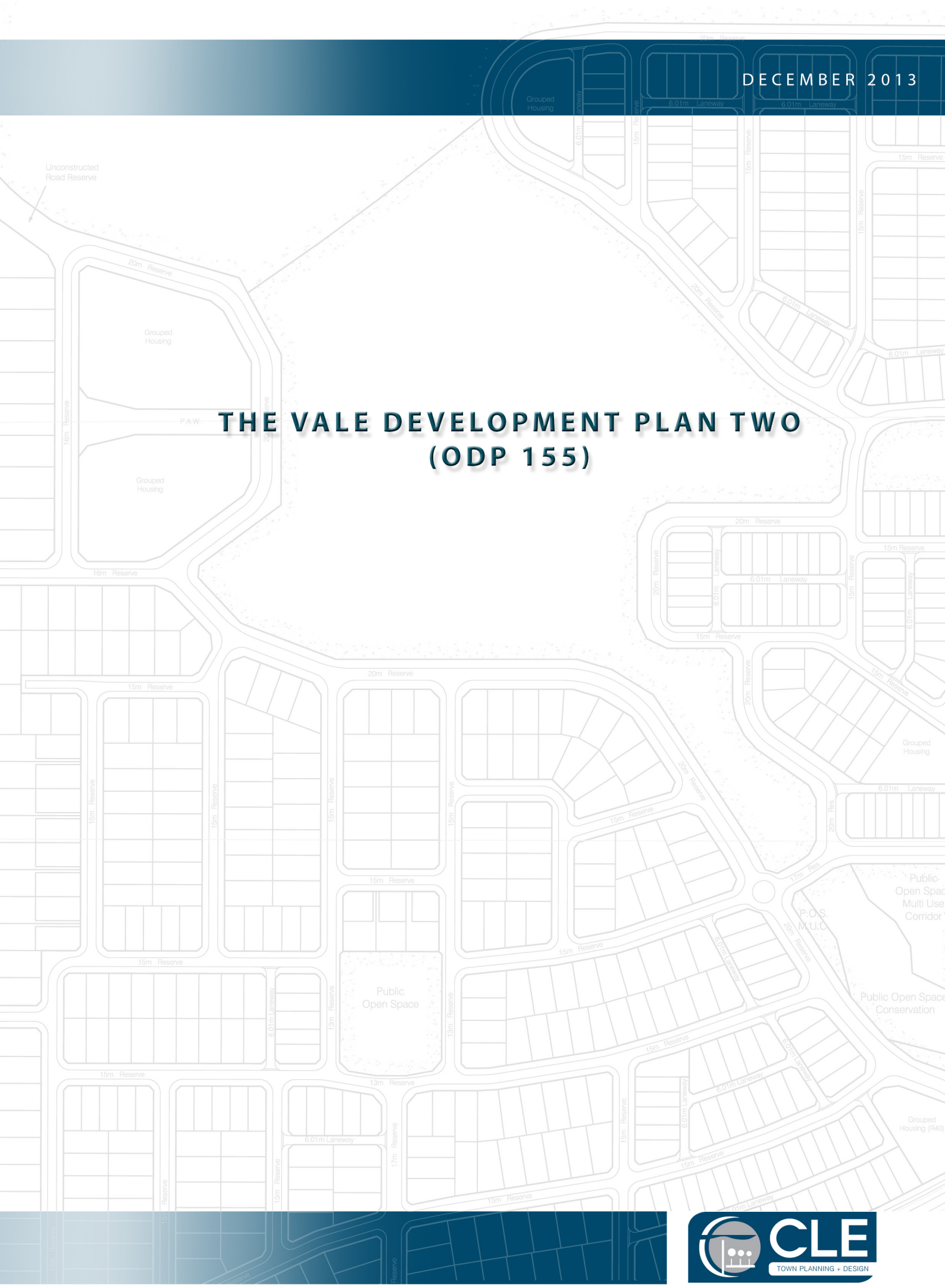
DECEMBER 2013

THE VALE DEVELOPMENT PLAN TWO (ODP 155)



CLE TOWN PLANNING + DESIGN

THE VALE DEVELOPMENT PLAN TWO

(ODP 155)

This Development Plan is prepared under the provisions of Appendix Six "Special Purpose – Ellenbrook" zone of the City of Swan Town Planning Scheme.

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ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the City of Swan Local Planning Scheme No. 17

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

14 February 2014

In accordance with Schedule 2, Part 4, Clause 28 (2) and refer to Part 1, 2. (b) of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

Date of Expiry: **31 October 2030**

Amendment No.	Description of Amendment	Finally Endorsed City of Swan	Finally Endorsed WAPC
1	• Modification of portion of Village Centre lot from Special Use Neighbourhood Centre Zone to Residential Zone		
2	• Reframe the approved development plan to allow the final allocation of densities to be determined against specific performance criteria at subdivision applicable to Precinct 1. • Incorporate a generic set of Residential Design Code variations applicable to Precincts 1 & 2 • Modify the boundary alignment of the 1.74 ha multiple use corridor public open space to capture existing vegetation not previously included, resulting in an improved environmental outcome.		

THE VALE PROJECT TEAM

• Landowner	Stockland Developments
• Project Manager	Stockland Developments
• Urban Design & Planning	CLE Town Planning + Design
• Civil Engineers	Cossill & Webley
• Environmental Consultant	PGV Environmental
• Traffic Engineers	Sinclair Knight Merz
• Landscape Architects	Emerge
• Environmental Hydrologist	Jim Davies & Associates
• Retail	Shrapnel Urban Planning
• Community	Earthcare Landscapes
• Fire Management	Natural Area Consulting

APPENDIX:

FIGURES

STATUTORY PLANS

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PART ONE: BACKGROUND

1.0 Background

1.1 Introduction

The Vale Development Plan Two is lodged pursuant to Appendix Six 'Special Purpose – Ellenbrook' zone of the City of Swan Town Planning Scheme, where an approved Development Plan is required prior to development within the 'Special Purpose – Ellenbrook' zone.

Development Plan Two is consistent with the approved Egerton Structure Plan (ODP 50) Review, (refer Fig.1). Development Plan Two is the second Development Plan to be prepared within the Egerton Structure Plan Area, The Vale Development Plan One (ODP 73) Review was approved in 2005.

The Egerton Structure Plan area, referred to as The Vale, covers approximately 537 hectares located north of Gnangara Road, Ellenbrook. The Development Plan Two area covers the northern portion of the Egerton Structure Plan, totalling approximately 173 hectares generally north of Millhouse Road within Lots 80, 148 and 9010 (refer Fig.2).

Development Plan Two will be the basis for future subdivision applications, preparation of Detailed Site Plans and development in the northern portion of the project area.

1.2 Statutory Planning Framework

The Egerton Structure Plan area is zoned 'Special Purpose – Ellenbrook' in the City of Swan Town Planning Scheme (refer Fig.3). Appendix Six of the Scheme outlines the special statutory provisions which relate to the zone, including the requirements for a Structure Plan and a Development Plan.

Development Plan One (ODP 73) Review 2004 was approved by the Western Australian Planning Commission, concurrently with the Egerton Structure Plan (ODP 50) Review 2004, in 2005. Subdivision approvals have been received over the entire Development Plan One area (refer Fig.4).

The general purpose of a Development Plan is to refine the proposals in a Structure Plan over the same land, to guide future development. The Development Plan shall conform with the zoning and land use policies, guidelines, development standards and objectives contained in an approved Structure Plan. A proposed Development Plan is required to show such detail as the Council requires to ensure that the development of the land is consistent with orderly and proper planning and the achievement of the highest appropriate level of amenity.

It must include information or detail dealing with the following:

- The definition of reserves and zones in accordance with the range of reservations and zones set out in Clauses 2.1 and 2.2 respectively of the Scheme;
    - i) Proposed residential densities within zones where residential use is permissible;
    - ii) Development objectives, standards and criteria and design guidelines;
- Proposed transportation systems; road layouts and vehicular traffic; cycle and pedestrian networks; underpass locations; and public transport routes;
- Provision for major land uses including residential, shopping, commercial, office, educational, civic, employment centre, open space, recreational, and community facilities;
- Indicative lot pattern and general location of any major buildings, and;
- The integration of land use and development.

This Report satisfies the requirements of the City of Swan Town Planning Scheme, setting out background information and statutory documentation for Development Plan Two, consistent with the Egerton Structure Plan (ODP 50) Review.

1.3 Site Description and Local Context

The Vale project area consists of approximately 537 hectares located on Gnangara Road, Ellenbrook 12 kilometres north of Midland.

The Development Plan Two area occupies approximately 173 hectares within the northern portion of the landholding.

The western and northern boundary of Development Plan Two abuts the Ellenbrook development. The Vines development lies to the north-east and land immediately east is included within the Swan Valley (Act) Area. The southern boundary of the development area generally follows Millhouse Road and the Multiple Use Corridor.

The Development Plan has a strong interface with the Ellenbrook development, particularly via linkages to The Broadway and Ellenbrook District Centre to the north, and the Ellenbrook Regional Centre via Millhouse Road to the west.

1.4 Development Plan Two: Key Initiatives

Key initiatives of Development Plan Two to be discussed in this report include:

- Residential development at a range of densities between R10 to R60, achieving a dwelling density of 26.62 dwelling units per site hectare;
- A main street based Neighbourhood Centre adjoining Millhouse Road accommodating approximately 2 500m^2 of retail floorspace and mixed uses;
- The provision of an integrated open space, drainage and conservation network totalling 58ha, including Bush Forever Site 22 which comprises approximately 23ha;
- Use and management of conservation areas within open space in accordance with environmental approvals issued by the Minister for the Environment;
- A High School site and District Open Space to be shared with Ellenbrook, adjoining the northern boundary;
- An interconnected street network and lot layout promoting legibility and walkability; and
- Preparation of supporting technical documents as detailed in Section 1.5.

1.5 Supporting Documents

A number of supporting reports and documents have been prepared in conjunction with Development Plan Two:

- Drainage and Nutrient Management Programme (refer Appendix Two)
- Wetland Management Plan - Development Plan Two Area – North West Wetland and Creeklines (refer Appendix Three)
- Public Open Space Concept Plans and Maintenance Costing (refer Appendix Four)
- Traffic Modelling Report (refer Appendix Five)
- Updated Centres Strategy, July 2006 (refer Appendix Six)
- Engineering Report (refer Appendix Seven)
- Fire Management Plan (refer Appendix Eight)

PART TWO: ENVIRONMENTAL MANAGEMENT

2.0 Environmental Considerations

2.1 Background

The Egerton Structure Plan Review provides a detailed background to all of the environmental issues including wetlands, Bush Forever, conservation and drainage matters. A brief summary follows.

To support the initial lifting of Urban Deferment and zoning to Urban under the Metropolitan Region Scheme a Consultative Environmental Review (CER) was prepared and the Minister for the Environment set the Environmental Conditions of Approval on 18 November 1994.

Broadly these conditions required the preparation of more detailed Management Plans during the planning and development phases comprising;

- A Wetland Management Strategy (1995)
- A Drainage and Nutrient Management Plan (1995)
- A Bandicoot Protection Strategy (1995)
- A Western Swamp Tortoise Assessment (1995/1997)

These were subsequently prepared and approved by the relevant authorities and were used as the basis for approval of the original 1997 Development Plan One - ODP 73 and subsequent stage one subdivision application. Importantly the then Department of Environmental Protection gave notice on the 9 February 1998 that urban development at Egerton had "substantially commenced" by virtue of the number of conditions satisfied and the lifting of Urban Deferment.

Development at The Vale is covered by the requirements of this approved CER and the four endorsed Management Plans. Development Plan Two is guided by these Management Plans and more detailed strategies prepared pursuant to these documents. A Drainage and Nutrient Management Programme and Wetland Management Plan are required pursuant to the CER at Development Plan stage, refer Sections 2.2 and 2.3.

A summary of Environmental Reporting Requirements pursuant to the CER is provided in Appendix One, this summary will be used on an ongoing basis to monitor reporting requirements during the implementation of Development Plan Two.

2.2 Drainage and Nutrient Management Programme

A Drainage and Nutrient Management Programme (DNMP) for Development Plan Two is required pursuant to the Drainage and Nutrient Management Plan (1995) and provides a more detailed strategy to address drainage matters, specifically relating to water quality and quantity, within each of the Development Plan stages. The background to Drainage and Nutrient Management is explained in full in Section 4.0 of the Structure Plan Review document. The DNMP is consistent with the approved Drainage and Nutrient Management Plan adopted in 1995 in accordance with the CER.

The DNMP relevant to Development Plan Two is submitted with this Report, refer Appendix Two. The following is a summary of the planning implications of the document, refer to the complete Drainage and Nutrient Management Plan prepared by JDA Consulting for further details.

Development Plan Two is entirely within the catchment of the northern most creek, referred to in the 1995 Drainage and Nutrient Management Plan as North-West Creek. There is no external catchment which contributes surface drainage to Development Plan Two.

Water Quantity

- The DNMP proposes the construction of detention basins within Multiple Use Corridors as previously undertaken for DP1 to ensure that post-development peak flow rate in the creek (100 year ARI) would be no greater than predevelopment rate. The Multiple Use Corridors within Development Plan Two (Fig. S4) entirely contain the detention basins.
- Catchment flood modelling has been undertaken to confirm the predevelopment flow estimates and to stimulate the effect of proposed detention basins (lakes/swales) to ensure compliance.

Water Quality

- The approach to water quality control has been through source control measures emphasising a reduction in the application of nutrients on the post-development landscape. This approach has also been used for DP1 and is supported by the State Government over the use of water pollution control ponds (WPCP's) and is also supported by the latest DOE/DOW Stormwater Management Manual.
- All drainage within Development Plan Two is to be at an elevation at or above the average annual maximum groundwater level (AAMGL), unless it can be shown that a lower elevation would have acceptable environmental impacts.

2.3 Wetland Management Plan

A Wetland Management Plan (WMP) for the North West Wetland and Creek Lines within Development Plan Two is a requirement of the Wetland Management Strategy (1995) and is submitted with this Report, refer Appendix Three. The following is a summary of the planning implications of the document.

The Egerton Wetland Management Strategy (Alan Tingay & Associates, 1995) was approved by the Minister for the Environment in June 1995. The Strategy identified the boundaries of the wetland areas to be retained and described the broad principles for management. The Strategy designated Management Priority Areas (MPA) within the wetlands according to their proposed functions within the urban environment as follows;

- Conservation;
- Special Conservation;
- Passive Recreation; and
- Drainage.

The Strategy required the preparation of more detailed Wetland Management Plans as a part of the Development Planning for areas adjacent to the wetlands. The wetlands requiring Management Plans included:

- The Mid-West Wetland;
- The North-South Linear Wetland;
- The North-West Wetland; and
- The Creek Lines.

The MPA boundaries set out under the Wetland Management Strategy 1995, remain unaltered in Development Plan Two and associated Wetland Management Plan and all are shown as open space. The varying recreational utility of the MPA's is described further in Section 5.0 consistent with the Egerton Structure Plan for the purpose of calculating the open space provision. These areas and their roles are also described in detail in the 2004 Structure Plan Review document.

The WMP has been prepared for the wetland that occurs in the north west corner of the Egerton property (North West Wetland) and the drainage lines (Creek Lines) within the Development Plan Two area that run in an easterly direction towards the Ellenbrook and associated dam. Bush Forever Site 22 is located within Development Plan Two and covers the northern portion of the North West wetland, which is Conservation MPA, and the Egerton Seepage, which is Special Conservation MPA.

The WMP outlines the proposed treatment of the Wetland and Creek Line areas as well as implementation of the plan, management and future monitoring requirements.

The Fire Management Plan, refer Appendix Eight, has been prepared in conjunction with the WMP, Drainage and Nutrient Management Programme and Open Space Strategy.

The following is a summary of the management of the North West Wetland and Creek Lines, for further information refer to the WMP.

North West Wetland

Access to the wetland, which is largely shown as Conservation MPA, will be limited to the provision of a few paths that traverse the wetland to enable strategic access. Access will be restricted using appropriate perimeter fencing, retaining walls where necessary and internal fencing of paths within the wetland. Interpretive signage will be provided. Revegetation will be undertaken in areas that are degraded and in association with works to create access paths.

The Seepage is designated as a Special Conservation MPA and no pedestrian access is proposed. The Special Conservation MPA will be fenced to prevent indiscriminate access and access paths traversing the North West Wetland will be directed away from the area.

Creek Lines

The Creek Lines are designated as Drainage MPA and are retained in Multiple Use Corridors. The drainage function of the Creek Lines will be maintained in accordance with the Wetland Management Strategy (1995).

The majority of the remnant over storey vegetation will be retained within the Creek Lines. The creek areas will incorporate grassed POS areas, areas of rehabilitated native vegetation and dual use paths to allow both passive recreation and drainage functions.

Monitoring and Reporting Commitments

In accordance with the Wetland Management Strategy a monitoring programme will be implemented within Development Plan Two, refer Appendix One. Monitoring will be undertaken for the following;

- Wetland vegetation;
- Rehabilitation works;
- Fauna (Bandicoots);
- Groundwater levels and quality (see Drainage and Nutrient Management Plan); and
- Surface water quality and quantity (see Drainage and Nutrient Management Plan).

A Weed Management Programme and Rehabilitation Plan will be prepared for the North West Wetland and Creek Lines as part of ongoing reporting.

2.4 Aboriginal Heritage

The DP2 area was assessed during an archaeological and ethnographic survey of the Egerton property in 1993. The survey was undertaken by McDonald Hale and Associates to provide information for the preparation of the CER.

The archaeological survey included a search for existing sites and a search of the property for additional archaeological material over a three day period. The ethnographic survey involved an onsite inspection with five key Aboriginal informants and interviews with 11 other informants.

The 1993 survey recorded two archaeological and two ethnographic sites within the Egerton property which are now listed in the Permanent Register of Aboriginal Sites. The two archaeological sites are located in close proximity to the Horseshoe Wetland within DP1 to the south of DP2 and have been managed in accordance with the Section 18 approval. One ethnographic site comprising two separate campsites is also located in close proximity to the Horseshoe wetland. The other ethnographic site is part of the Ellen Brook Upper Swan mythological site and within the Egerton property comprises of a tributary to Ellen Brook known as Aviary Creek. Aviary Creek is located within DP3 and the sites will be retained in POS accordingly. Therefore, no archaeological or ethnographic sites were located within the DP2 area and those within DP1 and DP3 have received Section 18 approval and managed accordingly.

PART THREE: DEVELOPMENT PLAN TWO

3.0 Land Use Summary

The Land Use Schedule below describes Development Plan Two, as shown in Figure S1.

TABLE 1: LAND USE SCHEDULE DEVELOPMENT PLAN TWO

Gross Area *(Development Plan)*		**173 ha**
Non Residential Land Uses		
▪ High School	4.25 ha *	
▪ Local Centre B - Retail Uses	2.0 ha (est)	
▪ Bush Forever/ Special Conservation	23.07ha	
Total		**29.32 ha**
Gross Residential Area *(173 ha less 29.32 ha)*		**143.68 ha**
Open Space requirement Development Plan Area *(@ 10% of GRA)*		**14.36 ha**
Credit Open Space Provided *(refer POS Schedule)*		**20.95 ha**
Surplus POS @ 10% *(for DP2)*		**6.59 ha**

* Note: The high school site is adjoining the boundary of Ellenbrook and is a shared facility. The 4.25ha for the high school and 9ha for district open space is in accordance with the approved Structure Plan (ODP50). It is understood that the City of Swan and Department for Education & Training will continue to discuss the integration of these facilities to maximise community benefit and avoid duplication.

4.0 HOUSING STRATEGY

Development Plan Two provides for a range of lot types responding to the location of services, facilities, public transport routes, open space and topography. Residential densities in Development Plan Two range from Residential R10 to Residential R60.

Lot types and residential densities in Development Plan Two are based on the following principles:

- Provide diversity in housing choice and lot sizes;
- Higher density (R40 to R60), which could include aged persons/independent living accommodation, within 400 metres of the neighbourhood centre and around select open space sites;
- Promoting mixed use and residential development around and within the neighbourhood centre, including home based business, and;
- Environmentally sustainable design approaches in terms of solar orientation of lots.

The City of Swan adopted an *Urban Growth Policy*, which includes a *Neighbourhood Planning Policy*, in May 2006. The *Neighbourhood Planning Policy* (Policy No. C-Pol-103) states that '*urban development must provide for a range of dwelling types and tenures, including single houses, grouped dwellings, villas and townhouses, apartments and mixed use developments in centres*'. Development Plan Two provides this diversity in housing product.

Figure 5 sets out the typical lot type profiles anticipated within Development Plan Two, including typical dimensions and areas, setbacks, site cover and desirable R-Code variations. R-Code variations will be dealt with through the preparation of Detailed Area Plans at subdivision stage. Grouped housing sites will also be provided in close proximity to services and facilities as well as open space.

The *Neighbourhood Planning Policy* also sets out a residential density target of 22 dwellings/nett hectare (note: nett hectare, also referred to as 'site hectare' under Liveable Neighbourhoods, excludes roads, lanes, open space and other non residential land uses).

Based on the Yield Precinct Plan and Indicative Subdivision Plan (refer Fig. 6) Table 2 estimates a total dwelling yield of 1786 (or 1659 lots) or 26.62 dwelling units per site hectare, exceeding the density targets set out under the *Neighbourhood Planning Policy*.

The total dwelling units per site hectare for Development Plans One and Two is 23.06, exceeding the requirements of the *Neighbourhood Planning Policy*.

TABLE 2: RESIDENTIAL LOT YIELD AND DENSITY ESTIMATE

DEVELOPMENT PLAN ONE & DEVELOPMENT PLAN ONE SUPPLEMENT AREA

	Lots*							Dwelling Units (DX+GH)		Yield Calculations	
Stage	Single	Cottage	4 Pack	DX	GH	TX	Total	Dwellings	Total	Site Ha	Du/Site Ha
1	155	0	32	1	3	0	**190**	26	**205**	11.81	**17.35**
2	315	25	51	1	3	0	**394**	147	**537**	26.12	**20.56**
3	167	32	8	9	4	0	**211**	94	**292**	12.27	**23.8**
5	238	30	42	0	0	0	**310**	0	**310**	18.12	**17.11**
12	247	21	0	2	0	0	**268**	2	**269**	11.981	**22.46**
TOTAL	1122	108	133	13	10	0	1373	269	1613	80.301	20.09

DEVELOPMENT PLAN TWO (995-240A Staging)

Development Plan Two stage boundaries below are preliminary, to be confirmed

	Lots*							Dwelling Units (DX+GH)		Yield Calculations	
Stage	Single	Cottage	4 Pack	DX	GH	TX	Total	Dwellings	Total	Site Ha	Du/Site Ha
6	360	124	16	24	1	9	**501**	44	**529**	24.072	**21.97**
7	45	98	0	78	0	0	**143**	78	**182**	5.0912	**35.74**
8	126	163	12	72	0	6	**301**	78	**341**	11.081	**30.77**
9 to 11	325	121	0	0	0	0	**446**	0	**446**	14.613	**30.51**
13	42	61	0	0	0	0	**103**	0	**103**	3.3592	**30.66**
14	117	46	0	0	2	0	**165**	22	**185**	8.8523	**20.89**
TOTAL	1015	613	28	174	3	15	1659	222	1786	67.069	26.62

TOTAL (DEVELOPMENT PLAN ONE AND DEVELOPMENT PLAN TWO)

	Lots*							Dwelling Units (DX+GH)		Yield Calculations	
	Single	Cottage	4 Pack	DX	GH	TX	Total	Dwellings	Total	Site Ha	Du/Site Ha
TOTAL	2137	721	161	187	13	15	3032	491	3399	147.37	23.06

Note:

1. * Single, Cottage and 4 Pack lots all count as one dwelling unit.
2. Site hectare is as per the City of Swan Neighbourhood Planning Policy & Liveable Neighbourhoods (excluding roads, public open space, community facility sites and so forth).
3. Grouped housing site yield estimates have been based on the maximum acheivable yield based on the R Code (excepting Stage 14 where 32% road area has been extracted).
4. Refer Plan 995-240A for stage boundaries

5.0 PUBLIC OPEN SPACE STRATEGY

5.1 Background

Section 5.0 of the approved Structure Plan Review describes the overall open space strategy for Vale. The categories of open space within Development Plan Two are:

- Neighbourhood Parks (NP) (referred to as large parks and pocket parks in the Structure Plan Review)
- Passive Recreation (PR)
- District Recreation (DR)
- Drainage Open Space/Multi-use Corridors (MUC)
- Conservation (Con)
- Bush Forever / Special Conservation (BF)

Table 3 provides a summary of these open space types and the rate at which each may be credited towards subdivisional open space, as per the Structure Plan. The open space credits have been provided by the City of Swan and are explained further in the Structure Plan document.

