes Open Low Sedges.
Previous det.: Verticordia plumosa (Desf.)Druce

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: R. Davis 4465 Date: 06 11 1997 (PERTH 04931122)
LOCALITY Kargotich Road, 4.9 km S of Thomas Road WA
LAT 32 Deg 15 Min 1.600 Sec S LONG 115 Deg 57 Min 11.400 Sec E
Erect, compact shrub 60 cm high x 60 cm wide. Flowers pink. Littered, brown clayey sand. Roadside vegetation.
Abundance: occasional.
Previous det.: Verticordia plumosa var. brachyphylla (Diels)A.S.George

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: A.S. George & E.A. George ASG 16926 Date: 27 12 1988 (PERTH 1894242)
LOCALITY Kargotich Road, S of Randell Road, SW of Mundijong WA
LAT 32 Deg 19 Min Sec S LONG 115 Deg 57 Min Sec E
Much-branched shrub; flowers pink. In clay on road verge.

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: I. Morcombe s.n. Date: 13 11 1988 (PERTH 01894382)
LOCALITY Rockingham Road, Mundijong (near junction with Kargotich Road) WA
LAT 32 Deg 17 Min 48.000 Sec S LONG 115 Deg 58 Min 54.000 Sec E
Shrub 35-50 cm tall. In sand/clay. With Marri, Jacksonia, Kingia and Xanthorrhoea.

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: G.J. Keighery 13342 Date: 04 11 1992 (PERTH 04363698)
LOCALITY Mundijong Road; W of Mundijong WA
LAT 32 Deg 17 Min 54.000 Sec S LONG 115 Deg 57 Min 48.000 Sec E
Slender erect shrub to 60 cm. Flowers pink-purple, in full flower. Brown clay loam over laterite.

Calothamnus hirsutus/Verticordia low heath.
Abundance: locally common.
Previous det.: Verticordia plumosa var. pleiobotrya A.S.George

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: A.S. George & E.A. George ASG 16903
Date: 07 11 1986 (PERTH 1883577)
LOCALITY Mundijong road, 0.9 km E of Kargotich road, W of Mundijong WA
LAT 32 Deg 18 Min Sec S LONG 115 Deg 58 Min Sec E
Shrub to 40 cm, 1 stem at base, much branched above, leaves pale green, flowers pink.
Clay flat. Low heath.

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: G.R. Brand GRB 119 Date: 25 11 1998 (PERTH 05290384)
LOCALITY Between Kargotich (800 m E of) and Webb roads on Mundijong Road, WA
LAT 32 Deg 18 Min Sec S LONG 115 Deg 57 Min Sec E
Erect, open shrub 300 mm high x 200 mm wide. Small pale pink flowers. Open branching, light foliage.
Flat, damp - winter wet. Yellow sandy clay. Pinjarra Plain. Shrubland, Verticordia sp., Viminaria juncea.
Frequency:occasional.

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
Coll.: G.R. Brand 142 Date: 30 11 1999 (PERTH 05580188)
LOCALITY kargoyich road, 200 m N of Gossage Road, Mundijong, WA
LAT 32 Deg 15 Min Sec S LONG 115 Deg 57 Min 10.000 Sec E
Erect, compact shrub 500 mm high x 500 mm wide. Pink flowers in clusters along stems. Fine, short leaves in groups along stems.
Flat, roadside. Litter, brown sandy clay. Pinjarra plain. Roadside vegetation. Acacia.
Frequency:small patch of several plants.

Verticordia plumosa
var. pleiobotrya A.S.George (Myrtaceae)
CONSERVATION STATUS:R
TYPE STATUS: HOL
Coll.: A.S. George & E.A. George ASG 16902
Date: 07 11 1986 (PERTH 1886851)
LOCALITY Kargotich Road, 0.8 km S of Mundijong Road, W of Mundijong WA
LAT 32 Deg 18 Min Sec S LONG 115 Deg 57 Min Sec E
Shrub to 1 m with several robust stems, much-branched; flowers pink, scented. On sandy loam flat on road verge.
Among scrub.
Previous det.: Verticordia plumosa var. pleiobotrya A.S. George

15. SCP02 Southern wet shrublands, Swan Coastal Plain
Has the community been endorsed by the Minister for Yes
Current Category: Endangered

Occ.	Buffer	Site ID	Datum	Longitude	Latitude
27.	500	WATKINS PLOT2	GDA94	115° 59' 53"	-32° 17' 57"
		WATKINS03	GDA94	115° 59' 55"	-32° 17' 56"

16. SCP3a Eucalyptus calophylla - Kingia australis woodlands on heavy soils, Swan Coastal Plain
Has the community been endorsed by the Minister for Yes
Current Category: Critically Endangered

Occ.	Buffer	Site ID	Datum	Longitude	Latitude
11.	500	MYROMAN03	GDA94	115° 59' 18"	-32° 17' 49"

17. SCP3c Eucalyptus calophylla - Xanthorrhoea preissii woodlands and shrublands, Swan Coastal Plain
Has the community been endorsed by the Minister for Yes
Current Category: Critically Endangered

Occ.	Buffer	Site ID	Datum	Longitude	Latitude
8.	500	MYROMAN02	GDA94	115° 59' 19"	-32° 17' 47"

20. SCP20b Banksia attenuata and/or Eucalyptus marginata woodlands of the eastern side of the Swan Coastal Plain
Has the community been endorsed by the Minister for Yes
Current Category: Endangered

Occ.	Buffer	Site ID	Datum	Longitude	Latitude
7.	500	MYROMAN01	GDA94	115° 59' 19"	-32° 17' 40"
8.	500	MYBYFORD05	GDA94	115° 59' 18"	-32° 17' 24"
9.	500	MYBYFORD06	GDA94	115° 59' 26"	-32° 16' 50"
10.	500	MYBYFORD07	GDA94	115° 59' 34"	-32° 16' 17"
11.	500	BELLA01	GDA94	115° 59' 20"	-32° 16' 60"
19.	750	norm01	GDA94	116° 0' 50"	-32° 16' 11"
		norm03	GDA94	116° 0' 50"	-32° 16' 7"
		norm07	GDA94	116° 0' 33"	-32° 15' 52"
25.	500	WATKINS PLOT1	GDA94	116° 0' 25"	-32° 18' 10"
		WATKINS01	GDA94	116° 0' 26"	-32° 18' 5"

26.	500	**Site ID**	**Datum**	**Longitude**	**Latitude**
		WATKINS02	GDA94	116° 0' 7"	-32° 17' 59"

23. SCP3b Eucalyptus calophylla - Eucalyptus marginata woodlands on sandy clay soils of the southern Swan Coastal Plain

Has the community been endorsed by the Minister for Yes

Current Category: Vulnerable

Occ.	**Buffer**				
13.	500	**Site ID**	**Datum**	**Longitude**	**Latitude**
		MYBYFORD09	GDA94	115° 59' 44"	-32° 15' 42"
14.	500	**Site ID**	**Datum**	**Longitude**	**Latitude**
		MYBYFORD10	GDA94	115° 59' 50"	-32° 15' 22"
22.	500	**Site ID**	**Datum**	**Longitude**	**Latitude**
		norm04	GDA94	115° 59' 46"	-32° 15' 53"
		norm05	GDA94	116° 0' 13"	-32° 15' 44"
		norm06	GDA94	116° 0' 14"	-32° 15' 44"

APPENDIX 6 : TEC Categories

Categories of Threatened Ecological Communities (EPBC Act, 1999)

Conservation Code	Category
CE	**Critically Endangered** If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
E	**Endangered** If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
V	**Vulnerable** If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Categories of Threatened Ecological Communities (DEC, 2007)

Conservation Code	Category
PD	**Presumable Totally Destroyed** An ecological community that has been adequately searched for which no representative occurrences have been located
CE	**Critically Endangered** An ecological community that has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future
E	**Endangered** An ecological community that has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future
V	**Vulnerable** An ecological community that has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future.

APPENDIX 7 : Declared Plants

Paterson's curse (*Echium plantagineum*)

Category: P1

Location: for the whole of the State

Category: P3

Location: Serpentine-Jarrahdale (S)

Description

Family: Boraginaceae

Form: Herbaceous – Annual or biennial

Status: Present in WA

An erect annual (occasionally biennial) herb to 1.5 m high, commonly 30-60 cm, reproducing by seed. Native to southern Europe. Widespread throughout the south-west of Western Australia, and the eastern Goldfields.

Stems: One to several stems arise from base, much branched and covered with stiff white hairs.

Leaves: Alternate, bristly. Rosette leaves to 25 cm long, oval to oblong, stalked and with distinct lateral veins. Stem leaves are smaller and narrower, not stalked and almost clasping the stem.

Flowers: Purple, rarely pink or white, crowded along one side of a curved spike. Five petals joined in a curved trumpet shape, 2-3 cm long. Five stamens, two of which are longer than the others and extend beyond the petals.

Fruit: A group of four nutlets surrounded by a stiffly bristled calyx.

Seeds: Brown to grey, 2-3 mm long, three sided strongly wrinkled and pitted.

Recommended herbicides*

In cereals

- Chlorsulfuron
- Metsulfuron methyl
- Logran®
- Tigrex
- Broadstrike
- Jaguar
- Bromoxynil + MCPA

In Pasture

- Up to 4 leaf stage
  - Jaguar®
  - Tigrex®
  - Broadstrike®
  - Bromoxynil + MCPA
- At early flowering – seed set control
  - Chlorsulfuron
  - Metsulfuron methyl
  - Logran®
  - Glyphosate + 2,4-D ester

*Refer to DAF website for details of application timing and concentrations (www.agric.wa.gov.au)

Cotton bush (*Gomphocarpus fruticosus*)

Category: P4

Location: Serpentine-Jarrahdale (S)

Description

Family: Asclepiadaceae

Form: Shrub – Perennial

Status: Present in WA

An erect slender shrub 1-2 metres high, with narrow opposite leaves, and bladder-like fruit. All parts of the plant exude a milky white sap when damaged. It reproduces by seed and suckers.

Stems: Pale green, 60-180 cm covered with short whitish downy hairs when young.

Leaves: Dull green, occasionally with shiny upper surface. They are 5-12 cm long, 6-18 mm wide tapering to a point and are opposite each other in pairs.

Flowers: White or creamy with 5 fringed waxy lobes turned sharply outwards. They are formed in a loose drooping cluster of 3-10 flowers in the leaf axils.

Fruit: Inflated pod, egg shaped, tapering to a point, inflated pod 6 cm long, 2-2.5 cm wide covered with long soft bristles (1 cm long). Attached to the plant by an 'S' shaped stalk.

Seeds: Contained within a thin walled sack that is separated from the outer wall by an air space. Brown coloured, flattened and egg shaped about 6 mm long and 3 mm wide with a tuft of silky hairs about 3 cm long at one end

Recommended herbicides*

When actively growing - spring to December

- Glyphosate
- Triclopyr

*Refer to DAF website for details of application timing and concentrations (www.agric.wa.gov.au)

Cape Tulip, one leaf; two leaf Cape tulip (*Moraea flaccida, Moraea miniata*)

Category: P1

Location: for the whole of the State

Category: P4

Location: Serpentine-Jarrahdale

Description

Family: Iridaceae

Form: Herbaceous – Perennial

Status: Present in WA

One leaf Cape tulip (*Moraea flaccida,* syn. *Homeria flaccida*) is a native of South Africa. Perennial herb to 70 cm high, distinguished by fibrous-sheathed corm at the base of the plant, orange to salmon pink flowers that are yellow in the centre; single leaves and presence of seeds in capsules. Corms 1–4 cm wide, developing new corms each year. Spread by seed and movement of corms. Often in hay cut from infested paddocks.

Leaves: Leaf folded, ribbed, linear, to 1 m long, extended and drooping above the flowers.

Flowers: Borne on branched stems. Flowers with 6 petal-like perianth segments, each 2.6–4 cm long, not joined to each other; yellow forms have been found in WA. Flowers in spring when 2 or 3 years old.

Seeds: Angular red brown seeds, about 2 mm long, in narrow-cylindrical capsules 2.5–5 cm long, splitting from the apex into 3 parts.

Originally introduced as a garden plant in the 19th century. Seeds germinate in autumn and plants regrow from corms at the same time. Poisonous to stock but generally avoided by them. Young stock may be affected if there is no alternative grazing available. One-Leaf Cape Tulip is a serious pasture weed in WA, SA and Vic.

Two leaf Cape tulip *(Moraea miniata* syn*. Homeria miniata)* is a perennial herb to 60 cm high, native to South Africa. Confused with One-Leaf Cape Tulip, *Moraea flaccida*, which produces seed and has a single basal leaf. Distinguished by scaly covering around corm at the base of the plant, leaves 2 or 3;

Leaves: Folded, ribbed, linear, to 80 cm long.

Flowers: Pink–salmon coloured flowers with a green dotted yellow centre on branched stems. Flowers with 6 petal-like perianth segments, segments 1.3–2.5 cm long, not joined together. Flowers late winter and spring when 2 or 3 years old. Does not produce seeds, but does form a capsule to 1.5 cm long, spliting from the apex into 3 parts.

Corms: Corms 1–2.5 cm wide, developing new corms each year. Plants produce clusters of cormils in the swollen leaf axils and often small corms (cormils) around the parent corm. Grows from corms and cormils in autumn

Spread by movement of corms and cormils caught in farm machinery and in agricultural produce. Poisonous to stock but generally avoided by them. Cormil production may exceed many thousands per square metre, and may remain viable in the

soil for many years. Less common than One-Leaf Cape Tulip, the 2 species may grow together.

Recommended herbicides*

(1 leaf) August-September, (2 leaf) July-end August:

- 2,4-D ester (cereals and pasture)
- 2,4-D amine (cereals and pasture)
- 4-DB (cereals and pasture)
- Gramoxone (blanket wiper)

Full emergence to early August

- 2,2-DPA

Wheat pre-sowing or post-emergence. Barley and oats post-emergence only

- Chlorsulfuron

Wheat - 10 days presowing. Barley post-emergence

- Metsulfuron

At point of corm exhaustion (pasture)

- Spinnaker® (for two leaf only)

*Refer to DAF website for details of application timing and concentrations (www.agric.wa.gov.au)

Arum lily (*Zantedeschia aethiopica*)

Category: P1

Location: for the whole of the State

Category: P4

Location: for the whole of the State

Description


Arum lily flower

Family: Araceae

Form : Herbaceous – Perennial

Status: Present in WA

Arum lily is a robust, dark green, succulent herb, sometimes also known as Calla or White arum lily. It was introduced to WA from South Africa as a garden plant and subsequently escaped to become established as a weed. It is found in creeks, irrigation ditches and areas of summer-moist land in the higher rainfall south west of Western Australia, often creating large dense patches or chumps.

Arum lily competes with valuable perennial pasture plants on summer land. It has been suspected of causing eczema in humans. Stock deaths have occurred from grazing arum lily.

Arum lily has fleshy roots and forms extensive tubers. The roots when boiled provide a starchy food for some South African tribes; however, they are poisonous when eaten raw.

Arum lily spreads vegetatively by regeneration from tuber fragments and by seeds.

Leaves: The petioles (leaf stalks) are up to 0.4 m long and smooth; the leaf blades are thick and fleshy, pointed at the apex with blunt lobes at the base.

Flowers: White to greenish white and tubular flowers, becoming funnel shaped at the top with a slit down one side. Flowering takes place in spring.

Fruit: The berry is oval, yellowish, about 1 cm in diameter and contains several round seeds about 3 mm in diameter.

Recommended herbicides*

- Chlorsulfuron
- Metsulfuron
- 2,4-D amine
- Gramoxone

*Refer to DAF website for details of application timing and concentrations (www.agric.wa.gov.au)

P1 REQUIREMENTS Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P3 REQUIREMENTS Aims to control infestation by reducing area and/or density of infestation	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infestation • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Of the remaining infested area:- Where plant density is 1-10 per hectare treat 100% of infestation. Where plant density is 11-100 per hectare treat 50% of infestation. Where plant density is 101-1000 per hectare treat 10% of infestation. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
P4 REQUIREMENTS Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- • within 100 metres inside of the boundaries of the infested property • within 50 metres of roads and highwater mark on waterways • within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas .

APPENDIX 8 : Weed Management Media Statement

Media Statements

Last 7 Days

Major Statements

Ministers

Previous Ministers

Special Interests

Regions

Search

Register for Notification Service

Government of Western Australia
Media Statement

David Templeman MLA
Minister for the Environment; Climate Change; Peel

Notification Service

Statements Home Page

Statement Released: 18-Dec-2007
Portfolio: Environment

Local bushland cleaned up

18/12/07

Three Bush Forever sites within the Serpentine Jarrahdale Shire have received second-year funding for urgent conservation work through the State Government's Saving our Species initiative.

Almost $330,000 will go towards the continuation of priority conservation work at nine Bush Forever sites throughout Perth, including Watkins Road Nature Reserve, Cardup Nature Reserve and a private property in Lowlands.

Environment Minister David Templeman said Bush Forever sites provided a guarantee of future access to beautiful natural bushland and it was important their high conservation value was protected.

"Earlier this year, the Department of Environment and Conservation (DEC) undertook urgent conservation work at these sites, many of which had previously lacked sufficient on-ground management," Mr Templeman said.

"The second stage of work will include weed control, removal of illegally-dumped household and building rubbish, closure of unused tracks, vegetation rehabilitation and installation of signage and fencing."

DEC has urged people using the shire's Bush Forever sites to respect the bushland by not driving vehicles on unauthorised tracks and not leaving any rubbish behind.

"Conservation workers have previously removed a large amount of household and building rubbish, including hazardous piles of illegally dumped asbestos at Watkins Road Nature Reserve," the Minister said.

"They also manually removed an extensive population of the invasive cotton bush weed at Lowlands."

DEC has currently working with shire rangers to rehabilitate native vegetation, close unused tracks and improve conservation signage at the Watkins Road site.

This will help protect native vegetation from the damage caused by illegal access with off-road vehicles.

As part of the project, fencing will be erected along the western side of the South West Highway next to the nature reserve, to restrict the entry of unauthorised vehicles and illegal rubbish dumping, while still allowing access for bushwalkers.

Active weed management and control for weeds such as cotton bush, arum lily, watsonia and blackberry will remain a large feature of the work.

Saving our Species is a two-year, $15million biodiversity conservation initiative

addressing critical biodiversity conservation priorities where significant long-term results could be achieved from a short-term, strategic focus.

Minister's office - 9220 5050

Comment

Back to Statements list

APPENDIX 9 : Vegetation Condition Scale

The vegetation condition scale used in this report is a general purpose condition scale for assessment of native vegetation, reproduced from Keighery B J (1994).

