PACKHAM NORTH, SPEARWOOD & COOGEE. LANDSCAPE DESIGN PRINCIPLES

CITY OF COCKBURN

DATE
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emerge ASSOCIATES
Integrated Science & Design

ABN 44 656 153 170

EMERGE ASSOCIATES

Suite 4, Centro Ave Subiaco

Western Australia 6008

Telephone: 08 9380 4988

Facsimile: 08 9380 9636

admin@emergeassociates.com.au

www.emergeassociates.com.au

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1. PURPOSE OF LANDSCAPE STRATEGY REPORT

The purpose of the Landscape Design Principles is to provide guidance at the District level to inform the design of public open space and establish a framework for landscaping within the public realm.

The factors addressed include design context, addressing community requirements, the protection of remnant vegetation, fauna habitat and ecological linkages, and ensuring allowance for drainage and water sensitive urban design features within the development area.

2. INTRODUCTION

SITE LOCATION

The Packham North development is comprised of a grouping of private landowners within the Spearwood/Coogee area which are bounded by a heavy duty rail line to the north, Mell Road to the south, Rockingham Road in the east and to the west the Regional Open Space that links through to Beeliar Regional Park.

The Packham North site includes the site of the former George Weston Foods processing factory which operated here for over a hundred years, closing in 2009. The factory site is predominantly surrounded by cleared land, in what was required by government guidelines as an odour buffer, whilst the factory was in production. The remainder of the site beyond the buffer has been predominantly used for market gardening by individual landholders, and as such is also mostly cleared land.

Figure 1: Location Plan

DISTRICT CONNECTIONS

The subject site is well served through surrounding facilities such as Coogee Plaza to the south of the subject site and the larger Phoenix Shopping Centre. Active pursuits are catered for through nearby sporting fields such as Beale Park to the north and Watson Reserve and Edwardes Park to the east which both surround a public school with further playing fields. There are numerous walking trails throughout Beelier Regional Park which houses landscaped Manning Lake, and in the south Market Garden Swamp is surrounded by a dual use path.

Figure 2: Site Analysis Plan

TOPOGRAPHY, GEOLOGY & GEOMORPHOLOGY

The topography of the site varies in the range of 1.0 AHD to 24.0 AHD. There is a relatively steep average topography of 5% across the site, sloping inwards towards the low points (refer to Figure 2: Site Analysis Plan for existing contours).

The site is located within the Spearwood Dunes region within the Swan Coastal Plain, which generally comprises the Tamala Limestone geological unit. The majority of the site consists of Spearwood sands, and along the western edge, corresponding with the highest points of the site, the soil consists of Limestone.

CLIMATE

The climate in the Spearwood/Cockburn area is Mediterranean. The site experiences warm to hot dry summers and mild, wet winters.

The key data is as follows:

Summer	-average monthly maximum temperature	30.4 degrees c
Winter	-average monthly maximum temperature	18.3 degrees c

The average annual rainfall is around 826.6mm and has been declining since 1972.
Information sourced from:
http://www.bom.gov.au/jsp/ncc/cdio/cvg/av?p_stn_num=009172&p_prim_element_index=0&p_comp_element_index=0&redraw=null&p_display_type=statistics_summary&normals_years=1981-2010&tablesizebutt=normal

SURFACE WATER

Two significant areas of surface water exist on the site. One is the Ocean Road wetland, an isolated and degraded area on the southern boundary of the development site. The other significant surface water feature is a series of three basins that were used by the former factory, in what capacity is unclear. They are situated in a naturally occurring depression that appears to have been modified by the factory owners to accommodate excess site water. This low lying area continues south from these former catchment ponds and runs south in a linear manner.

GROUND WATER

Information gathered from the RPS Wetland Management Plan in March 2010, states that the groundwater quality is considered fresh to marginally brackish. Groundwater level and quality monitoring has been undertaken by Cardno BSD since October 2008 at several bores on the site. Local groundwater levels have been recorded from 0.03 mAHD to 1.62 mAHD.

LANDSCAPE OPPORTUNITIES

The key principles guiding the ongoing landscape design within the public realm of the Packham North site shall be:

- Rehabilitate existing drainage areas in concert with efforts to retain and infiltrate predicted stormwater flows, in accordance with the DWMS/LWMS prepared by Cardno (2011).
- Retention and protection of existing stands of existing significant vegetation.
- Understanding that the two central POS located at the entry point to the development on Hamilton Road provide the opportunity to establish a highly visible entry. The amenity provided by these civic parklands offers the opportunity for higher density living in this location.
- Provision of public facilities which cater primarily for passive activities to suit the predicted demographic for Packham North.
- An opportunity exists to portray the historical context of the site through the incorporation of the original homestead steps on the GWF Factory site into POS.
- Protect and enhance, where practical, elements of the GWF factory and the associated land uses. This may include:
    - Retention of built form or machinery if deemed structurally sound and suitable for incorporation into the public realm. This may form the basis for a public art strategy.
    - Retention and rehabilitation of the former factory water catchment basins and surrounding area.
- The variability of the topography and the requirement for the POS to cater for stormwater retention will create multiple tiered public spaces. Each POS shall provide suitable usability for the community. Such uses shall not be limited to active pursuits but shall also allow for passive uses such as picnics and nature observation.