TABLE 3: PUBLIC OPEN SPACE TYPES & SUMMARY

Use Category		Description	Contribution Rate Agreed by City (2000)	Contribution Rate agreed by City (2004)	Structure Plan Contribution Rate Applied
Public Open Space	Neighbourhood Parks	Parks with strong active recreation focus. Over 0.5ha and can be co-located with primary schools	100%	100%	100%
	Passive Rec. (PR)	Defined in WMS as Passive Recreation areas. Generally located on land adjacent degraded wetlands within Management Priority Areas (refer WMS)	100%	100%	100%
	District Open Space (DOS)	Organised sports	100%	100%	100%
	Drainage Open Space/Multi-Use Corridors (MUC)	Defined in WMS. Multi-use corridors on existing drainage lines. Enhanced to include drainage basins, drainage swales, artificial wetlands, recreation/ grassed areas and walk trails etc (Note: areas exclude permanent water)	100%	50%	50%
Conservation (Con)		Defined in WMS. Vegetation and Wetlands protected and managed for low impact passive recreation (paths, BBQ etc)	50%	25%	25%
Bush Forever & Special Conservation (BF)		Special Conservation Area defined in WMS. Bush Forever Site No.22. Conservation only with limited public access	50%	Nil	Nil

5.2 Development Plan Two Open Space Strategy

Figure S4 depicts the Open Space Strategy for Development Plan Two, consistent with the open space types detailed above, the Structure Plan and the CER.

Table 4 describes the open space contribution for the Development Plan Two, using criteria established in Table 3.

Note that Table 3 in the Structure Plan Report describes the overall contribution to open space for the Structure Plan area. Based on the overall calculation at Structure Plan stage the total Public Open Space at Vale is in excess by around 4.6ha. A large portion of this open space is included in this Development Plan Two, as shown in Table 4.

TABLE 4: DEVELOPMENT PLAN TWO OPEN SPACE SCHEDULE

	Category	Locations	Gross Area (ha)	P Water (est)*	Nett Area (ha)	Contribution Rate	Credit Area (ha)
PUBLIC OPEN SPACE	Neighbourhood Parks (NP)	Precinct 1^	0.73	Nil	0.73	100%	0.73
		2	0.50	Nil	0.50		0.50
		3	0.77	Nil	0.77		0.77
		Subtotal	**2.00**	**Nil**	**2.00**		**2.00**
	Passive Recreation (PR)	1	2.17	Nil	2.17	100%	2.17
		Subtotal	**2.17**	**Nil**	**2.17**		**2.17**
	Multiple Use Corridors (MUC)	1	3.70	Nil	3.70	50%	1.85
		2	1.43	Nil	1.43		0.71
		3	0.45	Nil	0.45		0.22
		4	0.23	Nil	0.23		0.11
		5	2.70	Nil	2.70		1.35
		6	0.58	Nil	0.58		0.29
		7	1.74	Nil	1.74		0.87
		8	0.49	Nil	0.49		0.24
		Subtotal	**11.32**	**Nil**	**11.32**		**5.66**
	District Open Space (DOS)	1	8.78	Nil	8.78ha	100%	8.78
		Subtotal	**8.78**	**Nil**	**8.78ha**		**8.78**
Conservation (CON)		1	9.96	Nil	9.96	25%	2.49
		2	0.94	Nil	0.94ha		0.23
		Subtotal	**10.90**	**Nil**	**10.90**		**2.75**
BushForever & Special Conservation (BF)		1	23.07	Nil	23.07ha	Nil	0
		Subtotal	**23.07**	**Nil**	**23.07ha**		**0**
TOTAL AREA (Devt Plan Two)			**58.24**	**0.56**	**58.24**		**20.95**
POS Required @ 10% (Refer Table 1)							**14.36 ha**
POS Surplus (Refer Table 1)							**6.59ha**

* Note: Estimate only of permanent water in drainage features.

^ Note: A minimum area of 0.73ha of Neighbourhood Park POS shall be provided in Precinct 1.

5.3 Public Open Space Types and Descriptions

A Preliminary Landscape Concept for open space in Development Plan Two has been prepared and is included with maintenance cost estimates as Appendix Four. The preliminary Landscape Concept Plans, Wetland Management Plan and Drainage & Nutrient Management Programme are all co-ordinated in content.

Any proposed development of Public Open Space will need to comply to Council's Landscape Guidelines for Streetscapes and Public Space. The key design principles for each category of open space included within Development Plan Two are summarised below and are reflected in further detail in Appendix Four:

Bush Forever & Conservation

Refer Sections 2.3 and 5.4 of this Report.

Multiple Use Corridor

- Retention, recontouring and stabilisation of existing creek lines where appropriate;
- Installation of linking dual use path systems as part of a greenbelt system across the development;
- Inclusion of drainage where necessary, refer Section 2.2;
- Retention of existing significant vegetation;
- Feature landscape areas including seating and signage nodes, viewing areas and informal rec areas;
- Predominantly native species with some smaller introduced feature planting areas;
- Minimal irrigation use, and;
- Minimal maintenance areas.

District Open Space

- To be developed by the City of Swan.

Passive Recreation

- Open, active, informal, grassed recreation area;
- Shade trees;
- Pedestrian path links to adjacent residential areas;
- Playground and picnic facilities;
- Introduced and native plant species, and;
- Irrigated where required.

Neighbourhood Parks

- Retention of existing vegetation where possible (NP2);
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture;
- Low retaining walls as may be needed;
- POS lighting where required, and;
- Irrigated where required.

The function and management of public open space area P1 is to be confirmed following discussions with Department for Planning & Infrastructure. The City of Swan resolved to remove the notation on this open space as Neighbourhood Park.

5.4 Bush Forever

The Egerton Structure Plan (ODP 50) Review – 2004 includes Negotiated Planning Solution – Bush Forever Site No. 22 comprising Egerton Mound Spring and adjacent bushland. The Wetland Management Plan relating to this area is discussed in Section 2.

In accordance with *SPP 2.8 Bushland Policy for the Perth Metropolitan Region* this significant bushland site has been clearly demarked on Development Plan Two to facilitate protection and management as part of a Negotiated Planning Solution.

It is recognised that the conservation area is required under the State Government's policy to be set aside over the normal 10 per cent contribution and ceded free of cost to an appropriate management body, or secured through a statutory conservation covenant. Accordingly the Bush Forever area has been shown as a non-residential land uses and treated as a deduction from the Gross Residential Area (refer Table One). Given the high conservation value, it is envisaged that the site will require specialist management by the State Government, and Multiplex is working with State Government to this end.

6.0 MOVEMENT NETWORKS

The major elements of the road network within the Development Plan are described in Section 8.0 of the 2004 Structure Plan Review based on the Sinclair Knight Merz (SKM) Traffic Modelling Report. In preparing Development Plan Two SKM have revised and updated the Traffic Modelling Report as it relates to the Development Plan Two area, refer Appendix Five.

Key findings of the Development Plan Two SKM Traffic Modelling Report, which are consistent with those in the Egerton Structure Plan Review, are as follows:

- Millhouse Road and the north-south road adjoining the western boundary of the High School are classified as District Distributor B.
- Traffic volumes in the order of 11,000 vpd - 13,000 vpd are forecast for Millhouse Road to the west and 7,000 vpd – 9,000 vpd are forecast for Millhouse Road to the east. These traffic volumes can be accommodated within a 30m Road Reserve. The design of Millhouse Road will ensure lots address and survey the road and it does not become a pedestrian barrier, consistent with the annotation on Development Plan One.
- Traffic volumes between 6,000 vpd and 8,000 vpd are forecast for the main north-south District Distributor adjoining the western boundary of the High School.
- The northern extension of Egerton Drive is classified as a Neighbourhood Connector and is forecast to have traffic volumes between 1,500 vpd and 2,500 vpd.
- Provision has been made for cyclists with on-street cycle lanes along District Distributors and the Neighbourhood Connector.
- On local access roads it is envisaged that cyclists will share the roadway with motorists due to the low traffic volumes (less than 3,000 vpd) and small speed differential.
- Where land use permits, it is becoming common practice for a shared use path (path to be 2.5m) to be provided on both sides of a District Distributor road and along at least one side of a neighbourhood connector (with a 1.5m footpath on the other side). However, shared use paths are usually not appropriate in front of shops, retail and café precincts. Provision has been made within the cross sections for a shared use path along at least one side of the Neighbourhood Connector. The shared use paths along Millhouse Road will form an extension of those established within Ellenbrook.
- The proposed cross section for the Neighbourhood Connector and District Distributor roads are wide enough to accommodate bus routes.

7.0 COMMERCIAL CENTRES STRATEGY

The Structure Plan Review shows a Neighbourhood Centre within Development Plan Two adjoining Millhouse Road, referred to as 'Village Centre B'. The Structure Plan has an annotation relating to this centre which states:

> *'The final location of Village Centre, Mixed Use and Primary School to be determined at Development Plan stage in liaison with relevant Government agencies'.*

The size, function and conceptual layout of this centre has been detailed in the preparation of Development Plan Two as outlined below.

7.1 Summary of Updated Vale Commercial Centres Strategy

Shrapnel Urban Planning has prepared a review of the Vale Local Centres Strategy in 2010, which was an update of the previous Centres Strategy prepared in 1999, and revised in 2003 and again in 2006. The development of the Vale and surrounding Estates has substantially progressed over the last five years hence the need to undertake a review of the Vale Centre Strategy floor space allocations.

Council adopted a Commercial Centres Strategy for the City of Swan in June 2004. Based on the dwelling and population projections in Egerton Structure Plan Consolidation 2004 and the City of Swan Population and Household Projections to 2021, the City's Commercial Centres Strategy identified the need for two Medium Neighbourhood Centres and three Small Local Centres within the Structure Plan area.

Originally, Vale was to provide two 'medium' size local centres, however, analysis undertaken by Shrapnel Urban Planning as part of the Vale 2005 Structure Plan review and preparation of Development Plan 2 (ODP 155) revised these two local centres to 'small' based on a reduce dwelling yield for the Vale, given the subdivision approvals granted in Development Plan One, and detailed planning of the Development Plan Two area.

As part of the ongoing detailed planning and analysis for the Vale and more specifically Village Centre 2, Shrapnel Urban Planning undertook a detailed review of floorspace allocation for Village Centre 2, (refer to attached Report). The report is based upon the most recent retail modelling and it is now clear that the classification shown in the City's Commercial Strategy provides adequate and necessary flexibility. The report envisages the main retail core being constructed on the southern side of Millhouse Road, at its intersection with Egerton Drive. Subsequently it is considered Village Centre 2 should remain as a 'medium' neighbourhood centre to allow for a significantly sized supermarket and specialty shops in a main street environment.

Permitted land uses within Village Centre B are set out in Section 10.0 of this Report.

7.2 Village Centre B Development Concept

A Detailed Area Plan has been prepared for Village Centre B, demonstrating how it could be developed as a centre of approximately 3 500m2 to 4500m2 (refer Fig. 8). The purpose of the Detailed Area Plan is to provide general development standards to the Village Centre to create a main street and demonstrate how development of the Village Centre could occur.

The Detailed Area Plan for the Centre and its surrounds includes details of:

- Land Use and integration of mixed use residential;
- Streetscape and Built Form;
- Setbacks;
- Car parking;
- Vehicular and Pedestrian access;
- Ancillary features and landscaping; and,
- Interface treatment along public open space.

The following summarises the key design elements of the Detailed Area Plan:

- Main street based centre with uses addressing public spaces;
- Treatment of Egerton Drive and Millhouse Road to provide an integrated pedestrian friendly environment;
- Mixed use centre potentially accommodating retail, office, community and residential opportunities;
- Interface with surrounding open space (Multiple Use Corridors);
- Permeable internal road layout; and,
- Car parking distributed so as to not detract from the amenity of the centre and on street parking where possible.

7.3 Primary School

The Structure Plan Review shows a Primary School south of Millhouse Road, adjoining Village Centre B, the annotation of the Structure Plan states that the final location and layout of this centre including the Primary School is to be determined at Development Plan stage.

When locating Primary Schools it is important to consider a number of locational criteria including access, catchment and integration with surrounding land uses. In preparing the Concept Plan for the Village Centre it was found that a Primary School at the intersection of Millhouse Road and Egerton Drive did not meet this criteria and was not the optimum location. The Primary School site on the Structure Plan is bounded by Millhouse Road to the north, carrying approximately 10 000 – 11 000 vpd, as well as Multiple Use Corridor to the south and east, consequently local road interface for pick up and drop off as well as opportunities for direct integration with the surrounding catchment.

Discussions have been held with the Department for Education and Training who have indicated that they support the relocation of the Primary School site into Development Plan Three area south of MUC 5, consistent with the note on the Structure Plan Review. The location of the Primary School south of MUC 5 continues to provide opportunities for integration with the Village Centre, potentially less than 150m from the Village Centre.

8.0 COMMUNITY DEVELOPMENT

A Community and Economic Development Plan (CEDP) was prepared with the City of Swan as part of the Structure Plan Review submission. A number of community initiatives outlined in this CEDP have been implemented in Development Plan One, and will continue to be implemented in Development Plan Two.

Multiplex are committed to implementing the CEDP and are currently reviewing and updating the CEDP with the City of Swan as an ongoing and overall initiative for Vale. Multiplex have also signed a community infrastructure Memorandum of Understanding with the City of Swan.

The various initiatives within the current and revised CEDP follow commitments set down in the Wetland Management Plan and Drainage Nutrient Management Programme. A summary of these initiatives is listed below:

Community Infrastructure Initiatives

- Bush Forever and Wetlands
- Heritage, Culture and Environmental Interpretive Trail
- Community and Wetland Interpretive Centre
- Community Gardens
- Community Facilities and Infrastructure
- Art and Landscape
- Transport and Accessibility

Community Living, Belonging and Governance

- Community Development Fund
- Cultural Development
- Community Engagement
- Residents Evenings/Days
- Vale Online – Community Intranet
- Life-long Learning
- Local Educational Information

Sustainable Local Economy

- Local Employment and Enterprise and Home-Based Businesses
- Partnership Approach

Youth Development

- School Art Project
- Youth Planning Exercises
- Ribbons Of Blue
- Excursions
- Leadership Programmes
- Youth Groups
- Indigenous Connections
- V- Crew
- Presentations
- School Garden Project

Building, Enhancing and Consolidating Partnerships

- Whiteman Park
- Solar Cities Consortium

Ongoing Review of the Community Development Model

- Data Collection and the Use of a Continual Improvement Model
- Surveys

Sustainability Throughout the Development Process

- Builders' Waste Initiative
- Civil Contracting at Vale
- Builders Display – Stage 2
- Front Landscape Packages
- Smart Gardening Workshops
- Vale Living Kit
- New Purchasers Workshops
- Public Open Spaces – Sustainability Assessment
- Suppliers and Trades
- Composting
- Tree Harvesting and Recycling Into Local Uses
- DP2 – Pine Forest Harvesting
- Urban Water Management

Communication Strategy

- Newsletters, Flyers, Posters, Intranet Site, Photos

9.0 SERVICING AND INFRASTRUCTURE

Cossill & Webley Consulting Engineers have prepared a Report on Engineering Aspects Associated with Development Plan Two, refer Appendix Seven.

Key servicing initiatives and staging in Development Plan Two is summarised below:

Roads Infrastructure

- Construction of the developments roads will be staged to suit the rate and pattern of development.
- Vale falls within the City of Swan's policy area for *Subdividers Contributions – Henley Brook Drive (North) and Millhouse Road*. All lots within Development Plan Two will incur this per lot cost in accordance with this Policy.
- The construction of Millhouse Road and Egerton Drive will be carried out in accordance with the *Egerton Infrastructure Construction Memorandum of Understanding* between City of Swan and Multiplex.

Siteworks and Earthworks

- Earthworks will tie into levels of Ellenbrook to the west and design levels to the north.
- Where of a suitable standard for building topsoil will be stripped and reused within the site with the aim of minimising the amount of topsoil exported from the development area, in line with sustainability principles.
- In general it is expected that the western dunal lots will be a cut-to-fill exercise with no imported fill required for the construction of these lots. East of this area however, it is anticipated that some importation of clean sand fill material will be required to gain sufficient cover.

Sewerage Infrastructure and Water Supply

- The current sewer strategy for Development Plan Two, completed by Water Corporation, shows the sewerage for this area flowing east along Millhouse Road to the proposed Ellenbrook "E" Pumping Station. Current discussions with the Water Corporation have the site located to the east of Development Plan Two.
- Water Corporation have programmed for the pumping station to be operational by December 2007, in line with the requirements to accept flow from lots developed within Vale.
- Water Supply to Development Plan Two will be via the extension of distribution and reticulation watermains from Ellenbrook within Millhouse Road.

Other Utility Services

- Electricity supply for Development Plan Two will be via an extension of the existing high voltage system in Development Plan One. At this stage it is not expected that any sites for sub-stations, other than for padmount transformers, will be required in Development Plan Two.

- Natural gas is supplied to the Vale via a connection to the existing Dampier-Bunbury pipeline and will be extended to Development Plan Two.
- Telephone supply will be extended north to Development Plan Two. Development Plan One is serviced via optic fibre cables along Gnangara Road from the Ellenbrook development.
- Provision has been made for MATV access within the Vale development, through Broadcast Engineering Services. Under this system, pit and pipe conduit is laid and BES provide optic fibre to every lot. This facility will enable cable TV, central security, video on demand, high speed internet, intranet facilities and other information technology services.

PART FOUR: STATUTORY DOCUMENTATION

10.0 STATUTORY DOCUMENTATION

10.1 Statutory Plans

The provisions of Appendix No.6 of the Scheme, 'Special Purpose – Ellenbrook' zone set out the statutory planning requirements for The Vale.

This document has been prepared to satisfy the requirements for a 'Development Plan'. The statutory components comprise the following plans, which are included separately under the Statutory Plans section of the Figures:

- Development Plan (refer Fig. S1)
- Zoning Classification Plan (refer Fig. S2)
- R-Code Plan (refer Fig. S3)
- Open Space Strategy, Pedestrian and Cycle Network (refer Fig. S4)

10.2 Land Use Permissibility

Land use definitions shall be in accordance with the City of Swan Town Planning Scheme.

Land Use Permissibility:

Land Use permissibility within the Structure Plan area shall be in accordance with the corresponding zone or reserve under the Scheme. In addition, the following land uses are classified as 'D' uses in the Residential zone.

Display Home Centre: A group of two or more dwellings and incidental car parking which are intended to be open for public inspection as examples of dwelling design.

Residential Sales Office: A building of either temporary or permanent nature, and incidental car parking used directly in relation to the sales of land and dwellings in new residential estates.

10.3 Special Purpose – Neighbourhood Centre Zone

Village Centre B is zoned 'Special Purpose – Neighbourhood Centre' under Development Plan Two. The provisions of this zone, set out below, are the same as those for Village Centre A within Development Plan One. The 'Special Purpose – Neighbourhood Centre' Zone allows for mixed use and commercial development in an integrated manner.

The following requirements apply to development within the 'Special Purpose – Neighbourhood Centre', in accordance with 'Special Purpose – Ellenbrook' zone of the City of Swan Town Planning Scheme.

Zone Purpose & Objective:

To facilitate the development of an integrated, mixed use neighbourhood centre that provides goods, services and facilities to the surrounding community and contributes to the overall amenity of the locality. Residential uses will be incorporated into the Neighbourhood Centre, complementing commercial uses and will not be the predominant use.

Land use permissibility for uses in the Special Purpose – Neighbourhood Centre zone shall be in accordance with the following table:

Use Class	Permissibility
Auction Mart	AA
Amusement Parlour	AA
Betting Agency	AA
Car Park	AA
Car Wash Station	AA
Child Day Care Centre	AA
Cinema / Theatre	AA
Civic Building	AA
Club Premises	AA
Consulting Rooms	AA
Consulting Rooms: Grouped	AA
Convenience Store	AA
Cultural Use	AA
Dwelling Grouped	AA
Dwelling Multiple	AA
Educational Establishment	AA
Fast Food Outlet	AA
Food and Beverage Industry	AA
Funeral Parlour	AA
Health Centre	AA
Health Studio	AA
Hire Service: Non-Industrial	AA
Home Based Business	AA
Hotel Private	AA
Infant Health Centre	AA
Lunch Bar	AA
Market	AA
Medical Centre	AA
Milk Depot	AA
Museum	AA
Night Club	AA
Office: General	AA
Office: Professional	AA
Office: Service	AA
Produce Store	AA
Public Amusement	AA
Reception Lodge	AA
Recreation Public	AA
Recreation Private	AA

Restaurant	AA
Service Station	AA
Shop	AA
Shopping Centre	AA
Showroom	AA
Tavern: Less Than 200sqm GLA	AA
Veterinary Consulting Rooms	AA
Veterinary Hospital	AA
Wine House	AA
Wet Fish Shop	AA
Any other uses not listed above	AA

Development Standards:

All development standards within the 'Special Purpose - Neighbourhood Centre Zone' shall be in accordance with relevant planning policies and provisions contained in the City of Swan Town Planning Scheme 'Special Purpose – Ellenbrook' Zone and the Residential Design Codes of WA, unless stated otherwise and depicted in an approved Detailed Site Plan and accompanying Design Guidelines.

A Detailed Site Plan and Design Guidelines shall address, but is not limited, to land use mix and compatibility, street block layout, built form and character, landscaping and public infrastructure, signage, integration of civic and/or community uses and spaces, integration of residential uses, pedestrian and cycle movement, vehicle parking and access, integration of public transport services, infrastructure servicing, development staging and relationship to surrounding land uses.

10.4 Precinct 1

The following provisions apply to development within Precinct 1.

Residential:

- *Dwelling Target*

a) Objective: To provide for a diversity of lot and housing types within the Structure Plan area.

b) Precinct 1 is to achieve a minimum yield of 15 dwellings per gross urban zoned hectare.

- *Density*

a) The locational criteria outlines the broad residential density ranges that apply to specific areas within the Structure Plan. Lot specific residential densities, within the defined residential density ranges, are to be subsequently assigned in accordance with a Residential Code Plan approved by the WAPC.

b) A Residential Code Plan is to be submitted at the time of subdivision to the WAPC and shall indicate the R Code applicable to each lot within the subdivision and shall be consistent with the Structure Plan, and the Residential Density Ranges indentified on Figure S3 and locational criteria outlined below.

c) The Residential Code Plan is to include a summary of the proposed dwelling yield of the subdivision.

d) Approval of the Residential Code Plan shall be undertaken at the time of determination of the subdivision application by the WAPC. The approved Residential Code Plan shall then form part of the Structure Plan and shall be used for the determination of future development applications.

e) Variations of the Residential Code Plan will require further approval of the WAPC, with a revised Residential Code Plan submitted generally consistent with the approved plan of subdivision issued by the WAPC. The revised Residential Code Plan shall be consistent with Residential Density ranges identified on Figure S3 and the locational criteria outlined below.

f) A revised Residential Code Plan, consistent with clause (e) will replace, wholly or partially, the previously approved Residential Code Plan, and shall form part of the Structure Plan as outlined in clause (d).

g) Revised Code Plans are not required if the WAPC considers that the subdivision is for one or more of the following:

   i) the amalgamation of lots

   ii) consolidation of land for 'superlot' purposes to facilitate land assembly for future development

   iii) the purposes of facilitating the provision of access, services or infrastructure; or

   iv) land which by virtue of its zoning or reservation under the Structure Plan cannot be developed or residential purposes.

