Clearing of 100 hectares of Native Vegetation for Agriculture: Kent Location 1910, Gairdner, Shire of Jerramungup

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Mr D W & Mrs S M Meade

Report and recommendations
of the Environmental Protection Authority

Environmental Protection Authority
Perth, Western Australia
Bulletin 1041
January 2002

ISBN. 0 7307 6669 1
ISSN. 1030 - 0120
Assessment No. 1253

Summary and recommendations

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the proposal by Mr D W & Mrs S M Meade (the proponents and landowners) to clear 100 hectares of native vegetation on Kent Location 1910 for agriculture. Specifically, the stated purpose of the proposed clearing is to enable the expansion of an existing grazing and cropping enterprise.

Location 1910 is located approximately 40 km south of Jerramungup on Roberts Road, in the Shire of Jerramungup.

The proposed clearing, if allowed to proceed, would reduce the amount of native vegetation on the property from 400 hectares (approximately 36% of the property) to 300 hectares (26% of the property).

The EPA has made its own assessment of the environmental impacts of the proposal, based on available information and advice from relevant government agencies without a requirement for the proponents to prepare their own environmental review.

This report is the EPA's report to the Minister for the Environment and Heritage on the proposal pursuant to Section 44 of the *Environmental Protection Act 1986*.

Environmental Factors

It is the EPA's opinion that the environmental factors relevant to this proposal are:

- Nature conservation and biological diversity - impacts due to loss of native vegetation;
- Land degradation – potential for adverse on-site and off-site impacts on land productivity and ecological processes;
- Impacts on ecological processes associated with the Gairdner River and Fitzgerald River National Park; and
- Greenhouse gas emissions.

Conclusions

The EPA has considered the proposal by Mr D W & Mrs S M Meade to clear 100 ha of native vegetation on Kent Location 1910 for agriculture with reference to the relevant environmental factors.

In assessing this proposal the EPA has taken into account the paucity of property specific information on the biophysical environment of the property and the high level of significance accorded to the nearby Fitzgerald Biosphere Reserve in terms of conservation of biodiversity. Kent Location 1910 is located in the biosphere's buffer and transition zone. Native vegetation communities in the biosphere area are likely to exhibit levels of plant species diversity and endemism which are of State, national and international significance.

The proposal also has potential for further adverse impacts on the ecological state of the Gairdner River and the Gordon Inlet which has been proposed for inclusion in Fitzgerald River National Park.

Based on the information which is available, and adopting a precautionary approach, the EPA considers that the proposed clearing of native vegetation on Kent Location 1910 cannot be judged to meet the EPA's objectives for nature conservation and biodiversity, land degradation or protection of ecological processes associated with the Gairdner River and Fitzgerald River National Park. Rather, the proposal would be likely to continue the loss of nature conservation and biological diversity values flora, fauna and ecosystems in the region.

The EPA is also aware that the proposal may obviate or lessen the effectiveness of the catchment restoration efforts of the community and local landholders, and funding obtained from the Commonwealth Natural Heritage Trust. The proposal also appears to be inconsistent with the Government's Bush Heritage Trust commitment to achieving the national goal of reversing the long term decline in the quality and extent of Australia's native vegetation cover by the year 2001.

Accordingly the EPA considers the proposal should be viewed as environmentally unacceptable and should not proceed.

The EPA has assessed a number of land clearing proposals in recent years. As a result of information derived from these assessments and growing scientific evidence of significant and broad scale environmental degradation and reduction of biodiversity in the agricultural area resulting from the clearing of native vegetation, the EPA has formed the view that any further reduction in native vegetation in this area through agricultural clearing cannot be supported.

Recommendations

The EPA submits the following recommendations to the Minister for the Environment and Heritage:

1. That the Minister considers the report on the relevant environmental factors of:

   a) Nature conservation and biological diversity - impacts due to loss of native vegetation;
   b) Land degradation – potential for adverse on-site and off-site impacts on land productivity and ecological processes;
   c) Impacts on ecological processes associated with the Gairdner River and Fitzgerald River National Park; and
   d) Greenhouse gas emissions,

   as set out in Section 4 of this report.

2. That the Minister notes that the EPA has concluded that the proposal:
   a) cannot be judged to meet the EPA's objectives for nature conservation and biodiversity, prevention of land degradation, or protection of ecological processes associated with the Gairdner River and Fitzgerald River National Park, and rather, would be likely to continue the loss of nature conservation and biological diversity values flora, fauna and ecosystems in the region;
   b) may if implemented, obviate or lessen the effectiveness of the catchment restoration efforts of local landholders and funding obtained from the Commonwealth Natural Heritage Trust; and
   c) would be inconsistent with the Government's Bush Heritage Trust commitment to achieving the national goal of reversing the long term decline in the quality and extent of Australia's native vegetation cover by the year 2001,

   and that accordingly the EPA considers the proposal should be viewed as environmentally unacceptable and should not proceed.

3. That the Minister not issue a statement that the proposal may be implemented.

Contents

1. Introduction and background

This report provides the advice and recommendations of the Environmental Protection Authority (EPA) to the Minister for the Environment and Heritage on the proposal by Mr D W & Mrs S M Meade (the proponents and landowners) to clear 100 hectares (ha) of native vegetation on Kent Location 1910 for agriculture. Kent Location 1910 is located approximately 40 kilometres (km) south east of Jerramungup on Roberts Road (see Figure 1). The stated purpose of the proposed clearing is to enable the expansion of an existing grazing and cropping enterprise.

The proposed clearing, if allowed to proceed, would reduce the amount of native vegetation remaining on the property from 400 ha (approximately 36% of the property) to 300 ha (27% of the property).

Under the *Soil and Land Conservation Act 1945*, any landholder wishing to clear native vegetation greater than 1 ha in area is required to notify the Commissioner of Soil and Land Conservation (the Commissioner). The Commissioner then decides whether or not to object to the clearing depending on whether land degradation is likely to occur and may issue a Soil Conservation Notice (SCN) to prevent that clearing taking place.

The proponents notified the Commissioner of their intention to clear the subject land on 17 September 1998. The proposal was then considered by the Inter Agency Working Group under the *'Memorandum of Understanding (MOU) for the protection of remnant vegetation on private land in the agricultural region of Western Australia.*

The Commissioner objected to the clearing of 59.6 ha because of the likelihood of land degradation. However, as it was recognised that the whole proposal (100 ha) would have a negative impact on nature conservation (biodiversity) values, the Commissioner referred the proposal to the EPA.

In January 1999 the EPA determined that the proposal should be formally assessed at Consultative Environmental Review (CER) under Part IV of the *Environmental Protection Act 1986* (the EP Act).

Following the setting of the level of assessment for the proposal, the proponents advised the EPA that they were not in a position to undertake the necessary investigations required to prepare a CER document. This resulted in the assessment of the proposal being suspended.

In June 2001, following the finalisation of the EPA's Position Statement No 2 on Environmental Protection of Native Vegetation, the Chairman of the EPA wrote to the proponents advising of the Authority's decision to proceed to reporting on the proposal to the Minister for the Environment and Heritage without the need for further work by the proponents. The proponents were invited to submit any supporting information that they wished to provide by 20 July 2001. However, no supporting information has subsequently been received.

This report is the EPA's report to the Minister for the Environment and Heritage on the proposal pursuant to Section 44 of the *Environmental Protection Act 1986*.