PUBLIC OPEN SPACE

The POS in Packham North shall be designed to be the focal point for community gathering, encompassing passive recreational activities, unorganised active recreation, and public facilities whilst catering for a wide range of residents and visitors. Opportunities exist for creatively designed discovery and learning playgrounds catering for children of all ages. Where appropriate areas are designated shelters and arbors shall be established to cater for parents and informal gatherings as well as picnics and gathering spaces.

Integrated path systems and potential boardwalks shall create areas suitable for walking, dog walking, cycling, skateboarding and similar. Informal open recreation spaces will support numerous passive recreation activities. Interpretive displays may offer insight into factory elements and the rehabilitation of the degraded drainage basins.

BIO-RETENTION BASINS

The low lying nature of some areas of the site and the need to contain all stormwater on-site provides the opportunity to create a number of multiple use drainage areas within the POS. The use of bio-retention basins will enable larger areas of open space to remain dry during the winter months thereby increasing the amount of usable open space available.

The basins designated for bio-filtration and retention – a mixture of both dry basin drainage and low-lying seasonal damp areas shall be designed to encourage residents to appreciate the flows of water through the catchments. Through the placement of interpretive signage and displays one could educate the community about the need for careful management of stormwater, limiting the use of fertilisers, the importance of vegetation in stripping nutrients and the importance of these areas as habitat for flora and fauna. The use of boardwalks (where appropriate) to elevate the public above the wetland systems increases usability of these areas, whilst at the same time protecting the vegetation.

PROPOSED LANDSCAPE PLANTING

Planting in POS areas will consist of a mixture of native and exotic species with emphasis placed on native species. However the guiding principle shall be the use of species which reinforce the diverse character and local context of the site. In general, there shall be an emphasis in these POS area on indigenous plantings as opposed to turf. In areas where it is preferred to have turf, there shall be irrigation and fertiliser management measures applied.

Proposed Planting in the Public Realm
The provision of planting in public areas and streetscapes serves to provide character, shade, interest, habitat and a point of reference in major streets or feature locations.



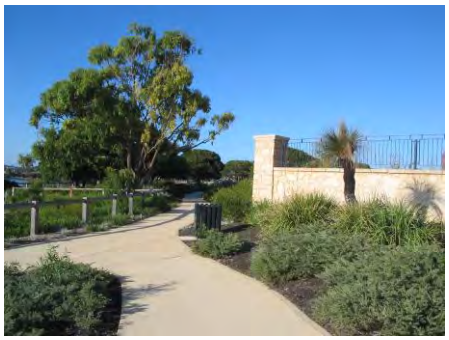


Figure 3: Lakeway, Claremont; Figure 4: Somerly Estate, Clarkson; Figure 5: Minim Cove, Mosman Park

Design Considerations

The selection and placement of species shall consider adjacent elements to limit future maintenance, public health and safety issues, promote the survival and health of the vegetation and provide ongoing social and visual benefits. Items of consideration may include:

- Proximity to traffic sightlines to ensure suitable view corridors
- Proximity and alignment to underground services to ensure no adverse impact
- Maximised seasonal influence of shade on adjacent facilities and areas
- Passive solar benefits influencing adjacent built form and residential dwellings
- Provision of seasonal visual colour
- Provision of a seasonal food source to local fauna
- Plant selection based on suitability to local climate, soils, rainfall and temperatures
- Selection based on minimal maintenance
- Buffer screening will be provided to residential or environmentally sensitive areas where required
- Minimisation of irrigation.
- Turf may be utilised where larger open areas may provide scope for unorganised recreational pursuits, to open up views into POS, or minimise maintenance.

Street trees

- Along Hamilton Road proposed trees will form a strong avenue to assist in screening the high voltage 132kV Transmission Lines. These will be compliant with the Western Power requirements.
- A variety of trees may be utilised to provide a diversity of precinct characters across the development.

Water Wise Planting

- It is intended that local species shall be used where suitable to minimise water dependence.
- Soil amendments will be used in order to reduce leaching and increase soil moisture holding capacity.
- All garden beds will be mulched to reduce water loss through evaporation.
- The principles of hydrozoning (grouping plants with similar water requirements together) and Xeriscaping (planting drought-resistant plants to conserve resources, especially water) will be utilised across the site where appropriate.