- *Locational Criteria*

The allocation of residential densities on the Residential Code Plan shall be in accordance with the following criteria:

a) A base density code of R30 shall be provided for all other residential lots within the Structure Plan.

b) Medium densities of R40 to R60 shall be provided in area of high amenity including:

   i) Within 800 metres of centres (activity and community);

   ii) Within 400 metres of public open space; or

   iii) Within 250 metres of public transport or neighbourhood connector routes.

Public Open Space:

Public Open Space provision shall be provided as shown on Plan S4.

Development:

- *Residential Design Code Variations*

Tables 5 and 6 set out variations to the Residential Design Codes that are deemed to constitute 'deemed to comply' Development within Precinct 1 and which do not therefore, require neighbour consultation and planning approval.

10.5 Precinct 2

The following provisions apply to development within Precinct 2.

Development:

- *Residential Design Code Variations*

Tables 5 and 6 set out variations to the Residential Design Codes that are deemed to constitute 'deemed to comply' Development within Precinct 2 and which do not therefore, require neighbour consultation and planning approval.

TABLE 5A: PRECINCTS 1 AND 2 R-CODE VARIATIONS - FRONT LOADED LOTS (FRONTAGE > 13M)

The following provisions apply as R-Code deemed to comply provisions and development standards under City of Swan Local Planning Scheme for front loaded lots. Front loaded lots are those where vehicle access is provided via a primary or secondary street and are not serviced by a rear laneway. Where there is conflict between the following provisions and the R-Codes the provisions below prevail. Compliance with the deemed to comply provisions below will not require neighbour consultation. Where the criteria outlined below cannot be satisfied, the application shall be addressed in accordance with the applicable design principles, as outlined in Part 5 and 6 of the Residential Design Codes.

	RELEVANT R-CODE CLAUSE	DEEMED TO COMPLY PROVISIONS FOR SINGLE DWELLINGS WITH FRONTAGE GREATER THAN 13m
Setbacks	5.1.2 C2.1, C2.2 & C2.4	Buildings to be setback from the primary street as follows: • Minimum Setback – 2m (including verandahs, porticos and other minor incursions). Buildings to be setback a minimum of 1m from the secondary street. Garages shall be set back a minimum of 4.5m from the primary street. The garage setback may be reduced to a minimum of 4.0m from the primary street, where a footpath has not been installed within the verge at the front of the property boundary. The minimum garage setback may need to be increased where an acceptable driveway gradient cannot be achieved. A garage is permitted forward of the building line to a maximum of 2m where a portico/front verandah is provided. The portico/front verandah is required to be a minimum depth of 2m.
Private Open Space	5.1.4 C4	The minimum open space requirement is reduced to 40% (60% site cover).
Directly Abutting POS	Additional Requirement 5.2.3 C3.2 5.2.4 C4 5.1.3 C3.2 5.2.1 C2.1	The following provisions apply to lots with a boundary directly abutting open space and does not apply to side boundaries of dwellings: • All dwellings shall have a minimum of one habitable room with a major opening facing toward the public open space. • All lots shall have visually permeable fencing to the public open space boundary, to the specification and satisfaction of the Local Authority. • Boundary walls are not permitted abutting the primary frontage to the public open space boundary. • Buildings on lots adjoining public open space shall be setback a minimum of 2m from the public open space boundary.
Street Surveillance	5.2.3 C3.2	Dwellings on corner lots shall provide a minimum of one habitable room window that has a clear view of the secondary street and secondary street setback area.

TABLE 5B: PRECINCTS 1 AND 2 R-CODE VARIATIONS - FRONT LOADED LOTS (FRONTAGE 13M OR LESS)

The following provisions apply as R-Code deemed to comply provisions and development standards under City of Swan Local Planning Scheme for front loaded lots. Front loaded lots are those where vehicle access is provided via a primary or secondary street and are not serviced by a rear laneway. Where there is conflict between the following provisions and the R-Codes the provisions below prevail. Compliance with the deemed to comply provisions below will not require neighbour consultation. Where the criteria outlined below cannot be satisfied, the application shall be addressed in accordance with the applicable design principles, as outlined in Part 5 and 6 of the Residential Design Codes.

	RELEVANT R-CODE CLAUSE	DEEMED TO COMPLY PROVISIONS FOR SINGLE & GROUPED DWELLINGS WITH FRONTAGE 13m OR LESS
Setbacks	5.1.2 C2.1, C2.2 & C2.4 5.2.1	Buildings setback from the primary street as follows: • Minimum Setback – 2m (including verandahs, porticos and other minor incursions). Buildings to be setback 1m from the secondary street. Garages shall be set back a minimum of 4.5 metres from the primary street. The garage setback may be reduced to a minimum of 4.0 metres from the primary street, where a footpath has not been installed within the verge at the front of the property boundary. The minimum garage setbacks may need to be increased where an acceptable driveway gradient cannot be achieved. A garage is permitted forward of the building line to a maximum of 2 metres where a portico/front verandah is provided. The portico/front verandah is required to be a minimum depth of 2m. For lots with frontage less than 10m, garages shall not exceed 3.5 metres in width. A double garage is permitted for double storey dwellings with frontage less than 10m provided a habitable room provides surveillance of the street. The garage is to sit no further than 2m in front of the habitable room. For lots with a frontage of 10m-13m, double garages are permitted where: • Surveillance of the street is provided from a habitable room; and • The design includes provision of a portico, front verandah or similar, that is located equal to or forward of the garage facade.
Street Surveillance	5.2.3 C3.1 & C3.2	The principal pedestrian access to the dwelling to be clearly visible from the street. Dwellings on corner lots with garages fronting the primary street (narrow frontage) shall provide: • Surveillance of the primary street via a major opening to a habitable room; and • A principal pedestrian access (front door) facing the primary street facade and shall be visible from the street. Dwellings on corner lots shall provide a minimum of one habitable room window that has a clear view of the secondary street and the secondary street setback area.

	RELEVANT R-CODE CLAUSE	DEEMED TO COMPLY PROVISIONS FOR SINGLE & GROUPED DWELLINGS WITH FRONTAGE 13m OR LESS
Boundary Walls	5.1.3 C3.2	Boundary walls are permitted to both side boundaries of a lot (excluding secondary street boundaries), within the following limits: <u>Single Storey</u> • Maximum height - 3.5m • Maximum length – No limit length <u>Two Storey & Above</u> • Maximum height – 6.5m • Maximum length – Up to 12m in For dwellings with a single pitched roof and ridgeline parallel to the street, the height of walls on side boundaries may be increased to the top of the ridgeline where this runs parallel to the front boundary and abuts a similarly configured wall.
Private Open Space	5.1.4 C4 5.3.1 C1.1	Minimum open space of 25% (site cover 75%) subject to the provision of an Outdoor Living Area with a minimum useable space of 24m², minimum dimension of 4m and may include the nominated secondary street setback area. Permanent roof cover up to a maximum of two thirds of the outdoor living area.
Directly Abutting POS	Additional Requirement 5.2.3 C3.2 5.2.4 C4 5.1.3 C3.2 5.2.1 C2.1	The following provisions apply to lots with a boundary directly abutting open space and does not apply to side boundaries of dwellings: • All dwellings shall have a minimum of one habitable room with a major opening facing toward the public open space. • All lots shall have visually permeable fencing to the public open space boundary, to the specification and satisfaction of the Local Authority. • Boundary walls are not permitted abutting the primary frontage to the public open space boundary. • Buildings on lots adjoining public open space shall be setback a minimum of 2m from the public open space boundary.

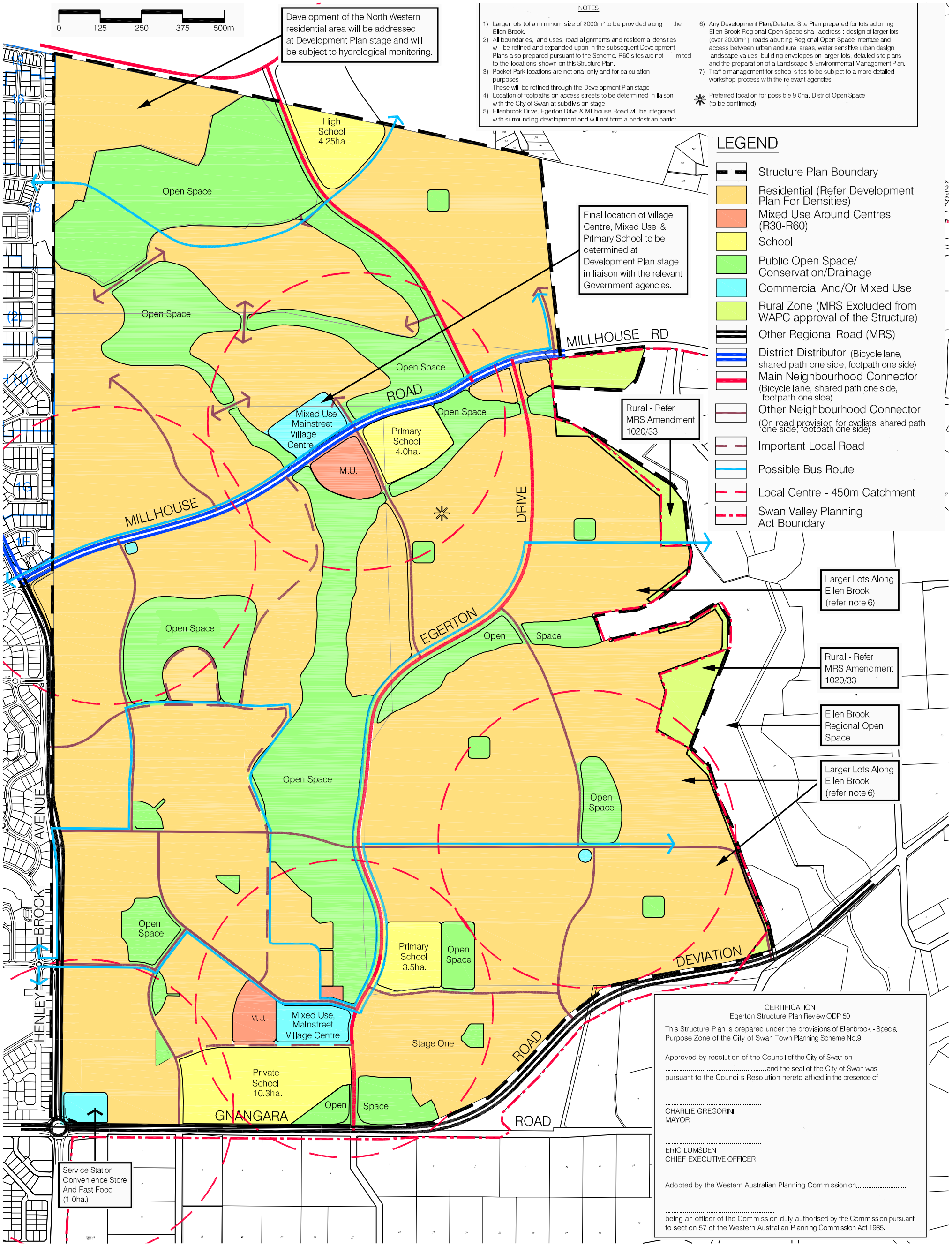
TABLE 6: PRECINCTS 1 AND 2 R-CODE VARIATIONS - REAR LOADED LOTS

The following provisions apply as R-Code deemed to comply provisions and development standards under City of Swan Local Planning Scheme for rear loaded lots. Rear loaded lots are those where vehicle access is provided via a rear laneway. Where there is conflict between the following provisions and the R-Codes the provisions below prevail. Compliance with the deemed to comply provisions below will not require neighbour consultation. Where the criteria outlined below cannot be satisfied, the application shall be addressed in accordance with the design principles, as outlined in Part 5 and 6 of the Residential Design Codes.

	RELEVANT R-CODE CLAUSE	DEEMED TO COMPLY PROVISIONS APPLICABLE TO LOTS WITH A LANEWAY ADJOINING THE REAR BOUNDARY
Directly Abutting POS	Additional Requirement 5.2.3 C3.2 5.2.4 C4 5.1.3 C3.2 5.1.2 C2.1	The following provisions apply to lots with a boundary directly abutting open space and does not apply to side boundaries of dwellings: • All dwellings shall have a minimum of one habitable room with a major opening facing toward the public open space. • All lots shall have visually permeable fencing to the public open space boundary, to the specification and satisfaction of the Local Authority. • Boundary walls are not permitted abutting the primary frontage to the public open space boundary. • Buildings on lots adjoining public open space shall be setback a minimum of 2m from the public open space boundary.
Setbacks	5.1.2 C2.1, C2.2 & C2.4	Buildings shall be setback from the primary street as follows: • Minimum Setback – 2m dwelling and 1.5m for verandah/front facade treatment. Garages are permitted up to the rear laneway boundary, except where: a) There is conflict with service infrastructure such as power domes; or b) The lot width is less than 8m; In which case the minimum setback is 1m. Setback distances may need to be increased where an acceptable driveway gradient cannot be achieved. Garage doors shall not overhang the laneway reserve when open or in the process of being opened. A wall up to a maximum height of 3.5m containing major openings shall provide a 1m minimum setback from the side boundary.
Street Surveillance	5.2.3 C3.2	Dwellings on corner lots shall provide a minimum of one habitable room window that has a clear view of the secondary street and secondary street setback area.

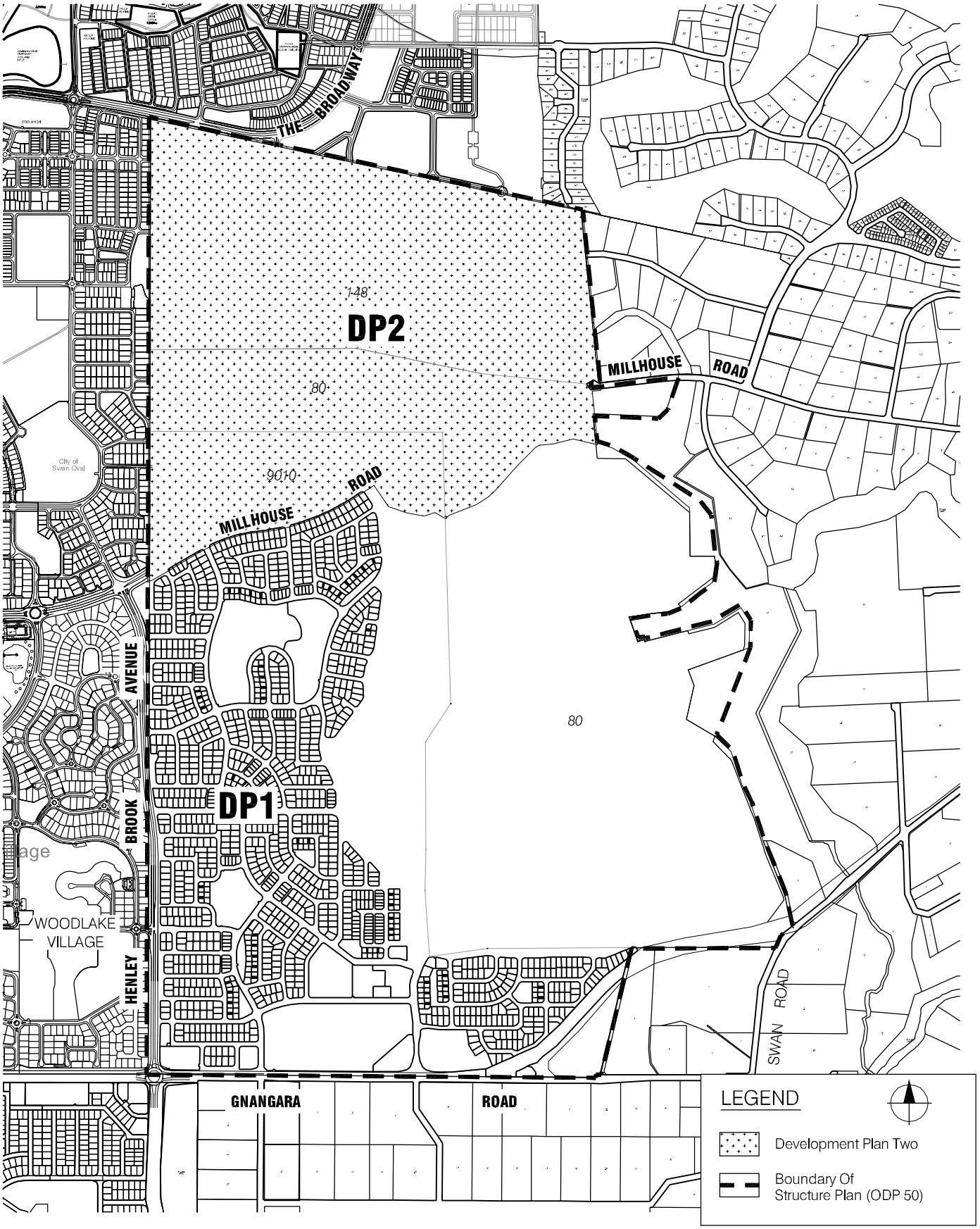
	RELEVANT R-CODE CLAUSE	DEEMED TO COMPLY PROVISIONS APPLICABLE TO LOTS WITH A LANEWAY ADJOINING THE REAR BOUNDARY
Boundary Walls	5.1.3 C3.2	Boundary walls are permitted to both side boundaries of a lot and the rear/ side laneway, within the following limits: <u>Single Storey</u> • Maximum height - 3.5m • Maximum length – No limit <u>Two Storey & Above</u> • Maximum height – 6.5m • Maximum length – Up to 12m in length Boundary walls up to 3.5m high and 6m in length are permitted up to the secondary street boundary where: • The secondary street boundary forms the southern or western boundary of the lot; • The boundary wall is set back a minimum of 4m from the corner truncation; • Surveillance of the secondary street is provided via a major opening to a habitable room. The height of walls to side boundaries may be increased to the top of the ridgeline for dwellings with a single pitched roof and ridgeline located parallel to the street, and where they abut a similarly configured wall.
Private Open Space	5.1.4 C4 5.3.1 C1.1	The minimum open space to be provided is 25% of the site (75% site cover) subject to the provision of an Outdoor Living Area with a minimum useable space of 24m², minimum dimension of 4m and may include the nominated secondary street setback area. Permanent roof cover is permitted up to a maximum of two thirds of the outdoor living area provided the outdoor living area is open on at least two sides.
Privacy	5.4.1 C1.1 (i)	With the exception of setbacks to major openings to bedrooms and studies for R60 lots, a minimum 4.5m cone of vision privacy setback applies to major openings to side and rear boundaries abutting residential properties where the floor level to any habitable space is greater than 500mm above natural ground level.
Design for Climate	5.4.2	Overshadowing provisions of the R-Codes do not apply.
Access & Parking	5.3.3 C3.1	On site car parking may be reduced to 1 bay per dwelling where the dwelling does not provide more than 2 bedrooms.
Essential Facilities	5.4.5	A recessed rubbish bin storage area shall be provided within the lot adjoining the laneway, 1m in depth and 1.5m in width, in accordance with the City of Swan requirements. Rubbish bin storage areas shall only extend into the 1m wide garage setback to the rear laneway on lots equal to or less than 8m in width and/or are corner lots with a rear truncation.
Ancillary Accommodation	5.5.1 C1 (i) & (iii)	Ancillary Accommodation comprises an additional dwelling or independent accommodation associated with a dwelling on the same lot where the accommodation can be separate to the main dwelling, and where there is a maximum floorspace of 60m². Ancillary Accommodation is permitted on lots less than 450m² where abutting a laneway. Ancillary Accommodation does not require an additional car parking bay on site where on-street parking is provided at the front of the property. Pedestrian access should be provided from the ancillary accommodation unit to the on-street car parking.

FIGURES



VALE DEVELOPMENT PLAN TWO, 2006 - APPROVED EGERTON STRUCTURE PLAN (ODP50) REVIEW 2004

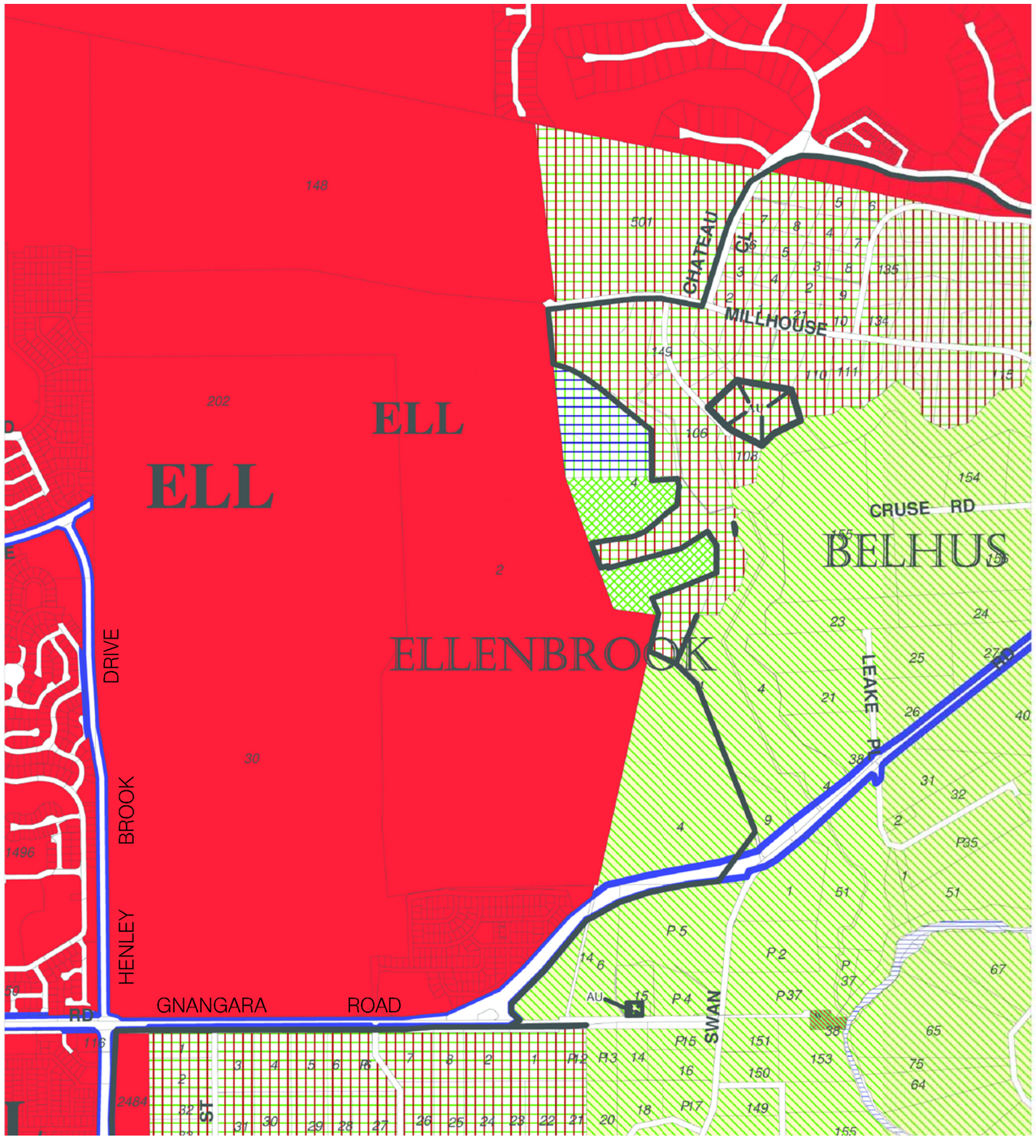
995-181, N.T.S. **Figure 1**



VALE DEVELOPMENT PLAN TWO, 2006 - LOCATION PLAN

995-180, N.T.S.

