Biota Environmental Sciences

Kemerton Power Station and Wastewater Pipeline

Holly Leaf Banksia
Banksia ilicifolia

Enamel Orchid
Elythranthera brunonis

Orange Stars
Hibbertia stellaris

Sinclair Knight Merz | Western Power

Flora, Vegetation and Fauna Survey

April 2003

Kemerton Power Station Site and Pipeline Flora, Vegetation and Fauna Survey

Contents

1.0 Introduction

Western Power Corporation is currently in the process of carrying out evaluation and preliminary planning studies for potential sites for a new power station within the south western portion of the state as part of a power procurement process. As part of this process, Sinclair Knight Merz Pty Ltd engaged Biota Environmental Sciences Pty Ltd to carry out a preliminary biological survey of a potential site within the Kemerton Industrial Park, and an associated wastewater pipeline route, situated to the northeast of the Port of Bunbury (Figure 1.1).

The principal aims of the preliminary survey were to:

- assess fauna habitats and potential rare species occurrence within both components of the study area;
- assess vegetation condition within the power station site and along the proposed wastewater pipeline route; and
- identify populations of significant flora species along the proposed wastewater pipeline route.

As a consequence of recommendations made within the preliminary biological survey, a detailed spring survey was carried out. In the intervening period between the preliminary and spring surveys, an open cycle power station became the preferred option, removing the need for the waste water pipeline. The detailed spring flora survey therefore applied only to the power station site.

The principal aims of the detailed spring flora survey of the power station site were to:

- evaluate the flora and vegetation including detailed flora sites, rare flora searches, condition assessment and identification of vegetation communities;
- produce a map of vegetation communities;
- identify the conservation significance of flora species and vegetation communities; and
- provide recommendations based on the outcomes of the above.

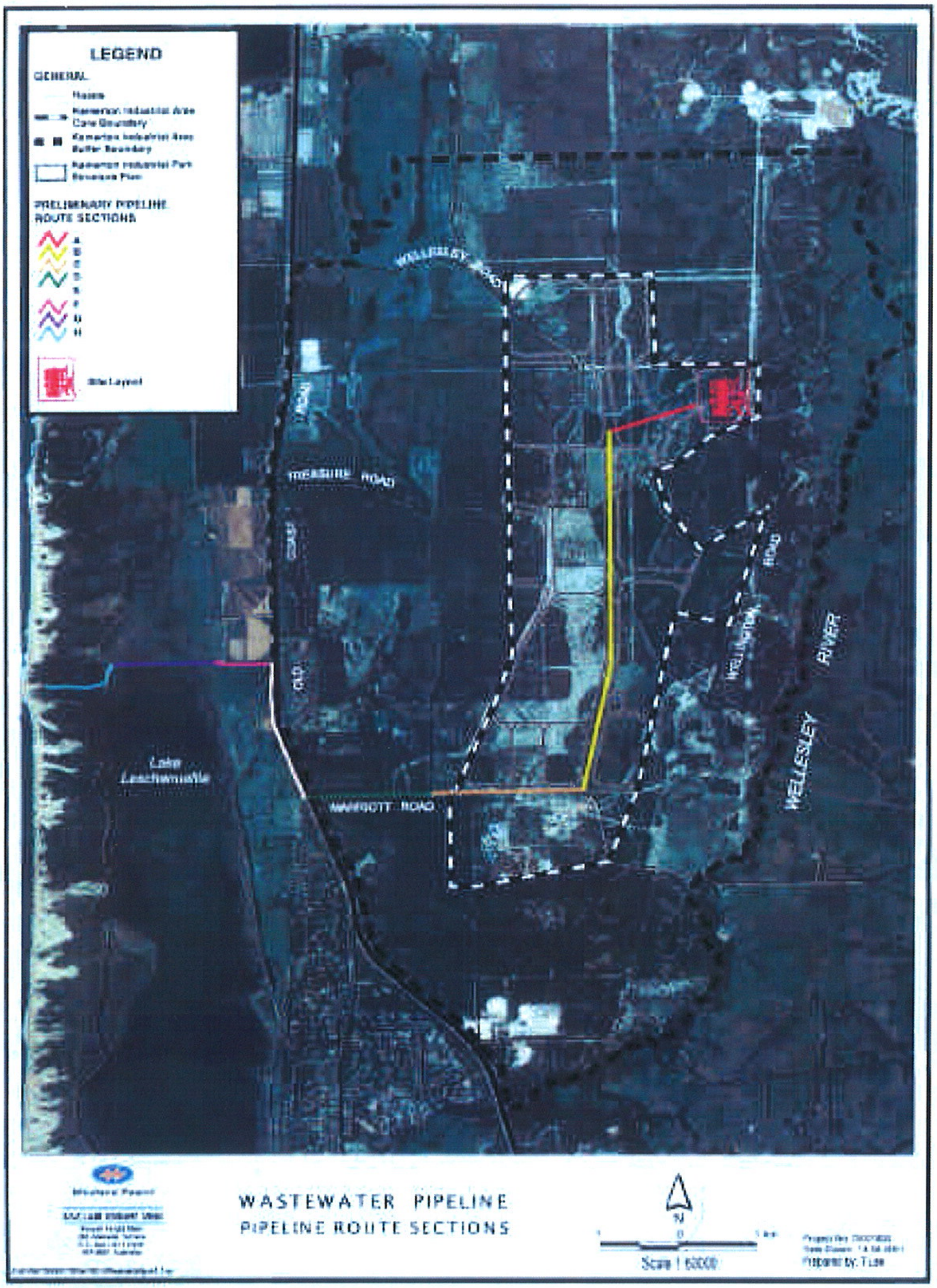

Figure 1.1: Study area locality map

2.0 Preliminary Fauna Survey

2.1 Fauna and Fauna Habitats

2.1.1 Proposed Power Station Site

The fauna habitat present in the proposed power station area comprises one primary unit; *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* woodland with open understorey on pale grey sands.

2.1.2 Wastewater Pipeline Route

Several habitat units are crossed by the wastewater pipeline route, including:

- Peppermint *Agonis flexuosa* / Jarrah *Eucalyptus marginata* woodland over weeds on Bassendean sands;
- *Agonis flexuosa* low woodland on coastal sands;
- *Eucalyptus marginata* and *Banksia attenuata* woodland;
- Samphire flats north of the Leschenault Estuary; and
- Coastal *Acacia* shrubland and spinifex on dunes.

These habitats are likely to support a range of native and introduced vertebrate fauna typical of the coastal southwest of Western Australia (Christensen et al., 1985; How et al., 1987). Without conducting any fauna survey work, there is little value in attempting to compile a listing of all species of mammal, birds and herpetofauna that may be present in the area. Given the strategic level of this assessment, habitat and distribution based assessment of potential occurrence was only undertaken for threatened fauna taxa (see Section 2.2).

2.2 Potential Threatened Fauna Species

In Western Australia, all native fauna species are protected under the *Wildlife Conservation Act* 1950-1979. Fauna species that are considered rare, threatened with extinction or have high conservation value are specially protected under the Act. In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice* 1998 recognises four distinct schedules of taxa (see Table 2.1).

Table 2.1: Schedules of conservation significance categories for fauna species.

1.	Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;
2.	Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;
3.	Schedule 3 taxa are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction which are declared to be fauna in need of special protection; and
4.	Schedule 4 taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, CALM also classify fauna under four different Priority codes:

- Priority One - Taxa with few, poorly known populations on threatened lands.

Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- Priority Two - Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.

Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- Priority Three - Taxa with several, poorly known populations, some on conservation lands.

Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- Priority Four - Taxa in need of monitoring.

Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

A search was commissioned of the Department of Conservation and Land Management's (CALM) Threatened Fauna database. Six species of Schedule listed fauna and eight species of Priority fauna were identified as potentially occurring in the study area (see Appendix 3).

- **Schedule 1 (Fauna which is Rare or likely to become Extinct)**

***Dasyurus geoffroii* – Chuditch**
This species occurs in a wide spectrum of habitats and occupies a considerable home range. The stronghold for the Chuditch tends to be the more open jarrah forests and woodlands south-west of the project area, but there is a recent record from north of Australind (Appendix 3). This species potentially occurs in both the woodland habitats in the eastern portion of the wastewater pipeline route and the woodlands of the proposed power station site.

***Pseudocheirus occidentalis* - Western Ringtail Possum**
The preferred habitat of this species comprises coastal Peppermint woodlands. The abundance and distribution of the Ringtail has considerably reduced since European occupation (How et al., 1987; Burbidge and de Tores, 1998). It is now restricted to coastal and near coastal Peppermint associations from the Australind - Eaton area to Waychinicup NP (Burbidge and de Tores, 1998). How et al. (1987) suggest, "Nowhere in the study area (coastal region from Busselton to Albany) are dense populations of either possum species (*Trichosurus vulpecula* and *P. occidentalis*) known to occur". The denser woodland habitats crossed by the wastewater pipeline route where *Agonis flexuosa* formed a dominant component are likely to provide a suitable habitat for this species. A translocated population exists in nearby Yalgorup National Park (Appendix 3).

***Calyptorhynchus baudinii* - Baudin's Cockatoo**
This species is most common in the far southwest of Western Australia where it breeds. Breeding records come from the southern forests north to Collie and east to near Kojonup.

Baudin's Black Cockatoo typically forms vagrant flocks and utilises the taller, more open Jarrah/Marri woodlands where it feeds predominantly on Marri seeds but also takes wood boring grubs (Blakers et al., 1984). Saunders and Ingram (1994) claimed that it is possible that the Baudin's Cockatoo has not declined over the past 50 years. However, like the Forest Red-tailed Black Cockatoo, forestry operations have the potential to affect this species by reducing the availability of nest sites. In contrast, Storr (1991) and Johnstone and Storr (1998) claim that this cockatoo has declined over the past 50 years, but do not speculate as to a possible cause. It occurs only in low numbers in the locality and is possibly an occasional visitor to the study area.

***Calyptorhynchus latirostris* - Carnaby's Cockatoo**
This species inhabits the southwest of Western Australia, with most breeding occurring between the 350mm and 700mm rainfall isohyets (Garnett, 1992). The preferred habitat is typically woodland where it preferentially feeds on plants of the family Proteaceae. Winter flocks also inhabit heaths. The species is considered to be scarce and patchily distributed in the deep south-west (Johnstone and Storr, 1998).

- **Schedule 4 (Fauna otherwise in need of special protection)**

***Falco peregrinus* - Peregrine Falcon**
The Peregrine Falcon is widespread across all of Australia, but only occurs at very low densities and with a patchy distribution. It is known to favour open woodlands amongst other habitats (Schodde and Tidemann, 1990) and may be an occasional visitor to the woodlands and woodland margins of the study area. *F. peregrinus* is a Schedule 4 species, indicating that while it is considered to require special protection, it is not regarded as being in danger of extinction.

***Morelia spilota imbricata* – Carpet Python**
This species is relatively widespread within the southwest but is typically not at high density within this range. It is known to occur in Yalgorup National Park (Appendix 3), and may occur in the habitats of the power station study area and the pipeline route.

- **Priority Fauna**

***Calyptorhynchus banksii naso* - Forest Red-tailed Black Cockatoo (Priority 3)**
A Priority 3 species, the Forest Red-tailed Black Cockatoo has seriously declined in numbers since European settlement (Saunders and Ingram, 1994).

***Phascogale tapoatafa* - Brush-tailed Phascogale (Priority 3)**
The Brush-tailed Phascogale is a largely arboreal, carnivorous dasyurid that occurs in a variety of regions in Australia with open, dry sclerophyll forests on ridges and reliable rainfall patterns (Cuttle, 1996). The southwest populations of *Phascogale tapoatafa* are listed by CALM as Priority 3 and this species has recently been recorded near Bunbury, in similar habitats to those present in the study area (Appendix 3).

***Isoodon obesulus fusciventer* - Southern Brown Bandicoot (Priority 4)**
This species is locally common in dense swamps in the southwest of the state and has recently been downgraded from Schedule 1 to a Priority 4 species. A translocated population of this species occurs in the Leschenault Conservation Park (Appendix 3). The species typically requires dense understorey vegetation to persist and may occur in the denser woodland vegetation occurring along Marriott Road.

***Macropus irma* - Western Brush Wallaby (Priority 4)**
This species is common in open northern Jarrah forest associations, but was not recorded on any of seven south coastal communities surveys detailed by Christensen et al. (1995). It is regarded by these authors as typically absent from high rainfall areas with dense closed understoreys. It is possibly present in the coastal woodlands crossed by the wastewater pipeline route.

Causes included clear felling and 80 year cut rotation forestry practices, which can significantly reduce the number of large tree hollows (Saunders and Ingram, 1994). Storr (1991) reports that the species was formerly common and is now uncommon and patchily distributed. The species utilises Jarrah - Marri woodlands (Appendix 3) and is likely to occur in such habitats along both the wastewater pipeline route and within the proposed power station site.

***Falsistrellus mackenziei* - Western False Pipstrelle (Priority 4)**
This bat species occurs in the high rainfall regions of the southwest including the Swan Coastal Plain (Appendix 3). It is known to occur nearby around Lake Clifton and may utilise the open woodlands of the study area.

***Thinornis rubricolis rubricolis* – Hooded Plover (Priority 4)**
This migratory bird species has been recorded from the margins and shallows of Leschenault Inlet. It may occasionally stray into samphire habitats crossed by the proposed wastewater pipeline route but is unlikely to be reliant on these areas for core habitat requirements.

***Numenius madagascariensis* - Eastern Curlew (Priority 4)**
Similar to the Hooded Plover, this species has also been recorded from the shallows and margins of the Leschenault Inlet (Appendix 3).

2.3 Survey Limitations

Fauna trapping work was not undertaken, with the potential occurrence of significant fauna species based on habitat types and existing database records only.

3.0 Preliminary Flora and Vegetation Survey

3.1 Methodology

An initial flora and vegetation survey of the study area was carried out from the 27th February to the 1st of March 2002. Different levels of survey were undertaken in the two components of the study area.

3.1.1 Kemerton Power Station Site

The proposed Kemerton Power Station site is largely situated on a timber plantation. The portion primarily addressed in the preliminary survey consisted of an area of natural bushland at the southern extremity of the site. The assessment comprised:

- vegetation condition assessment;
- vegetation association description; and
- a limited threatened flora search (Section 3.2).

Proposed Wastewater Pipeline Route

The wastewater pipeline route survey covered the length of the pipeline from the ocean outfall to the existing boundary of the Kemerton Industrial Park on Marriott Road.

The survey consisted of:

- vegetation mapping;
- vegetation condition assessment;
- detailed flora sites (10 by 10 m quadrats); and
- opportunistic and site based flora collections.

Vegetation mapping was done from 1:10,000 scale aerial photography, using both data from detailed flora sites and ground truthing.

The following parameters were recorded at detailed flora sites:

- vegetation type (a broad description based on dominant species and strata);
- location (recorded using a hand-held Global Positioning System (GPS) to an accuracy within 5 m in AGD84 datum);
- landform;
- substrate and general soil type;
- disturbance (evidence of vehicle tracks, fires etc); and
- flora species present within four main strata (trees, shrubs, sedges and herbs) and their estimated cover (to the nearest percent where possible, otherwise a range was used).

Vegetation condition assessment was based on the following classification scale (Table 3.1).

Table 3.1: Vegetation Condition Scale (Trudgen, 1988).

E = Excellent Pristine or nearly so; no obvious signs of damage caused by the activities of European man.
VG = Very Good Some relatively slight signs of damage caused by the activities of European man. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds such as **Ursinia anthemoides* or **Briza* spp., or occasional vehicle tracks.
G = Good More obvious signs of damage caused by the activities of European man, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or by selective logging. Weeds as above, possibly plus some more aggressive ones such as **Ehrharta* spp.
P = Poor Still retains basic vegetation structure or ability to regenerate to it after very obvious impacts of activities of European man, such as grazing, partial clearing (chaining) or very frequent fires. Weeds as above, probably plus some more aggressive ones such as **Ehrharta* spp.
VP = Very Poor Severely impacted by grazing, fire, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species including aggressive species.
D = Completely Degraded Areas that are completely or almost completely without native species in the structure of their vegetation; ie. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Flora species were identified in the field where identities were certain, or specimens were collected for later identification using the resources of the Western Australian Herbarium. A search was conducted of the CALM database of potential threatened flora species previously known from the locality. The survey botanists familiarised themselves with voucher specimens of these flora held at the WA Herbarium prior to undertaking the survey. General traverses of the study area were carried out for these species in addition to the quadrat sampling. Any other flora species not recorded from the quadrat sampling were also collected as part of these traverses. Flora taxonomy used in this report is based on the most recent version of Max (the WA Herbarium flora nomenclature database). Digital photographs were also taken of all flora sites.

3.2 Limitations of the Preliminary Assessment

The preliminary assessment was prepared on the basis of desktop information, consultation and a brief field assessment of the power station site.

Although a detailed flora survey was undertaken, the initial floristic sampling along the wastewater pipeline route was not done during a suitable season and is not considered an adequate documentation of the flora. Many shrubs were indeterminable to species level or had some level of doubt associated with their identity. This was due to the lack of reproductive material on the specimens at this time of year. Perhaps most significantly, the survey timing was also not ideal for late winter – spring flowering ephemerals. Specifically:

- Annual and herbaceous perennial species such as orchids, *Drosera* and *Stylidium* were almost absent. A number of Declared Rare (DRF) and Priority orchids, a *Stylidium* and a *Drosera* are known from the immediate area. There are 18 records of Priority Flora populations known from an area bounded by coordinates 33° 08' – 33° 14' S and 115° 40' – 115° 45 E. Seven of these 12 species (58%) are herbaceous perennials that would have been dormant, and therefore unable to be detected, at the time of the survey; and
- Annual species account for a large proportion of the species composition in Bassendean vegetation communities. This compromises baseline data and makes evaluation of conservation significance in comparison to other remnant vegetation difficult. This includes assessment of the representation of weed species.

Given the above, the preliminary assessment did not provide an exhaustive account of the flora and fauna of the study area. It was suitable to provide a preliminary appraisal but needed to be supplemented by suitable seasonal work. It is possible that some species or communities of potential significance were not detected or other ecological constraints and management issues may have been present that remain unidentified.

3.3 Vegetation Associations and Flora

3.3.1 Kemerton Power Station Site

The majority of the proposed power station site was covered by a Blue Gum plantation (Plate 3.1). A small section at the south consisted of Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banksia attenuata* Woodland in Good to Poor condition (Plate 3.2). The understorey has been historically impacted by either grazing or soil disturbance, with only a proportion of remnant shrub species. The dominant understorey species were Zamia Palm *Macrozamia riedlei*, *Hibbertia hypericoides,* Blue Boy *Stirlingia latifolia* and Grass Tree *Xanthorrhoea brunonis.* Herbaceous species were not adequately assessed, as they were dormant at the time of the survey.

Weeds were widespread at between 10 and 60% cover, however they were generally non-aggressive, annual herbs and grasses that are common throughout the sandy areas of the southwest of Western Australia (Hussey et al., 1997). The most common species were Flatweed **Hypochaeris glabra,* Blowfly Grass **Briza maxima,* Wild Oats **Avena* sp. and **Ursinia anthemoides*. Historical disturbance factors, such as grazing and clearing, typically account for the dominance of these weed species.

According to the initial survey of the broader industrial park (Muir et al., 1999), this type of vegetation is equivalent to 'Jarrah Woodland' with 'additional presence of Marri'.

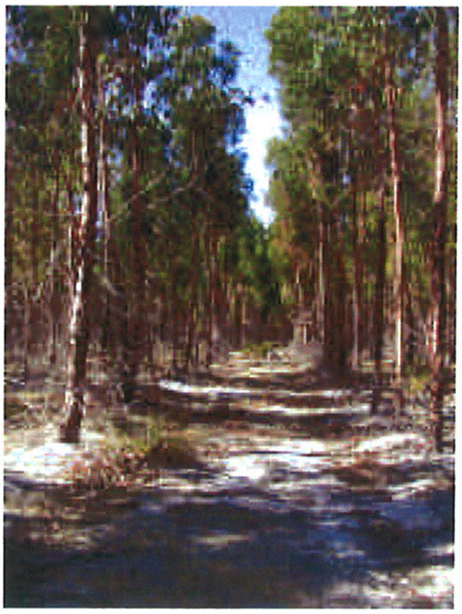

Plate 3.1: Blue Gum *Eucalyptus globulus* plantation (northern Kemerton Power Station site).

Plate 3.2: Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banksia attenuata* Woodland over scattered shrubs and annual weeds (remnant vegetation at south end, proposed Power Station site).

3.3.2 Wastewater Pipeline Route

The results of the field survey along the wastewater pipeline corridor are presented below within the five Sections from the western boundary of the Kemerton Industrial Park core area through to the coast (Sections D-H). Vegetation types along the route are mapped in Figure 3.1.


Figure 3.1
Overview Map: Kemerton Area
377000
378000
379000
380000
381000
382000
6327000
6326000
6325000
6324000
6323000
KP06
KP01
KP02
Legend
Detailed Flora Site
Acacia semitrullata (Priority 3)
Lasiopetalum ?membranaceum (Priority 3)
Proposed Pipeline Route (Indicative)
Vegetation Communities
Woodlands/Forest
1: Agonis flexuosa Forest over scattered shrubs and weedy understorey (Poor - Degraded)
2: Eucalyptus marginata and Banksia attenuata Woodland (Excellent)
Coastal Shrublands/Woodlands
3: Foredune: Sparse shrub and grassland (Good - Poor)
4: Secondary Dunes: Dense Acacia rostellifera Shrubland (Excellent)
5: Consolidated Dunes: Mosaic Acacia rostellifera Shrubland and Agonis flexuosa Low Woodland (Good - Excellent)
6: Mosaic Agonis flexuosa woodland with scattered Tuart Eucalyptus gomphocephala and Melaleuca rhaphiophylla (Poor - Good)
Samphire
7: Samphire flats (Good)
7/8: Samphire flats (Good - Degraded)
Degraded
8: Scattered remnant overstorey over weeds

Eight vegetation associations/types were identified along the wastewater pipeline route:

Woodlands/Forest

1. *Agonis flexuosa* Forest over scattered shrubs and weedy understorey.
2. *Eucalyptus marginata* and *Banksia attenuata* Woodland.

Coastal Shrublands/Woodlands

3. Foredune: Sparse shrub and grassland.
4. Secondary Dunes: Dense *Acacia rostellifera* Shrubland.
5. Consolidated Dunes: Mosaic *Acacia rostellifera* Shrubland and *Agonis flexuosa* Low Woodland.
6. Mosaic *Agonis flexuosa* woodland with scattered Tuart *Eucalyptus gomphocephala* and *Melaleuca rhaphiophylla.*

Samphire

7. Samphire flats.

Degraded

8. Scattered remnant overstorey over weeds.

According to the initial Kemerton Industrial Park survey (Muir et al., 1999), *Agonis flexuosa* Forest over scattered shrubs and weedy understorey (Association 1) is probably a heavily logged manifestation of *Eucalyptus marginata* and *Banksia attenuata* Woodland (Association 2). In Muir's survey, both of these associations were classified as 'Jarrah Woodland'. Associations 3 to 7 were not represented within the Kemerton Industrial Park according to Muir et al. (1999), as they are associated with more coastal areas.

Section D - Marriott Road

This section was mainly Jarrah *Eucalyptus marginata* over *Banksia attenuata* woodland (Association 2) in Excellent condition, with occasional tall Marri *Corymbia calophylla* (Site KP02; Plate 3.3).

There was a sparse small tree stratum of *Banksia grandis* and Woody Pear *Xylomelum occidentale.* The greatest recorded diversity at the time of the survey was in the lower shrub (less than 1m), herbaceous perennial and sedge strata, which were dominated by *Hibbertia hypericoides*, *Melaleuca thymoides*, Blue Boy *Stirlingia latifolia*, *Dasypogon bromeliifolius* and Zamia palm *Macrozamia riedlei.*

Stylidium, *Drosera*, Orchidaceae species and other seasonal herbaceous perennials and annuals expected from this association were absent at the time of the survey. At least a third of the floral species diversity of this association may therefore have been overlooked, significantly limiting the adequacy of the work. Much of this area had been burnt within the last two years.

At the west end near the highway and at the east end (boundary with Kemerton Industrial Park) there were areas of Peppermint *Agonis flexuosus* over degraded, weedy understorey (Association 1; Plate 3.4). The sparse lower perennial strata (<1m) mainly consisted of *Hibbertia hypericoides, Xanthorrhoea brunonis* and *Macrozamia riedlei* with occasional mixed shrubs and sedges. Weeds accounted for up to 90% of the vegetative ground cover and were dead during the survey. According to the initial survey of the Kemerton Industrial Park (Muir et al., 1999), this vegetation association is a disturbed version of Association 2 (Jarrah Woodland).

Plate 3.3: Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland Section D Marriott Road (Site KP02).

Plate 3.4: Peppermint *Agonis flexuosa* over degraded understorey. Eastern end Section D (Site KP01)

Section E – Pasture adjacent to Old Coast Road

Section E of the wastewater pipeline route runs to the west of Old Coast Road through degraded pasture, which contains no features of conservation significance (Association 8; Plate 3.5).

Section F – Buffalo Road East

Section F of the wastewater pipeline route runs to the north of Buffalo Road, again through degraded pasture (Association 8).

Section G – Buffalo Road West

This portion of the wastewater pipeline route crosses the northern margin of the Leschenault Estuary, on the north side of Buffalo Road. The vegetation was a mosaic of degraded weedy roadside and pasture, with Samphire shrubland in relatively good condition. The Samphire occurred on both sides of the road where it crosses the estuary, on sandy clay flats (Association 7; Plate 3.6).

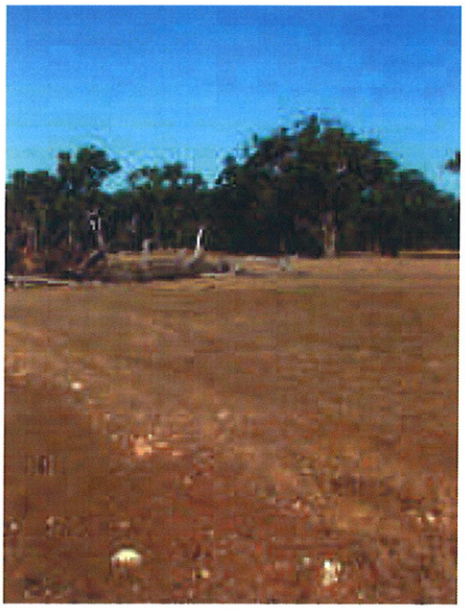

Plate 3.5: Pasture with remnant Tuart *Eucalyptus gomphocephala* over weeds. Section E.

Plate 3.6: Weed infested roadside vegetation above samphire flats (left). Section G (Site KP06).

Section H – Buffalo Road – Coast

The wastewater pipeline route in this section runs adjacent to an existing infrastructure corridor. The surrounding vegetation consisted of sparse shrubland and *Spinifex longifolius* and *S. hirsutus* along the coast (Association 3; Plate 3.7). The secondary dunes support dense stands of *Acacia rostellifera* (Association 4; Plate 3.8). Further inland, *Agonis flexuosa* forms increasingly dense stands of tall shrubs to low trees (Association 5; Plate 3.9).

Plate 3.7: Sparse coastal shrubland of *Spinifex longifolius* and *S. hirsutus.* Section H.

Plate 3.8: Low coastal scrub on foredune (first dune east of ocean). Section H.

Plate 3.9: Coastal thicket of *Acacia rostellifera.* Section H.

In dune swales towards the Leschenault Estuary, Tuart *Eucalyptus gomphocephala* sometimes occurred with the *Agonis flexuosa* association. Where this section of the wastewater pipeline route meets Buffalo Road, there was a small area of *Melaleuca rhaphiophylla* on water gaining soils.

The condition of the vegetation in Section H was variable. The foredune along the coast of Western Australia is typically vegetated to a large degree by introduced species. This area is naturally volatile, with large areas of bare sand and dune blowouts as common features. This may be exacerbated by off-road vehicle use and clearing of vegetation. There is already a large cleared area where the wastewater pipeline route exits to the ocean.

The secondary and consolidated dunes were generally in Very Good condition. However, the existing track and approximately 5m either side was generally in Very Poor condition as a result of historical and ongoing disturbance processes. Areas towards the east (mosaic of *Agonis flexuosa, Eucalyptus gomphocephala* and *Melaleuca rhaphiophylla*) had more weeds and degraded understorey than *Acacia rostellifera* shrublands closer to the coast.

3.4 Threatened Flora Species

In Western Australia, all native flora species are protected under the *Wildlife Conservation Act 1950-1979,* making it an offence to remove or harm native flora species without approval. In addition to this basic level of statutory protection, some plant species are assigned an additional level of conservation significance based on the fact that there is a limited number of known populations, some of which may be under threat (see Table 3.2). Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of four Priority flora categories.

The presence of specific endangered flora species may mean that it is necessary to refer proposals to the Federal Minister for the Environment under the *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999. A total of 658 taxa is currently listed nationally. In the case of Western Australia at least, this list comprises only the DRF.

Table 3.2: Categories of conservation significance for flora species (Atkins, 2001).

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.
Declared Rare Flora - Presumed Extinct. 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.
Priority 1 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
Priority 2 - 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 threat.
Priority 3 - Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under threat.
Priority 4 - Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

A search was conducted of the CALM database of potential threatened flora species previously known from the locality (Table 3.3)(Appendix 4). General traverses of the study area were carried out for these species in addition to the quadrat sampling.

Table 3.3: DRF and Priority flora previously collected from the locality of the study area.

Species	Conservation Status	No. of Populations in locality
Diuris micrantha	DRF	4
Drakaea elastica	DRF	2
Drakaea micrantha	DRF	2
Lasiopetalum membranaceum	Priority 3	1
Stylidium longitubum	Priority 3	Unspecified
Verticordia attenuata	Priority 3	1
Acacia flagelliformis	Priority 4	Unspecified
Aponogeton hexatepalus	Priority 4	Unspecified
Caladenia speciosa	Priority 4	1
Drosera marchantii	Priority 4	2
Jacksonia sparsa ms	Priority 4	Unspecified
Pultenaea skinneri	Priority 4	1

No DRF were recorded during the survey. There were therefore no species currently listed under the *EPBC Act* 1999 recorded in the site.

Two Priority flora species were recorded from Section D (Marriott Road) of the wastewater pipeline route. Both of these species are Priority 3 Flora (taxa which are known from several populations, at least some of not believed to be under threat).

- ***Acacia semitrullata* Priority 3**

This species is a small upright shrub with yellow, ovoid flowers typical of Wattles (Plate 3.10). It was scattered throughout the Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland along Section D (Marriott Road). The vegetation in this area was in excellent condition with all strata intact and only scattered annual weeds.

It has previously been recorded from Yallingup, Donnybrook, Harvey, Yarloop and Collie (Atkins, 2001). There were 29 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations these represented. Many of the populations were recorded from degraded road verges. At least one population is reserved within the Whicher Range Nature Reserve.

- ***Lasiopetalum ?membranaceum* Priority 3**

This species is a low rounded to sprawling shrub (Plate 3.11). It was located at the western end of Section D (Marriott Road) near Old Coast Road, in Marri *Corymbia calophylla* and Peppermint *Agonis flexuosus* Woodland. This vegetation was in Good to Poor condition with some of the native shrub strata absent and a ground layer of annual weeds.

L. ?membranaceum has previously been recorded from Yalgorup, Capel, Dwellingup, Yandup, Australind, Dawesville and Yanchep. There were 12 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations these represented. At least two populations are protected in the Yalgorup and Yanchep National Parks.

Plate 3.10: *Acacia semitrullata* (Priority 3), Section D: Marriott Road.

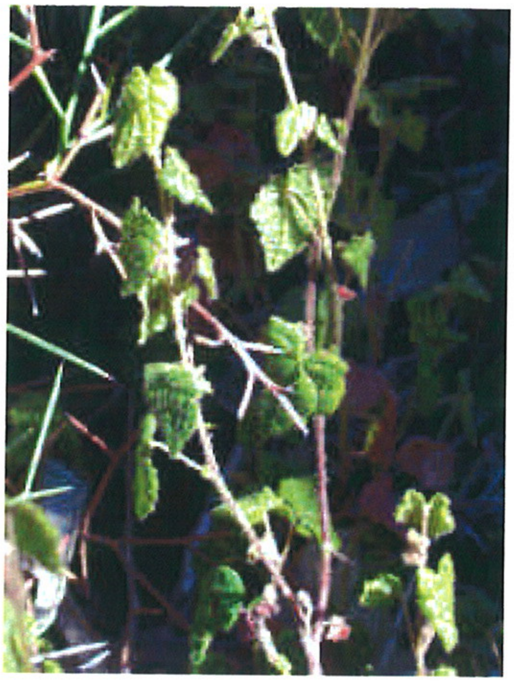

Plate 3.11: *Lasiopetalum ?membranaceum* (Priority 3), Section D.

4.0 Spring Flora and Vegetation Assessment

A detailed spring flora and vegetation survey was carried out at the proposed power station site from the 10th to 11th of October 2002.

4.1 Methods

Flora species were identified in the field where identities were certain, or specimens were collected for later identification using the resources of the Western Australian Herbarium. A search was conducted of the CALM database of potential threatened flora species previously known from the locality. The survey botanists familiarised themselves with voucher specimens of these flora held at the WA Herbarium prior to undertaking the survey. General traverses of the study area were carried out for these species in addition to the quadrat sampling. Any other flora species not recorded from the quadrat sampling were also collected as part of these traverses. Flora taxonomy used in this report is based on the most recent version of Max (the WA Herbarium flora nomenclature database). Digital photographs were also taken of all sites.

Vegetation was surveyed within four detailed flora quadrats with a precise measured area of 10m x 10m. The following parameters were recorded for the quadrat:

- vegetation type (a broad description based on dominant species and strata);
- location (recorded using a hand-held Global Positioning System (GPS) to an accuracy within 5 m in datum WGS84);
- landform;
- substrate and general soil type;
- disturbance (evidence of vehicle tracks, fires etc);
- flora species present within the main strata (trees, shrubs, sedges and herbs) and their estimated cover (to the nearest percent where possible, otherwise a range was used); and
- vegetation condition (Table 3.1).

4.2 Results

4.2.1 Flora

A total of 138 flora species was recorded from the power station site, comprising representatives from 98 genera and 38 families (see Tables 4.1 and 4.2). Thirty-two of the species recorded were weeds (23% of the flora), with four families and 28 genera only represented by exotics.

Table 4.1: Best represented flora families in the power station site.

Family		Native Species	Introduced Species	Total
Papillionaceae	Peas	12	5	17
Myrtaceae	*Eucalyptus, Melaleuca* etc.	11	0	11
Orchidaceae	Orchids	8	1	9
Proteaceae	*Banksia, Grevillea* etc	7	0	7
Mimosaceae	Wattles	6	0	6
Epacridaceae	Australian heaths	5	0	5
Stylidiaceae	Trigger plants	5	0	5
Dilleniaceae	Guinea flowers	5	0	5
Dasypogonaceae	Lilies	5	0	5
Poaceae	Grasses	1	10	11

Table 4.2: Best represented genera within the power station site.

Genus		Native Species	Introduced Species	Total
Acacia	Wattles	6	0	6
Hibbertia	Guinea flowers	5	0	5
Stylidium	Trigger plants	5	0	5
Drosera	Sundews	4	0	4
Lomandra	(Lilies)	4	0	4
Banksia	Banksias	3	0	3
Gompholobium	(Peas)	3	0	3
Jacksonia	(Peas)	3	0	3
Leucopogon	Beard heaths	3	0	3

Additionally, 18 native genera were represented by two species.

4.2.1.1 Rare Flora

No DRF were recorded during the survey. There were therefore no species currently listed under the *EPBC Act* 1999 recorded in the site (Section 3.4).

Two Priority flora species were recorded from the power station site, *Acacia semitrullata* (Priority 3) and *Jacksonia sparsa* (Priority 4).

***Acacia semitrullata* (Priority 3 Flora)**

This species is a small upright shrub with yellow, ovoid flowers typical of Wattles (Plates 3.10, 4.1 and 4.2). It was scattered throughout the Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland within the power site boundary (Figure 4.1).

It has previously been recorded from Yallingup, Donnybrook, Harvey, Yarloop and Collie (Atkins, 2001). There were 29 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations these represented. Many of the populations were recorded from degraded road verges. At least one population is reserved within the Whicher Range Nature Reserve.

Plate 4.1: *Acacia semitrullata* Priority 3 Flora showing habit (on road verge).

Plate 4.2: *Acacia semitrullata* Priority 3 phyllodes (leaves) and pods.

- *Jarrah Eucalyptus marginata* and *Banksia attenuata* woodland
- *Melaleuca preissiana* damplands
- *Astartea fascicularis* shrubland over *Lepidosperma longitudinale* sedgelands on damplands
- Blue gum **Eucalyptus globulus* plantation
- Detailed flora site
- Priority Flora Location

Vegetation Condition Scale is based on Trudgen (1995). See text for descriptions.

Figure 4.1: Vegetation Types at the Proposed Kemerton Power Station

Biota Environmental Sciences

- ***Jacksonia sparsa* ms (Priority 4 Flora)**

This species is an erect, upright, leafless and spiny shrub to 3 m with red, yellow and orange pea flowers (Paczkowska and Chapman, 2000) (Plate 4.3).

It has previously been recorded from the Whicher Range, Bunbury, Capel, Harvey, Pemberton, Boyanup, Dandalup, Nannup and Lake Clifton. In the study area it was recorded in Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland, along either side of the sealed road (Figure 4.1).

Plate 4.3: *Jacksonia sparsa* ms Priority 4 flora.

Previous Rare Flora Surveys

Acacia semitrullata has previously been recorded from this site, in a spring survey of the Kemerton Industrial Estate in 1999 (Armstrong, 1999a). This species was found to be widespread throughout the original core, expanded core and support industry area with over 40 collections made (Armstrong 1999a, 1999b and 1999c). Two DRF species *Drakaea elastica* and *D. micrantha* were recorded within five kilometres of the power station site, growing in similar habitats to those present in the intact vegetation of the study area. A Priority 1 flora species *Boronia juncea* subsp. *juncea* and two Priority 3 flora species *Dillwynia dillwynioides* and *Lasiopetalum membranaceum* have also been recorded in similar habitats within five kilometres of the study area (Armstrong, 1999a).

4.2.1.2 Declared Plants (Agricultural Weeds)

Weed species Declared under the *Agriculture and Related Resources Protection Act* 1976 are assigned to one of five control categories (Table 4.3). The study area was surveyed for the presence of Declared Plants.

Table 4.3: Control Categories for Declared Plants

PRIORITY	REQUIREMENTS
P1	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.
P2	Aim is to eradicate infestation Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3	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	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 high water 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.
P5	Infestations on public lands must be controlled.

One species of Declared Plant under the *Agriculture and Related Resources Protection Act* 1976 was recorded in the power station site:

Narrow leaved cotton bush **Gomphocarpus fruticosus*

This species is a P1 and P4 Declared Plant for the City of Bunbury and Harvey Shires and surrounding areas. P1 are those species for which 'The movement of plants or their seeds is prohibited within the State'. P4 are those plants for which the 'Aim is to prevent infestation spreading beyond existing boundaries of infestation' (Table 4.3). This species was recorded at the western end of the study area near the drain that runs through the centre of the Blue Gum plantation.

4.2.1.3 Environmental Weeds

All introduced flora present within bushland can be considered environmental weeds.

Both degraded and relatively undisturbed areas were assessed for the presence and abundance of environmental weeds. The presence or absence of serious environmental weeds is a good indicator of both condition and long-term viability of bushland.

Thirty-two species of introduced flora were recorded from the bushland of the power station site. The most widespread species within relatively intact bushland were Blowfly grass **Briza maxima, *Ursinia anthemoides,* Guildford grass **Romulea rosea* and Flatweed **Hypochaeris glabra*. All of these species are common and widespread naturalized weeds of native bushland on the Swan Coastal Plain. The introduced peas Yellow serradella **Ornithopus compressus, *Lotus* sp. and Clover **Trifolium* spp. were common weeds of drains and the dampland at the southern end of the study area.

Several species were only recorded from a damp drain through the middle of the plantation, including **Acetosella vulgaris,* Couch **Cynodon dactylon* and Mallow **Malva parviflora*. Annual grass weeds Barley grass **Hordeum leporinum*, Annual veldt grass **Ehrharta longiflora* and Wild oats **Avena barbata* were common on disturbed areas and bushland margins.

4.2.2 Vegetation

Two publications were consulted to aid in identifying the presence of threatened ecological communities:

- 'A Floristic Survey of the Southern Swan Coastal Plain' (Gibson et al., 1997). This publication is an overall assessment of vegetation based on floristics on the southern Swan Coastal Plain. The degree of conservation significance assigned to the floristic communities identified in the report is shown in Tables 4.4 and 4.5.

Table 4.4: Reservation Status of Vegetation Communities (Gibson et al., 1997)

Well Reserved	Known from two or more A class National Parks or Nature Reserves
Poorly Reserved	Known from a single A class National Park or Nature Reserve
Unreserved	Not know to occur in any A class National Park or Nature Reserve

Table 4.5: Conservation Status of Vegetation Communities (Gibson et al., 1997)

Presumed Destroyed	A community that is totally destroyed or so extensively modified that it is unlikely to re-establish ecosystem processes in the foreseeable future
Critical	A community with most or all of its know occurrences facing severe modification or destruction in the immediate future.
Endangered	A community in danger of severe modification or destruction throughout its range, if causal factors continue operating.
Susceptible	A community of concern because there is evidence that it can be modified or destroyed by human activities, or would be vulnerable to new threatening process.
Low Risk	A community that does not qualify for one of the above categories.
Insufficiently known	A community for which there is inadequate data to assign to one of the above categories.

- 'Identifying and Conserving Threatened Ecological Communities in the South West Botanical Province' (English and Blyth, 1997). This document lists naturally occurring assemblages of flora and fauna that are considered by CALM to be threatened by extinction through human activity. Each association identified in this document is classified according to the following table (Table 4.6).

Table 4.6: Threatened Ecological Community Categories (English and Blyth, 1997)

Category 1: Presumed Totally Destroyed	An ecological community which has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.
Category 2: Critically Endangered	An ecological community which has been adequately surveyed and found to have been subject to a major contraction in area and/or which was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.
Category 3: Endangered	An ecological community which has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or

	severe modification or destruction over most of its range in the near future.
Category 4: Vulnerable	An ecological community which has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community which is still widespread but threatening processes continue or begin operating throughout its range.
Category 5: Data Deficient	An ecological community for which there is inadequate data to assign it to one of the above categories and/or which is not yet evaluated with respect to status of threat.
Category 6: Lower Risk	A community which has been adequately surveyed and evaluated and available information suggests that it does not qualify for one of the above categories of threat.

There were three relatively intact communities present in the study area:

1. Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland

This association had a tall open overstorey of Jarrah *Eucalyptus marginata* over low woodland of *Banksia attenuata* over a moderately dense, low, diverse shrub and herbland. Other common but scattered trees in this association included Marri *Corymbia calophylla, Nuytsia floribunda, Banksia grandis, B. ilicifolia* and *Persoonia longifolia.* Dominant medium (0.6-1.3m) shrubs included *Melaleuca thymoides, Xanthorrhoea brunonis, Acacia extensa, A. pulchella* var. *pulchella, Adenanthos meisneri* and *Hibbertia hypericoides.* Other medium shrubs included *Macrozamia riedlei, Calytrix leschenaultii* and *Daviesia incrassata* subsp. *incrassata.* There were numerous low (less than 0.6m) sparse shrubs including *Hovea trisperma, Gompholobium* spp., *Conostephium pendulum, Calytrix flavescens, Bossiaea eriocarpa, Hibbertia* spp., *Leucopogon* spp., *Lysinema ciliatum, Petrophile linearis, Philotheca spicata, Platysace compressa, Stirlingia latifolia* and *Tetratheca hirsuta.* Herbaceous perennial sedges, rushes, grasses and grass-like herbs were common and included *Lepidosperma squamatum, Lyginia barbata, Desmocladus flexuosus, Lomandra* spp., *Patersonia occidentalis* and *Conostylis* spp.

Two detailed flora sites were completed within this association. Site 2 had a total of 57 species, of which three were introduced. This is a high species diversity and low weed count for a single season survey site and reflects the excellent condition of the vegetation that this site represented. Although Site 4 was in the same association, it was in a more degraded area adjacent to the Blue Gum plantation and had only 25 species, of which nine were introduced. Figure 4.1 illustrates the vegetation condition boundaries of this association.

This vegetation type is equivalent to Gibson et al. (1995) communities:

21a: Central *Banksia attenuata* - *Eucalyptus marginata* woodlands

Reservation Status: Well reserved
Conservation Status: Low risk

21b: Southern *Banksia attenuata* woodlands.

Reservation Status: Well reserved
Conservation Status: Susceptible

(See Tables 4.4 and 4.5 for status codes).

These communities are not listed as threatened by English and Blyth (1997).

Plate 4.4: Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland. Detailed flora site 2.

Plate 4.5: Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland. Detailed flora site 4.

2. *Melaleuca preissiana* damplands

This association occurred to the south of the study area, surrounding a winter wet depression (Association 3). It consisted of tall sparse *Melaleuca preissiana* and scattered *Nuytsia floribunda* over low, moderately dense shrubs, herbs and sedge-like species. Dominant and widespread medium shrubs were *Hypocalymma angustifolia, Pericalymma ellipticum* and *Astartea fascicularis* as well as the Grasstree *Xanthorrhoea preissii.* Other typical shrubs included *Euchilopsis linearis, Hibbertia vaginata, Dampiera linearis, Philotheca spicata, Acacia pulchella* and *A. semitrullata.* Sedges and sedge-like species included sparse *Schoenus efoliatus* and *Hypolaena exsulca*. Herbaceous perennial and annual herbs included sparse *Dasypogon bromeliifolius* and scattered *Lomandra* sp., *Patersonia occidentalis, Drosera gigantea* subsp. *geniculata, Chamaescilla versicolor, Thysanotus thyrsoideus, Caladenia flava* and *Elythranthera brunonis.*

Thirty-four species were recorded in the single detailed flora site done within this association, of which 11 were introduced. The condition of this association was Very Good with sparse weeds and some isolated disturbed areas.

This vegetation type is equivalent to Gibson et al. (1995) community:

4: *Melaleuca preissiana* damplands

Reservation Status: Well reserved
Conservation Status: Low risk

(See Tables 4.4 and 4.5 for status codes).

This community is not listed as threatened by English and Blyth (1997).

3. *Astartea fascicularis* shrubland over *Lepidosperma longitudinale* sedgeland on damplands

This association occurred in two disjunct areas; on the southern boundary of the study area in a low-lying, seasonally inundated dampland and in the centre of the study area amongst the Blue Gum plantation (Figure 4.1). It consisted of dense to open medium shrubs of *Astartea fascicularis* over sparse to open sedges of *Lepidosperma longitudinale* and open annual weeds. Other scattered native shrubs and sedge-like species included *Hibbertia stellaris, Meeboldina coangustata* and *Thelymitra flexuosa*. Weeds typically included **Hypochaeris glabra, *Briza maxima, *B. minima* and **Lotus* sp.

Fourteen species were recorded from the single site in this association, of which nine were introduced. This association was in Poor condition. There were widespread weeds and the number of species was low, with native herbs absent.

This vegetation type is equivalent to Gibson et al. (1995) communities:

9: Dense shrublands on clay flats.

Reservation Status: Well reserved
Conservation Status: Vulnerable

12: *Melaleuca teretifolia* and/or *Astartea fascicularis* shrublands

Reservation Status: Well reserved
Conservation Status: Low risk

(See Tables 4.4 and 4.5 for status codes).

These communities are not listed as threatened by English and Blyth (1997).

Plate 4.7: *Astartea fascicularis* shrubland over *Lepidosperma longitudinale* sedgeland on damplands. Site 1.

4.2.3 Dieback

It appears likely that dieback has been present in the power station site for a considerable time. There were very few individuals from the Epacridaceae family present, which are very susceptible to dieback. There were very few mature Bull Banksia *Banksia grandis* present in the site, however there were numerous seedlings, which were approximately 30cm tall. This species is also sensitive to dieback and the presence of seedlings may mean that the area is recovering.

5.0 Discussion and Recommendations

5.1 Preliminary Assessment

5.1.1 Potential Flora and Fauna Constraints

Based on this study, a number of areas of potential conservation value occur within the study area. These could comprise potential development constraints and should be taken into consideration as detailed planning and design progress for the power station and the proposed wastewater pipeline. Note that the assessment provided in this section is preliminary only, primarily due to the seasonal timing of the work (see Section 2.2).

The power station site appears to be largely unconstrained with respect to flora and fauna based on the available information and the work carried out as part of the initial assessment. The Blue Gum timber plantation area has little or no conservation value and the use of this area should be maximised. The vegetation in the southern portion of the site represents remnant native vegetation, which should be avoided as far as possible in the development of the power station design. More detailed seasonal work should, however, be completed on the site prior to finalising the design of the power station should it proceed in this location (see Section 5.2).

The currently identified features of potential conservation value along the proposed wastewater pipeline route occur mainly in Section D along Marriott Road and include:

- The relatively intact areas of vegetation in Section D (Marriott Road) and Section H (Coastal);
- The presence of two species of Priority 3 Flora in Section D (*Acacia semitrullata* and *Lasiopetalum ?membranaceum*); and
- The high potential for currently unidentified populations of annual (spring-flowering) DRF and Priority flora in Section D.

The relatively intact habitats of Sections D and H also have the greatest potential to support fauna species of conservation significance, particularly the Western Ringtail Possum *Psuedocheirus occidentalis* (Schedule 1) and the Southern Brown Bandicoot *Isoodon obesulus* (Priority 4). These areas should be avoided as far as possible in the final route selection. It appears from field inspection that there are several areas within the proposed wastewater pipeline corridor where disturbed ground or existing infrastructure corridors could be utilised for the installation of the proposed wastewater pipeline should it be constructed at this site.

Note that the portion of the proposed wastewater pipeline route between the boundary of the Kemerton 'core area' and the proposed power station site was not assessed and potentially contains other features of conservation significance. We understand that current project planning will include provision for more detailed assessment of the ecological features of this area by others.

5.1.2 Potential Impacts

Potential impacts at this stage of project development are identified in principal only, given the current design stage of the project. Impacts on flora and vegetation that may arise as a result of the proposed works include:

- Clearing of relatively intact vegetation at Section D and Section H;

- Clearing of some remnant habitat in the southern portion of the power station site;
- Dune destabilization near the coast (Section H);
- Fragmentation of vegetation at Section D by creating another clearance corridor;
- Disturbance or removal of priority flora populations; and
- Spread of weeds and/or soil-borne pathogens into relatively intact vegetation.

With respect to fauna, the impacts are more difficult to identify, given the lack of definitive data on the species present and the extent of their reliance on the habitats of the site. The principal impacts for most potential species of higher conservation significance are likely to reflect those related to the vegetation. That is, removal of the relatively intact habitats along Sections D and H is likely to have negative impacts on local populations of the Western Ringtail Possum and the Southern Brown Bandicoot, should these species be present. These species are the most reliant on intact shrub strata and dense Peppermint woodlands. Fragmentation of these areas by a new corridor would also potentially increase feral predator access to the more intact habitat units. A more detailed assessment of the fauna species occurring in the area would be needed if any more comprehensive analysis of potential impacts is to be undertaken.

The extent to which any of the above impacts are realised will be dependent on the final design and wastewater pipeline route selected, the findings of additional survey work and the adequacy of environmental management measures during and post construction.

5.1.3 Recommendations

The following recommendations were made based on the findings of the preliminary assessment:

1. The proposed wastewater pipeline should be placed along the existing Marriott Road reserve in the cleared verge area (Section D) and within the existing disturbed ground of the remaining infrastructure corridor (Section H). This would significantly reduce the requirement to clear native vegetation and remove relatively intact native fauna habitat.

2. If other constraints are such that it is impossible to realign the proposed wastewater pipeline route in Section D and Section H, a more detailed seasonal survey is required to:
    - assess annual and herbaceous perennial species diversity;
    - clarify the identity and extent of *Lasiopetalum ?membranaceum*, which was sterile at the time of the survey (Section D);
    - acquire adequate survey data for 10 by 10m quadrats for species richness comparisons and to enable a more complete conservation significance evaluation;
    - adequately survey for potential DRF and Priority flora that may have been dormant at the time of the initial survey; and
    - carry out more detailed fauna survey work to assess the occurrence of threatened fauna.

3. A seasonal survey including detailed flora sites should also be carried out in the area of natural bushland at the proposed Kemerton Power Station.

Dependent on the outcomes of the above work, and the nature of the final design if it is progressed at this site, CALM should be consulted as to management requirements for specially protected species or any statutory approvals processes that may be required.

5.2 Spring Flora and Vegetation Assessment

5.2.1 Additional Flora Constraints

The detailed spring flora and vegetation assessment of the power station site identified a number of issues in addition to those outlined in the preliminary assessment. The preliminary survey briefly assessed the area of Jarrah woodland that will be directly impacted by the current power station layout, while the detailed spring survey assessed all areas within the broader site boundary (Figure 4.1).

Two Priority Flora species were recorded within the Jarrah woodland of the site. *Acacia semitrullata* (Priority 3) is widespread at scattered densities, while *Jacksonia sparsa* (Priority 4) was recorded from the southeast corner on the east and west of the sealed road. Both of these species have at least one known population protected within reserves, however many populations are on degraded areas such as road verges. The populations at the power station site are in excellent condition, providing representation of these species within a relatively intact habitat.

The three DRF orchids previously recorded from the general area, *Diuris micrantha, Drakaea elastica* and *D. micrantha* may potentially occur in the study area. The damplands and adjoining Jarrah-Banksia woodland are the preferred habitat of these species. Orchids have a limited flowering period and may not flower at all for several seasons and so may not have been recorded during this survey.

The intact vegetation of the site has been impacted heavily in some areas, predominantly in places around its edge, adjacent to tracks and roads. The central areas however are in relatively good condition with high species richness, low weed invasion and an intact structure.

5.2.2 Potential Impacts

The spring survey work largely confirmed the potential flora constraints and impacts issues arising from the initial assessment.

Direct impacts on flora and vegetation that may arise as a result of the power station proposed works include:

- Clearing of or disturbance to relatively intact vegetation in the southern third of the site; and
- Disturbance or removal of priority flora populations (*Acacia semitrullata*, P3 and *Jacksonia sparsa*, P4).

Construction activities may result in more widespread and long-term effects beyond the immediate construction area. Long term and/or secondary damage may affect surrounding bushland during and after construction. Next to clearance and soil disturbance, weeds and diseases such as armillaria and phytophthora are the most significant threats to the long-term viability of the intact vegetation of the site.

5.2.3 Recommendations

The layout plans indicate that the current proposed size of the plant could be accommodated within the area currently utilized as Blue Gum plantation. The option of placing the power station within the plantation boundary should be fully investigated. This would result in avoiding all direct impacts on the constraints identified in Section 5.2.1.

To reduce the potential for secondary impacts caused by construction works, the following recommendations should be followed:

1. Hygiene procedures should be established and followed to prevent the introduction of weeds and soil borne pathogens. This means that soil and plant material be removed from contractors vehicles, machinery and equipment before they are brought on-site. The likelihood of soil borne weeds and diseases being brought on site by unclean equipment is extremely high;

2. No clearing or disturbance of any kind should occur in bushland outside the area required for the power plant. The clearing area should be clearly defined on design drawings and in the field, and disturbance should be prohibited outside this boundary. This includes the parking and storage of vehicles (including employees' private vehicles), equipment and machinery. Delineation of clearing limits on-site should constitute a hold-point requiring checking and approval by the site superintendent prior to clearing commencing;

3. Disturbed areas and existing tracks be used for access and storage for machinery, vehicles and equipment in preference to areas of bushland;

4. Dumping or temporary storage of waste construction material in bushland should be prohibited; and

5. A version of the above recommendations should be provided to all people involved in the construction process as part of site inductions. There should be checks for non-compliance at regular intervals by a qualified person, including both prior to and during construction.

6.0 Acknowledgements

Assistance with some of the flora identifications was kindly given by specialist botanists:

- Mr. Andrew Brown, botanist with the Department of Conservation and Land Management, identified Orchidaceae species.
- Mr. Allen Lowrie, consultant and *Stylidium* and carnivorous plant specialist, identified *Drosera, Stylidium* and *Levenhookia* species.

7.0 References

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Preliminary Survey Flora List

Appendix 1

16A ZAMIACEAE
Macrozamia riedlei

031 POACEAE
Austrodanthonia caespitosa
Austrostipa sp.
**Avena* sp.
**Briza maxima*
**Bromus* sp.
**Cynodon dactylon*
**Ehrharta calycina*
**Ehrharta longiflora*
**Eragrostis curvula*
**Hordeum marinum*
**Lagurus ovatus*
**Lolium* sp.
Spinifex hirsuta
Spinifex longifolius
**Stenotaphrum secundatum*

032 CYPERACEAE
Isolepis nodosa
Lepidosperma gladiatum
Lepidosperma squamatum
Schoenus ?curvifolius
Schoenus grandiflorus

039 RESTIONACEAE
Desmocladus fasciculatus
Desmocladus flexuosus
Hypolaena exsulca
Lyginia barbata

052 JUNCACEAE
Juncus kraussii

054C DASYPOGONACEAE
Acanthocarpus preissii
Dasypogon bromeliifolius

054D XANTHORRHOEACEAE
Xanthorrhoea brunonis
Xanthorrhoea preissii

054E PHORMIACEAE
Dianella revoluta

ANTHERICACEAE 054F
Corynotheca micrantha
Dichopogon capillipes
Tricoryne elatior

054G ASPHODELACEAE
**Asphodelus fistulosus*

054J COLCHICACEAE
Burchardia umbellata

055 HAEMODORACEAE
Conostylis aculeata
Phlebocarya ciliata

060 IRIDACEAE
Patersonia occidentalis
**Romulea rosea*

070 CASUARINACEAE
Allocasuarina fraseriana
Allocasuarina humilis

090 PROTEACEAE
Adenanthos meisneri
Banksia attenuata
Banksia grandis
Banksia ilicifolia
Dryandra sessilis
Hakea prostrata
Persoonia saccata
Persoonia longifolia
Petrophile linearis
Stirlingia latifolia
Synaphea sp.
Xylomelum occidentale

092 SANTALACEAE
Santalum acuminatum

097 LORANTHACEAE
Nuytsia floribunda

103 POLYGONACEAE
**Rumex* sp.

105 CHENOPODIACEAE
Halosarcia sp.
Rhagodia baccata subsp. *baccata*
Sarcocornia blackiana
Suaeda australis

110 AIZOACEAE
**Tetragonia decumbens*

119 RANUNCULACEAE
Clematis linearifolia

131 LAURACEAE
Cassytha flava
Cassytha racemosa
Cassytha sp.

138 BRASSICACEAE
**Cakile maritima*

163 MIMOSACEAE
Acacia cochlearis
Acacia cyclops
Acacia huegelii
Acacia pulchella var. *glaberrima*
Acacia rostellifera
Acacia saligna

†Acacia semitrullata
Acacia stenoptera
Acacia willdenowiana

164 PAPILLIONACEAE
Bossiaea eriocarpa
Daviesia divaricata
Gompholobium confertum
Gompholobium tomentosum
Hardenbergia comptoniana
Hovea trisperma
Jacksonia furcellata
Jacksonia sp.
Jacksonia sternbergiana
Kennedia prostrata
**Lupinus cosentinii*
Nemcia capitata
**Trifolium sp.*

167 GERANIACEAE
**Pelargonium capitatum*

173 ZYGOPHYLLACEAE
Zygophyllum sp.

175 RUTACEAE
Diplolaena dampieri

185 EUPHORBIACEAE
**Euphorbia australis*
**Euphorbia paralias*
**Euphorbia terracina*

215 RHAMNACEAE
Spyridium globulosum

223 STERCULIACEAE
†Lasiopetalum membranaceum

226 DILLENIACEAE
Hibbertia cuneiformis
Hibbertia hypericoides
Hibbertia sp.

243 VIOLACEAE
Hybanthus floribundus

273 MYRTACEAE
Agonis flexuosa
Calytrix flavescens
**Chamelaucium uncinatum*
Corymbia calophylla
Eucalyptus gomphocephala
Eucalyptus marginata
Kunzea ericifolia
Melaleuca huegelii
Melaleuca thymoides

275 ONAGRACEAE
Oenothera mollissima

281 APIACEAE
**Foeniculum vulgare*
Platysace compressa

288 EPACRIDACEAE
Astroloma pallidum
Conostephium pendulum
Leucopogon parviflorus
Leucopogon propinquus

301 OLEACEAE
**Olea europaea*

304 APOCYNACEAE
Alyxia buxifolia

313 LAMIACEAE
Hemiandra pungens

315 SOLANACEAE
Anthocercis littorea
**Solanum sodomeum*

341 GOODENIACEAE
Dampiera linearis
Scaevola crassifolia

343 STYLIDIACEAE
Stylidium sp.

345 ASTERACEAE
**Arctotheca calendula*
Hyalosperma cotula
**Hypochaeris glabra*
Olearia axillaris
**Sonchus oleraceus*
**Ursinia anthemoides*

Spring Survey Flora List

Appendix 2

BIOTA

011C PTERIDIACEAE
Pteridium esculentum

016A ZAMIACEAE
Macrozamia riedlei

031 POACEAE
Austrodanthonia acerosa
**Avena barbata*
**Briza maxima*
**Briza minor*
**Bromus diandrus*
**Cynodon dactylon*
**Ehrharta calycina*
**Ehrharta longiflora*
**Eragrostis curvula*
**Hordeum leporinum*
**Lolium perenne*

032 CYPERACEAE
Lepidosperma longitudinale
Lepidosperma squamatum
Schoenus efoliatus
Schoenus sublateralis

039 RESTIONACEAE
Desmocladus flexuosus
Hypolaena exsulca
Lyginia barbata
Meeboldina coangustata

040A HYDATELLACEAE
Trithuria submersa

052 JUNCACEAE
Juncus amabilis
Juncus pallidus

054C DASYPOGONACEAE
Dasypogon bromeliifolius
Lomandra caespitosa
Lomandra preissii
Lomandra sericea
Lomandra sp.

054D XANTHORRHOEACEAE
Xanthorrhoea brunonis
Xanthorrhoea preissii

054F ANTHERICACEAE
Chamaescilla versicolor
Johnsonia acaulis
Thysanotus manglesianus
Thysanotus thyrsoideus

054G ASPHODELACEAE
**Trachyandra divaricata*

054J COLCHICACEAE
Burchardia umbellata

055 HAEMODORACEAE
Conostylis aculeata
Conostylis serrulata

060 IRIDACEAE
Patersonia occidentalis
**Romulea rosea*

066 ORCHIDACEAE
Caladenia flava subsp. *flava*
**Disa bracteata*
Drakaea livida
Elythranthera brunonis
Paracaleana nigrita
Pterostylis vittata
Pyrorchis nigricans
Thelymitra aff. *macrophylla*
Thelymitra flexuosa

090 PROTEACEAE
Adenanthos meisneri
Banksia attenuata
Banksia grandis
Banksia ilicifolia
Persoonia longifolia
Petrophile linearis
Stirlingia latifolia

097 LORANTHACEAE
Nuytsia floribunda

103 POLYGONACEAE
**Acetosella vulgaris*

131 LAURACEAE
Cassytha sp.

143 DROSERACEAE
Drosera gigantea subsp. *geniculata*
Drosera paleacea subsp. *paleacea*
Drosera pallida
Drosera stolonifera subsp. *porrecta*

149 CRASSULACEAE
Crassula sp.

163 MIMOSACEAE
Acacia extensa
Acacia huegelii
Acacia pulchella var. *pulchella*
Acacia saligna

Acacia semitrullata
Acacia stenoptera

165 PAPILLIONACEAE
Aotus procumbens
Bossiaea eriocarpa
Daviesia incrassata subsp. *incrassata*
Euchilopsis linearis
Gompholobium capitatum
Gompholobium confertum
Gompholobium scabrum
Hovea trisperma
Jacksonia furcellata
Jacksonia sparsa
Jacksonia sternbergiana
Kennedia prostrata
**Lotus* sp.
**Lupinus cosentinii*
**Ornithopus compressus*
**Trifolium campestre*
**Trifolium* sp.

167 GERANIACEAE
Erodium botrys
Geranium molle
Pelargonium capitatum

175 RUTACEAE
Philotheca spicata

182 TREMANDRACEAE
Tetratheca hirsuta

185 EUPHORBIACEAE
Poranthera microphylla

221 MALVACEAE
**Malva parviflora*

226 DILLENIACEAE
Hibbertia huegelii
Hibbertia hypericoides
Hibbertia racemosa
Hibbertia stellaris
Hibbertia vaginata

273 MYRTACEAE
Agonis flexuosa
Astartea fascicularis
Calytrix flavescens
Calytrix leschenaultii
Corymbia calophylla
Eucalyptus marginata
Hypocalymma angustifolium
Kunzea glabrescens
Melaleuca preissiana
Melaleuca thymoides
Pericalymma ellipticum var. *floridum*

281 APIACEAE
Platysace compressa
Trachymene pilosa
Xanthosia huegelii

288 EPACRIDACEAE
Conostephium pendulum
Leucopogon aff. *conostephioides*
Leucopogon aff. *polymorphus*
Leucopogon propinquus
Lysinema ciliatum

305 ASCLEPIADACEAE
**Gomphocarpus fruticosus*

315 SOLANACEAE
Solanum nigrum

320 OROBANCHACEAE
Orobanche sp.

341 GOODENIACEAE
Dampiera linearis

343 STYLIDIACEAE
Stylidium brunonianum subsp. *brunonianum*
Stylidium diversifolium
Stylidium piliferum subsp. *piliferum*
Stylidium schoenoides
Stylidium striatum

345 ASTERACEAE
**Arctotheca calendula*
Cotula coronopifolia
**Dittrichia graveolens*
**Hypochaeris glabra*
**Lactuca serriola*
Lagenophora huegelii
Olearia axillaris
**Sonchus asper*
**Sonchus oleraceus*
**Ursinia anthemoides*

* = Introduced Flora
† = Priority Flora

Results of CALM Flora Database Search

Appendix 3

BIOta

Conservation

AND LAND MANAGEMENT

Your ref:
Our ref: 2005/001 [illegible]
Enquiries: John Riley
Phone: (08) 9334 0[illegible]
Fax: (08) 9334 0278
Email:

BIOTA Environmental Sciences
2/183 Scarborough Beach Road
MT HAWTHORN WA 6016

Attention: Kelli McCreery

Dear Ms McCreery

REQUEST FOR RARE FLORA INFORMATION

I refer to your request of [illegible] March 2007 for information on rare flora in the Bunbury area. The search co-ordinates used were 33° 08' - 33° [illegible] S and 115 40' - 1[illegible]° 38' E.

A search was undertaken for this area of (1) the Department's *Threatened (Declared Rare) Flora* database (for results, if any, see "Summary of Threatened Flora Data" - coordinates are GDA94), (2) the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, if any, see "WAHERB Specimen Database General Enquiry" - coordinates are AGD84) and (3) the Department's *Declared Rare and Priority Flora List* [this list, which may also be used a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3) or require monitoring (Conservation Code 4) - for results, if any, see "Declared Rare and Priority Flora List"].

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point which refers to the requirement to undertake field investigations for the accurate determination of rare flora occurrence at a site. *The information supplied should be regarded as an indication only of the rare flora that may be present and may be used as a target list in any surveys undertaken.*

An invoice for $100 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of rare flora encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss rare flora management, please contact my Principal Botanist, Dr Ken Atkins, on (08) 9334 0425.

Yours faithfully

for Keiran McNamara
ACTING EXECUTIVE DIRECTOR

[illegible] March 2007
Attach.

[illegible]
[illegible]
[illegible]

Diuris micrantha ms	DRF
Drakaea elastica	DRF
Drakaea micrantha	DRF
Lasiopetalum membranaceum	Priority 3
Stylidium longitubum	Priority 3
Verticordia attenuata	Priority 3
Acacia flagelliformis	Priority 4
Aponogeton hexatepalus	Priority 4
Caladenia speciosa ms	Priority 4
Drosera marchantii subsp. *marchantii*	Priority 4
Jacksonia sparsa ms	Priority 4
Pultenaea skinneri	Priority 4

Results of CALM
Fauna Database Search

Appendix 4

BIOTA

Department of
Conservation
and Land Management

Your Ref:
Our Ref: [illegible]
Enquiries: Peter [illegible]
Phone: (08) [illegible]
Fax: (08) [illegible]
Email: [illegible]

Ms Kelly McCreery
Bowman Environmental Sciences
2/183 Scarborough Beach Rd
MT HAWTHORN WA 6016

Dear Ms McCreery

REQUEST FOR THREATENED FAUNA INFORMATION

I refer to your request of 6 March for information on threatened fauna occurring in the Kemerton Industrial Area.

A search was undertaken for this area of the Department's Threatened Fauna database, which includes species which are declared as *Rare or likely to become extinct* (Schedule 1), *Birds protected under an international agreement* (Schedule 3), and *Other specially protected fauna* (Schedule 4). Attached are print outs from these databases where records were found.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the sixth point that refers to the requirement to undertake field investigations for the accurate determination of threatened fauna occurrence at a site. The information supplied should be regarded as an indication only of the threatened fauna that may be present.

An invoice for $[illegible] (includes GST), being the set charge for the supply of this information, will be forwarded.

It would be appreciated if any populations of threatened fauna encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss threatened fauna management, please contact my Senior Zoologist, Dr Peter Mawson on 08 [illegible].

Yours sincerely

for Keiran McNamara
ACTING EXECUTIVE DIRECTOR

8 March 200[illegible]

The search of the database indicated that the following threatened and priority fauna occur in the area in question

<u>Schedule 1 (Fauna which is Rare or likely to become Extinct)</u>

Chuditch (***Dasyurus geoffroii***) This species is highly mobile and occupies large home ranges in a range of habitats including woodland It has recently been recorded in the northern area of Australind

Western Ringtail Possum (***Pseudocheirus occidentalis***) A population of this species has been established in Leschenault Conservation Park (Leschenault Peninsula) through translocation Vagrants may occur in the Kemerton area

Carnaby's Black-Cockatoo (***Calyptorhynchus latirostris***) This species moves around in flocks to feeding areas through the Swan Coastal Plain but breeding occurs mainly in the eastern forests and wheatbelt

Baudin's Black-Cockatoo (***Calyptorhynchus baudinii***) This species occurs in low numbers in this part of the Swan Coastal Plain

<u>Schedule 4 (Fauna which is Otherwise Specially Protected)</u>

Peregrine Falcon (***Falco peregrinus***) This species is an occasional visitor to areas of open woodland and along margins with farmland

Carpet Python (***Morelia spilota imbricata***) This species may occur in areas of native vegetation along the coast from Australind to Yalgorup National Park

<u>Priority Taxa</u>

Quenda (***Isoodon obesulus fusciventer***) **P4** This species is moderately common in parts of the coastal plain where dense understorey vegetation occurs in woodland and around wetland areas The species has been translocated to Leschenault Conservation Park and may occur in other surrounding areas where there is suitable vegetation

Brush-tailed Phascogale (***Phascogale tapoatafa***) **P3** This species has recently been recorded on the outskirts of Bunbury It occurs in forest and woodland where suitable tree hollows are available and may occur in the area in question.

Western Brush Wallaby (***Macropus irma***) **P4** This species occurs in low numbers in areas of coastal forest and woodland supporting a dense shrub layer, and may occur in the vicinity of the Kemerton Industrial Area

Western False Pipistrelle (***Falsistrellus mackenziei***) **P4** This species of bat occurs in the higher rainfall areas of the southwest including the Swan Coastal Plain It roosts in small colonies in tree hollows and forages in the cathedral-like spaces between trees It has been recorded near Lake Clifton and may occur in the area in question

Forest Red-tailed Black Cockatoo (***Calyptorhynchus banksii naso***) **P3** This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the south-west and is occasionally observed on the coastal plain near Bunbury Requires tree hollows to nest and breed and is totally dependent on jarrah-marri forest

Hooded Plover (***Thinornis rubricollis rubricollis***) **P4** This species has been recorded along the margins and shallows of Leschenault Inlet

Eastern Curlew (*Numenius madagascariensis*) P4 This species is a migratory visitor and has been observed along the margins of Lesschenault Inlet

Black-stripe Minnow (*Galaxiella nigrostriata*) P5 This species typically occurs in shallow, isolated pools and has been recorded in the seasonal wetlands near the Kemerton Silica Sands Mine

We're connected to you.

Western Power

Western Power Corporation

Strategic Planning for Future Power Generation

Kemerton Power Station

Strategic Environmental Review
June 2002

SINCLAIR KNIGHT MERZ

Western Power

WESTERN POWER CORPORATION
Strategic Planning for Future Power Generation – Kemerton Power Station

INVITATION TO MAKE A SUBMISSION

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the DEP Project Assessment Officer would be most welcome.

Western Power intends to establish several sites as suitable for meeting the immediate and long-term power requirements of Western Australia, one of these sites being Kemerton Industrial Park. In accordance with Section 16(e) of the Environmental Protection Act, a Strategic Environmental Review (SER) has been prepared which describes this proposal and its likely effects on the environment. The SER is available for a public review period of four weeks from **Monday 17 June 2002** closing on **Monday 15 July 2002**.

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

WHY WRITE A SUBMISSION?

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

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

WHY NOT JOIN A GROUP?

If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

DEVELOPING A SUBMISSION

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

When making comments on specific elements of the SER:

- Clearly state your point of view;
- Indicate the source of your information or argument if this is applicable; and
- Suggest recommendations, safeguards or alternatives.

POINTS TO KEEP IN MIND

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

- Attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- Refer each point to the appropriate section, chapter or recommendation in the SER;
- If you discuss different sections of the SER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- Attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- Your name;
- Address;
- Date; and
- Whether you want your submission to be confidential.

The **closing date** for submissions is: **Monday 15 July 2002**

Submissions should ideally be emailed to:	John.Guld@environ.wa.gov.au
OR addressed to:	The Environmental Protection Authority PO Box K822 PERTH WA 6842
Attention:	**John Güld**

Executive Summary

Introduction

Western Power Corporation (Western Power) is the principal generator, transmitter, distributor and retailer of electricity in Western Australia. As early as 2004/05, Western Power will require access to additional generating capacity to continue to reliably meet the electricity requirements of its business and residential customers within the South West Interconnected System (SWIS).

The *Electricity Corporation Act 1994* requires Western Power to procure any substantial new generation capacity through a non-discriminatory and open procurement process. This process allows suitably qualified companies to compete for the opportunity to supply electricity to Western Power and is known as the SWIS Power Procurement Process.

To accelerate the process and ensure the availability of suitable sites for the bidding process, Western Power is seeking strategic environmental approval under Section 16(e) of the *Environmental Protection Act 1986* for a number of potential power station sites. A strategic site selection study conducted between Geraldton and Bunbury has identified several suitable sites/areas for additional power generating capacity, one of these being the Kemerton Industrial Park.

The objective of the Section 16(e) SER is to obtain advice and "in principle" approval prior to submission of final tenders, enabling full specification of environmental performance for the facilities in the tender process. Furthermore, the approach will ensure final approval for the facilities is attainable to meet the commissioning date.

Bidders may decide to identify and develop their own site. However, they will be required to demonstrate that environmental clearance and access to the site can be provided to suit the overall project development timeframe. Following the bidding process, a Preferred Bidder will be chosen and will be required to undertake a detailed Environmental Review of each confirmed development proposal at the selected site in accordance with Section 38 of the *Environmental Protection Act 1986.*

This document forms the Strategic Environmental Review Document for a power station development at the Kemerton site of up to 1,080MW capacity. This SER addresses the key environmental factors that have been identified by the EPA and additional environmental factors that are considered important to the community and key stakeholders. Environmental factors relevant to the biophysical and social environment are addressed.

Need for the Project

To satisfy existing customer demands over the next decade, an increase in total generating capacity of 700 – 900MW will be required. In addition to this, major industries may also have significant new power requirements above this demand. To maintain the safety and reliability of the electricity system, this additional capacity must be provided.

The Power Procurement Program will coincide with plant replacement that will be undertaken by Western Power, whereby older generating plant that is nearing the end of its operating life will be retired, or replaced by higher efficiency generating plant. Current planning studies and asset management strategies have given rise to the following Power Procurement Program:

- Around 240MW of peaking capacity to be in service as early as 2004/05 and no later than the summer of 2005/06; and
- Around 300MW of base load capacity to be in service by 2007/8.

Strategic Options for Future Power Generation

Energy Source Options

Renewable energy offers many opportunities for power generation and Western Power will continue to pursue developments in this area. However none of the renewable options currently available are capable of meeting the scale of the predicted power generation requirements (initially 240MW followed by about 300MW). Therefore for the SWIS Power Procurement Process, Western Power has focussed upon the conventional energy sources of natural gas, coal and liquid fuel.

Natural gas pipeline transport capacity constraints and the costs associated with expansion also support the need to maintain a diversity of energy sources to ensure security of power supply for the State.

Generating Plant Options

Western Power's own studies, verified by an independent expert commissioned by the Independent Person supervising the SWIS Power Procurement Process, have identified that the initial power procurement requirements would best be met by the installation of around 240MW of peaking capacity. This would typically consist of two units of open cycle gas turbines, each of 120MW to provide some flexibility in operation. However, it is open for Bidders to put forward alternative plant solutions if they believe they could achieve a better result, within parameters of the process.

To satisfy existing customer demands over the next decade, the second stage of the Power Procurement Program would consist of around 300MW of base load capacity to be in service by 2007/08. This requirement would likely be met by the following:

- Combined cycle gas turbine plant; or
- Steam turbine plant.

Specific plant requirements have not been defined beyond these first two stages of the Power Procurement Process. However, a nominal 120MW of additional capacity per year is expected to be required for subsequent years to maintain the reserve margin requirement. In addition to the new generating capacity to meet general increase in customer demand, new or expanded major industries may also have significant power requirements in the future. Therefore it is likely that a range of power generation plant and fuel options could be installed over the next decade.

Site Options

From the site selection study and other related work, the following development options (from north to south) were considered to be the most suitable for the requirements:

- Expansion of the existing Pinjar Gas Turbine Station from 575MW to 815MW (installation of an additional 240MW open cycle capacity);
- Construction of a new gas-fired power station within the central core of the Kwinana Industrial Area on Mason Road (initially of 240MW with capacity to expand up to 1,080MW);
- Construction of a new gas-fired power station within the core of the Kemerton Industrial Park (initially of 240MW with capacity to expand up to 1,080MW);
- Construction of a new open cycle power station at the old Bunbury Power Station site (initially of 240MW with capacity to expand to a maximum of 360MW); and
- Expansion of the existing Collie Coal-fired Power Station from 330MW to approximately 600MW (installation of an additional 300MW coal-fired unit).

Other potential sites north of Perth are still under consideration as part of this strategic assessment process.

Project Description

This Strategic Environmental Review Document reviews two development scenarios for the Kemerton site:

- The initial 240MW of peaking plant; and
- Installation of additional capacity at the site, the options for which are discussed below.

Two options have been identified for the ultimate development at the proposed power station site in Kemerton:

Option 1. 360MW of peaking plant and 540MW of base load plant; or

Option 2. 1,080MW of gas-fired base load plant.

The Strategic Environmental Review has assessed the "worst case" option with regard to each environmental factor during operation of the ultimate development to ensure that the impact assessment is based on conservative assumptions. In all cases, except for air quality issues, the worst case is Option 2.

It is likely that the initial 240MW installation would consist of gas turbine generators in open cycle arrangement that would operate on natural gas and liquid fuel back-up. The power plant would typically consist of:

- Gas turbine generators housed in noise attenuation and weather proof buildings and/or enclosures;
- Water treatment infrastructure including possible evaporation ponds;
- Switchyard to transfer generated power to the Western Power grid; and
- Infrastructure and services to support operation of the plant such as control systems, workshops, fuel supply and fire systems, drainage and roads.

Further development of the power station would typically comprise of combined cycle units that would operate on natural gas and consist of:

- Gas turbine generation housed in similar function to the open cycle arrangement;

- Heat recovery boilers;
- Steam turbine/s housed in a building or sound and weather proof enclosures;
- Cooling systems for the steam cycle (either by water cooling towers or air-cooled radiators);
- Water treatment infrastructure including possible evaporation ponds;
- Switchyard; and
- Infrastructure and services.

Provision is also required for the open cycle power station to operate on liquid fuel. The main factors that would result in liquid fuel being required include:

- Whenever sufficient gas is not available on the spot market and the Preferred Bidder has not established a gas reserve contract;
- A disruption in the gas supply; or
- If a gas supply to the site cannot be established.

For an open cycle gas turbine plant in peaking mode, it is anticipated that up to 100-hours of operation per year could be necessary on liquid fuel.

This Section 16(e) Strategic Environmental Review document seeks strategic advice and 'in principle approval' to:

- Establish a gas-fired power station (with liquid fuel back-up for peaking purposes) of up to 1,080MW capacity and associated infrastructure within Kemerton Industrial Park; and
- Install a wastewater pipeline to dispose of used cooling water to the ocean through the existing Collie Power Station ocean outfall.

Specifically this document does not assess the following aspects:

- Potential impacts related to the supply of water to the power station. Water supply would be provided by the Water Corporation and would be subject to a separate approval process;
- Potential impacts related to transmission network capacity requirements for an expansion of the site beyond the initial stage of Power Procurement. The network requirements will be determined by Western Power's network operations and any new capacity will be subject to a separate environmental approvals process; and
- Potential impacts related to the construction and operation of a natural gas pipeline lateral to the site. This pipeline would likely be constructed and operated by a gas supplier and would be subject to a separate approval process.

To meet the initial Power Procurement Program requirements for 240MW of peaking plant as early as 2004/05 and no later than 2005/06, construction of the peaking plant would need to commence by the second half of 2003 and would extend over a period of 12 to 18 months. Any further development at the site would be constructed at a later stage, possibly by 2010, but would be governed by the demand for electricity.

The construction workforce is expected to peak at 250 people for each construction phase. During the operational phase of the 240MW open cycle power station, on-site personnel would typically consist of a maximum of 5 personnel. If a base load plant is installed, the plant could be manned by up to 30 on-site personnel.

Flora, Vegetation and Fauna Habitats

Biota Environmental Services were commissioned by Sinclair Knight Merz to undertake a flora and vegetation survey of the preferred power station site and the section of the wastewater pipeline route outside of the Kemerton Industrial Park.

The preferred power station site is largely unconstrained with respect to significant vegetation flora. Approximately 20ha of the project site would be cleared to accommodate the power station, of which only 2.5ha is native vegetation, the remainder being under blue glum plantation. The native vegetation consists of Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banskia attenuata* Woodland in Good to Poor condition. This remnant vegetation on the site has been previously assessed by the Environmental Protection Authority (EPA) in their review of the Concept Plan for the expansion of the Kemerton Industrial Park, and included within the industrial core (WAPC, 2000). a or b? ? where not clear in main doc.

For the proposed wastewater pipeline corridor, it would be necessary to remove vegetation for construction of the pipeline in some locations along the corridor. The maximum width of area that would be disturbed is approximately 11m, however only a 5m easement would be required for long-term access and the remainder of the corridor would be rehabilitated following construction. Based on the vegetation and flora study undertaken by Biota Environmental Services (Biota Environmental Services, 2002), a number of areas of potential conservation value occur within the proposed wastewater pipeline corridor, which include:

- The relatively intact areas of vegetation in the Marriott Road section and coastal section;
- The presence of two species of Priority 3 Flora in the Marriott Road section (*Acacia semitrullata* and *Lasiopetalum ?membranaceum*); and
- The high potential for currently unidentified populations of annual (spring flowering) DRF and Priority Flora in the Marriott Road section.

The Preferred Bidder would be required to conduct a rare flora search over the entire area to be disturbed prior to any clearing. If any Declared Rare Flora species are found within the pipeline corridor, the route would be changed where practicable to avoid any impact on these plants and CALM consulted in respect of alternative management mechanisms such as relocation of plants.

The Preferred Bidder would be required to include clearing management strategies as part of the Construction Management Plan to manage potential impacts on vegetation and fauna habitats. The extent of vegetation removal would be minimised as far as practicable by designing the layout of the plant, construction lay-down areas and the route of the wastewater pipeline to minimise disturbance.

Marine Environment

The proposed ultimate development may have the potential to impact on the marine environment through ocean disposal of wastewater. Wastewater from a 240MW open cycle power station or an air-cooled combined cycle plant of up to 1,080MW could be disposed of on-site through evaporation in specially constructed lined ponds and therefore there would be no impact on the marine environment. However a water-cooled combined cycle power station of any size would produce volumes of wastewater beyond that manageable by evaporation ponds and other options for wastewater disposal would be required.

The preferred option for wastewater disposal from the power station would be through a centralised wastewater treatment facility at the Kemerton Industrial Park. However given the uncertain timing of the proposed power station and of the centralised wastewater treatment facility, the feasibility of disposal of wastewater through the existing Collie Power Station ocean outfall facility is considered within this report. Two ocean disposal scenarios have been considered, which include disposal through the existing Collie Power Station ocean outfall using the remaining capacity of the outfall (for discharge rates of up to 45L/s from the Kemerton Power Station) and disposal through the existing Collie Power Station ocean outfall with an extension of the existing diffuser by 100m. The second option also allows for an expansion of the Collie Power Station and/or discharge rates greater than 45L/s from the Kemerton Power Station.

To demonstrate that the diffuser design is capable of achieving the ANZECC National Guidelines for receiving environments given a 99% level of protection within the mixing zone for salinity, temperature and biocides, a dispersion modelling assessment was undertaken indicating the following:

- Increased discharge through the existing outfall diffuser to its design capacity would result in adequate dilution to meet environmental guidelines; and
- Extension of the existing outfall diffuser to allow increased capacity would result in adequate dilution to meet environmental guidelines.

If the Preferred Bidder's proposed development involves wastewater disposal by ocean outfall, they would be required to undertake a detailed modelling assessment of the ocean outfall discharge to demonstrate that the ANZECC National Guidelines are complied with at the edge of the mixing zone.

Prior to any construction activities commencing for the ocean outfall, the Preferred Bidder would be required to develop a Marine Management Plan as part of the Construction Management Plan. This plan would ensure that management strategies are undertaken to minimise the impact on the marine environment, in particular, footing blocks of the diffuser would be positioned to lie over bare sand.

Surface and Groundwater Quality

The Kemerton Industrial Park and proposed wastewater pipeline corridor falls within the boundaries of the Leschenault Inlet Management Area which aims to protect the Leschenault Estuary, an environmentally significant water resource. There are also a number of environmentally significant wetlands in the vicinity of the proposed power station site and wastewater pipeline corridor that are fed by surface water runoff and groundwater.

Although there would be no direct discharge of wastewater or contaminated stormwater into wetlands or the Wellesley River or its tributaries, there is the potential for contaminants to be transported to the Leschenault Estuary and other wetlands. Plant design, control features and compliance to guidelines and standards would ensure that the project does not adversely impact on nearby wetlands or groundwater.

Atmospheric Emissions

The atmospheric emissions of significance from the Kemerton Power Station would be oxides of nitrogen, sulphur dioxide (when the power station is operating on liquid fuel) and, to a lesser extent, particulates and unburnt hydrocarbons. The dispersion model DISPMOD was used to assess the predicted air quality impacts from a number of possible power station development scenarios and existing industries within Kemerton Industrial Park.

Normal Operation (Natural Gas)
The primary fuel supply to the power station is expected to be natural gas. When the power station is operating on gas the predicted concentrations would be well below the NEPM standard for NO_2 and PM_{10} and sulphur dioxide. For the maximum power station capacity or 1,080MW, these levels are predicted to be as follows for the power station in isolation and cumulatively respectively:

- 11.8% and 13% of the 1-hour average NO_2 standard;
- 0.68% and 0.71% of the annual average NO_2 standard;
- 0.52% and 0.6% of the 24-hour average PM_{10} standard;
- 0.02% and 14% of the 1-hour average SO_2 standard;
- 0.005% and 6.1% of the 24-hour average SO_2 standard; and
- 0.005% and 2.8% of the annual average SO_2 standard.

Therefore under normal operation, the power station is expected to have a minimal impact on air quality in the Kemerton area.

Liquid Fuel Operation (100-hours per year)
It is anticipated that the open cycle units of the power station could operate on liquid fuel for up to 100-hours per year. As a conservative estimate of the maximum concentrations that could result, the air quality assessment was undertaken assuming constant emissions for the entire year. The results of the air quality assessment during liquid fuel operation indicate the following:

- The maximum potential 1-hour average NO_2 concentrations would be up to 41.1% of the NEPM standard for a 360MW open cycle power station operating on liquid fuel without water injection for NO_x control and a 540MW combined cycle power station operating on natural gas. For this development scenario, the maximum cumulative 1-hour average concentration of NO_2 is 41.9% of the NEPM. These maximum values are predicted to occur within the Kemerton Industrial Park;

- Predicted annual average NO_2 concentrations from the power station would be well below the NEPM standard (less than 2.71%) even when conservatively assuming that the open cycle units are run on liquid fuel for the entire year;
- Predicted 24-hour average particulate concentrations would be minor (no greater than 1.4% of the NEPM standard);
- The maximum potential 1-hour average SO_2 concentrations would be up to 21.1% of the NEPM standard for a 360MW open cycle power station operating on liquid fuel of sulphur content 0.6% and a 540MW combined cycle power station operating on natural gas. For this development scenario, the maximum cumulative 1-hour average concentration of SO_2 is 21.4% of the NEPM. These maximum values are predicted to occur within the Kemerton Industrial Park;
- Predicted 24-hour and annual average sulphur dioxide concentrations would be at most 8.7% and 3% of the NEPM standards respectively, even when conservatively assuming that the open cycle units are run on liquid fuel for the entire year; and
- The predicted SO_2 and NO_2 concentrations would be well below the World Health Organisation recommended criteria for impacts on vegetation from both the existing industries and the proposed power station, and potential impacts on vegetation are considered negligible.

The Preferred Bidder would be required to verify that the air emissions from the power station are lower than or equal to those modelled in this assessment. If this could not be demonstrated, then re-modelling would be required to verify that the air quality criteria could be achieved. The Preferred Bidder would also be required to install low NO_x burners on gas turbine units.

Monitoring of NO_x and SO_2 emissions from stacks would be undertaken as a minimum on a routine basis and during periods when the power station is operating on liquid fuel.

Greenhouse Gas Emissions

Given that greenhouse issues are global in nature, this SER provides a discussion of greenhouse gas considerations related to the SWIS as a whole and not to a specific site proposal. Furthermore, the discussion relates only to the predicted additional demand by Western Power's existing customers by 2010, and does not assess the impact of additional requirements for new or expanded industries. Following is a summary of the changes in the greenhouse gas emissions specifically related to Western Power's Power Procurement Program and plant retirement/replacement.

Greenhouse gas emissions associated with electricity produced into the SWIS (both generated by Western Power and purchased by Western Power from independent producers) were 9.079Mtpa of CO_2 equivalent in 1990. By 2000 this had increased to 10.935Mtpa (20% increase on 1990). However, although greenhouse gas emissions associated with electricity supply to the SWIS have increased over the period 1990 to 2000, they have not increased proportionally with electricity demand. The improved greenhouse gas emission rate for electricity supplied into the SWIS is reflected by the generally downward trend in carbon intensity over that time. This has fallen from 0.98 tonnes CO_{2e}/MWh in 1990 to 0.89 in 2000 (a decrease of 9%), largely due to increased sourcing of electricity from high efficiency cogeneration plant and the overall increased penetration of gas-fired generation into the supply portfolio. This reduced carbon intensity represents a saving of over 1Mtpa of CO_{2e} in 2000 compared to producing the electricity at the 1990 intensity.

Actions in progress by Western Power (e.g. Albany wind farm and the Cockburn combined cycle gas turbine generator) are expected to result in the carbon intensity of electricity sent out in the SWIS to fall to 0.85 tonnes CO_{2e}/MWh by 2004 (a decrease of 13% on 1990 levels).

For the years 2004 to 2010, two potential scenarios for power procurement have been examined in terms of estimating the change in carbon intensity and overall greenhouse emissions. Both these scenarios have been assessed in conjunction with the plant replacement and retirement program. All details of the assumptions used for this analysis are provided in Section 3.5.

The two options are as follows:

- Option A – The installation of 240MW open cycle capacity by 2005/06 and the installation of a further 540MW of gas-fired power generation plant by 2010, consisting of 120MW of open cycle peaking plant and 420MW of combined cycle base load plant.
- Option B – Is similar to Option A except that 300MW of the base load plant in use by 2010 is assumed to be provided by a coal-fired power station.

Both options are assumed to generate approximately 3,443GWh annually by 2010.

