



# **Strategic Environmental Advice on the Dawesville to Binningup Area**

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**Advice of the Environmental Protection Authority to  
the Minister for Environment under Section 16(e) of the  
*Environmental Protection Act 1986***



**Report and recommendations  
of the Environmental Protection Authority**

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**Environmental Protection Authority  
Perth, Western Australia**

**Report 1359  
May 2010**

## Strategic Advice Timelines

<b>Date</b>	<b>Progress stages</b>
<b>4 May 2009</b>	<b>Release of Environmental Protection Bulletin No.4 Strategic Advice – Dawesville to Binningup</b>
<b>8 June 2009</b>	<b>Close of Call for Information</b>
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## Executive Summary

This report provides the Environmental Protection Authority's (EPA) advice to the Minister for Environment under section 16(e) of the *Environmental Protection Act 1986* on the significant environmental values of the Dawesville to Binningup area. It applies the state of current knowledge and scientific data about these values to identify areas of conservation significance and areas that may have potential for development and land use compatible with the environmental values of the area.

In May 2009 the EPA released Environmental Protection Bulletin No.4 *Strategic Advice – Dawesville to Binningup*. The Bulletin advised a strategic approach was required that could take into account the environmental and planning issues of the area.

The Dawesville to Binningup study area covers an area of approximately 286 square kilometres. Tims Thicket Road located approximately 13km south of Mandurah is the northern boundary of the study area which extends south to Buffalo Road, east to Old Coast Road and west to the coast.

The study area has important international, national and regional environmental values. The Yalgorup lakes as part of the Peel/Yalgorup System are recognised under the Ramsar Convention as wetlands of international importance. The area has also been identified as having geoheritage features of international significance, ecological communities, flora and fauna species of national significance (listed under the *Environment Protection and Biodiversity Conservation Act 1999*) and regionally significant vegetation, flora and fauna (*Wildlife Conservation Act 1956*), significant stands of *Eucalyptus gomphocephala* (Tuart) and significant coastal and landscape values.

An area that could be considered further for its development potential is land located south of Lake Preston and to the east of Binningup, near the Old Coast Road. This area appears to be less environmentally constrained than land between the Yalgorup lakes and the coast or on the eastern side of the Yalgorup lakes.

The internationally recognised Yalgorup lakes and other significant environmental values found together in the study area make it an extremely important area for conservation. These values should be protected by increasing and consolidating the area of the Yalgorup National Park through the acquisition of private land enclaves west of the lakes and lands adjacent to the lakes and/or those that contain internationally, nationally and regionally significant environmental values.

Subdivision and development near the Yalgorup lakes is highly likely to impact the ecological character and integrity of the lake ecosystems. The current decline of the Lake Clifton thrombolite community demonstrates how subdivision and development in the lakes catchment can have serious adverse consequences. The EPA considers the risk of impacts occurring from additional residential and agricultural development to the lakes and the significant vegetation, flora and fauna unacceptable.

## Recommendations

The EPA advises that:-

**The study area has natural values that are unique and significant at the global scale. The Ramsar listed Yalgorup lakes, migratory waterbirds, the Lake Clifton thrombolites and other geoheritage features are all internationally significant. Their existence together makes the area a special part of Western Australia that must be protected and preserved.**

Therefore the EPA recommends -

- 1. Existing cleared land south of Lake Preston and to the east of Binningup, near Old Coast Road is unlikely to be environmentally constrained, and may be examined further for its development potential.**

This area appears to have significantly less environmental values and constraints than the land west and east of the Yalgorup lakes. Maintaining the existing ecological linkage between Lake Preston and the Leschenault Peninsula is important. Proponents will be required to address any significant environmental issues by undertaking investigations of values at a local scale and within a regional context.

- 2. There is a presumption against further subdivision and residential development between the western side of the Yalgorup lakes system and the coast.**

Any development on the western side of the Yalgorup lakes system and the coast is highly constrained due to the significance of the special environmental values of the Yalgorup lakes system, and the necessity to maintain the complex hydrological functions which support this important ecosystem.

The EPA's presumption against development is based on the current regional scale information.

The EPA may review its position based on the outcome of future detailed environmental investigations for particular proposals.

- 3. Development on the eastern side of the Yalgorup lakes system is highly constrained.**

This is due to the significance of the Yalgorup lakes system, the Yalgorup National Park and the necessity to maintain the complex hydrological functions which support this important ecosystem.

The EPA's view is based on regional scale information and the EPA may review its position based on the outcome of future detailed environmental investigations for particular proposals.

4. **The Yalgorup National Park should be:**
  - a. **extended and consolidated, by incorporating private vegetated enclaves west of the Yalgorup lakes and other adjacent reserved lands; and**
  - b. **amended to significantly extend the vegetation buffer, particularly around the wetland areas of Lake Clifton and Lake Preston, including the eastern side.**

All areas of significant vegetation, flora or fauna should be included in the Yalgorup National Park or placed into conservation reserves, where they can be managed and protected. Resources to enable effective management should be provided.

5. **Current land management practices adjacent to Lake Clifton which are causing reductions in either groundwater quality or quantity should be rectified to prevent any further decline of the internationally significant Lake Clifton thrombolites.**

The existing management controls and practices are not adequate to maintain water quality and quantity and an urgent management response is needed now to further define and address the impacts occurring from existing development.

6. **All existing vegetation on the eastern side of Lake Clifton must be retained, and where degraded, rehabilitated.**
7. **Additional east/west roads which would intersect the Yalgorup National Park, or proposed extensions to the Park, should not be built.**
8. **Any essential infrastructure, including roads within the study area, should utilise existing cleared areas and be sited to avoid any further habitat fragmentation.**
9. **The existing road, servicing properties west of Lake Preston, should remain a low standard road, and be realigned well away from the lake and its fringing vegetation.**
10. **The Coastal and Lakelands Planning Strategy should be reviewed. This Strategy and other land use planning initiatives in the study area should be guided by this report's advice and recommendations.**
11. **The Department of Water should establish a comprehensive and targeted monitoring program for key indicators of ground and surface water quality and quantity around the Yalgorup lakes system, to detect trends and impacts from land use activities in the catchment.**
12. **A comprehensive groundwater management program should be developed as a priority to ensure environmentally sustainable allocations are established and not exceeded.**

The Department of Water should commence the preparation and implementation of the South West Coastal Allocation Plan.



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# **1. Background**

The coastal region between Mandurah and Bunbury is under increasing pressure for more intensive land use and development. The EPA recognised the need for strategic environmental advice after noting an increasing number of current and proposed amendments to Town Planning Schemes, subdivision proposals and structure planning in the area.

In May 2009 the EPA released Environmental Protection Bulletin No.4: *Strategic Advice – Dawesville to Binningup*. The Bulletin advised that a strategic approach was required that could take into account the environmental and planning issues of the area. A review to clarify the environmental values of the area and the state of current knowledge and scientific data about these values would be undertaken to develop the strategic advice. The information was considered necessary to identify the natural values of the area, areas of conservation significance and areas that may have potential for development and land use compatible with the environmental values.

The EPA indicated that its advice would consider the results of studies being undertaken or coordinated by the Department of Environment and Conservation (DEC) on flora, fauna, hydrology, geoheritage and coastal landforms. It would also consider previous studies, planning and policy documents. Bulletin No.4 called for people to submit scientific or other environmental information relevant to the study area. A number of submissions were received from residents, landowners, environmental consultants and local conservation groups providing a variety of information ranging from fauna sightings to land development interests. Advice was also sought from the Department of Water, Department of Mines and Petroleum, Department for Planning, Western Power, Water Corporation and Department of Agriculture.

The Dawesville to Binningup study area covered by this advice is located in the south west of Western Australia on the Swan Coastal Plain. The northern boundary of Tims Thicket Road is located approximately 13km south of the Mandurah townsite and 80 kilometres (km) south of Perth CBD. The Old Coast Road forms the eastern boundary except for a small parcel of vegetated land in the north between Old Coast Road and the Harvey Estuary. The southern boundary is at Buffalo Road and the coast is the western boundary (Figure 1). It is an extensive area that covers 286 square kilometers (km<sup>2</sup>).

## **2. International Significance of the Area**

The Dawesville to Binningup Study area has important environmental values that are recognised at the global scale.

The ten lakes of the Yalgorup lakes system, which form part of the Peel/Yalgorup system, are one of nine wetland areas in WA recognised under the Ramsar Convention as wetlands of international importance (Figure 2). In addition to important waterbird habitat, the lakes all have different limnological characteristics and contain unique benthic microbial communities.