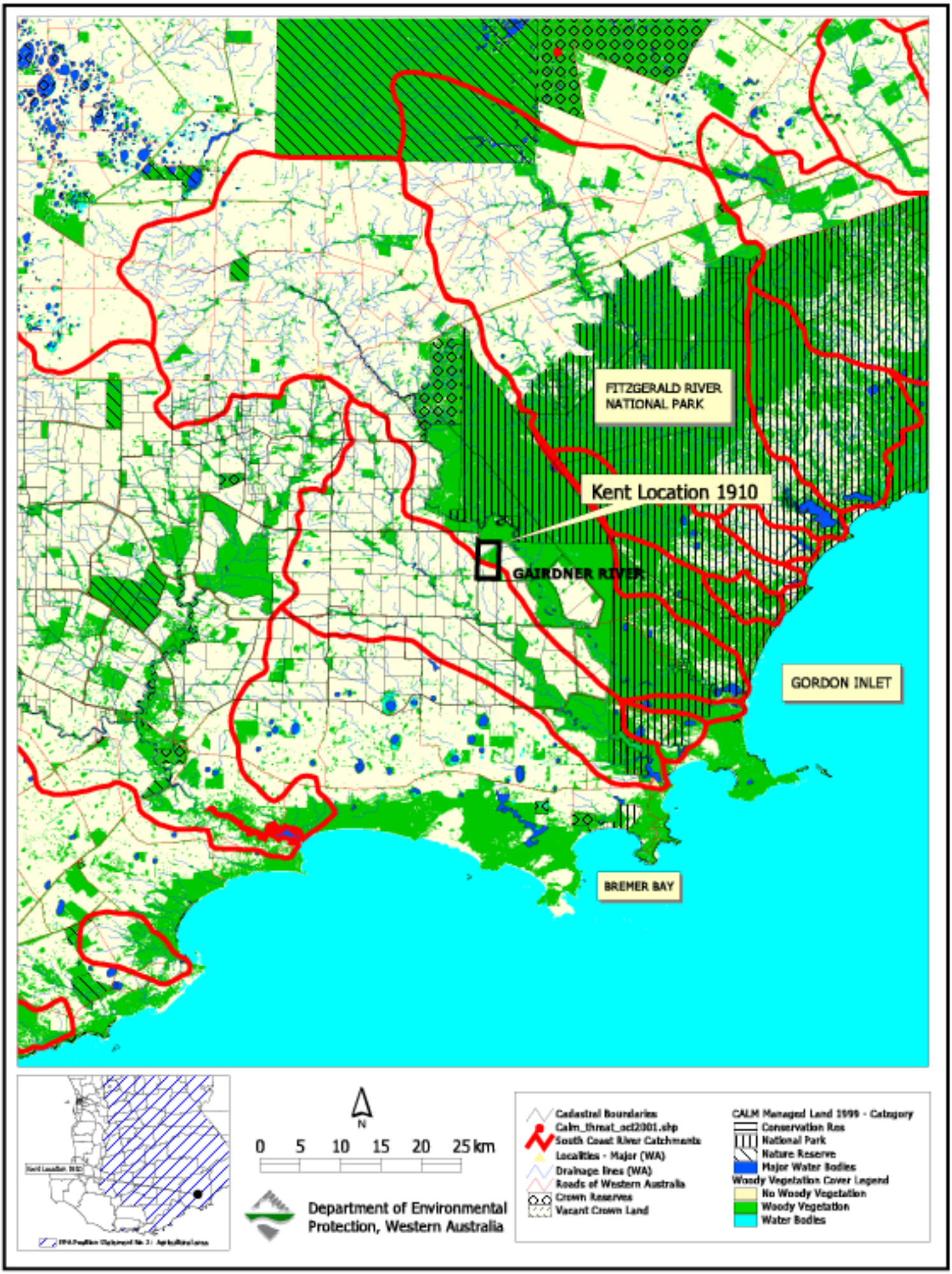

Figure 1. Location Map : Kent Location 1910

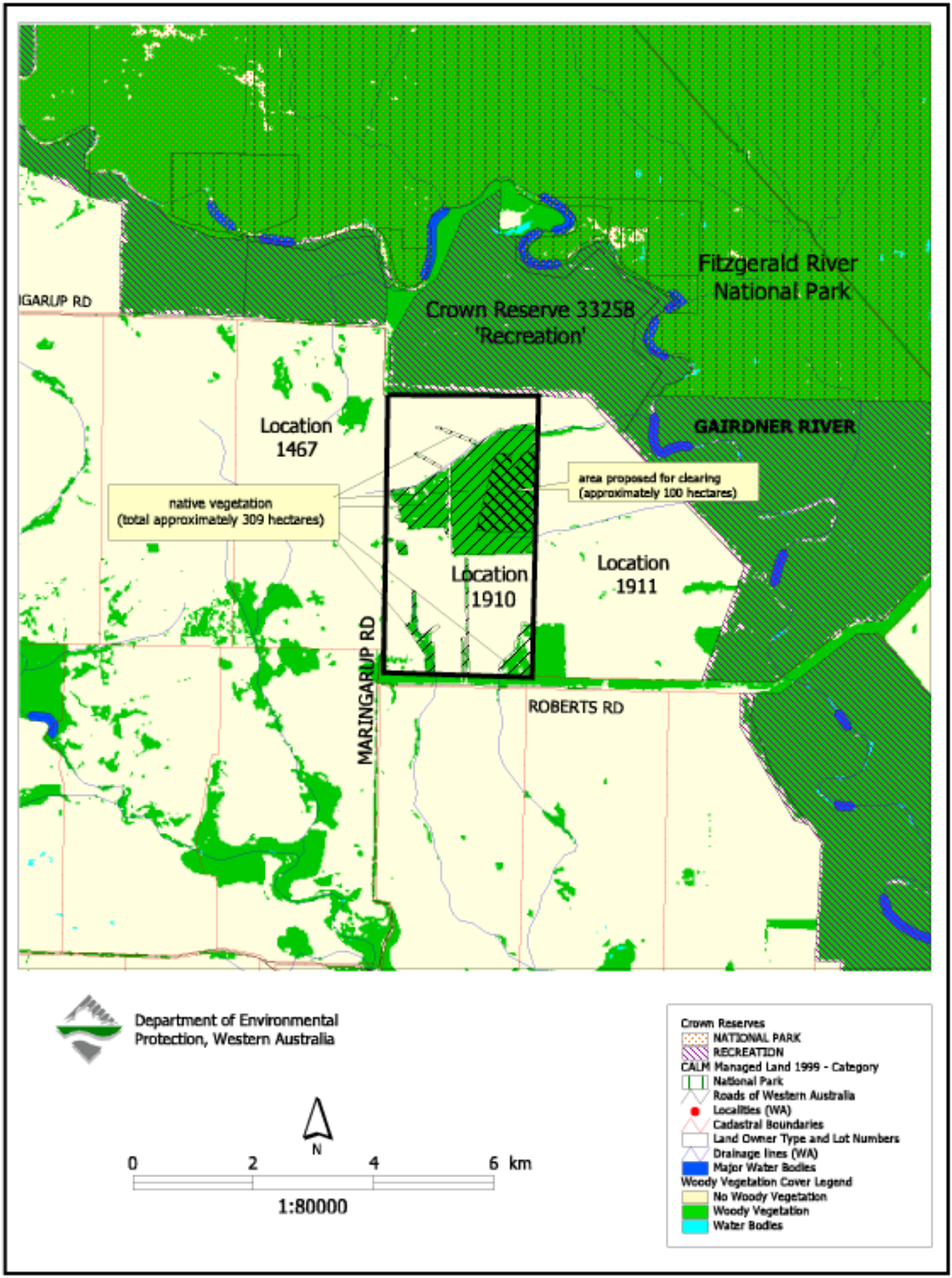

Figure 2: Kent Location 1910 : Locality Plan & Proposal for Clearing

2. The proposal

A locality and site plan of the proposal is provided as Figure 2.

The main characteristics of the proposal are summarised in Table 1 below.