1 = Pristine
Pristine or nearly so, no obvious signs of disturbance.

2 = Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.

3 = Very good
Vegetation structure altered, obvious signs of disturbance. Fore example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

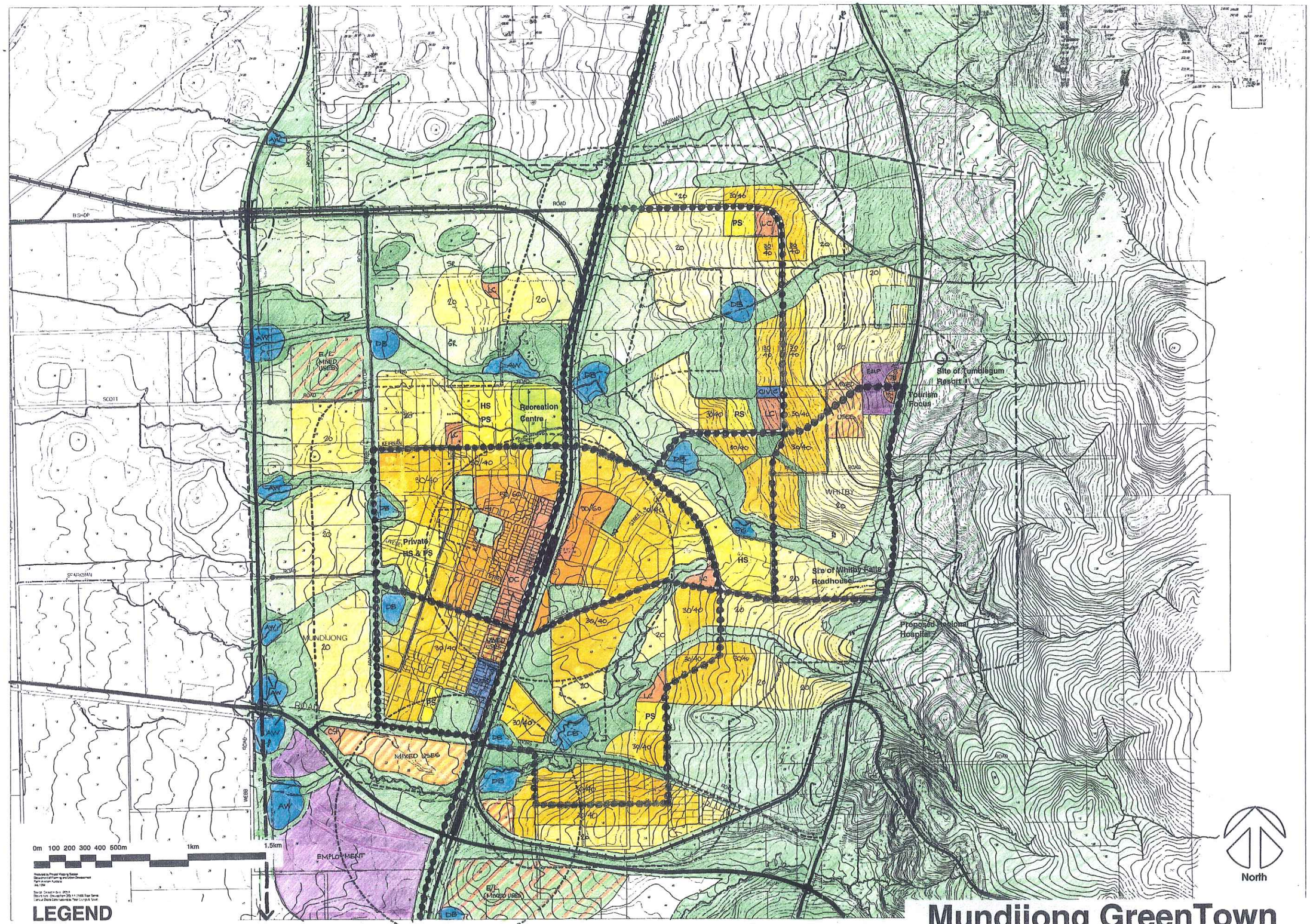
4 = Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

5 = Degraded
Basic vegetation structure severely impacted by disturbance. Scope for regeneration, but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

6 = Completely degraded

The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX 10 : Mundijong Green Town Map



LEGEND

- Special Rural R 1-2
- Landscape and Agricultural Protection
- Environmental Assets
- R 50-60
- R 30-40
- R 20
- District and Local Centres
- Civic
- Mixed Uses: Business and Residential
- Employment
- Employment/Living
- School: HS: High School PS: Primary School
- Study Boundary
- Railway
- Railway Station
- Bus Routes
- Major Roads
- Detension Basins and Artificial Wetlands
- Water Courses and Drains
- Transport Catchment (Walking Distance)

Mundijong GreenTown Preferred Option

Serpentine-Jarrahdale Greentowns Study

For

The Shire of Serpentine-Jarrahdale

Prepared by
Hocking Planning and Architecture Pty Ltd
417 Rokeby Road Subiaco 6008 Western Australia Telephone 388 2810 Facsimile 388 2817

Date December 1994 Scale As Shown/1:10,000 Drawn G Siero

APPENDIX 11 : Fauna Species Previously Identified in the MW Cell

Mammals previously recorded within the Study Area

Introduced	Species	Common Name	Harvey *et al* 1997	Maunsell 2006
	Antechinus flavipes	Mardo	x	
	Cercartetus concinnus	Western Pygmy Possum	x	
	Phascogale tapoatafa ssp.	Brush-tailed Phacsogale		
	Isoodon obesulus fusciventor	Quenda		x
x	*Mus musculus*	House Mouse	x	
x	*Oryctolagus cuniculus*	Rabbit	x	
x	*Vulpes vulpes*	Fox		x

Amphibians previously recorded in the Study Area

Introduced	Species	Common Name	Harvey *et al* 1997
	Crinia georgiana	Quacking Frog	x
	Crinia insignifiera	Squelching Froglet	x
	Heleioporous eyrei	Moaning Frog	x
	Limnodynastes dorsalis	Banjo Frog	x
	Pseudophryne guentheri	Guenther's Toadlet	x

Reptiles previously recorded in the Study Area

Introduced	Species	Common Name	Harvey *et al* 1997	Maunsell 2006
	Aprasia repens	Sand-plain Worm Lizard	x	
	Pogona minor	Bearded Dragon	x	
	Cryptoblepharus plagiocephalus	Fence Skink	x	
	Ctenotus fallens	West Coast Ctenotus	x	
	Ctenotus impar	South-western Odd-striped Skink	x	
	Lerista elegans	West Coast Four-toed Lerista	x	
	Menetia greyi	Dwarf Skink	x	
	Morethia obscura	Dusky Morethia	x	
	Tiliqua rugosa	Bobtail	x	x
	Varanus gouldii	Gould's Sand Monitor	x	
	Ramphotyphlops australis	Southern Blind Snake	x	
	Egernia kingii	King's Skink		x

Birds previously recorded in the Study Area

Introduced	Species	Common Name	Harvey *et al* 1997	Maunsell 2006
	Accipeter cirrocephalus	Collared Sparrohawk	x	
	Platycercus spurious	Red-capped Parrot	x	x
	Platycercus zonarius	Ringnecked Parrot	x	x
	Calyptorhynchus baudinii	Buadin's Black Cockatoo	x	
x	*Dacelo gigas*	Laughing Kookaburra	x	
	Halcyon sancta	Sacred Kingfisher	x	
	Merops ornate	Rainbow Bee-eater		
	Hurundo nigricans	Tree Martin	x	
	Coracina novaeholandiae	Black-faced Cuckoo-shrike	x	
	Pachycephala rufiventris	Rufous Whistler	x	
	Petroica multicolour	Scarlet Robin	x	
	Gerygone fusca	Western Flyeater	x	
	Smicrornis brevirostris	Weebill	x	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	x	
	Acanthiza inornata	Western Thornbill	x	
	Malurus splendins	Splendid Fairy-wren	x	
	Pardolotus striatus	Striated Pardolote	x	
	Zosterops lateralis	Grey-breasted White-eye	x	
	Lichmera indistincta	Brown Honeyeater	x	x
	Phylidonyris novaehollondiae	New Holland Honeyeater	x	x
	Acanthoryhnchus superciliosus	Western Spinebill	x	
	Anthochaera carunculata	Red Wattlebird	x	x
	Cracticus tibicen	Australian Magpie	x	
	Caracticus torquatus	Grey Butcherbird	x	
	Corvus coronoides	Australian Raven		

APPENDIX 12 : DEC Rare Fauna Search

32.24 °S 115.95 °E / 32.31 °S 116.018 °E Study area, Shire of Sepentine/Jarrahdale

*	Date	Certainty	Seen	Location Name	Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Dasyurus geoffroii — Chuditch — *0 records*

This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors. It may occur in the area in question.

Phascogale tapoatafa ssp. (WAM M434) — Brush-tailed Phascogale — *1 records*

This arboreal marsupial occurs in forest and woodland where suitable tree hollows are available. Populations fluctuate dramatically in response to invertebrate prey abundance.

2003	1	1	Mundijong	Dead

Calyptorhynchus banksii naso — Forest Red-tailed Black-Cockatoo — *1 records*

This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the south-west. It requires tree hollows to nest and breed and is totally dependent on jarrah-marri forest.

1997	1	1	Cardup Nature Reserve	Day sighting

Calyptorhynchus baudinii — Baudin's Black-Cockatoo — *1 records*

This species is a seasonal visitor to the northern forests and adjacent eastern edge of the coastal plain, feeding on the seeds of eucalypts and various proteaceous species. It breeds in spring/summer in the southern forests, nesting in tree hollows (primarily in Marri).

2005	1	1	Mundijong	Dead

Priority One: Taxa with few, poorly known populations on threatened lands

Arbanitis inornatus — Arbanitis inornatus — *1 records*

This species of trapdoor spider is found on the Darling Range escarpment between the Brockman and Serpentine Rivers south to the Murray River system. Small isolated populations also occur on the Swan Coastal Plain. The species is under threat from land development.

2006	1	0	Whitby	Definite signs

Priority Five: Taxa in need of monitoring (conservation dependent)

Isoodon obesulus fusciventer — Quenda — *3 records*

This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses, that provides ample protection from predators.

1998	1	1	Cardup Nature Reserve	Day sighting
2004	1	1	Mundijong	Caught or trapped
2005	1	1	Cardup	Dead

***** Information relating to any records provided for listed species:-
Date: date of recorded observation
Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.
Seen: Number of individuals observed.
Location Name: Name of reserve or nearest locality where observation was made
Method: Method or type of observation

APPENDIX 13 : Historical Title

WESTERN AUSTRALIA

REGISTER NUMBER	
11/D89270	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	**2/7/2004**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2053** FOLIO **524**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 11 ON DIAGRAM 89270

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PIONEER CONSTRUCTION MATERIALS PTY LTD OF LEVEL 11, TOOWONG TOWER, 9 SHERWOOD ROAD, TOOWONG, QUEENSLAND.

(T I839837) REGISTERED 1 APRIL 2004

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. *J794534 AMALGAMATION ORDER. LAND INCLUDED INTO THE FREEHOLD ESTATE. REGISTERED 20.6.2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: D89270 [SHEET 1].
PREVIOUS TITLE: 1988-429, 1776-725.
PROPERTY STREET ADDRESS: 1339 SOUTH WESTERN HWY, WHITBY.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: I481286 DEPOSITED PLAN 37006 LODGED

WESTERN AUSTRALIA

REGISTER NUMBER	
10/D89658	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**31/1/2007**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2107** FOLIO **678**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 10 ON DIAGRAM 89658

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PIONEER AUSTRALIA WASTE MANAGEMENT PTY LTD OF LEVEL 1, 369 HIGH STREET, KEW, VICTORIA
SITA-BFI WASTE SERVICES PTY LTD OF LEVEL 1, 64-84 WATERVIEW CLOSE, HAMPTON PARK, VICTORIA
AS TENANTS IN COMMON IN EQUAL SHARES
(T G986000) REGISTERED 22 DECEMBER 1998

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. 62945/1967 EASEMENT BENEFIT SEE SKETCH ON VOL 2107 FOL 678. REGISTERED 1.1.1967.
2. K035345 THIS EDITION WAS ISSUED PURSUANT TO SECTION 75 OF THE TLA. REGISTERED 22.12.2006.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2107-678 (10/D89658).
PREVIOUS TITLE: 1644-850.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: I481286 DEPOSITED PLAN 37006 LODGED

INSTRUCTIONS

1. If insufficient space in any section, Additional Sheet, Form B1, should be used with appropriate headings. The boxed sections should only contain the words "see page ..."
2. Additional Sheets shall be numbered consecutively and bound to this document by staples along the left margin prior to execution by the parties.
3. No alteration should be made by erasure. The words rejected should be scored through and those substituted typed or written above them, the alteration being initialled by the persons signing this document and their witnesses.

NOTES

1. DESCRIPTION OF LAND
   Lot and Diagram/Plan/Strata Plan number or Location name and number to be stated. If share only, specify.
   Extent—Whole, part or balance of the land comprised in the Certificate of Title to be stated.
   The Volume and Folio or Crown Lease number, to be stated.
   If this document relates to only part of the land comprised in the Certificate of Title further narrative or graphic description may be necessary.
2. CAVEATOR
   State full name of the Caveator.
3. State the address for service of notice on the Caveator within the present limits of the City of Perth. An additional address within the State of Western Australia but outside the limits of the City of Perth may be inserted, if desired.
4. REGISTERED PROPRIETOR
   State full name of the Registered Proprietor/Proprietors and the address/addresses to which future notice can be sent.
5. Specify the Estate or Interest claimed.
6. Specify the grounds on which claim is made.
7. State whether "Absolutely" or "Unless such Instrument be expressed to be subject to the Caveator's claim", or "until after notice of any intended registration or registered dealing to the Caveator at the address for service of notice".
8. CAVEATOR'S OR HIS AGENTS EXECUTION
   A separate attestation is required for every person signing this document. Each signature should be separately witnessed by an Adult Person. The address and occupation of the witness must be stated.

OFFICE USE ONLY

F 86427 C
14 Jan, 1993 15:58

REG. $ 62.00

CAVEAT

TIME CLOCK

LODGED BY PARKER - PARKER

ADDRESS

PHONE No.

FAX No.

REFERENCE No.

ISSUING BOX No.

PREPARED BY PARKER & PARKER
(SCE:THS:ART9249647

ADDRESS 140 St George's Terrace
PERTH WA 6000

PHONE No. 322 0321 FAX No. 322 2243

INSTRUCT IF ANY DOCUMENTS ARE TO ISSUE TO OTHER THAN LODGING PARTY.

TITLES, LEASES, DECLARATIONS ETC. LODGED HEREWITH

1. plc AC
2.
3.
4.
5.
6.

Received Items
Nos. 1

R
Receiving Clerk

ENDORSING INSTRUCTION

As to portion only

NOTICES TO BE SENT:

EXAMINED

Lodged pursuant to the provisions of the TRANSFER OF LAND ACT 1893 as amended on the day and time shown above and particulars entered in the Register Book.

INITIALS OF SIGNING OFFICER

REGISTRAR OF TITLES

05377/1/92–5M–OC/651

FORM C1

WESTERN AUSTRALIA
TRANSFER OF LAND ACT 1893 AS AMENDED.

AGREEMENT DATED 14.1.93
STAMPED PRESENTED TO STAMP OFFICE
SIGNED

CAVEAT

DESCRIPTION OF LAND (Note 1)	EXTENT	VOLUME	FOLIO
AS TO PORTION ONLY That part of Lot 6 the subject of Diagram 64866 being the land shown and edged in red on the sketch Plan attached and marked with the letter "A"	WHOLE	1644	850

CAVEATOR (Note 2)

BROWNING-FERRIS INDUSTRIES (AUSTRALIA) PTY LTD (A.C.N. 005 179 484) of 123 Whitehorse Road, Deepdene, Victoria and PIONEER AUSTRALIA WASTE MANAGEMENT PTY LTD (A.C.N. 006 229 832) of 1183 Toorak Road, Hartwell, Victoria

ADDRESS FOR SERVICE OF NOTICE ON CAVEATOR (Note 3)

PARKER & PARKER of 140 St George's Terrace, Perth, Western Australia

REGISTERED PROPRIETOR (Note 4)

BRISTILE LIMITED (A.C.N.)08 668 540) of 1st Floor, 66 Kings Park Road, West Perth, Western Australia

ESTATE OR INTEREST BEING CLAIMED (Note 5)

In fee simple as Grantee of an option to purchase

The CAVEATOR claims an estate or interest as specified herein of the estate or interest of the abovenamed REGISTERED PROPRIETOR in the land above described BY VIRTUE OF (Note 6)

An Option Deed dated 14 January 1993 between the Registered Proprietor and the Caveator

And FORBIDS the registration of any Instrument affecting the estate or interest (Note 7)

