

APPENDICES

Planning and Development Committee Meeting

02 September 2015

5.30pm

City of Albany Council Chambers

PLANNING AND DEVELOPMENT COMMITTEE
APPENDICES –02/09/2015

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Yakamia/Lange structure plan

Water management strategy

Prepared for City of Albany

By Essential Environmental

February 2014



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environmental



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1 INTRODUCTION

Consistent with *State Planning Policy 2.9: Water Resources* and *Better urban water management* (WAPC 2008a), a local water management strategy is required to be submitted to support any amendment of a Local Scheme to ensure that appropriate water management strategies are identified at the appropriate time.

The position of this strategy within the state government planning framework is defined in *Better urban water management* (WAPC 2008a) and *Planning bulletin no. 92, urban water management* (WAPC 2008b) and is outlined in Figure 1.

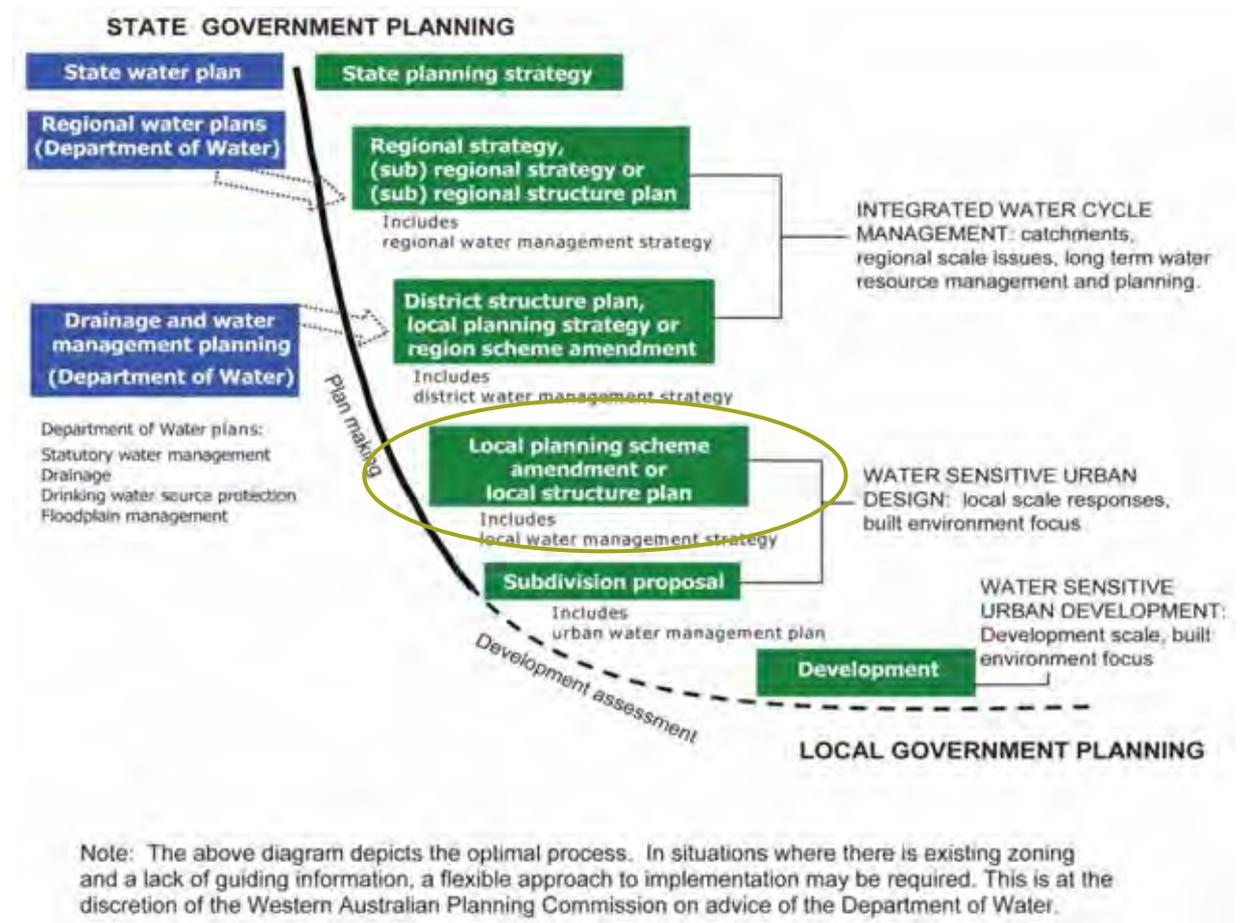


Figure 1: Planning framework, integrating water management with the land planning process (WAPC 2008)

In the absence of any site specific strategic water management guidance this plan's strategies and management principles have been informed by *State Planning Policy 2.9: Water Resources* and *Better urban water management* (WAPC 2008a).

2 PLANNING AND PROPOSED DEVELOPMENT

2.1 The structure plan area

The Yakamia/Lange structure plan area is located in the City of Albany, to the north of the developed portion of the city and within the catchment of the Yakamia Creek. The area is bounded to the north by Mercer Road and to the south by Ulster Road and North Road. The existing developed area of Yakamia marks the western boundary although there is an additional isolated pocket of undeveloped land that is included within the structure plan and is located to the west of the main structure plan area at the northern end of Barnesby Drive.

Figure 2 presents structure plan area together with the boundary of the Yakamia Creek catchment.

2.2 Existing land use

The Yakamia/Lange structure plan area is a mix of rural land uses including; rural residential, some small scale horticulture and grazing. Much of the area is cleared although significant areas of vegetation remain, particularly within and fringing the flood plain.

The southern half of the structure plan area is currently zoned 'Future Urban' in accordance with the City's Town Planning Scheme 1A. The northern half of the structure plan area is zoned 'Rural' in accordance with the City's Town Planning Scheme 3. The structure plan proposes that the uses designated under the Structure Plan apply to the land as if incorporated into the Scheme(s).

2.3 Proposed development

The *Yakamia/Lange Structure Plan* proposes significant new residential development in the Yakamia Creek catchment to the north of the existing built-up area of Albany. This water management strategy guides and supports the Yakamia/Lange structure plan.

The structure plan encompasses an area of approximately 363 ha. Due to the close proximity of the activity centre at Chester Pass Rd to the northern part of the structure plan there is little need for significant additional commercial development. As such, the predominant land use proposed for the area is residential. Three housing densities are proposed by the current structure plan. The majority of the proposed development areas are proposed to be medium density urban areas R25, with slightly higher density (R30) in the areas adjacent to the Chester Pass Rd activity centre, and in the Beaufort Road precinct. In contrast, low density (semi-rural) development areas (R2.5; 4000 m² lots) and split zonings (R2.5 / R25) are proposed in areas adjacent to vegetated protection areas and greater fire and flooding risk, on steep slopes and areas potentially constrained by infrastructure. Development has been identified along the north side of Ulster Road as a means to encourage subdivision and ultimately facilitate access to Yakamia creek and/or transfer it into Crown ownership that will improve management of that area.

In addition to residential landuses, key areas will be set aside for the purposes of:

- Developing conservation corridors –the Yakamia Creek Foreshore area will be ceded to the Crown at the time of development;

- Protecting areas of high biodiversity – Priority Ecological Communities will be maintained and protected as POS or in private ownership via conservation covenant;
- Vegetation Protection Lots – areas of remnant vegetation in good-excellent condition will be maintained and protected as POS or in private ownership via conservation covenant;
- Transportation;
- School sites – a primary school site has been identified at the corner of Catalina Rd and Lockheed St;
- Public recreation space – for both passive and active (sporting) recreation, in accordance with Liveable Neighbourhoods recommendations. Nine areas of POS have been identified in the local structure plan area, including both local parks, and district parks supporting active recreation, most of these providing dual use for drainage management; and
- Flood ways – to support a stormwater system that minimises risk to public health and amenity, protects the built environment from flooding and water logging, protects existing waterways, wetland and foreshore and can be sustainably maintained in the long term.

An approximate break down of potential land use in the Yakamia/Lange structure plan area is presented in Table 1.

Table 1: Potential land use area breakdown of Yakamia/Lange structure plan area

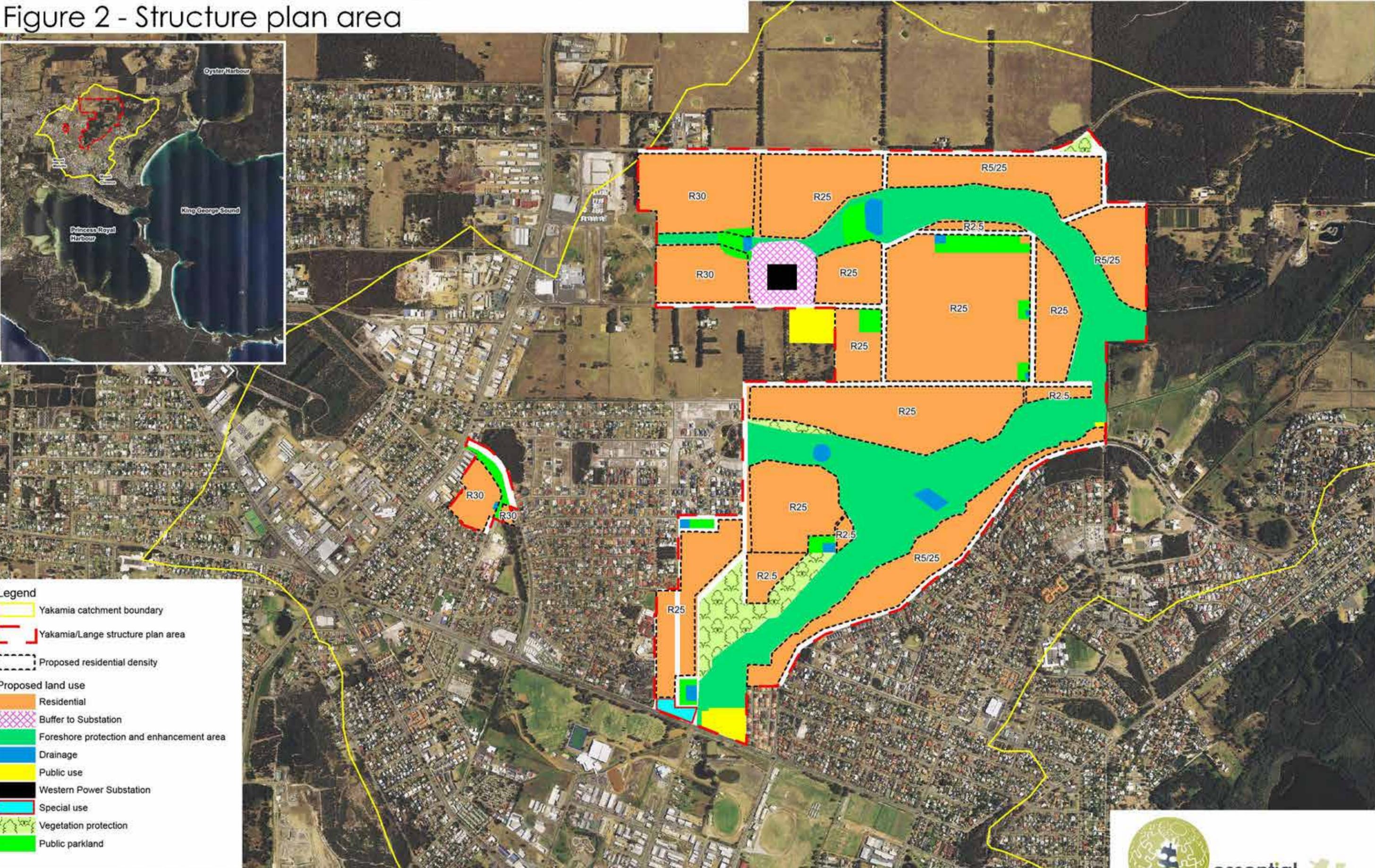
Land use	Area (ha)
High residential density area (R30)	106.8
Medium density residential area (R20)	18.1
Low density residential area (R5)	67
Public open space	21.2
Public use	5.8
Flood way	22.8
Yakamia Creek foreshore reserve	71.4
Vegetation protection	41.1
Western Power substation and buffer	9.8
Total	364

Table 2: Full potential residential lot breakdown in the Yakamia/Lange structure plan area

Density coding	Density (dwellings/ha)	Area (ha)	Number of dwellings
R5	0.95*	74.4	71
R20	14	20.1	280
R30	30	118.6	2,360

*As per existing structure plan

Figure 2 - Structure plan area



- Legend**
- Yakamia catchment boundary
 - Yakamia/Lange structure plan area
 - Proposed residential density
- Proposed land use**
- Residential
 - Buffer to Substation
 - Foreshore protection and enhancement area
 - Drainage
 - Public use
 - Western Power Substation
 - Special use
 - Vegetation protection
 - Public parkland

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3 KEY WATER ISSUES

Surface water and groundwater resources in the Yakamia/Lange structure plan area play a vital role in supporting Oyster Harbour which is recorded on the national *Directory of Important Wetlands in Australia* (Environment Australia 2001). The structure plan area is located at the interface between the existing urbanised upper catchment of the Yakamia Creek with its rural lower catchment. The structure plan proposes to increase the urbanised part of the catchment and this has the potential to substantially change the hydrology of the catchment and cause impacts to the remaining rural landscape as well as downstream infrastructure and environments including Oyster Harbour.

Within this context the key water-related issues that are relevant to the future planning and development of the structure plan area are:

- Drainage and flood management
- Supporting and sustaining the values of the rural environment
- Water availability

3.1 Drainage and flood management

The provision of a stormwater system that minimises risk to public health and amenity, protects the built environment from flooding and water logging, protects existing waterways, wetland and foreshore and can be sustainably maintained in the long term is a major objective of the structure plan.

The Yakamia Creek catchment is characterised by substantial seasonal baseflow arising from high ground where there is limited storage capacity in the soils. This baseflow contributes a significant proportion of winter stream flows and limits the receiving capacity of drains and watercourses during large storm events.

The Creek is also subject to erosion from high velocity surface water flows generated in the upper urban catchment during and immediately following rainfall events. Sediment generation from urban areas during these events can be significant and this has been identified as a contributing factor in historic flooding.

Historic flooding has also been attributed to poor management of the downstream catchment, where watercourses have been deepened and straightened to form drains but not maintained. Over time these drains have become eroded and subjected to sediment build-up leading to substantially reduced capacity in artificial drainage channels.

3.1.1 Planning considerations

Development in the structure plan area will need to provide capacity for the safe conveyance of storm event flows in addition to the significant seasonal baseflow that is characteristic of the catchment.

Drainage systems will need to be designed to limit high velocity erosive flow rates and provide appropriate opportunities for sediment deposition.

It is also important that downstream wetlands, watercourses and their foreshores are provided with adequate protection and management including stock exclusion, bank stabilisation and revegetation and weed eradication.

3.1.2 Arterial drainage planning

Modelling of the Yakamia Creek catchment has been undertaken to provide an assessment of arterial drainage requirements for the structure planning area.

Hydrology and hydraulic performance of the existing and potential future drainage system was modelled using DRAINS (Watercom 2013).

A digital terrain model was developed using LiDAR survey information and used, along with asset information, to define the extent of the drainage catchments and a representation of infrastructure and overland flow paths throughout the Yakamia Creek drainage catchment. The layout of the arterial drainage model in relation to major subcatchments and the Structure Plan boundary is illustrated in Figure 3.

Hydrology within the catchment was calibrated to reproduce the peak flow rate which was observed downstream of North Road during flow monitoring between 1993 and 2002. The majority of the catchment upstream of this location has been developed. The hydrology of existing undeveloped and rural land is assumed have similar hydrology to pervious areas within the urban catchment. Notwithstanding, the calibration provides some confidence in relevance of model assumptions, and is considered adequate for the purpose of informing the structure plan. A detailed explanation of modelling assumptions is provided in the *Yakamia Creek Arterial Drainage Plan* (Essential Environmental 2013).

Without provision for adequate arterial drainage infrastructure, development within the Structure Plan area will result in changes to peak flow rates and volumes of stormwater discharged from the site, with potential impacts on flood recurrence for downstream agricultural land, and/or impacts to environmental systems from acute erosion or sediment transport.

The arterial drainage modelling provides an estimate of existing peak flow rates (Table 3) at key locations illustrated in Figure 3. The extent of flooding estimated by the arterial drainage model under the existing hydrological conditions is also illustrated in Figure 3. In the absence of site specific flow monitoring data the predicted **existing** flood modelling results presented in Table 4 can be used to inform conceptual design of flow control structures for future development areas. Monitoring of surface water flows will be required to confirm existing flow rates and peak water levels to inform design of arterial drainage infrastructure.

Key requirements of any development within the structure plan area relating to arterial drainage are:

- Detention of surface water flows to ensure that development does not result in an increase to peak flow rates to downstream drainage systems or natural flow paths. The aim of this requirement is to preventing damage or increased rates of erosion to natural flow paths and to maintain similar flood frequency in downstream drainage systems.
- Provide drainage infrastructure which provides conveyance of stormwater from upstream catchments without increases to upstream flood frequency. This can be assessed through hydraulic analysis that demonstrates that peak flow rates from upstream catchments can be received without changes to upstream flood levels.
- Control of sediment transport through management of flow velocities and provision of sediment control points prior to discharge and energy dissipation structures at discharge points.
- Development of land adjacent to the existing Yakamia Creek Drain downstream of North Road must facilitate upgrades to the drain that will incorporate energy dissipation structures, improve the stability of the drain and reduce flow velocities. The

key aim of this requirement is to reduce erosion and sediment transport from this vulnerable part of the arterial drainage system and improve downstream water quality.

- Development of land in the Barnseby Drive precinct should facilitate reconstruction of Yakamia Drain to the western side of Beauford Road and provide a defined floodway for safe passage of flows.
- Proposed future intersections at Barnseby Drive / Chester Pass Road and Range Road / North Road will need to be designed to facilitate safe passage of major flood events.

The model of the existing system was modified to represent the future landuse scenario proposed by the structure plan, and development of other areas outside of the structure plan area. This preliminary modelling suggests that provision of detention storage at 19 locations can be effective in managing peak flow rates and therefore achieve the objectives outlined above. The post-development arterial drainage plan is illustrated in Figure 4 and Figure 5. Peak discharge rates and design storage volumes for each of the flood storage areas is outlined in Table 3.

Table 3: Indicative infrastructure sizing

Location	Design Detention Volume (m3)	Peak Discharge (m3/s)	
		5 year	100 year
S1	2132	0.192	1.148
S4a	1000	0.087	0.118
S4b	491	0.091	0.295
S6	869	0.138	0.705
S7	1228	1.027	3.979
S8	3110	0.129	0.97
S10	1242	0.076	0.546
N1	8112	0.147	1.502
N2a	4333	0.172	1.379
N2b	4262	0.181	1.25
N3	2654	0.095	0.677
N4a	790	0.167	2.224
N4b	1287	0.07	1.305
N4c	1181	0.153	2.852
N5	1717	0.057	0.65
N6a	296	0.06	0.164
N6b	928	0.13	0.849
N6c	551	0.019	0.427
N7	1944	0.073	0.495
N8	1299	0.066	0.463

Note: Design detention volume is peak predicted to occur during 5yr event and contained without overflow.

The impact of development using the proposed detention arrangements can be assessed by observing the predicted change in peak discharge rates at the key locations as presented in Table 4. It can be seen that the proposed detention storages achieve protection of downstream systems by providing nominal reductions or manageable increases in peak flow rates during major and minor events. Further, the arterial drainage plan accommodates predicted peak flow rates from flow paths with nominal impact on upstream systems.

The exception to these conclusions is for Locations A1 and B. Here the preliminary design results in some restriction of flow at A1 and an increase in Major event peak flow at location B. This is due to piping of a section of the drain immediately downstream of location A1 and realignment of the creek near Beauford Street which removes flooding (and associated detention of peak flow) that is predicted to occur under current conditions. Further detailed hydraulic analysis will need to be undertaken to examine the impact of proposed changes and/or opportunities to provide additional flood storage.

The arterial drainage plan has made a conservative assessment of detention requirements in B3 and B5 by assuming that there is only nominal detention of peak flows upstream of System Control Location G1. The development of the land which lies upstream and outside of the study area should be required to detain peak flow rates discharged from that development. Detention requirements downstream can be re-assessed once the upstream development form has been resolved.

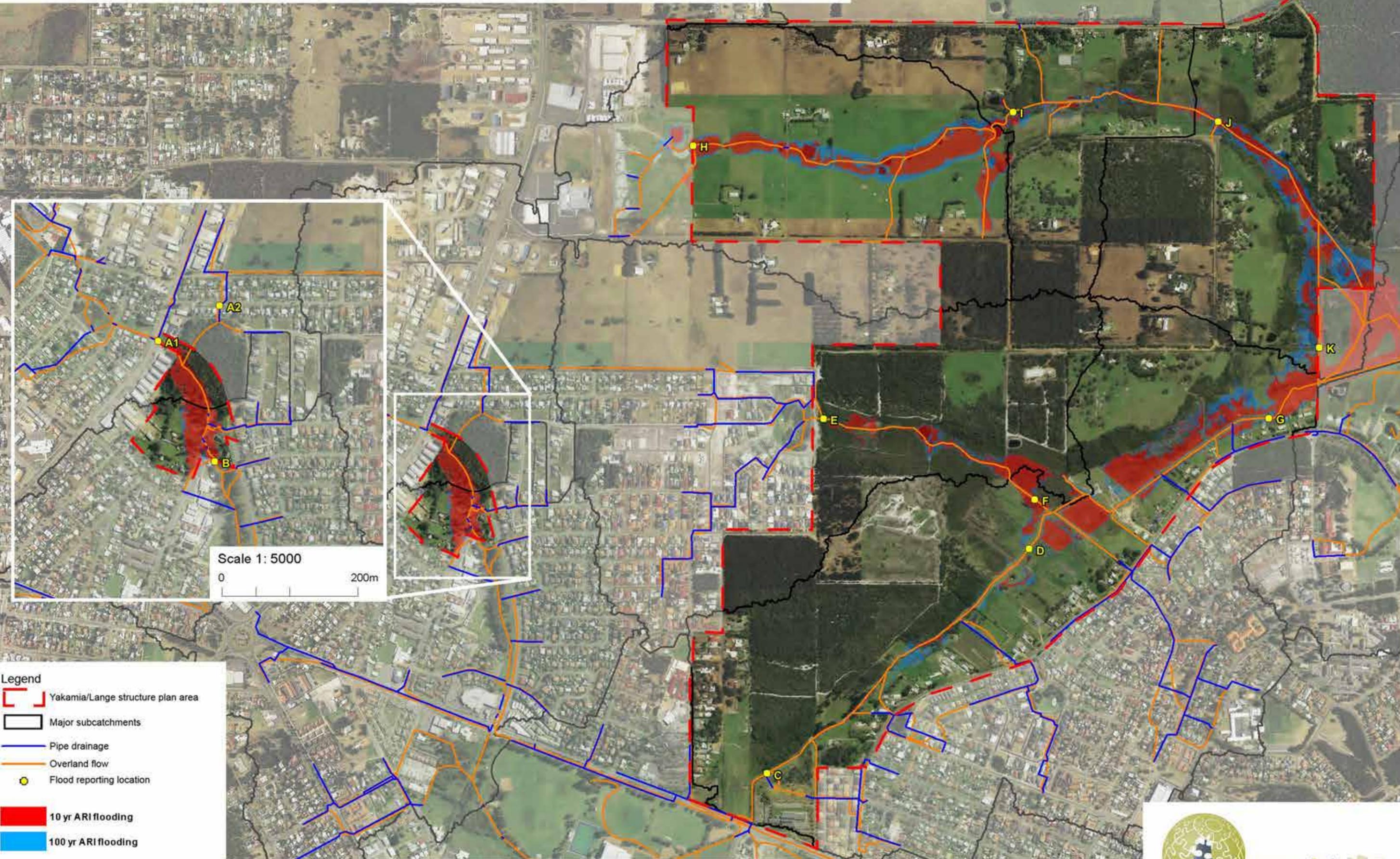
Table 4: Surface water modelling results – peak flow (m³/s)

Location	Existing		Post-development		Change %		Comment
	5 year	100 year	5 year	100 year	5 year	100 year	
A1	2.735	9.116	2.684	7.5	-1.9%	-17.7%	Reduction due to piping existing drain. Upstream impact to be assessed further during design.
A2	0.335	1.22	0.262	0.986	-21.8%	-19.2%	Assumed detention storage to be provided in upstream catchment reduces flow rates
B	3.466	7.856	3.583	9.189	3.4%	17.0%	Increase due to removal of localised flooding. Downstream impact to be assessed further during design.
C	8.19	16.88	8.3	17.08	1%	1%	Nominal increase due to local urbanisation
D	8.49	19.67	8.81	20	4%	2%	Nominal increase due to local and upstream urbanisation. Impact is offset by improved environmental performance along creek / drain.
E	1.32	5.62	1.01	3.45	-23%	-39%	Reduced peak flows due to better utilisation of existing detention storage.
F	0.99	7.4	1.16	5.25	17%	-29%	Increased catchment from S8. Increase in minor event flow expected and can be accommodated with construction of living stream.
G	9.8	31.23	10.08	27.15	3%	-13%	The impact of small increase in minor event flows is offset by improved environmental performance along creek / drain.
H	0.17	0.47	0.32	0.73	88%	55%	A piped outlet will be provided from existing upstream detention area to improve safety and amenity; this has resulted in increased flow rates.
I	0.2	3.15	0.18	1.25	-10%	-60%	Nominal reduction in minor flows due to pipe size increments
J	0.75	14.82	0.78	7.41	4%	-50%	Nominal increase due to local urbanisation.
K	0.78	6.39	0.9299	5.5211	19%	-14%	Moderate increase due to local urbanisation. Impact is offset by improved environmental performance along creek / drain.

Notes:

- All flows are in m³/s

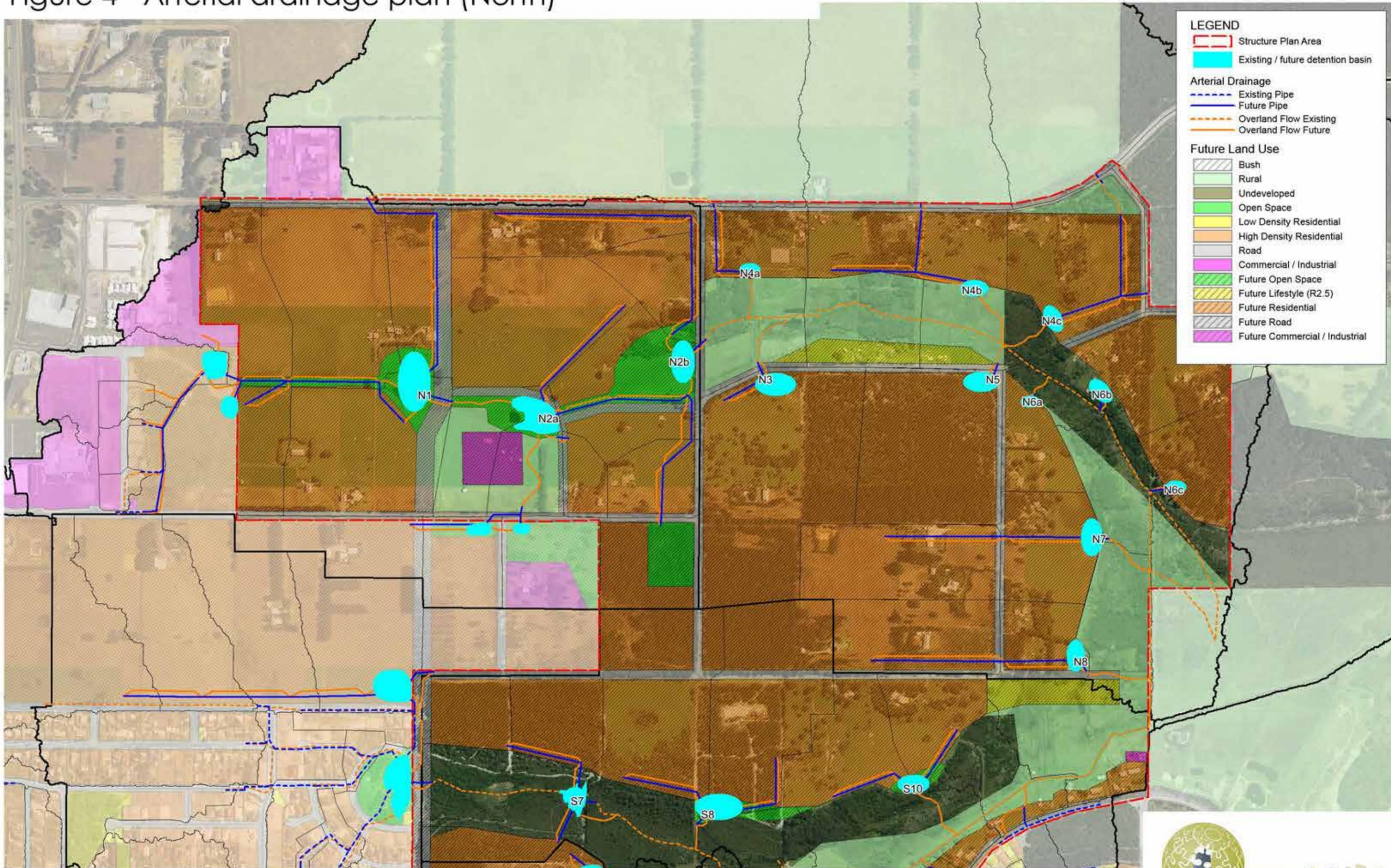
Figure 3 - Existing flood extent and key reporting locations



- Legend**
- Yakamia/Lange structure plan area
 - Major subcatchments
 - Pipe drainage
 - Overland flow
 - Flood reporting location
 - 10 yr ARI flooding
 - 100 yr ARI flooding

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Figure 4 - Arterial drainage plan (North)



LEGEND

- Structure Plan Area
- Existing / future detention basin

Arterial Drainage

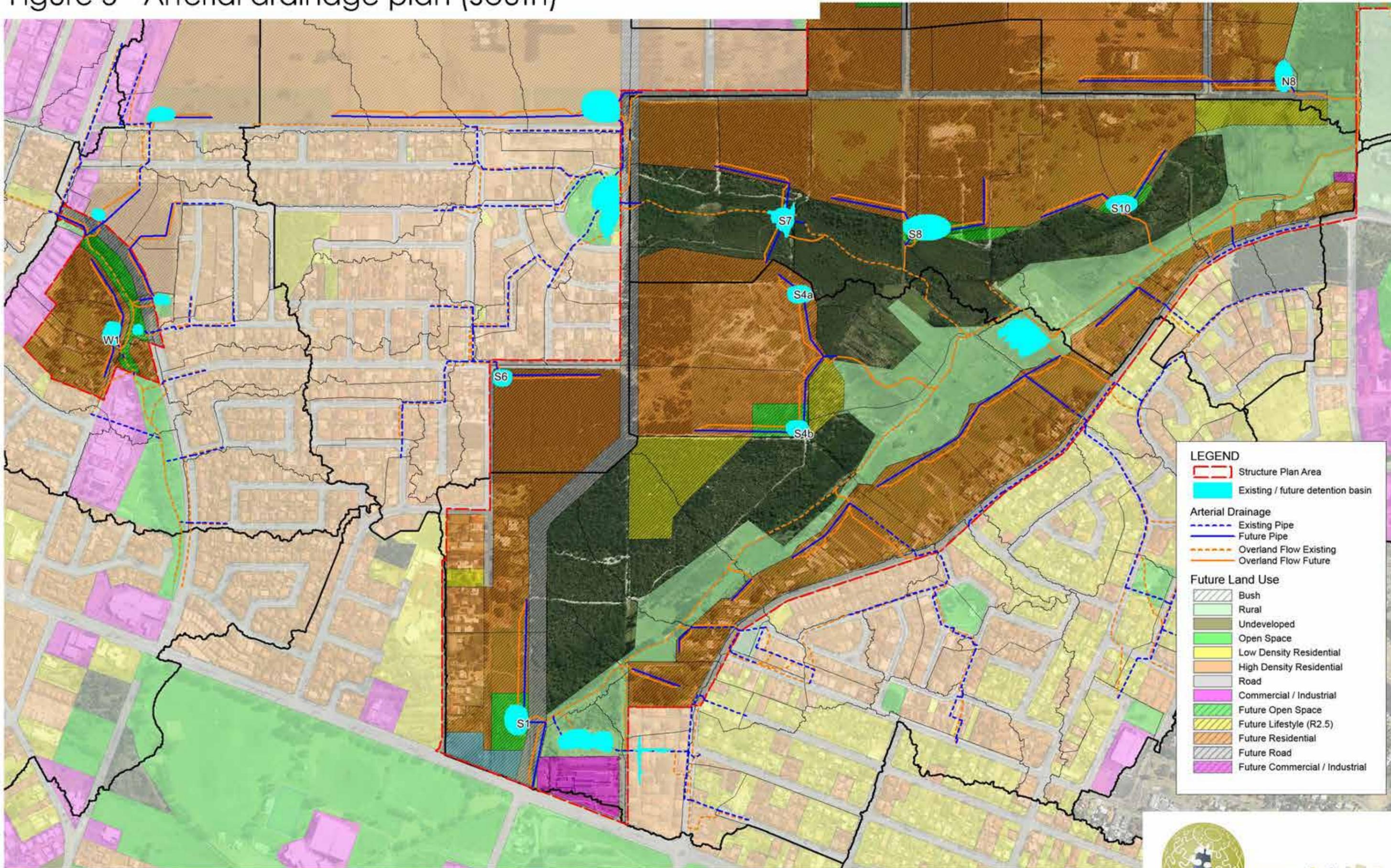
- Existing Pipe
- Future Pipe
- Overland Flow Existing
- Overland Flow Future

Future Land Use

- Bush
- Rural
- Undeveloped
- Open Space
- Low Density Residential
- High Density Residential
- Road
- Commercial / Industrial
- Future Open Space
- Future Lifestyle (R2.5)
- Future Residential
- Future Road
- Future Commercial / Industrial

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 Data source: City of Albany, Landgate, Department of Water. Created by: K Norris. Projection: MGA50: zone 50.

Figure 5 - Arterial drainage plan (South)



LEGEND

- Structure Plan Area
- Existing / future detention basin

Arterial Drainage

- Existing Pipe
- Future Pipe
- Overland Flow Existing
- Overland Flow Future

Future Land Use

- Bush
- Rural
- Undeveloped
- Open Space
- Low Density Residential
- High Density Residential
- Road
- Commercial / Industrial
- Future Open Space
- Future Lifestyle (R2.5)
- Future Residential
- Future Road
- Future Commercial / Industrial

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 Datasource: City of Albany, Landgate, Department of Water, Created by: K. Norris. Projection: MGA50: zone 50.

Scale 1: 7500

0 200m



3.2 Supporting and sustaining the values of the rural and natural environment

The natural and rural character of Albany is highly valued by residents and visitors alike. The surrounding area contains extensive areas of national park, state forest and other lands managed by the Department of parks and Wildlife, interspersed by cleared or partially cleared rural land.

Oyster Harbour is known to be at risk from significant inputs of nutrients and other types of pollution from the surrounding broad acre farming as well as excessive clearing and urbanisation.

Yakamia Creek is a substantial source of fresh water to Oyster Harbour and has been identified as providing a significant contribution of nutrients and heavy metals. Increasing urbanisation in the catchment has the potential to substantially alter the hydrology of the Creek system with increased drainage generating greater streamflow and thereby increasing loads of contaminants discharging to Oyster Harbour.

The government sewerage policy - consolidation draft (DoH 2011) requires that conventional septic tanks are located more than 100 m from watercourses and up to 1km "up-gradient" of wetlands. The policy allows that the buffer distance can be reduced through use of approved nutrient removing systems. Given the environmentally sensitive nature of Oyster Harbour and the wetlands associated with Yakamia Creek, it is recommended that all future on-site wastewater systems are nutrient removing.

Many residents have been drawn to Albany for the opportunity it offers for a rural or semi-rural lifestyle. Others have been resident in the Subregion for several generations and have strong ties to existing communities. There are extensive walking and cycle trails as well as canoe accessible waterways through outstanding natural areas. Albany also contains important heritage buildings and numerous Aboriginal heritage sites.

Supporting and sustaining the values of this rural environment requires that sufficient uncleared and protected land is retained to preserve the natural character of the area whilst providing for a growing population and a vibrant tourist industry. In addition, it is important to recognise the impacts that surrounding development can have on reserved and protected areas in particular through hydrological change increasing or decreasing the accessibility of water for dependent flora and fauna as well as through water quality decline and loss of connectivity.

3.2.1 Planning considerations

Development in the structure plan area should provide for the detention and treatment of baseflow and minor storm event flow from developed areas.

There are substantial opportunities for the downstream Yakamia Creek to be restored and diverted through treatment wetland areas to improve the quality of water discharged to Oyster Harbour.

The identified foreshore area for Yakamia Creek encompass both the 100 year floodway as well as areas of significant riparian and associated wetland vegetation in recognition of the important hydrologic, ecologic and social functions and values of the watercourse. A foreshore management plan will be necessary to provide guidance to developers and the City for the restoration, rehabilitation and ongoing management of the foreshore.

Effective management of foreshore areas and water quality as well as drainage design that avoids creation of new breeding habitats will assist to avoid mosquitoes and other insects becoming an unacceptable nuisance to the future community. Short term management through chemical interventions should be undertaken only as a last resort in response to surveillance indicators.

Development in the structure plan area should not rely on traditional building methodologies and should investigate innovative design solutions that integrate appropriately with their surrounding environments as well as providing for areas to maintain flow-paths and connectivity of vegetated areas.

In order to proceed with development in these locations it will be necessary to clearly define the natural, cultural and recreational values to be protected and include commitments for future ongoing management and monitoring of wetlands, watercourses and biodiversity.

3.2.2 Broad scale water balance

A broad scale water balance has been developed for the Yakamia Catchment to model the changes in hydrology that are expected following development and to gain an understanding of the potential impacts to Oyster Harbour. Five scenarios have been modelled:

1. Existing development
2. Proposed development of Yakamia/Lange with traditional drainage and water quality approaches
3. Proposed development of Yakamia/Lange with a water sensitive approach to hydrology including the use of rainwater tanks and/or other on-site retention but no additional water quality treatment
4. Proposed development of Yakamia/Lange with water sensitive urban design incorporating nutrient retention
5. Proposed development of Yakamia/Lange with water sensitive urban design principles incorporating nutrient retention and with modified management of public open spaces and rural land throughout the catchment

In scenarios 1 to 4 it has been assumed that the remainder of the catchment remains unchanged.

Nutrient input loads have been derived from land uses based on nutrient application rates estimated by the Department of Water for *Hydrological and Nutrient Modelling of the Peel-Harvey Catchment* (2011a). These loads have been derived from information gathered during surveys of fertiliser application rates undertaken on the Swan Coastal Plain and are likely to provide a reasonable estimate of application rates for Albany. Nutrient application rates are presented in Table 5.

Nutrient concentrations at the downstream extent of the Yakamia catchment recorded during monitoring of stormwater undertaken by the Department of Water as 'snapshots' in 2003 and 2011 (DoW 2011b). The average of reported concentrations for Total Nitrogen and Total Phosphorous have been used to derive output loads for the existing system based on the estimated annual streamflow discharge from the catchment (Table 6). It has been assumed that the nutrient uptake of the catchment (ie input load – output load) will remain proportionally the same following development of the Yakamia/Lange structure plan area.

Table 5: Typical nutrient application rates (kg/ha/year)

Land use	TN	TP
Bush	2	0
Rural	44.28	3.4
Low-med residential (R5-R20)	100.6	26.4
Med-high residential (R30)	23.4	6.9
Commercial/industrial	5	2.5
Road reserves	5	2.5
Public open space	123	24

Scenario 1 considers the existing land uses of the catchment and establishes a baseline for annual streamflows and nutrient export loads.

Scenario 2 assumes that Yakamia/Lange is developed using traditional approaches to drainage, therefore the new land uses apply nutrients the same rates as for the existing developed areas and the catchment achieves the same proportional reduction. This results in increases to streamflow as well as both applied and discharged nutrient loads.

Scenario 3 assumes that the development of Yakamia/Lange occurs without substantially changing the hydrology of the catchment. This is achieved through on-site retention and detention of stormwater using rainwater tanks and other storage mechanisms. Under this scenario, no changes have been made to nutrient application rates or reduction efficiency. The increase in discharged nutrient loads in this scenario is very slightly smaller than that seen in scenario 2 but is effectively negligible. This is because the lower Yakamia Creek acts as a large detention area, effectively capturing streamflow and therefore nutrients prior to their discharge into Oyster Harbour. Although development of the upper Yakamia catchment without detention substantially increases streamflow entering the lower creek,

Scenario 4 considers the impact of development undertaken following water sensitive urban design principles to reduce the load of nutrients entering the Yakamia Creek system. The applied nutrient loads from newly developed areas have been reduced by 45% for total nitrogen and by 60% for total phosphorous as compared to traditional urban areas within the developed areas only. These percentage reductions are consistent with the recommendations of *Better urban water management* (WAPC 2008a) and are considered achievable through the provision of:

- On-site retention of the first 15 mm of rainfall from constructed impervious areas
- Maintenance of pre-development 1 year ARI critical event peak flow rates and volumes for the subcatchment
- biofiltration sized at a minimum of 2% of the connected impervious area they receive runoff from
- soil amendment to include a 300-mm-deep layer of material that will reduce nutrient export (where in-situ soils have a PRI less than 5) undertaken across a minimum of 10% of the site including, but not limited to, all landscaped public open space and landscaped drainage features

This scenario results in an overall reduction in total nitrogen output load, largely through the conversion of rural land which has high fertiliser application rates to higher density residential areas. It should be noted that if target densities are not achieved and lower density urban

development is more widespread, nutrient application rates, and therefore output loads, are likely to be significantly greater. Total phosphorous loads remain slightly increased compared to the predevelopment scenario.

Scenario 5 considers a broader application of water sensitive urban design principles across the catchment, reducing nutrient loads applied to all public open spaces at the same rates as for the new development areas and rural areas by 10% for both total nitrogen and total phosphorous.

This scenario demonstrates that through broadscale application of water sensitive urban design principles to the management of public open spaces and rural land within the catchment in addition to development in Yakamia/Lange applying water sensitive urban design principles significant nutrient load reductions to Oyster Harbour could be achieved.

Table 6: Broad scale site water balance

Scenario	INPUTS			OUTPUTS		
	Rainfall	Nutrients		Streamflow	Nutrients	
		TN	TP		TN	TP
1	17,853	66.6	12.3	4,432	5.94	0.31
2	17,853	71.2	15.4	4,451	6.37	0.39
3	17,853	71.2	15.4	4,432	6.35	0.39
4	17,853	67.2	13.1	4,432	5.73	0.33
5	17,853	64.4	12.5	4,432	5.04	0.29

Notes:

- Streamflow and rainfall are in ML/year
- Nutrient loads are in T/year

It is recognised that this is a highly simplified approach to nutrient modelling. However, with very limited monitoring information available and without undertaking more complex catchment nutrient modelling this approach provides a basic understanding of the potential impacts and options for mitigation and improvement.

3.3 Water availability

Preliminary planning for new water and wastewater services has commenced however there are substantial opportunities for water efficiency and use of alternate sources to reduce the requirement for future expansion of these services.

The Lower Great Southern water resource development strategy, prepared by the Department of Water (DoW 2010), outlines potential new water source options to meet existing demand as well as satisfy future growth predictions in Albany, Denmark and Walpole. The strategy recommends considering the following before the development of new sources is undertaken:

- Reduction in water use through cost-effective demand-management;
- Fit-for-purpose use of existing water sources, including use of treated wastewater for commercial/industrial demands;
- Improved water use efficiency;
- Non-scheme options such as rainwater tanks; and
- Water recycling.

Under the *National Water Security Plan for Cities and Towns*, the Water Corporation implemented an integrated water efficiency program in the Great Southern region known as H2ome Smart. The program aimed to helping households to reduce water use and encourage water efficiency through the implementation of a behaviour change program, retrofitting, and an active leakage detection and repair program (DSEWPaC 2012). A 17-19% reduction in household water use was achieved by those who participated in the program (SKM 2012).

Groundwater is used for irrigation in parts of Albany. However groundwater use is limited by accessibility and quality. There are several small dams within the structure plan area that should be retained and integrated with developing public open spaces to provide amenity and function as irrigation lakes. The use of subsurface storage devices may be considered to harvest rainwater for irrigation of public open spaces where there are no existing dams or lakes.

3.3.1 Planning considerations

Development in the structure plan area should seek to limit the need for additional scheme water sources in particular through promotion of maximum water efficiency and the use of existing dams, rainwater tanks and lot-scale greywater systems.

It is recommended that rainwater tanks can be mandated for low density (R5) residential lots and should be strongly promoted for use on medium density (R20) lots. Developer-builders and owner-builders should be encouraged to provide rainwater tanks plumbed-in to toilets on these lots. The practical use of rainwater tanks on higher density residential lots is limited and so should be left to the individual lot owner.

Greywater systems can be cheaply and easily fitted to higher density lots to supply the relatively low irrigation demands for these properties and is a practical way for developer-builders and owner-builders/residents to contribute to reductions in use of scheme water.

3.3.2 Water demand analysis

The structure plan area principally contains residential and public open space land uses only. There is a Western Power substation site although the water demands from this site are negligible in comparison to other land uses. A water demand analysis has been undertaken and is presented in the following tables.

Table 7 presents the water demands for a typical low density (R5) residential lot of approximately 2,000 m². Provision of a 20,000 L rainwater tank to supply water for irrigation and toilet flushing can be expected to supply approximately 41% of the demand for these lots and reduce residential scheme water demand from 104 kL/person/year to 82 kL/person/year.

Table 7: Low density (R2.5) residential demands, kL/yr

Demand type	Per person demand	Total R2.5 demand	Estimated supply	Preferred source strategy
Toilets	12	2,139	3,947	Rainwater
Irrigation	42	7,526		Rainwater
Other (Drinking water)	49	8,774	14,492	Scheme water
Total	104	18,439		

Table 8 provides a similar assessment for a typical medium density (R20) lot of 713 m². Analysis indicates that provision of a 5 kL rainwater tank plumbed into the toilets could supply approximately 97% of the toilet flushing demand. Installation of a simple greywater recycling system could provide for 60% of irrigation demands. In combination, these initiatives could reduce residential scheme water demand from 99 kL/person/year to 65 kL/person/year.

Table 9 repeats the assessment for a higher density (R30) lot of 500 m² where space for provision of rainwater tanks is limited. Here installation of a simple greywater recycling system could provide for 85% of irrigation demands. This could reduce residential scheme water demand from 88 kL/person/year to 72 kL/person/year.

Table 8: Medium density (R20) residential demands, kL/yr

Demand type	Per person demand	Total R20 demand	Estimated supply	Preferred source strategy
Toilets	12	8,437	8,205	Rainwater
Irrigation	38	26,489	15,894	Greywater
Other (Drinking water)	49	34,600	45,428	Scheme water
Total	82	69,527		

Table 9: Higher density (R30) residential demands, kL/yr

Demand type	Per person demand	Total R20 demand	Estimated supply	Preferred source strategy
Irrigation	27	156,350	93,810	Greywater
Other (Drinking water)	61	362,743	425,283	Scheme water
Total	88	519,093		

Assuming that rainwater tanks are mandated for low density (R5) residential lots and that there is only 30% uptake on greywater systems (R20 and R30) and rainwater tanks (R20 only) then an average residential scheme water demand of 80 kL/person/year would be achieved for the whole structure plan area (Table 10).

Table 10: Annual summary water use (ML)

Scenario	Scheme	Rainwater	Greywater	Total	Per capita scheme	Per capita total
Residential	555	6	45	606	82	90

Assumptions:

- Approximate population, based on occupancy rates from the Yakamia/Lange draft structure plan is 6,778 people
- Domestic irrigation for 6 months of the year
- 20 kL rainwater tanks on R5 lots – expect 100% uptake
- 5 kL rainwater tanks on R20 lots – expect 30% uptake only
- Greywater recycling systems on R20 and R30 lots – expect 30% uptake only

In addition to residential demands there is a need to identify water sources for irrigation of open space within the study area. From a preliminary analysis of open space requirements it is estimated that the total demand for irrigation of POS, verges and the proposed school site could be 107 ML. Given that management of stream flow volumes has been identified as a key concern for water quality management (described in section 3.2.2), there is an opportunity for surface water storage to provide a key role in restoring natural water balances and providing water security for open space irrigation. It is recommended that further investigations are undertaken to investigate the viability of co-locating irrigation storage with flood detention areas.

4 WATER MANAGEMENT STRATEGY

This Water Management Strategy identifies the following objectives for water management in the Yakamia Creek catchment:

1. Design drainage systems that provide appropriate levels of serviceability and flood protection for the existing and future community and infrastructure
2. Protect and restore the water quality, hydrological and ecological function of Yakamia Creek and Oyster Harbour.
3. Protect and enhance the rural and environmental character of Albany.
4. Reduce water use overall and promote 'fit-for purpose' use of all available water resources.

These objectives have been developed in response to key water issues outlined in section 3.

In order to meet the objectives of this water management strategy, the following strategies, which aim to directly respond to the identified issues, should be implemented as part of future land use planning and development.

4.1 Drainage and flood management

- i. No development will be permitted in the floodway.
- ii. Habitable development (ie, filling, building, etc) proposed adjacent to a floodway is to have a minimum floor level of 0.5 metre above the adjacent 100 year ARI flood level.
- iii. Areas designated as 'flood way' are to be stabilised and landscaped in accordance with the *Yakamia Creek Foreshore Management Plan* and will be ceded to the Crown at the time of subdivision free of cost and without payment of compensation by the Crown.
- iv. To prevent damage or increased rates of erosion to natural flow paths and to maintain similar flood frequency in downstream drainage systems, development is required to detain surface water flows to prevent any increase in peak flow rates to downstream drainage systems or natural flow paths.
- v. Developments are required provide for conveyance of stormwater from upstream catchments without increases to upstream flood frequency.
- vi. Constructed piped drainage systems within residential streets should be designed to accommodate 1 in 5 year average recurrence interval (ARI).
- vii. Drainage systems shall be designed to control sediment transport through management of flow velocities, provision of sediment control points prior to discharge and energy dissipation structures at discharge points.
- viii. Flood detention or infiltration areas shall be designed with low flow outlets to avoid extended durations of inundation and facilitate passage of baseflow.
- ix. Drainage systems are to be designed to avoid excessive maintenance requirements.
- x. Direct drainage from any future subdivision areas into the creek system is not to occur.
- xi. The section of Yakamia Creek (open drain) running adjacent to the new section of Barnesby Drive is to be modified to avoid flooding of the residential lots in accordance with the *Yakamia Creek Arterial Drainage Plan* (Essential Environmental 2013).

4.2 Supporting and sustaining the values of the rural and natural environment

- xii. Future urban development and subdivision within the structure plan area is to be connected to reticulated sewer.

- xiii. Where it is not practical to connect reticulated sewer to future low density 'lifestyle' R5 and R2.5 lots, onsite wastewater treatment and disposal should be provided using an Aerobic Treatment Unit (ATU) designed to reduce nutrient concentrations prior to disposal.
- xiv. Areas designated as 'Yakamia Creek Foreshore Reserve' are to be rehabilitated and revegetated in accordance with the *Yakamia Creek Foreshore Management Plan* and will be ceded to the Crown at the time of subdivision free of cost and without payment of compensation by the Crown.
- xv. Access to the Yakamia Creek Foreshore Reserve is to be provided by easement or road reserve at the points indicated in the *Yakamia Creek Foreshore Management Plan*.
- xvi. Swales and bioretention or infiltration systems are to be designed to be free draining to ensure they do harbour static water remain permanently wet¹
- xvii. Developments are to be designed to incorporate water sensitive urban design principles appropriate for implementation at the site, including:
 - a. On-site detention of the first 15 mm of rainfall from constructed impervious areas through provision of biofiltration or other approved systems.
 - b. Maintenance of pre-development annual discharge volumes for the subcatchment
 - c. soil amendment to include a 300-mm-deep layer of material that will reduce nutrient export (where in-situ soils have a PRI less than 5) undertaken across a minimum of 10% of the site including, but not limited to, all landscaped public open space and landscaped drainage features

4.3 Water resource availability

- xviii. All future development and subdivision within the structure plan area is to incorporate water efficient fixtures and fittings and aim to achieve water consumption of less than 100 kL/person/year.
- xix. Future development and subdivision is to consider the use of rainwater tanks and lot scale greywater recycling systems which is expected to achieve scheme water consumption of less than 60 kL/person/year for those developments.
- xx. Where possible flood detention areas should be designed to provide surface water storage that will improve water security for irrigation of open space.

¹ Where infiltration systems are used, a minimum separation of 0.3 m is recommended from winter peak groundwater levels in an average year.

5 IMPLEMENTATION

Although this Strategy provides guidance on water management in the Yakamia/Lange Structure Plan area, additional design and detail is required and will be provided via Local (detailed) Area Plans in order to guide subdivision. Each Local Area Plan will need to be accompanied by an Urban Water Management Plan. Subdivision and development will then be required to be consistent with the Yakamia/Lange Structure Plan and Local Area Plan. The requirements for implementation of this Water Management Strategy are outlined below and summarised in Table 11.

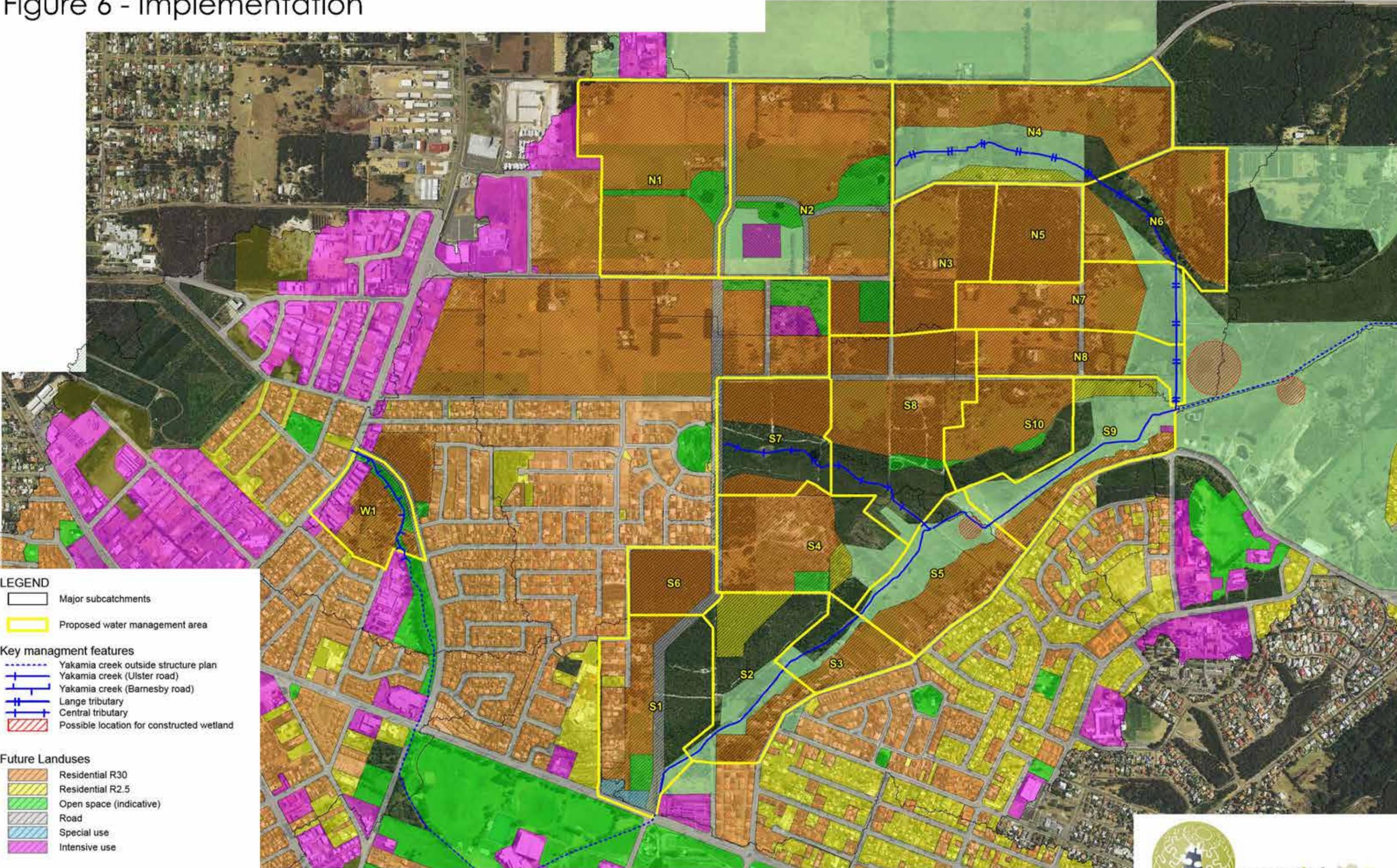
Due to the broad coverage and scale of this Water Management Plan it is useful to identify practical water management areas which could progress independently and therefore facilitate progressive development of the area.

The proposed spatial delineation of water management areas is illustrated in Figure 6. These are considered practical for addressing site specific implementation of the proposed strategies, in particular for management of stormwater and foreshore areas. Site specific requirements for each of these areas are described in Section 5.3.

Table 11: Summary of roles and responsibilities

Planning action	Water requirement	planning	Timing and responsibility	Additional comments
Yakamia/Lange Structure Plan	Supported by Yakamia/Lange WMS which includes objectives, strategies and criteria to be met as part of planning and development		Yakamia/Lange WMS accompanies the structure plan City of Albany	Yakamia/Lange WMS may be revised as detailed planning progresses or information comes to light
Local area plan (LAP) or precinct plan	Supported by an Urban Water Management Plan (UWMP) which demonstrates how the proposed development meets the objectives, strategies and criteria in the Yakamia/Lange WMS.		Required prior to any subdivision or development occurring Proponent	
Subdivision	Must meet the requirements of the relevant UWMP (and Yakamia/Lange WMS)		Should not occur until LAP and UWMP completed Proponent	Unlikely that a UWMP will be required due to the small scale nature of likely subdivision
Development	Must meet the requirements of the relevant UWMP (and Yakamia/Lange WMS)		Should not occur until LAP and Yakamia/Lange WMS completed Proponent	Should be consistent with relevant design guidelines

Figure 6 - Implementation



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5.1 Creek stabilisation and foreshore management

Detailed foreshore management planning will need to be undertaken through consultation between and with landowners, the City of Albany, the Water Corporation and the Department of Water to determine the appropriate extent of a foreshore reserve and site specific works required to improve amenity, environmental and social outcomes associated with the creek and foreshore areas.

It is recommended that an overall foreshore management plan is prepared for the structure plan area, which can then be refined through preparation of urban water management documentation and/or site specific foreshore management plans within each water management area.

Due to potential inequity in landowner returns, it is proposed that a contribution fund is established to assist in restoration of the northern tributary of Yakamia Creek (referred to as "Lange tributary" below and on Figure 6).

It is proposed that foreshore and streamline improvements to other parts of Yakamia creek are to be funded by development of adjacent landholdings, where local flood detention requirements can be provided "online" improving the yield of those lots.

5.2 Yakamia Creek water quality improvement

An additional, separate contribution fund is proposed to be established to facilitate implementation of water quality improvement works in the lower Yakamia Creek. Three locations have been identified (Figure 6) where topography is suitable to support diversion of minor flows and construction of artificial wetlands that could improve water quality.

It is proposed that all developments within the structure plan area contribute funds toward these works. It is noted that existing development within the catchment is equally (if not more) liable for water quality issues in the Yakamia creek catchment and it is therefore appropriate for the City to establish a separate mechanism for existing landowners to contribute to this fund; for construction of the facilities and/or ongoing maintenance.

5.3 Local Area Plans

More detailed planning and design information will be required at the precinct scale, via preparation of Local Area Plans. Each Local Area Plan should be accompanied by an Urban Water Management Plan, which will need to be developed in consultation with the City of Albany and the Department of Water.

Each Urban Water Management Plan should be based on local site investigations appropriate to the proposal and level of risk to water resources, and contain more detailed design which demonstrates how the objectives, strategies and design criteria contained in this Strategy are to be achieved. The Urban Water Management Plans should be consistent with the requirements of the Department of Water's *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008a). The default approach should be that Urban Water Management Plans will be prepared aligning with the proposed water management areas.

Site specific water issues for each of the water management areas are outlined in Table 12. In addition to site specific requirements, each water management area will need to:

1. Comply with general requirements of the Water Management Strategy (section 4)
2. Identify fit-for purpose water resources to service irrigation requirements for local public open space.
3. Make an appropriate contribution toward water quality improvement works within the lower Yakamia Creek.
4. Provide infrastructure and/or sediment ponds designed to retain sediment and gross pollutants within the urban area.