With these assumptions, the SWIS carbon intensity will continue to decrease to either 0.70 or 0.76 tonnes CO_{2e}/MWh for Option A and B respectively by 2010. This is a reduction of 29 or 22% respectively from the 1990 carbon intensity of 0.98 tonnes CO_{2e}/MWh. Although the carbon intensity on the SWIS in 2010 is predicted to decrease by at least 22% from 1990 levels, the overall growth in electricity demand between 1990 and 2010 is predicted to increase by approximately 76%. The resultant CO_2 equivalent greenhouse emissions, with the increase in electricity sent out in 2010 are estimated to be 11.3 and 12.4Mtpa respectively. This is around 24 to 36% higher than the 1990 emissions of 9.079Mtpa in 1990. These calculations, though only indicative, illustrate the impact that the various power supply options could have on the overall greenhouse emissions from the SWIS.

The above comparison demonstrates that coal-fired power generation would be the least preferred from a greenhouse perspective taking into account greenhouse emissions at the generating plant site. Although not performed for this review, previous whole of life studies have also confirmed this. However, there are compelling reasons for Western Australia to maintain coal-fired power generation in the suite of power supply options, most importantly the need to maintain some diversity of energy sources to ensure security of power supply and cost competitiveness.

Notwithstanding, the management of greenhouse gas emissions will be an integral part of the SWIS Power Procurement Process, and Western Power will require all Bidders to demonstrate how they will incorporate greenhouse considerations in their bid proposals.

The Preferred Bidder would be required to implement the following management strategies:

- Become a signatory to the Greenhouse Challenge;
- Implement best practicable thermal efficiency design and operating goals; and
- Identify and implement carbon sink projects, including an environmental tree planting program in Western Australia, which would have other environmental benefits as well carbon sequestration.

As a signatory to the Greenhouse Challenge, the Preferred Bidder would be required to report annual emissions to the Greenhouse Office. In addition, the Preferred Bidder would be required to undertake operational performance monitoring of combustion gases to ensure power generation meets design efficiency criteria.

Noise Emissions

Noise modelling was undertaken for various development scenarios by Herring Storer Acoustics. The predicted noise emissions from the power station with an "enhanced" level of noise attenuation would achieve the regulatory noise criteria at the boundary of the buffer zone. The noise levels from the power station received at the nearest residential properties would be below the residential night-time noise criteria.

In addition to the environmental noise criteria at residential and recreational receptors, the project would need to comply with a contributed noise limit of 65dB(A) around the perimeter of the lease boundary. Based on the preliminary site layout and the assumed equipment sound power levels, it is predicted that the boundary noise levels would achieve the 65dB(A) criteria. However, careful optimisation of site and equipment layout during the detailed design phase and incorporation of appropriate noise attenuation measures during design and equipment selection would be required ensure that boundary noise criteria are achieved.

On a cumulative basis, the noise emissions from the power station at its maximum capacity, combined with the potential future industry mix developed for the Kemerton Expansion Study are predicted to achieve the noise criteria at the boundary of the buffer zone.

The Preferred Bidder would be required to verify that the noise emissions from the plant are lower than or equal to those modelled in this assessment. If this could not be demonstrated, then re-modelling would be required to verify that the noise criteria could be achieved.

Solid and Liquid Waste Management

The proposed power station would produce some solid and liquid wastes. The only solid waste that would be generated would be normal domestic and commercial waste and waste from maintenance activities, the quantity of which would be less than 10 tonnes per year, which would be disposed of to a licensed landfill. The largest quantity of liquid waste would be wastewater from the cooling circuit. This water is expected to be discharged to the ocean through the existing Collie Power Station ocean outfall. The Preferred Bidder would be required to determine the best method for management and disposal of domestic wastewater.

The power station would also produce small quantities of hydrocarbon waste. This waste would be collected by a waste oil contractor and disposed to an approved facility.

Saline Water Management

Wastewater from the cooling circuit and demineralisation plant would either be stored in evaporation ponds or piped to the ocean for discharge. This water would be moderately saline (approximately 5,000mg/L TDS). It therefore has the potential to contaminate soil, nearby surface and ground waters with salt and impact on vegetation if this water is released from incidences such as leakages from the bottom of the evaporation ponds or from pipeline leaks/ruptures.

The Preferred Bidder would be required to implement special design features and stringent monitoring systems and procedures would ensure that saline water would be adequately contained and not impact on the surrounding environment.

Hydrocarbon and Hazardous Materials Management

The operation of the power station would require the transportation, storage and handling of hydrocarbon products including liquid fuel, lubricating oils and greases and degreasers and minor quantities of hazardous materials such as acids and biocides. The potential impacts associated with these activities include:

- Discharge to the environment contaminating surface and ground waters, the atmosphere and soil;
- Creation of acute and/or chronic toxic hazards; and
- Creation of flammable or explosive hazards.

The Preferred Bidder would be required to develop a Hydrocarbon and Hazardous Materials Management Plan as part of the Construction and Operational Environmental Management Plan based around a framework that:

- Reduces the volume of hydrocarbon and hazardous waste materials produced;
- Segregates hydrocarbon and hazardous materials from stormwater to reduce the volume of waste materials;
- Ensures appropriate transport, storage and handling procedures;
- Ensures appropriate clean-up procedures for spills; and
- Defines environmentally acceptable methods for the disposal of waste.

Aboriginal Heritage

McDonald Hales and Associates was commissioned by Sinclair Knight Merz to undertake a search of the Department of Indigenous Affair's Register of Aboriginal Sites. Fifteen Aboriginal sites were found to be located within a 5km radius of the proposed development. Of these sites, three (sites 4885, 4886 and 15371) were found to be located within the vicinity of the proposed route of the wastewater pipeline.

Due to the lack of detailed survey coverage, it is likely that the Aboriginal heritage potential of the Kemerton area has not been fully realised. Given this, the Preferred

Bidder would need to take appropriate steps to ensure on-going compliance with the provisions of the *Aboriginal Heritage Act 1972*, in particular an archaeological survey of the area to be disturbed would be required during the detailed design stage of the project.

Public Safety

A preliminary review has been performed of hazardous materials and processes that may be used in the operation of a generic 1,080MW combined cycle power station. Based on this review, the power station is not a major hazard facility and could be categorised as being Low Risk. Both the preferred site and the fallback site were assigned a "High Risk Category" under the Kemerton Expansion Study and therefore any potential risks from the power station would be accommodated on these sites.

In terms of off-site risk, the following is concluded:

- The transport of hazardous goods to the power station is in minor volumes only and this imposes no greater risk than other material cartage in the region;
- The transport of hydrocarbon products to the power station poses a low risk, but has the potential to cause severe impacts on significant water bodies such as the wetlands and Leschenault Estuary if spills occur within the vicinity of these waterbodies or tributaries to them; and
- The risk created by a new gas pipeline lateral to the site is no greater than the risk associated with the existing gas pipeline in the area.

The Preferred Bidder would be required to undertake a Quantitative Risk Analysis to confirm that the development meets the EPA criteria.

Visual Amenity

A visual impact assessment of the proposed expansion of the Kemerton Industrial Park was commissioned by the former Department of Resources Development (BSD Consultants, 2000). The assessment showed that, in almost all cases where there is continuous vegetation coverage within the road reserves of public roads, the Kemerton Industrial Core would be screened from view. From a comparison of the height of the tallest structures within the proposed power station (40m) and the results of the visual impact assessment for the proposed expansion of the Kemerton Industrial Park, it is unlikely that the power station would be visible from any areas to the west of the Park. However, the power station may be visible from farmhouses and other locations to the east of the Park.

To minimise visual impacts of the proposed power station, the Preferred Bidder would be required to design the buildings to blend into the surrounding terrain, plant screening vegetation and rehabilitate disturbed areas, including the pipeline corridor following construction.

Management Strategies

Western Power is committed to ensuring that the development of additional generating capacity is undertaken in a manner that minimises the impacts on the surrounding biophysical and social environments. Accordingly, environment management strategies and commitments have been nominated for the construction, pre-commissioning, commissioning, operation and decommissioning phases of the proposal that would be required to be undertaken by the Preferred Bidder.

The nominated environmental management commitments assume that the final proposed power station would be designed such that the plant characteristics fall within the same parameters as those assessed during the development of this Section 16(e) Strategic Environmental Review. If this is not the case, the Preferred Bidder will be required to perform additional environmental impact studies during the Section 38 Environmental Review process. The Preferred Bidder will develop specific management commitments during this Environmental Review process.

A summary of the environmental issues related to the development of the proposed power station and the proposed management strategies and predicted outcomes are provided in **Table ES1**.

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Contents

List of Figures

List of Tables

List of Plates

1. Introduction

1.1 Background

Western Power Corporation (Western Power) is the principal generator, transmitter, distributor and retailer of electricity in Western Australia. The challenge for Western Power is to continue to provide a reliable supply of electricity at the lowest price possible while effectively managing environmental and social responsibilities.

As early as 2004/05, Western Power will require access to additional generating capacity to continue to reliably meet the electricity requirements of its business and residential customers within the South West Interconnected System (SWIS). The need for this new capacity is driven by the growth in the economy and population of Western Australia.

In its active pursuit of cost effective means to reduce the need for increased generating capacity, Western Power will continue to implement demand management solutions. Western Power is already advanced in developing renewable energy generation with a focus on wind, biomass and solar technologies, and will also continue to pursue renewable energy projects such as the recently completed 22MW wind farm at Albany. However, despite these initiatives, there remains a need for additional conventional power supplies.

The *Electricity Corporation Act 1994* requires Western Power to procure any substantial (equal to or greater than three per cent of the total SWIS installed capacity) new generation capacity through a non-discriminatory and open procurement process. This process allows suitably qualified companies to compete for the opportunity to supply electricity to Western Power and is known as the SWIS Power Procurement Process.

A key principle of this process is the requirement of the *Electricity Corporation Act 1994* to seek to minimise the total delivered cost of electricity while maintaining safety and reliability. The successful proposal should deliver the best commercial outcome by minimising Western Power's overall cost of supplying electricity to its customers.

Additional capacity will be required as early as 2004/2005 to supply electricity to Western Power. The generation needs will be met by an electricity generation strategy, including both the public procurement of additional capacity in two stages and the separate replacement of ageing units in Western Power's existing portfolio to be undertaken by Western Power's Generation Business Unit, whereby older generating plant that is nearing the end of its operating life will be retired or replaced by higher efficiency generating plant.

The two stages of the Power Procurement Process are expected to consist of the following:

- Around 240MW of peaking capacity as early as 2004/05 and no later than the summer of 2005/06; and
- Around 300MW of base load capacity to be in service by 2007/08.

The Power Procurement Process and asset replacement program, including a discussion of future electricity demands, is provided in **Section 2** of this report.

To accelerate the process and ensure the availability of suitable sites for the bidding process, Western Power is seeking strategic environmental approval under Section 16(e) of the *Environmental Protection Act 1986* for a number of potential power station sites. A strategic site selection study conducted between Geraldton and Bunbury has identified several suitable sites/areas for additional power generating capacity, one of these being the Kemerton Industrial Park.

1.2 The Proposal

▪ ***This Report is seeking 'in principle approval' for a power generating facility within the Kemerton Industrial Park.***

This Report is seeking strategic environmental advice and 'in principle approval' for a power generating facility within the Kemerton Industrial Park. The Kemerton Industrial Park is located in the South West of Western Australia, approximately 140km south of Perth and approximately 17km north east of Bunbury. This Strategic Environmental Review aims to ensure that suitable land is set aside for future Proponent(s), who will then be required to obtain final construction and environmental approvals prior to development.

The initial power generation requirements are for 240MW of peaking plant to meet short duration, high power demands. This demand could be satisfied by a 240MW open cycle gas turbine plant installed at Kemerton Industrial Park. However, for the purpose of assessing the suitability of the Kemerton site for the longer term, it has been assumed that combined cycle gas turbine plant of up to 1,080MW capacity could be installed.

1.3 The Proponent

The proponent for this Section 16(e) Strategic Environmental Review is:

Western Power Corporation
363 Wellington St
PERTH WA 6000

Western Power is Western Australia's leading energy corporation with more than 810,000 industrial, commercial and residential customers in its home State. Western Power's customer base spans a 2,525,000 square kilometre land mass, which represents more than a third of the Australian continent and is home to almost 10% of the Australian population. Western Power owns, maintains and operates four major power stations and 31 smaller power stations with a total capacity of more than 3,000MW. The corporation operates two major interconnected systems (one in the South West corner of Western Australia and one in the Pilbara) as well as 29 separate systems in remote parts of the State.

Western Power is wholly owned by the Western Australian Government, and is a separate, corporatised business entity operating commercially in an increasingly competitive industry, which is being deregulated progressively. The Board of Directors is responsible to the Minister for Energy.

Under the *Electricity Corporation Act 1994*, the proposed power station may not necessarily be constructed or operated by Western Power. The power station may be owned and operated by an independent company, who would sell the electricity generated to Western Power. The role of Western Power in this proposal is to ensure that suitable sites are set aside for power generation purposes, and are available within the required timeframe.

▪ ***The power station may be constructed and operated by an independent power producer (IPP).***

▪ ***The role of Western Power in this proposal is to ensure that suitable sites are set aside for future power generation requirements.***

1.4 Project Scope

This Section 16(e) Strategic Environmental Review document seeks strategic advice and 'in principle approval' to:

- Establish a gas-fired power station (with liquid fuel back-up for peaking purposes) of up to 1,080MW capacity and associated infrastructure within Kemerton Industrial Park; and
- Install a wastewater pipeline to dispose of used cooling water to the ocean through the existing Collie Power Station ocean outfall.

Specifically this document does not assess the following aspects:

- Potential impacts related to the supply of water to the power station. Water supply would be provided by the Water Corporation and would be subject to a separate approval process;
- Potential impacts related to transmission network capacity requirements for an expansion of the site beyond the initial stage of Power Procurement. The network requirements would be determined by Western Power's network operations and any new capacity would be subject to a separate environmental approvals process; and
- Potential impacts related to the construction and operation of a natural gas pipeline lateral to the site. This pipeline would likely be constructed and operated by a gas supplier and would be subject to a separate approval process.

Preliminary details of this proposal were referred to the Environmental Protection Authority (EPA) in February 2002 through the submission of a Referral Document (Sinclair Knight Merz, 2002a and 2002b). The EPA confirmed that the proposal would be assessed as a Section 16(e) Strategic Environmental Review under Section 16(e) of the *Environmental Protection Act 1986*. A set of draft guidelines were developed by Western Power and submitted to the EPA accompanying the referral document. These guidelines were approved by the EPA.

The specific guidelines (Part A) are provided in **Appendix A**. The generic guidelines and attachments are available upon request.

1.5 Environmental Assessment Process

1.5.1 Overview

The development of any power generating facility would require environmental approval from the Western Australian and Commonwealth Governments. Therefore the Invitation for Expressions of Interest to sell electricity to Western Power through the Power Procurement Process is likely to initiate a series of referrals to the EPA of development proposals for power stations.

To streamline the Western Australian approval process, avoid community confusion arising from possibly many concurrent public assessments of power generating facilities and satisfy the projected commissioning date, Western Power has opted to follow a two-staged approval process. The two stages of the process are:

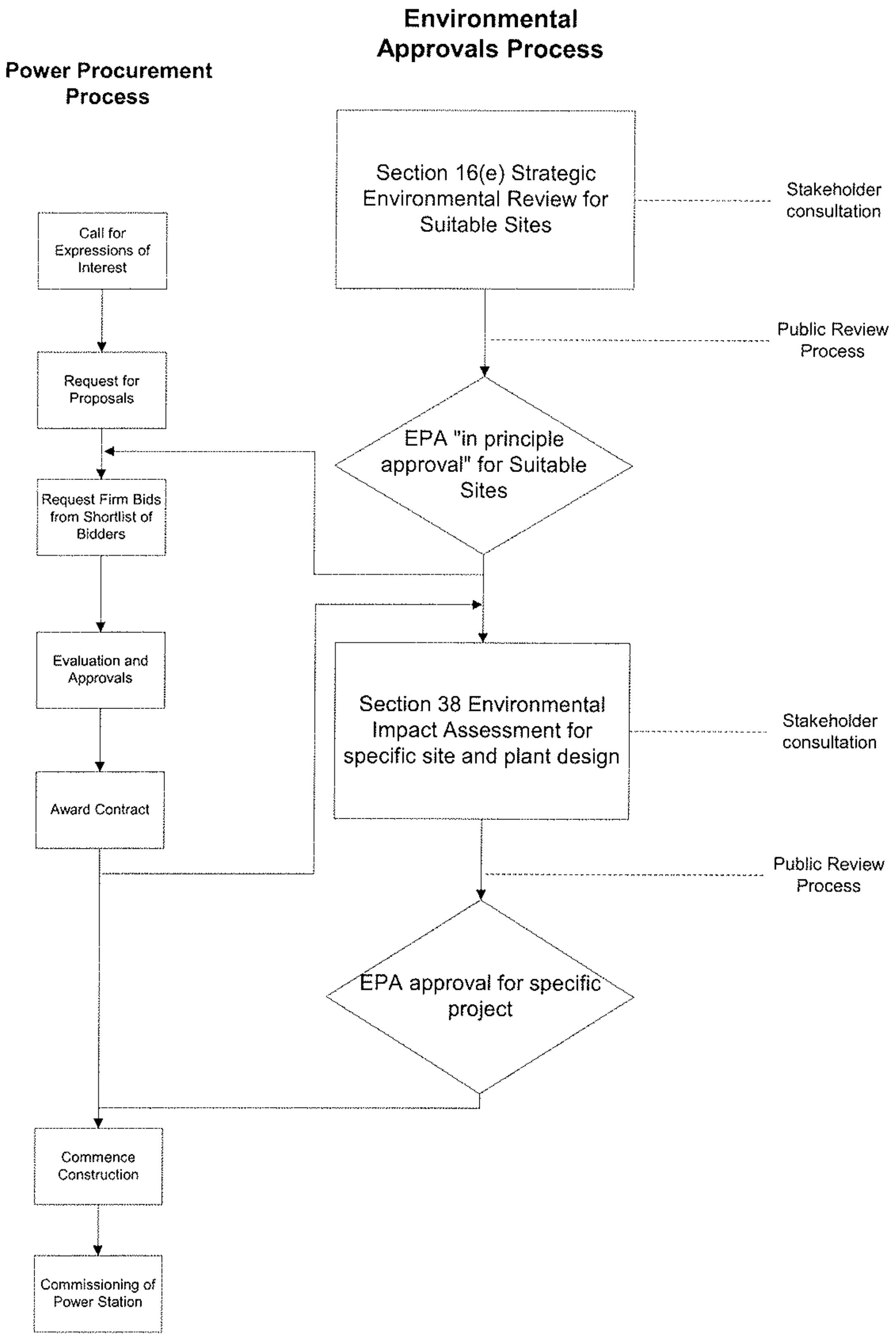
▪ ***Both stages of the environmental assessment process include a formal public review.***

- *Stage 1:* A Strategic Environmental Review (SER) of suitable sites, one of these being the Kemerton Industrial Park. The SER documents have been prepared by Western Power and will be considered by the EPA under Section 16(e) of the *Environmental Protection Act 1986;* and
- *Stage 2*: A detailed Environmental Review of each confirmed development proposal at the selected site will be undertaken by the Preferred Bidder in accordance with Section 38 of the *Environmental Protection Act 1986.*

The relationship between these stages is shown in **Figure 1-1**.

The objective of the Section 16(e) Strategic Environmental Review is to obtain advice and "in principle" approval prior to submission of final tenders, enabling full specification of environmental performance for the facilities in the tender process. Furthermore, the approach will ensure final approval for the facilities is attainable to meet the commissioning date.

Bidders may decide to identify and develop their own site, however, they will be required to demonstrate that environmental clearance and access to the site can be provided to suit the overall project development timeframe.



■ **Figure 1-1 Environmental Approvals and Power Procurement Processes**

1.5.2 Stage 1: Strategic Assessment (Section 16e)

Stage 1 of the approvals process involves the preparation of Strategic Environmental Review (SER) Documents for each of the sites, for the purpose of obtaining advice on their suitability from an environmental perspective under Section 16(e) of the *Environmental Protection Act 1986.* This section of the Act enables the EPA:

> *"to advise the Minister on environmental matters generally and on any matter which she may refer to it for advice, including the environmental protection aspects of any proposal, and on the evaluation of information relating thereto;"*

■ ***A Section 16(e) Strategic Environmental Review is a strategic assessment of a development for which no firm proposal currently exists.***

A Section 16(e) Strategic Environmental Review differs from formal assessments conducted under Section 38 of the Act, in that the review is intended to provide advice on a concept plan for which no firm development proposal currently exists. For each of the concept plans, the focus is on site selection, based on generic power station characteristics. The SER for each site will also investigate options for water supply, wastewater disposal and other infrastructure such as transmission lines.

The Section 16(e) Strategic Environmental Review is a public document and is subject to a four week public review period, during which the public and other groups are invited to make submissions to the EPA. The EPA will then review each concept plan with consideration being given to:

- Issues raised by the public;
- The Proponent's response to those issues;
- Specialist advice from government bodies;
- EPA's own investigations and research; and
- Research undertaken by other expert agencies, if required.

The EPA will then provide separate advice on each of the concept plans to the Minister for the Environment and Heritage in regard to whether it is likely that they can be implemented in an environmentally acceptable manner. The EPA's advice will be published in the form of a "Bulletin". This advice is not considered as a formal assessment under Part IV of the *Environmental Protection Act 1986.*

Unlike a Section 38 assessment process, no binding Ministerial Conditions will be placed on the project. However, these strategic assessments will seek "in principle" approval that each of the sites is suitable to accommodate a power generating facility based on generic performance design parameters.

1.5.3 Stage 2: Environmental Assessment (Section 38)

The second stage of the environmental approval process will be the environmental impact assessment of the detailed power generating proposal by the Preferred Bidder on a single site. This assessment will focus on the potential impacts of the fully defined power generating facility and the proposed strategies to mitigate potential impacts. The assessment would be conducted in accordance with Section 38 of the *Environmental Protection Act 1986.* As such, the assessment would be initiated by the submission of a referral document clearly describing the proposed development.

In response to the referral, the EPA would set the level of assessment and issue guidelines for the preparation of the Environmental Review Document.

In order to meet the State's power supply shortfall, limited time is available to gain environmental approvals between contract award and commencement of construction. However, if the Bidder chooses one of the sites selected for strategic assessment, many of the environmental factors will have already been assessed through this strategic assessment. In particular, the environmental performance indicators will have been ascertained and clearly specified within the tender documents.

Unlike the Stage 1 Strategic Environmental Review, the Stage 2 Environmental Review will result in legally binding Ministerial Conditions being placed on the Preferred Bidder, and the Bidder making appropriate legally binding commitments.

1.5.4 Relevant Legislation

In addition to gaining environmental approval from the Minister for Environment and Heritage, the Preferred Bidder will be required to comply with other legislation and regulations. A summary of key legislation and regulations is provided in **Table 1-1**.

- **Table 1-1 Key Environmental Legislation**

Legislation/Regulation	Application	Administrator
Aboriginal Heritage Act 1972-1980	Protects Aboriginal sites from disturbance	Department of Indigenous Affairs
Agriculture and related Resources Protection Act 1976	Management of weeds and pests	Agriculture Western Australia
Australian Heritage Commission Act 1975	Identifies areas of national heritage significance	Australian Heritage Commission
Bush Fires Act 1974	Manages fire safety	Local Government Authority
Conservation and Land Management Act 1984	Protection and management of nature reserves, state forest, marine parks etc	Department of Conservation and Land Management
Clean Air Regulations 1967	Regulates air borne emissions	Department of Environmental Protection
Dangerous Goods Regulations 1992	Regulations for management and handling of dangerous goods	Department of Minerals and Petroleum Resources
Environment Protection and Biodiversity Conservation Act 1999	Protects matters of national environmental significance	Environment Australia
Environmental Protection (NEPM-NPI) Regulations 1998	Requires industries to estimate emissions to air, land and water on an annual basis	Department of Environmental Protection
Environmental Protection (Noise) Regulations 1997	Noise limits, methods for noise assessment and control	Department of Environmental Protection
Environmental Protection (Liquid Waste) Regulations 1996	Control and abatement of liquid waste	Department of Environmental Protection
Environmental Protection Act 1986	Prevention, control and abatement of pollution and conservation protection and enhancement of environment	Department of Environmental Protection
Explosives and Dangerous Goods Act 1961-1986	Regulates the manufacture, use and storage of explosives and dangerous goods	Department of Minerals and Petroleum Resources
Fisheries Resources Management Act 1984	Conservation and development of fish resources within the State	Fisheries WA
Health Act 1911	Provides regulation for the protection of public health eg sewage disposal	Department of Health
Native Title Act 1993	Handles Aboriginal claims for land ownership	Native Title Tribunal
Pollution of Waters by Oil and Noxious Substances Act 1987	Protection of sea and certain waters from pollution by oil and other pollutants. Inspection of vessels and infrastructure	Department of Environmental Protection
Soil and Land Conservation Act 1945	Prevents disturbance to soil without authority	Agriculture Western Australia
State Planning Commission Act 1985	Controls land development in the state	Ministry for Planning
Waterways Conservation Act 1976	Conservation and management of waters and the associated land and environment	Water and Rivers Commission
Wildlife Conservation Act 1950	Protection of rare and endangered flora and fauna	Department of Conservation and Land Management

1.6 Project Schedule

The Power Procurement Process is expected to consist of the following:

- Around 240MW of peaking capacity as early as 2004/05 and no later than the summer of 2005/06; and
- Around 300MW of base load capacity to be in service by 2007/08.

The construction of a 240MW peaking plant will likely take between 12 to 18 months (for an open cycle gas turbine plant). Therefore, to meet the earliest commissioning date of 2004/05 for the initial stage, construction must commence by the second half of 2003.

1.7 Structure of this Report

This document provides the following information:

- Introduction to the project, overview of the environmental approvals process and purpose of this Strategic Environmental Review (**Section 1**).
- Justification of the project and project benefits (**Section 2**).
- Detailed evaluation of the options for energy sources, generating plant technology, site location and greenhouse gas considerations (**Section 3**).
- Project location, status of the land tenure and evaluation of options within the Kemerton Industrial Park (**Section 4**).
- Description of the Kemerton Power Station development concept (**Section 5**).
- Description of the environmental and social setting of the Kemerton area (**Section 6**).
- Potential construction impacts and proposed management and monitoring strategies (**Section 7**).
- Potential operational impacts and proposed management and monitoring strategies (**Section 8**).
- Potential impacts on the social surroundings of Kemerton and proposed management and monitoring strategies (**Section 9**).
- Comments and input from public consultation (**Section 10**).
- Summary of proposed environmental management commitments that the Preferred Bidder would be required to undertake (**Section 11**).
- EPA Guidelines for the Section 16(e) Strategic Environmental Review (**Appendix A**).
- Supporting technical information relating to the project (**Appendices B to G**).

2. Project Justification

2.1 The Need for Additional Generating Capacity

This section demonstrates the need for additional generating capacity within the South West Interconnected System (SWIS) grid.

2.1.1 The Existing South West Interconnected System

The existing SWIS grid supplies electricity to the south west corner of Western Australia. The grid extends to the north as far as Kalbarri and to the east as far as the Goldfields. The extent of the SWIS grid within the overall Western Australian electricity system is shown in **Figure 2-1**.

All of the power stations within the SWIS are interconnected so that any of the individual stations can supply power for use in load centres throughout the South West. A summary of Western Power's power generation plant within the SWIS is given in **Table 2-1**. Additional independent power generation plants also provide power to the SWIS, however these are not discussed further in this document.

- **Table 2-1 Summary of Western Power's Power Generation within the SWIS**

South West Interconnected System	Fuel	Capacity (MW)	Date Acquired or Commissioned	Energy Generated During 2000-01 (GWh)
Albany	Wind	22	2001	-
Collie	Coal	330	1999	2,285.6
Muja A & B	Coal & Heavy Fuel Oil	240	1965	1,118.2
Muja C	Coal & Heavy Fuel Oil	400	1981	2,407.0
Muja D	Coal & Heavy Fuel Oil	400	1985 - 86	2,725.3
Kwinana A & C	Coal & Gas	640	1970 - 76	1,640.6
Kwinana B	Gas	240	1970	450.6
Kwinana Gas Turbine	Gas & Distillate	21	1972	0.6
Geraldton Gas Turbine	Gas & Distillate	21	1973	-
Kalgoorlie Gas Turbines	Distillate	62	1984 - 90	1.9
Mungarra Gas Turbines	Gas	112	1990 - 91	242.1
Pinjar Gas Turbines	Gas & Distillate	586	1990 - 96	400.8
Wellington Dam	Hydro	2	1992	1.7
Worsley (50% Joint Venture Share)	Gas	60	2000	406.1
Tiwest	Gas	36	1999	234.2
Total		**3,172**		**11,914.7**

2.1.2 Meeting Future Electricity Demands

Accurate power demand forecasts are required for the short to medium term to assess the need for and capacity of new generating plant. Western Power's *Electricity Outlook Reports* provide information relating to Western Power's sales into SWIS including forecasts of capacity and energy.

The energy forecasts in the Outlook Reports represent the sent out energy from generators required to supply Western Power's Retail Division's load in the SWIS. These forecasts assume that some Independent Power Producers (IPPs), independent to the Power Procurement Process, would be supplying load connected to the SWIS.

The Power Procurement Program will coincide with plant replacement that will be undertaken by Western Power, whereby older generating plant that is nearing the end of its operating life will be retired, or replaced by higher efficiency generating plant.

Current planning studies and asset management strategies have given rise to the following plant replacement/retirement and Power Procurement Program:

Plant Replacement/Retirement

- Installation of Cockburn 1 – 240MW in 2003/04;
- Retirement of Kwinana Stage B – 240MW in mid 2005;
- Retirement of Muja Stage A/B – 240MW in mid 2006;
- Installation of Cockburn 2 – 240MW in 2005/06; and
- Retirement of Kwinana Stage A – 240MW in 2007/08.

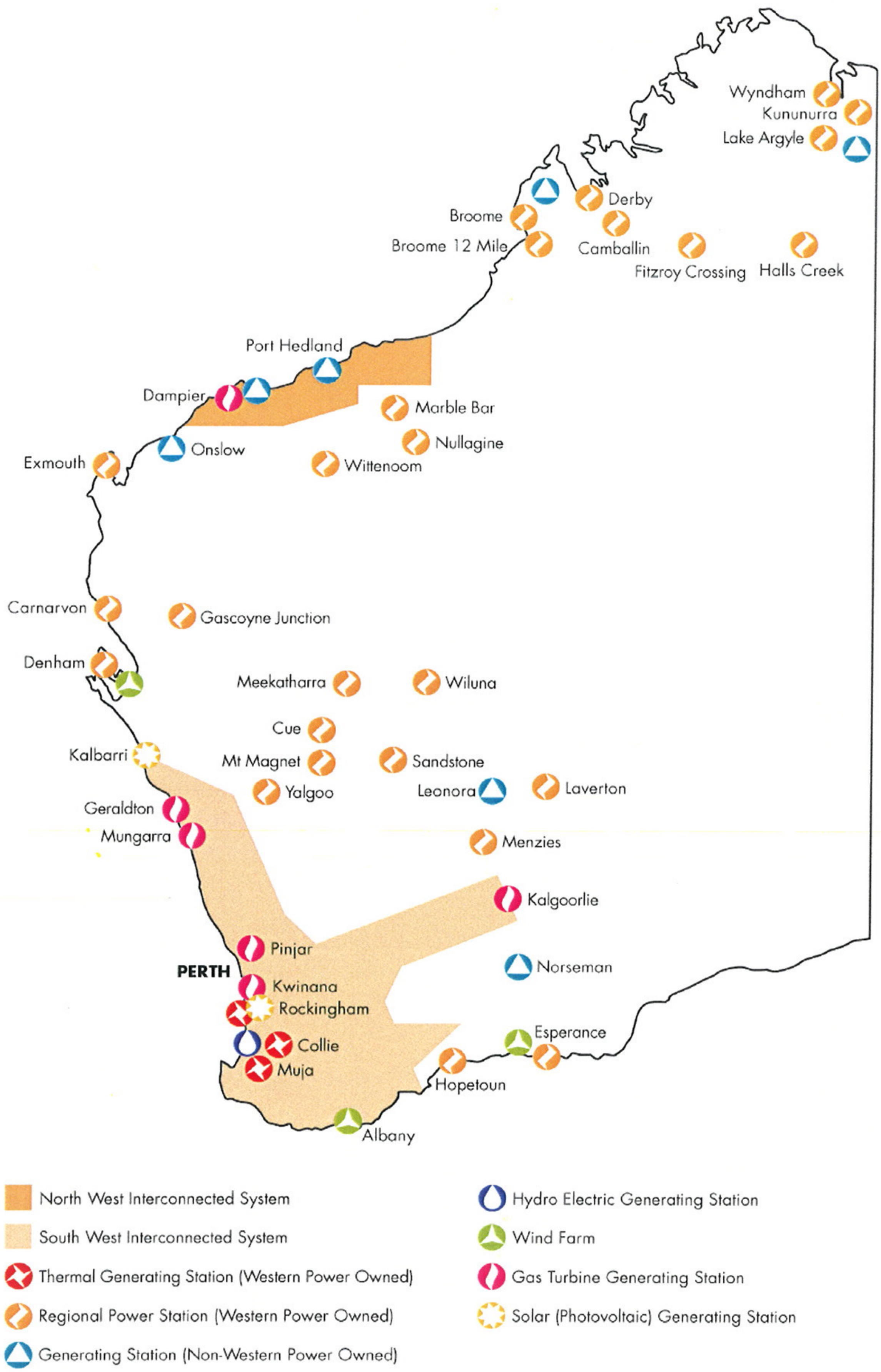
Power Procurement Program

- Around 240MW of peaking capacity to be in service as early as 2004/05 and no later than the summer of 2005/06; and
- Around 300MW of base load capacity to be in service by 2007/8.

The above programs combined with Western Power's existing plant capacity and a notional forecast demand are shown in **Figure 2-2**. Western Power's existing capacity is shown in light grey and the additional capacity requirements are shown in dark grey shading. The black line represents the notional forecast peak demand. On top of this notional forecast demand is the reserve margin requirement. Reserve margin is the difference between actual available system generation capacity and the maximum system demand. The recommended practice around the world, for systems with the characteristics of the SWIS, is to maintain a reserve margin of between 20 and 25%. This level of reserve is necessary to allow for scheduled maintenance and unscheduled outages of the generating plant throughout the year, and to ensure that incidents of blackouts are minimised.

The additional capacity requirements shown in **Figure 2-2** as the dark grey area represents the Power Procurement Program (240MW peaking 2005/06, 300MW base load 2007/08) and a nominal 120MW per year to 2009/10 to maintain the reserve margin requirement.

Areas serviced by Western Power

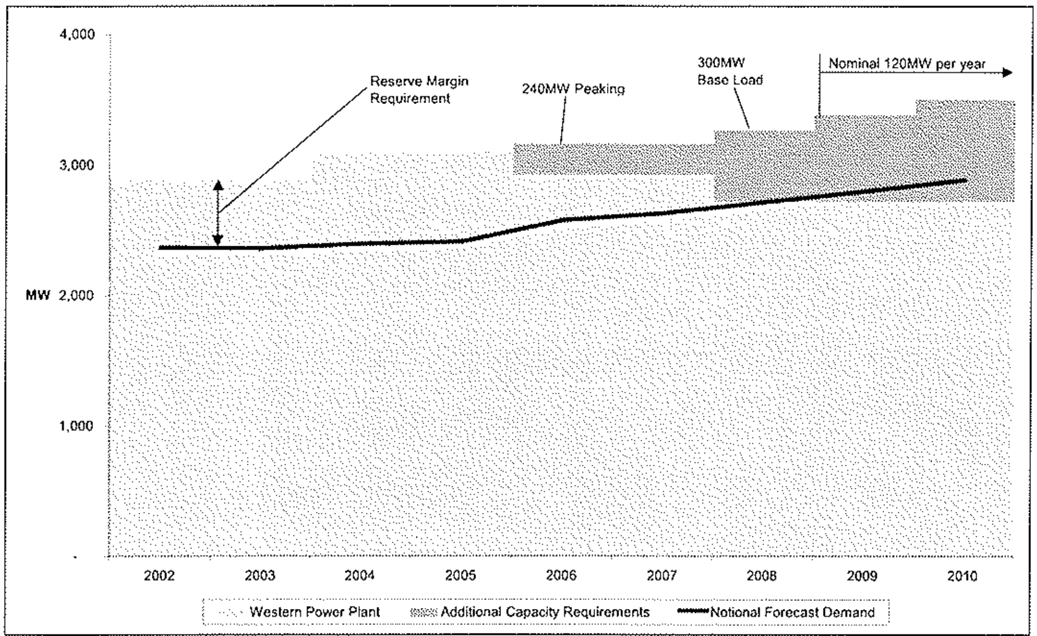


Western Power

SINCLAIR KNIGHT MERZ
Sinclair Knight Merz
263 Adelaide Terrace
P.O. Box H615 Perth
WA 6001 Australia

Western Australia's Electricity System

Figure 2-1
Project No.: WV02244
Figure prepared by: T.Lee
Date Prepared: 18/03/02



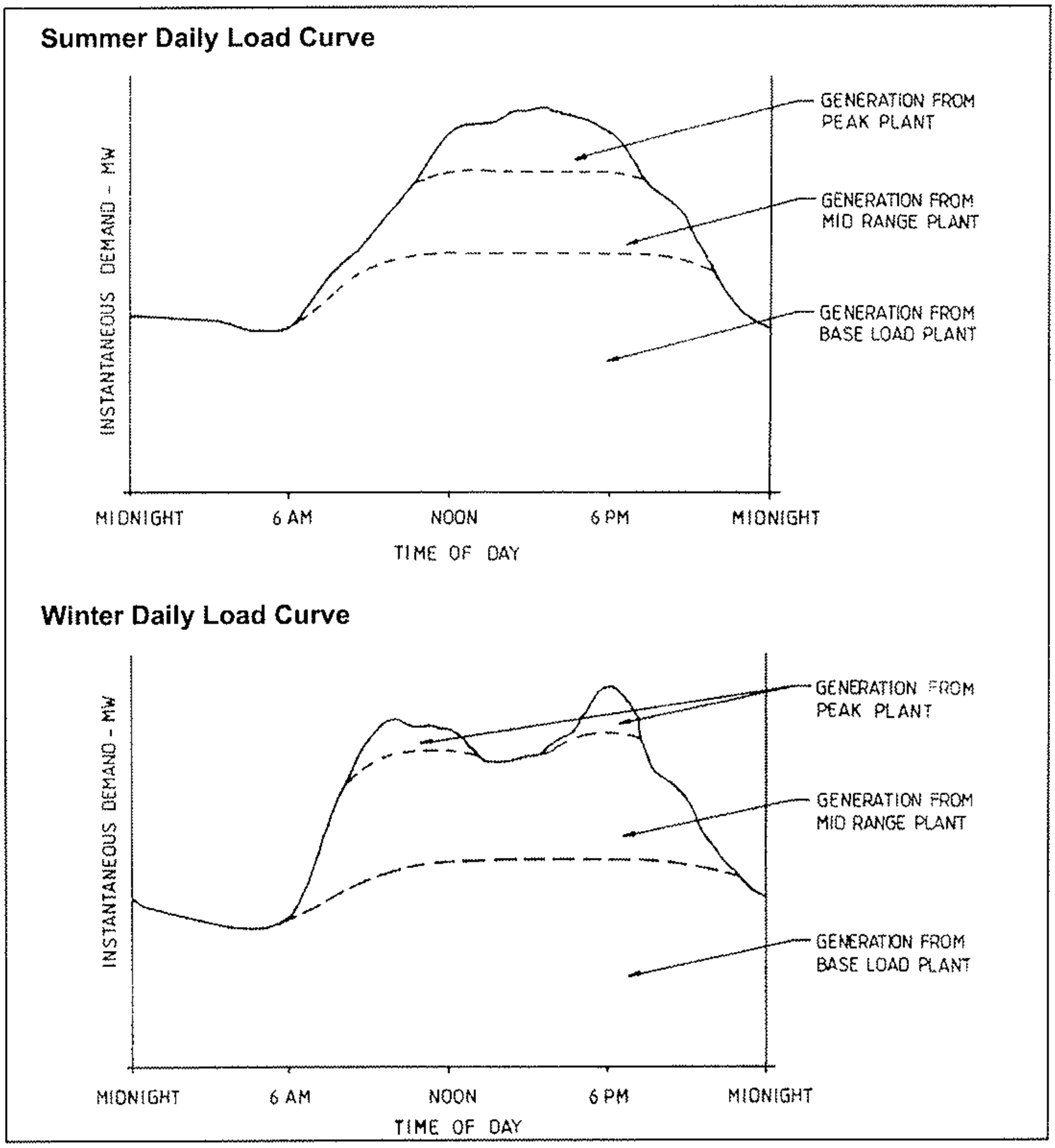
■ **Figure 2-2 Western Power's Capacity and Forecast New Generation Requirement (notional)**

2.1.3 Duty Required of Generating Plant

Electricity demand varies considerably throughout each day and from season to season. To minimise operating costs, Western Power only schedules into service sufficient plant to meet expected demand plus some margin to allow for unexpected events. Thus, depending on the duty it has to perform, generating plant is ideally designed to operate in one of three basic modes:

- Peaking or emergency mode;
- Mid-merit or mid range mode; and/or
- Base load mode.

The immediate power requirement for the SWIS is for additional peaking plant, although subsequent stages of the Power Procurement Process will be base load facilities. These modes are shown schematically in **Figure 2-3** and discussed in more detail in the following sections.



- **Figure 2-3 Daily Load Curves for Summer and Winter**

2.1.3.1 Base Load Mode

Base load demand is the power demand which is always present throughout the day and night time. The base load demand is met by generation plant which runs continuously throughout the year at close to full capacity, only shutting down for scheduled maintenance or faults. It is important that base load plant are as efficient as possible to minimise fuel cost, which is the major component of their operating costs. A higher capital cost of base load plant can generally be justified if increased efficiency and reliability allows operating costs to be reduced.

Coal-fired and gas turbine combined cycle plant are both suitable for base load duty. Increasingly, natural gas-fired gas turbine combined cycle plants are becoming more common because of the lower environmental impact, lower capital costs, and higher thermal efficiencies. However, modern coal-fired plants could be competitive in terms of overall life-cycle costings, and recent developments in coal-fired plant technology may reverse the trend towards natural gas.

2.1.3.2 Mid-Merit Mode

Mid-merit demand is essentially the daytime business demand. Mid-merit plant are generally not operated overnight or at weekends except during periods of very high demand or to allow for maintenance of base load plant.

It is usually detrimental (from a maintenance viewpoint) to start and stop base load plant on a daily basis. So for mid-merit plant, the generating units should be designed for this role. Gas turbines for mid-merit duty would usually be in a combined cycle arrangement, although open cycle gas turbines can also be used.

2.1.3.3 Peaking Mode

Peaking plant operates only at times of high power demand from the grid. These high power demands usually occur at certain times of the day (e.g. during breakfast time in the morning and evening mealtime). Power demands are also seasonal and demand is particularly high during summer, due to air conditioning loads (refer to **Figure 2-3**).

The demand during peak periods develops rapidly and only usually lasts for a short time. Therefore the power supplier must have plant that is capable of being brought on-line and off-line quickly to meet these demands. Gas turbine generators are suitable for this purpose because they can be started and be on-line at full load within 20 minutes. Once on-line, a gas turbine can be stopped and taken off-line without any major cost penalties. Typically, coal-fired plant is not suitable for peaking duty as it takes several hours to bring a coal unit on-line.

Since peaking plant only runs for a small proportion of the time, fuel costs are of secondary importance and capital costs become the dominant factor in the investment decision. Gas turbines used for peaking are typically open cycle type. These types of gas turbines represent the lowest capital cost per kilowatt installed of any other comparable generating plant. As they do not have any major requirements for cooling water, they could be located wherever fuel supplies and connections to the transmission system are cost effective.

2.1.4 Meeting Potential Major Industry Power Demand

In addition to the new generating capacity required to meet the general increase in existing consumer demand across the grid, major industries may also have significant power requirements. Large electricity intensive industries could have lead times from start of the project to commercial operation of typically two years or more. Strategic planning for future power generation (whether by Western Power or other power producers) at this early stage will assist in facilitating development of new industries in the future, by setting aside appropriate sites and addressing in advance the full range of environmental, social and infrastructure planning issues.

2.2 Summary of Benefits of the Project

The State of Western Australia would benefit from the development of additional generating capacity within the SWIS in the following ways:

- Capital investment of $160 million to $1 billion;
- Direct employment of construction workforces (up to 250 – 400 persons), plus associated indirect employment during several construction phases;
- Permanent employment of up to 5 personnel for a 240MW open cycle station and up to 25 to 30 personnel for a base load power station;
- Avoid future shortfalls in existing consumer electricity supply;
- Provide additional electricity for future new industries; and
- Potential to provide incentives for other industries to establish in certain areas by bringing forward water supply, wastewater disposal and gas supply infrastructure, providing co-generation opportunities and a more reliable power supply.

2.3 No Project Option

An increase in electricity demand within the state is closely linked with population and economic activity growth. Western Power's forecasts indicate the need for new capacity as early as 2004/05. If power generation plant construction is delayed or postponed, the ability of the existing ageing plant to meet demand would be increasingly compromised.

Unless industry and the community are prepared to accept increasing interruption to power supplies then additional power generation is needed in the near future.

Other potential losses to the State by this project not going ahead includes loss of local employment and service provision opportunities, and the loss of capital investment.

3. Evaluation of Options

3.1 Introduction

During the Power Procurement Process, a range of possible scenarios of both technology and location may be put forward by interested Bidders for each stage of the capacity procurement. The selection of the Preferred Bidder will be based upon criteria that reflect the requirements of the *Electricity Corporation Act 1994*, namely the ability to supply electricity in a way which minimises Western Power's total delivered cost of electricity (in the sense of the overall costs of delivering electricity to its customers) whilst maintaining the safety and reliability of the SWIS.

Until the Power Procurement Process is finalised, it is not possible to predict with certainty which technology and site will emerge from the bidding process. The basis of the bid evaluation process in terms of technology and site selection will be the ability to fulfil the requirements of the various stages of the Power Procurement Process. The main requirements are outlined below:

- Ability to minimise Western Power's total delivered cost of electricity whilst maintaining safety and reliability;
- Ability to safely and reliably supply the required duty cycle (initially around 240MW of peaking and later followed by around 300MW of base load capacity);
- For the first capacity stage, the ability to commence production as early as 2004/05 and no later than the summer of 2005/06; and
- For the second capacity stage, the ability to commence production by 2007/08.

An evaluation of available energy sources, generating plant technology, site options, and greenhouse gas considerations is given in the following sections.

3.2 Evaluation of Energy Sources

The sources of energy currently available in Western Australia for power generation include natural gas, coal, petroleum oil, and various renewable energy sources such as wind, solar and biomass. The most important energy sources and associated technologies are reviewed in the following sections with respect to their application to meet the power generation requirements of the SWIS Power Procurement Process.

3.2.1 Renewable Energy

Wind

Wind has been used for centuries as an energy source for sailing ships, pumping water and grinding grain. More recently, wind has become an alternative source of electricity. Wind is one of the cheapest renewable energy options in Western Australia and the State has an excellent wind resource (refer to **Plate 3-1**).

Source: Wind Energy Corporation

- **Plate 3-1 Example of Western Australia's Excellent Wind Resources**

Western Power has successfully trialed the full range of wind turbines available and developed a number of wind energy systems. These include Australia's first commercial wind farm at Esperance, and one of the world's most sophisticated wind/diesel systems at Denham. Western Power also completed construction of the Albany wind farm in July 2001, which is the largest wind farm in Australia (refer to **Plate 3-2**). The Albany wind farm now supplies on average 75% of the power needs of the Town of Albany. Western Power is also investigating the feasibility of a 30MW wind farm at Mumbida, south of Geraldton and a number of other proponents are investigating wind farm opportunities in Western Australia.

- **Plate 3-2 The Albany Wind Farm (22MW)**

In more remote areas, wind turbines become an attractive option for supplementing existing power supplies, hence saving on fuel supply costs for the existing power plant. However, despite its obvious attractions, there are major constraints to wind power. Power generation from wind is highly site sensitive and depends on the site having consistent winds. Nevertheless, even suitable sites have periods of low winds such that the capacity factors of these sites rarely reach more than 30% – 40% over the period of a year. In other words, the annualised generating output of a wind farm never exceeds more than one third of its total capacity. Also, the frequency of winds capable of generating power can be spasmodic and, as such, the availability of power generation from the wind farm will also be spasmodic precluding it as a reliable source of on-demand power.

Wind turbines, because of current restrictions in technology, are generally limited in output. The largest turbines currently available are 2MW, so for example, a 100MW wind farm would require 50 turbine units and would cover an area of over 500ha. Unlike conventional power generation plants, the land used for a wind farm does not preclude use of the land for other purposes, such as grazing. In comparison to a wind farm, a 1,000MW gas-fired power station would have a footprint less than 50ha (ten times the power for one-tenth the footprint). Similarly, a coal-fired unit of a comparable size could have a footprint of up to 150ha depending on the location and size of the required ash ponds and coal stockyards (ten times the power for less than one third of the footprint).

In summary, wind farms are not suitable for large-scale power generation because of the following disadvantages:

- Limited output;
- The need for a large windy site; and
- The spasmodic nature of power delivery and the need to be backed up by spinning reserve.

■ ***Wind power is being actively promoted by Western Power for some applications, however, wind farms are not suitable for large-scale power generation.***

Solar (Photovoltaic Cells)

Solar power is generated when the sun's rays fall on certain types of specially treated materials, typically silicon, and generate electricity. Solar equipment is a simple method of producing power, with no moving parts. Although Australia is ideally located for solar energy, the high installation cost of solar energy equipment generally means photovoltaics only make economic sense in remote locations or for very small applications (like wristwatches, calculators, and emergency freeway telephones). Currently, the only sizeable grid connected solar array in Western Australia is located at Kalbarri. This 20kW system was developed in conjunction with Western Power. It includes 256 solar PV panels on 16 trackers and powers about 20 average homes.

■ ***Solar power technology is very expensive and is better suited to remote locations or very small applications.***

Hydro-electric

Hydro-electric power is produced by the movement of water from rivers and lakes. The water flows downwards under the effect of gravity and the kinetic energy from this flow is converted into mechanical energy, which is then converted into electrical energy in hydro-electric power stations.

Hydro power in Western Australia includes Western Power's 2MW hydro-electric power station at Wellington Dam near Collie and a 30MW hydro power station at the Ord River dam on Lake Argyle, which is owned and operated by Pacific Hydro.

▪ *Western Australia's climate makes WA unsuitable for significant additional capacity from hydro-electric power.*

Hydro power stations can operate as base, mid-merit or peaking stations, however to meet the demands, a reliable rainfall with suitable catchment area is required. Given Western Australia's climate conditions, there is little prospect of any significant additional capacity from this source.

Biomass

Biomass describes any type of biological matter that can be used for fuel and includes energy crops and agricultural, commercial and domestic wastes. Within Western Australia, there are a number of biomass applications mainly utilising wood, landfill gas, wastewater and bagasse (the cane residue from sugar production). The applications used for power generation within WA include:

- A total installed capacity of around 10MW from landfill gas from four small power stations operated by Landfill Gas and Power;
- A capacity of 1.2MW from Biogas produced by the decomposition of sewage at Water Corporation's Woodman Point wastewater treatment plant;
- A 6MW cogeneration plant at the Ord Sugar Mill at Kununurra, which uses bagasse as a fuel; and
- A demonstration plant to be built in Narrogin by Western Power which will generate renewable electricity and produce activated carbon and eucalyptus oil from locally planted eucalyptus mallee trees. The pilot plant will produce 1MW, which is enough to power 1,000 homes.

▪ *Biomass applications are generally only practical in small-scale applications.*

Other biomass applications are being investigated and implemented, however these applications are generally only practical in small-scale operations in Western Australia.

3.2.2 Non-Renewable Energy

Natural Gas

Natural gas is sourced from Australian gas fields. Natural gas is used in industries for heating, raising steam and power generation. This same fuel is used in homes for domestic purposes. Natural gas is used as an energy source for both large and small-scale power stations in Western Australia, including the Kwinana Power Station and Pinjar Gas Turbine Station.

Natural gas is a relatively clean burning fuel, which produces lower emissions of particulate matter, sulphur dioxide and greenhouse gases than coal and liquid fuel.

Both gas and coal-fired power stations require substantial infrastructure to deliver the fuel. The infrastructure associated with the Dampier to Bunbury Natural Gas Pipeline has allowed natural gas to become a viable alternative to coal. However, there are pipeline capacity issues and expansion of pipeline capacity and the associated costs would need to be resolved to allow any significant increase in natural gas-fired power generation.

Coal

Coal is a fossil fuel that is sourced from the Collie Basin coalfield in Western Australia. It is used mainly in power generation and for steam raising. Coal is primarily used for base load power stations which generate power on a continuous basis (refer to **Section 2.1.3.1**). Existing power stations that operate on coal include Kwinana Power Station, Muja Power Station and the Collie Power Station. A number of the older coal-fired generating units at Muja and Kwinana are approaching the end of their economic life and will be withdrawn from service in the future (refer to **Section 2.1.2**).

There are a number of potential environmental impacts associated specifically with the use of coal as fuel in power stations. These include:

- The generation of ash, which requires substantial areas of land for disposal;
- Greater emissions of greenhouse gases than other fuel sources (refer to **Section 3.5.4.2**); and
- Emissions of fly ash and sulphur products from the boiler flue gas.

These impacts necessitate the need for careful planning and investigations into emerging coal technologies with less environmental impact.

Liquid Fuel

Liquid fuel includes petroleum products such as distillate and heavy fuel oil, and is used for power generation, heating and steam raising. Distillate is also used for automotive applications. Liquid fuel has been used extensively in the past for power generation, however, it has largely been displaced by natural gas, except for contingency/peaking duties.

Liquid fuel is still used for remote power generation, where natural gas is not available, due to its ease of transport. Liquid fuel is also used in dual fuel power systems where security of fuel supply is critical. In view of the natural gas transport constraints, the use of liquid fuel is an important consideration for the first stage of the Power Procurement Process.

3.2.3 Summary of Energy Source Options

As demonstrated above, renewable energy offers many opportunities for power generation and Western Power will continue to pursue developments in this area. However none of the renewable options currently available are capable of meeting the scale of the predicted power generation requirements (initially 240MW followed by about 300MW). Therefore for the SWIS Power Procurement Process, Western Power has focussed upon the conventional energy sources of natural gas, coal and liquid fuel.

Natural gas pipeline transport capacity constraints and the costs associated with expansion also support the need to maintain a diversity of energy sources to ensure security of power supply for the State.

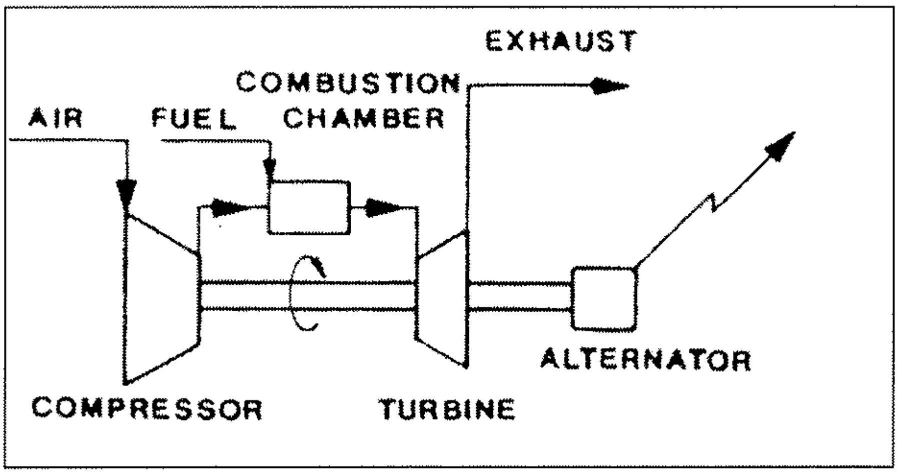
A discussion of the technology available for conventional plant is given in the following sections.

3.3 Evaluation of Generating Plant Technology

3.3.1 Gas Turbine Plant (Open Cycle)

Operation

In a gas turbine, a rotary compressor forces air into a combustion chamber in which fuel such as gas or liquid fuel is burned. The energy released forces the hot combustion gases to expand through a turbine providing the force to spin the shaft. The turning shaft is coupled to an alternator, which generates electricity. The turbine also drives the compressor. A schematic of the process is shown in **Figure 3-1.**



■ **Figure 3-1 Open cycle gas turbine schematic**

Advantages

- Lowest capital cost per kW installed of any other comparable generating plant;
- Does not require on-site operating staff;
- Requires less land than conventional steam turbine or combined cycle plant;
- Moderate efficiency compared with steam turbine plant;
- Available in small or large unit sizes;
- Short installation time (12 – 18 months);
- Can be brought into service quickly (within 20 minutes);
- Does not require cooling water; and
- Burns natural gas or liquid fuel.

Disadvantages

- Uses natural gas or liquid fuel, which may be more expensive than coal.

Uses

- Ideal for peaking duty operation.

Examples of Existing Plant in Operation in Western Australia

- Pinjar (Western Power);

- Mungarra (Western Power);
- Kalgoorlie (Western Power);
- Port Hedland and Newman (Duke Energy); and
- Burrup Peninsula (Woodside).

3.3.2 Combined Cycle Plant

Operation

Combined cycle plant is a combination of a gas turbine and steam turbine plant. In a combined cycle plant, conventional gas turbine plant is used to generate electricity, but the hot exhaust is directed through a boiler before being exhausted to the atmosphere. Steam is generated in the boiler and is used to drive another turbine to produce more electricity. In this way, a combined cycle plant produces considerably more electricity per unit of fuel consumed than a conventional gas turbine. A schematic of the process is shown in **Figure 3-2**.

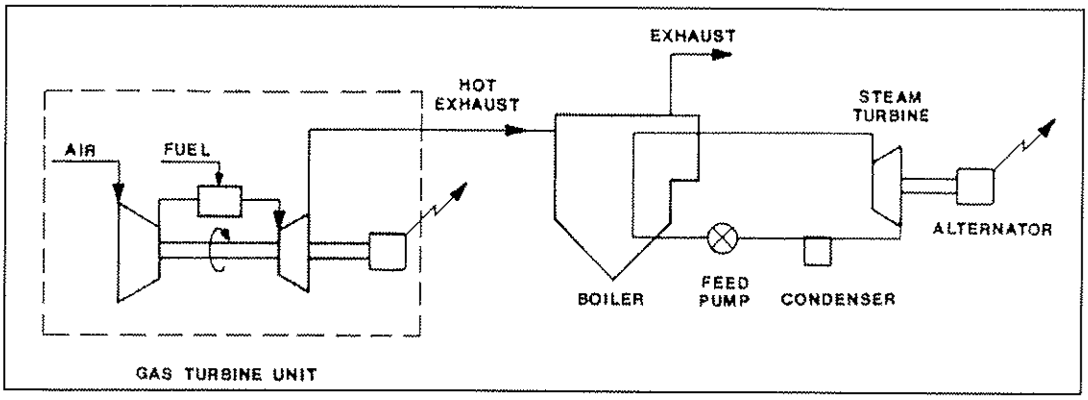


Figure 3-2 Combined Cycle Gas Turbine Schematic

Advantages

- Lower capital cost than steam turbine plant;
- Higher efficiency than steam turbine plant – over 50% is achievable;
- Available in a range of unit sizes;
- Short installation time (24 – 30 months);
- Air cooling can be used (with an associated reduction in efficiency) and, if water cooling is used, it requires much less (under 50%) cooling water than a similar capacity steam turbine plant;
- Requires less land than conventional steam turbine plant;
- Control of exhaust emissions is easier than for steam turbine plant; and
- Burns natural gas or liquid fuel.

Disadvantages

- Uses natural gas or liquid fuel, which may be more expensive than coal.

Uses

- Can be used for mid-merit or base load operation depending on the cost of available fuel.

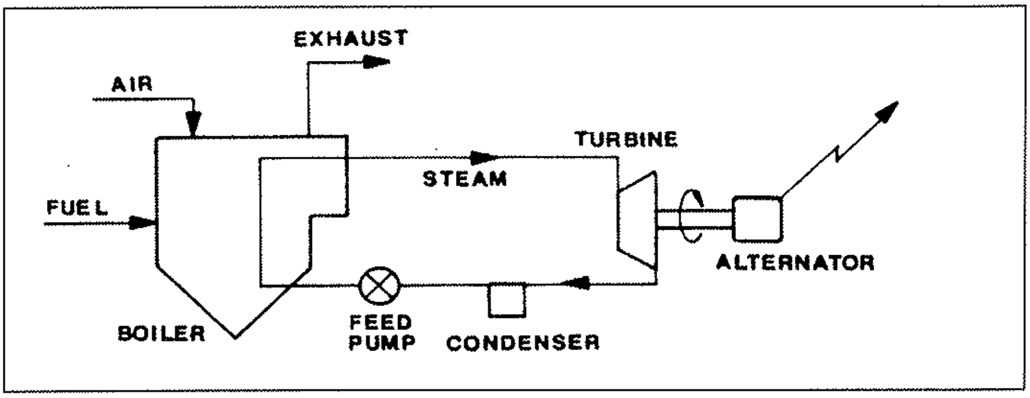
Examples of Existing Plant in Operation in Western Australia

- Kwinana (BP Mission Energy);
- Cockburn Unit under construction adjacent to the existing Kwinana Power Station site (Western Power); and
- Murrin Murrin (Anaconda Nickel).

3.3.3 Steam Turbine Plant

Operation

In a steam turbine plant, coal, natural gas or liquid fuel is burned in a boiler to heat water and produce steam. The steam drives the turbine and this is connected to the alternator which generates electricity. Steam exhausted from the turbine is condensed back to water and pumped back to the boiler to complete the cycle. Western Power's existing steam turbine plant use water for condensing the steam. A schematic of the process is shown in **Figure 3-3**.



- **Figure 3-3 Steam Turbine Schematic**

Advantages

- Can use low cost coal;
- Can use a range of other fuels;
- Moderate efficiency;
- Efficiency reduces more slowly at part load operation than an open cycle gas turbine; and
- Can be built in large sizes.

Disadvantages

- High capital cost;
- Long construction time (30 – 48 months);

- High manpower and maintenance requirements;
- Large minimum economic size;
- Requires large quantities of water for cooling; and
- Potential environmental impact from ash and air emissions such as carbon dioxide (CO_2) and sulphur dioxide (SO_2), depending on the fuel type.

Uses

- Ideal for base load operation; and
- Can be designed for mid-merit use.

Examples of Existing Plant in Operation in Western Australia

- Muja Power Station (coal) (Western Power);
- Collie Power Station (coal) (Western Power);
- Kwinana Power Station (gas/coal) (Western Power);
- Dampier 'C' (gas) (Hamersley Iron); and
- Cape Lambert (gas) (Robe).

3.3.4 Summary of Generating Plant Options

3.3.4.1 Initial Power Procurement Requirement

Western Power Corporation forecasts have identified that there will initially be a shortfall in generating capacity of 240MW during peak periods of demand. These periods are of short duration and require plant that is capable of being cycled on and off-line with rapid response. To meet peak demands in large electricity systems such as SWIS, it is usual to install small units that can be started quickly and in sufficient numbers to meet the demand prevailing at the time.

It is inefficient to run large base load plant such as combined cycle or steam turbine plant to meet these peak demands as:

- Base load plant would not be operating at their most efficient output for a majority of the time;
- Additional base load plant with consequentially higher capital cost would be required to be available on-line to meet both the base and peak demands; and
- Peak demand values can vary from day to day depending on various factors, not least the weather, so that the base plant may have to be cycled to the detriment of its reliability and maintenance requirements.

For the above reasons, coal-fired steam turbine plant would unlikely be suitable for the initial stage of power procurement.

Combined cycle gas turbine plants normally represent the most efficient of conventional generating plant, however they are not suitable for the fast starting requirements of peaking duties and are more generally used for mid-merit or base load applications for the following reasons:

- A combined cycle plant requires at least 1-hour to come up to full load, limiting the ability of the power provider to respond quickly to peak demands; and
- A combined cycle plant could not be shut down rapidly because of a need to avoid machinery being exposed to excessive changes in temperature.

Given these constraints, a combined cycle plant would need to be on-line for up to four hours to meet a two hour peak demand, causing inefficiency in fuel usage and increased emissions. Combined cycle plants also have higher capital costs than open cycle plants. For these reasons, a combined cycle plant would unlikely be suitable for the initial stage of the Power Procurement Process.

Open cycle gas turbines are ideal for peaking duties because of their ability to be started and be on-line at full load within 20 minutes. They represent the lowest capital cost option and could be installed quickly wherever there is a source of fuel (gas or liquid) and a connection into the electricity grid. They do not require large amounts of water for cooling and could be run with a minimum of operating staff. Noise can be limited by suitable attenuation devices without major capital costs.

Western Power's own studies, verified by an independent expert commissioned by the Independent Person supervising the Power Procurement Process, have identified that the initial power procurement requirements would best be met by the installation of around 240MW of peaking capacity. This would typically consist of two units of open cycle gas turbines, each of 120MW to provide some flexibility in operation. However, it is open for Bidders to put forward alternative plant solutions if they believe they could achieve a better result, within parameters of the process.

3.3.4.2 Subsequent Power Procurement Requirements over the Next Decade

As previously discussed (refer **Section 2.1**), to satisfy existing customer demands over the next decade, the second stage of the Power Procurement Program will consist of around 300MW of base load capacity to be in service by 2007/08.

This requirement would likely be met by the following:

- Combined cycle gas turbine plant, which would be gas-fired; or
- Steam turbine plant, which could be gas or coal-fired.

Specific plant requirements have not been defined beyond these first two stages of the Power Procurement Process. However, a nominal 120MW of additional capacity per year is expected to be required for subsequent years to maintain the reserve margin requirement. In addition to the new generating capacity to meet general increase in customer demand, new or expanded major industries may also have significant power requirements in the future. Therefore it is likely that a range of power generation plant and fuel options could be installed over the next decade.

3.4 Evaluation of Site Options

3.4.1 Strategic Site Selection Study

A site selection study was undertaken between Geraldton and Bunbury to identify suitable parcels of land to meet the future power generating requirements of the SWIS (Sinclair Knight Merz, 2000). The study involved a number of phases using a GIS based methodology. The purpose of the study was to identify sites that would meet the short-term power requirements and enable commissioning of the next power generating plant by 2004/05 or 2005/06, as well as several sites that would be more suitable to satisfy Western Australia's longer term power generation requirements.

The primary focus of the site selection study was to identify suitable sites for gas-fired power stations. It was recognised that a site located around the Collie Coal Basin would be suitable for coal fired generation. In particular, the Collie Power Station has been built with much of the infrastructure in place for an additional 300MW of generating plant.

The requirement for an additional 700 – 900MW of generating capacity for existing customers over the next decade will likely not be met at any one site. Furthermore, the generating capacity of each site may not be restricted to the requirement to satisfy existing customer demands, and may be used to meet the power requirements of new industry, as yet undefined. Therefore, Western Power is seeking to reserve several sites for the purpose of meeting power generation requirements into the future.

Site Selection Criteria

The following criteria were used to assess sites for suitability for future power generation:

- **Planning criteria/land zoning** – The land should be zoned appropriately for the development and be compatible with existing land uses. The sites should not compromise future options for land use and should be consistent with strategic plans for future infrastructure.
- **Availability of infrastructure and services** – The sites require infrastructure and services to be either already available or within an acceptable distance to the site. These service and infrastructure requirements include transmission lines, fuel supply, water supply, site access, labour forces and options for the disposal of wastewater.
- **Land capability criteria** – The sites should not have large variations in topography, unsuitable soil, poor drainage, high potential for earthquakes, or any other such features that may constrain the siting of a power station.
- **Environmental factors** – A number of environmental factors were considered. These included buffer distances to contain residual noise and air impacts, and the ability to manage potential impacts on sensitive ecological areas, surface waters and hydrology and groundwater.
- **Socio-economic factors** – Potential impacts on community lifestyle and socio-economic factors were also considered. These factors included visual amenity from residential and other sensitive locations, socio-economics of the surrounding area, community perceptions and attitudes, cost of land acquisition and Aboriginal/European heritage values.

- **Sustainable development opportunities** – Opportunities for sustainable development, such as enhancement of conservation values, development of carbon sinks and revegetation, were identified as advantages for strategic power station sites.

3.4.2 Site Selection Results

From the site selection study and other related work, the following development options (from north to south) were considered to be the most suitable for the requirements:

- Expansion of the existing Pinjar Gas Turbine Station from 575MW to 815MW (installation of an additional 240MW open cycle capacity);
- Construction of a new gas-fired power station within the central core of the Kwinana Industrial Area on Mason Road (initially of 240MW with capacity to expand up to 1,080MW);
- Construction of a new gas-fired power station within the core of the Kemerton Industrial Park (initially of 240MW with capacity to expand up to 1,080MW);
- Construction of a new open cycle power station at the old Bunbury Power Station site (initially of 240MW with capacity to expand to a maximum of 360MW); and
- Expansion of the existing Collie Coal-fired Power Station from 330MW to approximately 600MW (installation of an additional 300MW coal-fired unit).

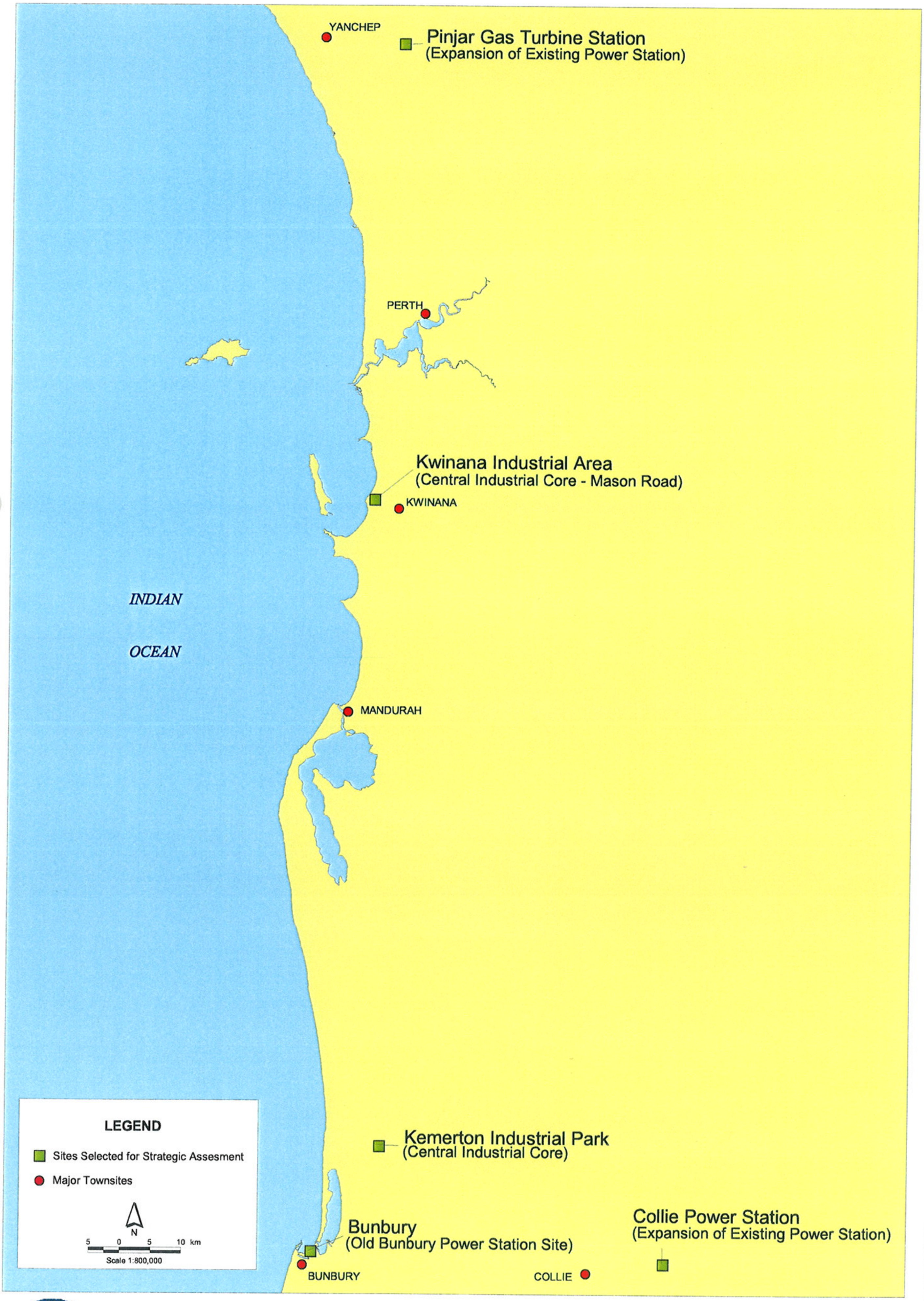
The locations of these five sites are shown in **Figure 3-4** and the rationale for site selection is summarised in the following sections. Other potential sites north of Perth are still under consideration as part of this strategic assessment process.

3.4.3 Pinjar Gas Turbine Station Expansion

Western Power presently owns and operates a gas turbine power station of 575MW capacity at Pinjar, 45km north of Perth. The installation of an additional 240MW open cycle gas-fired capacity at the existing Pinjar Gas Turbine Station was identified as being a suitable option for acquiring additional power generating capacity.

Benefits in siting additional power generating plant at Pinjar include:

- The suitability of the Pinjar Gas Turbine Station site for power generation has already been established and environmental approval for up to 915MW has previously been issued;
- The site has previously been disturbed therefore only minor additional clearing of remnant vegetation would be required;
- Much of the required infrastructure is already installed to allow for this additional capacity;
- The Pinjar facility has now been in operation for eleven years and community issues associated with the power station are well understood; and
- Detailed studies have already been conducted into air emissions, noise, water supply and waste management as part of the previous planning for the Pinjar Gas Turbine Station.



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SITES SELECTED FOR STRATEGIC ASSESSMENT – LOCALITY PLAN

FIGURE 3-4

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Project No.: WV02244
Figure Prepared by: T.Lee
Date Prepared: 19/02/02

3.4.4 Kwinana Industrial Area

The Kwinana Industrial Area, which is located approximately 30km south of Perth, was also identified as a potential area for siting of a gas-fired power station. The Kwinana Industrial Area was established during the 1950s to accommodate the development of major resource processing and other industries in the State. The area has since developed into the State's premier industrial location.

The benefits of siting a power generating plant at Kwinana include:

- The Kwinana Industrial Area is an established major industrial area;
- Availability of services and infrastructure;
- Close to the major load demand of the SWIS, which would result in smaller transmission losses;
- Lower cost of connection to gas and transmission infrastructure; and
- Detailed studies have already been conducted into air emissions, noise, water supply and waste management.

A preferred site has been selected south of Mason Road within the central core of the Kwinana Industrial Area that is suitable for a gas-fired power station of up to 1,080MW capacity. Two fallback options have been identified:

- A site north of Mason Road on former BHP land; and
- A site on the south east corner of Office Road and Patterson Road, within the East Rockingham Industrial Park.

These sites have been endorsed by LandCorp and the Office of Major Projects within the Department of Minerals and Petroleum Resources.

3.4.5 Kemerton Industrial Park

Kemerton Industrial Park is situated in the Shire of Harvey, approximately 17km north east of Bunbury. The benefits of siting a power generating plant at Kemerton include:

- The site is within close proximity to the Dampier-Bunbury natural gas pipeline and power transmission lines;
- Compatibility with existing land use, zoning and strategic planning – the suitability of the Kemerton Industrial Park for major industry has already been established;
- Detailed studies have already been conducted into air emissions, noise, water supply and solid and liquid waste disposal options as part of the previous planning for the Kemerton Industrial Park;
- A designated buffer zone has been established to accommodate potential emissions;
- Visual amenity is minimised through the presence of dunal ridges and a vegetated buffer zone;
- Considerable community consultation has been undertaken for the Kemerton Industrial Park for over 15 years;
- The site is within close proximity to a future industrial load centre; and

- There is the potential for sustainable development opportunities.

A preferred site has been selected within the Kemerton Industrial Park that is suitable for a gas-fired power station of up to 1,080MW capacity. A fallback option within the Kemerton Industrial Park has also been identified. Both sites have been endorsed by LandCorp and the Office of Major Projects within the Department of Minerals and Petroleum Resources.

3.4.6 Bunbury Power Station Site

Western Power has recently decommissioned the old Bunbury Power Station, which is located on the shores of Koombana Bay in an area of mixed industrial and port facilities, 5km north of the City of Bunbury and 180km south of Perth. This was identified as being a suitable option for the installation of up to 360MW capacity.

Benefits in siting a new power generating plant at this site include:

- The site is already disturbed, so no additional clearing would be required;
- The site is situated adjacent to other industrial and port facilities and additional land for a buffer would not be required; and
- The site is currently owned by Western Power and is available for the purpose of power generation.

Although the Bunbury site is coastal with ready access to seawater, the proposal for use of the site is for open cycle gas turbine plant only. No use of seawater for cooling purposes is involved in this proposal, as the capacity for Koombana Bay to accommodate thermal load has not been defined.

3.4.7 Collie Power Station Expansion

Western Power presently owns a 330MW coal-fired power station near Collie, in the South West of Western Australia. An Environmental Review and Management Program (ERMP) for the Collie Power Station, producing a nominal 600MW of electricity, was submitted to the Environmental Protection Authority in 1990. The proposal was approved by the Minister for the Environment in June 1991. Following a review of the State's power needs, the State Government decided to develop the Collie Power Station in stages. The initial stage was commissioned in May 1999 at a nominal capacity of 330MW, however the power station was designed and infrastructure was constructed to support a capacity of 600MW. Therefore there is the opportunity for a Power Procurement Bidder to construct a nominal 300MW of additional power-generating capacity on the site.

Any such additional plant at this site would, being coal-fired, fulfil a base load role within the SWIS (as discussed in **Section 3.3.4**).

3.4.8 Transmission Requirements for Site Options

This strategic environmental assessment has focussed on the transmission network requirements for each of the sites for the initial stage of the Power Procurement Process. Transmission network capacity requirements beyond the initial stage of Power Procurement will be determined by Western Power's network operations and are beyond the scope of this assessment. If any new transmission lines are required, they would be constructed by Western Power under a separate environmental approvals process.

3.5 Greenhouse Gas Considerations for the SWIS

Greenhouse gases such as water vapour (H_2O), tropospheric ozone (O_3), carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) occur naturally in the atmosphere and trap heat from the sun creating a greenhouse effect. This greenhouse effect is essential for maintaining the earth's surface at a temperature suitable to support life. Human activities such as the combustion of oil, coal and natural gas, land clearing, the burning of vegetation and farming have resulted in large amounts of greenhouse gases being released into the atmosphere, particularly over the last 200 years. The extra greenhouse gases trap extra heat, leading to the enhanced greenhouse effect (or global warming).

The effects of global warming will vary around the globe. Temperature rises are expected to be greater towards the Poles than near the Equator, and over land than at sea. While rainfall is expected to increase in some areas and decrease in others, likely changes in rainfall for particular regions are still highly uncertain (Australian Greenhouse Office, 1999).

Australia is subject to international agreements to reduce greenhouse gas emissions (see **Section 3.5.1**). Therefore, given that the production and supply of energy accounts for over half of Australia's greenhouse gas emissions (Australian Greenhouse Office, 2002), greenhouse gas issues are important when considering the development of additional power generating facilities.

As greenhouse issues are global in nature, the following discussion of greenhouse gas considerations relates to generating plants of the SWIS as a whole and not to a specific site proposal.

3.5.1 Legislative Requirements

Australia is a signatory to the Framework Convention on Climate Change 1992 and the Kyoto Protocol 1997.

Framework Convention on Climate Change

Australia became a party to the United Nations Framework Convention on Climate Change (FCCC) in 1992. The Convention aims to stabilise emissions of greenhouse gases at a level that would prevent dangerous human-induced interference with the climate system.

Australia produces an annual inventory of national greenhouse gas emissions, the National Greenhouse Gas Inventory (NGGI), as part of commitments under the FCCC. The NGGI is supplemented by periodic State and Territory inventories, which include Western Power's greenhouse gas emissions. Each inventory is a database of human-induced greenhouse gas emission sources and sinks categorised into six sectors:

- Energy;
- Land Use Change and Forestry;

- Agriculture;
- Industrial Processes;
- Solvent and Other Product Use; and
- Waste.

The NGGI forms a baseline from which it is possible to identify trends and patterns in sectors and monitor response action.

Kyoto Protocol

In 1998, Australia signed the Kyoto Protocol, a set of binding targets for industrialised countries to reduce the emission of greenhouse gases. This Protocol has strengthened the Framework Convention on Climate Change. Many countries including Australia have signed the Protocol, however Australia is yet to ratify the Kyoto Protocol, after which the greenhouse targets become legally binding. If ratified, Australia's target will require limiting the growth of greenhouse gas emissions to 8% above 1990 levels by 2008-12.

3.5.2 Framework for a Greenhouse Management Plan for the Electricity Generation Industry

The first substantial Australian national action for greenhouse response was the Greenhouse Challenge, a system of voluntary Cooperative Agreements with the Commonwealth Government under which industry agreed to develop, progress and report on action plans to abate greenhouse gas emissions.

Following this in 1997 was the Prime Minister's Statement *Safeguarding the Future: Australia's Response to Climate Change* in which a range of measures were announced. These spanned the Residential, Industry, Transport, Energy, Land Use and Government sectors. The measures most significant to the electricity industry were the development of generator efficiency standards and a mandated scheme for introduction of new renewable energy into the Australian electricity market.

A more integrated strategic framework for advancing Australia's Greenhouse response was developed in the National Greenhouse Strategy (NGS) in 1998. This incorporated the Prime Minister's measures and acknowledged Cooperative Agreements as a vehicle for implementation. Module 4 of the NGS focuses on *Efficient and Sustainable Energy Use and Supply* and identifies a number of strategies in each of three areas for action:

- Reducing the greenhouse intensity of energy supply;
- Harnessing renewable energy; and
- Improving end use energy efficiency.

Strategies relevant to electricity generation include:

- Improved efficiency and application of national Generator Efficiency Standards;
- Emissions reporting;
- Promotion of cogeneration and renewable energy opportunities; and
- Identifying opportunities for energy parks around power stations.

The Electricity Supply Association of Australia (ESAA) was an early signatory to a Cooperative Agreement and developed a Code of Environmental Practice to be observed by members. The Code acknowledges that measures to abate greenhouse gas emissions are an essential part of the electricity supply business's contribution to sustainable development and signatories to the Code are required to identify and implement measures to reduce greenhouse gas emissions and enhance greenhouse sinks.

3.5.3 Western Power's Greenhouse Cooperative Agreement

In Western Australia, Western Power was the first company in that State to sign a Cooperative Agreement, and is also a signatory to the ESAA Code of Environmental Practice. Western Power Corporation formally entered a Greenhouse Challenge Cooperative Agreement with the Commonwealth of Australia in March 1997. The Cooperative Agreement identified 42 actions that the Corporation could undertake to abate the rate of greenhouse gas emissions from its operation in the production and delivery of electricity in Western Australia. Since then new actions have been added to the Agreement bringing the total number of actions to 51, of which 42 have now been either completed or commenced.

Western Power's Cooperative Agreement actions cover:

- Renewable and alternative energy;
- Alternative energy technology research and demonstration;
- Efficient generation technologies such as cogeneration;
- Fuel strategies;
- Energy efficiency in Western Power operations;
- Energy efficiency in End User operations;
- Sequestration (tree planting); and
- Education on energy use and greenhouse.

Under the terms of the Cooperative Agreement, Western Power reports annually to the Australian Greenhouse Office on progress on actions in the Agreement.

Specific greenhouse gas abatement actions by Western Power include:

- Deployment of high efficiency gas-fired generating plant (160MW of cogeneration plant installed and 240MW of combined cycle plant being installed);
- Planning for further replacement of ageing generation plant with higher efficiency plant;
- Deployment of renewable energy generation including the 22MW Albany wind farm, currently Australia's largest, and planning for further renewable energy acquisitions to 2010; and
- Tree plantations as carbon sinks and the Greening Challenge reforestation project.

In addition to initiatives defined in the Cooperative Agreement, Western Power also:

- Is a member of the World Business Council for Sustainable Development; and
- Promotes programs which reduce greenhouse gas emissions. For example, one of the environmental objectives in the Western Power Environmental Policy is:

  "adopt cost effective measures to abate greenhouse gas emissions as part of business decisions."

3.5.4 Mechanisms for Reduction of Greenhouse Gas Emissions

There are five mechanisms available for emission reduction from electricity generation in Western Australia:

1) Optimise use of renewable energy sources for electricity generation;
2) Increase use of lower carbon intensity fuels in fossil fuelled generators;
3) Use higher efficiency generating technology;
4) Optimise operations to obtain maximum production efficiency from generating plant; and
5) Implement other greenhouse gas reduction measures, such as carbon sequestration projects.

Less directly, there is also monitoring and reporting on greenhouse gas emissions.

3.5.4.1 Optimise use of Renewable Energy Sources

Western Power has been and will continue to pursue a range of initiatives in renewable energy through its Sustainable Energy Branch, including wind farms and biomass conversion. Nonetheless, conventional fossil fuel power stations are the only viable options for the SWIS Power Procurement Process, given the quantity and reliability of the power supply requirements. Discussion of energy source options was provided in **Section 3.2.**

3.5.4.2 Increase use of Low Carbon Content Fuels

For large power generation plant in Western Australia, coal, gas and liquid fuels are the only viable energy options, as discussed in **Section 3.2.3**. Of these, **Table 3-1** indicates that gas-fired plant have the lowest greenhouse intensity, followed by liquid fuels and then coal. As such, a gas-fired, combined cycle power station represents the best combination of fuel and technology to minimise greenhouse gas emissions.

- **Table 3-1 Comparison of Greenhouse Gas Emissions from Conventional Power Generation Plant**

Power Station	Fuel	Typical Capacity Factor	kg CO_2/MWhr (Sent Out)
Peaking Plant			
Pinjar	Gas	8%	700
Typical New Gas-fired Open Cycle	Gas	10%	700[2]
Mid Merit			
Muja A/B	Coal	53%	1,205
Kwinana B	Gas	21%	610
Typical New Gas-fired Combined Cycle	Gas	50%	400
Base Load			
Muja C/D	Coal	73%	1,030
Collie Power Station	Coal	79%	950
Cockburn 1	Gas	85%	405
Western Power Regional Reciprocating Engines	Liquid fuel	80%	Typical 750 Lowest 675
Typical New Coal-fired Power Station	Coal	85%	900
Typical New Gas-fired Combined Cycle	Gas	85%	400
South West Interconnected Grid 2000	**All**	**43%**	**890**

Note:
1) Greenhouse intensities provided by Pel Weir, Western Power, 2002 (Personal Communication).
2) A value of 0.7 tonnes CO_{2e}/MWh for the new open cycle plant instead of a typical value of 0.6 tonnes CO_{2e}/MWh was used to account for the lower efficiency that results when running at part load, typical of peaking plant.

Table 3-1 indicates that greenhouse emissions per unit of electricity generated from a typical new coal-fired plant are around 2.4 times greater than from a typical new, gas-fired combined cycle station. Compared to the average of the SWIS in 2000, the emissions per unit of electricity from a typical gas-fired combined cycle station would be around 55% lower.

However, there are other ways of accounting for greenhouse gas emissions, which consider the whole of life emissions associated with power generation. **Table 3-2** and **Table 3-3** presents summaries of emissions from typical average 1995 US coal-fired power stations and typical combined cycle gas turbine plant under construction in 2000.

- **Table 3-2 Life Cycle Emissions Summary for Coal-fired and Natural Gas-fired Combined Cycle Power Systems (after Spath and Mann, 2000)**

Pollutant	Coal-fired System (average plant)		Natural Gas Combined Cycle Systems Emissions	
	(kg/MWh)	(% from power plant)	(kg/MWh)	(% from power plant)
NO_X	3.352	91	0.570	17
SO_X	6.700	96	0.324	0.6
Particulate	9.212	1	0.133	46
CO_{2e}	1,022	96	499	75

Note:
1) All values are from Spath and Mann (2000) Table 17, excepting the value of 1,022 which is from Spath *et al* (1999) and the value of 0.570 which is from Table 18 of Spath and Mann (2000).
2) CO_{2e} is calculated by multiplying the actual mass of emissions by the appropriate Global Warming Potential factor.

- **Table 3-3 Life Cycle Carbon Dioxide Equivalent Emissions for Coal-fired and Natural Gas-fired Combined Cycle Power Systems (after Spath and Mann, 2000)**

Coal-fired System		Gas-fired Combined Cycle System	
Source Net Greenhouse Gas Emissions	**kg CO_{2e}/MWh**	**Source Net Greenhouse Gas Emissions**	**kg CO_{2e}/MWh**
Surface Mining	9	Natural Gas Production and Distribution	124.5
Transportation – River	17	Ammonia Production and distribution	0.4
Construction	5	Construction and decommissioning	2.0
Power Plant operation	991	Power Plant operation	372.2
Total	**1022**	**Total**	**499.1**

Notes:

1) Gas-fired plant based on a 505MW combined cycle power station (typical of that being constructed in the US as at 2000) with efficiency of the system at 48.8% (fuel input energy HHV to energy sent to the grid), 80% capacity factor. NO_X control with water injection and Selective Catalytic Reduction using ammonia. Based on US typical pipeline natural gas sourced from 4,000km distant with a composition from the chemical Economics Handbook (Lacson, 1999) adjusted to include H_2S. This comprises 94.4% methane and 0.5% CO_2. Emissions from production and distribution of natural gas include 59.2 kg CO_{2e}/MWhr resulting from natural gas loss to atmosphere.
2) Coal-fired plant based on 360MW pulverised coal plant (typical average 1995 US plant), using Illinois No 6. Coal with an efficiency of the station of 32% (fuel input energy HHV to energy sent to grid) and 60% capacity factor. Pollution control includes a baghouse filter and conventional limestone gas clean up system. Coal was sourced from a surface coal mine with river transport to the power station.
3) Both based on a 30-year plant life.

These tables, noting the differences in relative age of the plant and assumptions involved, indicate the following on a life cycle basis:

- Emissions of CO_{2e} on a life cycle basis derive predominantly from combustion at the power stations. Therefore, greenhouse emissions from the power station are a good indicator of the overall life cycle emissions;
- Emissions of CO_{2e} on a life cycle basis for a combined cycle plant are around half those for a conventional coal-fired power station; and
- Emissions of other pollutants are significantly higher on a life cycle basis from a coal-fired plant than from a gas-fired combined cycle plant.

The above comparisons demonstrate that coal-fired power generation would be the least preferred from a greenhouse perspective taking into account greenhouse emissions at the generating plant site as well as on a life cycle basis.

In a report by Premier Coal and Griffin Coal (2002), a general life cycle comparison was made between indicative coal-fired and gas-fired power stations. The major conclusion of this report was that, based on the assumption that 1.5 – 2.0% of methane is lost through the gas transmission system (primarily through pipeline losses) and considering a 20-year time frame for assessing the global warming potential of methane, greenhouse emissions from a coal-fired power station are similar to those from a gas-fired power station. As such, the above conclusions of the life cycle analysis are critically dependent on the amount of natural gas leakage through the transmission system. The assumption of 1.5 to 2% gas leakage is more in line with losses through retail systems, rather than high pressure transmission lines.

Regardless of greenhouse gas considerations, there are compelling reasons for Western Australia to maintain coal-fired power generation in the suite of power supply options, most importantly the need to maintain some diversity of energy sources to ensure security of power supply and cost competitiveness.

Notwithstanding, the management of greenhouse gas emissions will be an integral part of the SWIS Power Procurement Process, and Western Power will require all Bidders to demonstrate how they will incorporate greenhouse considerations in their bid proposals.

3.5.4.2.1 Predicted Change in Greenhouse Emissions

Given that greenhouse issues are global in nature, the following discussion of greenhouse gas considerations relates to reducing the carbon intensity of fuels used in generating plants of the SWIS as a whole and not to a specific site proposal. Furthermore, the discussion relates only to the predicted additional demand by Western Power's existing customers by 2010, and does not assess the impact of additional requirements for new or expanded industries.

Figure 3-5, **Figure 3-6** and **Figure 3-7** present the actual 1990 to 2000 and forecast to 2010 electricity sent out on the SWIS, the carbon intensity of this sent out electricity and the associated greenhouse emissions.

The information for the years 1990 to 2000 is based on actual data published in Western Power/SECWA annual reports and in Western Power's Greenhouse Gas Inventory. Forecast SWIS GWh sent out for the years 2001 to 2010 has been estimated by a linear extrapolation from the year 2000 based on the average yearly increase in each of the years 1998, 1999 and 2000.