The most notable of the microbial communities is the thrombolite (microbialite) community of Lake Clifton, which was listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in January 2010. Microbialites are one of the oldest life forms on Earth and are now restricted to only a few places in the world. Lake Clifton contains the largest known example of a living non-marine microbialite reef in the southern hemisphere. Additional information on the Yalgorup lakes is provided in Appendix 1.

More than 100 waterbird species have been recorded at the Yalgorup lakes and 24 of these are listed under the Japan-Australia; China-Australia; and Republic of Korea-Australia migratory bird agreements. As a signatory to these agreements, Australia has a responsibility to protect and conserve important habitats. All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as matters of National Environmental Significance under the EPBC Act

The study area also has internationally significant geoheritage features. “Geoheritage” as defined previously by the EPA (EPA Bulletin 942) is:

A concept which encompasses the diversity of minerals, rocks and fossils, and the features that indicate their origin through time, and includes landforms and other geomorphic features that illustrate the effects of present, and past exposure to climate and earth forces.

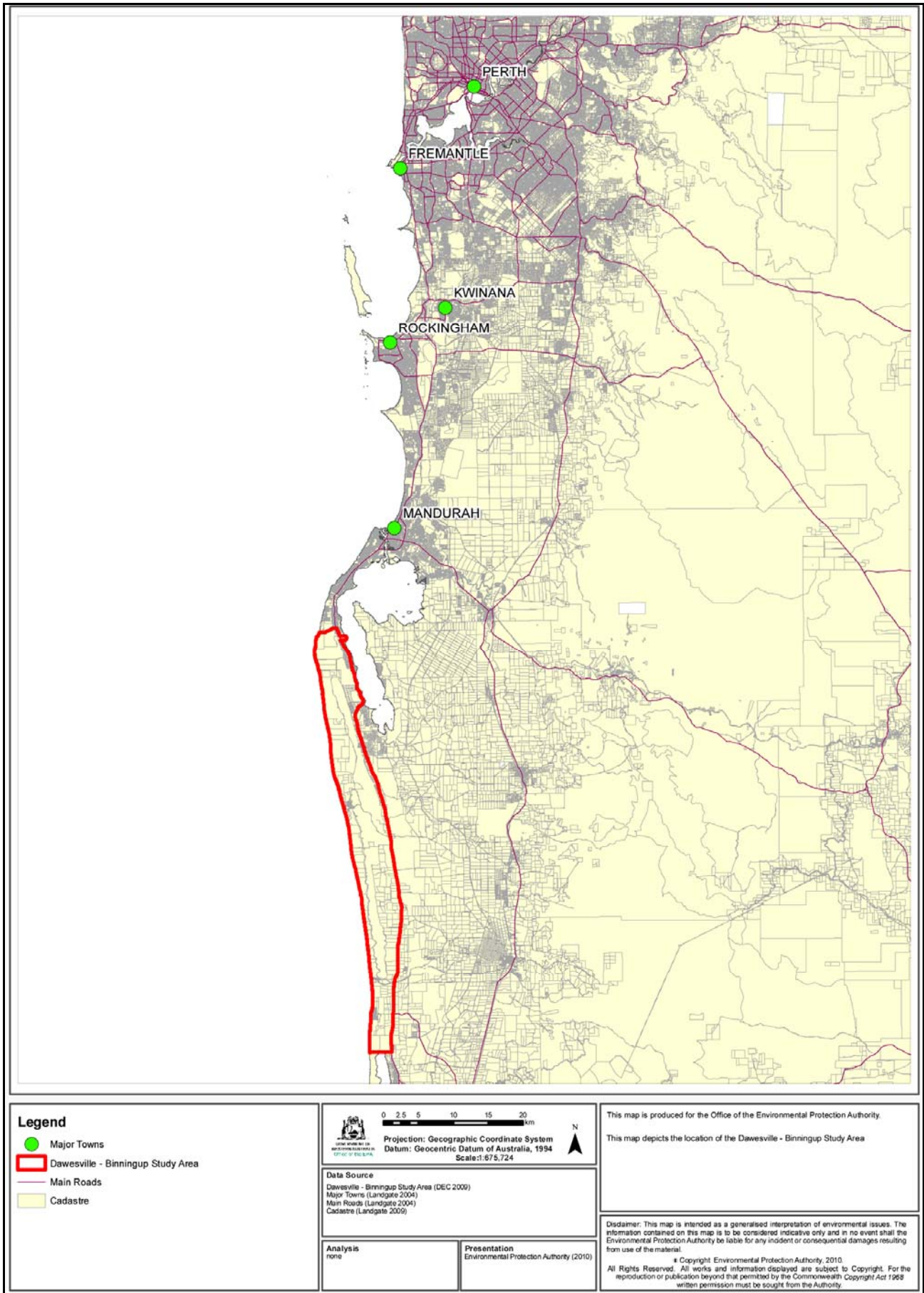
The report by V & C Semeniuk Research Group (2009) presents a detailed description of the quaternary geology and landforms of the study area and an analysis of the region’s characteristics against criteria for assessment of geoheritage. A summary of, and the full report, is provided in Appendix 1 and the attached CD.

Assessment of the key geoheritage features in the study area has concluded that the Yalgorup Plain in the study area is internationally significant for a range of geological features that are interrelated. The Pleistocene stratigraphy, landforms and history; the Holocene barrier dune; and the record of a rising sea in a bathymetrically complex coast together with the stromatolites/thrombolites are all internationally important.

It is clear that the study area has natural values that are unique and significant at the global scale. The Ramsar listed Yalgorup lakes, migratory waterbirds, the Lake Clifton thrombolites and other geoheritage features are all internationally significant. Their existence together makes the area a special part of Western Australia that must be appropriately protected and preserved.

### **3. National and State/Regional Significant Environmental Values**

In addition to the internationally significant Yalgorup lakes, other wetlands protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (EPP Lakes) and Conservation category wetlands (CCWs) as identified on the DEC’s *Geomorphic Wetlands Swan Coastal Plain* dataset are found in the study area. The EPA considers wetlands listed under the EPP Lakes policy and CCWs as critical environmental assets that must be protected.



**Figure 1: Dawesville – Binningup Locality Map and Study Area**



Figure 2: Ramsar, Lakes EPP and CCW Wetland

Vegetation and flora found in the study area are significant at the national, state and regional level. It is extensive and diverse in that it supports plant communities ranging from coastal heath to forest and sedgeland fringing the Yalgorup lakes. This diversity is attributed to the distinctive geological and hydrological features of the area.

Ecological communities (naturally occurring groups of plants and animals) and individual plant and animal species whose survival is threatened may be protected under the EPBC Act. One Threatened Ecologically Community (Sedgeland on Holocene dune swales), listed as Endangered under the EPBC Act is found in the study area.

Threatened plant and animal species can also be protected under the State's *Wildlife Conservation Act 1950* (WC Act). Protected under the WC Act and found within the study area are Three Declared Rare Flora (DRF) and 13 Priority species, one of which is not found outside the study area.

Ecological communities, although not protected under the WC Act, may be listed as threatened on a Ministerially endorsed list. Two Threatened Ecologically Communities (TECs) are found in the area. The EPA considers TECs, DRF and Priority species critical environmental assets that should be protected. Additionally, DEC has listed four communities recognised from the area as Priority Ecological Communities (PECs).

The vegetation and flora of the study area is also regionally significant based on EPA criteria (EPA 2006), representing high biodiversity at the genetic, species and community level. A summary of the vegetation and flora values of the study area is provided in Appendix 1 and a copy of the technical report is on the attached CD.

The study area supports extensive tracts of Tuart dominated forest and woodlands. The presence of healthy stands of Tuart is significant as the species has been impacted by factors that have not yet been fully described, commonly called Tuart decline. The EPA has recognised the threat to Tuarts and the need to protect the species through a range of measures, but principally and most effectively, through reservation.

The Yalgorup lakes and other associated wetlands are the most regionally significant wetland sites for waterbirds in Western Australia with over one hundred species of waterbirds (including shore birds) having been recorded in the area. The lakes, wetlands and vegetation also provide habitat for nationally and regionally significant fauna, including fauna that have reduced distributions on the Swan Coastal Plain.