Unless such instrument be expressed to be subject to the Caveator's claim

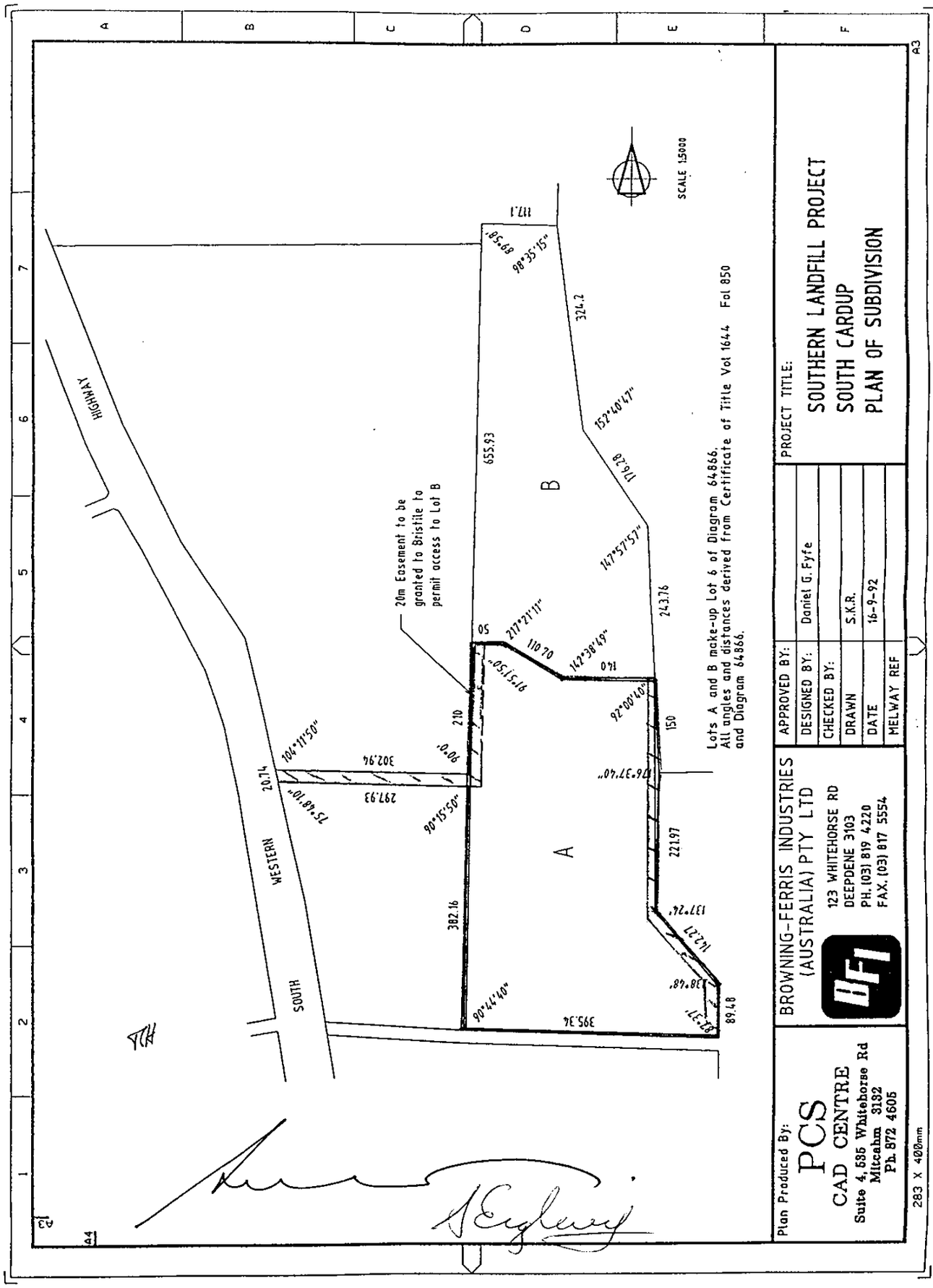
Dated this 14th day of January 19 93

CAVEATOR OR HIS AGENT SIGN HERE (Note 8)

Signed Parker and Parker Solicitors for Caveator

In the presence of S ENGLAND Solicitor - Perth

Annexure A



WESTERN AUSTRALIA

REGISTER NUMBER	
50/DP222868	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **914** FOLIO **13**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 50 ON DEPOSITED PLAN 222868

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SERPENTINE JARRAHDALE ROAD BOARD OF MUNDIJONG
(T T3180/1941) REGISTERED 8 MAY 1941

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 914-13 (50/DP222868).
PREVIOUS TITLE: This Title.
PROPERTY STREET ADDRESS: 15 BUTCHER ST, MUNDIJONG.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF MUNDIJONG TOWN LOT/LOT 50 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 50 ON DEPOSITED PLAN 222868 ON 01-JUN-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

WESTERN AUSTRALIA

REGISTER NUMBER	
221/D20218	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2198** FOLIO **804**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 221 ON DIAGRAM 20218

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SHIRE OF SERPENTINE-JARRAHDALE OF 6 PATERSON STREET, MUNDIJONG
(T H490015) REGISTERED 29 JUNE 2000

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2198-804 (221/D20218).
PREVIOUS TITLE: LR3121-103.
PROPERTY STREET ADDRESS: 9 BUTCHER ST, MUNDIJONG.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF MUNDIJONG TOWN LOT/LOT 221 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 221 ON FREEHOLD TITLE DIAGRAM 20218 ON 02-OCT-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

Transfer H490014

Volume 3121 Folio 103

WESTERN AUSTRALIA

VOLUME 2198 FOLIO 804

IN THE REGISTER

CERTIFICATE OF TITLE

UNDER THE " TRANSFER OF LAND ACT, 1893 " AS AMENDED

The person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 29th June, 2000

REGISTRAR OF TITLES

ESTATE AND LAND REFERRED TO

Estate in fee simple in Mundijong Lot 221, delineated on the map in the Third Schedule hereto.

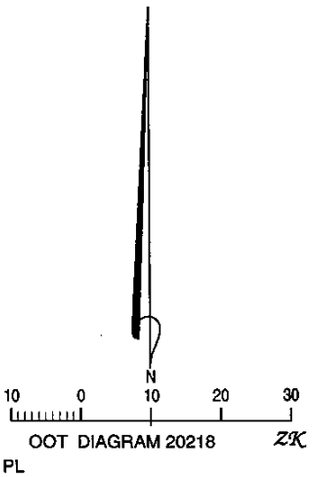
FIRST SCHEDULE (continued overleaf)

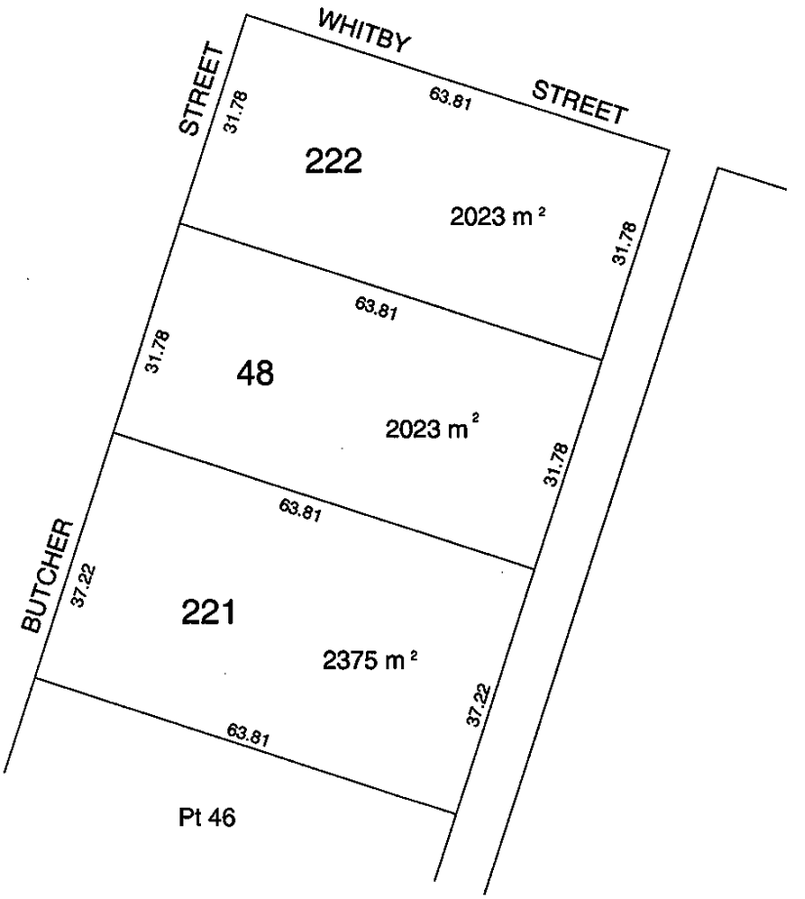
~~Water Corporation of 629 Newcastle Street, Leederville.~~

SECOND SCHEDULE (continued overleaf)

NIL

THIRD SCHEDULE





VOLUME 2198 FOLIO 804

IN THE REGISTER

FIRST SCHEDULE (continued) NOTE : ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS					
PARTICULARS	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL & INITIAL
Shire of Serpentine-Jarrahdale of 6 Paterson Street, Mundijong.	Transfer	H490015	29.6.2000	12.53	

SECOND SCHEDULE (continued)	REGISTERED or LODGED	TIME	SEAL & INITIAL	CANCELLATION NATURE	CANCELLATION NUMBER	REGISTERED or LODGED	SEAL & INITIAL

WESTERN AUSTRALIA

REGISTER NUMBER	
222/DP222868	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2198** FOLIO **805**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 222 ON DEPOSITED PLAN 222868

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SHIRE OF SERPENTINE-JARRAHDALE OF 6 PATERSON STREET, MUNDIJONG
(T H490015) REGISTERED 29 JUNE 2000

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2198-805 (222/DP222868).
PREVIOUS TITLE: LR3121-104.
PROPERTY STREET ADDRESS: 13 BUTCHER ST, MUNDIJONG.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF MUNDIJONG TOWN LOT/LOT 222 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 222 ON DEPOSITED PLAN 222868 ON 27-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

LT.175

ORIGINAL: Not to be removed from the Department of Land Administration.

Application H490014

Volume 3121 Folio 104

WESTERN AUSTRALIA

VOLUME	FOLIO
2198	805

IN THE REGISTER

CERTIFICATE OF TITLE

UNDER THE " TRANSFER OF LAND ACT, 1893 " AS AMENDED

The person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 29th June, 2000

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

ESTATE AND LAND REFERRED TO

Estate in fee simple in Mundijong Lot 222, delineated on the map in the Third Schedule hereto.

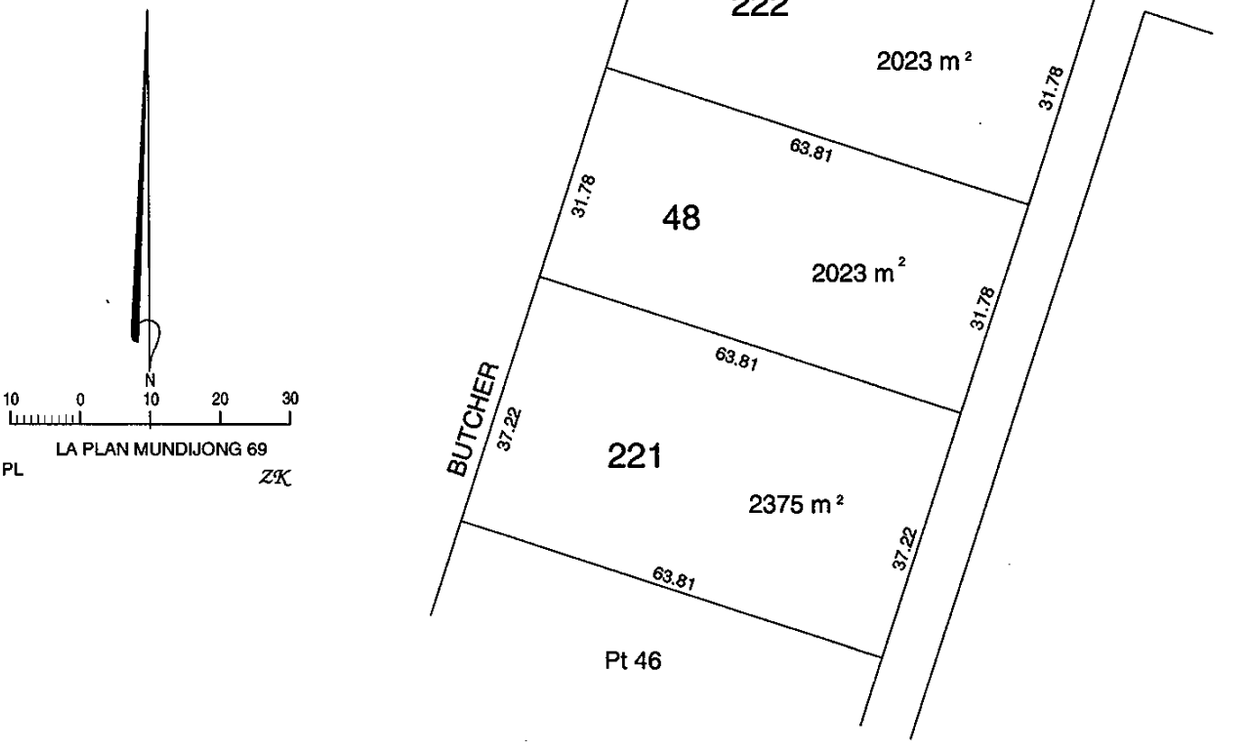
FIRST SCHEDULE (continued overleaf)

~~Water Corporation of 629 Newcastle Street, Leederville~~.

SECOND SCHEDULE (continued overleaf)

NIL

THIRD SCHEDULE



NOTE: Entries may be affected by subsequent endorsements.

VOLUME 2198 FOLIO 805

IN THE REGISTER

FIRST SCHEDULE (continued)

NOTE : ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

PARTICULARS	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL & INITIAL
Shire of Serpentine-Jarrahdale of 6 Paterson Street, Mundijong.	Transfer	H490015	29.6.2000	12.53	

SECOND SCHEDULE (continued)

	REGISTERED or LODGED	TIME	SEAL & INITIAL	CANCELLATION NATURE	CANCELLATION NUMBER	REGISTERED or LODGED	SEAL & INITIAL

WESTERN AUSTRALIA

REGISTER NUMBER	
48/DP222868	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2198** FOLIO **806**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 48 ON DEPOSITED PLAN 222868

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SHIRE OF SERPENTINE-JARRAHDALE OF 6 PATERSON STREET, MUNDIJONG
(T H490016) REGISTERED 29 JUNE 2000

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2198-806 (48/DP222868).
PREVIOUS TITLE: LR3121-102.
PROPERTY STREET ADDRESS: 11 BUTCHER ST, MUNDIJONG.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF MUNDIJONG TOWN LOT/LOT 48 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 48 ON DEPOSITED PLAN 222868 ON 02-OCT-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

Transfer H490016

Volume 3121 Folio 102

WESTERN AUSTRALIA

VOLUME 2198 FOLIO 806

IN THE REGISTER

CERTIFICATE OF TITLE

UNDER THE " TRANSFER OF LAND ACT, 1893 " AS AMENDED

The person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 29th June, 2000

REGISTRAR OF TITLES

ESTATE AND LAND REFERRED TO

Estate in fee simple in Mundijong Lot 48, delineated on the map in the Third Schedule hereto.

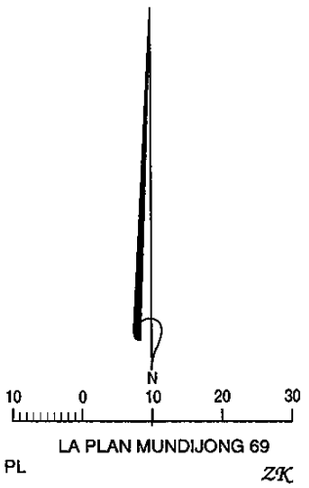
FIRST SCHEDULE (continued overleaf)

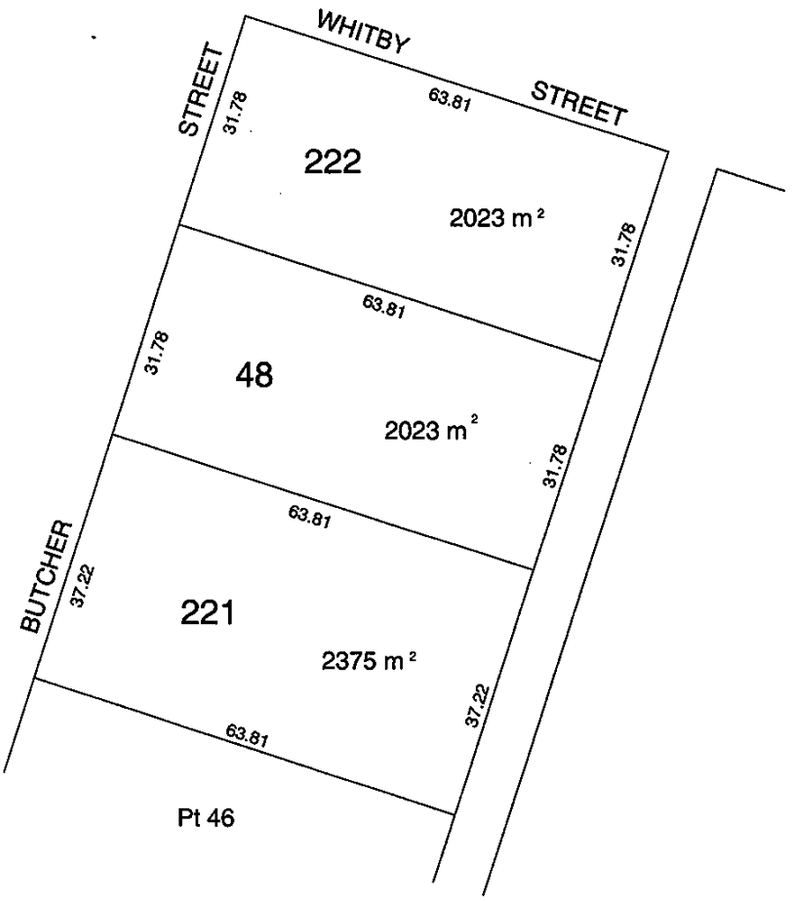
Shire of Serpentine-Jarrahdale of 6 Paterson Street, Mundijong.

SECOND SCHEDULE (continued overleaf)

NIL

THIRD SCHEDULE





VOLUME 2198 FOLIO 806
IN THE REGISTER

FIRST SCHEDULE (continued) NOTE - ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS					
PARTICULARS	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL & INITIAL

SECOND SCHEDULE (continued)	REGISTERED or LODGED	TIME	SEAL & INITIAL	CANCELLATION NATURE	CANCELLATION NUMBER	REGISTERED or LODGED	SEAL & INITIAL

WESTERN AUSTRALIA

REGISTER NUMBER	
11/D89282	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**9/8/2006**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2052** FOLIO **559**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 11 ON DIAGRAM 89282

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

WELLSTRAND PTY LTD OF CARE OF DONALD F. MUNRO AND ASSOCIATES, 789 WELLINGTON STREET, PERTH

(A F970316) REGISTERED 1 SEPTEMBER 1995

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	2052-559 (11/D89282).
PREVIOUS TITLE:	1974-313.
PROPERTY STREET ADDRESS:	29 TAYLOR RD, MUNDIJONG.
LOCAL GOVERNMENT AREA:	SHIRE OF SERPENTINE-JARRAHDALE.

LT. 37

ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF TITLES

Application F970316

Volume 1974 Folio 313

WESTERN AUSTRALIA

REGISTER BOOK
VOL. FOL.

CT 2052 559

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

559 FOL.

VOL. 2052

Page 1 (of 2 pages)

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

REGISTRAR OF TITLES

Dated 1st September, 1995

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Serpentine Agricultural Area Lot 36 and being Lot 11 on Diagram 89282, delineated on the map in the Third Schedule hereto.

FIRST SCHEDULE (continued overleaf)

Wellstrand Pty. Ltd. of care of Donald F. Munro and Associates, 789 Wellington Street, Perth.