Figure 6: Existing mature Norfolk Island Pine

RETAINED VEGETATION

The retention of existing vegetation in defined locations caters for the preservation of existing habitat, preserves natural assets and a historic/cultural reference and provides visual relief against the urban backdrop.

Vegetation Type and Quality

Whilst some of the vegetation on site has suffered through the effect of the various past land uses and management, the areas where stands of vegetation have been preserved offer positive outcomes through their retention. It is recommended that all significant trees within the subject site be assessed for retention by a qualified Aboriculturalist and all efforts be taken to retain trees identified as worthy of protection.

Figure 7: Grove of existing trees within subject site.

5. PUBLIC OPEN SPACE TYPOLOGIES

GENERAL

Each of the open space areas has a unique and distinctive landscape character type. These range from limestone coastal ridges and depressed wetland areas, to the more urbane settings associated with the former factory and the higher densities proposed along Hamilton Road. This will inform the final use and design response for the parks, be it vegetation, conservation and/or recreation.

The areas of POS within the Packham North site have been categorised as follows:

- Village Precinct
- Neighbourhood Parks
- Streetscapes
- Rehabilitation Areas

Figure 8: Minim Cove, Mosman Park

VILLAGE PRECINCT

The proposed town centre at the northern end of the Packham North site provides an opportunity to create a village like precinct amongst the adjoining POS areas. The village precinct shall satisfy the requirements of the workers and visitors to the businesses located within the town centre. Structural elements from the former factory could be incorporated within the village precinct giving them a new, innovative purpose as sculptural public art pieces.

The sweep of open space adjacent to the Hamilton Road at the northern end of the subject site could provide an opportunity to establish an attractive vista into the development.

Design of the village precinct shall consider the existing historical aspects of the rose garden and the remaining steps and wall from the old Watson homestead within the POS.

Figure 9: Walls, steps and rose garden from original homestead;
Figure 10: Mature cypresses line entrance into the old GWF site;
Figure 11: Old GWF factory buildings.

NEIGHBOURHOOD PARKS

Smaller areas of POS have been designated throughout the development to serve as neighbourhood parks. Predominately passive in nature, these smaller parks may also cater for small playgrounds and kickabout areas providing unorganised active recreation.

Drainage areas may be required in these open spaces, and where provided will be multi-purpose landscaped basins, serving a recreational and amenity function. Drainage swales within Neighbourhood POS areas will have turf to enable multiple use and ease of maintenance. Where agreed to by City of Cockburn, smaller parks which receive the 'first flush' from storm events may be separated and planted with indigenous sedges to assist in nutrient stripping.

Neighbourhood parks may contain:

- Small playground equipment.
- Lawn area for non-organised play activities.
- Shade trees.
- Dual use circulation paths.
- Provision for clear sight lines to view points.

STREETSCAPES

All roads within the Packham North development shall be lined with suitable street trees, in consultation with the City of Cockburn. These will be determined according to traffic volumes, street widths and house set back distances.

As previously mentioned Hamilton Road requires measured consideration of trees to be planted. The west side of the street, being dominated by the large high voltage power lines require trees and planting to remain under three metres in height, as set out in the Western Power guidelines.

Figure 12: Existing high voltage power lines along Hamilton Road.

REHABILITATION AREAS

With the requirement to retain stormwater on-site the use of bio-retention basins will play an important role in POS designs. The placement of these basins will provide not only a viable drainage function but also a variety of ecological zones and rehabilitation opportunities.

Planting within the basins is to consist of endemic species with a variety of tree, shrub, groundcover, reed and sedge species, with shrub planting on the banks to provide stabilisation and native reed and sedge planting within the basins to enhance nutrient uptake. The use of turf can also be considered where appropriate.

In order to maximise accessibility to these areas, the incorporation of raised pathways and boardwalks in the appropriate locations is applicable.

The use of vertical retaining walls to minimise the surface area extent of the drainage basins could be incorporated into POS designs. Unless otherwise approved by the City of Cockburn, these vertical walls shall be limited to a maximum height of 900mm.