Table 1 - Summary of key proposal characteristics

Element	Description
Total area of property	1150 hectares
Approximate area of property uncleared	409 hectares (36%))
Approximate area to be cleared (estimated by the Department of Agriculture)	100 hectares (9%)
Area of native vegetation remaining after proposed clearing	Approximately 309 hectares (27%)
Area of native vegetation to be protected under an Agreement To Reserve (ATR)	0 hectares
Purpose of proposed clearing	Establishment of pasture for cropping and grazing
Method of disposal of vegetation proposed to be cleared	Chaining and burning
Condition of vegetation	The vegetation does not appear to have previously been cleared and is in 'Very good' condition using the condition scale of Connell (1995)
Mapped description of the type/s of vegetation proposed to be cleared according to GIS mapping of Beard vegetation types (1981)	*Shrublands; tallerack mallee-heath* (90% of proposed clearing area) *Shrublands; mallee scrub; black marlock (*10% of proposed clearing area) (from CALM GIS data)
Total representation in (IUCN Category I to IV) secure conservation reserves of vegetation type/s proposed to be cleared according to Hopkins *et al*. (1996).	*Shrublands; tallerack mallee-heath* approximately 18% of pre European extent *Shrublands; mallee scrub; black marlock* approximately 13% of pre European extent
Total mapped extent of Beard Vegetation type supporting woody vegetation (any condition).	*Shrublands; tallerack mallee-heath* approximately 35% of pre European extent *Shrublands; mallee scrub; black marlock* approximately 26% of pre European extent (DEP, CALM, Department of Agriculture GIS data)
Mapped description of the proposed clearing area according to Soil/Landscape Systems Map Version 2, Schoknecht (1999)	*Lower Gairdner System* 60% of proposed clearing area *Yarmarlup System* 40% of proposed clearing area (from Department of Agriculture GIS data)
Total mapped extent of Soil/Landscape Systems supporting woody vegetation (any condition)	*Lower Gairdner System* approximately 11% *Yarmarlup System* approximately 28%

3. Strategic context

3.1 The development of government policy on land clearing

It is now well recognised that broad-scale land clearing and consequential hydrological changes, including salinity have had a dramatic effect on biodiversity in the agricultural area through the direct loss of vegetation communities and plant species, and the associated loss of mammals, birds, and other animals which depend upon large enough areas of healthy bush for food and shelter. These impacts have been reported in both the State and Commonwealth State of the Environment reporting (Government of Western Australian 1998, Cth of Australia, 1996b).

In response to impacts on biological diversity and nature conservation, as well as land and water degradation, the State and Commonwealth Governments have over recent years developed and implemented various policy positions and programs to provide a strategic context for the protection of remnant vegetation.

These include:

- *Western Australian State Government position on land clearing (Government of Western Australia, 1995);*
- *National Strategy for the Conservation of Australia's Biological Diversity (Commonwealth of Australia 1996);*
- *Memorandum of Understanding for the protection of native vegetation on private land in the agricultural region of Western Australia (MOU 1997);*
- *Natural Heritage Trust partnership agreement, Western Australia (Commonwealth of Australia 1997);*
- *Commonwealth State of the Environment Report (Commonwealth of Australia 1998a);*
- *Western Australian State of the Environment report (Government of Western Australia, 2000);*
- *WA Salinity Strategy (Government of Western Australia, 2000); and*
- *National Greenhouse Strategy (Commonwealth of Australia, 1998b).*

In addition, the Government's 2001 election policy statements provided information on agricultural land clearing as follows:

- The clearing of remnant native vegetation is one of the main pressures on biodiversity as well as contributing to salinity and other forms of land degradation.
- Clearing native vegetation within the agricultural area is generally not acceptable other than relatively small areas where alternative mechanisms for biodiversity are addressed.
- Applications for clearing should be assessed on their scientific merits.
- Preventing farmers from clearing remnant native vegetation raises issues of equity which must be addressed.

The most recent development in Government Policy on protection of native vegetation is the agreed document entitled National Objectives and Targets for Biodiversity Conservation stemming from the National Strategy for the Conservation of Australia's biodiversity 2001-2005 (Commonwealth of Australia, 2001). Within this document, the Commonwealth Government and the majority of the States, including Western Australia, have agreed to pursue the target of ensuring that by 2001, all jurisdictions have clearing controls in place that will have the effect of reducing the net national rate of land clearance to zero.

While the EPA recognises the importance of the resolution of equity issues relating to farmer proponents, it is unable to consider these issues in undertaking environmental assessments under Part IV of the EP Act.

3.2 The EPA's position on environmental protection of native vegetation

The EPA has assessed a number of land clearing proposals over recent years.

Based on the issues arising from information presented during these assessments, the strategic framework provided by government policy positions and programs referred to, and general scientific information which has become available on the potential cumulative impacts of broadscale clearing on the environment, the EPA has developed a Position Statement regarding 'Environmental Protection of Native Vegetation in Western Australian' (EPA, 2000).

Specifically in relation to the 'agricultural region', as illustrated in Figure 1 of the Position Statement, the EPA's current position on clearing in the region includes the following:

"1. Significant clearing of native vegetation has already occurred on agricultural land, and this has led to a reduction in biodiversity and increase in land salinisation. Accordingly, from an environmental perspective any further reduction in native vegetation through clearing for agriculture cannot be supported.

2. All existing remnant native vegetation should be protected from passive clearing through, for example, grazing by stock or clearing by other means such as use of chemicals including fertilisers.

3. All existing remnant native vegetation should be actively managed by landholders and managers so as to maintain environmental values.

4. Because of the extent of over clearing in the agricultural area, development of revegetation strategies at a landscape level, including the provision of stepping stones, linkages and corridors of native vegetation should be a priority.

5. Clearing of deep rooted native vegetation for replacement with non native deep rooted crops (eg Tagasaste or bluegums) is generally not regarded as acceptable and these alternative deep rooted crops should be planted on already cleared land." (EPA, 2000)

While the EPA has considered and made an assessment of the environmental factors relevant to the present proposal as discussed in Section 4 of this report, the EPA considers that the cumulative impacts from clearing native vegetation in the agricultural area, as described in the EPA's Position Statement Number 2, are such that the present proposal for clearing on Kent Location 1910, which lies within the agricultural region, be regarded as environmentally unacceptable.

The EPA holds strongly to its view, in relation to clearing within the agricultural region, that the challenge for Government is to establish a response to the equity issue as soon as possible, rather than to continue to allow further clearing.

3.3 Regional context for the proposal

South-western Australia is widely recognised as one of the richest plant habitats on earth (CALM, 1998a).

Both the Geraldton Sandplains (IBRA) Bioregion referred to in the Interim Bioregionalisation for Australia (Thackway and Cresswell, 1995) and the Esperance Plains IBRA Bioregion are recognised as containing significant areas of very high biological diversity in the context of South Western Australia (Griffin et al, 1990). In particular the Mt Lesueur area (Geraldton Sandplains Bioregion) and Fitzgerald River area (Esperance Plains Bioregion) are considered as biodiversity hotspots (Myers et al, 2000, Hopper et al, 1996). The ecological significance of both areas is related to the number of regionally endemic plant species, the high level of species richness of vascular plants and vertebrate animals, and the diverse vegetation associations and communities.

Kent Location 1910 is located within the 3 537 000 ha Esperance Plains Bioregion (see Figure 3). Approximately 41% of the area of this Bioregion is currently believed to support 'woody vegetation' according to the Department of Agriculture's 1996 dataset and approximately half of this (20% of the bioregion) occurs within dedicated conservation reserves vested in the Conservation Commission of Western Australia (CCWA).

The property also lies within the Buffer/Transition Zone of the Fitzgerald Biosphere Reserve (FBR). The Core area of the FBR incorporates the Fitzgerald River National Park (FRNP). The Buffer/Transition Zone of the FBR covers adjacent areas of land, both public and private, cleared and vegetated, on which land use and management may have potential to contribute to or impact on the values of the Core.

Overall the FBR Core area occupies 329 000 ha or 9% of the Esperance Plains bioregion, and the Buffer/Transition Zone occupies a further 130 000 ha (3.5% of the bioregion).

The FRNP area is internationally recognised as having an exceptionally rich flora. One indication that the area possesses very high nature conservation and biological diversity values is that there are more than 1750 named vascular plant species in the FRNP (Hopper et al 1996).

The FRNP also has a richer fauna species diversity than any other conservation area in the south-west of Western Australia. In the FRNP there are understood to be at least 193 bird species (3 declared rare and 2 declared in need of special protection), 22 native mammal species (7 declared rare), 12 frog species and 42 reptile species (1 declared in need of special protection) (CALM, 1998b).

Through the United Nations Educational, Scientific and Cultural Organisation (UNESCO) International Biosphere Reserve (IBR) program, the Fitzgerald River area has gained international recognition as one of two 'model' biosphere reserves in Australia (CALM, 1998b). The IBR program seeks to encourage use of the Buffer/Transition Zones of biosphere reserves for human activities that are in harmony with the natural environment. The FBR embodies the essential elements of the IBR program by using the Buffer/Transition Zone to protect the ecological values of the FRNP (Sanders, 1996).