Figure 2



REGIONAL RESERVES

- PARKS & RECREATION
- PRIMARY REGIONAL ROADS
- OTHER REGIONAL ROADS
- RAILWAYS
- STATE FORESTS
- WATERWAYS
- PUBLIC PURPOSES

LOCAL RESERVES

- RECREATION
- IMPORTANT LOCAL ROAD
- LOCAL ROAD
- PUBLIC PURPOSES
- CIVIC & CULTURAL AREAS
- PROPOSED ROAD WIDENING & NEW STREET ALIGNMENT
- ROAD TO BE CLOSED
- PUBLIC PARKING

RURAL ZONES

- GENERAL RURAL
- SPECIAL RURAL
- SWAN VALLEY RURAL
- RURAL LIVING
- RURAL RESIDENTIAL
- LANDSCAPE
- RESOURCE

RESIDENTIAL ZONES

- RESIDENTIAL DEVELOPMENT
- RESIDENTIAL 1
- RESIDENTIAL 2
- RESIDENTIAL 3
- R20 R CODE & BOUNDARY
- CONSERVATION PRECINCT

OTHER ZONES

- SPECIAL PURPOSE
- AU ADDITIONAL USE

VALE DEVELOPMENT PLAN TWO, 2006 - CITY OF SWAN T.P.S. No. 9

995-182, N.T.S.

Figure 3

DEVELOPMENT PLAN TWO

BALANCE STAGE

STAGE 5B

STAGE 5C

STAGE 5D

STAGE 5A

STAGE 4E

STAGE 4C PHASE 2

STAGE 4D

STAGE 4C PHASE 1

STAGE 4B PHASE 2

STAGE 3D

STAGE 4A

STAGE 4B PHASE 1

STAGE 2E

STAGE 3B

STAGE 3A

STAGE 2F

STAGE 3C

STAGE 2D

STAGE 2B

STAGE 2A

STAGE 1C

STAGE 1A

STAGE 1B

STAGE 2C

STAGE 2G

WAPC Ref: 129263

WAPC Ref: 125988

WAPC Ref: 129378

WAPC Ref: 131725

WAPC Ref: 127868

WAPC Ref: 111089 122997

WAPC Ref: 124790

WAPC Ref: 131530

CONSERVATION

P.O.S.

GROUP HOUSING

TAVERN

SCHOOL SITE

COMMERCIAL

AVENUE

BROOK

HENLEY

GNANGARA

ROAD

DP 2

DP 1

Development Plan One Boundary

VALE DEVELOPMENT PLAN TWO, 2006 - DEVELOPMENT PLAN ONE SUBDIVISION LAYOUT

995-64K, N.T.S.

Figure 4

LOT TYPE PROFILES FOR THE VALE DEVELOPMENT PLAN TWO

CHAPPELL LAMBERT EVERETT

STANDARD LOT TYPE PROFILES

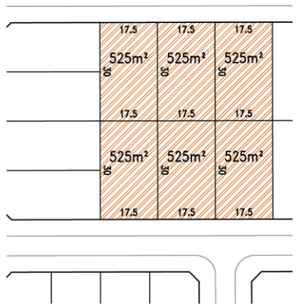
TRADITIONAL FAMILY (R20/R30)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width (m)	Depth (m)	Area (m^2)
17.5-18	30-32	525-576

R-CODE SETBACKS AT R20/R30		
Primary (m)	Secondary (m)	Other (m)
6.0m/4.0*	1.5	-
* Min. front setback for du of 3m or 2m with averaging.		

R-Code Variations Required	None



LARGE HOMESTEAD (R10)

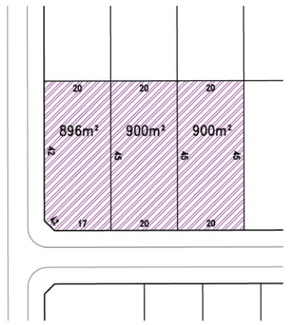
CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width	Depth	Area (m^2)
20-25	45-55	900-1100

R-CODE SETBACKS AT R10		
Primary	Secondary	Other
6.0m	1.5	-

R-Code Variations Required	None

Note: Large homestead lots have been located in steeply sloping areas which are not conducive to smaller lot product.



LANEWAY BASED COTTAGE LOTS

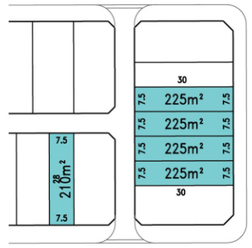
TERRACE (R60)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width (m)	Depth (m)	Area (m^2)
7.5-8.0	28-30	210-230

R-CODE SETBACKS AT R60		
Primary (m)	Secondary (m)	Other (m)
4	1.0	-
Min. front setback of 2.0m for du with averaging.		

SITE COVER AT R60
55%



MAIN DESIRABLE R-CODE VARIATIONS

SETBACKS TO PRIMARY ST.		
	Min. (m)	Max. (m)
Dwelling	1.5	3.0

SITE COVER INCREASE
75%

BOUNDARY WALLS		
	Max. Height	Max. Length
Single	3.5m	None
Double	6.5m	12m

ZERO LOT
Both sides

NON LANEWAY BASED SMALL LOTS

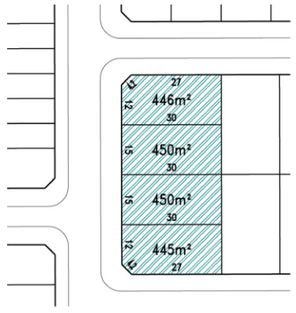
CONTEMPORARY LIFESTYLE LOT (R20/R30)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width (m)	Depth (m)	Area (m^2)
15	30-32	450-480

R-CODE SETBACKS AT R20/R30		
Primary (m)	Secondary (m)	Other (m)
6.0m/4.0*	1.5	-
* Min. front setback for du of 3m or 2m with averaging.		

R-Code Variations Required	None*
* Designated boundary walls desired	



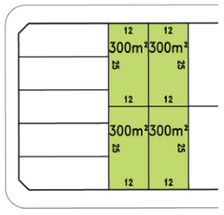
VICTORIAN COTTAGE (R60)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width (m)	Depth (m)	Area (m^2)
12-12.5	25-28	300-336

R-CODE SETBACKS AT R60		
Primary (m)	Secondary (m)	Other (m)
4	1.0	-
Min. front setback of 2.0m for du with averaging.		

SITE COVER AT R60
55%



MAIN DESIRABLE R-CODE VARIATIONS

SETBACKS TO PRIMARY STREET		
	Min. (m)	Max. (m)
Dwelling	1.5	3.0

SITE COVER INCREASE
75%

BOUNDARY WALLS		
	Max. Height	Max. Length
Single	3.5m	None
Double	6.5m	12m

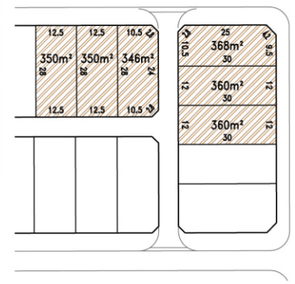
STANDARD COTTAGE (R30/R40/R60)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width (m)	Depth (m)	Area (m^2)
12-12.5	28-30	336-360

R-CODE SETBACKS AT R30/R40/R60		
Primary (m)	Secondary (m)	Other (m)
4	1.5	-
Min. front setback of 2.0m for du with averaging.		

SITE COVER AT R30/R40/R60
55%



MAIN DESIRABLE R-CODE VARIATIONS

SETBACKS TO PRIMARY ST.	
Min. (m)	Max.(m)
1.5	3.0

SITE COVER INCREASE
60%-70%

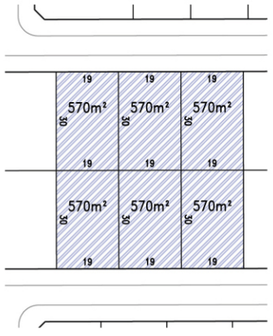
HOMESTEAD (R20/R30)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width	Depth	Area (m^2)
19-20	30-32	570-640*
* Less than 600m^2 in R30		

R-CODE SETBACKS AT R20/R30		
Primary	Secondary	Other
6.0m	1.5	-

R-Code Variations Required	None



FOUR PACK LOTS (R30/R40)

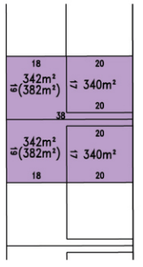
CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS			
Width (m)	Depth (m)	Area (m^2)	Access Leg Width
17-20	20	300-430	2m*

* Note: 2m vehicular access leg is shared with the adjoining lot via an easement for reciprocal use. This creates a 4m wide shared access leg, sufficient width for vehicle access as well as maximising the effective lot areas.

R-CODE SETBACKS AT R30/40		
Primary (m)	Secondary (m)	Internal Access Leg
4*	1.5-1.0**	1.5
*Min. front setback of 2.0m for du with averaging.		
**1m secondary street setback at R40		

SITE COVER AT R30/R40
55%



MAIN DESIRABLE R-CODE VARIATIONS

SETBACKS AT R30/40 (minimum)		
Primary (m)	Secondary (m)	Other (m) (Internal Access Leg)
2.0	0.5	0.5

SITE COVER INCREASE
65% (lots abutting primary streets)
60% (Rear Lots)

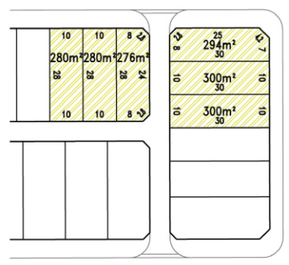
SMALL COTTAGE (R30/R40/R60)

CHAPPELL LAMBERT EVERETT

TYPICAL LOT DIMENSIONS		
Width (m)	Depth (m)	Area (m^2)
10	28-30	280-300

R-CODE SETBACKS AT R30/R40/R60		
Primary (m)	Secondary (m)	Other (m)
4	1.5	-
Min. front setback of 2.0m for du with averaging.		

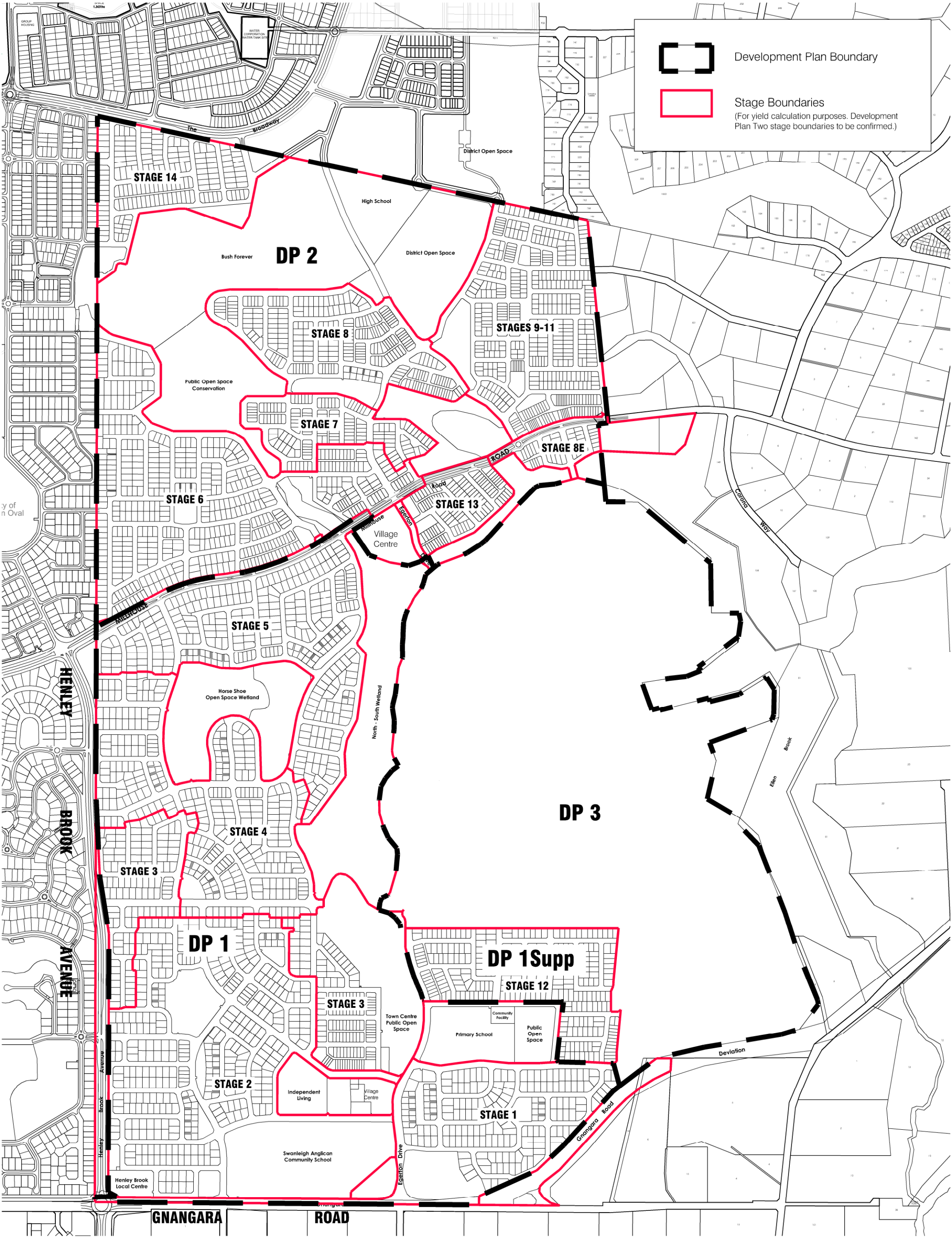
SITE COVER AT R30/R40/R60
55%



MAIN DESIRABLE R-CODE VARIATIONS

SETBACKS TO PRIMARY ST.	
Min. (m)	Max.(m)
1.5	3.0

SITE COVER INCREASE
70%



DWELLING UNIT YIELD CALCULATION STAGES

995-240A-02, (19.02.2013), 1:10,000

Figure 6

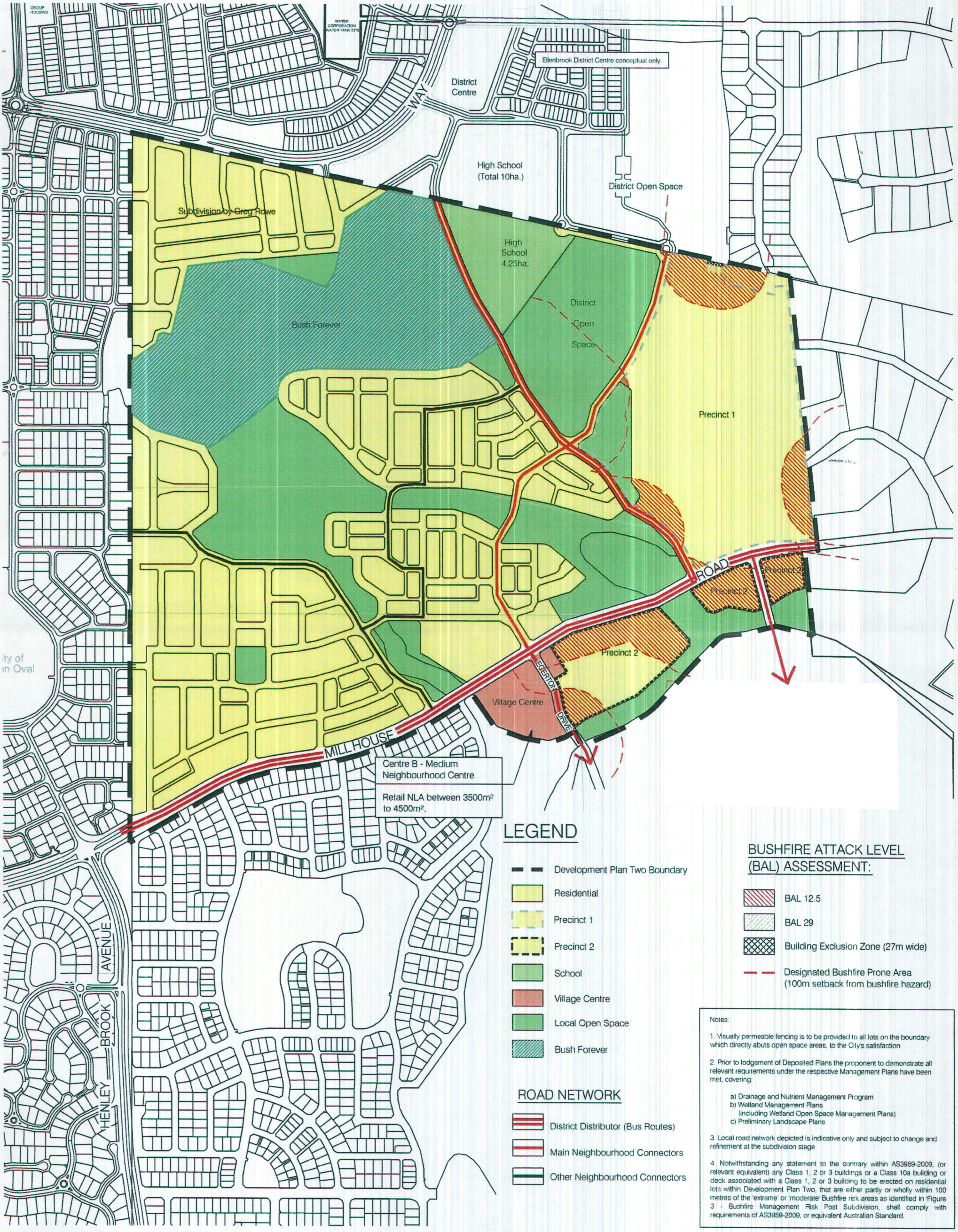
VALE DEVELOPMENT PLAN TWO, 2006 - VILLAGE CENTRE 'B' INDICATIVE CONCEPT PLAN

995-174A-01, 21.02.2013, N.T.S.

Figure 7

STATUTORY PLANS

CLE TOWN PLANNING + DESIGN



LEGEND

- Development Plan Two Boundary
- Residential
- Precinct 1
- Precinct 2
- School
- Village Centre
- Local Open Space
- Bush Forever

ROAD NETWORK

- District Distributor (Bus Routes)
- Main Neighbourhood Connectors
- Other Neighbourhood Connectors

BUSHFIRE ATTACK LEVEL (BAL) ASSESSMENT:

- BAL 12.5
- BAL 29
- Building Exclusion Zone (27m wide)
- Designated Bushfire Prone Area (100m setback from bushfire hazard)

Notes:

1. Visually permeable fencing is to be provided to all lots on the boundary which directly abuts open space areas, to the City's satisfaction.

2. Prior to lodgement of Deposited Plans the proponent to demonstrate all relevant requirements under the respective Management Plans have been met, covering:

   a) Drainage and Nutrient Management Program
   b) Wetland Management Plans (including Wetland Open Space Management Plans)
   c) Preliminary Landscape Plans

3. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.

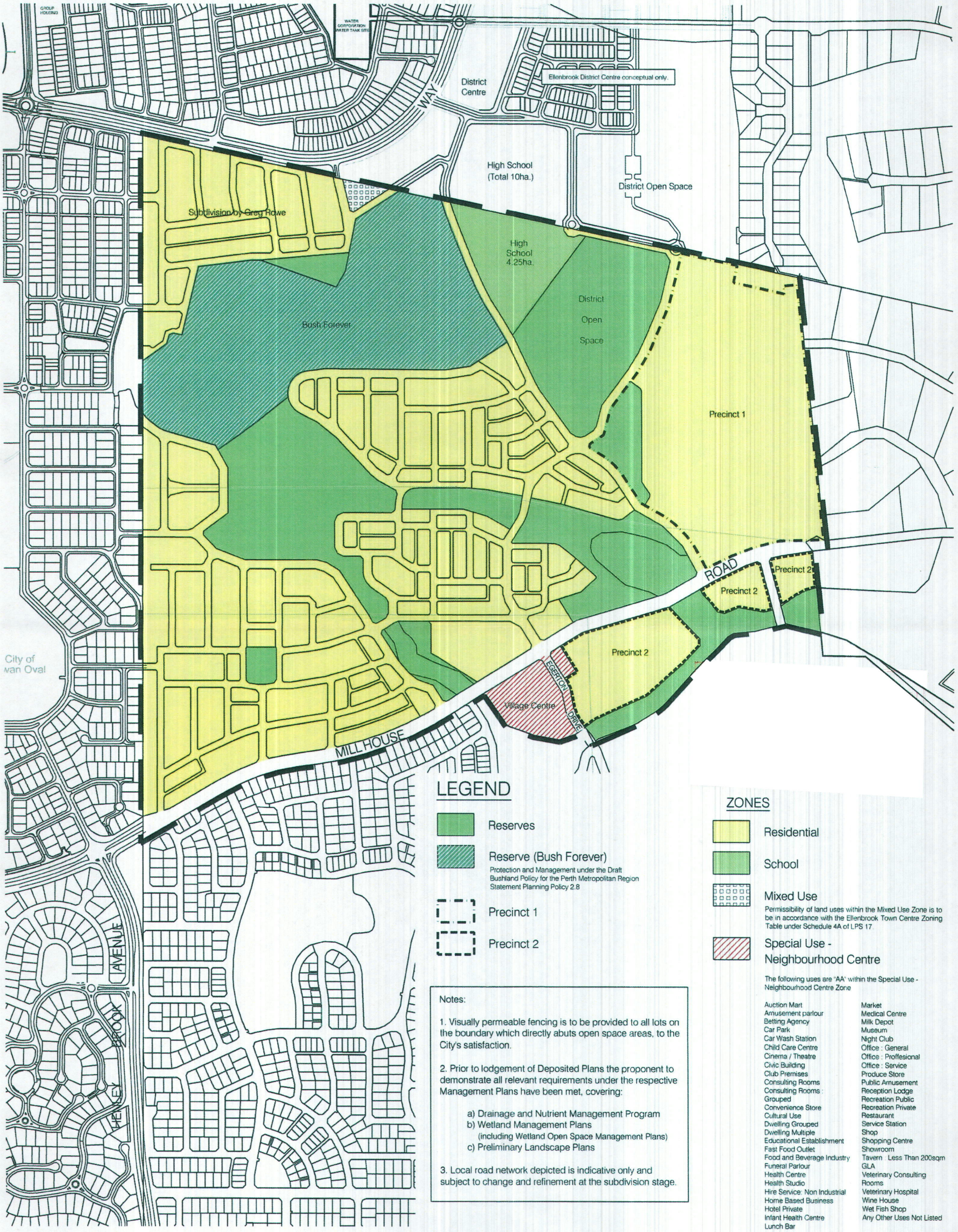
4. Notwithstanding any statement to the contrary within AS3959-2009, (or relevant equivalent) any Class 1, 2 or 3 buildings or a Class 10a building or deck associated with a Class 1, 2 or 3 building to be erected on residential lots within Development Plan Two, that are either partly or wholly within 100 metres of the 'extreme' or 'moderate' Bushfire risk areas as identified in 'Figure 3 - Bushfire Management Risk Post Subdivision, shall comply with requirements of AS3959-2009, or equivalent Australian Standard.