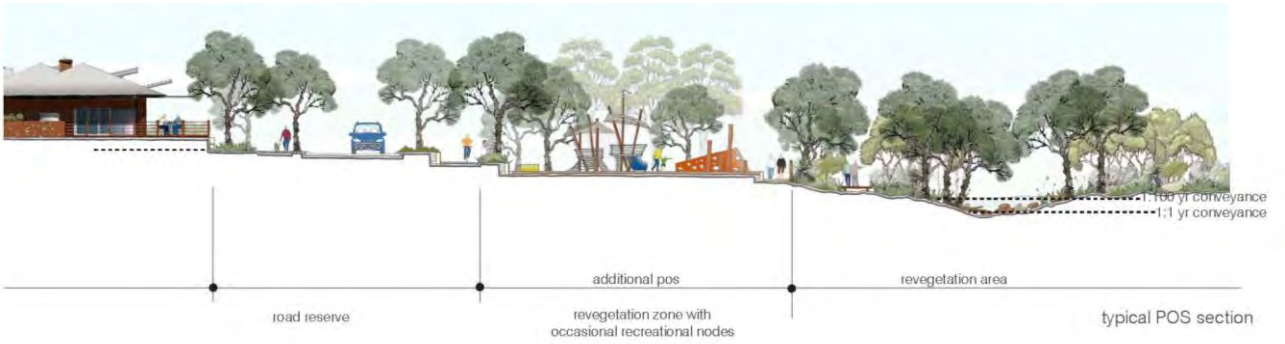


Figure 13: Typical POS Section

The section above illustrates
- separation of uses,
- tiered walls,
- access to revegetation/drainage areas for observation and education.

These treatments vary amongst the POS and are dependent upon the width and depth of the POS and engineering constraints dictating size and depth of the basins.



Figures 14 – 16: Existing drainage basin areas within Packham North site.

Figure 17: Newhaven Estate, Piara Waters; Figure 18: Boardwalk at Point Fraser, Perth City

Figure 19: Boardwalk at Salt Estate, Kingscliffe, NSW

Figure 20: POS Location Plan

POS A

This POS is situated at the base of the railway bank and shall consist predominantly of a bio-retention basin which will play an important role as a drainage basin for bank and lot/road run-off. POS A will also further contribute to the entry statement impact of POS C & D, as the subject site is entered from the north. There is no significant vegetation to be retained in POS A. The basins could have tiered retained walls to achieve the required surface water area and may contain planted areas to assist in surface water filtration into sub-surface groundwater reservoirs.

POS B

The majority of surface water run-off into POS B will come from lots in the vicinity and roads encircling the POS. Hence this POS will consist of a series of basins to capture this run off. These basins shall accommodate turfed areas for non-organised play and passive pursuits, and planted bio-filtration areas to provide both a useable and functional space which also filters run off before entering the groundwater system. As the site is fully cleared and has no constraints there is no significant vegetation to retain.

POS C & D

These two POS's are located within the village precinct. As well as providing aesthetically pleasing areas for staff from the surrounding businesses to enjoy, combined they will provide a strong entrance statement from the north side of the estate. POS D contains the remnants of the original William Watson homestead – a set of steps and walls running either side, which have been retained and will be incorporated into the overall landscape design for this POS. Also the possibility for the inclusion of existing mature trees into the POS landscape exists in POS D.

POS E

This POS centres on the degraded drainage basin which shall be rehabilitated through a programme of revegetation with local endemic species, weed eradication and retaining existing trees.

Pre-development water flows will increase post-development, so a programme of works will allow for seasonal variations in water flow eliminating overflow of banks. This is envisaged as being a series of adjacent basins, some of which can be used for non-organised passive and active recreation, which will adapt in peak water flow periods to retain superfluous water. For instance, the stormwater flows will be separated from bio-retention prior to groundwater infiltration after a heavy downpour through the thoughtful placement of basin walls and wall heights.

The recreational opportunities this area shall include are primarily passive and unorganised active recreation. Boardwalk access around the wetland, with educational interpretive signage placed at strategic locations, could enable the site to be enjoyed year round. This approach is considered suitable if maintenance replacement costs could be demonstrated to be reasonable.

POS F

This linear POS shall also host a combination of POS typologies. Within the GWF land is the area that was initially the retention site for extraneous water from the factory site, which is being retained and turned into a bio-retention area. The name given to this area by factory staff was "The Ponds", and is referred to as the Eastern Wetland area within the Cardno produced DWMS/LWMS Packham North report. As The Ponds are located in one of the lowest lying areas of the site this is the ideal position for their rehabilitation into use as bio-retention basins for the storage and treatment of stormwater.

There is some wetland tolerant vegetation growing within the wetland area, however much of the wetland area is said to be degraded (Cardno May 2011). If practical, and the wetland design allows for it, it should be the landscape architects intention to retain of any healthy wetland tolerant vegetation.

POS G

As per the rehabilitation typology, this POS will retain stormwater on-site and store it away from high use mixed business area to the north, the use of bio-retention and bio-filtration basins will retain and treat run off, whilst providing additional open space areas for the public to enjoy.

POS H, I, J

These three POS areas all fall within the neighbourhood park typology, and will have a similar function to POS G, in that they will consist predominantly of bio-retention and bio-filtration basins, surrounded by passive recreation areas.

RAILWAY RESERVE BUFFER

The existing belt of Eucalypts located within the railway reserve area should be retained and reinforced where practical.