Fauna protected under the EPBC Act and the WC Act are found in the study area and include the Western Brush Wallaby, Quenda, Western False Pipistrelle, Carpet Python and the Perth Lined Lerista. Carnaby's Cockatoo is not only a common seasonal visitor but also breeds in the area. Forest Red-tailed and Baudin's Cockatoo also utilise the area. Limited surveys for invertebrates have been undertaken, however, the Graceful Sun Moth, listed as Endangered under the EPBC Act, has been recorded in several locations throughout the study area.

It is clear that vegetation and species of flora and fauna of significant value to Western Australia and Australia are found within the study area. Their identification contributes to the EPA's view that the areas environmental values must be protected.

#### **4. Protection of the Yalgorup Lakes**

Review of the regional scale hydrological information shows that the hydrology of the study area is extremely complex. A summary of the area's hydrology and geology is provided in Appendix 1 and the technical reports are included in the attached CD.

In brief, the Yalgorup lakes are groundwater sinks. They receive water from the underlying aquifer which contains fresher groundwater resting on saline groundwater. As shown in Figure 3, the flow of groundwater to the lakes occurs from both the east and west. Groundwater flow varies in response to local variations in the geology and exhibits seasonal variation.

The hydrology of the area is undoubtedly the key element responsible for the area's lakes, vegetation and fauna which together function as an ecosystem. Subdivision and/or developments which change existing land uses and management systems such as the intensification of agricultural practices that require increased groundwater extraction and the application of fertilisers or excavation for mining may adversely impact the lake ecosystems through changes to groundwater quality and quantity.

The grazing of livestock in fringing wetland vegetation and other areas of native vegetation not only impacts native vegetation through its direct removal, trampling and the spread of weeds but also water quality of the lakes through the addition of nutrients via surface and groundwater flows. The impact of grazing by domestic stock upon the shoreline of Lake Clifton is described as a threat by the Threatened Species Scientific Committee (2010a). The clearing of native vegetation through grazing is considered to be "clearing" under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004. Exemptions to the Regulations may not apply as the Yalgorup lakes area is designated an Environmentally Sensitive Area.

Increased groundwater extraction may reduce the amount of fresh groundwater seeping into the lakes. Changes to the regional and local groundwater regime would potentially impact each of the Yalgorup lakes individual biochemical processes and composition, causing changes to the benthic flora and ultimately the waterbirds reliant on it. Fringing vegetation, other groundwater dependent vegetation and terrestrial fauna would subsequently be affected.

The EPA is particularly concerned that the Lake Clifton living microbialites are in serious decline and that the likely cause of the decline is a reduction of fresh groundwater to the lake caused by the existing land development and groundwater use east of Lake Clifton. It appears that the finalised criteria (contained in the EPA's Bulletin 864) for land use planning on private land within the catchment of Lake Clifton to protect water quality and the hydrological balance of the lake, are not sufficient to prevent decline. Potential development west of Lake Clifton may amplify impacts to Lake Clifton by altering the quality and quantity of groundwater flow from the west.

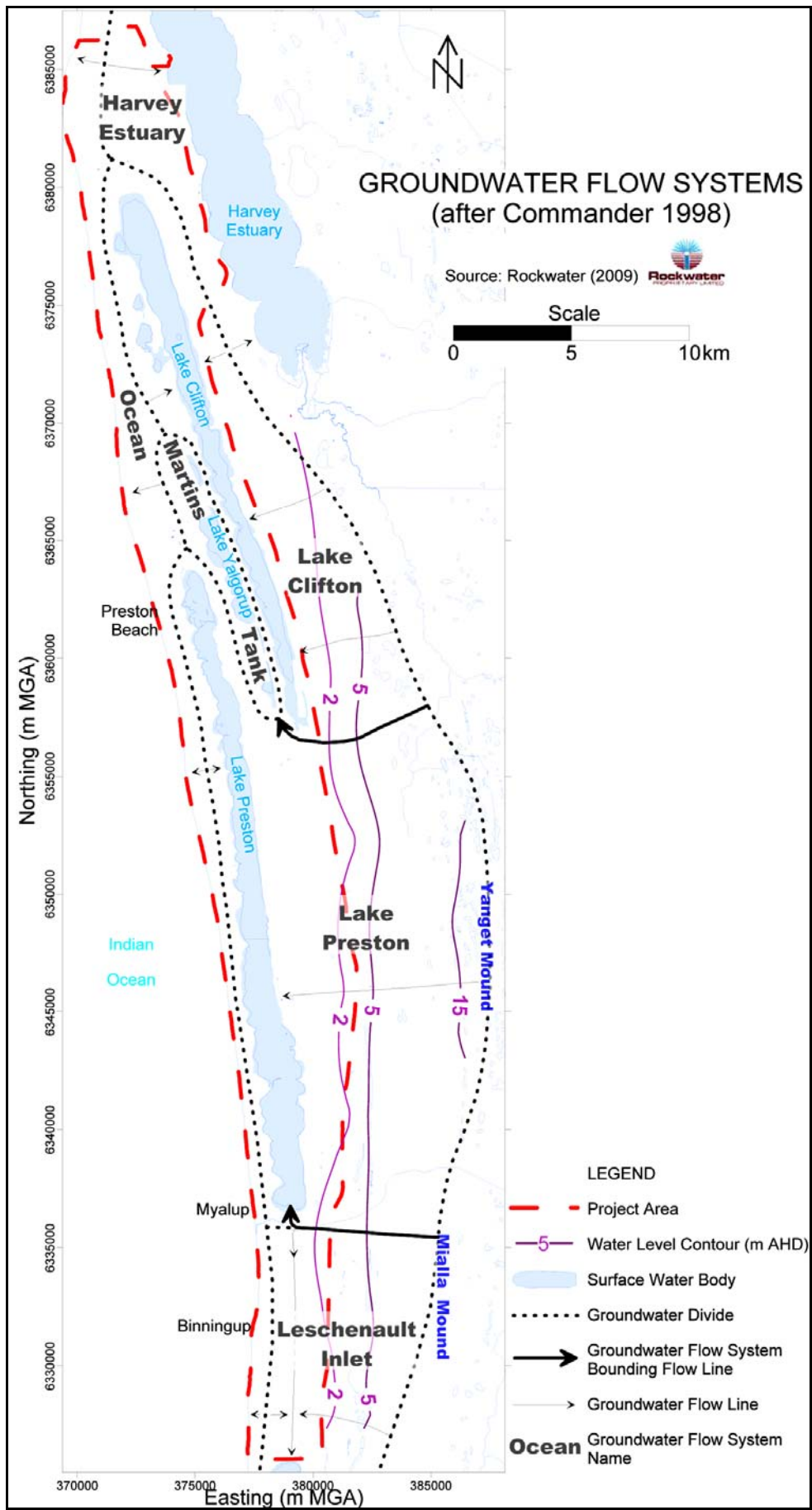


Figure 3: Groundwater Flow Systems



Governments at all levels have a responsibility to protect Ramsar wetlands. According to Hale and Butcher (2007) this includes management that promotes conservation, and wise and sustainable use that is compatible with maintaining the natural features of the wetlands ecosystems and ecological character.

The environmental values of the area are intrinsically linked. The hydrology of the area is the key factor that underpins the ecology and most importantly the internationally significant Yalgorup lakes. Protection and maintenance of the natural groundwater regime is therefore of utmost importance.

It is the EPA's view that subdivision and development, particularly adjacent to the Yalgorup lakes pose a significant risk and unacceptable threat to the ecological character of the Yalgorup lakes.

The EPA therefore considers the potential for further subdivision and development of the area east and west of the lakes to be very limited.

The EPA's presumption against development is based on the current regional scale information and it may review its position based on the outcome of future detailed environmental investigations for particular proposals.

## **5. Consolidation of Yalgorup National Park**

The Yalgorup National Park (the Park) was established in the early 1970s in recognition of the need to protect the Yalgorup lakes. The Park has high conservation, scientific and educational values. In addition to the Yalgorup lakes and other wetlands, the Park contains vegetation complexes and fauna habitats not well represented outside of the study area. It is the largest coastal reserve on the Swan Coastal Plain within the Guidance Statement 10 (EPA 2006) area and is unique as it is the only conservation area on the Swan Coastal Plain containing extensive saltwater lake systems.

With an area of 13,137 hectares of which 38% is water (lakes), the Park represents 46% of the study area. Its shape is long and narrow with several disconnected blocks of land and private land enclaves. Consequently there is limited core terrestrial habitat area in the Park. In several locations the Park's boundaries are at the high water mark and include only minimal fringing vegetation to the lakes (Figure 4). This is particularly the case for some of the shores of Lake Clifton and Lake Preston. These issues severely reduce the Park's effectiveness to maintain the environmental values over the long term and to create the 'wilderness' experience. It also makes management intensive, difficult and costly.