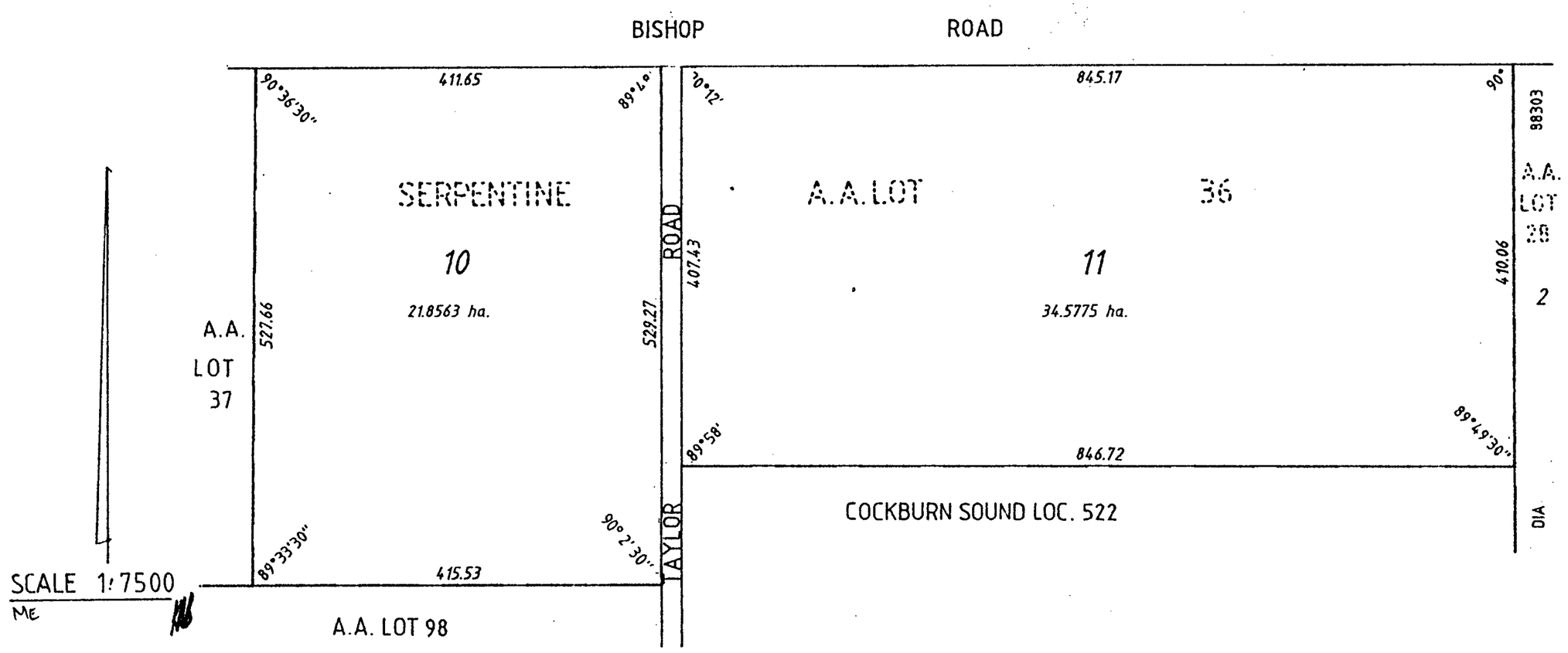
SECOND SCHEDULE (continued overleaf)

1. MORTGAGE D664906 to National Australia Bank Ltd. Registered 4.2.88 at 9.31 hrs.

~~2. MORTGAGE F473147 to Primary Industry Bank of Australia Ltd. Registered 4.3.94 at 14.45 hrs.~~

Discharged H38977 2.3.99 (Dup c/t not prod)

THIRD SCHEDULE



PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

Superseded - Copy for Sketch Only

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

LT. 37

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT		REGISTERED	TIME	SEAL	CERT. OFFICER
	NATURE	NUMBER				

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT		PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
NATURE	NUMBER										

CERTIFICATE OF TITLE VOL. 2052 FOL. 559

WESTERN AUSTRALIA

REGISTER NUMBER	
4396/DP219889	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

VOLUME **LR3111** FOLIO **72**

RECORD OF CERTIFICATE OF CROWN LAND TITLE

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 4396 ON DEPOSITED PLAN 219889

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: NATIONAL PARKS & NATURE CONSERVATION AUTH

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. K136045 PART RESERVE 23012 FOR THE PURPOSE OF CONSERVATION OF FLORA AND FAUNA REGISTERED 27.3.2007.
MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: LR3111-72 (4396/DP219889).
PREVIOUS TITLE: LR3014-669.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF COCKBURN SOUND LOCATION 4396 ON SUPERSEDED PAPER CERTIFICATE OF CROWN LAND TITLE CHANGED TO LOT 4396 ON DEPOSITED PLAN 219889 ON 04-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE

END OF PAGE 1 - CONTINUED OVER

ORIGINAL CERTIFICATE OF CROWN LAND TITLE

REGISTER NUMBER: 4396/DP219889 VOLUME/FOLIO: LR3111-72 PAGE 2

OF TITLE.

NOTE 3: K136045 CORRESPONDENCE FILE 00344-1949-02RO

NO DUPLICATE ISSUED

Application H443222
Corr. 05009-1914-03ro
Volume. Folio.
3014 669

REGISTER VOLUME 3111 FOLIO 72

WESTERN AUSTRALIA

CERTIFICATE OF CROWN LAND TITLE

UNDER THE "TRANSFER OF LAND ACT 1893" AS AMENDED
AND THE "LAND ADMINISTRATION ACT 1997"

The undermentioned land is Crown land, in the name of the
STATE of WESTERN AUSTRALIA,
subject to the interests and status orders in the First Schedule which interests and status orders are subject to the interests, easements, encumbrances and notices shown in the Second Schedule hereto.

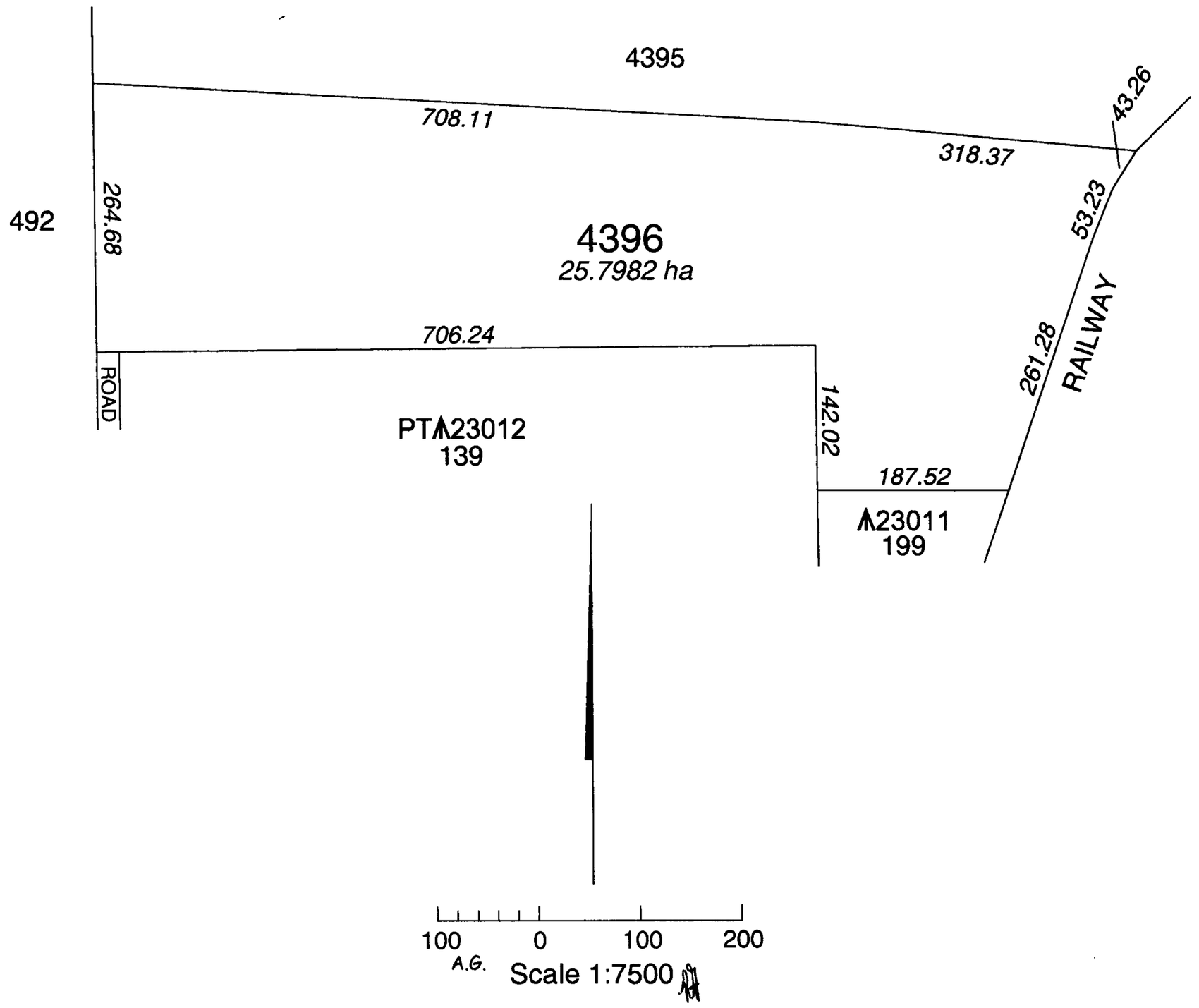
Dated 12 May 2000

REGISTRAR OF TITLES

LAND REFERRED TO

Cockburn Sound Location 4396 on Land Administration Plan 19889 delineated on the sketch in the Third Schedule.

THIRD SCHEDULE



CERTIFICATE OF CROWN LAND TITLE VOL. 3111 FOL. 72

FIRST SCHEDULE

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT									
NATURE	NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL
Creation of Reserve	H443223	Reserve No. 46138 for the purpose of **Parkland and Recreation**.	12.5.00	12.40					
Management Order	H443224	Care, Control and Management to **Minister for Health** of care of the Health Department of Western Australia, 189 Royal Street, East Perth with power to lease (sub lease or licence) for any term.	12.5.00	12.40					

SECOND SCHEDULE

NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT									
NATURE	NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL

WESTERN AUSTRALIA

REGISTER NUMBER	
15/D100631	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	**10/11/2003**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2199** FOLIO **537**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 15 ON DIAGRAM 100631

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MEELIA PTY LTD OF 238 STIRLING HIGHWAY, CLAREMONT
(T H752129) REGISTERED 18 MAY 2001

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. B410671 EASEMENT BURDEN SEE SKETCH ON VOL 2199 FOL 537. REGISTERED 30.9.1977.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2199-537 (15/D100631).
PREVIOUS TITLE: 2030-989.
PROPERTY STREET ADDRESS: LOT 15 SOUTH WESTERN HWY, JARRAHDALE.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

Application H523455

Volume 2030 Folio 989

WESTERN AUSTRALIA

VOLUME 2199 FOLIO 537

IN THE REGISTER

CERTIFICATE OF TITLE

UNDER THE " TRANSFER OF LAND ACT, 1893 " AS AMENDED

The person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements, encumbrances and notices shown in the Second Schedule hereto.

Dated 11th August, 2000

REGISTRAR OF TITLES

ESTATE AND LAND REFERRED TO

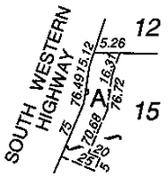
Estate in fee simple in portion of each of Cockburn Sound Locations 36, 104 and 240 and being Lot 15 on Diagram 100631, delineated on the map in the Third Schedule hereto.

FIRST SCHEDULE (continued overleaf)

Clive John Glands and **Gladys Lottie Glands** both of Lot 6 Jarrahdale Road, Mundijong, **as joint tenants.**

SECOND SCHEDULE (continued overleaf)

Not To Scale



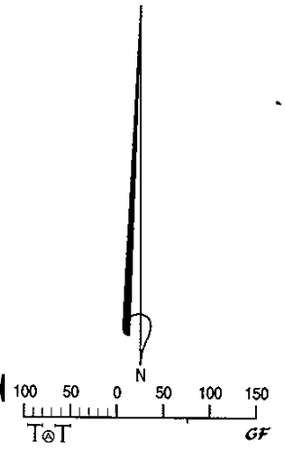
1. TRANSFER B410671. The right to enter upon the portion of the within land marked 'A' on the map in the margin for the purpose of exercising certain water rights as set out in the said Transfer is reserved to the proprietor or proprietors for the time being of Lot 7 on Plan 11781. Registered 30.9.77 at 2.21 o'c

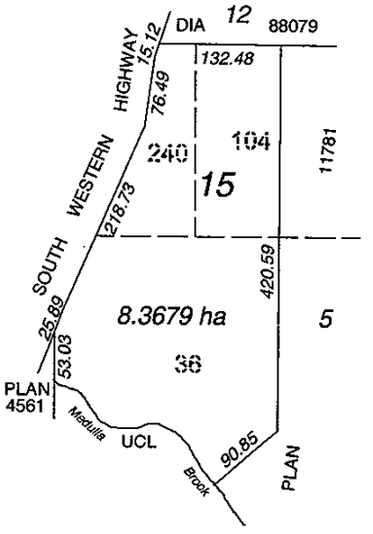
2. MORTGAGE B997336 to **The Commissioners of the Rural & Industries Bank of Western Australia .** Registered 26.9.80 at 9.08 o'c.

3. MORTGAGE C916682 to **The Commissioners of the Rural & Industries Bank of Western Australia .** Registered 11.12.84 at 9.02 o'c.

4. MORTGAGE F411115 to **R&I Bank of Western Australia Ltd.** Registered 30.12.93 at 8.11 hrs.

THIRD SCHEDULE





VOLUME 2199 FOLIO 537
IN THE REGISTER

FIRST SCHEDULE (continued) NOTE : ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

PARTICULARS	INSTRUMENT		REGISTERED	TIME	SEAL & INITIAL
	NATURE	NUMBER			

SECOND SCHEDULE (continued)	REGISTERED or LODGED	TIME	SEAL & INITIAL	CANCELLATION		REGISTERED or LODGED	SEAL & INITIAL
				NATURE	NUMBER		

WESTERN AUSTRALIA

REGISTER NUMBER	
10/D75640	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **1863** FOLIO **686**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 10 ON DIAGRAM 75640

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

SILVAGOLD CORPORATION PTY LTD OF CARE OF COLLI & SONS, LOT 2 BROOKTON HIGHWAY, KELMSCOTT
(T E280741) REGISTERED 22 JANUARY 1990

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. F965223 MORTGAGE TO NATIONAL AUSTRALIA BANK LTD REGISTERED 28.8.1995.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 1863-686 (10/D75640).
PREVIOUS TITLE: 1421-504.
PROPERTY STREET ADDRESS: 426 ROBERTSON RD, CARDUP.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF

CT 1863 0686 F

1863 686

Transfer E280741

Volume 1421 Folio 504

WESTERN AUSTRALIA

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 22nd January, 1990

REGISTRAR OF TITLES

OFFICE OF TITLES WESTERN AUSTRALIA

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Serpentine Agricultual Area Lot 20 and being Lot 10 on Diagram 75640, delineated on the map in the Third Schedule hereto.

FIRST SCHEDULE (continued overleaf)

Silvagold Corporation Pty. Ltd. of Lot 2 Brookton Highway, Kelmscott.

SECOND SCHEDULE (continued overleaf)

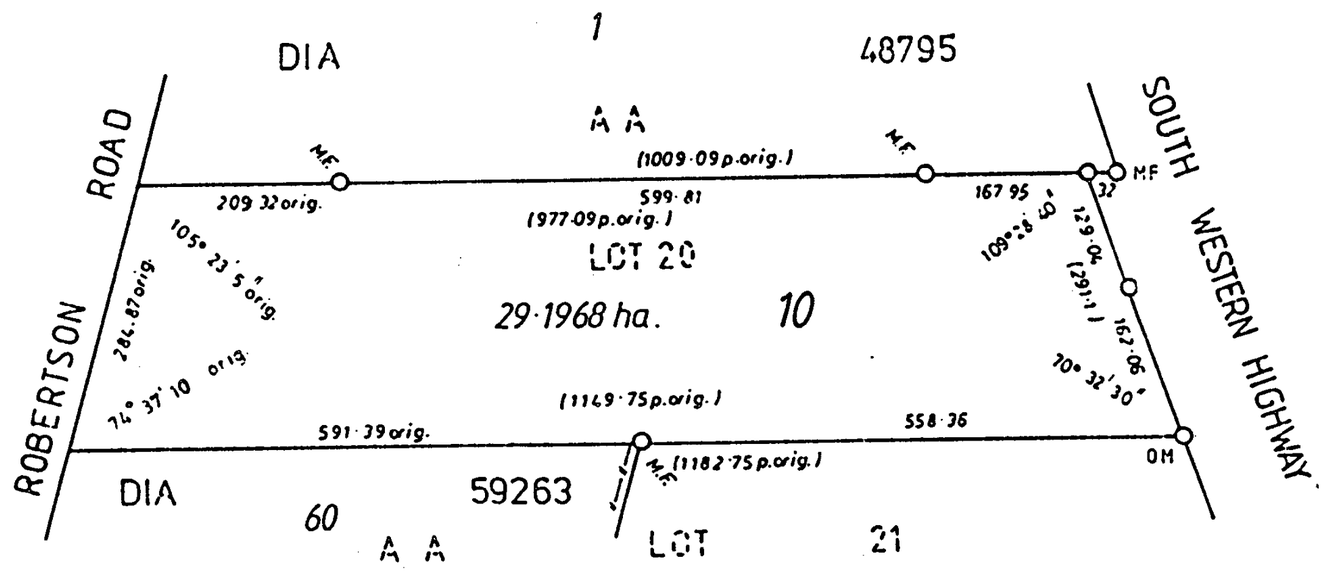
1. MORTGAGE D596688 to Westpac Banking Corporation. Registered 6.11.87 at 9.04 hrs.