The indicative layout of the arterial drainage plan, including drainage catchments and detention areas required to achieve the stormwater management objectives is illustrated in Figure 4 and Figure 5. Proposed detention volume for each area are outlined in 3.1.2.

Table 12: Site specific issues for proposed water management areas

Area	Key issues / requirements
N1	<ul style="list-style-type: none"> • Stormwater design must accommodate incoming piped and overland flows from the future urban area immediately east and from the land on the north side of Mercer Road. • Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N2) do not exceed predevelopment conditions. • Developers in the area should make contribution toward restoration of the “Lange tributary”.
N2	<ul style="list-style-type: none"> • Stormwater design must accommodate incoming piped and overland flows from the future urban area immediately south west and from area N1. • Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N4) do not exceed predevelopment conditions. • Developers in the area should make contribution toward restoration of the “Lange tributary”.
N3	<ul style="list-style-type: none"> • Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N4) do not exceed predevelopment conditions. • Works should be carried out to limit erosion and facilitate the safe passage of stormwater from the development area into the creek. • Developers in the area should make contribution toward restoration of the “Lange tributary”.

Area	Key issues / requirements
N4	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the rural land north of Mercer Road, and from areas N2, N3 and N5. Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N6) do not exceed predevelopment conditions. Developers in the area should make contribution toward restoration of the "Lange tributary". The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out, using contribution funds (Lange tributary), to improve the environmental condition of the creek in the section bounded by N4.
N5	<ul style="list-style-type: none"> Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N4) do not exceed predevelopment conditions. Works should be carried out to limit erosion and facilitate the safe passage of storm water from the development area into the creek. Developers in the area should make contribution toward restoration of the "Lange tributary".
N6	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the rural and bushland to the north east, and from area N4. Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N7) will not exceed predevelopment conditions. Developers in the area should make contribution toward restoration of the "Lange tributary". The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out, using contribution funds (Lange tributary), to improve the environmental condition of the creek in the section bounded by N6.
N7	<ul style="list-style-type: none"> Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to N8) will not exceed predevelopment conditions. Developers in the area should make contribution toward restoration of the "Lange tributary". The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out, using contribution funds (Lange tributary), to improve the environmental condition of the creek in the section bounded by N7.

Area	Key issues / requirements
N8	<ul style="list-style-type: none"> Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (downstream to the lower Yakamia creek) will not exceed predevelopment conditions. Developers in the area should make contribution toward restoration of the "Lange tributary". The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out, using contribution funds (Lange creek), to improve the environmental condition of the creek in the section bounded by N8.
S1	<ul style="list-style-type: none"> Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (into Yakamia creek) will not exceed predevelopment conditions. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development and/or construction of the new Range Road to improve the environmental condition of the creek in the section bounded by S1.
S2	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the existing urban area to the east. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development to improve the environmental condition of the creek in the section bounded by S2.
S3	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the existing urban area to the east. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development to improve the environmental condition of the creek in the section bounded by S3.
S4	<ul style="list-style-type: none"> Stormwater infrastructure must be provided to ensure that theoretical peak discharge rates downstream in Yakamia creek (location D on Figure 3) are not increased as a result of the development. Works should be carried out to limit erosion and facilitate the safe passage of stormwater from the development area into the Yakamia creek.
S5	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the existing urban area to the east. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development to improve the environmental condition of the creek in the section bounded by S5.

Area	Key issues / requirements
S6	<ul style="list-style-type: none"> Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area into the downstream piped drainage system do not increase the frequency of flooding in the downstream urban area.
S7	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the existing urban area to the west. Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (into S8) will not exceed predevelopment conditions. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development to improve the environmental condition of the creek in the section bounded by S7.
S8	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from S7. Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the area (into S5) will not exceed predevelopment conditions. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development to improve the environmental condition of the creek in the section bounded by S7.
S9	<ul style="list-style-type: none"> Stormwater design must accommodate incoming piped and overland flows from the existing urban area to the east. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development to improve the environmental condition of the creek in the section bounded by S5.
W1	<ul style="list-style-type: none"> The design and construction of the Barnesby Road extension and the proposed creek realignment through W1 must: <ul style="list-style-type: none"> accommodate incoming piped and overland flows from the existing bushland and future urban area to the north, ensure that flood risk upstream of Chester Pass Road is not increased, and mitigate against potential for increased peak flow resulting from the proposed modifications to the alignment of Yakamia Creek. The subdivision process should facilitate; (1) transfer of the creek foreshore to the crown and/or (2) access for maintenance and restoration works. Works should be carried out as part of development or construction of Barnesby Road extension to improve the environmental condition of the creek. Stormwater detention / retention infrastructure must be provided to ensure that the peak discharge rates from the development area (into Yakamia Creek) will not exceed predevelopment catchment runoff.

5.4 Subdivision

Subdivision should be undertaken in accordance with the approved local structure plan and be consistent with the objectives, strategies and design criteria in this Local Water Management Strategy.

It is recognised that subdivision in some areas is likely to involve less than 30 lots. In these instances, an urban water management plan will not normally be required; however development should be consistent with the objectives, strategies and design criteria in this Water Management Strategy.

The City of Albany and/or the Department of Water may request preparation of an urban water management plan to support an application for subdivision where they consider additional information is required to demonstrate compliance with this Strategy. In this instance, the Urban Water Management Plan should be developed and assessed in accordance with the Department of Water's *Urban Water Management Plans: Guidelines for Preparing Plans and for Complying with Subdivision Conditions* (DoW 2008a).

5.5 Development

All development is to be in accordance with the objectives, strategies and design criteria in this Water Management Strategy. Additional design criteria may need to be met, particularly where they are specific to particular precincts. These will be outlined in the relevant Local Area Plan, Urban Water Management Plan or associated development guideline.

Engineering and building drawings submitted to Council for development approval are to be supported by clear and auditable documentation, providing details outlining the water management requirements including any proposed staging, and demonstrating compliance with design criteria.

Where required, the City of Albany may seek the advice of the Department of Water regarding water management measures outlined in any development application.

5.6 Monitoring and investigation requirements

A monitoring program will be implemented jointly by the City of Albany and Department of Water through developer contributions to gather information and monitor post-development impacts. The program will include monitoring of the following:

- Monitoring of flow at selected System Control Points
- Water quality of the Yakamia Creek system;
- Groundwater in the local vicinity where possible;
- Changes in vegetation within the creeks, flood plains and buffers;
- Rehabilitation success.

Geotechnical, acid sulfate soils and contaminated sites investigations as well as suitable predevelopment surface water and groundwater monitoring will be required to support subdivision or development proposals (Table 13).

Table 13: Summary of investigation requirements

Planning action	Investigation requirement
Local area plan (LAP) or precinct plan	Acid sulfate soils investigations/ potential acid sulfate soils management plan
	Contaminated sites investigations/ potential acid sulfate soils management plan
	Flora and fauna investigations
	Aboriginal consultation
Subdivision and development	Geotechnical investigations

5.7 Review

This Water Management Strategy should be reviewed every 5 years or as required to ensure currency of recommendations and that ongoing, viable and sustainable water management solutions are being achieved.

6 ENVIRONMENTAL PROFILE

6.1 Climate

The climate in Albany is typical of south coastal Western Australia with mild summers and cool, wet winters. The average summer maximum since records began in 1877 is 22.9 °C falling to an average winter minimum of 8.1 °C. Rainfall is typically at its highest in June and July and lowest in January and February. Albany receives an average annual rainfall of 931 mm (BoM 2013) which is significantly higher than Perth's annual average of 773 mm (Perth airport: BoM 2013). Summary climate data are presented in chart 1 below.

In November 2008, Albany was hit by a record breaking storm during which 113.6 mm of rain fell on the city, the highest daily rainfall recorded there since 1907. The 2008 rainfall record is also provided on Chart 1 for comparison.

Historic rainfall records do not display the significant recent decline in rainfall that has been seen in other parts of the south west of Western Australia although there has been a gradual decline in the calculated 30 year moving average since its peak in the mid 1930's as shown in chart 2.

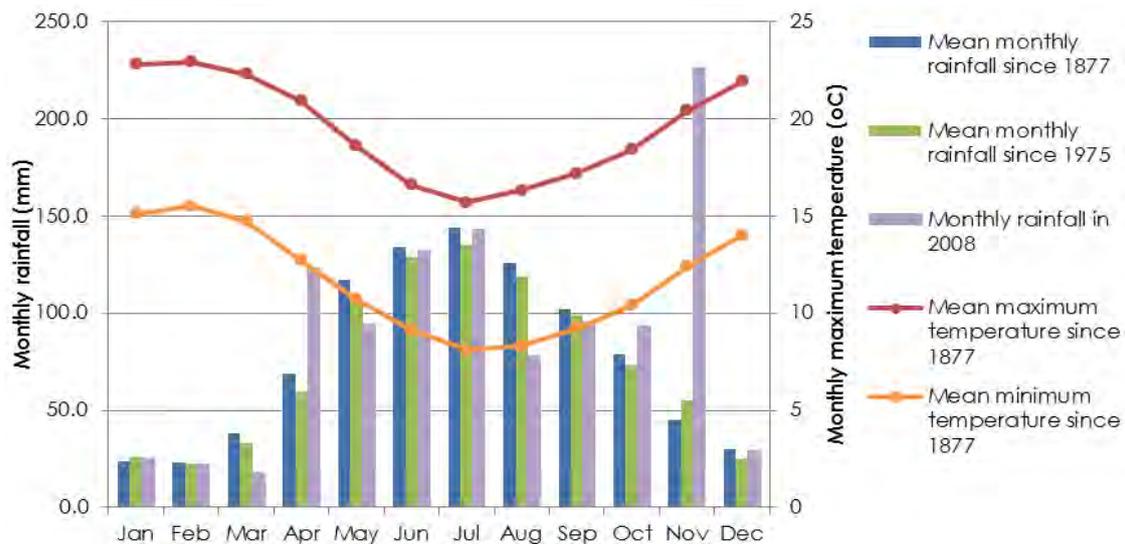


Chart 1: Albany climate summary data (Bureau of Meteorology station ref: 9500)

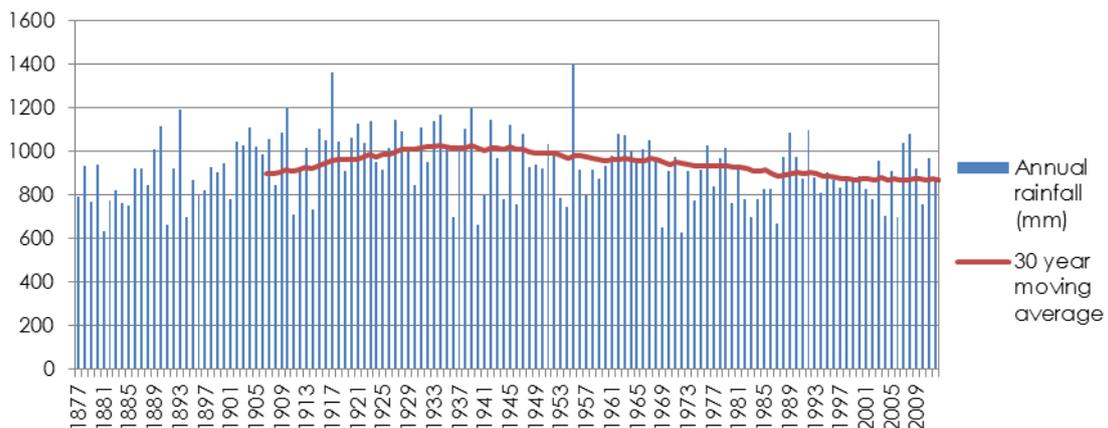


Chart 2: Historic rainfall in Albany (Bureau of Meteorology station ref: 9500)

6.2 Topography and geology

The topography of the Yakamia/Lange structure plan area is mapped in Figure 7.

The site contains three distinct ridges with three intermediate valleys sloping generally to the east which combine to form the larger Yakamia Creek floodplain valley which marks the south-eastern boundary of the site. The land is generally steep in the west but becomes more gently undulating as the eastern extent is approached.

The isolated, Barnesby Drive area is located towards the top of another steeply sloped valley heading southward towards North Road. The site itself slopes on both sides toward Yakamia Creek which forms the lowest part of the Yakamia/Lange structure plan area at 20 m AHD in the Barnesby Drive area and 5 m AHD in the main eastern area of the site.

6.3 Soils and geomorphology

Department of Mines and Petroleum environmental geology mapping of Albany and surrounds (Figure 7) describes the soils of the Yakamia/Lange structure plan area as:

- white to pale grey alluvial sand (S₁₄) within the floodplain of the creek
- laterite (LA₇) in the uplands
- pale grey sand (S₆) in the bulk of the remaining land

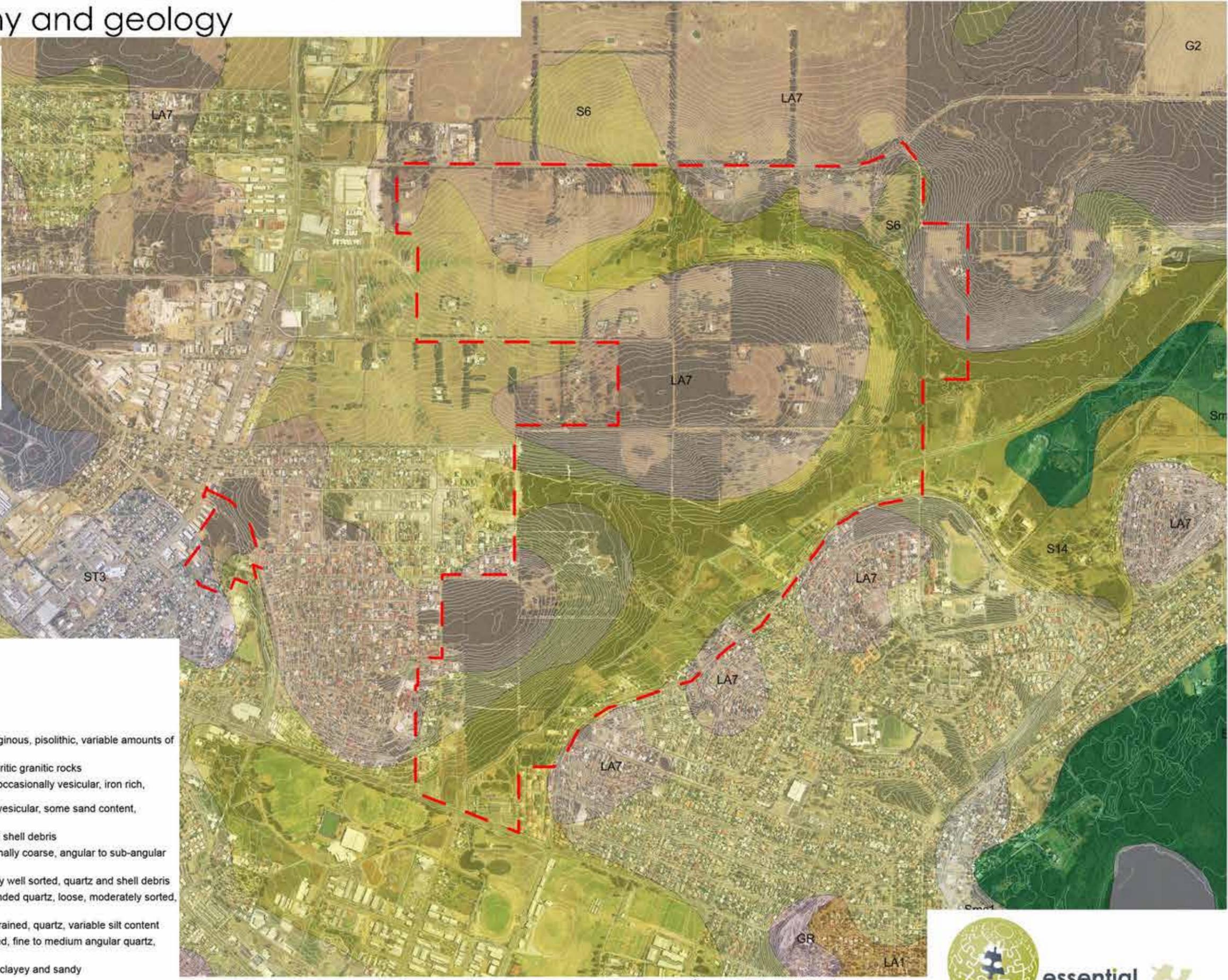
Mapping indicates some brown and yellowish brown siltstone (ST₃) in the Barnesby Drive area and although there is no mapped spongolite (SP₁ – white to yellow siltstone with abundant sponge spicules, bryozoa and macrofossils) it is known to occur and has been found during local investigations in several parts of the catchment (notably land surrounding the regional recreation centre).

Geomorphology presented in Department of Mines and Petroleum environmental geology mapping describes the site as floodplain fringed by colluvial slopes and relict foredunes rising to gently undulating lateritic uplands.

The sandy and lateritic soils prevalent in the structure plan area have high or moderate permeability and are therefore expected to achieve good infiltration rates, however because of the steepness of the catchment combined with high rainfall and shallow groundwater the infiltration capacity of the soils is limited, particularly during winter. In addition these sandy soils possess relatively low phosphorus retention ability (Aurora environmental 2013). This has implications for pollutants contained in runoff that may infiltrate into groundwater and/or be flushed into Yakamia Creek, and ultimately Oyster Harbour.

The underlying geology of the Albany region is impermeable granitic or gneissic rocks and the overlying highly permeable soils layer is typically thin, particularly in the steeper upper catchments. This combination results in rapid drainage of the upper catchment and seasonal waterlogging of the lower catchment.

Figure 7 - Topography and geology



- Legend**
- Yakamia/Lange structure plan area
 - Elevation contours (1 m)
- Surface geology**
- G2 - GRAVEL - strong brown, coarse, sub-rounded, ferruginous, pisolithic, variable amounts of sand and silt in matrix
 - GR - GRANITE - fine to coarse, even-grained and porphyritic granitic rocks
 - LA1 - LATERITE - massive, friable to strongly indurated, occasionally vesicular, iron rich, developed on GR and GN
 - LA7 - LATERITE - massive, friable to strongly indurated, vesicular, some sand content, developed on ST3
 - S13 - SAND - white, medium-grained rounded quartz and shell debris
 - S14 - SAND - white to pale grey, fine to medium, occasionally coarse, angular to sub-angular quartz, few fines, moderately sorted
 - S2 - SAND - white, medium to coarse-grained, moderately well sorted, quartz and shell debris
 - S6 - SAND - pale grey, fine to coarse, angular to sub-rounded quartz, loose, moderately sorted, occasional pebbles of laterite
 - Sm2 - SILTY SAND - greyish brown, medium to coarse-grained, quartz, variable silt content
 - Smc1 - CLAYEY SILTY SAND - pale, yellow-brown mottled, fine to medium angular quartz, silt binder
 - ST3 - SILTSTONE - brown and yellowish brown, variably clayey and sandy

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 Datasource: Custodians, Created by: H Brookes. Projection: MGA50:zone 50.

6.3.1 Acid sulfate soils

Acid sulfate soil risk has been mapped for Albany by the Department of Environment Regulation and this mapping is presented in Figure 8. The Yakamia Creek floodplain is classified as having a moderate to high risk of acid sulfate soils within 3 m of the natural surface.

6.4 Contaminated sites

There are two sites within the Yakamia/Lange structure plan area that are registered with the Department of Environment Regulation as contaminated which are mapped in Figure 9. These sites are recorded due to hydrocarbons and hydrocarbon impacted soils related to previous use of the sites as a depot (Aurora environmental 2013). The Department of Environment Regulation classifies these sites as:

- 102 and 120 North Road Yakamia – remediated restricted use

6.5 Groundwater

The Yakamia/Lange structure plan area lies entirely within the western section of the Bremer Basin within the unproclaimed Karri groundwater management area. The aquifers present are broadly classified, in order of increasing depth, as:

- Bremer West – Superficial
- Bremer West – Sedimentary
- Bremer West – Fractured Rock

All are unconfined and salinity generally increases with depth from generally fresh to brackish Superficial Aquifers to the mostly saline Fractured Rock Aquifers (WRC 1997). Because the Yakamia catchment lies in an unproclaimed groundwater area and the aquifers present are not artesian, there is no requirement for a license to take groundwater in the catchment.

Superficial Aquifers, where present, are located in sand and calcareite dunes along the coast such as those accessed for the Albany town water supply (WRC 2001). There are not expected to be any significant superficial aquifers present in the Yakamia catchment.

Sedimentary Aquifers are typically formed in siltstone and although they often have low hydraulic conductivities, and are therefore low yield, they can represent an opportunity for resource development (WRC 1997). Of particular interest is the potential for Spongelite Aquifers to exist within the Yakamia catchment. Spongelite sections of siltstone are generally more permeable, because of their high proportion of fossilized marine sponge material, and where located, if favourable recharge conditions exist, these aquifers can provide good yields of fresh to brackish groundwater resources (Agriculture WA 2000).

Fractured Rock Aquifers consist largely of granite and gneiss, generally have low yields and do not usually present significant groundwater resource opportunities (WRC 1997).

6.5.1 Water quality

Department of Water groundwater quality data extracted from the Water Information Network (WIN) database by Aurora environmental (2013) indicates that groundwater often exceeds the ANZECC water quality guideline trigger values for lowland rivers in south-west WA of 1.2 mg/L for Total Nitrogen and 0.065 mg/L for Total Phosphorus.

Figure 8 - Acid sulfate soil risk



Legend
 Yakamia/Lange structure plan area
Acid sulfate soil risk
 High to moderate risk
 Moderate to low risk

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Scale 1: 15000
 0 600m



Figure 9 - Contaminated sites



- Legend**
- Yakamia/Lange structure plan area
 - Registered contaminated sites (DEC)**
 - Contaminated - remediation req
 - Contaminated - restricted use
 - Remediated for restricted use
 - Contaminated sites (CoA)

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6.5.2 Shallow groundwater flow

The upper Yakamia catchment is steep and has relatively thin layers of sand and sedimentary rocks overtopping granite and gneiss. Whilst the sand and sedimentary rocks are relatively permeable, the steepness of the catchment can result in quite rapid down-slope flow of groundwater through this layer. This geology, coupled with high rainfall distributed throughout the year means that there is limited water retention capacity within the catchment and results in almost continual base flow within drains and watercourses that intercept this 'groundwater flow layer'.

Shallow groundwater flow and long-term base flow in watercourses and drains is a characteristic of the catchment that provides significant challenges for water management both in terms of quantity and quality. The channel capacity of drains and watercourses in the catchment does not typically exceed base flow substantially and there is often insufficient capacity to manage even relatively minor event peak flows. Short catchment retention times and steep fast flowing drains and watercourses also results in limited retention of nutrients and other pollutants in the catchment and may be a contributing factor to poor water quality in downstream receiving environments.

It is worth noting that whilst the hydrology of the Yakamia catchment presents some water management challenges, they are not unique to Albany and can deliver watercourses that are high amenity community and environmental assets with potential opportunities for stormwater harvesting.

6.6 Surface water

The Yakamia/Lange structure plan area is located in the Yakamia Creek catchment (Figure 10) which is approximately 21 km² in total and contains a large proportion of the urban area of Albany. Approximately 80% of the catchment has been cleared of native vegetation (Aurora environmental 2013).

Existing rainfall is partly intercepted by vegetation and pasture prior to infiltration to silty sands. Little overland flow is generated except in wetter months when soil profiles are saturated, such as during the flood of April 2005.

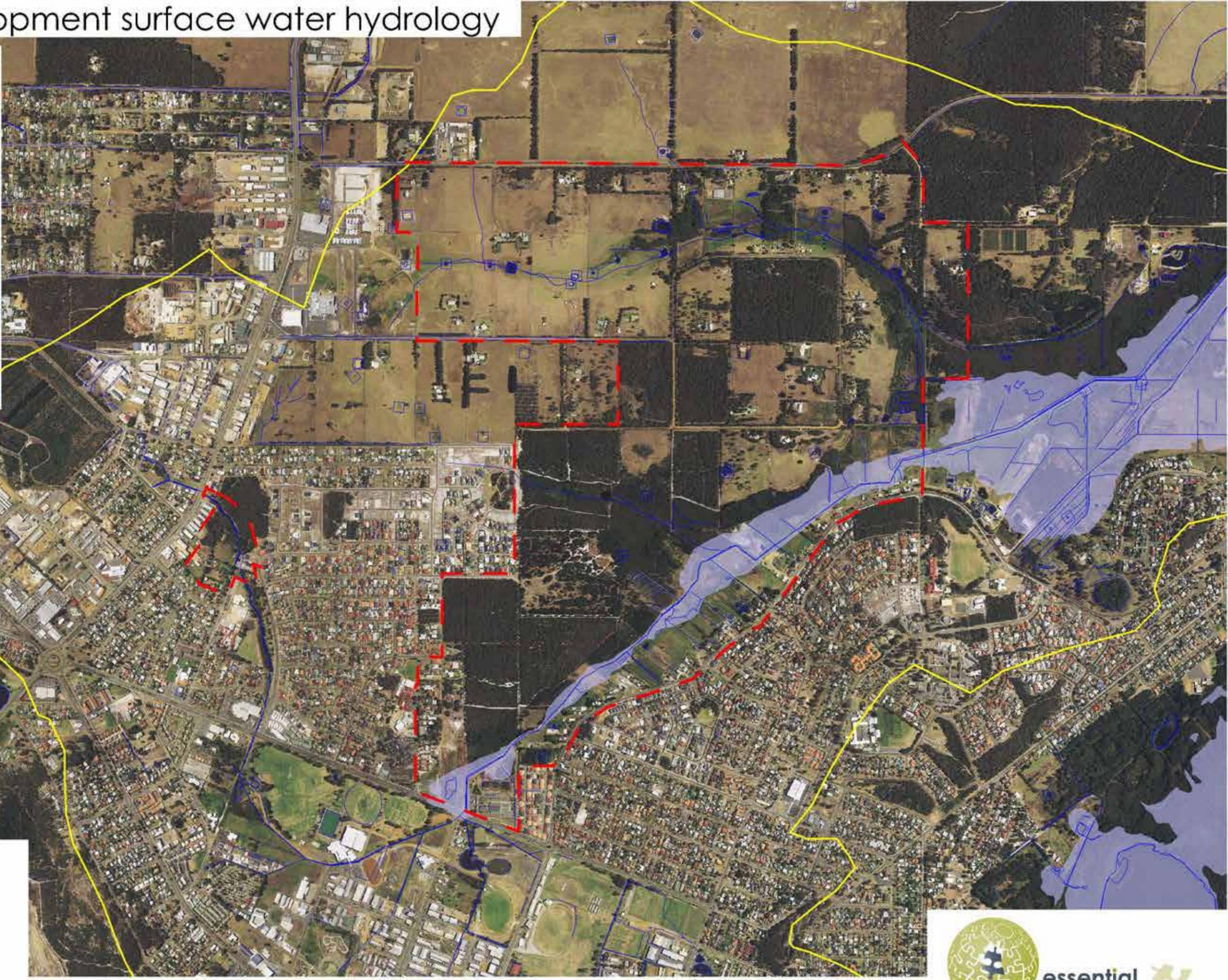
The southern boundary of the structure plan area is marked by the floodplain of the Yakamia Creek which is joined by two significant tributaries in the valleys of the structure plan area. These tributaries have broad, shallow channels and densely vegetated swampy flood plains that are bounded by forested or partly cleared hillsides. The smaller and further upstream of these tributaries drains some of the more recently urbanised areas of Yakamia but largely remains unmodified. The second, larger tributary joins Yakamia Creek at Martin Road.

The creek ultimately discharges into Oyster Harbour. In 2007, in a water resources background paper for the *Lower Great Southern Strategy* (WAPC 2007) The Department of Environment estimated that Yakamia Creek discharges approximately 4000 ML per year to Oyster Harbour.

The Barnesby Drive area drains to the south to join the main Yakamia Creek at North Road. Yakamia Creek has generally been excavated to form a linear, straight banked channel and is dominated by weeds and grasses.

Yakamia Creek was modified in the 1980's to form a deep linear trapezoidal drain in attempts to improve drainage through the catchment (Hopkinson 2000). This is particularly evident in the section between North Road and Martin Road.

Figure 10 - Predevelopment surface water hydrology



- Legend**
- Yakamia catchment boundary
 - Yakamia/Lange structure plan area
 - Waterways and waterbodies
 - Yakamia and Lake Seppings floodway

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Between Martin Road and Lower King Road the floodplain becomes very broad and in part is heavily vegetated. There are indications that historically this area would have been a wetland and although significant attempts have been made to drain the land this area remains undeveloped. Downstream of Lower King Road the creek has reverted to a somewhat natural condition through lack of maintenance as well as by virtue of its proximity to Oyster Harbour.

Previous studies have noted that downstream of North Road the creek is highly prone to siltation, particularly where banks surrounding drop structures have eroded. This siltation promotes growth of grasses and aquatic weeds within the drain which has reduced the efficiency of flood conveyance (Hopkinson 2000).

6.6.1 Water quality

Water quality monitoring of stormwater in the Albany Harbours was undertaken by the Department of Water as 'snapshots' in 2003 and 2011 (DoW 2011b).

Results from eight monitoring locations in Yakamia Creek showed nutrient concentrations exceeded ANZECC trigger levels for lowland rivers in south-west WA (ANZECC & ARMCANZ 2000) for all nutrients measured (Total Nitrogen (TN), ammonium (NH₄), nitrogen oxides (NO_x), Total Phosphorus (TP) and Filterable Reactive Phosphorus (FRP)), in all locations (YAK001, YAK002, YAK003, YAK005, YAK007, YU, YAK010 and YAK1) for the three 2011 monitoring events.

Results from the one monitoring event undertaken in 2003 showed FRP concentrations were less than ANZECC trigger levels at all locations. However, the remaining nutrient concentrations (TN, NH₄, NO_x, and TP) were greater than trigger levels at the most downstream location (YAK010) for this event.

In 2011, concentrations of TN, NH₄, and NO_x, generally decreased from the most upstream monitoring location (YAK002) to the most downstream monitoring location (YAK1). This trend was not evident for TP and FRP concentrations.

Potential catchment sources of nutrients identified by the Department of Water in the Albany Harbours area include fertilisers, organic matter entering stormwater drains, and septic tank systems (Particularly for nitrogen).

The heavy metals; Aluminium, Copper, Iron and Zinc were also measured during the Department of Water monitoring program. Total aluminium and zinc concentrations exceeded ANZECC trigger values for freshwater at a 95% level of protection on all occasions, at all monitoring sites. Total Iron exceeded the Canadian water quality guidelines on all occasions, at all monitoring sites. Total copper concentrations exceeded the ANZECC trigger value on most occasions, at all monitoring sites.

Potential catchment sources of heavy metals identified by the Department of Water in the Albany Harbours area include vehicle use and deterioration, infrastructure deterioration (such as pipes and roof tops), fungicides and herbicides (for Copper), and naturally derived from local soils (Aluminium and Iron in particular).

6.7 Wetlands

There are no Federal or State protected wetlands within the Yakamia/Lange structure plan area.

In 2007, the Department of Water undertook an evaluation of wetlands in the City of Albany using a similar classification procedure to that used by the Department of Parks and Wildlife in

its *Geomorphic Wetlands Database (Swan Coastal Plain)*. This assessment identified floodplains in the structure plan area as multiple use wetland with one small isolated location identified as resource enhancement wetland. Figure 11 presents the results of the Department of Water's wetland evaluation assessment.

Coffey Environments (2008) have undertaken a rapid assessment of the southern portion of the structure plan area. This assessment included ground truthing of mapped information created by the Department of Water (DoW 2007). The assessment identified that Yakamia Creek and its tributaries share the values and attributes of a conservation category wetland due to the presence of:

- Poorly represented vegetation types
- Species or communities that are considered to be threatened or have a priority status
- Sites of cultural or historical significance

6.7.1 Oyster Harbour

Oyster Harbour (Figure 11 inset), the receiving waterbody for the Yakamia Creek, is a shallow permanently open estuary that supports extensive mudflat and seagrass habitats as well as fringing forests, sedgeland and saltmarsh. Oyster Harbour is used by thousands of waterbirds for feeding, and is the only known habitat of the bivalve mollusc *Anadara trapezia* in Western Australia (South Coast Rivercare). Oyster Harbour is recorded on the national *Directory of Important Wetlands in Australia* (Environment Australia 2001).

Oyster Harbour is known to be at risk from significant inputs of nutrients and other types of pollution from the surrounding broadacre farming as well as excessive clearing and urbanisation.

Salinity in Oyster Harbour is close to that of the sea (approximately 35,000 parts per million) and tends to be higher in the summer due to evaporation and reduced fresh water runoff from its two main tributaries along its northern shore, the King (fresh water) and Kalgan (brackish water) Rivers.

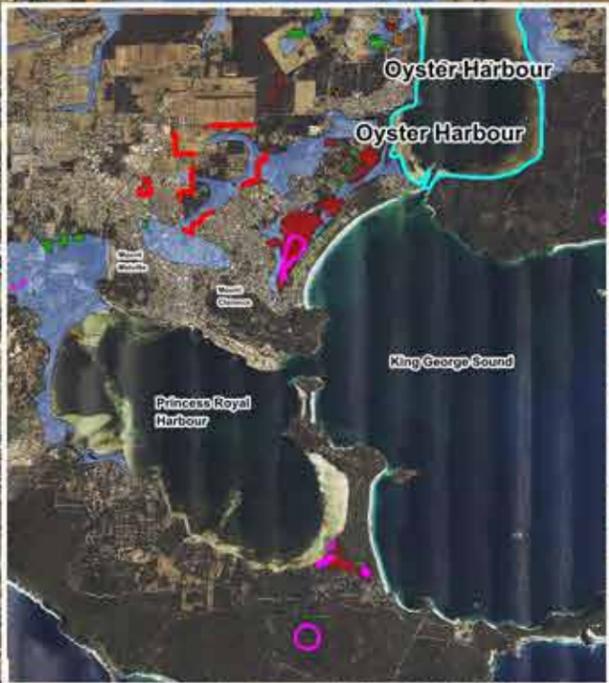
The waters of Oyster Harbour are vertically stratified in salinity, temperature and density - which are probably important to the bottom-dwelling macro algae by controlling the availability of nutrients and restricting growth. Temperatures in Oyster Harbour vary between 21°C in February and 12°C in July – though these are affected by seasonal and yearly changes. Excessive nutrients in the 'eutrophic' conditions of the bay cause microscopic and larger algae to grow profusely. This in turn reduces the clarity of the water and smothers the seagrass which are then replaced by other dominant forms of algae. Active pursuit of reducing fertiliser and nutrient runoff has seen these levels reduce and clarity and seagrass health improving (WRC 1999).

6.8 Biodiversity

The Albany Local Planning Strategy (ALPS) (CoA 2007) recognises the City's biodiversity as one of its most important assets, creating a sense of the area's identity. The Strategy establishes the encouragement of biodiversity preservation and the conservation of remnant vegetation as planning principles and recognises the need to identify and protect areas of high biodiversity.

The Yakamia/Lange structure plan area is located in the Jarrah Forest IBRA biogeographic region and lies within the Southwest Australian Biodiversity Hotspot, one of 34 internationally recognised biodiversity hotspots which correspond to the Southwest Botanical Province (Myers et al. 2000; Conservation International 2004).

Figure 11 - Wetlands



Legend

- Yakamia/Lange structure plan area
- Nationally important wetlands (DSEWPaC)
- South Coast significant wetlands (DEC)

Albany wetland evaluation (DoW 2007)

- Conservation
- Conservation (cultural)
- Conservation (social)
- Multiple use
- Resource enhancement

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Scale 1: 15000

0 600m



6.8.1 Flora and fauna

Table 14 summarises the results of a preliminary search of the Department of Parks and Wildlife (DPaW) Naturemap database completed in January 2013. This search returned no record of declared rare flora within the structure plan area. One priority 3 species; *Boronia crassipes*, and one priority 4 species; *Laxmannia jamesii* were recorded.

Table 14: Preliminary flora and fauna search results (Naturemap, January 2013)

Conservation Status	Species	Records
Fauna:		
Rare or likely to become extinct	2	19
Protected under international agreement	6	6
Other specially protected fauna	1	2
Flora:		
Priority 3	1	1
Priority 4	1	1
Non-conservation taxon	165	1609
TOTAL	176	1638

The Naturemap database search also returned two records of rare or likely to become extinct bird species; Baudin's Cockatoo and Carnaby's Cockatoo. Six species of birds protected under international agreement and one other specially protected bird species have also been recorded within the structure plan area.

A search of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999 protected matter search tool* returned 19 threatened species and 8 listed migratory species within the structure plan area. The results of this search are summarised in Table 15.

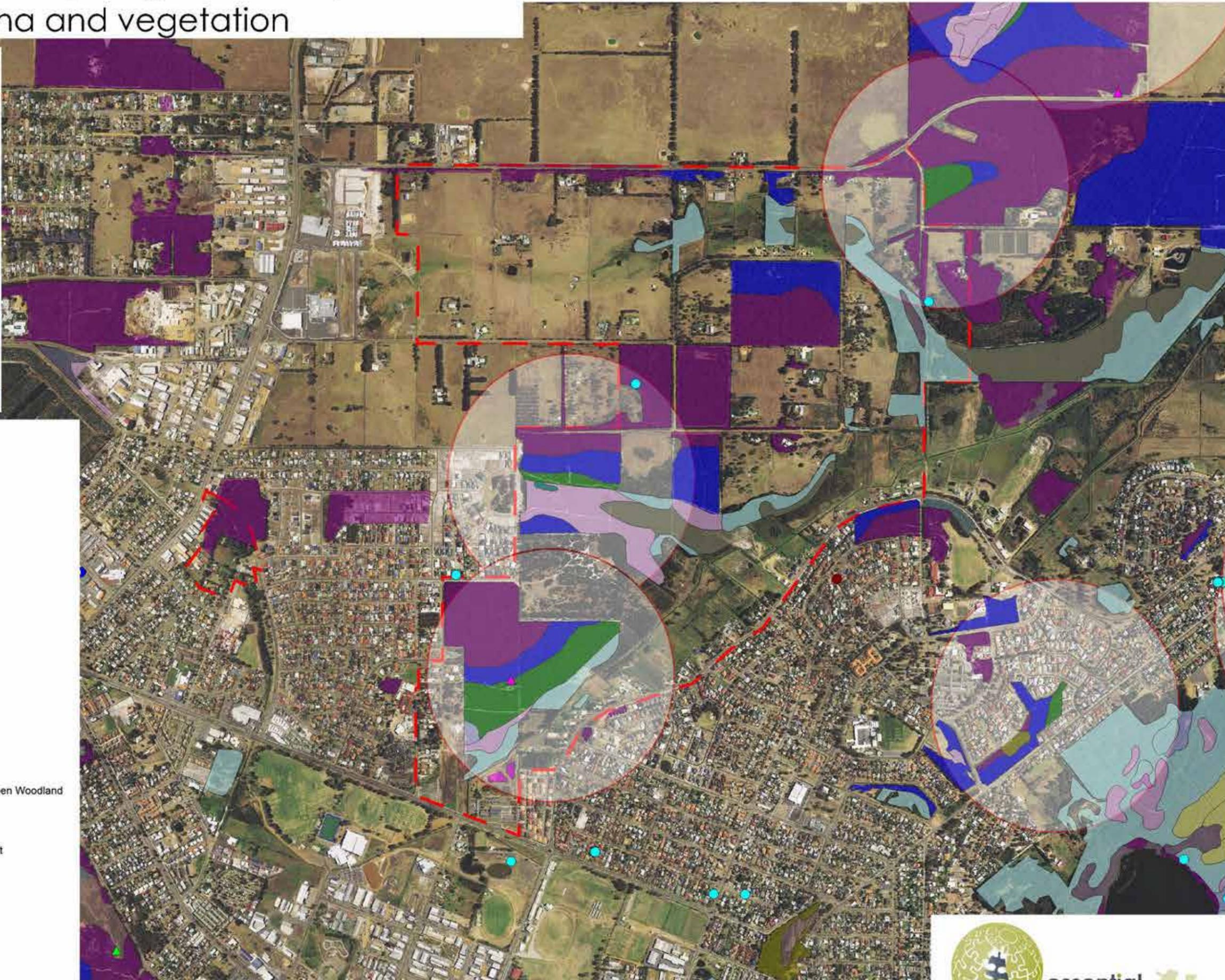
Table 15: EPBC Act search results (January 2013)

Conservation Status	Birds	Mammals	Plants	Total
Threatened species:				
Vulnerable	4	3	3	10
Endangered	2		7	9
Listed migratory species:				
Vulnerable	1			1
Others	7			7
Listed marine species	5			5
Invasive species		4	8	12

A number of flora surveys have been undertaken within the structure plan area between 1996 and 2009 and have identified conservation significant flora in addition to those listed in the Naturemap and the EPBC Act search results. This includes additional Priority 2, 3 and 4 flora species (Aurora Environmental 2013).

A Level 2 fauna survey was undertaken in the Yakamia Structure Plan Area by Coffey Environments during December 2006 and March 2007 (Aurora environmental 2013). A number of threatened species were recorded during this survey, including: Baudin's Cockatoo; Carnaby's Cockatoo; Red-tailed Black Cockatoo; and Western Ring-tail Possum. The fauna habitats of these species comprise a combination of Jarrah/Sheoak woodland, Jarrah/Albany Blackbutt woodland and Wetland mosaic (Aurora Environmental 2013).

Figure 12 - Flora, fauna and vegetation



- Legend**
- Yakamia/Lange structure plan area
 - Declared rare and priority flora**
 - ▲ Priority 1
 - ▲ Priority 2
 - ▲ Priority 3
 - ▲ Priority 4
 - ▲ Threatened - Declared rare and priority fauna**
 - Priority 1
 - Priority 2
 - Priority 3
 - Priority 4
 - Priority 5
 - Scheduled
 - Threatened - Threatened and priority ecological species**
 - Priority 1
 - Priority 2
 - Priority 3 - ARVS vegetation units**
 - Banksia coccinea Shrubland/Eucalyptus staeri/Sheoak Open Woodland
 - Callistachys spp Thicket
 - Evandra aristata Sedgeland
 - Homalospermum firmum/Callistemon glaucus Peat Thicket
 - Jarrah/Marri/Sheoak Laterite Forest
 - Jarrah/Sheoak/E. staeri Sandy Woodland
 - Melaleuca cuticularis/M. preissiana Open Woodland
 - Peppermint Low Forest
 - Taxandria juniperina Closed Forest
 - Typha orientalis Sedgeland

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6.8.2 Vegetation

Albany regional vegetation survey – extent, type and status (Sandiford & Barrett 2010) is an EPA endorsed report on mapping and assessments undertaken to provide a local and regional overview of the native vegetation of the area, to assist land use and conservation planning in the region.

Ten of the vegetation units described by Sandiford & Barrett (2010) are found within the Yakamia/Lange structure plan area (Figure 12):

- **Jarrah/Marri/Sheoak Laterite Forest** – found on well drained shallow loamy/sandy soil, with outcropping laterite, usually occurring on the crests and middle slopes of low relief hills and plateaus with occasional occurrences on lower slopes.
- **Jarrah/Sheoak/Eucalyptus staeri Sandy Woodland** – usually found on gentle middle to lower slopes on sandy soil overlying laterite.
- **Banksia coccinea Shrubland/Eucalyptus staeri/Sheoak Open Woodland** – found on deep white/light grey sand on the lower slopes and valleys, usually occurring just upslope of seasonally wet drainage lines.
- **Melaleuca cuticularis/M. preissiana Open Woodland** – found on low-lying poorly drained flats and broad drainage depressions on dark grey to dark brown sandy loam overlying a clay layer.
- **Taxandria juniperina Closed Forest** - found around swamps, freshwater lakes and along drainage lines and the dense canopy of *Taxandria juniperina* is a characteristic of this unit.
- **Peppermint Low Forest** – typically restricted to coastal dune system, commonly occurring in swales and flat.
- **Callistachys spp. Thicket** – occurs where local soaks or seepages occur on minor drainage lines, flats, gullies and slopes, on sandy to peaty soil.
- **Evandra aristata Sedgeland** – found on seasonally wet soils, sand through to sandy loam and sandy peat. Widespread on the upper margins of drainage depressions, and also occur on some poorly drained flats.
- **Homalospermum firmum/Callistemon glaucus Peat Thicket** – found in drainage depressions below the seepage zone on dark brown peat or sandy peat that is waterlogged in winter and moist in summer.
- **Typha orientalis Sedgeland** – non-native sedge vegetation found with remnant vegetation, most notably *Baumea articulata* Closed Sedgeland around lake edges.

One of these vegetation units; *Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland, is a priority one ecological community which occurs twice within the structure plan area.

Beard Regional Vegetation Mapping indicates that there are two vegetation associations in the Yakamia Structure Plan Area: Medium Forest – Jarrah Marri (Association 3) and Low Forest – Jarrah, *Eucalyptus staeri* and *Allocasuarina fraseriana* (Association 978).

Mapping associated with the results of the *Albany regional vegetation survey* (ARVS) is not considered consistent with Beard regional vegetation mapping (Aurora Environmental 2013). Due to the uncertainty of the pre-clearing extent of ARVS vegetation units, it is not considered possible to determine the extent of these vegetation units remaining.

Statewide Vegetation Statistics calculated recently by the former Department of Environment and Conservation indicate that the Jarrah Marri Medium Forest (Association 3) has 69.3% remaining, with 18.49% of the original extent in secure tenure for conservation (DEC 2011). This vegetation type is relatively well represented in the state conservation estate, meeting the

State Government's Bush Forever initiative which seeks to ensure that at least 10% of each vegetation complex is reserved in secure tenure for conservation.

The Jarrah *Eucalyptus staeri* and *Allocasuarina fraseriana* Low Forest (Association 978) has 39.23% remaining, with 9.08% of its original extent in secure tenure for conservation (Government of Western Australia 2011). An opportunity exists to assist in meeting the 10% in secure tenure goal, through the retention of good quality areas of this vegetation unit in the Yakamia/Lange structure plan area. This Beard vegetation unit broadly correlates with the *Albany regional vegetation survey* Jarrah/Sheoak/*Eucalyptus staeri* Sandy Woodland unit.

Sandiford & Barrett (2010) used the *Vegetation assets, states and transitions* (Thakway and Leslie 2006) framework for modification to describe the condition of vegetation identifying the following categories:

- **Residual** – Native vegetation community structure, composition, and regenerative capacity intact – no significant perturbation from land use/land management practices.
- **Modified** – Native vegetation community structure, composition, and regenerative capacity intact – perturbed by land use/land management practices.
- **Transformed** – Native vegetation community structure, composition, and regenerative capacity significantly altered by land use/land management practice.
- **Replaced /Adventive** – Spontaneous occurrence of alien species.

Most of the mapped and areas in the structure plan area are described as 'residual'. However, a large proportion of *Taxandra juniperia* Closed Forest, which is found within the floodplains of the Yakamia Creek and its tributaries, is 'modified' or 'transformed' and some small patches of both Jarrah/Marri/Sheoak Laterite Forest and Jarrah/Sheoak/*Eucalyptus staeri* Sandy Woodland are also 'modified'.

Melaleuca cuticularis/*M. preissiana* Open Woodland is only found in two small patches of the structure plan area close to the Yakamia Creek which are both 'transformed'.

6.8.3 Invasive species

Some parts of the structure plan area, particularly areas associated with Yakamia Creek, are heavily infested with environmental weeds (Aurora Environmental 2013), including:

- Sydney Golden Wattle (*Acacia longifolia*);
- Taylorina (*Psoralea pinnata*);
- Blackberry (*Rubus fruticosus*); and
- Pine trees (*Pinus radiata*).

Kikuyu grass which is considered a weed grows prolifically throughout much of the catchment. However, this grass is considered to be of some benefit due to its stabilising and filtering function (Hopkinson 2000).

In addition, the risk of introduction and spread of dieback is threat to the conservation values of native vegetation, particularly the priority ecological communities.

Mosquitos and Chironomid Midges

Mosquitoes and Chironomid Midge swarms are common environmental problems associated with urban wetlands and waterways in Australia. The Yakamia/Lange structure plan area contains a significant area of potential mosquito and midge breeding habitat.

Effective management of foreshore areas and water quality as well as drainage design that avoids creation of new breeding habitats will be necessary to avoid insects becoming an unacceptable nuisance to the future community. Short term management through chemical interventions should be undertaken only as a last resort in response to surveillance indicators.

Foreshore management should include removal of weeds (particularly exotic grasses), and grading, landscaping and revegetation of the foreshore reserve in accordance with the recommendations of *River Science Issue 26: Constructed ephemeral wetlands on the Swan Coastal Plain - the design process* (DoW and SRT 2007). These actions will:

- minimise the proliferation of mosquito and midge breeding and sheltering habitat
- create shade and provide habitat for mosquito and midge predators such as frogs, fish and dragonflies
- improve the amenity and environmental value of the foreshore reserve and associated water bodies

Improved water quality is a key way that nuisance insects can be managed by minimising nutrient loads and thereby reducing potential for algal blooms and through encouraging and sustaining healthy populations of predator species including fish and dragonflies.

6.9 Infrastructure

The majority of the Yakamia/Lange structure plan area contains little or no existing infrastructure with the exception of a few minor roads and drains.

The City of Albany previously managed a works depot on the southern portion of Lot 4743 North Road, Yakamia. A Water Corporation sewer pump station is also located on Lot 100 North Road.

There is a new arterial road proposed to link North Road to Mercer Road, roughly along the boundary of existing development. This road will cross Yakamia Creek and its tributaries in at least three locations.

Western Power owns property within the structure plan area (Lot 36 Catalina Road, Lange) and currently plans to develop the site as a zone substation in around 2030. Development proposed adjacent to the proposed Western Power Substation is to achieve a separation distance to the satisfaction of the City (100 m).

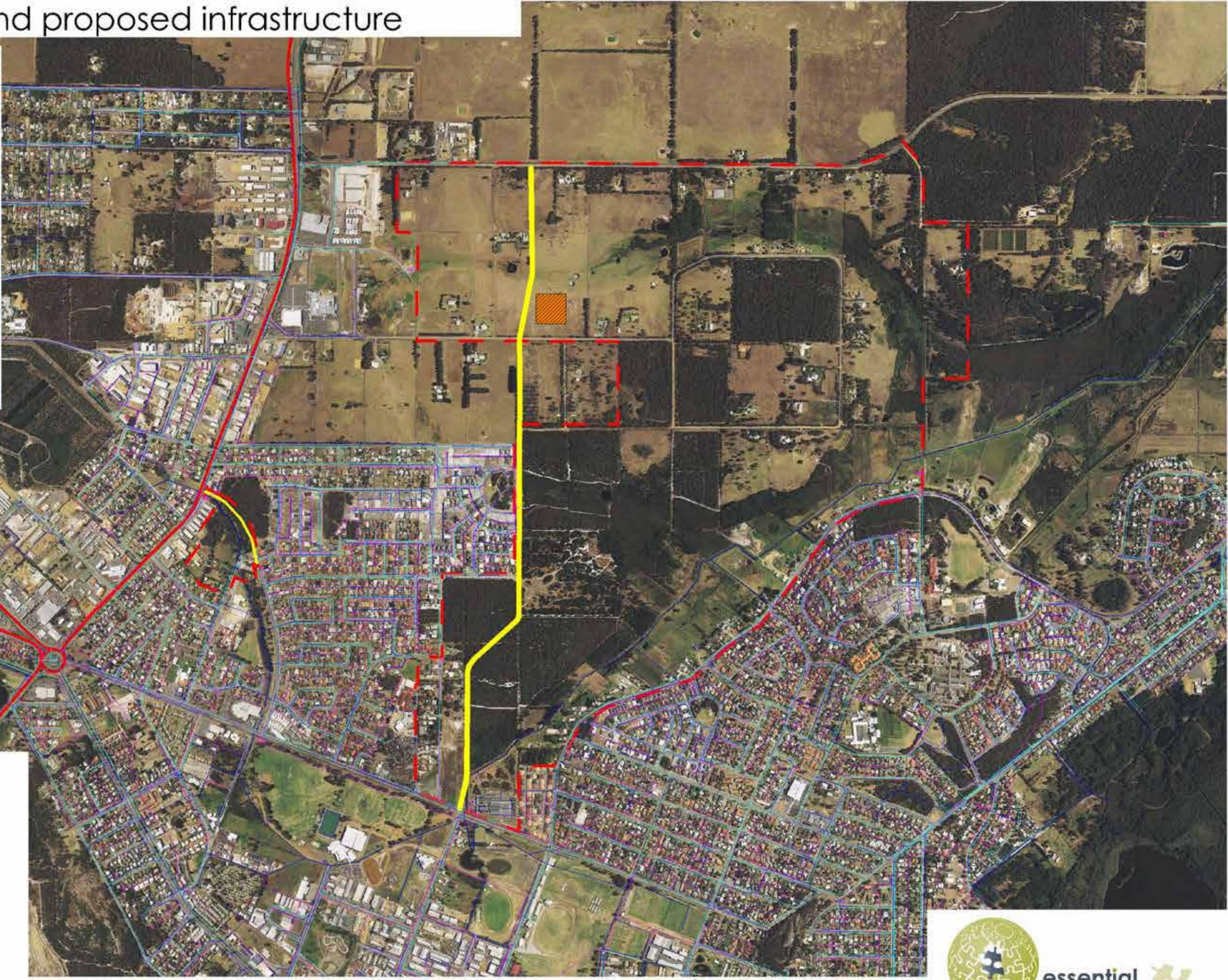
Existing and proposed infrastructure are presented in Figure 13.

6.9.1 Water services

The Water Corporation undertakes water services planning and allocates funds for infrastructure upgrades on the basis of land use planning information. Prefunding of these works may therefore be required where a development proposal requires water or wastewater infrastructure which has not been planned for by the Water Corporation.

The Water Corporation has undertaken some preliminary planning for new water infrastructure to be provided in the Yakamia/Lange structure plan area including two new pump stations located on Mason Road and Martin Road and a new pressure pipe along Bond Road and Curtis Road (Figure 13).

Figure 13 - Existing and proposed infrastructure



- Legend**
- Yakamia/Lange structure plan area
 - Highways
 - Roads
 - Proposed future roads
 - Sewers (Water Corporation)
 - Water distribution (Water Corporation)
 - City of Albany drainage
 - Proposed Western Power substation

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Drinking water

The Lower Great Southern towns water supply scheme currently supplies Albany, as well as Narrikup, Mount Barker, Kendenup and Porongurup. This scheme is sourced primarily by groundwater from the Albany borefield, and surface water from Angrove Creek (see Table 16). Non-potable water is also supplied to Porongurup from Bolganup Creek as part of the scheme.

Table 16: Lower Great Southern towns water supply scheme - historical water usage and source capacity (Source: DoW, 2010)

Water source	Capacity/licensed use (ML/year)	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09
Albany borefield	3,950	3,311	4,198	4,055	4,493	4,172	3,728
Angrove Creek	1,600	1,281	801	874	763	508	829
Limeburners Creek	200	0	0	0	0	0	0
Bolganup Creek (non-potable)	200	142	36	19	45	131	66
TOTAL (ML/year)		4,734	5,035	4,948	5,301	4,811	4,623

To meet the immediate needs of a growing population, seasonal water demands and improve the spread of groundwater abstraction for the Albany and Lower Great Southern towns water supply scheme, the Water Corporation will be constructing a series of new bores and replacing a number of older bores in the Albany borefield. This work is scheduled to commence in late 2013 and is expected to be completed in 2016 (Water Corporation 2013a). The Water Corporation is also considering possible sites for a desalination plant around Albany (Water Corporation 2013b).

Wastewater

The Yakamia/Lange structure plan area is located within the Water Corporation's Sewerage Operating Licence Area. Wastewater recycling is well established with 100% of Albany's wastewater currently recycled for irrigation of an Albany tree farm. (ERA 2013)

Upgrades to the Albany wastewater treatment plant are currently planned by the Water Corporation (Water Corporation 2013b) and it is expected that the structure plan area will be connected to the main sewerage scheme.

6.10 Heritage

6.10.1 Aboriginal heritage

Any government agency, organisation or individual who is the proponent for strategic or statutory planning documents, construction of individual developments or engaged in any ground-disturbing activities should seek advice from the Department of Aboriginal Affairs (DAA) on their requirements and obligations under the *Aboriginal Heritage Act 1972*, and any other investigations that may be required. A preliminary search of the registered Aboriginal heritage sites recorded in Landgate's database has been undertaken and returned records identified in Figure 14. Of particular interest is that Yakamia Creek is lodged as a; Mythological, Historical site with the Department of Aboriginal Affairs but has not yet been assessed and is currently listed as an 'other heritage place' (ID: 24418).

Other Aboriginal sites may exist in the catchment and:

- not have been recorded in the *Register of Aboriginal sites* or elsewhere; or
- not have been identified in previous heritage surveys or reports on that area but remains fully protected under the Act.

Consultation with relevant Aboriginal communities and native title claimants is recommended to identify any additional Aboriginal sites that may exist and what, if any further heritage surveys may be required.

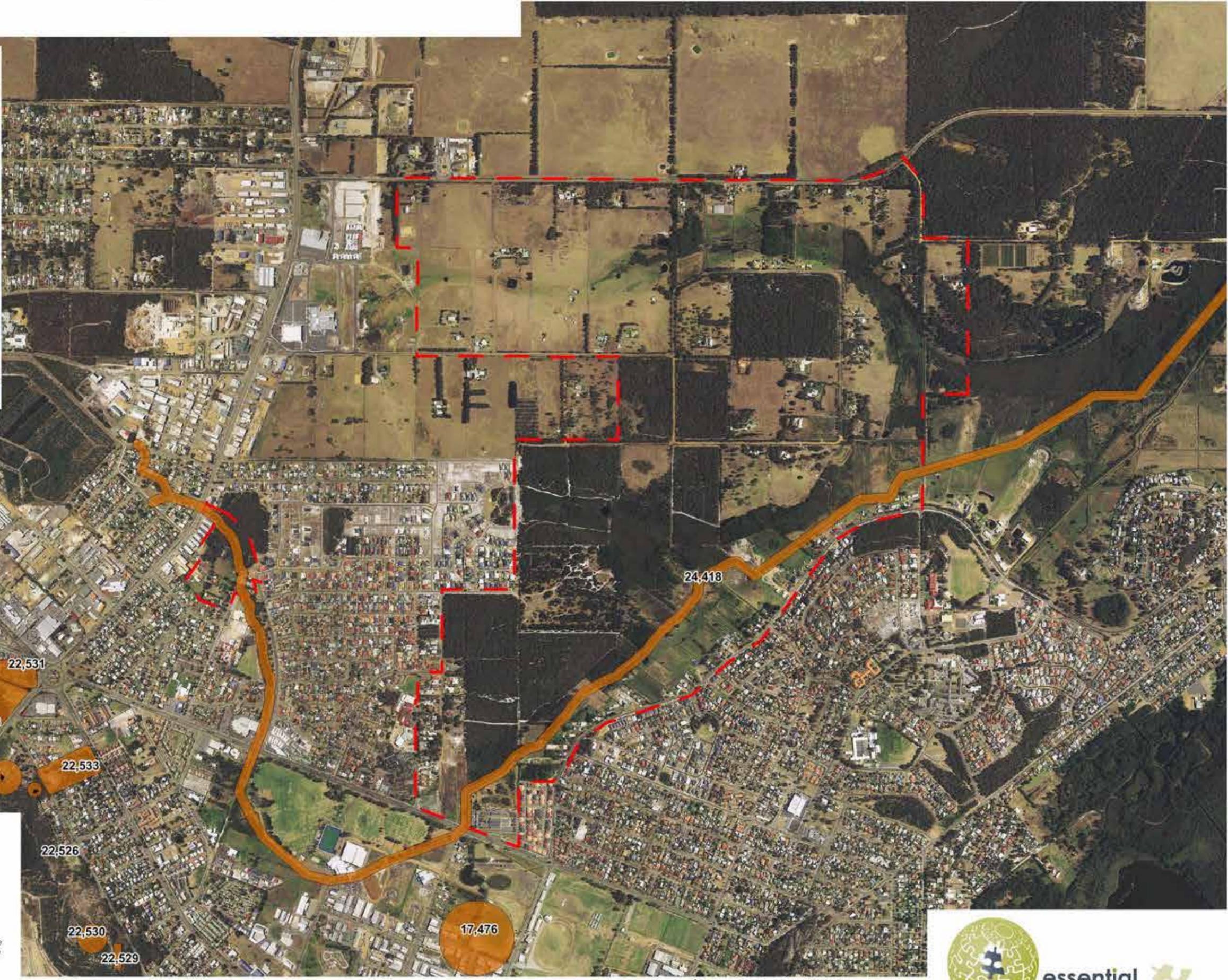
An Aboriginal heritage survey was undertaken for the Yakamia Structure Plan area by Brad Goode and Associates in 2007. Consultation undertaken with the Aboriginal Heritage Reference Group Aboriginal Corporation identified Yakamia Creek as a place of importance for the gathering of resources, travel and association with spiritual beliefs in the *Marchant* (water snake). The group recommended that that Yakamia Creek be registered with the Department of Aboriginal Affairs (DAA) as a site under Section 5(b) of the *Aboriginal Heritage Act 1972*.

