

**ALKIMOS LOCAL STRUCTURE PLAN
ENVIRONMENTAL ASSESSMENT**

Part Lots 101 and 1004 Alkimos

Prepared by:

RPS

290 Churchill Avenue, SUBIACO WA 6008

PO Box 465, SUBIACO WA 6904

T: 618 9382 4744

F: 618 9382 1177

E: admin02@rpsgroup.com.au

W: www.rpsgroup.com.au

Prepared for:

**LANDCORP AND LOT 101 JOINT
VENTURE**

c/- Woodsome Management

PO Box 899

WEST PERTH WA 6872

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SUMMARY

Alkimos – Eglinton consists of a 2,660 ha parcel of land located 40 km north-west of the Perth Central Business District. The Environmental Protection Authority (EPA) assessed Metropolitan Region Scheme (MRS) Amendment 1029/33 for Alkimos-Eglinton under Section 48A of the *Environmental Protection Act 1986* in 2006. Through the assessment, the EPA identified regionally significant areas of Alkimos-Eglinton, principally identified for their geoheritage and biodiversity values. Amendment 1029/33 was approved by the Minister for the Environment on 24 April 2006 (Statement 722), and gazetted by the Western Australian Government on 23 June 2006. As a result of the assessment, the areas of interest to the EPA; some 500 ha or 20% of the Alkimos-Eglinton site, is now reserved for conservation under the MRS as Parks and Recreation and Public Purpose (Conservation). Alkimos-Eglinton is now zoned/reserved under the MRS for a variety of uses including Urban, Urban Deferred, Central City Area, Parks and Recreation, Public Purpose, Railways and Other Regional Roads.

A District Structure Plan (DSP) has been prepared providing further definition for land use, urban design and environmental management against the zonings set out in the MRS.

The Alkimos Local Structure Plan (LSP) area is zoned 'Urban' in the MRS. The Alkimos LSP area is bordered on the east by Marmion Avenue and private land (Lot 3), and private land (Lot 9) in the south. It abuts the Water Corporation's Alkimos Waste Water Treatment Plant (WWTP) and associated buffer in the north, which is zoned 'Public Purposes' and a section of the buffer has been zoned for the purpose of 'Conservation' in the MRS. To the west is the beach and coastal foredunes, the Alkimos LSP area includes the area of the foreshore reserve within Lot 1004, the foreshore reserve is zoned 'Parks and Recreation' (Figure 1).

The Alkimos LSP site contains some of the most degraded environments in the Alkimos-Eglinton area. The site was historically used for grazing and consequently some areas now support a high percentage of weed species and are considered to be in 'Degraded' to 'Completely Degraded' condition. The majority of better quality vegetation on the site is located on the dune ridges that were not grazed as intensively. Localised areas of disturbance exist from off-road vehicle tracks, also in recent months the construction of the Alkimos WWTP has resulted in localised disturbance on the site.

The proposed Alkimos LSP is predominantly a residential area, in line with the 'Urban' zoning in the MRS. This report provides an environmental assessment of the proposed Alkimos LSP, including an analysis of the environmental opportunities and constraints of the site and a description of the response of the Alkimos LSP to these opportunities and constraints.

Geoheritage, vegetation and fauna values on the Alkimos LSP site do not present a significant environmental constraint to the implementation of the Alkimos LSP. The EPA assessed a range of relevant environmental factors during the Environmental Review of MRS Amendment 1029/33 including:

- Vegetation.

- Fauna.
- Odour (Waste Water Treatment Plant) – (deferred factor).
- Geoheritage.
- Aboriginal heritage – (deferred factor).
- Risk (Groundwater Treatment Plant).

The EPA's assessment of Amendment 1029/33 was based on a consideration of the environmental values across the entire Alkimos-Eglinton site which lead to the identification of specific areas of regional environmental significance, which were set out in Bulletin 1207 (EPA, 2005). Following the WA Government's gazettal of MRS Amendment 1029/33, the areas of environmental significance identified by the EPA have been reserved for Parks and Recreation and Public Purposes. Part of the Public Purposes reserve has been identified for protection as a 'conservation, landscape and complimentary proposes reserve' in the MRS. The area that has been reserved for conservation proposes in perpetuity in the MRS occupies approximately 500 ha or 20% of the Alkimos-Eglinton site. The conservation area consists of three linkages across the site (two east-west linkages and one north-south linkage). In Statement 722, amongst other matters, the Minister for the Environment has set environmental management conditions which must be met for these areas.

During its assessment the EPA recognised the foreshore reserve as a regionally significant area and this reserve was expanded based on recommendations of the EPA to better protect Karli Spring and vegetation in the foreshore reserve. The 'Urban' zoned portion of the Alkimos LSP site does not contain any of the areas considered to be regionally significant by the EPA, however it does contain Tuart trees which were recognised as being significant.

As sites within Alkimos-Eglinton, like the Alkimos LSP, are developed for residential proposes, most of the retention of original flora and vegetation on the site, and most of the fauna movement through the site will be within and via the conservation linkages which are now zoned for conservation proposes in the MRS.

A number of environmental opportunities have been identified for the Alkimos LSP site, including the following:

- Retain good examples of consolidated Quindalup dunes in Conservation Public Open Space (POS) to preserve elements of the natural landscape character and vegetation of the Alkimos LSP site.
- Maintain ecological linkages across the site through the retention of strategic areas of remnant vegetation in Conservation POS.
- Concentrate residential development in areas that are already degraded.
- Preserve good quality examples of Priority Ecological Communities 29b and 24 (Priority 3) within Conservation POS.

- Retain Tuart trees in good health where possible and plant additional Tuart trees in landscaping areas.
- Rehabilitate Karli Spring in consultation with the relevant Aboriginal groups.

A number of specific management plans have been developed to address the key environmental management issues of vegetation, fauna and the coastal environment, as follows:

- *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy, Part Lots 101 and 1004 Alkimos (RPS, 2008).*
- *Alkimos Local Structure Plan, Foreshore Management Strategy, Part Lots 101 and 1004 Alkimos (RPS, 2008).*

This *Environmental Assessment* of the proposed Alkimos LSP concludes that the potential environmental impacts identified in this report can be managed in accordance with Western Australian environmental legislation to prevent significant impacts on regionally significant values of the site and surrounds.

The site may contain habitat for two fauna species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*: Carnaby's Black-Cockatoo and Graceful Sun Moth. The Alkimos LSP may require referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* if the potential impacts on one of these species are likely to be significant.

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1.0 INTRODUCTION

1.1 Description of Proposal

This report provides an environmental assessment of the Local Structure Plan (LSP) that is proposed for a section of Lot 101 and Lot 1004 in Alkimos. The Alkimos LSP site is 289 ha in area and is shown in Figure 1. The Alkimos LSP site is bordered on the east by Marmion Avenue, the Indian Ocean to the west, the Water Corporation's Alkimos Waste Water Treatment Plant (WWTP) and associated buffer to the north and private land (Lot 9) to the south.

The Alkimos LSP contains zones for urban development, schools, major roads and transport routes, areas for reservation in Regional Open Space (ROS) and Public Open Space (POS), a coastal node and the WWTP ocean outfall launch site.

1.2 Project Setting

Alkimos-Eglinton consists of a 2,660 ha parcel of land located 40 km north-west of the Perth Central Business District. The land was subject to a Metropolitan Region Scheme (MRS) Amendment 1029/33 which was assessed as an Environmental Review under Section 48A of the *Environmental Protection Act 1986* by the Environmental Protection Authority (EPA). The EPA released its report and recommendations in November 2005 (Bulletin 1207).

The EPA assessed a range of relevant environmental factors during the Environmental Review of MRS Amendment 1029/33 including:

- Vegetation.
- Fauna.
- Odour (Waste Water Treatment Plant) – (deferred factor).
- Geoheritage.
- Aboriginal heritage – (deferred factor).
- Risk (Groundwater Treatment Plant).

The EPA's assessment of Amendment 1029/33 was based on a consideration of the environmental values across the entire Alkimos-Eglinton site which lead to the identification of specific areas of regional environmental significance, which were set out in Bulletin 1207 (EPA, 2005).

Amendment 1029/33 was approved by the Minister for the Environment on 24 April 2006 (Statement 722), and gazetted by the Western Australian Government on 23 June 2006. The site is now zoned/reserved under the MRS for a variety of uses including Urban, Urban Deferred, Central City Area, Parks and Recreation, Public Purpose, Railways and Other Regional Roads.

Following the Western Australian Government's gazettal of MRS Amendment 1029/33, the areas of environmental significance identified by the EPA have been reserved for Parks and Recreation and Public Purposes. Part of the Public Purposes reserve has been identified for protection as a 'conservation, landscape and complimentary proposes reserve' in the MRS. The area that has been reserved for conservation proposes in perpetuity in the MRS occupies approximately 500 ha or 20% of the Alkimos-Eglinton site. The conservation area consists of three linkages across the site (two east-west linkages and one north-south linkage). In Statement 722, amongst other matters, the Minister for the Environment has set environmental management conditions which must be met for these areas.

The conservation areas in the MRS on the site will contribute to the protection of biodiversity through the reservation of approximately 500 ha or 20% of the site. As Alkimos-Eglinton is developed for residential proposes, most of the retention of original flora and vegetation on the site, and most of the fauna movement through the site will be within and via the conservation linkages which are now zoned for conservation proposes in the MRS.