Electricity demand on the SWIS has grown from 9,224GWh in calendar year 1990 to 12,243GWh in 2000 (33% increase on 1990) and is forecast to grow to 13,153GWh by June 2004. Western Power installed capacity totalled 2,280MW in 1990 and 3,150MW in 2000.

Greenhouse gas emissions associated with electricity produced into the SWIS (both generated by Western Power and purchased by Western Power from independent producers) were 9.079Mtpa of CO_2 equivalent in 1990. By 2000 this had increased to 10.935Mtpa (20% increase on 1990). However, although greenhouse gas emissions associated with electricity supply to the SWIS have increased over the period 1990 to 2000, they have not increased proportionally with electricity demand. The improved greenhouse gas emission rate for electricity supplied into the SWIS is reflected by the generally downward trend in carbon intensity over that time. This has fallen from 0.98 tonnes CO_{2e}/MWh in 1990 to 0.89 in 2000 (a decrease of 9%), largely due to increased sourcing of electricity from high efficiency cogeneration plant and the overall increased penetration of gas-fired generation into the supply portfolio. This reduced carbon intensity represents a saving of over 1Mtpa of CO_{2e} in 2000 compared to producing the electricity at the 1990 intensity.

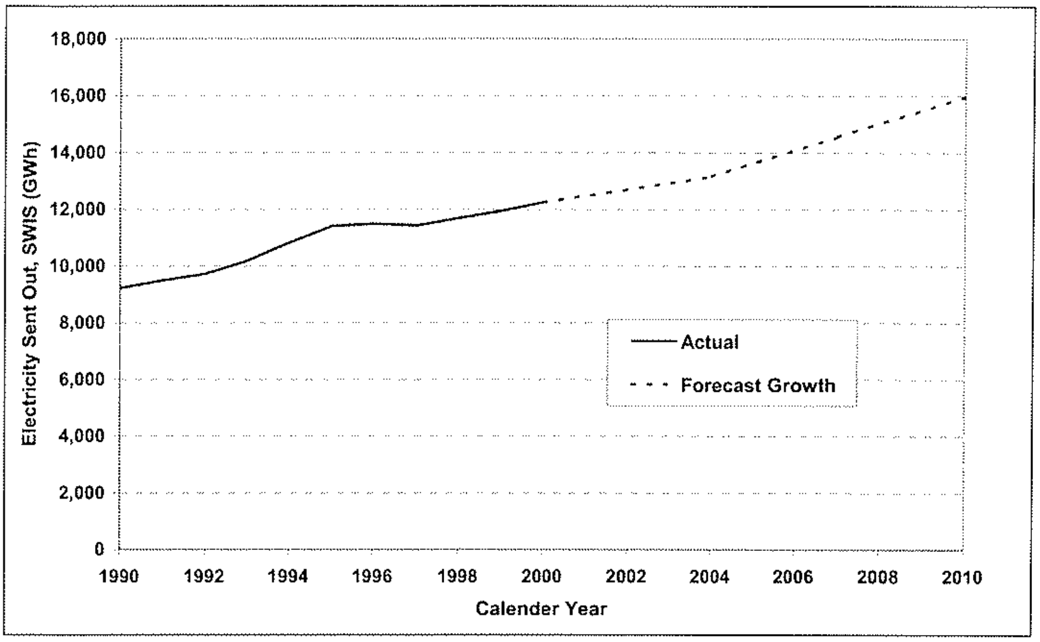
Actions in progress by Western Power (e.g. Albany wind farm and the Cockburn combined cycle gas turbine generator) are expected to result in the carbon intensity of electricity sent out in the SWIS to fall to 0.85 tonnes CO_{2e}/MWh by 2004 (a decrease of 13% on 1990 levels).

For the years 2004 to 2010, two potential scenarios for power procurement have been examined in terms of estimating the change in carbon intensity and overall greenhouse emissions. Both these scenarios have been assessed assuming that the plant replacement and retirement program detailed in **Section 2.1** of this report proceeds. The two options are as follows:

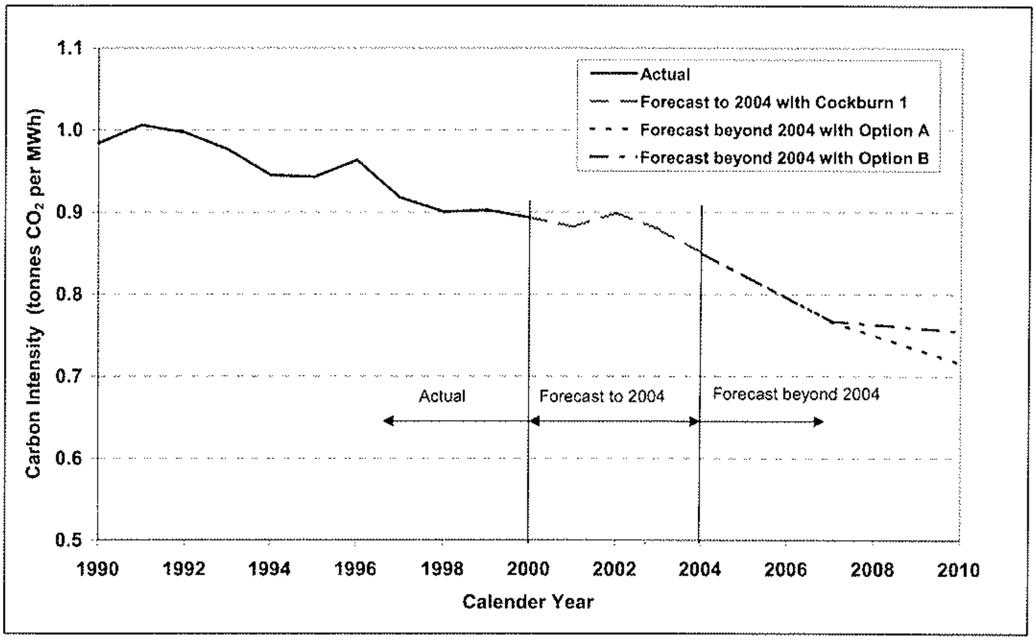
- Option A – The installation of 240MW open cycle capacity by 2005/06 and the installation of a further 540MW of gas-fired power generation plant by 2010, consisting of 120MW of open cycle peaking plant and 420MW of combined cycle base load plant. For this scenario, carbon intensities of 0.405 and 0.7 tonnes CO_{2e}/MWh were assumed for the combined cycle and open cycle plant respectively. A value of 0.7 tonnes CO_{2e}/MWh for the new open cycle plant was used to account for the lower efficiency that results when running at part load, typical of peaking plant. At 2007 the capacity factors for the new open cycle plant were specified at 33%, to reflect the higher usage required from this plant for the initial years, whilst at 2010 capacity factors were assumed at 10% for the open cycle plant and 85% for the combined cycle plant installed by 2010; and
- Option B – Is similar to Option A except that 300MW of the base load plant in use by 2010 is assumed to be provided by a coal-fired power station. The carbon intensity of this plant is taken as lower than the existing Collie Power Station (0.95) at 0.90 tonnes CO_{2e}/MWh to account for improvements in technology.

Both options are assumed to generate approximately 3,443GWh annually by 2010.

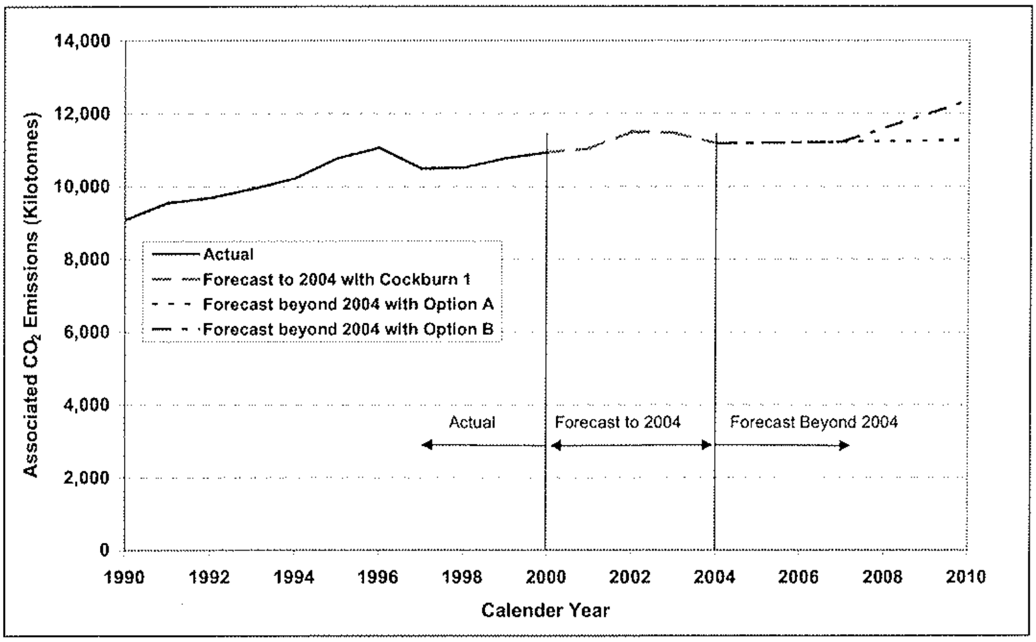
With these assumptions, **Figure 3-6** predicts that the SWIS carbon intensity will continue to decrease to either 0.70 or 0.76 tonnes CO_{2e}/MWh for Option A and B respectively by 2010. This is a reduction of 29 or 22% respectively from the 1990 carbon intensity of 0.98 tonnes CO_{2e}/MWh. Although the carbon intensity on the SWIS in 2010 is predicted to decrease by at least 22% from 1990 levels, the overall growth in electricity demand between 1990 and 2010 is predicted to increase by approximately 76%. The resultant CO_2 equivalent greenhouse emissions in 2010 are estimated to be 11.3 and 12.4Mtpa respectively (**Figure 3-7**). This is around 24 to 36% higher than the 1990 emissions of 9.079Mtpa in 1990. The above calculations, though only indicative, illustrate the impact that the various power supply options to meet the predicted growth in demand could have on the overall greenhouse emissions from the SWIS.



- **Figure 3-5 Actual and Forecast Electricity Demand on the SWIS from 1990 to 2010**



- **Figure 3-6 Actual and Forecast Carbon Intensity for Sent Out Electricity on the SWIS from 1990 to 2010**



- **Figure 3-7 Actual and Forecast Greenhouse Emissions Associated with Electricity Sent Out on the SWIS from 1990 to 2010**

3.5.4.3 Use of Higher Efficiency Generating Technology

Best practice levels of tonnes of greenhouse gas per unit of product have not been formally established for electricity generation in the Western Australian context. The capacity and duty cycle required of new plant would therefore largely influence the selection of fuel and generation technology to be offered. Beyond this, efficiency of individual plant items can be specified to meet recognised standards, and operating performance criteria can be specified to maintain plant at optimum operating efficiency. As one of its national greenhouse measures, the Commonwealth Government has introduced Generator Efficiency Standards (GES) to cover existing and new electricity generation in Australia. Though voluntary, the Standards establish binding performance targets for electricity generation plant installed and operated by participating utilities. Proponents of new generating plant could be required to participate in the Commonwealth GES measure.

Gas-fired Generating Plant

For the greenhouse gas emission comparison in **Table 3-1**, efficiencies of 32% and 52% have been used to represent typical open cycle and combined cycle plant. These are indicative of existing plant, however new plant that is coming onto the market could achieve higher efficiencies in the range of 35-40% and 55-60% respectively when rated at ISO conditions. However, there may be a cost penalty associated with this increased efficiency and limitations in the choice of plant to meet the generation requirements. The trade-off between best practice in efficiencies versus commercial and operational constraints would need to be carefully reviewed.

Emerging Coal Technologies

There are several coal burning technologies that have come onto the market or are in the process of development. These are:

- Super Critical steam cycles;
- Fluidised Bed boilers; and
- Integrated Combined Cycle Gasification (ICCG).

Super critical steam cycles are in commercial operation whereby the cycle employs ultra high steam pressures and temperatures to achieve as high a cycle efficiency as possible. These plants typically have efficiencies in excess of 40% but at higher capital cost than conventional plant. The minimum size of plant is currently around 400MW, which is too large to be accommodated for system security purposes within the SWIS.

Fluidised bed boilers are alternatives to conventional pulverised coal boilers. However, while they can provide lower emissions on a variety of coal types, their modest operating temperatures do not provide superior efficiencies.

ICCG plant involves gasifying coal, with the synthetic gas so produced being burnt in a conventional gas turbine combined cycle plant. These plants are still in development and none are in commercial operation. While these plants can offer the potential of higher efficiencies than even super critical plants, their commercial and technical viability remains to be proven.

Both the super critical and ICCG plants provide marginally lower greenhouse gas emission rates over comparable conventional coal-fired plant because of their superior efficiencies. However, the commercial and technical risks associated with these plants would need to be carefully considered in any coal-fired proposal.

3.5.4.4 Implement Other Greenhouse Gas Reduction Measures

Greenhouse gas offset measures in the Kyoto Protocol are *carbon sinks* and the three *flexibility mechanisms*: Emission Trading; the Clean Development Mechanism (CDM); and Joint Implementation (JI). Carbon sinks remain difficult to determine to universal agreement and carbon rights are not yet firmly established in law in Western Australia. The flexibility mechanisms are at different stages of development and availability and presently rely on bilateral agreement (usually international) to be effected. For these reasons it is not yet feasible to prescribe Kyoto Protocol offset measures for proponents of new electricity generating plant in Western Australia.

A more beneficial approach could be to require proponents to undertake an environmental tree planting program in Western Australia that could have other environmental benefits as well as carbon sequestration. Over the last six years, Western Power has undertaken a substantial tree planting and catchment management initiative called the Greening Challenge. This program included planting of four million seedlings in several salt affected and degraded catchment areas in the South West of Western Australia, largely with volunteer labour from Western Power staff, family and friends. The program has now been expanded to facilitate volunteer labour from other corporations and the general public.

Similar tree planting initiatives could be embraced by the IPPs, and the Power Procurement Process would require Bidders to indicate their intentions in this area.

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4. Project Location

This document presents a Strategic Environmental Review of a power station development concept within the Kemerton Industrial Park. Environmental impact assessments for other sites are presented in separate documents. The remainder of this document focuses on Kemerton.

4.1 Kemerton Industrial Park

The Kemerton Industrial Park is located in the South West of Western Australia, approximately 140km south of Perth. The Kemerton Industrial Park is situated in the locality of Wellesley, within the Shire of Harvey and lies approximately 17km north east of Bunbury (**Figure 4-1**).

Kemerton Industrial Park is the largest industrial estate in the South West and is one of Western Australia's strategic industrial areas. Planning of the Industrial Park has been ongoing since the mid-1980s.

The Park is located immediately east of the Leschenault Estuary and the Australind townsite and west of the Wellesley River. The Old Coast Road, a major route connecting Bunbury to Perth, abuts the western boundary of the Park and separates the Park from the nearest townsites. The Park is also serviced by a 330kV power grid and a gas pipeline (Dampier to Bunbury natural gas pipeline).

A number of site options within the Kemerton Industrial Park were investigated in conjunction with the Office of Major Projects and LandCorp (refer to **Section 4.5.1**). The preferred project site is approximately 50ha in area and is located in the north east of the Kemerton Industrial Park (**Figure 4-1**) and a fallback site has been identified to the south of this site within the existing Kemerton Industrial Core zone.

4.2 Land Use Planning

The Kemerton Industrial Park was established with the primary purpose of accommodating heavy industry. The existing structure plan for the Park includes a central core for heavy industry, a surrounding buffer zone to accommodate potential risk, noise and air emissions and zones for supporting industries with a direct relationship to the heavy industries (**Figure 4-2**). The Kemerton Industrial Park currently covers 5,429ha and is reflected within the Shire of Harvey Town Planning Scheme No. 1.

In 1995 an expansion of Kemerton was recommended by Government consultants to ensure that it remains internationally competitive for the next 50 years and beyond. This ultimately led to the preparation of the *Kemerton Expansion Study* (BSD Consultants, 1997), which proposed an expansion of the industrial core by 1,505ha. The study was summarised and presented in *Industry 2030 – Greater Bunbury Industrial Land and Port Access Planning Study* (WAPC, 1998) for community and government comment. A submission on this report was prepared by the Environmental Protection Authority (EPA) under Section 16(j) of the *Environmental Protection Act 1986* (EPA, 1998). Following the Industry 2030 review process, the proposed expansion area for the industrial core was reduced to 955ha, with an associated reduction in the required buffer area (WAPC, 2000a).

From the *Kemerton Expansion Study* (BSD Consultants, 1997) and *Industry 2030 Study* (WAPC, 2000a) a Final Concept Plan for the Kemerton Industrial Park was developed. The Final Concept Plan and supporting strategies are shown in **Figure 4-2** and include:

- An industrial core area of 2,106ha;
- A buffer area of 5,437ha; and
- A total Park area of approximately 7,543ha.

This concept plan has been adopted by the Western Australian Planning Commission (WAPC) and endorsed by the State Government as the preferred strategic planning framework for Kemerton (WAPC, 2000a). This plan is currently being implemented through a number of planning mechanisms including the Greater Bunbury Region Scheme (GBRS), land ownership, town planning schemes, local planning strategies, subdivision and development control and government policy.

4.3 Surrounding Landuse

The closest townsites to the Kemerton Industrial Park are Leschenault, which adjoins the south western edge of the buffer zone, Binningup, located 5.5km to the west of the Park, and Myalup, located 6km to the north west of the Park. Local farming properties and smaller semi-rural holdings surround the Kemerton Industrial Park.

Land uses to the north, east and west of the Park include grazing, horticulture and dairy farming activities. A number of major market gardens have become well established to the west of the Park.

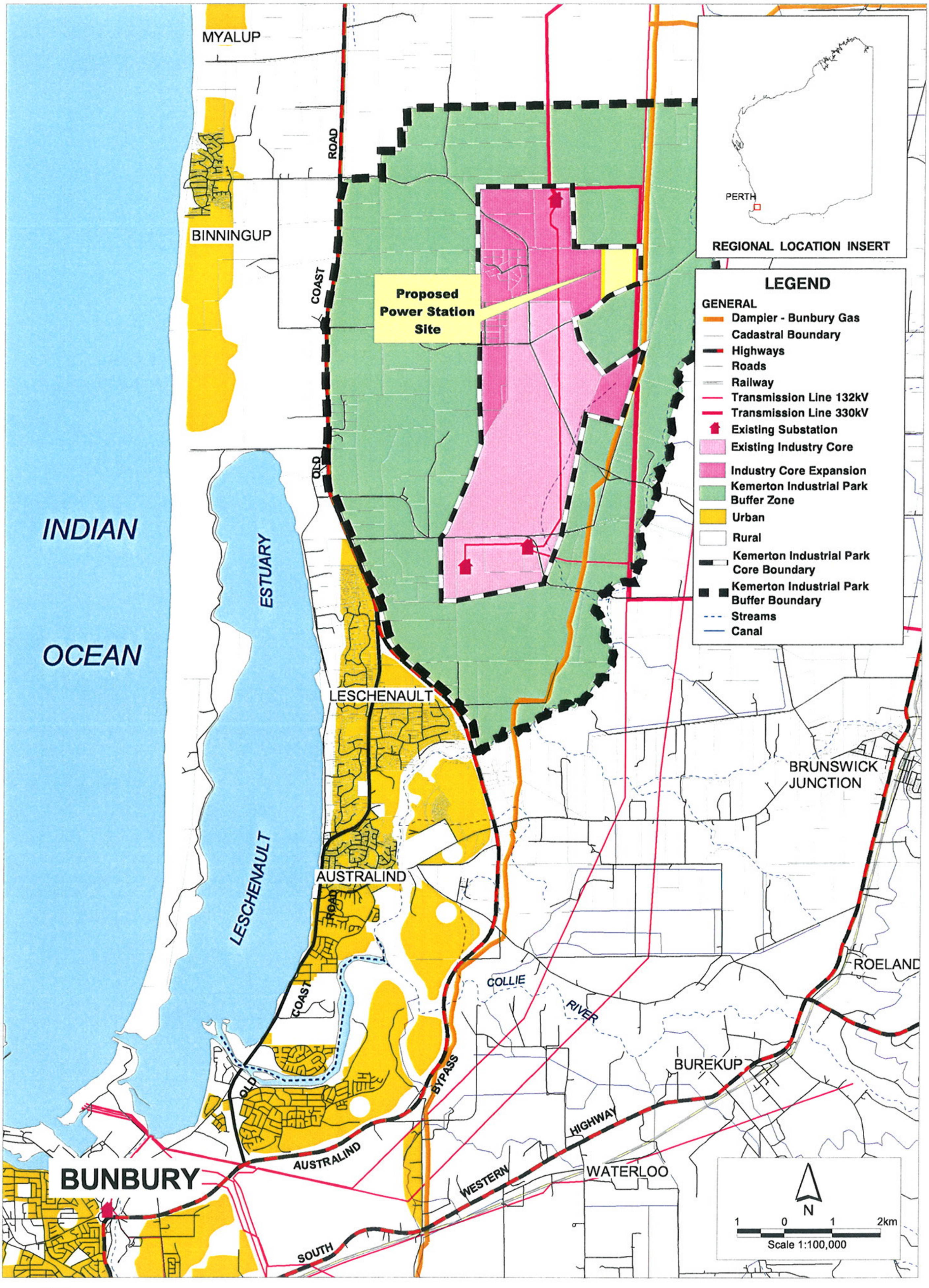
Existing heavy industries at Kemerton are the Millennium Inorganic Chemicals (MIC) Titanium Dioxide pigment plant and the SIMCOA Silicon Smelter. There are also a number of support industries including BOC Gases (air separation), NuFarm Coogee (chlor-alkali) and Cockburn Cement (lime).

4.4 Land Tenure and Availability

The status of land tenure within the Kemerton Industrial Park as of May 2002 is shown in **Figure 4-3**. This Figure shows that all land within the existing Heavy Industrial Core is under State Government/Crown ownership (with the exception of the Simcoa and Millennium sites). Within the proposed expanded core a few parcels of land in the north west remain in private ownership, however it is intended that the remainder of this land will be progressively brought into public ownership (WAPC, 2000a).

The Shire of Harvey Town Planning Scheme No. 1 identifies the following land zonings within the Kemerton Industrial Park:

- Kemerton Park Industry;
- Kemerton Buffer;
- Kemerton Ancillary Industry; and
- Inter-industry Buffer.



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KEMERTON POWER STATION
LOCALITY MAP

FIGURE 4-1

Job No. DE01833
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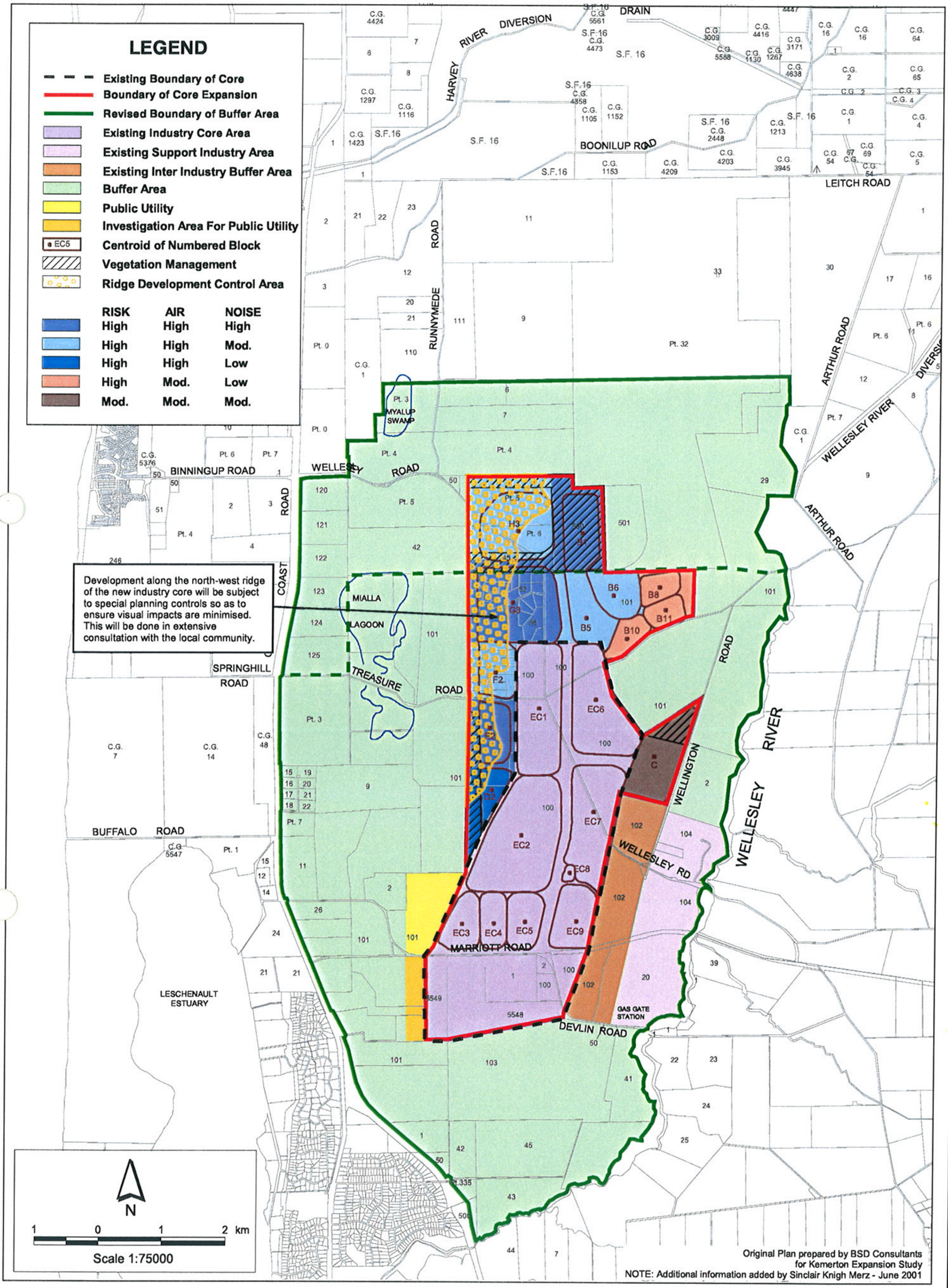

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KEMERTON POWER STATION

KEMERTON EXAPANSION STUDY - FINAL CONCEPT PLAN

FIGURE 4-2

Project No. DE01833
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Prepared by: T.Lee

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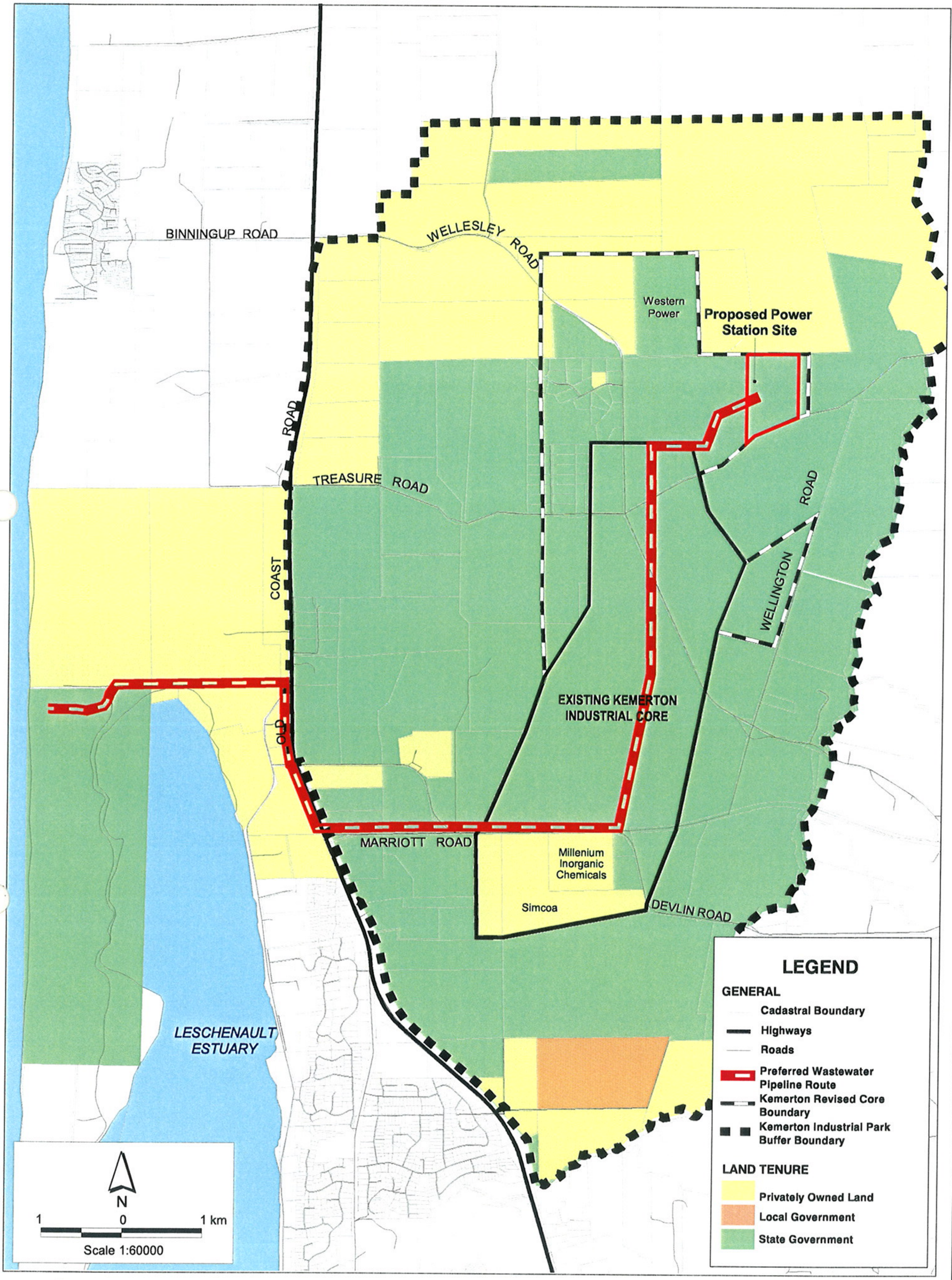

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KEMERTON POWER STATION
LAND TENURE

FIGURE 4-3

Project No. DE01833
Date Drawn: 14.08.2001
Prepared by: T.Lee

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The preferred site for the power station is presently located within the Kemerton Buffer zone, but within the area identified as Industrial Core under the Final Concept Plan for the Kemerton Industrial Park (refer to **Section 4.2**). The land would need to be rezoned to 'Industrial (Heavy)' before it could be developed for a power station. This rezoning is planned under the GBRS, however given the timing of the implementation of the GBRS, a fallback site has been identified for the power station that lies within the land zoned 'Industrial (Heavy)' under the existing Town Planning Scheme. Further discussion on this site is given in **Section 4.5.1**.

The Department of Conservation and Land Management (CALM) currently owns the preferred site and Western Power is undergoing discussions with LandCorp to facilitate access to this site and the fallback site. The Department of Minerals and Petroleum Resources (Office of Major Projects) and LandCorp have given a statement of preliminary endorsement for a power station to be located on these sites (**Appendix B**).

4.5 Options Within Kemerton Industrial Park

Following the identification of the Kemerton Industrial Park as appropriate for future power generating requirements, feasibility studies were undertaken to determine the most suitable location for the power station within the Park and to identify whether there were any fatal flaws in terms of water supply or wastewater disposal issues (Sinclair Knight Merz, 2001). The outcomes of these studies are given below.

4.5.1 Site Options Within Kemerton Industrial Park

Several locations within the industrial core of the Kemerton Industrial Park have been assessed to identify any limiting factors on the development and whether the Kemerton Industrial Park could accommodate a power station (Sinclair Knight Merz, 2001). These locations are shown in **Figure 4-4**. From this assessment, a preferred site has been identified, which is shown as Site D. This site has been selected because of the following:

- Proximity to natural gas and power transmission lines;
- Noise emissions from the site would comply with criteria at the boundary of the buffer zone; and
- The site is consistent with the Final Concept Plan for the expansion of the Kemerton Industrial Park such that it minimises fragmentation of larger areas of the core, leaving these areas available for future major industrial developments (**Figure 4-2**).

As discussed in **Sections 4.2** and **4.4**, the preferred site is located within the Kemerton Buffer zone, but within the area identified as Industrial Core under the Final Concept Plan for the Kemerton Industrial Park. This concept plan has been endorsed by the WAPC and the State Government and is currently being implemented through a number of planning mechanisms including the GBRS (WAPC, 2000a).

Access to the preferred site depends on the implementation of this Final Concept Plan. Given the uncertainties in the timing of implementation of the Final Concept Plan, Western Power will also secure access to a second site, Site A in **Figure 4-2**, as a fallback site option. Site A is entirely contained within the existing Industrial Core.

The remainder of this document focuses on the Site D, the preferred site. However, most of the environmental issues and proposed management and monitoring strategies relevant to the preferred site would apply equally to the fallback site A, with the following distinctions:

- Air Quality and Noise – Site A is more centrally located within the Kemerton Industrial Core, and therefore has a larger buffer zone to accommodate air and noise emissions. Both sites would comply with the applicable air quality criteria (refer to **Section 8.4.1**);
- Noise – Noise modelling was undertaken for a 1,080MW combined cycle power station at each of the site options during the feasibility studies for Kemerton (Sinclair Knight Merz, 2001). It was found that the power station could comply with the noise criteria at all sites, although additional attenuation measures would need to be added to power station at the southern site (Site B); and
- Terrestrial Flora and Vegetation – Site A is cleared and is described as having no significant conservation values (Biota Environmental Services, 2000).

This document therefore aims to demonstrate the suitability of the Kemerton Industrial Park for siting a power generating facility, with environmental impact assessments focussed on the preferred site.

4.5.2 Generating Plant Options Assessed for Environmental Impact

For the purpose of environmental impact studies at the Kemerton site, two scenarios have been reviewed:

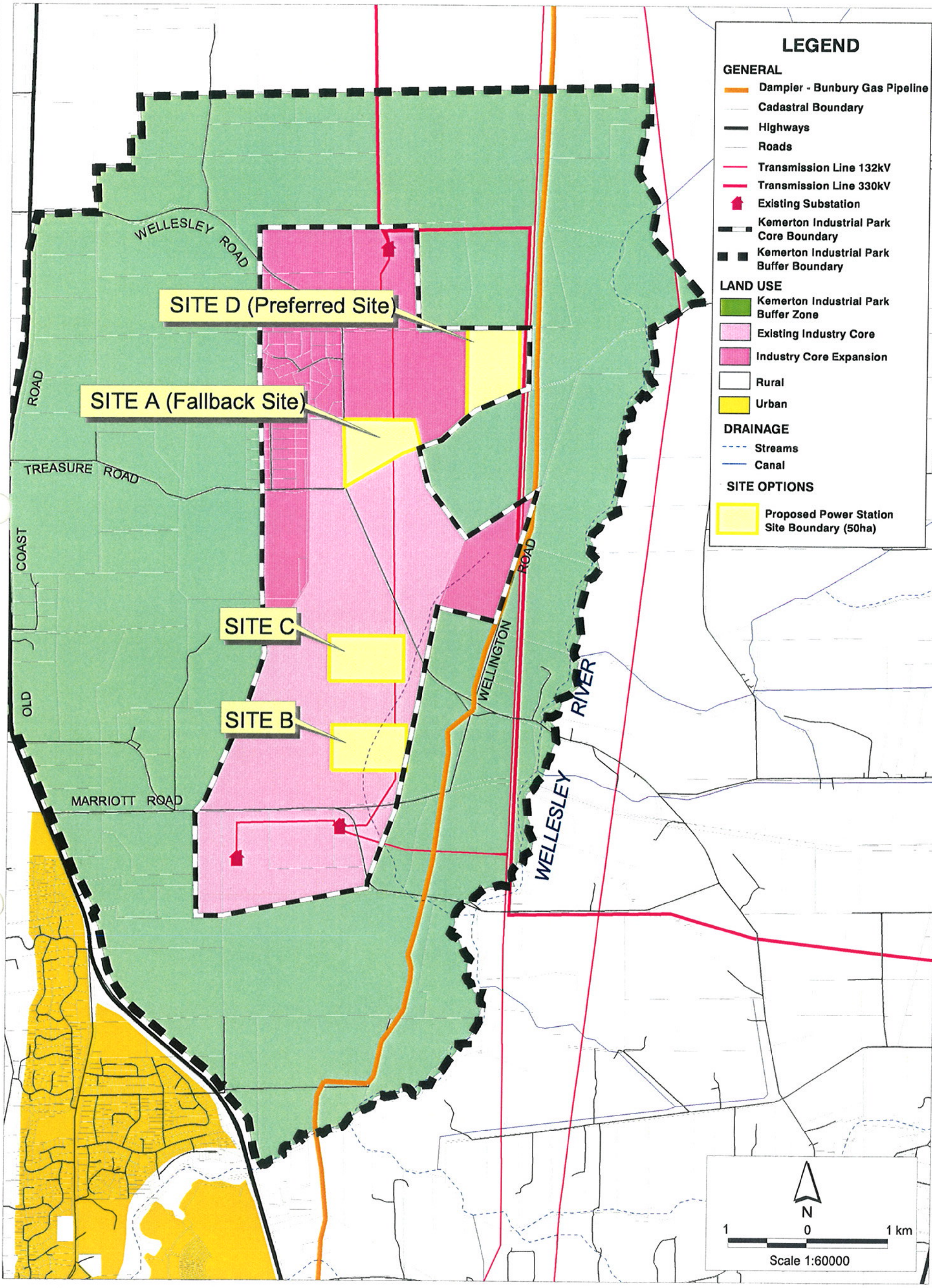
- The initial 240MW of peaking plant, consisting of 2 × 120MW open cycle units. For assessment purposes it has been assumed that this would run for 1,000 hours each year, running on gas for 900 hours and liquid fuel for 100 hours; and
- Installation of additional capacity at the site, the options for which are discussed below.

To satisfy existing customer demands over the next decade, an increase in total generating capacity of 700 – 900MW will be required. In addition to this, major industries may also have significant new power requirements above this demand.

Given both these demands, two options have been identified for the ultimate development at the preferred power station site in Kemerton:

Option 1. 360MW of peaking plant consisting of 3 × 120MW open cycle gas turbine units (for assessment purposes it has been assumed that this would run for 1,000 hours each year, running on gas for 900 hours and liquid fuel for 100 hours); and 540MW of base load plant consisting of 3 × 180MW of combined cycle units (each unit consisting of 120MW of gas turbine and 60MW of steam turbine plant, running continuously except for maintenance and unplanned outages); or

Option 2. 1,080MW of gas-fired base load plant, consisting of 6 × 180MW of combined cycle plant (each unit consisting of 120MW of gas turbine and 60MW of steam turbine plant, running continuously except for maintenance and unplanned outages).



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KEMERTON POWER STATION
SITE OPTIONS WITHIN KEMERTON INDUSTRIAL PARK

FIGURE 4-4

Project No. DE01833
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For each environmental factor, this Strategic Environmental Review has assessed the "worst case" option with regard to potential environmental impacts during operation of the ultimate development:

- *Water supply and wastewater discharge* – In terms of water supply and wastewater disposal requirements Option 2 is "worse case" compared to Option 1 because open cycle turbines do not require water for cooling (refer to **Sections 5.4.4**, **5.4.5**, **7.3.3**, **8.3.1** and **8.4.6**);
- *Noise impact* – Option 2 has been assessed, although the difference between noise emitted from the two options is minimal and is more dependent on layout and technology chosen than duty cycle (refer to **Section 8.4.3**); and
- *Air quality* – Due to sub options related to air quality control equipment, all options have been assessed (refer to **Section 8.4.1**).

For the remainder of the environmental impact assessments the type of generating plant used to achieve the ultimate plant is not a significant factor and Option 2 has been assessed for these cases.

4.5.3 Water Supply Options for Kemerton

Water supply options for Kemerton have been investigated to determine if sufficient water is available for a water-cooled combined cycle plant (Sinclair Knight Merz, 2001). The volume of water required for the power station depends upon the following factors:

- Capacity of power plant – higher capacity plants require more water; and
- Quality of water available – the more saline the water, the higher the water requirements.

The following sources were assessed as part of the feasibility study:

- Future Brunswick River Dam;
- Surplus from Harvey Dam;
- Wellington Dam, abstracted from the Collie River; and
- Groundwater.

The Water Corporation has been awarded the Contract (by the Office of Water Regulation) for the provision of water supply services for the Kemerton Industrial Park. The Water Corporation is actively investigating strategies for water supply to the area, which include some of the above sources (refer to **Appendix C**).

These options are also being considered to provide a major water supply for the longer-term development of Kemerton Industrial Park and to fulfil any water requirements of an expansion of the power station.

4.5.4 Wastewater Disposal Options for Kemerton

As part of the feasibility studies, Sinclair Knight Merz (2001) also investigated wastewater disposal options from a water-cooled combined cycle power plant of varying capacity. The volumes of wastewater generated depend on the capacity of the plant and the quality of the water used for cooling (refer to **Section 5.4.5**). The following wastewater disposal options were investigated:

- Evaporation;
- Deep well injection;
- On-site treatment and re-use;
- Sequential re-use; and
- Ocean outfall.

The study recommended wastewater disposal via ocean outfall as the most feasible option. This is compatible with previous recommendations by Burns and Roe Worley (1998) in the report *Industrial Water Supply and Wastewater Management for the Kemerton Industrial Park* who considered options for a proposed centralised wastewater treatment plant for the Kemerton Industrial Park.

The Burns and Roe Worley study recommended that this centralised wastewater treatment plant receives water from industry within the Park that would be of a standard such that it could be disposed of with no further treatment required. Therefore the centralised treatment plant would essentially consist of a collection facility, an ocean outfall facility (as this is the recommended option for wastewater disposal) and a pipeline connecting the two. At present, this is still in a concept phase and will not be developed any further until there is industry within the Kemerton Industrial Park that has a need for wastewater disposal.

The EPA has also advised that they would prefer any additional outfalls in the Buffalo Beach area to be designed to cater for wastewater disposal from the centralised wastewater treatment facility at the park (EPA, 1998). This would be the preferred option of disposal of wastewater from the power station, however given the unknown timing of the proposed power station and of the centralised wastewater treatment facility, the option of disposal of wastewater through an alternative ocean outfall is considered in the following section.

4.5.4.1 Ocean Outfall Options for Kemerton

A number of ocean outfall options have been investigated for the disposal of wastewater from the proposed power station (Sinclair Knight Merz, 2001). These include:

- Use of the existing MIC outfall off Buffalo Road;
- Use of the Western Power Collie Power Station wastewater pipeline and outfall off Buffalo Road;
- Construction of a new pipeline to the existing Collie Power Station outfall and discharge through the existing outfall; and
- Construction of a new pipeline and a new ocean outfall.

The use of the MIC outfall is not viable due to capacity issues and the complications associated with maintenance and licensing issues associated with co-use of the pipeline and outfall facility. The suitability of the other three options depends upon the size of the power station and the timing of construction of the centralised wastewater treatment facility and ocean outfall.

The features of the existing Collie Power Station wastewater pipeline and ocean outfall are:

- The pipeline has a maximum capacity of 92.5L/s;
- The ocean outfall has a maximum capacity of 220L/s;
- It is assumed that the Collie Power Station presently discharges at 47.5L/s (just over half of the capacity of the pipeline).

Therefore the options for wastewater disposal from the Kemerton Power Station are summarised as:

- If wastewater volumes are less than 45L/s and the Collie Power Station discharge rate does not increase, a pipeline could be run from Kemerton and join into the Collie Power Station wastewater pipeline near the corner of Marriott Road and Old Coast Road for disposal through the existing outfall. This option would not require any modifications to be made to the existing outfall;
- If wastewater volumes are greater than 45L/s and the Collie Power Station discharge rate increases by a significant amount, then a new pipeline would need to be built from Kemerton to the existing Collie Power Station ocean outfall facility. If the total discharge rates remain less than 175L/s the diffuser at the ocean outfall would need to be extended roughly proportional to the flow to maintain the necessary number of dilutions; or
- If the total wastewater volumes are greater than 175L/s then a new ocean outfall would be required. Under this scenario a duplicate or new combined outfall could be constructed to replace the existing Collie Power Station outfall.

These scenarios are illustrated in **Figure 4-5**, which shows that even with the maximum possible discharge rates from the Kemerton Power Station, there remains capacity for discharge rates of up to 106L/s to allow for an expansion of the Collie Power Station.

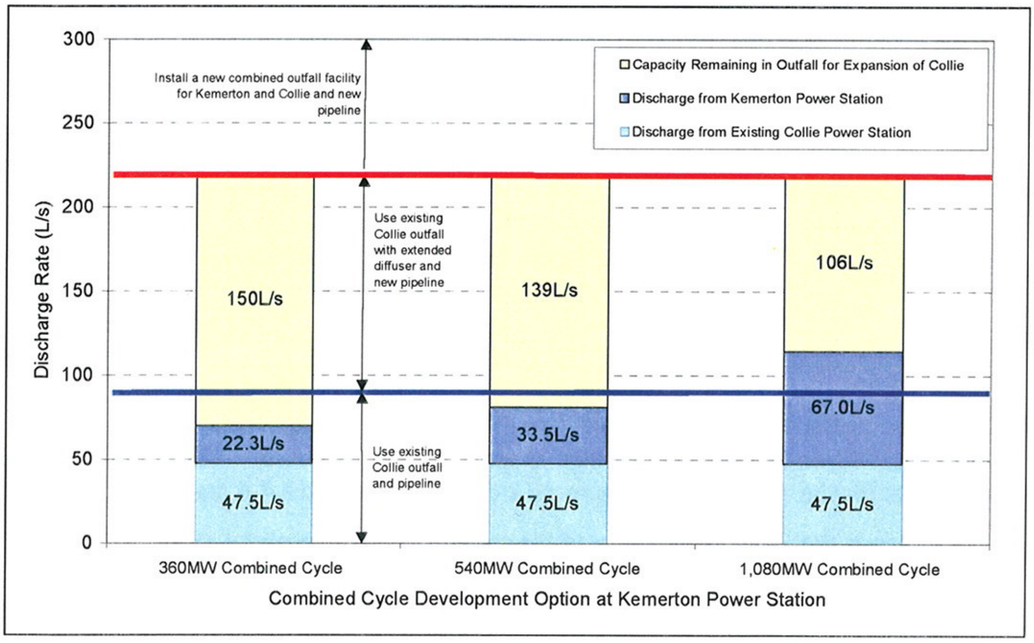


Figure 4-5 Wastewater Disposal Pipeline and Outfall Options

Given the uncertainties about the capacity of the proposed power station and the possibility of an expansion of the Collie Power Station, the option that requires construction of a new pipeline from Kemerton to the existing ocean outfall facility and an extension of the existing diffuser has been examined within this report.

4.5.4.2 Wastewater Pipeline Route Options for Kemerton

This section considers the route options for a wastewater pipeline running from the preferred power station site to the existing Collie Power Station outfall facility at the ocean. A proposed pipeline route is shown in **Figure 4-6**.

Within the Kemerton Industrial Park, the wastewater pipeline would utilise the planned service corridor, which was proposed in the development of the Final Concept Plan for the Kemerton Industrial Park (BSD Consultants, 1997). This proposed corridor has a width of 150m wide, the purpose of which is to provide road access to the Structure Plan 'super lots' as well as rail, drainage and power services. This wastewater pipeline would follow this corridor through the core of the Industrial Park.

The proposed route from this point follows Marriott Road to Old Coast Road, where it crosses the road and traverses north to Buffalo Road. In evaluating the options for this section of the pipeline, the recommendations of Burns and Roe Worley (1998) in their study of the water supply and wastewater management options for the Kemerton Industrial Park were considered. A brief description of the route options considered by Burns and Roe Worley and the reasoning behind the selection of this preferred route by Burns and Roe Worley is given below:

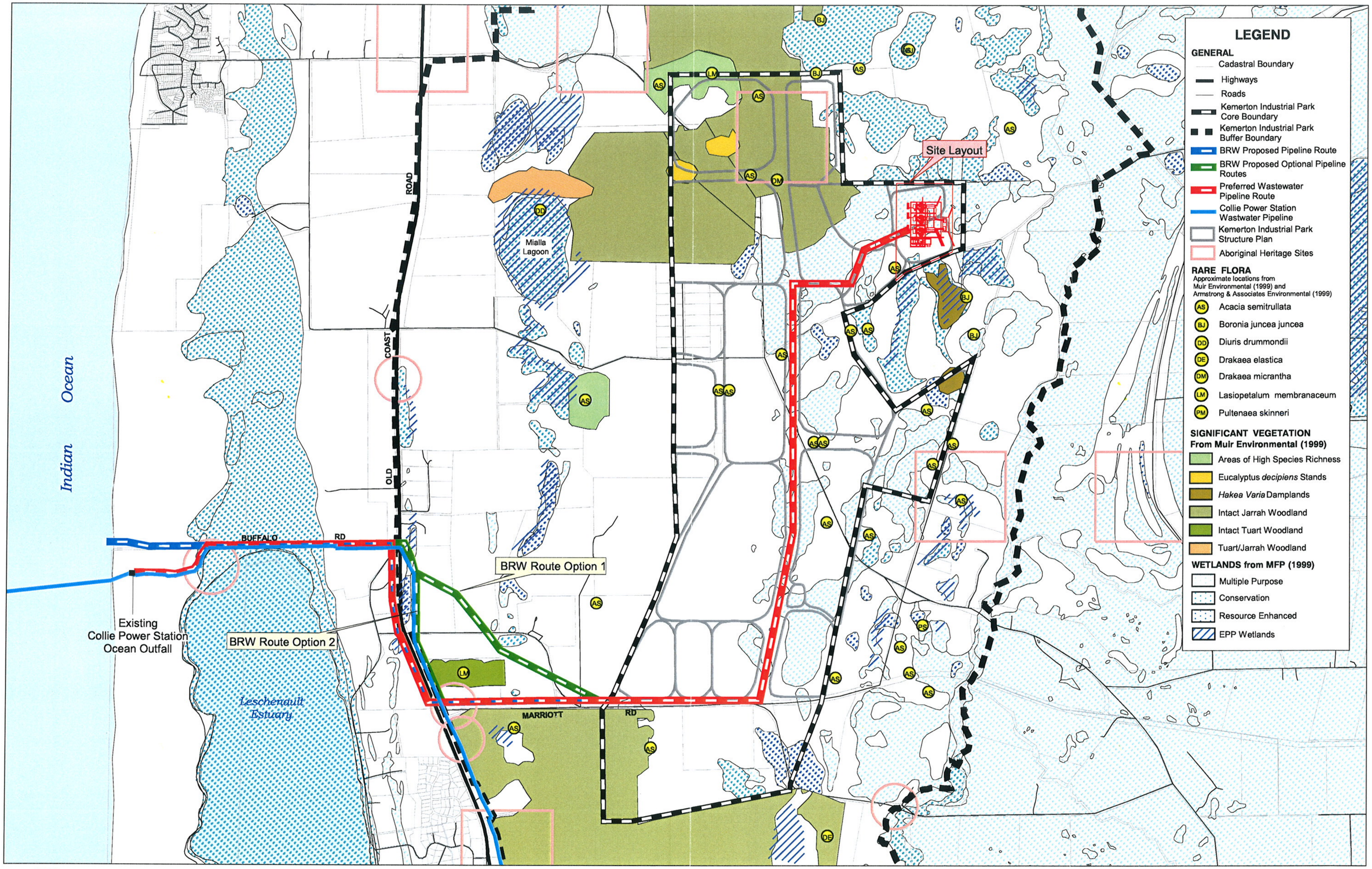
- Route Option 1: Direct route from the Industrial Park across the buffer area to Buffalo Road. Although a shorter route, this alignment impacts on two mineral claims, cuts diagonally across properties (thereby sterilising land that may be earmarked for future development) and deviates to avoid two wetland areas;
- Route Option 2: This route follows Marriott Road, the eastern side of the Old Coast Road and the northern side of Buffalo Road. Although on government property, it crosses wetlands near the Buffalo and Old Coast Roads intersection and requires 'significant stands of timber to be cleared'; and
- Proposed Route: The proposed pipeline route follows Marriott Road, the western side of the Old Coast Road and the northern side of Buffalo Road.

The Burns and Roe Worley proposed route option is shown in **Figure 4-6** as a blue dashed line and the other route options are shown as green dashed lines.

At Buffalo Road, the pipeline would follow the existing Collie Power Station wastewater pipeline to the coast.

This route preferred by Burns and Roe Worley (1998) has been selected for the Kemerton Power Station wastewater disposal pipeline route. The environmental constraints for the selected pipeline route are shown in **Figure 4-6** and include:

- Wetlands that have been assessed for conservation or resource management;
- Declared Rare Flora and Priority Flora species;
- Existing land uses (subject to landowner consultation);



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KEMERTON POWER STATION
WASTEWATER PIPELINE ROUTE OPTIONS AND CONSTRAINTS

FIGURE 4-6

Project No. DE01833.200
Date Drawn: 14.08.2001
Prepared by: T.Lee

- Areas of conservation significance; and
- Aboriginal heritage sites.

Further information on the potential environmental constraints associated with this route is described in **Section 6**.

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5. Project Description

5.1 Project Overview

This section describes the development concept for a strategic power station development within Kemerton Industrial Park. For the purpose of this assessment at the Kemerton site, two scenarios have been reviewed:

- The initial 240MW of peaking plant, consisting of 2 × 120MW open cycle units. For assessment purposes it has been assumed that this would run for 1,000 hours each year, running on gas for 900 hours and liquid fuel for 100 hours; and
- Installation of additional capacity at the site, the options for which are discussed in **Section 4.5.2**.

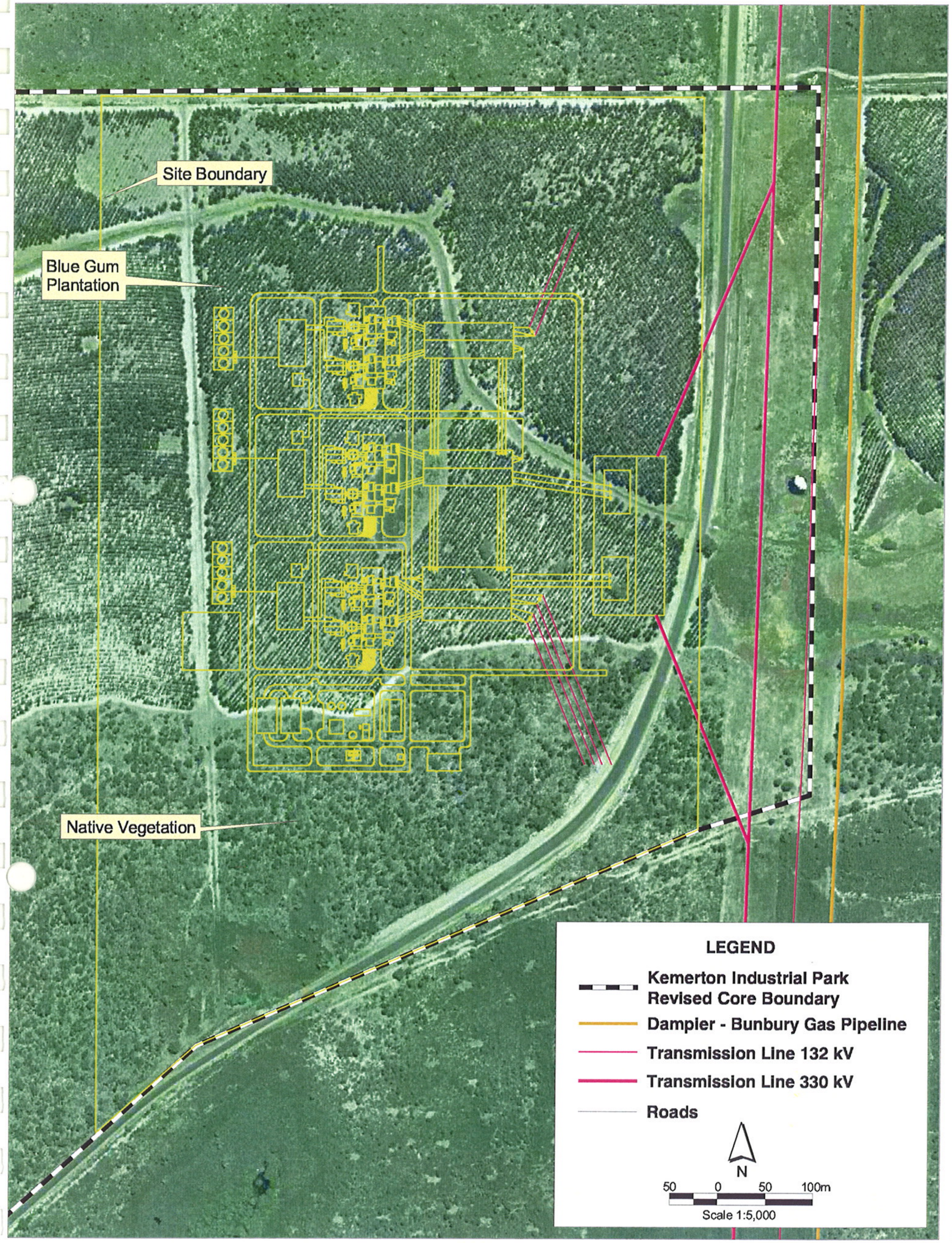
A conceptual layout of a 1,080MW combined cycle power station power station (Option 2) on the preferred site is illustrated in **Figure 5-1.**

Table 5-1 provides a summary of the key project characteristics of a 240MW peaking power station and a 1,080MW base load power station at Kemerton.

Table 5-1 Key Project Characteristics

Characteristic	240MW Open Cycle Peaking Plant	1,080MW Combined Cycle Plant
Project Purpose	To produce electricity to supply to the SWIS grid.	To produce electricity to supply to the SWIS grid.
Project Life	25	25
Project Value	Approx. $160 million	Approx. $1 billion
Power Generating Capacity	240MW	1,080MW
Energy Generated per Year	240GWh	8,987GWh
Facility Footprint	10 hectares	50 hectares
Plant Facilities		
Number and size of Gas Turbines	2 x 120MW (depending on model of gas turbines selected)	6 x 120MW (depending on model of gas turbines selected)
Number of Stacks	2	6
Height of Stacks	40m	40m
Number of Cooling Towers	0	3
Number of Liquid Fuel Storage Tanks[1]	2 x 3,500kL tanks	2 x 3,500kL tanks
Plant Operation	Peaking plant – runs for short periods in the morning and in the afternoon/ evening, 5 days per week.	Base Load Plant – Continuous operation, only shut down for maintenance.
Shutdown Time	In standby mode all other times when not running, apart from maintenance periods.	Base Load Plant – Only shut down for maintenance.
Fresh Water	3ML/yr (3,000m^3/yr)	5ML/yr (5,000m^3/yr)
Water to Demineralisation Plant	6ML/yr (6,000m^3/yr)	200ML/yr (200,000m^3/yr)
Cooling Water	Nil	12,500ML/yr
Wastewater Generated	3.6ML/yr	Up to 2,000ML/yr
Wastewater Disposal Method	Evaporation Pond	Pipeline of length 15km to existing Collie Power Station Ocean Outfall
Natural Gas Input	70×10^6 Nm^3 taken from Dampier to Bunbury natural gas pipeline	$1{,}500 \times 10^6$ Nm^3 taken from Dampier to Bunbury natural gas pipeline
Natural Gas Pipeline Length	5km	5km
Transmission Line Length	500m	500m
Gaseous Emissions		
NO_x[2]	115 – 213tpa[3, 4]	2,696tpa
CO_2	0.15Mtpa	3.6Mtpa
CO	40tpa	960tpa
SO_2	33 – 79tpa[3, 5]	4.81tpa
Volatile Organic Compounds (VOCs)	5tpa[3]	105tpa
Polycyclic Aromatic Hydrocarbons (PAHs)	7kg/yr[3]	0.065tpa
Particulate	5tpa[3]	82tpa
Noise at Nearest Resident	23dB(A)	31dB(A)
Solid Waste	<5tpa	<10tpa
Estimated Individual Risk Level	Negligible increase to existing risk at boundary or nearest neighbour (qualitative assessment)	Negligible increase to existing risk at boundary or nearest neighbour (qualitative assessment)
Construction Period	12 – 18 months	24 – 30 months
Workforce	Up to 5 operation/maintenance (day shift only), construction peaking at 250	25 – 30 operation, construction peaking at 250.[6]

Notes:
1) Assumes that a full years liquid fuel supply is stored on-site.
2) Low NO_x burners will be specified for all gas-turbine proposals.
3) Emissions based on the open cycle power station operating for 900-hours on natural gas and 100-hours on liquid fuel per year.
4) Depends on whether water injection utilised when operating on liquid fuel.
5) Depends on sulphur content of fuel.
6) Assumes phased construction.



Western Power

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KEMERTON POWER STATION
CONCEPTUAL SITE LAYOUT

FIGURE 5-1

Project No. DE01833
Date Drawn: 20.08.2001
Prepared by: T.Lee

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5.2 Land Requirements and Access

A concept plan for the layout of the power station has been developed and is shown on the preferred site for a 1,080MW combined cycle plant in **Figure 5-1**. This Figure identifies the area required (approximately 50ha) for the site and the area of native vegetation to be cleared on this site. The land required for the wastewater pipeline, gas and transmission infrastructure and access to the preferred site is shown in **Figure 5-2**.

Access to the proposed power station would be through existing roads. If any new roads are required to access the power station, these would be consistent with the Final Concept Plan for the expansion of the Kemerton Expansion Study (WAPC, 2000a). Refer to **Section 9.5** for further discussion on the transport routes and management strategies.

5.3 Process Description

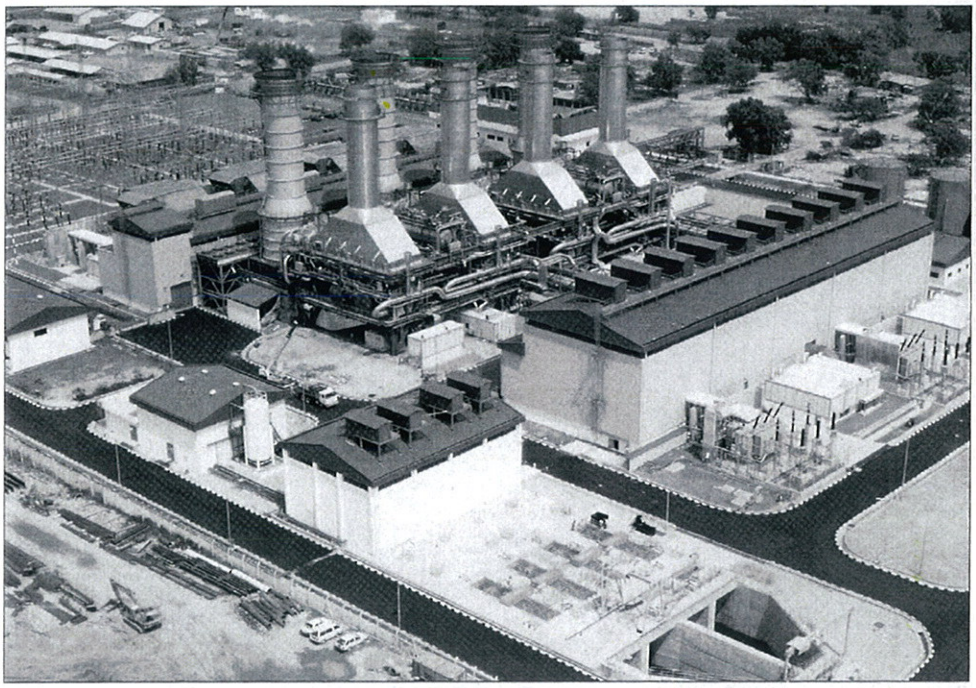
For the purposes of this assessment, it has been assumed that 240MW of peaking power plant could be provided by two 120MW units in open cycle.

If the site is later used for base load duty, Bidders could offer combined cycle plant of any size that exceeds 240MW, the decision resting on the economics and availability of the plant as estimated by each Bidder. It is assumed that a combined cycle plant of 1,080MW would consist of six Frame 9E gas turbines and three steam turbines with necessary cooling and infrastructure plant.

The power plant would be constructed around natural gas-fired gas turbines driving alternating current generators. Provision could also be made for the unit to be run on liquid fuel. Examples of similar power station developments are shown in **Plates 5-1** to **5-3**.

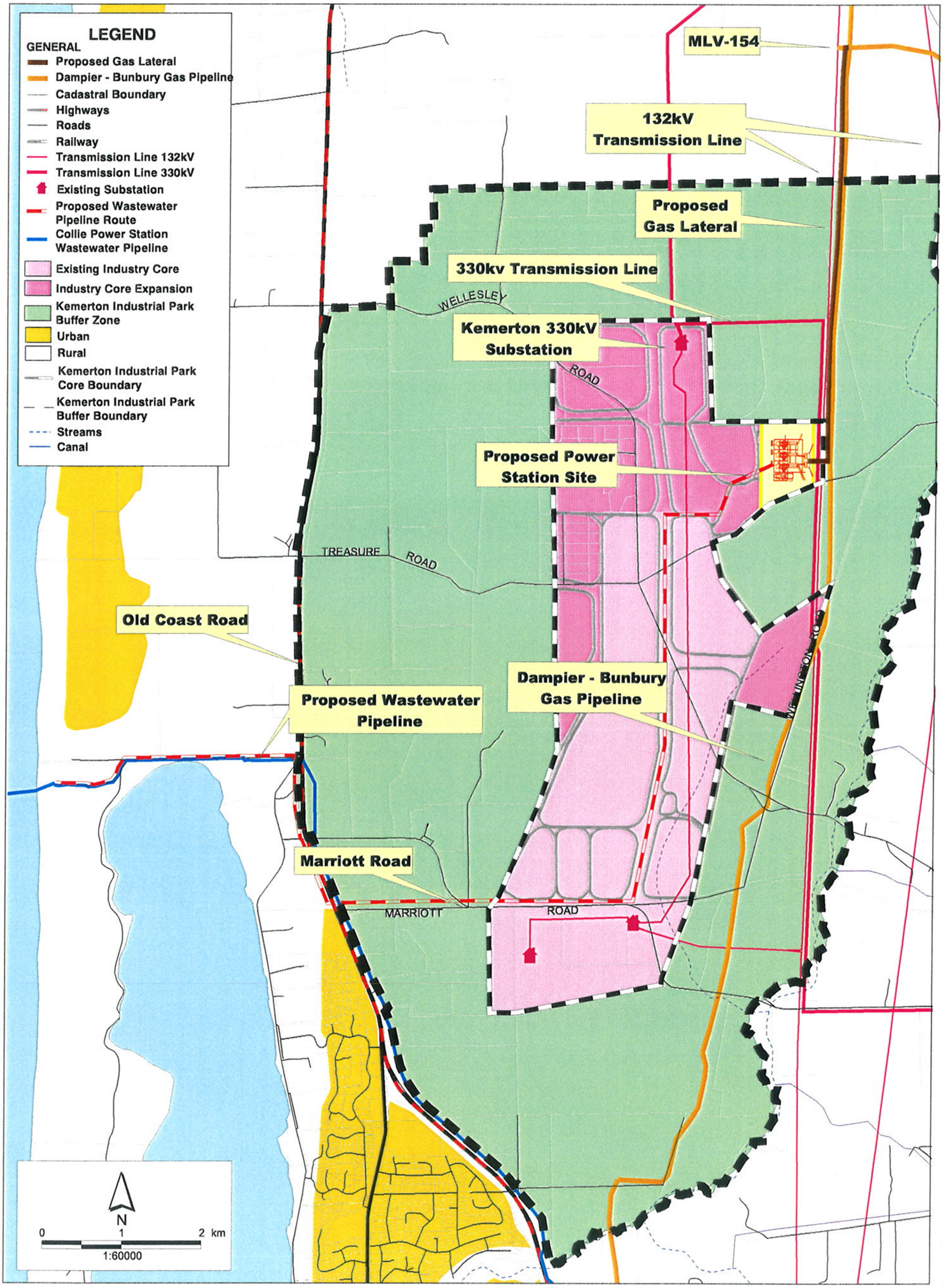
Construction of the first phase of South Humber Bank 750-MW combined cycle in England. Two HRSGs exhaust into one stack, foreground, the third boiler exhausts into a single stack. Unusual arrangement was required to meet local 'visual impact' environmental regulations.

- **Plate 5-1 Example of a 750MW Combined Cycle Power Station**



Paka combined cycle plant during construction. Stainless steel clad HRSGs and stacks are at center; bypass dampers and stacks to their rear next to the gas turbine hall. Large building in front of the HRSGs houses two steam turbine generators; ›lant sea water cooling system seen under construction in the foreground.

- **Plate 5-2 Example of an 800MW Combined Cycle Power Station**



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KEMERTON POWER STATION
WASTEWATER PIPELINE, NATURAL GAS, TRANSMISSION AND SITE ACCESS ROUTES

FIGURE 5-2

Job No. DE01833
Date Drawn: 14.08.2001
Prepared by: T.Lee

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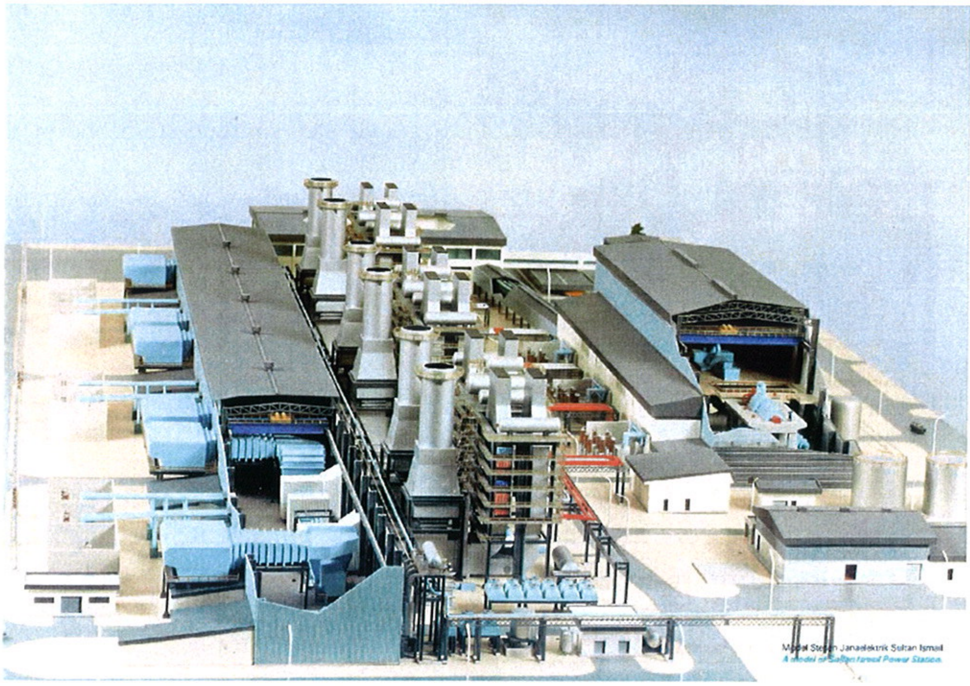


Plate 5-3 Example of a 900MW Combined Cycle Power Station

For the initial 240MW installation, the gas turbine generators would be open cycle arrangement. The power plant would typically consist of:

- Gas turbine generators housed in noise attenuation and weather proof buildings and/or enclosures;
- Water treatment infrastructure including possible evaporation ponds;
- Switchyard to transfer generated power to the Western Power grid;
- Infrastructure and services to support operation of the plant such as control systems, workshops, fuel supply and fire systems, drainage and roads; and
- Low NO_x burners will be installed on all gas turbines to reduce NO_x emissions when operating on the primary fuel, being natural gas. As an option, demineralised water may be injected into the gas turbine combustion chambers for NO_x suppression when operating on liquid fuel (less than 100-hours per year).

Further development of the power station could consist of additional combined cycle units up to the maximum output of 1,080MW. The plant would typically consist of:

- Gas turbine generation housed in similar function to the open cycle arrangement;
- Heat recovery boilers;
- Steam turbine/s housed in a building or sound and weather proof enclosures;
- Cooling systems for the steam cycle (either by water cooling towers or air-cooled radiators);
- Water treatment infrastructure including possible evaporation ponds;
- Switchyard; and
- Infrastructure and services.

5.4 Services and Utilities

5.4.1 Fuel Supply

The primary fuel supply to the plant would be natural gas, sourced from one of the major suppliers in the North West of Western Australia. This gas would be taken from the Dampier-Bunbury natural gas pipeline (DBNGP). Due to the limited capacity of the pipeline running to the east of the site, a dedicated, buried gas lateral would be required to be constructed from MLV-154 to the plant. This junction is located approximately 5km to the north of the preferred site as shown in **Figure 5-2**. The gas lateral would run south along the corridor of the existing gas pipeline and then west directly across to the site and would be approximately 5km in length. Construction of and environmental approvals for this pipeline lateral would be undertaken by the gas supplier.

The power station would use from 70 million m^3 per year of natural gas for the initial development of 240MW to 1,500 million m^3 per year for the ultimate development of 1,080MW in base load. The gas requirements for each of the power station configurations are given in **Table 5-2**. The Preferred Bidder would be required to negotiate the supply and delivery of the gas with the gas suppliers.

- **Table 5-2 Natural Gas Requirements**

Plant	Hourly Usage	Annual Usage	Operating Mode
240MW Open Cycle	70,000 Nm^3	70 $x10^6$ Nm^3	Peaking
1,080MW Combined Cycle	210,000 Nm^3	1,500 $x10^6$ Nm^3	Base Load

The Dampier–Bunbury natural gas pipeline upstream of MLV-154 may require some enhancement, mainly in the form of increased compression and possible line looping to meet the power station's requirements. Specific impacts of and management strategies for this pipeline lateral construction and operation and enhancements of the main gas pipeline would be addressed in the separate environmental approvals for the construction of the gas lateral, which would be undertaken by the gas supplier.

Provision is also required for the open cycle power station to operate on liquid fuel. The main factors that would result in liquid fuel being required include the following:

- For a power station development of open cycle gas turbines for peaking duties, securing sufficient natural gas supplies can result in "take or pay" contracts that are uneconomic because of the relatively small quantities involved and the variable power demands of the peaking regime. To avoid reserving gas that may not be used but has to be paid for, the Preferred Bidder may operate on liquid fuel. This liquid fuel would be used whenever sufficient gas is not available on the spot market (i.e. there is no surplus gas available for resale by other purchasers or suppliers).
- A disruption in the gas supply to the power station from incidents such as pipeline ruptures. In this case liquid fuel would be used as an emergency fuel until gas supplies are restored.
- When a gas supply to the site cannot be established. This could be the case should existing gas supply constraints in the DBNGP not be resolved in time for

the first stage of power procurement. In this case, the power station may be fuelled by liquid fuel until the natural gas supply issues are resolved.

For an open cycle gas turbine plant in peaking mode, it is anticipated that up to 100-hours of operation per year could be necessary on liquid fuel and that the amount of fuel consumed in a year would be around 7,000kL for a 240MW and 10,500kL for a 360MW development. The liquid fuel storage system would consist of storage tanks, delivery and forwarding systems, environmental protection facilities such as leak proof bunding and fire protection systems.

Conversion of the power station into a base load power station would mean that the power station has sufficient gas demands to secure a gas supply contract. Therefore liquid fuel would only be required as an emergency or standby fuel supply to cover the possible temporary loss of natural gas in the event that the gas supplier could not guarantee supply for 100% of the year.

The quantity of liquid fuel to be stored would depend on the period deemed necessary for gas supplies to be restored and is typically around 24 to 72 hours. The liquid fuel storage initially installed for the open cycle peaking plant would also be sufficient to cover up to three days operation of a 1,080MW combined cycle plant.

The liquid fuel requirements for each of the power station configurations are shown in **Table 5-3**. Liquid fuel would be delivered to site via road tanker.

- **Table 5-3 Liquid Fuel Requirements**

Plant	Hourly Usage	Annual Usage	Operating Need
240MW Open Cycle	70kL	7,000kL[1]	Back-up of Gas Supply
1,080MW Combined Cycle	210kL	2,800kL	Emergency and Testing[2]

Note:
1) Assumes plant is run on liquid fuel 100-hours per year.
2) Assumes liquid fuel used for testing integrity of system for 1-hour on a monthly basis.

5.4.2 Support and Infrastructure Facilities

The following facilities would be required to support the operation of the power station:

- Fire protection systems – These would consist of fire hydrant water systems, inert gas flooding and fire extinguishers together with the necessary detection, alarm and initiation systems.
- Communication and Control Systems – The power station would be automated to allow minimum human intervention. However, operators on-site would monitor and adjust the power station as necessary. A secure communication link with Western Power would be installed. The controls and communication services would be housed in a dedicated central control room.
- Workshops and Maintenance Facilities – To enable the power plant equipment to be maintained, a workshop would be provided to carry out the maintenance in protected areas. Storage facilities for spare parts and tools would also be provided.
- Switchyard – In order to transfer electrical power to the grid, a 330kV switchyard would form part of the power station. The switchyard would consist of the necessary transformers, circuit breakers, busbars and protection equipment.

- Drainage Systems – The power station site would include the necessary drainage, collection and treatment systems for oily and contaminated water spills or leaks.
- Water Supplies – Storage and pumping facilities would be provided.
- Gas Receival Station – This receival station (also referred to as a gate station) would filter, pressure control and meter the gas received from the gas lateral pipeline.
- Liquid fuel storage facilities.
- Administration Building – This building would house staff and documentation for the day to day administration of the power station.
- Roads and Fencing – Internal hard surfaced access roads would be provided together with necessary security fencing to prevent unauthorised access to the power station and plant.
- Electrical Supplies – Internal electrical supplies would be provided to the overall power station from the switchyard and, if necessary, from an emergency back-up supply from the Western Power Grid.

5.4.3 Power Transmission

Western Power's 330kV transmission line runs along the eastern side of the Kemerton Industrial Park Core and a sub-station is located to the north of the Core (**Figure 5-2**). The power station would be connected to the existing 330kV transmission network. The length of additional transmission line required would depend on the location of the power station. If the power station is located on the preferred site (Site D), then the existing 330kV transmission line would be run through the station.

5.4.4 Water Supply

The water requirements of the power station would be dependent on the configuration. Water would be required for the following main uses:

- Make-up water for cooling;
- Feed to demineralisation plant;
- Potable water for staff amenities, safety showers and general domestic use;
- Backwashing and cleaning of filters and plant; and
- Raw water for landscape reticulation and fire water system testing.

Table 5-4 contains estimates of water supply requirements for a number of power station configurations.

- **Table 5-4 Water Supply Requirements**

	Cooling System	Potable Water (kL/yr)	General Fresh Water[3] (kL/yr)	Feed to Demin Plant (kL/yr)	Make-up Fresh Water for Cooling (kL/yr)	Total Water Supply (ML/yr)
Open cycle 240MW	Air	200	3,000	6,000[2]	-	9
Combined cycle 1,080MW	Air	500	5,000	200,000[1]	-	205
Combined cycle 1,080MW	Evaporative (Fresh water)	500	5,000	200,000[1]	12,500,000	12,705

Notes:
1) Assumes maximum recovery of wastewater, 1% HRSG blow-down.
2) Assumes water injection for NO_x control on liquid fuel operation and power station runs on liquid fuel for 100-hours per year.
3) General fresh water use includes water for filter backwash and plant cleaning, landscape reticulation and fire water system testing.

Cooling Water

Volumes of make-up water required for cooling would depend on the quality of the water supply and the power station configuration. **Table 5-4** contains estimates of make-up water for a fresh water supply. Actual volumes would also depend on other water quality parameters, namely Silica concentrations. With the absence of actual water quality information, the quantities in **Table 5-4** have been used for preliminary assessment of water supply options.

The Water Corporation has been awarded the Contract (by the Office of Water Regulation) for the provision of water supply services for the Kemerton Industrial Park. The Water Corporation is actively investigating strategies for water supply to the area and water supply options are discussed in **Section 4.5.3**. The Water Corporation has advised that sufficient water could be made available to meet the power station requirements, as well as accommodating future needs of other Kemerton industry (refer to correspondence in **Appendix C**).

The Water Corporation would operate any surface water supply and would undertake any approvals required for this supply.

Demineralisation Plant Water

Demineralised water would be required for

- Radiator filling and topping up;
- Compressor blade washing; and
- Injection into the gas turbine combustion chambers for NO_x emission reduction when operating the open cycle units on liquid fuel.

Demineralised water demand for compressor blade washing and for topping up radiator water is very small and less than 10kL per year. By far the greatest demand for demineralised water would be for NO_x suppression on the open cycle units when operating on liquid fuel. The Preferred Bidder would be required to install low NO_x burners on all gas turbine to reduce NO_x emissions when operating on natural gas. However, the dry low NO_x combustion systems installed for NO_x emission reduction when operating on natural gas do not provide NO_x suppression for liquid fuel burning without water injection. This water is emitted in the gas turbine exhaust as water vapour and is totally lost to the atmosphere. The Preferred Bidder may have grounds to argue that low NO_x control through water injection may not be required when operating on liquid fuel given that this would only occur for less than 100-hours per year (refer to discussion of air quality criteria in **Section 8.4.1.1**).

A demineralisation plant could be constructed on-site to provide this high quality water.

Potable Water

Potable water would be required for staff domestic use and filter backwashing and plant cleaning purposes. Treated scheme water would be purchased from the Water Corporation or a small potable water treatment plant could be installed on the site.

Fresh Water

Untreated fresh water would be required for filter backwash and plant cleaning, landscape reticulation and fire water system testing. The fresh water supply would be purchased from the Water Corporation.

5.4.5 Wastewater Disposal

Wastewater would be generated from the site from sewage, blow-down from the demineralisation plant, blow-down from the cooling system and drainage from general water use. The greatest source of wastewater is blow-down from the cooling system, the volume of which depends on the quality of the water supply and the power station configuration. Estimated wastewater quantities for various power station configurations are included in **Table 5-5**.

- **Table 5-5 Wastewater Quantities**

	Cooling System	Blow-down from Cooling System (kL /yr)	Blow-down from Demin Plant[1] (kL/yr)	General Wastewater[3] (kL/yr)	Treated Sewage (kL /yr)	Total Wastewater Discharge (ML/yr) (L/s)
Open cycle 240MW	Air	1,500	300	1,800	50	3.6 (<1 L/s)
Combined cycle 1,080MW	Air	4,000	450[2]	4,000	100	8.5 (<1 L/s)
Combined cycle 1,080MW	Evaporative (Fresh water)	2,000,000	450[2]	4,000	100	2,000 (67 L/s)

Notes:
1) Assumes water injection for NO_x control on liquid fuel operation and power station runs on liquid fuel for 100-hours per year.
2) Assumes recycling and reuse of demineralisation wastewater (not economic for open cycle plant).
3) General wastewater would be generated from fire water testing and washdown of plant and equipment.

Wastewater from an open cycle power station or an air-cooled combined cycle plant could be disposed of on-site through evaporation in specially constructed lined ponds.

If a higher capacity plant with a water-cooling system is implemented, the volumes of wastewater would increase beyond that handled by evaporation ponds and other options for wastewater disposal would be required. An initial feasibility undertaken for the project (Sinclair Knight Merz, 2001) recommended that wastewater disposal from the proposed power station should be via ocean outfall. This report details the scenario of a wastewater pipeline being constructed from the preferred power station site to the existing Collie Power Station ocean outfall and an extension of the diffuser on this facility to accommodate the extra water flow if required. Further discussion on the options for wastewater disposal is given in **Section 4.5.4**.

Wastewater from sewage would be disposed of separately in a manner approved by the Department of Environmental Protection and Health Department. A discussion on the options for sewage treatment and disposal is given in **Sections 7.4.4** and **8.4.5**.

Wastewater Characteristics

The quality of the wastewater that would be carried in the pipeline is not confirmed, however, the salinity is not expected to exceed 5,000mg/L Total Dissolved Solids (TDS). The wastewater would also be relatively free from contaminants. The actual contaminants would be dependent on the quality of the water supply to the plant and on the chemicals required for pre-treatment of water prior to use in the plant. These chemicals are likely to include a biocide and a corrosion and scale inhibitor.

Wastewater Disposal Pipeline and Outfall

The exact size and type of the wastewater disposal pipeline would be determined during the detailed design. The pipeline diameter would not be expected to significantly affect the width of disturbance required to install the pipeline.

Construction would require approximately 11m width to be disturbed (refer to **Section 7.3.1.1**). This would allow for digging of the trench, stockpiling of the soil material from the trench, laydown of the pipeline and working room to install the pipe into the trench. In sensitive areas, the working width could be reduced to about 5m.

After construction there would be a requirement to keep a vehicular access track (approximately 4m wide) on or adjacent to the pipeline for maintenance and inspection purposes.

In areas where groundwater is within the excavation limits, short-term dewatering may be required. This would be conducted in accordance with good practice and to the management requirements of relevant authorities.

A leak detection and management system would be designed into the pipeline system. This is likely to be similar to that installed in the Collie Power Station wastewater pipeline and would likely include:

- A flow meter at each end of the pipeline. When discrepancies are detected between the two flow rates, pumping is turned off; and
- Non return valves installed intermittently at strategic locations so as to minimise the amount of water that could discharge in the event of pipeline failure.

A pipe bridge would be installed at any drainage crossing points so that the pipeline does not impact on the flows of the drain.

The existing Collie Power Station ocean outfall consists of a 300mm HDPE pipe that extends approximately 800m offshore and is attached to concrete blocks on the sea bed with stainless steel fittings. The end of the outfall pipeline has a 92m linear diffuser lying in 10m of water with twenty three 50mm ports. To facilitate the increased capacity in wastewater flow, the existing diffuser would need to be extended by a likely 120m. The diffuser extension is likely to consist of a pipeline with discharge outlets sitting on top of concrete blocks (with footprints of approximately 1.7m^2), nominally 0.5m off the seabed.

5.5 Hours of Operation and Workforce

The operational hours for the proposed power station would depend on the duty cycle of the plant. If a peaking plant is installed it likely that it would be run for short periods in mornings and in the afternoon/evenings, five days per week and during emergencies. This plant would only be manned during the day. If the plant needs to be started up during the night to provide emergency load, this would be done remotely so would not require manning.

During the initial operating period for the 240MW station, permanent on-site personnel would typically consist of up to 5 administration and maintenance personnel on day shift. Some of these personnel would be capable of operating the plant locally if the need arises.

If a base load plant is installed it would be run continuously and only shut down for maintenance. This plant would be manned by 20 – 25 people during the day and six people during the night.

5.6 Construction Workforce

The workforce required to construct the power station would vary over the course of the work. Over a period of some 12 to 18 months, the construction workforce for the initial 240MW development stage is expected to peak at around 250 personnel mid way through the period with some 20 personnel at the end of construction carrying out commissioning and testing prior to hand-over for commercial operation.

These levels of construction manning would be similar or slightly less for subsequent power station developments.

5.7 Project Staging

To meet the initial Power Procurement Program requirements for 240MW of peaking plant by no later than the summer of 2005/06, construction of the peaking plant would need to commence by the second half of 2003 and would extend over a period of 12 to 18 months. Any further development at the site would be constructed at a later stage, and it is anticipated that an expansion of up to 1,080MW could be developed in various stages at the site by 2010 (refer to **Section 4.5.2**).

6. Existing Environment

6.1 Introduction

The following section presents a description of the regional environmental characteristics of the Kemerton Industrial Park and the local environmental features of the preferred power station site and the proposed wastewater pipeline route.

The Kemerton Industrial Park is zoned for industrial land use and therefore its suitability for industrial use is well established. In addition, the Kemerton Expansion Study, as presented in *Industry 2030 – Greater Bunbury Industrial Land and Port Access Planning* (WAPC, 1998), was reviewed by the Environmental Protection Authority (EPA) in 1998 under Section 16(j) of the *Environmental Protection Act 1986* (EPA, 1998). The EPA identified the following factors as the main environmental issues associated with the proposed expansion of the Kemerton Industrial Park:

- Buffer requirements for noise, air quality and risk;
- Protecting regionally significant wetlands, watercourses and vegetation;
- Maintaining a sustainable groundwater balance;
- Protecting water quality in Wellesley River and Leschenault Estuary; and
- Solid and liquid waste disposal.

Those factors specific to the power station proposal are considered in further detail in the following sections.

The following reports have been used as the main sources of information for this report:

- Helleman, Frans & Associates (1985). Western Australian Aluminium Plant, Environmental Review and Management Programme / Draft Environmental Impact Statement. Report prepared for International Aluminium Consortium of Western Australia.
- Dames and Moore (1989). Kemerton Aluminium Smelter Public Environmental Report. Report prepared for Kemerton Aluminium Limited.
- BSD Consultants (1997). Kemerton Expansion Study Report. Report prepared for Kemerton Study Management Group.
- Environmental Protection Authority (1998). Industry 2030 – Greater Bunbury Industrial Land and Port Access Planning. Bulletin 902.
- Bowman Bishaw Gorham (1999). Kemerton Water Study. Report prepared for LandCorp, Department of Resources Development, Water and Rivers Commission and Water Corporation.
- Muir Environmental (1999). Report of Biological Survey – Phase 1: Kemerton Industrial Estate, Volume 1 and 2. Report prepared for LandCorp.
- Armstrong, P.G. and Associates (1999). Kemerton Industrial Estate (Original Core Zone), Rare Flora Search. Report prepared for Muir Environmental and LandCorp/Department of Resources Development.

- Bamford, M.J. and A.R. (1999). Kemerton Fauna Study – Supplementary Report. Report prepared for Muir Environmental.
- BSD Consultants (2000). Kemerton Industrial Park Expansion Visual Impact Assessment. Report prepared for Department of Resources Development.
- Biota Environmental Services (2002). Vegetation and Flora Survey – Kemerton Power Station and Cooling Water Pipeline Route. Report prepared for Sinclair Knight Merz.
- McDonald Hales and Associates (2002). Aboriginal Heritage Review – Proposed Kemerton Power Station Site and Wastewater Pipeline, Shire of Harvey WA. Report prepared for Sinclair Knight Merz.
- Herring Storer Acoustics (2002). Proposed Kemerton Power Station Acoustic Assessment. Revision 1. Report prepared for Sinclair Knight Merz.
- Sinclair Knight Merz (2001). Feasibility Study for Kemerton Industrial Park. Internal Report prepared for Western Power Corporation.

6.2 Climate

The Kemerton area experiences a Mediterranean type climate that is dominated by the influence of the Indian Ocean. This climate is distinctly seasonal with cool to mild wet winters and hot, dry summers.

A summary of the meteorological data for Bunbury for the period 1877 – 1985 is presented in **Table 6-1**. In 1985, the Bunbury weather station was moved from the post office to the former Bunbury Power Station. In 1995 it was then moved again to the Bunbury Airport. As these sites are a significant distance from each other it is not appropriate to merge the data from 1985 – present with that from 1877 – 1985, therefore data from 1985 – present is not presented in this report.

Table 6-1 Summary of Climatic Data for Bunbury Post Office (1877-1985)

Month	Temperature (°C)		Relative Humidity (%)		Pan Evaporation[1] (mm)	Rainfall (mm)	
	Mean Daily Max	Mean Daily Min	9am Mean	3pm Mean	Mean Daily	Mean	Mean No. of Rain days
January	28	15	62	57	8.1	11.1	2
February	28	15	66	57	7.6	11.8	2
March	26	14	69	59	5.7	21.9	4
April	23	12	75	64	3.7	46.4	7
May	20	10	79	66	2.3	128.1	14
June	20	9	81	68	1.5	182.9	18
July	18	8	82	69	1.6	170.6	19
August	17	8	78	67	2.0	123.6	17
September	18	9	75	65	2.7	80.4	14
October	20	10	69	62	3.9	54.1	11
November	23	12	65	60	5.6	26.2	6
December	25	14	63	59	7.1	13.7	4
Annual Mean	**22**	**11**	**72**	**63**	**4.3**	**72.6**	**10**
Annual Total						**871.2**	**120**

Note:
1) Pan evaporation is not recorded at Bunbury. Readings shown are from Roelands.
2) Data from Bureau of Meteorology, 2001.

6.2.1 Temperature and Humidity

Due to the proximity of the Indian Ocean to the site, cool to mild temperatures are experienced throughout the year.

The annual mean daily maximum and minimum temperatures for Bunbury are 22°C and 11°C, respectively. Mean daily maximum temperatures range from 17°C in August to 28°C in January and February. Mean daily minimum temperatures range from 8°C in July/August to 15°C in January/February.

The annual mean relative humidity for Bunbury is 72% at 9am and decreases to 63% at 3pm.

6.2.2 Rainfall and Evaporation

The typical characteristics of a seasonal Mediterranean type climate means that rainfall events are usually predictable throughout the year. Over 70% of the total annual rainfall of 871mm occurs during winter or during the months May through to September.

The main factors determining the winter rainfall – summer drought regime of this climate are latitude and the regions' maritime position. As a result of the northward movement of subpolar low-pressure systems during winter, associated cold fronts bring rain bearing westerly winds.