995-727E-01 (02.07.2013), nts

VALE DEVELOPMENT PLAN TWO, 2013

Figure S1

CLE TOWN PLANNING + DESIGN



LEGEND

- Reserves
- Reserve (Bush Forever)
  Protection and Management under the Draft Bushland Policy for the Perth Metropolitan Region Statement Planning Policy 2.8
- Precinct 1
- Precinct 2

ZONES

- Residential
- School
- Mixed Use
  Permissibility of land uses within the Mixed Use Zone is to be in accordance with the Ellenbrook Town Centre Zoning Table under Schedule 4A of LPS 17.
- Special Use - Neighbourhood Centre

The following uses are "AA" within the Special Use - Neighbourhood Centre Zone

Auction Mart	Market
Amusement parlour	Medical Centre
Betting Agency	Milk Depot
Car Park	Museum
Car Wash Station	Night Club
Child Care Centre	Office : General
Cinema / Theatre	Office : Proffesional
Civic Building	Office : Service
Club Premises	Produce Store
Consulting Rooms	Public Amusement
Consulting Rooms : Grouped	Reception Lodge
Convenience Store	Recreation Public
Cultural Use	Recreation Private
Dwelling Grouped	Restaurant
Dwelling Multiple	Service Station
Educational Establishment	Shop
Fast Food Outlet	Shopping Centre
Food and Beverage Industry	Showroom
Funeral Parlour	Tavern : Less Than 200sqm GLA
Health Centre	Veterinary Consulting Rooms
Health Studio	Veterinary Hospital
Hire Service: Non Industrial	Wine House
Home Based Business	Wet Fish Shop
Hotel Private	Any Other Uses Not Listed
Infant Health Centre	
Lunch Bar	

Notes:

1. Visually permeable fencing is to be provided to all lots on the boundary which directly abuts open space areas, to the City's satisfaction.

2. Prior to lodgement of Deposited Plans the proponent to demonstrate all relevant requirements under the respective Management Plans have been met, covering:

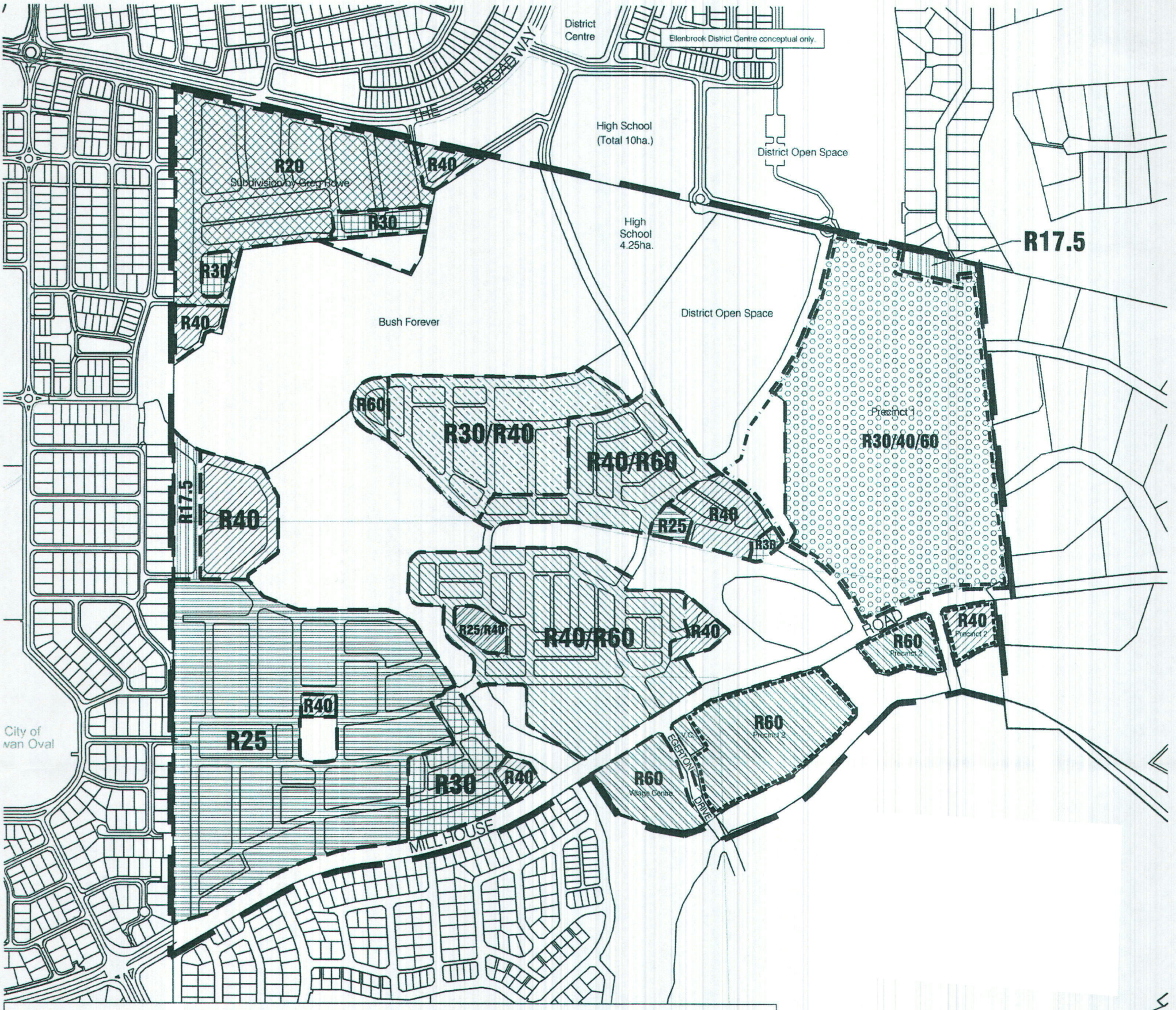
   a) Drainage and Nutrient Management Program
   b) Wetland Management Plans
      (including Wetland Open Space Management Plans)
   c) Preliminary Landscape Plans

3. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.

VALE DEVELOPMENT PLAN TWO, 2013 - ZONING CLASSIFICATION PLAN

995-728E-01 (02.07.2013), nts

Figure S2



NOTES:

1. Visually permeable fencing is to be provided to all lots on the boundary which directly abuts open space areas, to the City's satisfaction.
2. Prior to lodgement of Deposited Plans the proponent to demonstrate all relevant requirements under the respective Management Plans have been met, covering:
   a) Drainage and Nutrient Management Program
   b) Wetland Management Plans
      (including Wetland Open Space Management Plans)
   c) Preliminary Landscape Plans
3. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.

Residential Zone Density Coding*

Where a dual coding applies (ie R30/R40, R30/R60, R40/R60 or R25/R40) the lower code applies as the base R Coding (ie R30 or R40).

The higher code applies (ie R40 or R60) where the following conditions are satisfied:

1. The lot is a corner lot served by a street and/or laneway at both the front and side boundaries.
   The lot may also have a laneway at the rear boundary, although this is not essential to fulfil this requirement.*
2. It can be demonstrated through a Detailed Site Plan that the lot can have vehicular access to serve two or three dwellings (whichever is applicable) which:
   i. Minimises adverse impact on the streetscape; and
   ii. Can be appropriately located with regard to engineering considerations, including level differences, sightlines, truncations and on street parking.*

Not withstanding the above Grouped Housing Lots (ie lots greater than 1000m²) are coded the higher code (ie R40 or R60).

* All lots affected by the above dual coding provisions shall require a development application and are required to be developed in accordance with the approved subdivision plan WAPC Ref. 133535 (City of Swan Ref. SB007/2007), WAPC Ref. 137739 (City of Swan Ref. SB-53/2008) and WAPC Ref. 138047 (City of Swan Ref. SB-67/2008).

Precinct 1: Density Coding

1. The split coding of R30/40/60 applies in Precinct 1 as follows:

   a. A base density coding of R30 shall be provided for all other residential lots within the Structure Plan.
   b. Medium densities of R40 to R60 shall be provided in areas of high amenity including:
      i. Within 800 metres of centres (activity and community);
      ii. Within 400 metres of public open space; or
      iii. Within 200 metres of public transport or neighbourhood connector routes.

The R-Code variations contained in Tables 5 and 6 of the Structure Plan Report apply to Precinct 1.

Precinct 2:

The R-Code variations contained in Tables 5 and 6 of the Structure Plan Report apply to Precinct 2.

LEGEND

RESIDENTIAL DENSITY CODINGS

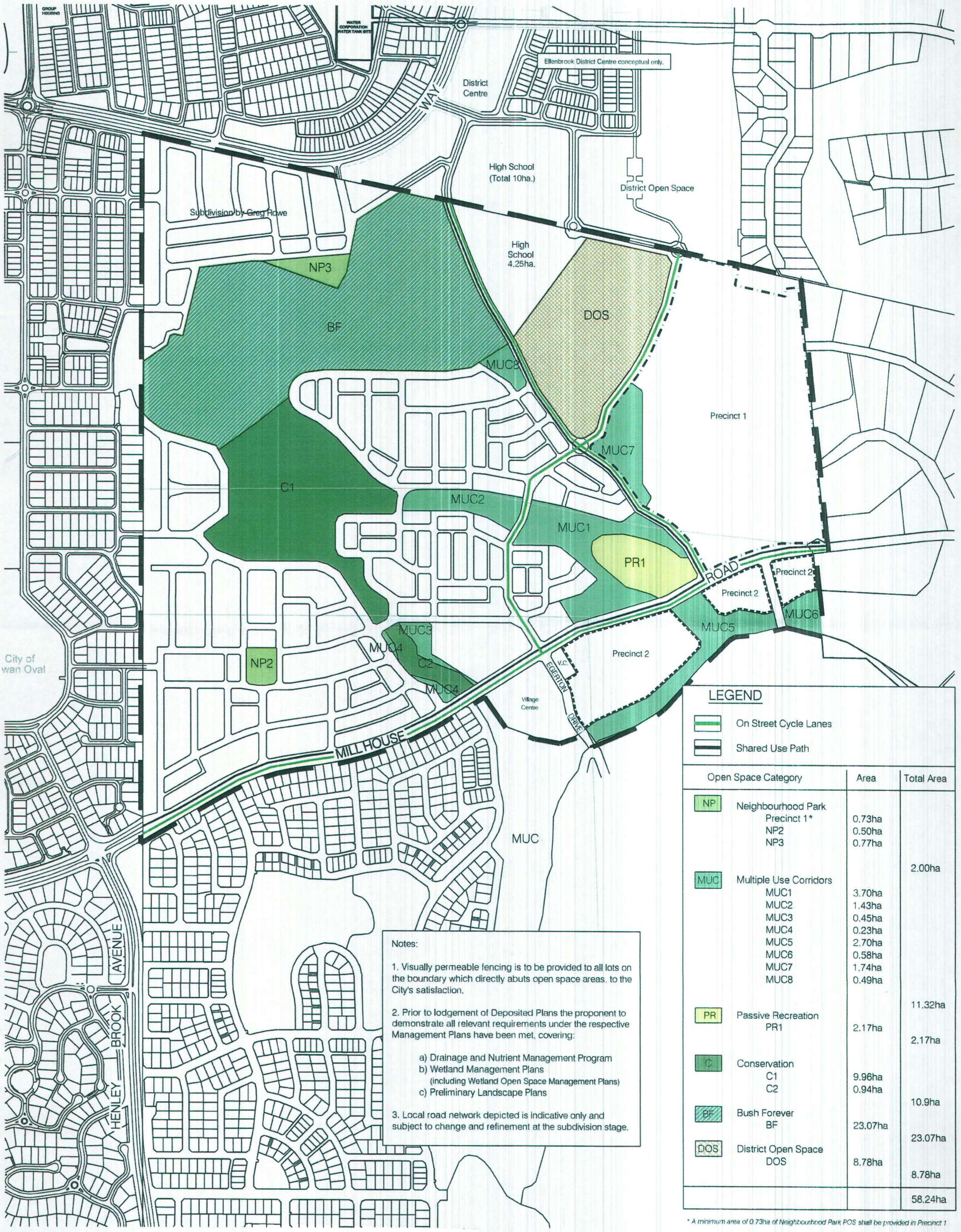
- R17.5
- R20
- R25
- R30
- R25/40*
- R30/40*
- R30/40/60*
- R40/60*
- R40
- R60

- R-Code Boundaries
- Precinct 1
- Precinct 2

VALE DEVELOPMENT PLAN TWO, 2013 - R-CODE PLAN

Figure S3

CLE TOWN PLANNING + DESIGN



Notes:

1. Visually permeable fencing is to be provided to all lots on the boundary which directly abuts open space areas, to the City's satisfaction.

2. Prior to lodgement of Deposited Plans the proponent to demonstrate all relevant requirements under the respective Management Plans have been met, covering:

   a) Drainage and Nutrient Management Program
   b) Wetland Management Plans
      (including Wetland Open Space Management Plans)
   c) Preliminary Landscape Plans

3. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.

LEGEND

- On Street Cycle Lanes
- Shared Use Path

Open Space Category		Area	Total Area
NP	Neighbourhood Park		
	Precinct 1*	0.73ha	
	NP2	0.50ha	
	NP3	0.77ha	
			2.00ha
MUC	Multiple Use Corridors		
	MUC1	3.70ha	
	MUC2	1.43ha	
	MUC3	0.45ha	
	MUC4	0.23ha	
	MUC5	2.70ha	
	MUC6	0.58ha	
	MUC7	1.74ha	
	MUC8	0.49ha	
			11.32ha
PR	Passive Recreation		
	PR1	2.17ha	
			2.17ha
C	Conservation		
	C1	9.96ha	
	C2	0.94ha	
			10.9ha
BF	Bush Forever		
	BF	23.07ha	
			23.07ha
DOS	District Open Space		
	DOS	8.78ha	
			8.78ha
			58.24ha

* A minimum area of 0.73ha of Neighbourhood Park POS shall be provided in Precinct 1

VALE DEVELOPMENT PLAN TWO, 2013
- OPEN SPACE STRATEGY & PEDESTRIAN & CYCLE NETWORK

995-730CB-01 (14.02.2013), nts

Figure S4

APPENDICES

APPENDIX ONE

Vale Summary of Reporting Requirements - Development Plan Two

VALE SUMMARY OF REPORTING REQUIREMENTS - DEVELOPMENT PLAN 2

Issue	Responsibility	Structure Plan	Completed	Development Plan	Completed	Subdivision	Date Due	Date Completed	Ongoing Reporting	Report To	Reporting Required	Date of last report	Date next report due	Comments
Overarching CER Reporting Commitments	ATA	Nill	n/a	Nil	n/a	Nil	n/a	n/a	• Preparation of Project Compliance Report to demonstrate that all commitments are being met.	EPA audit unit	Periodic	Nil	End 2007	Nil
Drainage (1994 CER)	JDA	Drainage and Nutrient Management Plan (1995)	✓	Drainage and Nutrient Management Programme	✓	Nil	Nil		• Drainage and Nutrient Monitoring Programme • Preparation of drainage and nutrient monitoring reports, monthly monitoring and annual reporting.	CoS DoE WC	Annually for 10 years.	Nil	TBC	Nil
Wetlands (1994 CER)	ATA	Wetland Management Strategy (1995)	✓	DP2 Wetland Management Plan	✓	n/a	n/a	n/a	• Annual Monitoring Report for DP2 area incorporating - Annual report on wetland hydrology. - Annual report on vegetation monitoring - Annual report on bandicoot monitoring	CoS DoE	TBC	Nil	TBC	Nil
						Nil	Nil		• Rehabilitation Plan • Weed Strategy • Monitor and report on success of rehabilitation programme once commenced.	CoS	6-Monthly	Nil	TBC	Nil
Southern Brown Bandicoot (1994 CER)	ATA	Bandicoot Management Strategy (1995)	✓	Nil	n/a	Nil	n/a	n/a	• Bandicoot monitoring report (Monitored as per Wetland Report).	CoS	Annually	June 2006	July 2007	Nil
Western Swamp Tortoise (1994 CER)	ATA	Western Swamp Tortoise Survey (1995) Reporting committments satisfied as no tortoises were found.	✓	Nil	n/a	Nil	n/a	n/a	Nil	n/a	n/a	n/a	n/a	Nil
Acid Sulphate Soils (Condition of Subdivision)	ATA	Nil	n/a	Nil	n/a	Acid Sulphate Soils Investigation conducted for each stage development. ASS Management Plan prepared if required - refer ongoing reports	n/a	n/a	• Monitoring Report • Closure Report	DoE DoE	As needed. As needed.	Nil Nil	TBC TBC	Copy also provided to CoS.
Infrastructure Contributions (City of Swan MOU)	MPX	Infrastructure MOU	✓	Review and Update MOU Annually	n/a	Review and Update MOU Annually.	n/a	n/a	• Review and Update MOU annually.	CoS	Annually	June 2006	June 2007	Nil

APPENDIX TWO

Development Plan Two Drainage and Nutrient Management Programme

MULTIPLEX DEVELOPMENT OPERATIONS LIMITED

EGERTON
Development Plan 2

DRAINAGE AND NUTRIENT MANAGEMENT PROGRAMME

March 2007

JDA Consultant Hydrologists

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APPENDICIES

1. INTRODUCTION

1.1 Background

Egerton is situated adjacent to Ellen Brook in the City of Swan, approximately 22 kilometres north east of the Central Business District of Perth (Figure 1). The property extends over 588 hectares and is a rural estate and stud, breeding quality cattle, sheep and horses.

A Structure Plan for Egerton was developed in 1993 by Multiplex Constructions Pty Ltd (referred to in this document as "Multiplex"). The proposal to rezone the property from Urban Deferred to Urban in the Metropolitan Region Scheme was assessed by the Environmental Protection Authority (EPA) at the Consultative Environmental Review level (Alan Tingay & Associates, 1994). In June 1994, the EPA released its report and recommendations on the rezoning proposal (Bulletin 743) and concluded that the proposal was environmentally acceptable (EPA,1994).

One of the principal areas of concern to the EPA was the future management of runoff water quality and quantity in terms of the protection of wetlands on the property, as well as receiving water bodies downstream including Ellen Brook and Henley Brook. The (then) Minister for the Environment list of conditions included Condition 3-2 requiring preparation of a Nutrient and Drainage Management Plan, to address management of groundwater and surface water following urban development.

To achieve those aims, Alan Tingay & Associates *et al.* (1995) prepared the Egerton DNMP (referred to in this document as the "1995 DNMP") which addressed:

- the effect of development on groundwater levels
- the effects of development on existing wetlands
- surface drainage volumes and flow rates following development
- expected nutrient loads to Ellen Brook and Henley Brook, tributaries of the Swan River
- the development of a monitoring programme for water levels and water quality.

The 1995 DNMP was based on the 1993 Structure Plan which was drafted in accordance with Water Sensitive Urban Design (WSUD) and Best Management Practices (BMP's) of that time, as described in the North East Corridor Drainage Management Strategy (DMS) which was being prepared at that time (GB Hill, 1995). The 1995 DNMP received Ministerial Approval in 1995.

In 2000 an Outline Development Plan (ODP) for Egerton was approved and conditional subdivision approval was given for the initial stages of development, with a drainage strategy based on the 1995 DNMP. Urban development of Egerton commenced with Stage 1 along Gnangara Rd in 2004.

Since approval of the 1995 DNMP and 2000 ODP, there has been a significant change in urban stormwater management in Western Australia, with the Water and Rivers Commission (WRC) (now Department of Water) adopting a whole of catchment approach to urban water management. This shift places an emphasis on infiltration, source controls, and non structural water quality techniques. This contrasts with previous WSUD and BMP techniques which concentrated on the use of end of pipe techniques for water quality control.

Multiplex Development Operations Ltd acknowledges these changes in urban stormwater management and has commissioned the preparation of refined DNMP's and has commissioned the preparation of refined DNMPs and associated monitoring programmes as follows:

- Egerton Development Gnangara Creek DNMP (JDA, 2003b)
- Egerton Development Gnangara Creek Monitoring Programme (JDA, 2006a)
- Egerton Development DP1 – DNMP (JDA, 2004)
- Egerton Development DP1 - DNMP Monitoring Programme (JDA, 2006b)

- Egerton Development DP1 – DNMP Monitoring Programme (Stages 4 & 5) (JDA, 2006c)
- Egerton Development DP2 – DNMP (this document)

This DP2 DNMP is consistent with the previous DNMP's referred to above.

The first quarterly monitoring report for Gnangara Creek DNMP has been issued (JDA, 2006d).

1.2 Objectives

The key objectives of this DNMP for the Development Plan 2 (DP2) area are:

- To provide a bridging document between the 1995 DNMP and the Stormwater Management Manual for WA (DoE, 2004).
- To propose responsibilities for drainage and water quality management for the Development Plan 2 area.
- To provide an opportunity for both state and local government to pilot the implementation of DoE new principles and objectives for urban stormwater management in the North East Corridor.
- To provide an opportunity for state and local governments to assess the performance of catchment management and source control measures, with a view to providing data to refine approaches being established at a regional level (GHD, 2003).
- To enable the performance of the DP2 DNMP to be assessed. This provides flexibility for continual improvements in WSUD to be incorporated in the future Egerton planning and development process, subject to economic considerations.

2. HISTORICAL CONTEXT

2.1 The North East Corridor DMS

In 1995 the North East Corridor Drainage Management Strategy (DMS) was prepared (GB Hill, 1995).

It provided a regional drainage strategy based on detention basins for flood control and Water Pollution Control Ponds (WPCP's) as the preferred method of trapping nutrients in the drainage system prior to discharge into receiving water bodies. This strategy represented the preferred approach by government agencies at that time to managing urban stormwater quality.

The North East Corridor DMS (GB Hill, 1995) proposed a detention basin E4 and a WPCP E2 downstream of the landholding, Figure 2. The proposed WPCP (E2) is on land owned by WAPC. E2 is an existing dam referred to locally as the Heritage Dam.

2.2 The 1995 DNMP

The 1995 DNMP was prepared in response to Ministerial Condition 3-2 following rezoning of the Egerton property from 'Urban Deferred' to 'Urban' by the EPA in June 1994. The Condition was incorporated into the Minister for the Environment's approval of the rezoning over concern of the future management of runoff water quality and quantity in terms of protection of wetlands on the property, Ellen Brook, the Swan River and adjoining land.

The 1995 DNMP addressed management of groundwater and stormwater of the proposed development based on the 1993 Structure Plan consistent with the North East Corridor Drainage Management Strategy (GB Hill, 1995). It proposed a drainage scheme (Figure 3) managed by a network of wet detention basins in the mid to upper catchments to attenuate peak flows, and by WPCP's where discharge to an external water body occurred. No source control measures were proposed as part of the 1995 DNMP, with sole reliance on WPCP's for water quality management.

Negotiations with agencies at the time precluded the use of the Heritage Dam as a WPCP as proposed in GB Hill (1995). The requirement instead was for flood detention and water quality improvement to be incorporated upstream of the Heritage Dam. Consequently in DP2 detention storages (N1 to N6 and N8) were proposed together with a WPCP N9 on Northwest Creek as indicated on Figure 3.

Note that Figure 3 shows a proposed detention basin N3 at the location of an existing soak with flow down stream to N4 basin. This is incorrect, as the natural flow path from N3 is towards N8 basin.

The 1995 DNMP proposed post development monitoring requirements and envisaged responsibility for implementation and monitoring would be between the (then) Water Authority WA, City of Swan and Multiplex, subject to negotiation.

The 1995 DNMP received Ministerial Approval in 1995. In 1995 the functions of the Water Authority were split between the Water Corporation (a utility) and Water & Rivers Commission, (now Department of Water) the water resource manager.

2.3 The North East Corridor TRC

The Ellenbrook Southern Catchment DNMP (Cossill & Webley et al 1994), located immediately west of Egerton, resulted in the creation of a Technical Review Committee (TRC) for Drainage and Nutrient Management in the North East Corridor.

The TRC has met at irregular intervals since 1995, and has focussed attention almost exclusively on the Ellenbrook landholding which commenced development in late 1994. The minutes of the TRC show that the TRC did not consider the Egerton 1995 DNMP in Draft form and has not dealt with it since its completion and approval.