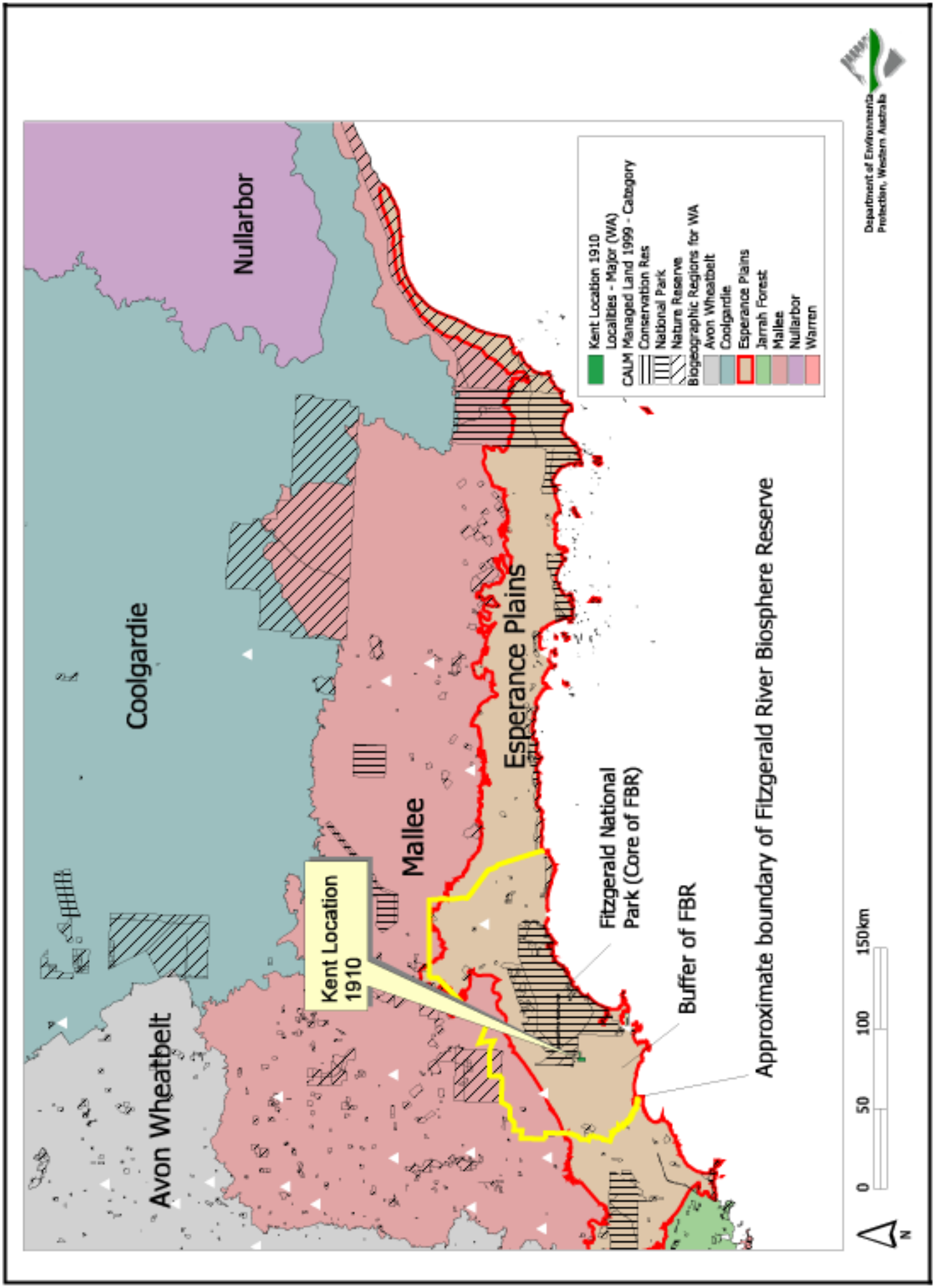

Figure 3. Esperance Plains IBRA Bioregion and Fitzgerald Biosphere Reserve (FBR).

In 1997 an Integrated Vegetation Management Plan was prepared for the 'Zone of Cooperation' portion of the FBR (Robinson, 1997). The Zone of Cooperation is the privately owned portion of the Buffer/Transition Zone. This document reported on a review of the state of catchments within the FBR and identified key areas for land management and ecological restoration within 12 identified catchments. The Gairdner River catchment was identified as being the one facing the greatest threat from salinity of all catchments in the FBR. The report also recommended that clearing be prohibited within the entire FBR, and that equity issues associated with such a prohibition be addressed by government as a component of overall expenditure on catchment protection and restoration.

The greatest threat to the maintenance of biodiversity values of the core area of the FBR is the spread of the soil borne fungal disease known as dieback (*Phytophthora* spp) (CALM, 1998b). In the event of increased dieback spread within the Core areas of the FBR, the significance of areas of native vegetation in the buffer is particularly those close to the Core such as those on Kent Location 1910, may increase, and these areas may also become vital in providing refuge habitat in the event of major new infestations of dieback or unplanned fire events.

Kent Location 1910 is located approximately 1.8 km east of the Gairdner River, which flows into Gordon Inlet. This inlet, along with other coastal estuaries within the FBR, has been nominated for inclusion in the adjacent Fitzgerald National Park (CALM, 1998b). The catchment of the Gordon Inlet is estimated to be approximately 60% cleared (Bancroft et al, 1997) and of the remaining native vegetation within this catchment, approximately 85% occurs within the FRNP and associated crown reserves.

Clearing of native vegetation was identified as a key threat to the ecological integrity of the coastal estuaries associated with the FBR, and the Gordon Inlet in particular, was identified as being seriously impacted by sedimentation, eutrophication and salinity, primarily due to the extent of development within the catchment (Bancroft et al, 1997).

3.4 The Natural Heritage Trust and local conservation initiatives.

The EPA is aware that in the Jerramungup area, there is a strong community commitment to nature conservation and sustainable human development and part of this commitment is in recognition of the high level of conservation significance of the FBR (Upper Gairdner Catchment Group, 1999). An indication of the level of local community endeavour in relation to natural resource management in the area is the number of community based programs that have recently received funding under the Commonwealth's Natural Heritage Trust. These include:

- The Gairdner River Sub-regional Catchment Strategy of the Jerramungup Land Conservation District Committee (LCDC);
- Gairdner River Riparian Protection Program;
- Strategy Development Coordinator – West Fitzgerald Biosphere;
- Enhancing the Fitzgerald – Magenta Bush Corridor;
- South Coast Regional Initiative; and
- Fitzgerald Biosphere sub-regional Extension Coordinator.

Further clearing of native vegetation in the area may obviate or lessen the effectiveness of the expenditure of these funds and the efforts of the community. The EPA is also aware that all Australian Governments, including Western Australia, have committed themselves through the Bush Heritage Trust section of the Natural Heritage Trust Partnership Agreement, to achieving the national goal of reversing the long term decline in the quality and extent of Australia's native vegetation cover by the year 2001. Allowing further substantial clearing of native vegetation within a sub-catchment in which funds are being expended to preserve and re-establish nature conservation values, without an appropriate offset contribution by the landholder, would conflict with the Bush Heritage Trust commitment.

4. Environmental factors

Section 44 of the *Environmental Protection Act 1986* requires the EPA to report to the Minister for the Environment and Heritage on the environmental factors relevant to the proposal and on the conditions and procedures to which the proposal should be subject, if implemented. In addition, the EPA may make recommendations as it sees fit.

It is the EPA's opinion that the environmental factors relevant to this proposal are:

- Nature conservation and biological diversity - impacts due to loss of native vegetation;
- Land degradation – potential for adverse on-site and off-site impacts on land productivity and ecological processes;
- Impacts on ecological processes associated with the Gairdner River and Fitzgerald River National Park; and
- Greenhouse gas emissions.

These relevant environmental factors are discussed in Sections 4.1 to 4.4 of this report.