This section outlines the management requirements applicable to the open space areas within the subject site. These management requirements have been termed 'management elements', as one or more of the elements may be applicable to any particular open space area, however this will ultimately be dependent upon the intent and location of the open space area in question.

Following is a description of the purpose of each element, where appropriate the specific instance/s the element will be required, the management requirements (both at subdivision and on-going maintenance, hand-over and long-term management stages) and when these measures should be implemented.

MANAGEMENT ELEMENTS

Fire Management

The Swan Coastal Plain has historically been susceptible to fire, generally as a result of the inherently flammable vegetation, dry summers, periodic drought and lightning ignition events. Although not considered a high risk, the sector of the subdivision which is bordering the two regional open space areas to the west and south of the subject site does contain significant remnant vegetation which would be susceptible to bush fire. With an appropriate and manageable built form response in place it is anticipated that after development the fire risk will be minimal.
This response could include, but not be limited to;

- Maintain low fuel loads in the vicinity through the planting of flora species which are fire retardant, ensure tree crowns do not overhang buildings, incorporate roads, footpaths and verges into a hazard separation zone and maintain the verges as green areas (i.e. as lawn or landscaped gardens).
- Ensure the risk areas are accessible by two vehicular routes, which meet the standards outlined in Element 2 of *Planning for Bush Fire Protection Edition 2* (FESA 2007).
- Within the risk areas – reduce the fuel loads by weed eradication and maintain fire breaks along the perimeter.

More detailed fire risk assessments may need to be undertaken and Fire Management Plans produced at the local structure planning stage.

Drainage Basins

The subject site contains low lying areas that have historically been seasonally inundated by stormwater flows. The vegetation in and around these precincts is in a 'Degraded" condition and contains a large proportion of introduced weed species.

The management of the drainage basins and surrounds will be undertaken to enhance ecological processes and functions, enhance the "Degraded' vegetation values and protect these areas from current and potential future impacts arising from adjacent land uses. Within these areas, the management measures should include:

- Retain all indigenous remnant vegetation.
- Minimise significant earthworks (cut or fill) undertaken.
- Avoid the use of fertiliser and chemical applications within the wetland or buffer, or in areas adjacent to the wetland. An exception for the application of chemicals is the use of herbicides to control weed species, with City of Cockburn approval.
- Implement the *DWMS/LWMS for Packham North* (Cardno 2011) and subsequent Urban Water Management Plans.
- Revegetate using turf (where appropriate), local endemic species, or native species appropriate to the soil, hydrological conditions and intended use of the POS area.

The implementation of the management measures will largely be accommodated at the subdivision and development stages, when civil construction and landscaping occur.

Figure 21: Newhaven Estate, Piara Waters.

Vegetation and Tree Retention

It is anticipated all significant vegetation will be retained within the subject site where practical. Although the majority of the tree species are not endemic to the area, the retention of as many mature trees as practical will support the landscape in terms of general amenity and sense of place values.

To maximise retention of vegetation and provide appropriate management of these areas the following measures should be taken:

- Maximise retention of trees through the careful alignment of road reserves and carriageways.
- Planning of drainage areas to avoid trees and their root systems, wherever possible.
- Protect trees and areas or remnant vegetation during and following construction and as a part of the on-going maintenance of open space areas and road reserves. This includes temporary fencing and signage around all vegetation to be retained and for ripping and compaction to ideally not occur within 5 metres of the existing drip line of trees, as per *Australian Standard 4970-2009 Protection of trees on development sites.*
- Temporary irrigation of retained trees to reduce potential stress if disturbed during construction.

The implementation of the management measures will largely be accommodated at the subdivision and development stages, when civil construction and landscaping occur.

Weed Management

Weeds are recognised as a major contributor to the degradation of rehabilitated areas. Weeds often prevent successful rehabilitation of areas and as such weed species require control in order to maintain the ecological integrity of these areas. Numerous weed species have been identified within the subject site.

Generally all management of weeds involves all presence of the weed to be destroyed and seed set prevented. Weed management is achieved through the removal of the species and the prevention of weeds entering the area and includes:

- Manual removal – this is generally undertaken in smaller areas, where either specific weeds can be targeted, or weed species are not numerous, however it can also involve machinery removing large tracts of weeds.
- Chemical removal – this involves the use of herbicides to eradicate weed species.
- Use of soil and mulch which does not contain weed seed.

Generally weed control and management will be an ongoing requirement, but it is expected to be most intensive during the subdivision and development stage.

Planting within Rehabilitation Areas

Planting within the rehabilitation areas will largely consist of revegetation. Revegetation is largely aimed at re-establishing native vegetation to create habitat for native fauna, improve water quality and to protect existing vegetation and environmental values (Greening Australia 2003). A revegetation program should aim to maximise the diversity of both the species and structure (ground, middle and overstorey).