A key consideration for this water management strategy is the identification of the Yakamia Creek itself as an Aboriginal site. This means that consultation with local relevant Aboriginal groups or individuals is likely to be required prior to any physical alteration taking place.

6.10.2 *Post-European settlement heritage*

Whilst the City of Albany has significant Post-European values with many important sites located in the area, there are no Heritage WA listed or other notable sites located within the structure plan area.

Figure 14 - Heritage



Legend

- Yakamia/Lange structure plan area
- Recorded Aboriginal heritage sites & ID (Landgate)^A
- Recorded heritage sites (Heritage WA)

^ARegistered Aboriginal heritage sites were obtained from the Landgate database. Note that not all Landgate sites located within or adjacent to the Structure Plan area are consistent with those shown in the Department of Aboriginal Affairs' Aboriginal Heritage Inquiry System database.

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Scale 1: 15000
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7 REFERENCES AND RESOURCES

- Agriculture Western Australia (WA), 2000, *A conceptual model for the Lake Warden recovery catchments*, Prepared for the National Land and Water Resource Audit, Dryland Salinity Theme – Project 3
- ARMCANZ & ANZECC, 2000, *Australian and New Zealand guidelines for fresh and marine water quality*, Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand
- Aurora environmental, 2013, *Yakamia structure plan area, City of Albany – Environmental assessment – Opportunities and constraints*
- Bureau of Meteorology (BoM), 2013, web based resources: www.bom.gov.au
- City of Albany (CoA), 2005, *Photos from April 2005 flood event*
- City of Albany (CoA), 2007, *Albany Local Planning Strategy*
- City of Albany (CoA), 2011, *Local Planning Policy 5E – Development in Flood Prone Areas*
- Coffey Environments, 2008, *Yakamia Structure Plan Wetlands and Waterways Assessment*. Report to the City of Albany. Report 2007/221 V1, March 2008
- Conservation International, 2004, *Biodiversity Hotspots, Hotspots E-News Fall 2004*. A newsletter covering the Biodiversity Hotspots
- Department of Environment and Conservation (DEC), 2011, *Statewide Vegetation Statistics incorporating the CAR Reserve Analysis*
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC), 2012, *Great Southern Integrated Water Efficiency*. Available from: <http://www.environment.gov.au/water/policy-programs/cities-towns/projects/wa-albany-denmark.html> [22nd August 2013]
- Department of Water (DoW), 2004–09, *Stormwater management manual for Western Australia*
- Department of Water (DoW), 2007, *The South Coast Wetland Mapping Classification and Evaluation Project, Mapping and Assessing the Values of Albany's Wetlands*
- Department of Water and Swan River Trust (DoW and SRT), 2007, *River Science Issue 26: Constructed ephemeral wetlands on the Swan Coastal Plain - the design process*
- Department of Water (DoW), 2008, *Urban water management plan: Guidelines for preparing plans and complying with subdivision conditions*
- Department of Water (DoW), 2009, *Decision process for stormwater management in Western Australia*
- Department of Water (DoW), 2010, *Lower Great Southern water resource development strategy*
- Department of Water (DoW), 2011a, *Hydrological and Nutrient Modelling of the Peel-Harvey Catchment*

Department of Water (DoW), 2011b, *Albany Harbours Stormwater Water Quality Snapshot 2011*.

Economic Regulation Authority (ERA), 2013, *2012 Water Wastewater and Irrigation Performance Report*

Environment Australia, 2001, *A Directory of Important Wetlands in Australia Third Edition*, Commonwealth of Australia.

Essential Environmental, 2013, *draft Yakamia Creek Arterial drainage plan*, prepared for the City of Albany.

Hopkinson, K. 2000, *Survey and Management recommendations for the Foreshores of the Yakamia Creek Catchment*, Greenskills

Institute of Engineers Australia, 2001, *Australian rainfall and runoff, a guide to flood estimation*

Institute of Engineers Australia, 2006, *Australian runoff quality guidelines*

Myers, N. Mittermeier R.A., Mittermeier, C.G., da Fonseca, G.A.B. and Kent, J., 2000, *Biodiversity hot spots for conservation priorities*. Nature 403 803-8

Opus, 2005, *Flood Assessment Report*

Opus, 2007, *City of Albany Flood Management Plan – Yakamia B Catchment*

Public Works Department, 1981, *Yakamia Creek Flood Investigation Report*

Sandiford, E. M. & Barrett, S., 2010, *Albany Regional Vegetation Survey – Extent Type and Status*

Sinclair Knight Merz (SKM), 2012, *Saving water by changing behaviour*. Available from <<http://www.globalskm.com/Insights/News/2012/Saving-water-by-changing-behaviour.aspx>> [22nd August 2013]

South Coast Rivercare, web based resources: www.rivercare.southwest.org.au

Thackway, R. and Leslie, R., 2006, *Reporting vegetation condition using the Vegetation Assets, States and Transitions (VAST) framework*. Ecological Management and Restoration 7(S1): S53-S62

Water and Rivers Commission (WRC), 1997, *Hydrogeology of the Mount Barker-Albany 1:250,000 Sheet*

Water and Rivers Commission (WRC), 1999, *Albany Waterways Resource Book: Water quality – The water quality of Albany's waterways*. Available from: <file:///S:/Projects/Albany/Yakamia/Info/Albany%20Waterways%20resource%20book.html> [6 December, 2012]

Water and Rivers Commission (WRC), 2001, *Yakamia Creek Flood Study*

Water Corporation/Binnie & Partners Pty Ltd, 1989, *Yakamia Creek Management Study*

Water Corporation, 2013a, *Albany water supply*. Available from: <<http://www.watercorporation.com.au/water-supply-and-services/ongoing-works/albany-water-supply>> [22nd August 2013]

Water Corporation, 2013b, *Great Southern*. Available from: <
<http://www.watercorporation.com.au/water-supply-and-services/solutions-to-regional-water-supply/great-southern>> [22nd August 2013]

Western Australian Planning Commission (WAPC), 2003a. *Planning bulletin no. 64: acid sulfate soils*

Western Australian Planning Commission (WAPC), 2004, *Statement of planning policy no. 2.9: Water resources policy*

Western Australian Planning Commission (WAPC), 2007, *Lower Great Southern Strategy*

Western Australian Planning Commission (WAPC), 2008a, *Better Urban Water Management*

Western Australian Planning Commission (WAPC), 2008b, *Planning bulletin no. 92, urban water management*



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**YAKAMIA STRUCTURE PLAN AREA,
CITY OF ALBANY-
ENVIRONMENTAL ASSESSMENT -
OPPORTUNITIES AND
CONSTRAINTS**

Prepared For:	City of Albany 102 North Road, Yakamia WA 6330
Report Number:	AA2012/020
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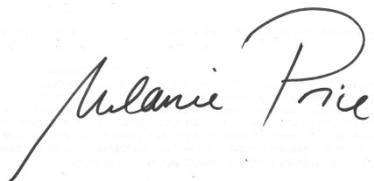
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5 March 2013

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5 March 2013

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LIST OF ABBREVIATIONS

ALPS	Albany Local Planning Strategy
ANZECC	Australian and New Zealand Environment and Conservation Council
ARVS	Albany Regional Vegetation Survey
ASS	Acid Sulfate Soils
DAFWA	Department of Agriculture and Food Western Australia
DEC	Department of Environment and Conservation
DIA	Department of Indigenous Affairs
DoW	Department of Water
DSEWPC	Department of Sustainability, Environment, Water, Population and Community
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GSWA	Geological Survey of Western Australia
ha	Hectare
IUCN	International Union for Conservation of Nature
LWMS	Local Water Management Strategy
mAHD	Metres Australian Height Datum
PEC	Priority Ecological Community
POS	Public Open Space
TEC	Threatened Ecological Community
VAST	Vegetation Assets States and Transitions
WAPC	Western Australian Planning Commission
WIN	Water Information Network
YSPA	Yakamia Structure Plan Area
YSP	Yakamia Structure Plan

EXECUTIVE SUMMARY

The City of Albany is preparing a structure plan to guide the development of Yakamia and a part of Lange for residential and related purposes. This report is a summary of previous environmental assessments that have been undertaken in the area and provides updated information to allow for identification of opportunities and constraints related to:

- Geology and soils;
- Acid sulfate soils (ASS);
- Contaminated sites;
- Vegetation and flora;
- Fauna;
- Invasive species;
- Ecological connectivity;
- Wetlands and watercourses;
- Groundwater;
- Yakamia floodplain and areas prone to inundation; and
- Heritage.

A brief summary of these issues is included in Table 1.

**TABLE 1
SUMMARY OF OPPORTUNITIES AND CONSTRAINTS**

ENVIRONMENTAL ISSUE	OPPORTUNITY/CONSTRAINT
Topography and Landform	<ul style="list-style-type: none"> • Mostly unconstrained. Some steeper slopes may present constraints for development and drainage management. Recommendation: Constraints related to steeper slopes can be managed via the planning and design process.
Geology and soils	<ul style="list-style-type: none"> • Relatively low phosphorus retention ability in sandy soils. • Relatively low ease of excavation in areas containing massive laterite. Recommendation: That geotechnical studies be undertaken by individual landowners at the subdivision stage to determine soil classes and foundation soundness.
Acid Sulfate Soils	<ul style="list-style-type: none"> • Areas associated with wetlands, Yakamia Creek and its tributaries have a high to moderate risk of ASS. Recommendation: Once development areas have been determined, individual landowners will be responsible for determining management of ASS if land contains a high to moderate risk (rezoning/ subdivision stage).

Contaminated Sites	<ul style="list-style-type: none"> • Lots 100 and 4743 have been remediated and are suitable for their current land uses. <p>Recommendation: No action required for identified sites unless there is a proposal to change the land use to a more sensitive type (e.g. residential).</p>
Vegetation	<ul style="list-style-type: none"> • Vegetation community <i>Banksia coccinea</i> shrubland/ <i>E. staeri</i>/ Sheoak Open Woodland has been identified as a Priority Ecological Community (PEC) by DEC. • The YSPA is constrained by vegetation in Very Good to Excellent condition which supports significant ecological communities and Threatened or Priority flora and fauna. • Cleared areas and vegetation in Good to Degraded condition present few constraints to development. • Beard vegetation types in the YSPA have more than 30% of original extent remaining. Jarrah Marri Medium Forest is relatively well represented in secure tenure. Jarrah, <i>Eucalyptus staeri</i> and <i>Allocasuarina fraseriana</i> Low Forest has slightly less than 10% in secure tenure for conservation. <p>Recommendation: Vegetation community <i>Banksia coccinea</i> shrubland/ <i>E. staeri</i>/ Sheoak Open Woodland (a PEC) is a priority for retention. It would also be beneficial to retain areas of Emar/ Afra/ E.sta which are in Very Good to Excellent condition to assist in meeting the 10% minimum in secure tenure goal. Liaison with the Office of the Environmental Protection Authority (EPA) and DEC is required to determine areas of native vegetation to be retained for conservation purposes.</p>
Flora	<p>No Threatened flora has been identified in YSPA.</p> <p>Priority flora identified in YSPA area includes:</p> <ul style="list-style-type: none"> • <i>Laxmannia jamesii</i> (P4) • <i>Andersonia depressa</i> (P4) • <i>Leucopogon alternifolius</i> (P3) <p>Several areas containing vegetation in Good to Degraded condition have not been subject to flora surveys. This is not considered to be a high risk given the relatively poor condition of the vegetation.</p> <p>Recommendations:</p> <p>The status of <i>Agrostocrinum scabrum</i> needs to be clarified to determine if the taxon represents the sub species <i>littorale</i> (P2).</p> <p>While it is preferable that Priority Flora is retained, the presence of these species may not preclude development. The presence of other significant features is likely to determine the need for retention of Priority Flora (e.g. presence of PEC, poorly represented vegetation, wetland, water course etc.). Liaison with the Office of the EPA and DEC is required to determine</p>

	<p>areas of native vegetation to be retained for conservation purposes.</p>
Fauna	<p>Fauna has not been surveyed in the northern and eastern sections of the YSPA. This does not represent a high risk given the relatively poor condition and connectivity of this vegetation.</p> <p>Baudin's, Red-tailed Forest and Carnaby's Black Cockatoos (Threatened) forage in the vegetation dominated by Jarrah and Sheoak woodland and Jarrah <i>E. staeri</i> Sheoak woodlands.</p> <p>Western Ring-tail Possums occur in low densities across the YSPA, favouring Jarrah Sheoak woodlands.</p> <p>The Priority 5 species Quenda (<i>Isodon obesulus fusciventer</i>) is found in low densities where thick vegetation protects them from predation.</p> <p>Recommendation: Retention of vegetation suitable for Threatened Black Cockatoos, Western Ring-tail Possums and Priority Quenda are most likely to benefit other significant species which may occur in the area. These fauna habitat types comprise a combination of JSW, JABW and WM. It will be most beneficial to retain elements of these vegetation types which enhance connectivity and coincide with other significant features (e.g. wetlands and watercourses) as shown in Figure 12. It is recommended that liaison with the Office of the EPA and DEC be undertaken to determine priorities for retention of significant fauna. In addition, where species listed under the EPBC Act are likely to be affected, the need for referrals to DSEWPC will need to be considered.</p>
Management of invasive species, access etc.	<p>Yakamia Creek and associated tributaries contain infestations of environmental weeds including Sydney Golden Wattle, Taylorina, Blackberry and Victorian Tea-tree. Development of the YSPA should facilitate removal of these invasive weeds and rehabilitation of key areas for recreation, water function, conservation and access.</p> <p>Dieback introduction and spread should be minimised through careful planning of construction in development areas and ongoing management of Public Open Space (POS) areas.</p> <p>Recommendation: A Parks and Recreation Management Plan needs to be prepared to integrate management actions for fire, weeds, dieback, access, installation of water management infrastructure and recreational facilities.</p>
Ecological Connectivity/ Greenways	<p>Yakamia Creek and its tributaries provide a significant district ecological connection to Oyster Harbour and beyond. Connectivity associated with these features should be retained and strengthened through provision of adequate buffers and rehabilitation of degraded areas.</p>

	<p>Recommendation: High priority areas for ecological linkage are shown in red in Figure 12. Liaison with the Office of the EPA and DEC is required to determine areas of native vegetation to be retained for ecological linkage purposes.</p>
<p>Wetlands and Watercourses</p>	<p>Yakamia Creek and its associated wetlands and tributaries have been assigned a Conservation Management Category. A minimum 50m buffer from wetland vegetation is recommended by the EPA and DEC.</p> <p>Recommendations:</p> <ul style="list-style-type: none"> • Retain conservation category wetlands and incorporate a minimum 50m buffer (in line with EPA Guidance Statement No. 33, 2008), noting that a larger conservation area may be required to incorporate vegetation values not related to the presence of the wetland (e.g. upland vegetation, PECs, ecological corridor). Buffer distances can be refined, based on wetland values, existing and proposed land uses and threats posed by development. • Areas of good quality vegetation within the buffer of Yakamia Creek should be protected and disturbed areas considered for rehabilitation, treatment of storm water from upstream and/or incorporation of passive recreation infrastructure (e.g. dual use paths, boardwalks, lookouts and interpretive signage). • Stormwater draining from development within YSPA will need to be treated as close to its source as possible, based on principles outlined in Better Urban Water Management (WAPC, 2008a). A Local Water Management Strategy is being prepared to address this treatment at a structure plan level. • Liaise with DEC and DoW regarding adequacy of buffers and multiple uses in existing degraded areas of Yakamia Creek, associated wetlands and water courses.
<p>Yakamia Floodplain, areas prone to Inundation and water management</p>	<p>There are currently planning provisions to prevent inappropriate development within the Yakamia Creek floodplain.</p> <p>The Yakamia Creek tributaries that have been cleared to form a diffuse ephemeral water course in the northern portion of the YSPA may be prone to inundation during wet months.</p> <p>Recommendations:</p> <ul style="list-style-type: none"> • Incorporate information from the Local Water Management Strategy (in preparation) to update floodplain information and related planning policies. • Determine level of constraint for diffuse seasonal watercourse based on geotechnical information provided by individual

	landowners (rezoning or subdivision stage).
Water Management	<p>A Local Water Management Strategy (LWMS) is currently being developed to determine key water management requirements.</p> <p>Recommendation: Incorporate information from LWMS into opportunity and constraints analysis to determine development footprint for YSPA.</p>

A series of maps have been produced to illustrate environmental features (Figures 1 to 11), with the inclusion of a summary opportunities and constraints map (Figure 12). It should be noted that a high level of constraint assigned to a parcel of land may not preclude development of any or all of the land indicated. However, it does reflect that environmental issues relating to local, State and/or Federal legislation and policy are likely to be a concern and development proposals may be refused, modified and/or require a high level of mitigation.

Due to the environmental factors present in the YSPA, proposals to develop areas that are designated 'Relatively Constrained' in Figure 12 may require assessment under the Western Australian *Environmental Protection Act 1986* and/or the Commonwealth *Environment Protection and Conservation Biodiversity Act 1999*.

1 INTRODUCTION

1.1 BACKGROUND

The City of Albany is preparing a structure plan to guide development of the Yakamia Lange localities. The Yakamia Structure Plan (YSP) will:

- Indicate the location of major infrastructure such as schools, arterial roads and water treatment infrastructure;
- Provide general guidance for the layout of lots to ensure that the Liveable Neighbourhoods policy (WAPC, 2009) can be achieved;
- Seek to integrate the provision of Public Open Space (POS) with the retention of key natural features, including native vegetation, fauna habitat, wetlands, watercourses and ecological linkages.

The Yakamia Structure Plan Area (YSPA) is located in the City of Albany about 2 kilometres (km) north of the Albany central business district and occupies approximately 375 hectares (ha) (Figures 1 and 2). There has been a long history of consideration of the YSPA for residential expansion, including:

- Albany Regional Strategy (Department of Planning and Urban Development, 1994a);
- Residential Expansion Strategy for Albany to 2012 (Department of Planning and Urban Development, 1994b); and
- Albany Local Planning Strategy (City of Albany, 2009).

A Draft Yakamia District Structure Plan was prepared by Taylor Burrell (1999) to facilitate, guide and coordinate the urban development of Yakamia. More recently, Allering Burgess (2004) prepared a draft structure plan based on a context and site analysis.

The City of Albany has initiated the rezoning of Lot 4743 North Road from 'Future Urban' to 'Residential R20' and 'Parks and Recreation'. The EPA is currently assessing this amendment under Section 48(1) of the *Environmental Protection Act 1986*. The Environmental Review will be advertised for public comment in 2013.

1.2 PURPOSE AND SCOPE OF THIS OPPORTUNITIES AND CONSTRAINTS ANALYSIS

Aurora Environmental has been commissioned by the City of Albany to conduct a review and analysis of environmental assessments previously undertaken in the YSPA. The purpose of this analysis is to review existing environmental information in the context of contemporary legislation, policies and guidelines to provide an outline of key constraints and potential opportunities for urban development. Advice regarding environmental approvals and strategies for management are also outlined.

This study has:

- Reviewed existing studies and environmental documents;
- Interrogated environmental databases:

- Department of Environment and Conservation (DEC) databases to provide up to date information on threatened and priority species and communities;
- Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) database for Matters of National Significance;
- Landgate's Western Australian (WA) Atlas;
- Department of Indigenous Affairs' (DIA) Aboriginal Heritage Inquiry System;
- Heritage Council of Western Australia's heritage database;
- Reviewed vegetation condition in the YSPA;
- Analysed recent vegetation mapping and calculations for representativeness of vegetation types; and
- Identified gaps in knowledge.

1.3 PLANNING FRAMEWORK

Albany Local Planning Strategy (City of Albany, 2009)

The Albany Local Planning Strategy (ALPS) urban settlement strategy demonstrates how Albany can accommodate up to 100,000 people in an additional 40,000 dwellings in areas zoned for Future Urban which will allow for a 3% to 5% annual growth rate to 2021. Yakamia and Lange have been identified as an area that can be fully serviced for future residential development and has been assigned 'Priority 1' for current and future development.

ALPS noted that regional planning requirements and constraints provide a framework for local planning opportunities and constraints that include:

Constraints

- Development opportunities may be constrained by various remnant vegetation communities within the City which may be below the minimum threshold levels set by the Environmental Protection Authority (EPA).
- Retaining remnant vegetation communities in the inner City areas, such as Yakamia, will affect the achievement of compact urban form and staged urban frontal (outlying areas) development.

Opportunities

- Most areas of high biodiversity value within the City of Albany are contained within land managed by DEC and existing reserve networks; and
- Remnant vegetation within the rural hinterland along the region's waterways provides opportunity to create regional and local open space corridors and linkage between areas of high biodiversity values.

1.4 RECENT PLANNING AND ENVIRONMENTAL ADVICE

Lot 4743 North Road is currently the subject of formal assessment by the EPA as part of the Town Planning Scheme Amendment process to change the zoning of the land from 'Future Urban' to

'Residential' and 'Parks and Recreation'. While the Environmental Review has yet to be advertised for public comment, the City of Albany has received advice from DEC regarding an acceptable development footprint for the land based on vegetation, flora, fauna and water management values. The proposed footprint for development includes an alignment for the extension of Range Road, which will create a major north south link through YSPA to North Road. The City proposes to retain 8.01ha of the 14ha site as foreshore reserve and conservation area. The Environmental Review is expected to be completed in 2013.

The EPA has provided informal advice that the environmental values investigated for Lot 4743 are likely to apply to other areas in the YSPA and that the Structure Plan and planning process will need to consider and provide provisions for the management of possible environmental impacts.

1.5 RESERVATION OF LAND

Town Planning Schemes divide land into zones and reserved areas and describe the types of land uses which may occur. Where a scheme shows privately owned land as a Reserve (e.g. for Parks and Recreation or Public Purposes) compensation can be requested by the landowner, unless there is an agreed mechanism for the landowner to cede the land free of cost. Ceding of land free of cost usually occurs through the subdivision process where a landowner develops a portion of land and certain areas are ceded free of cost for public open space, foreshore reserve or other functions. As local government authorities do not usually have funds to purchase land for public purposes, this is often the only way that land can be secured for infrastructure, community use or conservation values. As subdivision is the choice of the landowner, and will only be undertaken if it is likely to be financially viable, the COA acknowledges the need to provide planning options that promote development in order to secure land for public purposes. In the YSPA area, the City will endeavour to incorporate flexibility of land uses into the Structure Plan as long as the use is compatible with opportunities and constraints that have been identified.

1.6 LAND USE HISTORY

Parts of the project area have been used for agricultural purposes and have been cleared of native vegetation (Figure 2). Some areas of native vegetation occur, including areas in association with wetlands and water courses.

The City of Albany previously had a works depot on the southern portion of Lot 4743 North Road, Yakamia. A Water Corporation sewer pump station is located on Lot 100 North Road.

2 EXISTING ENVIRONMENT

2.1 TOPOGRAPHY AND LANDFORM

The YSPA is characterised by gently undulating topography with the highest areas forming low crests in the centre (40mAHD) and south west (50mAHD) as shown in Figure 2. From the central crest, the land falls away to the north, east and south to broad valleys associated with Yakamia Creek and its tributaries. The south western crest falls away to the south and east towards Yakamia Creek.

Yakamia Creek forms the lowest part of the YSPA at 20mAHD (western area) and 5mAHD (eastern area) of the YSPA. Land immediately to the north of Ulster Road is characterised by a relatively narrow strip of elevated land (approximately 5-15mAHD) which falls away to the Yakamia flood plain relatively steeply (5-10mAHD).

Some of the steeper slopes in the YSPA may present constraints in relation to development and management of drainage. However, these constraints can typically be managed through the planning and design process.

2.2 GEOLOGY AND SOILS

Geological mapping for the region conducted by the Geological Survey of Western Australia (GSWA) describes the site comprising gently undulating lateritic upland, colluvial slopes and floodplain (Gozzard, 1989; Figure 3). The mapping also indicates that the YSPA area comprises Tertiary material represented by the following soil units (Gozzard, 1989):

- Sand - White to pale grey, fine to medium, occasionally coarse angular to sub-angular quartz, little fines, moderately sorted.
- Sand - Pale grey, fine to coarse, angular to sub-rounded quartz, loose moderately sorted with occasional pebbles of laterite.
- Laterite - massive, friable to strongly indurated, vesicular, some sand content, developed on siltstone. Some of these areas may experience constraints related to excavation and installation of services.

Churchward *et al.* (1988) have described the soils of the South Coast and Hinterland, including the YSPA. A description of these is included in Table 2.

**TABLE 2:
GEOLOGY AND SOIL TYPES**

UNIT CODE	UNIT NAME	LANDFORM	GEOLOGY	SOIL TYPE	OPPORTUNITY / CONSTRAINT
242KgS7f	Minor Valleys S7 floor Phase	Foot slopes and swampy valley floors of minor valleys.	Colluvial and alluvial deposits over weathered sedimentary rocks.	Wet and semi-wet soils, pale deep sands and grey deep sandy duplexes	Moderate phosphorus export risk. Excavation is likely to be relatively unconstrained.
242KgS7h	Minor Valleys S7 slope Phase	Side slopes of minor valleys.	Colluvium, sedimentary rocks.	Pale deep sands and grey deep sandy duplexes.	Low to moderate phosphorus export risk.
242KgDMc	Dempster crest Phase	Broad convex crests of sandy and lateritic spurs and ridges.	Deeply weathered siltstone.	Duplex sandy gravels, grey deep sandy duplexes, pale deep sands and shallow gravels.	Low phosphorus export risk. Moderate difficulty for excavation in some areas (laterite).
242KgS6	Minor Valleys 6 Subsystem	Narrow V - shaped valleys, in sedimentary rocks;<10 m relief. Sandy yellow duplex soils on slopes. Deep sands on narrow swampy floor; sedges and reeds.	Siltstone, colluvium over sedimentary rocks.	Sandy yellow duplex soils on slopes.	Low to moderate phosphorus export risk. Low to moderate difficulty for soil excavation.

Source: Soil Landscape Subsystems, Department of Agriculture and Food Western Australia (DAFWA, 2012).

It is recommended that geotechnical studies be undertaken by individual landowners at the rezoning or subdivision stage to determine soil classes, foundation soundness and suitability for stormwater management.

2.3 ACID SULFATE SOILS

Acid sulfate soils (ASS) are wetland soils and unconsolidated sediments that contain iron sulfides which, when exposed to atmospheric oxygen in the presence of water, form sulfuric acid. ASS commonly occurs in low-lying coastal areas associated with Holocene marine muds and sands. When disturbed, these soils may produce significant quantities of acid and release iron, arsenic, aluminium,

manganese and other heavy metals from soil into groundwater. The release of these reaction products can result in detrimental effects to biota, human health and built infrastructure.

The DEC (DEC, 2009) and WAPC (2008b) have released guidance notes on ASS, covering the requirement for assessing sites and the management of sites where ASS are identified. ASS investigations are commonly required as part of the conditions of subdivision or as a requirement for a dewatering license application.

Proponents of developments that involve the disturbance of soil or the change of groundwater levels in areas susceptible to ASS are required to conduct desktop and field-based investigations. The objective of these investigations is to determine the extent and magnitude of ASS at the site. Adequate investigations are required prior to soil disturbance to determine the potential risks and to allow for the formulation of appropriate management strategies.

Based on the ASS risk maps produced by the DEC (Landgate, 2012), areas associated with Yakamia Creek and its tributaries are classified as having a 'high to moderate risk of ASS occurring within 3m of natural ground surface' (Figure 4). Areas not associated with creeks and tributaries have 'no known risk of ASS occurring within 3m of natural soil surface (or deeper)'.

As ASS risk maps are generally produced based on interpretation of geological and landscape information with very limited dedicated ASS investigative fieldwork, the precision of the mapping of boundaries between ASS risk areas is variable. The portion of the site mapped at high to moderate risk is approximately 25%. However it should be noted that areas identified as having significant risk of ASS, where dewatering or extensive earthworks are proposed, require further assessment prior to development. For relatively large scale areas, DEC guidelines recommend 2 sample locations per hectare, with samples collected at 0.25m intervals from surface to at least 1m below the proposed depth of disturbance.

In order to appropriately target the necessary future investigations, it is beneficial to identify areas of the site that will remain undisturbed, and to determine the likely maximum depth of disturbance across the site. This approach enables the investigations to be targeted and specific in their consideration, thereby minimizing investigation costs.

The implementation of ASS management plans can be costly due to the requirements for soil treatment and verification, and extensive groundwater and surface water monitoring. These costs can be reduced through considered civil design practices which minimise soil and groundwater disturbance, including the use of fill to raise site levels, and designing with an aim to eliminate or minimise the need for dewatering during construction. In addition, where interaction with the ASS profile is minimal and on-site acidity has been adequately profiled, on-site management using standard neutralisation (e.g. addition of aglime or other fine-grained neutralising agent) may be adequate. It may not be necessary to treat identified acidity in topsoil, providing the material is retained for use on-site. This is because the acidity in the topsoil represents actual acidity which is already exposed to oxidation and is being slowly released into the environment through natural wetting and drying cycles.

It is recommended that once development areas have been determined, individual landowners within high to moderate ASS risk areas will be responsible for investigating and managing the ASS risk. This can typically be undertaken as a condition of subdivision approval.

2.4 CONTAMINATED SITES

Under the *Contaminated Sites Act 2003* and associated *Contaminated Sites Regulations 2006* where contamination is suspected, the State has powers to classify sites that require further investigation or require remediation. The Act requires owners, occupiers and polluters to report known or suspected contaminated sites to DEC and has a hierarchy of responsibility for clean-up. The polluter or person who caused the contamination is primarily responsible for remediation.

A review of the DEC Contaminated Sites Database (DEC, 2012) indicates that two registered contaminated sites are present in YSPA including Lot 4743 North Road and Lot 100 North Road (Figure 2). These areas were previously used as a depot site by the City of Albany and contain soil impacted by polyaromatic hydrocarbons (e.g. diesel and bitumen). The sites have been remediated by capping and containing the contaminated soil and have been assigned a classification of ‘Remediated for Restricted Use’ as shown in Table 3, Figure 2 and Appendix A. As the sites have been remediated and are compatible with the current land use, (i.e. City of Albany administration buildings) they do not pose a constraint to development of the YSPA unless there is a change of use proposed for these sites whereby the new use is no longer compatible with the site classification.

Sites which are registered as ‘potentially contaminated’ do not appear in the DEC database: only sites which have been classified as ‘contaminated – remediation required’, ‘contaminated – restricted use’, or ‘remediated – restricted use’ are listed. It is also possible that other potentially contaminated sites are present, but have not been identified and registered.

**TABLE 3:
AREAS IN YSPA ON THE CONTAMINATED SITES DATABASE**

SITE	CLASSIFICATION	COMMENT
Lot 4743 on Plan 248843, 102 North Road, Yakamia	Remediated for restricted use. History and details relating to the site are included in Appendix A.	Classification is due to previous use of part of Lot 4743 as a depot. Soil impacted by diesel and bitumen have been contained in cells. General access to these cells is restricted until further notice.
Lot 100 on Diagram 92820, 120 North Road, Yakamia	Remediated for restricted use. History and details relating to the site are included in Appendix A.	Classification is due to previous use of Lot 100 as a depot. Soil impacted by diesel and bitumen have been contained in cells. General access to these cells is restricted until further notice.

2.5 VEGETATION

2.5.1 Background

EPA Position on Vegetation Representation

Environmental Protection Authority (EPA) Position Statement No. 2 (EPA, 2000) states that to protect biodiversity, at least 30% of the original extent of ecological communities should be retained to prevent unacceptable cumulative and potentially irreversible loss of biodiversity. In the Perth Metropolitan Region, the State Government's Bush Forever initiative has sought to ensure that at least 10% of each vegetation complex (based on Heddle *et al.* 1980) is reserved in secure tenure for conservation.

Regional Vegetation Mapping and Representation

Beard regional vegetation mapping (Beard, 1979) is generally used to determine regional context of vegetation complexes for environmental impact assessment. While the Albany Regional Vegetation Survey (ARVS; Sandiford and Barrett, 2010) provides more detailed and contemporary regional data, there is very little correlation between Beard and ARVS mapping. Given the uncertainty of the pre-clearing extent of ARVS vegetation units, it is not possible to determine the extent of these vegetation units remaining. For consistency, the EPA expects that Vegetation Association Values identified in Shepherd *et al.* 2002 (digitised by the Department of Agriculture and Food; DAFWA, 2005) should be used to provide pre-clearing and current extent of ecological communities in the Albany Region (EPA, 2011). More recently, the DEC has calculated Statewide Vegetation Statistics (Government of WA, 2011) which have been used for analysis in this report.

Beard Regional Vegetation Mapping indicates that there are two vegetation associations in the YSPA: Medium Forest – Jarrah Marri (Association 3) and Low Forest – Jarrah, *Eucalyptus staeri* and *Allocasuarina fraseriana* (Association 978). Both of these vegetation associations have more than 30% remaining compared to their original extent (Table 4).

The Jarrah Marri Medium Forest (Association 3) has 69.3% remaining, with 487,373ha or 18.49% of the original extent in secure tenure for conservation (International Union for Conservation of Nature (IUCN) I-IV reserves¹) and an additional 888ha or 0.03% is held in IUCN V and VI reserves which have designated purposes other than for conservation. Therefore, this vegetation type is relatively well represented in the conservation estate.

The Jarrah *Eucalyptus staeri* and *Allocasuarina fraseriana* Low Forest (Association 978) has 39.23% remaining, with 4,748ha or 9.08% of original extent in secure tenure for conservation (IUCN I-IV reserves). Ideally, good quality, protectable portions of this vegetation type in the YSPA will be

¹ IUCN Reserves I-IV comprise lands protected (reserved) for conservation e.g. DEC Conservation Estate. IUCN V-VI are lands reserved with a primary purpose not for conservation e.g. multiple use crown lands. Non IUCN are lands reserved but with a purpose other than for conservation. Crown freehold land – Department interest – Free hold lands acquired and proposed for conservation but not yet reserved. DEC Managed Land – All lands managed by DEC. Not all are managed primarily for conservation and not all are reserved.

retained for conservation to assist in meeting the 10% in secure tenure goal. These areas broadly correlate with Emar/Afra/E.sta as shown in Figure 5.

**TABLE 4:
BEARD REGIONAL VEGETATION REPRESENTATION**

VEGETATION ASSOCIATION	PRE-EUROPEAN EXTENT (ha)	CURRENT EXTENT (ha)	% REMAINING	IUCN 1-4 IN PRE-EUROPEAN EXTENT	IUCN 1-4 IN CURRENT EXTENT	% CURRENT EXTENT PROTECTED (IUCN 1-4) FOR CONSERVATION (PROPORTION OF PRE-EUROPEAN EXTENT)	% PRE-EUROPEAN EXTENT IN IUCN 1-4	% CURRENT EXTENT IN IUCN 1-4 (PROPORTION OF CURRENT EXTENT)	IUCN 5-6 IN PRE EUROPEAN EXTENT	IUCN 5-6 IN CURRENT EXTENT	NO. IUCN IN PRE EUROPEAN EXTENT WITHIN DEC MANAGED LAND	NO. IUCN IN CURRENT EXTENT WITHIN DEC MANAGED LAND
3 - Medium Forest – Jarrah Marri	2,661,405	1,844,285	69.3	492,040	487,373	18.31	18.49	26.43	888	869	1,058,496	989,639
978 - Low Forest; jarrah, Eucalyptus staeri & Allocasuarina fraseriana	53,231	20,883	39.23	4,833	4,748	8.92	9.08	22.73			322	321

Source: Government of WA, 2011

2.5.2 Albany Regional Vegetation Survey

The EPA has endorsed the ARVS report (Sandiford and Barrett, 2010) as a key information source to guide land use planning in the Albany Region. The survey report provides information on native vegetation and flora at a regional level. Ten vegetation units were mapped in the YSPA (Table 5; Figure 6) with 122.4ha of native vegetation. Vegetation descriptions are included in Appendix B.

Digital maps generated by the ARVS have been analysed for vegetation types present in the YSPA, with a comparison of total area of vegetation mapped and proportion retained in secure tenure. The results of this analysis are shown in Tables 5 and 6.

The ARVS did not estimate the original extent of vegetation units, so it is not possible to calculate percentage of vegetation units remaining compared to original extent. In addition, because of the limited study area, some of the vegetation units extend beyond the study area boundary so the estimates of the existing extent are inaccurate.

**TABLE 5:
ARVS VEGETATION UNITS – AREAS IN YSPA**

VEGETATION UNIT (SANDIFORD AND BARRETT, 2010)	VEGETATION CODE	VEGETATION UNIT CODE	VEGETATION UNITS IN YSPA (ha)	COMMENT
Peppermint Low Forest	2	Afle	0.5	
Jarrah / Marri / Sheoak Laterite Forest	12	Afra /Emar / Ccal / Athe	51.4	Potentially/ largely restricted to ARVS area. This vegetation unit is poorly represented in the conservation estate. However, it is also the most common vegetation type in the ARVS area.
Jarrah / Sheoak / <i>Eucalyptus staeri</i> Sandy Woodland	13	Emar / Afra / E.sta	20.5	Potentially/ largely restricted to ARVS area.
<i>B. coccinea</i> Shrubland / E. staeri / Sheoak Open Woodland	14	Bcoc / Esta / Afra	10.5	Potentially/ largely restricted to ARVS area. Identified by DEC as a Priority 1 Ecological Community
<i>Callistachys spp</i> Thicket	36	Clan	0.2	
<i>Evandra aristata</i> Sedgeland	46	Eari	10.5	
<i>Homalospermum firmum</i> / <i>Callistemon glaucus</i> Peat Thicket	47	Hfir / Cgla / Egra	7.2	More than 70% of the remaining extent of this vegetation type is on privately owned land.

VEGETATION UNIT (SANDIFORD AND BARRETT, 2010)	VEGETATION CODE	VEGETATION UNIT CODE	VEGETATION UNITS IN YSPA (ha)	COMMENT
<i>Melaleuca cuticularis</i> / <i>M. preissiana</i> Open Woodland	52	Mcut / Mpre / Alae	0.4	
<i>Taxandria juniperina</i> Closed Forest	59	Tjun	21.3	This vegetation unit is poorly represented in the conservation estate.
<i>Typha orientalis</i> Sedgeland	68	Tori	0.8	Non native vegetation (not counted in total area of native vegetation)
Total Area of Native Vegetation in YSPA: 122.4ha				
Total Area of YSPA: 375.6ha				

2.5.2.1 ARVS Vegetation Representation

The ARVS report calculates existing areas of vegetation units within its study area. A summary of vegetation units, existing and security of tenure is summarised in Tables 5 and 6 and below:

- Peppermint Low Forest (Afle) has 22.8% or 281ha of its current extent in IUCN I-IV Reserves. A further 50.2% or 619ha is contained in other Crown Reserves. There is 1,232ha of this vegetation unit in the ARVS study area which is 2.8% of the surveyed vegetation. Sandiford and Barrett (2010) considered that the range of this unit occurs within 10km east of the ARVS study boundary. Only 0.5ha of this vegetation unit is present in the YSPA.
- Jarrah/Marri/Sheoak Laterite Forest (Afra/Emar/Ccal/Athe) is likely to have less than 10% (9.8% or 1,273ha) of its present extent in the ARVS study area within IUCN I-IV Reserves. A further 3991.6ha or 30.4% is contained in other Crown Reserves. This vegetation type is the most common in the ARVS study area with 13,144ha remaining. Sandiford and Barrett (2010) considered that this unit is largely restricted to the ARVS study area. The YSPA contains 51.4ha of this vegetation unit.
- Jarrah/Sheoak/ *Eucalyptus staeri* Sandy Woodland (Emar/Afra/E.sta) has 25.9% (1,134ha) of its existing extent (5,148ha) in IUCN I-IV Reserves. A further 1,817ha or 36.5% is contained in other Crown Reserves. Sandiford and Barrett (2010) considered that this unit is largely restricted to the ARVS study area. The YSPA contains 20.5ha of this unit.
- *B. coccinea* Shrubland/ *E. staeri*/Sheoak Open Woodland (Bcoc/Esta/Afra) has 50.7% or 674ha of its current extent (1,330ha) in IUCN I-IV Reserves. A further 35.2% or 468ha is contained in other Crown Reserves. Only 188ha or 14.1% occurs on private land. Sandiford and Barrett (2010) considered that this unit is largely restricted to the ARVS study area. This vegetation unit is listed by DEC as a Priority 1 Ecological Community (PEC) due to the susceptibility of *Banksia coccinea* to dieback. The YSPA contains 10.5ha of this vegetation unit.

- *Callistachys spp.* Thicket (Clan) has 10.9% or 4ha of its existing extent (36ha) in IUCN I-IV Reserves. A further 8ha or 23.7% of this unit is contained in other Crown Reserves. 65.5% or 23ha are in non-reserved land. This vegetation unit is not restricted to the ARVS study area, so estimates for extent remaining cannot be calculated. The YSPA contains 0.2ha of this unit.
- *Evandra aristata* Sedgeland (Eari) has 12.5% or 219ha of its existing extent (1,747ha) in IUCN I-IV Reserves. A further 1,046ha or 59.9% of this unit is contained in other Crown Reserves. This vegetation unit is not restricted to the ARVS study area, so estimates for extent remaining cannot be calculated. The YSPA contains 10.5ha of this unit.
- *Homalospermum firmum/Callistemon glaucus* Peat Thicket (Hfir/Cgla/Egra) has 12.6% or 263ha of its existing extent (2083ha) in IUCN 1-IV Reserves. A further 214ha or 10.3% is in other Crown Reserves. A total of 77.1% or 1,606ha occurs in non-reserved land. This vegetation unit is not restricted to the ARVS study area, so estimates for extent remaining cannot be calculated. The YSPA contains 7.2ha of this unit.
- *Taxandria juniperina* Closed Forest (Tjun) has 9.9% or 77ha of its current extent (779ha) in IUCN I-IV Reserves. 201ha or 25.8% is contained in other Crown Reserves. This vegetation unit is not restricted to the ARVS study area, so estimates for extent remaining cannot be calculated. The YSPA contains 21.3ha of this vegetation unit.
- *Melaleuca cuticularis/M. preissiana* Open Woodland (Mcut/Mpre/Alae) has 36.9% or 97ha of its current extent in IUCN I-IV Reserves. A further 29.9% or 83ha is contained in other Crown Reserves. There is 263ha of this vegetation unit in the ARVS study area which is 0.6% of the surveyed vegetation. The range limit of the vegetation unit is unknown. The YSPA contains 0.4ha of this vegetation unit.

The ARVS report (Sandiford and Barrett, 2010) states that *Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland is Priority 1 PEC due the susceptibility of key species to *Phytophthora* species (dieback). Units 12 and 13 (the most common vegetation units in the study area) may be restricted or almost restricted to the ARVS study area. However this has not been verified (Sandiford and Barrett, 2010). The study notes that care needs to be taken when interpreting the areas listed above as vegetation in significant conservation areas (West Cape Howe, Torndirrup, Waychinicup national parks and Two Peoples Bay Nature Reserve) adjacent to the ARVS study area were not included in calculations which could lead to an underestimation of vegetation units present in the Albany area.

**TABLE 6:
ARVS VEGETATION UNITS – EXISTING AREAS IN SECURE TENURE**

VEGETATION UNIT	VEGETATION CODE	VEGETATION CODE	AREA OF VEGETATION UNIT IN YSPA (ha)	AREA OF VEGETATION IN ARVS AREA (ha)	VEGETATION IN ARVS AREA (%)	IUCN I-IV RESERVES (ha)	IUCN I-IV RESERVES (%)	SUMMARY % IN SECURE TENURE	OTHER CROWN RESERVES (ha)	OTHER CROWN RESERVES (%)	OTHER CROWN RESERVES (SUMMARY %)	NON RESERVE (ha)	NON RESERVE (%)	NON RESERVE (SUMMARY %)
Total remnant vegetation within ARVS Context area				71,686	34									
Total remnant vegetation within ARVS Survey area				44,093	35	8574	19		17054	39		18464	42	
Peppermint Low Forest	2	Afle	0.5	1232	2.8	281	22.8		619	50.2		332	26.9	
Jarrah/Marri/Sheoak Laterite Forest	12	Afra / Emar / Ccal /Athe	51.4	13,144	29.8	1273	9.8	<10	3991.6	30.4		7879	59.9	
Jarrah/Sheoak/ <i>Eucalyptus staeri</i> Sandy Woodland	13	Emar / Afra / E.sta	20.5	5,148	11.7	1134	25.9		1817	36.5		1936	37.6	
<i>B. coccinea</i> Shrubland/ <i>E. staeri</i> /Sheoak Open Woodland	14	Bcoc / Esta / Afra	10.5	1,330	3	674	50.7		468	35.2		188	14.1	
<i>Callistachys spp</i> Thicket	36	Clan	0.2	36	0.1	4	10.9		8	23.7	23	65.5		
<i>Evandra aristata</i> Sedgeland	46	Eari	10.5	1,747	4	219	12.5		1046	59.9		482	27.6	
<i>Homalospermum firmum</i> / <i>Callistemon glaucus</i> Peat Thicket	47	Hfir / Cgla / Egra	7.2	2,083	4.7	263	12.6		214	10.3		1,606	77.1	>70
<i>Melaleuca cuticularis</i> / <i>M. preissiana</i> Open Woodland	52	Mcut / Mpre / Alae	0.4	263	0.6	97	36.9		83	31.6		83	31.5	
<i>Taxandria juniperina</i> Closed Forest	59	Tjun	21.3	779	1.8	77	9.9	<10	201	25.8		501	64.3	
Total Area of Vegetation Units in YSPA (ha)			122.4											

2.5.3 Vegetation Condition

The condition of the vegetation in the YSPA was rated by ATA Environmental in 2000 and ENV (2006) using the vegetation condition scale developed by Keighery (1994). Sandiford and Barrett (2010) mapped the condition of vegetation using the national standard Vegetation Assets States and Transition (VAST) framework (Thackway and Lesslie, 2006). These vegetation condition scales are described in Appendix C, with a summary comparison of the different scales shown in Table 7.

In 2013, Aurora Environmental revisited the site to check the current condition of the vegetation. The condition rating scale outlined in Table 6 was used to characterise vegetation condition and to allow comparison with the VAST framework and the Keighery condition rating. Condition ratings are shown in Figure 6. Generally, the larger more consolidated areas of vegetation are in the best condition.

Much of the vegetation associated with Yakamia Creek does not constitute native vegetation due to almost complete invasion by weeds. Future strategies for rehabilitation and/or multiple use of key areas should be explored in the YSP as a potential opportunity for improvement of conservation and recreational values and where appropriate, management of stormwater.

**TABLE 7:
VEGETATION CONDITION RATING**

CONDITION - KEIGHERY 1994	DESCRIPTION - KEIGHERY 1994	CONDITION - VAST FRAMEWORK	DESCRIPTION – VAST FRAMEWORK
Pristine	Pristine or nearly so, no obvious signs of disturbance	Type 1 - Residual	Unmodified, structural and compositional integrity of native vegetation is very high
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.		
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.		
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.	Type II - Modified	Natural regeneration tolerates/endures under past &/or present current land management practices. Structure is predominantly altered but intact e.g. a layer and/growth form and or age classes removed. Composition of vegetation is altered but intact

CONDITION - KEIGHERY 1994	DESCRIPTION - KEIGHERY 1994	CONDITION - VAST FRAMEWORK	DESCRIPTION – VAST FRAMEWORK
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	Type III - Transformed	Natural regenerative capacity is limited/at risk under past &/or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice Dominant structuring species of native vegetation community significantly altered e.g. a layer frequently and repeatedly removed
Completely degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as ‘parkland cleared’ with the flora comprising weed or crop species with isolated native trees or shrubs.	Type IV – Replaced Adventive	Regeneration of native vegetation community has been suppressed by ongoing disturbances of the natural regenerative capacity Limited potential for restoration. Dominant structuring species of native vegetation removed or predominantly cleared or extremely degraded.

Source: Keighery, 1994; Thackway and Lesslie, 2006; Sandiford and Barrett, 2010

2.5.4 Threatened and Priority Ecological Communities

A search was undertaken of the DEC Threatened Ecological Community (TEC) database on 4 December 2012. The search identified two Priority 1 PECs of ‘*Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland’ (also identified as Community 14a in Sandiford and Barrett 2010). Vegetation type 14a occurs as shown in Figure 5

2.5.5 Recommendations Relating to Vegetation

The highest priority areas of vegetation for retention are those which are poorly represented, comprise PECs, are associated with watercourses and wetlands and contribute to ecological linkage. These factors, when combined with vegetation in Very Good to Excellent condition provide a starting point of the most significant vegetation to be considered for retention. Areas of vegetation which meet these criteria are shown in Figure 5. It is recommended that liaison with the Office of the EPA and DEC be undertaken to determine areas of native vegetation that may need to be retained for conservation purposes.

2.6 FLORA

2.6.1 Previous Flora surveys

Flora studies in the YSPA been undertaken over an extended period of time, between 1996 and 2009 and are summarised in Table 8. Information in this document is a summary of all the data available and includes updated taxon nomenclature and conservation status, where applicable. A composite of all flora surveys is included in Appendix D.

In summary, 282 species of native flora have been identified within the YSPA, with 57 introduced species. The Families with the highest representations are Proteaceae with 36 native species, Fabaceae with 34 native species, Myrtaceae with 24 native species, Cyperaceae with 18 native species and Ericaceae with 18 native species.

Areas not previously surveyed are shown in Figure 7 and generally comprise relatively small, isolated areas of vegetation in Degraded to Good Condition.

**TABLE 8:
PREVIOUS FLORA STUDIES**

STUDY REFERENCE	STUDIES UNDERTAKEN	AREA SURVEYED
Alan Tingay and Associates (1996)	Opportunistic flora survey.	Lot 79 and 80 Bond Street
ATA Environmental (2000) Yakamia Environmental Assessment – Cell B. Report No. 2000/29	Opportunistic flora and vegetation survey February 2000 (to supplement 1996 survey).	Lot 79 and 80 Bond Street
Sandiford (2005) Vegetation and Flora Survey – Location 4743 Yakamia	Opportunistic data collection (not quadrat data).	Lot 4743 North Road
ENV (2005) Flora and Vegetation Survey for the Yakamia Structure Plan	Flora and vegetation survey including 11, 10m x 10m quadrats between 22 - 26 November 2005 (YAK01 – YAK11).	Previous Yakamia Structure Plan Area
Coffey Environments (2008a) Albany Regional Vegetation Assessment – Phase One	Five 10m x 10m quadrats on 10 October 2007 (07Q17, 07Q18, 07Q19, 07Q20, 07Q21).	Lot 4743 North Road

2.6.2 Data base searches

A search of DEC’s Threatened (Declared Rare) and Priority Flora data bases was undertaken on 28 November 2012 for the YSPA plus a 5km buffer (Appendix E). Data bases searched include:

- DEC Threatened (Declared Rare) and Priority Flora database (TPFL);
- The Western Australian Herbarium Specimen database for priority species opportunistically collected in the area of interest (WAHERB); and

- DEC Threatened and Priority Flora List, which is searched using ‘place names’. This list can be used as an indicative guide for what is likely to be found in the area and also includes declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) (TPList).

In addition, DSEWPC’s Protected Matters Database was searched for flora protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

A description of the Conservation Codes for Threatened and Priority Flora in Western Australia is included in Appendix E. Information from these databases was cross checked against the composite flora list to determine the status of species that have been recorded in the YSPA. The DEC data base results do not necessarily represent a comprehensive list of the Threatened and Priority Flora in the area. However, when coupled with information from previous flora surveys, the resulting data indicates that most species from the area are likely to have been identified.

2.6.3 Threatened and Priority Flora

The DEC Threatened (Declared Rare) and Priority Flora database indicated that nine conservation significant flora species are known within 5km of the YSPA (Table 9). This includes two Threatened species, Orchids *Caladenia harringtoniae* and *Drakaea micrantha*. Priority species include:

- Priority 1: *Stylidium falcatum*;
- Priority 2: *Degelia flabellata*; and
- Priority 3: *Andersonia auriculata*, *Melaleuca diosmifolia* and *Poa billardierei*.

**TABLE 9:
THREATENED AND PRIORITY FLORA POTENTIALLY PRESENT IN THE YSPA**

SPECIES NAME	CONSERVATION STATUS	EPBC ACT 1999 STATUS
<i>Andersonia auriculata</i>	Priority 3	
<i>Caladenia harringtoniae</i>	Threatened	Vulnerable
<i>Degelia flabellata</i>	Priority 2	
<i>Drakaea micrantha</i>	Threatened	Endangered
<i>Drosera fimbriata</i>	Priority 4	
<i>Laxmannia jamesii</i>	Priority 4	
<i>Melaleuca diosmifolia</i>	Priority 3	
<i>Poa billardierei</i>	Priority 3	
<i>Stylidium falcatum</i>	Priority 1	

The Western Australian Herbarium Specimen database for threatened and priority flora opportunistically collected in the Albany area is shown in Appendix F.

When comparing these databases with data collected from historical flora surveys, the following conservation significant flora have been identified in the YSPA:

- *Leucopogon alternifolius* (Priority 3);
- *Andersonia depressa* (Priority 4); and
- *Laxmannia jamesii* (Priority 4).

Agrostocrinum scabrum was identified in flora survey of Lots 997 and 998 Mason Road. If this plant is *Agrostocrinum scabrum* subspecies *littorale*, it is a Priority 2 flora species. The known distribution of Priority species in the YSPA is shown in Figure 8 and a description of the flora is included in Appendix G.

It is recommended that Priority species be retained where other values relating to vegetation type and condition indicate that the area should be retained for conservation, water management or other purposes.

2.6.4 Invasive Species

Some parts of the YSPA, particularly areas associated with Yakamia Creek are heavily infested with environmental weeds, including:

- Sydney Golden Wattle (*Acacia longifolia*);
- Taylorina (*Psoralea pinnata*);
- Blackberry (*Rubus fruticosus*); and
- Pine trees (*Pinus radiata*).

In addition, the risk of introduction and spread of dieback is threat to the conservation values of native vegetation, particularly the PEC.

2.6.5 Recommendations relating to Flora and Invasive Species

The status of the species *Agrostocrinum scabrum* on Lots 997 and 998 Mason Road needs to be clarified to determine if it is subspecies *littorale* (a Priority 2 species).

While it is preferable that Priority Flora is retained, the presence of these species may not preclude development. The presence of other significant features is likely to determine the need for retention of Priority Flora (e.g. presence of PEC, poorly represented vegetation, wetland, water course etc.). It is recommended that liaison with the Office of the EPA and DEC be undertaken to determine priorities for retention of significant flora.

It is recommended that future planning includes consideration of dieback management and rehabilitation of weed infested areas.

2.7 FAUNA

2.7.1 Previous Fauna surveys

A Level 2 fauna survey was undertaken in the YSPA by Coffey Environments (2008b) during December 2006 and March 2007 and comprised:

- Trapping at 12 sites in four habitat types (Jarrah/Sheoak Woodland, Jarrah/*Eucalyptus staeri* Woodland, degraded Shrubland and wetland mosaic; Figure 9);
- Avifauna survey;
- Spotlighting survey for nocturnal fauna;
- Frog survey;
- Targeted survey for Western Ring-tail Possums (day time drey survey and night time spotlighting);
- Bat survey; and
- An invertebrate survey.

Areas in the amended YSPA area that have not been surveyed are shown in Figure 9.

2.7.2 Fauna Habitat

Three broad fauna habitat types in the YSPA were mapped by Coffey Environments (2008b) (see Figure 9) and are described as::

- Jarrah/Sheoak woodland (JSW) - Jarrah (*Eucalyptus marginata*) and Sheoak (*Allocasuarina fraseriana*) woodland over shrubland of species such as *Agonis theiformis*, *Astartea fascicularis*, *Allocasuarina humilis*, *Melaleuca thymoides* and *Xanthorrhoea brunonis* over a mixed sedgeland. This habitat was in a very good to excellent condition which includes sites YK 1, YK2, YK3, YK4, YK9, YK10 and YK11;
- Jarrah/Albany Blackbutt woodland (JABW) – Jarrah (*Eucalyptus marginata*), Albany Blackbutt (*Eucalyptus staeri*) and Sheoak (*Allocasuarina fraseriana*) woodland over shrubland of species such as *Agonis theiformis*, *Astartea fascicularis*, *Allocasuarina humilis*, *Melaleuca thymoides* and *Xanthorrhoea brunonis* over a mixed sedgeland. This habitat was in a very good to excellent condition and includes sites YK6 and YK7; and
- Wetland Mosaic (WM) - Peppermint (*Agonis flexuosa*) and *Callistachys lanceolata* woodland over *Pteridium esculentum*. This habitat was in a good to very good condition and includes site YK5, YK8 and YK12.

The condition of the vegetation was assessed using the Keighery (2004) vegetation condition rating scale. A number of lots within the central and northern portion of the Structure Plan area including a significant proportion of land adjacent to Yakamia Creek have been cleared for agricultural activities and are in completely degraded condition (Figure 9). These areas were not surveyed.

Priority fauna habitat types include native vegetation:

- In very good to excellent condition;
- Of greatest biodiversity;
- That offer multiple functions (e.g. related to hydrological function, ecological linkage, excellent condition); and
- That provides specific habitat for conservation significant fauna.

Following these criteria, the vegetation shown in red in Figure 12 is likely to be the most significant based on its condition, diversity, presence of conservation significant fauna and linkage via Yakamia Creek and its tributaries.

2.7.3 Fauna Assemblages

A list of species recorded in the YSPA area is summarised in Appendix H and includes the current conservation status of fauna under Western Australian and Federal legislation. Table 10 outlines the number of species recorded and status by group.

**TABLE 10:
FAUNA SPECIES BY GROUP**

GROUP	NUMBER OF SPECIES	COMMENT
Frogs	Five of a possible 14 species found in the region.	No Threatened or Priority species recorded
Reptiles	Eighteen species of reptiles including 12 skinks, three elapids, one gecko, one pygopod and one varanid. An additional 16 species of reptiles are known to occur in the region but were not recorded in YSPA.	No Threatened or Priority species recorded
Birds	Fifty-nine bird species were recorded in YSPA. A total of 150 bird species are likely to be found in the Albany region. However, many are associated with marine habitats and are not likely to utilise or rely on the YSPA.	Carnaby’s Black Cockatoo Baudin’s Cockatoo Red-tailed Black Cockatoo
Mammals	Eleven native species of mammals were recorded in the YSPA including three bat species. Three introduced species were recorded (cat, fox and rabbit).	Western Ring-tail Possum Southern Brown Bandicoot

2.7.4 Significant Fauna

A search of the DEC Threatened Fauna database (6 December 2012) included the YSPA and a five kilometre buffer. The database includes species which are declared as:

- ‘Rare or likely to become extinct (Schedule 1)’;
- ‘Birds protected under an international agreement (Schedule 3)’; and
- ‘Other specially protected fauna (Schedule 4)’.

Information from the database is summarised in Appendix I and discussed below. In addition, a search was undertaken of the DSEWPC ‘Protected Matters of National Environmental Significance’ database on 23 November 2012 (Appendix J) for YSPA and a one kilometre buffer. Definitions of the classification system for significant fauna are provided in Appendix G.

The fauna species listed in Table 11 have special conservation status under State and/or Commonwealth legislation (*EPBC Act*). Each species has either been previously recorded or has been listed as having the potential to occur in the vicinity of Yakamia and Lange.

Ten Schedule 1 species, two Schedule 4 species and two ‘species in need of special protection’ listed under the *Wildlife Conservation Act 1950* potentially occur within five kilometres of the YSPA. In addition, five Priority species are also predicted to occur.

Several species predicted to occur in the vicinity of the YSPA are of conservation significance under the Commonwealth *EPBC Act 1999*, with two endangered species, seven vulnerable species, a number of migratory marine/wetland birds and listed marine species.

Of the predicted conservation significant species, four Threatened species have been confirmed in the YSPA and two species may be present but were not recorded during survey. One Priority fauna species has been confirmed at YSPA and four are likely to occur there. Predicted significant species are listed in Table 11 with an assessment of the likelihood of the species occurring in YSPA (Appendix H).