4.1 Nature conservation and biological diversity – impacts due to loss of native vegetation

4.1.1 Description

Levels of protection of affected ecosystems

Kent Location 1910 is located in the Gairdner River Catchment, where there is approximately 40% of the original vegetation cover remaining. A large portion (approximately 85%) of the catchment's remaining vegetation is in the Fitzgerald River National Park (FRNP) and adjacent Crown Reserves. Some of the vegetation types that historically occurred within this catchment have been extensively cleared for agriculture. These vegetation types are under-represented in secure conservation reserves.

No site specific surveys of the vegetation on Location 1910 have been carried out. However based on regional mapping of vegetation by Beard (1981), 90% of the vegetation proposed to be cleared can be described as the *'Shrublands; tallerack mallee-heath'* vegetation type and the remaining 10% of the area proposed to be cleared can be described as the *'Shrublands; mallee scrub; black marlock'* vegetation type.

Analysis of the estimated Pre-European extent of the *'Shrublands; tallerack mallee-heath'* vegetation type and that currently remaining using Geographic Information Systems data indicates that only approximately 16.7% of the Pre-European extent now remains within secure conservation reserves (largely the FRNP). Approximately 35% of the overall Pre-European extent of the vegetation type is now estimated to support 'woody native vegetation' as identified in the Department of Agriculture's 1996 woody native vegetation dataset.

The quality of areas of 'woody vegetation' mapped within the Department of Agriculture's woody vegetation dataset is highly variable, in many cases incorporating aggregations of trees and degraded native vegetation with a limited understorey component, as well as intact native bushland. The information used in the dataset is also approximately 5 years old and therefore the current area of intact native vegetation with long-term viability for biodiversity conservation is likely to be less than the figures referred to above. The overall remaining extent of the *'Shrublands; tallerack mallee-heath'* vegetation type is therefore likely to be very close to, or less than the 30% threshold referred to in EPA Position Statement No. 2.

Similar analysis of the distribution of *'Shrublands; mallee scrub; black marlock'* has estimated that 11.9% of the Pre-European extent of this vegetation type occurs in secure reserves and that 26% is now estimated to support 'woody native vegetation'. The overall extent of this vegetation type is therefore less than the 30% threshold, beyond which species extinction is believed to occur at an exponential rate, (EPA 2000).

Within the Esperance Plains IBRA Bioregion, the geographic database of Soil/Landscape Systems also provides indicative information on the distribution of plant communities. The distribution of plant communities (defined in terms of floristic composition) has been demonstrated to be closely related to Department of Agriculture's soil-landscape mapping (Griffin pers comm.). This mapping is more detailed than Beard's vegetation and maps cleared and uncleared areas equally well. Therefore, the level of protection of native vegetation occurring within the area covered by each Soil/Landscape System provides an indicator of the level of biodiversity conservation which is complementary to that provided by evaluation using Beard (1979) vegetation types.

The vegetation proposed to be cleared is within the *Lower Gairdner* and *Yarmalup* Soil/Landscape system. Approximately 11% of the area of the *Lower Gairdner* system is estimated to support woody vegetation based on GIS analysis and approximately 28% of the *Yarmalup* system is estimated to support woody vegetation (Department of Agriculture GIS data).

In summary, based on the available vegetation mapping and data sets, the overall extent of remaining vegetation types mapped as occurring within the Beard vegetation types and Soil/Landscape Systems affected by this proposal is below or close to the 30% minium threshold level referred to in EPA Position Statement No 2.

The EPA notes that the mapping of Beard vegetation types and Soil/Landscape Systems mapping is of a broad nature and that little information is known, at the association or plant community level, regarding the type and condition of the vegetation proposed to be cleared, or vegetation in the general region. It is therefore not possible to reach a definitive conclusion as to whether or not any of plant communities occurring on Location 1910 are adequately represented in the region.

Based on the available information as referred to in the preceding discussion however, it appears that the area of native vegetation proposed for clearing is likely to contain plant communities that are poorly conserved overall, particularly in vegetation remnants with long term viability for biodiversity conservation. These communities are therefore also likely to be inadequately represented in secure

nature conservation reserves, such that any further clearing may have irreversible consequences for the conservation of biodiversity.

Significant Flora

The EPA notes that no specific flora or vegetation surveys have been carried out for the vegetation proposed to be cleared. Therefore, it is not possible to definitively evaluate the potential impact of the present proposal on significant flora (Declared Rare Flora (DRF) and priority flora). However, analysis of the records of the Department of Conservation and Land Management (CALM) on known populations of significant flora, indicates that there are three known populations of significant flora occurring within 15 km of Kent Location 1910 and 21 populations of significant flora within a 30 km radius. Several of these populations occur within similar vegetation types to those proposed for clearing in this proposal. Significant flora may therefore occur within the native vegetation that is proposed to be cleared.

As no survey has been carried out to establish the presence or absence of significant flora within the clearing area, the EPA is unable to establish whether the proposal can meet the EPA's objectives for conservation of significant flora as a component of Nature conservation and biodiversity.

4.1.2 Assessment

Further clearing of native vegetation on Kent Location 1910, is likely to further reduce the extent of viable and intact native vegetation within affected vegetation types and Soil/Landscape Systems to below the 30% threshold, below which species loss is believed to occur at an exponential rate.

Further, it is not possible to establish whether the impacts of the proposal on significant flora would be acceptable unless further investigations were carried out or sponsored by the proponent. However, in view of the EPA's general position in relation to clearing of native vegetation within the Agricultural area as set out in Position Statement No 2, and the impact of the proposal on vegetation types that have been reduced to below 30% of their Pre-European extent as described above, the EPA does not consider this investigative work to be warranted for the present proposal.

The EPA is therefore of the view, based on available information, that the proposal cannot be judged to meet the EPA's objectives for nature conservation and biodiversity.

4.2 Land degradation - potential for adverse on-site and off-site impacts on land productivity and ecological processes

4.2.1 Description

In providing advice on the impacts of the proposal on water resources and related ecosystems through the Interagency Working Group under the MoU, the Water and Rivers Commission (WRC) has advised that, with respect to the potential of the proposed clearing to detrimentally alter the hydrogeology, *"Groundwater salinity in the area is greater than 14,000 mg/l. Kent Location 1910 is situated north of a groundwater divide and represents a local groundwater recharge area."*

The WRC advice also indicates that the clearing of native vegetation *"…may have an impact on the groundwater system through enhanced recharge to the superficial aquifer. This may be expressed through watertable rise, which will be most pronounced in the north-eastern portion of Kent Location 1911."*

And finally that, *"The effect of enhanced recharge on the area's watertable is difficult to assess in the area due to the near presence of the Gairdner River and tributaries. An on-site hydrogeological report of the area's groundwater characteristics would be recommended prior to a decision on this application."*

No on-site hydrological assessment has been carried out for the proposal. However, information provided to the EPA by the Commissioner of Soil and Land Conservation at the time of his referring the clearing proposal indicates that the clearing would lead to an increase in the risk of salinity on the property, and that the nature of soils and landforms on Location 1910 and in the catchment leads to further risks from water erosion, and in some areas, wind erosion. For this reason the Commissioner of Soil and Land Conservation objected to a portion of the clearing and has applied a Soil Conservation Notice to part of the clearing area to prevent clearing.

The EPA notes that although 40% of the surface catchment of the Gairdner River remains vegetated, the characteristics of local and regional hydrogeology appear to be such that this level of vegetation cover is inadequate to provide a water balance that will prevent land degradation and protect the water quality of the Gairdner River and Gordon Inlet (eg Bancroft et al, 1997). The EPA also notes the advice provided by the Department of Agriculture that the nature of soils and landforms on Location 1910 and in the catchment leads to further risks from water erosion, and in some areas, wind erosion.

These land degradation risks may have impacts both on and off site. Possible off-site impacts include the potential to reduce the productivity of local agricultural land, rise in stream sedimentation and nutrient enrichment, and the risk of an increased discharge of saline groundwater, which could also impact adversely on riparian areas associated with the Gairdner River and Gordon Inlet.