A District Structure Plan (DSP) for Alkimos-Eglinton has been prepared providing further definition for land use urban design and environmental management against the zonings set out in the MRS. The DSP for Alkimos-Eglinton includes:

- Two town centres and two to three rail stations.
- Three coastal nodes and a marina.
- A waste water treatment plant and a groundwater treatment plant.
- Nine primary schools, two high schools and two private schools.
- A surf lifesaving club.
- Approximately 22,300 dwellings.

The DSP has been adopted by the City of Wanneroo (CoW) and has been sent to the Western Australian Planning Commission (WAPC) for approval.

The report; *Alkimos Eglinton District Structure Plan (DPS, 2008)* provides objectives and strategies that are relevant to this Environmental Assessment of the Alkimos LSP.

Section 6.9 of the report; *District Structure Plan, Environmental Assessment – Alkimos-Eglinton (RPS, 2008)* which formed Appendix 2 to the report; *Alkimos Eglinton District Structure Plan (DPS, 2008)* provides the following environmental commitments for the implementation of the DSP at the LSP stage:

1. *Implement the environmental conditions of the Minister for the Environment's Statement 722.*

2. *Maintain ecological integrity and biodiversity value of regional ecological linkages in Regional Open Space as well as can be practically achieved whilst also enabling effective functioning of the area for urban uses.*
3. *Prepare an Environmental Management Plan in accordance with Condition 2 of the Minister for the Environment's Statement 722 for proposals that will have an impact on the areas of Parks and Recreation and Public Purposes that are identified for the purpose of conservation, landscape and complementary proposes in the MRS.*
4. *Retain as much Carnaby's Black Cockatoo foraging habitat as can be practically achieved whilst also enabling effective functioning of the area for urban uses.*
5. *Retain the small number of tuart trees that occur on the site wherever possible in POS and road reserves.*

The Alkimos LSP for part of Lots 101 and 1004 provides a further level of planning detail for a 289 ha subset of the Alkimos-Eglinton site. The Alkimos LSP is located in the south-west corner of Alkimos-Eglinton, it represents about 8.5% of the Alkimos-Eglinton site. The Alkimos LSP site is located in an area that is zoned Urban in the MRS, it abuts Bush Forever site 397 (the foreshore reserve) at its western boundary and the Alkimos dune east-west conservation linkage at its northern boundary.

1.3 Objectives

Part One of the report; *Alkimos Eglinton District Structure Plan (DPS, 2008)* provides the following objectives:

- *To integrate areas of local significance (as defined by WALGA/ Perth Biodiversity Project's Local Government Biodiversity Planning Guidelines of the Perth Metropolitan Region 2004) and / or significant natural features within POS areas, road reserves, Green Linkages and suitably controlled private space.*
- *To maintain the ecological integrity of the coastal foreshore and manage it focussing on the needs for recreations and activity.*
- *To provide for a range of coastal recreational activities on the foreshore reserve and to enable development associated with Coastal Activity Centres, to satisfy the needs of the community.*
- *To provide a range of recreational opportunities within the DSP area, including active recreation, passive recreation and conservation areas and utilise multiple use opportunities such as passive recreation with conservation uses.*

- *To integrate the built environment with the natural ecosystem in a complementary manner.*
- *To consider the natural topography in conjunction with vegetation retention and the built environment.*
- *Accessible and high quality walking and cycling networks connect with key destinations and other transport modes.*

The LSP area is predominantly a residential area, in line with the 'Urban' zoning in the MRS. The environmental leadership objectives of the Alkimos LSP are:

- *Respond to and respect the protection of the natural environment.*
- *Preserve areas of highest conservation value and incorporate differing natural areas into the urban fabric.*
- *Facilitate minimising the carbon footprint in all phases of development including the ongoing living community.*
- *Understand and apply an integrated approach to management of all aspects of the water cycle to minimise water use, maximise water reuse and protect the health of water.*
- *Minimisation of use of resources through application of and adherence to Sustainability Principals addressing:*
 - *Energy.*
 - *Water.*
 - *Transport and movement efficiency and reduction in private car use and increased public transport usage.*
 - *Materials.*
 - *Water management.*
 - *Built form.*
- *Promotion of excellence and innovation in all aspects of environmental design and management.*

1.4 Purpose and Scope

The Alkimos LSP objectives listed in Section 1.3 of this report are addressed in several stand-alone documents that have been prepared to support the *Alkimos Local Structure Plan*.

Specifically, all sustainability initiatives and urban water issues are addressed in the following reports:

- *Report for Alkimos Local Structure Plan - Environmental Sustainability Strategy* (GHD, 2009).
- *Report on Alkimos Local Structure Plan - Local Water Management Strategy* (GHD, 2009).

The purpose of this Environmental Assessment document is to demonstrate how the Alkimos LSP has been designed so that development and occupancy of the site will proceed with proper reference to the environmental factors and issues highlighted in the *Alkimos Eglinton District Structure Plan* (DPS, 2008).

The scope of this document is to report on the existing environment of the site and the opportunities and constraints for the development of the site for residential proposes in accordance with the 'Urban' zoning in the MRS. This report also provides environmental management and implementation procedures in order to ensure that effective environmental management occurs during the implementation of the Alkimos LSP.

The following management plans provide specific details for the key environmental issues of vegetation and fauna management and foreshore management:

- *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy – Part Lots 101 and 1004 Alkimos* (RPS, 2009).
- *Alkimos Local Structure Plan, Foreshore Management Strategy - Part Lots 101 and 1004 Alkimos* (RPS, 2009).

1.5 Relevant Documents

Planning for the Alkimos-Eglinton project commenced in the 1990's involving extensive background studies over a range of issues, most of which were completed prior to the MRS Amendment 1029/33.

Environmental reports which have been prepared over the history of the project and contain relevant background information include:

- *Environmental Assessment of the Alkimos-Eglinton District Structure Plan* (RPS Bowman Bishaw Gorham, 2006).

- *Alkimos-Eglinton Coastal Strategy* (RPS Bowman Bishaw Gorham, 2006).
- *Alkimos-Eglinton Metropolitan Region Scheme Amendment No. 1029/33: Bulletin 1207* (EPA, 2005).
- *Metropolitan Region Scheme Amendment 1029/33: Alkimos-Eglinton Flora, Vegetation and Fauna Baseline Information* (ATA Environmental, 2005).
- *Alkimos-Eglinton Environmental Review* (ATA Environmental, 2003).
- *Coastal Planning Strategy* (ATA Environmental, 2003).
- *Coastal Planning Strategy Update* (Alan Tingay and Associates, 1999).
- *Alkimos-Eglinton Coastal Engineering Study* (MP Rogers and Associates, 1998).
- *Alkimos-Eglinton Environmental Report* (Alan Tingay and Associates, 1997).
- *Alkimos-Eglinton Vertebrate Fauna Survey* (Alan Tingay and Associates, 1996).
- *Vegetation Condition and Conservation Values Lots 8 and 11 Eglinton, City of Wanneroo* (Armstrong, 1996).
- *Alkimos-Eglinton Study: Definition of Foreshore Reserve Boundary and Environmental Assessment of proposed Alignment of Marmion Avenue/Mitchell Freeway* (Alan Tingay and Associates, 1993).
- *Eglinton Beach Resort: Report and Recommendations of the Environmental Protection Authority: Bulletin 500* (EPA, 1991).
- *A Report on the Flora and Vegetation of the Alkimos Area and Conservation Issues Affecting It* (Trudgen and Keighery, 1990). Unpublished report for LandCorp.
- *A Report on the Flora and Vegetation of the Ningana Area and Conservation Issues Affecting It* (Trudgen and Keighery 1990). Unpublished report for LandCorp.
- *Eglinton Beach Resort an appraisal of the vertebrate fauna* (Ninox Wildlife Consulting, 1990).

1.6 Definitions

Term	Definition
Declared Rare Flora	Those flora species protected under the <i>Wildlife Conservation Act 1950</i> , as identified in the current listing.
Biodiversity	<p>The variety of all life forms. The different plants, animals and micro-organisms, the genes they contain, and the ecosystems of which they form a part. Biodiversity has two key aspects:</p> <ul style="list-style-type: none"> ▪ Its intrinsic value at the genetic level, individual species level, and species assemblages levels. ▪ Its functional value at the ecosystem level. <p>Two species assemblages may have different intrinsic values but still have the same functional value in terms of the part they play in maintaining ecosystem processes.</p>
Bush Forever	A ten year strategic plan to protect some 51,200 ha of regionally significant bushland, representing, where achievable, a target of protecting at least 10% of each of the original twenty-six vegetation complexes on the Swan Coastal Plain portion of the Perth Metropolitan Region.
Ecological Linkages	Non-contiguous natural areas that connect larger natural areas by forming stepping stones that allow the movement over time of organisms between these larger areas.
Habitat Fragmentation	The process of isolating (usually by land clearing) a once continuous habitat into smaller isolated natural areas.
Priority Flora	Plant taxa that are under consideration as threatened flora, but need further survey to adequately determine their status, or are adequately known but require monitoring to ensure that their security does not decline. Priority Flora lists are maintained by the Department of Conservation and Land Management (CALM).
Priority Fauna	'Conservation significant' animal species listed by CALM's Threatened Species Consultative Committee but which are not currently listed under Section 14(2)(ba) of the <i>Wildlife Conservation Act 1950</i> as Specially Protected Fauna.
Specially Protected Fauna	Species protected under the <i>Wildlife Conservation Act 1950</i> .
Threatened Ecological Community	An ecological community that has been assessed through a procedure (coordinated by CALM) and assigned to a category related to the status of the threat to the community.
Threatened Flora	Plant species likely to become extinct or which are rare, and declared so, under Section 23F of the <i>Wildlife Conservation Act 1950</i> . See Declared Rare Flora.
Threatened Fauna	Animal species likely to become extinct or which are rare, and declared so, under Section 14(2)(ba) of the <i>Wildlife Conservation Act 1950</i> . See Specially Protected Fauna.