Discharged F811554 21.2.95

THIRD SCHEDULE

SCALE 1:1000

SGT RR



NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

E67590/3/89-20M-L/4664

Superseded - Copy for Sketch Only

LT. 37

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	CERT. OFFICER
The correct address of the registered proprietor is now of care of Colli & Sons, Lot 2 Brookton Highway, Kelmscott	By	F811556	21.2.95	10.50	OFFICE OF TITLES WESTERN AUSTRALIA	

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

	INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
2	Mortgage	E362428	to Westpac Banking Corporation.	17.5.90	12.59	OFFICE OF TITLES WESTERN AUSTRALIA		Discharged	F811555	21.2.95	OFFICE OF TITLES WESTERN AUSTRALIA	
2	Mortgage	E362429	to Westpac Banking Corporation.	17.5.90	12.59	OFFICE OF TITLES WESTERN AUSTRALIA		Discharged	F811553	21.2.95	OFFICE OF TITLES WESTERN AUSTRALIA	
	Mortgage	F811556	to Esanda Finance Corporation Ltd	21.2.95	10.50	OFFICE OF TITLES WESTERN AUSTRALIA		Discharged	F965222	28.8.95	OFFICE OF TITLES WESTERN AUSTRALIA	
	Mortgage	F965223	to National Australia Bank Ltd.	28.8.95	9.24	OFFICE OF TITLES WESTERN AUSTRALIA						

CERTIFICATE OF TITLE VOL. 1363 FOL. 686

116D

WESTERN AUSTRALIA

REGISTER NUMBER	
N/A	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	**18/10/2007**

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME **2672** FOLIO **275**

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

THIS IS A SHARE TITLE

LAND DESCRIPTION:

1/2 UNDIVIDED SHARES OF
LOT 60 ON DIAGRAM 59263

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

KANDALEE PTY LTD OF LOT 629 SOUTH WEST HIGHWAY, BRIDGETOWN
AS SOLE PROPRIETOR OF THE SHARE SHOWN IN THE LAND DESCRIPTION
(T K360599) REGISTERED 28 SEPTEMBER 2007

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. THE RIGHT TO MINES OF COAL OR OTHER MINERALS BEING EXCLUDED FROM PORTION OF THE SAID LAND

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: D59263 [SHEET 1].
PREVIOUS TITLE: 1568-591.
PROPERTY STREET ADDRESS: 394 ROBERTSON RD, CARDUP.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

116D

WESTERN AUSTRALIA

REGISTER NUMBER	
N/A	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	18/10/2007

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 2672 FOLIO 276

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

THIS IS A SHARE TITLE

LAND DESCRIPTION:

1/2 UNDIVIDED SHARES OF
LOT 60 ON DIAGRAM 59263

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

MECCA HOLDINGS PTY LTD OF 57 ROKEWOOD WAY, KARRAGULLEN
AS SOLE PROPRIETOR OF THE SHARE SHOWN IN THE LAND DESCRIPTION
(T K360600) REGISTERED 28 SEPTEMBER 2007

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. THE RIGHT TO MINES OF COAL OR OTHER MINERALS BEING EXCLUDED FROM PORTION OF THE SAID LAND

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: D59263 [SHEET 1].
PREVIOUS TITLE: 1568-591.
PROPERTY STREET ADDRESS: 394 ROBERTSON RD, CARDUP.
LOCAL GOVERNMENT AREA: SHIRE OF SERPENTINE-JARRAHDALE.

Town or District.	Number of Lot or Location.	Field Book.	Scale.	Certificate in which Land is Vested.	Area
SERPENTINE	Lot 51 of A.A.Lot 21 & Ptn. A.A. Lot 21.	44144	1:7500.	Vol. 1502 Fol. 270 " 1502 " 271	

Portion hachured brown subject to Section 15 of the Public Works Act.

2
A.A. Lot 20.

DIA 48795

F.B. 35965

591.39 orig.

105° 22' 50" orig

74° 36' 50" orig.

301.63 orig.

M.F.

A.A. LOT 21.

0.6 to Fence M.F.

179° 12' 15"

60

47·3903 ha

1568
591

900.33 orig

ROBERTSON RD.

Ringlock fence in poor cond'n.

174.06

(393.92)

obt. 0.24

obt. 0.25

219.86

125° 25' 5"

(687.88 per orig)

378.13

144.8 orig

M.F. Ringlock fence in good cond'n.

164.95 orig

M.F.

44.83 orig.

198° 29' 40" orig

See Enlargement

ROAD

M.F.

44.83 orig.

126° 7' 38" orig.

1.08 orig.

126° 7' 37" orig.

M.F.

Enlargement - Not to Scale.

IN ORDER FOR DEALINGS
Subject to (1) Approval Diag. 56882
(2) 2 owners Ass. Ins. Plans RWC 2/7/80

FISHER LEWIS CONSULTING SURVEYORS
34 ST. [illegible] AVE, CLAREMONT 6010 Ph. 384 7035

DIA 59263

CI

CERTIFICATE

I hereby certify that this survey was performed by me personally (or under my own personal supervision, inspection and field check) in strict accordance with the Licensed Surveyors (Guidance of Surveyors) Regulations, 1961.

Date 13-5-80 Licensed Surveyor

Approved by Town Planning Board

Date 27th May 1980 Chairman

Approved	On	Registered	Diagram No.
APPROVED Inspector of Plans and Surveys Examined M. Schofield Date 10-7-80	Plan Diagram 56882 Index Plan PEEL 5000 09.12 " " 09.13	28 5 80	59263

82316 79 4M L 271 Dkt Dia 29112

NOTES.

1. If any of the boxed sections has insufficient space then the relevant information may be added on Annexure Form B1. Appropriate headings should be shown. The boxed sections should only contain the words "See Annexure 'A' (or as the case may be) attached". Annexure sheets should be dated, signed by the persons signing this document and be pinned to this form.
2. No alteration should be made by erasure. The words rejected should be scored through and those substituted typed or written above them, the alteration being initialled by the persons signing this document.

D 684721 C

No. D684721 MICRO-FILMED

CAVEAT

FEES (office use)	$	c
'88 FEB 29 14:20	35	

Parties .....

.....

.....

Lodged by CONVEYANCER
Address CROWN LAW DEPARTMENT PERTH
Phone No. 327 1711
CL D 11889/87 C11
MR D 41/170-31
WP REF (BHK219F12)

Use this space for instructions if any documents are to issue to other than lodging party. Box 59

Agreements, Duplicates, Declarations, etc., lodged with this document. (To be filled in by person lodging.)

1. CONTRACT OF SALE
2. .....
3. .....
4. .....
5. .....
6. .....

Received items

No's .....

Rec. Clerk.

BELOW THIS LINE FOR OFFICE USE ONLY.

As to portion only RB

Endorsing instruction. X Inofficiff

Lodged 24th February, 1988

at 14-20 o'clock and

particulars entered in the Register Book.

Initials of Signing Officer.

REGISTRAR OF TITLES.

EXAMINED. RW

16627/12/81—5M—MS/1119

Form C1.

INSTRUMENT DATED 28/1/88

GROSS CONSDN $5,600.00

CHTLS ~ V.G.O. VALUED ☐

WESTERN AUSTRALIA.

Transfer of Land Act 1893 as amended No. D684721

CAVEAT

DESCRIPTION OF LAND BEING CAVEATED. State whether whole or part of land comprised in Certificate of Title and/or Crown Lease. If share only, specify.

Portion of Serpentine Agricultural Area Lot 20 and being that part of Lot 2 on Diagram 48795 as is delineated and coloured green on the plan annexed hereto and being part of the land contained in Certificate of Title Volume 1421 Folio 504.

CAVEATOR. Full name, address and occupation. If a minor, state date of birth.

COMMISSIONER OF MAIN ROADS of Waterloo Crescent East Perth

REGISTERED PROPRIETOR. Full name, address and occupation as shown on Certificate of Title.

SILVAGOLD CORPORATION PTY LTD of 1205 Hay Street Perth

a. Specify the Estate or Interest claimed.

THE CAVEATOR claims an estate or interest (a) as purchaser in fee simple

b. Specify the grounds on which claim is made.

as to the estate or interest of the abovenamed Registered Proprietor in the Land above described BY VIRTUE OF (b) an agreement dated 28TH day of JANUARY 1988 made between the registered proprietor as vendor and the Caveator as purchaser.

c. State whether. Absolutely OR unless such instrument be expressed to be subject to the Caveator's claim OR until after notice of any intended registration or registered dealing to be given to the Caveator at the address hereinafter mentioned.

and FORBIDS the registration of any person as transferee or proprietor of, and of any instrument affecting the said estate or interest (c) absolutely

d. State some address or place within the present limits of the City of Perth. (An additional address may be inserted if desired.)

and appoints (d)

THE OFFICE OF THE CONVEYANCER
CROWN LAW DEPARTMENT PERTH

as the place at which notices and proceedings relating to this caveat may be served.

Dated this 29TH day of FEBRUARY 1988

e. Signature of the Caveator or his Agent.

Signed in the presence of

f. Signature of Witness. (May be any adult person.)

(f) Gayle Ferguson

Address CLASSIFIED OFFICER IN THE STATE PUBLIC SERVICE

Occupation CROWN LAW DEPT PERTH

(e) .....

CLERK IN CHARGE COVEYANCING
CROWN LAW DEPARTMENT PERTH
AS AGENT AGENT FOR THE CAVEATOR

If insufficient space hereon annexures may be added. (Use Annexure Form B1) See Note 1 on back hereof.

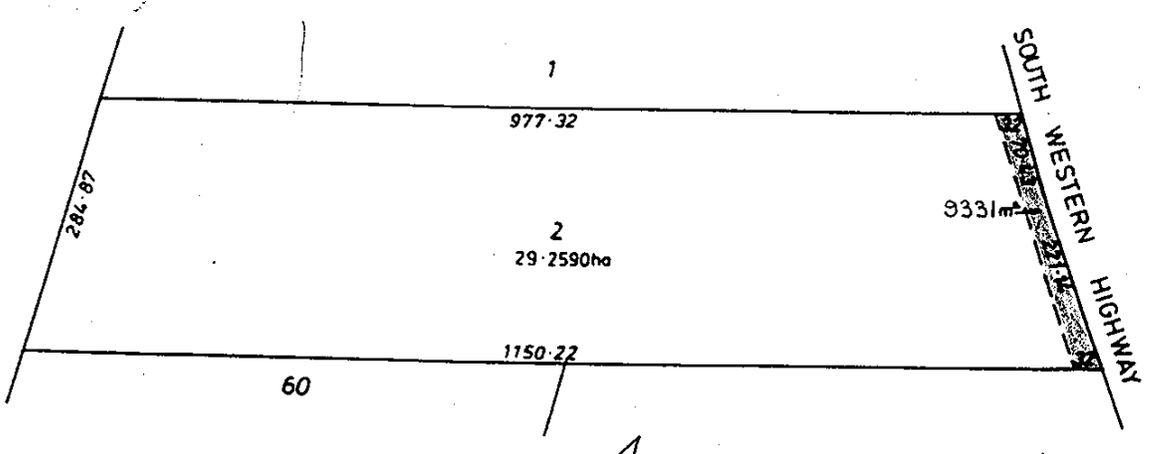
WILLIAM C. BROWN GOVERNMENT PRINTER WESTERN AUSTRALIA ©

LAND REQUIRED FOR ROAD PURPOSES FROM LOT 2 OF PT. SERPENTINE AGRICULTURAL AREA LOT 20

CT 1421/504

SUBJECT TO SURVEY

AMENDED PLAN



Caveat C/T 1421 504 20.11.87

Gayle Ferguson

N

SCALE 1:7500
DK 24-4-87

LAND REQUIRED FOR OTHER MAJOR HIGHWAYS RESERVATION

INSTRUCTIONS

1. If insufficient space in any section, Additional Sheet, Form B1, should be used with appropriate headings. The boxed sections should only contain the words "see page ..."
2. Additional Sheets shall be numbered consecutively and bound to this document by staples along the left margin prior to execution by the parties.
3. No alteration should be made by erasure. The words rejected should be scored through and those substituted typed or written above them, the alteration being initialled by the persons signing this document and their witnesses.

NOTES

1. DESCRIPTION OF LAND
   Lot and Diagram/Plan/Strata Plan number or Location name and number to be stated. If share only, specify.
   Extent—Whole, part or balance of the land comprised in the Certificate of Title to be stated.
   The Volume and Folio or Crown Lease number, to be stated.
   If this document relates to only part of the land comprised in the Certificate of Title further narrative or graphic description may be necessary.
2. CAVEATOR
   State full name of the Caveator.
3. State the address for service of notice on the Caveator within the present limits of the City of Perth. An additional address within the State of Western Australia but outside the limits of the City of Perth may be inserted, if desired.
4. REGISTERED PROPRIETOR
   State full name and address of the Registered Proprietor/ Proprietors as shown on the Certificate of Title or Crown Lease and any address/addresses to which future notice can be sent.
5. Specify the Estate or Interest claimed.
6. Specify the grounds on which claim is made.
7. State whether "Absolutely" or "Unless such Instrument be expressed to be subject to the Caveator's claim", or "until after notice of any intended registration or registered dealing to the Caveator at the address for service of notice".
8. CAVEATOR'S OR HIS AGENTS EXECUTION
   A separate attestation is required for every person signing this document. Each signature should be separately witnessed by an Adult Person. The address and occupation of the witness must be stated.

ENDORSING INSTRUCTION

NOTICES TO BE SENT: 2 L.P.R. 1490/369.

EXAMINED

05377/1/92–5M–OC/651

OFFICE USE ONLY

F 183561 C
07 May, 1993 11:52

REG. $ 62.00

CAVEAT

A&S - 3[illegible]

TIME CLOCK

LODGED BY MALLESONS STEPHEN JAQUES

ADDRESS ST. GEORGE'S SQUARE,
225 ST. GEORGES TERRACE, PERTH
PHONE: 324 8333
ISSUING BOX No. 4

PHONE No.

FAX No.

REFERENCE No.

ISSUING BOX No.

PREPARED BY MALLESONS STEPHEN JAQUES

ADDRESS 225 St George's Terrace
PERTH WA 6000
MGH:JN:101778702

PHONE No. 324 8333 FAX No. 321 1017

INSTRUCT IF ANY DOCUMENTS ARE TO ISSUE TO OTHER THAN LODGING PARTY.

35 36

TITLES, LEASES, DECLARATIONS ETC. LODGED HEREWITH

1. Dup Caveat
2. Affge
3.
4.
5.
6.

Received Items
Nos. 2
Receiving Clerk

Lodged pursuant to the provisions of the TRANSFER OF LAND ACT 1893 as amended on the day and time shown above and particulars entered in the Register Book.

INITIALS OF SIGNING OFFICER

GJack 1

REGISTRAR OF TITLES

FORM C1

WESTERN AUSTRALIA
TRANSFER OF LAND ACT 1893 AS AMENDED.

AGREEMENT DATED 28/4/93

STAMPED lodged

SIGNED

CAVEAT

DESCRIPTION OF LAND (Note 1) | EXTENT | VOLUME | FOLIO

See page 2

CAVEATOR (Note 2)

R&I BANK OF WESTERN AUSTRALIA LTD ACN 050 494 454

ADDRESS FOR SERVICE OF NOTICE ON CAVEATOR (Note 3)

c/- Mallesons Stephen Jaques, St Georges Square, 225 St George's Terrace, Perth (JN:101778702)

REGISTERED PROPRIETOR (Note 4)

BRISTILE LTD ACN 008 668 540 (previously of corner Lord and Newcastle Streets, Perth and) previously of 212 Adelaide Terrace, Perth and now of Level 1, 66 Kings Park Road, West Perth

ESTATE OR INTEREST BEING CLAIMED (Note 5)

As equitable mortgagee

The CAVEATOR claims an estate or interest as specified herein of the estate or interest of the abovenamed REGISTERED PROPRIETOR in the land above described BY VIRTUE OF (Note 6)

A mortgage dated 28 April 1993 granted by the Registered Proprietor in favour of the Caveator over the Land

And FORBIDS the registration of any Instrument affecting the estate or interest (Note 7)

Absolutely

Dated this 29th day of April 19 93

CAVEATOR OR HIS AGENT SIGN HERE (Note 8)

Signed

Mallesons Stephen Jaques
Solicitors and agents for the Caveator
FUT191/DJN

In the presence of Wu Yungren
Daven Yungren Wu
Articled Clerk
22 McGregor Street
Embleton WA

	DESCRIPTION OF LAND	EXTENT	VOLUME	FOLIO
23.	Lot 12 on Diagram 52677	Whole	1580	066
24.	Portion of Cockburn Sound Location 721 the subject of Diagram 4790	Whole	1580	067
25.	Lot 30 on Plan 3699 (Sheet 2)	Whole	1582	918
26.	Lot 6 the subject of Diagram 64866	Whole	1644	850
27.	Lot 4 the subject of Diagram 20746	Whole	1658	171
28.	Portion of each of Collie Agricultural Area Lots 25 and 26 and being part of Lot 1 on Diagram 14316	Whole	1658	172
29.	Swan Location 2983 and portion of Swan Location 3114	Whole	1698	977
30.	Lot 104 on Diagram 65714	Whole	1712	979
31.	Portion of Murray Location 1149	Whole	1726	132
32.	Murray Location 1612	Whole	1726	133
33.	Portion of Canning Location 31 being part of Lot 11 on Diagram 30689	Whole	1764	976
34.	Portion of Swan Location 2982	Whole	1815	650

Mallesons Stephen Jaques
Solicitors and agents for the Caveator

FORM B1

WESTERN AUSTRALIA
TRANSFER OF LAND ACT 1893 AS AMENDED.

ADDITIONAL PAGE TO CAVEAT

Dated 29th April 1993

	DESCRIPTION OF LAND	EXTENT	VOLUME	FOLIO
1.	Peel Estate Lot 187	Whole	46	90A
2.	Lot 1 the subject of Diagram 34893 except and reserving metals, minerals gems and mineral oil (excluding clays, kaolinised schist and associated silicate minerals) all as specified in Transfer 7633/1945	Whole	82	1A
3.	Lot 2 the subject of Diagram 41779	Whole	548	152A
4.	Swan Locations 2986 and 2988	Whole	961	200
5.	Portion of Cockburn Sound Location 721 and being part of the land on Diagram 7854	Whole	1002	316
6.	Portion of Cockburn Sound Location 22 the subject of Diagram 7928	Whole	1002	317
7.	Swan Location 2987	Whole	1063	704
8.	Swan Location 2984	Whole	1099	219
9.	Portion of Cockburn Sound Location 521	Whole	1104	242
10.	Portion of Collie Agricultural Area Lot 26 and being part of Lot 2 on Diagram 14316	Whole	1117	209
11.	Portion of Collie Agricultural Area Lot 25	Whole	1186	474
12.	Swan Location 2985	Whole	1208	612
13.	Peel Estate Lot 448	Whole	1304	977
14.	Portion of each of Cockburn Sound Locations 216 and 295 the subject of Diagram 17851	Whole	1314	172
15.	Portion of Cockburn Sound Location 521 including part of Lot 10 on Diagram 26892	Whole	1482	080
16.	Portion of Serpentine Agricultural Area Lot 19 and being part of Lot 1 on Diagram 1945	Whole	1482	082
17.	Lot 7 on Diagram 10840	Whole	1482	083
18.	Portion of Cockburn Sound Location 521	Whole	1484	575
19.	Lot 101 the subject of Diagram 53190 less portion resumed	Whole	1490	369
20.	Lot 12 the subject of Diagram 53506	Whole	1500	671
21.	Lot 50 the subject of Diagram 52748	Whole	1506	326
22.	Portion of Cockburn Sound Location 521 and being part of the land on Plan 5063 (Sheet 2)	Whole	1521	165

Mallesons Stephen Jaques
Solicitors and agents for the Caveator

FUT185/DJN

INSTRUCTIONS

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ENDORSING INSTRUCTION

NOTICES TO BE SENT: Z L.P.R. 1490/369

EXAMINED

05377/1/92–5M–OC/651

F 183562 C
07 May, 1993 11:52

REG. $ 62.00

CAVEAT

TIME CLOCK

LODGED BY

ADDRESS MALLESONS STEPHEN JAQUES
ST. GEORGE'S SQUARE,
225 ST. GEORGES TERRACE, PERTH
PHONE: 324 8333
ISSUING BOX No. 4

PHONE No.