4.2.2 Assessment

The EPA considers that available evidence indicates there is a significant risk that the proposal would cause, or further contribute to, land degradation through salinity, wind erosion or water erosion and related environmental impacts. Furthermore, as referred to in Section 3.4 of this report, the clearing could serve to undermine the effect of revegetation efforts within the catchment. The EPA therefore considers that the proposal cannot meet the EPA's objectives of preventing land degradation and related off-site environmental impacts.

4.3 Impacts on ecological processes associated with the Gairdner River and Fitzgerald River National Park

4.3.1 Description

As noted in Section 3.3 of this report, clearing of native vegetation was identified as a key threat to the ecological integrity of the coastal estuaries associated with the FBR, and the Gordon Inlet in particular was identified as being seriously impacted by sedimentation, eutrophication and salinity, having a catchment that is 60% cleared (Bancroft et al, 1997). As the Gordon Inlet is contiguous with, and proposed for addition to conservation reserves which are the core of the FRB, any adverse impacts on the Gairdner River should be regarded as potentially environmentally significant.

The EPA notes that much of the native vegetation currently remaining on Location 1910 is of an area and shape that should allow it to retain viability in functioning as a 'stepping stone' for fauna, particularly for bird species, by linking the Fitzgerald River National Park with vegetation systems along the Bremer River, or as a fauna habitat refuge in the event of natural or human induced catastrophe in the FBR core. The proposed clearing would significantly reduce the area of native vegetation on the property, while significantly increasing the area of bushland exposed to infestation by introduced pasture species. This enhanced 'edge effect' is likely to have a negative impact on the long-term viability of the remaining area of bushland.

As part of the development of the FBR Buffer/Transition Zone, fauna survey work has been undertaken. The information gathered by this work has indicated that the nature conservation value of the Buffer/Transition Zone for fauna is high and it is likely that native vegetation within the buffer areas provides a supporting function to the maintenance of biodiversity within the core (Upper Gairdner Catchment Group, 1999, Sanders, 1996). The level of ecological functionality of the Buffer/Transition Zone may be essential to the maintenance of the long term ecological health of the FRNP. An example of the potentially significant relationship between the FRNP and the buffer to re-colonisation relates to wildfire. In the event of the whole, or a large proportion of the FRNP being burnt at one time, remnant vegetation in the Buffer/Transition Zone may serve as a temporary refuge area and may also assist re-colonisation of the Park (Sanders, 1996).

The EPA notes the advice provided by CALM that the native vegetation on Kent Location 1910 should be assessed for its flora and fauna values, and that there is a strong likelihood that the area would serve as permanent or temporary refuge habitat for a range of fauna occurring within the FRNP. The EPA also notes the advice from CALM that further changes resulting in increased levels of salinity in the Gordon Inlet would be undesirable.

4.3.2 Assessment

The EPA considers that as a result of the proximity of Kent Location 1910 to FRNP and the ecological relationship between the FRNP, the Gairdner River and the native vegetation on Kent Location 1910, this vegetation may be considered to be of high potential conservation significance, particularly for fauna and the protection of significant wetlands. In particular, the potential for movement of fauna between the FRNP and bushland on Kent Location 1910 and other remnants is likely to play a significant role in the long term ecological health of the local portion of the FRNP and the reserves associated with the Gairdner River. Additionally, the potential for clearing of native vegetation to further impact on the ecological health of the Gairdner River and ultimately, Gordon Inlet, demands restraint on further clearing of vegetation within the catchment. Therefore, based on available information, the clearing of native vegetation on Kent location 1910 would not meet the EPA's objectives for the maintenance of ecological processes associated with the Gairdner River and Fitzgerald River National Park.

4.4 Greenhouse gas emissions

4.4.1 Description

The clearing and burning of approximately 100 ha of native vegetation will lead to the emission of greenhouse gases including carbon dioxide.

The prediction of greenhouse gas emissions resulting from a proposal for a land use change from native vegetation to agriculture is complex and involves the estimation of emissions from removal of aboveground biomass, decay of surface and subterranean material such as tree roots, emissions from the soil profile, long term loss of a carbon sink effect from vegetation retention and carbon fluxes generated by agricultural activities including cropping and grazing.

Detailed estimation of the long term carbon sink effect of not clearing the vegetation (ie carbon sequestration by the vegetation over the long term, if it were retained) and carbon fluxes generated by agricultural activities including grazing and cropping is beyond the scope of this assessment.

However, the National Greenhouse Gas Inventory Committee (NGGIC) has developed a simplified methodology for calculating greenhouse gas emissions from clearing in order to assist land managers in broadly assessing the effects of land management and development. These are discussed in the booklet *'Land Use Change and Forestry: Workbook for Carbon Dioxide from the Biosphere'* (DASET, 1994).

By adapting the methodology outlined in the NGGIC workbook, and making the assumption that essentially all of the above ground biomass from clearing will be burnt or other wise converted into greenhouse gases within a twenty year period following clearing, it is estimated that approximately 1440 tonnes of carbon would be emitted from the initial clearing of the native vegetation, with a further 1960 tonnes lost from the soil over a 20 year period. An approximation of the potential carbon emissions from clearing (which excludes the effect of change in land use) is therefore given as 3400 tonnes.

4.4.2 Assessment

The EPA does not presently have specific objectives for the assessment of land clearing proposals that create a net source of carbon emissions. However, the EPA is aware of the commitment that Australia has made under the Kyoto protocol to ensuring that greenhouse gas emissions, Australia-wide, will not increase by more than 8% over 1990 levels for the first reporting period in 2012. The EPA is also aware that Australia will be reporting in 2005 on progress toward meeting that target. The National Greenhouse Strategy also encourages the retention of native vegetation as a carbon sink.

While the EPA does not have a specific objective for this assessment in terms of levels of greenhouse gas emissions which are acceptable, the clearing of vegetation under the present proposal will not assist in meeting Australia's greenhouse targets.

The EPA has also taken the impact of land clearing on greenhouse gas emissions into account in formulating its position statement on the protection of native vegetation.

5. Other advice

5.1 Final report of the Native Vegetation Working Group

The Native Vegetation Working Group was established by the former Minister for Primary Industry to 'develop mechanisms that minimise the economic burden carried by individual landholders in the protection and retention of privately owned bushland in agricultural areas'. The Working Group reported in January 2000 (Western Australian Government, 2000b).

In the Report Introduction, the Working Group set out that:

"Most of Western Australia's farmland has been cleared and developed in the past 100 years. We have now reached the limit of expansion, and there is now a high level of agreement across the community, rural and urban, that the time of broadacre clearing has passed. Amongst the challenges facing us is to determine a useful and well supported future of bushland in our farming areas. Indeed, unless there is a substantial increase in tree and bush cover many of the farms established in the last hundred years may fall victim to increasing salinity."

The Report discusses a range of mechanisms aimed at both assisting in the protection and management of bushland, and ensuring that the costs are spread more equitably across the whole community. The Working Group put forward fifteen recommendations.

The EPA commends the Working Group on its report on mechanisms and encourages Government to give active consideration to the recommendations (Western Australian Government, 2000b).

As noted in the EPA's advice to the Minister for the Environment on environmental issues arising from the assessment of individual land clearing proposals (EPA, 1999), "the challenge now is to establish a response to these applications in terms of addressing the equity issue rather than continuing to allow clearing". The EPA sees the Working Group's report and recommendations as clearly progressing this issue.

6. Conclusions

The EPA has considered the proposal by Mr D W & Mrs S M Meade to clear 100 ha of native vegetation on Kent Location 1910 for agriculture with reference to the relevant environmental factors.

In its advice to the Minister for the Environment on issues arising from use of Section 38 to assess clearing proposals (EPA, 1999), the EPA drew attention to the difficulties presented to the Authority as a result of the limited detailed information which was generally available to it to assess individual proposals. In the case of the present proposal there is very limited site specific information regarding the vegetation proposed to be cleared. There is also a paucity of analysis of the vegetation in both the local and regional contexts.

In assessing this proposal the EPA has also had regard to the high level of significance accorded to the Fitzgerald Biosphere Reserve in terms of conservation of biodiversity. Kent Location 1910 is located in the biosphere's buffer and transition zone. Native vegetation communities in the biosphere area are likely to exhibit levels of plant species diversity and endemism which are of State, national and international significance. The proposal also has potential for further adverse impacts on the ecological state of the Gairdner River and the Gordon Inlet which has been proposed for inclusion in Fitzgerald River National Park.