The most significant areas of revegetation will be in the currently degraded drainage basins on Ocean Road and within the GWF factory site.

Revegetation can involve a range of techniques, which will vary depending upon the scale of work, the availability of resources and the site conditions. The broad techniques applicable to revegetation are outlined below:

- Natural regeneration is generally the germination of seedlings from seed fall of existing or nearby vegetation.
- Direct seeding involves the sowing of treated seeds directly onto an area to achieve germination and establishment. This technique can be undertaken by machine or hand depending upon the scale of revegetation.
- Planting of seedlings involves the utilisation of seedlings grown by a nursery or re-vegetation specialist to establish areas quickly. As with direct seeding, this technique can be undertaken by hand or machine

The planting of seedlings is seen as the most practical technique for the scale of the areas in question.

A revegetation program involves a number of steps and considerations which are outlined below and considered as a part of this strategy.

- Planning to determine where revegetation is to occur and at what scale. Within the subject site, revegetation is proposed to occur at the site and local level, with specific conservation areas (mentioned above) the focus.
- Preparation of the ground, which includes soil preparation to produce loose, well drained and aerated soil appropriate for plant establishment and weed control to reduce competition on seeds/seedlings.

- Pest animal management, in which the exclusion of animals is undertaken to prevent grazing during establishment and may include fencing and plant guards, or more intensive management of rabbits and insects (such as snails, slugs, ants, grasshoppers and mites).
- Seeds and seedlings, which depending on the revegetation technique to be employed may include seed collection, cleaning and ordering and/or propagation.
- Revegetation program, through both natural regeneration and direct seeding and planting (outlined above)
- Maintenance, which includes replacing and removing plant guards, management of pests and when required watering.
- Monitoring to determine success of revegetation and whether further planting is required.

Where revegetation is required, local provenance material should be used wherever possible to ensure the genetic integrity of this area is maintained. Root stock is expected to be grown in local nurseries and transferred to the conservation areas as part of the restoration process. The plant species listed should be collected from nearby local sites, germinated and then planted by experienced native revegetation contractors.

The extent of revegetation within the different conservation areas will depend on a number of factors, including:

- Soil and natural hydrological conditions.
- Availability of local native species.
- The location of revegetation – i.e. within the foreshore area, slope and the water flows will influence plant species and densities. For example, emergent planting of sedges will be planted differing distances from the low water mark, depending on the expected height of the water, shallowness of the bank profile and the water requirements of the particular species.

In locations where revegetation is to be undertaken, the revegetation planting densities should be provided within the detailed landscape documentation, to be submitted to City of Cockburn at the subdivision stage.

Figure 22: Local bird life at The Ponds

Planting within Open Space Areas

The provision of planting in open space areas will provide character, shade, interest, habitat for fauna and be a point of reference in the major streetscapes and feature locations. Open space areas are considered to be Neighbourhood Parks, Streetscapes, Rehabilitation Areas and the Village Precinct.

In general, planting within open space areas will follow the principles that have been outlined below.

Predominantly native plant species to be planted throughout the development, to achieve at least 70 per cent local and native plant species, however this will be determined in consultation with the City of Cockburn.

Exotic specimens, shade and historical/cultural reference trees will be included, but limited to high profile streets and entry locations, some avenue planting and in feature locations within open space areas.

- Shrub planting to be used for screening and for the spatial definition of areas.
- Groundcover planting to occur within medians, planters and areas requiring clear views.
- Reed and sedge planting within drainage areas and swales. Turf can also be used where appropriate.
- Turf to be used for informal usable space and recreation areas.
- The proposed mix of native species and exotic cultural plantings in feature locations will provide a blend of character and define feature points.

8. IRRIGATION STRATEGY

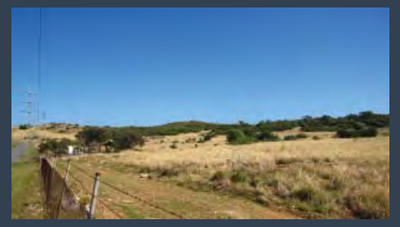
In general terms, the development of the subject site will be undertaken utilising water sensitive urban design, with the principal aim to ensure that irrigation is supplied in an effective and efficient manner, with minimal impact on existing groundwater resources and to preserve and improve water quality.