FAX No.

REFERENCE No.

ISSUING BOX No.

PREPARED BY MALLESONS STEPHEN JAQUES

ADDRESS 225 St George's Terrace
PERTH WA 6000
JLB:JN:101778702

PHONE No. 324 8333 FAX No. 321 1017

INSTRUCT IF ANY DOCUMENTS ARE TO ISSUE TO OTHER THAN LODGING PARTY.

36

TITLES, LEASES, DECLARATIONS ETC. LODGED HEREWITH

1. Dup Caveat
2. _____
3. _____
4. _____
5. _____
6. _____

Received Items

Nos.

Receiving Clerk

Lodged pursuant to the provisions of the TRANSFER OF LAND ACT 1893 as amended on the day and time shown above and particulars entered in the Register Book.

INITIALS OF SIGNING OFFICER

G Sach 1

REGISTRAR OF TITLES

FORM C1

AGREEMENT DATED 28/4/93

WESTERN AUSTRALIA
TRANSFER OF LAND ACT 1893 AS AMENDED.

STAMPED Godyard

SIGNED

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Dated this 29th day of April 19 93

CAVEATOR OR HIS AGENT SIGN HERE (Note 8)

Signed

Mallesons Stephen Jaques
Solicitors and agents for the Caveator
FUT184/DJN

In the presence of

Daven Yungren Wu
Articled Clerk
22 McGregor Street
Embleton WA

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Mallesons Stephen Jaques
Solicitors and agents for the Caveator

FORM B1

WESTERN AUSTRALIA
TRANSFER OF LAND ACT 1893 AS AMENDED.

ADDITIONAL PAGE TO CAVEAT Dated 29th April 1993

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15.	Portion of Cockburn Sound Location 521 including part of Lot 10 on Diagram 26892	Whole	1482	080
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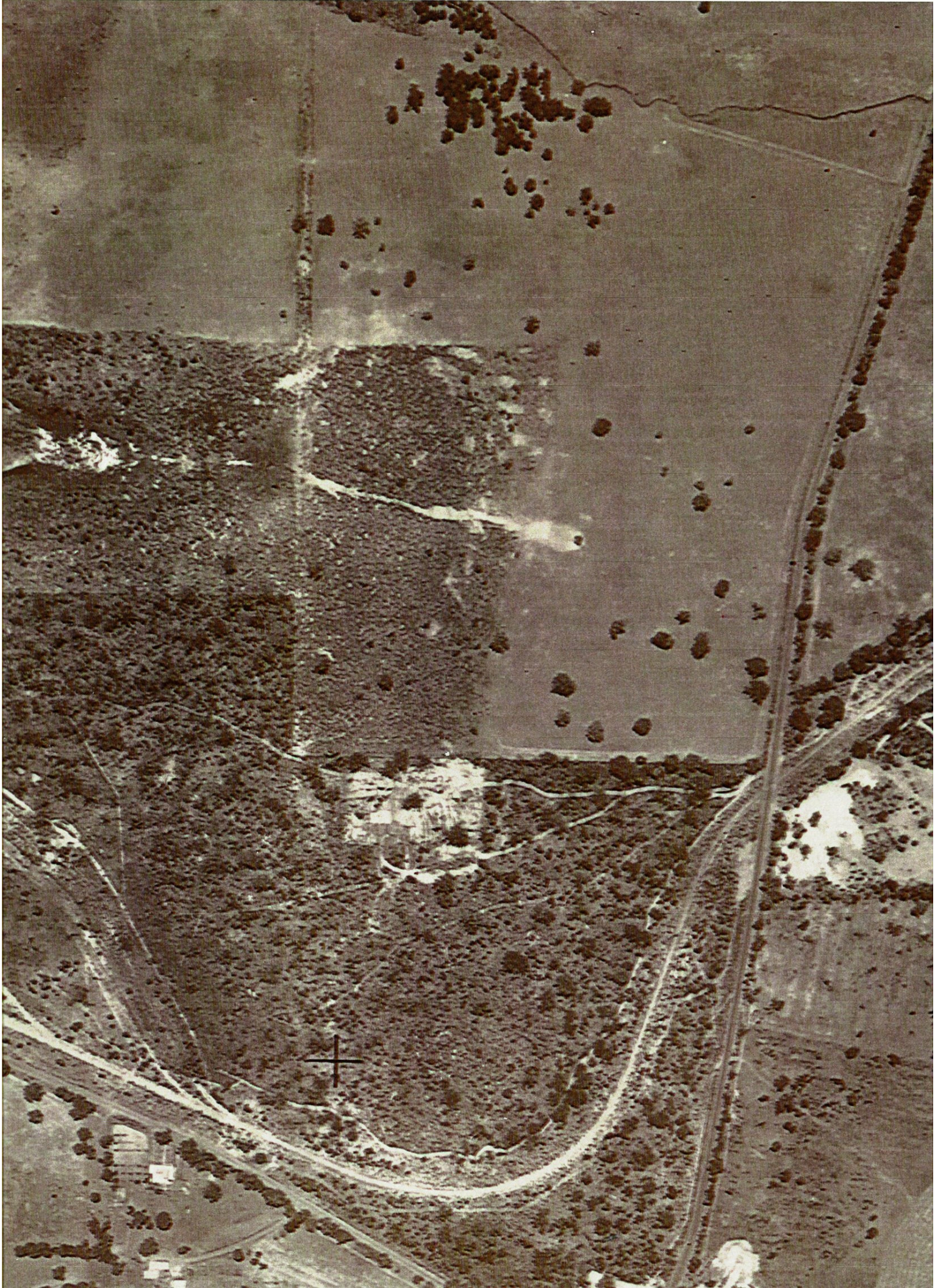
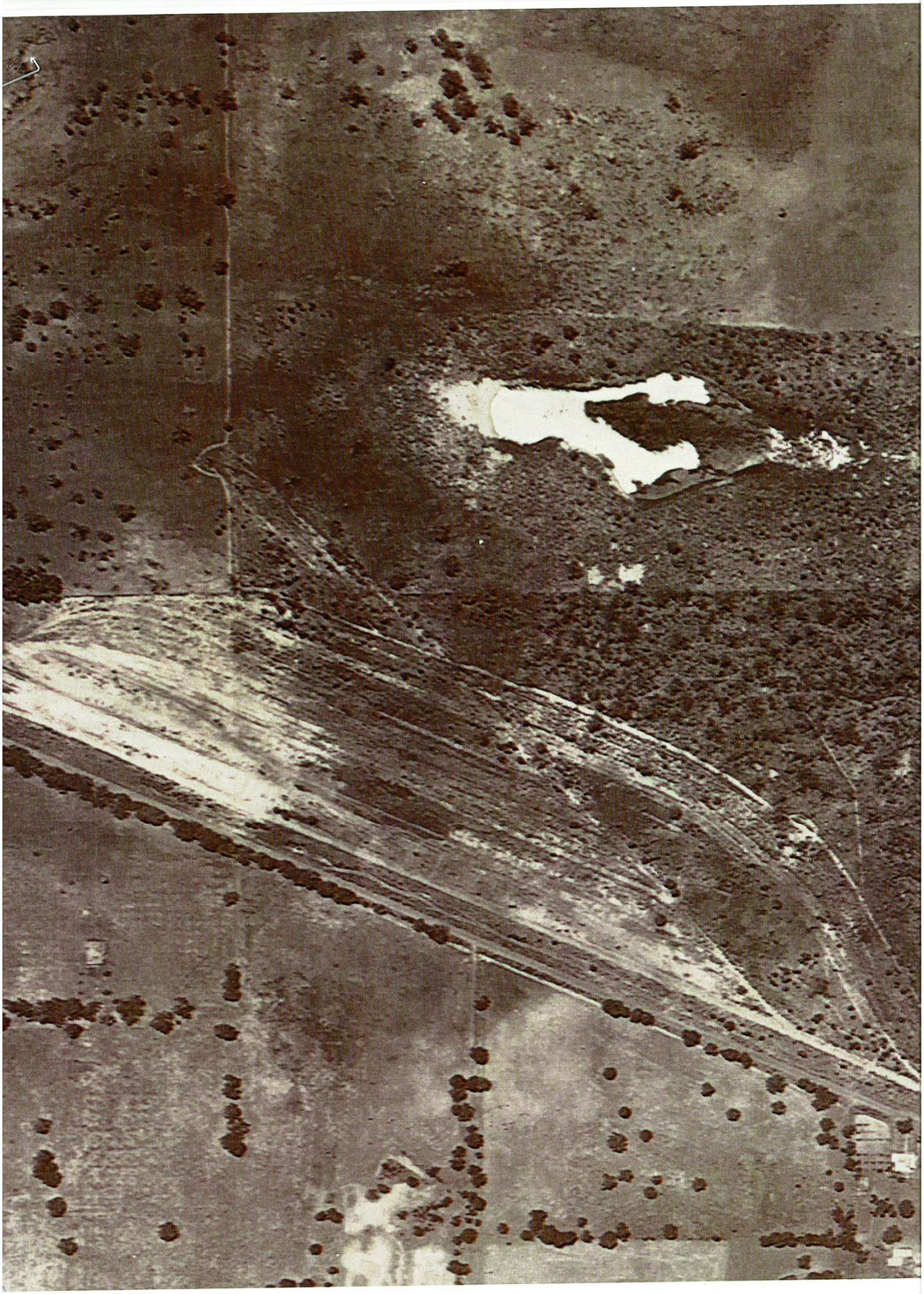
17.	Lot 7 on Diagram 10840	Whole	1482	083
18.	Portion of Cockburn Sound Location 521	Whole	1484	575
19.	Lot 101 the subject of Diagram 53190 less portion resumed	Whole	1490	369
20.	Lot 12 the subject of Diagram 53506	Whole	1500	671
21.	Lot 50 the subject of Diagram 52748	Whole	1506	326
22.	Portion of Cockburn Sound Location 521 and being part of the land on Plan 5063 (Sheet 2)	Whole	1521	165

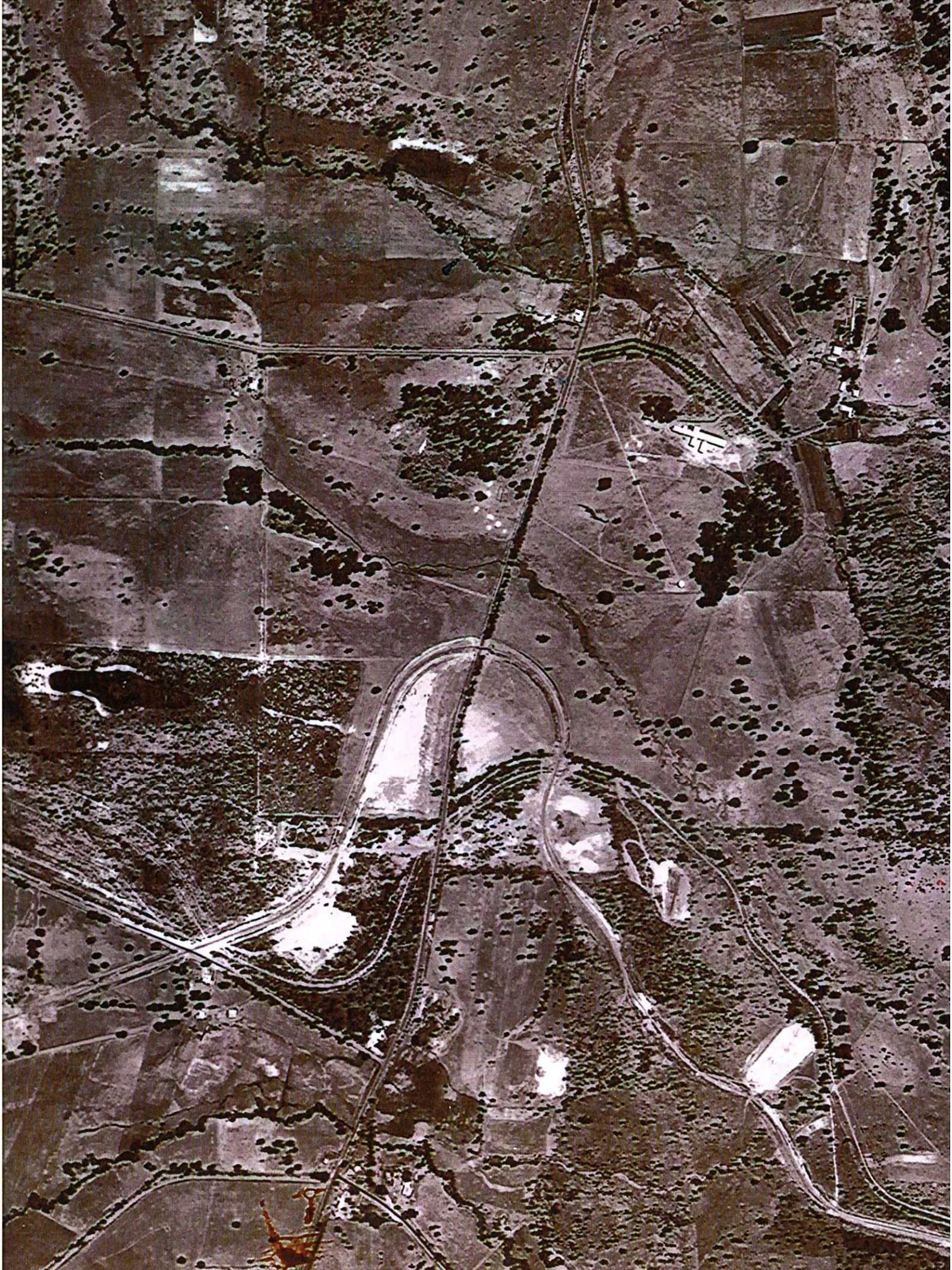
Mallesons Stephen Jaques
Solicitors and agents for the Caveator

FUT185/DJN

APPENDIX 14 : Historical Aerials







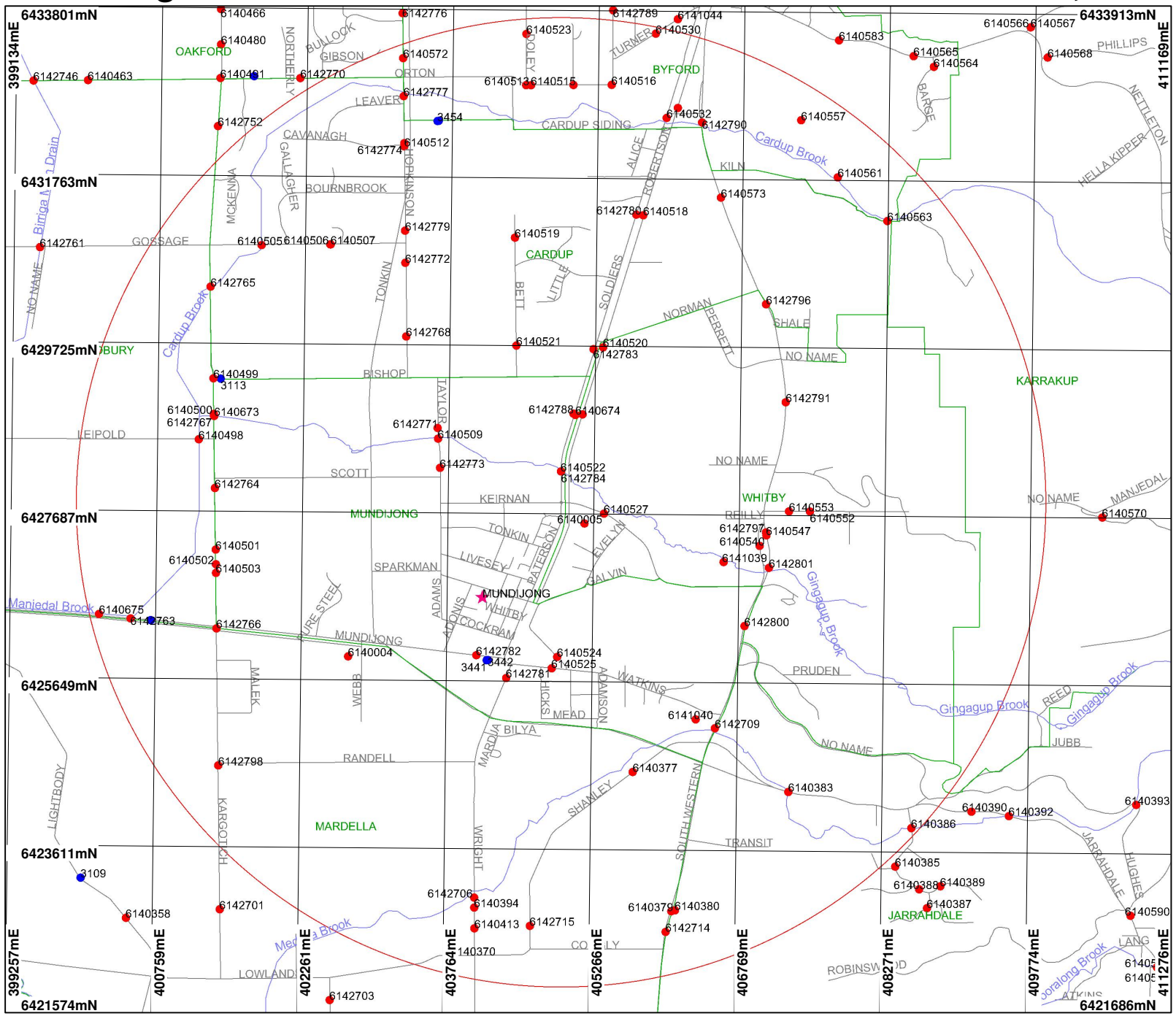

U-1 4
CONTROLLED
5289
WA1435 PINJARRA 1:250,000 SHEET RUN 5(5280-5316)1:40,000 152.56mm 11.12.72 PROJ. N 28


WILD 15/4 UAGA
Nr.13037 152.72
000032
5258 WA 2271 PINJARRA 1:250 000
RUN 5 (5251–5282)
SCALE 1:50 000
12.1.85
JOB NO. 840098


N
1953 m
Image © 2007 DigitalGlobe
© 2007 Google™
Pointer 32°16'17.38" S 115°58'52.40" E
Streaming 100%
Eye alt 6.76 km

APPENDIX 15 : Department of Water (WRC: WIN Database)

oW Monitoring Bores within a 5km rad of Int Keiman St & Paterson St, Mundijong



LEGEND

- Road Centrelines - DLI 1/5/04
- Localities - DLI
- Hydrography, linear (hierarchy) - DOW
- Australian Coastline - DOW
- Towns - DLI 8/04
- WIN Groundwater Sites, Monitoring - DoW
- WIN Surface Water Sites, Other - DoW
- WIN Surface Water Sites, Stream Gauging - DoW

N

0 ~1.5 km

Scale 1:61470

(Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been projected. This may result in geometric distortion or measurement inaccuracies.