Based on the information which is available, and adopting a precautionary approach, the EPA considers that the proposed clearing of native vegetation on Kent Location 1910 cannot be judged to meet the EPA's objectives for nature conservation and biodiversity, land degradation or protection of ecological processes associated with the Gairdner River and Fitzgerald River National Park. Rather, the proposal would be likely to continue the loss of nature conservation and biological diversity values flora, fauna and ecosystems in the region.

The EPA is also aware that the proposal may obviate or lessen the effectiveness of the catchment restoration efforts of the community and local landholders, and funding obtained from the Commonwealth Natural Heritage Trust and would be inconsistent with the Government's Bush Heritage Trust commitment to achieving the national goal of reversing the long term decline in the quality and extent of Australia's native vegetation cover by the year 2001.

Accordingly, the EPA considers the proposal should be viewed as environmentally unacceptable and should not proceed.

The EPA has assessed a number of land clearing proposals in recent years. As a result of information derived from these assessments and growing scientific evidence of significant and broad scale environmental degradation and reduction of biodiversity in the agricultural area resulting from the clearing of native vegetation, the EPA has formed the view that any further reduction in native vegetation in this area through agricultural clearing cannot be supported.

7. Recommendations

The EPA submits the following recommendations to the Minister for the Environment and Heritage :

1. That the Minister considers the report on the relevant environmental factors of:

   a) Nature conservation and biological diversity - impacts due to loss of native vegetation;

   b) Land degradation – potential for adverse on-site and off-site impacts on land productivity and ecological processes;

   c) Impacts on ecological processes associated with the Gairdner River and Fitzgerald River National Park; and

   d) Greenhouse gas emissions,

   as set out in Section 4 of this report.

2. That the Minister notes that the EPA has concluded that the proposal:

   a) cannot be judged to meet the EPA's objectives for nature conservation and biodiversity, prevention of land degradation, or protection of ecological processes associated with the Gairdner River and Fitzgerald River National Park, and rather, would be likely to continue the loss of nature conservation and biological diversity values flora, fauna and ecosystems in the region;

   b) may if implemented, obviate or lessen the effectiveness of the catchment restoration efforts of local landholders and funding obtained from the Commonwealth Natural Heritage Trust; and

   c) would be inconsistent with the Government's Bush Heritage Trust commitment to achieving the national goal of reversing the long term decline in the quality and extent of Australia's native vegetation cover by the year 2001,

   and that accordingly the EPA considers the proposal should be viewed as environmentally unacceptable and should not proceed.

3. That the Minister not issue a statement that the proposal may be implemented.

Appendix 1

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Appendix 2

Summary advice provided by involved agencies within the Level 3 MoU process

OUTCOME OF LEVEL 3 SUMMARY SHEET - NOTICE OF INTENT TO CLEAR LAND

L 3 Assessment Date:	11 November 1998
Proponent:	MEADE, David Wayne and Sandra Michelle
Location:	KENT Location 1910 Approximately 60 km south of Jerramungup, on Roberts Road (Shire of Jerramungup)
NOI Date:	17 September 1998
Area Notified:	100 ha
Intended use:	Grazing and cropping

Issues:

1. Land degradation

Likelihood of increased on-site salinity in some areas notified to clear and recharge leading to off-site salinity. Risk of wind erosion on the eastern boundary of the property.

2. Nature Conservation

The area is close to the Fitzgerald National Park.

3. Wetlands/drainage

The area is within the Gairdner River Catchment - the Gairdner River is approximately 1.5 km from the property boundary.

Commissioner's (Regulatory) Opinion:

Part objection on land degradation grounds.

IAWG Advice to the Commissioner:

WRC:	Clearing may have an impact on the groundwater system. Suggest on-site hydrological assessment to allow some clearing.
CALM:	Viable habitat, aim to maintain. Several priority species known in the vicinity. Flora survey required before clearing commences.
DEP:	Vegetation likely to have flora conservation values and high floristic values. Rare species survey before clearing is carried out.
IAWG:	**Recommend Commissioner liaise with proponents to carry out flora survey of areas not under objection prior to next L3 meeting. If not finalised within 90 days, refer to EPA. Ken Atkins is available for advice.**

LEVEL 3 SUMMARY SHEET - NOTICE OF INTENT TO CLEAR LAND

Department of Environmental Protection Comments

IAWG Meeting Date: 11 November 1998 (20th Meeting)

Proponent: MEADE, David Wayne and Sandra Michelle

Location: KENT Location 1910
Approximately 60 km south of Jerramungup, on Roberts Road (Shire of Jerramungup)

NOI Date: 17 September 1998

Area Notified: 100 ha

Intended use: Grazing and cropping

DEP's Interim Advice to the Commissioner:

1. The vegetation within the area notified is a complex mosaic reflecting small changes in soil conditions. It is also complex floristically with many poorly collected taxa and the high probability of undescribed taxa.

2. The vegetation likely to have flora conservation values. It is likely to have significant flora species similar to the Fitzgerald River National Park.

3. The vegetation is likely to have high floristic diversity.

4. The vegetation has the potential to have significant fauna and fauna habitat values.

5. Flora conservation issues will need to be addressed. The area is likely to contain priority species. There are 3 records of priority species within a 15 km radius on the same Beard veg type as that proposed to be cleared.

6. The vegetation has some corridor and stepping stone values.

7. The current condition of the vegetation has been assessed as very good.

8. A survey to identify any DRF, Priority or Significant taxa should be carried out prior to any clearing approval.

9. A survey to identify any Declared threatened fauna, Other specially protected fauna or Priority listed fauna or the presence of suitable habitats of these species should be carried out prior to any clearing approval.

10. There appears to be some land degradation risks associated with this proposal.

Reporting Officer and Phone Number: Mr Nigel Livesey (08) 9222 7113

LEVEL 3 SUMMARY SHEET - NOTICE OF INTENT TO CLEAR LAND

Water and River Commission Comments

IAWG Meeting Date: 11th November 1998 (20th Meeting)

Proponent: MEADE, David Wayne and Sandra Michelle

Location: KENT Location 1910
Approximately 60 km south of Jerramungup, on Roberts Road (Shire of Jerramungup)

NOI Date: 17 September 1998

Area Notified: 100 ha

Intended use: Grazing and cropping

WRC's Interim Advice to the Commissioner:

Groundwater risk assessment:

The proposed clearance may have an impact on the groundwater system through enhanced recharge to the superficial aquifer. This may be expressed as an increase in the watertable, which will be most pronounced in the northeastern portion of Kent Location 1911.

The effect of enhanced recharge on the area's watertable is difficult to assess in the area due to the near presence of the Gairdner River and tributaries. A hydrogeological assessment of the area's groundwater characteristics is recommended prior to a decision on this application.

This assessment is based upon:

- A deep groundwater table;
- Saline groundwater;
- Saline surface water flows within the Gairdner River; and
- The presence of the incised Gairdner River and tributaries, which will limit the extent of groundwater rise in the area.

Reporting Officer and Phone Number: Luke Pen 08 9278 0374

LEVEL 3 SUMMARY SHEET - NOTICE OF INTENT TO CLEAR LAND

Department Of Conservation And Land Management Comments

IAWG Meeting Date: 11th November 1998

Proponent:	MEADE, David Wayne and Sandra Michelle
Location:	KENT Location 1910 Approximately 60 km south of Jerramungup, on Roberts Road (Shire of Jerramungup)
NOI Date:	17 September 1998
Area Notified:	100 ha
Intended use:	Grazing and cropping

CALM's Interim Advice to the Commissioner:

Several priority flora known from the general area, locations are not precise, but a few could be close to the property. Soil types are compatible for some priority flora to occur on site. This is supported by the Fitzgerald River NP Ranger who also considers it likely to contain rare fauna, although other advice is that rare fauna would probably have disappeared from the location by now due to predation and the pressure from adjacent agriculture.