1.7 Abbreviations

Acronym	In Full
ANZECC	Australia and New Zealand Environment and Conservation Council
CoW	City of Wanneroo
DEC	Department of Environment and Conservation
DSP	District Structure Plan
DoW	Department of Water
DPS 2	City of Wanneroo District Planning Scheme No. 2
EPA	Environmental Protection Authority
FCT	Floristic Community Type
Ha	Hectares
Km	Kilometre
LSP	Local Structure Plan
M	Metre
MRS	Metropolitan Regional Scheme
PEC	Priority Ecological Community
POS	Public Open Space
ROS	Regional Open Space
TEC	Threatened Ecological Community
TPS	Town Planning Scheme
UXO	Unexploded ordnance
WAPC	Western Australian Planning Commission
WWTP	Waste Water Treatment Plant

2.0 EXISTING ENVIRONMENT

2.1 Location

The Alkimos LSP site is located approximately 40 km north of the Perth Central Business District. The land is bounded by the Indian Ocean in the west, Marmion Avenue and private land to the east, the Alkimos WWTP and associated buffer to the north and private land to the south (Figure 1).

2.2 Topography, Geology and Soils

2.2.1 Topography

Topography varies from 45 m above sea level in the east of the site to less than 1 m AHD to the west of the site in the foreshore reserve (DoW, 2000). The landscape is undulating, dominated by consolidated Quindalup dune formations, with swales between dune phases (Figure 2).

The Water Corporation is currently constructing the Alkimos WWTP. As part of the site works for the Alkimos WWTP, some 3,000,000 m³ of soil was excavated from the site. It is intended that this soil will be used as fill for the Alkimos LSP site. At the time of writing, there is a stockpile of soil in the south-east of the Alkimos LSP site, the dimensions of this stockpile are not known. Plans for fill over the Alkimos LSP site are discussed in more detail in the following report:

- *Alkimos Local Structure Plan - Report on Engineering Aspects* (Cossill and Webley, 2009).

2.2.2 Geomorphology

Soil mapping by McArthur and Bartle (1980) shows that the Alkimos LSP area primarily contains Quindalup dune formations comprised of unconsolidated sand (quartz grains) and shell fragments. The shell fragments are mostly calcium carbonate, so the sands are alkaline. The surface layers on the older dunes are darker due to organic matter accumulating over time.

Quindalup dunes are divided into four categories (Q1, the oldest dunes, to Q4 the youngest dunes). Q3 dunes dominate the Alkimos LSP site, these dunes have formed parabola shapes and generally extend up to 1 km inland. Q4 dunes are the dominant landform at the coast, in the foreshore reserve.



Plate 1: Q3 dune ridges and an inter-dunal basin

2.2.3 Surface Geology

The surface geology of the site varies from Safety Bay Sands in the west to calcarenite and kankar in the east, these are described below:

- Safety Bay Sands – eolian and beach lime sand, slightly lithified. Safety Bay sands have an average calcium carbonate content of over 50% and are made up of shell fragments (mainly foraminifera and molluscs) with variable amounts of quartz and minor feldspar. This poorly to moderately consolidated sand can be weakly cemented below the dune surfaces (Playford et al., 1976).
- Calcarenite and kankar – A limestone of coral or shell sand or sand derived from the erosion of older limestones, with sand sized particles. Calcarenite is generally formed by evaporation of lime-bearing waters drawn to the surface by capillary action (IGU, 2008).

2.2.4 Soils

The soils of the site were mapped by McArthur and Bartle (1980). Twelve mapping units were described based on geology, landform and soils. The dominant soil type on the LSP site is Quindalup (Q3). This unit is comprised of loose, calcareous sand with some organic matter in the first 10 cm and incipient cementation at depth.

The following soil types are also found on the site:

- Quindalup (Q4): Loose pale brown calcareous sand with no soil profile development.

- Quindalup (Qp): Quindalup Deep sand flat phase – dark grey-brown sand to about 50 cm and then pale brown sand.
- Quindalup Shallow sand flat phase (Qs): Shallow calcareous sands over limestone.
- Karrakatta Shallow Soils Phase: Bare rock, yellow/brown shallow sands and stony soils.

2.3 Hydrology and Hydrogeology

2.3.1 Surface Water Features

A small wetland known as Karli Spring is the only surface water feature in the vicinity of the site, it is located in an inter-dunal depression in the foreshore reserve in the south-west of the site. Karli Spring is an expression of groundwater; the result of a topographic depression in the Quindalup Dune System. Karli Spring is 1 m below sea level, approximately 175 m east of the coast. It contains permanent water and experiences only minor water level fluctuations (ATA Environmental, 2003).

The soils around Karli Spring consist of fine to medium grained calcareous sands of the Safety Bay Sand geological unit. According to the *Perth Groundwater Atlas* (DoW, 2004), the groundwater is migrating in a westerly direction, towards the Indian Ocean.

Karli Spring is not identified as a wetland in the DEC's *Geomorphic Wetlands of the Swan Coastal Plain Database* and does not have an assigned management category.

A preliminary investigation into the water quality and hydrological characteristics of Karli Spring has been undertaken by RPS between October 2008 and July 2009. The investigation included the installation of three groundwater monitoring bore in the vicinity of the wetland and a quarterly groundwater and surface water monitoring program.

The results of the investigation indicate concentrations of Total Nitrogen, Reactive Phosphorous and Total Phosphorus were higher than the ANZECC Guidelines. Groundwater is neutral to slightly alkaline, most likely due to the carbonate in the aquifer materials. As expected, dissolved oxygen levels are considerably higher in the surface water than the groundwater.

Groundwater entering Karli Spring contained higher NO_x-N levels than the water within and to the west of the wetland. Ammonia levels, however were higher to the west, while there was no ammonia in the water entering or within the wetland. Ammonia is generally indicative of reducing conditions and its presence is likely to be the result of thick reeded vegetation. Phosphorus levels are somewhat higher in the surface water; the lower groundwater concentrations are potentially the result of plant uptake and sorption to aquifer soils.

The bioavailable component of nitrogen is the dissolved inorganic nitrogen (DIN), which is the sum of NO_x-N and ammonia-N. The DIN value was not detected in the surface water samples, indicating the water in the wetland has minimal bioavailable nitrogen. The FRP, which is the bioavailable component of phosphorus was generally a high fraction the TP concentration, indicating much of the phosphorus in the surface water is bioavailable.

The historical land uses for the site are not likely to have continually influenced concentrations of nutrients in the groundwater of the area. Higher than normal results may be indicative of naturally occurring background levels.



Plate 2: Karli Spring

2.3.2 Groundwater

The *Perth Groundwater Atlas* (WRC, 1997) indicates the regional groundwater flow direction is south-east toward the Indian Ocean at a gradient of 0.001. The *Perth Groundwater Atlas* (WRC, 1997) indicates that the groundwater beneath the Alkimos LSP site is approximately at sea level; maximum groundwater levels range from 0 m AHD at the coast to 1 m AHD in the north-east of the site. The topography of the site varies significantly as described in Section 2.2, and consequently the depth to groundwater is generally the height of the land above sea level, which ranges on the LSP site between 5 and 45 m AHD.

2.4 Vegetation and Flora

Vegetation and flora of the Alkimos-Eglinton site has been comprehensively investigated during the planning for the site over the last two decades. Detailed vegetation and condition mapping over Alkimos-Eglinton was produced in 2004 to support the EPA assessment of the MRS Amendment 1029/33. Results are presented in ATA Environmental (2005), this information is reproduced in this report for the Alkimos LSP site (Figures 4 and 5).

2.4.1 Vegetation

The Alkimos LSP area predominantly supports Quindalup vegetation complex. Remnant vegetation covers approximately 50% of the Alkimos LSP site. Historically grazing has been conducted on the site, the effects of this activity are most prevalent in the relatively level inter-dunal basins, where there is now a high percentage of weed species. The majority of better quality vegetation on the site is located on the dune ridges that were not grazed as intensively.

As discussed in Section 2.2.1 of this report, there is a stockpile of soil in the south-east of the LSP site from the excavation required from the Alkimos WWTP site. This stockpile was located in a previously cleared section of the site in order to minimise the disturbance of the better quality vegetation on the site. Haul roads between the Alkimos WWTP site and the stockpile area has caused some disturbance to vegetation on the Alkimos LSP site.