3. RECENT DEVELOPMENTS IN WSUD

3.1 DoW Objectives and Principles

DoW (formerly DoE, WRC) is the state government agency responsible for preparation of regional drainage management strategies in WA, to guide development and allow the planning and provision of sufficient infrastructure, particularly for water quality and quantity, to ensure land use change is environmentally sustainable.

Water Sensitive Urban Design (WSUD) for urban development was previously guided by WRC's "Manual for Managing Urban Stormwater Quality in Western Australia" (WRC, 1998). Following further research and a paradigm shift to "at source controls", a revised Manual has been prepared (DoE, 2004). WRC's current position on Urban Stormwater Management in WA is outlined in their Interim Position Statement Principles and Objectives February 2003 (WRC, 2003). Principal objectives for managing urban water quality and quantity in WA are stated as :

- **Water Quality.** To maintain or improve the surface and groundwater quality within development areas relative to pre-development conditions.
- **Water Quantity.** To maintain the total water cycle balance within development areas relative to the pre-development conditions.

The following stormwater management hierarchy are then presented to achieve these objectives:

- **Retain and restore natural drainage systems.** Retain and restore existing valuable elements of the natural drainage system, including waterway, wetland, groundwater features and processes.
- **Implement non-structural source controls.** Minimise pollutant inputs principally via planning, organisational and behavioural techniques, to minimise the amount of pollution entering the drainage system
- **Minimise runoff.** Infiltrate or reuse rainfall as high in the catchment as possible. Install structural controls at or near the source to minimise pollutant inputs and the volume of stormwater
- **Use of 'in-system' management measures.** Includes vegetative measures, such as swales and riparian zones, and structural quality improvement devices such as gross pollutant traps

The Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy (UWMS) (JDA, 2002) represents the first regional drainage management strategy locally to adopt a source control approach to urban water management. The UWMS marked a shift of emphasis from attempts to trap or retard pollutant in their journey from land application to estuary discharge, to a more fundamental "Prevention is better than Cure" philosophy. The UWMS aims for a reduction in pollutant input with land use change compared with current broadscale agricultural activity and therefore a subsequently lower long term export to the receiving environment. The UWMS demonstrated application of traditional WSUD water quality measures such as WPCP and swales are not capable of providing this outcome.

3.2 Review of North East Corridor DMS

During 2002, WRC commissioned GHD to review the North East Corridor DMS (GB Hill 1995). According to WRC's project brief, the review was initiated by the Water Corporation's perceived high cost and poor performance of the Henley Brook WPCP, constructed as a condition of the Ellenbrook (South Catchment) DNMP.

A preliminary draft of the review report (GHD, 2003) was circulated in April 2003 to a Steering Committee comprising representatives of Water Corporation, WRC, DEP and UDIA. The Steering Committee met in April 2003, to discuss the draft document and provide feedback to WRC. It is understood this document is still in draft form, with expected completion during 2006 (Peter Kata, DoW, *pers. comm.)*.

The current review of the North East Corridor Drainage Management Strategy is considered likely to adopt a catchment management (source control) methodology for quality and continue the use of detention basins/swales for flood attenuation.

3.3 Stormwater Management Manual for WA

In May 2004 Chapters 1, 2, 8 of the manual were released (DoE, 2004), with Chapter 6 released during 2006.

4. DEVELOPMENT PLAN 2 DNMP

4.1 Approach

The approach in this DP2 DNMP is a total water cycle management, both from a flood management (water quantity) and water quality perspective. It incorporates elements of the previously approved 1995 DNMP, with a focus towards including source controls and catchment management techniques to achieve water quality objectives, consistent with WRC's Interim Position Statement Principles and Objectives (WRC, 2003) and the Stormwater Management Manual for WA (DoE, 2004).

It proposes a drainage network designed for flood management purposes, with water quality managed by a series of 'at source' controls throughout the catchment, rather than end of line treatments.

This approach differs from the 1995 DMNP which relied entirely on a WPCP at the catchment outlet to achieve water quality objectives. This DP2 DNMP addresses both groundwater and surface water quality issues, whereas the 1995 DMNP dealt with surface water quality issues only.

The proposed drainage network will comprise a piped/swale system with a combination of swales and infiltration basins where feasible. Detention storage for flood management purposes will be located along the tributaries of North West Creek (Figure 4).

It is likely that Water Corporation will assume responsibility for the most downstream detention basin in DP2 prior to discharge from the landholding, consistent with their decision in Stage 1 of Egerton (Kevin Chinnery *pers. comm.*).

In Development Plan 1 area a detention basin is proposed (Town Centre Lake). The outlet from this basin will discharge to Aviary Creek within the Multiplex landholding and as such it is not likely to be taken over by the Water Corporation as a detention basin. The Corporation may assume responsibility for a subsequent downstream detention basin on Aviary Creek in future stages of Egerton Development.

Water quality in the DP2 area will be managed by a treatment train of BMP's consistent with current WSUD principles, with particular emphasis on source controls. For each sub-catchment within the Development Plan 2 area, where feasible, stormwater will be retained and treated locally, particularly for the first flush event and frequently occurring storm events (<1 year ARI).

At source water quality controls will be incorporated into landuse planning (POS and landscape design), particularly during the detailed design phase, and will include vegetated swales, strategic plantings, street sweeping, stormwater pollutant traps, and community education.

It is proposed that the water management concepts outlined in this DP2 DNMP obtain design based approval, similar to the Egerton Development Stage 1 and DP1 DNMP's (JDA, 2003b/2004). That is, the DP2 DNMP supplements and extends the principles of Egerton Development Stage 1 and DP1 DNMP's, without any requirement for retro fitting of structural controls, unless economically viable to the agencies. Should the source control methodology not perform as predicted, the contingency measure is to reinforce the source control methodology itself.

It is envisaged that with this approach being consistent with current stormwater principles and objectives of Water Corporation, DoE/DoW, and the City of Swan, if proven to be successful, will also be applied to the future stages of development of Egerton.

4.2 Groundwater Management

4.2.1 WRC AAMGL Policy

WRC's Average Annual Maximum Ground Water Level (AAMGL) policy was developed in the 1990's, to prevent nutrient rich groundwater being discharged to downstream water bodies, with the aim of preventing the drying out of wetlands and associated vegetation and protecting downstream water bodies from nutrient enrichment. The AAMGL policy required new open drains, basin outlets and subsoil drains to be laid at an elevation at or above the AAMGL.

Prior to adoption of the AAMGL policy, in many areas of Perth the existing drainage system was installed below the AAMGL to allow control of the water table without the necessity of importing large quantities of fill material.

WRC supports the balance between environment and development and uses the AAMGL based on the most recent 25 years of data. Where man-made or open agricultural drains exist, AAMGL mapping is also allowed to consider the restriction in the rise of the water table due to the drain.

A more flexible approach was adopted in the Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy (JDA, 2002), where post development drain levels were discussed as potentially being set below AAMGL, provided it could be shown by a land developer that:

- Wetland groundwater levels would not be adversely affected
- Limiting peak seasonal groundwater levels does not significantly increase nutrient export

It is important to note that limiting the peak groundwater level rise does not effectively lower groundwater levels in an area over the whole year, but rather only limits the seasonal peak rise in groundwater level. For all times other than when the groundwater is at its peak, groundwater levels are unaffected by any setting of drainage below AAMGL.

4.2.2 Groundwater Levels

Following change in land use from native vegetation to urban development, a change in the general water hydrologic balance, particularly in groundwater levels is observed.

Preliminary modelling of the AAMGL pre and post development was included in the 1995 DNMP, based on groundwater data from regional monitoring bores. Based on monitoring recommendations contained in the 1995 DNMP, 28 shallow groundwater bores have since been installed at Egerton (Figure 5). These bores have been monitored monthly since 1995, with hydrographs for these bores shown in Figure 6.

JDA (2003a) updated the pre-development AAMGL contours for the entire Egerton property based on this additional monitoring data as shown in Figure 7.

Post development groundwater levels are proposed to be maintained at pre-development levels. This will be achieved through the use of a subsoil drainage system as described in the next section.

4.2.3 Subsoil Drainage

Minimum building floor levels require compliance with standard requirements of a 1.2m clearance above the AAMGL. This separation will be achieved by a combination of filling and subsoil drainage if not available.

Subsoil drainage is to be installed to maintain the groundwater levels at the pre-development AAMGL This will protect against rises in water table due to any increase in recharge associated with development. It will also provide protection for existing wetlands and groundwater dependent vegetation.

The subsoil drainage network will consist of perforated pipes surrounded by crushed rock bed, with inverts set approximately at the pre-development AAMGL. Flow collected in the subsoil drainage system will be discharged into downstream storages.

4.3 Water Quantity Management

4.3.1 Proposed System

The stormwater management system will be designed using the minor/major approach. The minor drainage system is defined as the system of swales, kerbs and underground pipes etc. designed to manage runoff generated by low frequency ARI storms, typically less than 5 year ARI. The major drainage system is defined as the arrangement of roads, drainage reserves and open space to manage stormwater runoff from extreme events which exceed the capacity of the minor system.

Under this approach, frequent minor flows are retained/detained at source by the pipe/swale system and/or on site detention. Rarer major floods including the 100 year Average Recurrence Interval (ARI) storm event will be conveyed by overland flow paths to safe disposal points further downstream, or stored and infiltrated on site where technically feasible.

4.3.2 Flood Modelling

Flood modelling has been performed to determine the required sizing of detention storages based on pre and post development stormwater runoff as presented in Appendix A.

Figure 4 shows the preliminary location for these basins. Exact locations and sizes to be determined at detailed design stage.

4.4 Water Quality Management

This DP2 DNMP adopts an integrated catchment management approach to water quality, building on the strengths of both the 1995 DNMP and Best Management Practices of WSUD as outlined in DoE (2004) Stormwater Manual for WA. While infiltration opportunities will be maximised for high frequency and low intensity storms, this DP2 DNMP also provides a greater emphasis on strengthening source controls and catchment management measures to reduce nutrient and pollution input, rather than attempting to treat nutrients and pollutants once applied to the catchment.

In developing a water quality management strategy for the Development Plan 2 area, the primary focus is on nutrient input as the most significant water quality issue.

The following sections provide an outline of existing (pre-development) and post development nutrient inputs, identify the relative cost and effectiveness of various in-transit and source control measures, and evaluate effective nutrient (and other pollutant) management options.

4.4.1 Existing Groundwater Quality

Groundwater and surface water quality (Nitrogen and Phosphorus) has been measured 3 monthly at Egerton since 1999, consistent with recommendations contained in the 1995 DNMP. The data forms pre-development baseline data to which post development water quality may be compared.

Groundwater concentrations shown in Table 1 indicate both Nitrogen and Phosphorus concentrations measured in the DP2 bores are below the Swan Canning Cleanup Program (Swan River Trust, 1998) 5 year targets for the Ellen Brook catchment, and also below the 20 year target in most instances. Furthermore, these results are also well below surface water concentrations measured at the John St Gauging Station on Henley Brook.

Table 1: DP2 Existing Groundwater Quality

Nutrient	DP 2 Monitoring Bores[3]				SCCP Targets[1]		John St Gauging Station[2]
	B3	B4	B18	B3	5 year	20 year	
Phosphorus (mg/L)	0.02	0.58	0.01	0.01	0.2	0.1	0.5
Nitrogen (mg/L)	1.7	4.4	2.3	1.6	2.0	1.0	2.5

Note: 1. Swan Canning Cleanup Program Action Plan (SRT, 1998) water quality targets for the Ellen Brook catchment.
2 URS (2001) John St Gauging Station monitoring data (200ha rural catchment)
3. Average concentrations from 4 monthly measurements taken since March 1999.

4.4.2 Existing Surface Water Quality

Surface water quality has been measured 3 monthly (when possible) at six sites (S1 to S6) at Egerton between 1999 to 2001. Of these sites, S2 and S3 are on Northwest Creek upstream of Heritage Dam and S1 is at the outlet from the dam (Figure 5). Table 2 presents median run-off nutrient concentrations (Nitrogen and Phosphorus) for these 3 sites based on samples taken periods of flow.

Table 2: DP2 Existing Surface Water Quality

Nutrient	Site	Median	Low	High	SCCP Targets[1]		John St Gauging Station[2]
					5 year	20 year	
Phosphorus (mg/L)	S1	0.24	0.13	0.35	0.2	0.1	0.5
	S2	0.01	0.01	0.01			
	S3	0.07	0.02	0.18			
Nitrogen (mg/L)	S1	1.55	0.42	20.0	20.0	1..2	2.5
	S2	0.30	0.01	1.70			
	S3	0.50	0..24	5.40			

Note: 1. Swan Canning Cleanup Program Action Plan (SRT, 1998) water quality targets for the Ellen Brook catchment.
2. URS (2001) John St Gauging Station monitoring data from a 200ha rural catchment.

4.4.3 Water Quality Management Options

Details of various structural water quality control measures applicable to the Development Plan 2 area are presented in Tables 3 and 4. These tables have been adapted from the Southern River/Forrestdale/Brookdale/Wungong Urban Water Management Strategy (JDA, 2002) and summarise the suitability of pollutant removal efficiencies, constraints and relative capital and operating costs.

Table 3 indicates that structural controls are only effective in removing gross pollutants and coarse sediment. They are ineffective in removing fine sediments and oil and grease, and in particular nutrients. They also have a moderate potential for allowing pollutants to be remobilised.

Table 4 also indicates that the majority of these structural controls are associated with a high ongoing/maintenance or capital cost. Consequently, they are considered to be inefficient in pollutant removal and should not be relied on for the majority of water quality management control within the Development Plan 2 area.

TABLE 3 : POLLUTANT REMOVAL EFFICIENCIES FOR VARIOUS STRUCTURAL CONTROLS

Treatment Measure	**Pollutant Removal Efficiency** **neg** : Negligible [0-10% removal] **L** : Low [10-50% removal] **M** :Moderate [50-75% removal] **H :** High [75-100% removal]									
	Litter and gross pollutants (>500 µm)	Coarse sediment (>200 µm)	Fine sediment & suspended solids (<200 µm)	Total phosphorus	Dissolved phosphorus	Total nitrogen	Dissolved nitrogen	Oil and grease	Oxygen demanding substances (BOD)	Potential for pollutant re-mobilisation
Litter baskets/ pits/ bags	**H**	**L**	**Neg**	**neg**	**neg**	**neg**	**neg**	**neg**	**L**	**L**
Litter / trash racks	**M**	**L**	**Neg**	**neg**	**neg**	**neg**	**neg**	**neg**	**L**	**M**
Gross Pollutant Traps	**H**	**H**	**M**	**L**	**neg**	**L**	**neg**	**L**	**L**	**M**
Detention torages	**L**	**H**	**M**	**M**	**neg**	**L**	**Neg**	**neg**	**L**	**M**
Vegetated swales	**L**	**H**	**M**	**L**	**neg**	**L**	**neg**	**L**	**L**	**L**
Bioretention systems	**L**	**L**	**H**	**H**	**L**	**H**	**L**	**M**	**L**	**L**

Adapted from JDA (2002).

TABLE 4 : POTENTIAL CONSTRAINTS FOR VARIOUS STRUCTURAL CONTROLS

Treatment Measure	**Potential Constraint** ✖ : Constraint may preclude use • : Constraint may be overcome with appropriate design ✓ : Generally not a constraint								**Indicative Relative Cost** H : High M : Medium L : Low	
	Steep site/catchment slope	High water table	Limited land availability	Polluted groundwater	Covered treatment measure is required	High sediment input	Treatment measure requires pre-treatment	Hydraulic head loss limitation	Ongoing operation / maintenance costs	Capital cost
Litter baskets/ pits/ bags	✓	✓	✓	✓	✓	•	✓	•	**H**	**L**
Litter / trash racks	✓	✓	✓	✓	•	•	✓	✖	**H**	**L**
Gross Pollutant Traps	✓	✓	•	✓	•	•	•	✖	**H**	**M**
Detention storages	•	•	✖	•	✖	✖	✓	•	**L**	**M**
Vegetated swales	✖	✖	✖	✓	✖	✓	✓	✓	**L**	**L**
Bioretention systems	✖	✖	✖	✓	✖	✖	✓	✓	**M**	**M**

Adapted from JDA (2002).

With non-structural source controls, it is more difficult to predict their effectiveness on pollutant removal efficiencies. Presented in Figure 8 is a concept summary of the relative costs for reducing phosphorus input based on source controls compared to end of pipe controls (extract from JDA, 2002). It clearly shows that there are smaller costs and greater efficiencies associated with preventing nutrient application, compared to incorporating more expensive end of pipe infrastructure (structural controls).

Based on this concept and the fact that the structural controls discussed earlier are less efficient in pollutant removal, it is recommended that the water quality management program developed for the Development Plan 2 area largely reflect non-structural source controls rather than the end of pipe structural controls. For this DP2 DNMP, the following source controls are proposed where possible:

- **Landuse Planning**
  Inclusion of water quality considerations in land use planning decisions – land zonings and layout, and POS design and location.

- **Education Campaigns**
  Distribution of leaflets, posters and newsletters (topics include but not limited to drains to rivers – Ellen Brook, fertilising habits, composting, car washing detergents and practices, lawn and garden cutting disposal, techniques for minimising stormwater runoff pollutants), drain stencilling and plaques, erection of informative signs in public areas, newspaper articles etc.

- **Refinement of Management and Maintenance Activities**
  Education of staff and regular review of work practices, refinement of street sweeping programmes and practices, landscaping, and enforcement through infringement and pollution control regulation.

- **Balanced Planting Regime**
  Retention of existing, and landscaping with native vegetation in POS areas, and encouragement of native plantings in residential lots where possible.

- **Street Sweeping**
  Undertaking of co-ordinated street cleaning programs to remove sediment build up, particularly during development and housing construction phase.

4.4.4 Modelled Nutrient Input Using NiDSS

NiDSS (Nutrient Input Decision Support System) is a tool developed by JDA Consultant Hydrologists to assist in landuse management planning, by allowing quantitative estimation of nutrient input rates and the potential reduction in nutrient input for various combinations of WSUD management measures. It focuses on the adoption of an integrated catchment approach to water quality management, including measures to minimise nutrient inputs at source, and provides a logical framework for the evaluation of the effectiveness of various best management practices for nutrient input management.

It calculates the total expected nutrient input for a particular development proposal based on aggregating individual nutrient inputs from different land uses (housing lots, POS, road reserves, conservation areas etc.) prior to implementation of stormwater management measures. The impact of individual source and in-transit controls on nutrient input can then be determined by either turning on/off individual controls or varying the effectiveness of these measures. The results present information on:

- Estimates of total phosphorus (TP) and total nitrogen (TN) application to an area
- Estimates of reductions due to source control measures (education, street sweeping)
- Estimates of reductions due to in-transit controls (Stormwater Pollutant Traps, WPCP's)
- Estimates of the cost of removal (in PV terms) for a selected WSUD program.

NiDSS modelling was applied to the Development Plan 2 area to model the existing and proposed land use nutrient input rates, see Appendix B. The nutrient application rates were adopted from Southern River/Forrestdale/Brookdale/Wungong UWMS (JDA, 2002), which based application rates on a nutrient input survey conducted by JDA of medium density residential areas and on previous work of Gerritse et al (1991, 1992). Table 5 summarises the results. For existing land use TP and TN inputs are estimated at 3.7 and 11.1 t/yr

Following urban development, there is the potential for an increase in nutrient input. For the Development Plan 2 area, estimates of post-development nutrient input rates from NiDSS are shown in Table 5. These estimates are based on residential development with a mixture of R35 zoning (285m^2lots) and R15 zoning (670m^2 lots) without any Water Sensitive Urban Design (WSUD) measures implemented.

Table 5 indicates that TP input will reduce slightly from 3.7 to 3.5t/yr, while TN will increase form 11.1 to 15.7t/yr.

TABLE 5: DP2 NUTRIENT INPUT ANALYSIS (USING NIDSS MODEL)

	Pre Development	Post Development (without WSUD)	Post Development (with WSUD Example 1)	Post Development (with WSUD Example 2)
Total Phosphorus Input (t/yr)	3.7	3.5	1.8	1.5
Total Nitrogen Input (t/yr)	11.1	15.7	9.5	7.6

Through the application of various water management options, the potential for increased nutrient input can be managed. Furthermore a combination of these options can be used to develop an effective water quality management program to effectively reduce the post development inputs even further. Presented in Tables 5 and 6 are two examples on how an effective water quality management program, based on source controls can reduce post development Total Nitrogen and Total Phosphorus inputs. In these examples, an education effectiveness of 25% and 33% respectively is assumed, that is, 1 in 4 or 1 in 3 people will adopt the WSUD principles as listed. These effectiveness percentages are not considered to be unrealistic.

Note that these management options shown in Table 6 represent effective example programs only. There are many other various combinations of management options available that can also be used to achieve

a similar result. For Development Plan 2 catchment, it is recommended that a specific water management program be developed by Multiplex Development Operations Ltd in consultation with the relevant agencies.

TABLE 6 : MANAGEMENT OPTIONS ADOPTED IN EXAMPLE WSUD PROGRAMS

NiDSS WSUD Parameter	WSUD Example 1	WSUD Example 2	Description of WSUD Parameter
Street Sweeping	100%	0%	% of area street sweeping applies to
Education Effectiveness *(i.e. number of people that adopt WSUD listed below)*	25% *1 in 4*	33% *1 in 3*	% of people adopting WSUD principles
Community Education on Fertiliser Use	✓	✓	Fertiliser application as per manufacturers recommendations
Community Education on Pet Waste	✓	✓	Proper disposal of waste in rubbish bins
Balanced Planting Regime[1] (from Exotic gardens)	40%	50%	% of exotic garden replaced with a balanced planting regime
Balanced Plating Regime[1] (from Lawn area)	30%	50%	% of lawn area replaced with a balanced planting regime

1. Balanced Planting Regime also includes native plants.

If the water quality management program developed is ineffective and nutrient inputs increase as shown in Table 3 without WSD, there will be a long term impact on groundwater quality as all stormwater is infiltrated. However, if the proposed source control methodology adopted is as effective as modelled in NiDSS (WSUD Example 1), the total phosphorus input to the catchment will be reduced to 1.8t/yr and nitrogen reduced to 9.5t/yr (Table 5).

4.5 Monitoring Program

A monitoring program will be designed for the Development Plan Two area to allow quantitative assessment of hydrological impacts of the proposed development. In particular the Program will include the monitoring of surface water discharge from the development via the detention storage, and monitoring of groundwater levels and quality (Nitrogen and Phosphorus), in addition to the existing groundwater monitoring program.

The Program will build on existing groundwater level and quality data and will continue for 10 years to allow for time lag for full impacts of development on the receiving environment if any to occur. The Program will be periodically reviewed, and modified (if necessary) as monitoring data is collected to ensure the Program's suitability and practicality.

It is suggested that the process for developing the details of the Monitoring Program (water quality parameters, locations, frequency and reporting) be similar to that adopted for Stage 1 of the Egerton development. That is, details of the Monitoring Program are to be designed separately from this DNMP by Multiplex , City of Swan, Department of Environment and JDA Consultant Hydrologists.

4.6 Implementation

4.6.1 Operation and Maintenance

Design and construction of the local drainage system will be the responsibility of the developer (Multiplex Development Operations Ltd), and handed over to local government (City of Swan) at Practical Completion.

It is considered that the following operating and maintenance practices will be implemented periodically by the relative agencies as outlined in Table 7:

- Removal of debris to prevent blockages
- Street sweeping to reduce particulate build up on road surfaces and gutters
- Stripping and removal of vegetation from the detention storage
- Cleaning of sediment build up and litter layer on the bottom of infiltration basins and the detention storage
- Mowing of grassed open channel sections monthly and grass clippings removed
- Undertake education campaigns regarding source control practices to minimise pollutant runoff into the stormwater drainage system
- Conduct regular operational and maintenance activity reviews with regard to assessing activity impact on water quality

4.6.2 Roles and Responsibility

Key roles and responsibilities for various agencies for implementing the DP2 DNMP are shown in Table 7.