The vegetation type in the location is, however, known to support a range of (non-threatened) native fauna. The creekline adjacent to the area to be cleared links via a vegetated corridor to FRNP and thus has some value as a native fauna corridor. The maintenance of a viable bush area could stock fauna for movement to the NP.

There are no known poorly represented ecological communities in the area.

Concern is expressed by the Region that the clearing will result in further salinity pressure on the Gordon Inlet.

The amended clearing proposal is more acceptable as it provides greater buffer to the creek system, but the value of the area as flora and fauna habitat should be further determined.

Reporting Officer and Phone Number: Dr K Atkins 9334 0425

Agriculture
WESTERN AUSTRALIA

3 Baron-Hay Court South Perth Western Australia 6151 Phone: (08) 9368 3282 Fax: (08) 9368 3654
Postal Address: Locked Bag No 4, Bentley Delivery Centre WA 6983

981186V01P0C
Mrs Kelly Holyoake (9368 3282)
14 December 1998

110145

DEPARTMENT OF
ENVIRONMENTAL PROTECTION
17 DEC 1998
File No: 1210/2 Name
File No: Name

Mr Bernard Bowen
Chairman
Environmental Protection Authority
"Westralia Square" 8th Floor
141 St Georges Terrace
PERTH WA 6000

Dear Mr Bowen

NOTICE OF INTENTION TO CLEAR LAND
DAVID AND SANDRA MEADE– KENT LOCATION 1910

A Notice of Intention to Clear land was received on 17 September 1998 from Mr and Mrs David and Sandra Meade to clear approximately 100 hectares within Kent Location 1910.

The property is located on Roberts Road, approximately 60 kms south of Jerramungup townsite, within the Shire of Jerramungup. Mr and Mrs Meade propose to use the cleared land for grazing and cropping.

The proposal has been considered by the Inter Agency Working Group (IAWG) comprising Agriculture Western Australia, the Department of Conservation and Land Management (CALM), the Water and Rivers Commission (WRC) and the Department of Environmental Protection. Copies of the assessment reports and advice are attached.

This IAWG has advised me that there is likelihood that nature conservation values may be affected by this proposal, including the possibility of declared and priority species occurring on the property.

As I am of the opinion that land degradation is likely to result if land clearing is carried out within the areas identified on the attached plan as Area A, I have objected to clearing within these areas. However, I have concluded that some clearing may be considered within Area B on land degradation grounds.

Therefore, in view of the advice that the proposed clearing is likely to impact on nature conservation values, I refer the clearing proposal, relating to Area B, to the Environmental Protection Authority for assessment.

135076

Please be aware that Mr and Mrs Meade may appeal my objection to clearing within Area A. Should Mr and Mrs Meade decide to appeal, you may wish to consider assessing this area as well.

Attached to this letter are the documents required to assist your deliberations, as set out in Schedule 7 of the Memorandum of Understanding, for the protection of remnant vegetation on private land in the agricultural region of Western Australia. This letter constitutes Document 1, the Transmittal Letter of Referral, as set out in the Memorandum.

Also attached is a copy of public comment concerning this proposal. The writer has consented to the inclusion of their comments with this referral letter.

Yours sincerely

Andrew Watson
COMMISSIONER (REGULATORY)
SOIL AND LAND CONSERVATION

Att: 1) Notice of Intent to Clear
2) Level Assessment Report
3) Interim Advice from Department of Conservation and Land Management
4) Interim Advice from Water and Rivers Commission
5) Interim Advice from the Department of Environmental Protection
6) Outcome of Level 3 Inter Agency Working Group Meeting
7) Commissioner's advice to Mr and Mrs Meade and plan

cc Mr and Mrs Meade
Dr K Atkins, Department of Conservation and Land Management
Dr L Pen, Water and Rivers Commission
Mr B Carr, Department of Environmental Protection
Mr S Sadlier, Department of Environmental Protection
Ms N Schiller, LCO, Jerramungup

Appendix 3

Calculation of greenhouse emissions for proposal to clear native vegetation:

Kent Location 1910

Calculation of estimated greenhouse gas (carbon) emissions: Proposal to clear native vegetation: Kent Location 1910

Methodology and data from the CNGGIC workbook (Commonwealth of Australia, 1997b)

Assumptions used in Calculations

Calculations of emissions from proposals to clear native vegetation require several assumptions:

1. It is assumed that where vegetation is cleared for agricultural purposes, all burning occurs in the year of clearing;
2. The net result from CO_2 uptake during subsequent regrowth is zero;
3. If the area was cleared, there is no indication of the portion of the cleared biomass which will be burnt. Some might be burnt in the field to facilitate clearing (on-site burning) and some may be removed and used as fuel (off-site burning);
4. A fraction of any material burned off-site is assumed to be completely oxidised and builds up in the soil as charcoal, undergoing no further CO2 release;
5. Any above ground biomass which remains on site but is not burned, will oxidise in approximately a decade.

Estimating Above Ground Biomass

In estimating the above ground biomass the following approach was taken:

- Biomass estimates for each vegetation type vary widely partly because of variation in growth with climatic and soil conditions and also because of the range of species within vegetation type;
- Actual values vary even within a State. For example, in the Northern Territory, 'woodland and scrub' biomass changes from about 25t dm (dry matter)/ha near the coast to a lower value in the drier inland, with an average that might be as low as 17.5 dm/ha[1];
- IPCC default methodology assumes that original above ground biomass is destroyed after conversion from native vegetation to agricultural lands, 90% occurring immediately and 10% over 10 years. New above ground biomass is given the default value of 10t dm/ha [2]; and
- Average estimated before clearing above ground biomass for 'woodland and scrub' is 21tC/ha [1].

Estimating Below Ground (including roots) Carbon Release:

For the estimation of below ground carbon release the following approach was taken:

- Even within one area, the magnitude and rate of loss of soil carbon after the conversion of native vegetation to agricultural land is highly variable due to a strong dependence on regional rainfall, soil water and isolated soil physio-chemical characteristics;
- From the limited data available, it is estimated that 30% of soil carbon is lost upon conversion of native vegetation to agriculture [1];

- The assumed time span for loss of soil carbon following clearing is 20 years[3] – it is assumed that soil carbon release is linear over the 20 year period (however, the rate of decay will be much faster in (say) the Northern Territory;[1]
- The assumed time span for CO_2 release from decaying roots is 10 years;
- For crops and pastures, the root biomass is assumed to be half of the above ground biomass (default value of 10t C/ha);
- The soil carbon content of unimproved pasture is 50 tC/ha and improved pasture 62.5t C/ha;
- The soil carbon of 'woodland and scrub' is estimated at 70 tC/ha[1]; and
- For calculating the annual CO_2 flux associated with the loss of soil carbon following vegetation clearing, it is assumed that soil carbon release is linear over a 20 year period. To calculate the rate of carbon released from below ground (including roots) after land clearing, the area of land clearing is multiplied by the change in soil carbon between a vegetation system and a 20 year old regrowth system, in this case to pasture (The Algorithm for this is located at Section 3.4, page 28, NGGIC workbook, 4.2)

Calculations

The calculated values from this approach was as follows:

- Above ground biomass carbon is estimated to be 21 tC/ha;
- Assume that new pasture above ground biomass is about 5tC/ha;
- Assume 100 ha;
- Emitted by clearing is 16 x 100 = 1600 tC;
- Of this amount, 90%(1440 tC) will be released immediately and 10% (160 tC) over 10 years;
- The below ground biomass soil carbon of 'woodland and scrub' is estimated at 70t C/ha;
- Assume 100 ha;
- Assume that new pasture below ground regrowth is 10t C/ha;
- Assume 30% of soil carbon is lost upon clearing (in actual fact, the change in soil carbon is a complicated calculation of the difference between a vegetation system and a 20 year old regrowth system, in this case to pasture);
- Then 30% x (70–10) x 100 = 1800 t C would be lost from below ground biomass, in a linear fashion over 20 years after clearing (ie 90 t C/yr);

Therefore, total carbon emissions occurring as a result of clearing and conversion to pasture is estimated to be:

- 1440 tC released immediately, a further 1060 (900+160) released over 10 years and a further 900 (90 x 10) released over the next 10 years ie a total of approximately 3400 tC over 20 years.