Private land holdings between the lakes and coast contain areas of significant vegetation and fauna habitat. Cleared and parkland cleared areas adjacent to the Park also play a role in maintaining the biological diversity of the study area by providing habitat and linkage to other areas of habitat value. The Public Environment Review for the proposed rural subdivision of land (proposal area) located west of Lake Clifton (ENV 2009) recognises that the proposal area has significant biodiversity values including TECs, PECs, threatened flora species and a CCW with a buffer that immediately adjoins Lake Clifton. The PER proposal area is an enclave surrounded

by the Yalgorup National Park. The DEC has previously expressed an interest in purchasing the proposal area but did not have funding available at the time.

It is the EPA's opinion that there is a need to consolidate and buffer the Park to enhance and complement its features. Private land holdings west of Lakes Clifton and Preston that retain significant environmental values, complement the existing values and contain values not well represented in the Park or that would aid in management of the Park, should be acquired for inclusion in Yalgorup National Park. Reserves and vacant crown land vested in local government and areas adjoining the lakes should also be incorporated into the Park.

The objective of boundary consolidation is to improve representation of ecological communities, flora species and fauna habitat, and provide improved ecological connectivity whilst reducing the threats to conservation values associated with adjoining land uses along an extended boundary. This will enhance the core area, reduce edge effect impacts from surrounding land uses and improve management.

A vegetated buffer to Lakes Clifton and Preston based on the water requirements of the lakes and vegetation should be added to the Yalgorup National Park. Rehabilitation should be undertaken where the vegetation is degraded or inadequate.

The existing road servicing properties west of Lake Preston should remain a low standard road and be realigned well away from the lake and its fringing vegetation. The current road reserve should be added to the Yalgorup National Park.

## **6. Potential for Development in the Study Area**

Current land uses in the study area include broad-acre agriculture including horticulture, grazing, plantations, small rural holdings and tourism. The area also includes the coastal townsites of Preston Beach, Myalup and Binningup. The study area is known for its basic raw materials, predominately sand and limestone resources. Current operations occur on private land and are managed by the relevant local government under Extractive Industry Licences.

The broad pattern of land use in the study area is defined by the Peel Region Scheme and the Greater Bunbury Region Scheme. The Region Schemes provide the statutory basis for planning in the study area, and local governments are required to provide detailed plans (Local Planning Schemes and Strategies) consistent with the Region Schemes.

The EPA's formal assessments of the Peel Region and Greater Bunbury Region Schemes only considered proposed changes in land zoning and not existing zonings where no change was proposed. The EPA notes that the majority of the existing land use zonings in the study area occurred prior to the *Legislation Amendment Act 1996* and have therefore not been considered by the EPA.

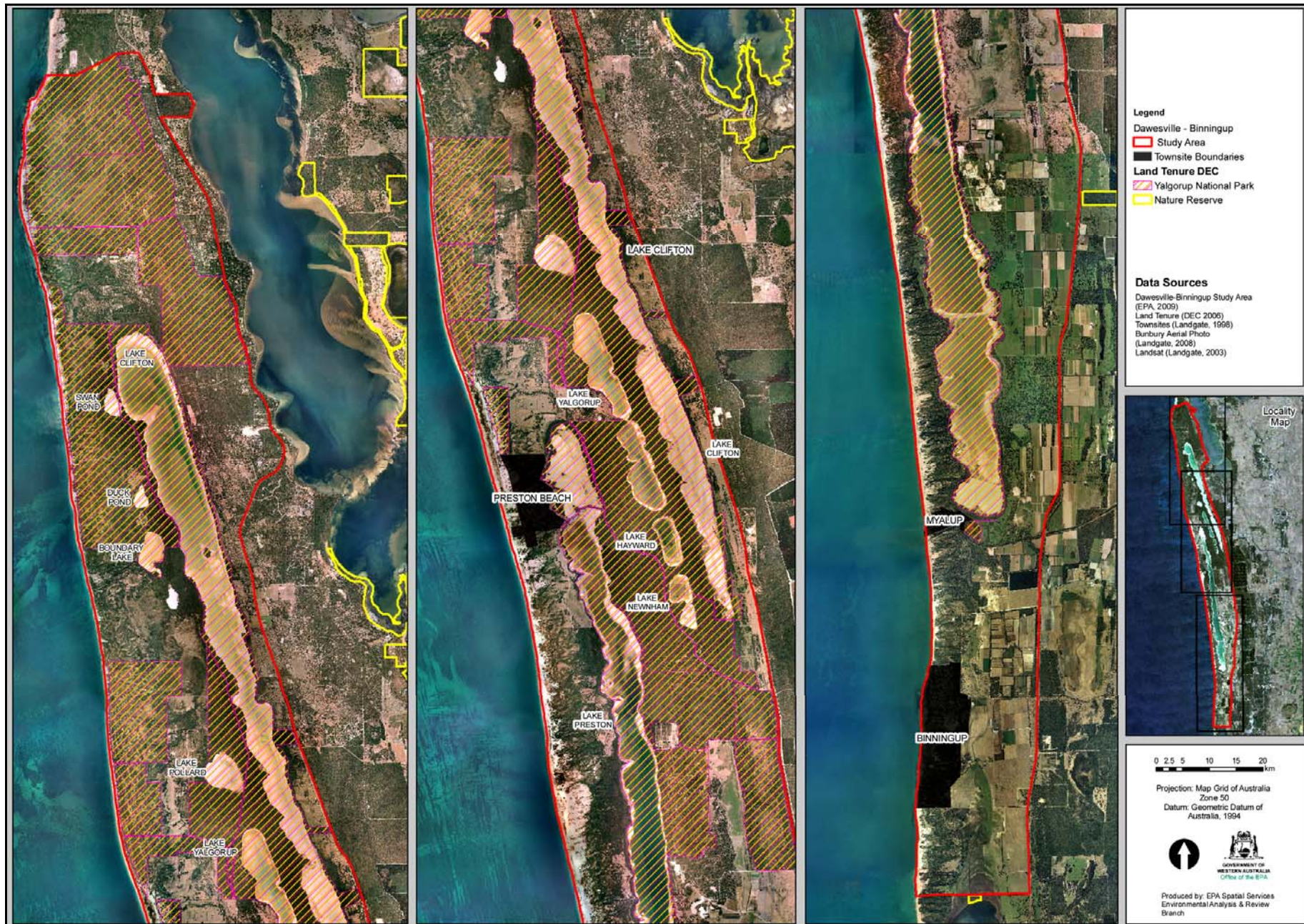


Figure 4: Yalgorup National Park and other Reserves

The Coastal and Lakelands Planning Strategy (Western Australian Planning Commission 1999), a non-statutory planning document, acknowledges the environmental values and constraints of the study area and makes recommendations regarding future land use within the area. The Coastal and Lakelands Planning Strategy is now more than 10 years old and should be reviewed. It is expected that the EPA's section 16(e) advice will assist in guiding the revision of the strategy and other land use planning activities in the study area.

Directions 2031 (Western Australian Planning Commission 2009) is a (draft) strategic planning document that sets out a spatial framework for accommodating expected future growth in the Perth area. Directions 2031 recognises the existing zonings in the study area and mentions the Preston Beach Townsite Strategy that is currently under preparation.

The EPA acknowledges that the area between the Yalgorup lakes and the coast is under considerable pressure for development. Some of the public submissions received on Bulletin 4 also advised of development interests elsewhere in the study area and other landowners may have development interests of which the EPA is not yet aware.

The Preston Beach Townsite Strategy (which encompasses urban zoned land adjacent to the north of Preston Beach townsite and land to the south identified as future urban) proposes that the townsite expand by between 1,600 to potentially 3,500 dwellings. The Department of Planning and proponents for the development have advised the EPA that environmental studies are being undertaken and that they have been consulting with the DEC. Whilst the EPA has been advised of the proposal, formulation of the strategy is still in progress and therefore the EPA has not reviewed the results of the environmental investigations.

Other development interests in the area include rural and urban zoned land located at the northern boundary of the study area between Yalgorup National Park and the Harvey Estuary. Whilst some of this land is already zoned Urban, the EPA in its assessment of the Peel Region Scheme recognised the potential environmental significance of the site and deferred consideration of the environmental factor of vegetation. Therefore any proposal for the urban zoned land that may have a significant impact on the vegetation is expected to be referred to the EPA. It is understood that the landowners are in the process of developing their proposal and undertaking environmental studies.