This DNMP proposes the management of water quality by predominantly non-structural source controls within the catchment.

As a demonstration project of urban water management source controls, it is proposed that the monitoring of performance of each element will be given prominence. At present the ability of source controls measures to ensure post-development water quality will be as good as, or better than, pre-development water quality, has not been established.

Discussions with government agencies suggests that it is not a responsibility of any arm of government to collect such information to allow more rational decisions to be made in future. With this situation in mind it is proposed that the Development Plan 2 area be established on “design based” water quality methods, rather than “performance based”. That is, we propose that the data to be collected on the performance of the different source control measures will be made generally available to the government and land development industry.

It is further proposed that no liability is incurred by any participating agency, Multiplex Development Operations Ltd included, should the source control measures proposed not result in the desired water quantity and quality outcomes. The contingency measure in this circumstance would be to reinforce the source control methodology, to improve implementation in this and subsequent stages of the urban development of this catchment.

The information obtained from monitoring will be documented in annual reports by Multiplex Development Operations Ltd, so that progress can be assessed and future land development at Egerton, and elsewhere in Perth, benefit from it.

TABLE 7: EGERTON DEVELOPMENT PLAN 2 DNMP AGENCIES ROLES AND RESPONSIBILITIES

Item No.	Management Issue	Responsibility & Funding
1.	Groundwater level and quality monitoring	❑ Multiplex Development Operations Ltd for 10 years.
2.	Structural control compliance with DP2 DNMP (installation, operation & maintenance) - detention storage (general) - detention storage (downstream)	❑ Multiplex Development Operations Ltd for 10 years. ❑ Water Corporation
3.	Detention storage outlet gauging station (including water quality) - installation - operation - maintenance	❑ Water Corporation
4.	Non structural source control compliance with DP2 DNMP - development of agreed source control program - education campaigns - balanced planting regime - review of operating and maintenance practices	❑ Multiplex Development Operations Ltd for 10 years (in liaison with City of Swan). City of Swan thereafter.
5.	Non structural source control compliance with DP2 DNMP - street sweeping	❑ Multiplex Development Operations Ltd for the first five years, City of Swan thereafter.
6.	Structural source control compliance with DP2 DNMP (installation, operation & maintenance) - Stormwater Pollutant Traps (SPT's) - swales	❑ Multiplex Development Operations Ltd for the first five years, City of Swan thereafter.
7.	Detention storage inflow quantity and quality monitoring	❑ Multiplex Development Operations Ltd for 10 years.
8.	Preparation of Annual Monitoring Reports	❑ Multiplex Development Operations Ltd for 10 years.
9.	Assessments of performance of catchment management and source control measures (from Annual Monitoring Reports Item 8)	❑ Multiplex Development Operations Ltd in conjunction with City of Swan, Department of Environment (WRC) and Water Corporation.
10.	Strategic planning for future stages of Egerton and review of drainage planning, including flexibility for continual improvements in WSUD to be incorporated based on monitoring outcomes from DP2 DNMP	❑ Multiplex Development Operations Ltd
11.	Refinement of regional strategic drainage planning, based on DP2 DNMP monitoring outcomes	❑ Department of Water

5. CONCLUSIONS

- Since approval of the 1995 DNMP and 2000 ODP, there has been a significant change in urban stormwater management in WA, with DoW (previously Doe, WRC) adopting a whole of catchment approach to urban water management. This shift places an emphasis on infiltration, source controls, and non structural water quality techniques. This compliments with previous WSUD and BMP techniques which concentrated on the use of end of pipe techniques for water quality control.

- Multiplex Development Operations Ltd acknowledges these changes in urban stormwater management, and to this end has commissioned preparation of a DNMP for the Development Plan 2 area. It aims to maintain key agreed principles of the approved 1995 DNMP, with a focus to including source controls and catchment management techniques to achieve improved water quality outcomes. It supplements and extends on the principles of the Egerton Development Stage 1 and DP1 DNMP's.

- The drainage network will comprise a piped/swale system with infiltration basins and detention storages. The network will be designed for retention and treatment of stormwater locally, particularly for the first flush event and frequently occurring storm events.

- Water Corporation may wish to assume responsibility for the most downstream detention basin in DP2, consistent with their approach in Stage 1 Egerton.

- The primary focus for the water quality management strategy for the Development Plan 2 area is nutrient input and export as the most significant issue. Water quality will be managed by a treatment train of BMP's consistent with current Stormawater Management Manual. Stormwater for frequently occurring storm events will be retained and infiltrated on site. At source controls will be incorporated into landuse planning (POS and landscape design) and will include strategic plantings, street sweeping, stormwater pollutant traps, and community education.

- This water quality approach differs from the 1995 DMNP which relied entirely on a WPCP at catchment outlet to achieve surface water quality objectives. The DP2 DNMP approach now addresses both groundwater and surface water quality issues, rather than surface water quality issues only.

- The DP2 DNMP provides an opportunity for both state and local government to pilot the implementation of WRC's new principles and objectives for urban stormwater management in the North East Corridor in a demonstration project. It also enables the performance of the DP2 DNMP to be assessed, prior to application in subsequent later stages of Egerton. This provides flexibility for continual improvements in WSUD to be incorporated in Egerton planning and development.

- Multiplex Development Operations Ltd is committed to Egerton being an industry leader in the application of Water Sensitive Urban Design. In the context of a demonstration project, this DNMP proposes the Development Plan 2 area to be implemented on "design based" water quality methods, rather than "performance based".

- It is recommended that no liability is incurred by any participating agency, Multiplex Development Operations Ltd included, should source control measures proposed not result in desired water quality outcomes. The contingency measure in this circumstance would be to reinforce the source control methodology, to improve implementation in this and subsequent stages of the urban development of this catchment.

- The information obtained from monitoring will be documented in annual reports, so that the effectiveness of source controls locally can be assessed, and future stages of land development at Egerton, and elsewhere in Perth, benefit from this approach.

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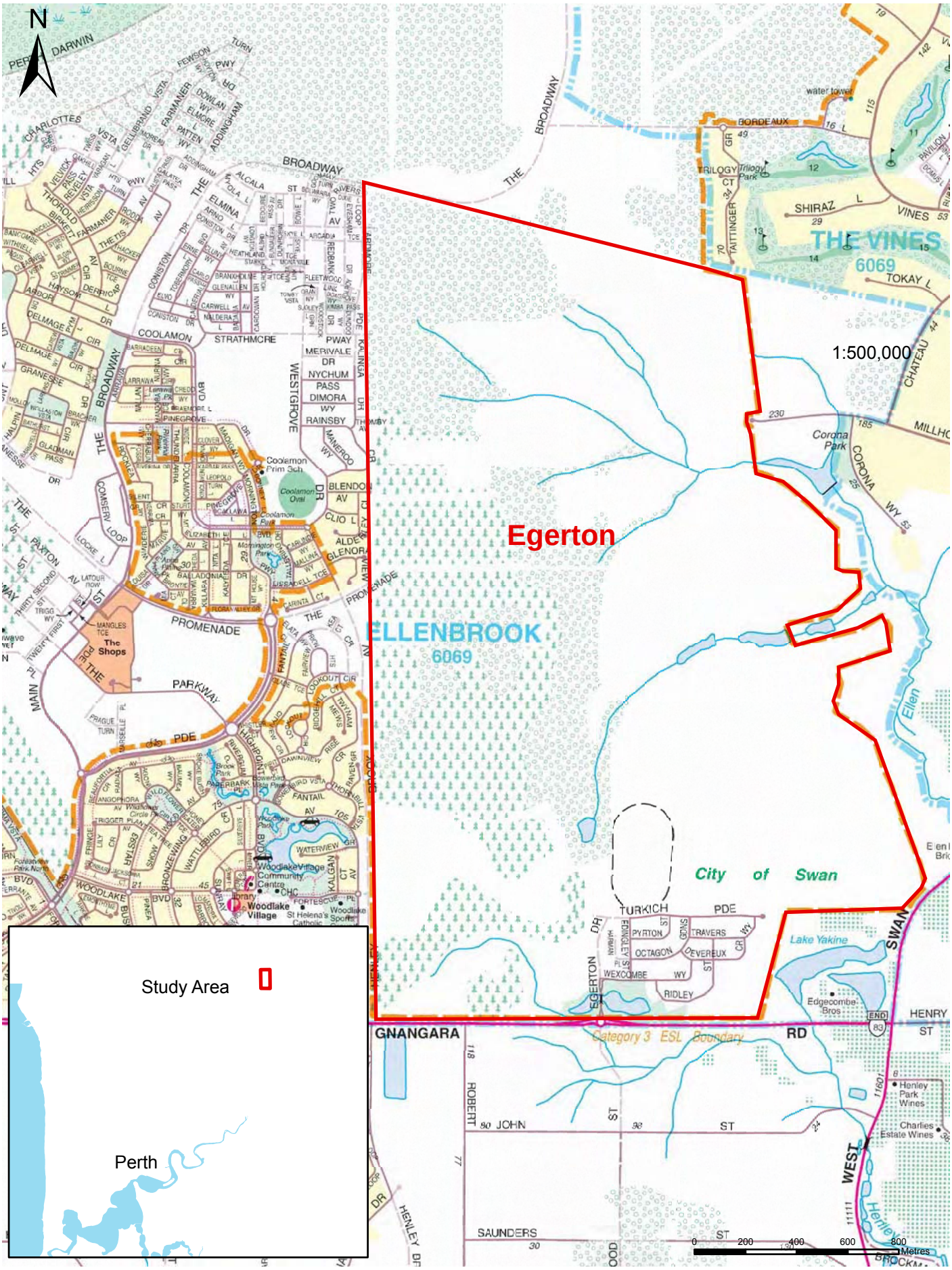
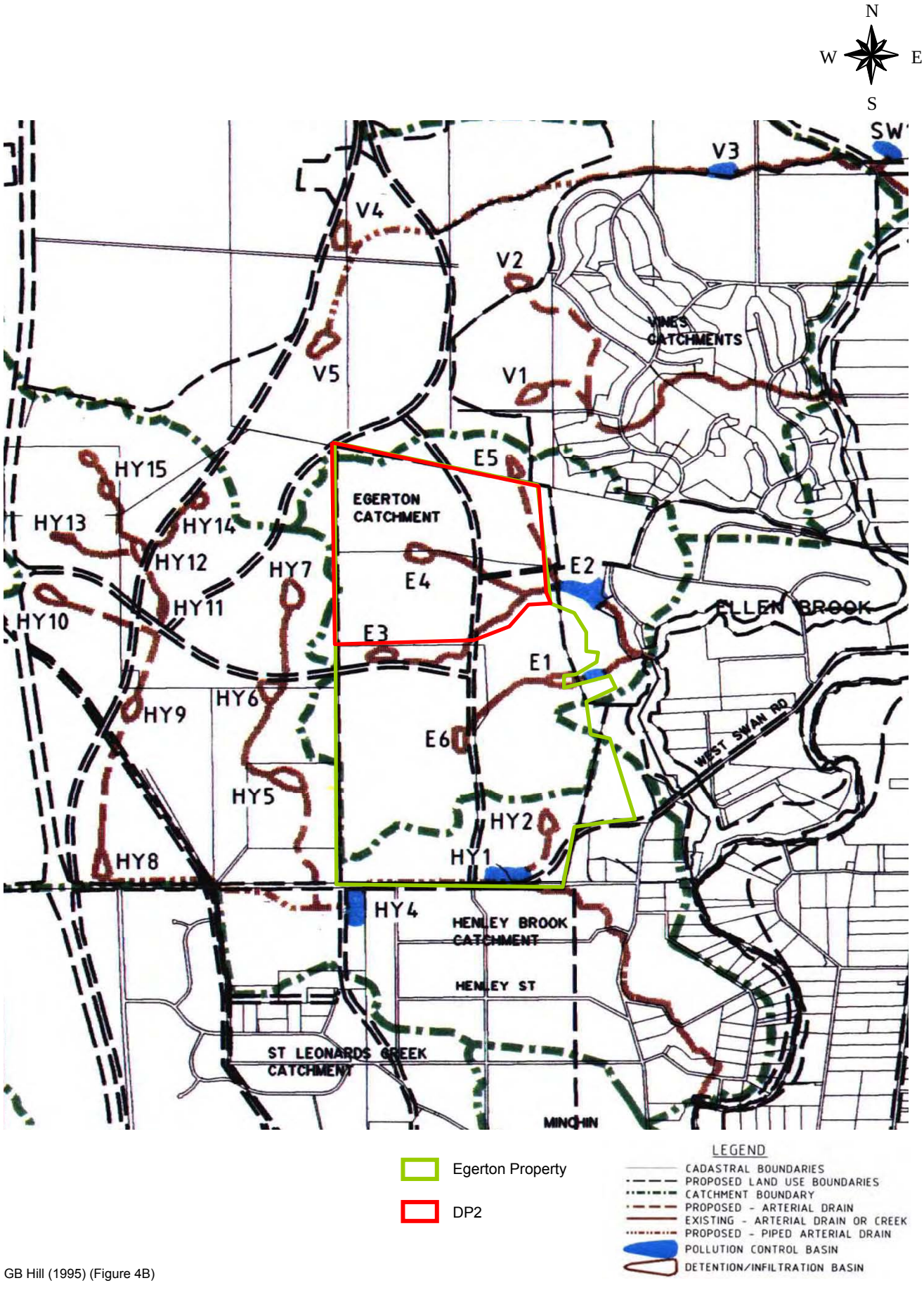
FIGURES



JDA Consultant Hydrologists	Job No: J3718 Scale 1:20,000	Multiplex Development Operations Ltd Egerton- Development Plan Two DNMP **Figure 1: Location Plan**



Source: GB Hill (1995) (Figure 4B)

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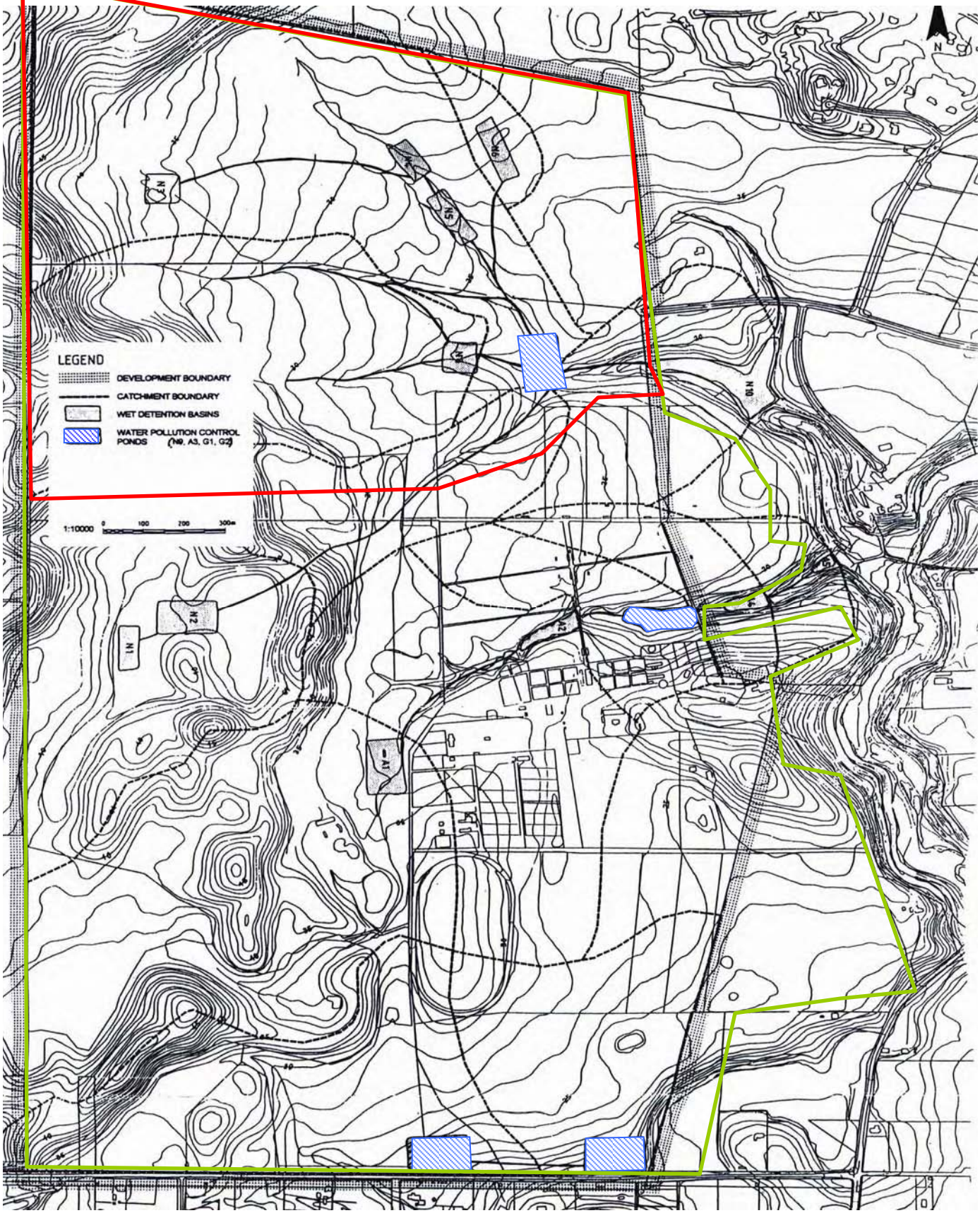
Job No. J3718
Scale 1 : 37500

Multiplex Development Operations Ltd
Egerton-Development Plan Two DNMP
Figure 2: Regional Drainage Strategy



Source: Alan Tiingay & Associates *et. al.* (1995)

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Job No. J3718

Multiplex Development Operations Ltd
Egerton- Development Plan Two DNMP
Figure 3: 1995 DNMP Drainage Scheme

NP 1

- No existing vegetation currently on site
- Formal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Native shrub species, exotic trees
- Fully irrigated
- Higher level of maintenance

NP 2

- Existing vegetation unable to retained
- Formal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Native shrub species, exotic trees
- Fully irrigated
- Higher level of maintenance

NP 3

- Retain existing vegetation currently on site where possible
- Informal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- All native plant species
- Partly irrigated
- Higher level of maintenance

* Function and Management of POS to be confirmed.

C 1

- Retention of existing vegetation with improvements where necessary to edges etc to preserve its conservation value
- Pedestrian access to controlled paths with Interpretive signage
- Pedestrian lookout structures & shelters at suitable vantage points
- Light vehicular access on pedestrian paths (emergency / maintenance)
- No facilities proposed,
- No irrigation except to residential edges where suitable
- All native species
- Low maintenance level

C 2

- Retention of existing vegetation with improvements where necessary to edges etc to preserve its conservation value
- Pedestrian access to controlled paths with Interpretive signage
- Light vehicular access on pedestrian paths (emergency / maintenance)
- No facilities proposed
- No irrigation except to residential edges where suitable
- All native species
- Low maintenance level

BF (to Department of Environment & Conservation requirements)

- Retention of existing vegetation in its current condition (no improvements proposed),
- Retention of existing natural spring, creeklines and open waterbody.
- Possible picnic facilities and shelters to degraded area around open waterbody.
- Limited pedestrian access to controlled paths with Interpretive signage to edges,
- Pedestrian lookout structures & shelters at suitable vantage points,
- No vehicular access (other than emergency),
- No facilities proposed,
- Fenced edges to restrict human and domestic animal access with fire breaks where necessary,
- No irrigation
- All native species
- Low maintenance level

PR 1

- Retention of existing significant vegetation
- Open active informal grassed recreation area
- Shade trees
- Pedestrian path links to adjacent residential areas
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Introduced and native plant species
- Fully irrigated
- Higher maintenance level

LEGEND.

- RETAINED BUSHLAND.
- TURF AREAS.
- WETLAND AREAS

MUC 1

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales/infiltration/sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes/viewing areas/informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 2

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 3

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 4

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Retention of existing significant vegetation
- Manicured landscape areas edging road verge (seating & signage nodes/viewing areas/informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Minimal irrigation use
- Minimal maintenance areas

MUC 5

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of drainage where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 6

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of drainage where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 7

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales/infiltration/sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes/viewing areas/informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Minimal irrigation use
- Minimal maintenance areas

MUC 8

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

VALE

DEVELOPMENT PLAN - Proposed Subdivision (PLAN 2 of 2)