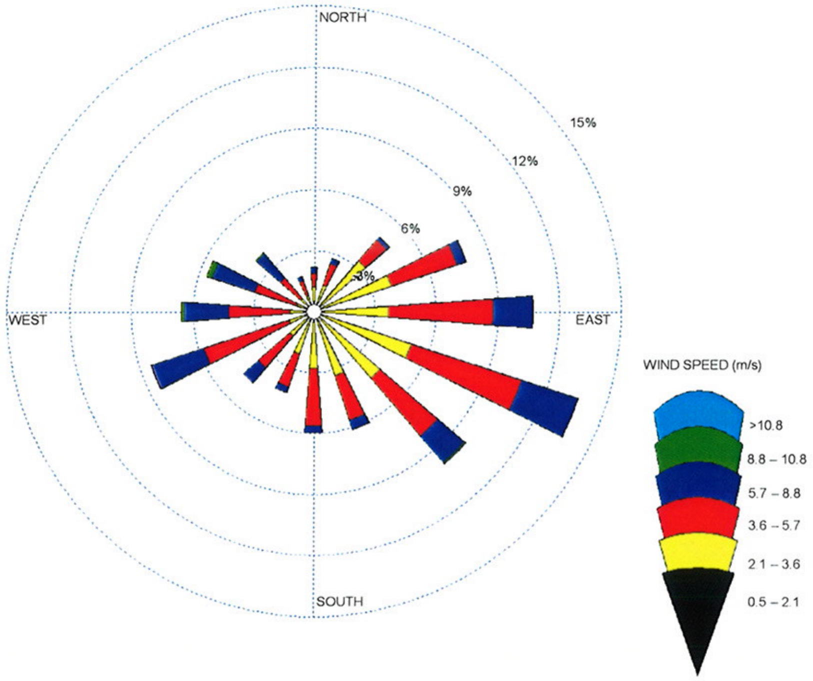
Pan evaporation is not currently measured by the Bureau of Meteorology's Bunbury Station. The nearest site that the Bureau of Meteorology has evaporation data for is Roelands, which is approximately 8km south south east of the Kemerton Industrial Park, and for this report has been used to approximate evaporation at Kemerton.

6.2.3 Wind

Winds in the Kemerton area are determined largely by the locations of the sub-tropical high-pressure ridge and the migratory low-pressure systems (extra-tropical cyclones) which exist on the poleward side of the ridge.

In summer, morning winds blow predominantly from the south east or east, usually at 11 – 20km/hr, and swing to the west in the afternoon, usually at 21 – 30km/hr. Winter morning winds may occur from any quarter but predominantly from the north and north east, up to 20km/hr. In the afternoon they tend to swing to the north, north west and west, usually over 10km/hr and frequently over 20km/hr.

As described in **Section 8.4.1.4.2**, wind data from the meteorological station within the Kemerton Industrial Park was used for the air dispersion modelling. The annual wind rose for Kemerton is presented in **Figure 6-1** indicating the predominance of south easterly winds and to a lesser extent westerlies.



■ **Figure 6-1 Annual Wind Rose for Kemerton**

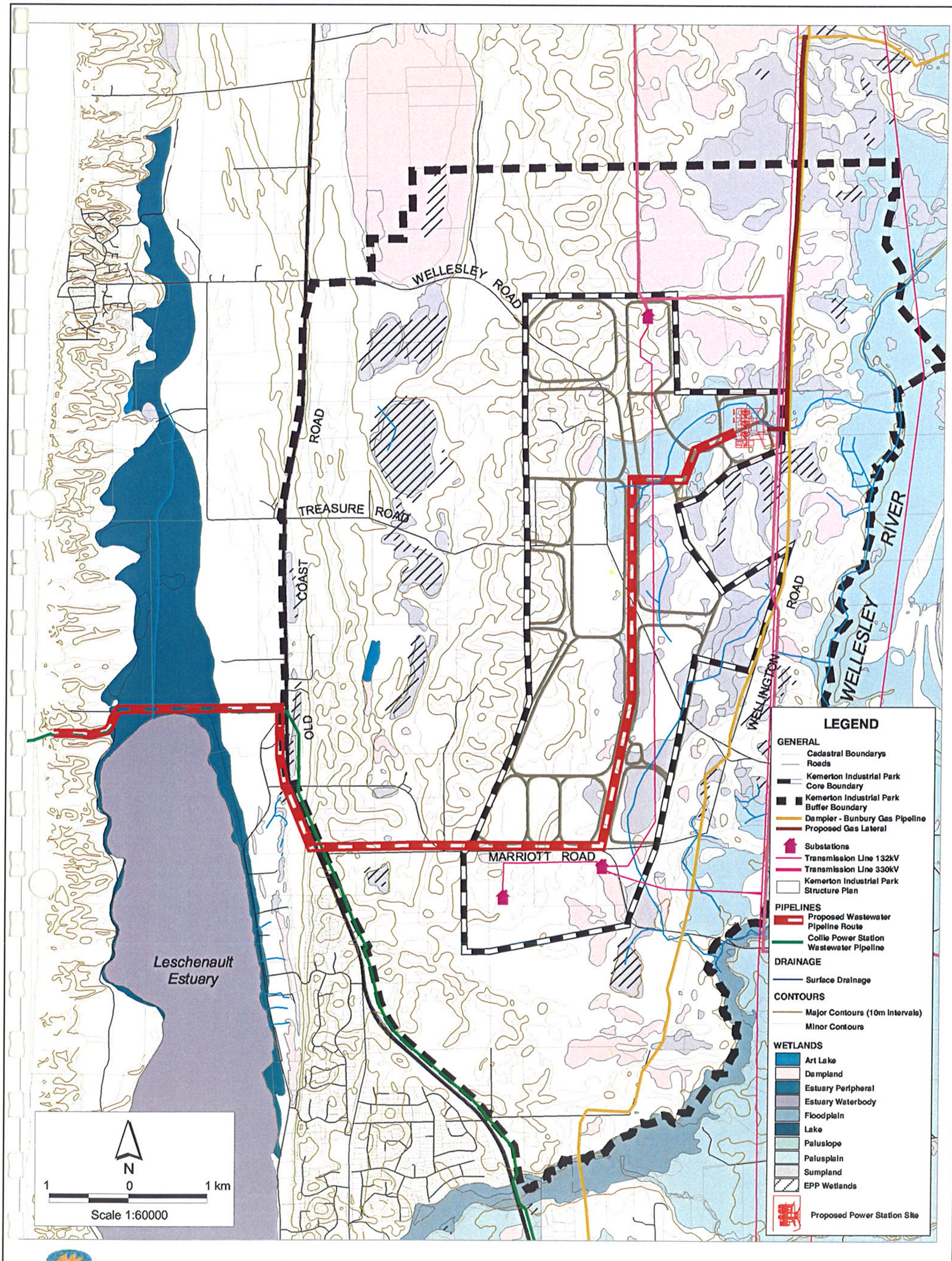
6.3 Topography and Landforms

Two main topographic features dominate the landscape around the Kemerton Industrial Park. These are a north – south running dune of up to 45m above Australian Height Datum (AHD) bounding the western edge of the industrial core zone; and a gently undulating plain about 15m AHD dominating the industrial core zone and eastern buffer zone (**Figure 6-2**). This plain rises slightly in elevation towards the east close to the Wellesley River, up to approximately 20m AHD.

In the western buffer there is a second small dune to the west of the main dune, which reaches heights of up to 25 – 35m AHD. Between these two dunes is a depression which dips to around 5 – 10m AHD.

A small part of the Kemerton Industrial Park (mostly on the far eastern boundary of the Park) occurs on the Pinjarra Plain landform system. The Pinjarra Plain landform is basically an alluvial plain, consisting also of river terraces and stream deposits (at the same level as the plain), swamps and drainage areas. The soils are moderately to poorly drained sandy clays (duplex soils), mainly of alluvial origin, as well as uniform fine textured soils with a clay surface. Most areas of the plain have poor natural drainage because of the flat topography and predominantly duplex soils which give rise to perched water tables in winter. The highly productive well drained soils are adjacent to the major rivers, either on the higher or lower terraces.

The preferred power station site is located within a low lying area, less than 15m AHD. This site lies within the gently undulating plain within the north eastern area of the expanded industrial core.



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KEMERTON POWER STATION
TOPOGRAPHY AND SURFACE DRAINAGE OF THE KEMERTON REGION

FIGURE 6-2

Project No. DE01833.200
Date Drawn: 14.08.2001
Prepared by: T.Lee

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6.4 Geology and Soils

The geology of the Kemerton region was mapped in 1979 at 1:50,000 scale as part of the Geological Survey of Western Australia Urban Geology series. The information presented in this section is derived from the Harvey (2031-Lake Preston) sheet.

The Spearwood Dune System is located on the western side of the Kemerton Industrial Park (**Figure 6-3**). The Spearwood System consists of a series of sand dunes of rolling topography aligned roughly parallel to the coast and reaching an altitude of up to 40m. These dunes are of aeolian origin, which overlie limestone (calcrete and calcarenite) at depth. The depth of the sand varies and, in places, limestone outcrops occur.

Deflation of the dunes and leaching of the carbonate has lead to highly leeched surface sand. The dissolved carbonate may be deposited as a hard calcrete cap on the underlying limestone. This effect does not appear to be as well developed as elsewhere in the Spearwood System (e.g. Oakajee). However the limestone can be very friable to completely lithified and ranges in calcium carbonate content from 30 to 65%. Elsewhere in the same formation, karst conditions exist with some caves in the limestone. None are recorded for this location.

The Bassendean Dune system which occupies the area of the Kemerton Industrial Park east of the ridgeline (**Figure 6-3**), forms a gently undulating to rolling landscape with broad very low rises rarely more than 20m above mean sea level and intervening low-lying poorly-drained areas. The Bassendean sands are typically fine to medium grained and have low fertility and water holding capacity. There is an extensive mosaic of seasonal wetlands within this system, in the zone immediately west of the Wellesley River.

The Bassendean sands vary in thickness from low rounded dunes (up to 15m thick) to a thin veneer (usually 2 – 5m thick). The sands are typically fine to medium grained, well drained grey to off-white in colour at the surface and pass though cream to yellow layers at depth. They are indistinguishable from the sands of the Spearwood System and mostly defined by the older age reflected in the more deflated physiography.

The Bassendean sands overlie the Guildford Formation which is a more clay based sediment formed of sandy and silty clays through to clayey sands with some semi-lithified lateritised clay. This unit is less permeable than the overlying Bassendean and a perched water table in the overlying sands may form springs at the edge of the dunes. The Guildford Formation may be waterlogged in winter. Where the Guildford formation is coarser and better drained it is used extensively for horticulture and vegetable gardens.

The Guildford Formation encroaches on the eastern boundary of the Park. The soils are moderate to poorly drained sandy clays mainly of alluvial origin as well as uniform fine textured soils with a clay surface.

Preferred Power Station Site

The preferred power station site is located within the Bassendean System. The major soil types in the area are Bassendean sands overlying the clayier Guildford Formation. To the south of the site there are some swamp deposits and to the north east lies the Guildford Formation.

Proposed Wastewater Pipeline Route

The alignment of the proposed wastewater disposal pipeline route crosses an area of Bassendean Sands and the Spearwood System (**Figure 6-3**). These are virtually indistinguishable at the surface consisting of grey to white sands at the surface, grading downwards into cream and pale yellow to buff coloured. These sands are fine to medium grained although may be coarser particularly towards the base of the unit.

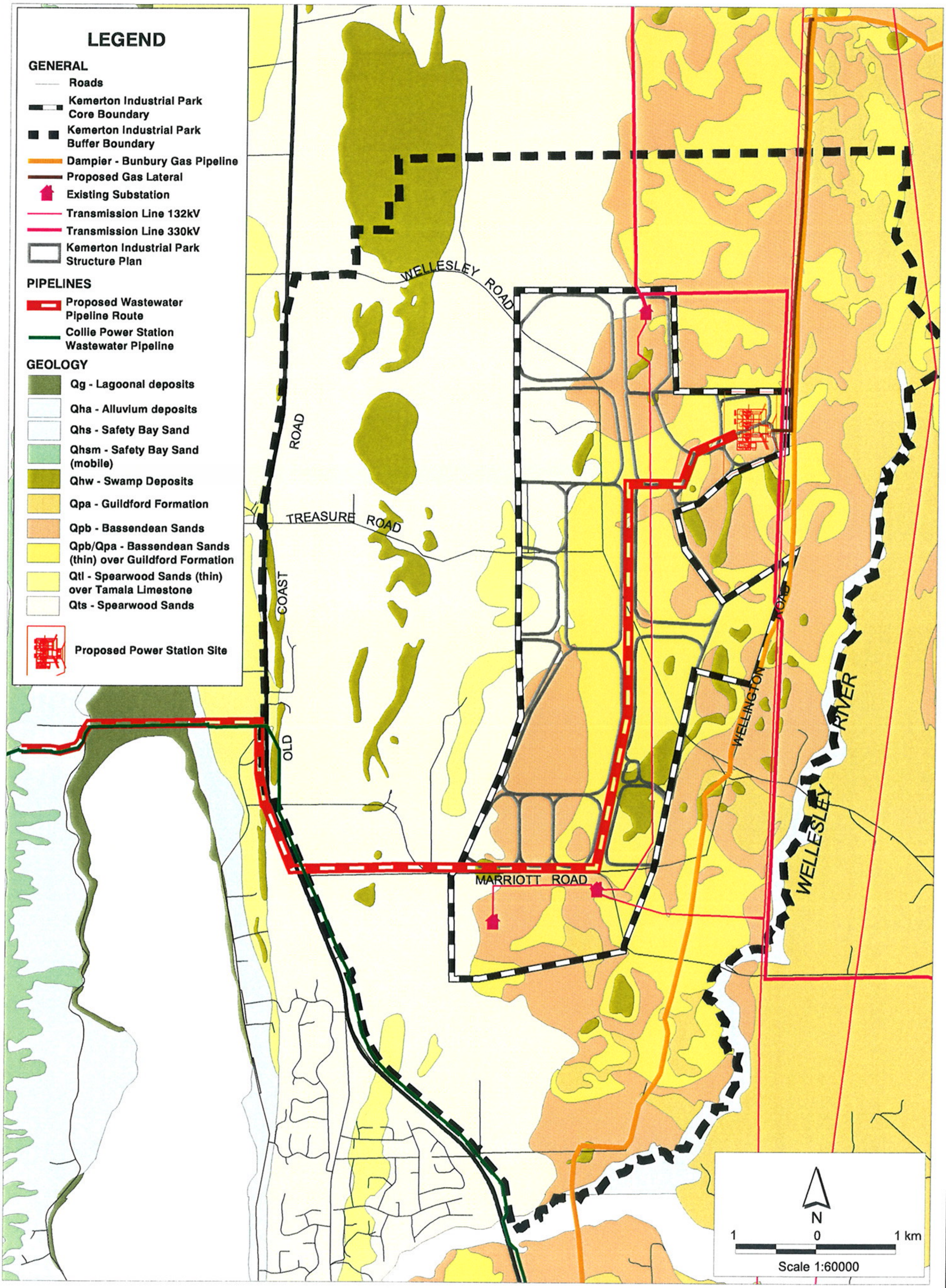
The Bassendean sand is mostly distinguished by its physiography. Being an older unit of aeolian deposition it is usually more deflated (more subdued expression) than the sands of the Spearwood system towards the west.

Going westward the proposed wastewater pipeline route crosses the Spearwood system of sands which have been formed by decalcification of the sandy Tamala Limestone unit. Limestone probably occurs at relatively shallow depths under this sand. The surface of the limestone may have an indurated capping of calcrete formed from the carbonate leeched from the overlying sands. This calcrete may be quite hard and trenching into this unit may be difficult. Where the caprock is not present, the Tamala limestone can be quite friable. Shallow limestone is indicated on geology maps to occur west of the Old Coast Road.

North of Leschenault Estuary, the proposed wastewater pipeline route crosses an area of alluvium and lagoonal deposits. The alluvium is a mixture of fine to coarse sands, silt clay and smooth clay. Adjacent to the Estuary, this alluvium is related to reworking of the adjacent sands from the Spearwood System and contemporaneous with the adjacent lagoonal deposits. Interbedding of sands and muds is probable. The alluvium grades westwards into lagoonal deposits.

The lagoonal deposits north of the Leschenault Estuary are composed of brown and black muds and silts with some interbedded sands deposited in a shallow near shore to estuarine environment. The conditions of low oxygenated estuarine to lagoonal waters would have encouraged anaerobic sulphide producing bacteria and thus formation of acid sulphate soils. Excavation of these muds would be expected to release hydrogen sulphides and water of lower pH. In addition, these muds are saturated with saline water with salt concentrations in summer higher than seawater due to evaporation.

West of Leschenault Estuary the proposed wastewater pipeline route crosses the Safety Bay Sands. These are of marine origin washed up by the sea and developed into dunes along the coastal fringe by wind action. They are composed mostly of quartz sand with between 10 and 80% calcium carbonate from shell fragments. Leeching of the carbonate and re-deposition forms a network of fossilised root channels through the dunes. These may develop at depth to a partly lithified calcarenite at depth, although this unit normally remains quite friable.



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KEMERTON POWER STATION

GEOLOGY OF THE KEMERTON REGION

FIGURE 6-3

Project No. DE01833
Date Drawn: 23.08.2001
Prepared by: T.Lee

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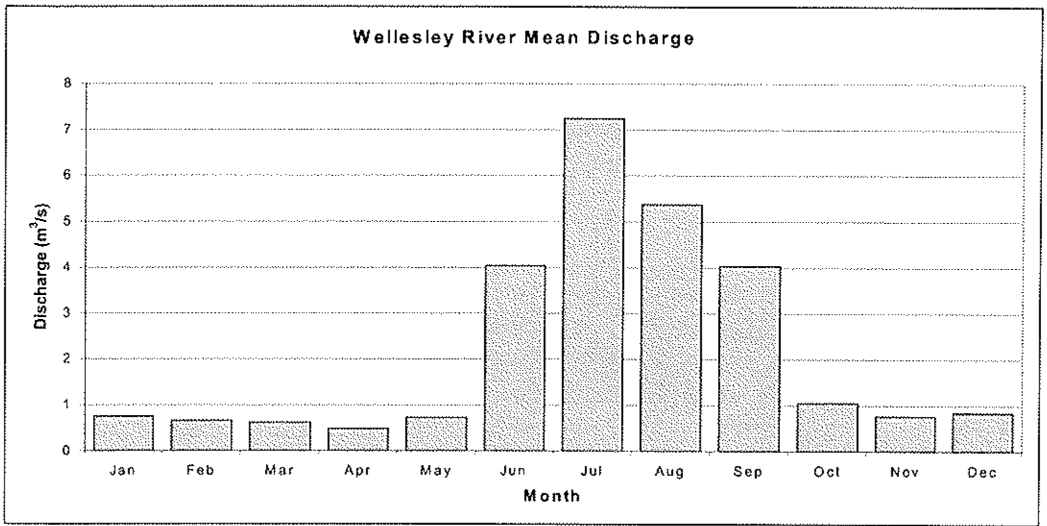
6.5 Surface Hydrology

The surface hydrology of the Kemerton Industrial Park has been described in a number of previous studies associated with development within the Park (BSD Consultants, 1997; Frans Helleman & Associates, 1985). Surface hydrological and topographical features of the Kemerton Industrial Park and surrounds were mapped in 1985 at 1:25 000 scale, by the Department of Lands and Surveys and are presented on the Lake Preston 2031-IV SE and Harvey 2031-I SW sheets. The following section is based on information contained in these studies and surveys.

The Kemerton Industrial core area is relatively flat and subject to inundation. The surface drainage features of the Kemerton region are shown in **Figure 6-2**.

The major drainage system in the Kemerton area is the Wellesley River, which is located to the east of the Kemerton Industrial Park. Several minor drainage channels constructed in the cleared agricultural areas feed the Wellesley River and it is reported that the Wellesley River does not directly drain the Kemerton Industrial Park (BSD Consultants, 1997). The Wellesley discharges into the Brunswick River, which then combines with the Collie River, discharging via the Leschenault Estuary and ultimately into the ocean. The Wellesley River flows all year round with maximum mean discharge occurring in July (see **Figure 6-4**). The Wellesley River stream height is reported to vary by around 1m between the dry season and wet season (BSD Consultants, 1997). Contributions to stream flow are derived from both surface runoff and groundwater seepage.



Source: Water and Rivers Commission station 612039 located near Marriott Road

- **Figure 6-4 Wellesley River Flow**

The preferred power station site intersects an agricultural drainage channel, which flows eastwards, discharging into the Wellesley River. The proposed wastewater pipeline route also crosses this drain in places near the plant site (**Figure 6-2**).

There are a number of natural perennial and seasonal wetlands and swamps in the Kemerton area, particularly to the east and west of the industrial core (**Figure 6-2**). The wetlands to the east of the Park, near the preferred power station site are reported to be expressions of the water table and as a result they are fed by groundwater and surface runoff (BSD Consultants, 1997). Further discussion on the wetlands in the Kemerton area is given in **Section 6.6**.

In the area west of the Kemerton Industrial Park the major water body is the Leschenault Estuary, which is further discussed in **Section 6.6**. A large portion of the Kemerton Industrial Park falls within the boundaries of the Leschenault Estuary catchment. The catchment area is managed by the Leschenault Inlet Management Authority (LIMA) and is known as the Leschenault Inlet Management Area.

The Leschenault Waterways Management Programme was developed in 1992 to address issues such as catchment management, urban expansion, water quality and land uses (Waterways Commission, 1992). Management strategies would be required to ensure that the proposed development is compatible with the Leschenault Waterways Management Programme and protection of the estuary environment.

Project design features and management strategies to minimise potential impacts on surface water resources are discussed in **Sections 7.3.4** and **8.3.2**.

6.6 Wetlands

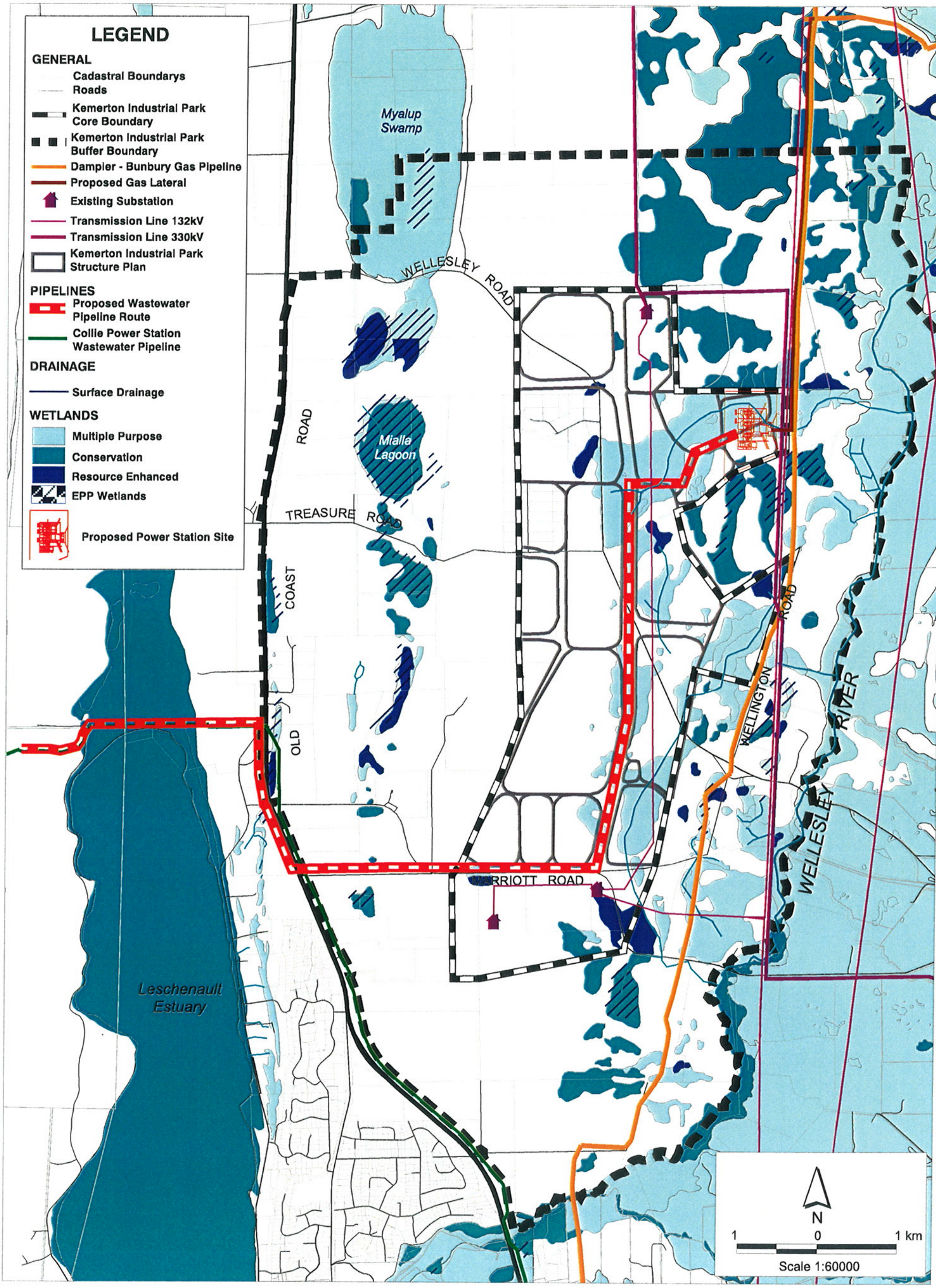
Wetlands extend through much of the Bunbury/Kemerton region. The wetlands in the vicinity of the Kemerton Industrial Park are shown in **Figure 6-5**.

In general, extensive development on the Swan Coastal Plain has led to a large decline in the number of wetlands that now exist on the Plain. Development activities such as housing, waste disposal and agriculture have led to filling or draining of most natural wetlands. This has led to the conservation value of the remaining wetland systems of the Swan Coastal Plain being recognised.

The Environmental Protection Authority released *the Environmental Protection (Swan Coast Plain Lakes) 1992 Policy* (EPP), which defined many wetlands that contained permanent water bodies. The purpose of the EPP is to facilitate the identification and protection of wetlands within the particular policy area that are considered by the EPA to be worthy of inclusion in a wetlands register. Generally, a wetland is likely to satisfy the wetland registration criteria if it has been recognised as an internationally, nationally or regionally significant site or exhibits significant attributes or values. The preferred plant site lies just north of a series of EPP wetlands, however none exist within the site (**Figure 6-5**).

A more comprehensive review of the wetlands of the Swan Coastal Plain was conducted by Hill *et al* in 1996. This defined wetlands (ephemeral as well as permanent) from Gingin to Dunsborough. The southern part of this, from Mandurah to Dunsborough, was updated in 1998. This study has updated the Water and Rivers Commission (WRC) Wetlands Geomorphic Database on the Swan Coastal Plain.

The Wetlands Geomorphic Database defines the boundaries of wetlands, classifies them according to wetland type (e.g. dampland, ephemeral wetland) and evaluates their conservation significance, assigning them a management category, based on the system established by Hill *et al.* (1996) as shown on **Figure 6-5.**



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KEMERTON POWER STATION

SIGNIFICANT WETLANDS WITHIN THE KEMERTON REGION

FIGURE 6-5

Project No. DE01833.200
Date Drawn: 14.08.2001
Prepared by: T.Lee

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Evaluation Class:	**Management Objective:**
C (Conservation)	Preserve natural attributes through reservation or statutory protection.
R (Resource Enhancement)	Preserve remaining ecological attributes through reservation or management.
M (Multiple Use)	Maintain hydrological functions and remaining natural attributes.

The WRC is expected to place a high priority on avoiding direct and indirect impacts on wetlands, particularly those of C and R categories (Bowman Bishaw Gorham, 1999).

The preferred power station site lies on palusplain and dampland, which assigned a multiple use management objective and does not directly imp wetlands of conservation significance (**Figure 6-5**).

no but effectively Clearing a buffer of a ccw

The proposed wastewater pipeline route runs through the central core of th Industrial Park which crosses palusplain and dampland which have bee multiple use management objective. The route through the buffer zone an Old Coast Road to Buffalo Road is designed to avoid any wetlands in this area (refer to **Section 4.5.4.2**). The proposed wastewater pipeline route then runs across the northern boundary of the Leschenault Estuary (**Figure 6-5**). The fringing wetlands along this northern shoreline have been listed as areas of conservation significance. ← System 6! The Leschenault Estuary supports 28 plant communities, as well as 62 species of birds, some of which are endemic to the area (Waterways Commission, 1992). In addition, the estuary provides a suitable habitat for juvenile fish development. The northern section of the estuary supports a large population of invertebrate fauna, while lizards and snakes are found in the fringing vegetation.

Project design features and management strategies to minimise potential impacts on wetlands surrounding the project area are discussed in **Sections 7.3.4** and **8.3.2**.

6.7 Groundwater

The groundwater of the Kemerton Industrial Park has been described by Bowman Bishaw Gorham (1999) in the *Kemerton Water Study*. The following section is primarily based on information given in this report.

The Kemerton Industrial Park is underlain by an unconfined superficial aquifer. This aquifer is further underlain with the confined aquifers (by increasing depth) of the Leederville Formation and the Cockleshell Gully Formation. In the Kemerton area it is believed that the Yarragadee Formation (present throughout most of the South West) and the Cockleshell Gully formation are hydraulically connected. This Yarragadee Formation/Cockleshell Gully Formation is the most significant groundwater resource in the Kemerton area.

The depth to the watertable over much of the area is less than 2m and extensive areas of wetland (both permanent and seasonal) occur in the eastern and western parts of the Park. The shallow groundwater system is recharged by direct infiltration of rainfall and lateral flow from the Mialla Mound, a low groundwater mound, the southern end of which is located in the north east of the Park (**Figure 6-5**). Groundwater in the superficial aquifer discharges to the wetlands including Myalup Swamp, the Wellesley River and Leschenault Estuary. Some leakage also occurs to the underlying Leederville Formation which forms a confined aquifer. Hydraulic gradients in both the Leederville and Cockleshell Gully Formations are low and there has been no significant decline in water levels despite substantial groundwater abstraction in the area. Any substantial abstraction in the superficial aquifer may however result in significant drawdown.

The wetlands to the east of the Kemerton Industrial Core are expressions of the local groundwater table. Groundwater discharges to the wetlands in conjunction with surface water runoff following rainfall, and the wetlands act as localised groundwater sinks through evapotranspirational processes (BSD Consultants, 1997). Preliminary modelling has suggested that abstraction rates of 3GL/yr from the superficial aquifer could cause drawdowns of as much as 1.5m in the conservation wetlands (Bowman Bishaw Gorham, 1999). The Kemerton wetlands are regarded by the Water and Rivers Commission to be of major regional significance (refer to **Section 6.6**) and thus rates of abstraction such as these are unlikely to be acceptable.

Groundwater in the superficial aquifer ranges in salinity from 100 – 1,500mg/L TDS along the Wellesley River and near Myalup Swamp. There are however, local areas of higher salinity (up to 8,600mg/L) near the river in the south eastern corner of the Park (Bowman Bishaw Gorham, 1999). Salinity of groundwater in the Leederville Aquifer is around 600mg/L TDS. In the underlying Cockleshell Gully Formation salinities range from 310 – 1,300mg/L at depth in the south and between 2,500 and 26,000mg/L in the north.

At the preferred power station site the depth to groundwater is likely to be about 0.5 – 1m and flowing in an east south easterly direction (Bowman Bishaw Gorham, 1999).

For most of the length on the proposed wastewater pipeline route the groundwater is deeper than 2m from the surface, however there may be areas where the groundwater is closer to the surface.

Project design features and management strategies to minimise potential impacts on groundwater are discussed in **Sections 7.3.4** and **8.3.2**.

6.8 Flora and Fauna

The Kemerton area is situated within the Drummond Botanical Sub-district, within the Darling Botanical District and the South West Botanical Province.

The flora and fauna of the Kemerton Industrial Park has been described in several studies associated with the development of the area as an Industrial Park. These reports have summarised information from fauna and flora surveys, mapping and studies spanning two decades. Information on the Kemerton Industrial Park in general in the following section is based on information primarily contained in the studies by Muir Environmental (1999), Armstrong P.G. and Associates (1999), and M.J. and A.R. Bamford (1999).

In addition, Biota Environmental Services was commissioned by Sinclair Knight Merz to undertake a flora and vegetation survey and desktop fauna study of the preferred power station site and the section of the proposed wastewater pipeline route outside of the Kemerton Industrial Park (Biota Environmental Services, 2002).

6.8.1 Vegetation and Flora

6.8.1.1 Flora and Vegetation Survey Methodology

Biota Environmental Services undertook a flora and vegetation survey of the preferred power station site and the section of the proposed wastewater pipeline route outside of the Kemerton Industrial Park on the 27th February to the 1st of March 2002. Different levels of survey were carried out in the two components of the study area and are discussed below:

Preferred Power Station Site

The preferred Kemerton Power Station site is largely situated on a timber plantation. The portion covered in this report consists of an area of natural bushland at the southern extremity of the site. The assessment consisted of:

veg mapping?

- Vegetation condition assessment;
- Vegetation community description; and
- A threatened flora search (limited).

Proposed Wastewater Pipeline Route

The proposed wastewater pipeline route survey consisted of that portion of the route that extends from the western boundary of the Kemerton Industrial Park on Marriott Road through to the coast. The survey consisted of:

- Vegetation mapping;
- Vegetation condition assessment;
- Detailed flora sites (10m by 10m quadrats); and
- Opportunistic and site based flora collections.

· no mention of System 6?
· Veg condition - what ref. used?

Vegetation mapping was done from 1:10,000 scale aerial photography, using both data from detailed flora sites and ground truthing.

The following parameters were recorded at detailed flora sites:

- Vegetation type (a broad description based on dominant species and strata);
- Location (recorded using a hand-held Global Positioning System (GPS) to an accuracy within 5m in AGD84 datum);
- Landform;
- Substrate and general soil type;
- Disturbance (evidence of vehicle tracks, fires etc); and
- Flora species present within four main strata (trees, shrubs, sedges and herbs) and their estimated cover (to the nearest percent where possible, otherwise a range was used).

Vegetation condition assessment was based on the classification scale given in **Table 6-2**.

(cont'd)

- **Table 6-2 Vegetation Classification Scale**

Condition	Weed Invasion	Vegetation Strata
Pristine	No weeds	Strata intact, diversity intact.
Excellent	Scattered, non-aggressive weeds <5% cover	Strata intact, diversity intact.
Good	Sparse to open weeds <20% cover.	Shrub or herb layer may be impacted, diversity somewhat diminished.
Poor	Weeds widespread 20%+ cover	One or more strata severely impacted or absent. Diversity obviously diminished.
Degraded	Weeds or bare soil 80%+ cover	Only scattered individuals of original vegetation may remain.

Flora species were identified in the field where identities were certain, or specimens were collected for later identification using the resources of the Western Australian Herbarium. A list of the flora species recorded from the project area is given in **Appendix D**. A search was conducted of the Department of Conservation and Land Management (CALM) database of potential threatened flora species previously known from the locality. The survey botanists familiarised themselves with voucher specimens of these flora species held at the WA Herbarium prior to undertaking the survey. General traverses of the study area were carried out for these species in addition to the quadrat sampling. Any other flora species not recorded from the quadrat sampling were also collected as part of these traverses. Flora taxonomy used in this report is based on the most recent version of Max (the WA Herbarium flora nomenclature database). Digital photographs were also taken of all flora sites.

6.8.1.2 Limitations of this Assessment

Systematic floristic sampling was conducted along the proposed wastewater pipeline route, but this was not undertaken during a suitable season and is not considered an adequate documentation of the flora. Survey timing was not ideal for late winter – spring flowering ephemerals which means:

- Annual and herbaceous perennial species such as orchids, *Drosera* and *Stylidium* were almost absent. There are a number of Declared Rare (DRF) and Priority orchids, a *Stylidium* and a *Drosera* known from the area. There are 18 records of Priority Flora populations known from an area bounded by coordinates 33°08' – 33°14'S and 115°40' – 115°45'E. Seven of these 12 species (58%) are herbaceous perennials that would have been dormant, and therefore unable to be detected, at the time of the survey;
- Annual species account for a large proportion of the species composition in Bassendean vegetation communities. This compromises baseline data and makes evaluation of conservation significance in comparison to other remnant vegetation difficult. This includes assessment of the representation of weed species; and
- Many shrubs were indeterminable to species level or had some level of doubt associated with their identity. This was due to the lack of reproductive material on the specimens at this time of year.

Given the above, this study should not be regarded as an exhaustive account of the flora and fauna of the study area. It is suitable to provide a preliminary appraisal and needs to be supplemented by suitable seasonal work. It is possible that some species or communities of potential significance have not been detected or other ecological constraints and management issues may be present that remain unidentified.

6.8.1.3 Vegetation Associations and Flora of the Kemerton Industrial Park

Muir Environmental (1999) summarised the vegetation of the Kemerton Industrial Park in three major north – south trending belts. The eastern side is described as mainly wetland complexes, the central portion is largely Jarrah woodland; and the western side is Tuart and some Jarrah woodland on Spearwood sands and Redheart (*Eucalyptus decipiens*) on limestone. A good proportion of the vegetation is in reasonably good condition although virtually all the woodlands have been heavily logged or grazed at some time.

Vegetation in the Industrial Core is composed primarily of upland Jarrah to the west, pine plantation to the south east with small patches of lowland Jarrah and some heath wetland complexes on the eastern side of the Park. Tasmanian Blue Gum plantations are present in the north east of the Core Expansion Area. A large portion of land through the centre of the Industrial Core is cleared. A cleared transmission line easement also runs from north to south through the eastern side of the Industrial Core.

Most of the central part of the Kemerton Industrial Park including the Industrial Core is, or was originally Jarrah woodland. The woodland extended from the high points on Spearwood Sand down to the damplands and their adjacent areas of Bassendean Sand. The most obvious variation in the woodland occurs with increasing numbers of *Banksia ilicifolia*, *Kunzea ericifolia* and a few other species in the lowland Jarrah.

Jarrah dominated vegetation is generally 14 – 20m in height with *Banksia attenuata* and/or *Banksia ilicifolia* as the most common sub-tree stratum. The understorey is mostly dominated by *Melaleuca thymoides* over a denser ground layer of mixed shrubs including *Hibbertia hypericoides*. This structure and composition of Jarrah woodland is common over much of the southern Swan Coastal Plain where Jarrah woodland remains. All of the Jarrah woodlands have been heavily logged in the past. The woodlands which remain are a mixture of old growth trees which were unsuitable for logging or are new growth which has arisen since logging took place.

Some evidence of Dieback infection was observed in 64% of woodland sites surveyed by Muir Environmental (1999). Two main areas of severe infestation were observed; one well north of the Kemerton Industrial Park expansion boundary, and one right at the southern tip of the buffer zone (approximately 1km north of where the Australind bypass crosses the Wellesley River). One other site was observed to be infested and this location is within and central to the northern buffer zone. All other sites only recorded minor infestations.

As part of the planning process for the development of the Kemerton Industrial Park expansion, the Environmental Protection Authority required LandCorp to commission comprehensive flora and fauna studies of the proposed Kemerton Industrial Park expansion. These are the Muir Environmental (1999) and Armstrong P.G. and Associates (1999) reports. The review of these studies, by the EPA, resulted in modifications to the Final Concept Plan for the Kemerton Industrial Park (refer to **Section 4.2**).

In this review, the EPA assessed vegetation within the Industrial Park, either:

- As being suitable for industrial development, parts of which have significant vegetation or wetland values and would need to be managed to ensure that these areas are retained and protected; or

- As significant remnant vegetation which should be provided with a high level of protection.

Within the industry core, the EPA has recommended that the areas shown as "Vegetation Management" in **Figure 4-2** be managed to ensure their significant vegetation and wetland values are retained and protected within the industrial estate (WAPC, 2000a). None of these areas cover the preferred power station site or wastewater pipeline route.

6.8.1.4 Vegetation Associations and Flora of Kemerton Power Station Site

The majority of the preferred power station site is on a Blue Gum plantation, as shown in **Plate 6-1**. A small section at the south consists of Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banksia attenuata* Woodland in Good to Poor condition (**Plate 6-2**). The understorey has been historically impacted by either grazing or soil disturbance, with only a proportion of remnant shrub species. The dominant understorey species were Zamia Palm *Macrozamia riedlei*, *Hibbertia hypericoides*, Blue Boy *Stirlingia latifolia* and Grass Tree *Xanthorrhoea brunonis*. Herbaceous species were not adequately assessed, as they were dormant at the time of the survey.

- **Plate 6-1 Blue Gum *Eucalyptus globulus* plantation (northern part of the preferred power station site)**

- **Plate 6-2 Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banksia attenuata* Woodland over scattered shrubs and annual weeds (remnant vegetation at southern end of preferred power station site)**

Within this remnant vegetation area, weeds are widespread at between 10 and 60% cover, however they are generally non-aggressive, annual herbs and grasses that are common throughout the sandy areas of the South West of Western Australia. The most common species were Flatweed **Hypochaeris glabra*, Blowfly Grass **Briza maxima*, Wild Oats **Avena* sp. and **Ursinia anthemoides*. Some form of historical disturbance accounts for the dominance of these weed species, such as grazing.

According to the initial survey of the broader industrial estate (Muir Environmental, 1999), this type of vegetation is equivalent to 'Jarrah Woodland' with 'additional presence of Marri'.

6.8.1.5 Vegetation Associations and Flora of Proposed Wastewater Pipeline Route

The results of the field survey along the proposed wastewater pipeline route are presented below within five Sections from the western boundary of the Kemerton Industrial Park Core area through to the coast. Vegetation types along the route are mapped in **Figure 6-6**.

Eight vegetation communities were identified along the proposed wastewater pipeline route:

Woodlands/Forest

1) *Agonis flexuosa* Forest over scattered shrubs and weedy understorey.
2) *Eucalyptus marginata* and *Banksia attenuata* Woodland.

Coastal Shrublands/Woodlands

3) Foredune: Sparse shrub and grassland.
4) Secondary Dunes: Dense *Acacia rostellifera* Shrubland.

5) Consolidated Dunes: Mosaic *Acacia rostellifera* Shrubland and *Agonis flexuosa* Low Woodland.

6) Mosaic *Agonis flexuosa* woodland with scattered Tuart *Eucalyptus gomphocephala* and *Melaleuca rhaphiophylla.*

Samphire

7) Samphire flats.

Degraded

8) Scattered remnant overstorey over weeds.

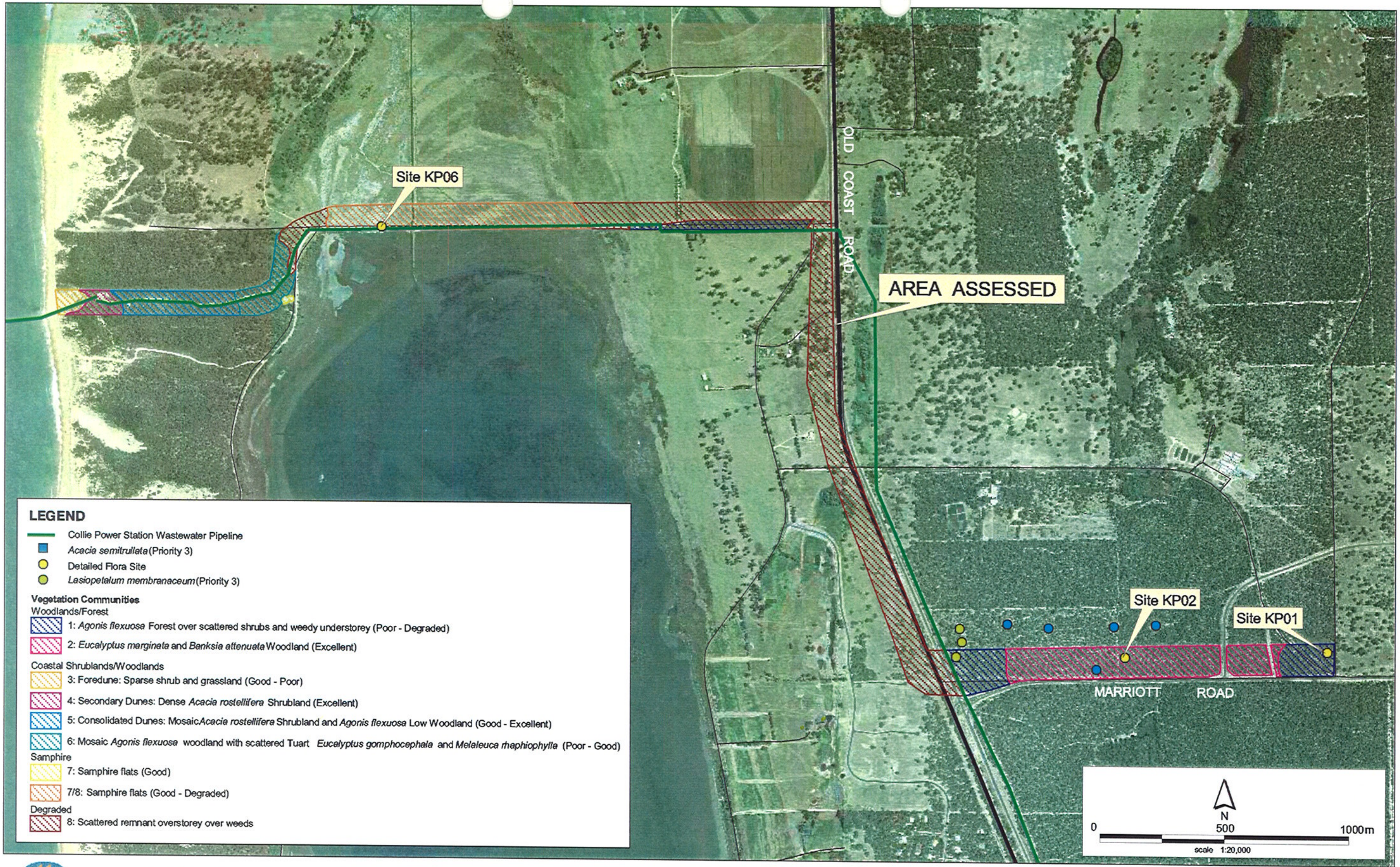
According to the initial Kemerton Industrial Park survey (Muir Environmental, 1999), *Agonis flexuosa* Forest over scattered shrubs and weedy understorey (Community 1) is probably a heavily logged manifestation of *Eucalyptus marginata* and *Banksia attenuata* Woodland (Community 2). In Muir Environmental's survey, both of these associations were classified as 'Jarrah Woodland'. Communities 3 to 7 were not represented within the Kemerton Industrial Park according to Muir Environmental (1999), as they are associated with more coastal areas.

Marriott Road Section:

This section of the proposed route consists predominantly of Jarrah *Eucalyptus marginata* over *Banksia attenuata* woodland (Community 2) in Excellent condition, with occasional tall Marri *Corymbia calophylla* (**Plate 6-3**) (Site KP02).

- **Plate 6-3 Jarrah *Eucalyptus marginata* and *Banksia attenuata* Woodland (Site KP02 – Marriott Road section of proposed wastewater pipeline route)**

There is a sparse small tree strata of *Banksia grandis* and Woody Pear *Xylomelum occidentale.* The greatest recorded diversity at the time of the survey was in the lower shrub (less than 1m), herbaceous perennial and sedge strata, which was dominated by *Hibbertia hypericoides*, *Melaleuca thymoides*, Blue Boy *Stirlingia latifolia*, *Dasypogon bromeliifolius* and Zamia palm *Macrozamia riedlei.*



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KEMERTON POWER STATION

VEGETATION MAP OF THE PROPOSED WASTEWATER PIPELNE CORRIDOR OUTSIDE OF THE KEMERTON INDUSTRIAL PARK

FIGURE 6-6

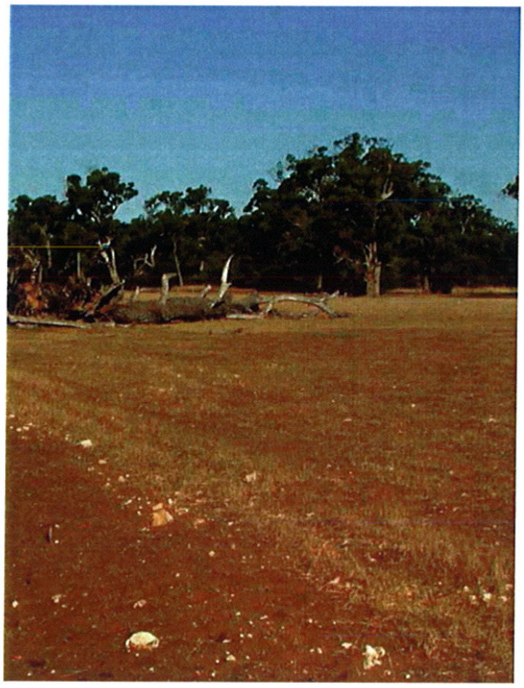
Project No. DE01833.200
Date Drawn: 14.08.2001
Prepared by: T.Lee

Stylidium, *Drosera*, *Orchidaceae* species and other seasonal herbaceous perennials and annuals expected from this community type were absent at the time of the survey, significantly limiting the adequacy of the work. Given this, at least a third of the floral species diversity of this community may have been dormant. Much of this area had been burnt within the last two years.

At the west end near the highway and at the east end (boundary with Kemerton Industrial Park) there is an area of Peppermint *Agonis flexuosus* over impacted, weedy understorey (**Plate 6-4**) (Community 1). The sparse lower perennial strata (less than 1m) mainly consisted of *Hibbertia hypericoides, Xanthorrhoea brunonis* and *Macrozamia riedlei* with occasional mixed shrubs and sedges. Weeds accounted for up to 90% of the ground cover and were dead during the survey. According to the initial survey of the Kemerton Industrial Park (Muir Environmental, 1999), this vegetation community is a disturbed version of Community 2 (Jarrah Woodland).

Pasture adjacent to Old Coast Road:
The proposed wastewater pipeline route runs to the west of Old Coast Road in degraded pasture, which contain no features of any conservation significance (**Plate 6-5**) (Community 8).

- **Plate 6-4 Peppermint *Agonis flexuosa* over degraded understorey (Site KP01 – eastern end of Marriott Road section of proposed wastewater pipeline route)**



- **Plate 6-5 Pasture with remnant Tuart *Eucalyptus gomphocephala* over weeds (pasture adjacent to Old Coast Road section of proposed wastewater pipeline route)**

Buffalo Road East:
The proposed wastewater pipeline route runs to the north of Buffalo Road, which is again degraded pasture (Community 8).

Buffalo Road West:
This is the portion of the wastewater pipeline route where it crosses the northern margin of the Leschenault Estuary, on the north side of Buffalo Road. The vegetation is a mosaic of degraded weedy roadside and pasture, with Samphire shrubland in relatively good condition. The Samphire occurs on both sides of the road where it crosses the estuary, on sandy clay flats (**Plate 6-6**) (Community 7).

- **Plate 6-6 Weed infested roadside vegetation above samphire flats (Site KP06 – Buffalo Road west section of proposed wastewater pipeline route)**

Buffalo Road – Coast:
The wastewater pipeline route in this section runs adjacent to an existing infrastructure corridor. The surrounding vegetation consists of sparse shrubland and *Spinifex longifolius* and *S. hirsutus* along the coast (**Plate 6-7**) (Community 3). The secondary dunes support dense stands of *Acacia rostellifera* (**Plate 6-8**) (Community 4). Further inland *Agonis flexuosa* forms increasingly dense stands of tall shrubs to low trees (**Plate 6-9**) (Community 5).

- **Plate 6-7 Sparse coastal shrubland of *Spinifex longifolius* and *S. hirsutus* (Buffalo Road – coast section of proposed wastewater pipeline route)**

- **Plate 6-8 Low coastal scrub on foredune (first dune east of ocean) (Buffalo Road – coast section of proposed wastewater pipeline route)**

- **Plate 6-9 Coastal thicket of *Acacia rostellifera* (Buffalo Road – coast section of proposed wastewater pipeline route)**

In dune swales towards the Leschenault Estuary, Tuart *Eucalyptus gomphocephala* is sometimes present in association with the *Agonis flexuosa* association. Where this section of the proposed wastewater pipeline route meets Buffalo Road, there is a small area of *Melaleuca rhaphiophylla* on water gaining soils.

The condition of the vegetation in this section is variable. The foredune along the coast of Western Australia is typically vegetated to a large degree by introduced species. This area is naturally volatile with large areas of bare sand and dune blowouts a common feature. This may be exacerbated by off road vehicles and clearance of vegetation. There is already a large cleared area where the proposed wastewater pipeline route exits to the ocean and the use of this disturbed area should be maximised during detailed design.

The secondary and consolidated dunes are generally in Good condition. Areas towards the east (mosaic *Agonis flexuosa, Eucalyptus gomphocephala* and *Melaleuca rhaphiophylla*) have more weeds and impacted understorey than *Acacia rostellifera* shrublands closer to the coast. However, the existing track and approximately 5m either side is generally in Poor condition as a result of existing and ongoing disturbance processes.

6.8.1.6 Threatened Flora Species

In Western Australia, all native flora species are protected under the *Wildlife Conservation Act 1950*, making it an offence to remove or harm native flora species without approval. In addition to this basic level of statutory protection, a number of plant species are assigned an additional level of conservation significance based on the fact that there is a limited number of known populations, some of which may be under threat (see **Table 6-3**). Species of the highest conservation significance are designated DRF, either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of four Priority flora categories.

- **Table 6-3 Categories of Conservation Significance for Flora Species (Atkins, 2001)**

Category	Description
Declared Rare Flora – Presumed Extinct	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.
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.
Priority 1 – Poorly Known Taxa	Taxa which are known from one or a few (generally less than 5) populations which are under threat.
Priority 2 – Poorly Known Taxa	Taxa which are known from one or a few (generally less than 5) populations, at least some of which are not believed to be under threat.
Priority 3 – Poorly Known Taxa	Taxa which are known from several populations, at least some of which are not believed to be under threat.
Priority 4 – Rare Taxa	Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

No DRF flora were recorded during the field survey, but two Priority Flora species were recorded along the Marriott Road section of the proposed wastewater pipeline route, which are described below. Both of these species are Priority 3 Flora (taxa which are known from several populations, at least some of which are not believed to be under threat).

Acacia semitrullata (Priority 3)

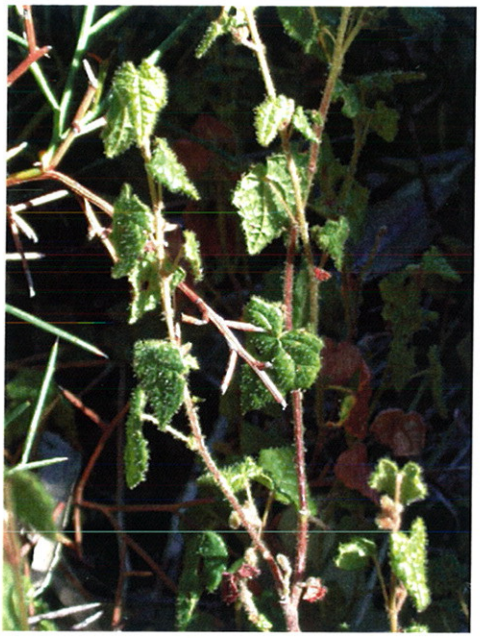
This species is a small upright shrub with yellow, ovoid flowers typical of Acacias (**Plate 6-10**). It was scattered throughout the Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland along the Marriott Road Section of the proposed wastewater pipeline route. The vegetation in this area is in excellent condition with all strata levels intact and only scattered annual weeds.

It has previously been recorded from Yallingup, Donnybrook, Harvey, Yarloop and Collie (Atkins, 2001). There were 29 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations this represents. Many of the populations were recorded from degraded road verges. At least one population is reserved within the Whicher Range Nature Reserve.

Lasiopetalum ?membranaceum (Priority 3)

This species is a low rounded to sprawling shrub (**Plate 6-11**). It was located at the western end of Marriott Road Section of the proposed wastewater pipeline route near Old Coast Road, in Marri *Corymbia calophylla* and Peppermint *Agonis flexuosus* Woodland. This vegetation is in Good to Poor condition with some of the native shrub strata absent and a ground layer of annual weeds. It has previously been recorded from Yalgorup, Capel, Dwellingup, Yandup, Australind, Dawesville and Yanchep. There were 12 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations this represents. At least two populations are protected in the Yalgorup and Yanchep National Parks.

- **Plate 6-10 *Acacia semitrullata* (Priority 3) (Marriott Road section of proposed wastewater pipeline route)**



- **Plate 6-11 *Lasiopetalum ?membranaceum* (Priority 3) (west end of Marriott Road section of proposed wastewater pipeline route)**

In addition, searches were commissioned of the CALM Threatened (Declared Rare) Flora, Western Australian Herbarium Specimen and Declared Rare and Priority Flora List databases. A summary of the known local occurrence, status and distribution of these species in the study area is provided in **Table 6-4** below.

- **Table 6-4 Other Declared Rare and Priority Flora Species known from the Locality of the Study Area**

Species	Conservation Status	No. of Populations in locality
Diuris micrantha	DRF	4
Drakea elastica	DRF	2
Drakea micrantha	DRF	2
Verticordia attenuata	Priority 3	1
Caladenia speciosa	Priority 4	1
Pultenaea skinneri	Priority 4	2
Drosera marchantii	Priority 4	1

The CALM DRF and Priority list also notes *Acacia flagelliformis* (Priority 4), *Aponogeton hexatepalus* (Priority 4), *Jacksonia sparsa* ms (Priority 4) and *Stylidium longitubum* (Priority 3) as known records from the locality of the study area.

Strategies to minimise potential impacts on flora and vegetation are discussed in **Section 7.3.1.2**.

6.8.2 Fauna and Fauna Habitats

6.8.2.1 Fauna Habitats

Preferred Power Station Site

The fauna habitat present in the preferred power station site area comprises one primary unit; *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* woodland with open understorey on pale grey sands (see **Section 6.8.2.2**; **Plate 6-2**).

Proposed Wastewater Pipeline Route

Several habitat units are crossed by the proposed wastewater pipeline route, including:

- Peppermint *Agonis flexuosa*/Jarrah *Eucalyptus marginata* woodland over weeds on Bassendean sands;
- Peppermint *Agonis flexuosa* low woodland on coastal sands;
- *Eucalyptus marginata* and *Banksia attenuata* woodland;
- Samphire flats north of the Leschenault Estuary; and
- Coastal Acacia shrubland and spinifex dunes.

These habitats are likely to support a range of native and introduced vertebrate fauna, typical of the coastal South West of Western Australia (Christensen *et al*, 1985; How *et al*, 1987). Without conducting any fauna survey work there is little value in attempting to compile a full listing of all species of mammal, birds and herpetofauna that may be present in the area. Given the strategic level of this assessment, habitat and distribution based assessment of potential occurrence has only be undertaken for threatened fauna taxa (see **Section 6.8.2.2**).

6.8.2.2 Potential Threatened Fauna Species

In Western Australia, all native fauna species are protected under the *Wildlife Conservation Act 1950*. Fauna species which are considered rare, threatened with extinction or have high conservation value are specially protected under the Act. In addition, some species of fauna are covered under the 1991 Australian and New Zealand Environment and Conservation Council (ANZECC) convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice 1998* recognises four distinct schedules of taxa which are outlined in **Table 6-5**.

- **Table 6-5 Schedules of Conservation Significance Categories of Fauna Species**

Schedule	Description
Schedule 1	Fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection
Schedule 2	Fauna which are presumed to be extinct and are declared to be fauna in need of special protection
Schedule 3	Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction which are declared to be fauna in need of special protection
Schedule 4	Fauna that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, CALM also classifies fauna under four different Priority codes, which are detailed in **Table 6-6**.

- **Table 6-6 CALM Fauna Priority Classification Codes**

Priority Code	Description
Priority 1 Taxa with few, poorly known populations on threatened lands.	Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 2 Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.	Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 3 Taxa with several, poorly known populations, some on conservation lands.	Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.
Priority 4 Taxa in need of monitoring.	Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

A search was commissioned of CALM Threatened Fauna database. Six species of Schedule listed fauna and eight species of Priority fauna were identified as potentially occurring in the study area.

6.8.2.2.1 Schedule 1 (Fauna which is Rare or likely to become Extinct)

Dasyurus geoffroii – Chuditch

This species occurs in a wide spectrum of habitats and occupies a considerable home range. The stronghold for this species tends to be in the more open jarrah forests and woodlands south west of the project area, but there is a recent record from north of Australind. This species potentially occurs both in the woodland habitats in the eastern portion of the proposed wastewater pipeline route and the woodlands near the preferred power station site.

Pseudocheirus occidentalis – Western Ringtail Possum
The preferred habitat of this species comprises coastal peppermint woodlands. The abundance and distribution of the Ringtail *Pseudocheirus occidentalis* is considerably reduced since European occupation (How *et al*, 1987; Burbidge and de Tores, 1998). It is now restricted to coastal and near coastal peppermint associations from the Australind – Eaton area to Waychinicup National Park (Burbidge and de Tores, 1998). How *et al* (1987) suggests that "Nowhere in the study area (coastal region from Busselton to Albany) are dense populations of either possum species (*Trichosurus vulpecula* and *P. occidentalis*) known to occur". The denser woodland habitats crossed by the proposed wastewater pipeline route where *Agonis flexuosa* formed a dominant component are likely to provide a suitable habitat resource for this species. A translocated population exists in nearby Yalgorup National Park.

Calyptorhynchus baudinii – Baudin's Cockatoo
This species is most common in the far South West of Western Australia where it breeds. Breeding records come from the southern forests north to Collie and east to near Kojonup.

Baudin's Black Cockatoo typically forms vagrant flocks and utilises the taller more open, Jarrah/Marri woodlands where it feeds predominantly on marri seeds but also takes wood boring grubs (Blakers *et al*, 1984). Saunders and Ingram (1994) claimed that it is possible that the Baudin's Cockatoo has not declined over the past 50 years. However, like the Forest Red-tailed Black Cockatoo, forestry operations have the potential to affect this species by reducing the availability of nest sites. In contrast, Storr (1991) and Johnstone and Storr (1998) claim that this cockatoo has declined over the past 50 years, but do not speculate as to a possible cause. It occurs only in low numbers in the locality and is possibly an occasional visitor to the study area.

Calyptorhynchus latirostris – Carnaby's Cockatoo
This species inhabits the South West of Western Australia with most breeding occurring between the 350mm and 700mm rainfall isohyets (Garnett, 1992). The preferred habitat is typically woodland where it preferentially feeds on plants of the *Proteaceae*. Winter flocks also inhabit heaths. The species is considered to be scarce and patchily distributed in the deep South West (Johnstone and Storr, 1998).

6.8.2.2.2 Schedule 4 (Fauna otherwise in need of special protection)

Falco peregrinus – Peregrine Falcon
The Peregrine Falcon is widespread across all of Australia, but only occurs at very low densities and with a patchy distribution. It is known to favour open woodlands amongst other habitats (Schodde and Tidemann, 1990) and may be an occasional visitor to the woodlands and woodland margins of the study area. *F. peregrinus* is a Schedule 4 species, indicating that while it is considered to require special protection, it is not regarded as being in danger of extinction.

Morelia spilota imbricata – Carpet Python
This species is relatively widespread within the South West but typically not at high density within this range. It is known to occur in Yalgorup National Park, and may occur in the habitats of the power station study area and the proposed wastewater pipeline route.

6.8.2.2.3 Priority Fauna

Phascogale tapoatafa – Brush-tailed Phascogale (Priority 3)
The Brush-tailed Phascogale is a largely arboreal, carnivorous dasyurid that occurs in a variety of regions in Australia with open, dry sclerophyll forests on ridges and reliable rainfall patterns (Cuttle, 1996). The South West populations of *Phascogale tapoatafa* are listed by CALM as Priority 3 and have recently been recorded in similar habitats near Bunbury.

Isoodon obesulus fusciventer – Southern Brown Bandicoot (Priority 4)
This species is locally common in dense swamps in the South West of the state and has recently been downgraded from Schedule 1 to a Priority 4 species. A translocated population of this species occurs in the Leschenault Conservation Park. The species typically requires dense understorey vegetation to persist and may occur in the denser woodland vegetation occurring along Marriott Road.

Macropus irma – Western Brush Wallaby (Priority 4)
This species is common in open northern Jarrah forest associations, but was not recorded on any of seven south coastal communities surveys detailed by Christensen *et al* (1985) and is regarded by these authors as typically absent from high rainfall areas with dense closed understoreys. It is possibly present in the coastal woodlands crossed by the proposed wastewater pipeline route.

Calyptorhynchus banksii naso – Forest Red-tailed Black Cockatoo (Priority 3)
A Priority 3 species, the Forest Red-tailed Black Cockatoo has seriously declined in numbers since European settlement (Saunders and Ingram, 1994). Causes included clear-felling and 80 year cut rotation forestry practices which could significantly reduce the number of large tree hollows (Saunders and Ingram, 1994). Storr (1991) reports that the species was formerly common and is now uncommon and patchily distributed. The species utilises Jarrah – Marri woodlands and is likely to occur in such habitats both along the proposed wastewater pipeline route and within the preferred power station site.

Falsistrellus mackenziei – Western False Pipstrelle (Priority 4)
This bat species occurs in the high rainfall regions of the South West including the Swan Coastal Plain. The species is known to occur nearby around Lake Clifton and may utilise the open woodlands of the study area.

Thinornis rubricolis rubricolis – Hooded Plover (Priority 4)
This migratory bird species has been recorded from the margins and shallows of Leschenault Estuary. It may occasionally stray into samphire habitats crossed by the proposed wastewater pipeline route but is unlikely to be reliant on these areas for core habitat requirements.

Numenius madagascariensis – Eastern Curlew (Priority 4)
Similar to the Hooded Plover, this bird species has also been recorded from the shallows and margins of the Leschenault Estuary.

Strategies to minimise potential impacts on fauna and fauna habitats are discussed in **Section 7.3.2.2**.

6.9 Marine

A water-cooled combined cycle power station developed at Kemerton may have the potential to impact on the marine environment through ocean disposal of wastewater from blow-down from the cooling system (refer to **Section 4.5.4** and **5.4.5**). As discussed in **Section 4.5.4**, the preferred option for wastewater disposal from the power station would be through the common user centralised wastewater treatment facility for Kemerton Industrial Park proposed by the Department of Minerals and Petroleum Resources, Office of Major Projects. However, given the uncertain timing of the proposed power station development and of the construction of the centralised wastewater treatment facility, the option of disposal of wastewater through the existing Collie Power Station ocean outfall facility is considered within this report.

The Collie Power Station ocean outfall was commissioned in mid 1998 and significant discharge from the outfall did not commence until January 1999. The outfall extends approximately 800m offshore and is attached to concrete blocks on the sea bed. The end of the outfall pipeline consists of a linear diffuser lying in 10m of water. Since the commencement of discharge to the marine environment, a monitoring program has reported no significant impact on water or sediment quality nor bioaccumulation in mussels deployed at the site (Pacific Western, 2000).

The Collie Power Station ocean outfall discharges into the ocean offshore just south of Buffalo Road, north of the Leschenault Estuary (**Figure 4-6**). The area around the outfall consists of a gently sloping seabed. The depth of the water increases gradually, reaching a maximum depth of 20m approximately 6km offshore (SECWA, 1994). The seabed then remains relatively flat up to the edge of the continental shelf, which is approximately 90km offshore.

There are no well developed reefs in the immediate vicinity of the outfall (SECWA, 1994).

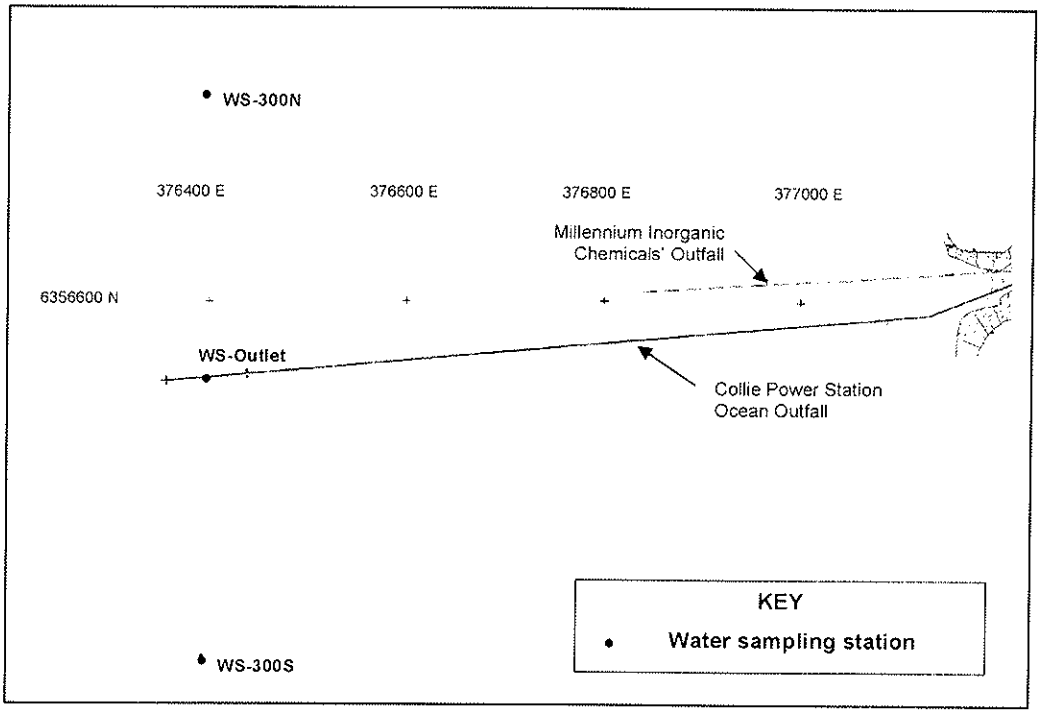
Millennium Inorganic Chemicals (MIC) also discharges wastewater into the ocean near the Collie Power Station ocean outfall. Due to the distance between the two outfalls (approximately 500m), there is no interaction of effects between the waters discharged from the Collie Power Station ocean outfall and the MIC outfall.

6.9.1 Water Quality Survey

A water quality survey was undertaken in the marine environment adjacent to the existing Collie Power Station ocean outfall on May 30th, 2001 by Sinclair Knight Merz staff and the Marine and Freshwater Research Laboratory (MAFRL) on behalf of Western Power. The purpose of the survey was to obtain the following information:

- Ambient physico-chemical data (temperature, salinity, dissolved oxygen, pH and turbidity); and
- Chemical composition data (metals, major anions and major cations).

The study area is shown in **Figure 6-7,** which also indicates water sampling locations. A total of three water quality stations were sampled.



■ **Figure 6-7 Marine Water Quality Survey – Sampling Locations**

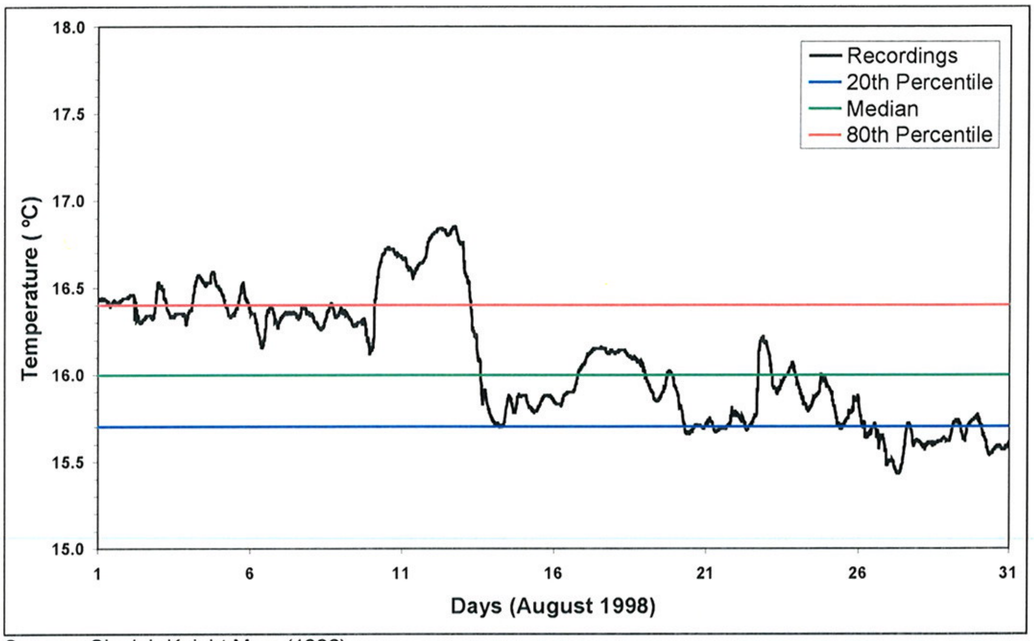
The water quality in the vicinity of the existing Collie Power Station ocean outfall was found to approximate the physical and chemical properties of typical coastal waters for the region (**Table 6-7**).

■ **Table 6-7 Water Quality in Bottom Waters in the Vicinity of the Existing Collie Power Station Ocean Outfall and Compared with Typical Values**

Parameter	Unit	Water Sampling Locations[1]			Typical Values[2]
		WS-300N	WS-Outlet	WS-300S	
Temperature	°C	17.9	18.0	17.9	15–24
Salinity	‰	35.1	35.1	35.1	34.5–35.5
Dissolved Oxygen	mg/L	7.3	7.3	7.3	6.3–7.7
pH		8.08	8.08	8.09	8.0–8.2
Turbidity	NTU	2.6	2.9	2.9	0–100

Note:
1) Water quality sampling undertaken by Sinclair Knight Merz in May 2001.
2) Typical reference values from Sinclair Knight Merz (1998).

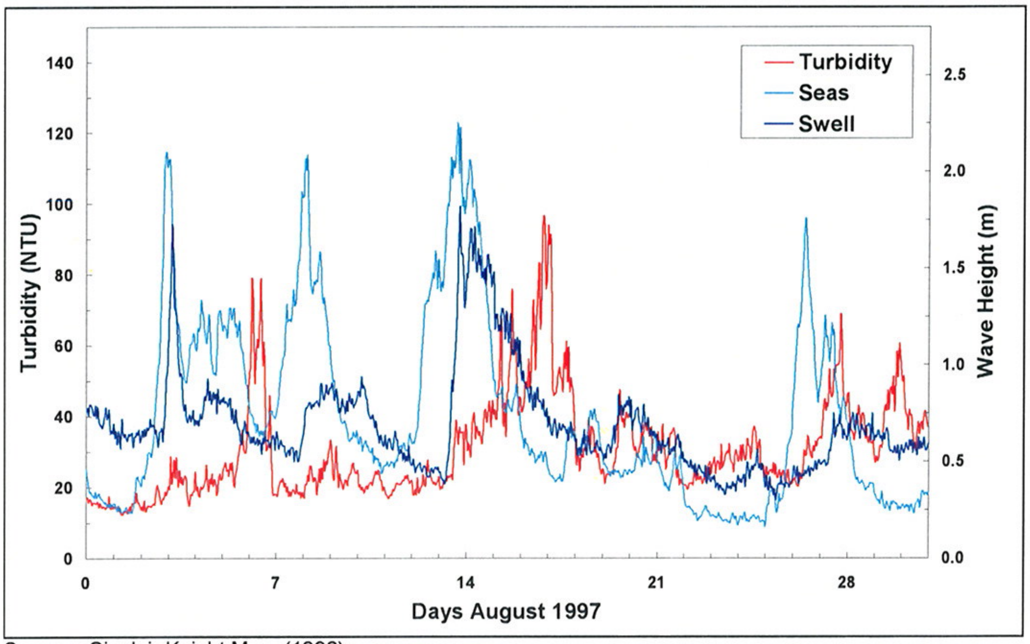
The winter seawater temperature profile at the study site is presented in **Figure 6-8** and is based on 15-minute recordings made during August 1998 (Sinclair Knight Merz, 1998). The median, 20th percentile and 80th percentile values were calculated from the 1998 data set and are also plotted in **Figure 6-8**.



Source: Sinclair Knight Merz (1998)

■ **Figure 6-8 Winter Seawater Temperature Profile**

One of the major influences on the water quality in the region is the input of waters from the Leschenault Estuary, which discharges to the south and is carried by the prevailing currents northward through the area. Winter discharge from the Estuary is highly turbid and contains nutrients from the surrounding catchment. The absence of any high relief reef to the west of the area means that the effects of seas and swell significantly influence sediment resuspension and thus turbidity (Sinclair Knight Merz, 1998). The delayed influence of sea and swell wave height on turbidity can be seen in **Figure 6-9**.



Source: Sinclair Knight Merz (1998)

■ **Figure 6-9 Winter Ocean Turbidity and Wave Height Profile**

The temperature and salinity regime in the area is also highly influenced by the discharge from the Leschenault Estuary due to colder brackish water flowing northward through the area in winter. Often a density gradient results with warmer more salty water being trapped below a colder brackish layer.

6.9.2 Benthic Habitat Survey

A benthic habitat survey was conducted by Sinclair Knight Merz on behalf of Western Power in the vicinity of the Collie Power Station ocean outfall. The purpose of the survey was to obtain the following information:

- Percentage cover of the seabed by various habitat categories; and
- An overall assessment of the health of the benthic habitat adjacent to the existing outfall.

6.9.2.1 Methodology

Field investigations were undertaken on May 30th and 31st, 2001 by Sinclair Knight Merz and MAFRL staff. A total of 14 video transects were sampled. The study area is shown in **Figure 6-10** which also indicates video transect lines.

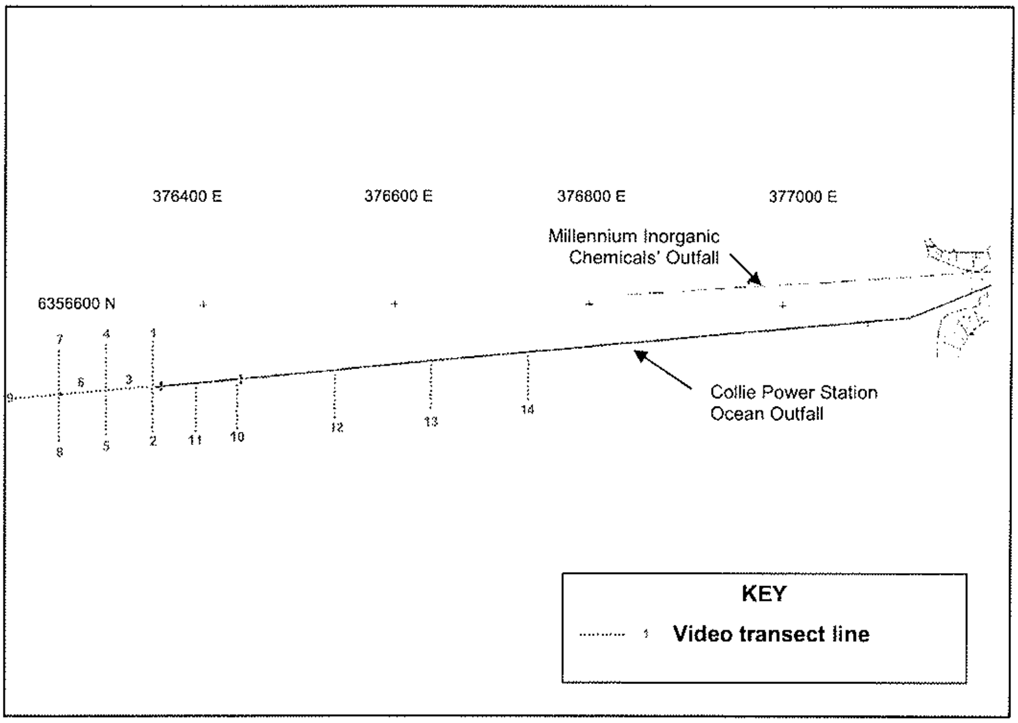


Figure 6-10 Marine Survey – Video Transect Locations

Underwater video footage of the site was acquired by movement of the video camera along 50m transects. Divers maintained a constant speed with the video maintained approximately 0.5m above the seabed. This obtained a transect width of around 0.6m and provided an area of $30m^2$.

The video recording was captured to an electronic file and then stored on a compact disk. The Sinclair Knight Merz Video Transect Analysis System then retrieved the electronically recorded transect for analysis. The program requires input of transect start and finish (frame number), location, replication number and site location. It then proceeded to randomly select the specified number of frames (200), each allocated with a randomly placed spot.

The benthos occurring under the random spot were identified to an appropriate taxonomic level and entered into a database. Most fauna in the study area was either cryptic or very sparse, therefore, the quantification of habitat was based on the following categories:

- Bare sand;
- Pavement;
- Macroalgae;
- Seagrass; and
- Detritus.

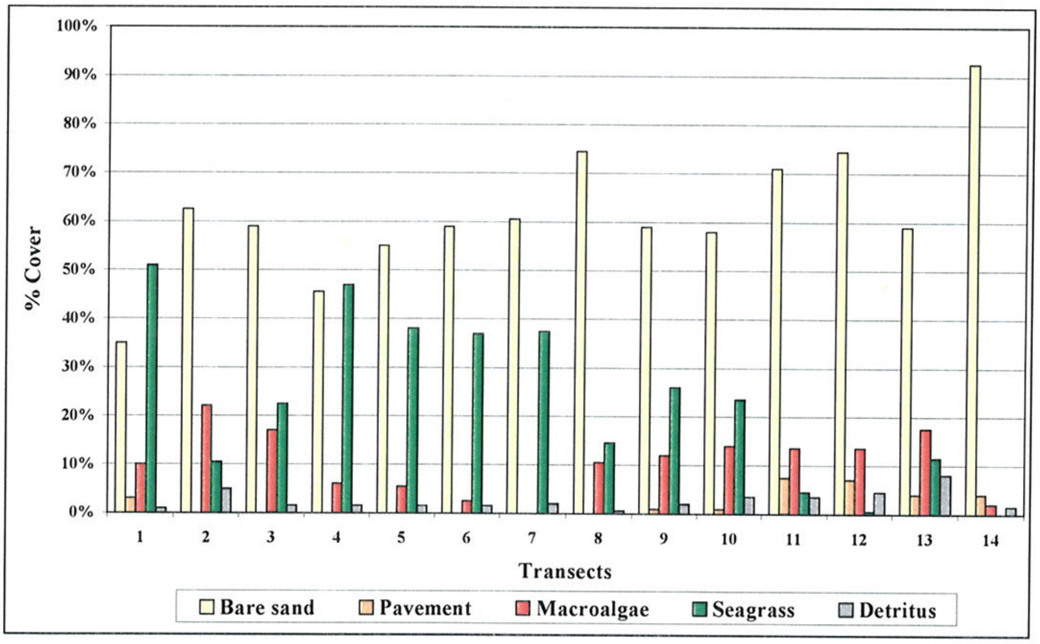
Benthic codes were assigned to respective spots according to the habitat type beneath it. Codes were retrieved from the Videocode database. Once codes were assigned and the respective frame completed, the program advanced to the next randomly selected frame along the transect and the process was repeated until the designated number of frames were completed. The program then computed percentage cover of each habitat category.

6.9.2.2 Results

The percentage cover of the seabed along the 14 transects is presented in **Table 6-8** and graphically in **Figure 6-11**.

- **Table 6-8 Percentage Cover of Benthic Habitat**

Transect	Benthic Categories (% Cover)				
	Sand	Pavement	Detritus	Macroalgae	Seagrass
1	35%	3%	1%	10%	51%
2	63%	0%	5%	22%	11%
3	59%	0%	2%	17%	23%
4	46%	0%	2%	6%	47%
5	55%	0%	2%	6%	38%
6	59%	0%	2%	3%	37%
7	61%	0%	2%	0%	38%
8	75%	0%	1%	11%	15%
9	59%	1%	2%	12%	26%
10	58%	1%	4%	14%	24%
11	71%	8%	4%	14%	5%
12	75%	7%	5%	14%	1%
13	59%	4%	8%	18%	12%
14	93%	4%	2%	2%	0%



■ **Figure 6-11 Benthic Habitat Cover**

The habitat in the vicinity of the existing Collie Power Station ocean outfall varies with distance from shore. The nearshore habitat is dominated by bare sand overlying limestone pavement. Further offshore, predominantly sand and pavement habitat has patches of low relief reef and sparse seagrass (*Posidonia angustifolia*). Seagrass meadows are generally confined to offshore areas (greater than 600m) due to the sediment mobility and the presence of pavement, low relief reef and very coarse sediments. Seagrass meadows within 1km of shore in the area are often sparse while those further offshore in deeper water (12 – 15m) are more dense. The high energy nature of the area often leads to significant sediment transport and often seagrass meadows are undermined in the process (Sinclair Knight Merz, 1998).

There is a significant seagrass community to the west of the existing outfall, principally to the north of or in line with any potential extension of the outfall. The seagrass in the area is largely of one species, *Posidonia angustifolia,* that is commonly found in waters of 10 to 30m depth and often forms meadows with a sparse density.

The seagrasses in the vicinity of the outfall were found to be in a healthy condition with low epiphyte loads and no signs of leaf damage. There was no obvious difference between the seagrass along the existing outfall and that further to the west.

The existing outfall appears to have had little affect on the adjacent seagrasses. The outfall was purposely positioned to minimise being laid over meadows, however, the effluent has no physical or chemical properties that would harm seagrasses. It is only the footprint of the concrete blocks that support the pipeline that would impact on seagrasses beneath it. The pipeline and outfall are raised above the seabed and as a result have not significantly affected sediment transport or deposition.

A discussion on the potential impacts on the marine environment and proposed management and monitoring strategies is provided in **Section 7.3.3** and **8.3.1**.

6.10 Socio-Economic Environment

Due to the close proximity of the Kemerton Industrial Park to the City of Bunbury, it is assumed that the majority of the construction and operation workforce would reside in Bunbury and nearby areas. As such, details of the socio-economic environment are provided for the Bunbury-Wellington region, which covers 6,125km^2 and comprises the local government areas of the City of Bunbury, and the Shires of Capel, Collie, Dardanup, Donnybrook-Balingup and Harvey.

6.10.1 Economic Overview

The Kemerton Industrial Park is situated in the Bunbury-Wellington region, one of four sub-regions which make up the South West region of Western Australia. The economic activity of the Bunbury-Wellington region is undergoing a rapid change of emphasis from rural based agricultural activities to mining, processing and tourism. The majority of the workforce is employed in industries that make the most significant contribution to the region's economy, which include mineral extraction, agriculture, manufacturing and tourism. The Bunbury-Wellington region produces 37% of the State's mineral sands in terms of total value and all of the State's coal. Approximately 20% of the value of WA's alumina is produced in the region and, together with coal and mineral sands, is worth $661 million (BSD Consultants, 1997).

The principal economic statistics for the Bunbury-Wellington region are displayed in **Table 6-9**. Mineral extraction, processing and manufacturing is the largest contributor to the South West regional economy, at approximately $1.0 billion per annum.

Table 6-9 Summary of Bunbury-Wellington Region Economic Statistics

Population	
• Estimated Resident Population (2001)	• 78,690
• Population Growth Rate (2000-2001)	• 2.6%
(2000-2001)	• 2.6%
• Population Projections: 2006, 2011, 2016	• 85,000; 92,000; 98,500
Labour Force (September Quarter 2001)	
• Number Unemployed	• 2,686
• Labour Force	• 41,599
• Unemployment Rate (South West Region)	• 6.5%
• Employment Rate (South West Region)	• 93.5%
Agriculture	
• Value of Agricultural Production (1998/99)	• $173,863,267
Building & Construction (2000/01)	
• Total Value of Building Approvals	• $123,494,000
- Residential	- $82,327,000
- Non-Residential	- $41,167,000
Forestry (1999/00)	
• Delivered Value of CALM Log Production in SW Region	• $87,076,000
Mining (1999/00)	
• Total Mining – Tonnes	• 9,709,981t
• Total Mining – Value	• $1,120,891,807
Tourism (2000)	
• Total Tourist Expenditure in South West Region	• $563,000,000
• Total Visitors to South West Region	• 1,601,500
Property Values (2000)	
• Average Sale Value of Dwellings (Bunbury)	• $144,652

Source: South West Development Commission (2002)

The unemployment rate in the South West Region is consistently lower than the Western Australian State average (SWDC, 2002).

The economic benefits associated with the development of additional generating capacity on the South West Interconnected System (SWIS) are highlighted in **Section 2.2**.

6.10.2 Tourism and Recreation

Tourism is a growing sector of the economy of the Bunbury-Wellington region. In particular, Bunbury is a centre for tourism in the South West region of Western Australia.

The wetlands surrounding Kemerton Industrial Park are potential recreational areas, however public access to these wetlands is currently limited to defined routes and viewpoints (or 'look-outs'). These wetlands are mainly located within the buffer area of the Park and would not be directly impacted by the proposed development.

Myalup, Binningup, Buffalo Beaches and Leschenault Estuary are popular recreational areas. Recreational activities undertaken around these areas include sightseeing, shore and boat based fishing, swimming and diving.

A discussion on the potential impacts on tourism and recreational areas and the proposed management strategies is provided in **Section 9.3**.

6.10.3 Visual Amenity

The Kemerton Industrial Park includes a parkland buffer area located between heavy industry and surrounding land uses. This buffer area comprises:

- Appropriate landscaping of industrial development;
- Maintenance of the existing woodlands and parklands;
- Establishment of plantation buffers;
- Conservation of wetlands; and
- Provision of appropriate recreational facilities.

The landscaping, maintenance and establishment of vegetated areas would minimise the aesthetic impacts of developments on surrounding neighbours.

Future industries establishing within the existing industrial core are expected to be visible from residences along Ridgeview Way. These residences are occupied by tenants of LandCorp on short-term lease arrangements. Residential use of these properties will cease in due course as the development of the Kemerton Industrial Park proceeds.

The closest major public thoroughfare is the Old Coast Road, which travels north south approximately 6km west of the preferred site. The Kemerton core industrial area is shielded from the Old Coast Road by two dunal ridge systems and a vegetated buffer zone.

A discussion on the potential visual impacts from the power station development and proposed management strategies is provided in **Section 9.4**.

6.10.4 Transport Network

Kemerton Industrial Park is located approximately 2-hours south of Perth and 20-minutes north of Bunbury. Bunbury is serviced by an extensive network of roads and highways. Major roads in the area include the South Western Highway and Old Coast Road, both of which are under the control of Main Roads Western Australia. Old Coast Road is a dual carriageway for most of the distance between Bunbury and Kemerton and some of the distance between Kemerton and Perth, while the South Western Highway is a single carriageway. A commitment has also been made to construct the Peel Deviation, a rapid transport link from Bunbury to Perth, by 2005 (SWDC, 2002). Wellesley, Treasure and Marriott Roads are the main roads that provide access into the Kemerton Industrial Park.

There are no rail facilities that service the Kemerton Industrial Park although provision for a corridor through to the South West railway line has been made in the Structure Plan for the Kemerton Industrial Park expansion.

The Kemerton Industrial Park is located less than 20km from the Port of Bunbury, which is used to handle silica sands from Kemerton, in addition to other cargo from the area.

Airports exist at both Bunbury and Busselton, while Manjimup, Margaret River and Augusta have sealed airstrips.

A discussion on the proposed transport strategy for the construction and operational phases of the power station and the proposed management strategies is provided in **Section 9.5**.

6.10.5 Health and Education

Health facilities servicing the Kemerton area are predominantly located in Bunbury. Hospitals, specialist medical facilities and community based health services are available in Bunbury, in addition to retirement villages and other aged care facilities. Both public and private facilities are available.

The closest educational institutions available to the Kemerton area are also located in Bunbury. Both government and private facilities are available for pre-primary through to secondary students. The Bunbury campus of Edith Cowan University and the South West Regional College of TAFE are available for tertiary students. TAFE centres are also located at other smaller towns, including Collie and Harvey.

6.10.6 Minerals and Energy

Extensive mining ventures in the Bunbury-Wellington area make mineral extraction, processing and manufacturing the largest industry sector in the area (SWDC, 2002). In 1999/2000, almost 10 million tonnes of minerals were mined, which was valued at over $1 billion (**Table 6-9**).

Natural gas is supplied to the area via the pipeline from the North West Shelf. Bulk quantities of gas are provided to the Worsley Alumina refinery and other large industries in the area. The natural gas pipeline runs through the Kemerton Industrial Park, adjacent to the preferred power station site.

Further discussion of the potential social impacts on the local community and proposed management strategies is provided in **Section 9.2**.

6.11 European Heritage

A search of the Register of Heritage Places, kept by the Heritage Council of WA and the Register of National Estate Database kept by the Australian Heritage Commission, was undertaken, and no European heritage sites were found within the vicinity of the proposed power station or associated infrastructure. The closest sites are Upton House, Australind and the Cathedral Avenue and Wetlands and Cooks Park Farmhouse Buildings in Leschenault.