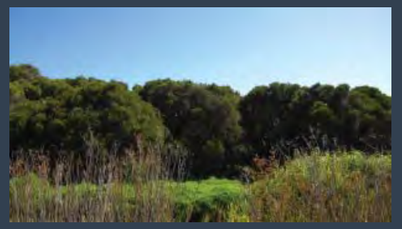
The following principles will guide irrigation practices within the development:

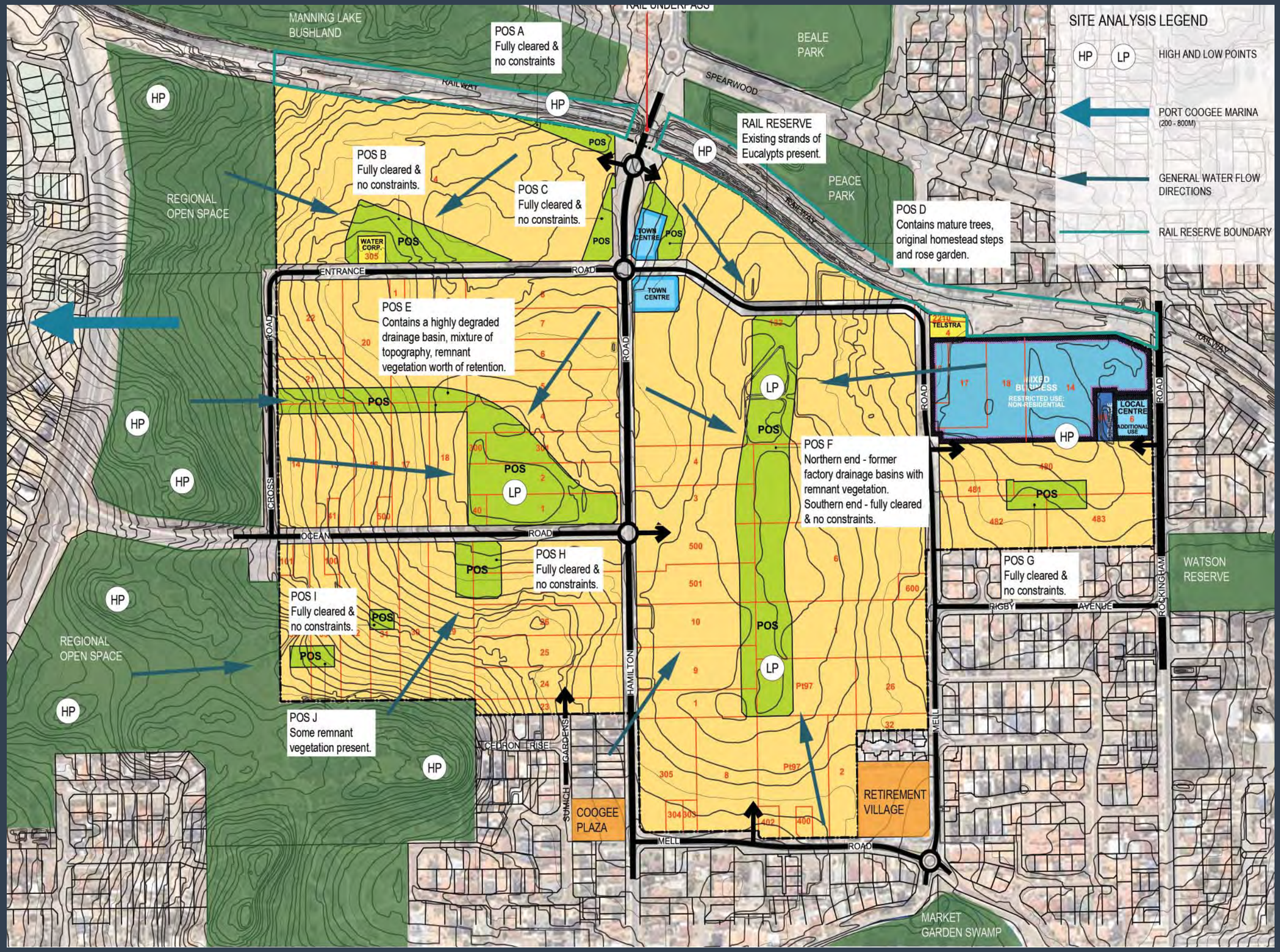
- Minimise the extent of irrigation and the volume of water consumed.
- Minimise the extent of irrigated turf.
- Minimise the extent of long term irrigation in open space areas.
- Reduce areas under surface spray water application.
- Utilise water-wise plant species, and avoid species which require extensive irrigation.
- Use of xeriscaping where practical.
- Use of hydro-zoning.
- Installation of adequate irrigation control systems to ensure that water can be supplied selectively within the development and seasonally.
- Utilise water harvesting techniques where practical.

Irrigation will incorporate elements of subsurface, drip and trickle water application methods. Water application will be based on seasonal need, with hydro-zoning principles incorporated as a part of subdivision and detailed design.

Figure 23: Dual use path set within existing mature trees.