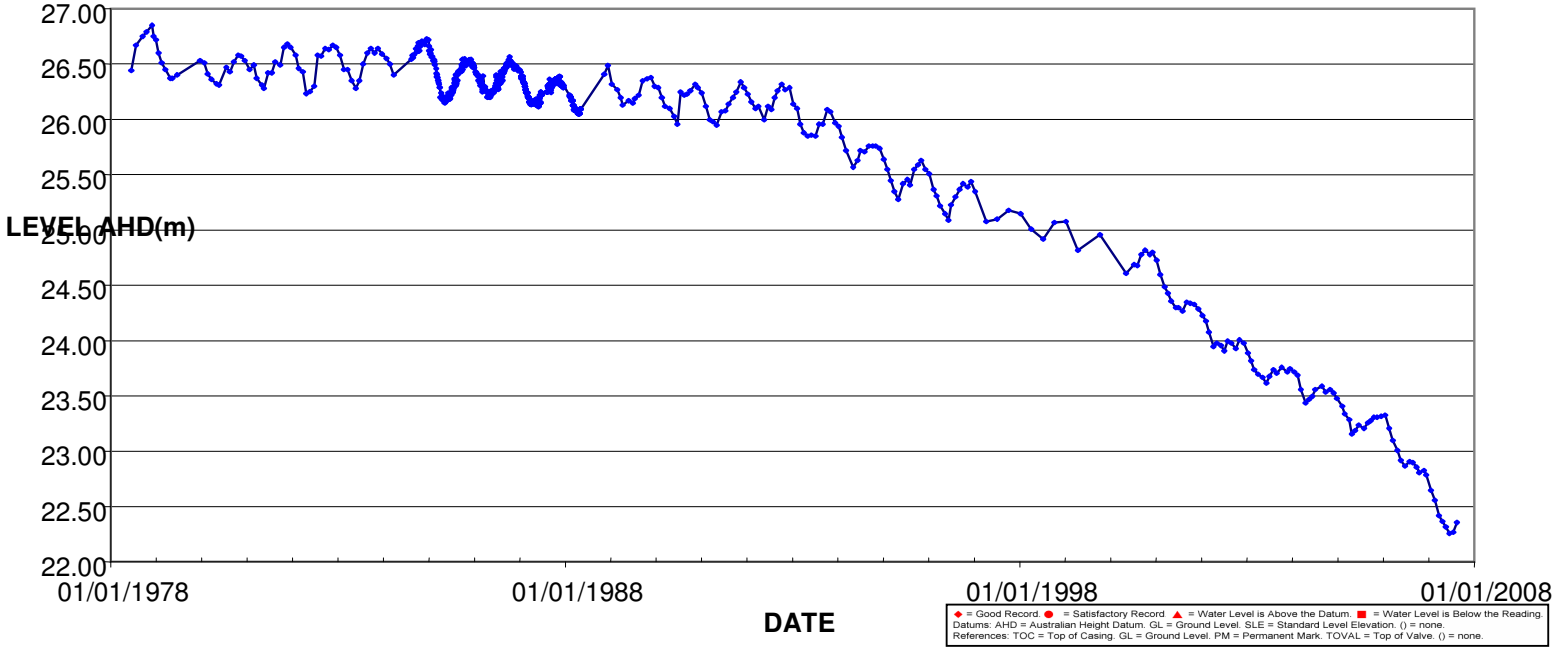
Prepared by: brownt
Prepared for: DR19951
Date: 4/09/2007 12:49:32 PM

Information derived from this map should be confirmed with the data custodian acknowleged by the agency acronym in the legend.

Department of Water
Government of Western Australia

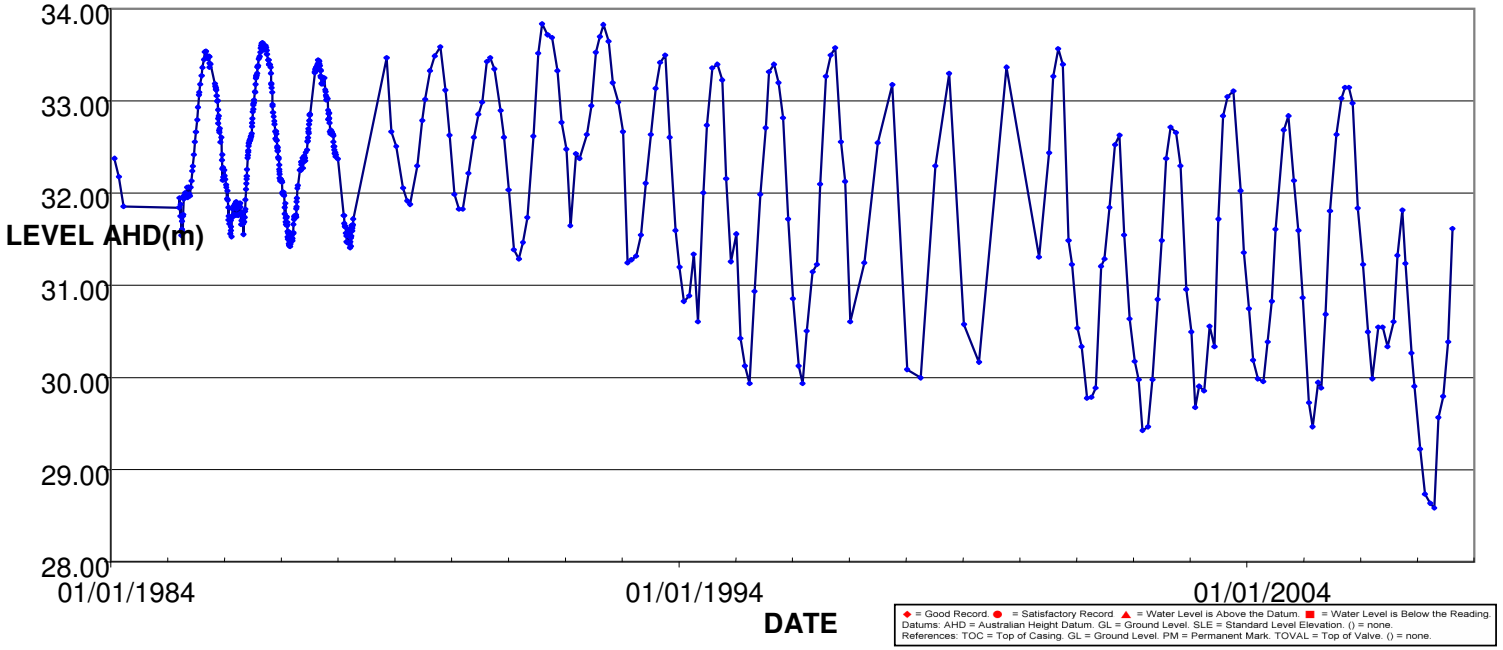
61415041 ARTESIAN MONITORING AM56

Easting = 404176.00 Northing = 6425908.00 Zone = 50 TOC = 34.697mAHD WIN SITE ID = 3441



61415042 ARTESIAN MONITORING AM56A

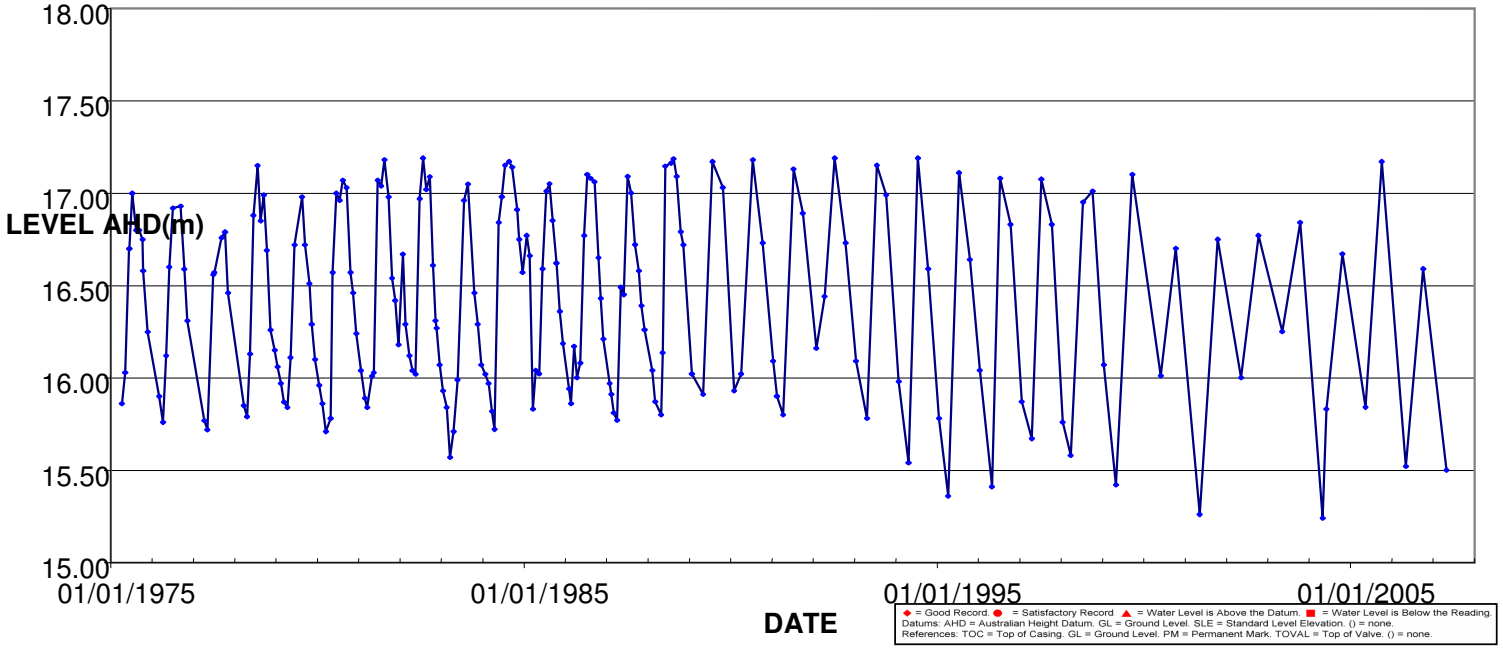
Easting = 404190.00 Northing = 6425909.00 Zone = 50 TOC = 35.176mAHD WIN SITE ID = 3442



◆ = Good Record. ● = Satisfactory Record. ▲ = Water Level is Above the Datum. ■ = Water Level is Below the Reading.
Datums: AHD = Australian Height Datum. GL = Ground Level. SLE = Standard Level Elevation. () = none.
References: TOC = Top of Casing. GL = Ground Level. PM = Permanent Mark. TOVAL = Top of Valve. () = none.

61410151 LAKE THOMSON T270

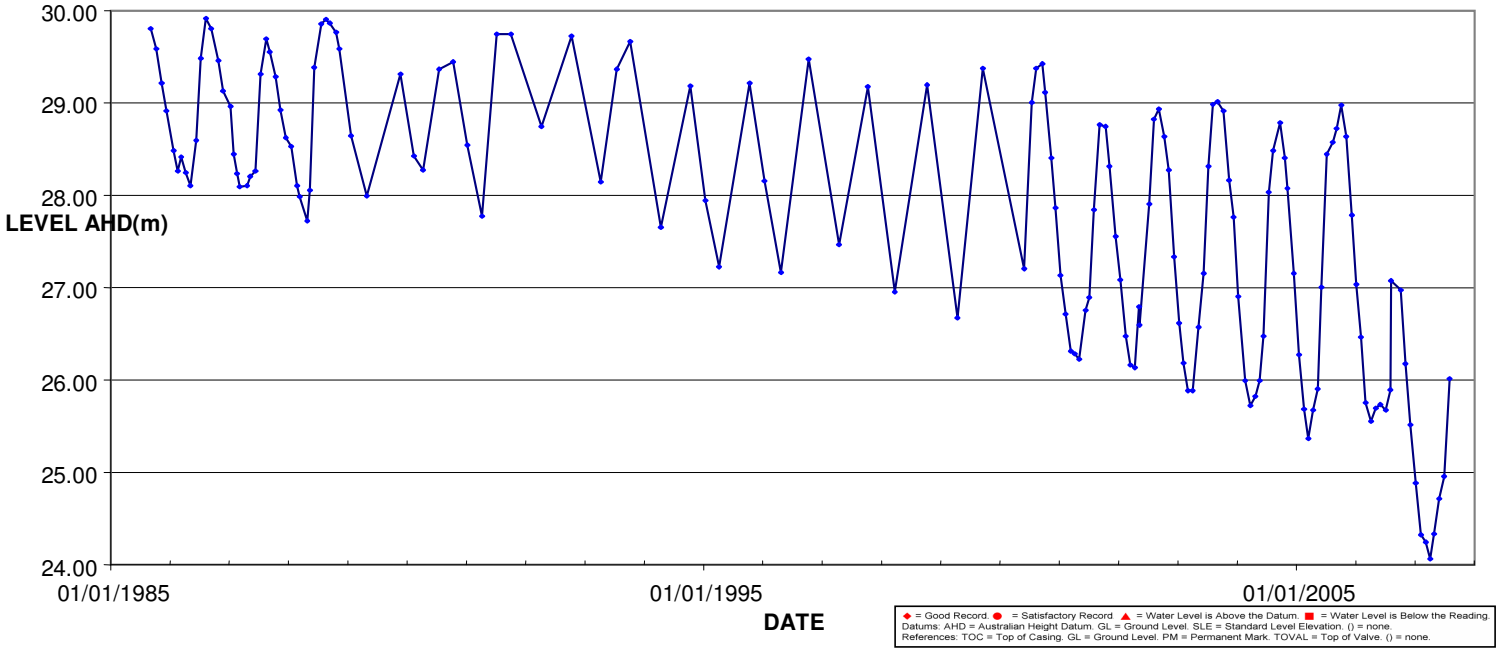
Easting = 401401.00 Northing = 6429300.00 Zone = 50 TOC = 17.271mAHD WIN SITE ID = 3113



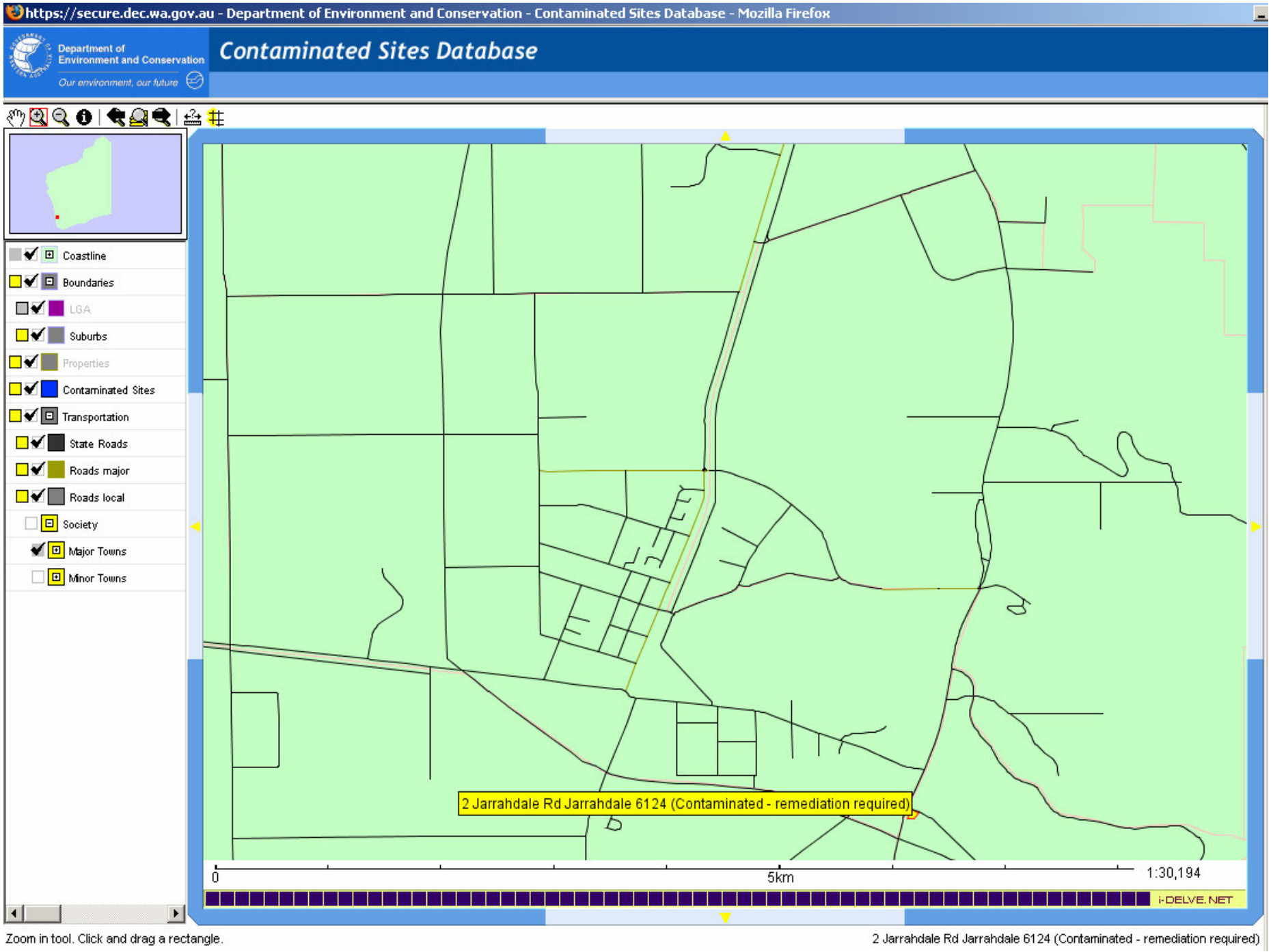
◆ = Good Record ◆ = Satisfactory Record ▲ = Water Level is Above the Datum. ■ = Water Level is Below the Reading.
Datums: AHD = Australian Height Datum. GL = Ground Level. SLE = Standard Level Elevation. () = none.
References: TOC = Top of Casing. GL = Ground Level. PM = Permanent Mark. TOVAL = Top of Valve. () = none.