The PER for Cape Bouvard Investment's proposed rural subdivision of land between Lake Clifton and the coast previously mentioned in this report is still to be considered by the EPA. The public submission period for the PER recently closed. The EPA is also aware that several landowners with holdings west of Lake Preston have subdivision interests.

The EPA notes that another issue confronting subdivision and development interests between the lakes and coast is that the area is not well serviced. It has limited road access to and within it. The requirement for additional vehicle access to improve public safety from fire is an important issue that would need to be addressed as part of

any subdivision or development proposal. The provision of infrastructure services can have a significant impact on the environment.

The information considered by the EPA on key environmental values and processes for this review is based on current knowledge and this information is mainly only described at the regional scale. At this scale the information is sufficient to highlight the environmental significance and sensitivity of the area, particularly that the hydrology is extremely complex. However, this level of information is not sufficient for undertaking environmental impact assessment of individual development proposals. Comprehensive site specific information is expected to be provided by proponents as part of an environmental impact assessment process.

The EPA will assess proposals that may have a significant impact on the environmental values of the study area on their merits. The EPA expects that environmental information of a high standard and level based on the environmental values of the site and surrounding area would be undertaken and that all potential impacts would be considered and addressed. The studies required will depend on the scale and location of the proposal but will most likely include hydrology, geology and karst, vegetation and flora, fauna, coastal processes/setbacks, visual amenity, fire management and acid sulfate soils.

Over the past few years, many of the key ecological parameters for some of the environmental values have changed, for example increases in salinity and nutrients in Lake Clifton, which has the potential to significantly affect values such as the thrombolite community in the long-term. The level of information the EPA requires will therefore need to reflect the risk to these ecological threatened communities. Reliance on studies conducted prior to these significant changes in the environment is not sufficient for environmental impact assessment purposes. Information provided should be of recent duration, conducted over multiple events, seasons or years and relate to the threats and pressures from the development. Where information about a particular threatened ecological community is limited, particularly for the thrombolite community or where limits of acceptable change are difficult to establish, a clear demonstration of impact avoidance, minimisation and use of best practice principles will be required to satisfy the EPA that risks to that ecological community can be managed.

For proposals in the Lake Clifton catchment, site specific investigations would need to be presented in the context of demonstrating the EPA's criteria in Guidance Statement 28 (1998) for new land use developments in the Lake Clifton Catchment.

The coastal area is potentially vulnerable to sea level rise as a result of climate change. Due to the area's sensitivity, interpretation of the effects of climate variability and anthropogenic change should consider a range of possible scenarios, with variation of winds, wave and water levels.

Whilst the potential for subdivision and development between the lakes and coast is very limited, the EPA considers that cleared land south of Lake Preston and generally east of Binningup towards the Old Coast Road may have development potential that could be explored to determine its suitability. The EPA understands there is currently no planning context for development of this area and issues of land use conflict with

existing agricultural land uses and basic raw material extraction sites would need to be considered.

Based on the available information, this area is the least environmentally constrained. The path of groundwater flow is not as direct to the lakes although hydrology will still be an important factor requiring investigation, particularly the hydrological connection between Lake Preston and the Leschenault Inlet and its geoheritage value. Although mostly cleared, surveys have identified some important areas of native vegetation and significant fauna sites in the area.

## **7. Recommendations**

**The EPA advises that:-**

**It is clear that the study area has natural values that are unique and significant at the global scale. The Ramsar listed Yalgorup lakes, migratory waterbirds, the Lake Clifton thrombolites and other geoheritage features are all internationally significant. Their existence together makes the area a special part of Western Australia that must be protected and preserved.**

**Therefore the EPA recommends -**

- 1. Existing cleared land south of Lake Preston and to the east of Binningup, near Old Coast Road is unlikely to be environmental constrained, and may be examined further for its development potential.**

This area appears to have significantly less environmental values and constraints than the land west and east of the Yalgorup lakes. Maintaining the existing ecological linkage between Lake Preston and the Leschenault Peninsula is important. Proponents will be required to address any significant environmental issues by undertaking investigations of values at a local scale and within a regional context.

- 2. There is a presumption against further subdivision and residential development between the western side of the Yalgorup lakes system and the coast.**

Any development on the western side of the Yalgorup lakes system and the coast is highly constrained due to the significance of the special environmental values of the Yalgorup lakes system, and the necessity to maintain the complex hydrological functions which support this important ecosystem.

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This is due to the significance of the Yalgorup lakes system, the Yalgorup National Park and the necessity to maintain the complex hydrological functions which support this important ecosystem.

The EPA's view is based on regional scale information and the EPA may review its position based on the outcome of future detailed environmental investigations for particular proposals.

4. **The Yalgorup National Park should be:**
  - c. **extended and consolidated, by incorporating private vegetated enclaves west of the Yalgorup lakes and other adjacent reserved lands; and**
  - d. **amended to significantly extend the vegetation buffer, particularly around the wetland areas of Lake Clifton and Lake Preston, including the eastern side.**

All areas of significant vegetation, flora or fauna should be included in the Yalgorup National Park or placed into conservation reserves, where they can be managed and protected. Resources to enable effective management should be provided.

5. **Current land management practices adjacent to Lake Clifton which are causing reductions in either groundwater quality or quantity should be rectified to prevent any further decline of the internationally significant Lake Clifton thrombolites.**

The existing management controls and practices are not adequate to maintain water quality and quantity and an urgent management response is needed now to further define and address the impacts occurring from existing development.

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7. **Additional east/west roads which would intersect the Yalgorup National Park, or proposed extensions to the Park, should not be built.**
8. **Any essential infrastructure, including roads within the study area, should utilise existing cleared areas and be sited to avoid any further habitat fragmentation.**
9. **The existing road, servicing properties west of Lake Preston, should remain a low standard road, and be realigned well away from the lake and its fringing vegetation.**
10. **The Coastal and Lakelands Planning Strategy should be reviewed. This Strategy and other land use planning initiatives in the study area should be guided by this report's advice and recommendations.**

- 11. The Department of Water should establish a comprehensive and targeted monitoring program for key indicators of ground and surface water quality and quantity around the Yalgorup lakes system, to detect trends and impacts from land use activities in the catchment.**
- 12. A comprehensive groundwater management program should be developed as a priority to ensure environmentally sustainable allocations are established and not exceeded.**

The Department of Water should commence the preparation and implementation of the South West Coastal Allocation Plan.





# **Appendix 1**

## **Summary of Environmental Factors**



## 1. The Yalgorup Lakes

The ten lakes of the Yalgorup lakes system, as part of the Peel/Yalgorup system, are one of nine wetland areas in WA recognised under the Ramsar Convention as wetlands of international importance (Figure 2).

Listed in 1990, the lakes met 4 out of 6 of the original Ramsar criteria. Since then the Criteria have been further development and re-numbered. According to CALM (2003) the Criteria applicable to the Peel/Yalgorup system and justifications are:

1. *It contains a representative, rare or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.*

The Site includes the largest and most diverse estuarine complex in South-Western Australia and particularly good examples of coastal saline lakes and freshwater marshes.

3. *It supports populations of a plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.*

The Site is one of only two locations in south-western Australia and one of very few in the world where living thrombolites occur in hyposaline water

5. *It regularly supports 20,000 or more waterbirds.*

The Site comprises the most important area for waterbirds in south-western Australia, supporting in excess of 20,000 waterbirds annually, with greater than 150,000 individuals recorded at one time (February 1977).

6. *It regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.*

The Site regularly supports 1% of the population (based on 4<sup>th</sup> edition Waterbird Population Estimates ) of at least six shorebirds: Red-necked Avocet *Recurvirostra novaehollandiae*, Red-necked Stint *Calidris ruficollis*, Red-capped Plover *Charadrius ruficapillus*, Banded Stilt *Cladorhynchus leucocephalus*, Caspian Tern *Sterna caspia* and Fairy Tern *Sterna nereis*.

Other important wetlands protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* and Conservation category wetlands as identified on DEC's *Geomorphic Wetlands Swan Coastal Plain* dataset are also located in the study area.