**TABLE 11:
SIGNIFICANT FAUNA SPECIES RECORDED OR PREDICTED TO OCCUR IN YSPA**

SPECIES	WILDLIFE CONSERVATION ACT 1950 SCHEDULE/PRIORITY	STATUS UNDER EPBC ACT 1999	COMMENT
Carnaby’s Black-Cockatoo <i>Calyptorhynchus latirostris</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Endangered	Species <i>recorded</i> in the project area. Preferred habitat JSW and JABW
Baudin’s Black-Cockatoo <i>Calyptorhynchus baudinii</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>recorded</i> in the project area. Preferred habitat JSW and JABW
Forest Red-tailed Black-Cockatoo <i>Calyptorhynchus banksii naso</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>recorded</i> in the project area. Preferred habitat JSW and JABW
Australasian Bittern <i>Botaurus poiciloptilus</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Endangered	Species <i>unlikely</i> in the project area due to its specific habitat requirements and the modified nature of Yakamia Creek
Noisy Scrub-bird <i>Atrichornis clamosus</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>unlikely</i> in the project area
Western Bristlebird <i>Dasyornis longirostris</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i>	Species listed as Vulnerable	Species <i>unlikely</i> in the project area due to the proximity of the project area to

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SPECIES	WILDLIFE CONSERVATION ACT 1950 SCHEDULE/PRIORITY	STATUS UNDER EPBC ACT 1999	COMMENT
	(Specially Protected Fauna)		development and the species susceptibility to disturbance
Chuditch, Western Quoll <i>Dasyurus geoffroii</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>possibly</i> in the project area. Preferred habitat Jarrah/ Marri/ Sheoak Laterite Forest, Jarrah/ Sheoak/ E. staeri Sandy Woodland and Banksia coccinea Shrubland/ E. staeri/ Sheoak Woodland (JSW and JABW)
Western Ringtail Possum <i>Pseudocheirus occidentalis</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>recorded</i> in the project area. Preferred habitat Jarrah/ Marri/ Sheoak Laterite Forest, Jarrah/ Sheoak/ E. staeri Sandy Woodland and Banksia coccinea Shrubland/ E. staeri/ Sheoak Woodland (JSW and JABW)
Quokka <i>Setonix brachyurus</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>possibly</i> in the project area although it is not likely due to absence of preferred habitat and the proximity of urbanisation.
Southern Brush-tailed Phascogale <i>Phascogale tapoatafa</i> ssp. WAM434	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)		Species <i>possibly</i> in the project area
Short-nosed Snake <i>Elapognathus minor</i>	Priority 2: Species listed on the DEC's Priority Fauna list		Species recorded in region and <i>possibly</i> found in YSPA
Carpet Python <i>Morelia spilota imbricata</i>	Species listed as 'other specially protected fauna' that is in need of special protection under Schedule 4 of the <i>Wildlife Conservation Act 1950</i>		Species recorded in region and <i>possibly</i> found in the YSPA
Peregrine Falcon <i>Falco peregrinus</i>	Species listed as 'other specially protected fauna' that is in need of special protection under Schedule 4 of the <i>Wildlife Conservation Act 1950</i>		<i>Possible</i> infrequent visitor to the YSPA
Masked Owl <i>Tyto novaehollandiae novaehollandiae</i>	Priority 3: Species listed on the DEC's Priority Fauna list		Species <i>possibly</i> in the YSPA

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SPECIES	WILDLIFE CONSERVATION ACT 1950 SCHEDULE/PRIORITY	STATUS UNDER EPBC ACT 1999	COMMENT
Western Brush Wallaby <i>Macropus irma</i>	Priority 4: Species listed on the DEC's Priority Fauna list		Species <i>possibly</i> in the YSPA
Australian Bustard <i>Ardeotis australis</i>	Priority 4: Species listed on the DEC's Priority Fauna list		Species <i>possibly</i> in the area but unlikely to rely on YSPA
Quenda, Southern Brown Bandicoot <i>Isoodon obesulus fusciventer</i>	Priority 5: Species listed on the DEC's Priority Fauna list		Species <i>recorded</i> in the YSPA. Preferred habitat is wetland mosaic.
Rainbow Bee-eater <i>Merops ornatus</i>		Species listed as Migratory. International Agreement/ Marine Terrestrial Species/ Listed Marine Species	Species <i>possibly</i> in the YSPA but unlikely to rely on the area
Osprey <i>Pandion haliaetus</i>		Species listed as Migratory/ International Agreement	Species <i>possibly</i> in the YSPA but unlikely to rely on the area
White-bellied Sea Eagle <i>Haliaeetus leucogaster</i>		Species listed as Migratory	Species <i>possibly</i> in the YSPA but unlikely to rely on the area
Fork-tailed Swift <i>Apus pacificus</i>		Species listed as Migratory Marine Bird/ Listed Marine Species	Infrequent visitor but unlikely to rely on YSPA
Eastern Great Egret <i>Ardea modesta</i>		Species listed as Migratory/ International Agreement	Species <i>possibly</i> in the YSPA but unlikely to rely on the area
Cattle Egret <i>Ardea ibis</i>		Species listed as Migratory/ Migratory Marine Bird/ Migratory Wetlands Bird/ Migratory Marine Bird	Species <i>possibly</i> in the area but unlikely to rely on YSPA
Great Egret <i>Ardea alba</i>		Species listed as Migratory/ International Agreement/ Migratory Marine Bird/ Migratory	Species <i>possibly</i> in the area but unlikely to rely on YSPA

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SPECIES	<i>WILDLIFE CONSERVATION ACT 1950 SCHEDULE/PRIORITY</i>	<i>STATUS UNDER EPBC ACT 1999</i>	COMMENT
		Wetlands Bird/ Migratory Marine Bird	
Grey Plover <i>Pluvialis squatarola</i>		Species listed as Migratory	Species <i>highly unlikely</i> in the YSPA
Eastern Reef Egret, Eastern Reef Heron <i>Egretta sacra</i>		Species listed as Migratory/ International Agreement	Species <i>possibly</i> in the area but unlikely to rely on YSPA
Greater Sand Plover <i>Charadrius leschenaultii</i>		Species listed as Migratory/ International Agreement	Species <i>possibly</i> in the area but unlikely to rely on YSPA
Lesser Sand Plover <i>Charadrius mongolus</i>		Species listed as Migratory/ International Agreement	Species <i>possibly</i> in the area but unlikely to rely on YSPA
Pacific Golden Plover <i>Pluvialis fulva</i>		Species listed as Migratory/ International Agreement	Species <i>possibly</i> in the area but unlikely to rely on YSPA
Atlantic Yellow-nosed Albatross <i>Thalassarche chlororhynchos</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)		Species <i>unlikely</i> to rely on the YSPA
Indian Yellow-nosed Albatross <i>Diomedea chlororhynchos</i> subsp. <i>carteri</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)		Species <i>unlikely</i> to rely on the YSPA
Tristan Albatross <i>Diomedea exulans</i> subsp. <i>exulans</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)		Species <i>unlikely</i> to rely on the YSPA
Caspian Tern <i>Sterna caspia</i>		Species listed as Migratory/ International Agreement	Species <i>unlikely</i> to rely on the YSPA
Mallee Fowl <i>Leipoa ocellata</i>	Species listed as Threatened under Schedule 1 of the <i>Wildlife Conservation Act 1950</i> (Specially Protected Fauna)	Species listed as Vulnerable	Species <i>unlikely</i> in the project area due to the proximity of the project area to development and the species

SPECIES	WILDLIFE CONSERVATION ACT 1950 SCHEDULE/PRIORITY	STATUS UNDER EPBC ACT 1999	COMMENT
			susceptibility to disturbance

Source: Coffey Environments (2008b)

Appendix K contains a description of conservation significant fauna species that have been recorded or are likely to occur in YSPA, describes preferred habitat and threatening processes.

2.7.5 Recommendations relating to Fauna

Retention of vegetation suitable for Threatened Black Cockatoos, Western Ring-tail Possums and Priority Quenda are most likely to benefit other significant species which may occur in the area. These fauna habitat types comprise a combination of JSW, JABW and WM. It will be most beneficial to retain elements of these vegetation types which enhance connectivity and coincide with other significant features (e.g. wetlands and watercourses) as shown in Figure 12. It is recommended that liaison with the Office of the EPA and DEC be undertaken to determine priorities for retention of significant fauna. In addition, where species listed under the EPBC Act are likely to be affected, the need for referrals to DSEWPC will need to be considered.

2.8 GREENWAYS AND HABITAT CONNECTIVITY

One of the main threatening processes to environmental assets is the fragmentation of natural systems which creates ‘islands’ of natural areas within urban and rural land uses and increases vulnerability to diseases, fire, weeds, pests, salinity and climate change. When prioritising areas to be retained for conservation, consideration needs to be given to the size, shape and connectivity of remaining bushland, wetlands and water courses.

Previous studies which have examined connectivity across the landscape in the Albany area include:

- ATA Environmental (2002) Albany Greenways; and
- Wilkins *et al.* (2006) The Western Australian South Coast Macro Corridor Network – A bioregional strategy for conservation by DEC.

ATA Environmental (2002) identified Yakamia Creek and its associated tributaries as potential ecological corridors (Figure 1). Subsequent environmental of Yakamia wetlands and watercourses (Coffey Environments, 2008c) suggested that rehabilitation of degraded areas of Yakamia Creek and retention of a combination of floodplain, wetland and upland vegetation would be beneficial to the persistence and dispersal of flora and fauna in the landscape. It is noted that existing degraded areas along Yakamia Creek and its tributaries are suitable for multiple uses, including recreation, water management infrastructure and access (emergency and dual use path).

At a landscape scale, the vegetation close to the coast in the Albany urban area is part of the ‘Coastal’ portion of the Macro Corridor network which links the western forests (e.g. Walpole, Denmark and Redmond) to the Two People’s Bay corridor. This corridor has been assigned as ‘Very High Priority’ as it links two or more very high nature conservation areas with (almost) continuous vegetation. While Yakamia is, in some ways peripheral to the Coastal corridor, it helps to reinforce the corridor, provide feeder corridors and facilitate access to different habitat types. Therefore,

consideration of retaining and creating linkage of natural systems within YSPA will assist in reinforcing ecological resilience in the broader Albany area.

High priority areas for ecological linkage are shown in red in Figure 12. It is recommended that liaison with the Office of the EPA and DEC be undertaken to determine priorities for the retention and enhancement of ecological linkages.

2.9 SURFACE DRAINAGE AND GROUNDWATER

Surface drainage in the YSPA is determined by topography with:

- A east to west ridge running along the northern edge of Bond Road directing water north to a tributary of Yakamia Creek and south to a southern tributary of Yakamia Creek (Figure 11);
- An east west ridge extending through Lots 77 Range Road, 420 Target Road and 4743 North Road directing water to the north east to a tributary of Yakamia Creek (Figure 11) and to Yakama Creek in the south.
- Water directed to Yakamia Creek is discharged to Oyster Harbour prior to flow into King George Sound.

Existing rainfall is partly intercepted by vegetation and pasture prior to infiltration to silty sands. Little overland flow is generated except in wetter months when soil profiles are saturated.

Yakamia Creek is a modified drainage network which comprises constructed and natural areas with a main stream length of 9.5km, a catchment of 21km² and 80% of the catchment cleared of native vegetation (SCRIPT, 2004). Much of the creek has been excavated to form a channel with steep banks which can be prone to undermining when water energy is high (Greenskills, 2000). Slumping of stream banks has occurred in the area (Taylor Burrell, 1998). A flood study was conducted in 2001 by the (then) Water and Rivers Commission which refers to the historical problems of erosion and siltation and the occurrence of flooding upstream from the YSPA. The deposition of sediments that have been transported downstream exacerbates the creek's tendency to flood. Planning for urban water management will need to focus on detaining stormwater as close to source as possible to mitigate peak flows and treat nutrients.

Levels of phosphorus and nitrogen in the waters of Yakamia Creek regularly exceed Australian and New Zealand Environment and Conservation Council (ANZECC) Guideline levels. The pH of Yakamia Creek water has ranged between 6.9 to 9.3 (Coffey Environments, 2008) indicating that it is relatively alkaline when compared with ANZECC guideline range of 6.5 to 8. The creek has also reportedly experiences hydrocarbon and heavy metal contamination (Government of WA, 2007b).

The annual discharge from Yakamia Creek to Oyster Harbour is approximately 4000 mega litres (Government of WA, 2007b). Yakamia Creek flows permanently, fed by perched winter groundwater tables but it is unlikely that there is any superficial aquifer base flow or connection to the regional groundwater body (Government of WA, 2007b)

Groundwater in the YSPA comprises a sedimentary aquifer with intergranular porosity (Coffey Environments, 2008a) which is part of a regional groundwater resource (Government of WA, 2007b).

DoW data extracted from the Water Information Network (WIN) database indicates that the level of nitrogen in the groundwater often exceeds the trigger value of 1.2mgL^{-1} indicated in ANZECC Guidelines. The groundwater also often exceeds the trigger value of 0.065mgL^{-1} set for Total Phosphorus. The pH of the groundwater varies but is generally slightly acidic. To ensure that development does not exacerbate acidity in groundwater, management of disturbance in high ASS risk areas will need to occur.

2.10 WETLANDS AND WATERCOURSES

Coffey Environments (2008c) have undertaken a wetland and waterways assessment of the southern portion of the YSPA (Figure 10). This area did not include the northern section of the revised YSPA which includes additional wetland and water features (Figure 10).

Coffey Environments' (2008c) assessment included ground truthing of mapped information created by the Department of Water (DoW, 2007). The assessment included Yakamia Creek and its tributaries which have been assigned a conservation management category due to the presence of:

- Poorly represented vegetation types;
- Species or communities that are considered to be threatened or have a priority status; and
- Sites of cultural or historical significance.

Conservation category wetlands have the highest priority for retention and management for their natural values (Water and Rivers Commission, 2001). The EPA (2008) recommends a minimum of a 50m buffer be retained around a wetland. Any extra width which may be required is based on the:

- Wetland and surrounding vegetation values;
- Activities, land uses or development near the wetland (existing and proposed); and
- Threats posed by the adjacent activities, land uses or development.

Recommendations for YSPA are described below and highest priority areas for protection and multiple use are shown in Figure 11. These recommendations have been extrapolated, where appropriate, to areas outside the initial Coffey Environments assessment.

The following is recommended:

- Retain conservation category wetlands and incorporate a minimum 50m buffer (in line with EPA Guidance Statement No. 33, 2008), noting that a larger conservation area may be required to incorporate vegetation values not related to the presence of the wetland (e.g. upland vegetation, PECs, ecological corridor). Buffer distances can be refined, based on wetland values, existing and proposed land uses and threats posed by development.
- Areas of good quality vegetation within the buffer of Yakamia Creek should be protected and disturbed areas considered for rehabilitation, treatment of storm water from upstream and/or incorporation of passive recreation infrastructure (e.g. dual use paths, boardwalks, lookouts and interpretive signage).
- Stormwater draining from development within YSPA will need to be treated as close to its source as possible, based on principles outlined in Better Urban Water Management (WAPC, 2008a). A

Local Water Management Strategy is being prepared to address this treatment at a structure plan level.

- Liaise with DEC and DoW regarding adequacy of buffers and multiple uses in existing degraded areas of Yakamia Creek, associated wetlands and water courses.

2.11 YAKAMIA CREEK FLOOD PLAIN AND WATER MANAGEMENT

The Yakamia Creek Flood Study was undertaken by Water and Rivers Commission and Aquaterra and reported in the Department's Hydrology and Water Resources Series in 2001. Design flows and design flood flows were estimated based on urbanisation of the catchment in 2001 (32% of the catchment) and future urbanisation of the catchment (44%). It is likely that the figure of 44% of the catchment becoming urban was an underestimate, based on proposed urban areas in policy documents such as ALPS. The preparation of modelling is currently being undertaken to incorporate more contemporary estimates of urbanisation which will allow for a more accurate picture of flood risk and mitigation planning.

Broadly, however, it is likely that future design considerations will need to include detention of high rainfall events in the Yakamia Creek floodplain and periphery to reduce the risk of flooding in susceptible areas between North Road and Lower King Road. Figure 11 shows areas where the creation of detention infrastructure may be achieved with minimal impact on environmental values.

Recommendations include the following:

- Incorporate information from the Local Water Management Strategy (in preparation by Essential Environmental Services) to update floodplain information and related planning policies.
- Determine level of constraint for diffuse seasonal watercourse based on geotechnical information provided by individual landowners (rezoning or subdivision stage).

2.12 ABORIGINAL AND EUROPEAN HERITAGE

An Aboriginal heritage survey was undertaken for the southern portion of YSPA (south of Bond Road) by Brad Goode and Associates in 2007. At the time, no archaeological or ethnographic sites have been recorded in the YSPA. As a result of the survey, Yakamia Creek was identified as a place of importance for the gathering of resources, travel and association with spiritual beliefs in the Marchant (water snake). Yakamia Creek was subsequently listed as a mythological and historical site under Section 5(b) of the *Aboriginal Heritage Act 1972* (Site Id 24418; Appendix L). Aboriginal groups consulted in 2007 requested that the creek be rehabilitated with local native plant species and that an adequate buffer be to development be incorporated.

No archaeological sites were identified in the 2007 survey.

3 CONCLUSIONS AND RECOMMENDATIONS

3.1 SUMMARY OF OPPORTUNITIES AND CONSTRAINTS

Environmental opportunities and constraints for land parcels within the YSPA are summarised in Figure 12. The least constrained areas have been assigned a code of 'Relatively Unconstrained'. Areas that have 1 or 2 issues have a code of 'Some Constraints'. Areas with 3 or more issues have been assigned a code of 'Relatively Constrained'. Sites with moderate to significant constraints are likely to require more detailed investigation to clarify if constraints can be adequately managed, or if other measures such as inclusion as parks and recreation or POS will be required. In addition, proposals to develop areas with 'Some Constraints' or 'Relatively Constrained' areas may require:

- Referral to the EPA under the EP Act where development is likely to have a significant impact on the environment; and/or
- Referral to DSEWPC under the EPBC Act where there is likely to be a significant impact on Protected Matters of National Environmental Significance.

A summary of recommendations relating to opportunities and constraints is included in Table 1.

3.2 KEY ENVIRONMENTAL IMPACTS LIKELY TO ARISE FROM DEVELOPMENT

Environmental impacts which may result from urban development if not carefully managed are listed in Table 12. In addition, the table lists further investigation and management strategies which will assist in mitigating or reducing impacts to acceptable levels.

3.3 APPROVALS PROCESS

Western Australia has a system of tiered assessment of environmental issues during the planning process. The land use planning and development system allocates land for various purposes and regulates certain types of land uses. Planning decisions influence environmental outcomes throughout the planning process via statutory and non-statutory processes with the following key stages applicable to YSPA:

- Structure Plan;
- Town Planning Scheme amendments (rezoning);
- Subdivision approvals; and
- Development approvals.

The EPA has the ability to formally assess proposals which are likely to have a significant impact on the environment at either the level of Assessment on Proponent Information, Public Environmental Review (Section 38 of EP Act) or as part of a Town Planning Scheme amendment (Section 48 of EP Act). Where proposals can be managed using mechanisms such as planning policies and advice from other government agencies, the EPA may choose not to formally assess a proposal, but can provide advice.

Impacts on Protected Matters of National Significance need to be referred to the DSEWPC under the EPBC Act. There is a bilateral agreement between the Commonwealth and the State of WA that provides that assessment under Part 8 of the EPBC Act is not required where the EPA assesses the proposal and considers criteria relevant to the EPBC Act.

State Government agencies such as DEC and DoW are also able to provide advice during the planning process.

TABLE 12
ENVIRONMENTAL FACTORS, IMPACTS AND MANAGEMENT STRATEGIES

ENVIRONMENTAL FACTOR	EPA OBJECTIVE	POTENTIAL IMPACT	MANAGEMENT STRATEGIES AND FURTHER INVESTIGATIONS
Native Terrestrial Vegetation and Flora	<p>To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystems levels through the avoidance or management of adverse impacts and improvement in knowledge.</p> <p>Protect Declared Rare and Priority Flora consistent with the provisions of the Wildlife Conservation Act 1950.</p> <p>Protect other flora of conservation significance.</p>	<p>Potential clearing of native vegetation.</p> <p>Loss of biodiversity and fragmentation of ecological connectivity.</p> <p>Increased protection and management of vegetated areas retained.</p>	<p>Preparation and adoption of guidelines relating to landscaping and use of local native plant species.</p> <p>Preparation of a Management Plan for Parks and Recreation areas, including wetlands and watercourses. To be based on EPA Guidance Statement 33 'Preparing a Management Plan for a Natural Area' and include:</p> <ul style="list-style-type: none"> • Reasons for preparing the management plan and overall objectives; • A description of the plan area and context; • A summary of issues specific to the area; • Information about the preservation and enhancement of the area's ecological values; • The provision of adequate buffers around creeks; • Specific management aims and objectives and identify management responsibilities; • Management actions to achieve the objectives, e.g. restoration, flood control, fencing, weed control; • The preparation of a diagrammatic management plan; • An outline of funding arrangements; • A description of the attributes that will be monitored, the program, criteria and management response to triggers; • A program for restoration and preservation of native flora and fauna; and • Details relating to flood control, including rehabilitation and earthworks where necessary. • Incorporation of buffers around creeks; and • Water quality and other monitoring. <p>The plan should address access, weed management, reduction of dieback introduction and spread, fire management, interpretation, signage and infrastructure.</p> <p>Clearing of native vegetation will require a clearing permit under the Environmental Protection Act 1986 unless an exemption for clearing applies. Referral to DSEWPC may be required if there is likely to be a significant impact on Protected Matters of National Significance.</p>
Native Terrestrial Fauna	<p>To maintain the abundance, diversity, geographic distribution and productivity of native fauna at the species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.</p> <p>Protect specially protected (threatened) fauna and priority fauna, consistent with the provisions of the <i>Wildlife Conservation Act 1950</i>.</p> <p>Protect other fauna of conservation significance.</p>	<p>Future development and clearing of native vegetation in the YSPA may result in the loss of fauna habitat and the loss of sedentary species. There is the potential for more mobile species to move to retained areas of habitat, especially areas adjacent to Yakamia Creek.</p>	<p>The plan should address access, weed management, reduction of dieback introduction and spread, fire management, interpretation, signage and infrastructure.</p> <p>Clearing of native vegetation will require a clearing permit under the Environmental Protection Act 1986 unless an exemption for clearing applies. Referral to DSEWPC may be required if there is likely to be a significant impact on Protected Matters of National Significance.</p>
Groundwater, Wetlands and Waterways	<p>The EPA's position statement No.4 on the environmental protection of wetlands sets out the EPA's overarching goals for wetlands as follows:</p> <ul style="list-style-type: none"> • To protect the environmental values and functions of wetlands in WA; • To protect, sustain and, where possible, restore the biological diversity of wetland habitats in WA; • To protect the environmental quality of the wetland ecosystems of WA through sound management in accordance with the 	<p>Development of the YSPA area has the potential to directly and indirectly impact on wetlands, Yakamia Creek and its tributaries through activities which may include:</p> <ul style="list-style-type: none"> • Alteration to hydrological regime through inappropriate stormwater management; • Application of nutrients and use of chemicals in the catchment associated with current and future land uses; • Erosion and export of sediment through native vegetation clearing and construction activities; 	<p>A LWMS is currently being prepared for the YSPA.</p> <p>Urban Water Management Plans (UWMPs) will need to be prepared and implemented for areas within the YSPA at the subdivision stage to address stormwater management issues in line with the LWMS. The UWMPs will include information on:</p> <ul style="list-style-type: none"> • Stormwater frameworks and issues in national, State and regional contexts; • Updated drainage reports;

	<p>concept of 'wise use', as described in the Ramsar Convention, and ecologically sustainable development principles, regardless of land use or activity.</p> <p>To have as an aspirational goal, no net loss of wetland values and functions.</p> <p>To maintain the integrity, ecological functions and environmental values of waterways.</p>	<ul style="list-style-type: none"> • Introduction of weed and pest species; • Dumping of rubbish and increased fire frequency; • Increased human activity. <p>Development for residential purposes and associated infrastructure (e.g. roads) could also lead to increased management and protection of Yakamia Creek and its tributaries within any areas retained for conservation and recreation purposes. Additionally, management and ecological restoration of portions of the creek will provide an opportunity to improve the flood and nutrient attenuation functions of the area.</p>	<ul style="list-style-type: none"> • Site characteristics; • Catchment values to be protected; • Stormwater threats; • Management objectives; • Priority management issues; • Management actions (including drainage (structural and non-structural controls) and nutrient management) with specific reference to the implementation of water sensitive urban design principles; • Implementation; • Performance monitoring and review; and • Conclusions and recommendations. <p>The UWMP will:</p> <ul style="list-style-type: none"> • Incorporate best practice Water Sensitive Urban Design principles to maximise on-site water infiltration. • Ensure that changes to surface flow volumes are not significantly altered, and that peak surface flows are not increased; and • Specify ongoing maintenance requirements and ongoing management responsibility.
<p>Acid Sulfate Soils</p>	<p>To maintain the integrity, ecological functions and environmental values of the land (soils).</p> <p>To ensure that the quality of water emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.</p>	<p>If disturbed, ASS are prone to produce acidity and may consequently mobilise pollutants, including heavy metals into the environment. The release of these products can be detrimental to biota, human health and built infrastructure.</p>	<p>Further ASS investigations will be undertaken at subdivision stage when the location and nature of ground disturbing activities is known. If ASS is identified within the YSPA area that is proposed for development an ASS Management Plan will be prepared and implemented by the developer. The ASS Management Plan will identify construction requirements, rehabilitation, ongoing monitoring and compliance and propose contingency measures.</p>
<p>Water Management</p>	<p>To maintain the quantity of water (surface and ground) so that existing and potential environmental values, including ecosystem maintenance are protected.</p> <p>To ensure that the quality of water emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.</p> <p>Without proper management, urban development could cause the introduction of more nutrients to the groundwater as a result of the application of fertilisers to gardens and could also contribute hydrocarbons from road networks. Pesticides and pathogens may also impact groundwater as may irrigation and stormwater runoff.</p> <p>Disturbance during construction, particularly, dewatering may initiate ASS formation which may in turn acidify groundwater.</p> <p>Increasing urbanisation may lead to increased runoff which may cause erosion of the creek banks and bed. There is also the associated potential for runoff to carry pollutants.</p>	<p>Without proper management, urban development could cause the introduction of more nutrients to the groundwater as a result of the application of fertilisers to gardens and could also contribute hydrocarbons from road networks. Irrigation and stormwater runoff, pathogens and application of pesticides may also impact groundwater.</p> <p>Disturbance during construction, particularly, dewatering may initiate ASS formation which may in turn acidify groundwater.</p> <p>Increasing urbanisation may lead to increased runoff which may cause erosion of the creek banks and bed. There is also the associated potential for runoff to carry pollutants.</p> <p>Clearing of native vegetation in the YSPA for development could result in alterations to the hydrological regime, including potential increased runoff and decreased infiltration on site.</p> <p>Uncontrolled stormwater movement may also contribute to erosion of both the banks of Yakamia Creek and the sloping areas of the site.</p>	<p>Water sensitive urban design principles and Sustainable Urban Drainage Systems will be applied to the development in the YSPA area.</p> <p>Apart from the proposed alignment of Range Road, a POS and Foreshore Reserve will buffer Yakamia Creek.</p> <p>The development will be serviced by reticulated sewer. Wastewater will be treated at the Timewell Road wastewater treatment plan and discharged to the Water Corporation tree farm on Albany Highway for further treatment.</p>

	<p>Clearing of native vegetation for development could result in alterations to the hydrological regime, including potential increased runoff and decreased infiltration on site.</p> <p>Uncontrolled stormwater movement may also contribute to erosion of both the banks of Yakamia Creek and the sloping areas of the site.</p>		
<p>Aboriginal and European Culture and Heritage (biophysical environment)</p>	<p>To ensure that changes to the biophysical environment resulting from the proposal do not affect historical and cultural associations within the area and comply with the requirements of relevant heritage legislation.</p>	<p>Ground-disturbing activities associated with development may unearth previously unknown archaeological sites in the area.</p> <p>Clearing of native vegetation will remove resources that may previously have provided bush tucker and other resources.</p> <p>Earth moving and installation of infrastructure may impinge on the 50m buffer requested for the Yakamia Creek ethnographic site.</p>	<p>Yakamia Creek and a significant buffer will be retained as Parks and Recreation / Foreshore Reserve and rehabilitated to enhance conservation and passive recreation objectives.</p> <p>Development of infrastructure in areas associated with Yakamia Creek will require a Section 18 approval under the <i>Aboriginal Heritage Act 1972</i>.</p> <p>Developers will be required to prepare an Aboriginal Heritage Protocol prior to undertaking any earthworks of the subject land. The Protocol will be prepared to ensure:</p> <ul style="list-style-type: none"> • The requirements of the Aboriginal Heritage Act 1972 are met so that the development does not affect cultural heritage and associations with the area; • Commitments made during consultation with Aboriginal groups are maintained during all stages of planning; • Appropriate recommendations are incorporated into development and subdivision plans which seek to maintain the cultural values of Yakamia creek; and • Prior to the commencement of site works, contractors shall undergo a briefing on Aboriginal Heritage issues to enable them to recognise material that may constitute an Aboriginal site. During earthworks, all contractors shall be supervised by the Site Manager, who will seek advice from the Department of Indigenous Affairs to confirm the identification of any suspected site. • Consideration of Aboriginal Heritage issues will also be undertaken in the preparation of a POS and Foreshore Management Plan (POS/FMP).

4 REFERENCES

Alan Tingay and Associates (1996) Botanical Assessment for Ardross Estates. Lots 79 and 80 Bond Road, Yakamia

Allerding Burgess (2004) Yakamia (Draft) Structure Plan – Cells A and B. Chesterpass Road, Yakamia. Prepared for the City of Albany by Allerding Burgess, Bowman Bishaw Gorham and Connell Wagner.

ATA Environmental (2000) Yakamia Environmental Assessment. Cell B. Prepared for the City of Albany. Report 2000/029.

ATA Environmental (2002) Albany Greenways. Prepared for the City of Albany.

Australasian Reptile & Amphibian Specialist Group (1996) *Elapognathus minor*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

Beard J.S. (1979) The Vegetation of the Albany and Mt Barker Areas, Western Australia. Map and Explanatory Memoir, 1:250,000. Vegetation Survey of Western Australia.

BirdLife International (2012a) *Falco peregrinus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

BirdLife International (2012b) *Tyto novaehollandiae*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

BirdLife International (2012c) *Merops ornatus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

BirdLife International (2012d) *Haliaeetus leucogaster*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

BirdLife International (2012e) *Bubulcus ibis*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

Brad Goode and Associates (2007) Aboriginal Heritage Survey for Yakamia Structure Plan Area.

Churchward, H.M. McArthur, W.M. Sewell P.L. and Bartle, G.A. (1988) Landforms and Soils of the South Coast and Hinterland, Northcliffe to Manypeaks, Western Australia. CSIRO Division of Groundwater Research.
City of Albany (2009) Albany Local Planning Strategy. Final.

City of Albany (2009) Albany Local Planning Strategy. November 2009. Albany, Western Australia.

Coffey Environments (2008a) Albany Regional Vegetation Assessment – Phase One. Prepared for CAMABB Pty Ltd, City of Albany, Heath Development Company and LandCorp Report 2007/145 V1, March 2008.

Coffey Environments (2008b) Terrestrial Fauna Assessment, Yakamia Structure Plan Area, Albany. Report to City of Albany.

Coffey Environments (2008c) Yakamia Structure Plan Wetlands and Waterways Assessment. Report to the City of Albany. Report 2007/221 V1, March 2008.

DAFWA, Department of Agriculture and Food Western Australia (2012) Soil Landscape Subsystems. Sourced from WA Atlas, Landgate.

DAFWA, Department of Agriculture and Food Western Australia (2005) Pre-European Vegetation – Western Australia (NVIS Compliant Version). Perth, Western Australia.

DEC, Department of Environment and Conservation (2009) Identification and investigation of Acid Sulfate Soils and Groundwater. Acid Sulfate Soil Guideline Series. Land and Water Quality Branch. Perth, Western Australia.

DEC, Department of Environment and Conservation (2012) Contaminated Sites Database. Sourced on-line 27 November 2012. <https://secure.dec.wa.gov.au/idelve/css/>

Department of Planning and Urban Development (1994a) Albany Regional Strategy. State Planning Commission.

Department of Planning and Urban Development (1994b) Residential Expansion Strategy for Albany. State Planning Commission.

DoW, Department of Water (2007) The South Coast Wetland Mapping Classification and Evaluation Project, Mapping and Assessing the Values of Albany's Wetlands. A report prepared for SCRIPT for funding received through the Australian and State Government support of the Natural Heritage Trust and National Action Plan for Salinity and Water Quality. Department of Water, January 2007.

de Tores, P., Burbidge, A., Morris, K. & Friend, T. (2008) *Setonix brachyurus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

DSEWPC, Department of Sustainability, Environment, Water, Populations and Communities (Date Not Provided) Action Plan for Reptiles – Family Elapidae. Species Recovery Outline: Short-nosed Snake (*Elapognathus minor*).

DSEWPC, Department of Sustainability, Environment, Water, Population and Communities (2012a) *Calyptorhynchus banksii naso* in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: <http://www.environment.gov.au/sprat>. Accessed Wed, 19 Dec 2012 18:42:02 +1100.

DSEWPC, Department of Sustainability, Environment, Water, Population and Communities (2012c) *Calyptorhynchus baudinii* in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra. Available from: <http://www.environment.gov.au/sprat>. Accessed Wed, 19 Dec 2012 18:42:50 +1100.

DSEWPC, Department of Sustainability, Environment, Water, Population and Communities (2012b) *Calyptorhynchus latirostris* in Species Profile and Threats Database, Department of

Sustainability, Environment, Water, Population and Communities, Canberra. Available from: <http://www.environment.gov.au/sprat>. Accessed Wed, 19 Dec 2012 18:43:23 +1100.

ENV Australia (2006) Flora and Vegetation Survey for the Yakamia Structure Plan. Report to Connell Wagner.

EPA, Environmental Protection Authority (2000) Position Statement 2 – Environmental Protection of Native Vegetation in Western Australia. Clearing of Native Vegetation with Particular Reference to the Agricultural Area. Environmental Protection Authority, Perth.

EPA, Environmental Protection Authority (2008) Guidance Statement No. 33: Environmental Guidance for Planning and Development.

EPA, Environmental Protection Authority (2011) Environmental Protection Bulletin No. 13. Guidance for the use of the Albany Regional Vegetation Survey in Environmental Impact Assessment. Perth, Western Australia.

Government of Western Australia (2007a) Stormwater Management Manual for Western Australia. Department of Water. Section 4.3 Living Streams.

Government of Western Australia (2007b) Draft Lower Great Southern Strategy Background Paper: Water Resources. Department of Environment.

Government of Western Australia (2011) 2011 Statewide Vegetation Statistics incorporating the CAR Reserve Analysis (Simplified). Department of Environment and Conservation, Perth, Western Australia.

Gozzard J.R. (1989) Geological Survey of Western Australia Environmental Geology Series [1 : 100 000] : Part Sheets 2427, 2428 II, 2527 II & 2528 III. Geological Survey of Western Australia, Perth, WA.

Heddle E.M., Loneragan, O.W., and Havel, J.J. (1980) Vegetation Complexes of the Darling System. In DCE 1980 Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Perth, Western Australia.

Keighery, B.J. (1994) Bushland Plant Survey. A Guide to Plant Community Survey for the Community. Wildflower Society of WA (Inc.), Nedlands, Western Australia.

Landgate (2012) Acid Sulfate Soil Mapping – Albany and Torbay. Sourced from WA Atlas.

Menkhorst, P., Rhind, S. & Ellis, M. (2008) *Phascogale tapoatafa*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

Morris, K., Friend, T. & Burbidge, A. (2008) *Macropus irma*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

Sandiford E.M. (2005) Vegetation and Flora Survey – Lot 4743 North Road, Yakamia. Prepared for the City of Albany.

Sandiford, E.M. and Barrett, S. (2010) Albany Regional Vegetation Survey, Extent, Type and Status. Unpublished Report. Department of Environment and Conservation, Western Australia.

SCRIPT, South Coast Regional Initiative Planning Team (2004) Southern Prospects 2004 – 2009: South Coast Regional Strategy for Natural Resource Management. Background Paper 4: Water Resources in the South Coast Region. Department of Environment.

Shepherd, D.P., Beeston, G.R. and Hopkins, A.J.M. (2002) Native Vegetation in Western Australia: Extent, Types and Status. Department of Agriculture, Western Australia.

Shine R.A. & Allison, A. (2010) *Morelia spilota*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **08 February 2013**.

Taylor and Burrell (1999) Yakamia District Structure Plan. Prepared for the City of Albany by Taylor and Burrell, Environmental Capability and Wood and Grieve Engineers.

Thackway, R. and Lesslie, R. (2006) Reporting vegetation condition using the Vegetation Assets, States and Transitions (VAST) framework. Ecological Management & Restoration. 7, Suppl. 1. S53-S62.

WAPC, Western Australian Planning Commission (2008a) Better Urban Water Management. Perth, Western Australia.

WAPC, Western Australian Planning Commission (2008b) Acid Sulfate Soils. Planning Guidelines. Perth, Western Australia.

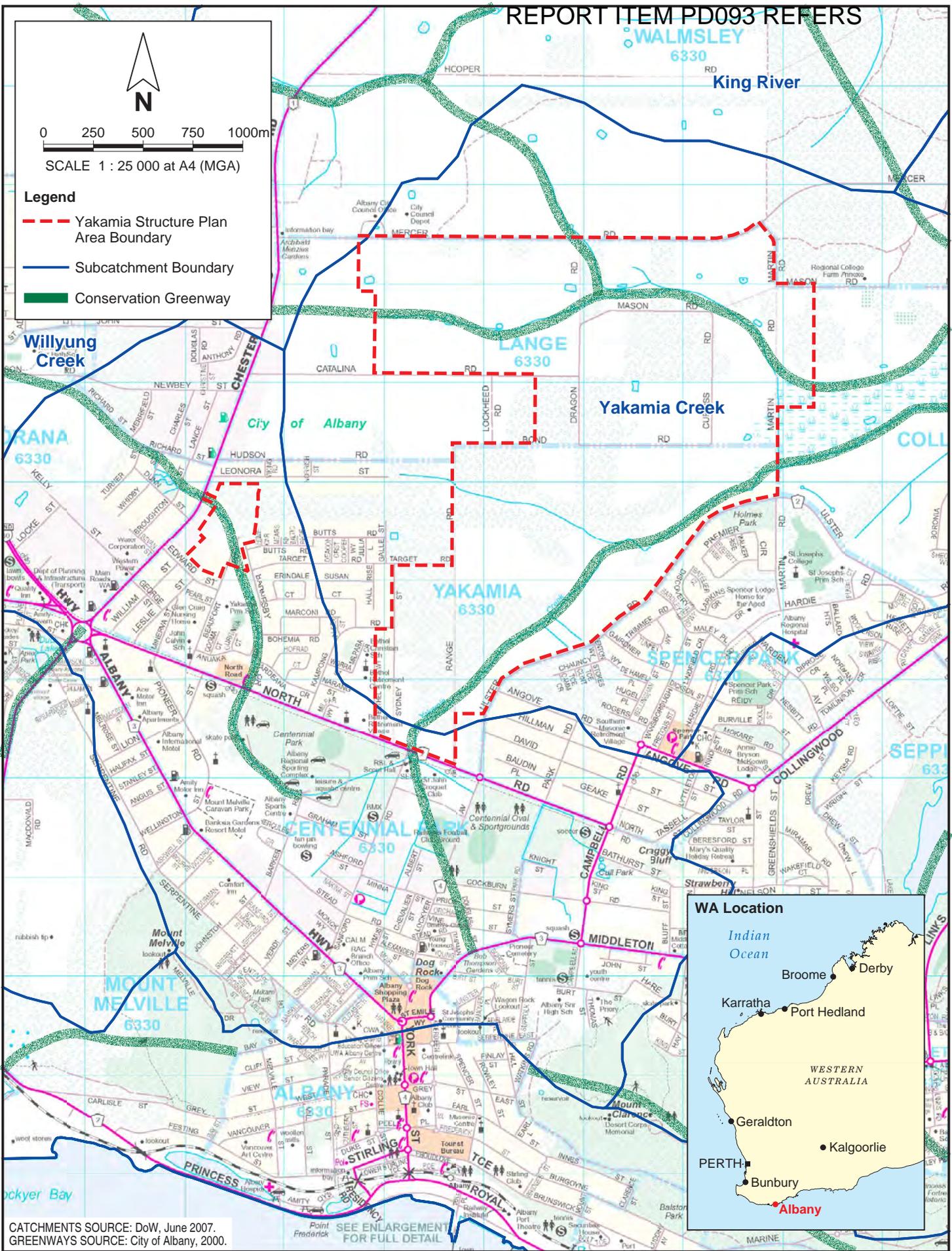
WAPC, Western Australian Planning Commission (2009) Liveable Neighbourhoods. Update 2. Perth, Western Australia.

Water and Rivers Commission (2001) Position Statement: Wetlands. Perth, Western Australia.

Wilkins P., Gilfillan, S., Watson J. and Sanders, A. (2006) The Western Australian South Coast Macro Corridor Network – A bioregional strategy for conservation. Department of Environment and Conservation and South Coast Natural Resource Management.

FIGURES

REPORT ITEM PD093 REFERS



CAL2012-001-001_mpf-01.dgn
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CATCHMENTS SOURCE: DoW, June 2007.
GREENWAYS SOURCE: City of Albany, 2000.

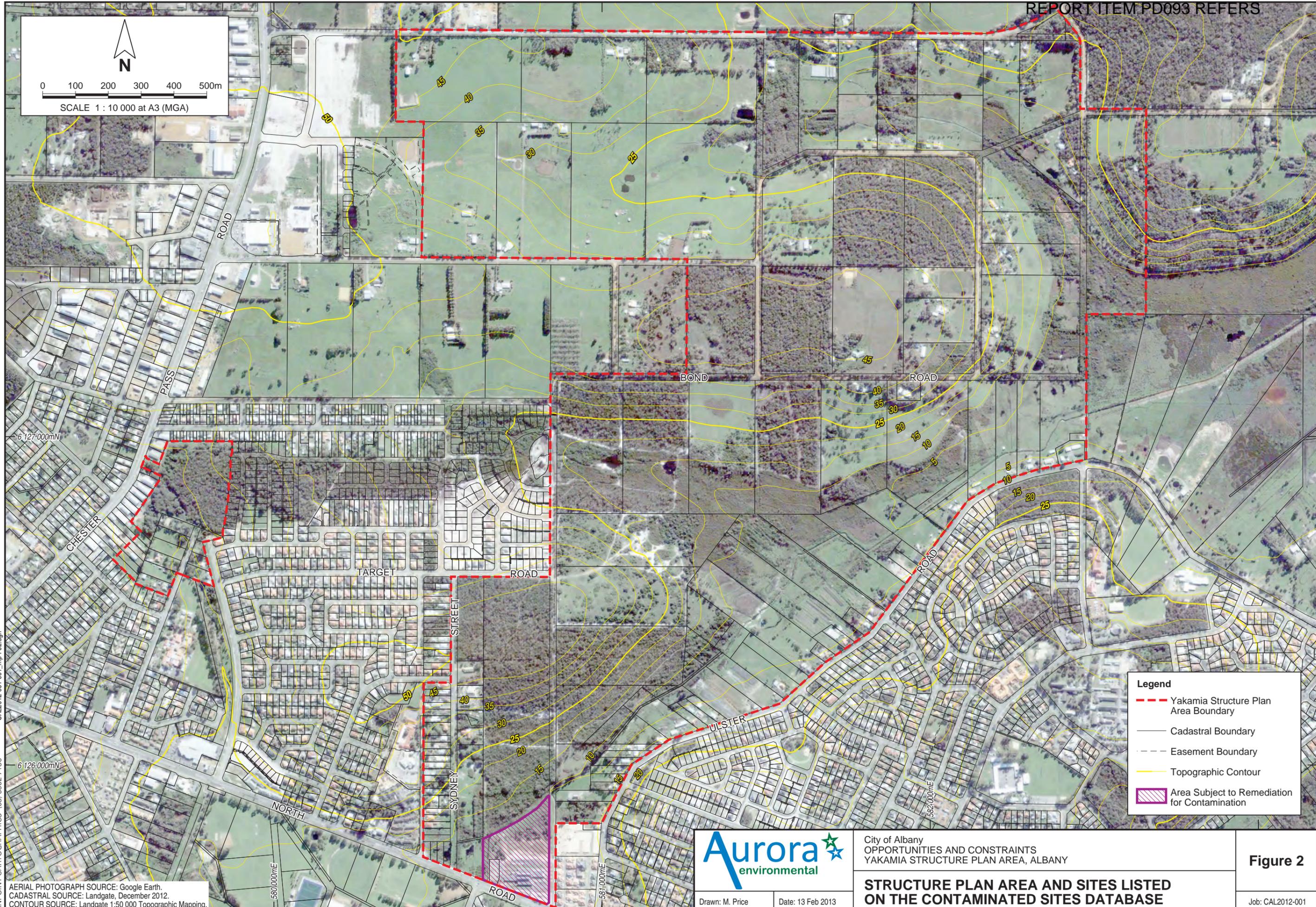
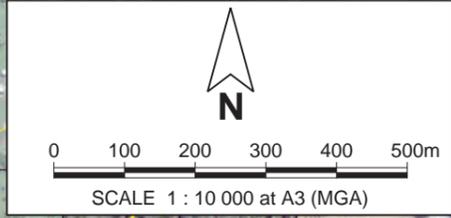


Drawn: M. Price
Date: 13 Feb 2013

City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

REGIONAL LOCATION

Figure 1
Job: CAL2012-001



Legend

- - - Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- - - Easement Boundary
- Topographic Contour
- Area Subject to Remediation for Contamination

CAL2012-001-001_mp_F02.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
CADASTRAL SOURCE: Landgate, December 2012.
CONTOUR SOURCE: Landgate 1:50 000 Topographic Mapping.

Aurora
environmental

Drawn: M. Price Date: 13 Feb 2013

City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

**STRUCTURE PLAN AREA AND SITES LISTED
ON THE CONTAMINATED SITES DATABASE**

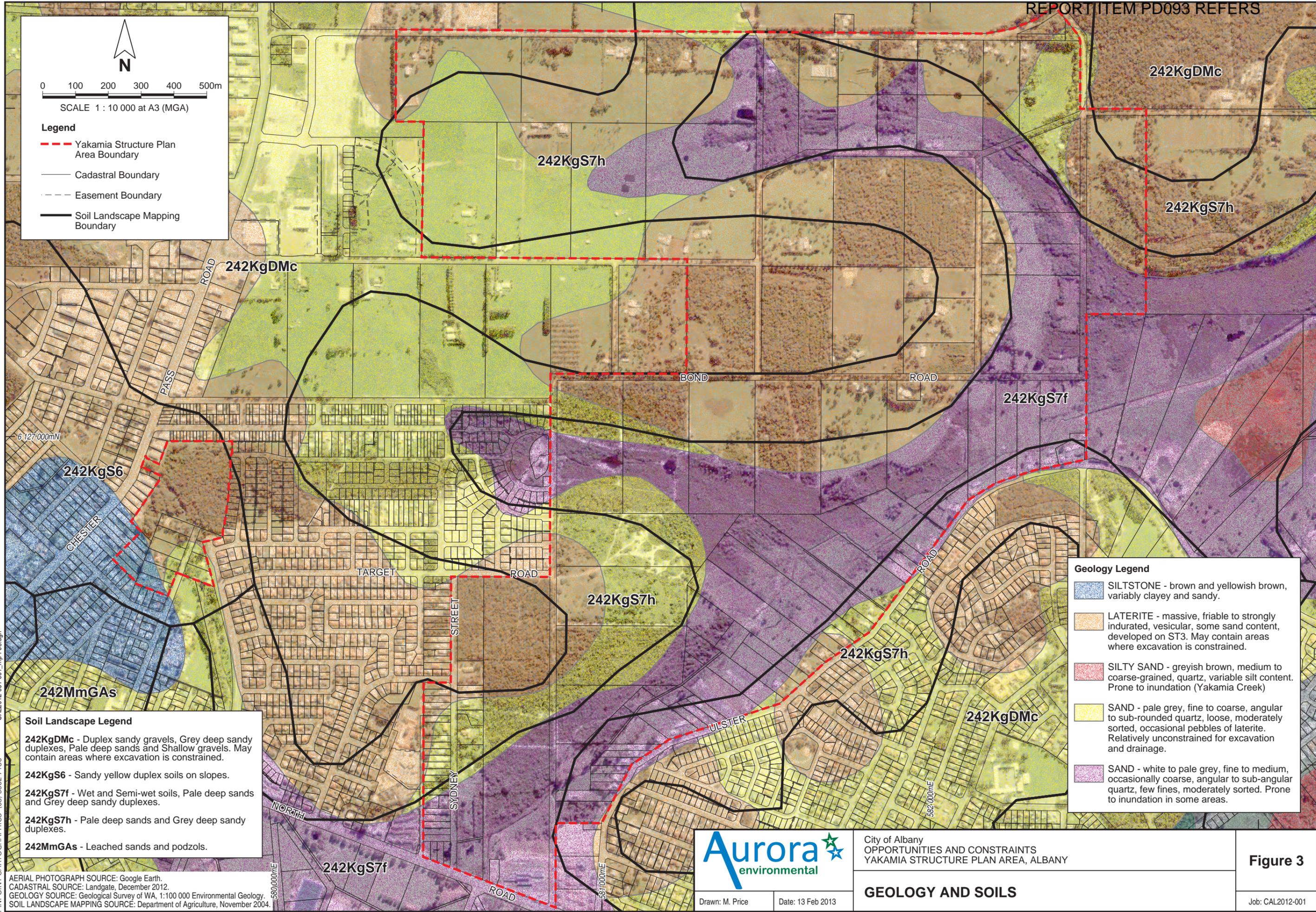
Figure 2

Job: CAL2012-001

0 100 200 300 400 500m
SCALE 1 : 10 000 at A3 (MGA)

Legend

- Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- - - Easement Boundary
- Soil Landscape Mapping Boundary



Geology Legend

- SILTSTONE - brown and yellowish brown, variably clayey and sandy.
- LATERITE - massive, friable to strongly indurated, vesicular, some sand content, developed on ST3. May contain areas where excavation is constrained.
- SILTY SAND - greyish brown, medium to coarse-grained, quartz, variable silt content. Prone to inundation (Yakamia Creek)
- SAND - pale grey, fine to coarse, angular to sub-rounded quartz, loose, moderately sorted, occasional pebbles of laterite. Relatively unconstrained for excavation and drainage.
- SAND - white to pale grey, fine to medium, occasionally coarse, angular to sub-angular quartz, few fines, moderately sorted. Prone to inundation in some areas.

Soil Landscape Legend

- 242KgDMc** - Duplex sandy gravels, Grey deep sandy duplexes, Pale deep sands and Shallow gravels. May contain areas where excavation is constrained.
- 242KgS6** - Sandy yellow duplex soils on slopes.
- 242KgS7f** - Wet and Semi-wet soils, Pale deep sands and Grey deep sandy duplexes.
- 242KgS7h** - Pale deep sands and Grey deep sandy duplexes.
- 242MmGAs** - Leached sands and podzols.

CAL2012-001-001_mp-F03.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
CADASTRAL SOURCE: Landgate, December 2012.
GEOLOGY SOURCE: Geological Survey of WA, 1:100 000 Environmental Geology.
SOIL LANDSCAPE MAPPING SOURCE: Department of Agriculture, November 2004.

City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

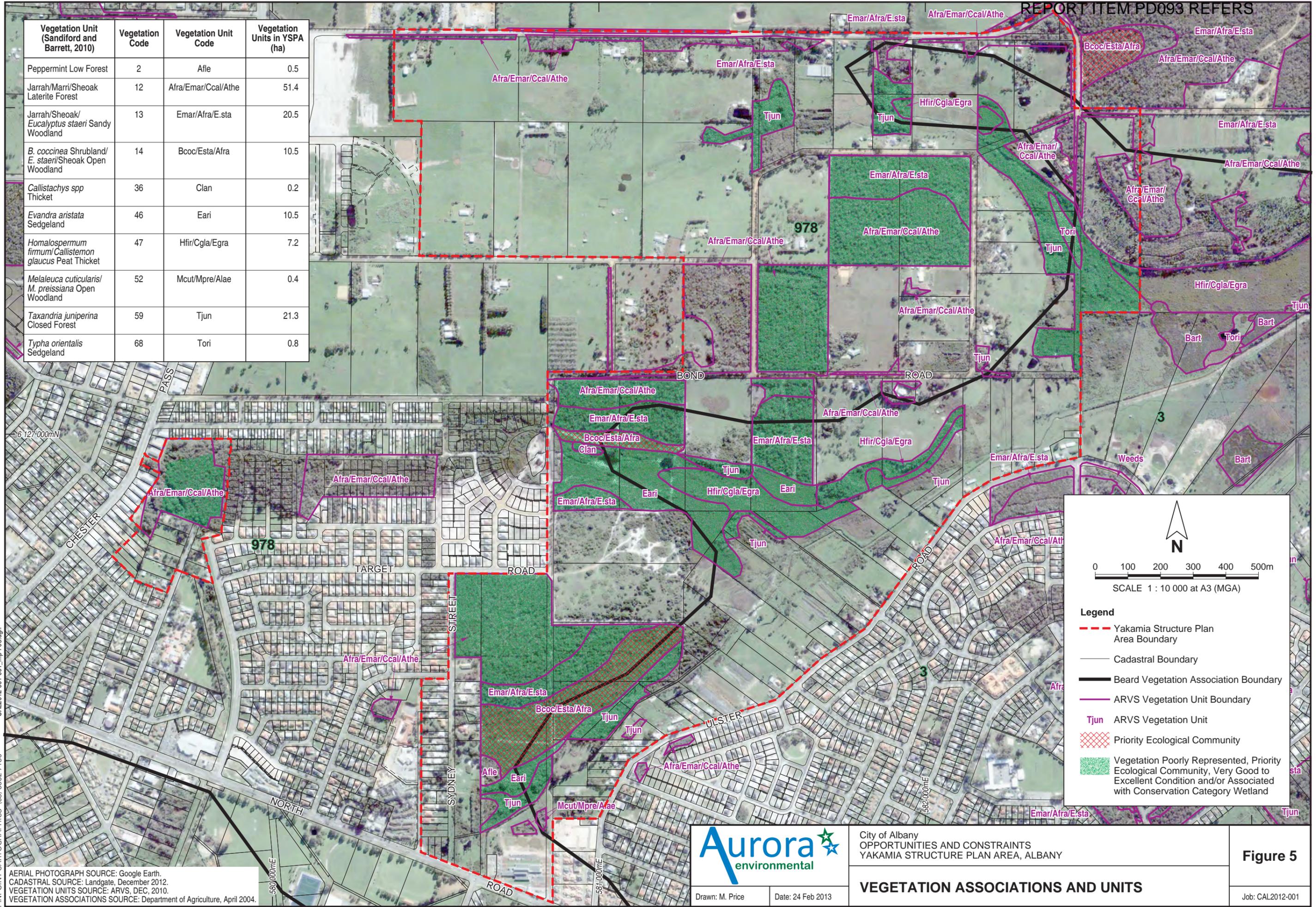
Drawn: M. Price Date: 13 Feb 2013

GEOLOGY AND SOILS

Job: CAL2012-001

Figure 3

Vegetation Unit (Sandiford and Barrett, 2010)	Vegetation Code	Vegetation Unit Code	Vegetation Units in YSPA (ha)
Peppermint Low Forest	2	Afle	0.5
Jarrah/Marri/Sheoak Laterite Forest	12	Afra/Emar/Ccal/Athe	51.4
Jarrah/Sheoak/ <i>Eucalyptus staeri</i> Sandy Woodland	13	Emar/Afra/E.sta	20.5
<i>B. coccinea</i> Shrubland/ <i>E. staeri</i> /Sheoak Open Woodland	14	Bcoc/Esta/Afra	10.5
<i>Callistachys</i> spp Thicket	36	Clan	0.2
<i>Evandra aristata</i> Sedgeland	46	Eari	10.5
<i>Homalospermum firmum</i> / <i>Callistemon glaucus</i> Peat Thicket	47	Hfir/Cgla/Egra	7.2
<i>Melaleuca cuticularis</i> / <i>M. preissiana</i> Open Woodland	52	Mcut/Mpre/Alae	0.4
<i>Taxandria juniperina</i> Closed Forest	59	Tjun	21.3
<i>Typha orientalis</i> Sedgeland	68	Tori	0.8



0 100 200 300 400 500m
SCALE 1 : 10 000 at A3 (MGA)

Legend

- Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Beard Vegetation Association Boundary
- ARVS Vegetation Unit Boundary
- Tjun ARVS Vegetation Unit
- Priority Ecological Community
- Vegetation Poorly Represented, Priority Ecological Community, Very Good to Excellent Condition and/or Associated with Conservation Category Wetland

CAL2012-001-001_mp-F05.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
CADASTRAL SOURCE: Landgate, December 2012.
VEGETATION UNITS SOURCE: ARVS, DEC, 2010.
VEGETATION ASSOCIATIONS SOURCE: Department of Agriculture, April 2004.

Aurora
environmental

City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

Drawn: M. Price Date: 24 Feb 2013

VEGETATION ASSOCIATIONS AND UNITS

Figure 5

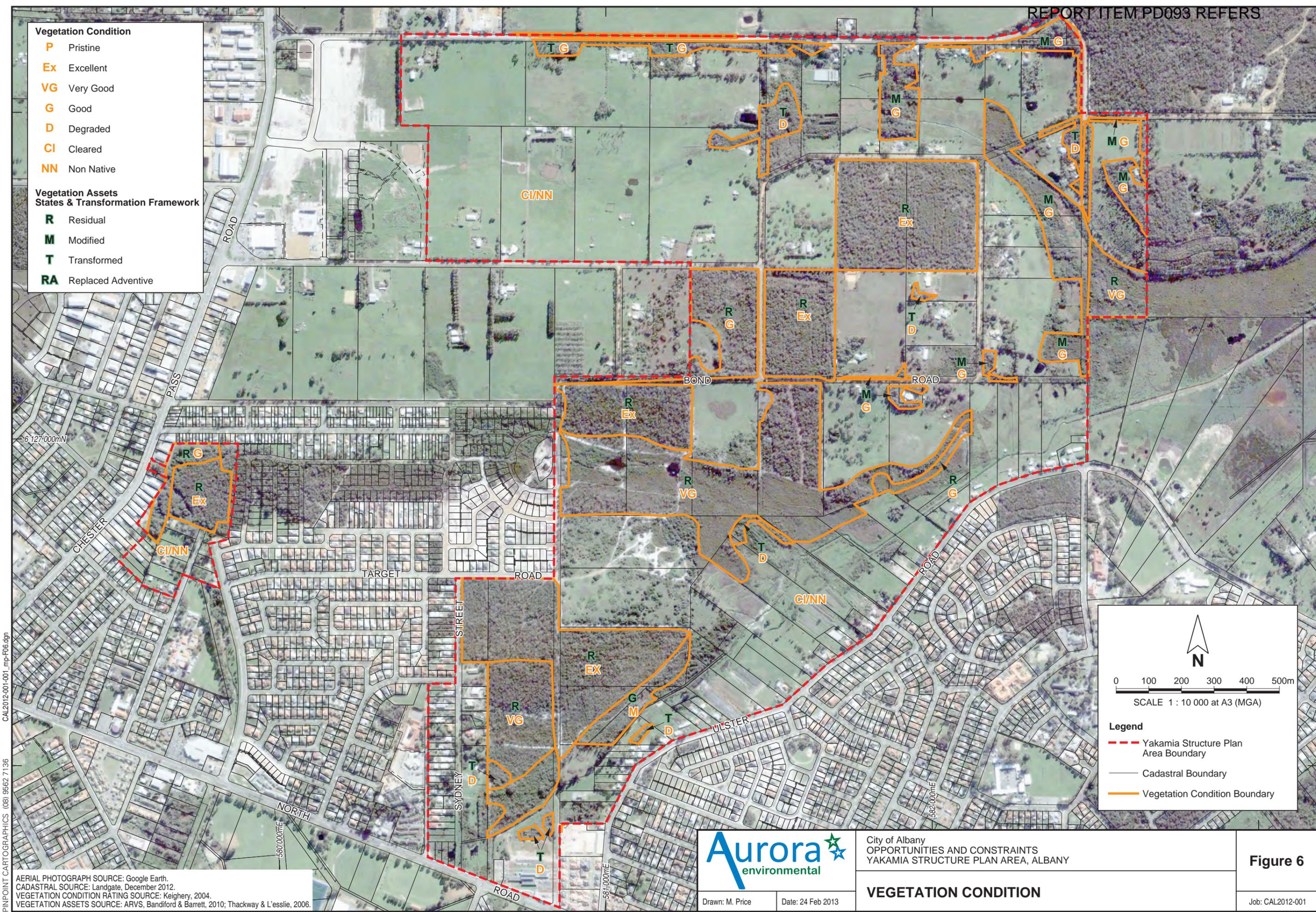
Job: CAL2012-001

Vegetation Condition

- P** Pristine
- Ex** Excellent
- VG** Very Good
- G** Good
- D** Degraded
- Cl** Cleared
- NN** Non Native

Vegetation Assets States & Transformation Framework

- R** Residual
- M** Modified
- T** Transformed
- RA** Replaced Adventive



N

0 100 200 300 400 500m

SCALE 1 : 10 000 at A3 (MGA)

Legend

- - - Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Vegetation Condition Boundary

CAL2012-001-001_mp_F06.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
 CADASTRAL SOURCE: Landgate, December 2012.
 VEGETATION CONDITION RATING SOURCE: Keighery, 2004.
 VEGETATION ASSETS SOURCE: ARVS, Bandiford & Barrett, 2010; Thackway & L'esslie, 2006.