The remnant dune vegetation is dominated by *Melaleuca systema* and *Lomandra maritima*. The only trees on the site are scattered Tuart (*Eucalyptus gomphocephala*), which generally occur in locations that are sheltered from the prevailing winds, near the WWTP buffer and the foreshore reserve (Figure 4).

An aboriculturalist was engaged in August 2008, to assess the condition of 49 Tuart trees located on or adjacent to the Alkimos LSP site. Due to the exposed location of the site, most of the trees are generally in poor condition and their growth has been stunted. Many of the trees have sparse upper and western canopies and they have grown at extreme angles due to the strong winds.

According to ATA Environmental (2005), the vegetation that remains on the site varies from 'Completely Degraded' to 'Very Good' condition.

According to ATA Environmental (2005), the Alkimos LSP site also contains two Floristic Community Types (FCTs) that are listed by the DEC as Priority Ecological Communities (PECs), as follows:

- FCT24 – Northern Spearwood shrublands and woodlands.
- FCT29b – Acacia shrublands on taller dunes, southern Swan Coastal Plain.

These PECs are Priority 3, indicating that the ecological community is poorly known, however these are communities known from several occurrences, of which a significant number or areas are not under threat of habitat destruction or degradation (DEC, 2007). As much of the Alkimos LSP site is in degraded condition, some areas of FCT 24 and FCT 29b are in poor condition.



Plate 3: Coastal Heath – Quindalup Dunes

2.4.2 Flora

No Declared Rare or Priority 1 Flora species have been recorded on the Alkimos LSP site. One Priority 2 species and two Priority 3 species were recorded on the site during the 2004 vegetation survey or earlier vegetation surveys (ATA Environmental, 2005) (Table 1) (Figure 4).

Table 1: Priority Flora Species

Taxon	Significance Code	Description
<i>Crassula colorata</i> <i>subsp. planescens</i>	Priority 2	This species was found by E. Bennett in 2004 (ATA Environmental, 2005).
<i>Hibbertia spicata</i> <i>subsp. leptotheca</i>	Priority 3	This species was found by Trudgen and Keighery (1990a) and E. Bennett in 2004 (ATA Environmental, 2005).
<i>Sarcozona</i> <i>bicarinata</i>	Priority 3	This species was found by E. Bennett in 2004 (ATA Environmental, 2005).

Priority 2 – Poorly-known ecological communities, known from few small occurrences all or most of which are actively managed for conservation.

Priority 3 – Poorly known ecological communities, known from several to many occurrences and known threatening processes exist that could affect them.

Priority 4 – Ecological communities that are adequately known, rare but not threatened or meet the criteria for Near Threatened, or that have been recently removed from the threatened list.

2.5 Fauna

A number of fauna surveys have been completed in the Alkimos region over the last 20 years. These surveys have been conducted using a range of desktop surveys and trapping programs (using Elliot pit fall and cage traps) and opportunistic surveys. Information on the fauna likely to occur on the Alkimos LSP site has been drawn from the following sources:

- *Alkimos proposed Waste Water Treatment Plant: Fauna Assessment* (Bamford and Davies, 2005)
 - This report was commissioned by the Alkimos Water Alliance. This document was prepared to fulfil the requirements of Condition 10-1, Ministerial Statement 755 for the Alkimos WWTP.
- *Terrestrial vertebrate fauna species likely to be found in the Alkimos-Eglinton area, with a comment on significant fauna species and the impacts of the proposed disturbance* (Thompson, 2005)
 - This report was commissioned by ATA Environmental as part of a series of environmental studies that were undertaken for MRS Amendment 1029/33. It contains a review of literature and opportunistic fauna sightings.
- *Alkimos-Eglinton Vertebrate Fauna Survey* (Alan Tingay and Associates, 1996)
 - This report was completed as part of a series of environmental studies commissioned by LandCorp and Eglinton Estates Pty Ltd to assist the development of planning strategies for the Alkimos-Eglinton region. It was a comprehensive fauna investigation that included fauna trapping.

The habitats within the Alkimos-Eglinton area can be broadly separated into three major types. These are based on the broad vegetation units that reflect the underlying soil types and geomorphic features. The main broad habitat types are comprised of:

- Old Quindalup heath.
- Limestone heath.
- *Banksia* woodland.

Other habitats which constitute a relatively minor proportion of the area include heath on the younger Quindalup dunes, Tuart Woodland and cleared grassland or pasture.

The habitats in the Alkimos LSP area generally comprise coastal heath and old Quindalup heath. The LSP area contains some of the most degraded areas on the Alkimos-Eglinton site due to historic agricultural land use.

Dr Mike Bamford from Bamford Consulting Ecologists was consulted during October 2008 to review the existing fauna lists for the Alkimos LSP area from Alan Tingay and Associates (1996), Thompson (2005) and Bamford and Davies (2005). Based on his extensive experience in the general area, including the Alkimos WWTP site, directly adjacent to the Alkimos LSP area, Dr. Bamford determined the fauna species that are most likely to occur in the Alkimos LSP area. These are presented in Table 2 (refer to Appendix 1 of the report; *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy* (RPS, 2009) for the consolidated list of fauna that may occur on the site).

Table 2: Significant Fauna Species that Potentially Occur on the Alkimos Site

Species	Common Name	EPBC Act 1999	Wildlife Conservation Act 1950	Specially Protected
Reptiles				
<i>Ctenotus catenifer</i>				CS3
<i>Ctenotus gemmula</i>	Jewelled Ctenotus			CS3
<i>Neelaps calonotos</i>	Black-striped Snake		CS2, Priority 3	
Mammals				
<i>Isodon obesulus fusciventer</i>	Quenda or Southern Brown Bandicoot		CS2, Priority 5	
<i>Trichosurus vulpecula</i>	Brush-tailed Possum			CS3
<i>Rattus fuscipes</i>	Moodit or Bush-rat			CS3
Birds				
<i>Calyptorhynchus latirostris</i>	Short-billed (Carnaby's) Black-Cockatoo	CS1 - Schedule 1		
<i>Neophema petrophila</i>	Rock Parrot			CS3
<i>Platycercus icterotis</i>	Western Rosella			CS3
<i>Malurus splendens</i>	Splendid Fairy-wren			CS3
<i>Malurus leucopterus</i>	White-winged Fairy-wren			CS3
<i>Sericornis frontalis</i>	White-browed Scrubwren			CS3
<i>Anthochaera lunulata</i>	Western Wattlebird			CS3
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater			CS3
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater			CS3
<i>Phylidonyris melanops</i>	Tawny-crowned Honeyeater			CS3
<i>Acanthorhynchus superciliosus</i>	Western Spinebill			CS3
<i>Petroica multicolor</i>	Scarlet Robin			CS3
<i>Melandodryas cucullata</i>	Hooded Robin			CS3
<i>Eopsaltria georgiana</i>	White-breasted Robin			CS3

Species	Common Name	EPBC Act 1999	Wildlife Conservation Act 1950	Specially Protected
<i>Artamus cinereus</i>	Black-faced Woodswallow			CS3
Insects				
<i>Synoemon gratiosa</i>	Graceful Sun Moth	CS1 - Endangered	CS1 – Schedule 1	

Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts.

Conservation Significance (CS) 2: Species not listed under State or Commonwealth Acts, but listed in publications on Threatened Fauna or as Priority species by DEC.

Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

Of the species listed in Table 2, the following significant species are considered to be the most relevant to the site, a brief description is provided below:

- *Calyptorhynchus latirostris* (Carnaby's Black-Cockatoo), is listed as 'Schedule 1' fauna under the *Wildlife Conservation Act 1950* and 'Endangered' under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). It is likely to regularly over fly the area due to the good quality foraging habitat that exists nearby. There is very limited foraging habitat (e.g. *Banksia sessilis*) available for the cockatoo on the Alkimos LSP site which may occasionally be used by the cockatoo for foraging however the site does not contain a significant food resource for this species compared to other areas in Alkimos-Eglinton and surrounds.
- At the time of the fauna review by Dr Mike Bamford, the Graceful Sun Moth (*Synoemon gratiosa*) was not considered likely to occur on the site. The Graceful Sun Moth is listed as 'Schedule 1' fauna under the *Wildlife Conservation Act 1950* and 'Endangered' under the EPBC Act. The Graceful Sun Moth was not known to occur in near coastal locations until its recent discovery in March 2009 at Ocean Reef, some 20 km south of the Alkimos LSP site. The Graceful Sun Moth has been added to Table 2 of this report as the result of its recent identification Ocean Reef, and due to the recent expansion of the possible range of this species on the DEWHA web based search tool for protected matters. The Graceful Sun Moth is known to be very localised in occurrence with low mobility and are thought to travel no more than 200 m from where they hatch. The only time to survey for the Graceful Sun Moth is during March. At the time of writing, it is not known whether the Graceful Sun Moth occurs on the site.
- *Isodon obesulus fusciventer* (Quenda or Southern Brown Bandicoot) a Priority 5 Species protected under the *Wildlife Conservation Act 1950* and *Neelaps colnotos* (Black-striped Snake) a Priority 3 Species protected under the *Wildlife Conservation Act 1950* are unlikely to be permanent residents within the site. If they are present on the site, they would most likely reside in the areas of better quality vegetation in the adjacent reserves.