The lakes all have different limnological characteristics with each having different levels of salinity and biochemical composition which support a diverse range of flora and fauna. Lake Clifton contains microbialites – stromatolites and thrombolites. Lakes Pollard and Hayward contain relic microbialite structures, and together with Yalgorup and Newman lakes, develop algal mats of cyanobacteria. According to McMaster et al, cited in FRAGYLE (2009) a species of brine shrimp not native to Australia and most likely introduced by migratory birds also resides in Lake Haywood. Lakes Preston, South Newman, Martins Tank and Boundary Lakes also include some cohesive microbial communities but they do not generally form algal mats (CALM 1994). Tepee structures and eroded microbialite mounds are present

along the eastern shore of South Lake Preston and some unusual formations offshore beyond the tepee zone were identified by Moore (1998).

The lakes contain unique benthic microbial communities that play an important role in the food chain for thousands of local and migratory birds. For example, every summer between November and February thousands of swans graze the algae in Lake Pollard. The lakes system is important as a nesting area and summer sanctuary for waterfowl from inland areas and also for migratory shorebirds listed in the Japan-Australia, China-Australia and Republic of Korea-Australia Migratory Bird Agreements (CALM 1994, Dell and Hyder 2009).

### **1.1. Lake Clifton**

The thrombolite (microbialite) community of Lake Clifton was listed as Critically Endangered under the EPBC Act in January 2010. It is the largest known example of a living non-marine microbialite reef in the southern hemisphere. They are found predominately on the north eastern side of Lake Clifton in a stretch approximately 15km long (Threatened Species Scientific Committee 2010b).

The microbialites are fed by calcium carbonate from subsurface upwellings of fresh groundwater from within the lake and from groundwater seepage along the lakes eastern foreshore. Various microbes photosynthesise and in doing so, precipitate the calcium carbonate which then forms the rock-like structures. Associated with the microbialites are many small animals such as amphipods, isopods, shrimp, fish, nematodes and a species of sea anemone (CALM 1994).

Monitoring by DEC has revealed that the thrombolite community is in serious decline. According to Threatened Species Scientific Committee (2010a) recent investigations show that the community composition of the microbes has changed with the once dominant cyanobacteria *Scytonema* sp., no longer being found in Lake Clifton. *Scytonema* sp. grows in fresh to brackish water with low nutrient levels.

According to the Threatened Species Scientific Committee (2010a):

The greatest current threat to the ongoing growth and survival of the Lake Clifton thrombolite community appears to be increased salinity due to increased groundwater extraction and altered groundwater flows, followed by increased nutrient levels coming from adjacent agricultural and rural-residential properties. If Lake Clifton becomes permanently hypersaline, it is likely that the patterns of thrombolite growth, faunal diversity and waterbird usage will also be affected. It is possible that the international scientific significance of the Lake will also be lost as a direct result (Knott *et al.* 2003). Current studies suggest that the change to a permanent state of hypersalinity may have already occurred (Alexander and John 2008).

Both salinity and nutrient levels in the lake have doubled since the 1980s, following the intensification of land use east of the lake. Increased groundwater extraction may be reducing the amount of fresh groundwater seeping into the lake. Algae and phytoplankton blooms in the lake will compete with the microbialites for space and also smother the microbialites, reducing the microbes' ability to photosynthesise (Threatened Species Scientific Listing 2010b).

## **2. Vegetation and flora**

The EPA's objective for native vegetation and flora is to "*maintain the abundance, diversity, geographic distribution and productivity of flora at the species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge*" (EPA 2004).

The Dawesville to Binningup study area supports a generally intact flora and vegetation assemblage due to the location of Yalgorup National Park. The vegetation of the study area is extensive and diverse in that it supports plant communities ranging from forest to sedgeland fringing the Yalgorup lakes (Freeman *et al.* 2009). The range of plant communities in the area is attributed to the distinctive geological and hydrological features of the area.

### **2.1 Plant Communities and Landform Features**

Extensive tracts of sand dune, wetland and wetland fringe vegetation, mostly in Excellent to Very Good condition, are an outstanding feature of the study area.

Wetland fresh and saline plant communities, often in near pristine condition, are associated with the Yalgorup lakes and other wetlands. Thirteen wetland plant communities are described in the study area compared with six upland plant communities (Freeman *et al.* 2009). Rare wetland plant communities of the Quindalup and Spearwood Dune Systems were identified in the study area as well as wetland plant communities previously undescribed on the Swan Coastal Plain, illustrating the unique values of both dune systems. Species normally found only on the eastern Swan Coastal Plain and wheatbelt wetlands are identified in the study area.

The three limestone ridges, including the most southern massive limestone ridge of the Swan Coastal Plain, occur in the study area. These ridges support both plant communities and conservation significant species that are disjunct from the closest related limestone communities of the Leeuwin-Naturaliste Ridge and Paganoni Swamp bushland. Limestone ridges in the study area support a complex mosaic of plant communities including limestone heaths, mallee woodland, and woodlands. A number of conservation significant and endemic flora have been identified on the limestone ridges in the study area.

In addition, the study area is one of the few remaining areas on the Swan Coastal Plain with a full suite of vegetated Quindalup Dune System features. North of the study area to Perth, the coastal dunes are mostly represented as the first (primary) dune from the ocean and in a band of less than 100 metres in width. The study area supports Quindalup Dunes up to 1.5km from the ocean and a range of conservation significant plant communities and flora species. The western side of the study area is an excellent example of the interface between the Quindalup Dune System and both the Vasse Wetlands System and Spearwood Dune System.

The study area is the most southern naturally vegetated coastal area of its type on the Swan Coastal Plain, containing extensive areas of common, and limited areas of rare, upland and wetland plant communities of the Quindalup and Spearwood Dune Systems. The closest area with a similar set of values is the Yanchep National Park,

though this area does not replicate the variety of saline wetland communities found in Yalgorup National Park.

The study area supports extensive tracts of Tuart dominated forest and woodlands. Tuart is the only forest tree endemic to the Swan Coastal Plain. It is found on the Spearwood and Quindalup Dune Systems in both upland and wetland habitats. While Tuart is most common on the Spearwood Dune System the mallee form has been identified on areas of exposed Quindalup Dune System. Significant areas of Tuart are also found on the Quindalup Dunes west of Lake Preston. Closed forests are found on both the Quindalup/Spearwood Dune System interface and in wetland communities associated with the lake fringes.

The presence of healthy stands of Tuart is significant as the species has been impacted by factors that have not yet been fully described, commonly called Tuart decline. The Tuart Response Group was established in 2001 to investigate a decline in the health of Tuarts in the Yalgorup area between Mandurah and Bunbury. The Tuart Response Group (2004) identifies the values of Tuart woodlands and forests as conserving biology, protecting ecosystem functioning, and providing connectivity between remnant vegetation. Threatening processes include habitat loss, fragmentation and alteration caused by changes in natural and human induced vegetation disturbance regimes.

Until its decline, the Yalgorup area and Yalgorup National Park were considered key conservation areas for Tuart. Yalgorup National Park is significant in research into the causes of Tuart decline. There appears to be a general improvement in the health of Tuart in the area and in some areas it was not impacted. The study area continues to be a significant Tuart conservation area.

Much of the vegetation in the study area is in Excellent condition. In general, the areas in best condition are in public lands. However there appears to be substantive areas in Excellent condition in private lands, especially within the Quindalup Dunes of the study area.

## **2.2 Threatened and Significant Flora**

More than 100 (108) taxa are listed as significant flora in the study area. Of these, three are listed as Declared Rare Flora (DRF) and 13 are listed as Priority taxa. Seventeen taxa, many of which are associated with the limestone communities, are endemic to the Swan Coastal Plain. One of these, the recently described *Hakea oligoneura* (a Priority 4 species, previously known as *Hakea* sp. Yalgorup) is endemic to the Yalgorup National Park.

A series of species of conservation significance, generally confined to Quindalup Dunes, are found in the study area. Of particular interest are the large populations of a variety of increasingly rare species of Quindalup Dune communities such as the grasses *Poa poiformis* var. *poiformis*, *Austrostipa flavescens*, *A. pycnostachya*, *Bromus arenarius*, *Stylidium maritimum* and *Leptorhynchos scaber*.