Aurora
 environmental

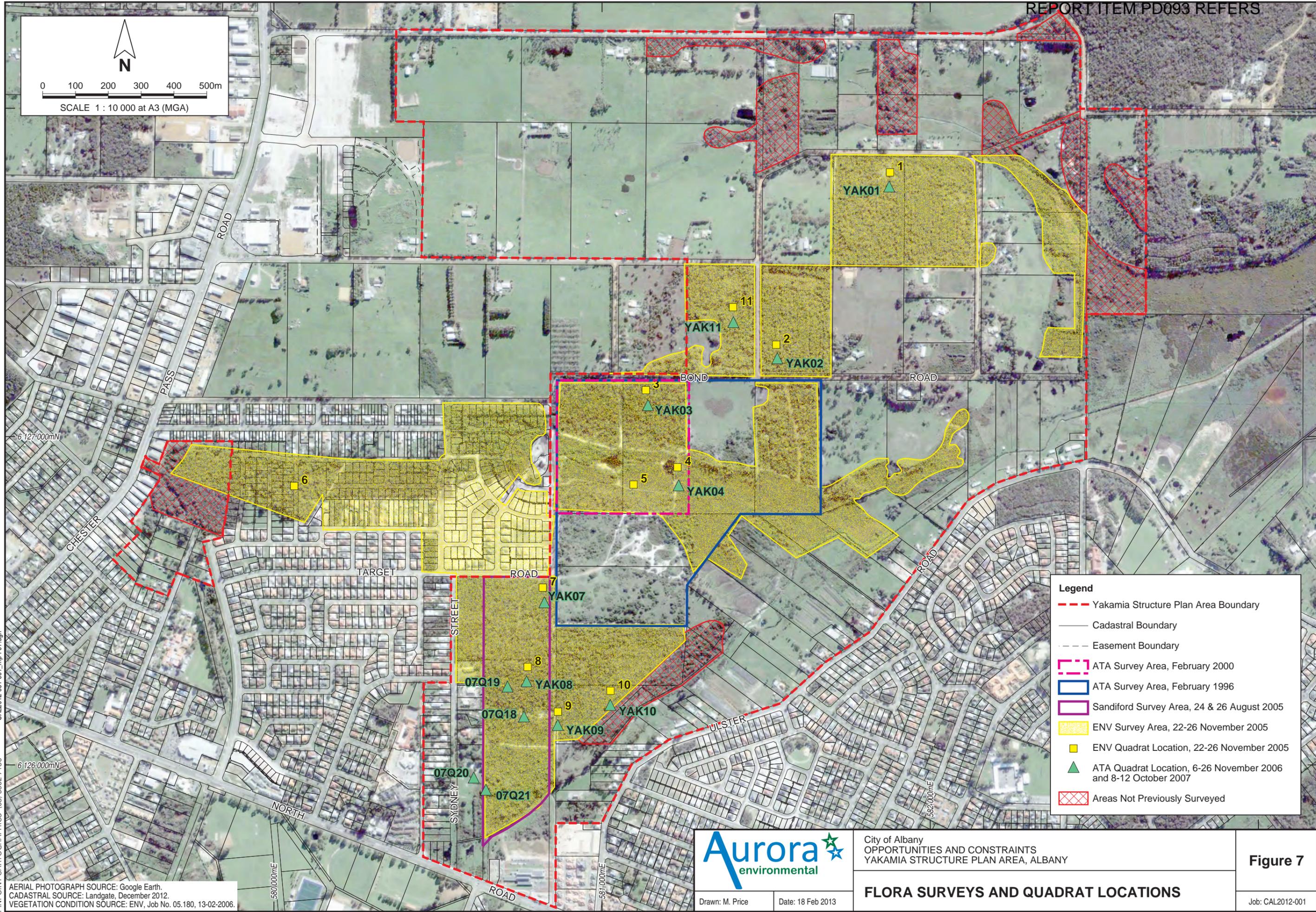
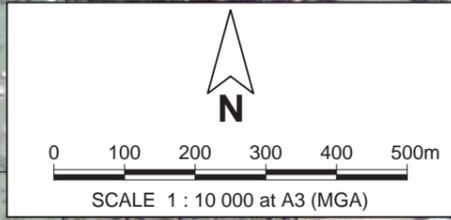
Drawn: M. Price Date: 24 Feb 2013

City of Albany
 OPPORTUNITIES AND CONSTRAINTS
 YAKAMIA STRUCTURE PLAN AREA, ALBANY

VEGETATION CONDITION

Figure 6

Job: CAL2012-001



Legend

- Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Easement Boundary
- ATA Survey Area, February 2000
- ATA Survey Area, February 1996
- Sandiford Survey Area, 24 & 26 August 2005
- ENV Survey Area, 22-26 November 2005
- ENV Quadrat Location, 22-26 November 2005
- ATA Quadrat Location, 6-26 November 2006 and 8-12 October 2007
- Areas Not Previously Surveyed

CAL2012-001-001_mp_F07.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
CADASTRAL SOURCE: Landgate, December 2012.
VEGETATION CONDITION SOURCE: ENV, Job No. 05.180, 13-02-2006.

Aurora
environmental

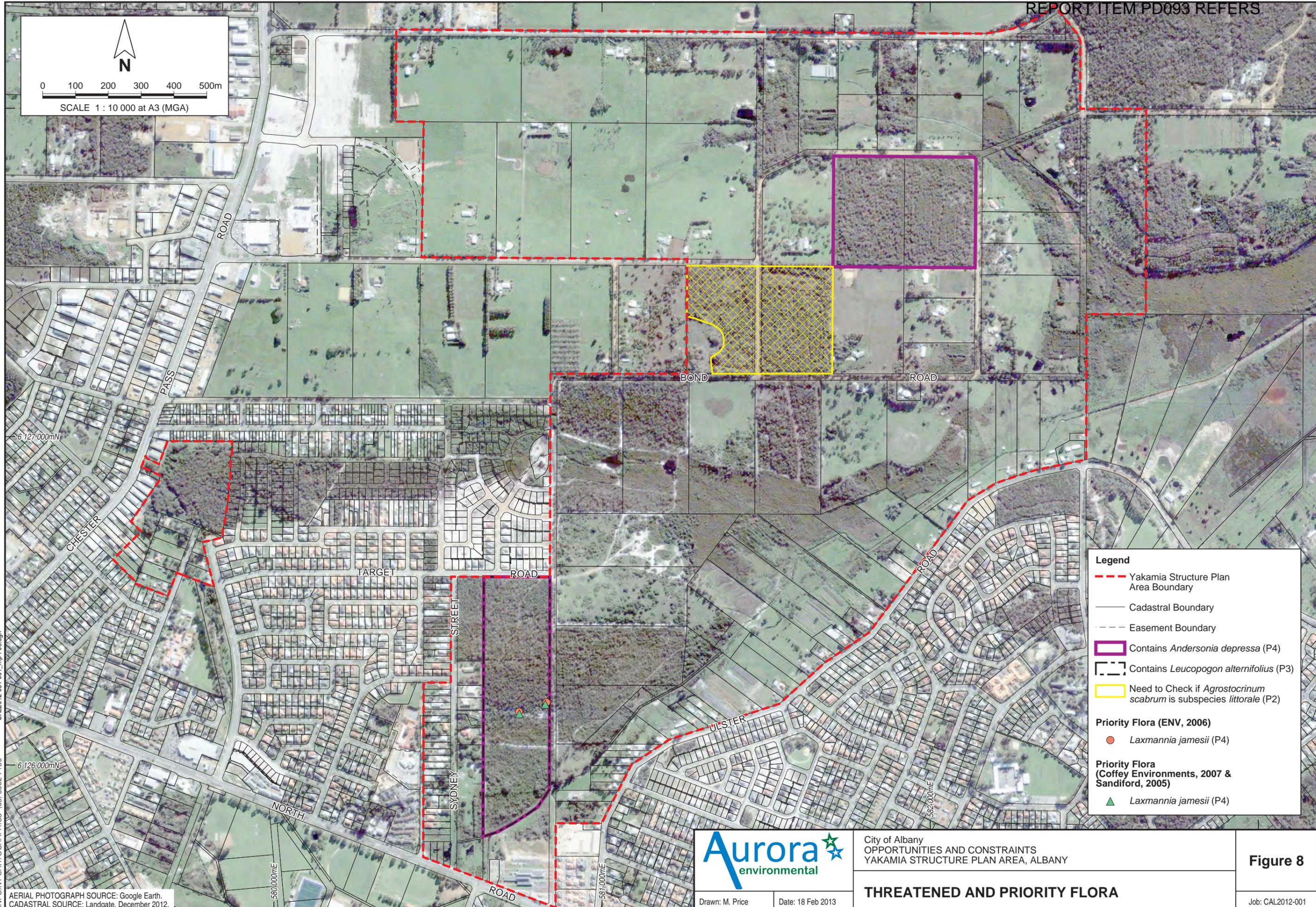
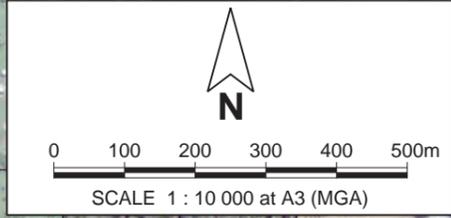
Drawn: M. Price Date: 18 Feb 2013

City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

FLORA SURVEYS AND QUADRAT LOCATIONS

Figure 7

Job: CAL2012-001



Legend

- - - Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Easement Boundary
- Contains *Andersonia depressa* (P4)
- Contains *Leucopogon alternifolius* (P3)
- Need to Check if *Agrostocrinum scabrum* is subspecies *littorale* (P2)

Priority Flora (ENV, 2006)

- *Laxmannia jamesii* (P4)

Priority Flora (Coffey Environments, 2007 & Sandiford, 2005)

- ▲ *Laxmannia jamesii* (P4)

CAL2012-001-001_mp_F08.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
CADASTRAL SOURCE: Landgate, December 2012.



City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

Drawn: M. Price

Date: 18 Feb 2013

THREATENED AND PRIORITY FLORA

Figure 8

Job: CAL2012-001

FAUNA HABITAT TYPES

(adapted from Coffey Environments, 2008)

JSW Jarrah (*Eucalyptus marginata*) and Sheoak (*Allocasuarina fraseriana*) woodland over shrubland of species such as *A. theiformis*, *Astartea fascicularis*, *A. humilis*, *M. thymoides* and *Xanthorrhoea brunonis* over a mixed sedgeland.

JABW Jarrah (*Eucalyptus marginata*), Albany Blackbutt (*Eucalyptus staeri*) and Sheoak (*Allocasuarina fraseriana*) woodland over shrubland of species such as *A. theiformis*, *Astartea fascicularis*, *A. humilis*, *M. thymoides* and *Xanthorrhoea brunonis* over a mixed sedgeland.

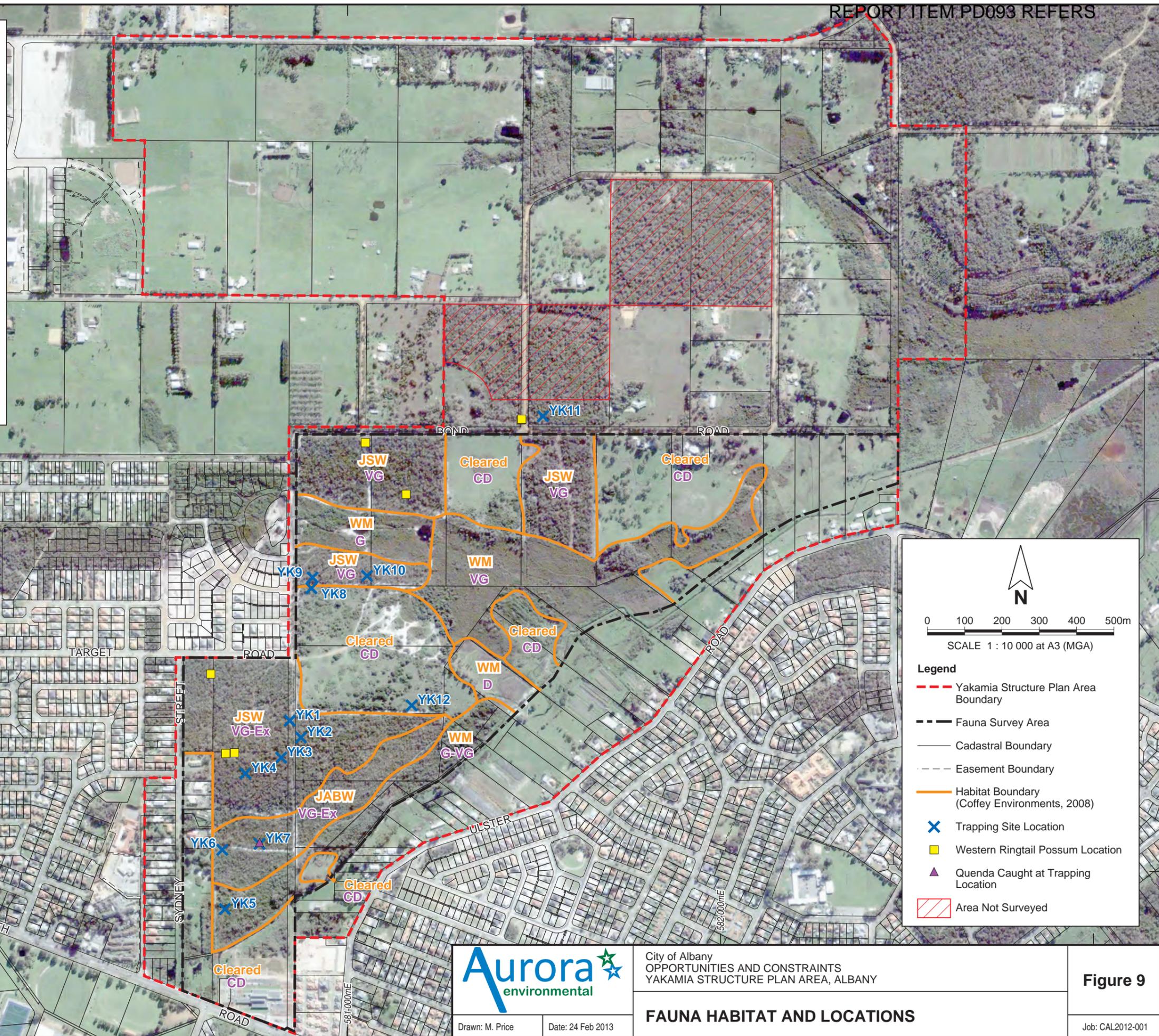
WM Wetland Mosaic of Peppermint (*Agonis flexuosa*) and *Callistachys lanceolata* woodland over *Pteridium esculentum*, *Homalospermum firmum* thicket and sedgeland.

VEGETATION CONDITION

(Legend Source: Keighery, 2004)

- P** Pristine
- Ex** Excellent
- VG** Very Good
- G** Good
- D** Degraded
- CD** Completely Degraded

NOTE: For full description see Section 3.3 of text.



0 100 200 300 400 500m
SCALE 1 : 10 000 at A3 (MGA)

Legend

- Yakamia Structure Plan Area Boundary
- Fauna Survey Area
- Cadastral Boundary
- Easement Boundary
- Habitat Boundary (Coffey Environments, 2008)
- X Trapping Site Location
- Western Ringtail Possum Location
- ▲ Quenda Caught at Trapping Location
- Area Not Surveyed

CAL2012-001-001_mp_F09.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
CADASTRAL SOURCE: Landgate, December 2012.

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environmental

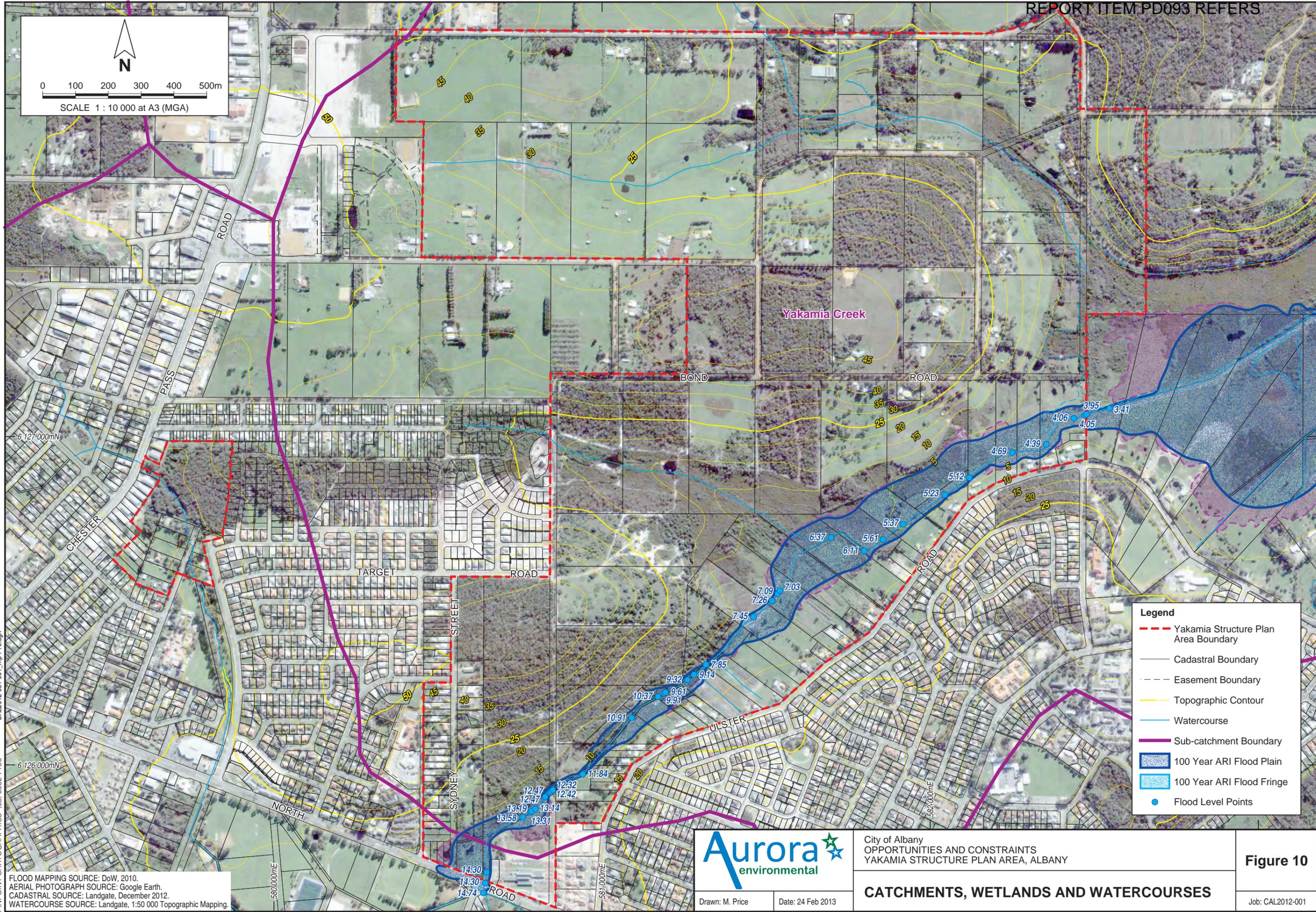
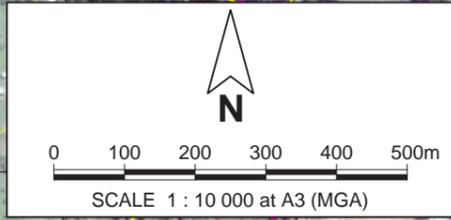
Drawn: M. Price Date: 24 Feb 2013

City of Albany
OPPORTUNITIES AND CONSTRAINTS
YAKAMIA STRUCTURE PLAN AREA, ALBANY

FAUNA HABITAT AND LOCATIONS

Figure 9

Job: CAL2012-001



Legend

- - - Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Easement Boundary
- Topographic Contour
- Watercourse
- Sub-catchment Boundary
- 100 Year ARI Flood Plain
- 100 Year ARI Flood Fringe
- Flood Level Points

CAL2012-001-001_mp-F10.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

FLOOD MAPPING SOURCE: DoW, 2010.
 AERIAL PHOTOGRAPH SOURCE: Google Earth.
 CADASTRAL SOURCE: Landgate, December 2012.
 WATERCOURSE SOURCE: Landgate, 1:50 000 Topographic Mapping.

Aurora
 environmental

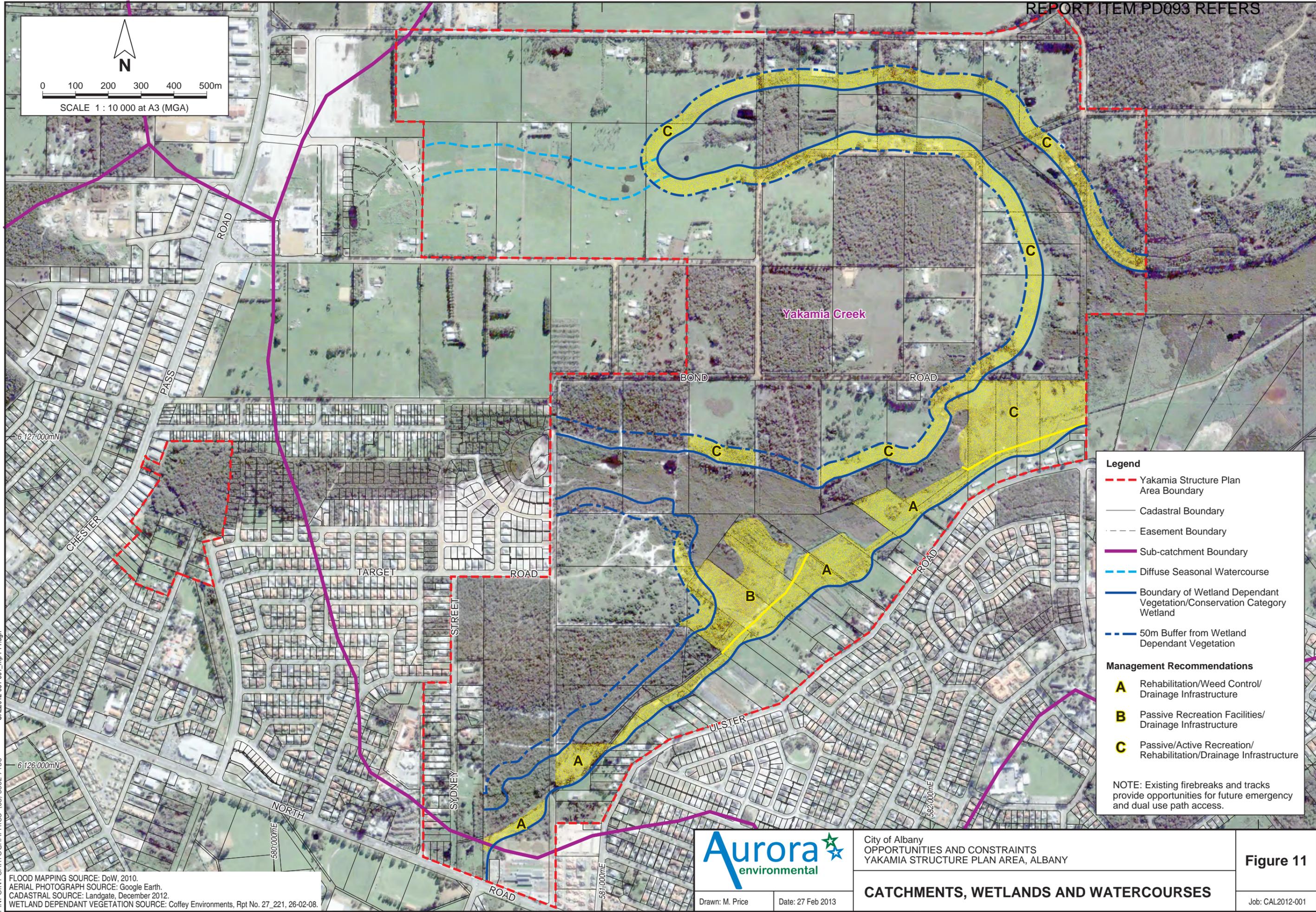
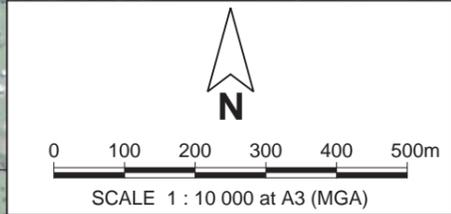
Drawn: M. Price Date: 24 Feb 2013

City of Albany
 OPPORTUNITIES AND CONSTRAINTS
 YAKAMIA STRUCTURE PLAN AREA, ALBANY

CATCHMENTS, WETLANDS AND WATERCOURSES

Figure 10

Job: CAL2012-001



Legend

- - - Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Easement Boundary
- Sub-catchment Boundary
- Diffuse Seasonal Watercourse
- Boundary of Wetland Dependant Vegetation/Conservation Category Wetland
- - - 50m Buffer from Wetland Dependant Vegetation

Management Recommendations

- A** Rehabilitation/Weed Control/ Drainage Infrastructure
- B** Passive Recreation Facilities/ Drainage Infrastructure
- C** Passive/Active Recreation/ Rehabilitation/Drainage Infrastructure

NOTE: Existing firebreaks and tracks provide opportunities for future emergency and dual use path access.

CAL2012-001-001_mp-F11.dgn
 PINPOINT CARTOGRAPHICS (08) 9562 7136

FLOOD MAPPING SOURCE: DoW, 2010.
 AERIAL PHOTOGRAPH SOURCE: Google Earth.
 CADASTRAL SOURCE: Landgate, December 2012.
 WETLAND DEPENDANT VEGETATION SOURCE: Coffey Environments, Rpt No. 27_221, 26-02-08.

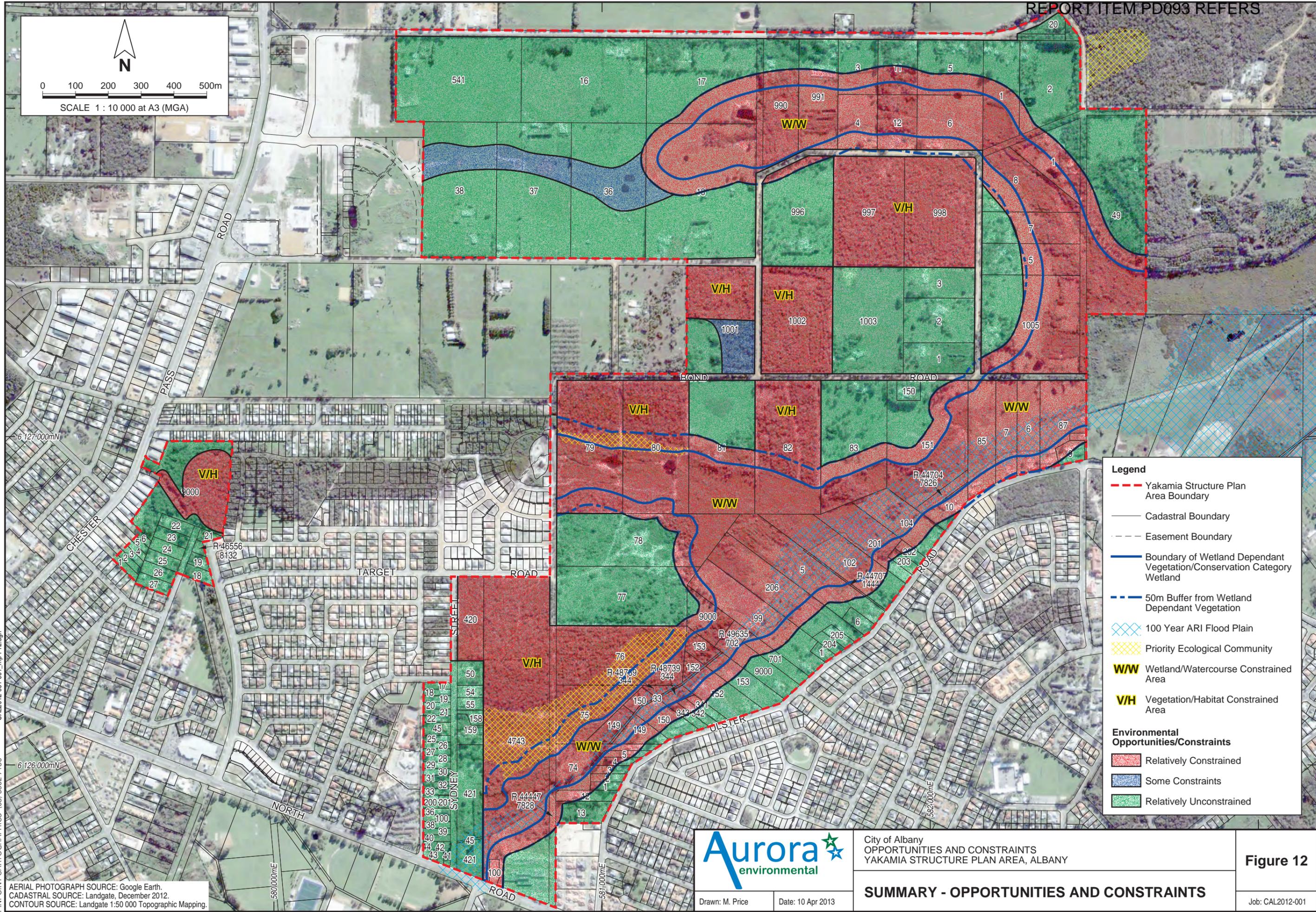
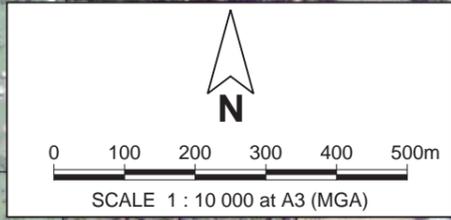
Drawn: M. Price
 Date: 27 Feb 2013

City of Albany
 OPPORTUNITIES AND CONSTRAINTS
 YAKAMIA STRUCTURE PLAN AREA, ALBANY

CATCHMENTS, WETLANDS AND WATERCOURSES

Figure 11

Job: CAL2012-001



Legend

- Yakamia Structure Plan Area Boundary
- Cadastral Boundary
- Easement Boundary
- Boundary of Wetland Dependant Vegetation/Conservation Category Wetland
- 50m Buffer from Wetland Dependant Vegetation
- 100 Year ARI Flood Plain
- Priority Ecological Community
- W/W** Wetland/Watercourse Constrained Area
- V/H** Vegetation/Habitat Constrained Area

Environmental Opportunities/Constraints

- Relatively Constrained
- Some Constraints
- Relatively Unconstrained

CAL2012-001-001_mp-F12.dgn
PINPOINT CARTOGRAPHICS (08) 9562 7136

AERIAL PHOTOGRAPH SOURCE: Google Earth.
 CADASTRAL SOURCE: Landgate, December 2012.
 CONTOUR SOURCE: Landgate 1:50 000 Topographic Mapping.

Aurora
 environmental

Drawn: M. Price Date: 10 Apr 2013

City of Albany
 OPPORTUNITIES AND CONSTRAINTS
 YAKAMIA STRUCTURE PLAN AREA, ALBANY

SUMMARY - OPPORTUNITIES AND CONSTRAINTS

Job: CAL2012-001

Figure 12

APPENDIX A

Contaminated Sites Reports –
Lots 100 and 4743 North Road, Yakamia



Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 11:16:43AM, 27/11/2012

Search Results

This response relates to a search request received for:

102 North Rd
Yakamia WA 6330

This parcel belongs to a site that contains 2 parcel(s).

According to Department of Environment and Conservation records, this land has been reported as a known or suspected contaminated site.

Address	102 North Rd Yakamia WA 6330
Lot on Plan Address	Lot 4743 On Plan 248843
Parcel Status	<p>Classification: 19/06/2009 - Remediated for restricted use</p> <p>Nature and Extent of Contamination:</p> <p>Soil impacted by polycyclic aromatic hydrocarbons (such as from diesel and bitumen) are present within three containment cells at the Site which are located beneath carparks to the west, north and south east of the proposed building pad for the council offices.</p> <p>Restrictions on Use:</p> <p>General access to soils below the carparks at the Site is restricted until further notice. A Site-specific health and safety plan is required to address the risks to the health of any workers undertaking intrusive works within the containment cells on the Site until further notice.</p> <p>Reason for Classification:</p> <p>This Site was reported to the Department of Environment and Conservation (DEC) prior to the commencement of the 'Contaminated Sites Act 2003'. The Site classification is based on information submitted to DEC by March, 2009.</p> <p>This Site was historically used as a municipal depot for approximately 40 years until 1999. The depot included: a drum storage area for pesticides, herbicides, fuels, and other chemicals; a refueling station with underground fuel storage tanks for diesel and unleaded petrol; a mechanical and spray painting workshop; a wash down area for rubbish trucks; a sludge disposal pit; and an area where bitumen was made up and burned. These activities have the potential to cause contamination, as specified in the guideline 'Potentially Contaminating Activities, Industries and Landuses' (Department of Environment, 2004).</p> <p>A contamination assessment was initially carried out on the Site in 2000 to assess the Site's suitability for the proposed change of land use from municipal depot to council offices.</p>

Disclaimer

This Summary of Records has been prepared by Department of Environment and Conservation (DEC) as a requirement of the *Contaminated Sites Act 2003*. DEC makes every effort to ensure the accuracy, currency and reliability of this information at the time it was prepared, however advises that due to the ability of contamination to potentially change in nature and extent over time, circumstances may have changed since the information was originally provided. Users must exercise their own skill and care when interpreting the information contained within this Summary of Records and, where applicable, obtain independent professional advice appropriate to their circumstances. In no event will DEC, its agents or employees be held responsible for any loss or damage arising from any use of or reliance on this information. Additionally, the Summary of Records must not be reproduced or supplied to third parties except in full and unabridged form.



Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 11:16:43AM, 27/11/2012

Several investigation reports have been prepared since the municipal depot was decommissioned in 1999. The most recent report held on DEC records is dated February, 2009.

The investigations found that soils in several areas of the Site were impacted by past activities at the Site. The soils from all of these areas were excavated in 2004 and subsequent testing confirmed that no impacted soils remain in these areas.

Approximately 2,500 m² of these soils were disposed off-site to appropriately licensed landfill facilities.

The remaining 2,192 m² of impacted soils was disposed of on-site within three "containment cells". These soils contain polycyclic aromatic hydrocarbons (such as from diesel and bitumen) at concentrations exceeding Ecological Investigation Levels and Health-based Investigation Levels for commercial and industrial Sites, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment, 2003). The three containment cells are located beneath carparks to the west, north and south east of the building pad for the council offices on 102 North Rd. Each containment cell is constructed of low permeability, compacted clays on its walls and base and is overlain by the impermeable bitumen surface of the car park inhibiting the infiltration of stormwater from the surface. Groundwater is below the base of the containment cells and the containment cells are situated above the 100 year flood level. The potential for leachate generation from the waste containment cells is minimal.

Based on the information provided, the Site appears suitable for continued commercial/industrial use, as long as the integrity of the containment cells is maintained and soils within the containment cells are not disturbed.

No potential contaminants were detected above guideline levels in the groundwater of the Site.

As the Site is contaminated and has been remediated such that it is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the Site is classified as 'remediated for restricted use'.

Periodic groundwater monitoring is recommended, to assess the performance of the containment cells over time.

A memorial stating the Site's classification has been placed on the Certificate of Title, and will notify any prospective owners of the contamination status of the Site.

General access to soils below the carparks at the site is restricted until further notice.

A Site-specific health and safety plan is required to address the risks to the health of any workers undertaking intrusive works within the containment cells on the Site until further notice.

DEC, in consultation with the Department of Health, has classified this Site based on the information available to DEC at the time of classification. It is acknowledged that the

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Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 11:16:43AM, 27/11/2012

	<p>contamination status of the Site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited.</p> <p>In accordance with Department of Health advice, if groundwater is being or is proposed to be abstracted, DEC recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.</p>
Certificate of Title Memorial	<p>Under the Contaminated Sites Act 2003, this Site has been classified as "Remediated - restricted use". For further information on the contamination status of this Site, please contact the Contaminated Sites section of the Department of Environment & Conservation.</p>
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: Nil</p> <p>Date Issued: Nil</p>
General	<p>No other information relating to this parcel.</p>

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Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 11:21:19AM, 27/11/2012

Search Results

This response relates to a search request received for:

120 North Rd
Yakamia WA 6330

This parcel belongs to a site that contains 2 parcel(s).

According to Department of Environment and Conservation records, this land has been reported as a known or suspected contaminated site.

Address	120 North Rd Yakamia WA 6330
Lot on Plan Address	Lot 100 On Diagram 92820
Parcel Status	<p>Classification: 19/06/2009 - Remediated for restricted use</p> <p>Nature and Extent of Contamination:</p> <p>Soil impacted by polycyclic aromatic hydrocarbons (such as from diesel and bitumen) are present within three containment cells at the Site which are located beneath carparks to the west, north and south east of the proposed building pad for the council offices.</p> <p>Restrictions on Use:</p> <p>General access to soils below the carparks at the Site is restricted until further notice. A Site-specific health and safety plan is required to address the risks to the health of any workers undertaking intrusive works within the containment cells on the Site until further notice.</p> <p>Reason for Classification:</p> <p>This Site was reported to the Department of Environment and Conservation (DEC) prior to the commencement of the 'Contaminated Sites Act 2003'. The Site classification is based on information submitted to DEC by March, 2009.</p> <p>This Site was historically used as a municipal depot for approximately 40 years until 1999. The depot included: a drum storage area for pesticides, herbicides, fuels, and other chemicals; a refueling station with underground fuel storage tanks for diesel and unleaded petrol; a mechanical and spray painting workshop; a wash down area for rubbish trucks; a sludge disposal pit; and an area where bitumen was made up and burned. These activities have the potential to cause contamination, as specified in the guideline 'Potentially Contaminating Activities, Industries and Landuses' (Department of Environment, 2004).</p> <p>A contamination assessment was initially carried out on the Site in 2000 to assess the Site's suitability for the proposed change of land use from municipal depot to council offices.</p>

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Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 11:21:19AM, 27/11/2012

Several investigation reports have been prepared since the municipal depot was decommissioned in 1999. The most recent report held on DEC records is dated February, 2009.

The investigations found that soils in several areas of the Site were impacted by past activities at the Site. The soils from all of these areas were excavated in 2004 and subsequent testing confirmed that no impacted soils remain in these areas.

Approximately 2,500 m² of these soils were disposed off-site to appropriately licensed landfill facilities.

The remaining 2,192 m² of impacted soils was disposed of on-site within three "containment cells". These soils contain polycyclic aromatic hydrocarbons (such as from diesel and bitumen) at concentrations exceeding Ecological Investigation Levels and Health-based Investigation Levels for commercial and industrial Sites, as published in 'Assessment Levels for Soil, Sediment and Water' (Department of Environment, 2003). The three containment cells are located beneath carparks to the west, north and south east of the building pad for the council offices on 102 North Rd. Each containment cell is constructed of low permeability, compacted clays on its walls and base and is overlain by the impermeable bitumen surface of the car park inhibiting the infiltration of stormwater from the surface. Groundwater is below the base of the containment cells and the containment cells are situated above the 100 year flood level. The potential for leachate generation from the waste containment cells is minimal.

Based on the information provided, the Site appears suitable for continued commercial/industrial use, as long as the integrity of the containment cells is maintained and soils within the containment cells are not disturbed.

No potential contaminants were detected above guideline levels in the groundwater of the Site.

As the Site is contaminated and has been remediated such that it is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the Site is classified as 'remediated for restricted use'.

Periodic groundwater monitoring is recommended, to assess the performance of the containment cells over time.

A memorial stating the Site's classification has been placed on the Certificate of Title, and will notify any prospective owners of the contamination status of the Site.

General access to soils below the carparks at the site is restricted until further notice.

A Site-specific health and safety plan is required to address the risks to the health of any workers undertaking intrusive works within the containment cells on the Site until further notice.

DEC, in consultation with the Department of Health, has classified this Site based on the information available to DEC at the time of classification. It is acknowledged that the

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Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 11:21:19AM, 27/11/2012

	<p>contamination status of the Site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited.</p> <p>In accordance with Department of Health advice, if groundwater is being or is proposed to be abstracted, DEC recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.</p>
Certificate of Title Memorial	<p>Under the Contaminated Sites Act 2003, this Site has been classified as "Remediated - restricted use". For further information on the contamination status of this Site, please contact the Contaminated Sites section of the Department of Environment & Conservation.</p>
Current Regulatory Notice Issued	<p>Type of Regulatory Notice: Nil</p> <p>Date Issued: Nil</p>
General	<p>No other information relating to this parcel.</p>

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APPENDIX B

ARVS Vegetation Unit Descriptions

Vegetation Unit Descriptions (Sandiford and Barrett, 2010)

Jarrah/Marri/Sheoak Laterite Forest (Unit 12)

Jarrah/Marri/Sheoak Laterite Forest is found on well drained shallow loamy/sandy soil, with outcropping laterite, usually occurring on the crests and middle slopes of low relief hills and plateaus with occasional occurrences on lower slopes. It has a strong affinity with the Dempster landform unit (Churchward *et al.* 1988).

Canopy structure varies from low woodland to an open forest and both *Eucalyptus marginata* and *Allocasuarina fraseriana* may be present as sole canopy species. *Banksia grandis* is often present as a secondary tree strata or a tall shrub layer. The understorey is often relatively open though structurally diverse with shrub, sedge and herb layers well developed. Common shrub species include *Bossiaea linophylla*, *Beaufortia decussata*, *Hakea florida*, *Hakea amplexicaulis*, *Agonis theiformis*, *Leucopogon verticillatus*, *Isopogon longifolius*, *Xanthorrhoea platyphylla*, *Acacia browniana* subsp. *browniana*, *Xanthosia rotundifolia*, *Tetratheca setigera*, *Sphaerolobium alatum*, *Hovea chorizemifolia*, *Hibbertia amplexicaulis* and in western areas *Bossiaea ornata*. The sedge layer is typified by the dominance of four sedges *Anarthria prolifera*, *Tetraria octandra*, *Tetraria capillaris* and *Desmocladius fasciculatus* with *Cyathochaeta avenacea* and *Lepidosperma gracile* occasionally present. Common herbs include *Stylidium amoenum*, *Conostylis setigera*, *Logania serpyllifolia*, *Patersonia umbrosa*, *Opercularia hispidula*, *Lomandra pauciflora*, *Lindsaea linearis* and *Lomandra sericea*.

This unit typically occurs upslope of Jarrah/Sheoak/*E. staeri* Sandy Woodland (13) with the boundary usually marked by a distinct change in sedge species with *Anarthria scabra* and/or *Cyathochaeta equitans* dominant in the latter unit. Where drainage is impeded over lateritic soils, this unit often abuts *Hakea* species Shrubland/ Woodland Complex (31). It is floristically most similar to Marri/Jarrah Coastal Hills Forest (17) and differs in its more open structure, the absence of *Hibbertia furfuracea*, *Crowea angustifolia*, *Hovea elliptica*, *Hakea elliptica*, *Gastrolobium coriaceum*, *Chorizema rhombeum*, and *Stylidium spathulatum* and rarity of *Banksia formosa* and *Hakea trifurcata*.

This vegetation unit is found in upland areas associated with crests across the YSPA.

Conservation significant flora that may be associated with this vegetation unit include: *Andersonia depressa* (P4), and *Banksia serra* (P4).

Jarrah/Sheoak/ *Eucalyptus staeri* Sandy Woodland (Unit 13)

Jarrah/Sheoak/*Eucalyptus staeri* Sandy Woodland is usually found on gentle middle to lower slopes on sandy soil overlying laterite. This unit usually occurs between Jarrah/Marri/Sheoak Laterite Forest (12) and *Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland (14) and shares many species with these units.

The understorey is typically very diverse though species and structural diversity decreases with age. A low open woodland of *Banksia attenuata* and less frequently *Banksia ilicifolia* is often present as a secondary tree strata over a tall open scrub, open heath, low shrubland, sedgeland and herbland. Dominant understorey species include *Banksia grandis*, *Beaufortia decussata*, *Persoonia longifolia*, *Melaleuca thymoides*, *Adenanthos cuneatus*, *Agonis theiformis*, *Isopogon longifolius*, *Leucopogon glabellus*, *Gompholobium scabrum*, *Daviesia flexuosa*, *Daviesia incrassata*, *Xanthosia rotundifolia*, *Beaufortia anisandra*, *Astroloma baxteri*, *Cyathochaeta equitans*, *Anarthria scabra*, *Tricostularia elatior* subsp. *elatior*, *Anarthria prolifera* and *Dasyopogon bromeliifolius*. On lower slopes *Eucalyptus*

marginata is usually absent and *Taxandria parviceps* is often the dominant shrub over a less diverse lower shrub layer and dense *Anarthria scabra*, *Dasyopogon bromeliifolius* sedgeland/herbland.

This unit often occurs upslope of *Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland (14) with the boundary marked by a more open tree strata, the dominance of *Banksia coccinea* and *Jacksonia spinosa* in the latter unit and absence of species typical of lateritic soil including *Eucalyptus marginata*, *Banksia grandis*, *Agonis theiformis*, *Persoonia longifolia* and *Isopogon longifolius*. Upslope it abuts Jarrah/Marri/Sheoak Laterite Forest (12) from which it differs in the presence of many species typical of sandy soil including *Banksia attenuata*, *Adenanthos cuneatus*, *Melaleuca thymoides*, *Cyathochaeta equitans* and *Anarthria scabra*.

This vegetation unit is found in upland areas across the YSPA.

Conservation significant flora that may be associated with this vegetation unit include: *Banksia goodii* (Threatened) and *Andersonia depressa* (P4), and *Banksia serra* (P4).

***Banksia coccinea* Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland (Unit 14)**

Banksia coccinea Shrubland/*Eucalyptus staeri*/Sheoak Open Woodland is found on deep white/light grey sand on the lower slopes and valleys, usually occurring just upslope of seasonally wet drainage lines. With the exception of occurrences on the lower slopes of Mt. Martin and Mt. Adelaide, it is absent from the coastal fringe. This unit is floristically very diverse and structurally quite variable. Typically *Allocasuarina fraseriana*, *Eucalyptus staeri*, *Banksia attenuata* and *Banksia ilicifolia* are present as emergents or as a low open woodland above a *Banksia coccinea* tall open scrub, mixed open/closed heath, mixed low open heath, mixed sedgeland and open herbland. *Jacksonia spinosa* often forms a distinct stratum above the heathland, dominant heath species are *Melaleuca thymoides*, *Adenanthos cuneatus*, *Leucopogon rubricaulis*, *Phyllota barbata*, *Hypocalymma strictum* and *Leucopogon glabellus*. Common sedges and herbs include *Anarthria scabra*, *Lyginia barbata*, *Schoenus caespitius*, *Anarthria prolifera*, *Anarthria gracilis* and *Cyathochaeta equitans*. *Banksia coccinea* sometimes forms dense thickets over a sparse understorey and dense sedgeland.

This unit usually occurs down slope of Jarrah/Sheoak/*E. staeri* Sandy Woodland (13) and the boundary is usually marked by a sparser canopy, dominance of *Banksia coccinea* and presence of *Jacksonia spinosa* and *Leucopogon rubricaulis*.

This vegetation unit is found in uphill from Yakamia Creek and its tributaries in the YSPA.

Conservation significant flora that may be associated with this vegetation unit includes: *Banksia goodii* (Threatened), *Drakaea micrantha* (Threatened), *Andersonia depressa* (P4), *Laxmannia jamesii* (P4) and *Verticordia harveyi* (P4).

***Callistachys* spp Thicket (Unit 36)**

Callistachys species Thicket was not well sampled in the ARVS as patches were usually very small and often disturbed. This vegetation type occurs where local soaks or seepages occur on minor drainage lines, flats, gullies and slopes, on sandy to peaty soil. This unit is dominated by a canopy of *Callistachys lanceolata*, either as shrubs or trees. The understorey is heterogeneous reflecting both small patch size and soil moisture. Species diversity and density appears to thin as the canopy closes over. Commonly recorded species include *Pteridium esculentum*, *Leptocarpus tenax*, *Baumea juncea*, *Lepidosperma striatum*, *Leucopogon obovatus*, *Hibbertia cuneiformis*, *Homalospermum firmum*, *Aotus intermedia*, *Gahnia decomposita* and *Anarthria prolifera*.

Callistachys lanceolata appears to intergrade with *Callistachys* species South Coast which has a coastal distribution and it is often difficult to differentiate between the two. Small *Callistachys* species South Coast thickets are restricted to the coastal fringe, near coastal gullies and seepages and are mapped as *Callistachys lanceolata* thickets as none were sampled.

This vegetation unit is found in one location associated with a tributary of Yakamia Creek in the YSPA.

Conservation significant flora that may be associated with this vegetation unit includes *Billardiera drummondii* (P4).

***Evandra aristata* Sedgeland (Unit 46)**

Evandra aristata Sedgeland is widespread on the upper margins of drainage depressions, often forming distinct bands on gentle slopes above the seepage zone. They also occur on some poorly drained flats. Soil types vary from sand through to sandy loam and sandy peat and are seasonally wet. This unit is floristically diverse, especially in the sedge stratum and the structure varies with soil, hydrology, landscape and fire history. The dominance of *Evandra aristata* appears to decline following fire. This trend is most notable where medium to tall shrubs are present with the structure changing over time from a sedgeland over an open low heath to an open or closed heath. Common sedges include *Evandra aristata*, *Leptocarpus tenax*, *Schoenus efoliatus*, *Schoenus multiglumis*, *Anarthria prolifera*, *Anarthria scabra*, *Mesomelaena gracilipes*, *Gymnoschoenus anceps*, *Lepidosperma* sp Down Road Fan, *Anarthria gracilis* and *Hypolaena fastigiata*. Dominant larger shrubs include *Beaufortia sparsa*, *Kunzea ericifolia*, *Taxandria fragrans*, *Taxandria parviceps*, *Banksia quercifolia* and *Sphaerolobium grandifolium*. Common lower shrubs include *Astartea corniculata*, *Sphenotoma gracilis*, *Pericalymma spongiocaula*, *Boronia spathulata*, *Adenanthos obovatus*, *Lysinema conspicuum*, *Pericalymma crassipes*, *Calothamnus schaueri*, *Pimelea longifolia*, *Hypocalymma strictum*, *Leucopogon distans* and *Dampiera leptoclada*. Common herbs include *Xyris lanata*, *Stylidium luteum* and *Dasypogon bromeliifolius*.

This vegetation unit is found in association with Yakamia Creek and its tributaries in the YSPA.

Conservation significant flora that may be associated with this vegetation unit includes *Gonocarpus simplex* (P4) and *Sphaerolobium pubescens* (P3).

***Homalospermum firmum/Callistemon glaucus* Peat Thicket (Unit 47)**

Homalospermum firmum/Callistemon glaucus Peat Thicket occurs in drainage depressions below the seepage zone on dark brown peat or sandy peat that is waterlogged in winter and moist in summer.

This unit has a distinctive dense sedgeland characterized by the presence and dominance of *Empodisma gracillimum*. Other co- or sub-dominant sedges include *Lepidosperma striatum*, *Leptocarpus tenax*, *Schoenus multiglumis*, *Gymnoschoenus anceps*, *Gahnia decomposita* and *Baumea rubiginosa*. The upper stratum is dominated by tall shrubs and varies from a closed tall scrub or closed heathland to a shrubland, a lower secondary shrub stratum may be present. Common shrub species include *Callistemon glaucus*, *Homalospermum firmum*, *Hakea linearis*, *Aotus intermedia*, *Acacia hastulata*, *Sphaerolobium fornicatum* and *Dampiera leptoclada*. The drainage channel is often marked by a line of *Taxandria linearifolia* and *Gahnia decomposita* with *Rhadinothamnus anceps* and *Callistachys lanceolata* also occasionally present.

This unit typically lacks a tree layer though *Eucalyptus megacarpa* is a frequent overstorey species in some areas of Angove Water Reserve where *Boronia stricta* and *Hypocalymma cordatum* are

common in the understorey. Elsewhere emergent *Taxandria juniperina* and *Melaleuca preissiana* are occasionally present. Along valleys, this unit often occurs down slope from *Evandra aristata* Sedgeland (46) with the boundary between the units marked by a seepage zone and sub-unit 47b. On broader flats, this unit frequently borders *Taxandria juniperina* Closed Forest (59) and it may grade into *Melaleuca preissiana* Low Woodland (49) which occurs on better drained sandier soil.

This vegetation unit is found in association with the tributaries of Yakamia Creek in the YSPA.

Conservation significant flora that may be associated with this vegetation unit includes *Boronia crassipes* (P3), *Amperea protensa* (P3), *Leucopogon alternifolius* (P3) and *Gonocarpus simplex* (P4).

***Taxandria juniperina* Closed Forest (Unit 59)**

Taxandria juniperina Closed Forest is found around swamps, freshwater lakes and along drainage lines and the dense canopy of *Taxandria juniperina* is a characteristic of this unit. Floristically the understorey is depauperate and shrub and sedge layers are often absent. The canopy varies from a low open forest to a closed forest.

Callistachys lanceolata may be present as a sub-dominant tree or secondary tree stratum and a *Pteridium esculentum* herbland is often present on drier and more disturbed sites. Common sedges include *Baumea vaginalis*, *Leptocarpus tenax*, *Baumea rubiginosa*, *Meeboldina scariosus*, *Lepidosperma effusum* and *Lepidosperma striatum* with common herbs including *Triglochin huegelii*, *Villarsia albiflora*, *Pteridium esculentum* and *Billardiera fusiformis*.

This unit frequently abuts *Homalospermum firmum/Callistemon glaucus* Swamp Thicket (47) and *Astartea scoparia* Swamp Thicket (56) and around fresh water lakes is usually fringed by *Baumea articulata* Closed Sedgeland (64). This unit differs from Coastal *Taxandria juniperina* Low Closed Forest (60) in the absence of *Melaleuca incana*, *Gahnia trifida*, *Schoenus* sp. South Coast and *Baumea juncea*.

This vegetation unit is found in association with Yakamia Creek and its tributaries in the YSPA.

No conservation significant flora has been associated with this vegetation unit.

****Typha orientalis* Sedgeland (Unit 68)**

This unit is dominated by the introduced sedge **Typha orientalis* and was only mapped where it occurred as a mosaic with remnant vegetation, most notably *Baumea articulata* Closed Sedgeland (64) around lake edges.