- *Rattus fuscipes* (Moodit or Bush Rat) may also be located on the site although it would be most likely to occur around Karli Spring which is located in the foreshore reserve (Bush Forever site 397). This species is not protected by Federal or State legislation.

2.6 Areas of Regional Conservation Significance

The EPA assessed the MRS Amendment 1029/33 under Section 48A of the *Environmental Protection Act 1986* as an Environmental Review, the assessment was finalised in 2006. Through their assessment the EPA identified regionally significant areas of Alkimos-Eglinton, principally identified for geoheritage and biodiversity values. These areas of interest to the EPA have subsequently been zoned as Parks and Recreation and Public Purpose (Conservation) in the MRS. As a result of the assessment, some 500 ha of or 20% of the Alkimos-Eglinton site is reserved for conservation.

The Alkimos LSP site includes the majority of the foreshore reserve along its western margin. This area is part of Bush Forever site 397 which forms part of a semi-contiguous north-south vegetated coastal strip. Karli Spring is located in Bush Forever site 397. The recommendations of the EPA in their report; *Alkimos-Eglinton Metropolitan Region Scheme Amendment No. 1029/33* (EPA, 2005) included increasing the size of the foreshore reserve around Karli Spring to include additional areas of consolidated Quindalup Dunes to protect Aboriginal Heritage values associated with Karli Spring and an excellent 2.8ha population of *Allocasurina lehmanniana* (Dune Sheak) Closed Heath that is not recorded elsewhere in the area and may be used as a feeding habitat by Carnaby's Black-Cockatoo and other bird species. The EPA considered that this area forms part of a larger natural area of outstanding regional significance; Bush Forever site 397 (EPA, 2005).

The Alkimos LSP site also abuts the east-west conservation linkage associated with the Alkimos WWTP buffer on the northern margin. This area is not currently a Bush Forever site, however it is zoned for Parks and Recreation and Public Purposes (Conservation) in the MRS.

The majority of the Alkimos LSP area is zoned 'Urban' in the MRS (Figure 6). According to EPA (2005), there are no known areas of regional conservation significance within the 'Urban' zoned portion in the Alkimos LSP site.

The site has not been assessed under the Commonwealth EPBC Act. The site may contain habitat for two fauna species protected under the EPBC Act; Carnaby's Black-Cockatoo and Graceful Sun Moth. The Alkimos LSP may require referral under the EPBC Act if the potential impacts on one of these species are likely to be significant.

3.0 RELEVANT ENVIRONMENTAL APPROVALS AND GUIDELINES

3.1 Environmental Approvals

Amendment 1029/33 to the MRS was assessed by the EPA from 2003 to 2006 under Section 48 of the *Environmental Protection Act 1986* as an Environmental Review. The amendment was approved by the Minister for the Environment on 24 April 2006 and gazetted by the Western Australian Government on 23 June 2006. Any future proposals for the area, that are in accordance with the assessed MRS, do not require assessment by the EPA (for the assessed environmental factors).

Proposals to subdivide land within the Alkimos-Eglinton area in accordance with the MRS and TPS can be referred to the EPA under Section 38 of the *Environmental Protection Act 1986* if the CoW considers that EPA assessment is necessary.

3.2 Environmental Guidance Documents

3.2.1 City of Wanneroo Local Environment Strategy

The Local Environment Strategy (CoW, 2002) identifies the following six 'Key Focus Areas':

- Biodiversity (bushland, wetland and coastal zone management).
- The enhanced greenhouse effect.
- Waste (reduction, reuse, recycling, cleaner production).
- Resource conservation and management.
- Community participation and environmental awareness.
- Sustainability.

3.2.2 City of Wanneroo Local Biodiversity Strategy

The CoW is participating in a pilot project with the Perth Biodiversity Project to develop a Local Biodiversity Strategy, and recently prepared the report; *Local Biodiversity Strategy 2008-2013: A Draft for Discussion* (CoW, 2008). The *Local Biodiversity Strategy 2008-2013: A Draft for Discussion* (CoW, 2008) outlines nine guiding principles for local biodiversity conservation, as follows:

- Retention of at least 30% of the pre-European extent of each ecological community is required to prevent an exponential loss of species and failure of ecosystem processes.
- Protect regionally significant and Locally Significant Natural Areas.

- Biodiversity is best conserved in situ; protecting what exists is preferable to revegetating.
- Regeneration is a higher priority than revegetation.
- Prioritise protection and management of the highest biodiversity value natural areas.
- Community involvement in helping biodiversity.
- Biodiversity values must be transparent in decision-making processes.
- Site-specific field survey is essential to understand biodiversity value.
- Natural area conservation is a legitimate land use (Del Marco et al., 2004).

The *Local Biodiversity Strategy 2008–2013: A Draft for Discussion* (CoW, 2008) recommends that conservation of biodiversity be achieved through the incorporation of natural areas in 'Passive POS'. A minimum of 10% of the gross subdivisible area is required to be allocated to POS, *Local Biodiversity Strategy 2008-2013: A Draft for Discussion* (CoW, 2008) indicates that approximately 30% of this area could be allocated to Passive POS, with the remaining 70% allocated to Active POS (i.e. 3% of the gross subdivisible area could be Passive POS, while 7% of the gross subdivisible area could be Active POS). The strategy endorses the following measures:

- Incorporate natural area retention into passive recreation space. These spaces should be vested as 'conservation and (passive) recreation' so that the conservation significance is acknowledged, however they should not be considered restricted open space.
- Where only a low proportion of active recreation POS is required (as confirmed by the cities leisure planners) the allocation of POS reserved for 'conservation' or 'conservation and (passive) recreation' should be increased where there is a demonstrated biodiversity outcome;
- Incorporation of natural areas with drainage (e.g. to uptake a 1 in 5 year rain event so that a higher proportion of restricted open space includes natural areas).
- Where density increases, increase POS provision.

3.2.3 **Guidance Statement No. 33 – Environmental Guidance for Land Development**

Guidance Statement No. 33 (EPA, 2005) outlines the environmental protection process and provides the EPA's advice on a range of environmental factors in order to assist in the protection, conservation and enhancement of the environment during the land planning and development process.

4.0 ENVIRONMENTAL OPPORTUNITIES AND CONSTRAINTS

4.1 Landform and Landscape

Geoheritage does not present a constraint to the development of the Alkimos LSP site. As described in Section 1 of this report, the Alkimos-Eglinton area, was assessed by the EPA between 2003 and 2006 under Section 48 of the *Environmental Protection Act 1986* as an Environmental Review. Geoheritage was one of the factors in the EPA's assessment. The dune formations in the 'Urban' zoned portion of the Alkimos LSP area were not deemed to be of geoheritage value by the EPA (EPA, 2005). The 'Alkimos Dune' to the north of the WWTP was considered to be a potential geological monument and have been retained in designated Regional Open Space.

All of the most recent Quindalup Dunes (Q4) on the site are retained in the foreshore reserve which is zoned for 'Parks and Recreation' in the MRS.

The Alkimos LSP area contains several interconnected lines of Q3 dune parabola formations. There is an opportunity to preserve these dunes and the vegetation they support that is in relatively good condition, in order to maintain some of the natural dune topography within the development area. The retention of some of the existing landforms on the Alkimos LSP site would add to the local character and visual amenity of a future development, while conserving remnant vegetation on the site and contributing to the sustainable vision of the Alkimos LSP site. The retention of a number of Q3 dunes within POS in the LSP design provides an opportunity to conserve the native vegetation the dunes support, create ecological linkages through the Alkimos LSP, preserve some of the Tuart trees and provide areas for recreational activities.

Additionally there is an opportunity to preserve some of the Q2 dune type east and central section of the LSP site. This is part of the less distinct, fretted, southern arm of the Alkimos Dune system; the northern arm of this parabola was recognised as having geoheritage significance by the EPA during the MRS Amendment 1029/33.

4.2 Vegetation and Flora

Vegetation and flora do not present a constraint to the development of the 'Urban' zoned portion of the Alkimos LSP site. As described in Section 1 of this report, the Alkimos-Eglinton area, was assessed by the EPA between 2003 and 2006 under Section 48 of the *Environmental Protection Act 1986* as an Environmental Review. 'Vegetation' was one of the factors in the EPA's assessment and consequently the vegetation values of the LSP site have been assessed by the EPA. Vegetation with regional significance values has been preserved in conservation areas in the MRS.

The foreshore reserve is zoned for 'Parks and Recreation' in the MRS, the EPA considered that this area forms part of a larger natural area of outstanding regional significance; Bush Forever site 397 (EPA, 2005). Bush Forever sites are to be managed principally for the purpose of conservation. Any proposals for the development of public infrastructure within the foreshore reserve should be developed in consultation with the Bush Forever office. Such proposals will also be subject to Condition 2 of Ministerial Statement 722 for MRS Amendment 1029/33, and as such, an Environmental Management Plan(s) (EMP) will be required to be prepared to the satisfaction of the Local Authority for proposals within the foreshore reserve.

The Alkimos LSP site contains vegetation of varying type and condition. Portions of the site were previously used for grazing; generally, the flatter areas were cleared for agriculture and the steeper dune areas were not cleared and therefore support the better areas of vegetation on the site. In addition to the historical land uses, in more recent times, parts of the site have been cleared to facilitate the construction of the Alkimos WWTP and the associated infrastructure, such as the ocean outfall site and haul roads.