Several properties in the Kemerton locality (including Upton House) have been identified in the Shire of Harvey's Municipal Inventory. Of these, the closest property is Runnymead (or Monastery) homestead, which is located on the corner of Wellesley and Runnymede Roads just to the south east of Myalup Swamp, near to the boundary of the Industrial Park (**Figure 6-12**). This homestead is well removed from the proposed development.

6.12 Aboriginal Heritage

McDonald Hales and Associates was commissioned by Sinclair Knight Merz to undertake a review of Native Title and Aboriginal heritage constraints associated with the preferred power station site and the section of the proposed wastewater pipeline route outside of the Kemerton Industrial Park. The objectives of the study were:

- To document any known or potential Native Title and Aboriginal heritage issues arising from the proposed development;
- To provide the proponent with strategic advice and recommendations on the management of known or potential Native Title and Aboriginal heritage issues; and
- To advise the proponent of their statutory obligations under the *Aboriginal Heritage Act 1972* and other relevant legislation.

6.12.1 Regional Ethnographic Context

Despite the large number of known and dated archaeological sites in the South West (Hallam, 1977; Ferguson, 1985; Smith, 1993; McDonald, Hales and Associates, 1994a, 1994b; Lilley, 1993), there have been surprisingly few studies undertaken at a regional scale of analysis. Most research to date has focused on the investigation of single sites or site complexes, from which somewhat unsubstantiated diachronic models of Aboriginal settlement and subsistence have been extrapolated (see for example C. Dortch, 2000; J. Dortch, 2000; Ferguson, 1985; Lilley, 1993; Schwede, 1990; Smith, 1993; O'Connor, Veth and Hubbard, 1993). As a consequence of these limitations in contemporary research, our understanding of the archaeology of the South West of Western Australia remains somewhat nebulous, with many questions and issues to be adequately addressed.

Berndt (1979), drawing on Tindale's analysis, argues that the Southwest of Western Australia was occupied by thirteen 'tribes' or socio-dialectal groups, which formed a discrete socio-cultural bloc. In contrast, Bates (1985) contends that a single 'tribe', which she referred to as the Bibbulmun, occupied the South West. Local groups were distinguished by dialectal and other names. South West Aboriginal people now generally refer to themselves as *Nyungar* (a term meaning man or person), recorded by Bates and other early observers.

Tindale (1974) believed that the area comprising the Kemerton Industrial Park had traditionally been a part of the territory of the *Pindjarup [Bindjared]* 'tribe' or socio-dialectal group.[1] Tindale (1974) describes the *Pindjarep* territory as lying between: "Pinjarra to Harvey and Leschenault Inlet and the lower reaches of the Murray River." Bates (1985) reports that the Bunbury district was occupied by the *Burrong wongi.*

Ethnohistorical data suggests that there was a great deal of movement in the coastal groups. The nature of individual and group movement generated a fluid local population with somewhat permeable territorial boundaries. Movement along 'runs' corresponded to pads connecting the metropolitan wetlands and rivers and extending from Perth to south of Rockingham, Mandurah and the Murray River (Hammond 1933). Given the availability of water and food resources, it is plausible that wetlands were the most intensely occupied areas with wells dug close to swamps to filter water and edible swamp vegetation. As they provided both access tracks and resource availability, site concentration is generally higher around waterways. O'Connor, Quartermaine and Bodney (1989) refer to the Serpentine/Murray and Peel Inlet-Harvey Estuary and the Brunswick/Collie River systems as 'runs' along which Aboriginal families camped and collected resources. At favoured points along these access 'runs', Aboriginal families had campsites whose location, in some cases, has been retained through oral history.

6.12.2 Previous Aboriginal Heritage Research at Kemerton

Numerous Aboriginal heritage surveys in the Kemerton region have been conducted over the past 30 years. However, the coverage of these investigations with respect to the preferred power station site and wastewater pipeline route has been selective, covering the parts of the proposed wastewater pipeline route that run along Marriott Road and Old Coast Road. No archaeological sites were found during these surveys.

The most relevant of these surveys to the preferred power station plant site is that by Pearce and Mulvaney in 1983, who undertook Aboriginal heritage investigations in relation to the proposed Kemerton Industrial Park, which extended from Marriott Road north to Treasure Road. No archaeological sites were found within the proposed development area. This was attributed to "the lack of permanent sources of surface water on this land, which is all sandy and nearly all well elevated above the surrounding country." While Pearce and Mulvaney (1983) conclude that "it is unlikely that significant archaeological material would occur within this area", several isolated flaked stone artefacts and clusters of artefactual material were identified by survey in adjacent areas, most notably along the Old Coast Road and Marriott Road.

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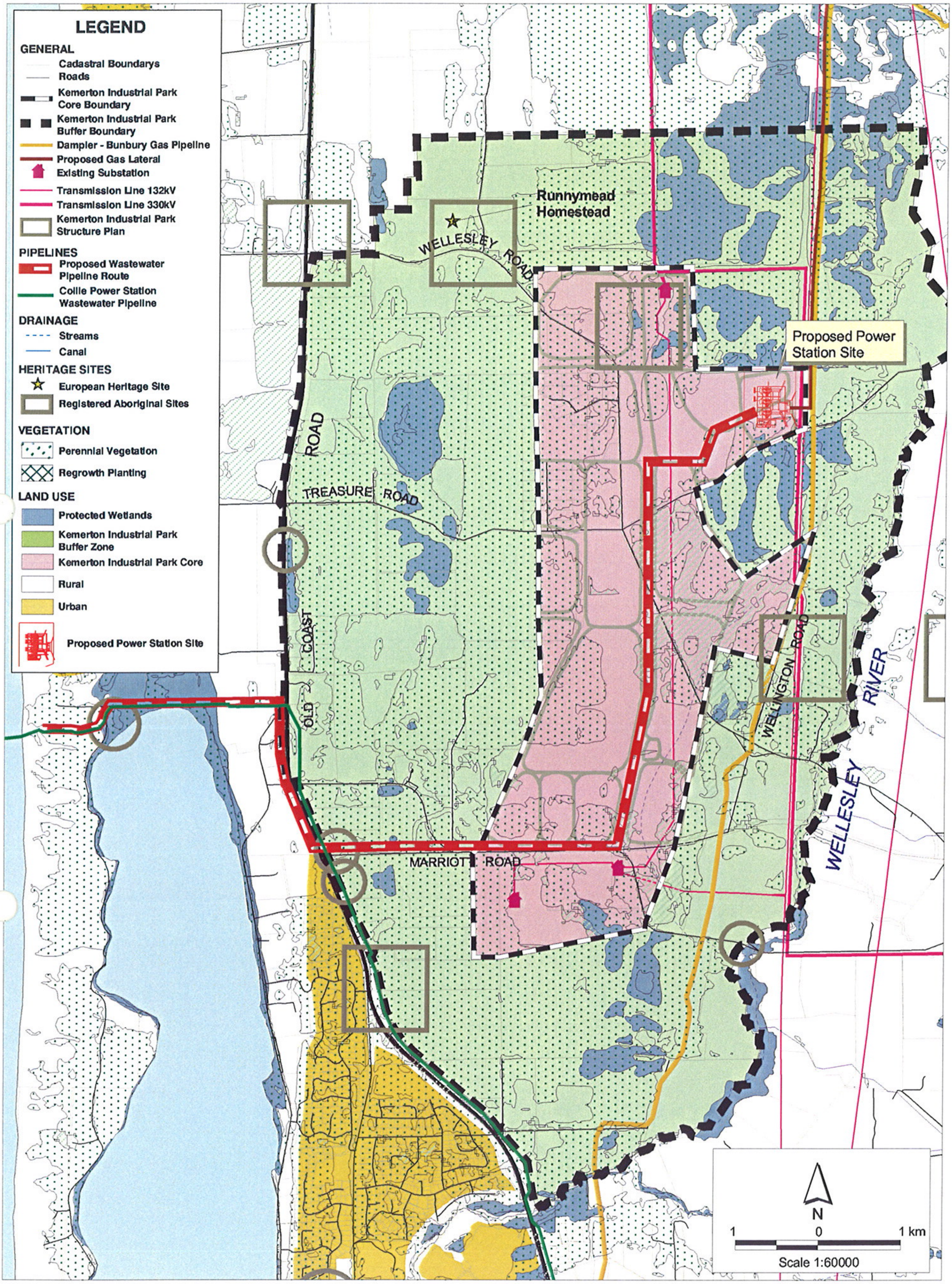
1 In his 1940 article Tindale concluded that the area was occupied by the Kaneang [Ganeang]. He later (1974:244) suggests that the tribe "in later days they went west to the coast".



Western Power

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KEMERTON POWER STATION

RECORDED ABORIGINAL AND EUROPEAN HERITAGE SITES WITHIN THE KEMERTON AREA

FIGURE 6-12

Project No. DE01833.200
Date Drawn: 14.08.2001
Prepared by: T.Lee

The most recent Aboriginal heritage investigations to have been conducted in the vicinity of the proposed wastewater pipeline route is Quartermaine's (2000) survey of the proposed Kemerton Wastewater Treatment Plant and associated infrastructure. The wastewater treatment plant is located on Lot 101 Marriott Road, and encompasses an area of approximately 60ha, 2ha of which would actually be occupied by the wastewater treatment plan site. Two pipeline options (one involving a 1.25km alignment east along Marriott Road to the Millennium Chemicals site; the other a 5km alignment following Rosamel Road and the Old Coast Road to Springhill Road) and a woodlot wastewater disposal area (located west of Old Coast Road between Springhill Road and Binningup Road; cf. McDonald Hales and Associates (1993)) were also surveyed. No Aboriginal sites were identified during this survey. As with previous studies, this was largely attributed to past Aboriginal land use practices, although post-depositional processes and infrastructure development are also implicated.

6.12.3 Aboriginal Heritage Sites

A search of the Department of Indigenous Affair's Register of Aboriginal Sites was conducted. This contains the approximate locations of significant Aboriginal sites. Fifteen Aboriginal sites were found to be located within a 5km radius of the proposed development (**Table 6-10** and **Figure 6-12**). Of these sites, three (sites 4885, 4886 and 15371) were found to be located within the vicinity of the proposed route of the wastewater pipeline.

- **Table 6-10 Summary of Previously Recorded Aboriginal Sites within a 5km Radius of the Proposed Development**

Site ID	Site No.	Site Name	Status	Access Type	Reliability	Site Type
4443	S02741	Mellet Creek	I	O	U	ART
4884	S01841	Old Coast Road 1	I	O	R	ART
4885	S01842	Old Coast Road 2	I	O	R	ART
4886	S01843	Old Coast Road 3	I	O	R	ART
4887	S01844	Marriott Road	I	O	R	ART
5803	S00350	Harvey/Brunswick Junction 51	I	O	U	ART
5804	S00351	Harvey 52/Brunswick Junction Road	I	O	U	ART
5805	S00352	Harvey 53/Brunswick Junction Road	I	O	U	ART
5806	S00353	Harvey 54/Brunswick Junction Road	I	O	U	ART
5807	S00354	Harvey 55/Brunswick Junction Road	I	O	U	ART
5808	S00355	Brunswick Junction 56	I	O	U	ART
5809	S00356	Brunswick Junction 57	I	O	U	ART
5810	S00357	Brunswick Junction 58	I	O	U	ART
15371	S03063	Australind: Buffalo Road Burial	I	O	R	C, BUR
17776	-	Brunswick River	I	O	R	M

Key:
I = Interim (in process of being assessed)
O = Open Access
U = Unreliable location
R = Reliable location

ART = Artefact
C = Ceremonial Site
BUR = Burial Site
M = Mythological Site

Site 4885 (Old Coast Road 2) is reported by Pearce and Mulvaney (1983) as a cluster of five quartz artefacts located on a low dune ridge bisected by the Old Coast Road, approximately 1km south of Marriott Road. This site is located in the immediate vicinity of the proposed wastewater pipeline route.

Site 4886 (Old Coast Road 3) is reported as an extremely low-density artefact scatter located approximately 1.2km south of Marriott Road on the eastern side of Old Coast Road. As with site 4885, this site was located in yellow sand on the slope of a road cutting through a low sand ridge. This site is located in the immediate vicinity of a section of the proposed wastewater pipeline route.

Site 15371 (Buffalo Road Burial) comprises partial human skeletal remains originally identified in March 1998 during the installation of the Collie Power Station wastewater pipeline. Initial police forensic advice indicated that the skeletal material was Aboriginal. Further investigations were undertaken by a qualified archaeologist under the supervision of local Aboriginal elders, and resulted in the recovery of partial remains. It was concluded that the skeletal material was probably introduced into the area during the construction of a car park some years earlier (Corsini, 1998). As such, the original provenance of the skeletal material remains unknown. The skeletal material was reinterred in a grass covered area in the centre of the car park, and is today commemorated by a memorial plaque.

Due to the lack of detailed survey coverage, it is likely that the Aboriginal heritage potential of the Kemerton area has not been fully realised. Given this, the Preferred Bidder would need to take appropriate steps to ensure on-going compliance with the provisions of the *Aboriginal Heritage Act 1972.* Proposed strategies to minimise potential impacts on Aboriginal heritage are discussed in **Section 9.6.2**.

6.12.4 Native Title Claims

A review of the Native Title Claims database maintained by the Department of Land Administration by McDonald, Hales and Associates (2002) revealed that the proposed wastewater pipeline route is encompassed within one extensive native title claim (Native Title Reference WC98_058: Gnarla Karla Booja) represented by the Noongar Land Council. The *Native Title Act 1993* provides a regime for determining whether native title exists over particular areas of land or waters, for validating certain past acts of government and for regulating future acts which may affect Aboriginal rights in land. Claims for compensation are also provided by the legislation, administered by the National Native Title Tribunal, which is essentially a negotiating and mediating body. Contested claims under the Native Title Act are to be determined in the first instance by the Federal Court.

As yet, there has been no native title determination that relates directly to claims covering Kemerton, however land covered by valid freehold grant (as is the preferred power station site) is not subject to native title, whereas Vacant Crown Land is. Further, a long history of use that is inconsistent with native title rights, such as may be characteristic of the Kemerton area, also extinguishes native title. As noted above, the situation remains unclear in respect of certain categories of leasehold (including pastoral leases) and reserves. Once further precedents have been established, the actual impact of potential areas of native title on development in the Kemerton area would become easier to determine.

Should native title persist in the areas proposed for the wastewater pipeline corridor, the Native Title Act provides a mechanism for validating the development that is consistent with the rights of the Native Title claimants. Subdivision K of the Native Title Act sets out a mechanism for validating projects that are designed to provide 'facilities for services to the public', which includes power supply and associated infrastructure (Section 24KA (2e)). Actions necessary to construct a 'public facility' are validated if they satisfy the following criteria:

- Native title holders/claimants have reasonable access to the land, taking into account health, safety and operations issues (Section 24K 1(c));
- An adequate state mechanism acts to protect places of Aboriginal heritage significance (Section 24KA 1(d)(ii)); and
- Adequate notice of the project and an opportunity to comment is provided to the native title holders/claimants.

Compensation is payable for any impairment of native title rights under Section 24KA 5 by the State government (Section 24KAB(ii)) unless the government has specifically legislated to transfer the burden of compensation to another party.

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7. Construction Impacts, Management and Monitoring

7.1 Introduction

The following section identifies the typical construction activities that would be undertaken during the construction of the power station and addresses each of the key environmental issues associated with these activities. The potential impacts have been identified and generic management and monitoring strategies to be implemented by the Preferred Bidder have been detailed.

The generic management and monitoring strategies provided represent the minimum standard that the Preferred Bidder will be required to implement. As outlined in **Section 1.5**, the proponent will also be required to gain approval for the project under Section 38 of the *Environmental Protection Act 1986* and it is anticipated that specific management and monitoring strategies would be developed as part of this approval process.

In addition, to ensure that these management objectives are fulfilled, the Preferred Bidder will be required to develop and implement an Environmental Management Plan (EMP) for the construction and operation of the power station and associated infrastructure to address the specific details in relation to management and monitoring strategies provided in **Sections 7** and **8** of this document. The Construction Management Plan will be required to be prepared prior to the commencement of construction and the Operations Management Plan will be required to be prepared prior to the commencement of operations.

Management Commitment 1*: The Preferred Bidder will be required to prepare an Environmental Management Plan for the construction and operational phases of the project.*

7.2 Summary of Construction Activities

Construction activities would typically consist of:

- Site clearing and levelling;
- Set up of site amenities (offices, ablutions, kitchen);
- Establishing waste handling and disposal facilities and procedures;
- Establishing temporary power and water supplies;
- Construction of internal roads and hard stands;
- Construction of foundations including possibly an on-site concrete batching plant (depending on size of power station);
- Delivery of plant to site including all major and minor items;
- Construction and erection of plant;
- Construction of drainage systems;
- Construction of waste water treatment and discharge facilities;
- Construction and erection of gas lateral to power station (by the gas supplier);

- Construction and erection of power transmission lines from the station (by Western Power);
- Construction and erection of liquid fuel storage facilities;
- Removal of temporary waste handling facilities;
- Construction of any landscaping;
- Establishing security, fencing and procedures;
- Establishing safety and first aid procedures;
- Establishing environmental management and emergency procedures; and
- Site clean up.

The remainder of this section identifies the potential impacts of the above mentioned activities, along with generic management and monitoring strategies.

7.3 Biophysical Environment

7.3.1 Terrestrial Flora and Vegetation

Management Objectives

- *Manage the abundance, species diversity, geographic distribution and productivity of vegetation communities; and*
- *Protect Declared Rare and Priority Flora, consistent with the provisions of the Wildlife Conservation Act 1950.*

7.3.1.1 Potential Impacts

During the construction phase, direct impacts on flora and vegetation would result from clearing for the power station site, construction laydown areas and corridors for access roads, infrastructure and the wastewater pipeline. The extent and significance of these impacts would largely depend on the final layout of the power station and corridor locations, and the significance of the vegetation and flora in the areas cleared. A description of the terrestrial flora and vegetation of the preferred power station site and the wastewater pipeline corridor is provided in **Section 6.8.1**.

The preferred power station site is largely unconstrained with respect to significant vegetation flora based on the available information and the work carried out by Biota Environmental Services in 2002 (Biota Environmental Services, 2002). The preferred power station site is predominantly under Blue Gum Plantation, which has little or no conservation value. As this plantation will be of harvestable age in 2016, the Preferred Bidder would be required to resolve issues regarding the commercial implications of a possible early harvest with the Forrest Products Commission.

The remnant vegetation in the southern portion of the preferred site has been previously assessed by the Environmental Protection Authority (EPA) in their review of the Concept Plan for the expansion of the Kemerton Industrial Park, and included within the industrial core (WAPC, 2000a). There has been no Declared Rare Flora (DRF) or Priority Flora recorded on the site and the recent survey by Biota Environmental Services classes this vegetation as being in Good to Poor condition (Biota Environmental Services, 2002). More detailed seasonal work should, however, be completed on the site prior to finalising the design of the power station to confirm this.

The conceptual power station layout shown in **Figure 5-1** on the preferred site would result in approximately 2.5 hectares of native vegetation being disturbed. In developing this conceptual layout, the disturbance of native vegetation on the south of the site has been minimised. This layout was placed as far to the north as far as possible, subject to compliance with the noise criteria at the northern boundary. There may be further scope for the Preferred Bidder to reduce the impact upon the native vegetation through refinement of the layout during the detailed design phase.

For the proposed wastewater pipeline corridor, it would be necessary to remove vegetation for construction of the pipeline in some locations along the corridor. Construction clearances in typical Western Power corridors are shown in **Figure 7-1**. The maximum width of area that would be disturbed is approximately 11m (which includes an access track), however only a 5m easement would be required for long-term access and the remainder of the corridor would be rehabilitated following construction.

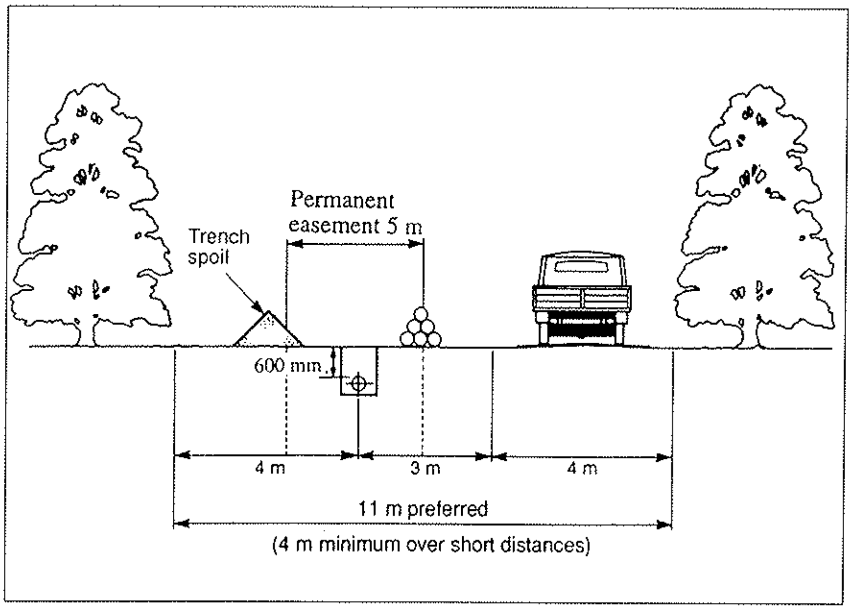


Figure 7-1 Typical Construction Corridor

The route options for the wastewater pipeline corridor route are discussed in **Section 4.5.4.2**. Based on the vegetation and flora study undertaken by Biota Environmental Services (Biota Environmental Services, 2002), a number of areas of potential conservation value occur within the proposed wastewater pipeline corridor. These could be potential development constraints and should be taken into consideration by the Preferred Bidder as detailed planning and design progresses. The features of potential conservation value along the pipeline route occur mainly along the Marriott Road section of pipeline and include:

- The relatively intact areas of vegetation in the Marriott Road section and coastal section;

- The presence of two species of Priority 3 Flora in the Marriott Road section (*Acacia semitrullata* and *Lasiopetalum ?membranaceum*); and
- The high potential for currently unidentified populations of annual (spring flowering) DRF and Priority Flora in the Marriott Road section.

Further details on the significance of the vegetation at the plant site and along the wastewater pipeline corridor is given in **Section 6.8.1**.

Given the strategic nature of this assessment, specific impacts associated with power transmission lines or the gas lateral have not been assessed in this document. Assessments of and management strategies for any clearing for new transmission line corridors and gas laterals would be undertaken by Western Power and the gas supplier in a separate approvals process and have not been considered in this assessment.

There is also the potential for indirect impacts to flora and vegetation during the construction phase through the following:

- Dust deposition on vegetation;
- Potential spread of dieback (*Phytophthora* species);
- Potential introduction and spread of weed species; and
- Potential leakage or spillage of environmentally hazardous materials or hydrocarbons.

7.3.1.2 Management Strategies

Management Commitment 2: The Preferred Bidder will be required to undertake vegetation surveys of the plant site and infrastructure corridors.

The Preferred Bidder would be required to include clearing management strategies as part of the Construction Management Plan, which would be implemented throughout the duration of the construction phase. In particular, the following strategies (or equivalent) would be required to minimise the impacts on flora and vegetation:

- The extent of vegetation removal would be minimised as far as practicable by designing the layout of the plant and construction lay-down areas to minimise disturbance;
- The route of the wastewater pipeline would be selected to minimise the extent of vegetation removal and the avoidance of significant vegetation. Where possible, the route would follow disturbed ground or existing infrastructure corridors;
- A rare flora search would be conducted over the entire area to be disturbed prior to any clearing. If any DRF species are found within the pipeline corridor, the route would be changed where practicable to avoid any impact on these plants and the Department of Conservation and Land Management (CALM) consulted in respect of alternative management mechanisms such as relocation of plants;
- Areas to be cleared would be marked in the field to avoid unnecessary areas being cleared;
- A site rehabilitation plan would be developed and, where possible, disturbed areas would be rehabilitated with species native to the area;
- A dieback hygiene plan would be implemented;
- A weed management and control plan would be implemented; and
- Dust mitigation measures would be implemented (refer to **Section 7.4.1.2**); and

- Materials that are potentially hazardous to vegetation would be contained and managed in accordance with strategies outlined in **Section 7.4.5.2.**

7.3.1.3 Monitoring

The Preferred Bidder would be required to supervise all clearing and earthwork activities to ensure that no unnecessary clearing is undertaken.

7.3.2 Terrestrial Fauna and Habitats

Management Objectives

- *Maintain the abundance, diversity and geographic distribution of terrestrial fauna; and*
- *Protect Specially Protected (Threatened) Fauna, consistent with the provisions of the Wildlife Conservation Act 1950.*

7.3.2.1 Potential Impacts

During the construction phase, potential impacts on fauna and their habitats would be through the removal of habitat that occurs within the areas required for the power station site, construction laydown areas and corridors for access roads, infrastructure and the wastewater pipeline. The extent and significance of these impacts would largely depend on the final layout of the power station and corridor locations, and the significance of the fauna in the areas to be impacted. A description of the terrestrial fauna and habitats of the preferred power station site and the wastewater pipeline corridor is provided in **Section 6.8.2.**

The potential impacts on fauna are more difficult to identify, given the lack of definitive data on the species present and their reliance on the habitat resources of the site (Biota Environmental Services, 2002). The principal impacts are likely to reflect those related to the vegetation for most potentially significant species. That is, the removal of the relatively intact habitat resources along the Marriott Road and coastal sections of the wastewater pipeline corridor is likely to have negative impacts on local populations of the Western Ringtail Possum *Psuedocheirus occidentalis* (Schedule 1) and the Southern Brown Bandicoot *Isoodon obesulus* (Priority 4), should these species be present. These species are the most reliant on intact shrub strata and dense Peppermint woodlands. Fragmentation of these areas by a corridor would also potentially increase feral predator access to the more intact habitat units. A more detailed assessment of the fauna species occurring in the area would be required if a more comprehensive analysis of potential impacts is to be undertaken.

The fauna of the nearby wetlands are not expected to be impacted by construction activities at the plant site as they are considered to be a sufficient distance from the site. However, there may be potential indirect impacts on fauna in habitat around the site from factors such as noise.

7.3.2.2 Management Strategies

To minimise the impacts on fauna and their habitats from the proposed development, the Preferred Bidder would be required to, where possible, minimise disturbance of vegetation and the habitats that are provided by vegetation. This would include the use of existing corridors for gas, transmission and the wastewater pipeline where possible. Clearing management strategies are detailed in the management strategies section for terrestrial flora and vegetation (**Section 7.3.1.2**). Noise management strategies are detailed in **Section 7.4.2.3** and **8.4.3.4**.

There also may be opportunities for reinstatement of habitat in degraded areas of the buffer zone that the Preferred Bidder may wish to investigate, perhaps in cooperation with other industries and the local community.

7.3.2.3 Monitoring

The Preferred Bidder would be required to supervise all clearing and earthwork activities to ensure that no unnecessary clearing of fauna habitats is undertaken.

7.3.3 Marine Environment

Management Objectives

- *Manage the marine ecological integrity and biodiversity; and*
- *Ensure that any impacts on locally significant marine communities are avoided.*

7.3.3.1 Potential Impacts

During the construction phase, the proposed power station may have the potential to effect the marine environment through construction activities related to a possible extension of the existing Collie Power Station ocean outfall diffuser. As described in **Sections 4.5.4** and **5.4.5**, wastewater from a 240MW open cycle power station or an air-cooled combined cycle plant up to 1,080MW could be disposed of on-site through evaporation in specially constructed lined ponds and would therefore not require ocean disposal. However if a water-cooled combined cycle plant of any capacity is installed, the volumes of wastewater would increase beyond that manageable by evaporation ponds and other options for wastewater disposal would be required.

As discussed in **Section 4.5.4**, the preferred option for wastewater disposal from the power station would be through a centralised wastewater treatment facility at the Kemerton Industrial Park. However given the uncertain timing of the proposed power station and of the centralised wastewater treatment facility, the option of disposal of wastewater through the existing Collie Power Station ocean outfall facility is considered within this report. This report considers the following ocean disposal scenarios:

1) Disposal through the existing Collie Power Station ocean outfall using the remaining capacity of the outfall (for discharge rates of up to 45L/s from the Kemerton Power Station); and
2) Disposal through the existing Collie Power Station ocean outfall with an extension of the existing diffuser by 100m so that the capacity of the existing outfall could be achieved. This option also allows for an expansion of the Collie Power Station and/or discharge rates greater than 45L/s from the Kemerton Power Station.

In Case 2, where an extension of the existing Collie Power Station diffuser is required, there is the potential for direct impacts on seagrasses within the footprint of the concrete blocks to support the diffuser. There is also the potential for indirect impacts from the construction activities on the marine environment (such as increased turbidity).

The benthic habitat survey of the area undertaken by Sinclair Knight Merz and the Marine and Freshwater Research Laboratory in May 2001 and detailed in **Section 6.9.2**, identified a significant seagrass community to the west of the existing outfall, principally to the north of or in line with the 100m extension proposed for Case 2. The seagrass in the area is largely of one species, *Posidonia angustifolia,* that is commonly found in waters of 10 to 30m depth and often forms meadows with a sparse density.

Given that each concrete block has a footprint of approximately 1.7m^2 and one concrete block is required every 4m, up to 42m^2 of seagrass community could potentially be lost for the construction of the diffuser detailed in Case 2. The seabed within the seagrass community is approximately 50 – 60% bare sand and 40 – 50% seagrass and macroalgae and there is therefore the potential to reduce direct impacts on seagrass by at least 50% by placing footing blocks on bare sand.

7.3.3.2 Management Strategies

Prior to any construction activities commencing for the ocean outfall, the Preferred Bidder would be required to develop a Marine Management Plan as part of the Construction Management Plan. This plan would include the management strategies that would be undertaken to minimise the impact on the marine environment. In particular, the following strategies (or equivalent) would be required:

- Where practicable the footing blocks of the diffuser would be positioned to lie over bare sand; and
- During the diffuser extension, construction equipment delivery and handling would be managed so as to minimise impacts on the marine and coastal environments.

7.3.3.3 Monitoring

The Preferred Bidder would be required to undertake monitoring of seagrass health in the vicinity of the outfall diffuser during the outfall construction activities.

7.3.4 Drainage and Site Hydrology

Management Objectives

- *Minimise the potential to impact the quality of local surface and groundwater; and*
- *Minimise the potential for erosion due to stormwater flow.*

7.3.4.1 Potential Impacts

Earthworks and terrain shaping would be carried out on the project site thus altering the existing surface water flows within and outside the site. The potential impacts associated with the proposal include the following:

- Increased erosion and sediment transport as a result of diversion of upstream surface runoff around the site;

- Soil deposition down gradient of project site; and
- Increased surface runoff volumes due to the creation of additional hard surfaces.

Also the proposed power station site intersects an agricultural drainage channel, which would need to be re-routed around the site.

more details in buffer?

During construction there would be a requirement for normal earthmoving equipment fuel, lubricant and oil supply to be temporarily stored on-site. There is the potential that these could be accidentally released and contaminate surface water or groundwater (refer to **Section 7.4.5**).

7.3.4.2 Management Strategies

The potential impacts identified above apply equally during construction as with operation. Therefore, for clarity, the discussion of management measures below includes aspects relating to operation activities as well.

The Preferred Bidder would be required to manage drainage and hydrology impacts with reference to the Environmental Protection Authority (EPA) Draft Guidance No. 26 '*Management of Surface Run-Off from Industrial and Commercial Sites*' (EPA, 1999a), specifically including the following strategies or equivalent:

- A Stormwater Management Plan would be developed prior to the commencement of construction.
- Clean water would be separated from potentially contaminated stormwater. These sources would be managed in the following ways:
  - All infrastructure which could potentially leak or spill contaminated substances would be sealed and bunded and the stormwater would be diverted into a lined storage area (or sump) for water quality testing. If the stormwater is found to be clean, it would be discharged into the 'clean' surface water drainage system. If the stormwater is found to be contaminated, Best Management Practices would be used to treat the stormwater to acceptable levels prior to discharge into the environment or the stormwater would be transported off-site for treatment and disposal.
  - A clean surface water drainage system would be provided comprising open channels, pipes and sedimentation trap(s).
  - Clean surface runoff would be diverted around the construction site and discharged into sediment traps prior to release into the environment. These sediment traps would serve to minimise erosion and attenuate flows.
  - The stormwater drainage would consist of a major/minor drainage system where the minor system would consist of internal pipe drainage that would convey the 1-in-5 year storm while the major drainage system would convey the 1-in-100 year storm;
  - Sediment traps would be designed to settle out suspended particles for frequently occurring storms (e.g. the 1-in-2 year event) and would be able to withstand a 1-in-100 year event; and
  - The velocity of flows in unlined open drains would be limited to prevent scour. Limiting velocities would be achieved by a combination of sensible drain configuration and energy dissipating structures.
- Wherever the wastewater pipeline crosses existing drainage channels a pipe bridge would be constructed. Should the construction of these result in

disturbance of the drainage channel surface standard erosion control practices would be implemented.

Also refer to management strategies for Pollution – Hydrocarbon and Hazardous Material Management (**Section 7.4.5.2**).

7.3.4.3 Monitoring

During the construction of the power station the Preferred Bidder would be required to undertake the following monitoring strategies or equivalent:

- Drainage and water collection structures would be inspected on a regular basis and properly maintained during construction;
- A water quality monitoring program would be established to ensure stormwater discharge is within guideline limits;
- The performance of drainage systems and the Stormwater Management Plan would be monitored and formally audited on at least a biannual basis during construction; and
- A groundwater monitoring network would be installed and a groundwater monitoring program implemented that would be aimed at detecting any changes that may occur during the construction period.

7.4 Pollution Management

7.4.1 Dust

Management Objectives

- *Ensure that dust generated during construction does not cause any environmental or human health problems or significantly impact on amenity; and*
- *Use all reasonable and practicable measures to minimise airborne dust.*

7.4.1.1 Potential Impacts

The potential for dust emissions during the construction phase would be largely related to local wind conditions, coupled with the frequency and duration of rainfall. During dry weather conditions, the wind may cause re-suspension of dust from areas of construction activity (e.g. where trucks are entering or departing the site).

Dust emissions may be generated during the construction of the power station and wastewater pipeline through a number of activities, including:

- Clearing vegetation;
- Earthmoving activities;
- Unloading trucks;
- Vehicular movement on unsealed tracks;
- Wind action on cleared/graded areas, stockpiles (topsoil/waste/excess);
- Spillages of soil, etc onto roads; and
- Blasting (if required).

Dust emissions arising as a result of all or some of the above-mentioned activities may have the potential to adversely impact on human health, visual amenity, and the surrounding vegetation and fauna. The proliferation of dust during construction also has a nuisance value.

7.4.1.2 Management Strategies

The Preferred Bidder would be required to include dust management strategies as part of the site Construction Environmental Management Plan, which would be implemented throughout the duration of the construction phase. The dust management strategies would be required to comply with the Department of Environmental Protection's (DEP) *Guidelines for the Prevention of Dust and Smoke Pollution from Land Development Sites in Western Australia* (DEP, 1996). Particular measures to reduce ambient dust levels should include:

- Regular watering of unsealed roads, exposed surfaces and stockpiles would be undertaken;
- Permanent access roads would be sealed;
- Revegetation and rehabilitation of temporarily disturbed land would occur as soon as practicable to minimise exposed surfaces;
- General housekeeping practices would be undertaken to ensure there is no accumulation of waste materials within the plant site that may generate dust;
- Vehicle washdown areas would be provided; and
- The construction contractor would be informed of the requirements to minimise ambient dust levels wherever possible.

Should blasting be required, the Preferred Bidder would be required to prepare a Blasting Management Plan to the satisfaction of the Department of Minerals and Petroleum Resources as a prerequisite of obtaining a blasting permit. This Plan shall include details of procedures and schematic blast design, and would consider dust management.

7.4.1.3 Monitoring

The Preferred Bidder would be required to monitor the effectiveness of dust control strategies during the construction phase of the operations. The following or equivalent activities would be undertaken:

- Dust control equipment would be checked on a regular basis;
- All complaints would be logged in a register;
- Visual inspections; and
- If dust is perceived to be an issue the site boundary, monitoring would be undertaken to determine whether a breach in the DEP limit of 1,000$\mu g/m^3$ over a 15-minute period has occurred and if so a Dust Contingency Plan would be implemented.

7.4.2 Noise and Vibration

Management Objectives

- *Ensure that noise impacts emanating from the proposed plant comply with statutory requirements specified in the Environmental Protection (Noise) Regulations 1997; and*
- *Ensure that vibration impacts emanating from the proposed plant are maintained at an acceptable level.*

7.4.2.1 Noise Criteria

Noise from construction works is addressed by Regulation 13 of the *Environmental Protection (Noise) Regulations 1997*. This regulation states that for construction work carried out between 7am and 7pm on any day, which is not a Sunday or public holiday, the following applies:

- The construction work must be carried out in accordance with control of noise practices set out in Section 6 of Australian Standard 2436-1981 "Guide to Noise Control on Construction, Maintenance and Demolition Sites";
- The equipment used for the construction must be the quietest reasonably available; and
- The DEP may request that a Noise Management Plan be submitted for the construction work at any time.

If the construction is undertaken outside of these hours, then the following additional requirements must be followed:

- The builder must submit to DEP a Noise Management Plan at least seven days before the work starts, and the plan must be approved by the DEP. The plan must include:
  - Details of and reasons for the construction work which is likely to be carried out;
  - Details of and duration of activities likely to result in noise emission that fail to comply with the standards prescribed under Regulation 7 of the *Environmental Protection (Noise) Regulations 1997*;
  - Predictions of noise emissions on the construction site;
  - Details of measures to be implemented to control noise emissions;
  - Procedures which will be adopted for monitoring noise emissions if required; and
  - Complaint response procedures to be adopted.
- The builder must advise all nearby occupants, who are likely to receive noise levels which fail to comply with the standard under Regulation 7, of the work to be done at least 24 hours before it commences; and
- The builder must show that it was reasonably necessary for the work to be done out of hours.

This section of the Noise Regulations also references Regulation 7, which provides assigned noise levels that are generally considered acceptable at the recipient. These are summarised below in **Table 7-1** for noise sensitive premises (refer to **Section 8.4.3.1** for details of noise sensitive premises).

■ Table 7-1 Assigned Noise Levels for Noise Sensitive Premises

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	$L_{A,Max}$
Noise sensitive premises (including buildings)	0700 to 1900 hours Monday to Saturday	45dB(A) + influencing factor	55dB(A) + influencing factor	65dB(A) + influencing factor
	0900 to 1900 hours Sunday and public holidays	40dB(A) + influencing factor	50dB(A) + influencing factor	65dB(A) + influencing factor
	1900 to 2200 hours all days	40dB(A) + influencing factor	50dB(A) + influencing factor	55dB(A) + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35dB(A) + influencing factor	45dB(A) + influencing factor	55dB(A) + influencing factor

Notes:
1) $L_{A,Max}$ – The loudest noise level assessed during a 15-minute to 4-hour sampling period;
2) L_{A1} – The noise level exceeded for 1% of a 15-minute to 4-hour sampling period, equating to the loudest 9 seconds measured during the survey period;
3) L_{A10} – The noise level exceeded for 10% of a 15-minute to 4-hour sampling period or the loudest 90 seconds. This is frequently referred to as the average-maximum noise level;
4) L_{A90} – The noise level exceeded for 90% of a 15-minute to 4-hour sampling period. This is frequently referred to as the background noise level.

The allowable noise level when received at a residence is determined by the calculation of an influencing factor that is added to the base criteria set out in **Table 7-1**. The Regulations, under Schedule 3 clause (5), also allows for a influencing factor of 5dB(A) to be added to the above assigned noise levels at the point of reception for noise emissions from any premises within the Kemerton Industrial Park in the following periods:

- 0900 hours to 1900 hours on a Sunday or public holiday;
- 1900 hours to 2200 hours on any day;
- 2200 hours to 0700 hours on Monday to Saturday inclusive; and
- 2200 hours to 0900 hours on a Sunday or public holiday.

Other influencing factors that would apply include:

- For residences located within the industrial core area, where the land is zoned industrial, the influencing factor to be added to the base level is 20dB(A) (the residences within the core are tenants of LandCorp on a short-term lease agreement); and
- For residences located to the west of the Park and within 100m of the Old Coast Road, a "transport influencing factor" of 2dB(A) would be added.

In summary, the noise emissions from the Kemerton Power Station site would be limited by the criteria outlined in **Table 7-2**, applicable under the *Environmental Protection (Noise) Regulations 1997.*

- **Table 7-2 Limiting Noise Criteria**

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	$L_{A,Max}$
Residential dwelling(s) outside the Industrial Park	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	40dB(A)	50dB(A)	60dB(A)
Residential dwelling(s) outside the Industrial Core zone and within 100m of Old Coast Road	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	42dB(A)	52dB(A)	62dB(A)
Residential dwelling(s) within the industrial core	All hours	60dB(A)	70dB(A)	80dB(A)
Industrial and utility premises	All hours	65dB(A)	80dB(A)	90dB(A)

The assigned noise levels are also conditional on no annoying characteristics existing, such as tonal components etc. If such characteristics exist, then any measured level is adjusted upwards accordingly. The adjustments that apply are detailed in **Table 7-3**.

- **Table 7-3 Adjustments for Annoying Characteristics**

Tonality	Modulation	Impulsiveness
+5dB	+5dB	+10dB

As the construction noise would be present for greater than 10% of the time, it is the L_{A10} criteria which is of concern. The majority of the equipment would be considered tonal and noise measurements may need to be adjusted upwards by 5dB(A), depending on the distance to the receptor.

7.4.2.2 Potential Impacts

Herring Storer Acoustics was commissioned by Sinclair Knight Merz to determine the expected noise levels from the construction of a power station at various distances from the proposed site.

Noise Assessment Methodology

Prediction of the noise propagation to surrounding areas was achieved utilising the computer program Environmental Noise Model (ENM). This program is accepted by the DEP.

The sound power levels presented in **Table 7-4** were used to model the noise from the construction equipment. The predominant noise during the construction phase of the project would be from the following equipment:

- Excavation equipment;
- Cranes;
- Hand tools; and
- Trucks and forklifts.

■ Table 7-4 Sound Power Levels of Equipment used in Modelling

Equipment	Sound Power Level dB(A)
Crane	94
Hand Tool (General)	108
Hand Tool (Angle Grinder)	117
Truck (Idle)	97
Forklift	97
Metal Cut-off saw	120
Truck (maximum revs)	113
Front End Loader	111
Reversing Beeper	116
Total	**124**

The model was run assuming all machinery could be operating at one time. Even though reversing beepers are a safety device and are excluded from the Regulations, they are a cause of annoyance and therefore have been included in the modelling and analysis.

Work 'out of hours' (i.e. after 7pm and before 7am on weekdays, and on weekends and public holiday) is not anticipated, but may be required (for example) for continuous concrete pours.

Predicted Noise Emissions

Table 7-5 provides estimates of the distances from the plant at which various noise levels are received.

■ Table 7-5 Approximate Distances for Various Noise Levels

Noise Level dB(A)	Distance from Site (m)
45	1,000
40	1,250
35	1,500
30	1,900

The nearest residences to the proposed power station site are along Ridgeview Way in the Industrial Core where the assigned level is 60dB(A), at a distance of approximately 2,000m. The nearest residences outside the Industrial Core, where the assigned level is 40dB(A) are 2,750m away. Therefore, from **Table 7-5**, it could be concluded that, even adjusted for a tonal component, the noise levels would be below the assigned noise levels as determined by Regulation 7 of the *Environmental Protection (Noise) Regulations 1997.*

7.4.2.3 Management Strategies

To manage noise from the construction of the power station, the Preferred Bidder would be required to prepare a Noise Management Plan to the satisfaction of the DEP as part of the Construction Environmental Management Plan. In particular, the following management strategies would be undertaken:

- Equipment used for construction would be the quietest reasonably available;
- Equipment would be subject to regular maintenance. This would include ensuring all noise control equipment is correctly fitted and operating at design performance;
- If required, a complaint log book would be maintained; and

- On parts of the site where high levels of noise are unavoidable and are likely to be a hazard to persons working on-site, prominent warning notices would be displayed and, where necessary, appropriate hearing protection would be provided.

All contractors would be required to carry out their work in accordance with the Noise Management Plan.

As stated in **Section 7.4.1.2**, should blasting be required, the construction contractor would be required to prepare a Blasting Management Plan to the satisfaction of the Department of Minerals and Petroleum Resources as a prerequisite of obtaining a blasting permit. This Plan would include details of procedures, schematic blast design, and statements of compliance with respect to the environmental limits detailed in Section 11 of the *Environmental Protection (Noise) Regulations 1997.*

7.4.2.4 Monitoring

Given the relatively low levels of construction noise predicted from the site, it is not anticipated that monitoring of the construction noise levels would be required, unless complaints are lodged. In such circumstances, repeated complaints would be investigated through noise monitoring, and a report would be prepared to address the extent of any impacts and a range of practical and feasible mitigation measures that should be adopted.

7.4.3 Solid Waste Management

Management Objectives

- *Ensure that the generation of solid wastes is minimised; and*
- *Solid waste is handled and disposed of in a manner that minimises the impact on receiving environment.*

7.4.3.1 Potential Impacts

The discharge of solid waste to the environment has the potential to reduce the quality of surface water and groundwater through leachate of contaminants, to generate odour and to increase the number of vermin. Potential changes in water quality could affect sensitive flora and fauna which rely on the maintenance of existing conditions.

During the construction phase, solid waste would generally comprise of domestic waste and construction waste from the plant area. Green waste would also be generated during vegetation clearing. Domestic waste quantities are expected to total approximately one tonne per day. The volume and nature of construction waste would depend on a range of variables that cannot be clearly defined at this stage. However, it is expected to comprise of:

- Packaging materials (plastic, cardboard, paper and pallets);
- Pipe offcuts and reinforcing steel;
- Damaged products (plasterboard, bricks, tiles, etc);
- Surplus fill;
- Timber scraps;

- Geotextiles;
- Paving materials;
- Electrical off-cuts; and
- Concrete.

No hazardous solid wastes are expected to be generated during construction activities.

7.4.3.2 Management Strategies

The Preferred Bidder would be required to prepare Solid Waste Management Plans as a requirement for each construction contract. These plans would include sections on waste reduction, material reuse and material recycling with the objective of minimising the quantity of waste requiring disposal. In particular, the following management strategies or equivalent would be undertaken:

- All waste generated on-site during construction would be disposed to a licensed landfill site in accordance with local government and DEP requirements;
- All waste to be diverted to landfill would be appropriately contained while awaiting transfer; and
- All green waste and cleared vegetation would be mulched and stockpiled in designated areas for incorporation into revegetation works.

7.4.3.3 Monitoring

The Preferred Bidder would be required to undertake the following or equivalent monitoring strategies for solid waste management:

- Waste Management Plans prepared for each contract would be audited to confirm that work being undertaken complies with the established procedures;
- Details of quantities of waste materials recycled and disposed to landfill would be maintained for reporting purposes;
- Visual inspections for litter and general waste (and clean ups if required) within and around the site perimeter would be undertaken; and
- Waste storage and disposal facilities would be inspected to ensure they are functioning sufficiently and dealing adequately with the quantities of waste.

7.4.4 Domestic Liquid Waste Management

Management Objectives

- *Ensure that domestic liquid waste is managed and disposed of in a manner that minimises impacts on the receiving environment; and*
- *Ensure compliance with all relevant Health and Environmental Regulations.*

7.4.4.1 Potential Impacts

The discharge of domestic liquid waste to the environment has the potential to reduce the quality of surface water and groundwater and therefore impact on the flora and fauna relying on these waters. It also has the potential to cause nuisance odours to surrounding areas and health effects.

During construction of the facilities, a labour force peaking at approximately 250 persons would be employed at the site. Domestic wastewater quantities from the site are expected to peak at approximately at 15kL/day.

The construction phase workforce would be housed in residential areas or accommodation facilities that are located in surrounding areas and therefore only domestic liquid waste generated at the power station site has been considered in this assessment.

7.4.4.2 Management Strategies

The Preferred Bidder would be required to determine the best method for management and disposal of domestic liquid waste in consultation with the Health Department and the DEP. Domestic wastewater would be either:

- Treated by septic tank and disposed of to infiltration trenches; or
- Sludge stored within the septic tanks and then removed from site by a licensed contractor.

The Preferred Bidder would be required to demonstrate that the management strategy implemented for the disposal of domestic wastewater does not result in a net increase in nutrients entering the Leschenault Estuary, as required by the Leschenault Inlet Management Authority nor impact adversely on nearby EPP wetlands.

All temporary facilities would be required to be removed from site at the end of the construction phase.

7.4.4.3 Monitoring

The Preferred Bidder would be required to undertake regular inspections of the domestic wastewater system to ensure it is operating effectively and maintain details of the quantities of any waste removed and treated off-site.

7.4.5 Hydrocarbon and Hazardous Materials Management

Management Objective

- *Ensure hydrocarbons and hazardous materials are handled and stored in a manner that minimises the potential for impact on the environment through leaks, spills and emergency situations.*

7.4.5.1 Potential Impacts

During construction there would be a requirement for hydrocarbon materials such as fuel, lubricant and oils to be stored on-site for the operation of earthmoving equipment. Hazardous materials such as herbicides, acids, solvents and explosives (if blasting required) may also be used and stored on-site.

There is the potential that these could accidentally be released which has the potential to:

- Contaminate surface and ground water and soils;
- Cause acute and/or chronic toxic hazards; and
- Cause flammable or explosive hazards.

7.4.5.2 Management Strategies

The Preferred Bidder would be required to include hydrocarbon and hazardous material handling and storage strategies as part of the site Construction Environmental Management Plan. Particular measures to reduce any potential impacts include:

- All fuel, lubricant and oil would be stored in bunded facilities in accordance with Australian standards;
- All equipment used on-site would be inspected to ensure it is not leaking fuel or oils to the environment;
- Only suitably trained and certified personnel would be involved in the application of herbicides and herbicides would only be applied only if climatic conditions are favourable (e.g. no rain, low winds), within 24 hours before and/or after spraying;
- Procedures would be developed to ensure all spills of hydrocarbon or hazardous materials would be contained where possible and immediately cleaned up; and
- Hazardous materials would be stored and handled in accordance with guidance provided on relevant Material Safety Data Sheets.

Further management strategies are also outlined in **Section 8.4.7.2, 8.4.8.2** and **9.7.3** for the operational phase.

7.4.5.3 Monitoring

The Preferred Bidder would be required to undertake housekeeping inspections during construction to ensure:

- The capacity of any hydrocarbon or hazardous material storage bunding is maintained through the removal of stormwater from bunds; and
- Equipment is well maintained to minimise the risk of leaks and spills.

8. Operational Impacts, Management and Monitoring

8.1 Introduction

The following section details the typical activities that would be undertaken during the operational phase of the power station and addresses each of the key environmental issues associated with these activities. The potential impacts and management objectives have been identified and generic management and monitoring strategies that would be required to be implemented by the Preferred Bidder have been detailed.

The generic management and monitoring strategies provided represent the minimum standard that the Preferred Bidder will be required to implement. As outlined in **Section 1.5**, the proponent will also be required to gain approval for the project under Section 38 of the *Environmental Protection Act 1986* and it is anticipated that more specific management and monitoring strategies would be developed as part of this approval process.

In addition, to ensure that these management objectives are fulfilled, the Preferred Bidder will be required to develop and implement an Environmental Management Plan for the construction and operation of the power station and associated infrastructure to address the specific details in relation to management and monitoring strategies provided in **Sections 7** and **8** of this document. The Construction Management Plan will be required to be prepared prior to the commencement of construction and the Operations Management Plan will be required to be prepared prior to the commencement of operations.

Management Commitment 1*: The Preferred Bidder will be required to prepare an Environmental Management Plan for the construction and operational phases of the project.*

8.2 Summary of Operational Activities

Operational activities cover not only the on-site activities of running the plant but also other off-site related activities. For the purpose of addressing potential impacts and management strategies, commissioning activities are also included in the following list:

- Commissioning of plant;
- Initial testing of licence compliance (e.g. noise, emission discharges);
- Operation of generating plant to produce electricity;
- Starting and stopping main generation plant (either locally or by remote control, manual or automatic) and auxiliary plant;
- Scheduled and unscheduled maintenance of all plant;
- Operating, monitoring and maintaining water treatment plant (where installed);
- Receival, monitoring and offloading liquid fuels and storage facilities;
- Monitoring gas receival systems;
- Monitoring wastewater facilities;
- Regular testing of licence compliance (emissions, noise, discharges, groundwater contamination);
- Monitoring plant performance;

- General cleaning and refurbishment activities;
- Maintaining security, training, first aid and safety procedures activities;
- Recording and reporting of plant operations;
- Regular liaison with local fire and emergency services;
- Carrying out of regular safety and emergency response drills;
- Liaison with Western Power regarding transmission/power receival issues;
- Liaison with local Authorities (Councils, Department of Environmental Protection (DEP), etc);
- Monitoring and maintaining flammable and dangerous goods inventory and handling; and
- Maintenance of spares inventories.

The remainder of this Section identifies the potential impacts of the above mentioned activities, along with generic management and monitoring strategies.

8.3 Biophysical Environment

8.3.1 Marine Ecology

Management Objectives

- *Manage the marine ecological integrity and biodiversity; and*
- *Ensure that impacts on locally significant marine communities are minimised.*

The proposed power station may have the potential to impact on the marine environment through ocean disposal of wastewater. Wastewater from a 240MW open cycle power station or an air-cooled combined cycle plant of up to 1,080MW could be disposed of on-site through evaporation in specially constructed lined ponds and therefore there would be no impact on the marine environment. However a water-cooled combined cycle power station of any size would produce volumes of wastewater beyond that manageable by evaporation ponds and other options for wastewater disposal would be required (refer to **Section 4.5.4.1** and **5.4.5**).

As discussed in **Section 4.5.4**, the preferred option for wastewater disposal from the power station would be through a centralised wastewater treatment facility at the Kemerton Industrial Park. However given the uncertain timing of the proposed power station and of the centralised wastewater treatment facility, the feasibility of disposal of wastewater through the existing Collie Power Station ocean outfall facility is considered within this report. This report considers the following ocean disposal scenarios:

1) Disposal through the existing Collie Power Station ocean outfall using the remaining capacity of the outfall (for discharge rates of up to 45L/s from the Kemerton Power Station); and
2) Disposal through the existing Collie Power Station ocean outfall with an extension of the existing diffuser by 100m so that the capacity of the existing outfall could be achieved. This option also allows for an expansion of the Collie Power Station and/or discharge rates greater than 45L/s from the Kemerton Power Station.

8.3.1.1 Marine Water Quality Guidelines

The quality of the water discharged to the ocean would be dependent on the quality of the water supply to the plant and on the chemicals required for pre-treatment of water prior to use in the plant.

These chemicals are likely to include a biocide (used in the plant to prevent bacterial and algal growth) and a corrosion and scale inhibitor. Biocides readily decompose and are continually added to maintain an effective concentration of approximately 0.5ppm. By the time the effluent reaches the ocean outfall the levels would be expected to be approximately 0.1ppm due to decomposition. At these levels dilution of only 33:1 is required for concentrations to meet the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ) 2000 Water Quality Guidelines (ANZECC/ARMCANZ, 2000). The wastewater is expected to be free of other contaminants.

The quality of the wastewater that would be discharged is not confirmed, however, salinity is not expected to exceed 5,000mg/L Total Dissolved Solids (TDS). This salinity is lower than the salinity in the receiving environment, which is approximately 35,000mg/L TDS. The wastewater would also have a higher temperature than the receiving environment.

The ANZECC/ARMCANZ 2000 Water Quality Guidelines contain trigger values which are based on the level of habitat protection. The Environmental Protection Authority (EPA) has adopted these guidelines. The level of protection for marine species is derived from research into the effects of contaminants on biota (ecotoxicology). A 99% level of protection reflects a concentration of a particular contaminant that is shown to have no observed effects (NOEC) on 99% of the tested species. Each contaminant has four trigger values based on the level of protection (99, 95, 90 and 80%). Trigger values are provided for each contaminant in the ANZECC/ARMCANZ 2000 guidelines. Temperature and salinity, while not contaminants, nonetheless are physico-chemical stressors and have trigger values and guidelines that must also be met.

The marine environment adjacent to the existing Collie Power Station ocean outfall has a 99% level of habitat protection which must be achieved at the boundary of the mixing zone (EPA, 2000a). The dilution required to meet acceptance criteria for biocides, salinity (TDS) and temperature are presented in **Table 8-1**. The salinity of the discharge is the parameter that requires the greatest dilution factor (60:1) to compensate for the less saline nature of the effluent.

- **Table 8-1 Dilution Factors Required to Meet Acceptance Criteria**

Parameter	Units	Effluent (Winter)	Ambient (Winter)	Acceptance Criteria	Dilution Factor Required
Hypochlorite	µg/L	100	0	31	33
Hydrobromide	µg/L	100	0	31	33
TDS	‰	5.0	35	34.5–35.5	60
Temperature	°C	24	16	15.7–16.4	20

Note:
1) Draft low reliability trigger value ANZECC/ARMCANZ (2000).

To demonstrate that the diffuser design is capable of achieving the appropriate guideline levels within the mixing zone for salinity and temperature, a dispersion modelling assessment was undertaken and is detailed below.

8.3.1.2 Dispersion Modelling Assessment

Modelling Methodology

An assessment of the dilution capability of the existing and extended Collie Power Station ocean outfall configuration was carried out using the United States Environmental Protection Authority model known as *PLUMES* (Baumgartner *et al*, 1994). The model has been extensively validated and has been used within the Perth Coastal Waters area (Kinhill, 1997).

The PLUMES model is in effect an interface for the RSB and UM nearfield models. In addition, it contains two farfield algorithms and the CORMIX1 flow categorisation scheme. The RSB model was based on hydraulic studies by Roberts (1977) and Roberts *et al.* (1989a, b, c). The UM model is the latest development of the models that were originally developed by Teeter and Baumgartner (1979) and later by Muellenhoff *et al.* (1985). The specific model used in this investigation was the UM model.

Two cases were assessed, which are presented in **Table 8-2** and include the components of discharge from the two effluent sources (Collie Power Station and the proposed Kemerton Power Station).

▪ Table 8-2 Outfall Cases Investigated

Case	Outfall Scenario	Collie (L/s)	Kemerton (L/s)	Total Discharge (L/s)
1	**Increased Discharge through Existing Diffuser** Allows for a fresh water-cooled power station of capacity up to 540MW at Kemerton using the remaining capacity of Collie Power Station outfall and existing diffuser.	47.5	45.0	92.5
2	**Extension of Existing Diffuser** Allows for a significant increase in discharge from the Collie Power Station and a fresh water-cooled plant at Kemerton of up to 1,080MW capacity. An extension of existing diffuser is required.	92.5[1]	127.5	220.0

Notes:
1) This discharge rate for the Collie Power Station has been assumed as this is the design capacity of the pipeline, which was designed for a nominal 600MW power station at Collie.

In both cases, the most conservative case scenario was investigated, that is assuming that the outfalls are discharging effluent at full capacity.

The existing Collie Power Station pipeline has a total design capacity of 92.5L/s and it is assumed that it is presently discharging at 47.5L/s. Therefore, in Case 1, it was assumed that the remaining design capacity would be made up of the discharge from the Kemerton Power Station. This capacity is sufficient for a fresh water-cooled combined cycle plant of up to 540MW capacity (refer to **Figure 4-5**).

Should the Collie Power Station discharge rate significantly increase, based on the existing approach of maintaining a gravity-fed discharge, the existing outfall would need to be extended to cater for the increased flow up to a maximum total discharge of 220L/s. It has been assumed that the ultimate discharge from the Collie Power Station would be 92.5L/s resulting in a remaining capacity of 127.5L/s for the Kemerton Power Station. This capacity is sufficient for a fresh water-cooled combined cycle plant of up to 1,080MW capacity.

Ambient and Effluent Water Quality Characteristics

Ambient sea characteristics and effluent discharge characteristics must be defined in the model to enable prediction of the amount of dilution. For this strategic assessment conservative assumptions have been made of the effluent discharge characteristics.

With the exception of biocides, it is assumed that the discharge water would be free of contaminants, therefore the temperature and salinity of the discharge is considered the critical environmental factor to be analysed. Winter discharge conditions were assumed as a worst case scenario. For winter discharge, the water column was assumed to be well mixed with the temperature and salinity of the receiving water at 16°C (Sinclair Knight Merz, 1998) and 35 parts per thousand (‰) respectively.

The characteristic of the effluent discharge for each case was estimated based on volumetric proportions of the mixture between the Collie Power Station and Kemerton Power Station discharges. It was assumed that the temperature of the Collie Power Station discharge was at an ambient temperature of 20°C for winter conditions and that the blow-down from the Kemerton Power Station would be at 25°C. In addition, it was assumed that both discharges would have a maximum salinity of 5‰. Based on the discharge volumes of the individual components, the characteristics of the combined mixture is presented in **Table 8-3**.

- **Table 8-3 Effluent Discharge Characteristics**

Parameters	Case 1	Case 2
Discharge rate (L/s)	92	220
Temperature (°C)	23	23
Salinity (‰)	5	5

Outfall Configuration

The configurations used for this investigation are presented in **Table 8-4**. For Case 1 the existing outfall configuration was used. For Case 2, the outfall length was factored up based on the discharge of future volumes compared with existing rates.

- **Table 8-4 Model Parameters and Configuration**

Parameters	Case 1	Case 2
Discharge rate (m^3/s)	0.092	0.220
Port diameter (mm)	50	50
Port Spacing (m)	8	8
Number of ports	23	55
Port elevation from seabed (m)	0.25	0.25
Port depth (m)	10	10

8.3.1.3 Potential Impacts

Simulation results for each case are presented in **Figures 8-1** and **8-2**. Each presents two plots. The top plot shows the travel trajectory of the plume from either side of the diffuser (situated at 0m in the x-axis) within the mixing zone whilst the bottom plot shows the corresponding dilutions achieved within the same distance from the diffuser. The figures also provide information on the temperature and salinity of the discharge along the trajectory of the plume, allowing easy identification of where these parameters achieve the recommended guidelines.

Due to the buoyant nature of the discharge, the plume rises relatively quickly upon discharge and results in a narrow mixing zone. Both cases show that high dilutions are achievable due to the nature of the discharge and the water depth available for mixing. Dilutions achieved by the diffuser (150:1) would exceed required dilution limits (60:1) for protection of the environment well within the mixing zone for both cases.

The characteristics of the initial mixing zone for each of the outfall diffuser scenarios modelled are presented in **Table 8-5**.

- **Table 8-5 Mixing Zone Characteristics**

Parameters	Case 1 (Increased Discharge through Existing Diffuser)	Case 2 (Extension of Existing Diffuser)
Discharge Rate (L/s)	92.5	220
Mixing Zone Width (m)	8.4	8.2
Mixing Zone Length (m)	92	220
Mixing Zone Area (m^2)	773	1,804
Dilution Ratio Achieved at the surface*	150:1	150:1

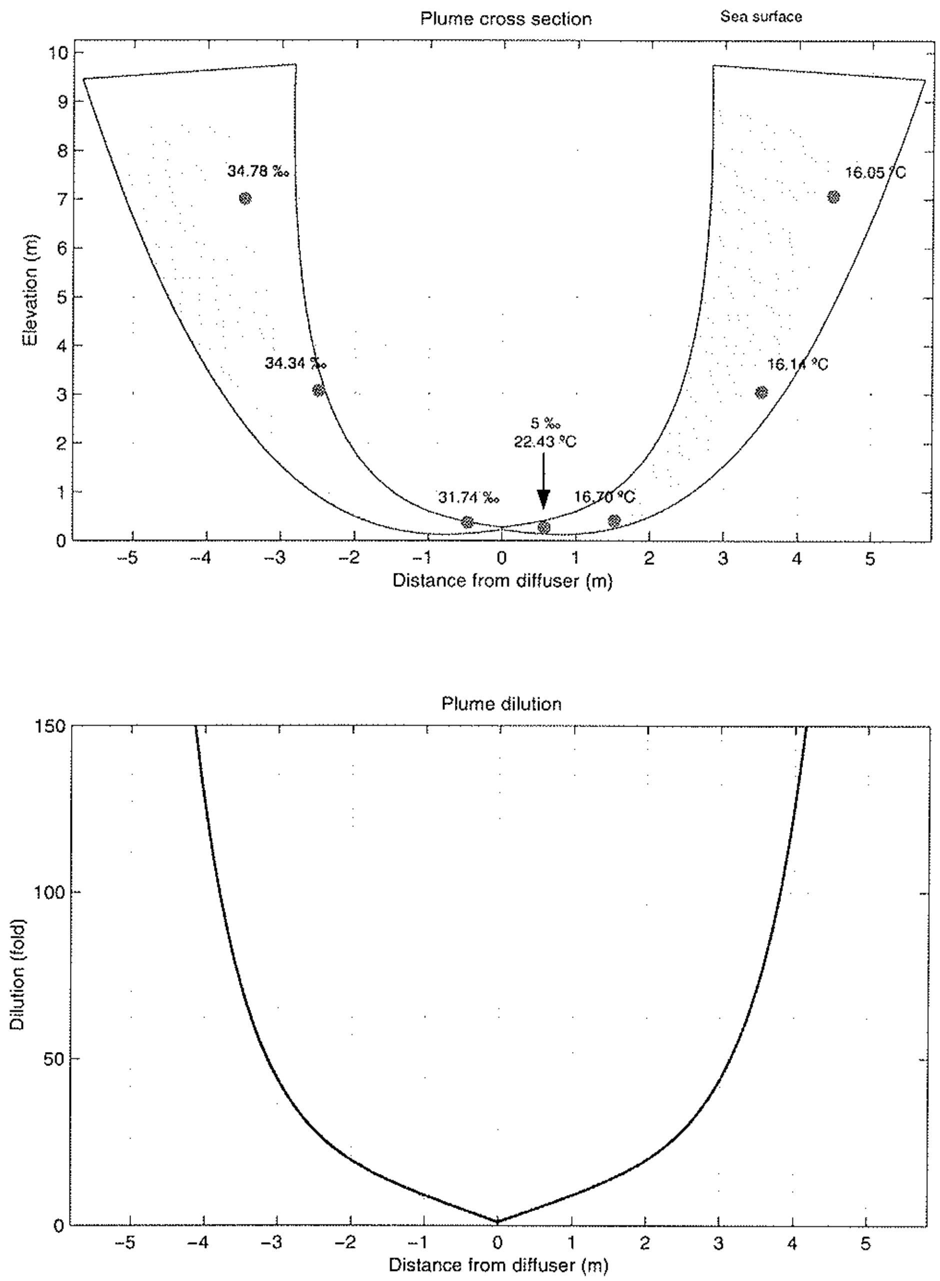
Note:
1) Minimum dilution ratio required is 60:1

The results of the modelling indicate the following:

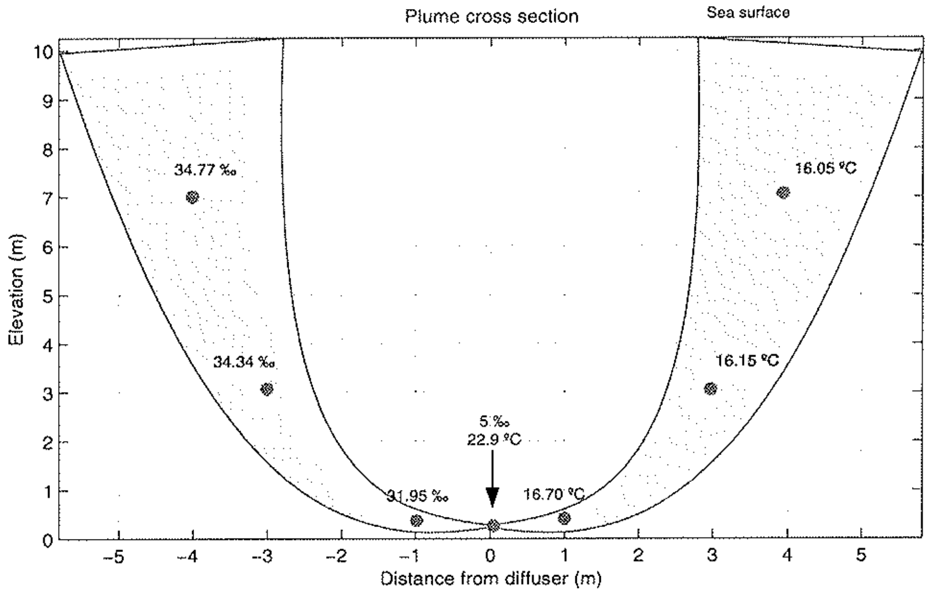
- Increased discharge through the existing outfall diffuser to its design capacity would result in adequate dilution to meet environmental guidelines; and
- Extension of the existing outfall diffuser to allow increased capacity would result in adequate dilution to meet environmental guidelines.

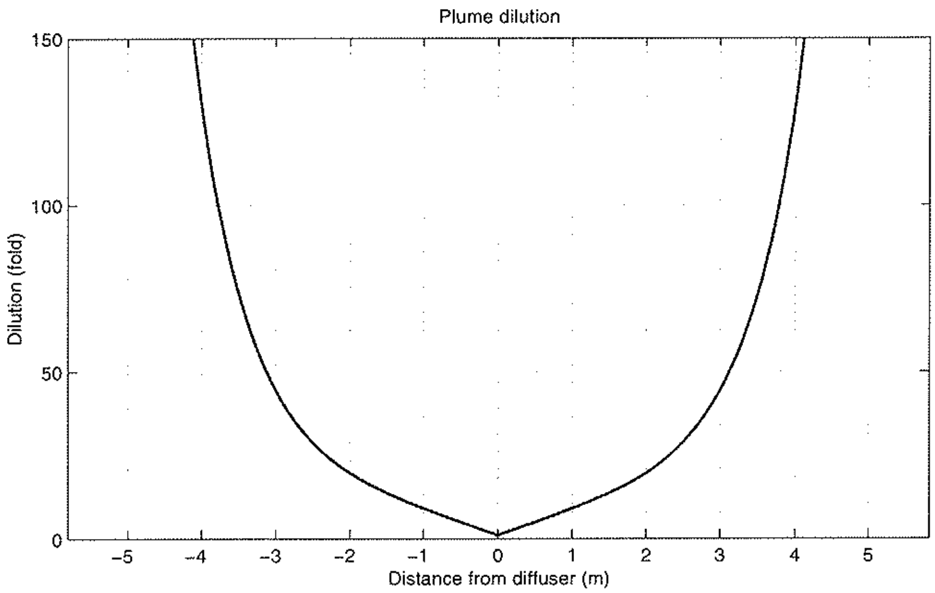
Also there is not expected to be any impact on the seagrasses in the vicinity of the outfall from the ocean discharge from the proposed Kemerton Power Station. This is based on the following observations made during the benthic habitat survey of the area by Sinclair Knight Merz and the Marine and Freshwater Research Laboratory on May 30th and 31st, 2001 and detailed in **Section 6.9.2**:

- The seagrasses in the study area were in a healthy condition with low epiphyte loads and no signs of leaf damage;
- There was no obvious difference between the seagrass along the existing outfall and that further to the west; and
- The existing outfall appears to have had little effect on the adjacent seagrasses.



■ **Figure 8-1 Wastewater Dispersion Modelling – Case 1 Plume Trajectory and Dilution**





■ **Figure 8-2 Wastewater Dispersion Modelling – Case 2 Plume Trajectory and Dilution**

8.3.1.4 Management Strategies

If the Preferred Bidder's development involves wastewater disposal by ocean outfall, they would be required to undertake a detailed modelling assessment of the ocean outfall discharge to demonstrate that the dilution criteria could be achieved.

The Preferred Bidder would also be required to demonstrate that the levels of other contaminants (such as biocides) discharged into the ocean meet the ANZECC/ARMCANZ 2000 Water Quality Guidelines at the edge of the mixing zone.

8.3.1.5 Monitoring

The Collie Power Station presently undertakes a comprehensive monitoring program of the existing wastewater ocean discharge. This monitoring program includes the following:

- Monitoring of the marine environment as follows:
  - Annual seawater sampling at 7 sites for heavy metals;
  - Annual sediment sampling at 7 sites for heavy metals; and
  - Annual mussel biomonitoring at 4 sites for heavy metals.
- Saline discharge pipeline input monitoring as follows:
  - Weekly sampling for flow rate, volume, temperature, Total Suspended Solids (TSS), TDS and pH; and
  - Weekly sampling for heavy metals, major ions, nutrients, oil and grease.

The Preferred Bidder would be required to incorporate a similar monitoring program to cover the combined discharge from the proposed Kemerton Power Station and the Collie Power Station with the addition of the following tasks:

- Data logging of temperature in the vicinity of the outfall diffuser to confirm the numerical modelling of dilution; and
- Monitoring of seagrass health in the vicinity of the outfall diffuser.

8.3.2 Surface Water and Groundwater

Management Objectives

- *Maintain the integrity, functions and environmental values of rivers, creeks, wetlands and estuaries;*
- *Minimise the potential to impact the quality of local surface and groundwater; and*
- *Minimise the potential for erosion due to stormwater flow.*

8.3.2.1 Potential Impacts

The Kemerton Industrial Park and proposed wastewater pipeline corridor falls within the boundaries of the Leschenault Inlet Management Area which aims to protect the Leschenault Estuary, an environmentally significant water resource. There are also a number of environmentally significant wetlands in the vicinity of the proposed power station site and wastewater pipeline corridor that are fed by surface water runoff and groundwater as discussed in **Section 6.6**.

In addition, the superficial aquifer in the Kemerton area is an important groundwater resource.

Although there would be no direct discharge of wastewater or contaminated stormwater into wetlands or the Wellesley River or its tributaries, there is the potential for contaminants to be transported to the Leschenault Estuary and other wetlands through the following indirect pathways:

- Uncontained stormwater from the site running into drainage channels that end up in the Wellesley River;
- Leaching of contaminants into the groundwater, which then is expressed within wetlands or the Wellesley River or its tributaries; and
- Accidental leakage or spillage of wastewater, hydrocarbons or other hazardous materials running directly into wetlands, the Wellesley River or the Leschenault Estuary.

Potential sources of contamination include the following:

- Hydrocarbon transport, storage, handling and disposal;
- Chemical and hazardous material transport, storage, handling and disposal;
- Domestic wastewater treatment and disposal;
- Waste cooling water disposal;
- Solid waste disposal; and
- Sediment from cleared areas.

8.3.2.2 Management Strategies

The management of stormwater during construction would apply equally during the operation of the project. The management measures are detailed in **Section 7.3.4.2**. It is important that in those areas where rainfall runoff is collected from impervious surfaces, the water is not infiltrated on-site. A concentrated influx of potentially contaminated stormwater could effectively transport leached contaminants significant distances within the groundwater system.

The Preferred Bidder would also be required to comply with the requirements of the Leschenault Inlet Management Authority (LIMA) for the protection of the Leschenault Estuary. In particular, management strategies must be consistent with the Leschenault Waterways Management Programme (Waterways Commission, 1992) and LIMA policy of no net increase of nutrient discharge within the Management Area.

Management strategies for the prevention of contamination of surface water and groundwater are detailed in **Sections 8.4.4.2**, **8.4.5.2**, **8.4.6.2**, **8.4.7.2**, **8.4.8.2** and **9.7.3**.

8.3.2.3 Monitoring

Monitoring would be required to ensure that the above management strategies are implemented to the expected standard. The Preferred Bidder would undertake the following or equivalent:

- Drainage and water collection structures would be inspected on a regular basis and properly maintained during operation;
- Water collected from potentially contaminated sources would be monitored prior to discharge, with monitored parameters including but not limited to TSS, pH, turbidity, total hydrocarbons and volumes; and
- Groundwater monitoring network would be installed to include bores immediately down gradient of any newly created potential sources of contamination such as fuel, oil, lubricant and chemical storage areas and any evaporation ponds.

8.4 Pollution Management

8.4.1 Atmospheric Emissions

Management Objective

- *To ensure that gaseous emissions from this proposal in isolation and in combination with emissions from neighbouring sources and background concentrations meet acceptable criteria for ambient ground level concentrations, and ensure that all reasonable and practicable measures are taken to minimise emissions of NO_x, SO_2, CO, Polycyclic Aromatic Hydrocarbons (PAHs), Volatile Organic Compounds (VOCs) and particulates.*

8.4.1.1 Air Quality Criteria

Within Western Australia, the Environmental Protection Authority (EPA) assesses any new proposal in terms of emissions at stack and the resultant ambient ground level concentrations.

Emission Standards and Limits

For emissions from industrial sources, the WA EPA requires that "all reasonable and practicable means should be used to prevent and minimise the discharge of waste" (EPA, 1999b). For new assessments the EPA requires an assessment of the best available technologies (BAT) for minimising the discharge of waste for the processes and justification for the adopted technology.

For best available technologies the EPA has in the past used the Australian Environment Council (AEC) and National Health and Medical Council (NHMRC) (1986) guidelines for new stationary sources as being indicative of what could be achieved as of 1985. The guidelines relevant for gas turbines are given in **Table 8-6**.

- **Table 8-6 National Guidelines for Emissions of Oxides of Nitrogen from Gas Turbines (AEC/NHMRC, 1986)**

Fuel	Rated Electrical Output	Maximum NO_x Emission Concentration	
		(g/m^3)	Equivalent (ppmv)
Gaseous Fuel	<10MW	0.09	44
	>10MW	0.07	34
Other Fuels	< 10MW	0.09	44
	> 10MW	0.15	73

Notes:
1) Gas volumes expressed dry at 0°C and at an absolute pressure equivalent to one atmosphere.
2) Oxides of nitrogen calculated as NO_2 at a 15% oxygen reference level.

Since the AEC/NHMRC guidelines have not been updated, the EPA has provided their own guidance for NO_x emissions from gas turbines (EPA, 1999b). This guidance document states that for new large gas turbines burning natural gas, dry low NO_x burner technology is best practice for open cycle. This technology could achieve NO_x emissions at base load of 25ppmv (dry at 15% oxygen reference level).

The guidance document does not specifically mention gas turbines operating on liquid fuels. NO_x emission from standard burners running on liquid fuels can be as high as 270ppm, however water injection can reduce NO_x emissions to as low as 42ppm and in this case represents best practice. The EPA guidance document specifies that the AEC/NHMRC guidelines should be used as an upper limit for NO_x emissions from new turbine installations. However, the guidance document states:

> *Requests from proponents for a relaxation of the Guidance for gas turbines in areas remote from human habitation and sensitive environments, or for projects where NO_x reduction systems capable of achieving the AEC/NHRMC guidelines would be unsuitable for reasons of operational performance or reliability, will be considered on a case by case basis.*

Given the constraints of the Kemerton location and that best practice technology exists (dry low NO_x burners), an upper limit of 25ppmv would be likely required by the EPA for the proposed Kemerton Power Station when operating on natural gas. However, the Preferred Bidder may have grounds to seek a relaxation of the guidelines when operating on liquid fuel based on the latter of the arguments above in italics, given that the power station would only operate on liquid fuels for less than 100-hours per year. This argument could also be supported by the fact that the European Commission has recently introduced new emission limit values for power plant, which exempts gas turbines for emergency use that operate less than 500-hours per year from the limits (Cassidy, 2002).

Ambient Ground Level Standards

For ambient ground level concentrations, the WA EPA does not have statewide standards. The National Environmental Protection Measure (NEPM) standards (NEPC, 1998) are listed below in **Table 8-7**. These specify a maximum concentration and the goal that is to be achieved within 10 years.

■ **Table 8-7 National Environmental Protection Measure – Air Quality Standards and Goals (NEPC, 1998)**

Pollutant	Averaging Period	Maximum Concentration ppm	Maximum Concentration Equivalent ($\mu g/m^3$)[1]	Goals within 10 years Maximum allowable exceedances
Carbon monoxide	8-hours	9.0	*11,240*	1 day a year
Nitrogen dioxide	1-hour	0.12	*246*	1 day a year
	1 year	0.03	*62*	none
Photochemical oxidants (as ozone)	1-hour	0.10	*214*	1 day a year
	4-hours	0.08	*171*	1 day a year
Sulfur dioxide	1-hour	0.20	*570*	1 day a year
	1 day	0.08	*228*	1 day a year
	1 year	0.02	*57*	none
Lead	1 year	-	0.5	none
Particles as PM_{10}	1 day	-	50	5 days a year

Note:
1) Concentrations of gaseous pollutants in italics have been converted to $\mu g/m^3$ based on a temperature of 0°C and a pressure of 101.3kPa.

These NEPM standards and goals have not been implemented in legislation throughout the state as yet, however the Western Australian DEP intends to implement them through the development of a state wide Environmental Protection Policy (EPP), as discussed in the document *Developing a Statewide Air Quality Environmental Protection Policy* (EPA, 1999c). This document proposes that these standards apply outside industrial areas and residence free buffer areas around industrial estates (EPA, 1999c). For the purpose of this assessment, these levels are taken to apply outside the Kemerton Industrial Park buffer zone and at residential premises within the Kemerton Industrial Park.

The NEPM is not intended to protect vegetation. For impacts on vegetation the World Health Organisation (WHO) has provided guidelines for protection of vegetation from the direct affect of gaseous sulphur dioxide, oxides of nitrogen and ozone (WHO, 2000). The guidelines for the pollutants of interest at Kemerton being, sulphur dioxide and oxides of nitrogen, are listed in **Table 8-8**.

- **Table 8-8 World Health Organisation Air Quality Guidelines for Europe (WHO, 2000)**

Pollutant	Vegetation Category	Guideline ($\mu g/m^3$)	Time Period
Sulfur dioxide	Agricultural Crops	30	Annual and winter mean (6 month winter)
	Forests and Natural Vegetation	20	Annual and winter mean (6 month winter)
	Lichens	10	Annual Mean
Oxides of nitrogen	All Vegetation	75	24-hour
	All Vegetation	30	Annual Mean

Apart from direct impacts on vegetation, oxides of nitrogen and sulphur dioxide can also effect vegetation through the deposition of nitrogen to the soils adding to soil nitrogen levels and the acidification of rain, mists and fogs. The estimation of the deposition of nitrogen and acidity is difficult to model. As these effects are considered minor here, given the relatively small source of emissions and the infrequent nature of operation on the open cycle units (e.g. up to 1,000-hours per year), comparison will only be made to the WHO European guidelines for direct effects on vegetation to indicate the acceptability of the impacts.

In this assessment, the NEPM values have been applied anywhere outside the Kemerton Industrial Park buffer zone and at residential premises within the Kemerton Industrial Park. Vegetation impacts have been evaluated anywhere outside the property boundary.

8.4.1.2 Existing Emission Sources

There are a number of existing small industries within the Kemerton area that emit a range of pollutants, including chlorine, carbon monoxide, hydrogen chloride, titanium tetrachloride, sulphur dioxide, oxides of nitrogen and dust. Of these substances, the Kemerton Power Station would emit significant levels of oxides of nitrogen, sulphur dioxide (when the power station is operating on liquid fuel) and, to a lesser extent, particulates and unburnt hydrocarbons (see **Section 8.4.1.4.1**) that would have the potential to add to existing levels. The emissions of oxides of nitrogen, PM_{10} and sulphur dioxide from existing industries within the Kemerton and Greater Bunbury regions are listed in **Table 8-9**.

- **Table 8-9 Existing Sources of NO_x, PM_{10} and SO_2 within the Kemerton Industrial Park and the Surrounding Region**

Source	NO_x		PM_{10}		SO_2	
	(tpa)	(g/s)	(tpa)	(g/s)	(tpa)	(g/s)
Within Kemerton Industrial Estate						
Simcoa Silicon Smelter	250	7.3	5.2	0.145	33	7.2
Millennium Inorganic Chemicals Titanium Dioxide Pigment Plant	12	0.38	1.3	0.04	130	5.0
Nufarm Chlor-alkali Plant	0	0	0	0	0	0
Outside Kemerton						
Cable Sands – Bunbury	No data	No Data	No data	No Data	No Data	No Data
CSBP Fertiliser Works – Picton	Negl	Negl	Negl	Negl	Negl	Negl
Wespine – Dardanup	19	0.6	1.5	0.05	1.5	0.05
Bristile – Waterloo	3.7	0.12	9.3	0.29	14	0.44
Meadow Lea Foods – Bunbury	1.9	0.06	0.15	0.005	0.01	0.0003
Millennium Inorganic Chemicals – Australind	59	1.9	5.7	0.18	1.1	0.035
Pioneer Quarries – Gelorup	7.20	0.22	13	0.41	0.7	0.022
Alcoa – Bunbury Port	0	0	100	3.2	0	0
Iluka Resources – Capel	No data	No data	No data	No Data	No data	No data
Challenge Dairy – Capel	18	0.6	0	0	0.046	0.0015
PB Foods – Brunswick	3	0.1	0.31	0.001	0.026	0.0008
Worsley Alumina Refinery	3,500	111	1,100	35	10,000	317
Wagerup Alumina Refinery	1,800	57	570	18	1.4	0.044
Collie Power Station	3,300	105	210	6.7	Not given	Not given
Muja Power Station	22,000	698	17,000	540	34,000	1,078

Note:
1) Emission rates in g/s from industries within Kemerton sourced from industry representatives.
2) Data for industries outside Kemerton and annual emissions from industries within Kemerton sourced from National Pollutant Inventory (NPI) website http://www.npi.gov.au/.
3) Emission rate in g/s determined by assuming that pollutants are emitted at a constant rate for the entire year.

This indicates that the existing industries within the Kemerton Industrial Park are minor emitters of NO_x, PM_{10} and SO_2. Outside the Park the significant emitters are the Worsley and Wagerup refineries and the Collie and Muja Power Stations. These are over 50km away and would have a minor impact on air quality within the Kemerton area.

8.4.1.3 Capacity of Kemerton Industrial Park

The former Department of Resources Development (now Office of Major Projects in the Department of Minerals and Energy Resources) in their development of the Concept Plan for the expansion of the Kemerton Industrial Park, commissioned air quality assessments to determine the capacity of the estate to accommodate a range of industries (Dames & Moore, 1991; Woodward Clyde, 1997).

Using typical industry emission characteristics and 60 and 100m stacks, Dames & Moore (1991) concluded that, "providing the total sulphur dioxide source strength does not exceed 1,100g/s, none of the air quality criteria is likely to be exceeded".

For the expansion of the estate, Woodward Clyde (1997) also modelled SO_2 with a range of 60 and 100m stacks at sites throughout the expanded estate. The results of this assessment found that, using the same total emission rate of 1,100g/s (approximately equal to the licensed maximum emissions from Kwinana at that time), the concentrations would be well below the Kwinana EPP residential criteria (the only criteria available at the time of the assessment) outside of the buffer zone.

8.4.1.4 Predicted Impacts

8.4.1.4.1 Atmospheric Emissions from the Power Station

The atmospheric emissions of significance from the Kemerton Power Station would be oxides of nitrogen, sulphur dioxide (when the power station is operating on liquid fuel) and, to a lesser extent, particulates and unburnt hydrocarbons. Of these, oxides of nitrogen, particulate matter and sulphur dioxide are important on a local scale, with oxides of nitrogen also having the potential to lead to photochemical smog. Carbon dioxide is important due to its contribution to the greenhouse effect rather than local air quality, and is discussed in **Sections 3.5** and **8.4.2**.

Emission characteristics for typical open cycle and combined cycle units that would be utilised in the power station are presented in **Table 8-10**. These emission characteristics are given for a 120MW open cycle gas turbine unit operating at maximum continuous rating on either natural gas or liquid fuel, and a 180MW combined cycle unit running on natural gas.

The maximum emissions of oxides of nitrogen, sulphur dioxide and particulates from the power station for the various scenarios assessed are given in **Table 8-11**.

- **Table 8-10 Air Emission Characteristics from Each Open Cycle and Combined Cycle Unit**

Parameter	Units	120MW Open Cycle Unit (Gas)	120MW Open Cycle Unit (Liquid Fuel)	180MW Combined Cycle Unit (Gas)
Power per Unit	MW	120	120	120 + 60
Stack Height	(m)	40	40	40
Stack Diameter	(m)	5.5	5.5	4.0
Mass Flow	(tonnes/hr)	1,450	1,450	1,450
Exit Volume	(Nm^3/s) dry	292	292	292
Exit Volume	(Am^3/s) wet	955	955	468
Exit Temperature	(°C)	550	550	130
Exit Velocity	(m/s)	40.2	40.2	37.2
NO_x Exit Concentration	(ppmv, dry, 15% O_2)	25	42 – 270	25
NO_x Emission Rate per unit	(g/s)	14.95	25.1 – 161.5	14.95
Particulate Emission Rate per unit	(g/s)	0.44	3.2	0.44
SO_2 Emission Rate per unit	(g/s)	0.025	46 – 110	0.025

Notes:
1) Assumes power station operating at maximum continuous rating.
2) Exhaust flows, concentrations and emission rates given at ambient temperature of 15°C.
3) Sulphur dioxide emissions based on an equivalent sulphur dioxide content of 2.7 mg/m^3 in natural gas (Western Power, 2000) and approximate gas consumption at full load. Emissions for liquid fuels based on a Sulphur content of 0.25% for GT grade distillate and 0.6% by weight for F301 fuel.
4) For combustion of liquid fuel, the NO_x values are given with and without water injection.

- **Table 8-11 Total NO_x, Particulate and SO_2 Emissions from the Power Station Scenarios Modelled**

Power Station Scenario Modelled	Fuel	Total NO_x Emissions (g/s)	Total Particulate Emissions (g/s)	Total SO_2 Emissions (g/s)
240MW Open Cycle Gas Turbine (OCGT)	Gas	29.9	0.88	0.05
	Liquid with water injection	50.2	6.4	92 – 220[1]
	Liquid without water injection	323	6.4	92 – 220[1]
540MW Combined Cycle Gas Turbine (CCGT) and 360MW OCGT	Gas	89.7	2.64	0.15
	CCGT – Gas OCGT – Liquid with water injection	120.1	10.9	138.1 – 330.1[1]
	CCGT – Gas OCGT – Liquid without water injection	529.3	10.9	138.1 – 330.1[1]
1,080MW CCGT	Gas	89.7	2.64	0.15

Notes:
1) Sulphur dioxide emissions for liquid fuels based on a Sulphur content of 0.25% and 0.6%.

8.4.1.4.2 Air Dispersion Modelling Methodology

To determine the predicted ground level concentrations of oxides of nitrogen, particulate matter and sulphur dioxide from the proposed power station, a modelling assessment was undertaken. As discussed in **Section 4.5.2**, a number of possible development scenarios are possible on the site and this SER has assessed the "worst case" option with regard to potential environmental impacts. Therefore the following scenarios were modelled in the air quality assessment:

- 240MW of peaking plant, consisting of 2 × 120MW open cycle units, running for 1,000-hours each year (900-hours on natural gas and 100-hours on liquid fuel);
- 360MW of peaking plant consisting of 3 × 120MW open cycle units, running for 1,000-hours each year (900-hours on natural gas and 100-hours on liquid fuel); and 540MW of base load plant consisting of 3 × 180MW of combined cycle units (each unit consisting of 120MW of gas turbine and 60MW of steam turbine plant), running continuously except for maintenance and unplanned outages on natural gas; and
- 1,080MW of gas-fired base load plant, consisting of 6 × 180MW of combined cycle plant (each unit consisting of 120MW of gas turbine and 60MW of steam turbine plant), running continuously except for maintenance and unplanned outages.

Predicted ground level concentrations from the proposed power station development were determined using the air dispersion model DISPMOD (v6.1), local meteorological data and emission characteristics for each source. DISPMOD is the WA DEP dispersion model and was developed to model dispersion in coastal regions and under convective conditions.

Meteorological data for the assessment was obtained from the meteorological station within the Kemerton Industrial Park as monitored by the Bureau of Meteorology for LandCorp. The processing of this data into a format suitable for DISPMOD is described in Woodward Clyde (1997). The source emission data used are given in **Table 8-10** for the proposed power station.

To determine cumulative air quality impacts, the power station was modelled in combination with the existing industries at Kemerton Industrial Park (Simcoa and Millennium Inorganic Chemicals). The emission characteristics from these industries were obtained from the respective industry representatives and the emission rates of NO_x, PM_{10} and SO_2 are given in **Table 8-9**.

A sample DISPMOD control, emission and input file for the 1,080MW power station with existing sources is presented in **Appendix E**.

Predicted impacts from the power station have been modelled assuming the power station runs continuously for a full year (8,760-hours) at full load. For a peaking plant it is anticipated that the station would only operate for around 1,000-hours per year and only during the daytime. As such, modelling for 8,760-hours would be conservative, notwithstanding that maximum ground level concentrations from the plant would occur during the daytime. Furthermore, the open cycle units that operate on both liquid and gaseous fuels were also modelled operating on liquid fuel for the entire period, when in fact that these units would operate on liquid fuel for an estimated 100-hours per year.