APPENDIX C

Vegetation Condition Descriptions

APPENDIX 4: Vegetation Condition Scale (Thackway and Lesslie 2006)

Vegetation Cover Class Criteria	Type 0 Naturally bare Areas where native vegetation does not naturally persist	Native Vegetation cover Type I Residual Native vegetation community structure, composition, and regenerative capacity intact – no significant perturbation from landuse/land management practice	Type II Modified Native vegetation community structure, composition and regenerative capacity intact – perturbed by land use /land management practice	Type III Transformed Native vegetation community structure, composition and regenerative capacity significantly altered by land use/land management practice	Non-native vegetation cover Type IV Replaced Adventive Native vegetation replacement – species alien to the locality and spontaneous in occurrence	Type V Replaced managed Native vegetation replacement with cultivated vegetation	Type VI Removed Vegetation removal
Diagnostic criteria	Natural regenerative capacity unmodified	unmodified, structural and compositional integrity of native vegetation is very high	Natural regeneration tolerates/endures under past &/or present current land management practices. Structure is predominantly altered but intact e.g. a layer and/growth form and or age classes removed. Composition of vegetation is altered but intact	Natural regenerative capacity is limited/at risk under past &/or current land use or land management practices. Rehabilitation and restoration possible through modified land management practice. Dominant structuring species of native vegetation community significantly altered e.g. a layer frequently and repeatedly removed	Regeneration of native vegetation community has been suppressed by ongoing disturbances of the natural regenerative capacity. Limited potential for restoration. Dominant structuring species of native vegetation community removed	Regeneration of native vegetation community lost or suppressed by intensive land management. Limited potential for restoration. Dominant structuring species of native vegetation community removed	Nil or minimal Vegetation absent or ornamental
ARVS notes	Not used Areas mapped as part of remnant vegetation or not mapped				Only used where small areas surrounded by native vegetation	Not used	Not used
Example	Lakes not mapped as remnant vegetation		Light firewood harvesting, scattered weeds, <i>Phytolthora</i> dieback front	Understorey removed by grazing, severely affected by <i>Phytolthora</i> dieback.	* <i>Typha orientalis</i> Sedgeland & * <i>Acacia longifolia</i> thickets surround by native vegetation.	Plantations, planted parklands, pastures,	Roads, gardens
Corresponding Keighery (1994) Condition Scale	Very good excellent, Pristine	Very good excellent, Pristine	Good to very good	Very degraded to degraded/good	Completely degraded	Completely degraded	

APPENDIX D

Yakamia Structure Plan Flora List

				Lots 997 and 998 Mason Road		Lots 1001 and 1002 Bond Rd		Lots 79 and 80 Bond Road		Lot 78 Range Road		Lot 78 Range Road		Assoc with Reserve 49287 Haywood Crescent		Lot 4743 North Road		Lot 4743 North Road		Lot 4743 North Road and Lot 75 Range Road		Lot 75 and 76 Range Road		Lot 1001 Bond Road	
FAMILY NAME	NATURAL SED	SPECIES	Conservation Code	ENV Quadrats 2006											Coffey Quadrats 2007					Sandiford 2005	Alan Tingay and Assoc 1996	ATA Environmental 2000			
				YAK01	YAK02	YAK03	YAK04	YAK05	YAK06	YAK07	YAK08	YAK09	YAK10	YAK11	07Q17	07Q18	07Q19	07Q20	07Q21	Opportunistic	Opportunistic	Opportunistic	Opportunistic		
Schizaeaceae		<i>Schizaea fistulosa</i>																							
Dennstaedtiaceae		<i>Pteridium esculentum</i>																							
Lindsaeaceae		<i>Lindsaea linearis</i>		X	X				X	X			X												
Poaceae		<i>Aira caryophyllea</i>											X												
	*	<i>Anthoxanthum odoratum</i>																							
	*	<i>Avena fatua</i>																							
	*	<i>Avena sp.</i>																							
	*	<i>Briza maxima</i>					X		X																
	*	<i>Briza minor</i>																							
	*	<i>Digitaria sanguinalis</i>																							
	*	<i>Cortaderia selloana</i>																							
	*	<i>Ehrharta erecta</i>																							
	*	<i>Ehrharta longiflora</i>																							
	*	<i>Holcus lanatus</i>																							
	*	<i>Microlaena stipoides</i>																							
	*	<i>Poa sp.</i>							X																
	*	<i>Paspalum dilatatum</i>																							
Cyperaceae	19	<i>Baumea acuta</i>																							
		<i>Baumea rubiginosa</i>																							
		<i>Cyathochaeta avenacea</i>				X				X	X														
		<i>Cyathochaeta equitans</i>																							
		<i>Evandra aristata</i>					X						X	X	X	X									
		<i>Gahnia trifida</i>																							
	*	<i>Gymnoschoenus anceps</i>					X																		
	*	<i>Isolepis prolifera</i>																							
		<i>Lepidosperma angustatum</i>																							
		<i>Lepidosperma squamatum</i>		X		X				X	X														
		<i>Lepidosperma striatum</i>																							
		<i>Mesomelaena graciliceps</i>			X																				
		<i>Mesomelaena stygia</i>																							
		<i>Mesomelaena tetragona</i>																							
		<i>Schoenus caespititius</i>																							
		<i>Schoenus efoliatus</i>				X	X						X	X											
		<i>Tetraria capillaris</i>		X	X			X	X		X	X	X	X	X										
		<i>Tetraria octandra</i>		X					X	X															
		<i>Tricostularia neesii</i>																							
Araceae	*	<i>Zantedeschia aethiopica</i>																							
Anarthriaceae		<i>Anarthria gracilis</i>																							
		<i>Anarthria prolifera</i>		X	X	X		X	X	X		X	X	X	X	X									
		<i>Anarthria scabra</i>		X		X	X	X	X	X	X	X	X	X	X	X									
Restionaceae		<i>Chaetanthus tenellus</i>						X																	
		<i>Desmocladus fasciculatus</i>			X	X			X	X	X		X	X	X										
		<i>Desmocladus flexuosus</i>		X																					
		<i>Empodisma gracillimum</i>																							
		<i>Hypolaena exsulca</i>						X				X		X	X	X									
		<i>Leptocarpus tenax</i>							X																
		<i>Loxocarya cinerea</i>																							
		<i>Lyginia barbata</i>						X																	
		<i>Lyginia imberbis</i>										X	X		X										

				Lots 997 and 998 Mason Road		Lots 1001 and 1002 Bond Rd		Lots 79 and 80 Bond Road		Lot 78 Range Road		Lot 78 Range Road		Assoc with Reserve 49287 Haywood Crescent		Lot 4743 North Road		Lot 4743 North Road		Lot 4743 North Road and Lot 75 Range Road		Lot 75 and 76 Range Road		Lot 1001 Bond Road		Lot 4743 North Road										Lot 79 and 80 Bond St, Yakamia			
FAMILY NAME	NATURAL SED	SPECIES	Conservation Code	ENV Quadrats 2006											Coffey Quadrats 2007						Sandiford 2005	Alan Tingay and Assoc 1996	ATA Environmental 2000																
				YAK01	YAK02	YAK03	YAK04	YAK05	YAK06	YAK07	YAK08	YAK09	YAK10	YAK11	07Q17	07Q18	07Q19	07Q20	07Q21	Opportunistic	Opportunistic	Opportunistic	Opportunistic																
		<i>Meeboldina scariosa</i>																												X	X								
Centrolepidaceae		<i>Aphelia cyperoides</i>																													X								
		<i>Centrolepis aristata</i>																													X								
		<i>Centrolepis drummondiana</i>																													X								
Juncaceae		<i>Juncus articulatus</i>																													X	X							
		<i>Juncus caespiticius</i>																													X								
		<i>Juncus pallidus</i>																													X								
Asparagaceae	*	<i>Asparagus asparagoides</i>																													X								
	*	<i>Asparagus sp.</i>																													X								
		<i>Lomandra nigricans</i>						X																							X	X							
		<i>Lomandra pauciflora</i>				X				X																					X								
		<i>Lomandra purpurea</i>																													X								
		<i>Lomandra sericea</i>																													X								
		<i>Lomandra sonderi</i>		X	X	X			X	X	X																				X								
		<i>Lomandra sp.</i>																													X								
Dasyopogonaceae		<i>Baxteria australis</i>																													X								
		<i>Dasyopogon bromeliifolius</i>				X		X					X	X																	X	X							
		<i>Kingia australis</i>																													X								
Xanthorrhoeaceae		<i>Xanthorrhoea brunonis</i>											X																										
		<i>Xanthorrhoea gracilis</i>		X		X?																										X							
		<i>Xanthorrhoea preissii</i>							X	X			X	X																	X								
		<i>Xanthorrhoea sp.</i>																													X								
Hemerocallidaceae		<i>Agrostocrinum hirsutum</i>		X																											X								
		<i>Agrostocrinum scabrum</i>	P2 if subsp littorale		X	X																									X								
		<i>Chamaescilla corymbosa</i>			X																										X								
		<i>Dianella divaricata</i>																													X	X							
		<i>Dianella revoluta</i>																													X								
		<i>Johnsonia lupulina</i>						X					X																	X	X								
		<i>Tricoryne elatior</i>											X																		X								
Colchicaceae		<i>Burchardia congesta</i>																													X								
		<i>Burchardia umbellata</i>		X																												X							
Haemodoraceae		<i>Anigozanthos sp.</i>																												X	X								
		<i>Anigozanthos bicolor</i>																													X								
		<i>Anigozanthos flavidus</i>																													X	X							
		<i>Anigozanthos humilis</i>																													X								
		<i>Conostylis aculeata</i>																													X								
		<i>Conostylis serrulata</i>																													X								
		<i>Conostylis setigera</i>		X	X	X			X	X	X																				X	X							
		<i>Haemodorum paniculatum</i>																													X								
		<i>Haemodorum sp.</i>																													X								
		<i>Haemodorum spicatum</i>																													X								
		<i>Phlebocarya ciliata</i>																													X								
Asparagaceae		<i>Laxmannia jamesii</i>	Priority 4																												X								
		<i>Thysanotus sp.</i>																													X	X							
		<i>Thysanotus manglesianus</i>																													X								
	*	<i>Yucca aloifolia</i>																													X								
Iridaceae	*	<i>Babiana angustifolia</i>																													X								

				Lots 997 and 998 Mason Road		Lots 1001 and 1002 Bond Rd		Lots 79 and 80 Bond Road		Lot 78 Range Road		Lot 78 Range Road		Assoc with Reserve 49287 Haywood Crescent		Lot 4743 North Road		Lot 4743 North Road		Lot 4743 North Road and Lot 75 Range Road		Lot 75 and 76 Range Road		Lot 1001 Bond Road		
FAMILY NAME	NATURAL SED	SPECIES	Conservation Code	ENV Quadrats 2006											Coffey Quadrats 2007						Sandiford 2005	Alan Tingay and Assoc 1996	ATA Environmental 2000			
				YAK01	YAK02	YAK03	YAK04	YAK05	YAK06	YAK07	YAK08	YAK09	YAK10	YAK11	07Q17	07Q18	07Q19	07Q20	07Q21	Opportunistic	Opportunistic	Opportunistic	Opportunistic			
		<i>Acacia myrtifolia</i>						X																		
		<i>Acacia myrtifolia</i> var. <i>angustifolia</i>																								
	*	<i>Acacia pulchella</i>																								
		<i>Acacia pycnantha</i>																								
		<i>Acacia robiniae</i>																								
		<i>Acacia saligna</i> subsp.																								
		<i>Bossiaea</i> sp.																								
		<i>Bossiaea dentata</i>																								
		<i>Bossiaea linophylla</i>		X	X		X						X													
		<i>Bossiaea praetermissa</i>																								
	*	<i>Callistachys lanceolata</i>																								
		<i>Chamaecytisus palmensis</i>																								
		<i>Chorizema reticulatum</i>																								
		<i>Gompholobium knightianum</i>		X						X	X															
		<i>Gompholobium polymorphum</i>		X			X				X	X														
		<i>Gompholobium scabrum</i>																								
		<i>Hardenbergia comptoniana</i>																								
		<i>Hovea chorizemifolia</i>		X	X					X	X	X														
		<i>Hovea trisperma</i>									X															
		<i>Isotropis cuneifolia</i>																								
		<i>Jacksonia furcellata</i>																								
		<i>Jacksonia horrida</i>																								
		<i>Jacksonia spinosa</i>																								
	*	<i>Kennedia coccinea</i>																								
	*	<i>Medicago polymorpha</i>																								
	*	<i>Ornithopus compressus</i>																								
	*	<i>Psoralea pinnata</i>																								
		<i>Pultenaea reticulata</i>																								
		<i>Sphaerolobium</i> sp.						X																		
		<i>Sphaerolobium alatum</i>																								
		<i>Sphaerolobium medium</i>																								
	*	<i>Trifolium campestre</i>																								
	*	<i>Ulex europaeus</i>																								
Geraniaceae	1	*																								
		<i>Pelargonium capitatum</i>																								
Oxalidaceae	3	*																								
		<i>Oxalis corniculata</i>																								
		<i>Oxalis pes-caprae</i>																								
		<i>Oxalis purpurea</i>																								
Tropaeolaceae	1	*																								
		<i>Tropaeolum majus</i>																								
Rutaceae	3																									
		<i>Boronia crenulata</i>		X			X			X	X	X	X	X												
		<i>Boronia crenulata</i> subsp. <i>crenulata</i>																								
		<i>Boronia spathulata</i>																								
Elaeocarpaceae	2																									
		<i>Tetradlea affinis</i>																								
		<i>Tetradlea setigera</i>																								
Polygalaceae	2																									
	1	*																								
		<i>Comesperma confertum</i>																								
		<i>Comesperma virgatum</i>		X																						
		<i>Polygala myrtifolia</i>																								

				Lots 997 and 998 Mason Road		Lots 1001 and 1002 Bond Rd		Lots 79 and 80 Bond Road		Lot 78 Range Road		Lot 78 Range Road		Assoc with Reserve 49287 Haywood Crescent		Lot 4743 North Road		Lot 4743 North Road		Lot 4743 North Road and Lot 75 Range Road		Lot 75 and 76 Range Road		Lot 1001 Bond Road			
																								Lot 4743 North Road		Lot 79 and 80 Bond St, Yakamia	
FAMILY NAME	NATURAL SED	SPECIES	Conservation Code	ENV Quadrats 2006											Coffey Quadrats 2007						Sandiford 2005	Alan Tingay and Assoc 1996	ATA Environmental 2000				
				YAK01	YAK02	YAK03	YAK04	YAK05	YAK06	YAK07	YAK08	YAK09	YAK10	YAK11	07Q17	07Q18	07Q19	07Q20	07Q21	Opportunistic	Opportunistic	Opportunistic	Opportunistic				
Euphorbiaceae	1	<i>Amperea ericoides</i>																									
Dilleniaceae	5	<i>Hibbertia acerosa</i>																									
		<i>Hibbertia amplexicaulis</i>																									
		<i>Hibbertia cuneiformis</i>																									
		<i>Hibbertia cunninghamii</i>																									
		<i>Hibbertia subvaginata</i>																									
Thymelaeaceae	3	<i>Pimelea hispida</i>																									
		<i>Pimelea longiflora</i>																									
		<i>Pimelea spectabilis</i>																									
Myrtaceae	24	<i>Agonis flexuosa</i>																									
		<i>Agonis theiformis</i>																									
		<i>Astartea fascicularis</i>																									
		<i>Astartea scoparia</i>																									
		<i>Astartea sp.</i>																									
		<i>Beaufortia anisandra</i>																									
		<i>Beaufortia decussata</i>																									
		<i>Beaufortia squarrosa</i>																									
		<i>Boronia crenulata</i>																									
		<i>Callistemon glaucus</i>																									
		<i>Corymbia calophylla</i>																									
		<i>Eucalyptus marginata</i>																									
		<i>Eucalyptus staeri</i>																									
		<i>Homalospermum firmum</i>																									
		<i>Hypocalymma sp.</i>																									
		<i>Hypocalymma cordifolium</i>																									
		<i>Hypocalymma ericifolium</i>																									
		<i>Hypocalymma strictum</i>																									
		<i>Kunzea ericifolia</i>																									
		<i>Melaleuca thymoides</i>																									
		<i>Pericalymma ellipticum</i>																									
		<i>Taxandria juniperina</i>																									
		<i>Taxandria linearifolia</i>																									
		<i>Taxandria parviceps</i>																									
Apiaceae	9	<i>Actinotus glomeratus</i>																									
		<i>Actinotus omnifertilis</i>																									
		<i>Platysace commutata</i>																									
		<i>Platysace compressa</i>																									
		<i>Platysace filiformis</i>																									
		<i>Platysace tenuissima</i>																									
		<i>Xanthosia candida</i>																									
		<i>Xanthosia huegelii</i>																									
		<i>Xanthosia rotundifolia</i>																									
Ericaceae	18	<i>Andersonia sp.</i>																									
		<i>Andersonia caerulea</i>																									
		<i>Andersonia depressa</i>	Priority 4																								
		<i>Andersonia micrantha</i>																									
		<i>Astroloma pallidum</i>																									
		<i>Cosmelia rubra</i>																									
		<i>Leucopogon alternifolius</i>	Priority 3																								
		<i>Leucopogon australis</i>																									
		<i>Leucopogon glabellus</i>																									

APPENDIX E

DEC Threatened and Priority Flora Search



Department of
Environment and Conservation

Our environment, our future



Your Ref: **CAL-2012-004**
 Our Ref: **65-1112FL**
 Enquiries: Jessica Donaldson
 Phone: (08) 9334 0123
 Fax: (08) 9334 0278
 Email: jessica.donaldson@dec.wa.gov.au

Aurora Environmental

2A Nakina Street
Albany WA 6330

Attention: Melanie Price

Dear Melanie Price,

REQUEST FOR THREATENED AND PRIORITY FLORA INFORMATION

I refer to your request of 23 November 2012 for Threatened (Declared Rare) and Priority Flora information in the Lange/Yakamia area. The search was conducted within the area of the polygon coordinates you supplied with an additional 5km buffer area.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) and Priority Flora* database (for results, *if any*, see "TPFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, *if any*, see "WAHERB"- coordinates are GDA94 – see condition number 9 in the attached 'Conditions in Respect of Supply' and **(3)**, the Department's *Threatened and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, *if any*, see "TP List"]. The results are attached electronically to this email.

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

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for \$300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of Threatened and Priority flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss Threatened and Priority flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9334 0455.

Yours faithfully

Rebecca Kay

.....
 THREATENED FLORA DATABASE OFFICER
 for the Director General

28 November 2012

Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dec.wa.gov.au

DEPARTMENT OF ENVIRONMENT AND CONSERVATION**THREATENED (DECLARED RARE) AND PRIORITY FLORA INFORMATION****CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION**

1. All requests for data to be made in writing to the Director General, Department of Environment and Conservation, Attention: Threatened Flora Database Officer, Species and Communities Branch.
2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Director General, Department of Environment and Conservation.
3. Specific locality information for Threatened and Priority Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information may not be used in public reports without the written permission of the Director General, Department of Environment and Conservation. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of Threatened and Priority Flora information.
4. Note that the Department of Environment and Conservation respects the privacy of private landowners who may have Threatened and Priority Flora on their property. Threatened and Priority Flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.
5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Environment and Conservation accepts no responsibility for this.
6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
7. **It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened and Priority Flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.**
8. Acknowledgment of the Department of Environment and Conservation as source of the data is to be made in any published material. The unique reference number that is given upon the request for information should be quoted when referencing the data. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention: The Manager, Species and Communities Branch.
9. The development of the PERTH Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being databased. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.

Species and Communities Branch

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DECLARED RARE AND PRIORITY FLORA LIST

CONSERVATION CODES
for Western Australian taxa

T: **Threatened Flora** (Declared Rare Flora - Extant)
Schedule 1 under the *Wildlife Conservation Act 1950* Rare Flora Notice

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

X: **Presumed Extinct Flora** (Declared Rare Flora – Extinct)
Schedule 2 under the *Wildlife Conservation Act 1950* Rare Flora Notice

Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

Threatened Flora (Schedule 1) are further ranked by the Department according to their level of threat using IUCN Red List criteria:

CR: **Critically Endangered** - considered to be facing an extremely high risk of extinction in the wild.

EN: **Endangered** –considered to be facing a very high risk of extinction in the wild.

VU: **Vulnerable** - considered to be facing a high risk of extinction in the wild.

A list of the current rankings can be downloaded from DEC's [Listing of species and ecological communities](http://www.dec.wa.gov.au/content/view/full/852/2010/) webpage at <http://www.dec.wa.gov.au/content/view/full/852/2010/>

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Possibly threatened species that have not been adequately surveyed to be listed as Threatened are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

1: Priority One: Poorly-known species

Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known species

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known species

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Recommendations for additions, deletions or changes to the Declared Rare and Priority Flora List should be forwarded to the Flora Administration Officer or Senior Botanist Species and Communities Branch, DEC.

Species and Communities Branch

17 Dick Perry Ave, Technology Park, Kensington

Phone: (08) 9334 0455 Fax: (08) 9334 0278

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REPORT ITEM PD093 REFERS

ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain
EDE	Educational Endowment
EDU	Educational purposes UWA
ENE	Enjoyment of Natural Environ.

EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PCR	Proposed for Conservation
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

APPENDIX F

WA Herbarium Opportunistic Flora Recordings – Albany Area

REPORT ITEM PD093 REFERS

Western Australian Herbarium Specimen Database (Opportunistic for Albany Area)		
Species	Cons_Code	Conservation Code
<i>Acacia ataxiphylla</i> subsp. <i>ataxiphylla</i>	3	Priority 3
<i>Acacia prismifolia</i>	X	Presumed Extinct
<i>Adenanthos x cunninghamii</i>	4	Priority 4
<i>Agrostocrinum scabrum</i> subsp. <i>littorale</i>	2	Priority 2
<i>Andersonia auriculata</i>	3	Priority 3
<i>Andersonia depressa</i>	4	Priority 4
<i>Andersonia setifolia</i>	3	Priority 3
<i>Astartea arbuscula</i>	4	Priority 4
<i>Banksia brownii</i>	T	Threatened
<i>Banksia goodii</i>	T	Threatened
<i>Banksia mucronulata</i>	T	Threatened
<i>Banksia serra</i>	4	Priority 4
<i>Banksia verticillata</i>	T	Threatened
<i>Boronia crassipes</i>	3	Priority 3
<i>Caladenia evanescens</i>	1	Priority 1
<i>Caladenia harringtoniae</i>	T	Threatened
<i>Calectasia cyanea</i>	T	Threatened
<i>Chorizema carinatum</i>	3	Priority 3
<i>Conospermum spectabile</i>	2	Priority 2
<i>Conostylis misera</i>	T	Threatened
<i>Corybas abditus</i>	3	Priority 3
<i>Corybas limpidus</i>	4	Priority 4
<i>Degelia flabellata</i>	2	Priority 2
<i>Drakaea micrantha</i>	T	Threatened
<i>Drosera fimbriata</i>	4	Priority 4
<i>Gonocarpus pusillus</i>	4	Priority 4
<i>Goodenia filiformis</i>	3	Priority 3
<i>Gyrostemon thesioides</i>	2	Priority 2
<i>Hakea tuberculata</i>	3	Priority 3
<i>Isopogon uncinatus</i>	T	Threatened
<i>Laxmannia jamesii</i>	4	Priority 4
<i>Lepidium pseudotasmanicum</i>	4	Priority 4
<i>Leucopogon alternifolius</i>	3	Priority 3
<i>Leucopogon altissimus</i>	3	Priority 4
<i>Leucopogon bracteolaris</i>	2	Priority 2
<i>Leucopogon cymbiformis</i>	2	Priority 2
<i>Lysinema lasianthum</i>	4	Priority 4
<i>Melaleuca diosmifolia</i>	3	Priority 3
<i>Microtis pulchella</i>	4	Priority 4
<i>Microtis quadrata</i>	4	Priority 4
<i>Petrophile longifolia</i>	3	Priority 3
<i>Poa billardiarei</i>	1	Priority 1
<i>Prasophyllum paulineae</i>	1	Priority 1
<i>Spyridium spadiceum</i>	2	Priority 2
<i>Stylidium articulatum</i>	2	Priority 2

REPORT ITEM PD093 REFERS

<i>Stylidium beagleholei</i>	3	Priority 3
<i>Stylidium falcatum</i>	1	Priority 1
<i>Synaphea preissii</i>	3	Priority 3
<i>Thelymitra variegata</i>	3	Priority 3
<i>Thomasia discolor</i>	4	Priority 4
<i>Thomasia multiflora</i>	1	Priority 1
<i>Thomasia solanacea</i>	4	Priority 4
<i>Thysanotus isantherus</i>	3	Priority 3
<i>Verticordia endlicheriana</i> var. <i>angustifolia</i>	3	Priority 3

APPENDIX G

Description of Priority Flora – YSPA

Description of Priority Flora***Leucopogon alternifolius* (Priority 3)**

Leucopogon alternifolius is an erect or semi erect scrambling shrub 0.1 to 2m tall (Florabase, 2012). It flowers between August and December and occurs in association with grey/white sands in swampy, seasonally wet areas. The species is distributed in the south west province of WA, including the Jarrah Forest and Warren IBRA regions (Southern Jarrah Forest and Warren subregions). Florabase (2012) lists 13 records of the species which:

- Can be common where it is found;
- Is associated with low woodland, wetlands, peaty sands, laterite and with *Eucalyptus staeri* and *Melaleuca preissiana*,
- Occurs between Walpole, Nornalup, Frankland National Park, Denmark, Mt Romance, Trent, Walpole-Nornalup National Park, Marbelup, Kentdale, West Cape Howe National Park and Albany district.

This species was identified in the flora survey carried out in Lot 4743 North Road (Sandiford, 2005).

***Andersonia depressa* (Priority 4)**

Andersonia depressa is a straggling prostrate shrub up to 0.1m high. It flowers between August and September and grows in white to grey sands, sandy gravel and clay on hills, flats and gentle slopes. The species is distributed in the south-west of WA in the bioregions of Esperance Sand Plains and Jarrah Forest (Florabase, 2012). Florabase (2012) lists 27 records of the species which:

- Is often locally common where it is found;
- Occurs in association with vegetation in woodlands and heath containing *Eucalyptus marginata*, *Allocasuarina fraseriana*, *Agonis flexuosa* and *Banksia* spp;
- Occurs in the following locations: Bayonet Head, Gull Rock National Park, Emu Point, Hay, Mt Clarence, Mt Martin, Lower Kalgan, Cheynes, Lower King, Bakers Junction Reserve, Kalgan, Marbelup and Redmond.

This species was identified in flora surveys undertaken in Lots 997 and 998 Mason Road (ENV, 2006) and Lot 4743 North Road (Sandiford, 2005).

***Laxmannia jamesii* (Priority 4)**

Laxmannia jamesii (James' Paperlily) is endemic to Western Australia and is known from 38 populations, with a wide distribution between the towns of Cowaramup and Kalgan. The majority of the populations are found on conservation estates, eight occur on road verges, four occur on shire reserves; four occur on private property, three occur in State Forest and one is on a Crown Reserve used as parkland (DEWHA, 2008b). There are at least 3000 plants, with the largest population having 1000 mature plants and occurring on conservation estate. The majority of the populations are considered stable and healthy. The extent of occurrences of James' Paperlily is estimated to be over

18,000km² (DEWHA, 2008b after DEC, 2008). Due to its minute size and its tendency to germinate after fire, this species is easily overlooked and it may be more widespread than reporting suggests.

This species was identified in the flora survey carried out in Lot 4743 North Road (Sandiford, 2005).

***Agrostocrinum scabrum* subsp. *littorale* Keighery (Priority 2)**

Agrostocrinum scabrum subsp. *littorale* Keighery is a rhizomatous herb (10-20cm) with dark blue flowers. This subspecies is known from two locations – Mount Manypeaks (just above the seas in sandy clay over granite, locally common) and Mutton Bird Island (adjacent to large granite rocks in granitic loam over granite).

While *Agrostocrinum scabrum* has been recorded in Lots 997 and 998 Mason Road, it is not clear if it is subspecies *littorale*. The status of this species needs to be clarified.

APPENDIX H

Fauna List – Region and YSPA

REPORT ITEM PD093 REFERS

VERTEBRATE SPECIES RECORDED OR PREDICTED TO OCCUR IN THE YAKAMIA STRUCTURE PLAN AREA

Endangered: Endangered species listed as Threatened under the *EPBC Act 1999*

Vulnerable: Vulnerable species listed as Threatened under the *EPBC Act 1999*

MMB: Migratory Marine Bird under *EPBC Act 1999*

MTS: Migratory Marine Bird under *EPBC Act 1999*

MWS: Migratory Wetlands Bird *EPBC Act 1999*

LMS: Listed Marine Species *EPBC Act 1999*

Threatened: Species listed as Threatened under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the Wildlife Conservation Act 1950

IA: Birds Protected Under International Agreement (DEC Database and EPBC Act)

S: Species listed as 'other specially protected fauna' that is in need of special protection under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the Wildlife Conservation Act 1950

Priority: Species listed on the DEC's Priority Fauna list

X: Species recorded in YSPA and/or in the Region

21: Number of individuals recorded during the survey

* : introduced species

^ Data from Coffey Environments 2008

Species Predicted to Occur within 5km of YSPA	Common Name	Status	Fauna Recorded in the Region	Bayonet Head [^]	Emu Point [^]	Yakamia (Study area shown in
AMPHIBIANS						
Hylidae (Tree frogs)						
<i>Litoria adelaidensis</i>			X	2		
<i>Litoria cyclorhyncha</i>			X			
<i>Litoria moorei</i>			X	13	4	3
Myobatrachidae (Ground frogs)						
<i>Crinia georgiana</i>			X	129		75
<i>Crinia glauerti</i>			X			
<i>Crinia pseudinsignifera</i>			X	7	2	2
<i>Crinia subinsignifera</i>			X			
<i>Geocrinia leai</i>			X			
<i>Heleioporus eyrei</i>			X	182	64	46
<i>Heleioporus psammophilus</i>			X			
<i>Limnodynastes dorsalis</i>			X	38	2	36
<i>Neobatrachus albipes</i>						
<i>Neobatrachus pelobatoides</i>						
<i>Pseudophryne guentheri</i>			X			
REPTILES						
Boidae (Pythons)						
<i>Morelia spilota imbricata</i>	Carpet Python	S	X			
Cheluidae (Tortoises)						
<i>Chelodina oblonga</i>	Long-necked Tortoise					
Elapidae (Elapid snakes)						
<i>Echiopsis curta</i>			X	2		
<i>Elapognathus coronatus</i>			X	10	26	25
<i>Elapognathus minor</i>	Short-nosed Snake	Priority 2	X			
<i>Notechis scutatus</i>	Tiger Snake		X	2	5	1
<i>Pseudonaja affinis</i>	Dugite		X			
<i>Rhinoplocephalus bicolor</i>			X			2
Gekkonidae (Geckoes)						
<i>Christinus marmoratus</i>			X			
Pygopodidae (Legless lizards)						
<i>Aprasia striolata</i>			X	2	4	5
<i>Delma australis</i>			X			
<i>Delma fraseri</i>						
<i>Pygopus lepidopus</i>			X			
Scincidae (Skinks)						

REPORT ITEM PD093 REFERS

Species Predicted to Occur within 5km of YSPA	Common Name	Status	Fauna Recorded in the Region	Bayonet Head^	Emu Point^	Yakamia (Study area shown in
<i>Acritoscincus trilineatum</i>			X	132	41	76
<i>Cryptoblepharus plagioccephalus</i>						
<i>Ctenotus catenifer</i>			X	62	82	4
<i>Ctenotus gemmula</i>			X			
<i>Ctenotus impar</i>						
<i>Ctenotus labillardieri</i>			X	3		
<i>Egernia kingii</i>			X	12	2	3
<i>Egernia luctuosa</i>			X	9		2
<i>Egernia napoleonis</i>			X	38	2	34
<i>Egernia pulchra</i>			X	27	14	14
<i>Glaphyromorphus gracilipes</i>				30	5	2
<i>Hemiergis initialis</i>				2		3
<i>Hemiergis peronii peronii</i>			X	113	27	133
<i>Lerista distinguenda</i>						
<i>Lerista microtis</i>			X	39	85	42
<i>Menetia greyii</i>			X	5		4
<i>Morethia obscura</i>			X	4	2	
<i>Tiliqua occipitalis</i>			X			
<i>Tiliqua rugosa</i>	Bobtail		X	38		10
Typhlopidae (Blind snakes)						
<i>Ramphotyphlops australis</i>			X			
Varanidae (Goannas)						
<i>Varanus rosenbergi</i>			X	1		4
BIRDS						
Acanthizidae (Thornbills)						
<i>Acanthiza apicalis</i>	Inland Thornbill		X	660	72	119
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped		X	157		21
<i>Acanthiza inornata</i>	Western Thornbill		X	17	24	43
<i>Gergone fusca</i>	Western Gerygone		X	611	19	138
<i>Sericornis frontalis</i>	White-browed		X	469	143	104
<i>Smicronis brevirostris</i>	Weebill					
<i>Hylacola cauta</i>	Shy Heathwren					
Accipitridae (Kites and Eagles)						
<i>Hamirostra isura</i>	Square-tailed Kite		X			2
<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk		X	4		
<i>Elanus axillaris</i>	Black-shouldered Kite		X	7	2	1
<i>Haliastur sphenurus</i>	Whistling Kite			3		1
<i>Accipiter fasciatus</i>	Brown Goshawk		X	1		4
<i>Circus assimilis</i>	Spotted Harrier					
<i>Circus approximans</i>	Swamp Harrier			1		2
<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle	IA/ MTS/ LMS				
<i>Aquila audax</i>	Wedge-tailed Eagle					
<i>Aquila morphnoides</i>	Little Eagle			7		1
<i>Pandion haliaetus</i>	Osprey	IA	X	10	2	
Aegothelidae (Owlet-nightjars)						
<i>Aegotheles cristatus</i>	Australian Owlet-		X	4		2
Anatidae (Ducks)						
<i>Anas superciliosa</i>	Pacific Black Duck		X	3		12
<i>Anas gibberifrons</i>	Grey Teal			1		
<i>Anas castanea</i>	Chestnut Teal		X			
<i>Anas rynchotis</i>	Australian Shoveler		X			
<i>Tadorna tadornoides</i>	Australian Shelduck			1		
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck					
<i>Aythya australis</i>	Hardhead					
<i>Chenonetta jubata</i>	Wood Duck		X	2		
<i>Oxyura australis</i>	Blue-billed Duck		X			
<i>Biziura lobata</i>	Musk Duck		X			
<i>Cygnus atratus</i>	Black Swan					

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Anhingidae (Darters)						
<i>Anhinga melanogaster</i>	Darter					
Apodidae						
<i>Apus pacificus</i>	Fork-tailed Swift	MMB/ LMS				
Ardeidae (Herons and Egrets)						
<i>Ardea alba</i>	Great Egret	IA/ MMB/ MWS/ LMS				
<i>Ardea modesta</i>	Eastern Great Egret	IA				
<i>Ardea pacifica</i>	Pacific Heron		X			
<i>Ardea ibis</i>	Cattle Egret	MMB/ MWS/				
<i>Ardea garzetta</i>	Little Egret					
<i>Ardea novaehollandiae</i>	White-faced Heron		X	12		4
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Threatened/ Endangered				
<i>Egretta sacra</i>	Eastern Reef Egret, Eastern Reef Heron	IA				
<i>Nycticorax caledonicus</i>	Rufous Night Heron					
Artamidae (Woodswallows)						
<i>Artamus personatus</i>	Dusky Woodswallow					
<i>Artamus cinereus</i>	Black-faced					
Atrichornithidae (Scrub Birds)						
<i>Atrichornis clamosus</i>	Noisy Scrub-bird	Threatened/ Vulnerable				
Campephagidae (Cuckoo-shrike)						
<i>Coracina novaehollandiae</i>	Black- faced Cuckoo-					
<i>Lalage tricolor</i>	White-winged Triller					
Caprimulgidae (Nightjars)						
<i>Eurostopodus argus</i>	Spotted Nightjar					
Casuriidae (Emu and Cassowary)						
<i>Dromaius novaehollandiae</i>	Emu					1
Charadriidae (Plovers and Dotterels)						
<i>Vanellus tricolor</i>	Banded Lapwing		X			
<i>Charadrius ruficapillus</i>	Red-capped Plover					
<i>Charadrius leschenaultii</i>	Greater Sand Plover	IA				
<i>Charadrius melanops</i>	Black-fronted Plover					2
<i>Charadrius mongolus</i>	Lesser Sand Plover	IA				
<i>Pluvialis fulva</i>	Pacific Golden Plover	IA				
<i>Pluvialis squatarola</i>	Grey Plover	IA				
Climacteriidae (Trecreepers)						
<i>Climacteris rufa</i>	Rufous Trecreeper			4		
Columbidae (Pigeons and Doves)						
<i>Phaps chalcoptera</i>	Common Bronzewing		X	306	92	117
<i>Ocyphaps lophotes</i>	Crested Pigeon			15	1	
<i>Phaps elegans</i>	Brush Bronzewing		X			
<i>Streptopelia senegalensis</i>	Laughing Turtle-dove			45	19	20
Corvidae (Crows and Ravens)						
<i>Corvus coronoides</i>	Australian Raven			162	34	76
Cracticidae (Butcherbirds and						
<i>Cracticus tibicen</i>	Australian Magpie		X	313	41	73
<i>Cracticus torquatus</i>	Grey Butcherbird				14	
<i>Strepera versicolor</i>	Grey Currawong		X	8		18
Cuculidae (Cuckoos)						
<i>Chrysococcyx basalis</i>	Horsfield's Bronze		X			3
<i>Cuculus pallidus</i>	Pallid Cuckoo					
<i>Chrysococcyx lucidus</i>	Shining Bronze Cuckoo		X	20		7
<i>Cuculus flabelliformis</i>	Fan-tailed Cuckoo			5	1	1
Dasyornithidae (Bristlebirds)						
<i>Dasyornis longirostris</i>	Western Bristlebird	Threatened				
Diomedidae (Albatross)						

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<i>Thalassarche chlororhynchos</i>	Atlantic Yellow-nosed Albatross	Threatened				
<i>Diomedea chlororhynchos subsp. carteri</i>	Indian Yellow-nosed Albatross	Threatened				
<i>Diomedea exulans subsp. exulans</i>	Tristan Albatross	Threatened				
Dicruridae (Flycatchers)						
<i>Rhipidura fuliginosa</i>	Grey Fantail		X	759	65	290
<i>Rhipidura leucophrys</i>	Willie Wagtail			21	2	
<i>Myiagra inquieta</i>	Restless Flycatcher		X			
<i>Grallina cyanoleuca</i>	Magpie-lark		X	33	17	4
Falconidae (Falcons)						
<i>Falco longipennis</i>	Australian Hobby		X	1		
<i>Falco berigora</i>	Brown Falcon		X			
<i>Falco cenchroides</i>	Australian Kestrel		X	23		3
<i>Falco peregrinus</i>	Peregrine Falcon	S	X			
Halcyonidae (Kingfishers)						
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	*	X	87	3	16
<i>Todiramphus sanctus</i>	Sacred Kingfisher		X	1		2
Hirundinidae (Swallows)						
<i>Hirundo neoxena</i>	Welcome Swallow		X	162	3	6
<i>Hirundo nigricans</i>	Tree Martin			241	9	43
Laridae (Gulls and Terns)						
<i>Larus novaehollandiae</i>	Silver Gull		X	8	51	13
<i>Larus pacificus</i>	Pacific Gull				4	
<i>Sterna caspia</i>	Caspian Tern	IA				
Maluridae (Fairy-wrens)						
<i>Malurus splendens</i>	Splendid Fairy-wren		X	471	79	279
<i>Malurus elegans</i>	Red-winged Fairy-wren		X	853	253	295
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-					
<i>Stipiturus malachurus</i>	Southern Emu-wren		X	451	132	9
Megapodiidae						
<i>Leipoa ocellata</i>	Malleefowl	Threatened/ Vulnerable				
Meliphagidae (Honeyeaters)						
<i>Acanthorhynchus superciliosus</i>	Western Spinebill		X	626	146	97
<i>Lichenostomus virescens</i>	Singing Honeyeater					
<i>Anthochaera carunculata</i>	Red Wattlebird		X	145	39	49
<i>Lichmera indistincta</i>	Brown Honeyeater			20		18
<i>Phylidonyris novaehollandiae</i>	New Holland		X	772	845	361
<i>Anthochaera lunulata</i>	Western Little					
<i>Phylidonyris nigra</i>	White-cheeked					
<i>Phylidonyris melanops</i>	Tawny-crowned		X			
<i>Melithreptus brevirostris</i>	Brown-headed					
<i>Lichenostomus ornatus</i>	Yellow-plumed					
<i>Melithreptus albogularis</i>	White-throated					
<i>Melithreptus lunatus</i>	White-naped			3		
<i>Epthianura albifrons</i>	White-fronted Chat			1		11
<i>Manorina flavigula</i>	Yellow-throated Miner		X			
Meropidae						
<i>Merops ornatus</i>	Rainbow Bee-eater	MTS/ LMS				
Motacillidae (Pipits)						
<i>Anthus australis</i>	Richard's Pipit		X	4		
Neosittidae (Sittelas)						
<i>Daphoenositta chrysoptera</i>	Varied Sittella		X	8		
Otididae (Bustards)						
<i>Ardeotis australis</i>	Australian Bustard	Priority 4				
Pachycephalidae (Whistlers, Shrike-thrush)						
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		X	49	16	31

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<i>Pachycephala rufiventris</i>	Rufous Whistler					
<i>Pachycephala pectoralis</i>	Golden Whistler		X	337	58	128
<i>Oreoica gutturalis gutturalis</i>	Crested Bellbird	Priority 4				
Pardalotidae (Pardalotes)						
<i>Pardalotus striatus</i>	Striated Pardalote		X	3		
<i>Pardalotus punctatus</i>	Spotted Pardalote		X	73	15	2
Passeridae (Finches)						
<i>Stagonopleura oculata</i>	Red-eared Firetail		X	42	17	33
Pelecanidae (Pelicans)						
<i>Pelecanus conspicillatus</i>	Australian Pelican		X	6	7	1
Petroicidae (Robins)						
<i>Eopsaltria australis griseogularis</i>	Western Yellow Robin		X			
<i>Eopsaltria georgiana</i>	White-breasted Robin		X	40		33
<i>Petroica multicolor</i>	Scarlet Robin			60		5
Phalacrocoracidae (Cormorants)						
<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant			3		
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant			1	3	
<i>Phalacrocorax carbo</i>	Great Cormorant					
<i>Phalacrocorax varius</i>	Pied Cormorant					
Phasianidae (Quails)						
<i>Coturnix novaezelandiae</i>	Stubble Quail			2		
<i>Coturnix ypsilophora</i>	Brown Quail					
Podargidae (Frogmouths)						
<i>Podargus strigoides</i>	Tawny Frogmouth		X	1		2
Podicipedidae (Grebes)						
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe		X			
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe		X			
Pomatostomidae (Babblers)						
<i>Pomatostomus superciliosus</i>	White-browed Babbler					
Procellariidae						
<i>Ardenna carneipes</i>	Fleshy-footed	IA				
<i>Macronectes giganteus</i>	Southern Giant Petrel	Priority 4				
<i>Puffinus carneipes</i>	Fleshy-footed	IA				
Psittacidae (Parrots and lorikeets)						
<i>Cacatua roseicapilla</i>	Galah		X	24	27	
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo	Threatened/ Vulnerable	X	54		9
<i>Calyptorhynchus baudinii</i>	Baudin's Black-Cockatoo	Threatened/ Vulnerable				X
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo	Threatened/ Endangered		21	13	16
<i>Glossopsitta porphyrocephala</i>	Purple-crowned		X	63	51	46
<i>Neophema elegans</i>	Elegant Parrot		X	18	15	10
<i>Platycercus icterotis</i>	Western Rosella		X	160	24	32
<i>Platycercus spurius</i>	Red-capped Parrot		X	339	79	96
<i>Platycercus zonarius</i>	Australian Ringneck		X		13	24
<i>Polytelis anthopeplus</i>	Regent Parrot		X			
Rallidae (Crakes, Coots and Rails)						
<i>Porzana tabuensis</i>	Spotless Crake		X			
<i>Porzana fluminea</i>	Australian Spotted					
<i>Porzana pusilla</i>	Baillon's Crake					
<i>Fulica atra</i>	Eurasian Coot		X	3		
<i>Porphyrio porphyrio</i>	Purple Swamphen			3		
Recurvirostridae (Stilts and Avocets)						
<i>Himantopus himantopus</i>	Black-winged Stilt					
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet					
Scolopaciade (Curlews and						
<i>Actitis hypoleucos</i>	Actitis hypoleucos	IA				
<i>Arenaria interpres</i>	Ruddy Turnstone	IA				

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<i>Calidris alba</i>	Sanderling	IA				
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	IA				
<i>Calidris alba</i>	Sanderling	IA				
<i>Calidris canutus</i>	Red Knot	IA				
<i>Calidris ferruginea</i>	Curlew Sandpiper	IA				
<i>Calidris ruficollis</i>	Red-necked Stint	IA				
<i>Calidris tenuirostris</i>	Great Knot	IA				
<i>Limosa lapponica</i>	Bar-tailed Godwit	IA				
<i>Numenius phaeopus</i>	Whimbrel	IA				
<i>Philomachus pugnax</i>	Ruff	IA				
<i>Tringa brevipes</i>	Grey-tailed Tattler	IA				
<i>Tringa glareola</i>	Wood Sandpiper	IA				
<i>Tringa hypoleucos</i>	Common Sandpiper	IA				
<i>Tringa nebularia</i>	Common Greenshank	IA				
<i>Tringa stagnatilis</i>	Marsh Sandpiper	IA				
<i>Xenus cinereus</i>	Terek Sandpiper	IA				
Strigidae (Owls)						
<i>Ninox novaeseelandiae</i>	Southern Boobook Owl		X	X		X
Sylviidae (Old World Warblers)						
<i>Megalurus gramineus</i>	Little Grassbird		X			
<i>Cincloramphus cruralis</i>	Brown Songlark					
<i>Cincloramphus matthewsi</i>	Rufous Songlark					
Threskiornithidae (Ibis and						
<i>Threskiornis molucca</i>	Australian White Ibis			21	11	8
<i>Threskiornis spinicollis</i>	Straw-necked Ibis			44		4
<i>Platalea flavipes</i>	Yellow-billed Spoonbill			3	1	
Turnicidae (Quails)						
<i>Turnix varia</i>	Painted Button-Quail					
Tytonidae (Owls)						
<i>Tyto alba</i>	Barn Owl		X			
<i>Tyto novaehollandiae</i>	Masked Owl	Priority 3	X			
Zosteropidae (Silver-eyes)						
<i>Zosterops lateralis</i>	Silvereye		X	1479	636	1511
MAMMALS						
Bovidae (Cows, Goats and Sheep)						
<i>Bos taurus</i>	Cow	*				
<i>Ovis aries</i>	Sheep	*				
Burramyidae (Pygmy-possums)						
<i>Cercartetus concinnus</i>	Western Pygmy Possum		X			
Canidae (Dogs, Foxes, Dingos)						
<i>Canis familiaris</i>	Domestic Dog	*				
<i>Vulpes vulpes</i>	Fox	*		X	X	X
Dasyuridae (Dunnarts, Mardo,						
<i>Dasyurus geoffroii</i>	Chuditch	Threatened/ Vulnerable	X			
<i>Antechinus flavipes</i>	Mardo		X			
<i>Phascogale tapaotafa tapaotafa</i>	Southern Brush-tailed Phascogale	Threatened	X			
<i>Sminthopsis griseoventer</i>	Grey-bellied Dunnart		X		26	60
Equidae (Horses)						
<i>Equus caballus</i>	Horse	*				
Felidae (Cats)						
<i>Felis catus</i>	Cat	*		X	X	X
Leporidae (Rabbits)						
<i>Oryctolagus cuniculus</i>	European Rabbit	*	X	X	X	X
Macropodidae (Kangaroos,						
<i>Macropus fuliginosus</i>	Western Grey Kangaroo		X	X	X	X
<i>Macropus irma</i>	Western Brush Wallaby	Priority 4				

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<i>Setonix brachyurus</i>	Quokka	Threatened/ Vulnerable				
Molossidae (Freetail Bats)						
<i>Tadarida australis</i>	White-striped Freetail			X		
<i>Mormopterus planiceps</i>	Western Freetail Bat					
Muridae (Mice, Rats)						
<i>Mus musculus</i>	House Mouse	*	X	16	6	52
<i>Hydromys chrysogaster</i>	Water Rat	Priority 4	X			
<i>Pseudomys albocinereus</i>	Ash-grey Mouse		X			
<i>Pseudomys occidentalis</i>	Western Mouse	Priority 4				
<i>Rattus fuscipes</i>	Bush Rat		X	524	182	298
<i>Rattus rattus</i>	Black Rat	*	X			
Peramelidae (Bandicoots)						
<i>Isoodon obesulus fusciventer</i>	Southern Brown	Priority 5	X	4	1	2
Phalangeridae (Brush-tail Possums)						
<i>Trichosurus vulpecula</i>	Brush-tail possum		X			
Pseudocheiridae (Ringtail Possums)						
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	Threatened/ Vulnerable	X	X	X	X
Tachyglossidae (Echidnas)						
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna					
Tarsipedidae (Honey Possum)						
<i>Tarsipes rostratus</i>	Honey Possum		X	29	24	1
Vespertilionidae (Evening Bats)						
<i>Chalinolobus morio</i>	Chocolate Wattled Bat		X	X		X
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			X		X
<i>Falsistrellus mackenziei</i>	Western False			X		
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat		X			
<i>Nyctophilus gouldii</i>	Goulds Long-eared Bat		X			
<i>Nyctophilus timoriensis</i>	Greater Long-eared Bat		X			
<i>Vespadelus regulus</i>	Southern Forest Bat		X	X		X

APPENDIX I

DEC Threatened and Priority Fauna Database



Government of **Western Australia**
Department of **Environment and Conservation**

Your ref: CAL-2012-004
Our ref: 2012/001079 #4387
Enquiries: Abby Thomas
Phone: (08) 9219 8636
Fax: (08) 9334 0278
Email: fauna.data@dec.wa.gov.au

Aurora Environmental
Attn: Melanie Price
2A Nakina Street
ALBANY WA 6330

Dear Melanie,

REQUEST FOR THREATENED FAUNA INFORMATION

I refer to your requests of 23rd November 2012 for information on threatened fauna occurring in the vicinity of the Yakamie-Lange, City of Albany.

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

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

An invoice for \$300.00 (plus GST), being the set charge for the supply of this information, will be forwarded.

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

If you require any further details, or wish to discuss threatened fauna management, please contact my Principal Zoologist, Dr Peter Mawson on 08 9334 0421.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'D. Mawson'.

.....
Threatened Fauna Database Officer
for DIRECTOR GENERAL
Department of Environment and Conservation

6 December 2012

Attachment

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

THREATENED FAUNA INFORMATION

Conditions In Respect Of Supply Of Information

- * All requests for data to be made in writing to the Executive Director, Department of Environment and Conservation, Attention: Principal Zoologist, Species and Communities Branch.
- * The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided without the prior consent of the Executive Director, Department of Environment and Conservation
- * Specific locality information for Threatened Fauna is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for Threatened Fauna may not be used in reports without the written permission of the Executive Director, Department of Environment and Conservation. Reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Principal Zoologist is to be contacted for guidance on the presentation of Threatened Fauna information.
- * Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Environment and Conservation accepts no responsibility for this.
- * Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
- * It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened Fauna of the area in question. Its comprehensiveness is dependent of the amount of survey carried out within a specified area. The receiving organisation should employ a biologist/zoologist, if required, to undertake a survey of the area under consideration.
- * Acknowledgment of the Department of Environment and Conservation as the source of data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention; Principal Zoologist, Species and Communities Branch.

Species Name	Common Name	Conservation Status - <i>Wildlife Conservation Act 1950</i>
Invertebrates		
<i>Helicarion castanea</i>	Albany land snail	Presumed Extinct
Reptiles		
<i>Caretta caretta</i>	Loggerhead Turtle	Threatened
<i>Dermochelys coriacea</i>	Leatherback Turtle	Threatened
<i>Elapognathus minor</i>	Short-nosed Snake	Priority 2
<i>Morelia spilota subsp. imbricata</i>	Carpet Python	Schedule 4: In need of special protection
Birds		
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Birds Protected Under International Agreement
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Threatened
<i>Atrichornis clamosus</i>	Noisy Scrub-bird	Threatened
<i>Pluvialis fulva</i>	Pacific Golden Plover	Birds Protected Under International Agreement
<i>Pluvialis squatarola</i>	Grey Plover	Birds Protected Under International Agreement
<i>Dasyornis longirostris</i>	Western Bristlebird	Threatened
<i>Sterna caspia</i>	Caspian Tern	Birds Protected Under International Agreement
<i>Leipoa ocellata</i>	Malleefowl	Threatened
<i>Ardeotis australis</i>	Australian Bustard	Priority 4
<i>Macronectes giganteus</i>	Southern Giant Petrel	Priority 4
<i>Puffinus carneipes</i>	Fleshy-footed Shearwater	Birds Protected Under International Agreement
<i>Calyptorhynchus banksii subsp. naso</i>	Forest Red-tailed Black-Cockatoo	Threatened
<i>Calyptorhynchus baudinii</i>	Baudin's Cockatoo (long-billed black-cockatoo)	Threatened
<i>Calyptorhynchus latirostris</i>	Carnaby's Cockatoo (short-billed black-cockatoo)	Threatened
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Birds Protected Under International Agreement
<i>Calidris alba</i>	Sanderling	Birds Protected Under International Agreement
<i>Calidris ferruginea</i>	Curlew Sandpiper	Birds Protected Under International Agreement
<i>Calidris ruficollis</i>	Red-necked Stint	Birds Protected Under International Agreement
<i>Calidris tenuirostris</i>	Great Knot	Birds Protected Under International Agreement

REPORT ITEM PD093 REFERS

<i>Philomachus pugnax</i>	Ruff	Birds Protected Under International Agreement
<i>Tringa brevipes</i>	Grey-tailed Tattler	Birds Protected Under International Agreement
<i>Tringa nebularia</i>	Common Greenshank	Birds Protected Under International Agreement
<i>Tringa stagnatilis</i>	Marsh Sandpiper	Birds Protected Under International Agreement
<i>Tyto novaehollandiae subsp. novaehollandiae</i>	Masked Owl (southern subsp)	Priority 3
<i>Ardea ibis</i>	Cattle Egret	Birds Protected Under International Agreement
<i>Charadrius leschenaultii</i>	Greater Sand Plover	Birds Protected Under International Agreement
<i>Charadrius mongolus</i>	Lesser Sand Plover	Birds Protected Under International Agreement
<i>Falco peregrinus</i>	Peregrine Falcon	Fauna in need of special Protection
<i>Arenaria interpres</i>	Ruddy Turnstone	Birds Protected Under International Agreement
<i>Arenaria interpres</i>	Ruddy Turnstone	Birds Protected Under International Agreement
<i>Calidris canutus</i>	Red Knot	Birds Protected Under International Agreement
<i>Numenius phaeopus</i>	Whimbrel	Birds Protected Under International Agreement
<i>Diomedea exulans subsp. exulans</i>	Tristan Albatross	Threatened
<i>Diomedea chlororhynchos subsp. carteri</i>	Indian Yellow-nosed Albatross	Threatened
<i>Limosa lapponica</i>	Bar-tailed Godwit	Birds Protected Under International Agreement
<i>Thalassarche chlororhynchos</i>	Atlantic Yellow-nosed Albatross	Threatened
<i>Actitis hypoleucos</i>	Common Sandpiper	Birds Protected Under International Agreement
<i>Ardea modesta</i>	Eastern Great Egret	Birds Protected Under International Agreement
<i>Ardenna carneipes</i>	Fleshy-footed Shearwater	Birds Protected Under International Agreement
<i>Egretta sacra</i>	Eastern Reef Egret, Eastern Reef Heron	Birds Protected Under International Agreement
<i>Xenus cinereus</i>	Terek Sandpiper	Birds Protected Under International Agreement
Mammals		
<i>Physeter macrocephalus</i>	Sperm Whale	Priority 4
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	Threatened

REPORT ITEM PD093 REFERS

<i>Phascogale tapoatafa subsp. tapoatafa</i>	Southern Brush-tailed Phascogale, Wambenger	Threatened
<i>Macropus irma</i>	Western Brush Wallaby	Priority 4
<i>Setonix brachyurus</i>	Quokka	Threatened
<i>Isoodon obesulus subsp. fusciventer</i>	Quenda, Southern Brown Bandicoot	Priority 5
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	Threatened
<i>Arctocephalus forsteri</i>	New Zealand Fur Seal	Schedule 4: In need of special protection
<i>Neophoca cinerea</i>	Australian Sea Lion	Schedule 4: In need of special protection
<i>Hydromys chrysogaster</i>	Water-rat	Priority 4
<i>Pseudomys occidentalis</i>	Western Mouse	Priority 4

APPENDIX J

Matters of National Significance – EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from the actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

<u>Commonwealth Lands:</u>	1
<u>Commonwealth Heritage Places:</u>	None
<u>Listed Marine Species:</u>	5
<u>Whales and Other Cetaceans:</u>	None
<u>Critical Habitats:</u>	None
<u>Commonwealth Reserves:</u>	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

Place on the RNE:	2
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		
<u>Atrichornis clamosus</u> Noisy Scrub-bird [654]	Vulnerable	Species or species habitat known to occur within area

Name	Status	Type of Presence
<u>Botaurus poiciloptilus</u> Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
<u>Calyptorhynchus banksii naso</u> Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
<u>Calyptorhynchus baudinii</u> Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Breeding known to occur within area
<u>Calyptorhynchus latirostris</u> Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
<u>Leipoa ocellata</u> Malleefowl [934]	Vulnerable	Species or species habitat may occur within area

MAMMALS

<u>Dasyurus geoffroi</u> Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
<u>Pseudocheirus occidentalis</u> Western Ringtail Possum [25911]	Vulnerable	Species or species habitat likely to occur within area
<u>Setonix brachyurus</u> Quokka [229]	Vulnerable	Species or species habitat may occur within area

PLANTS

<u>Banksia brownii</u> Brown's Banksia, Feather-leaved Banksia [8277]	Endangered	Species or species habitat likely to occur within area
<u>Caladenia harringtoniae</u> Harrington's Spider-orchid, Pink Spider-orchid [56786]	Vulnerable	Species or species habitat likely to occur within area
<u>Centrolepis caespitosa</u> [6393]	Endangered	Species or species habitat likely to occur within area
<u>Chordifex abortivus</u> Manypeaks Rush [64868]	Endangered	Species or species habitat likely to occur within area
<u>Conostylis misera</u> Grass Conostylis [21320]	Endangered	Species or species habitat may occur within area
<u>Diuris drummondii</u> Tall Donkey Orchid [4365]	Vulnerable	Species or species habitat likely to occur within area
<u>Drosera fimbriata</u> Manypeaks Sundew [18749]	Vulnerable	Species or species habitat known to occur within area
<u>Isopogon uncinatus</u> Hook-leaf Isopogon [20871]	Endangered	Species or species habitat likely to occur within area
<u>Sphenotoma drummondii</u> [21160]	Endangered	Species or species habitat may occur within area

Migratory Species

[Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
------	------------	------------------

Name	Threatened	Type of Presence
Migratory Marine Birds		
<u>Apus pacificus</u> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<u>Ardea alba</u> Great Egret, White Egret [59541]		Species or species habitat may occur within area
<u>Ardea ibis</u> Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
<u>Haliaeetus leucogaster</u> White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<u>Leipoa ocellata</u> Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
<u>Merops ornatus</u> Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
<u>Ardea alba</u> Great Egret, White Egret [59541]		Species or species habitat may occur within area
<u>Ardea ibis</u> Cattle Egret [59542]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [\[Resource Information \]](#)

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
<u>Apus pacificus</u> Fork-tailed Swift [678]		Species or species habitat likely to occur within area
<u>Ardea alba</u> Great Egret, White Egret [59541]		Species or species habitat may occur within area
<u>Ardea ibis</u> Cattle Egret [59542]		Species or species habitat may occur within area
<u>Haliaeetus leucogaster</u> White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
<u>Merops ornatus</u> Rainbow Bee-eater [670]		Species or species habitat may occur within area

Extra Information

Places on the RNE

[Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Indigenous <u>Mount Melville Area</u>	WA	Indicative Place
Historic <u>Matthew Culls House (former)</u>	WA	Indicative Place

Invasive Species

[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resources Audit,

Name	Status	Type of Presence
Mammals		
<u>Felis catus</u> Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
<u>Oryctolagus cuniculus</u> Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
<u>Sus scrofa</u> Pig [6]		Species or species habitat likely to occur within area
<u>Vulpes vulpes</u> Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
<u>Asparagus asparagoides</u> Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
<u>Genista sp. X Genista monspessulana</u> Broom [67538]		Species or species habitat may occur within area
<u>Lantana camara</u> Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
<u>Lycium ferocissimum</u> African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
<u>Pinus radiata</u> Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
<u>Rubus fruticosus aggregate</u> Blackberry, European Blackberry [68406]		Species or species habitat likely to occur

Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii

Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]

Species or species habitat likely to occur within area

Ulex europaeus

Gorse, Furze [7693]

Species or species habitat likely to occur within area

Coordinates

-34.985413 117.880778,-34.985032 117.901793,-34.983281 117.905067,-34.987012 117.906438,-34.997444 117.906133,-34.997368 117.902631,-34.998814 117.899357,
-35.002088 117.896387,-35.004068 117.893113,-35.00521 117.888925,-35.009627 117.887707,-35.003764 117.868823,-34.99851 117.872097,-34.988383 117.876514,
-34.988535 117.87994,-34.988535 117.87994,-34.985413 117.880778

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)

- [-Department of Environment and Conservation, Western Australia](#)
- [-Department of the Environment, Climate Change, Energy and Water](#)
- [-Birds Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-SA Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Atherton and Canberra](#)
- [-University of New England](#)
- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence](#)
- [-State Forests of NSW](#)
- [-Other groups and individuals](#)

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

[Please feel free to provide feedback via the Contact Us page.](#)

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APPENDIX K

Description of Conservation Significant Fauna -
Present or Likely to be Present in YSPA

Description of Conservation Significant Fauna -Present or Likely to be Present in YSPA**Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)**

The Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) is listed as Threatened under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950* and *EPBC Act 1999*. The level of threat is listed as 'Vulnerable' which means the species is facing a high risk of extinction in the wild. This species is found in the south west of Western Australia and inhabits dense Jarrah, Karri and Marri forests in areas that receive more than 600mm average rainfall annually (DSEWPC, 2012a). Habitat at YSPA which is most likely to be utilised by this Cockatoo for foraging and roosting would be the Jarrah/Sheoak woodland and the Jarrah/Albany Blackbutt woodland (Figure 9).

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Threatened under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950* and Endangered under the *EPBC Act 1999* which means the species is facing a very high risk of extinction in the wild. The species is endemic to and widespread in the south-west of Western Australia and occurs mostly in the Wheatbelt (areas with between 300mm and 750mm of rainfall annually) and wetter regions including the Swan Coastal Plain and South Coast (DSEWPC, 2012b). Its habitat mostly comprises uncleared or remnant native eucalypt woodlands, especially those that contain Salmon Gum and Wandoo, and in shrubland or kwongan heathland dominated by *Hakea*, *Banksia* and *Grevillea* species. Breeding habitat (or sites) encompasses those areas that contain suitable nest trees within the range of the species. Breeding activity is restricted to eucalypt woodlands mainly in the semiarid and subhumid interior (records from Three Springs District south to the Stirling Range, west to Cockleshell Gully and east to Manmanning). Breeding records indicate that this species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain, including Yanchep area, Lake Clifton and near Bunbury. The birds nest in large hollows in tall, living or dead eucalypts. Suitable hollows can take from 120–150 years to develop. The birds are not known to breed on the South Coast (Birds Australia, pers. Comm.). This species is threatened due to the high level of clearing of native vegetation in the Wheatbelt. Carnaby's black-cockatoos will traverse open space but may not use forage resources isolated from roosting habitat by long stretches of cleared agricultural land. A lack of connectivity between patches is "strongly implicated in the failure of Carnaby's cockatoo to survive in heavily cleared and fragmented rural landscapes" (DSEWPC, 2012b). Corridors with breaks of less than 4 kilometres between other foraging, commuting, breeding and roosting sites are considered important to allow the birds to move between areas. Habitat at YSPA which is most likely to be utilised by this Cockatoo for foraging and roosting would be the Jarrah/Sheoak woodland and the Jarrah/Albany Blackbutt woodland (Figure 9).

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) may also utilise the area and is listed as Threatened under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under

the *Wildlife Conservation Act 1950* and Vulnerable under the *EPBC Act 1999* which means the species is facing a high risk of extinction in the wild. This Cockatoo is found only in the extreme south-west of Western Australia and generally bounded by the 750mm rainfall isohyet (Albany, Gidgegannup and up to Mundaring and inland to the Stirling Ranges and Boyup Brook. Breeding has been recorded between Nornalup, northward to near Bridgetown, Lowden and Harvey (DSEWPC, 2012c). Habitat comprises heavily forested areas dominated by Marri and other Eucalyptus species (particularly Karri and Jarrah). Loss of habitat and forest management practices (not maintaining older trees) has previously impacted on the species. While the threat from habitat loss has largely abated in recent times (DSEWPC, 2012c) there has been an ongoing decline in population numbers due to illegal shooting and competition for nesting hollows with feral bees, compounded by a low annual reproductive rate. Habitat at YSPA which is most likely to be utilised by this Cockatoo for foraging and roosting would be the Jarrah/Sheoak woodland and the Jarrah/Albany Blackbutt woodland (Figure 9).

Western Ring-tail Possum (*Pseudocheirus occidentalis*)

The Western Ring-tail Possum (*Pseudocheirus occidentalis*) is listed as Threatened under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950* and Vulnerable under the *EPBC Act 1999* which means the species is facing a high risk of extinction in the wild. The species has patchy distribution in the south west of Western Australia, occurring most commonly in coastal or near coastal forest that includes Peppermint trees (*Agonis flexuosa*). Habitat loss is likely to be a major cause of modern decline of this species which has a limited ability to disperse and recolonise across fragmented landscapes. A total of eight WRPs were recorded during the December 2006 survey and one WRP was recorded during the March 2007 survey (Figure 9). No Western Ringtail Possum dreys were recorded in the survey area. Coffey Environments (2008) concluded that the species is present in low densities and favours Jarrah/Sheoak Woodland habitat.