Despite the degraded nature of the site, there is an opportunity to retain certain areas of comparatively better quality vegetation on the site and to locate future development on areas that are already degraded as a result of past land uses. The retention of remnant vegetation within the proposed Alkimos LSP for the site can provide the following environmental benefits:

- Provide habitat value for fauna (particularly where remnant vegetation contains mature trees or forms part of an ecological linkage).
- Maintain the biodiversity values of the site by preserving examples of the original vegetation and flora of the site.
- Maintain the character of the site.

According to ATA Environmental (2005), one Priority 2 flora species, two Priority 3 flora species and several other flora species considered significant in Bush Forever either occur on or in proximity to the Alkimos LSP site. There is an opportunity to reserve these species in Passive POS areas where possible and use these species in landscaping and rehabilitation works following construction.

4.2.1 Tuart Trees

Eucalyptus gomphocephala (Tuart) is a species of Eucalyptus endemic to the Swan Coastal Plain of Western Australia. The Tuart grows in a 400 km coastal band from Jurien Bay to just east of Busselton. It is the largest tree on the Swan Coastal Plain and can grow up to 42 m high.

Tuart trees are not formally protected through state or federal environmental legislation, however the significance of Tuart trees is well known.

There are approximately 50 Tuart trees on the site, in varying states of health due to the exposed nature of the site. Some trees may need to be removed because they would present a hazard in an urban environment. Despite this, there is an opportunity to retain suitable Tuart trees within POS reserves in the LSP design, trees that are to be retained will probably require dangerous, unhealthy or dead limbs to be removed by an arbouriculturalist to remove any risk to the public and to increase the likelihood of the survival of the trees in POS areas.

Through the development of the site for residential proposes, shelter from the prevailing winds will be created by buildings and other vertical features of the development. This will create microclimates on the site where trees, such as Tuart trees, will be able to grow with more success than in the current environment. There is an opportunity to plant more Tuart trees on the site in POS areas and road reserves to increase the total number of trees on the site and provide additional habitat for fauna.

4.3 Fauna

As described in Section 1 of this report, the Alkimos-Eglinton area, was assessed by the EPA between 2003 and 2006 under Section 48 of the *Environmental Protection Act 1986* as an Environmental Review. 'Fauna' was one of the factors in the EPA's assessment and consequently the habitat values of the LSP site have been assessed by the EPA. The EPA did not consider the fauna values of the 'Urban' zoned portion of the site fauna to be regionally significant.

The site may contain habitat for two fauna species protected under the Commonwealth EPBC Act: Carnaby's Black-Cockatoo and Graceful Sun Moth.

There is thought to be approximately 17,000 ha of foraging habitat for Carnaby's Black-Cockatoo in the City of Wanneroo. The Alkimos LSP site consists of mostly Quindalup vegetation types which are not favoured by the cockatoo as foraging habitat, however there are a few foraging habitat trees in relatively poor condition at the Quindalup/Spearwood soil interface within the Alkimos LSP site and it is possible that the Cockatoo will feed on the 2.8 ha stand of *Allocasurina lehmanniana* (Dune Sheoak) Closed Heath in the foreshore reserve. While some habitat may be lost through the implementation of the Alkimos LSP, there is an opportunity to use food plants for this species in landscaping to create a net gain in the cockatoo foraging habitat value of the Alkimos LSP site. At the appropriate stage of the planning process, the proposal to develop the site in accordance with the Alkimos LSP should be referred to the Federal Minister for the Environment for assessment under the EPBC Act to determine whether the potential effect on the Carnaby's Black-Cockatoo is likely to be significant under the terms of the EPBC Act.

At the time of writing, it is not known whether the Graceful Sun Moth occurs on the Alkimos LSP site. The only possible time to survey for the Graceful Sun Moth is during March. It is recommended that a survey is conducted for the Graceful Sun Moth and if the moth is found on the site, the proposal to develop the site in accordance with the Alkimos LSP should be referred to the Federal Minister for the Environment for assessment under the EPBC Act to determine whether the potential effect on this species is likely to be significant.

For all fauna species that occur on the site, there is an opportunity to retain some areas of native vegetation within Passive POS to form ecological corridors will facilitate fauna movement through the Alkimos LSP site to areas of native vegetation that are preserved through the MRS such as the foreshore reserve and Alkimos Dune reservation.

5.0 LOCAL STRUCTURE PLAN

5.1 Description

The Alkimos LSP has been developed to guide the subdivision and development of 289 ha of undeveloped land in the south-west section of the area known as Alkimos-Eglinton. The Alkimos LSP is described in the report *Alkimos Local Structure Plan (2009)*, to which this report forms an appendix.

The Alkimos LSP is predominantly a residential area in accordance with the zoning. The Alkimos LSP can be divided into the following land uses:

- Residential.
- Coastal node.
- Movement network.
- Schools.
- Public Open Space.
- Local shopping precinct.

The Alkimos LSP is shown in Figure 7.

5.2 Alkimos LSP Design Response

As discussed in Section 4.0 of this report, there are few environmental constraints on the Alkimos LSP site. This is the result of the EPA assessing Alkimos-Eglinton MRS Amendment 1029/33 as an Environmental Review under the *Environmental Protection Act 1986* and through that assessment recommending areas of regional environmental significance to be included in conservation reserves in the MRS to the Minister for the Environment.

The recommendations of the EPA in their report; *Alkimos-Eglinton Metropolitan Region Scheme Amendment No. 1029/33* (EPA, 2005) included increasing the size of the foreshore reserve around Karli Spring to include additional areas of consolidated Quindalup Dunes to protect Aboriginal Heritage values associated with Karli Spring and an excellent 2.8 ha population of *Allocasurina lehmanniana* (Dune Sheoak) Closed Heath that is not recorded elsewhere in the area and may be used as a feeding habitat by Carnaby's Black-Cockatoo and other bird species. The EPA considered that this area forms part of a larger natural area of outstanding regional significance; Bush Forever site 397 (EPA, 2005).

The Minister for the Environment implemented the EPA's recommendations in Ministerial Statement 722 and this resulted in approximately 500 ha or 20% of the greater Alkimos-Eglinton site being reserved for conservation proposes in the MRS, including additional areas being added to the foreshore reserve around Karli Spring to protect the ecological values of this area.

During their assessment, the EPA found that there were no areas of regional environmental significance on the 'Urban' zoned portion of the Alkimos LSP site. This portion of the site is already significantly degraded from historical farming practices and from recent works associated with the construction of the Alkimos WWTP.

The environmental opportunities presented on the Alkimos LSP site are discussed in Section 4.0 of this report. The Alkimos LSP design has responded to as many of these environmental opportunities as practicable in a residential area, as discussed in the following sections.

The foreshore reserve has high ecological and linkage values and where appropriate the area will be managed as a conservation reserve. Access to the beach will be concentrated at the proposed Alkimos coastal node. The environmental management of the foreshore reserve area is discussed in further detail in the report: *Alkimos Local Structure Plan, Foreshore Management Strategy – Part Lots 101 and 1004 Alkimos* (RPS, 2009).

5.2.1 Landform and Landscape

There are a number of environmental objectives which underpin the Alkimos LSP design and set the approach for landform and landscape. These are to:

- Preserve areas of highest conservation value and create ecological linkages.
- Conserve examples of different natural areas on site and preserve biodiversity.
- Create sustainable conservation areas.
- Incorporate natural areas into new urban fabric.
- Interpret existing landscape and site memory in development areas.
- Incorporate the natural local landscape character within new public domain planting.
- Develop community awareness and involvement.

Retention of landform and preservation of key landscape features is one of the driving elements of the LSP design. The LSP design response was to include the retention of prominent existing Quindalup dune areas within the developable area of the LSP. These will be retained within Passive POS areas in the future urban environment. The retention of these areas will provide examples of the pre-development landforms of the site and will also contribute to the retention of flora and fauna species and the preservation of biodiversity on the site.