PACKHAM NORTH SITE ANALYSIS
CITY OF COCKBURN

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POS A

This POS is situated at the base of the railway bank and shall consist predominantly of a bio-retention basin which will play an important role as a drainage basin for bank and lot/road run-off. POS A will also further contribute to the entry statement impact of POS C & D, as the subject site is entered from the north. There is no significant vegetation to be retained in POS A. The basins could have tiered retained walls to achieve the required surface water area and may contain planted areas to assist in surface water filtration into sub-surface groundwater reservoirs.

POS B

The majority of surface water run-off into POS B will come from lots in the vicinity and roads encircling the POS. Hence this POS will consist of a series of basins to capture this run off. These basins shall accommodate turfed areas for non-organised play and passive pursuits, and planted bio-filtration areas to provide both a useable and functional space which also filters run off before entering the groundwater system. As the site is fully cleared and has no constraints there is no significant vegetation to retain.

POS C & D

These two POS's are located within the village precinct. As well as providing aesthetically pleasing areas for staff from the surrounding businesses to enjoy, combined they will provide a strong entrance statement from the north side of the estate. POS D contains the remnants of the original William Watson homestead – a set of steps and walls running either side, which have been retained and will be incorporated into the overall landscape design for this POS. Also the possibility for the inclusion of existing mature trees into the POS landscape exists in POS D.

POS E

This POS centres on the degraded drainage basin which shall be rehabilitated through a programme of revegetation with local endemic species, weed eradication and retaining existing trees.

Pre-development water flows will increase post-development, so a programme of works will allow for seasonal variations in water flow eliminating overflow of banks. This is envisaged as being a series of adjacent basins, some of which can be used for non-organised passive and active recreation, which will adapt in peak water flow periods to retain superfluous water. For instance, the stormwater flows will be separated from bio-retention prior to groundwater infiltration after a heavy downpour through the thoughtful placement of basin walls and wall heights.

The recreational opportunities this area shall include are primarily passive and unorganised active recreation. Board-walk access around the wetland, with educational interpretive signage placed at strategic locations, will ensure the site is able to be enjoyed year round.

POS F

This linear POS shall also host a combination of POS typologies. Within the GWF land is the area that was initially the retention site for extraneous water from the factory site, which is being retained and turned into a bio-retention area. The name given to this area by factory staff was "The Ponds", and is referred to as the Eastern Wetland area within the Cardno produced DWMS/LWMS Packham North report. As The Ponds are located in one of the lowest lying areas of the site this is the ideal position for their rehabilitation into use as bio-retention basins for the storage and treatment of stormwater.

There is some wetland tolerant vegetation growing within the wetland area, however much of the wetland area is said to be degraded (Cardno May 2011). If practical, and the wetland design allows for it, it should be the landscape architects intention to retain of any healthy wetland tolerant vegetation.

POS G

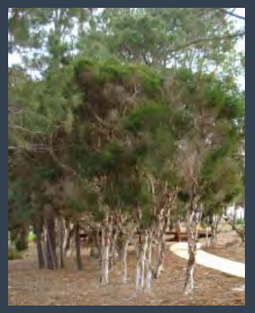
As per the rehabilitation typology, this POS will retain storm-water on-site and store it away from high use mixed business area to the north, the use of bio-retention and bio-filtration basins will retain and treat run off, whilst providing additional open space areas for the public to enjoy.

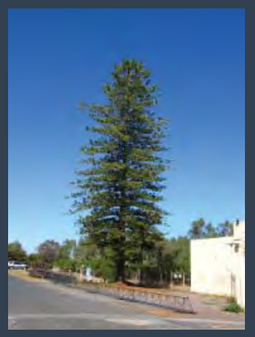
POS H, I, J

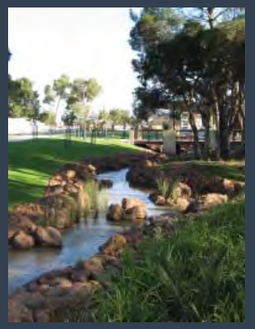
These three POS areas all fall within the neighbourhood park typology, and will have a similar function to POS G, in that they will consist predominantly of bio-retention and bio-filtration basins, surrounded by passive recreation areas.

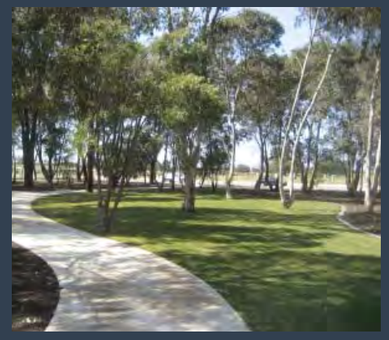
RAILWAY RESERVE BUFFER

The existing belt of Eucalypts located within the railway re-serve area should be retained and reinforced where practical.









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