61415054 ARTESIAN MONITORING AM50X

Easting = 403607.00 Northing = 6432448.00 Zone = 50 TOC = 31.374mAHD WIN SITE ID = 3454



APPENDIX 16 : DEC Contaminated Sites Database Search


https://secure.dec.wa.gov.au - Department of Environment and Conservation - Contaminated Sites Database - Mozilla Firefox
Department of Environment and Conservation
Our environment, our future
Contaminated Sites Database
Coastline
Boundaries
LGA
Suburbs
Properties
Contaminated Sites
Transportation
State Roads
Roads major
Roads local
Society
Major Towns
Minor Towns
2 Jarrahdale Rd Jarrahdale 6124 (Contaminated - remediation required)
0
5km
1:30,194
i-DELVE.NET
Zoom in tool. Click and drag a rectangle.
2 Jarrahdale Rd Jarrahdale 6124 (Contaminated - remediation required)

APPENDIX 17 : Photographs from Site Visits

Photographs 7&8: Dairy on Lot 11 (Taylor Rd)

Photograph 9: Poultry on Lot 2

Photographs 10, 11 & 12 Council Depot

Photograph 13: Garden Hire Business



Photographs 14, 15 &16: Decommissioned Landfill

Photograph 17: Telecommunications Tower

Photograph 18: Decommissioned Mine

Photograph 19: Stockfeeds



Photographs 20, 21 & 22 Motorcross Track

Photographs 23 & 24: Cardup Landfill

Photograph 25: Timber Mill

Photograph 26: Council Pound

APPENDIX 18 : WAPC South West Metropolitan ASS Risk Map

Western Australian Planning Commission
50 spatial planning years

N

0 1 2 3 4 5
kilometres

Produced by Project Mapping Section,
Mapping and GeoSpatial Data Branch,
Department for Planning and Infrastructure,
on behalf of the Western Australian Planning
Commission, Perth, WA May 2007

map7\ \plan_imp\plan_reform\acid_sulfate
\Review_Nov06\ass_SouthMetRegion_f20.dgn

1:50 000 acid sulfate soils data supplied by
Department of Environment and Conservation,WA
and has a positional accuracy of + or - 125 m

Legend

- high to moderate risk of ASS occurring within 3 m of natural soil surface
- moderate to low risk of ASS occurring within 3 m of natural soil surface
- no known risk of ASS occurring within 3 m of natural soil surface (or deeper)
- local government boundary

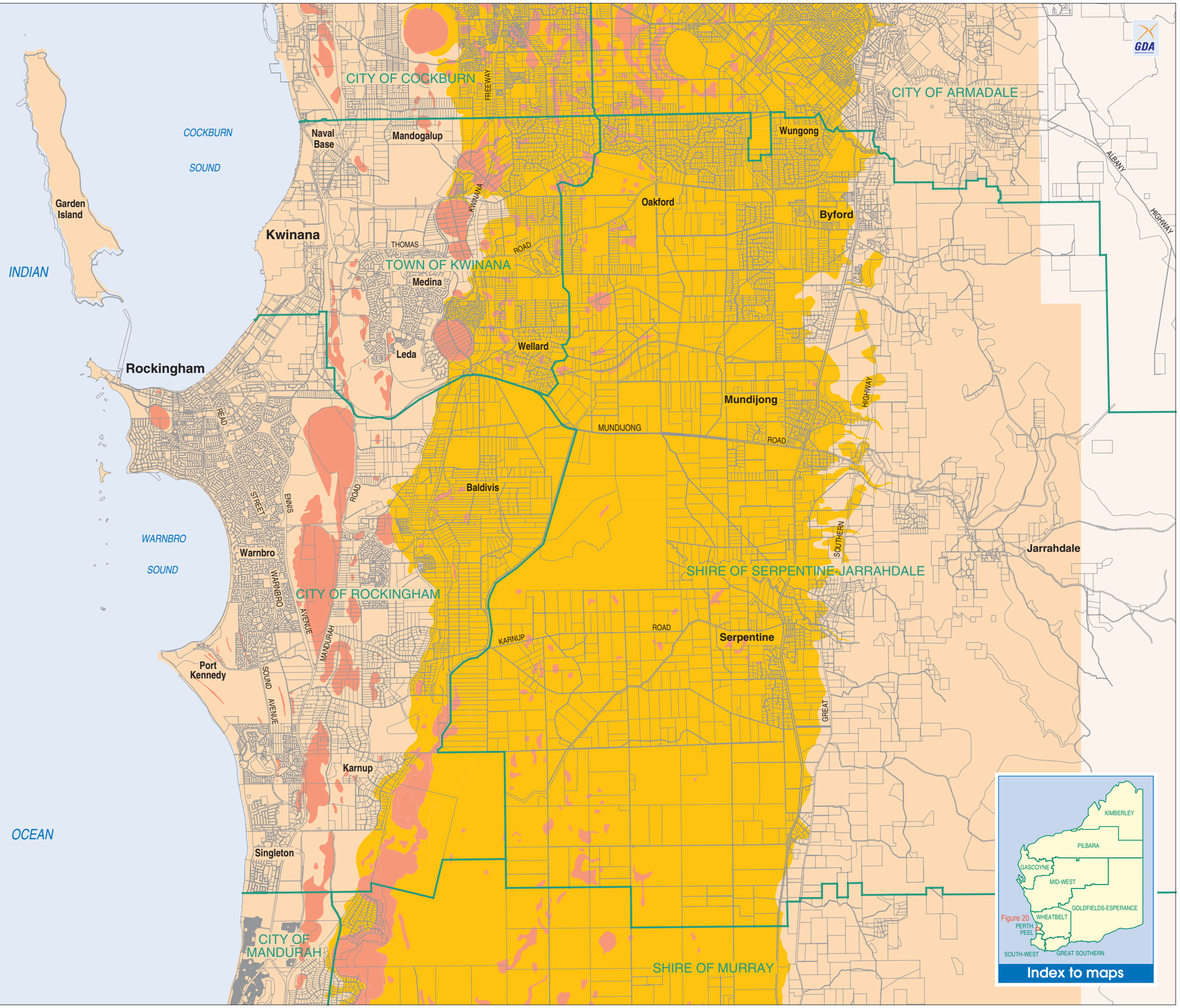
Risk classifications are not restricted to cadastral or hydrographic boundaries.

The acid sulfate soils maps set out in Planning Bulletin 64 are provided as a guide to the location of acid sulfate soil layers occurring at different depths in the areas of coverage. They have been prepared on the basis of geological origin, depth to groundwater and partial 'ground-truthing'.

The maps have been prepared by the Department of Environment and Conservation and the Department for Planning and Infrastructure on this basis in good faith, exercising all due care and attention. No representation or warranty, expressed or implied, is made as to the relevance, accuracy, completeness or fitness for purposes of these maps in respect of any particular user's circumstances. Users of these maps should satisfy themselves concerning their application to their situation and where necessary seek expert advice.

The acid sulfate soils maps set out in Planning Bulletin 64 will be periodically updated as new information becomes available and the State Government's acid sulfate soil mapping program progresses.

Users should check the Planning Bulletins page on the Western Australian Planning Commission's website at www.wapc.gov.au to ensure that they have the most up-to-date version of the mapping.



Planning Bulletin 64

South Metropolitan Region Scheme acid sulfate soils

Figure 20

APPENDIX 19 : Surface Water Quality within the MW Cell

Surface Water Quality Field Data

Sample Number	Location	Co-ordinates GPS (MGA Zone 50)	Temperature	pH	Lab pH	Difference	Electrical Conductivity	Lab EC (at 25°C)	Difference	Salinity	Turbidity	Oxidation Reduction Potential	Dissolved Oxygen		Comments
30-Oct-07			**(°C)**				**(µS/cm)**	**(µS/cm)**		**(ppt)**	**(NTU)**	**(mV)**	**(%)**	**(mg/L)**	
Surface Water Quality: Field Measurements															
SW1	Blank	NA	NA	NA	7.12	NA	NA	528	NA	NA	NA	NA	NA	NA	
SW2	Site 1	407043E, 6427006N	15.35	8.25	7.51	0.74	343	329	14	0.16	25.80	286.0	104.1	10.4	Minnows and Mussels
SW4	Site 7	404927E, 6428204N	16.96	8.10	6.89	1.21	359	346	13	0.15	11.70	271.0	138.6	12.5	
SW5	Site 6	404936E,6428561N	25.90	7.34	6.90	0.44	482	455	27	0.22	13.50	307.0	107.8	8.6	Water boatmen and tadpoles
SW7	Site 5	403662E, 6428590N	15.07	7.83	7.44	0.39	406	395	11	0.18	6.30	234.0	105.2	10.8	
SW9	Site 2	407079E, 6429072N	15.84	8.07	7.35	0.72	308	294	14	0.14	8.50	214.0	86.1	8.5	Tadpoles and oil scum
SW11	Site 3	407053E, 6430257N	16.70	7.67	7.93	-0.26	1150	1120	30	0.58	9.70	188.0	101.0	9.7	
SW12	Site 4	405314E, 6429679N	18.98	7.73	7.60	0.13	887	862	25	0.44	5.30	170.0	82.7	8.2	

Surface Water Quality Laboratory Data

Sample Number	Location	Co-ordinates GPS (MGA Zone 50)	pH	Electrical Conductivity (EC)	Ammonia NH4	Nitrite + Nitrate NOx	Total Kjeldahl Nitrogen (TKN)	Total Nitogen N	Total Phosphorus P	Reactive Phosphorus P	Arsenic As	Cadmium Cd	Chromium Cr	Copper Cu	Lead Pb	Nickel Ni	Zinc Zn	Mercury
30-Oct-07				**(mS/cm at 25°C)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**	**(mg/L)**
SW1	Blank	NA	7.12	528	**0.105**	**<0.010**	**0.200**	**0.200**	**0.010**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**0.0640**	**<0.001**	**<0.001**	**0.0200**	**<0.0001**
SW2	Site 1	407043E, 6427006N	7.51	329	**0.160**	**0.176**	**0.300**	**0.500**	**0.020**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
SW4	Site 7	404927E, 6428204N	6.89	346	**0.105**	**0.070**	**0.300**	**0.400**	**0.020**	**0.010**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
SW5	Site 6	404936E,6428561N	6.90	455	**0.118**	**0.017**	**0.200**	**0.200**	**0.030**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
SW7	Site 5	403662E, 6428590N	7.44	395	**0.111**	**0.059**	**0.300**	**0.400**	**0.030**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
SW9	Site 2	407079E, 6429072N	7.35	294	**0.137**	**<0.010**	**0.400**	**0.400**	**0.020**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
SW11	Site 3	407053E, 6430257N	7.93	1120	**0.141**	**1.380**	**0.700**	**2.100**	**0.020**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
SW12	Site 4	405314E, 6429679N	7.60	862	**0.137**	**<0.010**	**0.400**	**0.400**	**0.020**	**<0.010**	**<0.001**	**<0.0001**	**<0.001**	**<0.001**	**<0.001**	**<0.001**	**<0.005**	**<0.0001**
Limits of Reporting (Water Analyses)			**0.01**	**1.00**	**0.010**	**0.010**	**0.100**	**0.100**	**0.010**	**0.010**	**0.001**	**0.0001**	**0.001**	**0.001**	**0.001**	**0.001**	**0.005**	**0.0001**
Water Quality Objectives(refer Notes 1)			**6.5 - 8.5**	**120 -300**	**0.08**	**0.15**		**1.2**	**0.065**	**0.04**	**0.007**	**0.002**	**0.05**	**2**	**0.01**	**0.02**	**3***	**0.00**

Note: **1: ANZECC Drinking Water Quality Guidelines, 2004, and ANZECC *National Water Quality Management Strategy*, 2000 (Low land river) *Indicates aesthetic value where no health values has been determined**

Denotes exceedence of drinking water quality guidelines

APPENDIX 20 : Heritage Management Categories

The following Heritage Management Categories have been sourced from the *Municipal Heritage Inventory Shire of Serpentine-Jarrahdale Parts 1, 2 and 3*, 2000.

Category 1A: Conservation Essential

A place which may meet the criteria for inclusion in the State Register of Heritage Places (ie: of State or national value) on an individual level.

Highest level of protection appropriate;

Warrants a referral to the Heritage Council of WA and further assessment for possible entry into the State Register;

Provide maximum encouragement to the owner(s) to conserve the significance of the place;

Photographically record the place.

Possible Recommendations

Individual consideration of Town Planning Incentives. Assist in maintenance of the property and offer other financial/non-financial incentives to owners. Design guidelines/heritage policies should be developed in order to enhance and conserve the place in context with its location. Design guidelines/heritage policies should be developed which would include the place.

Category 1B: Conservation Essential

A place which may meet the criteria for inclusion in the State Register of Heritage Places (ie: of State or national value) because of its association with a group of places which together form a heritage precinct or area.

Highest level of protection appropriate for all places in the group;

Warrants a referral to the Heritage Council of WA and further assessment for possible entry into the State Register;

Provide maximum encouragement to the owner(s) to conserve the significance of the place;

Photographically record the place (individually and its relationship to other places).

Possible Recommendations

Individual consideration of Town Planning Incentives. Assist in maintenance of the property and offer other financial/non-financial incentives to owners. Design guidelines/heritage policies should be developed in order to enhance and conserve the place in context with its location.

Category 2: Conservation Highly Recommended

Of very considerable value to the Municipality.

High level of protection appropriate;

Provide maximum encouragement to the owner(s) under the Town Planning Scheme to conserve the significance of the place;

Encourage owner(s) to reinstate and/or retain original fabric/features of the place (ie verandas, shingles, timber windows);

All development applications (including demolition) should be considered by Council;

Photographically record the place prior to any major development or demolition.

Recommendations

Incorporate within the Town Planning Scheme and offer financial/non-financial incentives to owners. Design guidelines/heritage policies should be developed in order to enhance and conserve the place in context with its location.

Category 3: Conservation Encouraged

Significant as an individual building within the Municipality.

Retain and conserve if possible;

Endeavour to conserve the significance of the place through the provisions of the Town Planning Scheme;

Photographically record the place prior to any major development or demolition.

Recommendations

Incorporate in Heritage Precincts within the Town Planning Scheme and cover with development guidelines and incentives such as first consideration of verge maintenance and upgrading by Council and other financial/non-financial incentives.

Category 4: Conservation Desirable

Of some significance on an individual level or significant in contributing to local character or streetscape value. Not essential to an understanding of the history of the district.

Retain if possible;

Photographically record the place prior to any major development or demolition.

Recommendations

Incorporate in Heritage Precincts within the Town Planning Scheme and cover with development guidelines and incentives (ie protection of façade or retain scale and setback in the event of demolition and redevelopment).

Category 5: Historic Site or Significant Vegetation

Historic site without built features;

Historic site/building much modified or with association to historic personage(s) (ie monument/memorial);

A cultural or natural landscape valued by the community.

Recommendations

Recognise the significance with a plaque, paving stone or appropriate marker;

Incorporate into heritage trails;

Liaise with relevant government agencies (ie DEC) to retain and conserve quality and significance of the site and setting.

APPENDIX 21 : Aboriginal Heritage Search

Search Criteria

11 survey reports with information on the sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6425949	402822
6429252	406181

Disclaimer

Reports shown may not be held at DIA. Please consult report holder for more information. Refer to www.dia.wa.gov.au/heritage for information on requesting reports held by DIA.

Copyright

Legend

Access

Some reports are restricted. The type of restriction is shown as a code in brackets following the catalogue number. No code indicates an unrestricted report.

[CLOSED]	Closed
[OWE]	Open with exception
[TBD]	To be determined
[RESTRICTED PENDING]	Restricted pending

Report ID	Catalogue Number	Title	Author	Old Ref No.
105699	HSR MW 2001 MAC [OWE]	Aboriginal Heritage issues and cable crossings : upper Canning River downstream from Nicholson Road traffic bridge adjacent downstream from Canning Bridge and Narrows bridge utilzing internal bridge structure Swan River adjacent upstream to Causeway	Machin, Barrie	0781 01
104379	HSR MW 1986 HAL	Australian Research Grants Scheme: Final Report on the Project the Swan Coastal Plain, Western Australia.	Hallam, S.	86 069
105723	HSR MW 2001 PAR	Consultation for a Section 18 Application under the Aboriginatl Heritage Act (1972) of the Proposed route of the Tonkin Highway Extension Albany Highway/Mills Road West, Martin, to South Western Highway, Mundijong	Parker, Ronald T	0787 01
18175	HSR MW 1998 KOL [OWE]	Local subdivision & infrastructure plan : volume 2 - technical appendix	Koltasz Smith & Partners	0376 00
19121	HSR MW 1999 EDW [OWE]	Report of an Aboriginal Heritage Survey : proposed Tonkin Highway extension and Mundijong Road Realignment Project	Edwards, K	0633 01
101972	HSR SW 1995 BLO [OWE]	Report of an Aboriginal Heritage Survey, South-East Corridor Structure Plan. Oct.1995.	Blockley, E	95 139
104275	HSR SW 1989 OCO [OWE]	Report on a Survey for Aboriginal Sites on the Proposed Byford-Collie and Ongerup-Jerramungup Sections of the Perth to Adelaide Optic Fibre Cable Route. December 1989.	O'Connor, R. & Quartermaine, G.	97 004
102051	HSR MW 1996 BLO	Revised Report of an Aboriginal Heritage Survey South-East Corridor Structure Plan. March. 1996.	Blockley, E	96 041
19122	HSR MW 2001 BSD [OWE]	Summary report section 18 notice to disturb Aboriginal Sites : Tonkin Highway extension Mills Road West, Martin to South Western Highway, Mundijong	BSD Consultants Pty Ltd	0634 01
106036	HSR MW 2001 HOO	The report of an Aboriginal archaeological assessment of the proposed Pinjar to Cataby Transmission Line, Western Australia	Hook, Fiona	0943 02
19380	HSR MW 2001 WES	Tonkin Highway extension : public environmental review	Western Infrastructure	0887 02

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