Where possible, Passive POS areas known as 'Dune Parks', have been located to retain the most intact areas of Q2 and Q3 dune formations, the best quality vegetation on the site on the dune ridges and preserve ecological corridors through the site. There are four Dune Parks in the proposed Alkimos LSP, these are shown in Figure 7 and are described below:

- **Western Dune Park** is 10.6 ha and is located in the west of the Alkimos LSP area, it provides a strategic linkage between the foreshore reserve (Bush Forever site 397) and the area zoned as Public Purposes (for the purpose of Conservation) in the MRS located in the Alkimos WWTP buffer. The strategic location of POS in this area provides an alternative north–south linkage around the eastern side of the Alkimos WWTP. This linkage will be significant to the retention of biodiversity in the area following the development of the site for residential proposes. Following the development of the site, activity will be concentrated at the proposed coastal node at the Alkimos regional beach and at some stage in the future, a marina may be proposed for this location, both of which will impact the north-south linkage value of Bush Forever site 397. Due to its strategic function, the Western Dune Park will have minimal built insertions. The landform that will be retained in the Western Dune Park is a relatively intact Q3 dune. According to ATA Environmental (2005) the vegetation condition ranges from 'Very Good' to 'Completely Degraded', with areas of localised disturbance. This POS area was also located in this area to enable the retention of some existing Tuart trees. It is proposed that the Western Dune Park will be a Passive POS area with the primary function of conserving the environment while providing controlled access for passive recreation.
- **Central Dune Park** is 8.7 ha and is located in the central west of the Alkimos LSP area. This area was included in Passive POS to preserve a section of one of the dominant Q3 landforms on the site. Central Dune Park forms part of a non-contiguous east–west linkage from the foreshore reserve to a POS area in the neighbouring Lot 3. The landform is relatively intact and according to ATA Environmental (2005) the vegetation it supports is in 'Very Good' to 'Good' condition, however the eastern margin of this proposed POS area has recently been cleared during the construction phase of the Alkimos WWTP. It may be that this cleared area will be used as a landscaped 'Active POS' park adjacent to the area of Passive POS that will be retained in its original condition. It is intended that this POS area will have several small areas of active POS at the base of the dune. Central Dune Park POS area will contain areas of both Passive POS and Active POS.
- **South Alkimos Dune Park** is 5.9 ha and is located in the south-east of the Alkimos LSP area. This area was included in Passive POS to preserve a section of one of the dominant Q3 landforms on the site. South Alkimos Dune Park forms part of a non-contiguous east-west linkage from the foreshore reserve to a POS area in the neighbouring Lot 3. The landform is relatively intact and according to ATA Environmental (2005) the vegetation it supports is in 'Very Good' to 'Good'

condition, however areas in the northern and southern margins of this proposed POS area has recently been cleared during the construction phase of the Alkimos WWTP. It may be that these cleared areas will be used as landscaped 'Active POS' parks adjacent to the area of Passive POS that will be retained in its original condition. It is intended that this POS area will have several small areas of active POS at the base of the dune. South Alkimos Dune Park POS area will contain areas of both Passive POS and Active POS.

- **Gateway Dune Park** is 4.3 ha and is located in the east of the Alkimos LSP area. This area was included in POS to preserve the dominant section of Q2 dune on the site. The dune proposed to be preserved in this area of POS is part of the less distinct southern arm of the Alkimos Dune, the northern arm of which is now included in lands reserved for conservations proposes in the MRS following recommendations made by the EPA during the assessment of the Alkimos-Eglinton MRS Amendment 1029/33. This landform continues outside the site to the east, this area could become part of a future ecological link if the remainder of the dune is included in POS during the planning for the neighbouring Regional Centre. According to ATA Environmental (2005) the condition of the vegetation is 'Good' to 'Good-Degraded'. It is intended that this POS will have several small areas of active POS at the base of the dune. Gateway Dune Park POS area will contain areas of both Passive POS and Active POS.

Areas of POS in the Alkimos LSP have been developed to provide the necessary active recreation opportunities for the future residents of the area whilst also preserving as many ecological values as practicable on urban zoned land within the LSP area.

The design and character of the Dune Parks is driven by retained existing topography and remnant vegetation. In order to provide passive recreation opportunities for residents as well as encourage residents to walk to destinations within the LSP site, a network of pathways and tracks is proposed for the Dune Parks, extending the surrounding street network into and through the Dune Parks. Controlled access to diverse parts of the Dune Parks, such as exposed and protected areas, high and low points, will be provided to protect the vegetation from damage while providing good visual access.

Usable recreation areas are proposed for the base of the dunes, adjacent to the residential areas. These spaces will include areas of irrigated turf, playgrounds, park furniture, mass planting, dune revegetation and exercise equipment provide the ingredients for a community-focused recreation space, nestled into the natural dunal landscape.

The key principles for the Dune Parks are:

- Retain the designated dunes, enabling retention of the existing dunal vegetation. Remediate areas of disturbance and degradation.

- Provide new indigenous mass plating at the base of the dunes to define and stabilise the edges.
- Provide open-style dune fencing to protect remnant vegetation; and educational signage to encourage people to recreate only in designated areas.
- Provide way finding signage as part of a comprehensive signage strategy for Alkimos.
- Provide areas for rest and recreation on the sheltered lee side of the dune where possible.
- Locate boardwalks and walking tracks to provide a connected web of pathways which respect and respond to the dunal topography. Position lookouts at appropriate high points.
- Provide hardy shade trees appropriate to the soil and wind conditions.
- Limit and designate areas requiring irrigation.

In addition to preserving areas of existing landforms and vegetation in POS areas, new urban areas within the LSP will provide a web of green streets, linking Dune Parks, recreation areas and urban open spaces. This green armature is designed to tie-in with the existing local landscape character, incorporating a high proportion of native plant species. Retention and interpretation of the natural topography reinforces the 'memory' of the site.

Where appropriate, local linkages have been designed to include landscaped parks, ovals, schools, pedestrian boulevards, cycle paths, wide vegetated road reserves or drainage areas. Such linkages will also be utilised to provide a pedestrian network through the development between features such as the beach and the town centre, to encourage walk-ability and reduce the use of cars for short trips within the development.

5.2.2 Vegetation, Flora and Fauna

As discussed in Section 2.0 of this report, and shown in Figure 5, the better quality remnant vegetation that occurs on the site is located on the dune ridges due to the historical rural land use that occurred on the site, predominantly in the inter-dunal swales. The retention of landform in Passive POS areas described in Section 5.2.1, the retention of landforms on the site in Dune Parks, will also result in the retention of the best quality vegetation on the site.

There are a number of environmental objectives which underpin the Alkimos LSP design and set the approach for vegetation, flora and fauna. These are to:

- Preserve areas of highest conservation value and create ecological linkages.

- Conserve examples of different natural areas on site and preserve biodiversity.
- Create sustainable conservation areas.
- Incorporate natural areas into new urban fabric.
- Interpret existing landscape and site memory in development areas.
- Incorporate the natural local landscape character within new public domain planting.
- Develop community awareness and involvement.

Retention of natural dune vegetation in the LSP area is one of the driving elements of the Alkimos LSP design. The LSP design response was to include the retention of prominent existing Quindalup dune areas within the developable area of the LSP as described in Section 5.2.1. These will be retained within Passive POS in the future urban environment. The retention of these areas will provide examples of the pre-development landforms of the site and will also contribute to the retention of flora and fauna species and the preservation of biodiversity on the site.

Land attributes and functional values which have been accounted for in the process of identifying POS areas in the Alkimos LSP include the following:

- Conservation values.
- Recreation opportunities.
- Linkage values.
- Fauna habitat values.
- Significant tree values (the few tuart trees that exist on the site have been identified and should be retained in POS where practicable).

The area allocated to POS in the Alkimos LSP is 44.3 ha (or 20.7% of net subdivisible area). The total area of POS with a conservation function is 29.5 ha (or 10.2% of the net subdivisible area and 66.6% of the total area of POS). Some of this area will be used for Active POS, however the majority will be retained as Passive POS.

Where possible, the areas identified as Passive POS, the Dune Parks follow the criteria for locally significant areas from the *Local Government Biodiversity Planning Guidelines* (Del Marco et al. 2004). All POS areas with a conservation function are greater than 4 ha in area and where possible, POS areas have been selected to have a relatively squat, circular or rectangular shape, however the POS shape has been greatly dictated by the shape of the landform feature (sand dunes) being retained.

The shape of Passive POS areas generally follows the shape and contours of the dune being conserved in order to minimise disturbance to the edges of the POS areas by minimising earth-working required by minimising grade changes.

The Alkimos LSP site also contains two FCTs that are listed by the DEC as Priority Ecological Communities (PECs), as follows:

- FCT24 – Northern Spearwood shrublands and woodlands.
- FCT29b – Acacia shrublands on taller dunes, southern Swan Coastal Plain.

These PEC are Priority 3, indicating that the ecological community is poorly known, however there are communities known from several occurrences, of which a significant number or areas are not under threat of habitat destruction or degradation (DEC, 2007). Where practicable, areas of FCT24 and FCT29b in 'Good' or better condition have been retained in the Passive POS areas in the LSP design.

Areas of native vegetation to be preserved as Passive POS have been strategically located in order to maintain strategic linkages across the LSP site for flora and fauna.

The Western Dune Park provides an important link between the foreshore reserve and the conservation area in the Alkimos WWTP buffer. This linkage will be particularly important if a marina is proposed for the area which creates a break in the foreshore reserve. This Dune Park also provides a linkage around the Alkimos coastal node, which is the narrowest section of the foreshore reserve. The treatment of roads that intersect this Dune Park should reflect its strategic linkage value by slowing speeds and allowing roads verges to be as natural as possible (e.g. no curbs). Landscaping in this area should be with endemic species to enhance the value of the area to fauna.

The Central Dune Park and South Alkimos Dune Parks create an east-west linkage across the site from the foreshore reserve to connect with a POS area in the neighbouring Lot 3 LSP.

As stated in Section 4.3, some habitat for Carnaby's Black-Cockatoo will be lost through the implementation of the Alkimos LSP. The Alkimos LSP Landscaping Plan shows that following the development of the site for residential proposes, a net gain in the foraging habitat value of the Alkimos LSP site for this species will be achieved through using Carnaby's Black-Cockatoo food plants in landscape plantings in POS areas and road reservations.