To compare the predicted impacts with the NEPM standard for NO_2 the percentage of NO_x in the form of NO_2 is required. At release from gas turbines the percentage of NO_2 is usually less than 10% for standard burners and around 20% for dry low NO_x burners, with the remainder being NO, a less reactive oxide of nitrogen. Upon release the NO can be slowly converted to NO_2 through photochemical reactions. Studies at Kwinana and Pinjar have developed empirical relationships for the conversion of NO to NO_2 as a function of ground level concentrations. These studies have found that, for higher NO_x concentrations, the NO_2 conversion is limited and does not exceed around 60%. For this assessment, the relationship developed from three years of NO/NO_2 data at Kwinana (Dames & Moore, 1993) was used as presented in the following equation:

$$[NO_2] = 0.59 \times [NO_x] - 0.00038 \times [NO_x]^2 \qquad \textbf{Equation 8-1}$$

This indicates that at low NO_x concentrations, the NO_2 fraction has an upper bound of about 0.59, whilst for high NO_x concentrations, the NO_2 fraction decreases. This is primarily due to the NO_2 formation mechanism being a titration reaction with O_3, where the concentration of NO_2 formed is limited by the initial ambient concentration of O_3. This equation does not account that the conversion is a function of travel distance and will therefore overestimate the fraction of NO_2 close to the stacks.

8.4.1.4.3 Results

Oxides of Nitrogen and Nitrogen Dioxide

Predicted maximum 1-hour average ground level concentrations of NO_x and NO_2 from existing industries within the Kemerton Industrial Park are summarised in **Table 8-12** and the predicted NO_2 concentration contours presented in **Figure 8-3**. Maximum predicted NO_x levels outside the buffer are predicted to be 16μg/m^3 with an implied NO_2 concentration of 9μg/m^3. This is well within the NEPM criteria (3.7% of the NEPM). The maximum level occurs under weakly unstable conditions and light north easterly winds.

Predicted maximum 1-hour average NO_x and NO_2 concentrations from the various power station options are summarised in **Table 8-12**. The maximum 1-hour average ground level concentrations of NO_2 anywhere within the modelled grid from the power station in isolation range from 9.3μg/m^3 for a 240MW open cycle plant operating on gas, to 157μg/m^3 for a 540MW combined cycle plant and a 360MW open cycle plant operating on liquid fuel without water injection. The maximum concentrations from the power station are predicted to occur within 2km of the stacks and inside the buffer zone, under unstable conditions and light south easterly winds. Outside the buffer zone, the maximum 1-hour average NO_2 concentrations from the power station in isolation are predicted to range from 6.2 to 101μg/m^3, which are 2.5 – 41.1% of the NEPM 1-hour standard.

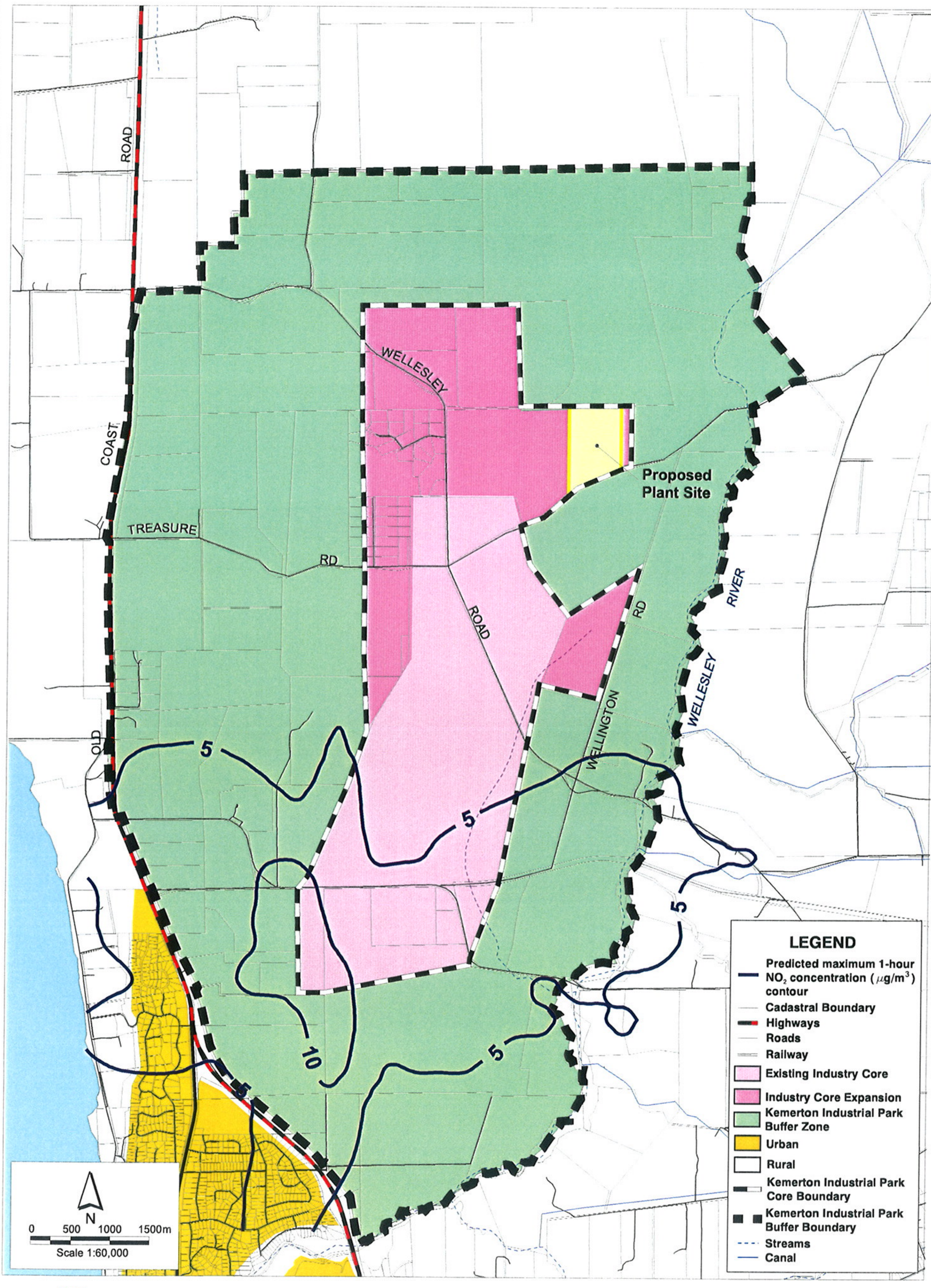
The NO_2 concentration contours for the power station in combination with the existing industries for the power station's "worst NO_x emission" cases are shown in **Figures 8-4** to **8-6**. Due to the distance between the existing industries and the proposed power station site, the existing industries contribute negligible amounts to the maximum ground level concentrations indicating that cumulative impacts are not an issue.

- **Table 8-12 Predicted Maximum 1-hour Average Ground Level Concentrations of NO_x and Implied NO_2 Levels**

Source	Power Station Fuel	Maximum Anywhere		Maximum Outside the Kemerton Buffer Zone			Figure No.[2]
		NO_x (μg/m^3)	Implied NO_2 (μg/m^3)	NO_x (μg/m^3)	Implied NO_2 (μg/m^3)	NO_2 as % of NEPM	
Existing Industries	-	25	14.5	16	9	3.7	**Fig 8-3**
240MW OCGT	Gas	16	9.3	11	6.2	2.5	-
	Liquid with water injection	25.6	14.9	18	10	4.1	-
	Liquid without water injection	173	90.6	106	58	23.6	-
540MW CCGT and 360MW OCGT	Gas	60	34	36	21	8.5	-
	CCGT – Gas OCGT – Liquid with water injection	77	43	44	25	10.1	-
	CCGT – Gas OCGT – Liquid without water injection	341	157	196	101	41.1	-
1,080MW CCGT	Gas	69	38.9	51	29.1	11.8	-
Existing Industries plus 240MW OCGT	OCGT – Liquid without water injection	174	91	113	62	25.2	**Fig 8-4**
Existing Industries plus 540MW CCGT and 360MW OCGT	CCGT – Gas OCGT – Liquid without water injection	341	157	200	103	41.9	**Fig 8-5**
Existing Industries plus 1,080MW CCGT	Gas	69	38.9	49	32	13	**Fig 8-6**

Note:
1) The NEPM standard of 0.12ppm is equivalent to 246μg/m^3 at 0°C and 101.3 kPa.
2) Due to the large number of scenarios modelled, concentration contours have only been shown for a limited number of scenarios as shown in the results tables.

Predicted maximum annual average ground level NO_x and implied NO_2 concentrations from the existing industries and proposed power station are given in **Table 8-13**. The annual average NO_2 concentration contours for a 540MW combined cycle with a 360MW open cycle plant operating on liquid fuel without water injection in combination with the existing industries (the "worst case" scenario) is given in **Figure 8-7**. On an annual basis, nitrogen dioxide levels would be low for all development



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PREDICTED MAX 1-HOUR NO_2 CONCENTRATIONS ($\mu g/m^3$) FROM EXISTING INDUSTRIES AT KEMERTON INDUSTRIAL PARK

FIGURE 8-3

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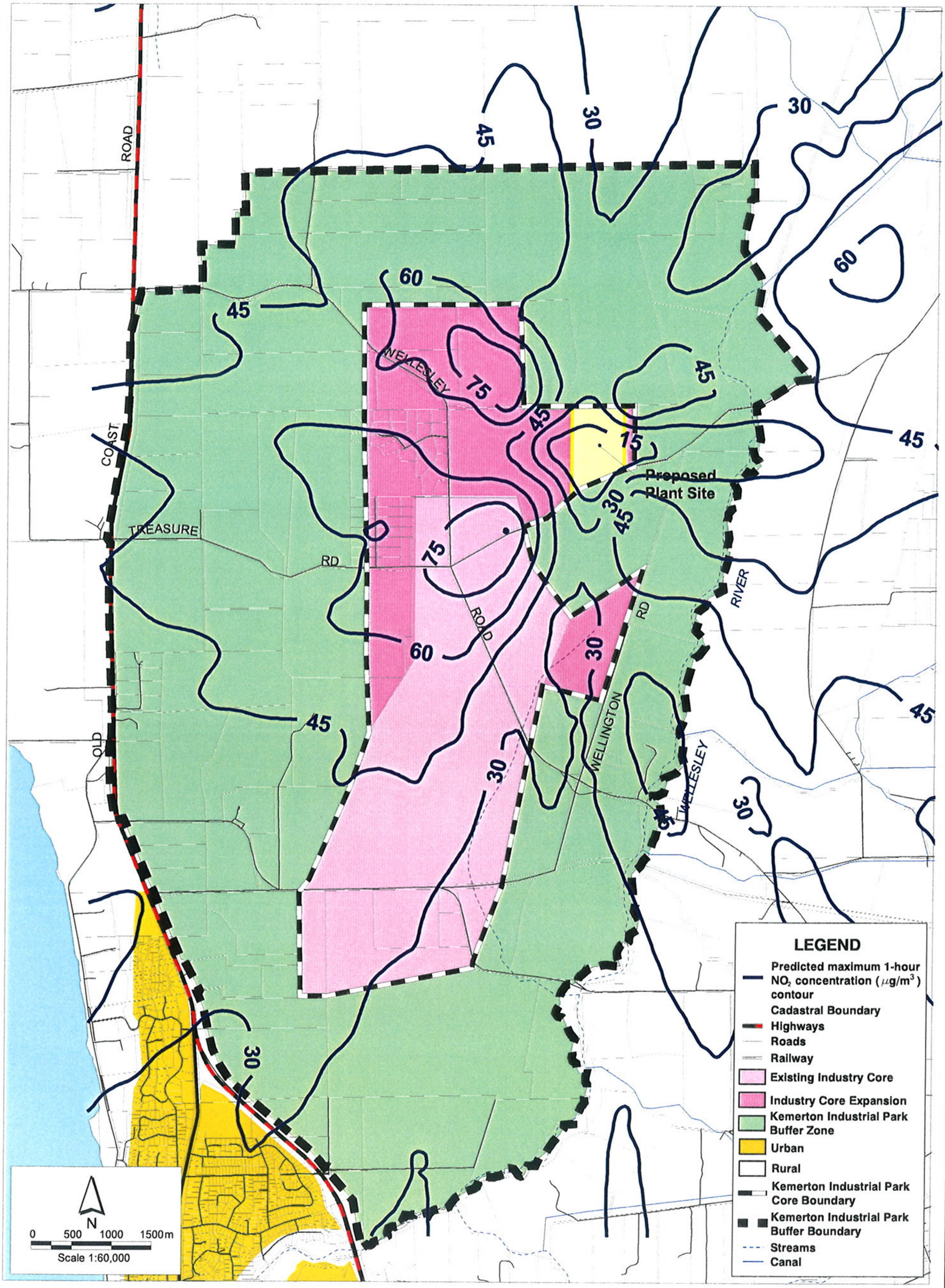

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PREDICTED MAX 1-HOUR NO_2 CONCENTRATIONS ($\mu g/m^3$)
FROM A 240MW LIQUID FUEL-FIRED (WITHOUT WATER INJECTION)
OPEN CYCLE POWER STATION PLUS EXISTING INDUSTRIES

FIGURE 8-4

Job No. DE01833.200
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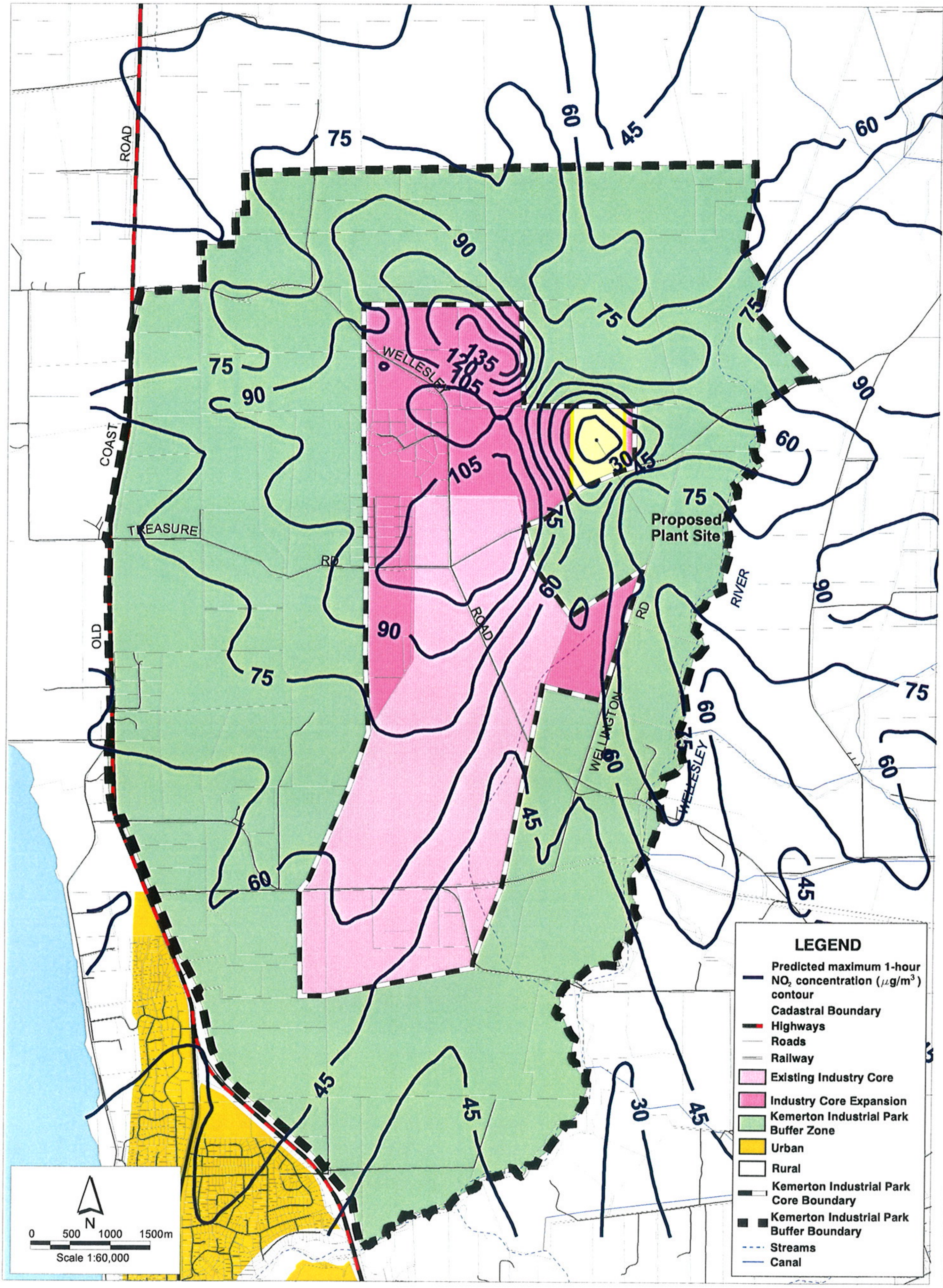

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PREDICTED MAX 1-HOUR NO_2 CONCENTRATIONS ($\mu g/m^3$) FROM A 540MW GAS-FIRED COMBINED CYCLE AND A 360MW LIQUID FUEL-FIRED (WITHOUT WATER INJECTION) OPEN CYCLE POWER STATION PLUS EXISTING INDUSTRIES

FIGURE 8-5

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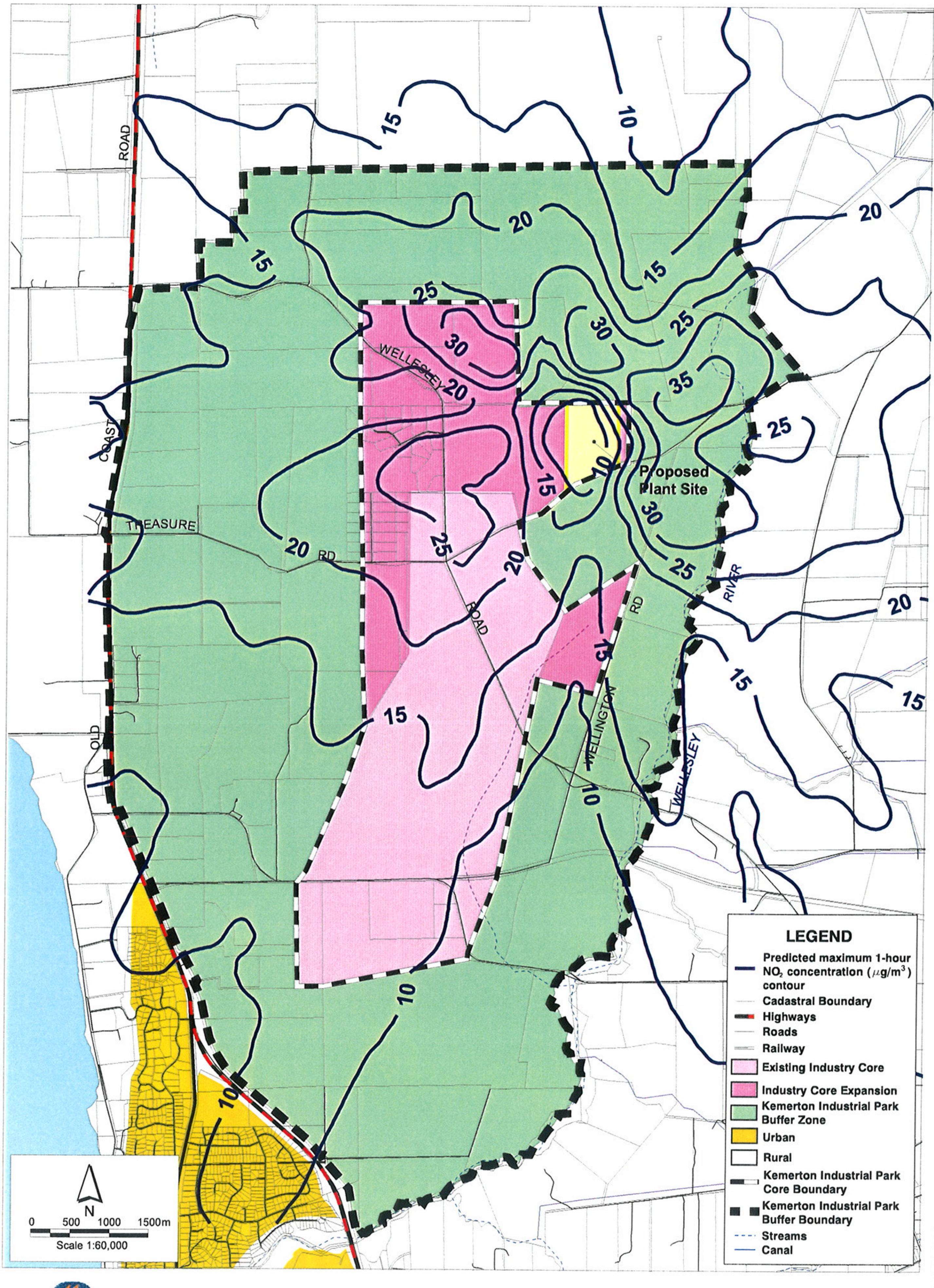

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PREDICTED MAX 1-HOUR NO_2 CONCENTRATIONS ($\mu g/m^3$)
FROM A 1,080MW GAS FIRED COMBINED CYCLE POWER STATION
PLUS EXISTING INDUSTRIES

FIGURE 8-6

Job No. DE01833.200
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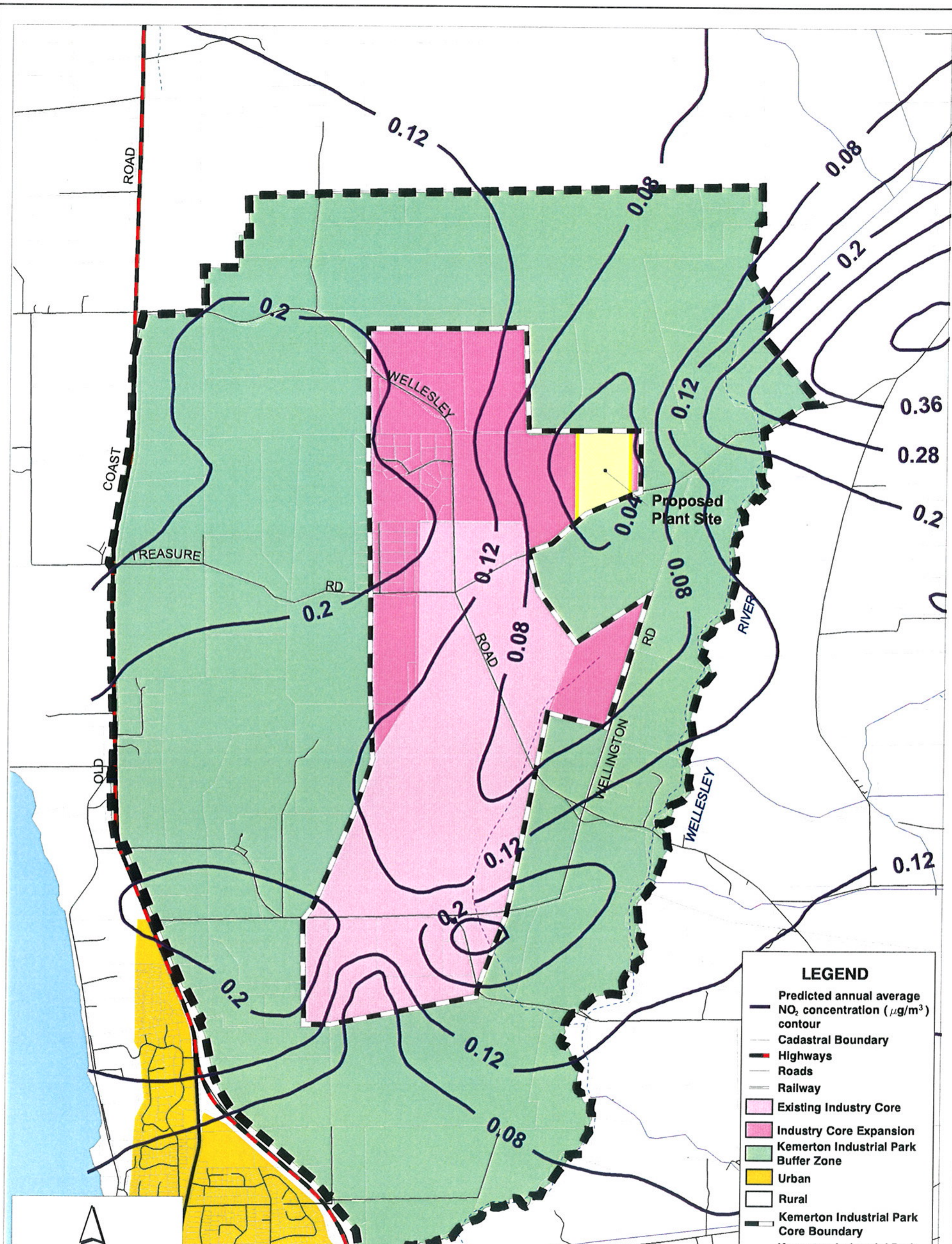

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PREDICTED MAX ANNUAL AVERAGE NO_2 CONCENTRATIONS ($\mu g/m^3$) FROM A 1,080MW GAS FIRED COMBINED CYCLE POWER STATION PLUS EXISTING INDUSTRIES

FIGURE 8-7

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K:\Wes\01700\DE01706\De01833.200\avprojects\air_quality\new08_05.01\fig8_7_r1.apr scenarios (<2.8% of the NEPM standard outside of the buffer zone) and would not be an issue.

- **Table 8-13 Predicted Annual Average Ground Level Concentrations of NO_X and Implied NO_2 Levels**

Source	Power Station Fuel	Maximum outside the Kemerton Industrial Area Buffer Zone Boundary			Figure No.
		NO_x ($\mu g/m^3$)	Implied NO_2 ($\mu g/m^3$)	NO_2 as % of the NEPM	
Existing Industries	-	0.26	0.15	0.24	-
240MW OCGT	Gas	0.12	0.07	0.11	-
	OCGT – Liquid with water injection	0.19	0.11	0.18	-
	OCGT – Liquid without water injection	1.30	0.76	1.23	-
540MW CCGT and 360MW OCGT	Gas	0.82	0.48	0.77	-
	CCGT – Gas OCGT – Liquid with water injection	0.92	0.54	0.87	-
	CCGT – Gas OCGT – Liquid without water injection	2.85	1.68	2.71	-
1,080MW CCGT	Gas	0.72	0.42	0.68	-
Existing Industries plus 240MW OCGT	OCGT – Liquid without water injection	1.34	0.79	1.27	-
Existing Industries plus 540MW CCGT and 360MW OCGT	CCGT – Gas OCGT – Liquid without water injection	2.88	1.70	2.74	-
Existing Industries plus 1,080MW CCGT	Gas	0.75	0.44	0.71	Fig 8-7

Note:
1) The NEPM standard of 0.03ppm is equivalent to 62µg/m³ at 0°C and 101.3kPa.

NO_x Impacts on Vegetation

An assessment of the likelihood for NO_x impacts on vegetation can be made by comparing the ambient levels for effects on vegetation to guidelines recommended by the World Health Organisation (WHO) (2000). These are a 24-hour guideline of 75µg/m³ and an annual guideline of 30µg/m³ for NO_x (**Table 8-8**).

With the existing industry and 'worst case' power station option the highest 24-hour and annual average concentration anywhere on the modelled grid is predicted to be 27.4µg/m³ and 1.70µg/m³, which are 36.5% and 5.7% of the recommended WHO guidelines respectively. These estimates are conservative as they assume that the power station would be operating on liquid fuel without water injection for 24-hours for the entire year, whereas a peaking plant would only operate for approximately 4-hours per day. Therefore it can be assumed that vegetation impacts from NO_x emissions would not be a significant issue for the proposed power station and existing industry.

Particulates

Table 8-14 presents the predicted maximum 24-hour average concentrations of particulates (as PM_{10}) from the existing industries and various power station options. The 24-hour average particulate concentration contours for a 540MW combined cycle with a 360MW open cycle plant operating on liquid fuel in combination with the existing industries (the "worst case" scenario) is given in **Figure 8-8**. Particulate levels are predicted to be low for all development scenarios (<1.2% of the NEPM standard outside of the buffer zone) and would not be an issue.

- **Table 8-14 Predicted Maximum 24-hour Average Ground Level Concentrations of PM_{10}**

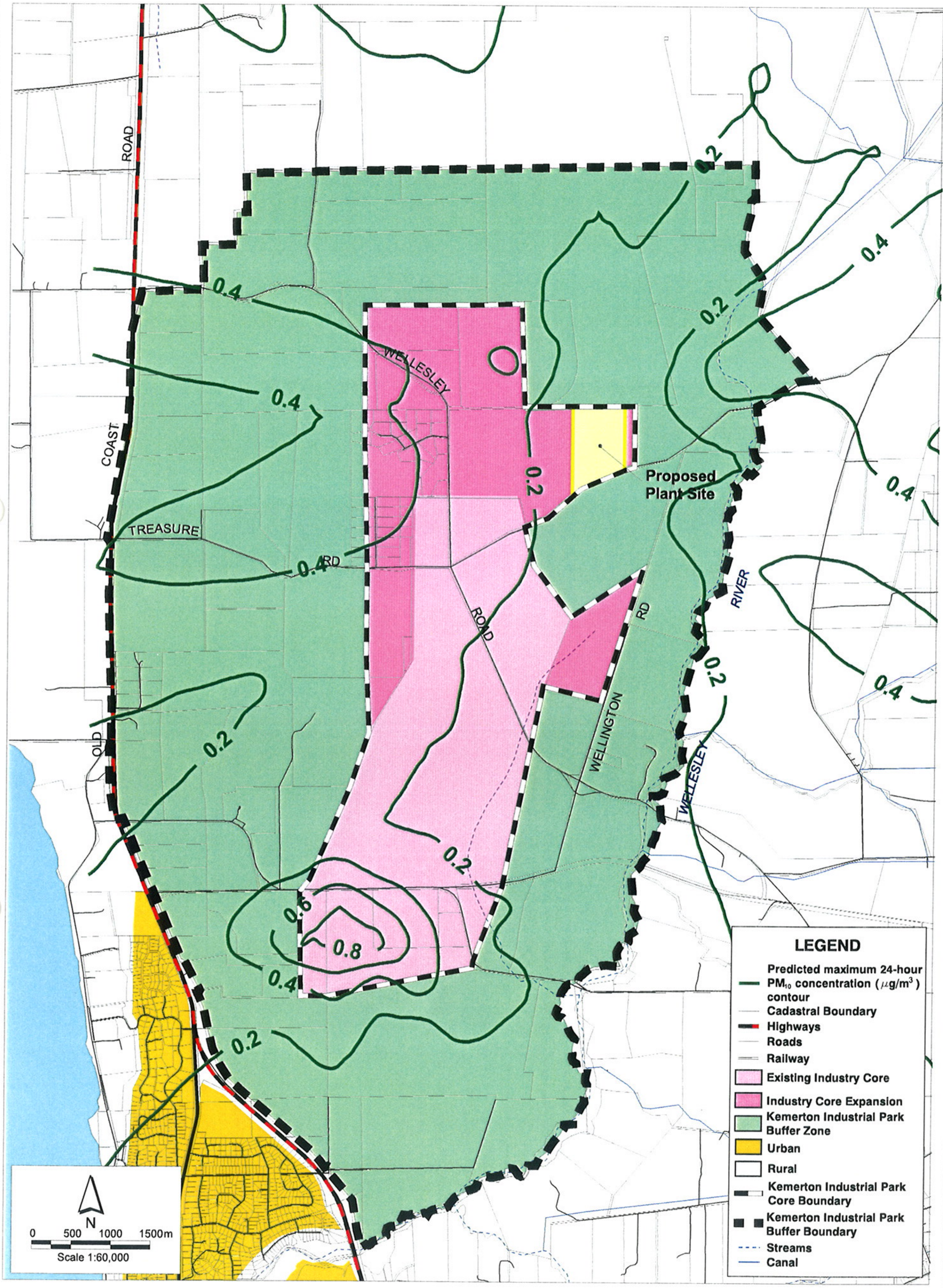
Source	Power Station Fuel	Maximum Anywhere	Maximum outside the Kemerton Buffer Zone		Figure No.
		PM_{10} (μg/m³)	PM_{10} (μg/m³)	PM_{10} as % of the NEPM	
Existing Industries	-	1	0.3	0.6	-
240MW OCGT	Gas	0.04	0.04	0.08	-
	Liquid Fuel	0.3	0.3	0.6	-
540MW CCGT and 360MW OCGT	Gas	0.2	0.2	0.4	-
	Liquid Fuel	0.7	0.7	1.4	-
1,080MW CCGT	Gas	0.26	0.26	0.52	-
Existing Industries plus 240MW OCGT	Liquid Fuel	1	0.3	0.6	-
Existing Industries plus 540MW CCGT and 360MW OCGT	Liquid Fuel	1	0.7	1.4	**Fig 8-8**
Existing Industries plus 1,080MW CCGT	Gas	1	0.3	0.6	-

Note:
1) The NEPM standard is 50μg/m³ with up to 5 exceedances per year.

Sulphur Dioxide

Predicted maximum 1-hour average ground level concentrations of SO_2 from existing industries within the Kemerton Industrial Park are summarised in **Table 8-15** and the predicted SO_2 concentration contours presented in **Figure 8-9**. The maximum SO_2 levels are predicted to be 320μg/m³ anywhere on the modelled grid and 80μg/m³ outside the buffer. However, these are likely to be over-predicted, as the venting from the Baghouse at Simcoa cannot be accurately modelled within DISPMOD, which only deals with stack sources. Outside the buffer zone, concentrations are well below the NEPM criteria (maximum of 14% of the NEPM). Predicted maximum 24-hour and annual average concentrations of SO_2 from the existing industries are relatively low at 6.1% and 2.5% of the NEPM standard respectively outside the buffer zone (**Table 8-16** and **8-17**).

The potential SO_2 emissions from the power station depend on the sulphur content of the fuel. **Table 8-15** presents the predicted maximum 1-hour average concentrations of sulphur dioxide from the various power station options. This indicates that for a gas-fired plant there would be an insignificant impact, there being no discernible increase in ground level concentrations from the proposed power station compared to existing SO_2 levels (14%) of the NEPM. However, these concentrations increase with use of liquid fuel. For the sulphur contents assumed of 0.25% and 0.6%, the maximum SO_2 concentrations from the power station in isolation would be around 8.9% to 21.1% of the NEPM standard outside of the buffer zone. Sulphur dioxide concentrations would increase from 21.1% to 21.4% if contributions for existing industries were included.



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PREDICTED MAX 24-HOUR PM_{10} CONCENTRATIONS ($\mu g/m^3$) FROM A 540MW GAS-FIRED COMBINED CYCLE AND A 360MW LIQUID FUEL-FIRED OPEN CYCLE POWER STATION PLUS EXISTING INDUSTRIES

FIGURE 8-8

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- **Table 8-15 Predicted Maximum 1-hour Average Ground Level Concentrations of Sulphur Dioxide**

Source	Power Station Fuel	Maximum SO_2 Anywhere ($\mu g/m^3$)	Maximum outside the Kemerton Buffer Zone		Figure No.
			SO_2 Conc. ($\mu g/m^3$)	SO_2 as % of the NEPM	
Existing Industries	-	320	80	14	**Figure 8-9**
240MW OCGT	Gas	-	-	-	-
	Liquid Fuel (0.25% S)	49	32	5.6	-
	Liquid Fuel (0.6% S)	117.7	68	11.9	-
540MW CCGT and 360MW OCGT	Gas	-	-	-	-
	OCGT – Gas CCGT – Liquid Fuel (0.25% S)	88	51	8.9	-
	OCGT – Gas CCGT – Liquid Fuel (0.6% S)	211	120	21.1	-
1,080MW CCGT	Gas	0.11	0.09	0.02	-
Existing Industries plus 240MW OCGT	Liquid Fuel (0.6% S)	320	80	14	-
Existing Industries plus 540MW CCGT and 360MW OCGT	OCGT – Gas CCGT – Liquid Fuel (0.6% S)	320	122	21.4	**Figure 8-10**
Existing Industries plus 1,080MW CCGT	Gas	320	80	14	-

Notes:
1) The NEPM standard of 0.2ppm is equivalent to 570$\mu g/m^3$ at 0°C and 101.3kPa.

Predicted maximum 24-hour and annual average concentrations of SO_2 are given in **Table 8-16** and **Table 8-17** respectively. The maximum concentrations over both of these averaging periods were relatively low and are predicted to be at most 8.7% and 3.0% of the NEPM standards respectively outside the buffer zone, including existing industries as well as the proposed power station.

- **Table 8-16 Predicted Maximum 24-hour Average Ground Level Concentrations of Sulphur Dioxide**

Source	Power Station Fuel	Maximum SO_2 Anywhere ($\mu g/m^3$)	Maximum outside the Kemerton Buffer Zone		Figure No.
			SO_2 Conc. ($\mu g/m^3$)	SO_2 as % of the NEPM	
Existing Industries	-	43.7	14	6.1	-
240MW OCGT	Gas	-	-	-	-
	Liquid Fuel (0.25% S)	4.3	4.3	1.9	-
	Liquid Fuel (0.6% S)	10.3	10.3	4.5	-
540MW CCGT and 360MW OCGT	Gas	-	-	-	-
	OCGT – Gas CCGT – Liquid Fuel (0.25% S)	8.1	8.1	3.5	
	OCGT – Gas CCGT – Liquid Fuel (0.6% S)	19.5	19.5	8.5	-
1,080MW CCGT	Gas	0.015	0.012	0.005	-
Existing Industries plus 240MW OCGT	Liquid Fuel (0.6% S)	43.7	14	6.1	-
Existing Industries plus 540MW CCGT and 360MW OCGT	OCGT – Gas CCGT – Liquid Fuel (0.6% S)	43.7	20	8.7	**Figure 8-11**
Existing Industries plus 1,080MW CCGT	Gas	43.7	14	6.1	-

Notes:
1) The NEPM standard of 0.08ppm is equivalent to 229$\mu g/m^3$ at 0°C and 101.3kPa.

Table 8-17 Predicted Maximum Annual Average Ground Level Concentrations of Sulphur Dioxide

Source	Power Station Fuel	Maximum SO_2 Anywhere ($\mu g/m^3$)	Maximum outside the Kemerton Buffer Zone		Figure No.
			SO_2 Conc. ($\mu g/m^3$)	SO_2 as % of the NEPM	
Existing Industries	-	4.7	1.4	2.5	-
240MW OCGT	Gas	-	-	-	-
	Liquid Fuel (0.25% S)	0.37	0.37	0.6	-
	Liquid Fuel (0.6% S)	0.88	0.88	1.5	-
540MW CCGT and 360MW OCGT	Gas	-	-	-	-
	OCGT – Gas CCGT – Liquid Fuel (0.25% S)	0.64	0.64	1.1	
	OCGT – Gas CCGT – Liquid Fuel (0.6% S)	1.55	1.55	2.7	-
1,080MW CCGT	Gas	0.0012	0.0012	0.002	-
Existing Industries plus 240MW OCGT	Liquid Fuel (0.6% S)	4.6	1.6	2.8	-
Existing Industries plus 540MW CCGT and 360MW OCGT	OCGT – Gas CCGT – Liquid Fuel (0.6% S)	4.7	1.7	3.0	-
Existing Industries plus 1,080MW CCGT	Gas	4.5	1.6	2.8	**Fig 8-12**

Notes:
1) The NEPM standard of 0.02ppm is equivalent to $57\mu g/m^3$ at 0°C and 101.3kPa.

The SO_2 concentration contours for the power station in combination with the existing industries for selected options are given in **Figures 8-10** to **8-12** for the 1-hour, 24-hour and annual averaging periods. Due to the distance between the existing industries and the proposed power station site, there is a negligible increase in predicted ground level concentrations between the power station in isolation and in combination with the existing industries, indicating that cumulative impacts are not an issue.

SO_2 Impacts on Vegetation

Impacts of sulphur dioxide on vegetation can likewise be assessed with reference to the WHO (2000) guidelines for protection of vegetation (**Table 8-8**). These are annual and winter means of $30\mu g/m^3$ for agricultural crops, $20\mu g/m^3$ for forests and natural vegetation and $10\mu g/m^3$ for the most susceptible organism, lichen.

Model predictions assuming the power station running continuously with the open cycle units operating on liquid fuels estimated that the maximum annual concentrations from the power station in isolation would be $1.55\mu g/m^3$ (**Table 8-17**). This concentration is well below the recommended annual concentration for the most susceptible organism, lichen. Also, this is an overestimate of the impact as the power station would run on liquid fuels for less than 100-hours per year and the concentrations from the power station operating on gas would be negligible.

On a cumulative basis, maximum SO_2 levels are predicted to be $4.7\mu g/m^3$ occurring within a few hundred metres of the Simcoa plant. The predicted concentrations from modelling is considered an overestimate due to the coarse approximation used to model the emissions from the baghouse. Therefore, potential SO_2 impacts on vegetation from the existing industries and proposed power station is considered negligible.

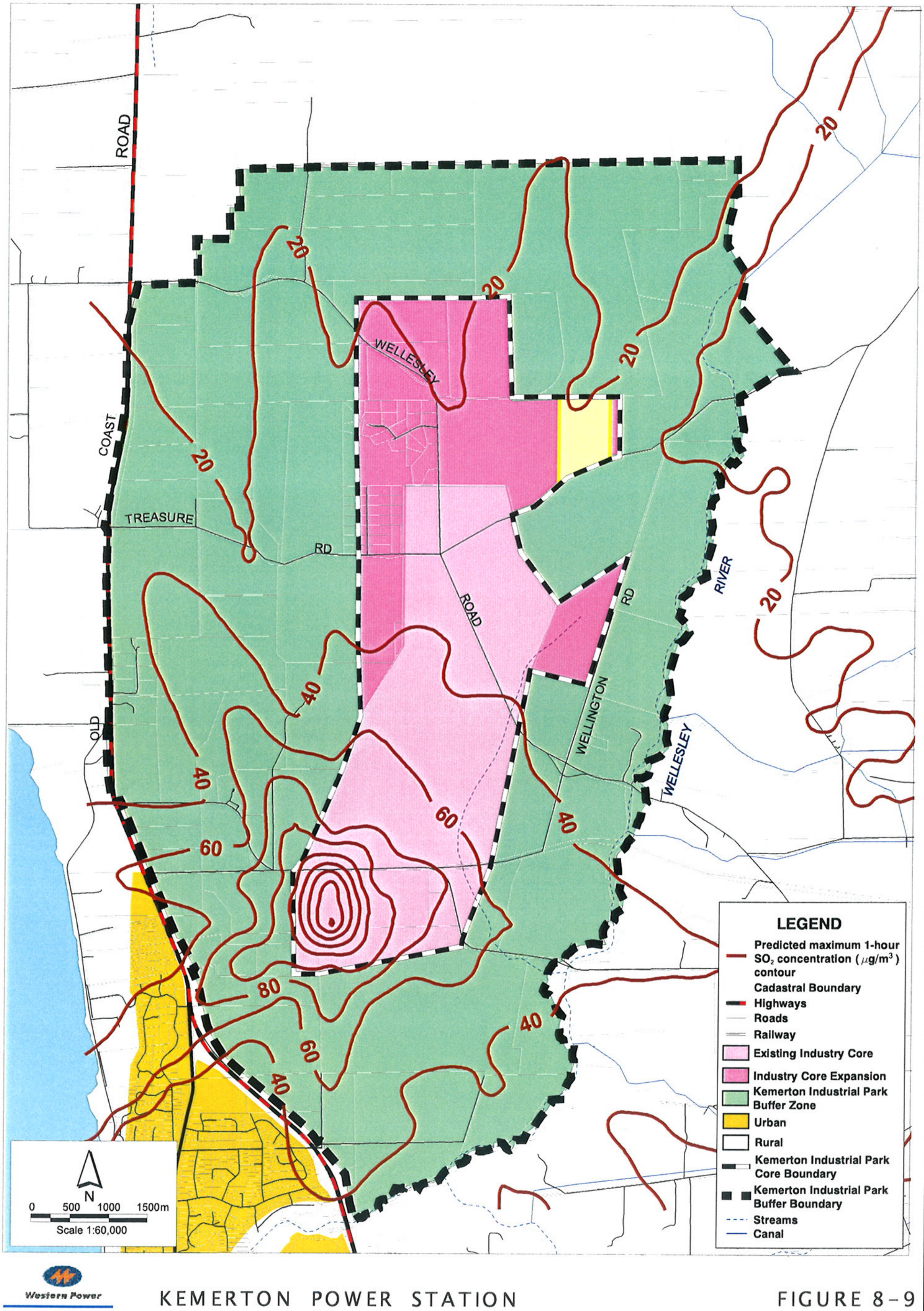

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FIGURE 8-9

PREDICTED MAX 1-HOUR SO_2 CONCENTRATIONS ($\mu g/m^3$)
FROM EXISTING INDUSTRIES AT KEMERTON INDUSTRIAL PARK

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Prepared by: T.Lee

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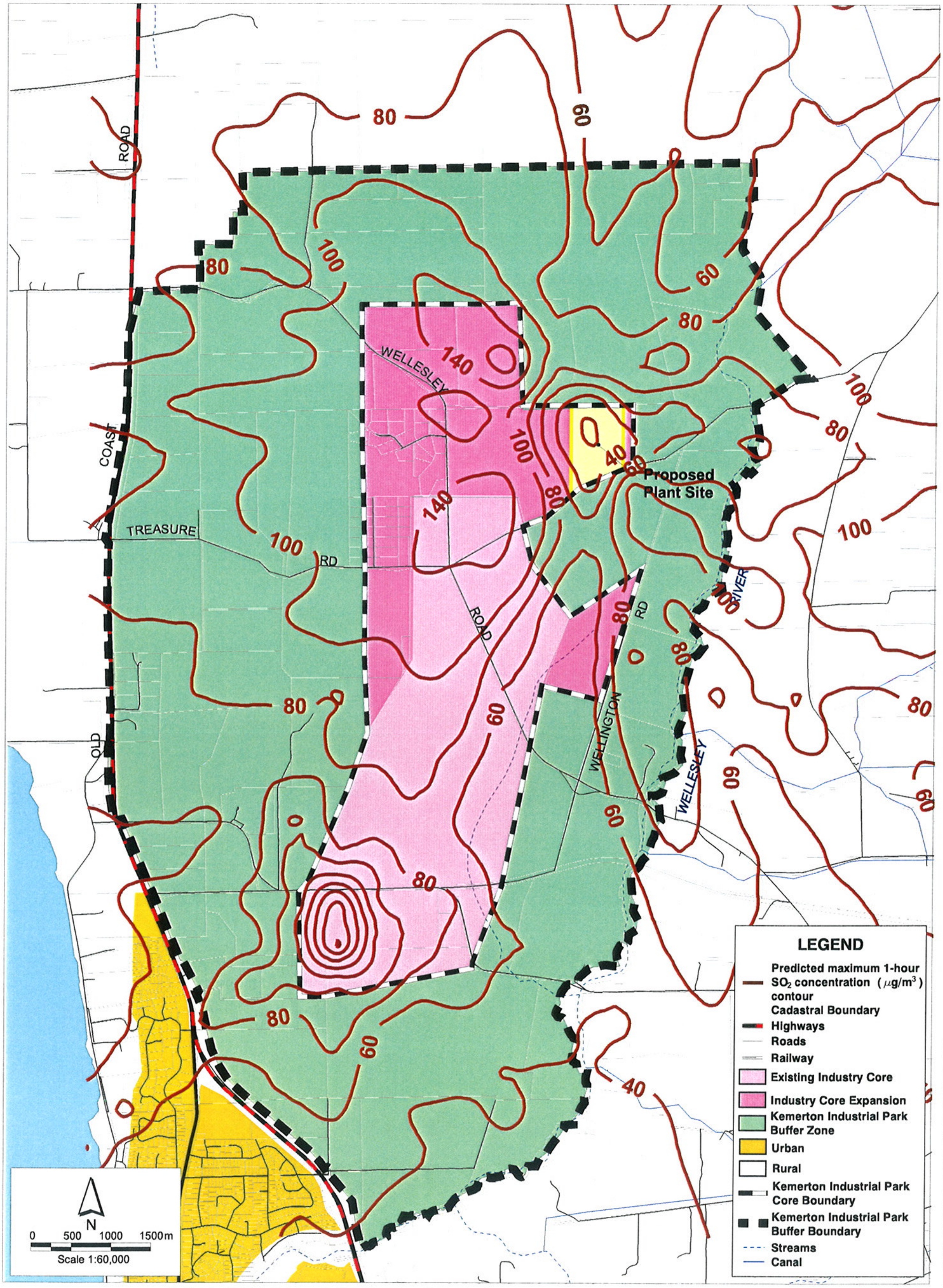

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PREDICTED MAX 1-HOUR SO_2 CONCENTRATIONS ($\mu g/m^3$)
FROM A 540MW GAS FIRED COMBINED CYCLE AND A 360MW
LIQUID FUEL-FIRED (0.6% SULPHUR) OPEN CYCLE POWER STATION
PLUS EXISTING INDUSTRIES

FIGURE 8-10

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Prepared by: T.Lee

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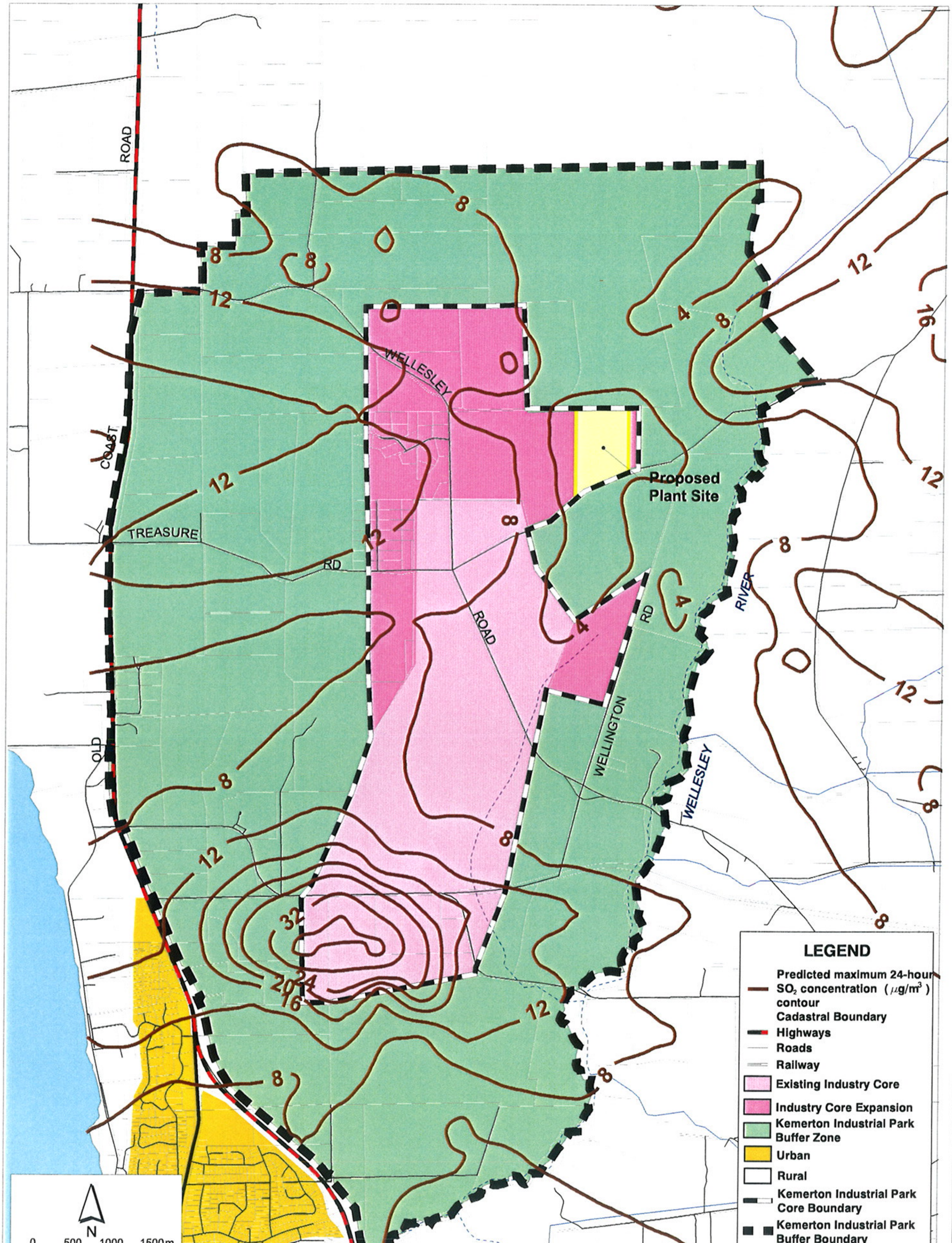

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PREDICTED MAX 24-HOUR SO_2 CONCENTRATIONS ($\mu g/m^3$) FROM A 540MW GAS FIRED COMBINED CYCLE AND A 360MW LIQUID FUEL-FIRED (0.6% SULPHUR) OPEN CYCLE POWER STATION PLUS EXISTING INDUSTRIES

FIGURE 8-11

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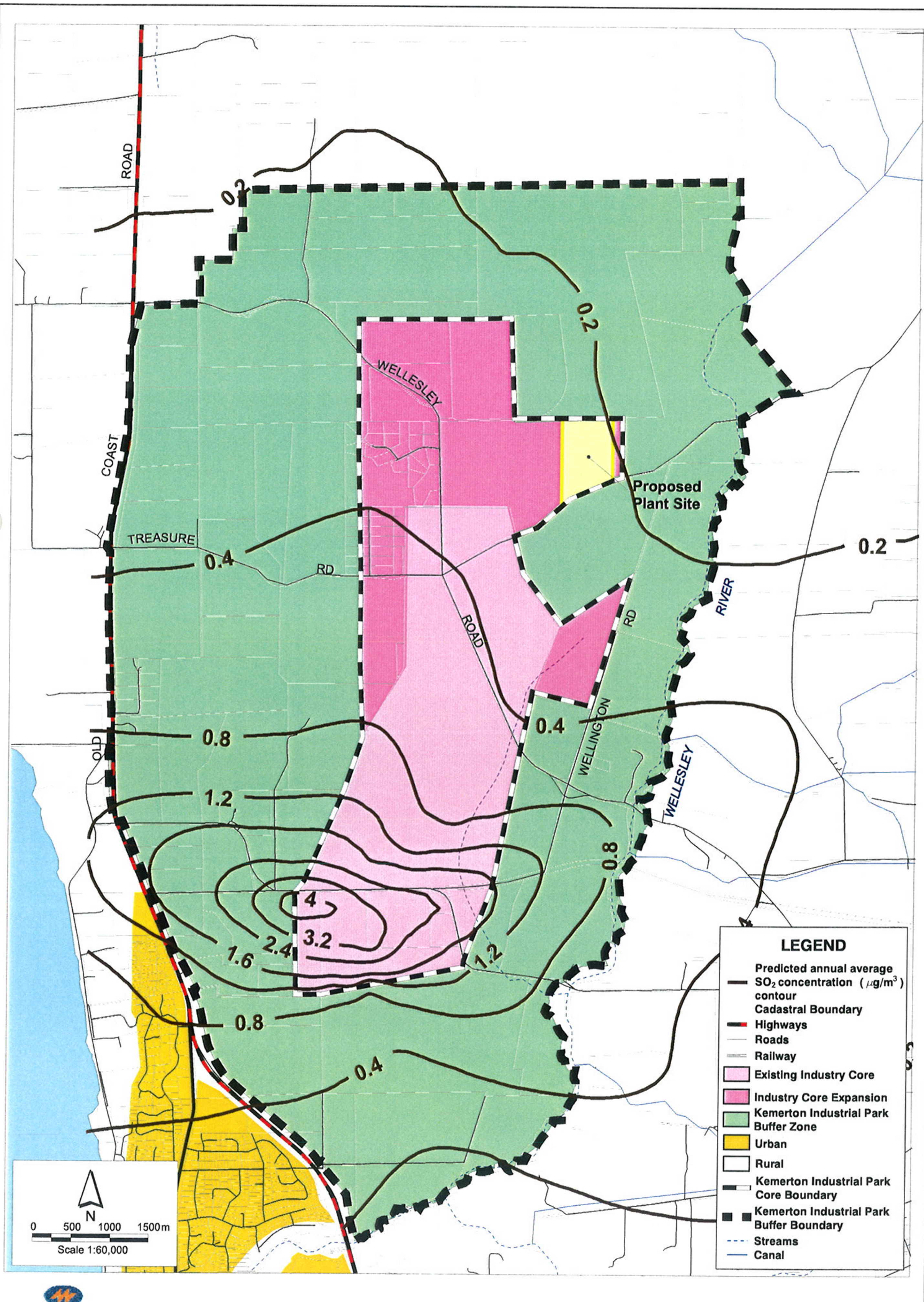

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FIGURE 8-12

PREDICTED MAX ANNUAL AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$) FROM A 1,080MW GAS FIRED COMBINED CYCLE GAS-FIRED POWER STATION PLUS EXISTING INDUSTRIES

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Prepared by: T.Lee

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8.4.1.4.4 Regional Air Quality Impacts

Photochemical smog is not deemed to be a problem in the Greater Bunbury Region (WAPC, 2000b). Smog modelling studies undertaken for the Peel Region, which is north of Bunbury concluded that the Peel Region will occasionally experience smog events due to the transport of pollutants from the Perth region. However as the Kemerton region is a further 100km south, it can be assumed that smog entering the Bunbury region from Perth would be less than that reaching the Peel region and that any smog from emissions from the Bunbury region would be highly unlikely to reach Perth (WAPC, 2000b).

The relative potential for smog can also be gauged by comparing the emissions of the major smog forming substances; oxides of nitrogen and non-methane volatile organic compounds from the Bunbury region to that of Perth. It is considered that the power station options would have a minor impact on existing low levels of smog as:

- Present emissions of NO_x from Kemerton are 7.68g/s, which is 0.38% of Perth anthropogenic emissions (motor vehicles and industry etc) of around 2,000g/s (DEP, 2002) with emissions of volatile organic compounds estimated at 0.1g/s compared to 1,700g/s for Perth (0.006%) ;
- Emissions from other industry in the Bunbury region are negligible (excluding consideration of more distant sources at Wagerup and Worsley); and
- The power station would emit between 30 to 530g/s of NO_x (1.5 to 26.5% of Perth emissions) and 1.2 to 3.6g/s VOC (0.07 to 0.21%) of Perth's anthropogenic emissions (DEP, 2002).

8.4.1.5 Summary of Potential Impacts on Air Quality

The atmospheric emissions of significance from the Kemerton Power Station would be oxides of nitrogen, sulphur dioxide (when the power station is operating on liquid fuel) and, to a lesser extent, particulates and unburnt hydrocarbons. The dispersion model DISPMOD was used to assess the predicted air quality impacts from a number of possible power station development scenarios and existing industries within Kemerton Industrial Park.

Normal Operation (Natural Gas)
The primary fuel supply to the power station is expected to be natural gas. When the power station is operating on gas the predicted concentrations would be well below the NEPM standard for NO_2 and PM_{10} and sulphur dioxide. For the maximum power station capacity or 1,080MW, these levels are predicted to be as follows for the power station in isolation and cumulatively respectively:

- 11.8% and 13% of the 1-hour average NO_2 standard;
- 0.68% and 0.71% of the annual average NO_2 standard;
- 0.52% and 0.6% of the 24-hour average PM_{10} standard;
- 0.02% and 14% of the 1-hour average SO_2 standard;
- 0.005% and 6.1% of the 24-hour average SO_2 standard; and
- 0.005% and 2.8% of the annual average SO_2 standard.

Therefore under normal operation, the power station is not expected to have major impact on air quality in the Kemerton area.

Liquid Fuel Operation (100-hours per year)

It is anticipated that the open cycle units of the power station could operate on liquid fuel for up to 100-hours per year. As a conservative estimate of the maximum concentrations that could result, the air quality assessment was undertaken assuming constant emissions for the entire year. The results of the air quality assessment during liquid fuel operation indicate the following:

- The maximum potential 1-hour average NO_2 concentrations would be up to 41.1% of the NEPM standard for a 360MW open cycle power station operating on liquid fuel without water injection for NO_x control and a 540MW combined cycle power station operating on natural gas. For this development scenario, the maximum cumulative 1-hour average concentration of NO_2 is 41.9% of the NEPM. These maximum values are predicted to occur within the Kemerton Industrial Park;
- Predicted annual average NO_2 concentrations from the power station would be well below the NEPM standard (less than 2.71% in isolation and 2.74% in combination with existing industries) even when conservatively assuming that the open cycle units are run on liquid fuel for the entire year;
- Predicted 24-hour average particulate concentrations would be minor (no greater than 1.4% of the NEPM standard);
- The maximum potential 1-hour average SO_2 concentrations would be up to 21.1% of the NEPM standard for a 360MW open cycle power station operating on liquid fuel of sulphur content 0.6% and a 540MW combined cycle power station operating on natural gas. For this development scenario, the maximum cumulative 1-hour average concentration of SO_2 is 21.4% of the NEPM. These maximum values are predicted to occur within the Kemerton Industrial Park;
- Predicted cumulative 24-hour and annual average sulphur dioxide concentrations would be at most 8.7% and 3.0% of the NEPM standards respectively, even when conservatively assuming that the open cycle units are run on liquid fuel for the entire year; and
- The predicted SO_2 and NO_2 concentrations would be well below the World Health Organisation recommended criteria for impacts on vegetation from both the existing industries and the proposed power station, and potential impacts on vegetation are considered negligible.

8.4.1.6 Management Strategies

The Preferred Bidder would be required to verify that the air emissions from the power station are lower than or equal to those modelled in this assessment. If this could not be demonstrated, then re-modelling would be required to verify that the air quality criteria could be achieved.

The Preferred Bidder would also be required to install low NO_x burners on gas turbine units.

8.4.1.7 Monitoring

The Preferred Bidder would be required to undertake emission monitoring following the commissioning of the power station to verify the assumptions made in the modelling assessment. Monitoring of NO_x and SO_2 emissions from stacks would be undertaken as a minimum on a routine basis and during periods when the power station is operating on liquid fuel.

8.4.2 Greenhouse Gas Emissions

Management Objective

- *Ensure that potential greenhouse gas emissions are adequately addressed in the planning/designing and operation of the proposed power station.*

Greenhouse gas considerations are presented in detail in **Section 3.5**, which includes discussion of legislative requirements, framework developed by the Electricity Generation Industry to reduce greenhouse gas emissions and a comparison of indicative greenhouse gas emissions for various electricity generation technologies. This section summarises specific greenhouse strategies which would be required of the Preferred Bidder.

8.4.2.1 Potential Impacts

Greenhouse gases are a natural part of the atmosphere. They trap outgoing infrared radiation from the earth and maintain the earth's surface temperature at a level necessary to support life. The burning of fossil fuels and other human activities are increasing the concentrations of these gases in the atmosphere which has the potential to enhance the greenhouse effect and cause global climate change.

The predicted change in greenhouse emissions from new generation capacity on the SWIS is presented in **Section 3.5.4.2.1**.

8.4.2.2 Management Strategies

The Preferred Bidder would be required to implement the following management strategies:

- Become a signatory to the Greenhouse Challenge;
- Implement best practicable thermal efficiency design and operating goals; and
- Identify and implement carbon sink projects, including an environmental tree planting program in Western Australia, which would have other environmental benefits as well carbon sequestration.

8.4.2.3 Monitoring

As a signatory to the Greenhouse Challenge, the Preferred Bidder would be required to report annual emissions to the Greenhouse Office. In addition, the Preferred Bidder would be required to undertake operational performance monitoring of combustion gases to ensure power generation meets design efficiency criteria.

8.4.3 Noise

Management Objectives

- *To ensure that noise impacts emanating from the proposed plant comply with statutory requirements specified in the Environmental Protection (Noise) Regulations 1997; and*
- *Ensure that vibration impacts emanating from the proposed plant are acceptable.*

8.4.3.1 Noise Criteria – Operational Phase

The criteria used to assist in determining the extent of any acoustical impacts from a project or development are defined within the *Environmental Protection (Noise) Regulations 1997.* The regulations takes into account the zoning (and land use) of the receiver location, and apply differing criteria for day, evening or night-time. **Table 8-18** presents the assigned noise levels in accordance with the EPA's regulations.

Table 8-18 Assigned Noise Levels for all Premises

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	$L_{A,Max}$
Noise sensitive premises at locations within 15m of a building directly associated with a noise sensitive use	0700 to 1900 hours Monday to Saturday	45dB(A) + influencing factor	55dB(A) + influencing factor	65dB(A) + influencing factor
	0900 to 1900 hours Sunday and public holidays	40dB(A) + influencing factor	50dB(A) + influencing factor	65dB(A) + influencing factor
	1900 to 2200 hours all days	40dB(A) + influencing factor	50dB(A) + influencing factor	55dB(A) + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35dB(A) + influencing factor	45dB(A) + influencing factor	55dB(A) + influencing factor
Noise sensitive premises at locations further than 15m from a building directly associated with a noise sensitive use	All hours	60dB(A)	75dB(A)	80dB(A)
Commercial premises	All hours	60dB(A)	75dB(A)	80dB(A)
Industrial and utility premises	All hours	65dB(A)	80dB(A)	90dB(A)

Notes:
1) $L_{A,Max}$ – The loudest noise level assessed during a 15-minute to 4-hour sampling period.
2) L_{A1} – The noise level exceeded for 1% of a 15-minute to 4-hour sampling period, equating to the loudest 9-seconds measured during the survey period.
3) L_{A10} – The noise level exceeded for 10% of a 15-minute to 4-hour sampling period or the loudest 90-seconds. This is frequently referred to as the average-maximum noise level.
4) L_{A90} – The noise level exceeded for 90% of a 15-minute to 4-hour sampling period. This is frequently referred to as the background noise level.

A *Noise Sensitive Premises* is defined in the Regulations as being premises relating to:

- Solely or mainly for residential accommodation purposes, including a caravan park or camping ground;

- A hospital (having accommodation for less than 150 in-patients) or sanatorium, home or institution for care of persons, a rehabilitation centre, home or institution for persons requiring medical or rehabilitative treatment;
- Educational building (school, college, university, technical institute, academy or other educational centre, lecture hall) or other premises used for the purpose of instruction;
- A place of public worship;
- A tavern, hotel, club premises, reception lodge or other premises which provides accommodation for the public;
- Aged care;
- Child care;
- A prison or detention centre; and
- Any other premises not referred to above that is not an industrial and utility or commercial premises.

The allowable noise level when received at a residence is determined by the calculation of an influencing factor that is added to the base criteria set out in **Table 8-18**. The Regulations under Schedule 3 clause (5), allow for an influencing factor of 5dB(A) to be added to the above assigned noise levels at the point of reception for noise emissions from any premises within the Kemerton Industrial Park in the following periods:

- 0900 hours to 1900 hours on a Sunday or public holiday;
- 1900 hours to 2200 hours on any day;
- 2200 hours to 0700 hours on Monday to Saturday inclusive; and
- 2200 hours to 0900 hours on a Sunday or public holiday.

Other influencing factors that would apply include:

- For residences located within the Industrial Core area, where the land is zoned industrial the influencing factor to be added to the base level is 20dB(A) (most of the residences within the Core are tenants of LandCorp on a short-term lease agreement); and
- For residences located to the west of the Park and within 100m of the Old Coast Road, a "transport influencing factor" of 2dB(A) would be added.

The assigned noise levels are also conditional on no annoying characteristics existing, such as tonal components etc. If characteristics exist, then any measured level is adjusted upwards accordingly. The adjustments that apply are detailed in **Table 8-19**.

- **Table 8-19 Adjustments for Annoying Characteristics**

Tonality	Modulation	Impulsiveness
+5dB	+5dB	+10dB

In summary, assuming no annoying noise characteristics, the noise emissions from the project site would be limited by the criteria outlined in **Table 8-20**, applicable under the *Environmental Protection (Noise) Regulations 1997.*

■ **Table 8-20 Limiting Noise Criteria**

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L_{A10}	L_{A1}	$L_{A,Max}$
Residential dwelling(s) outside the Industrial Core Park boundary	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	40dB(A)	50dB(A)	60dB(A)
Residential dwelling(s) outside the Industrial Core, but within the buffer zone	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	40dB(A)	50dB(A)	60dB(A)
Residential dwelling(s) outside the Industrial Core zone and within 100m of Old Coast Rd	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	42dB(A)	52dB(A)	62dB(A)
Residential dwelling(s) within the industrial core	All hours	60dB(A)	70dB(A)	80dB(A)
Industrial and utility premises	All hours	65dB(A)	80dB(A)	90dB(A)

For this study, the limiting criterion would be compliance with the L_{A10} objective.

The Regulations also account for the total noise that would be received at a premises from an area such as the Kemerton Industrial Park in order to prevent the cumulative effect of multiple sources that could result in a total noise level exceeding the criteria at the premises. The Regulations state that in order for an industry to be deemed as "not significantly contributing" to noise levels at a receptor, noise emissions from individual industries would need to be at least 5dB(A) below the assigned level.

8.4.3.2 Noise Modelling Methodology

Herring Storer Acoustics was engaged by Sinclair Knight Merz to undertake an acoustic assessment of the proposed power station for the following development scenarios (Herring Storer Acoustics, 2002):

- 240MW capacity open cycle plant;
- 360MW capacity combined cycle plant;
- 720MW capacity combined cycle plant;
- 1,080MW capacity combined cycle plant; and
- 1,080MW capacity combined cycle plant and the possible future industry mix used in *Kemerton Expansion Study Noise Modelling to Define the Northern Boundary of Industrial Core* (BSD Consultants, 1999).

The objectives of the assessment were:

- To determine the resultant noise levels for compliance with the *Environmental Protection (Noise) Regulations 1997*;
- To determine the resultant noise levels at the nearest residences; and
- To determine which stage of development would result in noise levels becoming higher than the residential criteria at the residences within the Industrial Core.

Base modelling of the noise emission propagation from the proposed power station was carried out using the Environmental Noise Model (ENM) software package. This computer program uses the following input parameters:

- Three-dimensional topography;

- The assigned octave band sound power level for the major plant items (based on the manufactures data);
- The placement of the sources in 3-dimensional space;
- The absorption (or reflective) characteristics of the intervening ground type;
- Air absorption; and
- Dispersion, at the rate of 6dB per doubling of distance.

The environmental parameters in **Table 8-21** were used in the modelling to ensure predictions are conducted in accordance with the "worst case" situation as stipulated within the Environmental Protection Authority's *"Draft Guidance for Assessment of Environmental Factors No. 8 – Environmental Noise"*.

■ Table 8-21 Environmental Factors Used in Modelling

Factor	Value
Time Period	Night-time
Wind Speed	3m/s
Temperature	15°C
Relative Humidity	50%
Temperature Inversion	2°C/100m

The modelling was undertaken for the power station layout shown in **Figure 5-1** for the development scenarios given above.

"Standard" noise emissions from gas turbine plant were determined based on manufacturers quoted standard design emissions, and are supported by the existing Pinjar Gas Turbine Power Station emissions (which are given in **Appendix F**). With "standard" noise attenuation, the noise characteristics of the major noise producing items of the power generation plant are outlined in **Table 8-22**.

■ Table 8-22 Sound Power Levels with "Standard" Attenuation

Items of Equipment	Sound Power Level dB(A)
Gas Turbine	111.8
Generator	111.6
Stack (Gas Turbine)	103.7
Steam Turbine	100.8
Evaporative Cooling Towers	105.0

Note:
1) For comparison, the sound power levels for Pinjar Gas Turbine Power Station are provided in **Appendix F**.

To comply with the legislative requirements, it was determined that additional noise attenuation to an "enhanced" level would be required for the proposed power station. "Enhanced" noise attenuation techniques are typically:[1]

- "Super" attenuated enclosures, e.g. double skinning;
- Installation of barriers such as concrete walls;
- Additional silencing on air intake and exhausts (e.g. extra lagging and splitters);

[1] The application of the above "enhanced" attenuation techniques would typically add up to 10% on the capital costs of standard attenuation techniques.

- Locating plant in acoustic enclosures inside buildings where the buildings are provided with sufficient sound attenuation to reduce external noise to desired levels (e.g. concrete wall construction);
- Additional silencing on fans and reduction of air velocities; and
- Identification of tonal noise emitters and provision of suitable attenuation measures such as individual noise attenuation enclosures for plant external to main enclosure.

With "enhanced" noise attenuation, the noise characteristics of the major noise producing items assumed for the acoustic assessment are outlined in **Table 8-23**. Manufacturers data was used to assign octave band spectral shape to the noise sources detailed below for input into the ENM noise prediction model.

Table 8-23 Sound Power Levels with "Enhanced" Attenuation

Items of Equipment	Sound Power Level dB(A)
Gas Turbine	96.8
Generator	96.6
Stack (Gas Turbine)	88.7
Steam Turbine	100.8
Evaporative Cooling Towers	102.0

The application of "enhanced" noise attenuation techniques would also eliminate any tonal components. Therefore with the installation of enhanced attenuation no penalties would apply to the calculated noise levels. Further discussion on tonality is provided in the following section on predicted noise emissions.

Cumulative Impact Assessment

The 1,080MW power station was also modelled with the noise emissions from the potential industry mix used in *Kemerton Expansion Study Noise Modelling to Define the Northern Boundary of the Industrial Core* (BSD Consultants, 1999) and included in the *Industry 2030 Greater Bunbury Industrial Land and Port Access Planning Final Report* (WAPC, 2000a). The sound power levels for the potential industry mix that was modelled is given in **Table 8-24**.

The purpose of this modelling was to ensure that the power station development is consistent with future plans for the Kemerton Industrial Park and the cumulative (combined) noise criteria is met at the buffer boundary when a range of industries are developed within the industrial park.

■ **Table 8-24 Sound Power Levels dB(A) for the Proposed Industry Mix**

ENM SOURCE No.	LOT[5]	Sound Power Level dB(A)
10	B6	114.6
6	B5	113.7
4	B10	105.7
18	D2	115.7
220	E2	109.6
17	EC1	107.9
30	EC2	109.7 104.0*
31	EC3	109.7
204	EC4	107.7
33	EC5	105.6
34	EC6	106.9
35	EC7	110.9 100.0*
37	EC9	105.6
22	F2	113.7
25	G3	118.6 109.8*
28	H3	120.9

Notes:
1) Source: Herring Storer (1999), in BSD Consultants (1999)
2) * Stacks
3) Noise emanating from EC8 was not included in the model, due to the small size of the block and to comply with the 65dB(A) criteria at the block boundary, noise received at the park boundary would be less than or equal to 25dB(A) and therefore, would not affect the overall noise level received at the park boundary.
2) Noise emissions from blocks B1 and C were not included in the model, as it is unlikely that these blocks would ever be developed due to the nature of the block (i.e. swampy) and environmental constraints.
3) Refer to Figure 8-17 for location of Lot numbers.

8.4.3.3 Predicted Noise Emissions

Noise emissions from the power station were predicted in accordance with the methodology detailed in **Section 8.4.3.2**. The power station was modelled for wind directions from the eight major compass directions and the results are presented in the form of noise contours.

8.4.3.3.1 Power Station in Isolation

The noise contours for the power station in isolation for a range of possible development scenarios (240MW, 360MW, 720MW and 1,080MW) are given in **Figures 8-13** to **8-16**.

Table 8-25 presents the predicted single point calculations at the nearest distance to boundary of the buffer zone and at the nearest residences (which are located within the Industrial Core) for wind directions from the power station towards the receiver.

■ **Table 8-25 Summary of Single Point Predictions – Operational Phase**

Power Station Capacity	Predicted Noise Level at Boundary of Buffer Zone (dB(A))	Predicted Noise Level at Nearest Residence (dB(A))
240MW Power Station	27dB(A)	23dB(A)
360MW Power Station	30dB(A)	26dB(A)
720MW Power Station	33dB(A)	29dB(A)
1,080MW Power Station	35dB(A)	31dB(A)
Limiting Noise Criteria (from **Table 8-20**)[1]	40dB(A)	60dB(A)

Note:
1) The Regulations state that in order for an industry to be deemed as "not significantly contributing" to noise levels at a receptor, noise emissions from individual industries would need to be at least 5dB(A) below the limiting noise criteria.

Based on the noise criteria defined in **Table 8-20**, the noise emissions from the power station at the preferred site would achieve the regulatory noise criteria at the boundary of the buffer zone. The noise levels from the power station received at the nearest residential properties would be below the residential night-time noise criteria (most of these residences are tenants of LandCorp on a short-term lease agreement).

In addition to the environmental noise criteria at residential and recreational receptors, the project would need to comply with a contributed noise limit of 65dB(A) around the perimeter of the lease boundary. Based on the preliminary site layout given in **Figure 5-1** and the assumed equipment sound power levels, it is predicted that the boundary noise levels would achieve the 65dB(A) criteria. However, careful optimisation of site and equipment layout during the detailed design phase and incorporation of appropriate noise attenuation measures during design and equipment selection would be required ensure that boundary noise criteria are achieved.

From field measurements, the background noise level under a 3m/s breeze at any location is approximately 40dB(A), as a result of natural wind movements around vegetation and other objects (Reynolds, 2002, pers. comm). This would mask the noise from the power station (outside the buffer area at the predicted levels) so that it would be inaudible. Any remaining annoying characteristics in the noise emissions from the power station would also not be audible, including tonality. At lower wind speed, when background noise levels are lower, noise received at the residences from the power station would also be reduced and be inaudible.

8.4.3.3.2 Cumulative Impacts

The noise contour for the 1,080MW power station combined with the potential future industry mix is shown in yellow on **Figure 8-17**. This contour shows that even with the cumulative effect of the power station at its maximum capacity and potential industry mix that may be developed at Kemerton in the future, the noise criteria is met at the boundary of the buffer zone.

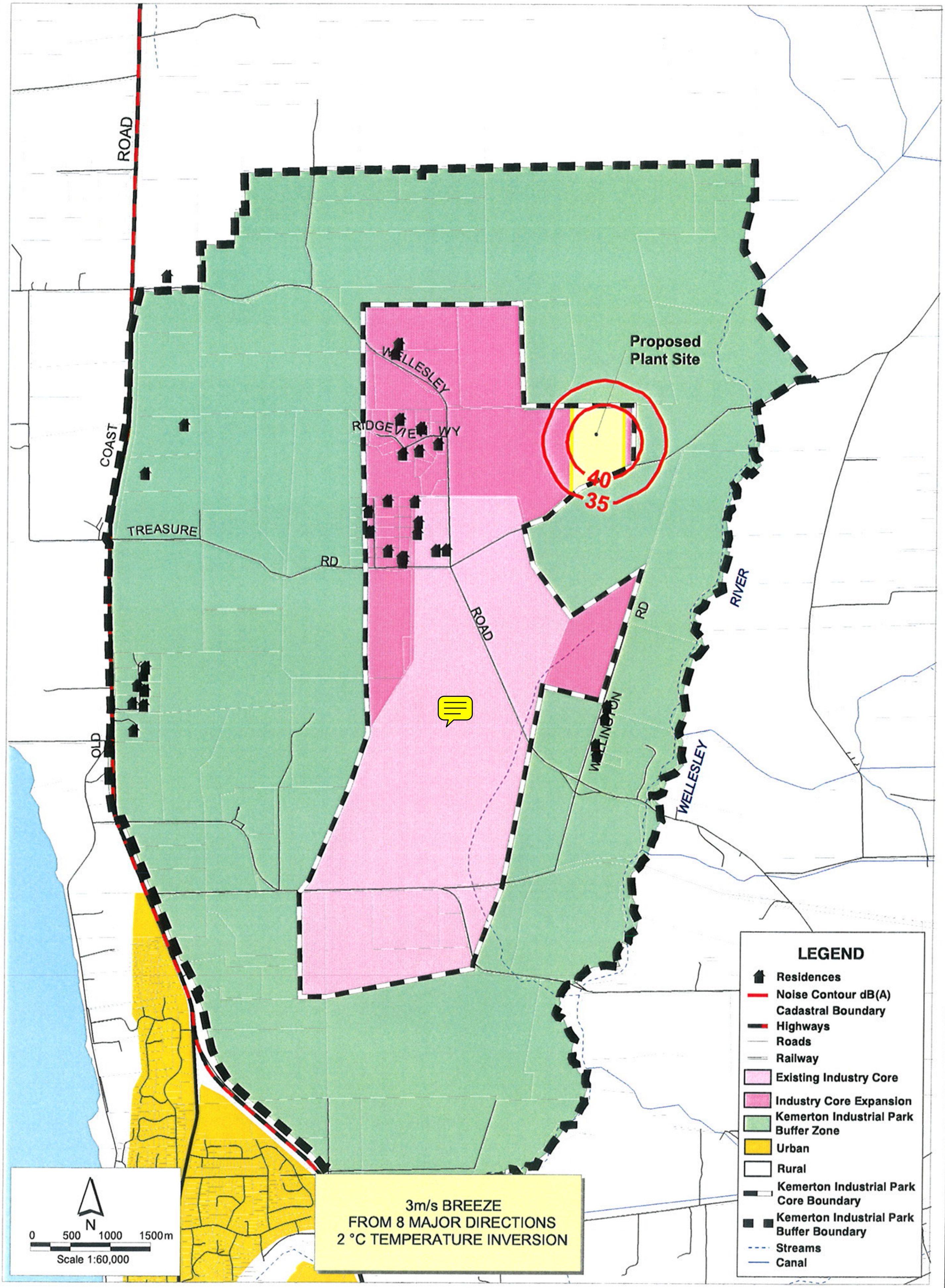
The contour developed for the Kemerton Expansion Study and presented in the final report of *Industry 2030 Greater Bunbury Industrial Land and Port Access Planning* (WAPC, 2000a) is also shown in red on **Figure 8-17**. There is a slight difference in the two contours on the southern and western side of the Kemerton Industrial Park, due to minor updates in the verions of the ENM model used for the two assessments (Tim Reynolds, Herring Storer Acoustics, pers comm, 2002).

8.4.3.4 Management Strategies

The sound power levels modelled assume that an "enhanced" degree of attenuation would be applied to the plant, which includes:

- Gas turbine in acoustic enclosures located inside a building/s;
- Acoustic treatment of all fans and ducting such as radiator fans, ventilation fans;
- Acoustic enclosures over all outdoor pumps; and
- Reduction in exhaust velocities of gas turbine and air fans.

It is expected that the Preferred Bidder would implement these management strategies or equivalent to ensure that the noise emissions from the plant would meet the noise criteria.



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KEMERTON POWER STATION
PREDICTED NOISE IMPACTS FROM
A 240MW POWER STATION

FIGURE 8-13

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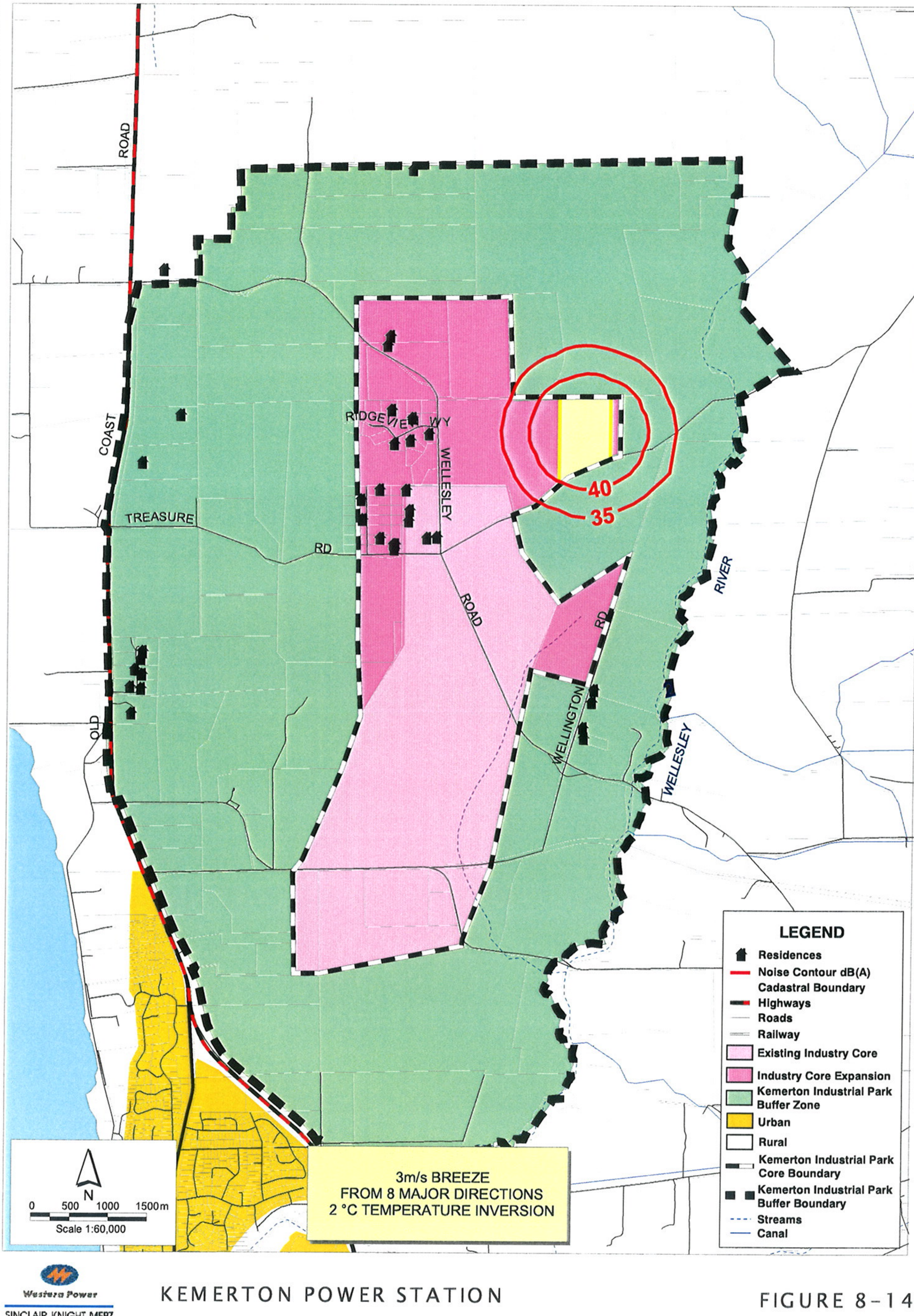

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KEMERTON POWER STATION
PREDICTED NOISE IMPACTS FROM A 360MW POWER STATION

FIGURE 8-14

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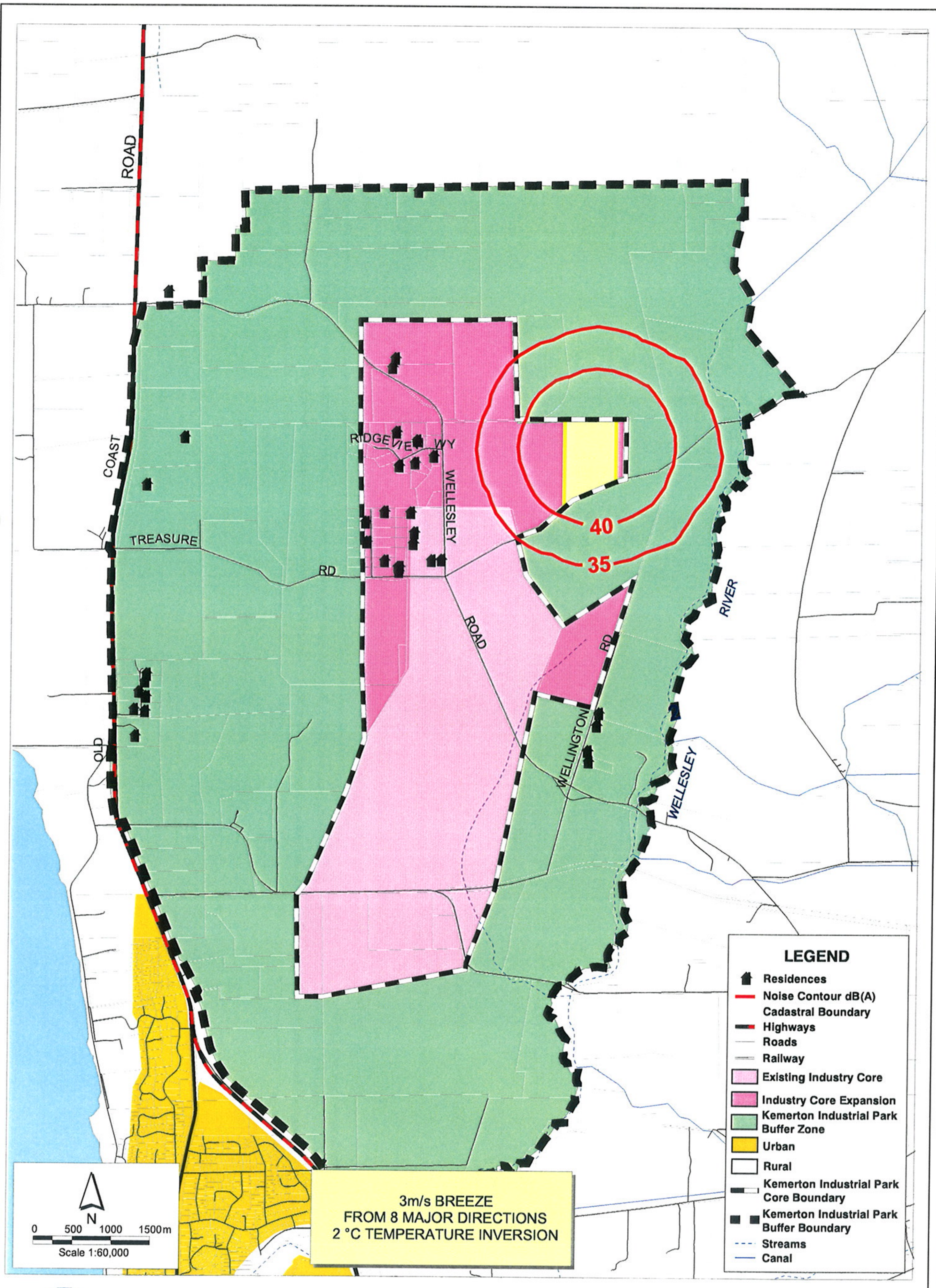

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KEMERTON POWER STATION
PREDICTED NOISE IMPACTS FROM A 720MW POWER STATION

FIGURE 8-15

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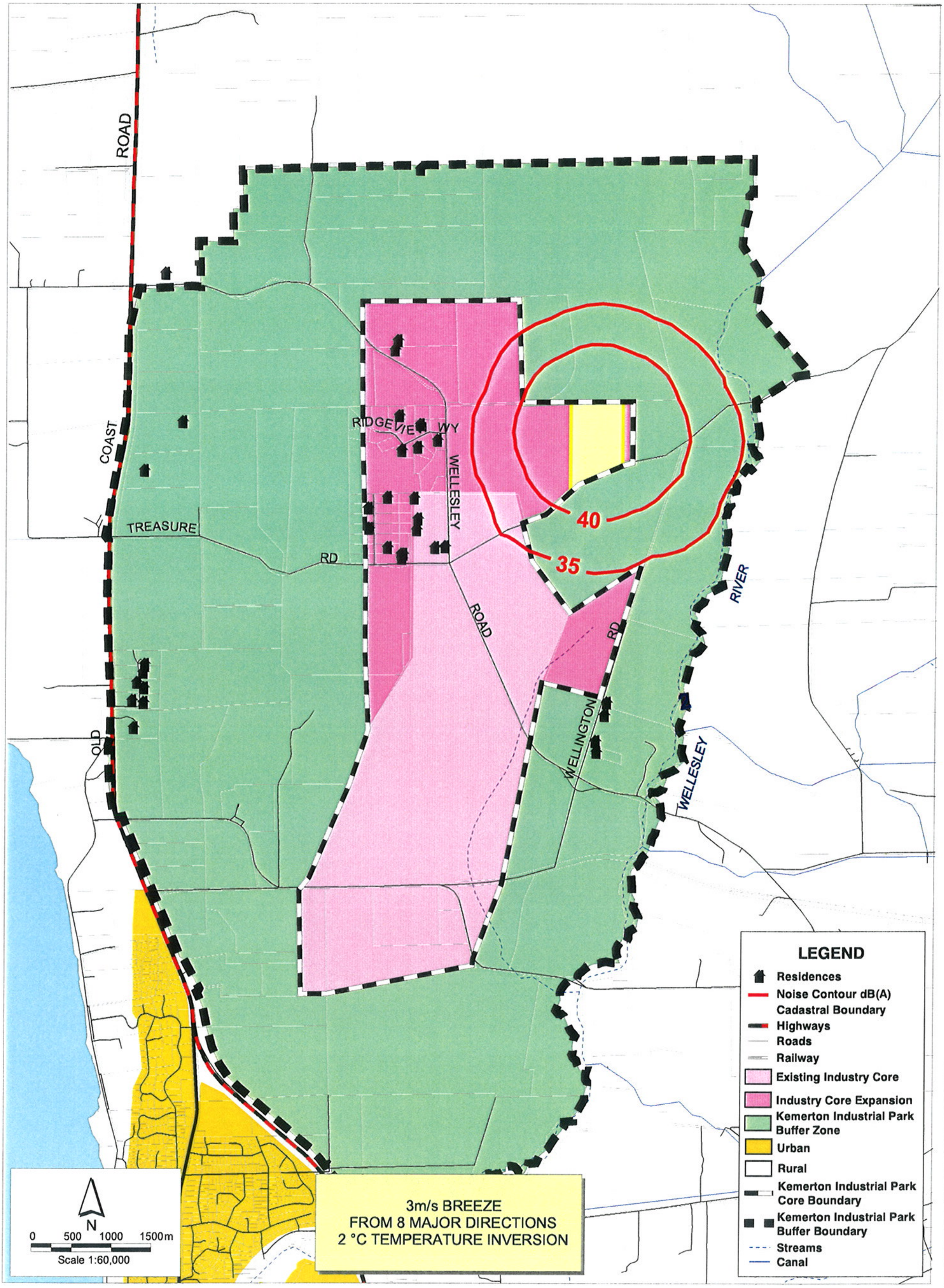

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KEMERTON POWER STATION PREDICTED NOISE IMPACTS FROM A 1,080MW POWER STATION

FIGURE 8-16

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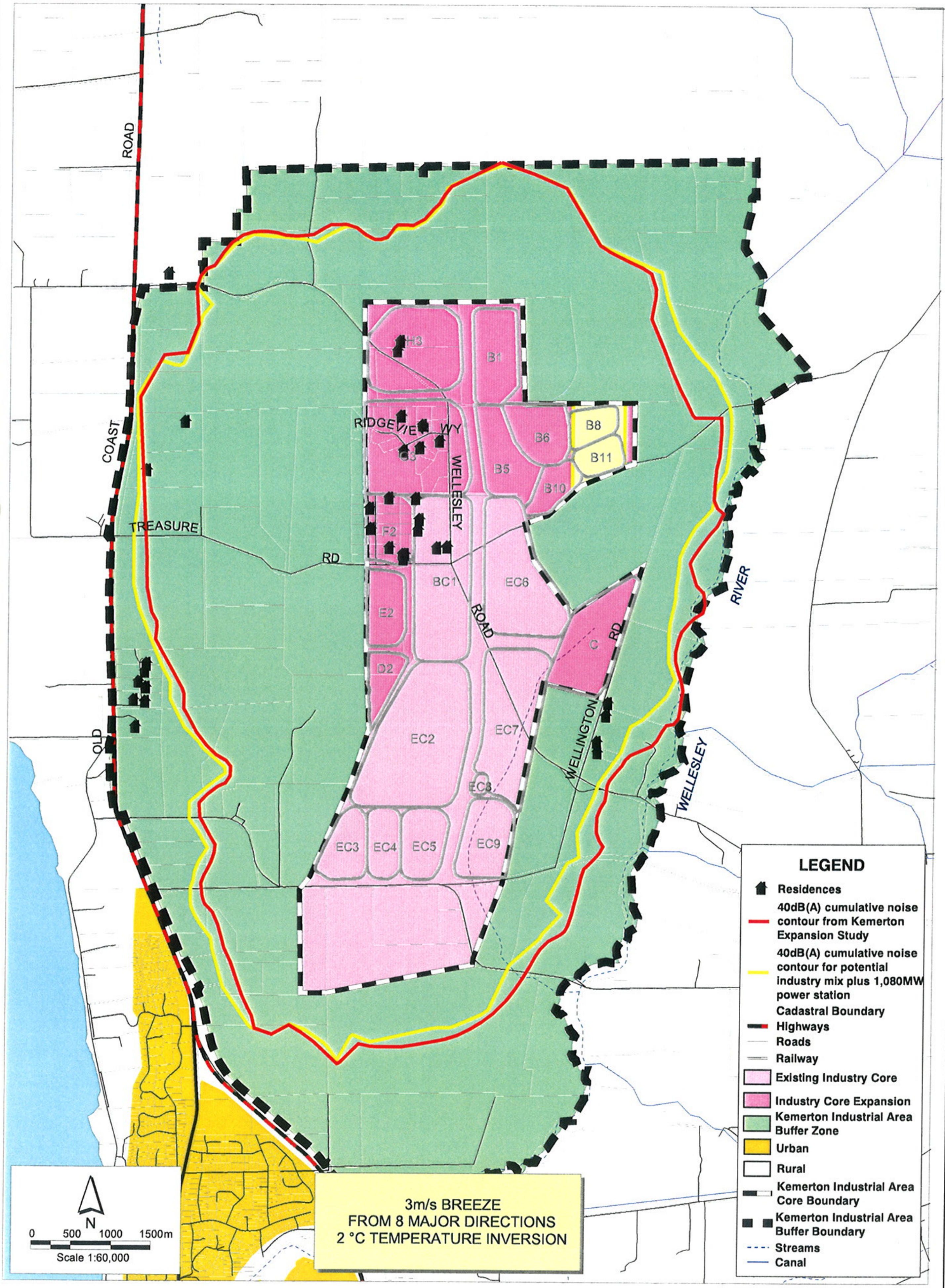

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KEMERTON POWER STATION
PREDICTED NOISE IMPACTS FROM 1,080MW COMBINED CYCLE POWER STATION IN COMBINATION WITH FUTURE POTENTIAL INDUSTRY MIX (FROM KEMERTON EXPANSION STUDY)

FIGURE 8-17

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Prepared by: I Jackson

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The Preferred Bidder would be required to verify that the noise emissions from the plant are lower than or equal to those modelled in this assessment. If this could not be demonstrated, then re-modelling would be required to verify that the noise criteria could be achieved.