## **2.3 Threatened and Significant Plant Communities**

Three Threatened Ecological Communities (TECs) and four Priority Ecological Communities (PECs) are identified, or are inferred to occur, in the study area by

Freeman *et al.* (2009). Three of these (one TEC and two PECs) were previously listed by DEC (SWAFCT 18, 29a and 29b). Those now recognised in the study area are:

- SWAFCT 19 - Sedgelands on Holocene dune swales (Endangered TEC under the EPBC Act 1999 and Critically Endangered by DEC);
- SWAFCT 18 - Shrublands on calcareous silts of the Swan Coastal Plain (Vulnerable TEC listed by DEC)
- SWAFCT 26a - *Melaleuca huegelii* – *Melaleuca acerosa* shrublands on limestone ridges (Endangered TEC listed by DEC);
- SWAFCT 25 - Southern Swan Coastal Plain *Eucalyptus gomphocephala* – *Agonis flexuosa* woodlands (Priority 3);
- SWAFCT 29a - Coastal shrublands on shallow sands, southern Swan Coastal Plain (Priority 3);
- SWAFCT 29b - *Acacia* shrublands on taller dunes, southern Swan Coastal Plain (Priority 3); and
- SWAFCT30b - Quindalup *Eucalyptus gomphocephala* and/or *Agonis flexuosa* woodlands (Priority 3).

Additional occurrences are expected to be located with targeted surveys and with further work, several restricted wetland communities related to SWAFCT 18 may be suitable for listing as rare and threatened communities.

#### **2.4 Ecological Linkage**

The EPA recognises that the current extent and condition of native vegetation in south-western Australia has resulted in a landscape which is fragmented to such an extent that a substantial loss of native species is already occurring. Therefore, in conjunction with careful conservation planning and management, the retention and restoration of well-planned and managed ecological linkages will be important for the persistence of remaining species (EPA 2009b).

Regionally significant ecological linkages identified are identified in the Greater Bunbury Region Scheme (EPA 2003) and the South West Regional Ecological Linkages Technical Report (Molloy *et al* 2009). The vegetated area bordering the Peel-Harvey estuary included within the study area boundary is significant as the only remaining intact and largely contiguous east-west linkage from the coast to the estuary in the north of the study area. The Yalgorup/Riverdale Road/Yarloop ecological linkage is another significant east-west linkage. The opportunities to maintain strong east-west linkages decline in the south of the study area, as more extensive clearing and disturbance is encountered, highlighting the importance of retaining remnant vegetation that retains linkage function. A strong north-south linkage is present in the north of the study area where the core of Yalgorup National Park tenure is greatest. This linkage extends south through private lands adjoining the park (Lake Preston) and represents perhaps the most extensive contiguous north-south link on the Swan Coastal Plain south of Perth.

### **3. Native Fauna**

The EPA's environmental objective for native fauna is to “*maintain the natural levels of abundance, diversity, geographic distribution and productivity of species and ecosystem through the avoidance or management of adverse impacts and improvement of knowledge*” (EPA 2004).



Studies elsewhere on the Swan Coastal Plain (e.g. How and Dell 1993, 1994, 2000) indicate that fauna have particular habitat and spatial requirements, and respond poorly to the effects of fragmentation and its associated perturbations, such as fire, weeds, competitors and predators. Populations of many species have declined significantly since European settlement and are now considered to be of conservation significance on the Swan Coastal Plain (Government of Western Australia 2000). The native fauna in the study area is largely dependent on the native bushland and wetland habitats that comprise much of the area, including Yalgorup National Park, its internationally significant lakes and regionally significant Tuart woodlands, as well as relatively extensive patches of woodland and shrubland vegetation.

The fauna within the study area is regionally significant and remains largely dependent on the vegetation and wetlands that were once part of the continuum that covered the study area. The fauna requires various habitat types of sufficient size, spatial replication and connectivity across the region to continue to persist. Further fragmentation or loss of vegetation will result in a reduction of the abundance, diversity, geographic distribution and productivity and hence impact on the long-term survival of fauna throughout the study area.

### **3.1 Herpetofauna**

The herpetofauna assemblage of the study area is rich and diverse consisting of at least 8 frogs and 39 reptiles comprising one freshwater turtle, 3 geckoes, 5 legless lizards, 2 dragons, 16 skinks, 2 monitors, one blind snake, one python and 8 front-fanged snakes (How *et al.* 2009). One gazetted species of Specially Protected Fauna, the Carpet Python (*Morelia spilota imbricata*) and one DEC Priority 4 listed species, the Perth Lined Lerista (*Lerista lineata*), are recorded from the study area. A number of species are regionally significant as they are known to be at or near the southern limits of their distribution. The population of *Ctenotus labillardieri* in the study area appears to be genetically distinct from populations on the Darling Scarp and Range and may yet be determined to be the Schedule 1 Threatened Lancelin Island Skink (*Ctenotus lanceolini*). The isolated population of the Ticking Frog (*Geocrinia leai*) represents the most northerly known population on the western side of the Swan Coastal Plain.

The reptile and frog fauna of the study area represent important contiguous populations of species that have been subjected to major fragmentation, alteration and extinctions further north on the Swan Coastal Plain and hence are of regional conservation significance. It is likely that further reptile and frog species will be recorded from the study area when additional sampling is undertaken.

### **3.2 Avifauna**

The study area has a rich and diverse avifauna comprising at least 174 species which includes 124 species of non-passerines and 50 species of passerines (Dell and Hyder 2009). Among the non-passerines the most species-rich families are those associated with wetland habitats. Other rich non-passerine families are the eagles, kites and hawks with 11 species and the parrots and cockatoos with 6 species. Among the passerines the most species-rich family is the honeyeater with 11 species. Small insectivorous families are well-represented with several species of fairy-wrens, thornbills and whistlers.

The study area is Internationally significant for wetland and shore birds. The wetlands are part of the Ramsar Peel-Yalgorup System, one of the largest and most diverse estuarine/wetland complexes in Western Australia. These areas are internationally important as habitat and refuge sites for waterbird species protected by JAMBA, CAMBA and ROKAMBA agreements. Over one hundred wetland dependent species of birds have been recorded, making this the most regionally significant wetland site for birds in Western Australia.

The extensive natural vegetation in the study area is also of National and State significance for bushland birds, providing habitat for four Nationally and State listed species, three DEC Priority listed species, and 45 regionally conservation significant species which have reduced distributions or populations on the Swan Coastal Plain (Dell and Hyder 2009).

The richness and diversity of the avifauna of the study area is exemplified by the fact that the total of 174 species comprises more than half of the 311 species known from the entire Swan Coastal Plain between the Moore River and Dunsborough. Such a rich and diverse assemblage of bushland bird species has not been documented anywhere else on the Swan Coastal Plain.

### **3.3 Mammals**

Seven insectivorous microbat species are known from the study area (Bullen 2009) including one Priority 4 species, Western False Pipistrelle (*Falsistrellus mckenziei*). The presence of this species is significant considering its apparent recent range contraction. The continuing presence of this species in the study area is considered to be closely linked to the combination of healthy and extensive open woodland stands in conjunction with permanent fresh water sources.

Seven native non-volant (non-flying) mammal species have recently been recorded within the study area (Hyder and Dell 2009). Of these, three are of conservation significance: Western Ringtail Possum, *Pseudocheirus occidentalis* (Vulnerable, EPBC Act 1999), Schedule 1, Wildlife Conservation (Specially Protected Fauna) Notice 2010 (Government of Western Australia 2010); Western Brush Wallaby, *Macropus irma* (DEC Priority 4); and Quenda, *Isodon obesulus* (DEC Priority 5). Fifteen other native non-volant mammal species are known from or likely to occur in the study area and most of these are of regional conservation significance as they have declined or disappeared from most of the Swan Coastal Plain (How and Dell 1993, 2000).

Habitats within the Dawesville to Binningup study area are regionally significant for mammals, particularly for those species and assemblages that have greatly reduced distributions or have declined in abundance elsewhere on the Swan Coastal Plain. These habitats also have conservation value for potential reintroductions of species which have become locally or regionally extinct. This is best exemplified by the successful reintroduction of Western Ringtail Possums in the northern part of the study area.

### **3.4 Invertebrates**

Invertebrates are a major, essential and abundant component of faunal assemblages but have been little studied in the project area. One invertebrate species, Graceful Sun Moth, *Synemon gratiosa*, (listed as Endangered, EPBC Act, and as 'fauna that is rare or likely to become extinct' on Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice 2010 (Government of Western Australia 2010) has been recorded by DEC as having significant populations in the project area.

## **4. Geology**

The landforms of the Swan Coastal Plain represented in the study area belong mainly to the Yalgorup Plain except for the most eastern section which is the Mandurah-Eaton Ridge and the Quindalup (Holocene coastal) Dune System. The landform units run parallel to the coast.