Southern Brown Bandicoot or Quenda (*Isodon obesulus fusciventer*)

The Southern Brown Bandicoot or Quenda (*Isodon obesulus fusciventer*) is listed as a Priority 5 species by the DEC. Quenda prefer dense scrub (up to one metre high), often in or near swampy vegetation. They will often feed in adjacent forest and woodland that is burnt and in areas of pasture and cropland lying close to dense cover. Major threats to Quenda include habitat fragmentation and loss of habitat on the Swan Coastal Plain and Wheatbelt, fire in fragmented habitat, predation by foxes, predation of young by cats and predation around residential areas by dogs. Two individuals were recorded in the Jarrah/Albany Blackbutt Woodland habitat in the project area at site YK7. It is possible that the Quenda occurs at low densities in all habitats throughout the project area where suitably dense vegetation occurs. Coffey Environments (2008) concluded that this species is likely to occur in the YSPA in low densities. It is likely that this species will favour dense vegetation where predation is likely to be a lower risk.

Carpet Python (*Morelia spilota subspecies imbricata*)

The Carpet Python (*Morelia spilota subspecies imbricata*) is listed as 'other specially protected fauna' that is in need of special protection under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950*. This subspecies occurs in southern Western Australia and has been recorded in semi-arid coastal and inland habitats including *Banksia* woodland, eucalypt woodlands and grasslands. This species is threatened by loss of habitat relating to clearing of native vegetation and changed fire regimes. This species has been recorded in the region, but not in YSPA. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' based on its wide distribution and tolerance for a broad range of habitats (Shine and Allison, 2010).

Short-nosed Snake (*Elapognathus minor*)

The Short-nosed Snake (*Elapognathus minor*) is listed as Priority 2 Fauna which is defined as fauna which is poorly known. That is, taxa from one or a few collections, some of which are on lands not under imminent threat of habitat destruction or degradation. Species included in this grouping may be comparatively well known from one or more locations but records do not meet adequacy of survey requirements and the species may be under threat from known threatening processes. This species is found along the humid coastal plains of south-west Western Australia from Busselton in the north to Two Peoples Bay east of Albany. Habitat includes open heath, tall open forests and woodlands, swampy areas amongst dunes, in heathland, the dense tussock understorey of coastal woodlands and occasionally in wet sclerophyll forests on sandy soils. The species is not known to have declined, but has a restricted distribution and is therefore sensitive to clearing of habitat. This species has been recorded in the region, but not in the YSPA. The IUCN Red List of Threatened Species has assigned this species a designation of 'low risk/near threatened' (Australasian Reptile and Amphibian Specialist Group, 1996).

Chuditch (*Dasyurus geoffroii*)

The Chuditch is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the *WA Wildlife Conservation Act 1950*. Formerly known from over 70% of Australia, the Chuditch now has a patchy distribution throughout the Jarrah forest and mixed Karri/Marri/Jarrah forest of south-west WA, but they have been found in dry sclerophyll forests, riparian vegetation, beaches and deserts. The Chuditch is able to utilise bush remnants and corridors and its preferred habitat does occur within the project area. However, the Chuditch was not recorded within the project area during either survey. If present, any clearing of vegetation is likely to result in a loss of habitat for this species and individuals will either perish or be forced to move to other remnant habitats.

Quokka (*Setonix brachyurus*)

Quokka (*Setonix brachyurus*) is listed as Vulnerable under the *EPBC Act 1999* and as a Schedule 1 species under the *WA Wildlife Conservation Act 1950*. At the time of European settlement the Quokka was common across the south-west of WA. The current distribution of the Quokka now includes Rottnest and Bald Islands and at least 25 sites on the mainland including Two Peoples Bay,

Torndirrup National Park, Mt Manypeaks National Park, Walpole-Nornalup National Park and swamp areas throughout the south-west forests from Jarrahdale to Walpole. The mainland Quokka generally inhabits densely vegetated coastal heaths, swamps and riverine habitats where they are less vulnerable to predation. No Quokkas were recorded in the project area during the surveys and as its preferred habitat does not occur within the YSPA, development in the area is highly unlikely to have any impact on this species. The IUCN Red List of Threatened Species has assigned this species a designation of 'vulnerable' (de Tores *et al.*, 2008).

Southern Brush-tailed Phascogale (*Phascogale tapoatafa* ssp. WAM434)

The Southern Brush-tailed Phascogale (*Phascogale tapoatafa* ssp. WAM434) is listed as Threatened under Schedule 1 of the Wildlife Conservation Act 1950. The present range of this species is believed to have been reduced to 50% of its former range. It is now known from Perth and south to Albany, west of Albany Highway. It occurs in low densities in the northern Jarrah forest with highest densities found in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton. This arboreal marsupial has been observed in dry sclerophyll forests and open woodland that contain hollow-bearing trees but a sparse ground cover. Records are less common from wetter forests. The Southern Brush-tailed Phascogale possibly occurs in the Jarrah/Sheoak Woodland habitat of the YSPA. However, it was not recorded during trapping and spotlighting surveys. The IUCN Red List of Threatened Species has assigned this species a designation of 'near threatened' (Menkhorst *et al.*, 2008).

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon (*Falco peregrinus*) is listed as 'other specially protected fauna' that is in need of special protection under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Wildlife Conservation Act 1950*. The Peregrine Falcon is uncommon, although widespread throughout much of Australia excluding the extremely dry areas and has a wide and patchy distribution. It shows habitat preference for areas near cliffs along coastlines, rivers and ranges and in woodlands along watercourses and around lakes. It favours hilly or mountainous country and open woodlands and may be an occasional visitor to the study area. No Peregrine Falcons were recorded in the project area during the surveys by Coffey Environments (2008) and it is likely that the Peregrine Falcon is an infrequent visitor to the YSPA. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' (Birds International, 2012a).

Masked Owl (*Tyto novaehollandiae novaehollandiae*)

The Masked Owl (*Tyto novaehollandiae novaehollandiae*) is listed as a Priority 3 species on the DEC Priority fauna list. The species is known from Yanchep east to Yealering, south to Gnowangerup and Albany and occasionally seen north to Geraldton. The Masked Owl inhabits forests and woodlands and nests in tree hollows. It is locally common around Karridale and Manjimup, but is generally uncommon elsewhere. The Masked Owl was recorded from Green Valley in 2001 which is 20km north of Albany. No Masked Owls were recorded in the project area during the Coffey Environments

surveys. However, the species could occur in the project area. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' (Birds International, 2012b).

Western Brush Wallaby (*Macropus irma*)

Western Brush Wallaby (*Macropus irma*) is listed as a Priority 4 species in the DEC Priority fauna list. This species was very common in the early days of European settlement, however, its range has been reduced and fragmented and there is a significant decline in abundance in most remaining habitat. It is now distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. The optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. The Western Brush Wallaby possibly occurs in the YSPA, which contains suitable habitat. However, it was not recorded during surveys. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' (Morris *et al.*, 2008).

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater (*Merops ornatus*) is listed as Migratory under the EPBC Act 1999. This species is found across Australia including islands. It prefers lightly wooded, preferably sandy, country near water. It is a resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor, wintering from the Gascoyne north to Indonesia. It moves south mainly in late September and early October and north from February to April. It is scarce to very common across its range. No Rainbow Bee-eaters were recorded in the project area during the surveys by Coffey Environments and while it may visit YSPA, the species is unlikely to rely on the YSPA for survival. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' (Birds International, 2012c).

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

White-bellied Sea Eagle (*Haliaeetus leucogaster*) is listed as Migratory under the EPBC Act 1999. White-bellied Sea Eagles are most commonly found around the coastline; however, they have been reported many kilometres inland. This species was not recorded during the Coffey Environments survey but the species may occur in the YSPA, however it is unlikely to rely on the area for survival. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' based on its wide distribution (Birdlife International, 2012d).

Cattle Egret (*Ardea ibis*)

Cattle Egret (*Ardea ibis*) is listed as Migratory under the EPBC Act 1999. This species is often seen in flocks of livestock and its adaptability has helped this species spread. It is usually associated with moist pastures with tall grass, shallow open wetlands and margins and mudflats. No Cattle Egrets were recorded in the project area during surveys, however, this species may be found within the wetland areas and paddocks in the YSPA. The IUCN Red List of Threatened Species has assigned this species a designation of 'least concern' based on its wide distribution (Birdlife International, 2012e).

Eastern Great Egret (*Ardea modesta*)

The Eastern Great Egret (*Ardea modesta*) is widespread throughout Australia and utilises a wide range of wetland habitats. It is threatened by loss and/or degradation of foraging and breeding habitat through alteration of water flows, drainage and/or clearing of wetlands for development. The species was not recorded in the YSPA, but it may visit the site where suitable habitat occurs.

APPENDIX L

Aboriginal Heritage Sites



Search Criteria

Site 24418

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

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Legend

Restriction	Access	Coordinate Accuracy
N No restriction	C Closed	Accuracy is shown as a code in brackets following the site coordinates. [Reliable] The spatial information recorded in the site file is deemed to be reliable, due to methods of capture. [Unreliable] The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.
M Male access only	O Open	
100F Female access	V Vulnerable	

Status

L - Lodged	ACMC Decision Made
Information lodged, awaiting assessment	R - Registered Site I - Insufficient information S - Stored Data

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code "closed" or "vulnerable". Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Sites Shown on Maps

Site boundaries may not appear on maps at low zoom levels



List of Other Heritage Places with Map

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
24418	L	O	N	Yakamia Creek	Mythological, Historical	Natural Feature, Water Source, [Other: Path of migration between a chain of historical]	*Registered Informant names available from DIA.	582068mE 6126907mN Zone 50 [Reliable]	



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Contribution Planning

Yakamia/Lange Structure Plan (2015)

Range Road

Contribution accounts for:

1. Proportion of vehicle usage;
2. Cost to design, to develop 2 lanes, to develop 6 intersections and to cede land.
3. Developers ceding land are to be credited.
4. CPI applied

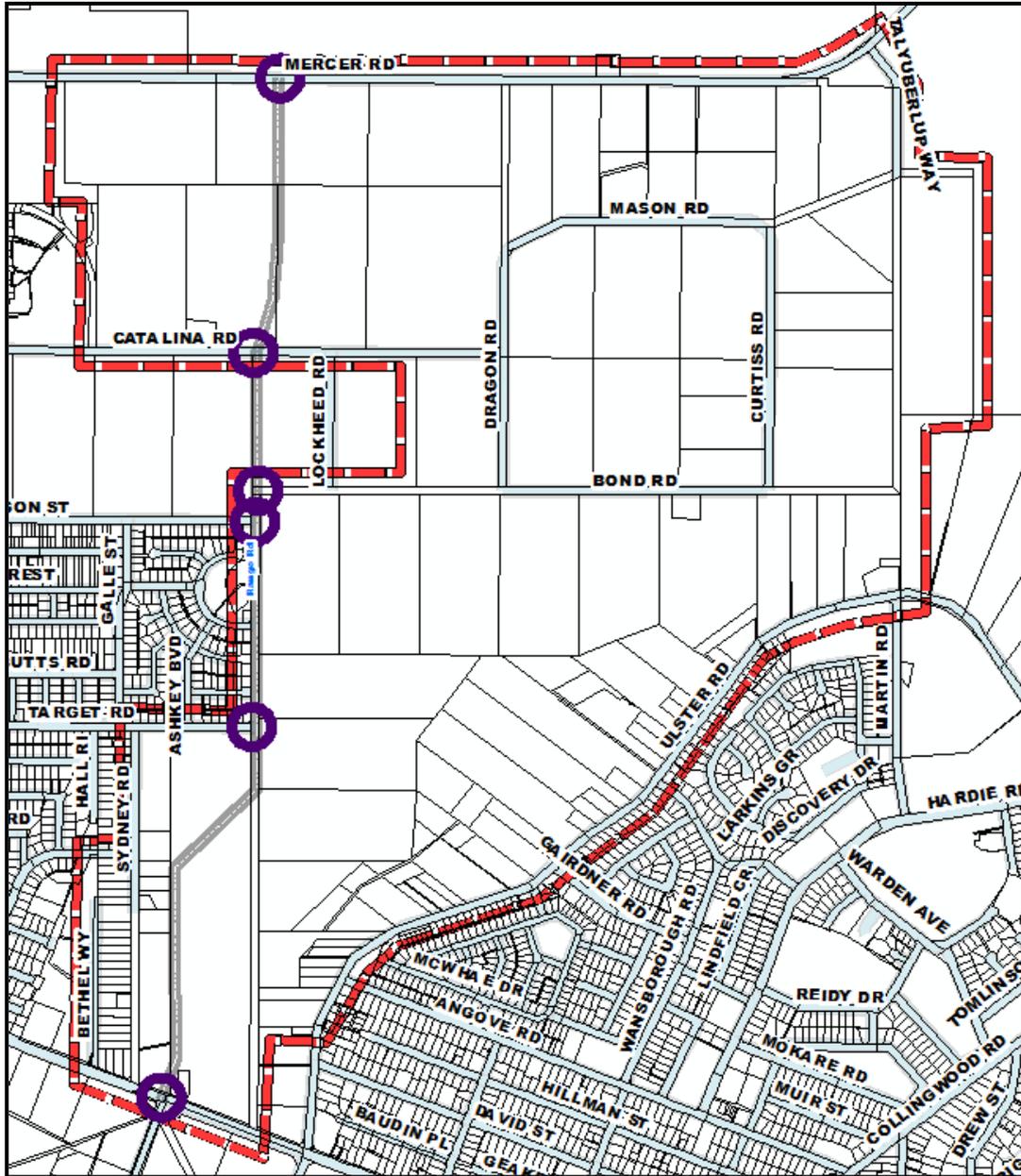
7m seal with 8.2m pavement width. 2 lanes kerbed & median with centre drain.

Range Road is proposed to be developed as follows:

Range Road			
Item	Characteristics	Rate	Value \$
Value of Land Ceded (LC) for Road and administration costs associated with ceding.	Width of Road	30m	1,400,390
	Length of Road (Mercer Rd – North Rd)	2,650km	
Value based on \$15/m ²			
Road Construction Costs	Number Lanes	X2	4,420,000
	Intersections	X6	1,153,674
	<ul style="list-style-type: none"> • North/Range • Range/Target • Range/Bond • Range/Hudson • Range/Catalina • Range/Mercer 		
	Survey and Design		200,000
	Drainage – North Rd		\$1.2m
	Contingency on Road Construction		677,367
	Total		
Total Development Cost	(Land Ceded) + (Development Cost)	\$1.5million + \$7,661,041m	9,051,431
Proportion of Vehicle Usage (VU) on Road (Beneficiaries) (Average Annual Daily Traffic based on Traffic Model: Year 2031)	Total generated vehicles	7,400v/d	
	Vehicles generated external to structure plan area	2,981v/d	
	Vehicles generated from structure plan area	4,419v/d	
	Total Proportion attributed to Structure Plan	56%	
Expected Dwellings	Structure Plan Area (14dwel/ha)	2570dwe	

REPORT ITEM PD093 REFERS

<p>Total Cost/Lot</p>	<p>(Total Development Cost X Total proportion attributed to structure plan) <u>divided by</u> (Total number dwellings)</p>	<p>(\$9,051,431 X 56%) divided by 2570dwe</p>	<p>1972 per lot</p>
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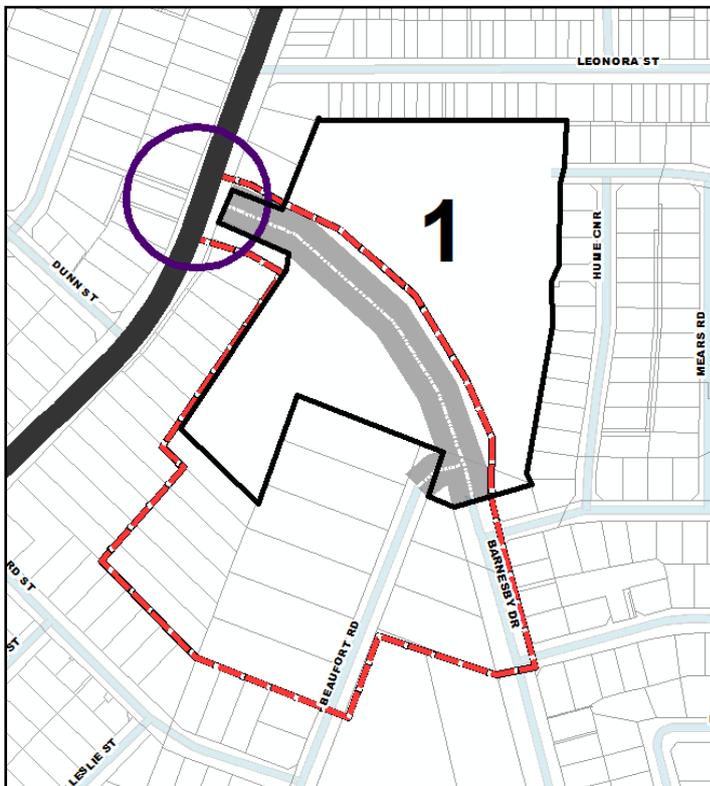


1. Barnesby Drive

(2 lanes kerbed & median with centre drain. 7m seal with 8.2m pavement width.)

Methodology:

1. At the time of Subdivision:
 - a. Developer (Refer to Map – Area ‘1’) Cede 30m road reserve (consistent with existing Barnesby Drive);
 - b. Developer design and develop Barnesby Drive (2 lanes kerbed & median with centre drain. 7m seal with 8.2m pavement width.)
 - c. Developer to develop Cul-De-Sac-Head for Barnesby Drive at Chester Pass Road as interim measure.
 - d. Developer develops drainage between existing Barnesby Drive and Chester Pass Road.



Ultimately Barnesby Drive will link with Chester Pass Road as a left in and left out treatment.

APPENDIX 4

ISSUES BACKGROUND PAPER

1.1 INTRODUCTION

This background paper is the product of a number of stakeholder workshops and earlier studies that provided initial direction and guidance on preparation of the Yakamia-Lange structure plan. The paper outlines the context of the site, provides recommendations on key matters to be addressed, and contains a number of indicative maps and design options for various elements of the structure plan.

This paper does not contain any statutory provisions however the information in this paper may be used to inform planning decision making within the structure plan area where appropriate.

1.2 PLANNING CONTEXT

There are approximately 150 different lots/landholdings identified within the structure plan area. The average lot size is 4.5ha with the largest lot being approximately 14ha. The land is either used for living purposes (single dwelling), market gardening, grazing or is vacant.

The structure plan encompasses an area of approximately 365ha, 50% of which, is indicated for residential, 20% identified as 'Public Parkland' (foreshore areas and passive recreation) and 8% for conservation. The area is capable of accommodating approximately 2570 dwellings and a population of 6168 persons.

Factors that have dominated discussion for land use planning in the area include the following:

Local Planning Scheme 1

1. The *Local Planning Scheme 1* governs use and development of the localities. Zonings for the localities include: 'Future Urban'; 'Yakamia Creek' and 'General Agriculture' (Refer to following zoning diagram).

Future Urban

In accordance with *Local Planning Scheme 1*, Clause 5.5.3; for any lot within the Future Urban zone, the Local Government may permit the following land uses: Single House/Relocated Dwelling; Ancillary Accommodation; Industry – Cottage; and Rural Pursuit, unless an adopted Structure Plan says otherwise.

Yakamia Creek

In accordance with *Local Planning Scheme 1*, Clause 4.2.4; the objective of the Yakamia Creek zone is to provide for large residential lots adjacent to the Yakamia Creek which:

- a) Provide for residential and limited incidental land uses: and
- b) Provide for home business, industry – cottage and rural pursuits.

In accordance with *Local Planning Scheme 1*, Clause 5.5.19; within the Yakamia Creek zone, the minimum lot size shall be 3000m².

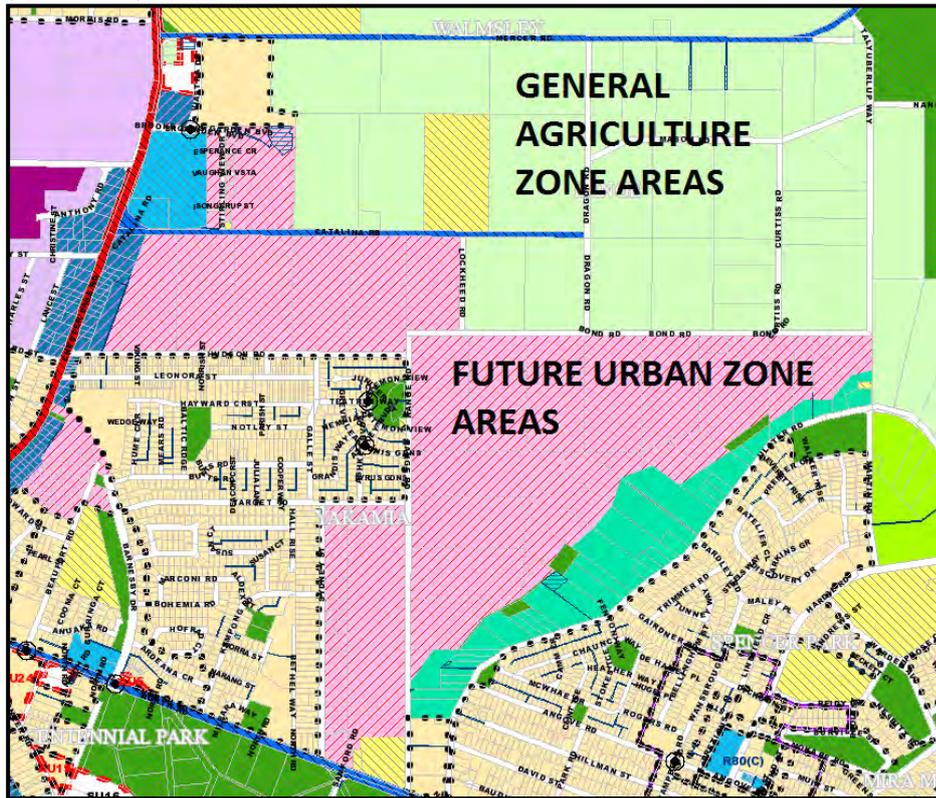
General Agriculture

In accordance with *Local Planning Scheme 1*, Clause 4.2.20; the objectives of the General Agriculture zone are to:

- a) Provide for agricultural activities; and
- b) Support complementary land uses, including tourism, where those land uses adversely impact on the continued use of the zone for agricultural purposes.

FIGURE 1. LAND ZONINGS

(source: COA)

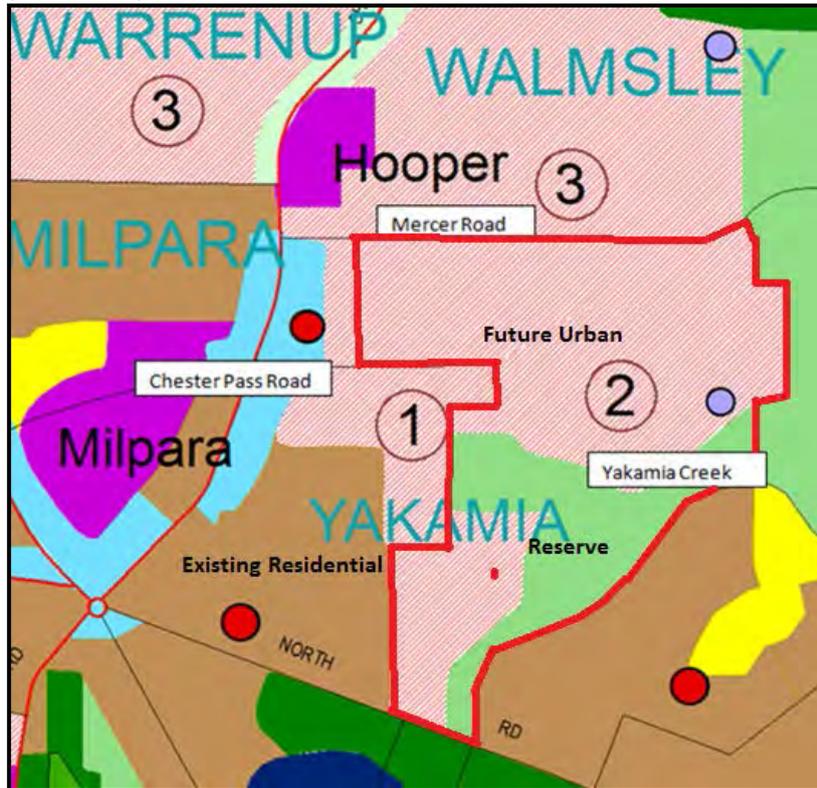


Albany Local Planning Strategy (2010)

1. The City of *Albany Local Planning Strategy (2010)* identifies the area as being suitable, in the short to medium term for 'future urban' and 'regional reserve' (refer to the following map and in particular, the areas coloured pink).

FIGURE 2. ALBANY LOCAL PLANNING STRATEGY MAP 9B

(source: COA)



Background Planning Reports

1. Consideration of an Arterial Drainage Plan (Environmental E. , Yakamia Creek, Arterial Drainage Plan, 2013), a Water Management Strategy (Environmental E. , Yakamia/Lange Structure Plan, Water Management Strategy, 2014) and an Environmental Opportunities and Constraints Plan (Environmental A. , 2013);

Planning Policies

1. Western Australian Planning Commission Structure Planning Guidelines, relevant State Planning Policies and Development Control Policies.

1.3 PREVIOUS REPORTS AND STUDIES

Deliberation over residential expansion of the localities stretches back to the 1970's. The following documents have all played some part in recommending or guiding development and environmental management for the localities of Yakamia and Lange:

TABLE 1. PREVIOUS REPORTS AND STUDIES

1970's	Town of Albany, Town Planning Scheme – portion of subject land zoned Future Urban (Albany).
1996	An opportunistic flora survey for Lots 79 and 80 Bond Street (Associates, 1996).
1998	The Yakamia District Structure Plan (draft) was developed to 'encourage a more contained urban area' (Burrell, 1998).
2000	An opportunistic flora and vegetation survey (2000) to supplement 1996 survey for lots 79 and 80 Bond Street (Environmental A. , 2000).
2001	A Yakamia Creek Flood Study report published by Water and Rivers Commission (2001) to help provide an understanding of the hydrological behavior of the creek (Commission, 2001).
2004	Allerding Burgess (2004) draft (local) structure plan following on from 1998 district structure plan (Burgess, 2004).
2005	Opportunistic flora survey – Lot 4743 North Road (Sandiford, 2005).
2008	Lot 4743 – Vegetation Assessment (Environments, 2008).
2008	Yakamia Structure Plan – Wetlands and Waterways assessment (Environments, Yakamia Structure Plan - Wetlands and Waterways Assessment, 2008).
2010	The Albany Local Planning Strategy (Albany C. o., 2010).
2010	Albany Regional Vegetation Survey (Barrett, 2010).
2013	The City of Albany rezoning documentation for Lot 4743 North Road from 'Future Urban' to 'Residential R20' and 'Parks and Recreation' (The EPA undertook preliminary assessment under Section 48(1) of the <i>Environmental Protection Act 1986</i>). (Aurora, 2013).
2013	An Environmental Opportunities Constraints Plan (Environmental A. , 2013) . This report reviews previous environmental reports and develops a consolidated environmental constraints plan.
2014	A Water Management Strategy and Arterial Drainage Plan (Environmental E. , Yakamia Creek, Arterial Drainage Plan, 2013), (Environmental E. , Yakamia/Lange Structure Plan, Water Management Strategy, 2014).

2015	Yakamia Creek Living Stream Management Plan (Janicke, 2015)
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1.4 KEY ELEMENTS AND RECOMMENDATIONS

1.4.1 LAND USE

The Yakamia/Lange area is currently a mix of urban and rural land uses including some small scale horticulture and grazing.

Much of the area is cleared although pockets of vegetation remain, particularly within and fringing a flood plain in the lower catchment and foreshores in upper catchments. The urban uses are on the fringe and are mixed between residential, industrial and commercial. There is a large neighbourhood shopping complex in the vicinity of the structure plan area (Corner of Catalina and Chester Pass Roads).

Due to the close proximity of the structure plan area to the neighbourhood centre at Chester Pass Rd, the predominant land use expected for the area is residential. The density of residential is expected to vary depending on constraints (i.e. high density adjacent to the existing activity centre and medium density adjacent to private conservation and foreshore areas (fire risk) and on steep slopes).

Residential – R25 (350m²) Areas

These areas should be developed at an R25 density.

Residential – R30 (300m²) Areas

These areas are unconstrained and within close distance to commercial nodes. These areas should be developed at an R30 density.

Residential (Yakamia Creek)

This area is constrained as it abuts an environmentally sensitive creek (Yakamia Creek). Minimum lot size of 3000m² applies to this area.

Land Use Recommendations

1. *It is recommended that future subdivision and development:*

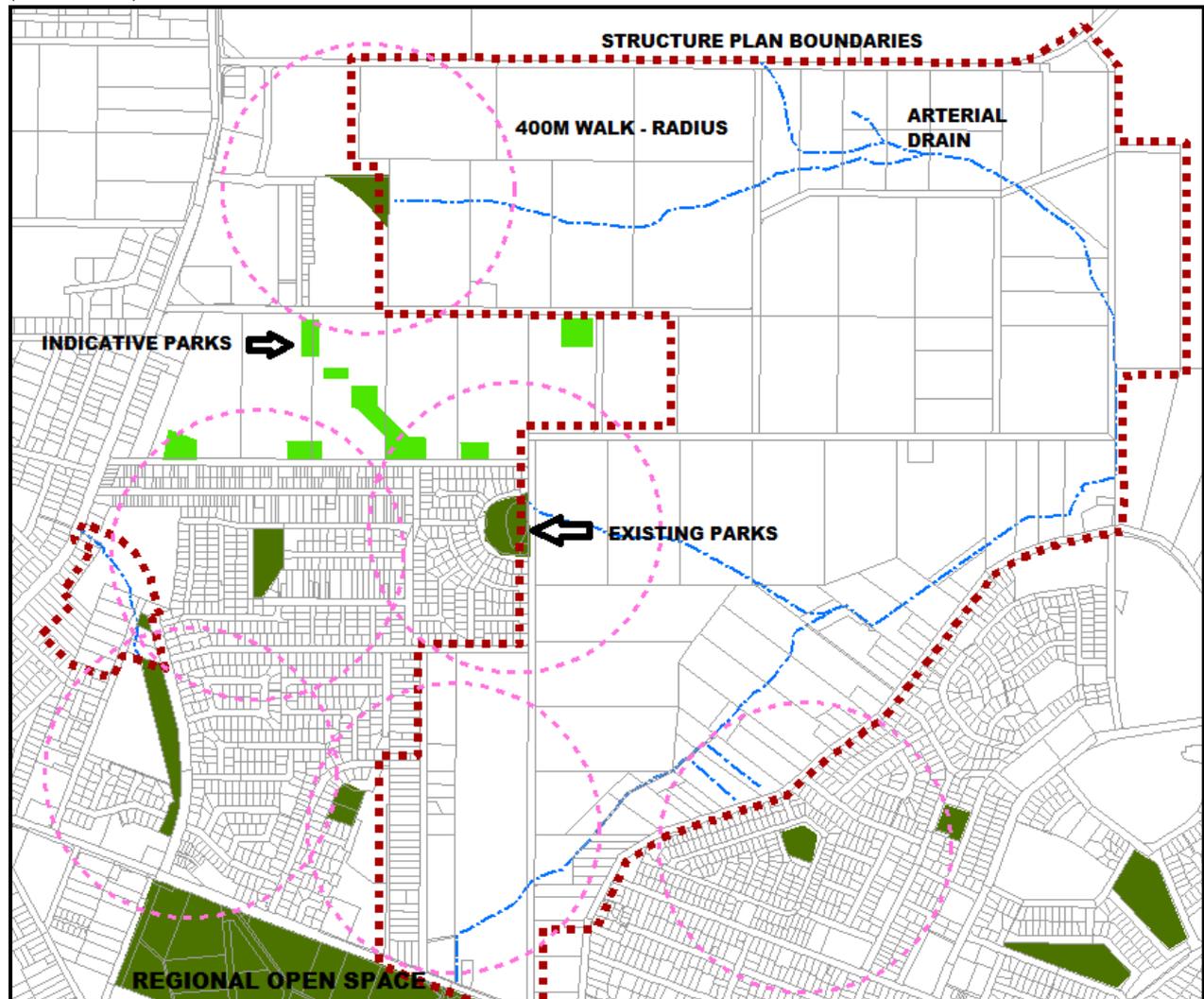
- *Supports higher densities adjacent to the commercial area at Chester Pass Rd;*
- *Supports medium density (R25) for steep gradient areas and for areas adjacent to arterial drains or areas subject to flooding and fire risk areas;*
- *Ensures no private development in Public Parkland areas;*
- *Ensures a suitable setback between development and sensitive areas (vegetated, foreshores, rivers, wetlands etc);*
- *Considers development in relation to visual integrity (eg. discourage development that dominates the landscape);*
- *Ensures the protection of the natural resources such as water, soil and vegetation (i.e. encourage revegetation to stabilize and neutralise soil conditions);*
- *Utilizes existing infrastructure (roads, sewer, water, drainage);*
- *Considers fire risk;*
- *Provides safe access;*
- *Provides pedestrian access;*
- *Ensures orientation of lots for solar access (orientate lots east west);*

1.4.2 PUBLIC PARKLAND

Public Open Space areas have been developed in areas surrounding the locality as a component of residential development. Additional Public Open Space areas have been recommended for development within the structure plan area as a component of earlier planning (Planning, 2012).

FIGURE 3: EXISTING AND PROPOSED RECREATION IN LOCALITY

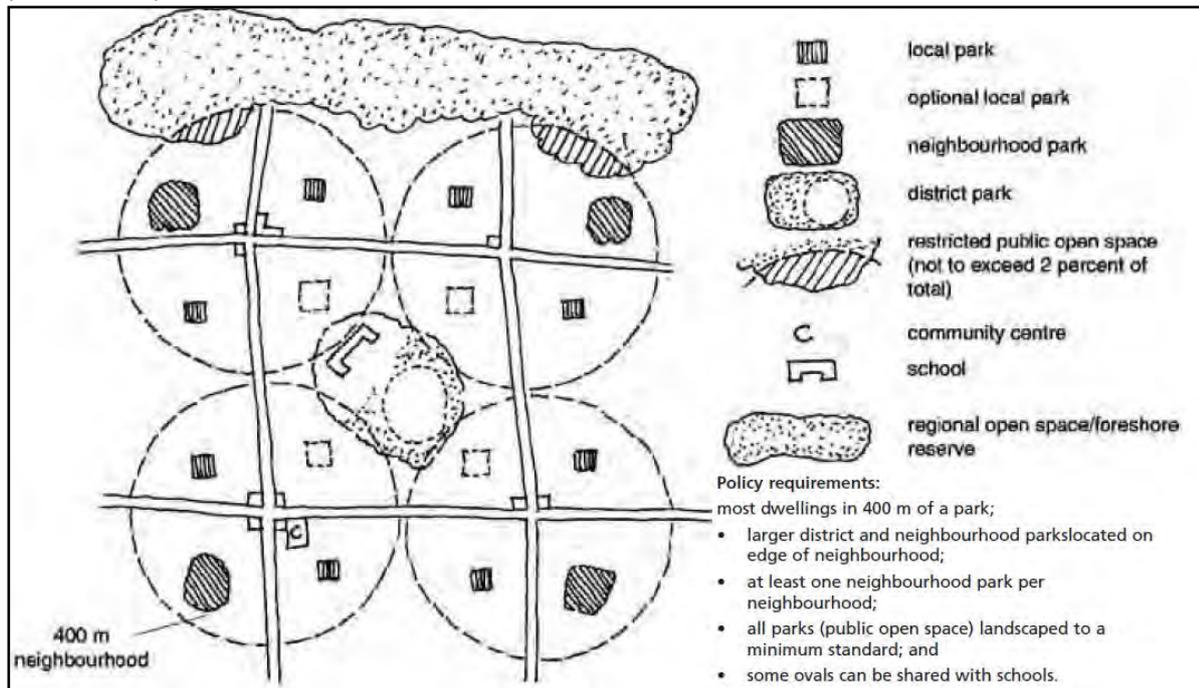
(source: COA)



Liveable Neighbourhoods (WAPC, 2007) recommends that public open space is developed in accordance with the following model. The model shows different size parks located relative to 400m radius neighbourhoods, activity centres, schools and regional reserves.

FIGURE 4. LIVEABLE NEIGHBOURHOODS – PUBLIC OPEN SPACE MODEL

(source: WAPC)



State legislation (Australia, Planning and Development Act, 2005) requires provision of land for public parkland, as a component of developing or subdividing an area for residential purposes. The state government will generally require other forms of public parkland, for example foreshore reserves, separately and in addition to public open space contributions.

The City of Albany has adopted a Public Parkland Policy. This policy recommends that public parkland is to be located:

1. Central to the neighbourhood;
2. Within 400m of dwelling(s);
3. To take advantage of natural features (foreshore, beach, creek, vegetation);
4. In accordance with the WAPC Model.

The City of Albany Public Parkland Policy also recommends that the following characteristics are considered when analysing appropriateness of public open space:

1. Is the space large enough to provide a combination of functions - drainage, active, passive and conservation, and to make more attractive/user friendly to community?
2. How easy is it to maintain the park? Careful thought needs to be given towards cost of maintaining parks. The developer should maintain a park for the first few years. Drainage, vegetation and infrastructure should be developed with a view to minimise maintenance cost.
3. Are passive and active features being developed in the park? Consider locating the park adjacent to a foreshore for passive attributes.
4. Consider the development of paths within the park and to provide external connectivity. Paths should be designed as a circuit.
5. Native vegetation is a valuable component for informal recreation and should be protected and enhanced.
6. Parks should be developed with play equipment that educates kids about nature.
7. Important to consider safety associated with persons (kids) and roads adjacent to parks.

8. Parks need to have flat areas for recreating.
9. The provision of POS and facilities should align with the City of Albany:
10. Consider creating a theme for each park.
11. The following facilities are highly valued with parks: Barbeque; Shelter; Reticulated grass; Quiet places; Seating; Toilets; Drinking water; Paths, bush walk trails and multi use trails (eg. mountain bikes); Open space; Parking; Child play equipment; Shade; and Waste disposal facilities and dog poo bags.
12. Need to feel safe (surveillance) walking within a POS area.
13. POS should be located adjacent to other high use facilities such as cafe, shops or a school.
14. POS needs to cater for the need to walk a dog.
15. Consider designing parks to accommodate events (eg. develop with amphitheatre).
16. Consider developing Yakamia Creek (through to Oyster Harbour) as a future Regional recreational facility.
17. Areas of bushland (eg. vegetation areas proposed for conservation) and drainage management areas that have little or no recreational value are not to be ceded to the City of Albany as POS.
18. POS should be provided as a priority over cash in lieu.
19. Where cash in lieu is provided, the following use of the cash should apply (listed in priority of order):
 - a) To purchase land for POS;
 - b) To develop informal and formal recreation facilities within POS;
 - c) To compensate developers contributing in excess of the 10%;
 - d) To develop recreation facilities within foreshore areas;
 - e) To purchase and/or develop areas for community recreation (eg. library);

Public Parkland Recommendations

1. *It is recommended that future subdivision and development:*

- *Apply state legislation (Australia, Planning and Development Act, 2005) and policy (Australia, Liveable Neighbourhoods, 2007) when planning for POS;*
- *Apply principles adopted as part of the City’s Public Parkland Policy;*
- *Applies the following designations in accordance with state legislation, City of Albany Policy and land characteristics:*

Active Recreation

1. A large (5ha) single area in the north-west precinct of the structure plan. The space is:
 - Central to future residential;
 - Capable of capturing water for reticulation;
 - Capable of being utilized to manage storm-water;
 - Capable of being developed (filled) to provide active recreation and connectivity between areas.



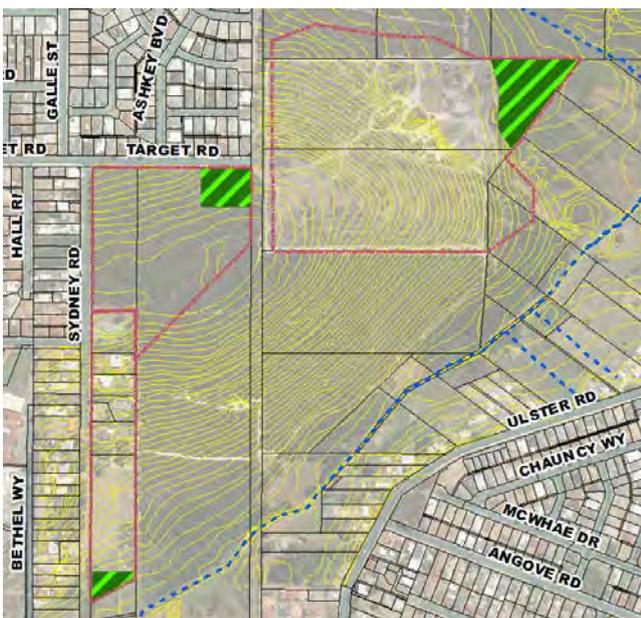
2. An approximate 5000m² area in the northern precinct of the structure plan. The space is reasonably flat and suitably located to provide active recreation and to manage stormwater.



3. A large (1.4ha) area in the north-eastern area on the structure plan. The space is:
 - Central to future residential;
 - Reasonably level and therefore capable of being developed (filled) to provide active recreation;
 - Alternatively locate to the north-west to act as a buffer to fire prone vegetation.



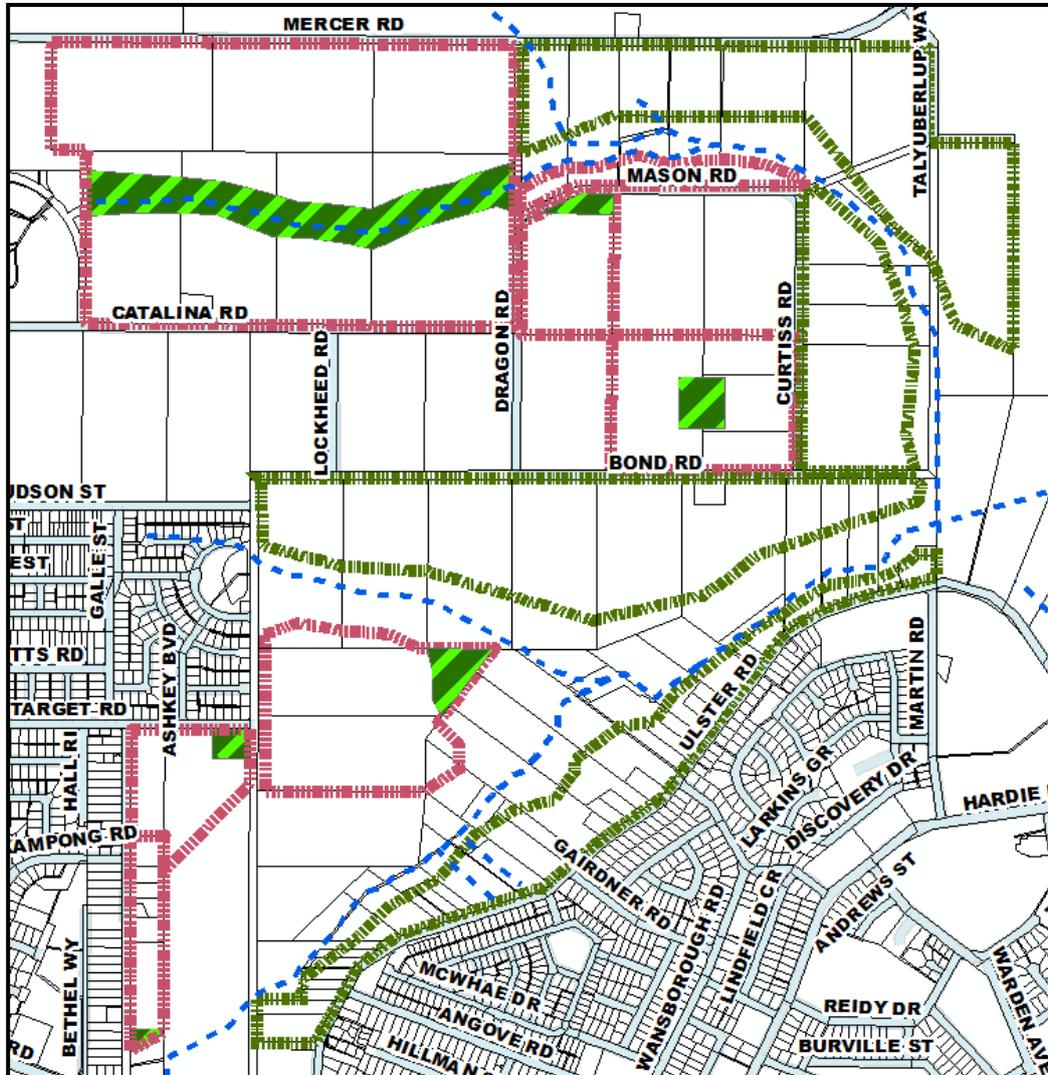
4. Three areas in the south west precinct of the structure plan.



Passive Recreation

Properties subdividing within the areas indicated by the green dotted line in the following plan may be required to provide a Public Open Space contribution in the form of cash-in-lieu.

FIGURE 5. INDICATIVE AREAS OF POS CASH CONTRIBUTIONS



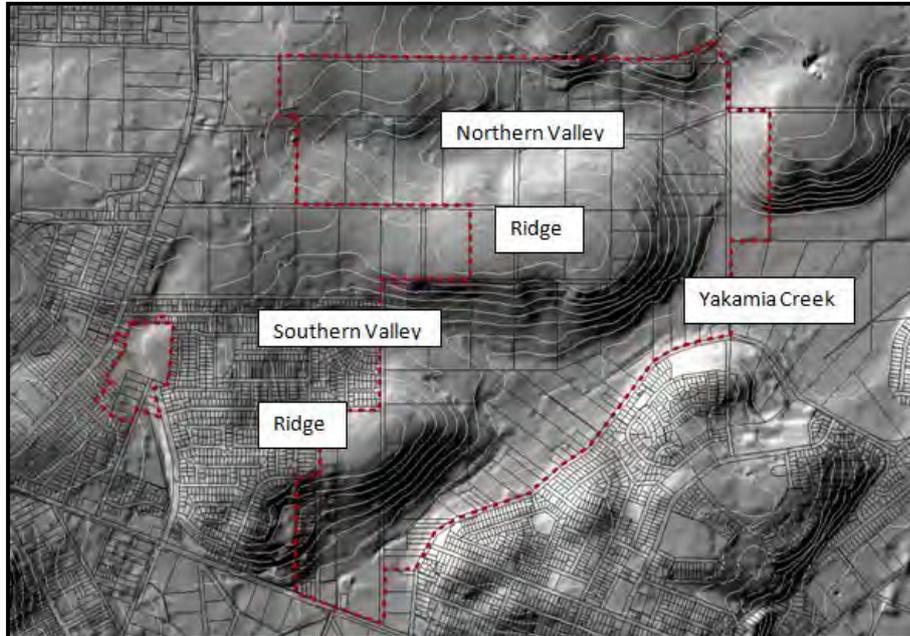
1.4.3 LANDFORM

The structure plan area is characterised by undulating topography. There are two major valleys with conservation, environmental, foreshore and public open space features. These slope east-west towards the Yakamia Creek, which floods during extended periods of rain. The northern most valley has a gentle gradient, is majority cleared and developed with some dams. The southern valley has steeper sides and is mostly vegetated. There are two ridges located between the valleys; they both have an aspect towards the south and are partly vegetated.

There are remnant stands of native vegetation in good to excellent condition located within the structure plan area. Nationally threatened species (Carnaby's Black-Cockatoo and Western Ringtail Possum) are known to exist amongst the vegetation.

FIGURE 6. LANDFORM PLAN

(source: COA)



Landform Recommendations

1. *The following provisions are recommended for future subdivision and development:*
 - *Roads should be located to follow the contour of the land where possible;*
 - *High retaining walls should be avoided on steep sites. Where retaining is necessary, this should be done within the dwelling walls or stepped and landscaped.*
2. *The structure plan designates development away from the valley floors where flooding may occur and where riparian vegetation exists.*
3. *The structure plan designates a lower density of development on the steeper slopes.*

1.4.4 BIODIVERSITY

The 'Albany Regional Vegetation Survey' (2010); the 'Flora Survey for the Yakamia Structure Plan Area' (2006); the 'Fauna Survey for the Yakamia Structure Plan Area' (2006); and the 'Environmental Opportunities Constraints Report' (2013) together provide an assessment of the extent, rarity, diversity and reservation status of flora and fauna within and around the structure plan area (the following plan illustrates remnant vegetation).

The Albany Regional Vegetation Survey (ARVS) report has been endorsed by the Environmental Protection Authority as a key information source. The ARVS report was produced to increase the understanding of regional flora and vegetation in the Albany region.

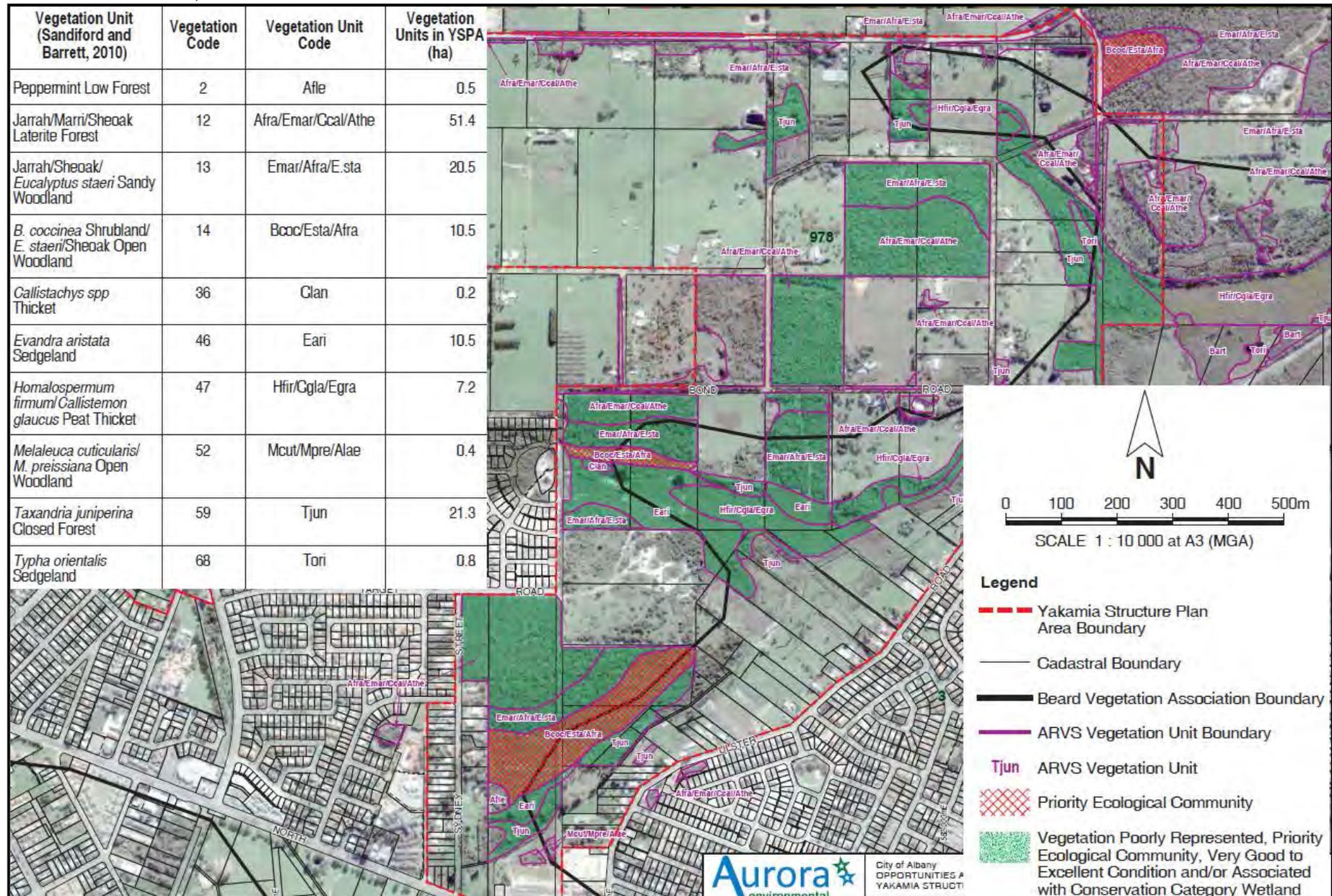
The major findings of the survey include:

1. *35% (44,093 ha) of the original extent of vegetation remains within the survey area.*
2. *19% of this remnant vegetation occurs within formal conservation reserves (IUCN I-IV) and 39% in other Crown reserves.*

3. *Identification of 67 native vegetation units, of which 19 units do not appear to have been described previously.*
4. *Many units only occur as small patches, with 49 units each having an area of less than 1% (<440ha) of the remnant vegetation within the ARVS area.*
5. *Over 50% of units occur at their range limit in the area, reflecting the location of the ARVS area at the junction of three bio-geographic regions.*
6. *Over 25% of units are likely to be restricted to the survey area with four units likely to have <30% pre-clearing extent remaining.*
7. *Over 800 species were recorded during the survey including six Declared Rare Flora, 43 Priority listed species and 19 species occurring beyond their previously known distribution.*
8. *Phytophthora dieback, hydrological change, weed invasion, fire, land clearing and grazing were identified as the major threats.*

FIGURE 7. VEGETATION

(Source: Aurora Environmental)



The 'Albany Regional Vegetation Survey' (2010) assessed and mapped the following vegetation units for the Yakamia locality:

Banksia Coccinea Shrubland/Eucalyptus Staeri/Sheoak Open Woodland;



Callistachys spp Thicket



Evandra Aristata Sedgeland Peat Thicket



Homalospermum Firmum/Callistemon Glaucus



Jarrah/Marri/Sheoak Laterite Forest



Jarrah/Sheoak/E.Staeri Sandy Woodland



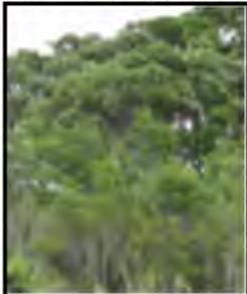
Melaleuca Cuticularis/M. Preissiana Open Woodland



Peppermint Low Forest



Taxandria Juniperina Closed Forest



Typha Orientalis Sedgeland



Typha is only mapped where it occurs as a mosaic with remnant vegetation (see page 185 ARVS 2010) as *Typha* is an introduced weed.

Of the species identified for the Yakamia locality:

- **Banksia coccinea Shrubland/Eucalyptus staeri/Sheoak Open Woodland** has been identified as a Priority 1 Ecological Community (possibly threatened) and therefore is worthy of protection. There are two areas where these communities exist. These areas are illustrated on the Environmental Opportunities and Constraints Map (cross hatch – orange).



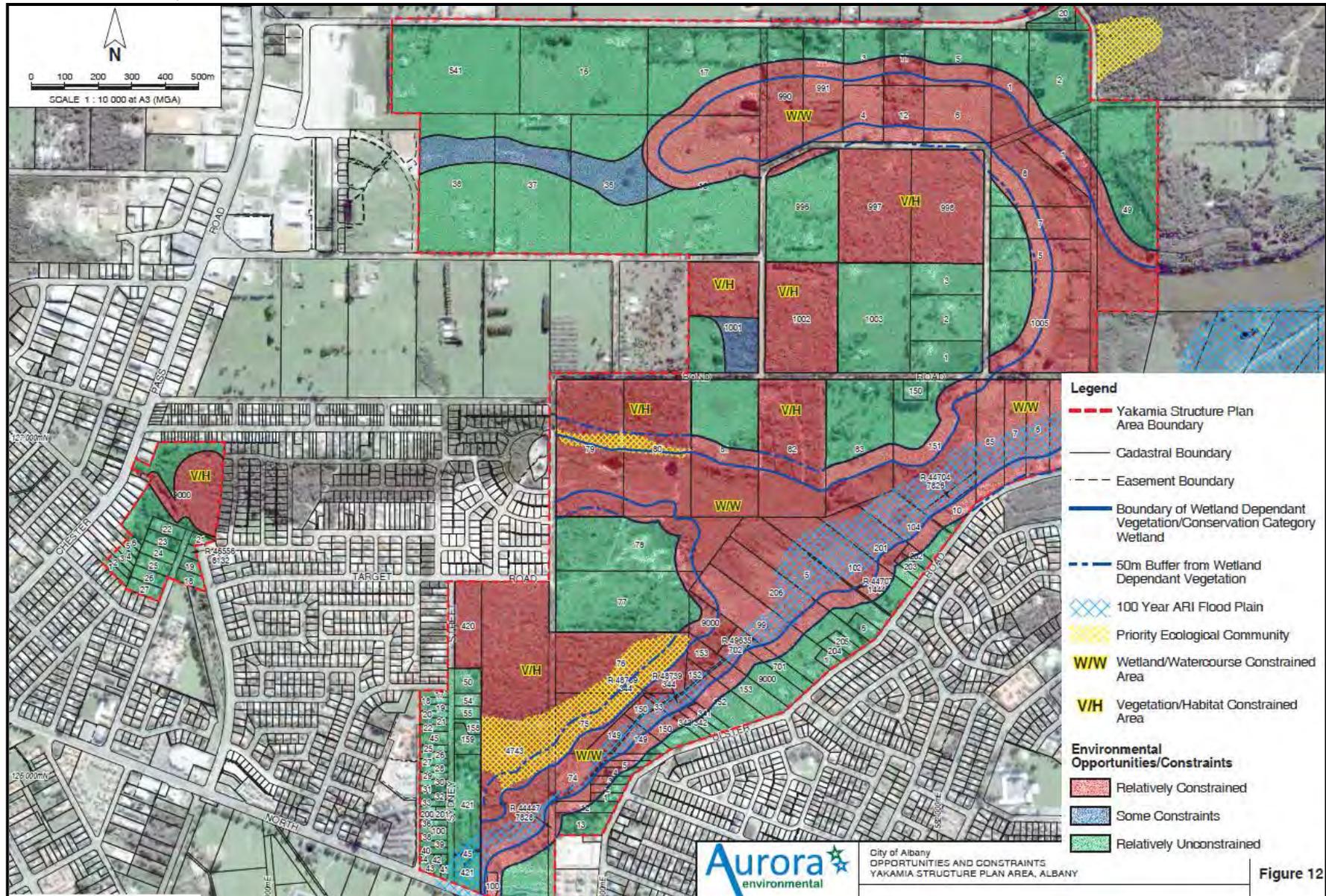
- The priority species: *Boronia crassipes* (P3), *Laxmania jamesii* (P3) and *Leucopogon altemifolius* (P4) are also evident within the area.
- Remnant **Jarrah/Marri/Sheoak** and **Jarrah/Sheoak/E.Staeri** vegetation exists throughout the area. While all naturally vegetated areas have environmental and amenity values, the EPA is primarily concerned with the protection of regionally significant natural areas.

The EPA has developed criteria for the identification of regionally significant natural areas which can be used across Western Australia. The criteria are (EPA, 2003, 2006, 2008):

- adequate representation of the range of ecological communities
 - areas with a high diversity of landforms, flora and /or fauna species or communities
 - areas containing rare or threatened species or communities maintaining ecological processes or natural systems
 - areas of scientific or evolutionary importance, and
 - areas of wetland, streamline and estuarine fringing vegetation and coastal vegetation.
- No threatened flora has been identified in the structure plan area.
 - Carnaby's Black-Cockatoo (white tail), Baudin's Black Cockatoo, Forest Red-tail Black Cockatoo, Southern Brown Bandicoot or Quenda and Western Ringtail Possum are likely to be found at different times throughout the locality. Carnaby's Black-Cockatoo (white tail) and Western Ringtail Possum are listed as threatened under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).
 - The Southern Brown Bandicoot or Quenda is listed as priority 5 'conservation dependent'.

FIGURE 8. SUMMARY OF OPPORTUNITIES AND CONSTRAINTS PLAN.

(Source: Aurora Environmental)



Biodiversity Recommendations

The following is recommended:

1. Enforce the development of foreshore management plans in anticipation of rehabilitating foreshores;
2. Identify Priority Ecological Community and vegetation in excellent condition that's large enough to sustain habitats as being suitable for protection;
3. Identify the need to refer applications involving the clearing of vegetation to the Office of the Environmental Protection Authority and the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (SEWPaC);

1.4.5 SOILS

The Yakamia catchment is steep and has relatively thin layers of sand and sedimentary rocks overtopping granite. This geology, coupled with high rainfall distributed throughout the year means that there is limited water retention capacity within the catchment and results in almost continual base flow within drains and watercourses. While this presents challenges for retention of nutrients it may provide opportunities for stormwater harvesting and can deliver watercourses that offer high amenity and environmental assets.

The subject locality comprises of three different soil characteristics being:

- Dc unit - Gravelly yellow duplex soils;
- S7 unit - Deep leached sands; and
- S7f unit - Humus podzols.