8.4.3.5 Monitoring

The Preferred Bidder would be required to undertake noise monitoring following the commissioning of each development stage of the project to ensure compliance with the noise regulations is achieved.

8.4.4 Solid Waste Management

Management Objectives

- *Ensure that the generation of solid wastes is minimised; and*
- *Solid waste is handled and disposed of in a manner that minimises the impact on receiving environment.*

This section discusses the management of solid waste. Management of domestic wastewater, saline wastewater, hydrocarbon and hazardous waste is discussed in **Sections 8.4.5** to **8.4.8.**

8.4.4.1 Potential Impacts

The discharge of solid waste to the environment has the potential to reduce the quality of surface water and groundwater through leachate of contaminants, to generate odour and to increase the number of vermin. Potential changes in water quality could affect sensitive flora and fauna which rely on the maintenance of existing conditions.

The only solid waste that would be generated during the operational phase would be normal domestic and commercial waste (paper, cans, plastic, food scraps) and miscellaneous solid waste generated during maintenance activities (oily rags, packaging materials, inert materials). The quantity generated is expected to be less than 10 tonnes per year.

Small quantities of solid waste from the domestic wastewater treatment plant would also be produced.

8.4.4.2 Management Strategies

Solid waste management would be based around the hierarchy listed below:

- AVOID the use of certain materials (if possible) if they are difficult to manage;
- REDUCE the amount of waste produced;
- REPLACE the use of difficult to dispose of materials, with more environmentally acceptable ones;
- SEGREGATE waste for easier management;
- RECOVER/REUSE waste where feasible;
- RECYCLE waste by reprocessing where feasible; and
- DISPOSE of waste in an environmentally responsible manner.

The Preferred Bidder would be required to develop a specific Waste Management Plan which would be implemented as part of the Operation Environmental Management Plan (EMP). Management strategies to be implemented in this Plan would include the following elements or equivalent:

- Waste generated would be segregated, as far as practicable, into different streams for disposal;
- Appropriate facilities and services would be provided for the disposal, storage and handling of solid wastes;
- All waste would be contained appropriately taking into consideration fire safety, pest and odour control, and protection of water and soil resources;
- All recyclable materials that are feasible to recover would be segregated and periodically removed from site by a contractor;
- Domestic rubbish would not be disposed of by burning;
- Domestic and commercial wastes (food scraps, plastics, packaging materials, etc) would be periodically removed from site and disposed to a licensed landfill site in accordance with local government and DEP requirements; and
- A licensed contractor would remove biosolids from the domestic wastewater system for further treatment off-site.

8.4.4.3 Monitoring

The Preferred Bidder would be required to maintain details of quantities of waste materials recycled, disposed to landfill and removed off-site. This data would be routinely reviewed to track performance and to identify improvement opportunities.

8.4.5 Domestic Liquid Waste Management

Management Objectives

- *Ensure that domestic liquid waste is managed and disposed of in a manner that minimises impacts on the receiving environment; and*
- *Ensure compliance with all relevant Health and Environmental Regulations.*

8.4.5.1 Potential Impacts

The discharge of domestic liquid waste to the environment has the potential to reduce the quality of surface water and groundwater and therefore impact on the flora and fauna relying on these waters. It also has the potential to cause nuisance odours to surrounding areas and health effects.

The estimated quantity of domestic liquid waste originating from the plant during operation are shown in **Table 8-26** for the various plant sizes.

- **Table 8-26 Predicted Quantities of Domestic Liquid Waste Generated (Operating Phase)**

Plant Size	Predicted Quantity of Treated Sewage (m^3/yr)
Open Cycle 240MW Peaking Plant	50
Combined Cycle 1,080MW Base Load Plant	100

8.4.5.2 Management Strategies

The Preferred Bidder would be required to determine the best method for management and disposal of domestic liquid waste in consultation with the Health Department and the DEP. Domestic wastewater would be either:

- Treated by septic tank and disposed of to infiltration trenches;
- Stored within the septic tanks and then removed from site by a licensed contractor; or
- Pumped to a central wastewater treatment plant within the Kemerton Industrial Park.

The Preferred Bidder would be required to demonstrate that the management strategy implemented for the disposal of domestic wastewater does not result in a net increase in nutrients entering the Leschenault Estuary, as required by the Leschenault Inlet Management Authority nor adversely impact on nearby EPP wetlands.

8.4.5.3 Monitoring

The Preferred Bidder would be required to undertake the following or equivalent:

- Regular inspection of the domestic wastewater system to ensure it is effective and in compliance with all regulations; and
- Maintain details of quantities of any waste removed from site.

8.4.6 Saline Water Management

Management Objective

- *Ensure that saline water is managed to minimise the potential for impact on the local natural environment.*

8.4.6.1 Potential Impacts

As the waste cooling water quantities from a 240MW open cycle power station or an air-cooled combined cycle plant are relatively small, it would likely be disposed of on-site through evaporation in specially constructed ponds (refer to **Section 4.5.4** and **5.4.5**). Potential impacts from the operation of this system include contamination of soil, nearby surface and ground waters and impacts on vegetation from moderately saline water leaking from the bottom of the evaporation ponds or from pipeline leaks/ruptures.

If a water-cooled combined cycle power station is developed, the volumes of wastewater would increase beyond that manageable by evaporation ponds and other options for wastewater disposal would be required. As discussed in **Section 4.5.4**, the preferred option for wastewater disposal from the power station would be via ocean discharge.

In addition to the potential marine impacts described in **Section 8.3.1**, potential impacts during the operation of this system would be associated with rupture of or leaks from the saline water pipeline from the power station to the ocean outfall. The severity of these potential impacts would be dependent on the size of the rupture or leak and location in which it occurs. Assuming that the pipeline would be buried, impacts would be increased salinity in soil and groundwater and resultant potential impact to vegetation, although some areas such as near wetlands and areas away from the coast would be more susceptible damage from the release of this wastewater. The salinity of the wastewater in the pipeline is predicted to be around 5,000 mg/L TDS.

The brine discharge from the cooling system and the demineralisation plant would be relatively free from contaminants. The actual contaminants would be dependent on the quality of the water supply to the plant and on the chemicals required for pre-treatment of water prior to use in the plant. These chemicals are likely to include a biocide and a corrosion and scale inhibitor.

8.4.6.2 Management Strategies

The Preferred Bidder would be required to develop a Saline Water Management Plan as part of the Operational Environmental Management Plan.

If wastewater is disposed of through evaporation in ponds on the site, the Preferred Bidder would be required to implement the following or equivalent management strategies as part of this Plan:

- Design the saline water evaporation ponds to include an impermeable liner; and
- Design the ponds to ensure a potential overflow would be contained locally.

If a wastewater pipeline is installed, the Preferred Bidder would be required to implement the following or equivalent management strategies as part of this Plan:

- Pressure test the pipeline during construction to identify and rectify potential problems and minor leakage;
- Ensure above ground sections of the pipeline are well signed and protected from impact damage, e.g. from vehicles;
- Install secondary containment around sections of the pipeline which pass through sensitive areas such as near wetlands (i.e. the pipeline could be encased or enclosed within another pipe);
- Undertake preventative maintenance on saline water pipelines to ensure system integrity;
- Install safety devices such as valves to isolate sections of the pipeline, manual isolating valves, scour valves at low points and discharge tanks at high points, to reduce the potential for and impact of pipeline ruptures;
- Institute measures so that an alarm would be raised and the pumps shut down automatically if a significant leak in the pipeline was detected; and
- Maintain access to the pipeline to facilitate inspections and to minimise delays if repairs are required.

In the rare event of a pipeline rupture or major leak of saline water, the Preferred Bidder would be required to repair any damage to the surrounding environment and remediate the area.

8.4.6.3 Monitoring

The Preferred Bidder would be required to develop and implement the following monitoring systems or equivalent:

- Ensure that the groundwater monitoring system is designed to be capable of recording a leak in the evaporation ponds;
- Conduct routine integrity inspections on the saline water evaporation ponds;
- Conduct routine inspections of saline water pipelines and undertake preventative maintenance to ensure system integrity; and
- Install continuous flow meters to monitor discharge to the ocean outfall, at the power station and entry to the Collie Power Station wastewater pipeline. This would be designed to ensure notification of a significant difference in flow and automatically shut down pumps.

8.4.7 Hydrocarbon Management

Management Objective

- *Ensure hydrocarbons are handled and stored in a manner that minimises the potential for impact on the environment through leaks, spills and emergency situations.*

8.4.7.1 Potential Impacts

The operation of the power station would require the transportation, storage and handling of hydrocarbon products including liquid fuel, lubricating oils and greases and degreasers. The potential impacts associated with these activities include:

- Discharge of hydrocarbons to the environment contaminating surface and ground waters, the atmosphere and soil;
- Creation of acute and/or chronic toxic hazards; and
- Creation of flammable or explosive hazards.

Waste hydrocarbons (oils, grease, degreaser and fuels) would also be generated from workshops, plant areas where rotating equipment and lube oil systems are located, liquid fuel storage and filling areas, waste oil storage and vehicle washdown facilities.

8.4.7.2 Management Strategies

The Preferred Bidder would be required to develop a Hydrocarbon Management Plan as part of the Operational Environmental Management Plan based around a framework that:

- Reduces the volume of hydrocarbon waste materials produced;
- Segregates hydrocarbons from stormwater to reduce the volume of waste materials;
- Ensures appropriate transport, storage and handling procedures;
- Ensures appropriate clean-up procedures for spills; and
- Defines environmentally acceptable methods for the disposal of waste.

The Preferred Bidder would be required to incorporate the following specific features or equivalent as part of the design process:

- Minimisation, segregation and containment of areas that could be contaminated with hydrocarbons by the use of appropriate bunding and drainage systems. This would include refuelling areas, storage areas, vehicle washdown areas and workshops;
- Storage of all liquid fuels and oils in accordance with the Australian Standard for *The Storage and Handling of Flammable and Combustible Liquids (AS1940)*;
- Installation of oil interceptor traps/oil separators to remove hydrocarbons from areas that could be contaminated with hydrocarbons; and
- Use of pipes and valves to prevent hydrocarbons from entering clean drainage waters.

The Preferred Bidder would be required to implement the following management practices or equivalent to minimise the generation of hydrocarbon waste and to manage clean up and disposal:

- Use of absorbent materials to collect spillage;
- Use of spill capturing platforms for drum storage;
- Effective maintenance of all valves and piping systems installed to prevent the mixing of hydrocarbons with clean stormwater;
- Procedures would be developed to ensure all spills of hydrocarbon materials would be contained where possible and immediately cleaned up;
- Reuse and/or recycling of waste oil where possible;
- Appropriate storage of waste oil, prior to its collection by an authorised waste contractor, where it cannot be recycled; and
- Storage and subsequent collection for off-site disposal of oily rags, used absorbent and similar materials.

The management of hydrocarbon waste would be included in the Waste Management Plan that would be developed to manage waste from the site (refer **Section 8.4.4.2**).

These practices would be implemented during the construction phase of the project as well as during the operating life of the Plant.

8.4.7.3 Monitoring

The Preferred Bidder would be required to perform regular inspections to ensure that hydrocarbon management systems are being used, are effective and are in compliance with regulations.

8.4.8 Hazardous Materials Management

Management Objective

- *Ensure hazardous materials are handled and stored in a manner that minimises the potential for impact on the environment through leaks, spills and emergency situations.*

8.4.8.1 Potential Impacts

The operation of the power station would involve the transportation, storage and handling of hazardous materials. A summary of the hazardous materials used in an open or combined cycle power station and the hazard posed is given in **Table 8-27**.

- **Table 8-27 Hazardous Material Inventory**

Material	Hazard	Quantities (Storage)
Natural Gas	Flammable	See **Section 5.4.1**
Liquid Fuel	Combustible	7,000kL storage
Lubricating Oils	Combustible	1,000L
Cleaning Fluids	Flammable	200L
Paints and thinners	Combustible/Flammable	200L
Biocides	Toxic/Flammable	200L
Water treatment chemicals (Acids, inhibitors)	Corrosive	10,000L
Battery fluids	Corrosive	200L

There is the potential that these could accidentally be released which has the potential to:

- Contaminate surface and groundwater and the soils;
- Cause acute and/or chronic toxic hazards; and
- Cause flammable or explosive hazards.

Further details on the potential impacts and management of hazardous materials is given in **Section 9.7** and **Table 9-1**.

8.4.8.2 Management Strategies

The Preferred Bidder would be required to ensure storage, handling and transportation of hazardous materials would comply with all relevant local and State regulations, including:

- *Mines Safety and Inspection Regulations 1995;*
- *Dangerous Goods Regulations 1992;*
- *Australian Standard for the Storage and Handling of Flammable and Combustible Liquids (AS 1940-1993);*
- *Environmental Protection (Liquid Waste) Regulations 1996; and*
- *Environmental Protection (Controlled Waste) Regulations 2001.*

The Preferred Bidder would be required to implement a Hazardous Materials Management Plan as part of the Environmental Management Plan and Safety Management Plan. Management strategies to be implemented in this Plan would include the following elements or equivalent:

- A formal policy statement on hazardous materials;
- Designated responsibility for all elements of the Plan;
- Training of employees in handling and storage requirements;
- Training of employees in management of spills and leaks;
- Dissemination of information to employees;
- Establishment of purchasing and inventory controls; and
- Environmental monitoring and auditing.

The Preferred Bidder would also be required to implement the following or equivalent management strategies:

- Natural gas would not be stored on-site apart from the gas contained in the reticulation pipework. The gas system would be designed to minimise leaks and protect the gas facilities from sources of ignition and would include suitable security fencing, warning signs and restricted access in accordance with the relevant Australian Standards. Emergency shut off valves would be provided to limit any abnormal escape of gas to the atmosphere;
- Liquid fuel would be stored in above ground tanks complying with international and Australian design standards. The tanks would be located in impermeable bunding to prevent leakage of liquid fuel or liquid fuel contaminated water to the environment;
- All other hazardous materials would be stored in a manner consistent with their Materials Safety Data Sheets (MSDS) and local and State regulations. Secure, purpose-built buildings would be fitted with independent bunded areas. Buildings would also be fitted with security and fire systems and would be located at a safe distance from any occupied building or facility;
- Procedures would be developed to ensure all spills of hazardous materials would be contained where possible and immediately cleaned up in a safe manner; and
- The management of hazardous waste would be included in the Waste Management Plan that would be developed to manage waste from the site (refer **Section 8.4.4.2**).

8.4.8.3 Monitoring

The Preferred Bidder would be required to develop and implement the following monitoring systems or equivalent:

- Maintenance of purchasing and inventory records for all hazardous materials on-site; and
- Monitoring in accordance with the Department of Minerals and Energy licence to store explosive goods.

9. Socio-Economic Impacts and Management

9.1 Introduction

The Kemerton Industrial Park was established with the primary purpose of accommodating heavy industry. Kemerton Industrial Park is the largest industrial estate in the South West and is one of Western Australia's strategic industrial areas. Planning of the Industrial Park has been ongoing since the mid-1980s.

The structure plan for the Park includes a central Core for heavy industry, a surrounding buffer zone to accommodate potential risk, noise and air emissions and zones for supporting industries with a direct relationship to the heavy industries. The proposed power station would be located within the Industrial zone according to the Final Concept Plan for the expanded Kemerton Industrial Park (refer to **Section 4.2**).

The nearest residential premises are located to the north west of the preferred site on Wellesley Road in the Industrial Core area. Most of these residents are occupied by tenants of LandCorp on short-term lease agreements. As discussed in **Section 4.4**, the Government is presently undertaking a planned acquisition of all properties within the defined boundaries of the Kemerton Industrial Park according to the approved Final Concept Plan for the expansion of the Kemerton Industrial Park. There are also some residences located within the buffer zone, along the Old Coast Road and on the eastern side of the Park. Local farming properties and smaller semi-rural holdings surround the Kemerton Industrial Park outside the buffer zone. The closest residential areas to the Kemerton Industrial Park include the Leschenault, Binningup and Myalup townsites.

The following section addresses the critical social factors and includes management strategies that would be required by the Preferred Bidder to ensure that:

- Potential impacts on community and recreational values of the surrounding area are minimised;
- Potential impacts on visual amenity are minimised;
- Potential impacts on sites of cultural significance to Aboriginal heritage are minimised and appropriate management of significant sites is undertaken; and
- Public safety is maintained in terms of risk and traffic management.

9.2 Social and Economic Issues

Management Objective

- *Ensure that any potential impacts from the development on the nearby community are minimised.*

9.2.1 Potential Impacts

There has been no detailed investigation of the social or economic issues associated with the expansion of the Kemerton Industrial Park (BSD Consultants, 1997). However other studies have determined that the maximum social impact area of the Kemerton Industrial Park is an area within 60km or 40-minutes travel from the Kemerton Industrial Core. The power station development could therefore expect to draw on the existing and future labour forces from the residential areas within this region, particularly the City of Bunbury.

The workforce required to construct the power station would vary over the course of the work. Over a period of up to 24 months, the construction workforce for each development stage is expected to peak at around 250 personnel mid way through the period with some 20 personnel at the end of construction carrying out commissioning and testing prior to handover for commercial operation.

Apart from the direct employment offered particularly during the construction period, the proposed development is likely to have a number of indirect benefits to the local economy. These would come mainly through the use of local labour, service industries and local supplies of materials during construction.

There may also be impacts on the local community which would mainly occur during the construction phase of the project and are therefore likely to be temporary in nature. Typical construction impacts may include:

- Housing of the construction workforce;
- Increased pressure on services such as health and education for a short period of time during the construction phase;
- Occasional disruptions to utilities such electricity services during the construction phase;
- Nuisance impacts associated with the construction works such as dust and noise; and
- Increased traffic, from construction workforce and heavy construction vehicles.

Potential impacts associated with dust and noise from the construction phase are dealt with in **Sections 7.4.1** and **7.4.2** and potential impacts from traffic are discussed in **Section 9.5**.

During the operational phase of the 240MW open cycle power station, on-site personnel would typically consist of a maximum of 5 personnel. If a base load plant is installed, the plant could be manned by up to 30 personnel.

This level of manning could easily be accommodated within the nearby communities without placing too much pressure on the services and infrastructure of the community. Therefore the most significant potential social impact experienced during the operational phase would relate to visual effects, which is dealt with in **Section 9.4**. Nuisances associated with air and noise emissions are discussed in **Sections 8.4.1** and **8.4.3** respectively and are not expected to impact on the nearby residences or communities.

9.2.2 Management Strategies

The Preferred Bidder would be encouraged to utilise the local workforce and services where possible. This would decrease the pressure placed on local communities by an influx of people associated with the development into the region.

The Preferred Bidder would be required to implement social management strategies as part of the Construction Environmental Management Plan. This management strategy should be prepared in consultation with the Kemerton Community Committee, Shire of Harvey and City of Bunbury. The plan would include strategies for the following:

- Keeping local residents and industries informed of construction and operational activities;
- Giving advance notice to affected parties of any planned disruptions to services during the construction phase;
- Minimisation of impacts to land uses within the wastewater pipeline corridor by selection of a route that minimises disruptions to land owners, burial of the pipeline and rehabilitation of excavated areas;
- Compensation of land owners should easements be acquired for the wastewater pipeline, with payments based on advice from the Valuer General's Office.
- Housing of the construction workforce, which is expected to peak at 250 personnel and extend over a period of up to 24 months for each development phase;
- Capacity of existing health and education facilities to cope with an influx of personnel during the construction phase; and
- Other issues associated with transient workforces.

The mitigation measures recommended to minimise disturbances to the local community and any visitors to the area during the construction and operational phases are discussed in more detail in the relevant sections on air, noise, traffic and visual amenity.

9.3 Recreational Areas

Management Objective

- *Ensure that recreational use of the areas surrounding the Kemerton Industrial Park is not compromised.*

9.3.1 Potential Impacts

During the construction phase there are not expected to be any significant impacts on tourism or recreation within the Greater Bunbury Region. The impacts during operation are also expected to be minimal.

The site of the proposed power station is located within the designated Industrial Core of the expanded Kemerton Industrial Park. The buffer zone within Kemerton Industrial Park is identified for passive recreation, however public access to the buffer zone is focussed along defined routes and view points (or 'look-outs'). The buffer zone of the Park would not be directly impacted by the proposed development.

Nearby waterways and coastal areas, including Myalup, Binningup and Buffalo Beaches and Leschenault Inlet, are popular recreational areas, with activities undertaken include sightseeing, shore and boat based fishing, swimming and diving. Development within the Kemerton Industrial Park is unlikely to preclude continued use of these beaches and the estuary, and would have a limited impact on visual amenity from these areas (refer to **Section 9.4**).

No other recreational areas (which may include caravan/camping parks, sporting grounds etc) are located within or adjacent to the Industrial Core of the Kemerton Industrial Park or the preferred site.

9.3.2 Management Strategies

The Preferred Bidder would be required to consult with local communities and recreational users of the nearby waterways and wetlands prior to the development of the power station.

9.4 Visual Amenity

Management Objective

- *Ensure that the visual amenity of the plant and associated infrastructure from adjacent public areas is minimised.*

9.4.1 Potential Impacts

The closest major public thoroughfare to the Kemerton Industrial Park is the Old Coast Road, which travels north south approximately 6km west of the preferred site. The Kemerton Industrial Core is shielded from the Old Coast Road by two dunal ridge systems and a parkland buffer zone. This buffer area is located between heavy industry and surrounding land uses and comprises:

- Appropriate landscaping of industrial development;
- Maintenance of the existing woodlands and parklands;

- Establishment of plantation buffers;
- Conservation of wetlands; and
- Provision of passive recreational facilities.

A visual impact assessment of the northern most areas of the proposed expansion of the Kemerton Industrial Park (as shown in **Figure 4-2**) was undertaken by BSD Consultants for the former Department of Resources Development (BSD Consultants, 2000). The visual assessment considered future development scenarios of the Industrial Core assuming hypothetical industries with stack heights of 60 and 100m and building heights of 35m. Views from 14 locations to the west and north of the Industrial Park were modelled and assessed.

The assessment showed that, in almost all cases where there is continuous vegetation coverage within the road reserves of public roads, the Kemerton Industrial Core would be screened from view. However from some sparsely vegetated locations, some of the developments containing tall stacks (60m and 100m) were visible and the buildings (35m high) were only just visible from two of the 14 locations assessed. The average height of structures within the power station would be 15 – 20m, with the stacks likely to be up to 40m high. It is therefore unlikely that the power station would be visible from any areas to the west of the Park. However, the power station may be visible from farmhouses and other locations to the east of the Park.

9.4.2 Management Strategies

To improve the visual amenity of the proposed power station, the Preferred Bidder would be required to undertake the following management strategies where appropriate:

- Where possible, buildings would be coloured to blend into the surrounding terrain;
- Building graphics/signage would be restricted to areas where they are not visible from outside of the Industrial Park;
- All temporary disturbances would be rehabilitated and revegetated with local species;
- Screening vegetation would be planted within the building setback of the power station site (subject to firebreak requirements, refer to **Section 9.7**);
- A high standard of housekeeping would be maintained at all times;
- The pipeline would be buried and rehabilitated following construction; and
- The ocean outfall and diffuser would not be visible at the beach except for a single concrete marker.

The Preferred Bidder would also be required to comply with any formal guidelines established for the Kemerton Industrial Park to reduce visual impact.

9.5 Transport

Management Objectives

- *Ensure that roads are maintained and road traffic managed to meet an adequate standard of level of service and safety; and*
- *Ensure the requirements of Main Roads of Western Australia are met.*

9.5.1 Potential Impacts

The construction phase would result in increased traffic on the access roads to the Kemerton Power Station. This increased traffic would result from workforce commuting and construction related deliveries of material and equipment.

The workforce traffic would mostly occur between 6.30am and 7.30am, and again between approximately 5.30pm and 6.30pm. Construction related deliveries would likely occur during normal construction hours (7am to 6pm, Monday to Friday). Traffic associated with the construction phase would build up as the peak construction period is reached and then decrease as the plant nears the commissioning phase.

Given that the construction workforce for the development is expected to peak at 250 personnel mid way through the period, a worst case maximum of approximately 500 vehicle movements a day could be expected. This assumes that no car-pooling arrangements are established and that each worker drives one motor vehicle and could be significantly reduced with the introduction of car-pooling and bus services. It is assumed that, on average, construction related deliveries would result in a maximum of 30 vehicle movements per day.

All traffic would access the power station site through the existing access roads (as shown in **Figure 5-2**) or roads developed under the Kemerton Expansion Final Concept Plan. The Kemerton Expansion Study (BSD Consultants, 1997) addressed the issue of traffic and transportation for the expansion of the Kemerton Industrial Park and developed a general traffic and transportation strategy. This study determined that the existing road network combining Marriott Road with the Old Coast Road is of a satisfactory standard to accommodate expected traffic movements between Kemerton and Bunbury and traffic volumes to 2020 and beyond.

9.5.2 Management Strategies

The Preferred Bidder would be required to implement a Traffic Management Plan which would include the following elements or equivalent:

- Coordination of all proposed traffic delays during the construction phase with Main Roads WA and relevant Shire;
- Scheduling the movement of construction items that could obstruct regular traffic flow to minimise delays and road closure;
- Installation of appropriate signage;
- Monitoring the movement of oversize vehicles to and from site;
- Notifying the community of any planned night-time transport to site.

9.6 Aboriginal Heritage

Management Objectives

- *Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and*
- *Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.*

9.6.1 Potential Impacts

McDonald Hales and Associates were commissioned by Sinclair Knight Merz to undertake a search of the Department of Indigenous Affair's Register of Aboriginal Sites. As detailed in **Section 6.12.3**, fifteen Aboriginal sites were found to be located within a 5km radius of the proposed development. Of these sites, three (sites 4885, 4886 and 15371) were found to be located within the vicinity of the proposed route of the wastewater pipeline:

- **Site 4885** – (Old Coast Road 2) is reported by Pearce and Mulvaney (1983) as a cluster of five quartz artefacts located on a low dune ridge bisected by the Old Coast Road, approximately 1m south of Marriott Road. This site is located in the immediate vicinity of the proposed wastewater pipeline route.
- **Site 4886** – (Old Coast Road 3) is reported as an extremely low-density artefact scatter located approximately 1.2km south of Marriott Road on the eastern side of Old Coast Road. This site is located in the immediate vicinity of a section of the proposed wastewater pipeline route.
- **Site 15371** – (Buffalo Road Burial) comprises partial human skeletal remains identified as being Aboriginal originally identified in March 1998 during the installation of the Collie Power Station wastewater pipeline. It was concluded that the skeletal material was probably introduced into the area during the construction of a car park some years earlier (Corsini, 1998). As such, the original provenance of the skeletal material remains unknown. The skeletal material was reinterred in a grass covered area in the centre of the car park, and is today commemorated by a memorial plaque.

Due to the lack of detailed survey coverage, it is likely that the Aboriginal heritage potential of the Kemerton area has not been fully realised. Given this, the Preferred Bidder would need to take appropriate steps to ensure on-going compliance with the provisions of the *Aboriginal Heritage Act 1972*.

9.6.2 Management Strategies

To ensure that potential disturbances to Aboriginal heritage sites are minimised, the Preferred Bidder would be required to undertake the following management strategies:

Management Commitment 3*: The Preferred Bidder will be required to perform a site survey for archaeological sites.*

- An archaeological survey of the area to be disturbed would be undertaken during the detailed design stage of the project;
- Where possible, the plant site and wastewater pipeline would be sited to avoid any known or identified sites. In instances where this is not possible, sites would not be disturbed without prior approval under Section 18 of the *Aboriginal Heritage Act 1972*;

- Preparatory earthworks associated with the wastewater pipeline would be supervised to ensure that inadvertent disturbance to Aboriginal heritage sites is avoided, especially in areas where the ground has not been previously disturbed; and
- Consultation would be undertaken by the Preferred Bidder with representatives of any Aboriginal groups that have associations with the area to be disturbed.

9.7 Public Health and Safety

Management Objectives

- *Ensure that the risk to the public is as low as reasonably practicable; and*
- *Ensure that risk is managed to meet the EPA's criteria for off-site individual fatality risk and that the Department of Mineral and Petroleum Resources Explosives and Dangerous Goods requirements in respect to public safety are met.*

Any industrial development that involves the storage, transportation or processing of hazardous substances could pose risk to employees, the public and the environment. The following section identifies potential hazardous events, assesses the outcomes and related risks, and develops management strategies to minimise risk.

9.7.1 Risk Criteria

The EPA has developed risk criteria that should be taken into account when assessing a proposed hazardous industry. Off-site individual risk is the risk of a certain outcome to an individual at a specific location.

Criteria relevant to the development of the proposed power station at Kemerton are summarised in the EPA publication, *Guidance for Risk Assessment and Management: Offsite Individual Risk from Hazardous Industrial Plant* (EPA, 2000b). This document specifies the off-site individual risk criteria for fatalities from a hazardous industrial plant:

- *"Risk levels from industrial facilities should not exceed a target of 50 in-a-million per year ($50x10^{-6}$) at the site boundary for individual industry, and the cumulative risk imposed upon an industry should not exceed a target of 100 in-a-million per year ($100x10^{-6}$).*
- *A risk level for non-industrial activity located in buffer zones between industrial facilities and residential zones of ten-in-a-million ($10x10^{-6}$) or lower is so small as to be acceptable to the EPA.*
- *A risk level in residential zones of 1 in-a-million per year ($1x10^{-6}$) or less is so small as to be acceptable to the EPA.*
- *A risk level in "sensitive developments", such as hospitals, child care facilities and aged care housing developments of between one half and one-in-a-million per year (0.5 to $1x10^{-6}$) is so small as to be acceptable to the EPA*

In addition, risk minimisation must be demonstrated in all new proposals".

On-site risks to employees are managed under the Occupational Safety and Health Act 1994 and Mines Safety and Inspection Act 1994 and Regulations, which are not discussed here.

The Kemerton Industrial Park includes a buffer zone which has been developed to protect the community from potential impacts of industry including the risk of industrial accidents. This buffer zone is shown in green in **Figure 4-1**.

9.7.2 Previous Risk Analyses

In 1997, risk assessment modelling was undertaken by BSD Consultants to determine the impact of hypothetical industry development within Kemerton Industrial Park (BSD Consultants, 1997). The following hypothetical industries were selected to represent the risk characteristics of possible industry types which could locate at Kemerton:

- Oil refinery;
- Paper pulp;
- Petrochemical plant;
- Chlorine storage;
- Mineral sands titanium dioxide pigment production; and
- Liquid petroleum gas (LPG) extraction.

The hypothetical industries were located within the estate having regard for the local meteorology and locations of residential areas and other sensitive receptors. The Millennium Inorganic Chemicals Titanium Dioxide Pigment Plant and the Nufarm Chlor-alkali Plant were also included in the model.

The modelling showed that the individual risk from these industries described above met the criteria set by the Department of Environmental Protection (DEP). Due to the buffer separation between the industrial development and residential areas, societal risks were also acceptable.

The Final Concept Plan for the Kemerton Industrial Park expansion divided the Industrial Core into parcels for different categories of industries, depending on their potential for various levels of emission of air, noise and risk. Each parcel of land under the Concept Plan was then assigned a high, moderate or low designation to indicate the capacity of each parcel to accommodate each type of emission. These assignment categories are shown in **Figure 4-2**. The preferred power station site is located within parcels of land assigned a high risk designation and therefore there is capacity for a high risk industry to be situated on this site.

9.7.3 Potential Risk Impacts and Management Strategies

A preliminary review has been performed of hazardous materials and processes that may be used in the operation of a generic 1,080MW combined cycle power station. The off-site risk during construction of the plant would be minimal compared to those during operation. The outcomes of this review are presented in **Table 9-1,** which provides a summary of:

- Potential risk scenarios associated with the use of hazardous materials;

- Potential effects on site, to the public, and the environment; and
- Recommended management strategies.

Based on the National Occupational Health and Safety Commission's (NOHSC) *Control of Major Hazard Facilities* document (NOHSC, 1996), the proposed power station would not be considered a major hazard facility because:

- There would be no materials stored or produced on site that exceed the threshold quantities listed in Tables 1 and 2 of the NOHSC document;
- Quantities of natural gas likely to be present at any time in pipework and plant located inside the power station boundaries would be less than the 200 tonnes threshold nominated in Table 1 of the NOHSC document;
- Quantities of liquid fuel which would comply with Class 3 Packaging Group III or Combustible liquid Class C1 to AS 1940 and which may be stored on site would not exceed the threshold quantities nominated in Table 2 of the NOHSC document (50,000 tonnes or 59,000kL);
- Aggregation of the above amounts for natural gas and liquid fuels would not exceed one according to the formula rule in Section S1.1 of the NOHSC document; and
- All other materials present on site would be less than 2% of the threshold values in Tables 1 and 2 of the NOHSC document.

In terms of off-site risk, the following is concluded:

- Based on the above, the power station could be categorised as being Low Risk and would be contained within the High Risk Category assigned to the preferred site;
- The transport of hazardous goods to the power station is in minor volumes only and this imposes no greater risk than other material cartage in the region;
- The transport of hydrocarbon products to the power station poses a low risk, but has the potential to cause severe impacts on significant water bodies such as the wetlands and Leschenault Estuary if spills occur within the vicinity of these waterbodies or tributaries to them; and
- The risk created by a new gas pipeline lateral to the site is no greater than the risk associated with the existing gas pipeline in the area.

The Preferred Bidder would be required to undertake a Quantitative Risk Analysis to confirm that the development meets the EPA criteria.

Table 9-1 Assessment of Potential Hazardous Events for a 1,080MW Combined Cycle Power Station

	Hazards to Site Operations	Hazards to the Public	Hazards to the Environment	Probability of Occurrence	Range of Severity of Effect	Quantities/ Other Comments
Natural Gas:						
External (to site) pipeline rupture.	Loss of fuel supply.	Fire/explosions. Injury/Death. Damage to property.	Bush fire. Injury/death. Loss of flora/fauna.	Low	No injury to multiple fatalities/ injuries. Zero to severe property/flora damage.	Max. flow rates: 70,000m^3/h OCGT 210,000m^3/h CCGT No on-site storage.
Management Strategies	*None applicable.*	*Maintain cleared Right of Way.* *Sign posting.* *Approved design and construction.* *Provision of isolating valves at regular intervals.* *Regular inspections (intelligent pig).* *Loss of pressure alarms.* *Provision of emergency response procedure.*	*As per public strategy.*			
Internal site pipe rupture.	Fire/explosion. Injury/death. Damage to power station plant.	Fire spread to outside power station. Injury/death. Damage to property.	Fire spread to outside power station. Bush fire. Loss of flora/fauna.	Low	No injury to multiple fatalities/ injuries. Zero to severe property/flora damage.	Max flow rates: 70,000m^3/h OCGT 210,000m^3/h CCGT
Management Strategies	*Provision of emergency shut off valves at gas pipeline entry to site.* *HAZOP/HAZAN studies.* *Provision of safety/emergency procedures.*	*Provision of buffer zone and fire breaks around station security fencing.* *Emergency procedure established with local fire brigade and emergency services.*	*As per public strategy.*			
Lubricating/Insulating Oil:						
Rupture of plant on board tanks/ pipework.	Contamination pathway.	N/A	Contamination pathway.	Low	Moderate soil contamination. Little likelihood of groundwater contamination.	25kL in on-board tanks. Up to 5kL in storage.
Management Strategies	*Internal bunding around each plant to retain 100% of the oil content.*	*N/A*	*As per site strategy.*			
Spillage of oil during servicing.	Contamination pathway.	N/A	Contamination pathway.	Medium	Zero to minor soil contamination.	200L
Management Strategies	*External spill pads adjacent to each plant.* *Dedicated drainage to contaminated water sump.* *Approved clean up procedures.*	*N/A*	*As per site strategy.*			
Spillage during transport to site.	N/A	Property damage.	Contamination pathway.	Low	Zero to moderate soil contamination. Zero to severe impact on surface water bodies (ie. wetlands or Leschenault Estuary). Possible moderate storm drainage contamination.	Up to 12,000L.
Management Strategies	*N/A*	*Provision of emergency response and clean up procedures (by Carrier).*	*As per public strategy.*			*Responsibility of Carrier.*
Water Treatment Chemicals:						
Open cycle gas turbine plant – Leaks, spillage during handling.	Personnel injury during handling	N/A	Contamination pathway.	Medium	Zero to minor injury. Very mild toxicity. Zero to minor soil contamination.	Up to 800L in storage.
Management Strategies.	*Wear appropriate personnel safety equipment.*	*N/A*	*Provide temporary bunding during servicing activities.*			
Combined cycle gas turbine plant – Leaks, spillage during handling.	Personnel injury during handling. Corrosion.	N/A	Contamination pathway.	Medium	Zero to minor injury. Zero to minor soil contamination. Mild toxicity, highly corrosive.	Up to 3kL of chemicals: - neutralising amines - diethy/hydroxyl amine - sodium phosphate - sodium hyperchlorite - Glycol Up to 3kL each of: - sulphuric acid - caustic
Management Strategies	*Wear appropriate personnel safety equipment.* *Provide secure and approved storage facility with 100% capacity bunding and dedicated drainage to contaminated water sump as appropriate.*	*N/A*	*Provide permanent or temporary bunding during servicing activities.* *As per site strategy.*			

	Hazards to Site Operations	Hazards to the Public	Hazards to the Environment	Probability of Occurrence	Range of Severity of Effect	Quantities/ Other Comments
Propane/Hydrogen:						
Leaks on-site, little ruptures.	As per natural gas.	As per natural gas.	As per natural gas.	Low	As per natural gas.	Up to 100 x 90kg bottles hydrogen. Up to 50 x 90 kg bottles propane. Note: Propane used for starting some types of gas turbine. Other gas turbine models do not use propane. Hydrogen used for cooling of generators. Not all models of generators require hydrogen cooling. Gas turbines and generators that do not use either hydrogen or propane or both would be preferred.
Management Strategies	*Secure bunded storage.* *Gas fire detection/protection where gas bottles located adjacent to plant.*	*As per natural gas.*	*As per natural gas.*			
Spillage/leaks during transport to site.	N/A	Fire/explosion. Injury/death. Damage to property.	Bush fires. Damage to flora/fauna.	Medium	No injuries or damage to multiple fatalities/injuries and severe damage.	
Management Strategies	*N/A*	*Provision of emergency procedures (by Carrier).*	*As per public strategy.*			*Responsibility of Carrier.*
Liquid Fuel:						
Rupture of liquid fuel storage tanks or pipework.	Fire. Injury/death.	Fire. Injury/death (if fire escapes from site).	Contamination pathway. Bush fire (if fire escapes from site).	Low	No injuries or damage to severe damage and multiple injuries.	Maximum storage for standby fuel up to 7,000kL.
Management Strategies	*Secure bunding in fuel farm.* *Fire protection facilities.* *Provision of safety/emergency procedures.*	*Provision for local/fire/emergency services call out.*	*Provision of emergency clean up procedures.*			
Spillage during transport to site.	N/A	Fire. Injury/death.	Major contamination pathway. Bush fire.	Low	Zero to moderate soil contamination. Zero to severe impact on surface water bodies (ie. wetlands or Leschenault Estuary). Possible moderate storm drainage contamination.	Up to 60,000L.
Management Strategies	*N/A*	*Provision for local/fire/emergency services call out.*	*Provision of emergency clean up procedures (by Carrier).*			*Responsibility of Carrier.*
Minor Chemicals:						
Cleaning fluids, paints and thinner spillage.	Personnel injury. Fire.	N/A	Minor contamination pathway.	Medium	No injuries or damage to minor injuries. Minor soil contamination.	Minor quantities (less than 400L)
Management strategies	*Wear appropriate personnel safety equipment when handling.* *Fire extinguishers in strategic locations.*	*N/A*	*Secure bunded storage.*			
Weed killer/and insecticide spillages.	Personnel injury.	N/A	Damage to flora.	Medium	Minor damage to flora. Minor skin injury.	Minor quantities (less than 200L).
Management Strategies	*Wear appropriate personnel safety equipment when handling.*	*N/A*	*Secure bunded storage.*			
Biocides	Personnel injury.	N/A	Damage to local flora.	Very low	Zero to minor injury to lungs/skin.	Minor quantities (less than 200L)
Management Strategies	*Wear appropriate personnel safety equipment when handling.* *Adherence to MSDS/Chem alert handling procedures.*	*N/A*	*Secure bunded storage.*			
Battery fluids	Personnel injury.	N/A	Minor contamination pathway.	Very low	No injuries or damage to minor injuries (corrosive). Minor soil contamination.	Minor quantities (less than 200L)
Management Strategies	*Wear appropriate personnel safety equipment when handling.* *Adherence to MSDS/Chem alert handling procedures.*	*N/A*	*Secure bunded storage.*			
Thermal Insulation:						
Health Risk during handling/installation/repair.	Personnel injury.	N/A	N/A	Very low	Zero to moderate injury to lungs.	Normally fully enclosed. Exposed only during repairs or new work.
Management Strategies	*Adherence to MSDS/Chem alert handling procedures.* *Approved/trained personnel only.* *Wear appropriate personnel safety equipment.*	*N/A*	*N/A*			

10. Public Consultation

10.1 Preliminary Stakeholder Consultation

Western Power has initiated a program of stakeholder consultation process designed to:

- Brief stakeholders on the project, regarding the key environmental issues associated with the project and the proposed management strategies to mitigate these impacts; and
- Gain feedback from stakeholders on the environmental, social and heritage aspects of the proposal.

A list of Government Authorities and interest groups briefed to date is given below:

State Authorities/Interest Groups:

- LandCorp;
- Department of Minerals and Petroleum Resources;
- Department of Planning and Infrastructure;
- Water Corporation;
- Department of Environmental Protection;
- Water and Rivers Commission;
- Conservation Council of Western Australia;
- Conservation and Land Management; and
- Chamber of Commerce and Industry WA.

Local and Regional Authorities/Interest Groups (South West):

- Shire of Harvey;
- City of Bunbury;
- Shire of Collie;
- South West Development Commission;
- Chamber of Commerce and Industry WA – South West;
- Chamber of Commerce and Industry WA – Bunbury;
- Department of Planning and Infrastructure – Bunbury;
- Leschenault Inlet Management Authority;
- Water and Rivers Commission – Bunbury;
- Forest Products Commission – Bunbury;
- Department of Environmental Protection – Bunbury;
- Conservation and Land Management – Bunbury;
- Water Corporation – Bunbury;
- Bunbury Port Authority; and
- Kemerton Industrial Park Coordinating Committee.

A range of issues have been raised through the preliminary consultation program to date. The majority of these issues relate to fuel supply and renewable energy options, the power procurement process, site selection process and water supply and wastewater disposal. **Table G-1** contained within **Appendix G** summarises the issues that were raised during the preliminary consultation phase, and Western Power's response to addressing these. This Table also provides reference to the relevant section in the SER document where these issues are discussed in further detail.

Western Power will continue to consult with government authorities and community stakeholders throughout the formal public review process and as detailed below.

10.2 Public Review Period

This Strategic Environmental Review Document is a basis for public consultation and informed comment on the proposal that will occur during the four-week public review period.

During the review period, Western Power will conduct a community consultation program to ensure that local issues and concerns are addressed and to facilitate public participation in the potential environmental and social impacts of the project.

Briefings will continue with stakeholders in the area and informal public information sessions will be held in the local communities during the public review period for the SER. These open days will take the form of manned public displays and will be supplemented by media releases and public communications. All activities will be well advertised and planned to ensure maximum public profile and access.

In addition, details of the Power Procurement Process and environmental approval will be progressively added to Western Power's webpage. Information provided on the webpage includes project highlights and question and answer sheets. Please see http://www.westernpower.com.au/our_organisation/swis_ppp/index.html.

11. Conclusions and Environmental Management Commitments

This Report is seeking strategic environmental advice and 'in principle approval' for a power generating facility within the central core of the Kemerton Industrial Park. This Strategic Environmental Review will ensure that suitable land is set aside for future Proponent(s), who would then be required to obtain final environmental approvals prior to development.

The initial power generation requirements are for 240MW of peaking plant to meet short duration, high power demands. This Strategic Environmental Review has demonstrated the suitability of the Kemerton Industrial Park to accommodate a combined cycle gas turbine plant with generating capacity of up to 1,080MW.

11.1 Management Commitments

Western Power is committed to ensuring that the development of additional generating capacity is undertaken in a manner that minimises the impacts on the surrounding biophysical and social environments. Accordingly, Western Power has proposed a number of management commitments that would be required to be undertaken by the Preferred Bidder. The commitments are summarised in **Table 11-1**.

- **Table 11-1 Summary of Proponent Management Commitments**

	Topic	Action	Objective	Timing	Advice
1	Environmental Management	The Preferred Bidder will be required to prepare an EMP for the construction and operational phases of the project.	Ensure detailed planning is performed for all key environmental factors. Specific management plans would include: ▪ Dust ▪ Clearing ▪ Marine ▪ Noise ▪ Waste ▪ Stormwater ▪ Saline Water ▪ Hydrocarbon ▪ Hazardous Material; and ▪ Emergency Response.	Preliminary Construction and Operational Management Plans will be developed for submittal to Western Power as part of the final bidding process. The Preferred Bidder will submit the Construction Environmental Management Plan to the Department of Environmental Protection (DEP) during the Work's Approval process, prior to construction. The Operational Environmental Management Plan will be submitted prior to commissioning.	DEP
2	Terrestrial Flora and Vegetation	The Preferred Bidder will be required to undertake vegetation surveys of the plant site and infrastructure corridors.	Although vegetation surveys have been performed for the site and the wastewater pipeline corridor, spring surveys shall be performed for both areas to ensure all potential species of significance are recorded.	Prior to submittal of the Section 38 Environmental Review Document.	CALM, Specialist Consultant.
3	Aboriginal Heritage	The Preferred Bidder will be required to perform a site survey for archaeological sites.	Ensure that the existence of any archaeological material is determined and managed appropriately.	Prior to submittal of the Section 38 Environmental Review Document.	Department of Indigenous Affairs

The above environmental management commitments assume that the final power station will be designed such that the plant characteristics fall within the same parameters as those assessed during the development of this Section 16(e) Strategic Environmental Review. If this is not the case, the Preferred Bidder would be required to perform additional environmental impact studies during the Section 38 Environmental Review process. The Preferred Bidder would also develop specific management commitments during this Environmental Review process.

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13. Glossary

13.1 Abbreviations

AEC	Australian Environment Council
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
AS	Australian Standard
BAT	Best Available Technology
CALM	Department of Conservation and Land Management
CAMBA	China-Australia Migratory Bird Agreement
CCGT	Combined Cycle Gas Turbine
CDM	Clean Development Mechanism
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_{2e}	Carbon Dioxide equivalent
DBNGP	Dampier – Bunbury Natural Gas Pipeline
DEP	Department of Environmental Protection
DIA	Department of Indigenous Affairs
DRF	Declared Rare Flora
EMP	Environmental Management Plan
ENM	Environmental Noise Model
EPA	Environmental Protection Authority
EPP	Environmental Protection Policy
ERMP	Environmental Review and Management Plan
ESAA	Electricity Supply Association of Australia
FCCC	Framework Convention on Climate Change
GBRS	Greater Bunbury Region Scheme
GES	Generator Efficiency Standards
GIS	Geographical Information System
GPS	Global Positioning System
H_20	Water
HHV	High Heat Value
ICCG	Integrated Combined Cycle Gasification
IPP	Independent Power Producer
ISO	International Organisation for Standardisation
JAMBA	Japan-Australia Migratory Bird Agreement
JI	Joint Implementation
LIMA	Leschenault Inlet Management Area
LPG	Liquefied Petroleum Gas
MAFRL	Marine and Freshwater Research Laboratory
MIC	Millennium Inorganic Chemicals
MSDS	Materials Safety Data Sheet
N_2O	Nitrous Oxide
NEPC	National Environmental Protection Council
NEPM	National Environmental Protection Measure
NGGI	National Greenhouse Gas Inventory

NGS	National Greenhouse Strategy
NHMRC	National Health and Medical Council
NO	Nitric Oxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
NOEC	No Observed Effect
NOHSC	National Occupational Health and Safety Commission
NPI	National Pollutant Inventory
O_3	Ozone
OCGT	Open Cycle Gas Turbine
PAH	Polycyclic aromatic hydrocarbon
PM_{10}	Particulate matter with a diameter up to 10μm
SECWA	State Energy Commission of Western Australia
SER	Strategic Environmental Review
SO_2	Sulphur Dioxide
SWDC	South West Development Commission
SWIS	South West Interconnected System
TDS	Total Dissolved Solids
TSS	Total Suspended Solids
VOC	Volatile Organic Compounds
WA	Western Australia
WAPC	Western Australia Planning Commission
WHO	World Health Organisation
WRC	Waters and Rivers Commission

13.2 Units

%	percentage
‰	parts per thousand
°C	degrees celsius (centigrade)
Am^3/s	actual cubic metres per second (measured at actual temperature and pressure)
dB	decibels
dB(A)	decibels (A-weighted)
g	grams
g/m^3	grams per cubic metre
g/s	grams per second
GL/yr	gigalitres per year
GWh	gigawatt-hours
hr	hours
ha	hectares
kg	kilograms
kg/h	kilograms per hour
kg/yr	kilograms per year
kL	kilolitres
kL/day	kilolitres per day
kL/yr	kilolitres per year
km	kilometres
km/h	kilometres per hour
km^2	square kilometres
kPa	kilopascals

kW	kilowatts
L	litres
L/s	litres per second
L/yr	litres per year
m	metres
m^2	square metres
m^3	cubic metres
m/s	metres per second
m^3/h	cubic metres per hour
m^3/s	cubic metres per second
m^3/yr	cubic metres per year
mg/L	milligrams per litre
ML/yr	mega-litres per year
Mtpa	mega tonnes per annum
MW	megawatts
MWh	megawatt-hours
Nm^3	normalised cubic metres (measured at 0°C and 101.3kPa)
Nm^3/s	normalised cubic metres per second
Nm^3/yr	normalised cubic metres per year
NTU	nephelometric turbidity units
ppm	parts per million
ppmv	parts per million by volume
tpa	tonnes per annum
μg/L	micrograms per litre
$\mu g/m^3$	micrograms per cubic metre

13.3 Glossary of Terms

Abstraction	Pumping from an aquifer.
Aeolian	Transported by wind.
Aquifer	A geological formation or group of formations capable of receiving, storing and transmitting significant quantities of water that can be pumped.
Assigned Noise Levels	Assigned noise levels are the levels of noise allowed to be received at a premises at a particular time of the day or night and are normally measured using $L_{A,Max}$, L_{A1} and L_{A10}.
Australian Standard (AS)	An Australian Standard that provides criteria and guidance on design, materials, fabrication, installation, testing, commissioning, operation, maintenance, re-qualification and abandonment.
A-weighting	A standardised frequency response used in sound measuring instruments which approximates the response of the human ear.
Background level	The concentration of air pollutants in a definite area without anthropogenic influence.
Benthic	Dwelling at the bottom of an aquatic habitat.

Benthos	All biota living upon or in the sediment of an aquatic habitat.
Bioaccumulation	The accumulation of a substance in the tissues of a living organism.
Biodiversity	The variety of all life forms, the different biota, the genes they contain and the ecosystems they form.
Biota	The plants, animals and microorganisms of a region.
Blow-down	Waste.
Combined cycle	Refer to full description in **Section 3.3.2**.
Contaminant	Any physical, chemical or biological substance or property which is introduced into the environment.
Dampland	A basin wetland where the soil is seasonally waterlogged.
Decibel	A logarithmic unit which represents the ratio of a measured quantity to a defined reference level.
Declared Rare Flora (DRF)	Under the Wildlife Conservation Act 1950, the Minister for the Environment may declare species of protected flora to be "Rare Flora" if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Such species are referred to as Threatened Flora and receive special management attention by CALM.
Demineralisation	The process of removing mineral ions from water.
Detritus	Small fragments of material that has broken away from the main body.
Distillate	A liquid condensed from vapour in distillation.
Emissions	Gases, particulates or liquids being released into the environment by either natural or human means. Some emissions are of concern to human and/or environmental health.
Environment	The surroundings of an organism including the other biota with which it interacts.
Environmental Management Plan	A procedure that identifies potential impacts and methodologies necessary to prevent or mitigate them.
Environmental Protection Policy	Policies prepared under the *Environmental Protection Act 1986* relating to the protection of environmental assets.
Ephemeral wetland	Wetland with surface water for a period of time but not every year.
Episodic wetland	Wetland with surface water for a period of time but not every year.
Ethnohistory	The study of native people using a combined anthropological and historical viewpoint.

Fauna	Collectively, the animal life of a particular region.
Flora	Collectively, the plant life of any particular region.
Frequency	The rate of vibration in cycles per second (Herz) commonly associated with pitch of a sound. Low frequencies produce treble sounds. The frequency range of the human ear is nominally 20Hz to 20,000Hz.
Greenhouse Gases	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and re-emit infrared radiation, including water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O).
Habitat	The specific place where an organism lives.
Hydrocarbon	An organic compound containing carbon and hydrogen.
L_{A1}	Assigned noise level which is not to be exceeded for more than 1% of the time.
L_{A10}	Assigned noise level which is not to be exceeded for more than 10% of the time. This is frequently referred to as the average-maximum noise level.
L_{A90}	Assigned noise level which is not to be exceeded for more than 10% of the time. This is frequently referred to as the background noise level.
L_{Amzx}	Assigned noise level which must not to be exceeded.
Licence	A statutory document, issued by an environmental agency, permitting a person or organisation to discharge, emit, or deposit waste into the environment, subject to a variety of conditions relating to control measures, monitoring volume, timing, nature, and composition of the waste. Licences are granted and in force under Part V of the Western Australian Environmental Protection Act 1986.
Life cycle analysis	The study of the effects of a product or activity on the environment from inception, manufacture, distribution, use and final disposal, with all the direct and indirect effects on the environment such as the effects of mining raw materials and the disposal of discarded plant and products.
Macroalgae	Large algae species.
Monitoring	Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels.
National Environmental Protection Council (NEPC)	A Ministerial Council with statutory powers to make national environmental protection measures on a co-operative basis. The Inter-governmental Agreement of the Environment provided for the establishment.
National Environment	A legal instrument which sets agreed national objectives for protecting particular aspects of the environment. NEPM are

Protection Measure (NEPM)	made by the NEPC.
National Pollution Inventory	A database designed to provide the community, industry and government with information on the types and amounts of certain chemicals being emitted to the environment.
Non-renewable energy	Energy that is derived from non-renewable, fossil fuel sources.
Objective	Overall goal, arising from the environmental policy, that an organisation sets itself to achieve, and which is quantified where practicable.
Open cycle	Refer to full description in **Section 3.3.1**.
Palusplain	A wetland typically flat rather than in a basin where the soil is seasonally waterlogged – typical of the Pinjarra Plain.
Perennial	Reappears on a yearly basis.
pH	The negative logarithm of the hydrogen ion activity. It denotes the degree of acidity or alkalinity in a solution.
Photochemical Smog	Photochemical smog is characterised by high concentrations of ozone at ground level. It forms when urban air pollutants, principally oxides of nitrogen (NO_x) and reactive organic compounds from motor vehicles and other sources, react together for a few hours under the influence of sunlight and high temperatures. The constituents of photochemical smog can have an adverse effect on people and the environment.
Pollution	Degradation or impairment of the purity of the environment by causing a condition that is hazardous to public health, safety aesthetics or welfare, or to biota.
Priority Listed Flora	Flora that have not been adequately surveyed but may be rare or endangered.
Remnant Vegetation	Remaining areas of natural vegetation
Renewable energy	Energy that is derived from sources that are either infinite (such as the sun and wind) or continuously renewing (such as biomass).
Risk	A measure of the probability that damage to life, health, property, and/or the environment will occur as a result of a given hazard.
Risk Management	The process of evaluating and selecting alternative regulatory and non-regulatory responses to risk. The selection process necessarily requires the consideration of legal, economic and behavioural factors.
Run-off	The part of rainfall which flows off the land surface towards drainage lines.
Saline	Containing salt.

Seagrass	Underwater flowering plants
Significantly Contributing	A noise emission is said to significantly contribute to a level of noise if the noise emission is less than a level which is 5dB below the assigned level at the point of reception.
Single Point Calculations	Show the influence of individual items on the overall noise resulting at a specific location.
Swamp	A wetland dominated by emergent vegetation (rather than open water), whether permanent, seasonal or ephemeral.
Swan Coastal Plain	Area of Western Australia between the sea and the Darling Range.
Tonal Noise	Noise containing one or more frequencies which dominate the spectrum. Typically whining or droning noises.
Topography	The land surface features of a region.
Turbidity	Measure of the clarity of a water body.
Unconfined aquifer	Underground water storage that has an upper water surface represented by the water table.
Wastewater	Domestic, industrial and municipal effluent.
Wetland	An area of permanent, seasonal or intermittent inundation, whether natural or otherwise; fresh, brackish or saline; static or flowing.

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Environmental Protection Authority Guidelines for the Preparation of the Strategic Environmental Review Document (*Part A: Specific Guidelines*)

Appendix A

Ms Lorie Jones
Executive Environmental Engineer
Sinclair Knight Merz
PO Box H615
PERTH WA 6001

Your Ref:
Our Ref: 186/02
Enquiries: Mr P Browne-Cooper

Dear Ms Jones

GUIDELINES FOR STRATEGIC ENVIRONMENTAL REVIEW
WESTERN POWER CORPORATION
KEMERTON POWER STATION

Please find attached for your consideration, a copy of the final guidelines which specify the scope and content of the public environmental review document for the above proposal.

During the preparation of the strategic environmental review document you are encouraged to consult with Ms Xuan Nguyen of the Department of Environmental Protection and Mr Peter Browne-Cooper who has been contracted to assist with assessment of the project.

Yours sincerely

Bernard Bowen

Bernard Bowen
CHAIRMAN

Final Guidelines

WESTERN POWER STRATEGIC SITE ASSESSMENT FOR FUTURE POWER GENERATION

These guidelines are proposed for the preparation of the proponent's Section 16(e) strategic environmental review document. The specific environmental factors to be addressed are identified in Section 4.3.

The Section 16(e) strategic environmental review document will address all elements of these guidelines. The proponent will fully consult with interested members of the public and relevant stakeholders, and take due care in ensuring any other relevant environmental factors, which may be of interest to the public and stakeholders, are addressed. The environmental review will document the results of all consultation undertaken.

Guidelines for the preparation of a Section 16(e) strategic environmental review document

1. Overview

All environmental reviews have the objective of protecting the environment. Environmental impact assessment is deliberately a public process in order to obtain broad-ranging advice. The review requires the proponent to describe:

- the proposal;
- receiving environment;
- potential impacts of the proposal on factors of the environment;
- proposed management strategies to ensure those environmental factors are appropriately protected; and
- demonstrate that the proposal will be judged by the EPA to be environmentally acceptable.

Throughout the assessment process it is the objective of the Environmental Protection Authority (EPA) to help the proponent to design the proposal to improve the protection to the environment. The Department of Environmental Protection (DEP) administers the environmental impact assessment process on behalf of the EPA.

The primary purpose of the environmental review is to provide information to the EPA on the proposal within the local and regional framework, with the aim of emphasising how the proposal may impact the relevant environmental factors and how those impacts may be mitigated and managed, so as to be environmentally acceptable.

2. Objectives of the Section 16(e) strategic environmental review

The objectives of the environmental review are to:

- place this proposal in the context of the local and regional environment;
- adequately describe all components of the proposal;
- provide the basis of the environmental management program that the final proponent will be required to implement, which shows that the environmental impacts resulting from the proposal, including cumulative impact, can be acceptably managed;
- communicate clearly with the public (including government agencies), so that the EPA can obtain informed public comment to assist in providing advice to government; and
- provide a document which clearly sets out the reasons why the strategic proposal will be judged by the EPA to be environmentally acceptable.

3. Preparation of the Section 16(e) strategic environmental review documents

The Proponent will maintain close contact with the DEP officer during the preparation of the environmental review. The draft environmental review will be provided to the DEP officer for comment. At this stage the document will have all figures produced in the final format and colours.

The proponent and DEP officer/Manager will agree on the time to be taken to review the draft, taking into account the level of consultation during the environmental review preparation, DEP officer's availability and the need for external review. Revision of the document may be requested to ensure that it addresses all topics and issues in these guidelines, can be read by the educated lay-person, contains no significant error of science and meets the required format.

When the EPA is satisfied with the standard of the environmental review document it will provide a written sign-off to the proponent, giving approval to advertise the document for public review. The review document will not be advertised for release before written approval is received.

The proponent will also provide the final document to the DEP in an electronic format for use on Microsoft Word 2000, and any scanned figures. Where possible, figures will be reproducible and legible in black and white.

4. Contents of the Section 16(e) strategic environmental review document

The contents of the environmental review will include an executive summary, introduction, invitation to make a submission (Attachment 2), and at least the following:

4.1 The proposal

General requirements

The environmental review document will provide a comprehensive description of the proposal including its location (address and certificate of title details where relevant).

Specific matters requiring attention are:

- justification and objectives for the proposed development;
- the legal framework, including existing zoning and environmental approvals, decision making authorities and involved agencies; and
- consideration of alternative options based on environmental and other factors.

Description of the proposal which is the subject of these guidelines

Western Power Corporation (the proponent) intends to establish several sites as suitable for meeting the immediate and long-term power requirements of Western Australia. The sites identified include, but are not limited to, the following:

1. Kemerton Industrial Park;
2. Kwinana Industrial Area (Mason Road);
3. Pinjar (expansion of the existing power station);
4. Bunbury Power Station Site (site of the decommissioned Bunbury Power Station); and
5. Collie (expansion of the existing power station).

The proposals for each site are tailored to reflect the technical, social and environmental constraints, and are detailed in the relevant referral document for each site.

The proposed sites are indicated on the attached plan (Attachment 1). Further detail on the Strategic Planning Framework for Future Power Generation is provided in the document titled "Strategic Planning for Future Power Generation – Power Procurement Process and Environmental Approvals Strategy, Public Position Paper" which is provided separately as a stand alone document.

Key characteristics of the proposal
The strategic environmental review will include a description of the components of the proposal, including the nature and extent of works proposed. This information will be summarised in the form of a table, an example of which is found in Table 1.1 of the relevant referral documents for each site.

Plans, Specifications, Charts
The strategic environmental review documents will include adequately dimensioned plans showing clearly the location and elements of the proposal which are significant from the point of view of environmental protection. They will also locate and show dimensions (for progressive stages of development, if relevant) of plant, amenities buildings, access ways, stockpile areas, waste product disposal and treatment areas, all dams and water storage areas, storage areas including fuel storage, landscaped areas etc.

Only those elements of plans, specifications and charts that are significant from the point of view of environmental protection will be included.

The plans will include:

- a map showing the proposal in the local context - an overlay of the proposal on a base map of the main environmental constraints;
- a map showing the proposal in the regional context.

The plan/s will include contours, a north arrow, a scale bar and legend, grid coordinates, the source of the data, and a title. If the data is overlaid on an aerial photo then the date of the aerial photo will be shown.

Other logistics

- timing and staging of project;
- ownership and liability for the proposal during construction and operation;
- further studies and investigations; and
- requirements for future proponents.

4.2 The environment

The strategic environmental review documents will provide a description of the existing environment in a local and regional context which includes, if appropriate:

- ecosystem processes;
- biodiversity;
- existing site contamination (soil and groundwater); and
- other environmental factors / constraints that may be fatal flaws to the proposal.

4.3 Environmental factors

The strategic environmental review documents will focus on the relevant environmental factors for the proposal and these will be agreed in consultation with the EPA, the DEP and relevant public and government agencies.

At this preliminary stage, the proponent believes the specific relevant environmental factors, objectives and work required this proposal are as detailed in **Table 2.1** of the relevant referral documents for each site which has been provided as Attachment 6.

These factors will be addressed within the strategic environmental review document for the public to consider and make comment to the EPA. It is expected that the EPA will address these factors in its report to the Minister for the Environment and Heritage.

The proponent will fully consult with interested members of the public and take due care in ensuring any other relevant environmental factors, which may be of interest to the public, are addressed.

Further environmental factors may be identified during the preparation of the environmental review, therefore on-going consultation with the EPA, DEP and other relevant agencies will be undertaken. It is understood that the DEP may advise on the recommended EPA objective for any new environmental factors raised. Minor matters which can be readily managed as part of normal operations for the existing operations or similar projects will be briefly described.

For discussion under each environmental factor:

- a description of where this factor fits into the broader environmental / ecological context (only if relevant - may not be applicable to all factors);
- a clear definition of the area of assessment for this factor;
- the objective for this factor;
- a description of what is being affected - why this factor is relevant to the proposal;
- a description of how this factor is being affected by the proposal - the predicted extent of impact;
- a straightforward description or explanation of any relevant standards / regulations / policy;
- environmental evaluation - does the proposal meet the objectives as defined in the relevant site referral documents, **Table 2.1** (provided as Attachment 6);
- if not, environmental management proposed to ensure the EPA's objective is met; and
- predicted outcome.

Where appropriate, the proponent will provide a summary table of the above information for all environmental factors, under the three categories of biophysical, pollution management and social surroundings, as shown below:

Table 1: Environmental factors and management (example only)

Environmental Factor	EPA Objective	Existing environment	Potential impact	Environmental management	Predicted outcome
BIOPHYSICAL					
vegetation community types 3b and 20b	Maintain the abundance, species diversity, geographic distribution and productivity of vegetation community types 3b and 20b	Reserve 34587 contains 45 ha of community type 20b and 34 ha of community type 3b	Proposal avoids all areas of community types 20b and 3b	Surrounding area will be fully rehabilitated following construction	Community types 20b and 3b will remain untouched Area surrounding will be revegetated with seed stock of 20b and 3b community types
POLLUTION MANAGEMENT					
Dust	Ensure that the dust levels generated by the proposal do not adversely impact upon welfare and amenity or cause health problems by meeting statutory requirements and acceptable standards	Light industrial area - three other dust producing industries in close vicinity Nearest residential area is 800 metres	Proposal may generate dust on two days of each working week.	Dust Control Plan will be implemented	Dust can be managed to meet EPA's objective
SOCIAL SURROUNDINGS					
Visual amenity	Visual amenity of the area adjacent to the project should not be unduly affected by the proposal	Area already built-up	This proposal will contribute negligibly to the overall visual amenity of the area	Main building will be in 'forest colours' and screening trees will be planted adjacent to road	Proposal will blend well with existing visual amenity and the EPA's objective can be met

4.4 Environmental management

Western Power Corporation (the proponent) will ensure that tender documentation will require that the final proponent (proponent for the derived proposal) to have in place an environmental management system (EMS). The EMS shall be appropriate to the scale and impacts of the proposal, including provisions for performance review and a commitment to continuous improvement.

The system may be integrated with quality and health and safety systems and will include the following elements:

- environmental policy and commitment;
- planning of environmental requirements;
- implementation of environmental requirements;
- measurement and evaluation of environmental performance; and
- review and improvement of environmental outcomes.

A description of the environmental management system will also be required from the final Bidder. If appropriate, the documentation can be incorporated into a formal environmental management system (such as AS/NZS ISO 14001). Public accountability will be incorporated into the approach on environmental management.

The environmental management program (EMP) is the key document of an environmental management system. The EMP will provide plans to manage the relevant environmental factors, define the performance objectives, describe the resources to be used, outline the operational procedures and outline the monitoring and reporting procedures which would demonstrate the achievement of the objectives.

4.5 Environmental management commitments

The future proponent for the derived proposal will be required to implement the commitments made by Western Power during the strategic environmental review (SER) process. A consolidated list of the commitments will be provided in the strategic environmental review documents. They will be written clearly and in a similar style to an environmental condition. Management strategies, policies, objectives and non-environmental issues will be separated from the commitments.

4.5.1 Commitment components

The commitments will be framed in a format similar to that of the conditions under a Section 38 assessment so that they can be easily implemented by the proponent and / or future proponents.

The standard format that will be followed for all commitments is as follows:

The proponent (**who**) will undertake an action (**what, how, where**) to meet an environmental objective (**why**) to a time frame (**when**), and on advice of somebody (**from whom**, eg. third party, government agencies such as Department of Conservation and Land Management, Department of Minerals and Energy, Water and Rivers Commission, Shire Council). With regard to 'whom' this need only be included if the expertise of a third party is relevant to implementing the commitment.

The consolidated list of commitments will be numbered correctly for easy reference in the implementation and auditing stages of the project. These will therefore be sequentially numbered 1, 2, 3, ... without use of subgroups such as 1.1, 1.2 or 2(i) or 2(a), 2(b).

The commitments will be presented in tabular form as described below.

4.5.3 Commitment format

Due to limitations of a paragraph format, a tabular format will be provided to define the commitments. The table column headings will be ordered as: 'commitment number', 'topic', 'action', 'objective', 'timing' and 'advice', or re-ordered if necessary.

Examples of commitments in tabular form in provided in examples 1 and 2 below.

Examples 1 & 2.

The proponent is committed to the following:

No.	Topic	Action **(What/How/Where)**	Objective/s **(Why)**	Timing **(When)**	Advice **(Agency to provide)**
1.	Dust management	Prepare a Dust Control Program for the foreshore construction site which addresses: 1) abc 2) xyz	• Minimise dust during the construction phase • Maintain the amenity of nearby land users • To meet EPA dust control criteria	Prior to the start of construction	Shire
2.	Dust management	Implement the approved Dust Control Program	Achieve the objectives of Commitment 1	Construction	-

Example 3.

No.	Topic	Action	Objective/s	Timing	Advice
3.	Fauna protection	Undertake a trapping programme for capturing and relocating the Southern Brown Bandicoots	Minimise impact on Southern Brown Bandicoots	Pre- construction (prior to commencement of ground disturbance)	CALM

Example 4.

No.	Topic	Action	Objective/s	Timing	Advice
4.	Vegetation	Revegetate disturbed areas with vegetation types indigenous to the area	• To minimise impact on local flora • To achieve the completion criteria stated in PER (Section 5.1.1)	Post-construction (progressively during operations)	Kings Park Board

Example 5.

No	Topic	Objective	Action	Timing	Advice
5.	Ground water	Minimise impact on groundwater levels, surface water levels and surrounding vegetation	Groundwater drawdown shall not exceed 0.5 m at any boundary of the mine site	Operation	Water and Rivers Commission

Example 6.

No.	Topic	Action	Objective	Timing	Advice
6.	Clean-up	Post-clean up activities will only proceed after demonstrating to (and gaining approval from) the DEP that the site clean-up criteria identified in the 1993 CER have been met	To achieve the soil quality objectives in the Australian and New Zealand Guidelines for the Assessment and Management of Contaminated Sites, Jan 1992	Post-clean up (On completion of cleanup and prior to commencement of post-cleanup activities)	--

5. Public consultation

A description of the public participation and consultation activities undertaken by Western Power Corporation (the proponent) in preparing the strategic environmental review will be provided. This will describe the activities undertaken, the dates, the groups / individuals involved and the objectives of the activities. Cross-reference will be made with the description of environmental management of the factors which will clearly indicate how community concerns have been addressed. Those concerns which are dealt with outside the EPA process will be noted and referenced.

5.1 Availability of the Section 16(e) strategic environmental review document

The availability of the environmental review document for each site will be advertised (Attachments 3 and 4), and copies will be distributed free of charge according to the following for each site.

Supplied to DEP:

- Library/Information Centre 9
- EPA members 6
- Officers of the DEP (Perth & Local) 6

Distributed by the proponent to:

Government departments	•	Department of Conservation and Land Management.....2
	•	Office of Major Projects 2
	•	Department of Land Administration...............................2
	•	Department of Planning and Infrastructure 1
	•	Ministry for Planning...1
	•	Water and Rivers Commission 2
	•	Water Corporation 2
	•	Department of Minerals and Petroleum Resources...2
	•	Department of Indigenous Affairs 1
	•	Heritage Council of Western Australia 1
Local government authorities	•	Relevant City/Shire 1
Libraries	•	J S Battye Library..3
	•	The Environment Centre 2
	•	Relevant local libraries 2
Other	•	Conservation Council of WA 1
	•	Other relevant groups/associations................................1

Available for public viewing

- J S Battye Library;
- Relevant local libraries; and
- Department of Environmental Protection Library.

6. Other information

Additional detail and description of the proposal, if provided, will go in a separate section.

Attachment 1

Location of Proposed Future Power Station Sites

Western Power

SINCLAIR KNIGHT MERZ

Sinclair Knight Merz
263 Adelaide Terrace
P.O. Box H615 Perth
WA 6001 Australia

K:\Wves\01700\DE01706\WV01926.1\av_project\pwr_stn_r1.apr

SITES SELECTED FOR STRATEGIC ASSESSMENT – LOCALITY PLAN

FIGURE 3-4

Project No.: WV02244
Figure Prepared by: T.Lee
Date Prepared: 19/02/02

Attachment 2

Example of the invitation to make a submission

The first page of the strategic environmental review documents will be the following invitation to make a submission, with the parts in square brackets amended to apply to each specific proposal. Its purpose is to explain what submissions are used for and to detail why and how to make a submission.

Invitation to make a submission

The Environmental Protection Authority (EPA) invites people to make a submission on this proposal. If you are able to, electronic submissions emailed to the DEP Project Assessment Officer would be most welcome.

The [proponent] proposes to [the proposal]. In accordance with Section 16(e) of the Environmental Protection Act, a Strategic Environmental Review (SER) has been prepared which describes this proposal and its likely effects on the environment. The SER is available for a public review period of four weeks from [**date**] closing on [**date**].

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

Why write a submission?
A submission is a way to provide information, express your opinion and put forward your suggested course of action - including any alternative approach. It is useful if you indicate any suggestions you have to improve the proposal.

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

Why not join a group?
If you prefer not to write your own comments, it may be worthwhile joining with a group interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group, as well as increase the pool of ideas and information. If you form a small group (up to 10 people) please indicate all the names of the participants. If your group is larger, please indicate how many people your submission represents.

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

When making comments on specific elements of the SER:

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

Points to keep in mind

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

- attempt to list points so that issues raised are clear. A summary of your submission is helpful;
- refer each point to the appropriate section, chapter or recommendation in the SER;
- if you discuss different sections of the SER, keep them distinct and separate, so there is no confusion as to which section you are considering; and
- attach any factual information you may wish to provide and give details of the source. Make sure your information is accurate.

Remember to include:

- your name;
- address;
- date; and
- whether you want your submission to be confidential.

The closing date for submissions is: [**date**]

Submissions should ideally be emailed to
project.officer@environ.wa.gov.au

OR addressed to:

The Environmental Protection Authority
PO Box K822
PERTH WA 6842

Attention: **[Project Officer name]**

Attachment 3

Advertising the environmental review

Western Power will be responsible for advertising the release and arranging the availability of the environmental review document in accordance with the following guidelines:

Format and content
The format and content of the advertisement will be approved by the DEP before appearing in the media. For joint State-Commonwealth assessments, the Commonwealth will also approve the advertisement. The advertisement will be consistent with the attached example.

Note that the DEP officer's name will appear in the advertisement.

Size
The size of the advertisement will be two newspaper columns (about 10cm) wide by about 14cm long. Dimensions less than these would be difficult to read.

Location
The approved advertisement will appear in the news section of the main daily paper ("The West Australian") Saturday edition, and in the news section of the main local paper at the commencement of the public review period and again two weeks prior to the closure of the public review period.

Timing
Within the guidelines already given, it is the GPSSC's prerogative to set the time of release, although the DEP will be informed. The advertisement will not go out before the report is actually available, or the review period may need to be extended.

Attachment 4

Example of the newspaper advertisement

[The Proponent]

Section 16(e) Strategic Environmental Review

[The proposal]

(Public Review Period: [**date**] to [**date**])

The [proponent] is planning to [the proposal].

A Strategic Environmental Review (SER) has been prepared by the [proponent] to examine the environmental effects associated with the proposed development, in accordance with Western Australian Government procedures. The SER describes the proposal, examines the likely environmental effects and the proposed environmental management procedures.

The [proponent] has prepared a project summary which is available free of charge from the company's office address.

Copies of the SER may be purchased for $10 from:
Company Name
Street
Suburb/Town WA Postcode
Telephone: (08) 9xxx xxxx

Copies of the complete SER will be available for examination at:

- Department of Environmental Protection
  Library Information Centre
  8th Floor, Westralia Square
  141 St Georges Terrace
  PERTH WA 6000

- Department of Environmental Protection
  Regional Office - if appropriate

- Relevant local libraries (to be listed)

Submissions on this proposal are invited by [**closing date**]. Please email your submission to: project.officer@environ.wa.gov.au OR address it to:

Chairman
Environmental Protection Authority
PO Box K822
PERTH WA 6842

Attention: [**Project Officer name**]

If you have any questions on how to make a submission, please ring the project officer, Mr [**Project Officer name**], on (08) 9222 7xxx.

Attachment 5

Air quality and air pollution guide:
Modelling Guidance Notes

1 Introduction

The Department of Environmental Protection (DEP) is frequently required to review assessments of the air quality impact of existing or proposed sources of air pollutants. This often occurs in the course of individuals or companies (generically called "proponents" below) meeting their obligations under the *Environmental Protection Act 1986* ("the Act"), notably environmental impact assessment under Part IV of the Act or in relation to Works Approvals and Licences under Part V of the Act.

Most air quality assessments employ computer modelling to provide estimates of the environmental (ambient) air quality impact. The quality of modelling efforts reviewed by the DEP/EPA over many years has varied from highly skilled to very inadequate. These guidance notes have been prepared to provide a clear understanding of the DEP's expectations with respect to air quality modelling.

2 Identify emissions and secondary pollutants

The proponent is responsible for identifying and quantifying all emissions to atmosphere with a potential to have a non-trivial impact on the environment (including impact on human health and well-being; odour; nuisance; amenity; vegetation - natural and agricultural; and fauna - natural and agricultural). Emissions of potential concern include SO_2, NO_X, CO, particulates, volatile organic compounds, fluorides, hydrogen sulphide, other odorous gases, heavy metals, dioxins, furans, PAH and other toxic compounds, unless the emission rates of these are insignificant (to be justified). Additionally, the formation and impact of secondary pollutants such as photochemical smog and aerosols should be assessed if applicable. Greenhouse gases and ozone-depleting compounds are beyond the scope of these guidelines.

3 Modelling to predict impacts (overview)

For all primary and secondary pollutants which cannot be dismissed as being of no significance, the proponent must provide model predictions of the impact of emissions on the various elements of the environment, in the form of concentrations and/or rates of deposition over the range of averaging periods normally associated with "relevant standards" for each pollutant, and assess the magnitude of this impact against the "relevant standards". "Relevant standards" means guidelines/goals/standards which the EPA/DEP has adopted or advised or, in the absence of an EPA/DEP position, guidelines/goals/standards proposed by the proponent on the basis of national or international practice and/or field investigations of environmental sensitivity. Data from experiments or justifiable extrapolations from published literature will also be required on the susceptibility of natural vegetation and crops.

NOTE:

The proponent may choose to carry out "worst case" screening analyses for particular pollutants (eg via simplified, <u>conservative</u> calculations or models) in order to demonstrate to the DEP/EPA that air quality impacts are insignificant and therefore that comprehensive modelling procedures are not warranted. The worst case analysis procedures (calculations, models) must be adequately described, with reference to their source. Most of the discussion which follows is directed towards full modelling exercises rather than screening analyses. Nevertheless, a screening analysis will be considered inadequate if it ignores any of the features or factors described below which may be potentially significant.

4 **Presentation of model results**

Modelling results should be presented in the form of:

- contour plots covering the region of interest (including population centres or isolated residences), with a grid density adequate to avoid significant loss of resolution;
- numerical values of concentrations at the point(s) of maximum impact (explain where this occurs) and other locations (receptors) of interest (eg places of human residence).

For each pollutant so modelled, the contours and numerical values should be presented with reference to relevant standards (eg at the averaging period and percentile level of the relevant standard) and the results evaluated against the standard. The meteorological conditions causing highest concentrations at important receptors should be determined (if possible) to check that the model is yielding sensible results.

5 **Modelling cumulative impacts**

For each pollutant modelled, the assessment must account for existing concentrations caused by other sources plus (if significant) the background concentration (whether natural or man-made) in order to estimate the cumulative concentration. When cumulative concentrations are modelled, the contribution of the proposal to high percentile short term (say 1-hour) averages is often masked. Consequently, in order for the contribution to be properly assessed, the DEP/EPA requires modelling results (as described in the foregoing point) to be presented for:

- the existing emissions plus background concentration (pre-proposal);
- the proposed development in isolation (excluding existing emissions); and
- the combined (existing plus proposed plus background) emissions.

The "existing emissions" must include not only those of existing, operating sources of emissions but also those expected from yet-to-be-constructed sources which are at a stage of approval, and commitment to proceed, ahead of the proposal. Such sources will need to be identified on a case-by-case basis. Industries proposed for location in Kwinana or other regions with airshed management policies will need to be assessed in accordance with the provisions of those policies; the DEP/EPA will provide details.

6 **Emissions estimates**

TheDEP/EPArequires assurance that the estimates of emissions employed in modelling assessments are realistic and that uncertainty is balanced by conservatism. Details on how the source parameters (stack dimensions, mass emission rates, gas flow rate, temperature, density, etc) were derived should be summarised. This is to include whether these parameters were derived from stack testing (in relation to an existing facility), from theoretical calculations such as from a mass balance approach, from other existing facilities or standard emission factors (eg USEPA AP42). If the emissions are derived from stack testing, details should be given on how many stack tests were taken and how representative these were. Unless otherwise agreed, the level at which emissions should be set for modelling purposes is described in EPA Vic (1985).

7 **Variable or intermittent emissions**

In the experience of the DEP, intermittent emissions (plant start-ups, plant upsets, etc) result in more pollution complaints than normal emissions from operating industries.

The modelling must properly assess both emissions which are continuous in nature and emissions which are intermittent. Intermittent emissions which are insignificant in magnitude and/or very improbable in the lifetime of the plant may be screened out; the remaining emissions should be modelled together on a probabilistic basis to estimate the total plant impact. Screening of emissions cases must be based on the joint consideration of probability and magnitude of emission. The DEP/EPA is able to provide guidance on how to screen and model intermittent emissions.

8 Model capability

The models and/or worst case calculation procedures and data employed in the assessment must be demonstrably capable of simulating, or accounting for, all of the features which are important in the context of determining the air quality impact of the project. The proponent is responsible for identifying and properly accommodating these. The following list may not be exhaustive but is provided for checking purposes:

- trapping of plumes in mixed layers of limited height or, alternatively, penetration of plumes through elevated temperature inversions;
- vertical plume dispersion in convective conditions;
- fumigation of plumes into an encroaching mixed layer or thermal internal boundary layer near a coastline. Investigations of this phenomenon may require estimates of wind direction shear in stable layers;
- sea breeze trapping, recirculation of pollutants;
- near-surface dispersion under very stable calm conditions (a feature of WA winter meteorology);
- topographic influences - impact of plumes on elevated terrain, effect on spatially varying wind fields, valley winds (anabatic and katabatic winds), ponding of air in stable conditions;
- surface roughness;
- building wake effects, stack tip downwash (avoided by good engineering stack design);
- deposition, chemical transformation;
- effects of positive or negative buoyancy;
- radiation from flares.

The modelling report should describe how each of the relevant features was treated. Examples are:

- Physical description of the site to be modelled. This is to include details on the topography, ie highest hill/mountain within the model region, distance to coast or any other major water bodies and how this was dealt with in the modelling;
- For a coastal site, details on how sea breeze effects were incorporated in the modelling;
- The value(s) of the roughness length and details on how this was determined (refer to USEPA (1997) for recommended approaches).

9 Meteorological data for conventional models applied to simple situations

If using a conventional model, the proponent will need to obtain at least one (preferably two or more) years' data on the meteorology of the area, with high data recovery and verifiable data accuracy. In the simplest situations, the data may be limited to that necessary to provide reliable hourly average estimates of:

- wind speed;
- wind direction;

- air temperature;
- mixing height, estimated or measured via methods acceptable to the DEP;
- atmospheric stability, estimated by a method acceptable to the DEP.

Methods described in USEPA (1997) are generally acceptable to the DEP. The report should include a description on the meteorological data used or alternatively a reference to a publicly available report which contains this information. The description is to include details on the methodology used to derive stability classes and mixing heights and is to present (as a minimum) the annual wind rose, annual stability frequency distribution and details on the mixing height distribution. The description should also include details on the quality of the anemometer used and its starting threshold.

10 Meteorological data for complex models and/or complex situations

Specialised and detailed meteorological data and associated calculations are necessary to accurately model some of the features listed in point 8. For example, to model shoreline fumigation, knowledge of the onshore-flow vertical temperature structure is required. The proponent is responsible for assessing the full range of pollution dispersion issues and designing an appropriate monitoring program. Where items of data are not based on the results of continuous monitoring (eg. based instead on intermittent field experiments or unverified hypotheses), the uncertainty of estimates must be offset by conservatism in these estimates. The proponent is invited to demonstrate to the DEP/EPA that complicated or costly monitoring programs and/or modelling procedures for particular meteorological parameters are not warranted.

11 Advanced models

The DEP/EPA accepts that advanced prognostic models may be less reliant on measurements than conventional (eg Gaussian) models. These advanced models would need to be well supported by published validation studies before they would accept their use in isolation.

12 Model acceptability and verification

The DEP/EPA does not generally prescribe which models must be used in particular circumstances. The DEP/EPA takes this position in order to allow scientific and technical advances to be introduced without regulatory delays. However the DEP/EPA reserves the right to reject a proposed model, or application thereof, if it considers it to be inadequate, inappropriate or unproven. The AUSPLUME and ISCST3 models are frequently used in an acceptable manner for modelling industrial emissions, but they have limitations which model users should understand and respect.

Unless the DEP/EPA agrees otherwise, proponents are required to present, in addition to model results, all of the model input files and configuration details to allow the DEP/EPA to check and reproduce the model results. Model output which describes the model configuration should also be provided. If the model has not been well validated and documented in the public domain (like AUSPLUME, USEPA regulatory models), references to model validation reports (and provision of these on request) are required.

References

EPA Vic (1985) Plume Calculation Procedure: an approved procedure under Schedule E of State Environment Protection Policy (The Air Environment). Environment Protection Authority of Victoria, March 1985, Publication 210.

USEPA (1997) On-site meteorological program guidance for regulatory modelling applications. U.S. Environmental Protection Agency, June 1997.