The stratigraphic units that generally underlie the main landforms from east to west include the Eaton Sand underlying the Mandurah-Eaton ridge. The subsidiary units of the Yalgorup Plain are the Youdaland - upward shoaling limestone known as Tims Thicket Limestone; the Myalup Sand Ridge in the north - quartz sand barrier ridge; the Myalup Sand Shelf in the south - quartz sand shelf; and, the Kooallupland - consisting of Kooalup Limestone. The most western unit, the Quindalup dunes, is the barrier dunes of Safety Bay Sands (V & C Semeniuk Research Group 2009).

V & C Semeniuk Research Group (2009) presents a detailed description of the quaternary geology and landforms of the study area and an analysis of the region's characteristics against criteria for assessment of geoheritage. They argue that the complex coastal geology of the area is of international, national and state-wide geoheritage significance for a range of geological features that are interrelated. V & C Semeniuk Research Group (2009) contends that the Pleistocene stratigraphy, landforms and history are internationally significant as the best example of this coastal type in the world, as is the Holocene barrier history and the record of a rising sea level in a bathymetrically complex coastline, contained in the landforms and serigraphy of the northern part of the study area. The line of lakes and limestone ridges is also potentially internationally significant and the south to north Holocene barrier dune and stratigraphy linked to hydrology is considered nationally significant.

Land clearing or development will compromise the landscape features and alteration of groundwater can cause chemical, physical or biological changes to the underlying stratigraphy. The wetlands and vegetation of the area that are linked geochemically and hydrologically to the underlying stratigraphy may also be detrimentally impacted (V & C Semeniuk Research Group 2009).

### **4.1 Karst Environments**

V & C Semeniuk Research Group (2009) advises that karst is a relatively unexplored feature of the study area. There are no known caves with speleotherms in the area, however there are numerous karst features which range in size from large dolines to linear solution features, pipes and fissures. Pipes enable surface water to travel quickly to the subsurface. A doline wetland is located in the southern part of the study area.

Stygofauna are groundwater-dwelling aquatic fauna that live in karstic strata, such as limestone. There are records of stygofauna communities in the South-West of the State, including a TEC associated with Tuart Root mats in karst environments. However, none have been recorded from the study area to date. It is likely the superficial aquifer in the study area contains habitat suitable for stygofauna and the absence of any records is most likely due to lack of targeted sampling (Rockwater 2009).

## **5. Hydrology**

The hydrogeology of the study area is extremely complex. The superficial aquifer, which is mainly unconfined and shallow, contains fresher groundwater resting on saline groundwater. The superficial aquifer is hydraulically connected to the underlying Leederville aquifer (Rockwater 2009).

Groundwater in the superficial aquifer discharges to the Yalgorup lakes, which are groundwater sinks. The lakes receive most of their water from groundwater with smaller quantities from rain falling directly on the lakes' surface and variable but minimal amounts of surface runoff. The latter however is dependent on the amount of fringing vegetation (Davies and Lane 1996). Water is lost from the lakes by evaporation only. Groundwater flow to the lakes occurs within separate flow systems. As shown in Figure 4, groundwater flows into the lakes from both the east and the west. The groundwater divide to the west and east is variable and moves in response to seasonal rainfall recharge (Rockwater 2009). The salinity of groundwater also changes in response to seasonal rainfall with it generally being freshest in spring (ENV Australia 2009).

According to Rockwater (2009), the superficial aquifer is hydrogeologically complex due to variations in the hydraulic properties of the different lithologies and thin sheets of impervious calcrete that extend across stratigraphic boundaries. Therefore, groundwater discharge to the lakes will vary according to local variation in the lithologies. Potentially, a small fall in the level of the water table may cause a substantial change in the location of groundwater discharge and result in discharge zones ceasing. This could not only significantly impact water levels and water quality (increasing salinity) but also fringing vegetation reliant on water at the point of discharge.

Monitoring of groundwater levels in the study area has shown a reduction of less than one metre over the last 30 years. Whilst this is mainly attributed to reduced rainfall, groundwater extraction is likely to have influenced water levels at the local scale. Large groundwater users are mainly located in the south of the study area and account for approximately half of the total water allocations. Allocations in the south are either above or approaching Department of Water (DoW) allocation limits.

Smaller allocations dominate the north, mainly for domestic and stock purposes. According to DoW, there is no allocation plan for the South West Coastal Groundwater Area (which covers the Lake Clifton subarea). Work is due to commence on the allocation plan next year (subject to DoW priorities) and it will take some time to complete. Monitoring of Lake Clifton by DEC indicates groundwater

flow could be reducing and this could threaten the thrombolite communities. Groundwater dependent vegetation would also be threatened (Rockwater 2009).

Rockwater (2009) identified several gaps in the available information. The existing hydrogeological data gives a regional-scale picture of the hydrogeology. Whilst this is useful for regional groundwater management it is not suitable for investigations of the hydrogeology on a more local scale. There is a network of groundwater monitoring bores for water level but groundwater quality data is only available from at the time when bores are installed.

Rockwater (2009) recommends that additional groundwater quality monitoring and a database of actual extraction volumes rather than allocation amounts be implemented to allow changes to be tracked. Monitoring bores for quality should be installed at new sites to target specific monitoring objectives, such as the quality of the groundwater upstream of discharge zones to the Yalgorup lakes. Detailed geological and hydrogeological investigations on groundwater discharge processes and quality at environmentally sensitive sites such as Lake Clifton should also be undertaken. There should also be a limit or curtailment of activities that may cause reductions in the quality or quantity of groundwater discharging to the Lake Clifton thrombolite community. The Department of Water has advised it supports the development of a comprehensive water quality monitoring program.

## **6. Coastal Processes**

Damara WA Pty Ltd's (2009) report on the geomorphology of the Yalgorup coast advised that the Yalgorup coast is contained in the coastal compartment extending from Binningup to Cape Bouvard which is part of the larger coastal area from Cape Naturalist to Rottnest Island. There are five sediment cells along the Yalgorup coast, Myalup; Lake Preston South; Preston Beach; Lake Clifton; and White Hills Road.

At a geological timescale, the Leschenault-Yalgorup Barrier (Quindalup dunes) has evolved in the past 10,000 years and barrier evolution continues as sediment is moved along and across the shore.

At medium time scales (decades and centuries) the barrier dune formation and migration is dependent on sediment supply from offshore and alongshore. Presently the alongshore movement of sediment is critical to coastal stability and evolution of the barrier. The future stability of the coast in the medium-term may be affected by any interference with sediment transport, by natural variability and changes to metocean (meteorology and oceanography) processes.

At sub-decadal time scales, the metocean processes interact with the underlying geology. The consequences of this are that the general northerly sediment drift is in places reversed due to interaction with shoreline salients and extensive rock outcrops. It also negates the Bruun Rule that has been widely applied in the calculation of coastal setback for development in WA.

The dunes in the study area vary from north to south. In the Myalup and Lake Preston cells, where the barrier dune is narrowest, the dunes are low and discontinuous. In the Preston Beach cell the dunes are higher. In the northern cells of Lake Clifton and

White Hill Road, the dunes are quite variable. In places there are no foredunes and those landwards of rock platforms have erosion scarps. The dunes vary from stable vegetated dunes to mobile unvegetated dunes. Active blowouts and tracts occur in all sediment cells but are most extensive in the Lake Preston and Preston Beach cells.

From analysis of the historic behaviour of the Yalgorup coast, Damara Pty Ltd (2009) has determined that the coastline in the study area responds (sometimes dramatically) to a range of coastal climatic parameters including sea level, wave direction and wave energy all of which are subject to considerable variability and uncertainty. The area's natural variability may either mask or intensify the effects of climate-change induced trends. Due to the area's sensitivity, interpretation of the effects of climate variability and anthropogenic change should consider a range of possible scenarios, with variation of winds, wave and water levels.



## **Appendix 2**

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## **Appendix 3**

### **Consultation**



Department of Water  
Department of Mines and Petroleum  
Department for Planning  
Western Power  
Water Corporation  
Department of Agriculture



## **Appendix 4**

### **Submissions From**



## **Organisations**

Peel Harvey Catchment Council

Myalup Bird Observers

RPS Koltasz Smith

Coffey/RPS

RPS

Urban Bushland Council

FRAGYLE

Peel Preservation Group

360 Environmental

MGA Town Planners

TME

Cardno

South West Environment Centre

Urban Bushland Council

FRAGYLE

## **Individuals**

R Campbell-Hicks and B Morton

C Bloye

T France

B Russell

T Hunter

G and N Fardin

R Burne

L Moore

## **Appendix 5**

**Dawesville to Binningup Technical Studies  
(On attached CD)**