6.0 POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT MEASURES

6.1 Landform and Landscape

Management Objectives

- Through appropriate environmental management protect the landform features to be retained in Passive POS in the Alkimos LSP.
- Through appropriate environmental management prevent potential incremental degradation of the landform features to be retained in Passive POS in the Alkimos LSP.

Potential Impacts

As described in Section 2.2 of this report, the site is dominated by Quindalup dunes, which occur in a complex series of parabolic dunes. The Alkimos LSP design includes the retention of some existing Quindalup dunes within Passive POS areas within the developable area of the site.

The potential environmental impacts on the landforms and landscape character that may result from the implementation of the LSP, include the following:

- During construction: Accidental clearing of conservation areas during current and future site works.
- Post-construction: Quindalup dunes are fragile as their vegetation is relatively shallow rooted in sandy soils. Incremental degradation over time from vehicular or pedestrian traffic creating tracks through Passive POS areas will displace vegetation cover and expose mobile sand.

Management Measures

The report *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy* (RPS, 2009) addresses the management requirements for potential impacts on Passive POS areas within the LSP, these include the following:

- Manage access – provide appropriate access along desire lines to prevent the creation of informal paths, use fencing where appropriate to restrict access to sensitive areas, such as areas with steep gradient, areas with low public surveillance and areas of particular environmental sensitivity. It may not be appropriate to use fencing in all situations and the types and locations of fencing should be assessed on a case by case basis for each POS area, for example, fencing may not be required in areas where there is high public surveillance.
- Hard edges between lawn turf areas and native areas to prevent grass from invading native areas, e.g. mowing strip, Dual Use Path.

Further information regarding POS management is provided in the report; *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy* (RPS, 2009).

6.2 Vegetation, Flora and Fauna

Management Objectives

- Retain vegetation to minimise the impacts of the development on biodiversity and fauna habitat where practicable.
- Maximise the use of local native vegetation species in revegetation and landscaping to increase biodiversity and minimise irrigation requirements.
- Maximise the use of native habitat species for significant fauna species in revegetation and landscaping.
- Minimise incremental degradation of vegetation in Passive POS areas by providing appropriate and managed public access.
- Discourage inappropriate use of conservation areas through appropriate design responses and passive surveillance.
- Maintain ecological linkages across the Alkimos LSP site.

Potential Impacts

Approximately 50% of the total area of the Alkimos LSP is either cleared or supports vegetation that is 'Degraded' to 'Completely Degraded' due to historical grazing practices, off-road vehicle use of the area and recent construction works associated with the Alkimos WWTP. The development of the site for residential proposes will result in additional clearing of remnant vegetation on the site, with the exception of those areas to be retained in Passive POS areas.

The report; *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy* (RPS, 2009) has been prepared to assist with minimising the impact of the residential development on the areas of native vegetation retained in Passive POS in the Alkimos LSP site and the areas of regionally significant vegetation located in proximity to the Alkimos LSP site. Potential impacts include, but are not limited to:

- Loss or changes in vegetation and fauna community structure, biodiversity and fauna habitats.
- Fragmentation of existing habitats.
- Increase in the population of feral predators (e.g. cats).
- Spread of weeds and pathogens (e.g. *Phytophthora Dieback*).
- Degradation of retained areas from unauthorised third party access and changes in fire regimes.

Management Measures

The report; *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy* (RPS, 2009) includes the following management outcomes:

- Pre-construction:
 - Fence conservation areas during the construction and development of the site to prevent accidental clearing.
 - Collect seed stock from existing vegetation to be propagated and used for rehabilitation of the site.
 - Trap and relocate of appropriate fauna individuals to conservation areas prior to the commencement of clearing activities.
- During Construction:
 - Stage clearing works and implement clearing methods designed to maximise the survival of fauna individuals on the site (e.g. clear vegetation in the direction of areas that are to be retained at a slow pace).
 - Rehabilitate degraded areas within conservation areas (that are not intended to be used for public infrastructure or some other purpose).

- Install appropriate fauna-permeable fencing along access paths through conservation areas to provide controlled access and prevent unauthorised third party access.
- Where possible provide natural road edge treatments adjacent to conservation areas, particularly where roads intersect fauna linkages, to allow for fauna movement across roads.
- Post-construction:
 - Use local native species in rehabilitation of the site following construction.
 - Implement feral animal trapping and population control programs.
 - Implement public awareness campaigns relating to the local environment and the importance of the conservation areas to local fauna.

6.3 Coastal Environment

Management Objectives

- Maintain continuity and function of ecological corridors in the foreshore reserve.
- Educate residents on the environmental values of the foreshore reserve.

Potential Impacts

The Alkimos LSP includes the majority of the regionally significant foreshore reserve and the development of the 'Urban' zoned portions of this site in accordance with the zoning will have some environmental impact on the ecological functions of this area. The report; *Alkimos Local Structure Plan, Foreshore Management Strategy* (RPS, 2009) has been prepared to assist with minimising the impact of the residential development on the foreshore reserve. Potential impacts include, but are not limited to:

- Loss of biodiversity.
- Spread of weeds.
- Loss of vegetation.
- Unauthorised third party access.
- Changes in fire regimes.
- Erosion of the dunes.

Management Measures

The report; *Alkimos Local Structure Plan, Foreshore Management Strategy* (RPS, 2009) includes the following management outcomes:

- Pre-construction:
 - Fence conservation areas during the construction and development of the site to prevent accidental clearing.
 - Collect seed stock from existing vegetation to be propagated and used for rehabilitation of the site.
- During Construction:
 - Rehabilitate degraded areas within the foreshore reserve (that are not intended to be used for public infrastructure or some other purpose).
 - Construct fenced beach access paths through the foreshore reserve to provide controlled beach access.

6.4 Other Management Issues

6.4.1 Littering / Illegal Rubbish Disposal

The Draft Biodiversity Strategy (CoW, 2008) highlights the importance of preventing illegal dumping or rubbish in natural areas. A number of management measures to prevent littering or illegal rubbish dumping in conservation areas include, but are not be limited to, the following:

- Place signage on the fence at regular intervals informing the public that littering is illegal and detailing relevant fines.
- Locate rubbish bins at regular intervals along access paths (determine appropriate locations for rubbish bins in consultation with CoW).
- Place fencing around conservation areas that is permeable to most fauna, but restricts human and the majority of pet dog access to conservation areas.

6.4.2 Unexploded Ordnance

There is a potential that Unexploded Ordnance (UXO) exist on the site. Prior to any ground disturbing activities occurring on site, the proponent will be required to conduct a UXO search. In order to complete the UXO search a portion of the vegetation must be slashed to the ground. In order to preserve the environmental values of conservation areas, UXO searching should not be conducted in these areas except the areas where public access will be provided (e.g. access paths). Signage about UXO risks should be provided discouraging the public from entering the unsearched, fenced conservation areas.

7.0 CONCLUSION

The Alkimos LSP site is one of the most degraded areas within Alkimos-Eglinton. Approximately 50% of the site has previously been cleared as the result of past agricultural land use or recent construction activity associated with the Alkimos WWTP.

The proposed Alkimos LSP aims to preserve approximately 29.5 ha (or 10.2% of the net subdivisible area) as POS with a conservation function. Some of this area will be used for Active POS, however the majority will be retained as Passive POS. The Alkimos LSP design thereby achieves the following environmental outcomes:

- The Alkimos LSP design preserves the foreshore reserve (Bush Forever site 397) in Regional Open Space.
- The Alkimos LSP design preserves examples of pre-development landforms, vegetation and fauna habitats in Passive POS.
- The Alkimos LSP design maintains strategic ecological linkages across the future residential area, connecting areas of regional environmental importance zoned for conservation proposes in the MRS.
- The Alkimos LSP design exceeds the criteria in *Local Biodiversity Strategy 2008-2013: A Draft for Discussion* (CoW, 2008) which aims to preserve 3% of the subdivisible area in Passive POS.

The EPA has assessed the environmental values of the site recently as part of its assessment of MRS Amendment 1029/33, and according to the results of this assessment, no known areas of regional environmental significance are located in the 'Urban' zoned portion of the Alkimos LSP area (EPA, 2005).

This *Environmental Assessment* of the proposed Alkimos LSP concludes that the potential environmental impacts identified in this report can be managed in accordance with Western Australian environmental legislation to prevent significant impacts on regionally significant values of the site and surrounds.

The site may contain habitat for two fauna species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*; Carnaby's Black-Cockatoo and Graceful Sun Moth. The Alkimos LSP may require referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* if the potential impacts on either of these species are likely to be significant.

8.0 RELATED REPORTS

The following reports are related to this document and should be read in conjunction with this document:

- *Alkimos Local Structure Plan (2009).*
- *Alkimos Local Structure Plan, Vegetation and Fauna Management Strategy – Part Lots 101 and 1004 Alkimos (RPS, 2009).*
- *Alkimos Local Structure Plan, Foreshore Management Strategy – Part Lots 101 and 1004 Alkimos (RPS, 2009).*
- *Report for Alkimos Local Structure Plan – Environmental Sustainability Strategy (GHD, 2009).*
- *Report on Alkimos Local Structure Plan – Local Water Management Strategy (GHD, 2009).*
- *Alkimos Local Structure Plan – Report on Engineering Aspects (Cossill and Webley, 2009).*

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FIGURES