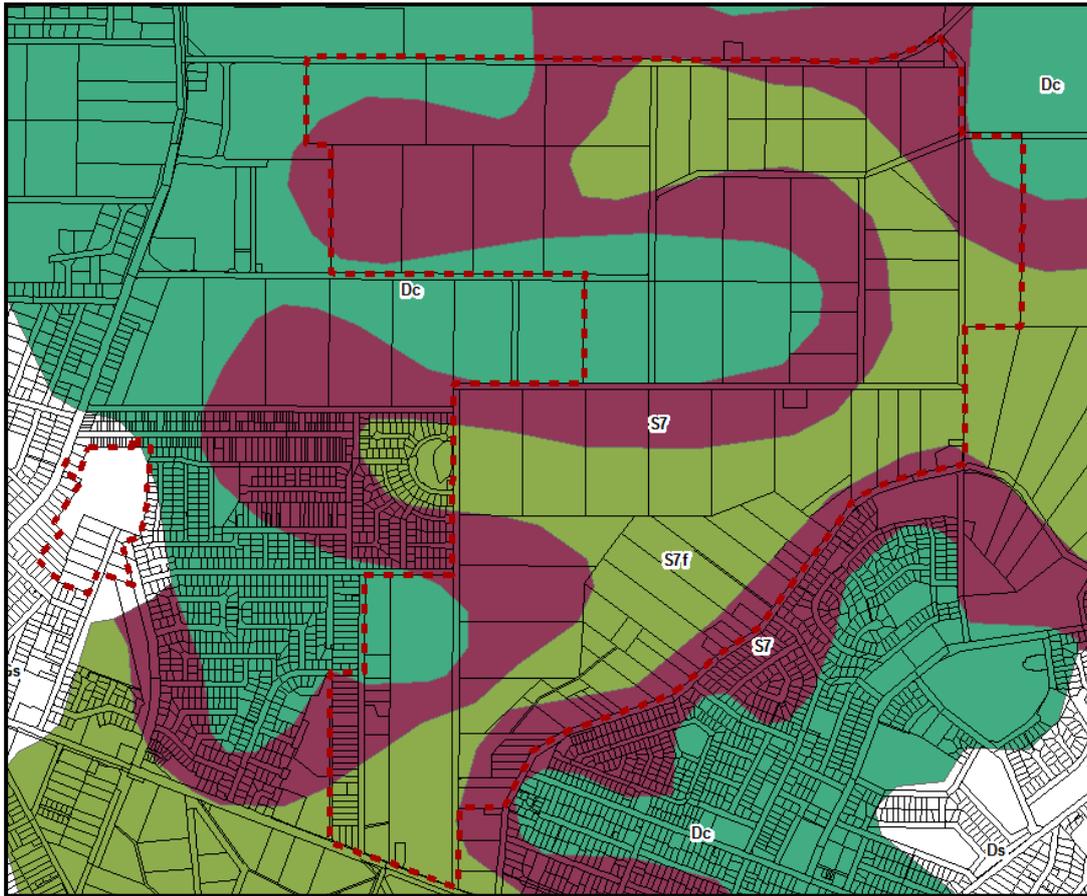
The Dc unit forms the ridges between the valleys and is made up of gravelly yellow duplex soils and some lateritic boulders. The flood risk for these areas is 'low' and the foundation soundness is 'fair' (source: *Environmental Report 1992 – AGC Woodward-Clyde Pty Ltd*).

The S7 unit forms the valleys and is made up of deep leached sands. The flood risk for these areas is 'Medium' and the foundation soundness is 'Good' (source: *Environmental Report 1992 – AGC Woodward-Clyde Pty Ltd*).

The S7f unit can be described as being humus podzols. The flood risk for these areas is 'Medium to High' and the foundation soundness is 'Good' (source: *Environmental Report 1992 – AGC Woodward-Clyde Pty Ltd*).

FIGURE 9. (SOIL ASSOCIATION MAPPING)

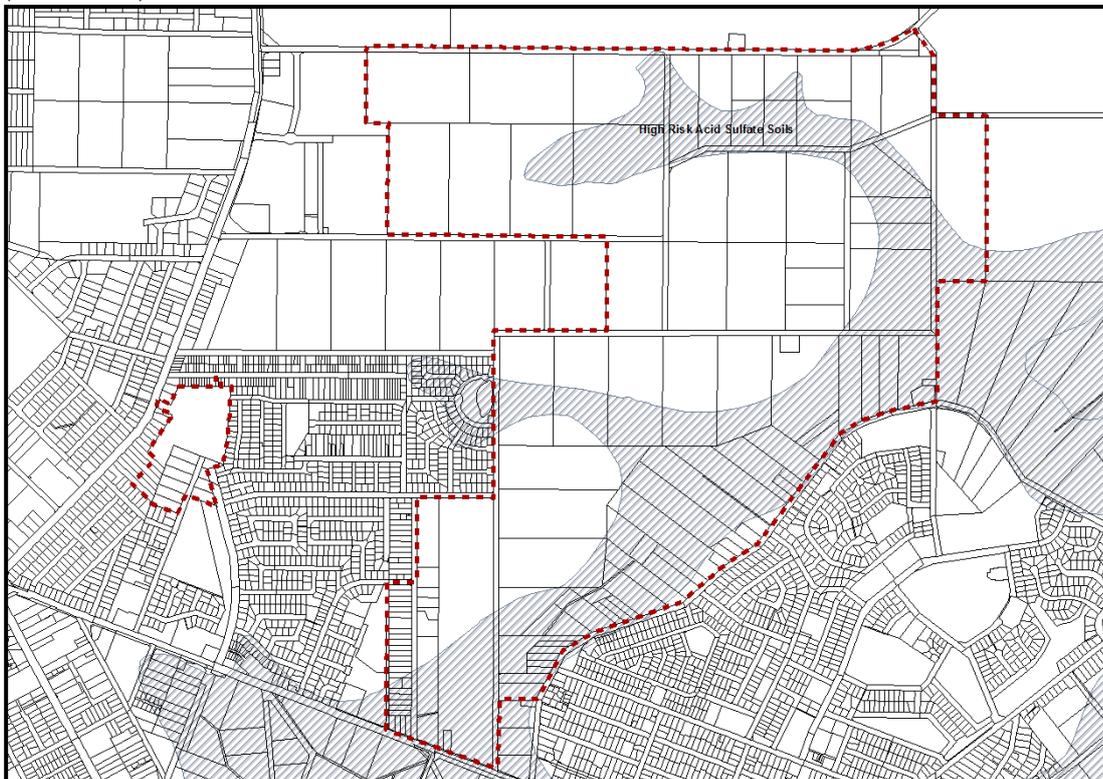
(Source: COA)



Geographical mapping indicates a 'high risk' of acid sulfate soils in the valley areas.

FIGURE 10. (ACID SULFATE SOILS)

(Source: COA)



Soil Recommendations

1. *The following provisions are recommended for future subdivision and development:*
 - *For the areas indicated as acid sulfate, prior to subdivision and development, an acid sulfate soil management plan needs to be written and implemented.*
 - *Development should be located in accordance with a Water Management Strategy.*

1.4.6 GROUNDWATER AND SURFACE WATER

Groundwater

Groundwater in the Yakamia area comprises a sedimentary aquifer with inter-granular porosity, which is part of an extensive regional groundwater resource (Government of Western Australia, 2007a). There is some evidence that perched water tables develop within the area during the winter months and the groundwater discharges into Yakamia Creek via the perched winter groundwater tables (Government of Western Australia, 2007b).

Surface Drainage

Surface drainage of the Structure Plan area is determined by two east-west ridges. The valleys adjacent to the ridges drain to the Yakamia Creek, which in turn drains into Oyster Harbour.

Because a large part of the developed and developing catchment is steep, the run-off generated within overland flow paths, drains and watercourses is fast moving and can represent a hazard. It is important to consider the accessibility and depth of high velocity flows in planning and designing drainage infrastructure.

A significant impact of high velocity flows is that overland flow paths, drains and watercourses are susceptible to erosion. Where erosion occurs, large amounts of sediment can be generated and subsequently deposited in downstream parts of the catchment causing blockages and environmental impacts. It is necessary to design drainage infrastructure to withstand high velocity flows where they occur to minimise erosion and generation of sediment. It is also important to consider placement of sediment control structures and/or systems in critical locations through the catchment.

Sediment/Nutrient

Oyster Harbour is known to be susceptible to high nutrient loads from its contributing catchments. The use of sediment control structures and/or systems will help to reduce nutrient and other pollutant loads to Oyster Harbour. Consideration should also be given to other structural and non-structural water sensitive urban design strategies to both reduce applied and discharged nutrient and other pollutant loads in the catchment.

During 2011 a stormwater snapshot was conducted in the Albany Harbours Catchment by the Department of Water. Eleven sites were sampled with eight sites on the Yakamia creek (YAK001-YAK1). Overall the nutrients exceeded the recommended trigger value on most occasions. Heavy metals including aluminium, Copper, Iron and Zinc were detected at various sites. Pathogens exceeding recommended guideline values were also detected. Land-uses within the catchment areas and adjacent to flood-ways and drains are clearly impacting on the quality of water being distributed to the harbours.

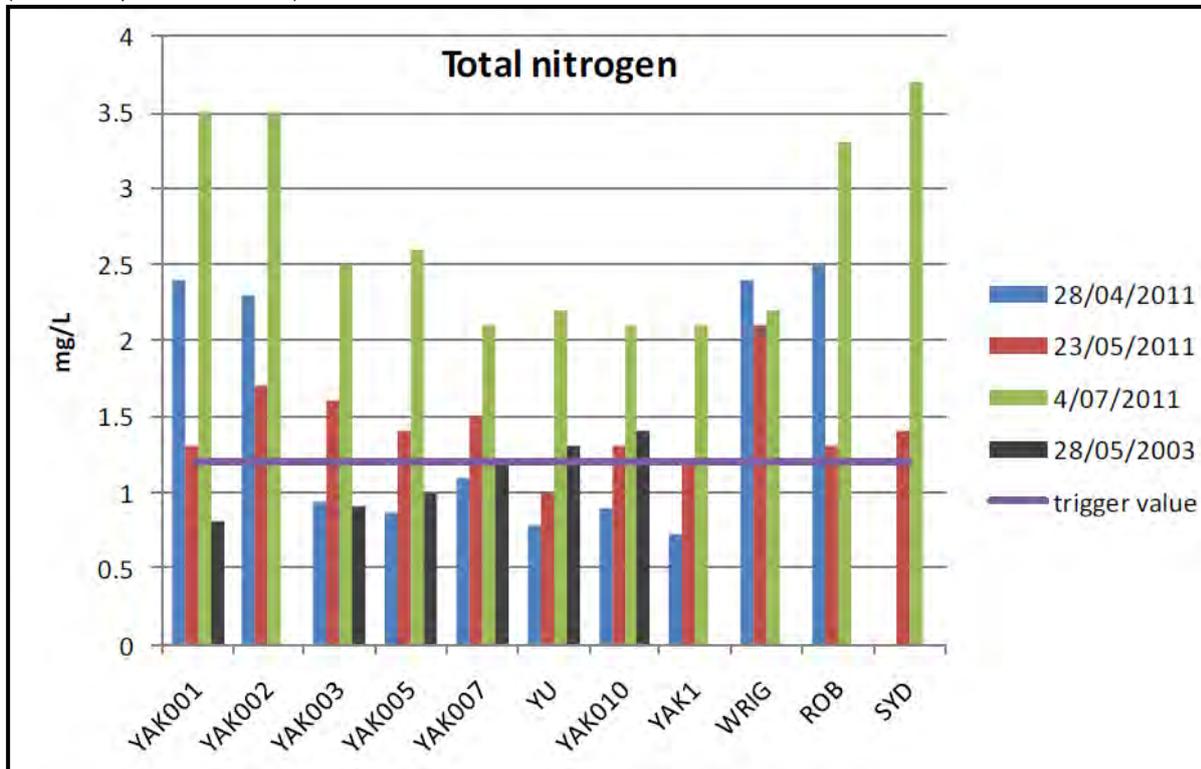
FIGURE 10. (STORM WATER SAMPLE SITES)

(Source: Department of Water)



FIGURE 11. (STORM WATER SAMPLE RECORDINGS - NITROGEN)

(Source: Department of Water)



Guiding Principles

The Department of Water, in carrying out its role in floodplain management, provides advice and recommends guidelines for development on floodplains with the object of minimising flood risk and damage. The Department of Water uses the following guiding principles to ensure proposed development in flood prone areas is acceptable with regard to major flooding:

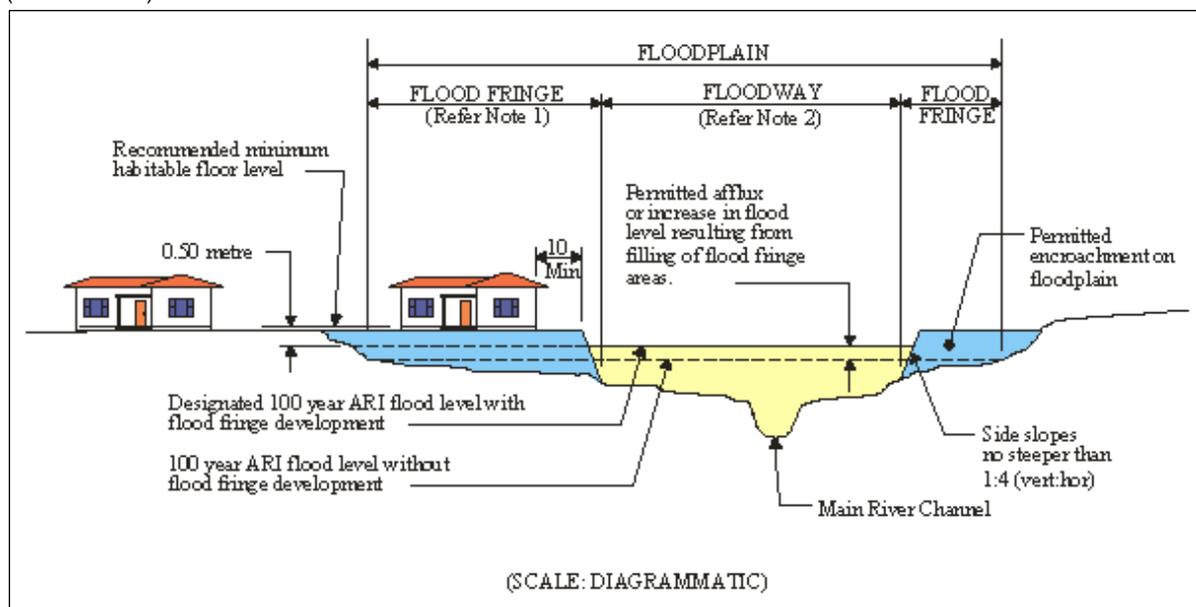
- Proposed development has adequate flood protection from a 100 year ARI flood; and
- Proposed development does not detrimentally impact on the existing 100 year ARI flooding regime of the general area.

The Department of Water’s recommended floodplain development strategy includes the following provisions which are graphically represented by the figure below:

1. Proposed development (ie, filling, building, etc) that is located within the flood fringe is considered acceptable with respect to major flooding. However, a minimum habitable floor level of 0.5 metre above the adjacent 100 year ARI flood level is recommended to ensure adequate flood protection.
2. Proposed development (ie, filling, building, etc) that is located within the floodway and is considered obstructive to major flows is not acceptable as it would increase flood level upstream. No new dwellings are acceptable within the floodway.
3. A failure to properly adhere to these recommendations will result in a greater exposure to risks of flood damage. This advice is related to major flooding only and other planning issues, such as environmental and ecological considerations, may also need to be addressed.

FIGURE 12. FLOODPLAIN DEVELOPMENT PLAN

(Source: DOW)



Yakamia Structure Plan – Water Management Strategy

A Water Management Strategy has been prepared to support the Yakamia/Lange Structure Plan. Key requirements of development relating to water management include:

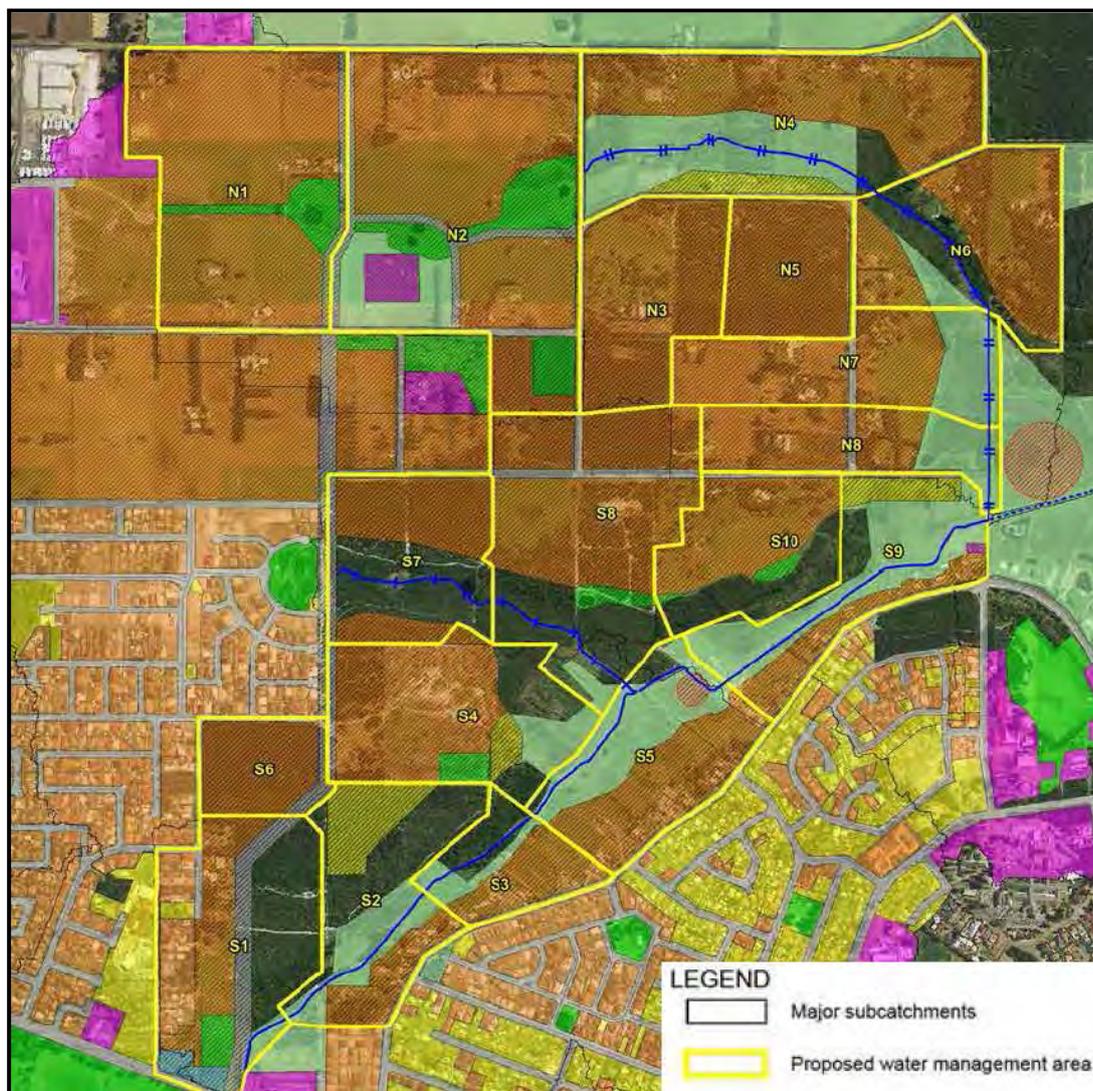
- Detention of surface water flows to ensure that development does not result in an increase to peak flow rates to downstream drainage systems or natural flow paths.
- Provide drainage infrastructure which provides conveyance of stormwater from upstream catchments without increases to upstream flood frequency.

REPORT ITEM PD093 REFERS

- Control of sediment transport through management of flow velocities and provision of sediment control points prior to discharge and energy dissipation structures at discharge points.
- Development of land in the Barnseby Drive precinct should facilitate reconstruction of Yakamia Drain to the western side of Beauford Road and provide a defined floodway for safe passage of flows.
- Proposed future intersections at Barnseby Drive / Chester Pass Road and Range Road / North Road will need to be designed to facilitate safe passage of major flood events.

The model of the existing drainage system was modified to represent the future landuse scenario proposed by the structure plan, and development of other areas outside of the structure plan area. Preliminary modelling suggests that provision of detention storage at 19 locations can be effective in managing peak flow rates and therefore achieve the key requirements outlined above.

FIGURE 13. PROPOSED WATER MANAGEMENT AREAS (ENVIRONMENTAL E. , 2014)



The impact of development using the proposed detention arrangements can be assessed by observing the predicted change in peak discharge rates at the key locations as presented in the following Table 2 and Plan 5. It can be seen that the proposed detention storages achieve protection of downstream systems by providing nominal reductions or manageable increases in peak flow rates during major and minor events.

REPORT ITEM PD093 REFERS

TABLE 2. SURFACE WATER MODELLING RESULTS – PEAK FLOW (M³/S)

Loc	Existing		Post-development		Change %		Comment
	5 year	100 year	5 year	100 year	5 year	100 year	
A1	2.735	9.116	2.684	7.5	-1.9%	-17.7%	Reduction due to piping existing drain. Upstream impact to be assessed further during design.
A2	0.335	1.22	0.262	0.986	-21.8%	-19.2%	Assumed detention storage to be provided in upstream catchment reduces flow rates
B	3.466	7.856	3.583	9.189	3.4%	17.0%	Increase due to removal of localised flooding. Downstream impact to be assessed further during design.
C	8.19	16.88	8.3	17.08	1%	1%	Nominal increase due to local urbanisation
D	8.49	19.67	8.81	20	4%	2%	Nominal increase due to local and upstream urbanisation. Impact is offset by improved environmental performance along creek / drain.
E	1.32	5.62	1.01	3.45	-23%	-39%	Reduced peak flows due to better utilisation of existing detention storage.
F	0.99	7.4	1.16	5.25	17%	-29%	Increased catchment from S8. Increase in minor event flow expected and can be accommodated with construction of living stream.
G	9.8	31.23	10.08	27.15	3%	-13%	The impact of small increase in minor event flows is offset by improved environmental performance along creek / drain.
H	0.17	0.47	0.32	0.73	88%	55%	A piped outlet will be provided from existing upstream detention area to improve safety and amenity; this has resulted in increased flow rates.
I	0.2	3.15	0.18	1.25	-10%	-60%	Nominal reduction in minor flows due to pipe size increments
J	0.75	14.82	0.78	7.41	4%	-50%	Nominal increase due to local urbanisation.
K	0.78	6.39	0.9299	5.5211	19%	-14%	Moderate increase due to local urbanisation. Impact is offset by improved environmental performance along creek / drain.

FIGURE 14. ARTERIAL DRAINAGE PLAN - NORTH (ENVIRONMENTAL E. , 2014)

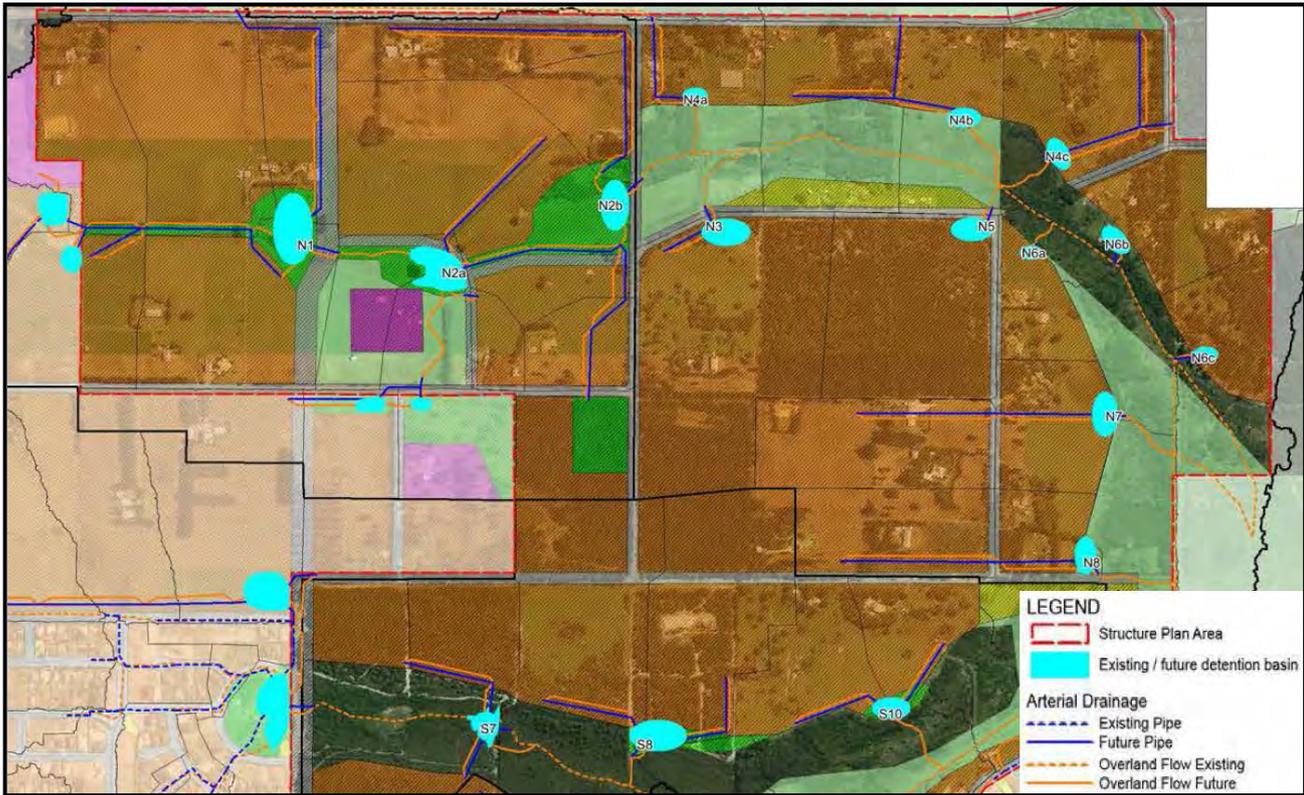
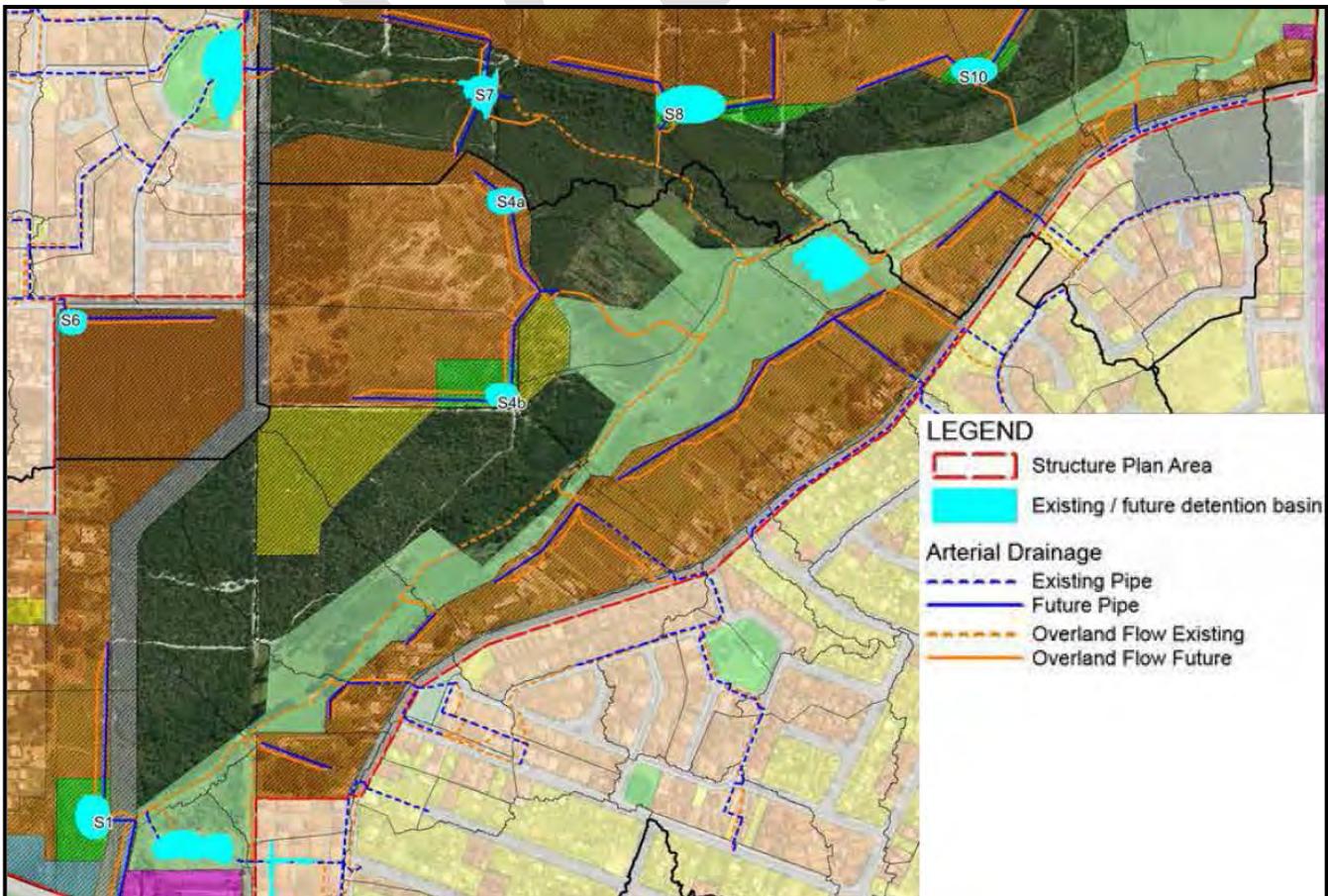


FIGURE 15. ARTERIAL DRAINAGE PLAN - SOUTH (ENVIRONMENTAL E. , 2014)



Water Recommendations

1. *The structure plan is to make reference to the Water Management Strategy and Arterial Drainage Plan developed for the Yakamia Catchment.*
2. *The structure plan is to indicate foreshores and flood-ways.*
3. *The following may apply to future subdivision and development:*
 - *Proposed development (ie, filling, building, etc) that is located within the flood fringe may be acceptable with respect to major flooding. However, a minimum habitable floor level of 0.5 metre above the adjacent 100 year ARI flood level is recommended to ensure adequate flood protection.*
 - *Proposed development (ie, filling, building, etc) that is located within the floodway and is considered obstructive to major flows is not acceptable as it would increase flood level upstream.*
4. *The following provisions may need to be applied for future subdivision and development:*
 - *Direct drainage from any future subdivision areas into the creek system is not to occur;*
 - *Nutrient and flood mitigation measures (detention or infiltration swales, filter strips, and nutrient stripping features) to be incorporated for primary treatment of stormwater before discharge;*
 - *Design drainage infrastructure to withstand high velocity flows where they occur to minimise erosion and generation of sediment.*
 - *Urban and foreshore water management planning is required prior to supporting subdivision;*
 - *Suitable management is required to minimise the extent and spread of weed infestations;*
 - *The use of Alternative Effluent Treatment systems where deep sewer is not capable of being developed;*
 - *Maintain overland flow paths;*
 - *Enforce the development of rainwater tanks to help harvest potable water and attenuate stormwater;*
 - *At subdivision stage, the developer will need to develop a monitoring program to gather baseline information. The monitoring program will need to gather information and monitor post-development impacts. The program should include monitoring of the following:*
 - *Water quality of the creek system;*
 - *Groundwater in the local vicinity where possible;*
 - *Changes in vegetation within the creeks, flood plains and buffers;*
 - *Rehabilitation success.*
5. *Development of land in the Barnesby Drive precinct should facilitate reconstruction of Yakamia Drain to the western side of Beaufort Road and provide a defined floodway for safe passage of flows.*
6. *Proposed future intersections at Barnesby Drive / Chester Pass Road and Range Road /North Road will need to be designed to facilitate safe passage of major flood events.*

1.4.7 BUSHFIRE HAZARD

Vegetated areas exist in pockets on the ridges and in strips adjacent to some valley/foreshore areas. The Western Australian Planning Commission and Fire and Emergency Services Authority of Western Australia endorsed the 'Planning for Bush Fire Protection Guidelines (edition 2)' in May 2010 to outline a range of matters that need to be addressed at various stages of the planning process. In March 2010, the 'Australian Standard 3959-2009: Construction of buildings in bushfire-prone areas (AS3959-2009)' was approved nationally to ensure that new buildings in bush fire prone areas are built to standards that improve their performance when subject to burning debris, radiant heat and flame contact.

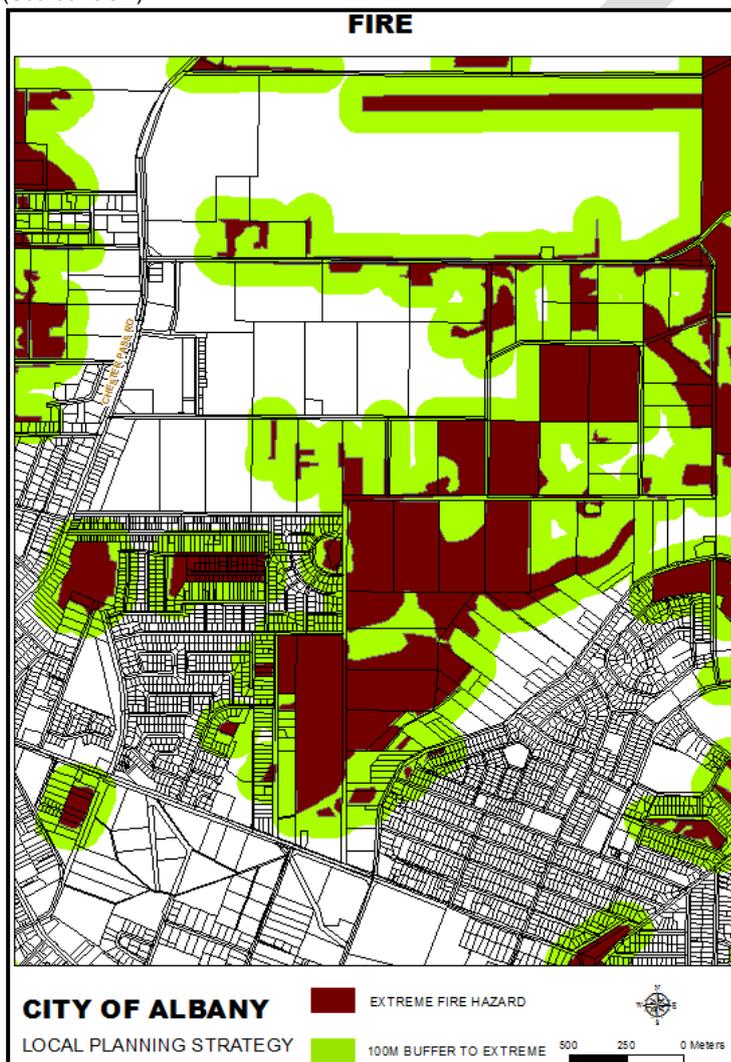
The City developed a *Bushfire Hazard Mitigation Strategy, June 2014*. The fire strategy has been prepared to facilitate the integration of specified bush fire management measures into local government planning, development and land management processes on the basis of the current bush fire hazards and risk levels assessed across the municipality.

The CoA BFHMS classifies bush fire prone areas throughout the CoA. The City's *Local Planning Scheme 1* requires all land use and development proposals to incorporate appropriate fire protection requirements by:

- *Implementing Western Australian Planning Commission Bushfire Protection policies;*
- *Implementing the City's Bushfire Hazard Mitigation Strategy;*
- *The provision of adequate firefighting water supply and equipment;*
- *the provision of fire access tracks; and*
- *incorporation of construction standards for buildings including those in AS 3959 – Construction of Buildings in Bushfire Prone Areas.*

FIGURE 16. FIRE MAPPING

(Source: COA)



Bushfire Recommendations

1. *A provision needs to be included to ensure that development adjacent to fire risk areas is designed, constructed and maintained to mitigate loss of property and life.*

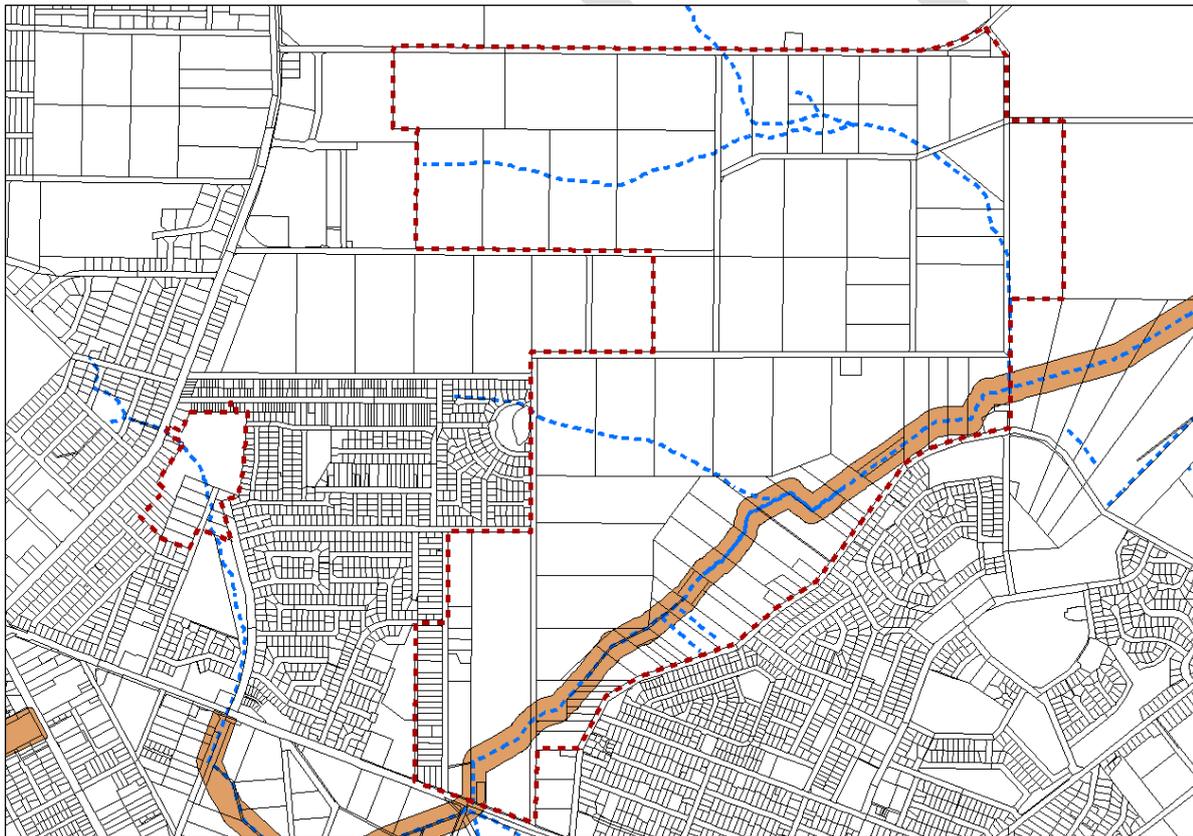
1.4.8 HERITAGE

An Aboriginal heritage survey was undertaken for the Yakamia Structure Plan area by Brad Goode and Associates in 2007. A search of archival records indicated that no Aboriginal heritage sites (archaeological or ethnographic) had been previously recorded within the Structure Plan area.

During the 2007 assessment, consultation was undertaken with ten members of the Aboriginal Heritage Reference Group Aboriginal Corporation (AHRGAC). The members identified Yakamia Creek as a place of importance for the gathering of resources, travel and association with spiritual beliefs in the *Marchant* (water snake). As a result, the group recommended that that Yakamia Creek be registered with the Department of Indigenous Affairs (DIA) as a site under Section 5(b) of the 'Aboriginal Heritage Act 1972'. The Group requested that provisions be made so that Yakamia Creek has a buffer zone (30m) where no urban development takes place and that the creek line be rehabilitated with local native plant species.

FIGURE 17. ABORIGINAL HERITAGE SITES

(Source: COA)



Heritage Recommendations

1. Future subdivision and development needs to be considerate of Heritage Values.

1.4.9 TRANSPORT

There are existing sealed and gravel roads constructed within the structure plan area, which provide access to existing land holdings.

Major developed roads either within or bordering the structure plan area include Catalina Road, Mercer Road, Barnesby Drive, North Road and Chester Pass Road.

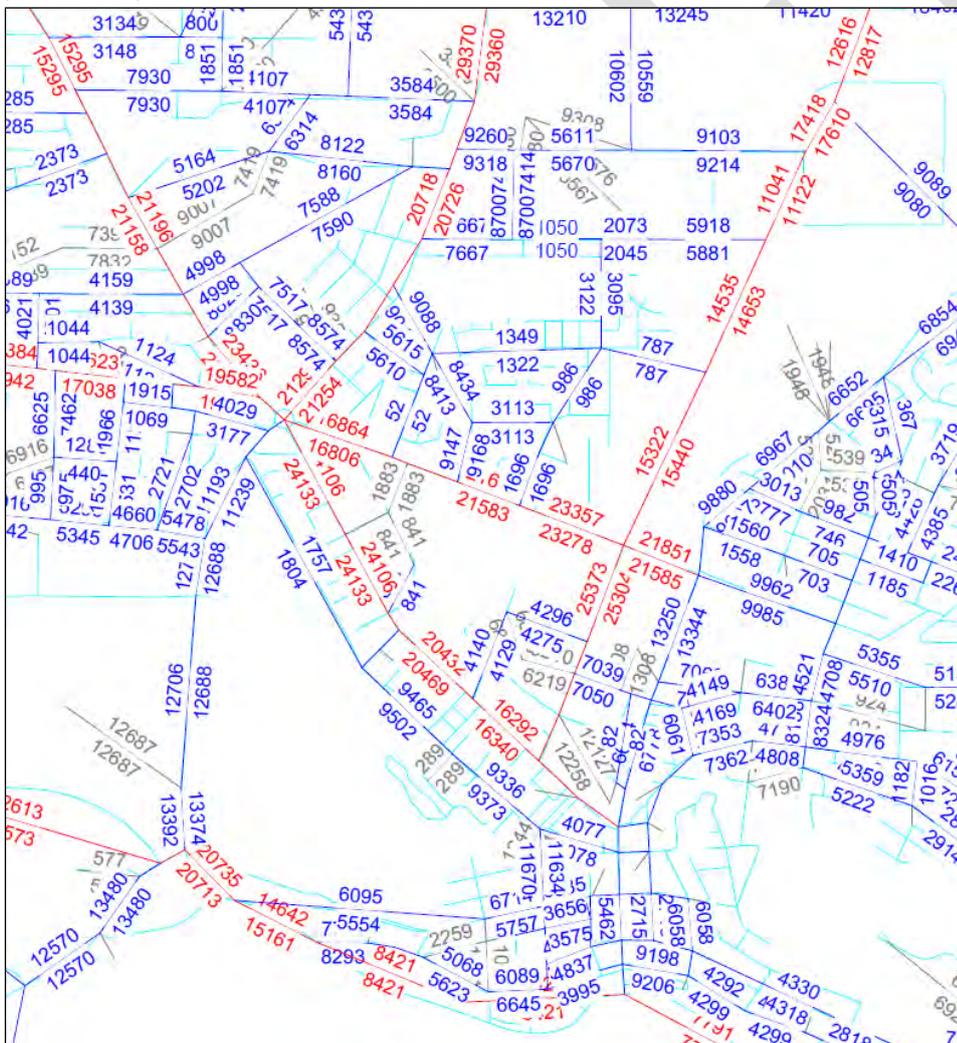
Traffic on these roads feed to and from the Chester Pass Roundabout. Safety and congestion concerns have been raised as a result of the existing and estimated future volume of traffic feeding to and from the roundabout.

If Albany is developed to its full potential in accordance with outcomes considered by the Albany Local Planning Strategy, the following vehicle movements are estimated:

- Approximately 80,000 vehicles are expected at the Chester Pass Road roundabout (refer to following plan), a substantial increase from the current approximate 55,000vpd;
- Approximately 30,000 vehicles are expected to use an indicative Range Rd (north/south link); and
- Approximately 18000 vehicles are expected to use Barnesby Drive if connected through to Chester Pass Road. (refer to following plan)

FIGURE 18. ALBANY TRAFFIC MODEL ESTIMATED – BUILT OUT SCENARIO – TRANSPORT

(Source: DOP)



Range Road

The development of Range Rd through to Mercer Road and Barnesby Drive through to Chester Pass Road will help to relieve traffic congestion at the Chester Pass Roundabout. Treatments may be necessary at various intersections along major roads.

Preliminary design drawings for intersection treatments at Range Rd and North Rd have been undertaken as seen in the figure below:

FIGURE 19. RANGE RD TO NORTH RD – INTERSECTION DESIGN

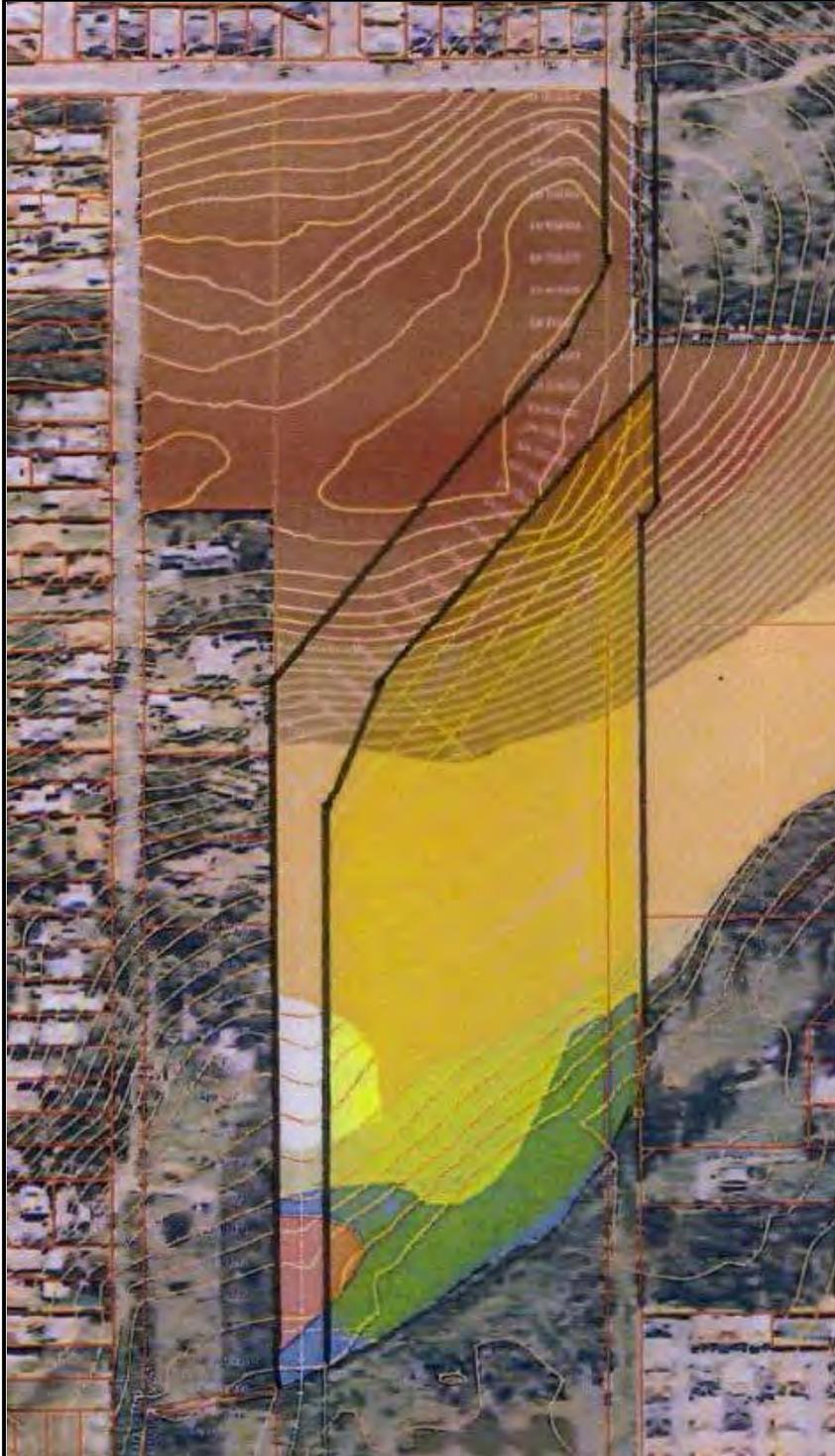
(source: COA)



The Department of Environment and Conservation has supported in principle the following road alignment for Range Rd through Lot 4743 North Rd.

FIGURE 20. DEC PREFERRED LOCATION FOR RANGE RD

(Source: COA)



A structure plan with the Range Rd alignment has been endorsed for the land between Hudson and Catalina Rd's.

FIGURE 22. CATALINA STRUCTURE PLAN

(Source: COA)



The Yakamia/Lange structure plan aligns Range Rd taking into consideration:

- The traffic model;
- The DEC preferred route;
- What has been endorsed for the area between Hudson and Catalina Roads;
- The constraints the result of the Western Power Lot to the north of Catalina Road; and
- Linkage to the north of Mercer Road.

Barnesby Drive

Due to a dedicated road reserve, an opportunity exists to connect Barnesby Drive through to Chester Pass Road. Considering Barnesby Drive intersects a Restricted Access Vehicle route (Chester Pass Road) at a gully and corner, impacts are expected to traffic and properties adjacent to the intersection. As such, the structure plan recommends that access is limited as follows:

- Barnesby Drive to Chester Pass Road; left turn only.
- Chester Pass Road to Barnesby Drive: left turn only.

Improvements for access to Chester Pass Road can also be achieved via Barnesby Drive to Hudson Street.

Sydney Street

An indicative design plan for connection of Sydney Street to Range Road is shown in Figure 23 below:

FIGURE 23. SYDNEY STREET-RANGE ROAD CONNECTION



Transport Recommendations

As a means to safely distribute vehicles the result of future development, the following is recommended:

1. The structure plan indicates a new north/south link road (Range Rd) between Mercer Rd and North Rd;
2. The structure plan indicates limited access via Barnesby Drive and Chester Pass Road.
3. The structure plan indicates a need for intersection treatments at:
 - Range Rd and Mercer Rd;
 - Range Rd and Catalina Rd;
 - Barnesby Drive and Chester Pass Road; and
 - Range Rd and North Rd.
4. The structure plan indicates a need for the upgrading of the following Rd's;
 - Mercer Road;
 - Catalina Road;
 - Bond Road; and
 - Dempster Road.
5. The structure plan indicates suitable road alignments to cater for surveillance to public parklands and to act as hazard separations for areas of fire risk.
6. Development of a contribution plan to guide payment of contributions to construction and/or upgrading of the road network within the structure plan area.

1.4.10 UTILITIES

Deep sewer, electricity and gas mains are all developed in the vicinity of the structure plan areas.

Western Power

Western Power own Lot 36 Catalina Rd, which is situated within the structure plan area. Western Power plan to develop (2030) this lot in the future (15-20 years) as a substation. A flat, sandy and dry area of 1.5ha (120m x 120m) with proximity to roads is required to support the development of the substation.

Western Power have advised that:

“Scope exists for the proposed major north-south link road to be incorporated into Western Power land. Agreement to this is dependent upon most suitable site for substation being protected, also that there are suitable developer contribution arrangements to be established in relation to its reservation and development.”

Water Corporation

The Water Corporation has provided plans illustrating the location and type of possible future infrastructure. Locations for future pressure and gravity pipes and a waste water pumping station have been illustrated.

The Water Corporation have advised the following in relation to a waste water pumping station (WWPS):

The ultimate pump rate of a WWPS has been planned to be in the order of 92 litres/second. The WWPS will therefore be built as a ‘Type 90’ WWPS, which requires an odour buffer of 30m radius measured from the centre of the WWPS wet well. A ‘Type 90’ WWPS site typically requires an area of 2,000-3,000m² (sometimes smaller). The size and configuration (usually rectangular) of the WWPS site will be based on the amount of underground emergency storage vessels required for that location. The site for the future WWPS will need to be created at the subdivision stage and transferred to the Water Corporation.

The Water Corporation advised that sewer is not available to the areas located in the Yakamia Creek zone between Yakamia Creek and Ulster Road.

The Water Corporation also advised that:

- The area will need to be developed in a logical and orderly manner. Leapfrogging the urban front will likely incur costs for the developers in the construction of temporary wastewater infrastructure and the extension of water reticulation mains.
- Landowners/developers bounded by Chester Pass Rd, Edward St and Beaufort Rd will need to coordinate and share the cost of sewerage extensions to service higher density development. A detailed plan should include a servicing report examining sewerage options and layouts.
- While the Water Corporation has made allowances for water servicing to the Yakamia area, the Corporation has not prepared a detailed water distribution and reticulation layout. Water reticulation mains of 200mm diameter and a water main along Catalina Rd of 250mm will be required.
- Servicing relies on the construction of a major waste pumping station shown in following plan. Provision will need to be made for a suitable odour buffer around the pumping station.

FIGURE 24. WATER CORPORATION – STRATEGIC INFRASTRUCTURE DEVELOPMENT

(source: Water Corporation)

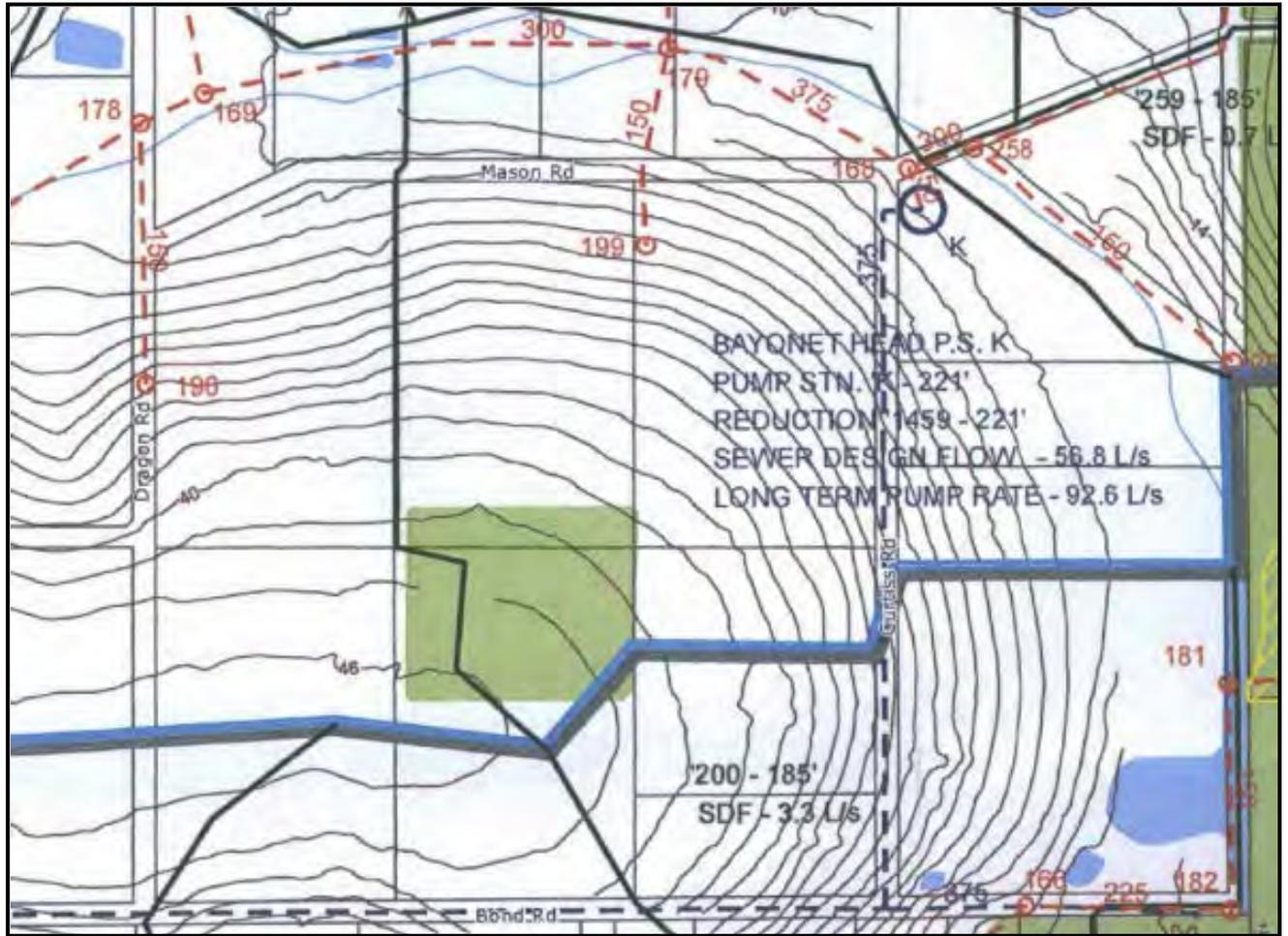
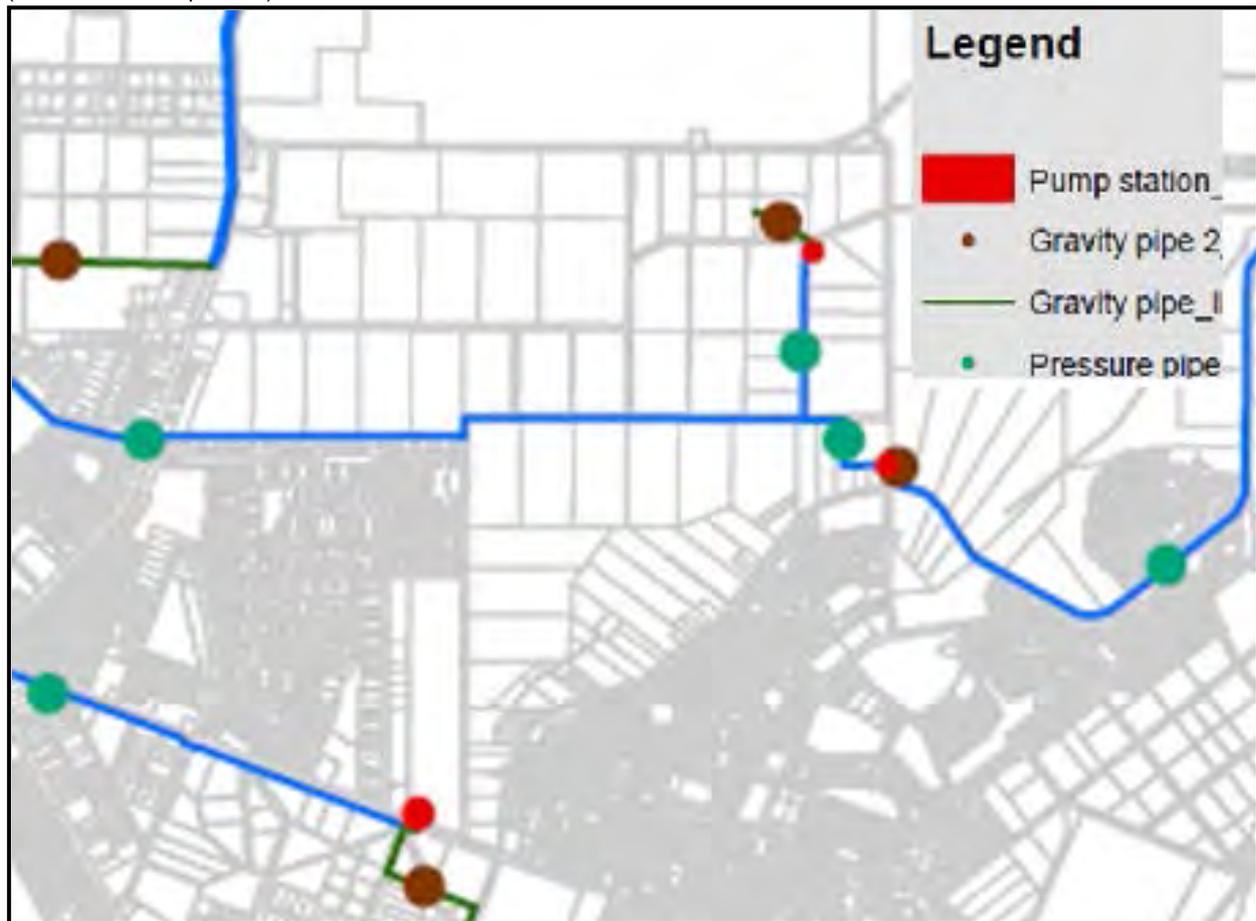


FIGURE 25. WATER CORPORATION – STRATEGIC INFRASTRUCTURE DEVELOPMENT (2)

(source: Water Corporation)



Utility Recommendations

1. It is recommended that the structure plan recognises proposals within the Western Power lot and plans development accordingly. Measures need to be established to ensure an interface with adjoining development and to mitigate safety, visual, nuisance and security impacts. For the substation, a provisions needs to be included to identify a 100m visual screening to adjoining sensitive land uses.
2. Road connections should be coordinated throughout the area to allow for future transmission lines.
3. Reticulated sewerage is required for all new subdivision and development in the structure plan area once the structure plan is endorsed.