Attachment 6

Extract from Specific Site Referral Document – Table 2.1 Summary of Environmental Issues and Management:

Table 2.1 Summary of Environmental Issues and Management

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Flora and Vegetation	Manage the abundance, species diversity, geographic distribution and productivity of vegetation communities.	*Kemerton Industrial Park* A survey of the vegetation of the Kemerton Industrial Park was undertaken by Muir Environmental in 1999. The significant vegetation and flora identified during this survey is shown in **Figure 1.4**. *Power Station Site* The majority of the power station site is covered by blue gum plantation and approximately 31.5 hectares of native vegetation occurs to the south of the power station site (refer **Figure 1.3**). *Wastewater Pipeline Route* The proposed wastewater disposal pipeline route will follow the designated service corridor for the Kemerton Industrial Park to the Old Coast Road, where it will follow the existing Collie Power Station Wastewater Pipeline (refer **Figure 1.4**).	*Power Station Site* Approximately 3 hectares of native vegetation will be cleared for the power station site (see **Figure 1.3**). This vegetation was not identified as significant in the Muir Environmental survey (see **Figure 1.4**). *Wastewater Pipeline* Some vegetation clearing will be required for the construction of the pipeline corridor.	Clearing will be minimised where possible and carefully controlled. The pipeline corridor will be rehabilitated following construction of the pipeline.	The vegetation of the preferred power station site and wastewater disposal pipeline route will be surveyed and mapped. The significance of any vegetation to be cleared will be detailed in the SER.
	Protect Declared Rare and Priority Flora, consistent with the provisions of the *Wildlife Conservation Act 1950*.	A rare flora search was undertaken by Paul G. Armstrong and Associates during Spring 1999. No Declared Rare or Priority Flora are known to occur within the power station site or proposed wastewater pipeline corridor (refer **Figure 1.4**).	No anticipated impacts to Declared Rare or Priority Flora.	Any clearing of native vegetation will be undertaken in accordance with the appropriate approvals.	A rare flora search will be undertaken over the power station site and wastewater disposal pipeline corridor during Spring. The results of this survey will be presented in the Section 38 environmental review.
Fauna	Maintain the abundance, diversity and geographic distribution of terrestrial fauna.	As part of the environmental assessment of the Kemerton Industrial Area, a detailed vertebrate fauna survey and review were undertaken in late 1998 and 1999 (Bamford and Bamford 1999).	No anticipated impacts to specially protected fauna.	No anticipated impacts to specially protected fauna.	A review of existing fauna studies will be undertaken to identify any potential issues. Fauna issues will be reviewed during the vegetation survey of the site and pipeline route.

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Rivers, Creeks, Wetlands and Estuaries	Maintain the integrity, functions and environmental values of rivers, creeks, wetlands and estuaries.	A number of wetlands exist in the buffer zone of Kemerton Industrial Park (refer **Figure 1.4**). Some of these wetlands are covered by the Environmental Protection (Swan Coast Plain Lakes) 1992 Policy. The major drainage system in the Kemerton Area is the Wellesley River, which is located to the east of the Kemerton Industrial Park (approx. 1.5 km from the power station site).	*Power Station Site* There is not expected to be any impacts on wetlands from the power station. *Wastewater Pipeline* The preferred wastewater pipeline route crosses over paluspIain, damplands and sumplands. The route crosses an estuary border which was evaluated as management for conservation purposes.	Appropriate surface and groundwater management strategies will be implemented to ensure that run-off or contamination from the site does not impact on nearby wetlands. The pipeline corridor will be rehabilitated following construction of the pipeline.	Details of the proposed disturbances and management strategies will be presented in the SER. Consultation with CALM will be undertaken to discuss the wastewater pipeline route.
Coastal Zone Areas (Coastal Dunes and Beaches)	Minimise disturbance to coastal dunes and beaches	The proposed wastewater pipeline route follows the existing Collie Power Station Wastewater Disposal pipeline, which runs through coastal dunes through to the Indian Ocean (refer **Figure 1.4**).	Direct impacts on a small portion of the dunes, within the existing pipeline easement.	The pipeline corridor will be rehabilitated following construction of the pipeline.	Details of the proposed disturbances and management strategies will be presented in the SER. Consultation with CALM will be undertaken to discuss the wastewater pipeline route.
Marine Areas and Biota	Manage the marine ecological integrity and biodiversity, and ensure that any impacts on locally significant marine communities are avoided.	The nearshore habitat is dominated by bare sand overlying limestone pavement. Further offshore predominantly sand and pavement habitat has patches of low relief reef and sparse seagrass. Seagrass meadows are generally confined to offshore areas (>600m). There are two ocean outfalls proximal to Kemerton that dispose of wastewater to the ocean – these are operated by Millennium Inorganic Chemical and Western Power (from the Collie Power Station). The existing outfall appears to have had little affect on the adjacent seagrasses.	The proposed power generation plant may have the potential to influence the marine environment through a wastewater disposal ocean outfall facility. It is proposed that the wastewater would be disposed of through the existing Collie Power Station ocean outfall (with upgrades if required).	Locally significant marine communities will be avoided. Monitoring of the outfall will be undertaken.	A water quality survey has been undertaken in the marine environment adjacent to the existing Collie Power Station Ocean Outfall with the purpose of obtaining the following information: ▪ Ambient physico-chemical data (temperature, salinity, dissolved oxygen pH, and turbidity); and ▪ Chemistry data (metals, major anions and major cations). A benthic habitat survey has been conducted in the vicinity of the Collie Power Station Ocean Outfall to obtain the following information: ▪ Percentage cover of the seabed by various habitat categories; and ▪ An overall assessment of the health of the benthic habitat adjacent to the existing outfall. The results of these surveys will be presented in the SER.

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Significant Areas and/or Land Features	Maintain the integrity, functions and environmental values of significant areas and land features.	The proposed wastewater pipeline route follows the existing Collie Power Station Wastewater Disposal pipeline, which runs through the fringe of the Leschenault Peninsula Nature Reserve (refer **Figure 1.4**).	Direct impacts on a small portion of the nature reserve, within the existing pipeline easement.	Clearing will be minimised where possible and carefully controlled. The pipeline corridor will be rehabilitated following construction of the pipeline.	Details of the proposed disturbances and management strategies will be presented in the SER. Consultation with CALM will be undertaken to discuss the wastewater pipeline route.
Surface Water and Groundwater Quality	Minimise the potential to impact the quality of local surface and groundwater.	The Kemerton area is relatively flat and subject to inundation, with the seasonal wetlands to the east. The major drainage system in the Kemerton area is the Wellesley River also located to the east. The Kemerton Industrial Park is underlain by an unconfined superficial aquifer. This aquifer is further underlain with the confined aquifers (by increasing depth) of the Leederville Formation and the Cockleshell Gully Formation. The depth to the watertable over much of the area is less than 2m. Groundwater in the superficial aquifer discharges to wetlands, the Wellesley River and Leschenault Inlet. Some leakage also occurs to the underlying Leederville Formation which forms a confined aquifer. Groundwater in the Superficial aquifer ranges in salinity from 100 to 8,500 mg/L TDS (BBG, 1999). At the preferred Power Station Site the depth to groundwater is likely to be about 0.5-1 metres and flowing in an east-south-easterly direction (BBG, 1999).	Contamination of groundwater due to leaks and spills of chemicals and hydrocarbons.	Stormwater runoff from the site will be managed such that there will be no discharge of contaminants from the site. The plant will be designed such that all spillages of chemicals or hydrocarbons are contained and collected.	Details of the existing surface water and groundwater environments and their significance will be given in the SER. The proposed management strategies that will be undertaken to minimise the impacts on these resources will be detailed in the SER.

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Water Supply	Minimise the impact on natural water resources by minimising water consumption.	A number of water supply options have been investigated for the Kemerton Industrial Park.	Potential impacts depend on the cooling option selected for the power station (refer **Section 1.5.2**), however the Water Corporation have indicated that they can meet this demand (see **Appendix A**).	Water supply will be provided by the Water Corporation under a separate environmental approvals process.	Studies have been undertaken to confirm water requirements for each stage of the powerhouse, and water quality characteristics. The results of these studies will be presented in the SER.
Solid and Liquid Wastes	Ensure that waste products are disposed of in an acceptable manner	Non-hazardous waste from the Kemerton area is disposed of in the Council Landfill. There is currently no sewage or wastewater collection or treatment facility in Kemerton. Plans for a centralised wastewater collection and treatment facility have been investigated Burns and Roe Worley (1998) and are being pursued by the Office of Major Projects.	Reduction in marine water quality at the wastewater disposal outfall.	Solid waste will be disposed of in an appropriate manner and according to regulations. Waste hydrocarbons will be contained, collected and disposed of off-site by an approved method. Cooling water will be discharged via ocean outfall. The cooling water circuit and outfall will be designed to ensure that water quality criteria are met. Domestic wastewater will be managed on site via package treatment plant.	Investigations have been undertaken into the most appropriate method of waste disposal (solid waste, sewage, cooling water and other wastes), which will be detailed in the SER. Dispersion modelling of the wastewater discharged into the marine environment has been undertaken to determine the dilution ratio achieved. Modelling has incorporated the existing Collie Power Station and proposed potential wastes to ensure environmental objectives can be achieved.

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Noise and Vibration	Ensure that noise impacts emanating from the proposed plant comply with statutory requirements specified in the Environmental Protection (Noise) Regulations 1997. Ensure that the power station meets the cumulative noise criteria at the Kemerton Industrial Park buffer boundary. Ensure that vibration impacts emanating from the proposed plant are acceptable.	Cumulative noise modelling was undertaken in 1999 for the Kemerton Expansion Study. This study investigated the noise emissions from a number of potential industries sited within the Kemerton Industrial Park. Noise was found to be the principal constraint in the optimum siting of industry within Kemerton Industrial Park.	Potential for noise levels to exceed criteria outside of the buffer zone boundary. Potential for noise emissions from the power station to exceed "cumulative criteria" at the buffer zone boundary. Vibration is not expected to be an issue, as gas turbine plant is designed to run at vibration levels which are essentially undetectable by humans at any distance away. The units are also installed on large concrete foundations such that any vibrations are damped out before reaching the ground in normal operating duties. Any ground detectable vibration would indicate a serious problem with the plant which would require it to be shut down before damage is incurred.	Reasonable and practicable noise abatement technology will be installed to ensure the proposed power station meets the relevant noise criteria.	Noise modelling of the power station (in isolation and in combination with the future potential industry mix used in the Kemerton Expansion Study) has been performed to determine the potential noise levels at the boundary of the buffer zone and at sensitive receptors and to determine the required site noise attenuation requirements. The results of these investigations will be presented in the SER.
Air Quality	Ensure that gaseous emissions from this proposal in isolation and in combination with emissions from neighbouring sources and background concentrations meet acceptable criteria for ambient ground level concentrations, and ensure that all reasonable and practicable measures are taken to minimise emissions of NOx, SOx, CO, PAHs, VOCs and particulates.	There are a number of industries within the Kemerton industrial estate that are minor emitters of NO_X and SO_2. Outside the estate there are only small emitters in the region apart from the two Alumina Refineries, which are over 30 kilometres away and the impacts on the estate will be relatively small.	Increased ground level concentrations of SOx, NOx and particulates caused by emissions from the power station. Increased smog levels in the region.	The main fuel for the powerhouse will be natural gas, so emissions of SO_2 will be negligible. Low NOx burners will be installed.	Dispersion modelling of NO_x has been undertaken for the power station in isolation and in combination with existing operations to ascertain ground level concentrations locally. The SER will provide information on how emissions of CO, odour, SO_2, particulates, dust, photochemical smog and other gaseous emissions such as PAHs and VOCs will be managed to meet the EPA's objectives.

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Greenhouse Gas Emissions	Ensure that potential greenhouse gas emissions are adequately addressed in the planning/designing and operation of the proposed power station.	This is a global issue.	Emission of up to 3.6 Mtpa of carbon dioxide from the power station, contributing to increased global greenhouse gases.	Natural gas will be used as the main fuel for the powerhouse, which has lower greenhouse gas emissions than other fossil fuels. Thermal efficiency design and operating goals will be implemented.	The SER will provide an estimate of greenhouse gas emissions over the lifetime of the project, and using annual CO_2 equivalent quantities, provide a comparison with other gas fired electricity generation plants/technology in a global context, and with 1990 levels. The SER will provide information on mechanisms to require future proponents to reduce greenhouse gas emissions to best practice levels in terms of energy efficiency and tonnes of greenhouse gas per unit of product during the design, construction and operation of the plants. The SER will provide recommendations/ suggestions on the implementation of other measures such as afforestation, storage, and other measures mentioned in the Kyoto Protocol to further offset greenhouse gas emission by future proponents. The SER will provide information on a framework for a Greenhouse management plan for the electricity generation industry at a State, National and individual plant level to meet the Kyoto Protocol and the Commonwealth Greenhouse Strategy.

Environmental Factor	Management Objective	Existing Environment	Potential Impacts	Management Strategies	Environmental Review- Scope of Work
Risk	Ensure that risk is assessed and managed to meet the EPA's criteria for off-site individual fatality risk. Ensure public risk associated with the construction and operation of the project is as low as reasonably practicable.	A cumulative risk assessment of Kemerton Industrial Park has been undertaken by the former Department of Resources Development (now Office of Major Projects) as part of the planning for the expansion.	The potential for increased off-site individual fatality risk from the proposed power station is low, based on preliminary advice from the DME.	Hazardous materials will be stored and handled according to regulations.	A qualitative risk assessment has been undertaken and will be detailed in the SER.
Social Surroundings	Ensure that the proposal complies with the requirements of the Aboriginal Heritage Act 1972; and Ensure that changes to the biological and physical environment resulting from the project do not adversely affect cultural associations with the area.	*Power Station Site* Sites of heritage value have been identified in the Kemerton area, although none of these are on the preferred site. *Wastewater Pipeline* Two aboriginal heritage sites occur in proximity to the preferred wastewater pipeline corridor.	Potential damage to sites of significance to aboriginal sites.	If sites of aboriginal significance are found, clearance will be obtained from the local Aboriginal community and Minister for Aboriginal Affairs before disturbance.	A desk-top heritage survey will be undertaken and detailed in the SER for the preferred site and the wastewater pipeline.
	Ensure visual impact is minimised.	The visual impact assessment of Kemerton Industrial Park has been undertaken by the former Department of Resources Development (now Office of Major Projects) as part of the planning for the expansion.	The plant site is well screened from the public through-roads (Old Coast Road) by the dune system.	Plant will be designed to a high standard to maintain aesthetic values. Vegetation management and landscape strategies will be developed as appropriate.	A review of the Kemerton Industrial Park visual assessment will be undertaken and detailed in the SER. Details of how the visual impact of the power station will be minimised will be given in the SER.

LandCorp/Department of Resources Development Correspondence Regarding Access to the Power Station Site

Appendix B

LANDCORP
DEVELOPING LAND FOR THE COMMUNITY

Telephone: (08) 9482 7499
Facsimile: (08) 9481 0861
www.landcorp.com.au
Email: landcorp@landcorp.com.au

RECEIVED
24 MAY 2002
ATG

Our Ref: 01P080 V1
Enquiries: Graham Sunderland - 9482 7422

General Manager
Emerging Business
Western Power Corporation
363 Wellington Street
PERTH WA 6000

Attention: Mr P Peake

ROLE	WHO	ACTION	SIGN	DATE
P Mgr	RJB			

JOB No FILE

Dear Mr Peake

ACQUISITION OF SITE FOR NEW POWER GENERATION FACILITY - KEMERTON INDUSTRIAL ESTATE

I refer to a recent meeting with Lorie Jones of Sinclair Knight Merz and Tom Grigson and Milka Klobucar at the Office of Major Projects.

Sinclair Knight Merz has requested a letter from the Authority supporting the establishment of a gas fired power station in the Kemerton Industrial Estate, in a specific location yet to be determined, to allow Western Power to proceed with a referral document to the Environmental Protection Authority under Section 16E of the Environmental Protection Act 1986.

Discussions to date with the Office of Major Projects, Sinclair Knight Merz and Western Power have identified Site D, on the attached plan, as the preferred site subject to further investigations.

As requested, this letter confirms the Authority's in principle support for the establishment of a gas fired power station in the Kemerton Industrial Estate subject to final site selection being agreed with this Authority and the Office of Major Projects, servicing considerations and negotiating a commercial agreement for the sale of the selected site to Western Power.

Yours sincerely

Graham Sunderland

Graham Sunderland
SENIOR PROJECT MANAGER

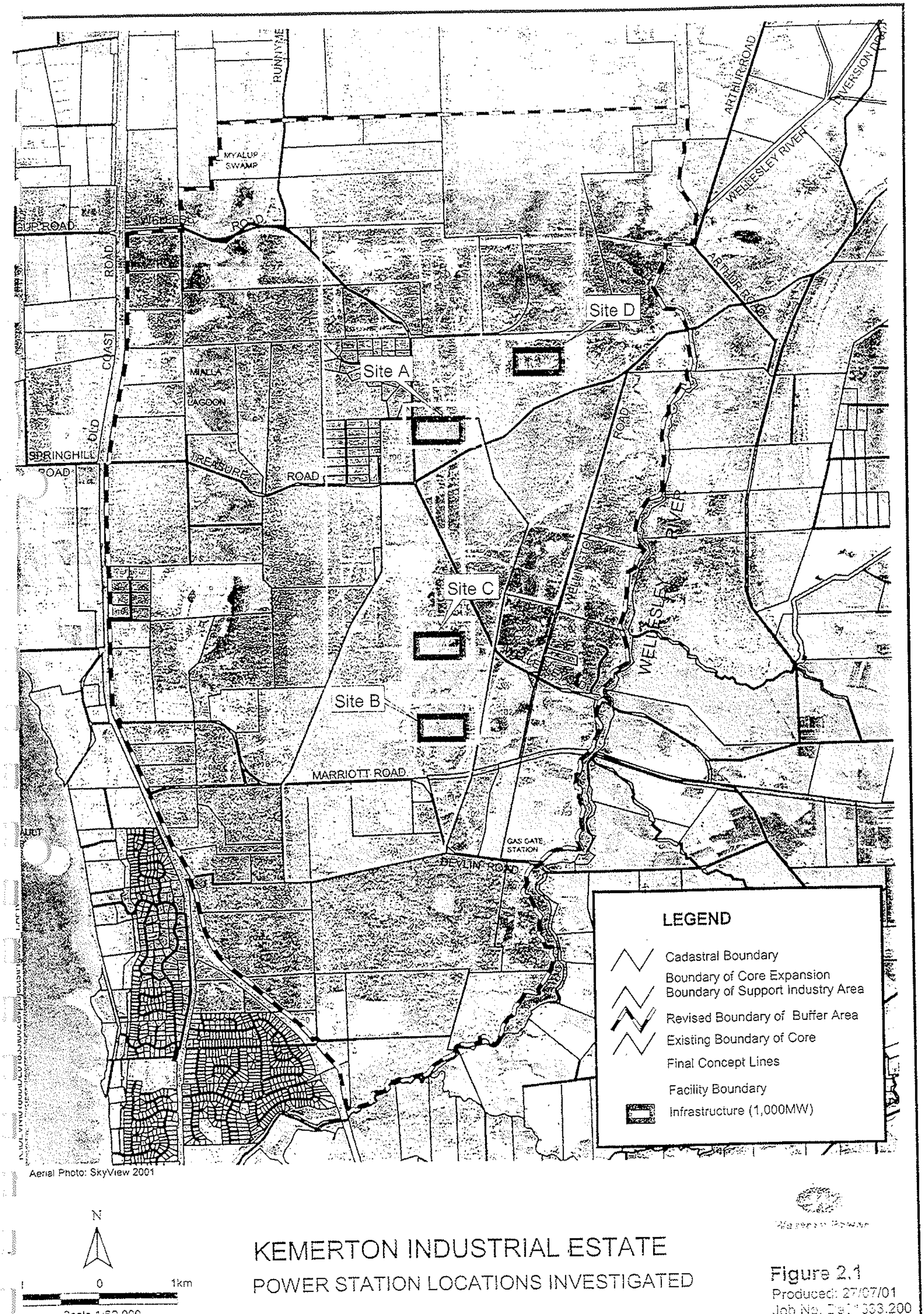
31 July 2001

Att.

cc. Ms Lorie Jones, Sinclair Knight Merz
Ms Milka Klobucar, Office of Major Projects

s:\grahams\bunbury\kemerton\jul2001.ltr to skm (jones).acq of site.doc\pdr

CUSTOMER FOCUS



KEMERTON INDUSTRIAL ESTATE

POWER STATION LOCATIONS INVESTIGATED

Figure 2.1
Produced: 27/07/01
Job No. D[illegible]303.200

DEPARTMENT OF RESOURCES DEVELOPMENT

168-170 St Georges Terrace,
Perth, Western Australia

Postal Address
PO Box 7606, Cloisters Square,
Perth, Western Australia 6850

Telephone (08) 9327 5555
Fax (08) 9327 5500

ABN 22 050 926 152

Your Ref: 927258v1
Our Ref: R0022/01V1

Mr P.R. Oates
General Manager
Emerging Business
Western Power
GPO Box L921
PERTH WA 6842

Dear Mr Oates

NEW POWER GENERATION FACILITIES: KEMERTON INDUSTRIAL ESTATE

Thank you for your letter of 3 July 2001 concerning Western Power's site acquisition process for future power generation.

With respect to the Kemerton site, the Department of Mineral and Petroleum Resources (Office of Major Projects (OMP)) supports, in principle, the location of a power station at Kemerton. The allocation of a specific site within Kemerton is to be determined at a later date, however, at this stage it appears that Site D would be preferred.

The OMP would appreciate being kept informed of developments in this matter.

Yours sincerely

Noel Ashcroft
EXECUTIVE DIRECTOR
OFFICE OF MAJOR PROJECTS

31 July 2001

(MIKL2156.DOC)

Water Corporation Correspondence Regarding Water Supply

Appendix C

LGS 16/4/02
→ R Gamble File & note

FILE COPY

WATER CORPORATION

cd0649
Graham Buckby
(08) 9420 3207

RECEIVED 15 APR 2002 SKF

629 Newcastle Street
Leederville 6007
Western Australia
PO Box 100
Leederville WA 6902
Tel (08) 9420 2420
Fax (08) 9420 3200

11 April 2002

Mr Trevor Harvey
Manager Power Procurement
Western Power Corporation
GPO Box L921
PERTH WA 6842

Dear Trevor

WATER ALLOCATIONS FOR FUTURE POWER GENERATION
REF: SM/77/23(80)V1

Thank you for your letter dated 25 February 2002 requesting confirmation of water allocations at either Kwinana or Kemerton WA. The Water Corporation is pleased to provide the following details and looks forward to further discussions once the project moves into an advanced stage.

PROPOSED KWINANA SITE LOCATION

Water Supply from Kwinana Water Recycling Project (KWRP)

The KWRP will commence production in late 2003/early 2004 at a site near the Tiwest JV operation (subject to completion of commercial contracts and other approvals). The facility will produce high-grade 50 TDS (total dissolved solids) industrial water and is readily expandable to accommodate any of your design options. Pricing can be determined once you have confirmed the final water demand and we would require 12 to 18 months advance notice before supply could commence.

A low-grade water option (800 TDS) could also be offered from the KWRP if desired. This would be a microfiltered/sterilised grade that is suitable for process cooling purposes.

As a customer of the KWRP we can likely offer access to the Cape Peron Ocean Pipeline (CPOP) for discharge of your waste effluent stream. Such access is subject to effluent quality parameters and approvals.

This supply option is preferred because of the current drought situation in Perth and the overall benefits the project delivers to the environment, Perth's water sources and also industry users.

Scheme Water Supply

Scheme water can be made available for all options. The largest request for 25Glpa could require **more than 4 years advance notice** to enable source development. Options of 4.1Glpa and above require at least 2 years advance notice.

If this water grade is preferred by Western Power we ask that you give as much notice to the Water Corporation as possible so that detailed planning can commence.

Proposed Kemerton Site Location

Water can be made available for all options. The largest request for 25Glpa could require **more than 4 years advance notice** to enable source development and requires further examination to ensure sustainability. All options of 4.1Glpa and above require at least 2 years advance notice.

Similarly, if this water grade is preferred by Western Power we ask that you give as much notice to the Water Corporation as possible so that detailed planning can commence.

The Water Corporation trusts that this information is sufficient for your consultation and approvals processes. If the timeframes indicated cause concern please contact myself to discuss how we may assist further to meet your requirements.

Yours faithfully

G. Buckby

Graham Buckby
Business Development Manager

RECEIVED

6 JUN 2001

WATER CORPORATION

Your Ref
Our Ref
Enquiries
Direct Tel

629 Newcastle Street
Leederville 6007
Western Australia

PO Box 100
Leederville WA 6902

Tel (08) 9420 2420
Fax (08) 9420 3200

1 June, 2001

Patrick Peake
Manager Power Procurement
Western Power
363 Wellington Street
PERTH WA 6000

Your Ref : SM / 77 / 13/ (80)

Dear Mr Peake

Western Power – Kemerton Water Supply Meeting of 29 March 2001

I acknowledge receipt of your letter to Geoff Hughes dated 1 May, and agree with your summary of the main points of discussion.

With respect to water supplies for any power station development within the Kemerton industrial estate, the Water Corporation is currently completing formalities with the Office of Water Regulation to establish the Corporation as the proponent for the Collie River Water Supply scheme. This scheme has been given an allocation for industrial use in the Kemerton estate.

The Water Corporation is also negotiating an extension of 5 years in relation to environmental approvals for this water supply. I will be in a position to provide the requested letter confirming a water supply for Kemerton when their formalities are complete.

When information from proponents for the power station development becomes available, the Water Corporation would be in a position to investigate other water supply alternatives.

Yours sincerely

Gary Watson
Business Development Manager

IIN 6785

Flora Species Recorded from the Project Area

Appendix D

Flora Species Recorded from the Project Area

Zamiaceae 16A
Macrozamia riedlei

Poaceae 031
Austrostipa sp.
**Avena* sp.
**Briza maxima*
**Bromus* sp.
**Cynodon dactylon*
Danthonia caespitosa
**Ehrharta calycina*
**Ehrharta longiflora*
**Eragrostis curvula*
**Hordeum marinum*
**Lagurus ovatus*
**Lolium* sp.
Spinifex hirsuta
Spinifex longifolius
**Stenotaphrum secundatum*

Cyperaceae 032
Isolepis nodosa
Lepidosperma gladiatum
Lepidosperma squamatum
Schoenus ?curvifolius
Schoenus grandiflorus

Restionaceae 039
Desmocladus fasciculatus
Desmocladus flexuosus
Hypolaena exsulca
Lyginia barbata

Juncaceae 052
Juncus kraussii

Dasypogonaceae 054C
Acanthocarpus preissii
Dasypogon bromeliifolius

Xanthorrhoeaceae 054D
Xanthorrhoea brunonis
Xanthorrhoea preissii

Phormiaceae 054E
Dianella revoluta

Anthericaceae 054F
Corynotheca micrantha
Dichopogon capillipes
Tricoryne elatior

Asphodelaceae 054G
**Asphodelus fistulosus*

Colchicaceae 054J
Burchardia umbellata
Haemodoraceae 055
Conostylis aculeata
Phlebocarya ciliata

Iridaceae 060
Patersonia occidentalis
**Romulea rosea*

Casuarinaceae 070
Allocasuarina fraseriana
Allocasuarina humilis

Proteaceae 090
Adenanthos meisneri
Banksia attenuata
Banksia grandis
Banksia ilicifolia
Dryandra sessilis
Hakea prostrata
Persoonia saccata
Persoonia longifolia
Petrophile linearis
Stirlingia latifolia
Synaphea sp.
Xylomelum occidentale

Santalaceae 092
Santalum acuminatum

Loranthaceae 097
Nuytsia floribunda

Polygonaceae 103
**Rumex* sp.

Chenopodiaceae 105
Halosarcia sp.
Rhagodia baccata subsp. *baccata*
Sarcocornia blackiana
Suaeda australis

Aizoaceae 110
**Tetragonia decumbens*

Ranunculaceae 119
Clematis linearifolia

Lauraceae 131
Cassytha flava
Cassytha racemosa
Cassytha sp.

Brassicaceae 138
**Cakile maritima*

Mimosaceae 163
Acacia cochlearis
Acacia cyclops
Acacia huegelii
Acacia pulchella var. *glaberrima*
Acacia rostellifera
Acacia saligna
Acacia semitrullata
Acacia stenoptera
Acacia willdenowiana

Papilionaceae 164
Bossiaea eriocarpa
Daviesia divaricata
Gompholobium confertum
Gompholobium tomentosum
Hardenbergia comptoniana
Hovea trisperma
Jacksonia furcellata
Jacksonia sp.
Jacksonia sternbergiana
Kennedia prostrata
**Lupinus cosentinii*
Nemcia capitata
**Trifolium sp.*

Geraniaceae 167
**Pelargonium capitatum*

Zygophyllaceae 173
Zygophyllum sp.

Rutaceae 175
Diplolaena dampieri

Euphorbiaceae 185
**Euphorbia australis*
**Euphorbia paralias*
**Euphorbia terracina*

Rhamnaceae 215
Spyridium globulosum

Sterculiaceae 223
Lasiopetalum membranaceum

Dilleniaceae 226
Hibbertia cuneiformis
Hibbertia hypericoides
Hibbertia sp.

Violaceae 243
Hybanthus floribundus

Myrtaceae 273
Agonis flexuosa
Calytrix flavescens
**Chamelaucium uncinatum*
Corymbia calophylla
Eucalyptus gomphocephala
Eucalyptus marginata
Kunzea ericifolia
Melaleuca huegelii
Melaleuca thymoides

Onagraceae 275
Oenothera mollissima

Apiaceae 281
**Foeniculum vulgare*
Platysace compressa

Epacridaceae 288
Astroloma pallidum
Conostephium pendulum
Leucopogon parviflorus
Leucopogon propinquus

Oleaceae 301
**Olea europaea*

Apocynaceae 304
Alyxia buxifolia

Lamiaceae 313
Hemiandra pungens

Solanaceae 315
Anthocercis littorea
**Solanum sodomeum*

Goodeniaceae 341
Dampiera linearis
Scaevola crassifolia

Stylidiaceae 343
Stylidium sp.

Asteraceae 345
**Arctotheca calendula*
Hyalosperma cotula
**Hypochaeris glabra*
Olearia axillaris
**Sonchus oleraceus*
**Ursinia anthemoides*

Example of an Air Quality Modelling (DISPMOD) Control and Emission File Used in this Assessment

Appendix E

Example of an Air Quality Modelling (DISPMOD) Control and Emission File Used in this Assessment

Control File

```
Kemerton power station 1080 MW CC with existing sources
  380000. 6320000.  500. 24 31 0.2833 -33.3 180.0   0.0   3.0  .083  .047  0.25
 01011995 31121995 0000 2400  3  1 77  1.9  2.3
  7 0.00 0100. 0200. 0246.  320. 0   5000.
  1  1  1  1  1  1  1  1  1
  1  2  3  4  5  6  7  8  9
  0        ! NUMBER OF STACKS THAT ARE NOT BEING USED
kem PS Stack1  40.0 4.00 386033 6329527 1.00  0. 500
kem PS Stack2  40.0 4.00 386033 6329595 1.00  0. 500
kem PS Stack3  40.0 4.00 386033 6329727 1.00  0. 500
Mil Ticl Heat  35.0 1.05 384167 6323850 1.00  0. 500
Mil Mainstack  66.0 0.60 383922 6323767 1.00  0. 500
Sim Charc Ret  47.0 1.50 383272 6323354 1.00  0. 500
Sim Baghouse   29.0 5.00 383193 6323688 1.00  0. 500
0
386535 6439110
386300 6436000
387600 6442600
387300 6433950
387750 6445800
381950 6429700
ipp3.dis

TITLE
(A)
XREF,YREF,GINT,NUMX,NUMY,DTSL,ALAT,CSTDIR,ZLSB,SGTHSB,SGPHSB,TIBPEN
(2F9.1,F6.1,2I3,F7.4,3F6.1,3F6.0)
IDS,IMS,IYS,IDF,IMF,IYF,IT1,IT2,IAV,IDATAV,IY1,CSIGON,CSIGOF
(2(1X,3I2),2I5,3I3,2F5.1)
**** NOTE - IAV     = MODEL TIME STEP IN MULTIPLES OF 10 MINUTES (EG. 3 = 30 MIN
                      TIMESTEP.
         - IDATAV = INPUT MET DATA AVERAGING TIME IN MULTIPLES OF 10 MINUTES
                      (EG. 3 = 30 MIN INPUT DATA)
**** NOTE - IAV CANNOT BE LESS THAN IDATAV AND IDATAV MUST BE GREATER THAN 0
NUMSCE,QMIN,ALEV1,ALEV2,ALEV3,ALEV4,I
(I3,F5.1,4F6.0,I2)
**** NOTE - POLPOT MODE IS NOW FOR MULTIPLE SOURCES WITH FIXED EMISSIONS.
READ IN THE NUMBER OF STACKS PER SOURCE GROUP
KSCE(I),I=1,NUMSCE
(22I3)
READ IN THE STACK NUMBERS IN THE ORDER OF USE (.IE SOURCE GROUPING)
(ISTNUM(I),I=1,ISTTOT
READ IN THE NUMBER OF STACKS NOT TO BE USED
NSNTUS
READ IN STACK INFORMATION DATA
C STKHGT - HEIGHT OF STACK
C STKDIA - DIAMETER OF STACK
C STKX   - LATITUDE OF STACK AMG COORDS
C STKY   - LONGITUDE OF STACK AMG COORDS
C TEMSL  - SLOPE OF THE TEMPERATURE LOSS EQUATION FOR STACK
C TEMIN  - INTERCEPT OF THE TEMPERATURE LOSS EQUATION FOR STACK
C TEMSL AND TEMIN ARE USED TO AMKE ALLOWANCE FOR THE TEMPERATURE LOSS OF
C          FLUE GASES IN THE STACK WHEN GAS TEMPERATURES ARE MEASURED AT
C          THE BASE OF THE STACK
C DCOAST - ARRAY DISTANCE (METRES) FROM THE COAST OF EACH SOURCE GROUP
C Q      - SOURCE STRENGTH (KG/S)
C STKVOL - SOURCE VOLUME (M**3/S) AT STACK TEMP (IE. GAS FLOW RATE)
C STKRHO - EMISSION DENSITY (KG/M**3) AT STACK TEMP
C IBUILD - BUILDING EFFECTS FOR THIS SOURCE (1=YES, 0=NO)
C HBSTK  - HEIGHT OF BUILDING
C WBSTK  - WIDTH OF BUILDING
STKHGT(K),STKDIA(K),STKX(K),STKY(K),DCOAST(K),Q(K),STKVOL(K),STKRHO(K),
IBUILD(K),HBSTK(K),WBSTK(K)
(14X,F5.1,F5.2,F7.0,F8.0,F5.2,F4.0,F6.0,3F8.0,I2,2F4.0)
*** NOTE- WITH BUILDING EFFECTS IT IS ASSUMED THAT THE LAST SOURCE IN THE
          SOURCE GROUP HAS THE BUILDING DIMENSIONS. THIS LAST SOURCE ALSO
          CONTAINS THE LOGICAL (IBUILD) WHICH DETERMINE WHETHER BUILDING
          EFFECTS ARE TO BE USED.
```

Emission File

Kemerton PS 1080 MW as NOx 3 source CC with existing sources

Name	Q	V	Rho	Nd	Nh	Int
kem PS Stack1	.0299	694.0	.424	0	0	0
kem PS Stack2	.0299	694.0	.424	0	0	0
kem PS Stack3	.0299	694.0	.424	0	0	0
Mil Ticl Heat	.0004	4.2	.610	0	0	0
Mil Mainstack	.0000	12.9	1.05	0	0	0
Sim Charc Ret	.0073	54.0	.561	0	0	0
Sim Baghouse	.0000	1.0	1.03	0	0	0

Sound Power Levels – Existing Pinjar Gas Turbine Station

Appendix F

Sound Power Levels – Existing Pinjar Gas Turbine Station

Name	Lw	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz
T9 Fans W1	97.2	67.1	70.5	77.6	90.1	86.1	83.3	73	63.3
T9 Fans W4	103.8	73.7	77	84.2	96.7	92.7	89.9	79.6	69.8
T9 Fans W3	104.2	74.1	77.5	84.6	97.1	93.1	90.3	80	70.3
T9 Fans W2	103.8	73.7	77	84.2	96.7	92.7	89.9	79.6	69.8
T9 W17	97.6	69.2	75.8	72.9	72.3	74.2	87	90.5	82.8
T9 W1	94.3	69.3	70	68.9	70.4	72.6	85.5	86.2	78
T9 W16	94.3	71.2	78.9	80.7	83.3	83.3	81.3	80.1	72.4
T9 W8	101.9	73.2	86.7	89.5	91.6	92.3	86.6	79.5	68.8
T9 W7	94.8	66.1	79.6	82.4	84.6	85.2	79.6	72.4	61.7
T9 W6	101.9	73.2	86.7	89.5	91.6	92.3	86.6	79.5	68.8
T9 W3	99.2	74	79.5	80.2	84.7	82.9	85	91.1	86.7
T9 W14	100.2	77.7	86.1	86	89.4	89.7	87.2	84.2	72.4
T9 W5	96.4	67.8	81.2	84.1	86.2	86.9	81.2	74	63.3
T9 W12	98.3	77.6	82.1	83.1	85.9	85.3	85.9	87.3	82.5
T9 W11	107.1	85.2	92.8	98.3	96.5	94.5	87.4	82	75
T9 W10	104.9	83	90.6	96.1	94.3	92.3	85.2	79.8	72.9
T9 W9	107.1	85.2	92.8	98.3	96.5	94.5	87.4	82	75
T9 Exhaust	113.8	93	99.1	101.2	105.5	102.7	93.1	67.6	57
T10 W12	98.4	69.8	83.2	86.1	88.2	88.8	83.2	76	65.3
T10 W5	96.3	75.2	82.6	82.4	85.9	85.4	82.3	80.1	74.4
T10 Fans W2	104.2	73.3	87.9	90.1	93.6	93.5	92.3	88.6	79.2
T10 Fans W1	103.8	72.9	87.5	89.7	93.2	93.1	91.9	88.1	78.8
T10 Fans W4	97.2	71.4	79.9	80.7	89	86.5	83.6	75.8	65.2
T10 Fans W3	103.8	76	84.8	87.2	94.9	93.8	91.3	81.8	71.4
T10 W14	99.3	74	79.5	80.2	84.7	82.9	85.1	91.1	86.7
T10 W3	100.3	68.3	79.9	87.5	89.4	87.5	90.6	84	74.7
T10 W11	106	88	88.6	95.3	96.9	93.7	89.5	82.7	73.8
T10 W10	104.8	86.8	87.4	94.1	95.7	92.5	88.3	81.5	72.6
T10 W9	106.1	82	92.7	96.9	96.2	92.5	87	80.8	72
T10 W16	94.3	69.3	70	68.9	70.4	72.6	85.5	86.2	78
T10 W17	97.5	76.9	83.2	84.8	87.8	84.2	83.8	82.9	73.5
T10 W1	94.3	71.3	79.9	79.7	83.2	83.5	81.5	79.2	75.2
T10 W8	101.2	73.6	82	84.3	91.5	92.2	88	81.9	70.3
T10 W7	94.8	69.2	80.8	81.5	85.1	84	77.7	79.4	58.2
T10 W6	101.2	73.6	82	84.3	91.5	92.2	88	81.9	70.3
T10 Exhaust	111.8	90.3	98.3	100.1	103.1	100.3	90.9	79.9	67.7
T11 W5	97.8	74.7	80	81.1	84.9	85.1	87.8	85.7	80.7
T11 W11	97.8	72.9	77.7	78.7	86.2	88.3	85.4	85.7	73.6
T11 W17	100.5	72.9	79.6	82.3	88.7	88.1	85.6	92.1	78.2
T11 W4	103.3	77.4	80.2	82.6	86.1	89.4	94.6	93.3	86.3
T11 W15	100.8	70.3	76.9	81	87.6	92.5	90.2	85.9	75.6
T11 W14	97	65.3	79.5	77.6	84.2	87.4	87.5	81.2	68.8
T11 W13	100.8	75.6	79.6	80.3	88.9	92.5	88.9	85.6	73.4
T11 W7	97.4	78	84.9	85.3	85.6	85.8	83.9	80.9	70.4
T11 W9	97.4	78	84.9	85.3	85.6	85.8	83.9	80.9	70.4
T11 W8	97.5	76.1	84.6	84.4	86.2	87.2	83.3	79.6	71
T11 W2	87.2	69.1	71.8	72.7	75.3	76.2	75.9	72	61.9
T11 W1	94.6	76.6	79.2	80.1	82.7	83.6	83.3	79.5	69.3
T11 W19	87.2	69.1	71.8	72.7	75.3	76.2	75.9	72	61.9
T11 Fans W4	100.5	75.8	85.6	87.1	89.3	88.4	88.3	85.8	83
T11 Fans W3	103.5	79.5	87.6	89.1	93.6	91.3	91.5	88	84
T11 Fans W2	102.5	77.8	87.6	89.1	91.3	90.4	90.3	87.8	85
T11 Fans W1	103.5	79.5	87.6	89.1	93.6	91.3	91.5	88	84
T11 Exhaust	93.6	77.2	79.1	81.1	82.3	82	80.4	76.7	67

Notes:
1. T9, T10 etc refers to turbine 9,10 etc.
2. W refers to wall or facade.
3. All data is in dB(A).
4. Frequency data refers to the middle 1/3 octave band within the octave band.
5. Standard Attenuation has been applied

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Summary of Preliminary Consultations

Appendix G

Table G-1 Summary of Issues Raised during Preliminary Consultations

Issue Raised	Comments	Relevant Section in Strategic Environmental Review
Fuel Supply and Renewable Energy Options		
Concerns relating to the gas constraints within the Dampier to Bunbury Natural Gas Pipeline.	All of the natural gas-fired power station development proposals have included the provision for the power station to run on liquid fuel. Should the existing gas supply constraints in the Dampier to Bunbury Natural Gas Pipeline not be resolved in time for the first stage of power procurement, then the power station would be run on liquid fuel until the natural gas supply issues are resolved.	5.4.1
What is the position of renewable energy in the power procurement process?	Renewable energy offers many opportunities for power generation and Western Power will continue to pursue options in this area. However none of the renewable options currently available are capable of meeting the scale of power generation requirements (initially 240MW followed by about 300MW). Therefore the SWIS Power Procurement Process has focussed on the conventional energy sources of natural gas, coal and liquid fuel.	3.2
Which is the preferred energy source option at the moment – coal or gas?	Both fuel sources have been considered to be suitable as energy sources options for the SWIS Power Procurement Process. However, given that the initial stage of Power Procurement is for peaking capacity, it is unlikely that coal-fired plant would be implemented in this stage. The second stage of Power Procurement is for base load plant, which offers opportunities for both coal-fired plant and gas-fired plant. The selection of the Preferred Bidder will be based upon a range of criteria related to the requirements of the *Electricity Corporation Act 1994*, namely the ability to supply electricity in a way that minimises Western Power's overall costs of delivering electricity to its customers whilst maintaining the safety and reliability of the SWIS.	2.1.2, 2.1.3, 3.1, 3.2, 3.3
Power Procurement Process		
Concerns about delays in the Power Procurement Process and the longer lead times required for base load plant.	Given the present time-frame, there will be sufficient time for a base load plant to be installed for the second stage of power procurement.	2.1.2
What is Western Power doing about demand management?	Western Power currently has two tariffs in place addressing demand management, namely Curtailable and Interruptible to address demand management.	
Site Selection Study		
Has the site selection study taken into account strategic land use planning and urban growth areas?	One of the criteria assessed in the site selection study was planning and land zoning. The site selection study was undertaken in 2000 and considered all information publicly available at the time.	3.4
Why do the power station development concepts vary across the sites?	The site selection study assessed each site in terms of the following criteria: ▪ Planning/land zoning; ▪ Availability of infrastructure and services; ▪ Land capability; ▪ Environmental factors; ▪ Socio-economic factors; and ▪ Sustainable development opportunities. From the site selection study, the capability of each site in terms of the above factors was determined. This has allowed the development concept to be tailored to reflect the constraints and opportunities associated with each site.	3.4

Issue Raised	Comments	Relevant Section in Strategic Environmental Review
Environmental Approval Process		
Is there a program for public information days?	During the review period, Western Power will conduct a community consultation program to ensure that local issues and concerns are addressed and to facilitate public participation in the management of potential environmental and social impacts of the project. Briefings will continue with stakeholders and informal public information sessions will be held in the local communities during the public review period for the SER. These open days will take the form of manned public displays and will be supplemented by media releases and public communications. All activities will be well advertised and planned to ensure maximum public profile and access.	10.2
Environmental Issues		
Concerns about multiple source air emissions and how cumulative impacts will be assessed for the Kemerton Power Station.	The air quality assessment of the Kemerton Power Station has considered other sources within the area and included the significant ones within the modelling assessment. The modelling assessment has shown that cumulative impacts would not be an issue at Kemerton.	8.4.1
What are the water supply limitations and sources at Kemerton?	Water would be supplied to the power station through arrangement with the Water Corporation. The Water Corporation is actively investigating strategies for water supply to the area, including Wellington Dam (abstracted from the Collie River), groundwater, future Brunswick River Dam and surplus from the Harvey Dam.	4.5.3, 5.4.4
What are the plans for wastewater disposal at Kemerton?	Wastewater from an open cycle power station or an air-cooled combined cycle plant would be disposed of on-site through evaporation in specially constructed lined ponds. If a water-cooled combined cycle power station was installed, then the wastewater from the power station would be disposed of through ocean disposal. The preferred option would be through a centralised wastewater treatment facility at the Kemerton Industrial Park as proposed by the MPR – Office of Major Projects. However given the uncertain timing of the proposed power station and of the centralised wastewater treatment facility, this proposal has considered the option of wastewater disposal through the existing Collie Power Station wastewater disposal ocean outfall. A pipeline would be run from the power station to the outfall. This outfall may require an extension of the existing diffuser to handle the increased volumes, a scenario that would also be required if the Collie Power Station expanded.	4.5.4, 5.4.5, 7.3.3, 8.3.1
Other Issues		
What additional infrastructure would be required, i.e. transmissions lines and gas pipelines.	The requirements for additional infrastructure vary across the sites. Gas laterals would be required to be constructed to the sites at Bunbury, Kemerton and Kwinana. The Preferred Bidder would be required to negotiate gas requirements with the gas supplier, who would be responsible for any the construction and operation of additional gas infrastructure. The Strategic Environmental Review documents have focussed on transmission network requirements for each of the sites for the initial stages of Power Procurement. At each of the sites, the existing transmission networks are sufficient for the initial installed capacity, however transmission lines may be required to be run from the Kemerton and Kwinana sites to the nearest substations (depending on the power station site). Transmission network capacity requirements beyond the initial stages of Power Procurement would be determined by Western Power's network operations and are beyond the scope of this assessment. If any new transmission lines are required, they would be constructed by Western Power under a separate environmental approvals process.	3.4.8, 5.4

ENTERED ON GIS

Name: Kemberton Power Station and Wastewater Pipeline Route
Date: 27/04/2006
Capture Author: Thomas Leong

Comments:
Polygon
Created to match documented study area with high level of accuracy

Accuracy Levels:
- High = Document contained visual and or described spatial references easily copied, resulting in little or no polygon boundary errors
- Acceptable = Document contained visual references with complex boundaries, resulting in possible polygon boundary errors
- Low = Document contained little or no visual references, resulting in polygon boundary errors

Attributes
Report Info – Captured without problems
Custodial/Contact – Captured without problems
Content – Captured without problems

Biota Environmental Sciences

Kemerton Power Station and Wastewater Pipeline Route

Coastal Peppermint *Agonis flexuosa* woodland

Sinclair Knight Merz

Preliminary Flora, Vegetation and Fauna Survey

March 2002

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Kemerton Power Station Site and Cooling Water Pipeline Route Survey

Contents

1.0 Introduction

Western Power Corporation is currently in the process of carrying out evaluation and preliminary planning studies for potential sites for a new power station within the south western portion of the state as part of a power procurement process. As part of this process, Sinclair Knight Merz Pty Ltd engaged Biota Environmental Sciences Pty Ltd to carry out a preliminary biological survey of a potential site within the Kemerton Industrial Park, and an associated wastewater pipeline route, situated to the north-east of the Port of Bunbury (Figure 1.1).

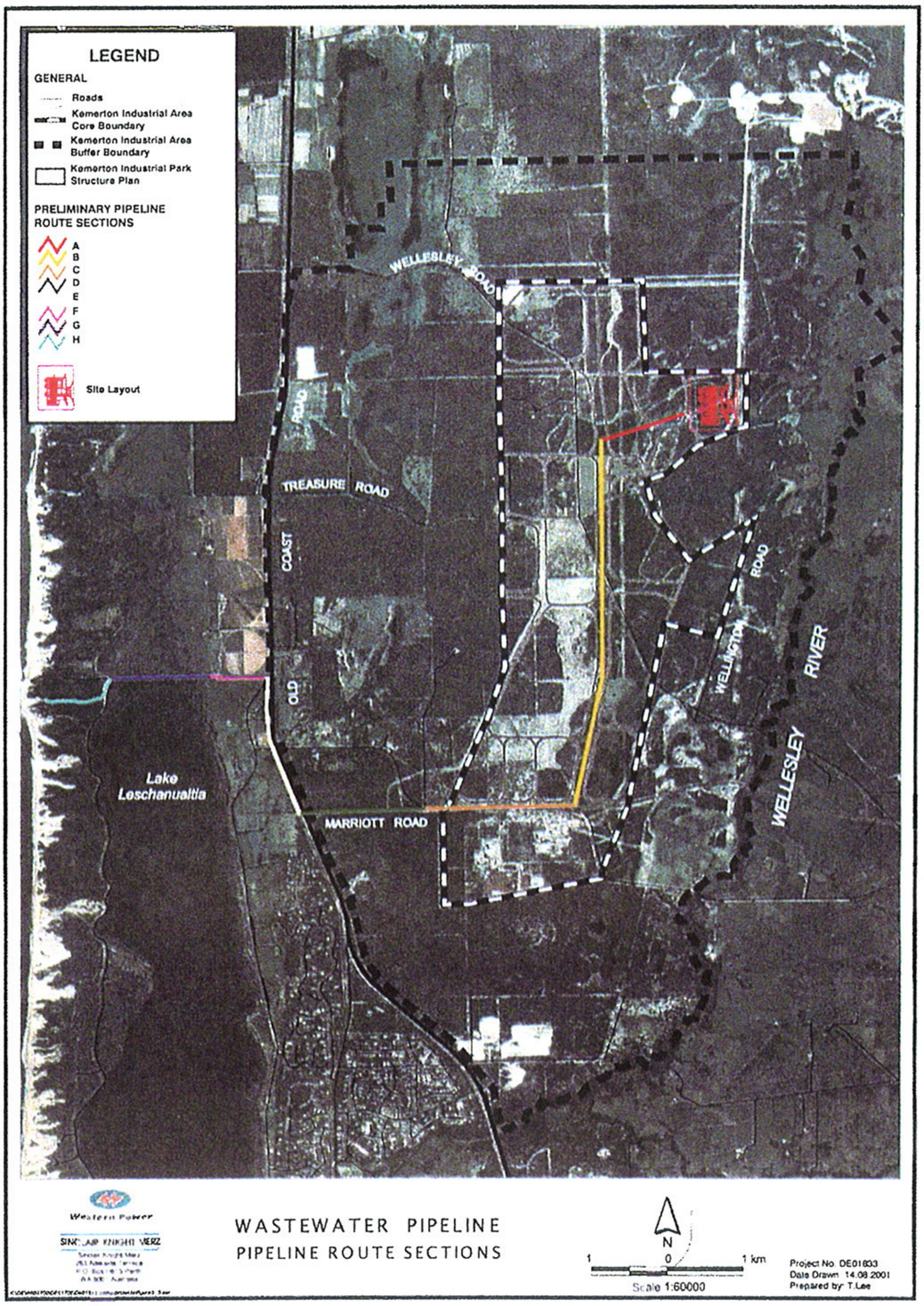

Figure 1.1: Study area locality map.

The principal aims of this survey were to:

- assess vegetation condition within the power station site and along the proposed wastewater pipeline route;
- assess fauna habitats and potential rare species occurrence within both components of the study area; and
- identify populations of significant flora species along the proposed wastewater pipeline route.

2.0 Methodology

2.1 Field Survey

A flora and vegetation survey of the study area was carried out from the 27th February to the 1st of March 2002. Different levels of survey were undertaken in the two components of the study area.

2.1.1 Kemerton Power Station Site

The proposed Kemerton Power Station site is largely situated on a timber plantation. The portion primarily addressed in this report consists of an area of natural bushland at the southern extremity of the site. The assessment consisted of:

- vegetation condition assessment;
- vegetation community description; and
- a limited threatened flora search.

2.1.2 Proposed Wastewater Pipeline Route

The proposed wastewater pipeline route survey covered the length of the pipeline from the proposed ocean outfall to the existing boundary of the Kemerton Industrial Park on Marriott Road.

The survey consisted of:

- vegetation mapping;
- vegetation condition assessment;
- detailed flora sites (10 by 10 m quadrats); and
- opportunistic and site based flora collections.

Vegetation mapping was done from 1:10,000 scale aerial photography, using both data from detailed flora sites and ground truthing.

The following parameters were recorded at detailed flora sites:

- vegetation type (a broad description based on dominant species and strata);
- location (recorded using a hand-held Global Positioning System (GPS) to an accuracy within 5 m in AGD84 datum);
- landform;
- substrate and general soil type;
- disturbance (evidence of vehicle tracks, fires etc); and

- flora species present within four main strata (trees, shrubs, sedges and herbs) and their estimated cover (to the nearest percent where possible, otherwise a range was used).

Vegetation condition assessment was based on the following classification scale:

Condition	Weed Invasion	Vegetation Strata
Pristine	No weeds	Strata intact, diversity intact
Excellent	Scattered, non-aggressive weeds; <5% cover	Strata intact, diversity intact
Good	Sparse to open weeds; <20% cover.	Shrub or herb layer may be impacted, diversity somewhat diminished
Poor	Weeds widespread; 20%+ cover	One or more strata severely impacted or absent. Diversity obviously diminished.
Degraded	Very weedy or bare soil; 80%+ cover	Only scattered individuals of original flora may remain.

Flora species were identified in the field where identities were certain, or specimens were collected for later identification using the resources of the Western Australian Herbarium. A search was conducted of the CALM database of potential threatened flora species previously known from the locality. The survey botanists familiarised themselves with voucher specimens of these flora held at the WA Herbarium prior to undertaking the survey. General traverses of the study area were carried out for these species in addition to the quadrat sampling. Any other flora species not recorded from the quadrat sampling were also collected as part of these traverses. Flora taxonomy used in this report is based on the most recent version of Max (the WA Herbarium flora nomenclature database). Digital photographs were also taken of all flora sites.

2.2 Limitations of this Assessment

This report has been prepared on the basis of desktop information, consultation and a brief field assessment of the power station site. Fauna trapping work was not undertaken, with the potential occurrence of significant fauna species based on habitat types and existing database records only.

The floristic sampling along the proposed wastewater pipeline route was not undertaken during a suitable season and is not considered an adequate documentation of the flora. Many shrubs were indeterminable to species level or had some level of doubt associated with their identity. This was due to the lack of reproductive material on the specimens at this time of year. Perhaps most significantly, the survey timing was also not ideal for late winter - spring flowering ephemerals. Specifically:

- Annual and herbaceous perennial species such as orchids, *Drosera* and *Stylidium* were almost absent. A number of Declared Rare (DRF) and Priority orchids, a *Stylidium* and a *Drosera* are known from the immediate area. There are 18 records of Priority Flora populations known from an area bounded by coordinates 33° 08' - 33 ° 14' S and 115 ° 40' - 115 ° 45E. Seven of these 12 species (58%) are herbaceous perennials that would have been dormant, and therefore unable to be detected, at the time of the survey; and
- Annual species account for a large proportion of the species composition in Bassendean vegetation communities. This compromises baseline data and makes evaluation of conservation significance in comparison to other remnant vegetation difficult. This includes assessment of the representation of weed species.

Given the above, this report should not be regarded as an exhaustive account of the flora and fauna of the study area. It is suitable to provide a preliminary appraisal and needs to be supplemented by suitable seasonal work (see Section 5.0). It is possible that some species or communities of potential significance have not been detected or other ecological constraints and management issues may be present that remain unidentified.

3.0 Vegetation Associations and Flora

3.1 Kemerton Power Station Site

The majority of the proposed power station site is covered by a Blue Gum plantation (Plate 3.1). A small section at the south consisted of Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banksia attenuata* Woodland in Good to Poor condition (Plate 3.2). The understorey has been historically impacted by either grazing or soil disturbance, with only a proportion of remnant shrub species. The dominant understorey species were Zamia Palm *Macrozamia riedlei*, *Hibbertia hypericoides,* Blue Boy *Stirlingia latifolia* and Grass Tree *Xanthorrhoea brunonis.* Herbaceous species were not adequately assessed, as they were dormant at the time of the survey.

Weeds were widespread at between 10 and 60% cover, however they were generally non-aggressive, annual herbs and grasses that are common throughout the sandy areas of the south-west of Western Australia (Hussey, et al., 1997). The most common species were Flatweed **Hypochaeris glabra,* Blowfly Grass **Briza maxima,* Wild Oats **Avena* sp. and **Ursinia anthemoides*. Historical disturbance factors, such as grazing and clearing, typically account for the dominance of these weed species.

According to the initial survey of the broader industrial park (Muir et al, 1999), this type of vegetation is equivalent to 'Jarrah Woodland' with 'additional presence of Marri'.

Plate 3.1: Blue Gum *Eucalyptus globulus* plantation (northern Kemerton Power Station site).

Plate 3.2: Jarrah *Eucalyptus marginata*, Marri *Corymbia calophylla* and *Banksia attenuata* Woodland over scattered shrubs and annual weeds (remnant vegetation at south end, proposed Power Station site).

3.2 Proposed Wastewater Pipeline Route

The results of the field survey along the proposed wastewater pipeline corridor are presented below within the five Sections from the western boundary of the Kemerton Industrial Park core area through to the coast (Sections D to H). Vegetation types along the route are mapped in Figure 3.1.

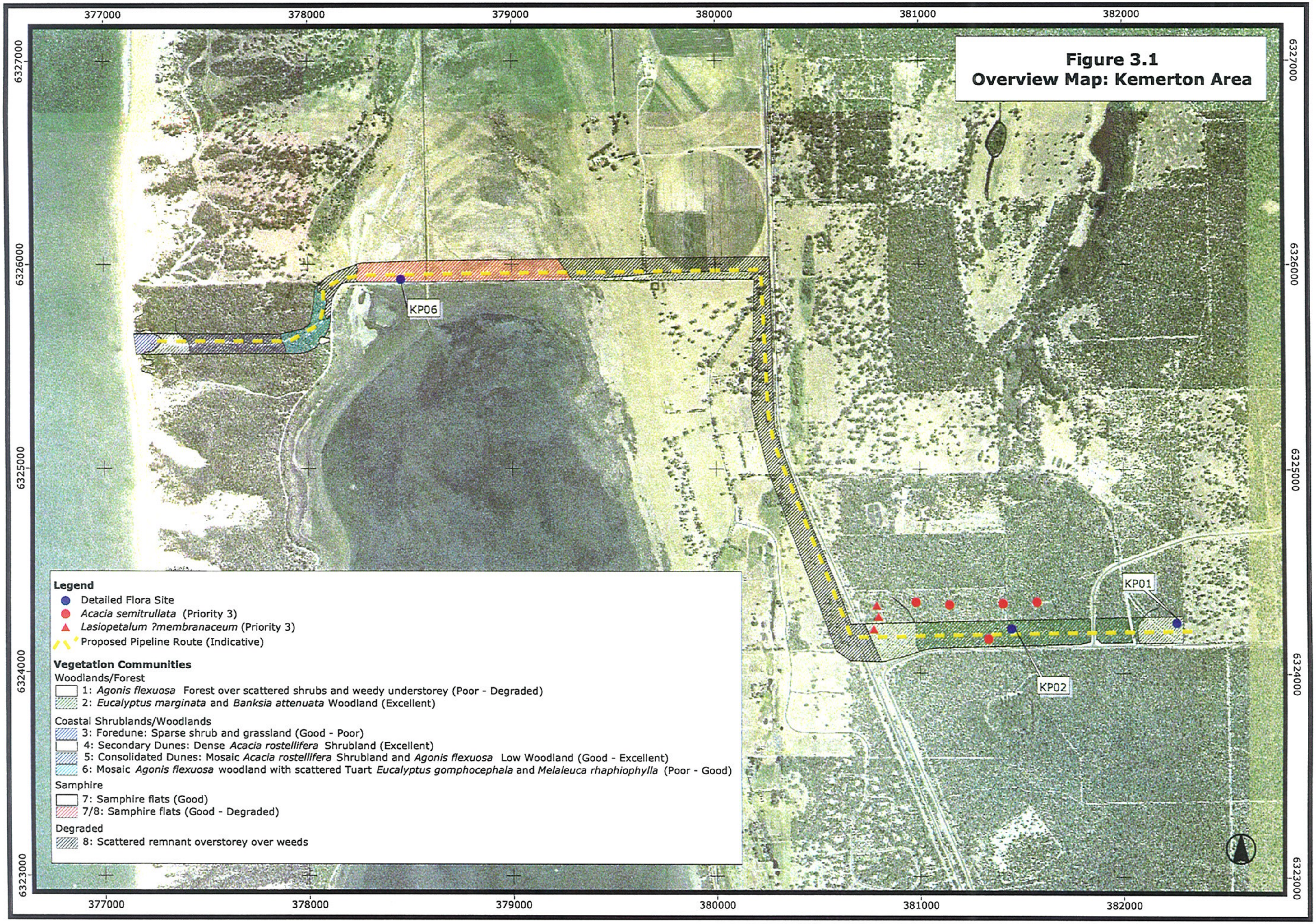
Figure 3.1
Overview Map: Kemerton Area
377000
378000
379000
380000
381000
382000
6327000
6326000
6325000
6324000
6323000
KP06
KP01
KP02
Legend
Detailed Flora Site
Acacia semitrullata (Priority 3)
Lasiopetalum ?membranaceum (Priority 3)
Proposed Pipeline Route (Indicative)
Vegetation Communities
Woodlands/Forest
1: Agonis flexuosa Forest over scattered shrubs and weedy understorey (Poor - Degraded)
2: Eucalyptus marginata and Banksia attenuata Woodland (Excellent)
Coastal Shrublands/Woodlands
3: Foredune: Sparse shrub and grassland (Good - Poor)
4: Secondary Dunes: Dense Acacia rostellifera Shrubland (Excellent)
5: Consolidated Dunes: Mosaic Acacia rostellifera Shrubland and Agonis flexuosa Low Woodland (Good - Excellent)
6: Mosaic Agonis flexuosa woodland with scattered Tuart Eucalyptus gomphocephala and Melaleuca rhaphiophylla (Poor - Good)
Samphire
7: Samphire flats (Good)
7/8: Samphire flats (Good - Degraded)
Degraded
8: Scattered remnant overstorey over weeds

Eight vegetation communities were identified along the proposed wastewater pipeline route:

Woodlands/Forest

1. *Agonis flexuosa* Forest over scattered shrubs and weedy understorey.
2. *Eucalyptus marginata* and *Banksia attenuata* Woodland.

Coastal Shrublands/Woodlands

3. Foredune: Sparse shrub and grassland.
4. Secondary Dunes: Dense *Acacia rostellifera* Shrubland.
5. Consolidated Dunes: Mosaic *Acacia rostellifera* Shrubland and *Agonis flexuosa* Low Woodland.
6. Mosaic *Agonis flexuosa* woodland with scattered Tuart *Eucalyptus gomphocephala* and *Melaleuca rhaphiophylla.*

Samphire

7. Samphire flats.

Degraded

8. Scattered remnant overstorey over weeds.

According to the initial Kemerton Industrial Park survey (Muir et al, 1999), *Agonis flexuosa* Forest over scattered shrubs and weedy understorey (Community 1) is probably a heavily logged manifestation of *Eucalyptus marginata* and *Banksia attenuata* Woodland (Community 2). In Muir's survey, both of these associations were classified as 'Jarrah Woodland'. Communities 3 to 7 were not represented within the Kemerton Industrial Park according to Muir et al. (1999), as they are associated with more coastal areas.

Section D - Marriott Road

This section was mainly Jarrah *Eucalyptus marginata* over *Banksia attenuata* woodland (Community 2.) in Excellent condition, with occasional tall Marri *Corymbia calophylla* (Site KP02 ; Plate 3.3).

There was a sparse small tree stratum of *Banksia grandis* and Woody Pear *Xylomelum occidentale.* The greatest recorded diversity at the time of the survey was in the lower shrub (less than 1m), herbaceous perennial and sedge strata, which were dominated by *Hibbertia hypericoides, Melaleuca thymoides*, Blue Boy *Stirlingia latifolia*, *Dasypogon bromeliifolius* and Zamia palm *Macrozamia riedlei.*

Stylidium, *Drosera*, Orchidaceae species and other seasonal herbaceous perennials and annuals expected from this community type were absent at the time of the survey, significantly limiting the adequacy of the work. Given this, at least a third of the floral species diversity of this community may have been dormant. Much of this area had been burnt within the last two years.

At the west end near the highway and at the east end (boundary with Kemerton Industrial Park) there was an area of Peppermint *Agonis flexuosus* over degraded, weedy understorey (Community 1; Plate 3.4). The sparse lower perennial strata (<1m) mainly consisted of *Hibbertia hypericoides, Xanthorrhoea brunonis* and *Macrozamia riedlei* with occasional mixed shrubs and sedges. Weeds accounted for up to 90% of the ground cover and were dead during the survey. According to the initial survey of the Kemerton Industrial Park (Muir et al, 1999), this vegetation community is a disturbed version of Community 2 (Jarrah Woodland).

Plate 3.3: Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland Section D Marriott Road (Site KP02).

Plate 3.4: Peppermint *Agonis flexuosa* over degraded understorey. Eastern end Section D (Site KP01)

Section E – Pasture adjacent to Old Coast Road

Section E of the proposed wastewater pipeline route runs to the west of Old Coast Road through degraded pasture, which contain no features of any conservation significance (Community 8; Plate 3.5).

Section F – Buffalo Road East

Section F of the proposed wastewater pipeline route runs to the north of Buffalo Road, again through degraded pasture (Community 8).

Section G – Buffalo Road West

This portion of the proposed wastewater pipeline route crosses the northern margin of the Leschenault Estuary, on the north side of Buffalo Road. The vegetation was a mosaic of degraded weedy roadside and pasture, with Samphire shrubland in relatively good condition. The Samphire occurred on both sides of the road where it crosses the estuary, on sandy clay flats (Community 7; Plate 3.6).

Plate 3.5: Pasture with remnant Tuart *Eucalyptus gomphocephala* over weeds. Section E.

Plate 3.6: Weed infested roadside vegetation above samphire flats (left) Section G (Site KP06).

Section H – Buffalo Road – Coast

The proposed wastewater pipeline route in this section runs adjacent to an existing infrastructure corridor. The surrounding vegetation consisted of sparse shrubland and *Spinifex longifolius* and *S. hirsutus* along the coast (Community 3; Plate 3.7). The secondary dunes support dense stands of *Acacia rostellifera* (Community 4; Plate 3.8). Further inland *Agonis flexuosa* forms increasingly dense stands of tall shrubs to low trees (Community 5; Plate 3.9).

Plate 3.7: Sparse coastal shrubland of *Spinifex longifolius* and *S. hirsutus* (Section H).

Plate 3.8: Low coastal scrub on foredune (first dune east of ocean). Section H.

Plate 3.9: Coastal thicket of *Acacia rostellifera.* Section H.

In dune swales towards the Lechenault Estuary, Tuart *Eucalyptus gomphocephala* was sometimes present in association with the *Agonis flexuosa* association. Where this section of the proposed wastewater pipeline route meets Buffalo Road, there was a small area of *Melaleuca rhaphiophylla* on water gaining soils.

The condition of the vegetation in Section H was variable. The foredune along the coast of Western Australia is typically vegetated to a large degree by introduced species. This area is naturally volatile with large areas of bare sand and dune blow-outs as common features. This may be exacerbated by off-road vehicle use and clearing of vegetation. There is already a large cleared area where the proposed wastewater pipeline route exits to the ocean and the use of this disturbed area should be maximised during detailed design.

The secondary and consolidated dunes were generally in Good condition. However, the existing track and approximately 5m either side was generally in Poor condition as a result of existing and ongoing disturbance processes. Areas towards the east (mosaic *Agonis flexuosa, Eucalyptus gomphocephala* and *Melaleuca rhaphiophylla*) had more weeds and degraded understorey than *Acacia rostellifera* shrublands closer to the coast.

3.3 Threatened Flora Species

In Western Australia, all native flora species are protected under the *Wildlife Conservation Act 1950-1979,* making it an offence to remove or harm native flora species without approval. In addition to this basic level of statutory protection, a number of plant species are assigned an additional level of conservation significance based on the fact that there is a limited number of known populations, some of which may be under threat (see Table 3.1). Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of four Priority flora categories.

Table 3.1: Categories of conservation significance for flora species (Atkins, 2001).

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.
Declared Rare Flora - Presumed Extinct. 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.
Priority 1 - Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations which are under threat.
Priority 2 - 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 threat.
Priority 3 - Poorly Known Taxa. Taxa which are known from several populations, at least some of which are not believed to be under threat.
Priority 4 - Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

No DRF flora were recorded during the field survey, but two Priority Flora species were recorded from Section D Marriott Road of the proposed wastewater pipeline route. Both of these species are Priority 3 Flora (taxa which are known from several populations, at least some of which are not believed to be under threat).

- ***Acacia semitrullata* Priority 3**

This species is a small upright shrub with yellow, ovoid flowers typical of Acacias (Plate 3.10). It was scattered throughout the Jarrah *Eucalyptus marginata* and *Banksia attenuata* woodland along Section D (Marriott Road). The vegetation in this area was in excellent condition with all strata intact and only scattered annual weeds.

It has previously been recorded from Yallingup, Donnybrook, Harvey, Yarloop and Collie (Atkins, 2001). There were 29 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations these represented. Many of the populations were recorded from degraded road verges. At least one population is reserved within the Whicher Range Nature Reserve.

- ***Lasiopetalum ?membranaceum* Priority 3**

This species is a low rounded to sprawling shrub (Plate 3.11). It was located at the western end of Section D (Marriott Road) near Old Coast Road, in Marri *Corymbia calophylla* and Peppermint *Agonis flexuosus* Woodland. This vegetation is in Good to Poor condition with some of the native shrub strata absent and a ground layer of annual weeds. It has previously been recorded from Yalgorup, Capel, Dwellingup, Yandup, Australind, Dawesville and Yanchep. There were 12 specimens of this species in the Western Australian Herbarium, however location details were insufficient to determine how many populations these represented. At least two populations are protected in the Yalgorup and Yanchep National Parks.

Plate 3.10: *Acacia semitrullata* (Priority 3), Section D: Marriott Road.

Plate 3.11: *Lasiopetalum ?membranaceum* (Priority 3), West end Section D.

In addition, searches were commissioned of the Department of Conservation and Land Management's Threatened (Declared Rare) Flora, Western Australian Herbarium Specimen and Declared Rare and Priority Flora List databases. A summary of the known local occurrence, status and distribution of these species in the locality of the study area is provided in Table 3.2 below.

Table 3.2: Other Declared Rare and Priority Flora species known from the locality of the study area.

Species	Conservation Status	No. of Populations in locality
Diuris micrantha	DRF	4
Drakea elastica	DRF	2
Drakea micrantha	DRF	2
Verticordia attenuata	Priority 3	1
Caladenia speciosa	Priority 4	1
Drosera marchantii	Priority 4	2
Pultenaea skinneri	Priority 4	1

The CALM DRF and Priority list also notes *Acacia flagelliformis* (Priority 4), *Aponogeton hexatepalus* (Priority 4), *Jacksonia sparsa* ms (Priority 4) and *Stylidium longitubum* (Priority 3) as known records from the locality of the study area.

4.0 Fauna and Fauna Habitats

4.1 Fauna Habitats

- **Proposed Power Station Site**

The fauna habitats present in the proposed power station area comprises one primary unit; *Eucalyptus marginata*, *Corymbia calophylla* and *Banksia attenuata* woodland with open understorey on pale grey sands (see Section 3.1; Plate 3.2).

- **Proposed Wastewater Pipeline Route**

Several habitat units are crossed by the proposed wastewater pipeline route, including:

- Peppermint *Agonis flexuosa* / Jarrah *Eucalyptus marginata* woodland over weeds on Bassendean sands;
- Peppermint *Agonis flexuosa* low woodland on coastal sands;
- *Eucalyptus marginata* and *Banksia attenuata* woodland;
- Samphire flats north of the Leschenault Estuary; and
- Coastal *Acacia* shrubland and spinifex on dunes.

These habitats are likely to support a range of native and introduced vertebrate fauna, typical of the coastal south west of Western Australia (Christensen, et al 1985; How et al 1987). Without conducting any fauna survey work there is little value in attempting to compile a listing of all species of mammal, birds and herpetofauna that may be present in the area. Given the strategic level of this assessment, habitat and distribution based assessment of potential occurrence has only been undertaken for threatened fauna taxa (see Section 4.2).

4.2 Potential Threatened Fauna Species

In Western Australia, all native fauna species are protected under the *Wildlife Conservation Act* 1950-1979. Fauna species that are considered rare, threatened with extinction or have high conservation value are specially protected under the Act. In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA). Classification of rare and endangered fauna under the *Wildlife Conservation (Specially Protected Fauna) Notice* 1998 recognises four distinct schedules of taxa (see Table 4.1).

Table 4.1: Schedules of conservation significance categories for fauna species.

1	Schedule 1 taxa are fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection;
2	Schedule 2 taxa are fauna which are presumed to be extinct and are declared to be fauna in need of special protection;
3	Schedule 3 taxa are birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction which are declared to be fauna in need of special protection; and
4	Schedule 4 taxa are fauna that are in need of special protection, otherwise than for the reasons mentioned in paragraphs (1), (2) and (3).

In addition to the above classification, CALM also classify fauna under four different Priority codes:

- Priority One - Taxa with few, poorly known populations on threatened lands.

Taxa which are known from few specimens or sight records from one or a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- Priority Two - Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.

Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- Priority Three - Taxa with several, poorly known populations, some on conservation lands.

Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

- Priority Four - Taxa in need of monitoring.

Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

A search was commissioned of the Department of Conservation and Land Management's Threatened Fauna database. Six species of Schedule listed fauna and eight species of Priority fauna were identified as potentially occurring in the study area (see Appendix 2).

- **Schedule 1 (Fauna which is Rare or likely to become Extinct)**

***Dasyurus geoffroii* – Chuditch**
This species occurs in a wide spectrum of habitats and occupies a considerable home range. The stronghold for this species tends to be the more open jarrah forests and woodlands south-west of the project area, but there is a recent record from north of Australind (Appendix 2). This species potentially occurs in both the woodland habitats in the eastern portion of the proposed wastewater pipeline route and the woodlands of the proposed power station site.

***Pseudocheirus occidentalis* - Western Ringtail Possum.**
The preferred habitat of this species comprises coastal peppermint woodlands. The abundance and distribution of the Ringtail *Pseudocheirus occidentalis* has considerably reduced since European occupation (How et al., 1987; Burbidge and de Tores, 1998). It is now restricted to coastal and near coastal peppermint associations from the Australind - Eaton area to Waychinicup NP (Burbidge and de Tores, 1998). How et al (1987) suggest that "Nowhere in the study area (coastal region from Busselton to Albany) are dense populations of either possum species (*Trichosurus vulpecula* and *P. occidentalis*) known to occur". The denser woodland habitats crossed by the proposed wastewater pipeline route where *Agonis flexuosa* formed a dominant component are likely to provide a suitable habitat for this species. A translocated population exists in nearby Yalgorup National Park (Appendix 2).

***Calyptorhynchus baudinii* - Baudin's Cockatoo (Schedule 1)**
This species is most common in the far south west of Western Australia where it breeds. Breeding records come from the southern forests north to Collie and east to near Kojonup.

Baudin's Black Cockatoo typically forms vagrant flocks and utilises the taller more open, Jarrah/Marri woodlands where it feeds predominantly on marri seeds but also takes wood boring grubs (Blakers et al., 1984). Saunders and Ingram (1994) claimed that it is possible that the Baudin's Cockatoo has not declined over the past 50 years. However, like the Forest Red-tailed Black Cockatoo, forestry operations have the potential to affect this species by reducing the availability of nest sites. In contrast, Storr (1991) and Johnstone and Storr (1998) claim that this cockatoo has declined over the past 50 years, but do not speculate as to a possible cause. It occurs only in low numbers in the locality 2and is possibly an occasional visitor to the study area.

***Calyptorhynchus latirostris* - Carnaby's Cockatoo (Schedule 1)**
This species inhabits the south-west of Western Australia with most breeding occurring between the 350mm and 700mm rainfall isohyets (Garnett, 1992). The preferred habitat is typically woodland where it preferentially feeds on plants of the family Proteaceae. Winter flocks also inhabit heaths. The species is considered to be scarce and patchily distributed in the deep south-west (Johnstone and Storr, 1998).

- **Schedule 4 (Fauna otherwise in need of special protection)**

***Falco peregrinus* - Peregrine Falcon (Schedule 4)**
The Peregrine Falcon is widespread across all of Australia, but only occurs at very low densities and with a patchy distribution. It is known to favour open woodlands amongst other habitats (Schodde and Tidemann, 1990) and may be an occasional visitor to the woodlands and woodland margins of the study area. *F. peregrinus* is a Schedule 4 species, indicating that while it is considered to require special protection, it is not regarded as being in danger of extinction.

***Morelia spilota imbricata* – Carpet Python (Schedule 4)**
This species is relatively widespread within the southwest but typically not at high density within this range. It is known to occur in Yalgorup National Park (Appendix 2), and may occur in the habitats of the power station study area and the planned pipeline route.

- **Priority Fauna**

***Phascogale tapoatafa* - Brush-tailed Phascogale (Priority 3)**
The Brush-tailed Phascogale is a largely arboreal, carnivorous dasyurid that occurs in a variety of regions in Australia with open, dry sclerophyll forests on ridges and reliable rainfall patterns (Cuttle, 1996). The south-west populations of *Phascogale tapoatafa* are listed by CALM as Priority 3 and this species has recently been recorded in similar habitats near Bunbury (Appendix 2).

***Isoodon obesulus fusciventer* - Southern Brown Bandicoot (Priority 4)**
This species is locally common in dense swamps in the south-west of the state and has recently been downgraded from Schedule 1 to a Priority 4 species. A translocated population of this species occurs in the Leschenault Conservation Park (Appendix 2). The species typically requires dense understorey vegetation to persist and may occur in the denser woodland vegetation occurring along Marriott Road.

***Macropus irma* - Western Brush Wallaby (Priority 4)**
This species is common in open northern Jarrah forest associations, but was not recorded on any of seven south coastal communities surveys detailed by Christensen et al. (1995) and is regarded by these authors as typically absent from high rainfall areas with dense closed understoreys. It is a possibly present in the coastal woodlands crossed by the proposed wastewater pipeline route.

***Calyptorhynchus banksii naso* - Forest Red-tailed Black Cockatoo (Priority 3)**
A Priority 3 species, the Forest Red-tailed Black Cockatoo has seriously declined in numbers since European settlement (Saunders & Ingram, 1994).

Causes included clear-felling and 80 year cut rotation forestry practices, which can significantly reduce the number of large tree hollows (Saunders & Ingram, 1994). Storr (1991) reports that the species was formerly common and is now uncommon and patchily distributed. The species utilises Jarrah – Marri woodlands (Appendix 2) and is likely to occur in such habitats along both the proposed wastewater pipeline route and within the proposed power station site.

Falsistrellus mackenziei **- Western False Pipstrelle (Priority 4)**
This bat species occurs in the high rainfall regions of the south west including the Swan Coastal Plain (Appendix 2). It is known to occur nearby around Lake Clifton and may utilise the open woodlands of the study area.

Thinornis rubricolis rubricolis **– Hooded Plover (Priority 4)**
This migratory bird species has been recorded from the margins and shallows of Leschenault Inlet. It may occasionally stray into samphire habitats crossed by the proposed wastewater pipeline route but is unlikely to be reliant on these areas for core habitat requirements.

Numenius madagascariensis **- Eastern Curlew (Priority 4)**
Similar to the Hooded Plover, this species has also been recorded from the shallows and margins of the Leschenault Inlet (Appendix 2).

5.0 Discussion and Recommendations

5.1 Potential Flora and Fauna Constraints

Based on this study, a number of areas of potential conservation value occur within the study area. These could comprise potential development constraints and should be taken into consideration as detailed planning and design progress for the power station and the proposed wastewater pipeline. Note that the assessment provided here is preliminary only, primarily due to the seasonal timing of the work (see Section 2.2).

The power station site appears to be largely unconstrained with respect to flora and fauna based on the available information and the work carried out as part of this report. The Blue Gum timber plantation area has little or no conservation value and the use of this area should be maximised. The vegetation in the southern portion of the site represents remnant native vegetation which should be avoided as far as possible in the development of the power station design. More detailed seasonal work should, however, be completed on the site prior to finalising the design of the power station should it proceed in this location.

The currently identified features of potential conservation value along the proposed wastewater pipeline route occur mainly in Section D along Marriott Road and include:

- The relatively intact areas of vegetation in Section D (Marriott Road) and Section H (Coastal);
- The presence of two species of Priority 3 Flora in Section D (*Acacia semitrullata* and *Lasiopetalum ?membranaceum*); and
- The high potential for currently unidentified populations of annual (spring-flowering) DRF and Priority Flora in Section D.

The relatively intact habitats of Sections D and H also have the greatest potential to support fauna species of conservation significance, particularly the Western Ringtail Possum *Psuedocheirus occidentalis* (Schedule 1) and the Southern Brown Bandicoot *Isoodon obesulus* (Priority 4). These areas should be avoided as far as possible in the final route selection. It appears from field inspection that there are several areas within the proposed wastewater pipeline corridor where disturbed ground or existing infrastructure corridors could be utilised for the installation of the proposed wastewater pipeline should it be constructed at this site.

Note that the portion of the proposed wastewater pipeline route between the boundary of the Kemerton 'core area' and the proposed power station site was not assessed and potentially contains other features of conservation significance. We understand that current project planning will include provision for more detailed assessment of the ecological features of this area by others.

5.2 Potential Impacts

Potential impacts at this stage of project development are identified in principal only, given the current design stage of the project. Impacts on flora and vegetation that may arise as a result of the proposed works include:

- Clearing of relatively intact vegetation at Section D and Section H;
- Clearing of some remnant habitat in the southern portion of the power station site;
- Dune destabilization near the coast (Section H);

- Fragmentation of vegetation at Section D by creating another clearance corridor;
- Disturbance or removal of priority flora populations; and
- Spread of weeds and/or soil-borne pathogens into relatively intact vegetation.

With respect to fauna, the impacts are more difficult to identify, given the lack of definitive data on the species present and the extent of their reliance on the habitats of the site. The principal impacts are likely to reflect those related to the vegetation for most potential species of higher conservation significance. That is, removal of the relatively intact habitats along Sections D and H is likely to have negative impacts on local populations of the Western Ringtail Possum and the Southern Brown Bandicoot, should these species be present. These species are the most reliant on intact shrub strata and dense Peppermint woodlands. Fragmentation of these areas by a new corridor would also potentially increase feral predator access to the more intact habitat units. A more detailed assessment of the fauna species occurring in the area would be needed if any more comprehensive analysis of potential impacts is to be undertaken.

The extent to which any of the above impacts are realised will be dependent on the final design and wastewater pipeline route selected, the findings of additional survey work and the adequacy of environmental management measures during and post construction.

5.3 Recommendations

The following recommendations are made based on the findings of this report:

1. The proposed wastewater pipeline should be placed along the existing Marriott Road reserve in the cleared verge area (Section D) and within the existing disturbed ground of the remaining infrastructure corridor (Section H). This would significantly reduce the requirement to clear native vegetation and remove relatively intact native fauna habitat.

2. If other constraints are such that it is impossible to realign the proposed wastewater pipeline route in Section D and Section H, a more detailed seasonal survey is required to:
   - assess annual and herbaceous perennial species diversity;
   - clarify the identity and extent of *Lasiopetalum ?membranaceum*, which was sterile at the time of the survey (Section D);
   - acquire adequate survey data for 10 by 10m quadrats for species richness comparisons and to enable a more complete conservation significance evaluation;
   - adequately survey for potential DRF and Priority flora that may have been dormant at the time of the initial survey; and
   - carry out more detailed fauna survey work to assess the occurrence of threatened fauna.

3. A seasonal survey including detailed flora sites should also be carried out in the area of natural bushland at the proposed Kemerton Power Station.

4. Dependent on the outcomes of the above work, and the nature of the final design if it is progressed at this site, CALM should be consulted as to management requirements for specially protected species or any statutory approvals processes that may be required.

6.0 References

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Flora Species Recorded from the Project Area

Appendix 1

Biota

Zamiaceae 16A
Macrozamia riedlei

Poaceae 031
Austrostipa sp.
**Avena* sp.
**Briza maxima*
**Bromus* sp.
**Cynodon dactylon*
Danthonia caespitosa
**Ehrharta calycina*
**Ehrharta longiflora*
**Eragrostis curvula*
**Hordeum marinum*
**Lagurus ovatus*
**Lolium* sp.
Spinifex hirsuta
Spinifex longifolius
**Stenotaphrum secundatum*

Cyperaceae 032
Isolepis nodosa
Lepidosperma gladiatum
Lepidosperma squamatum
Schoenus ?curvifolius
Schoenus grandiflorus

Restionaceae 039
Desmocladus fasciculatus
Desmocladus flexuosus
Hypolaena exsulca
Lyginia barbata

Juncaceae 052
Juncus kraussii

Dasypogonaceae 054C
Acanthocarpus preissii
Dasypogon bromeliifolius

Xanthorrhoeaceae 054D
Xanthorrhoea brunonis
Xanthorrhoea preissii

Phormiaceae 054E
Dianella revoluta

Anthericaceae 054F
Corynotheca micrantha
Dichopogon capillipes
Tricoryne elatior

Asphodelaceae 054G
**Asphodelus fistulosus*

Colchicaceae 054J
Burchardia umbellata
Haemodoraceae 055
Conostylis aculeata
Phlebocarya ciliata

Iridaceae 060
Patersonia occidentalis
**Romulea rosea*

Casuarinaceae 070
Allocasuarina fraseriana
Allocasuarina humilis

Proteaceae 090
Adenanthos meisneri
Banksia attenuata
Banksia grandis
Banksia ilicifolia
Dryandra sessilis
Hakea prostrata
Persoonia saccata
Persoonia longifolia
Petrophile linearis
Stirlingia latifolia
Synaphea sp.
Xylomelum occidentale

Santalaceae 092
Santalum acuminatum

Loranthaceae 097
Nuytsia floribunda

Polygonaceae 103
**Rumex* sp.

Chenopodiaceae 105
Halosarcia sp.
Rhagodia baccata subsp. *baccata*
Sarcocornia blackiana
Suaeda australis

Aizoaceae 110
**Tetragonia decumbens*

Ranunculaceae 119
Clematis linearifolia

Lauraceae 131
Cassytha flava
Cassytha racemosa
Cassytha sp.

Brassicaceae 138
**Cakile maritima*

Mimosaceae 163
Acacia cochlearis
Acacia cyclops
Acacia huegelii
Acacia pulchella var. *glaberrima*
Acacia rostellifera
Acacia saligna
Acacia semitrullata
Acacia stenoptera
Acacia willdenowiana

Papilionaceae 164
Bossiaea eriocarpa
Daviesia divaricata
Gompholobium confertum
Gompholobium tomentosum
Hardenbergia comptoniana
Hovea trisperma
Jacksonia furcellata
Jacksonia sp.
Jacksonia sternbergiana
Kennedia prostrata
**Lupinus cosentinii*
Nemcia capitata
**Trifolium sp.*

Geraniaceae 167
**Pelargonium capitatum*

Zygophyllaceae 173
Zygophyllum sp.

Rutaceae 175
Diplolaena dampieri

Euphorbiaceae 185
**Euphorbia australis*
**Euphorbia paralias*
**Euphorbia terracina*

Rhamnaceae 215
Spyridium globulosum

Sterculiaceae 223
Lasiopetalum membranaceum

Dilleniaceae 226
Hibbertia cuneiformis
Hibbertia hypericoides
Hibbertia sp.

Violaceae 243
Hybanthus floribundus

Myrtaceae 273
Agonis flexuosa
Calytrix flavescens
**Chamelaucium uncinatum*
Corymbia calophylla
Eucalyptus gomphocephala
Eucalyptus marginata
Kunzea ericifolia
Melaleuca huegelii
Melaleuca thymoides

Onagraceae 275
Oenothera mollissima

Apiaceae 281
**Foeniculum vulgare*
Platysace compressa

Epacridaceae 288
Astroloma pallidum
Conostephium pendulum
Leucopogon parviflorus
Leucopogon propinquus

Oleaceae 301
**Olea europaea*

Apocynaceae 304
Alyxia buxifolia

Lamiaceae 313
Hemiandra pungens

Solanaceae 315
Anthocercis littorea
**Solanum sodomeum*

Goodeniaceae 341
Dampiera linearis
Scaevola crassifolia

Stylidiaceae 343
Stylidium sp.

Asteraceae 345
**Arctotheca calendula*
Hyalosperma cotula
**Hypochaeris glabra*
Olearia axillaris
**Sonchus oleraceus*
**Ursinia anthemoides*

Results of CALM
Fauna Database Search

Appendix 2

BIOTA

Your Ref:
Our Ref: 2001F001096V01
Enquires: Peter Orell
Phone: (08) 9334 0454
Fax: (08) 9334 0278
Email: petero@calm.wa.gov.au

DEPARTMENT OF
Conservation
AND LAND MANAGEMENT
Conserving the nature of WA

Ms Kelli McCreery
Biota Environmental Sciences
2/183 Scarborough Beach Rd
MT HAWTHORN WA6016

Dear Ms McCreery

REQUEST FOR THREATENED FAUNA INFORMATION

I refer to your request of 6 March for information on threatened fauna occurring in the Kemerton Industrial Area.

A search was undertaken for this area of the Department's Threatened Fauna database, which includes species which are declared as *'Rare or likely to become extinct* (Schedule 1)', *'Birds protected under an international agreement* (Schedule 3)', and *'Other specially protected fauna* (Schedule 4)'. Attached are print outs from these databases where records were found.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the sixth point that refers to the requirement to undertake field investigations for the accurate determination of threatened fauna occurrence at a site. The information supplied should be regarded as an indication only of the threatened fauna that may be present.

An invoice for $110.00 (includes GST), being the set charge for the supply of this information, will be forwarded.

It would be appreciated if any populations of threatened fauna encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss threatened fauna management, please contact my Senior Zoologist, Dr Peter Mawson on 08 93340421.

Yours sincerely

....

for Keiran McNamara
ACTING EXECUTIVE DIRECTOR

8 March, 2002

The search of the database indicated that the following threatened and priority fauna occur in the area in question.

<u>Schedule 1 (Fauna which is Rare or likely to become Extinct)</u>

Chuditch (*Dasyurus geoffroii*) This species is highly mobile and occupies large home ranges in a range of habitats including woodland It has recently been recorded in the northern area of Australind.

Western Rintail Possum (*Pseudocheirus occidentalis*) A population of this species has been established in Leschenault Conservation Park (Leschenault Peninsula) through translocation. Vagrants may occur in the Kemerton area.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) This species moves around in flocks to feeding areas through the Swan Coastal Plain but breeding occurs mainly in the eastern forests and wheatbelt.

Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) This species occurs in low numbers in this part of the Swan Coastal Plain.

<u>Schedule 4 (Fauna which is Otherwise Specially Protected)</u>

Peregrine Falcon (*Falco peregrinus*) This species is an occasional visitor to areas of open woodland and along margins with farmland.

Carpet Python (*Morelia spilota imbricata*) This species may occur in areas of native vegetation along the coast from Australind to Yalgorup National Park.

<u>Priority Taxa</u>

Quenda (*Isoodon obesulus fusciventer*) **P4** This species is moderately common in parts of the coastal plain where dense understorey vegetation occurs in woodland and around wetland areas. The species has been translocated to Leschenault Conservation Park and may occur in other surrounding areas where there is suitable vegetation.

Brush-tailed Phascogale (*Phascogale tapoatafa*) **P3** This species has recently been recorded on the outskirts of Bunbury. It occurs in forest and woodland where suitable tree hollows are available and may occur in the area in question.

Western Brush Wallaby (*Macropus irma*) **P4** This species occurs in low numbers in areas of coastal forest and woodland supporting a dense shrub layer, and may occur in the vicinity of the Kemerton Industrial Area.

Western False Pipistrelle (*Falsistrellus mackenziei*) **P4** This species of bat occurs in the higher rainfall areas of the southwest including the Swan Coastal Plain. It roosts in small colonies in tree hollows and forages in the cathedral-like spaces between trees. It has been recorded near Lake Clifton and may occur in the area in question.

Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) **P3** This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the south-west and is occasionally observed on the coastal plain near Bunbury. Requires tree hollows to nest and breed and is totally dependent on jarrah-marri forest.

Hooded Plover (*Thinornis rubricolis rubricolis*) **P4** This species has been recorded along the margins and shallows of Leschenault Inlet.

Eastern Curlew (*Numenius madagascariensis*) **P4** This species is a migratory visitor and has been observed along the margins of Leschenault Inlet.

Black-stripe Minnow (*Galaxiella nigrostriata*) **P3** This species typically occurs in shallow isolated pools and has been recorded in the seasonal wetlands near the Kemerton Silica Sands Mine.