N

6th March 2006
SCALE 1:2,500

mcnally · newton
LANDSCAPE ARCHITECTS

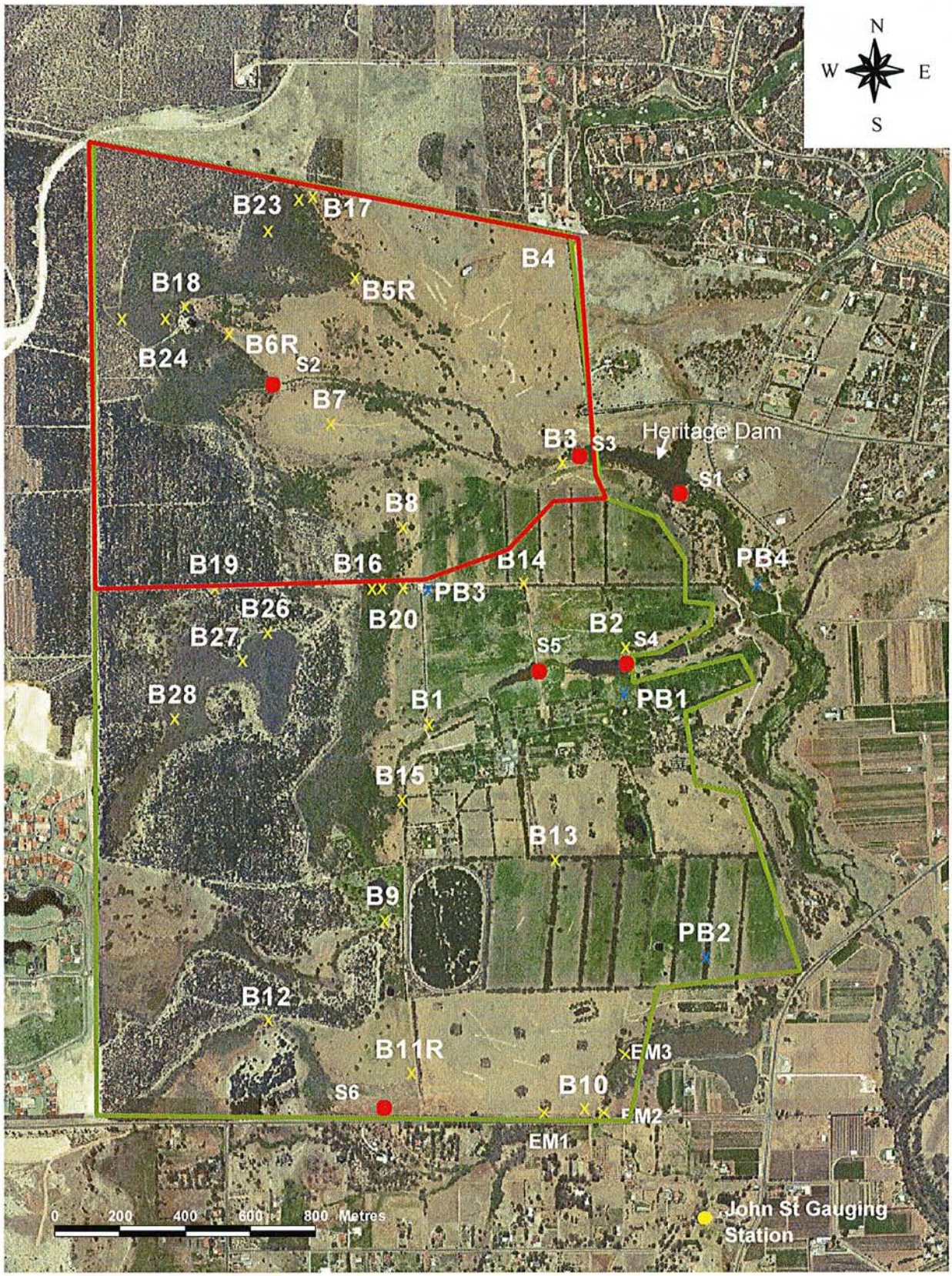

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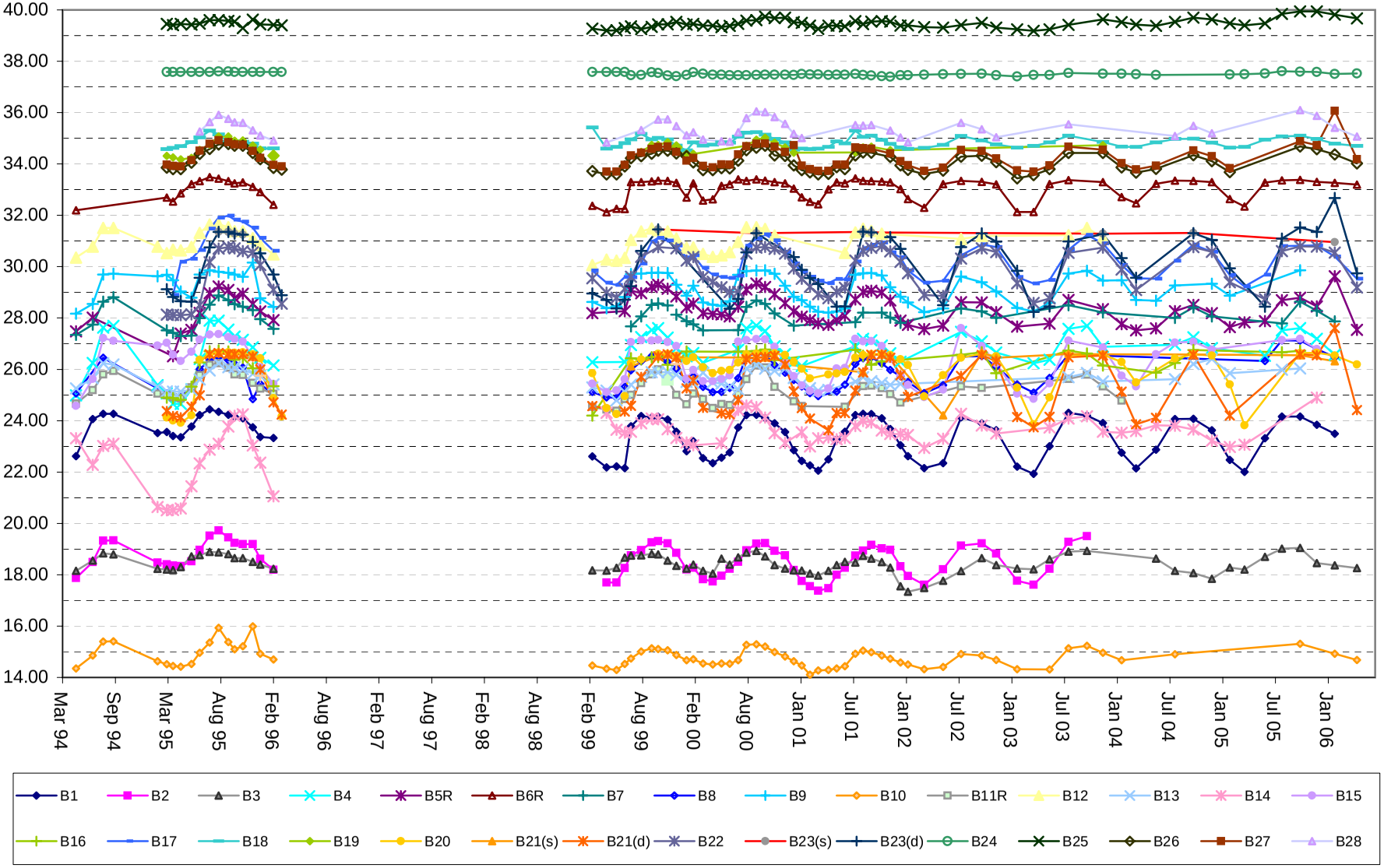
Figure 5: Groundwater and Surface Water Bore Locations



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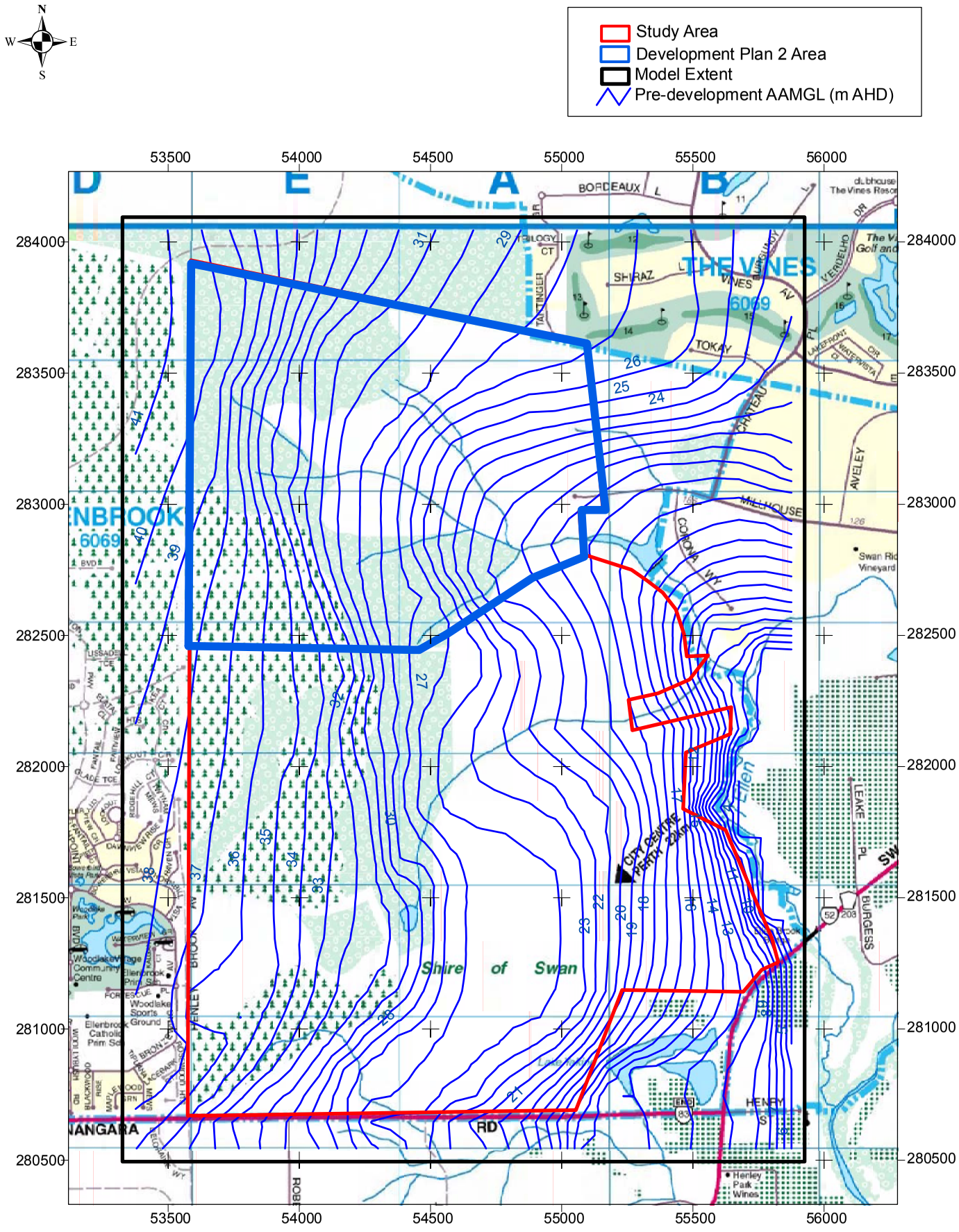
Egerton Development Plan Two DNMP

Figure 6: Groundwater Monitoring Bore Hydrograph



Data Source: Reproduced from JDA (2003) Figure 5

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Scale 1:20,000

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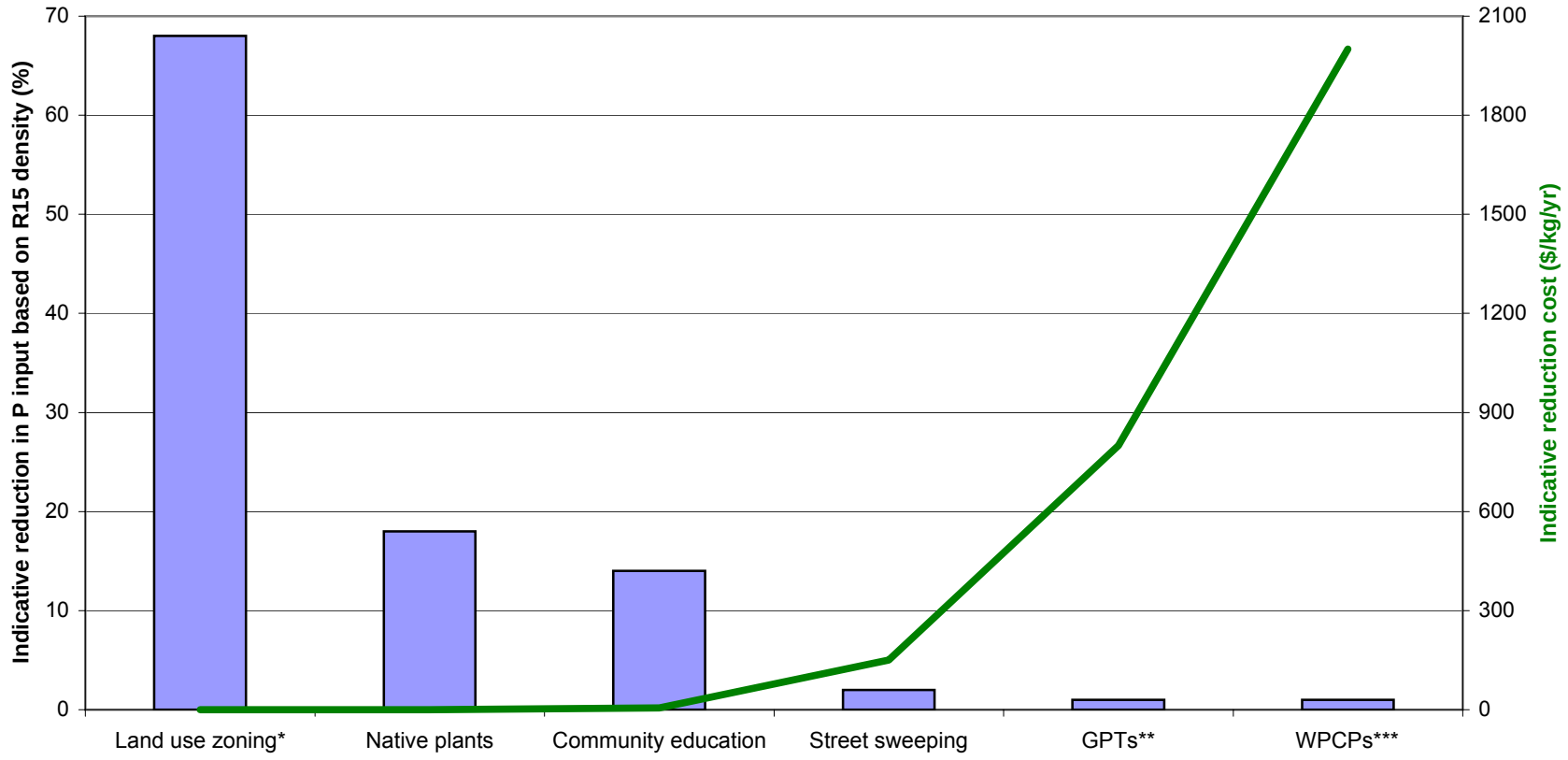
Egerton- Development Plan Two DNMP

Figure 7: Egerton Pre-development AAMGL



Note:

* Land use zoning reduction based on change in residential density from R15 to R35

** GPT = Gross Pollutant Trap

*** WPCP = Water Pollution Control Pond

Data Source: Southern River/Forrestdale/Brookdale/Wungong Structure Plan - UWMS (JDA, 2002).

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Multiplex Development Operations Ltd

Egerton- Development Plan Two DNMP

Figure 8: Concept of Cost of Nutrient Removal for Various Management Measures

APPENDIX A

Vale DP2 Flood Modelling

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ANNEXURES

1. INTRODUCTION

This Appendix describes flood modelling of Vale DP2 area.

Flood modelling has been performed to assess the ability of the proposed drainage network to manage stormwater runoff, and provide a guide to the proposed design.

Following urban development at Egerton, a change in the hydrological regime will occur with an increase in impervious areas. This increase in impervious area generates an increase in the volume and rate of surface runoff.

Flood management for DP2 comprises infiltration basins/swales as well as detention basins.

The area covered by DP2, predevelopment of Egerton property, drains to Northwest Creek.

This Appendix describes the flood modelling of DP2 which will drain to Northwest Creek.

2. EXISTING SURFACE WATER DRAINAGE

Figure 1 shows that DP2 is bounded by Henley Brook Drive to the west, the northern boundary of Egerton to the north, DP1 boundary to the south and the property boundary to the east.

Figure A2, from the 1995 DNMP for Egerton (ATA, 1995) shows the catchment boundaries then established between Northwest Creek, Aviary Creek and Gnangara Creek over the then development boundary area.

Flood modelling contained in the 1995 DNMP (ATA, 1995) estimated predevelopment flow rates in Northwest Creek at the outlet from the proposed detention basin N9 (see Annexure 1, Table 10) of 1.7 and 4.1 m^3/s in 10 and 100 yr ARI flood events respectively. This was based on the Rational Method assuming a 2 hr time of concentration and run-off coefficients of 0.2 and 0.3 for 10 and 100 yr storms respectively.

Predevelopment flows in Northwest Creek downstream beyond proposed basin N9 to the existing Heritage Dam N10 have been revised and results are presented in Tables A1 to A3. Note that the Heritage Dam has a spillway crest approximately 17.2 m AHD (approximately 2 m wide) and the dam crest itself is at approximately 17.5 m AHD. There is no low level pipe outlet from the dam and due to the base flow from Egerton seepage the water level is at overflow and all year round.

As previously, similar run-off coefficients have been used. This modelling is hydrograph based and uses a volumetric run-off coefficient rather than the Rational Method coefficient used previously.

Numerically coefficient values of 0.3 and 0.4 for 10 and 100 yr ARI events have been used.

Table A1 summarises the catchment areas draining to the detention basins N1 to N9 proposed in the 1995 DNMP, together with N10 (Heritage Dam). The listed catchment areas are unchanged from the 1995 DNMP. The contributing catchment areas presented in Table 1 represent those parts of the total catchment which are considered to contribute runoff to the proposed basin. For example, parts of the western catchments which have deep sandy soil profiles and deep water table are assumed to not contribute any runoff; similarly the Horse Shoe wetland is assumed not to fill and overflow. The only existing detention storage area (or basin) is Heritage Dam (N10), with area 17.5 ha.

Table A2 presents details of the outlets from N10, which has no low level culvert outlet, but does have a short spillway. The dam crest is only approximately 0.3 m above the spillway crest, and has been modelled as a higher level spillway.

Table A3 presents the results of the revised pre-development flood modelling at N10, in terms of peak inflow and outflow and maximum water level for 10 and 10 year ARI storms. The inflow and outflow rates are not significantly different, indicating that the Heritage Dam flood storage is small compared with flood inflow volumes. For 10 and 100 year ARI storms the peak inflows are 3.6 and 8.0 m3/s respectively, compared with 1.7 and 4.1 m3/s in Table 1 from the 1995 DNMP. The increase in estimated flood inflows is due to the different methodology – flood hydrograph rather than Rational Method, and associated parameter values. The revised (higher) values in Table 3 are considered more reliable.

Monitoring of surface water levels upstream of a culvert upstream of Heritage Dam commenced in July 2006, and will be used to refine estimates of rainfall runoff coefficient.

Water levels for both 10 and 100 year ARI storms in Table 3 are above Heritage Dam crest. This is of concern, as overtopping of an earth dam which is not scour protected is generally assumed to be high risk of catastrophic embankment failure. This would result in a flood wave passing along the downstream creek as the dam rapidly empties, which could cause damage to property and risk to human life. We have no information on the frequency of overtopping of the dam in the past. Our analysis suggests it occurs more frequently than once in 10 years.

3. FLOOD MANAGEMENT APPROACH

3.1 The 1995 DNMP Approach

The 1995 DNMP assumed a detention basins N1 to N6 and N8 would be constructed on Northwest Creek tributaries, together with a water pollution control pond (WPCP) upstream of the Heritage Dam.

The post-development modelling contained in the 1995 DNMP is summarised in Annexure 1 (Tables 4 to 6) and extends only to the outlet of the most downstream basin N9. It did not include modelling of the Heritage Dam N10. Outflows from basin N9 in 10 and 100 yr ARI storms were 1.4 and 1.9 m^3/s respectively. These outflows were less than the predevelopment estimates into Heritage Dam so that the modelled basins were considered satisfactory from a flood management view point in that they reduced the peak outflow to less than or equal to the predevelopment rates.

The sizing of the basins in the 1995 DNMP depended more on the nutrient stripping function to improve water quality, than on flood management. That is, the basin sizes required for nutrient stripping were found to be greater than those for flood management.

3.2 DP2 DNMP Approach

The updated flood modelling described in Chapter 2 for predevelopment conditions has been used for DP2 conditions also.

The Horse Shoe wetland has been modelled as a flood detention area, as have several swales or dry basins along the north-west creek tributaries within multiple use corridors (MUC's).

The Special Conservation and Bush Forever sites are modelled with predevelopment flow rates. Within the urban areas, the proposed road reserve areas are modelled as impervious areas with 0.8 runoff coefficient. The lots are assumed not to contribute runoff. Village Centre has been assigned 0.8 runoff coefficient.

The balance of runoff coefficients associated with proposed land use change is the overall change in individual land use coefficients weighted by area. Overall the alteration from existing wetland (represented by saturated ground and high runoff), to a combination of filled pervious dry lots and impervious road areas may not result in higher runoff rates and volumes.

Table A4 presents the catchment data for each proposed flood detention area, referred to loosely as a basin. These basins may be swales or dry basins. Permanently wet lakes would require disturbance of vegetation along the creek lines and are probably not required given the small change in flood magnitudes predicted by the modelling.

The proposed basins (NW1 to NW6), have total water surface area in 100 year ARI storm of 1.0 ha. In comparison the Horse Shoe wetland has an area of approximately 12 ha and the Heritage Dam 1.75 ha. The cumulative equivalent impervious areas listed in Table A4 can be compared with the existing areas in Table 1, as indication that we do not expect overall flood flow and volume to significantly increase. As a consequence, the flood detention requirement is relatively small. As described above, the flood modelling

will be reviewed and possibly revised when winter 2006 creek flow data has been analysed to provide real data on existing runoff rate relative to rainfall.

Table A5 summarises the proposed basin outlets, with culvert inverts at same elevation as existing natural surface within the creek lines. It is envisaged that the flood storage will be provided upstream of road and pedestrian/cycle crossings of creeks. These crossings will form a low bund forming temporary storage upstream, released through culverts. The proposed overflow (spillway) elevations in Table 5 are set at 10 year ARI level, so that they are only overtopped in rarer events.

Table A6 summarises the modelling of the basins in terms of peak inflow, peak outflow and maximum water level.

Table A6 shows that 10 and 100 yr ARI storm inflows to the Heritage Dam are 2.9 and 4.0 m3/s respectively, lower than existing values of 3.6 and 8.0 m3/s (Table A3) .

Note that the attenuation storage in existing basins A2 to A5 is small relative to the flow rates so that very little attenutation of the flow occurs.

4. REFERENCES

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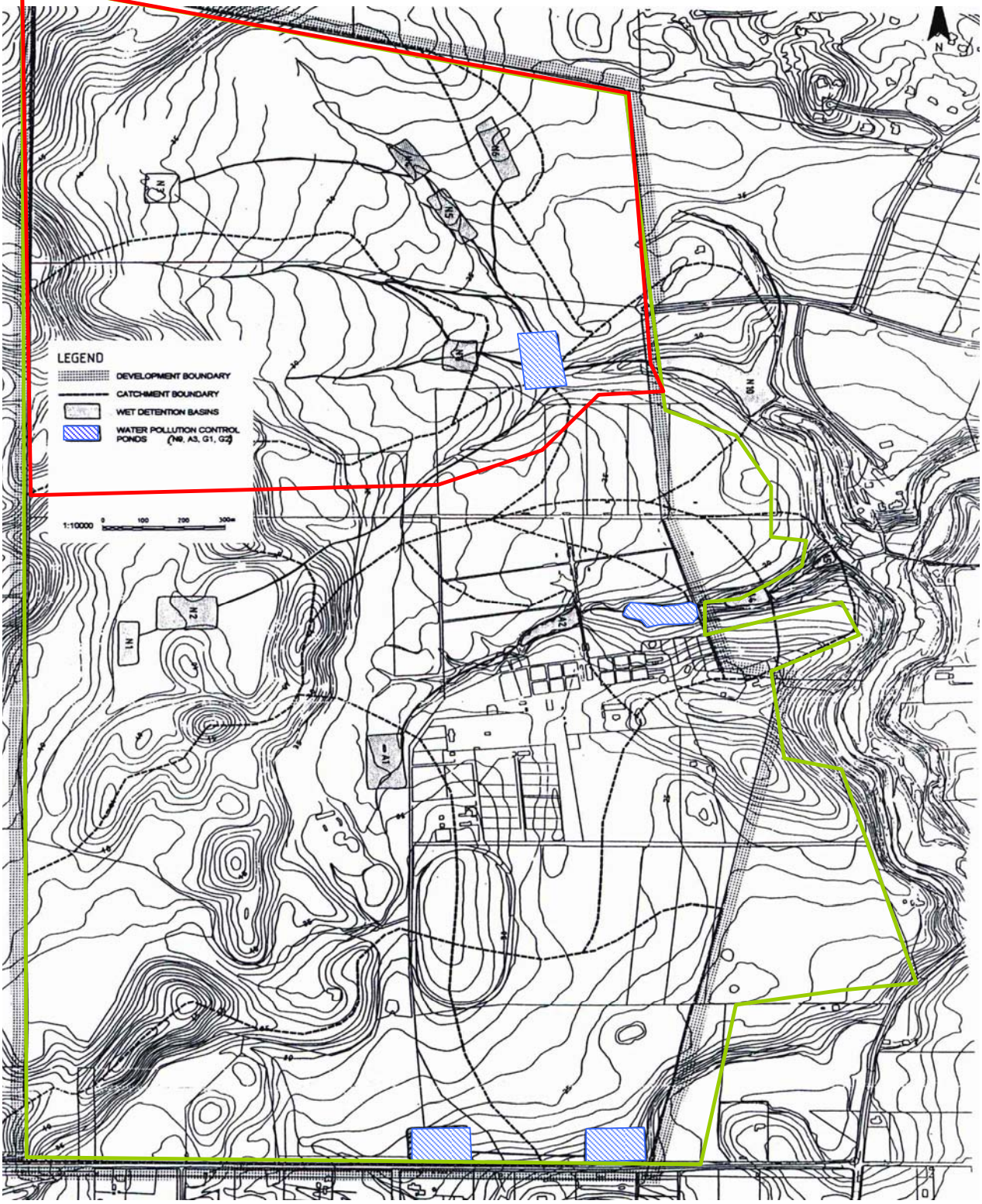

Egerton Property

DP2

Source: Alan Tiingay & Associates *et. al.* (1995)

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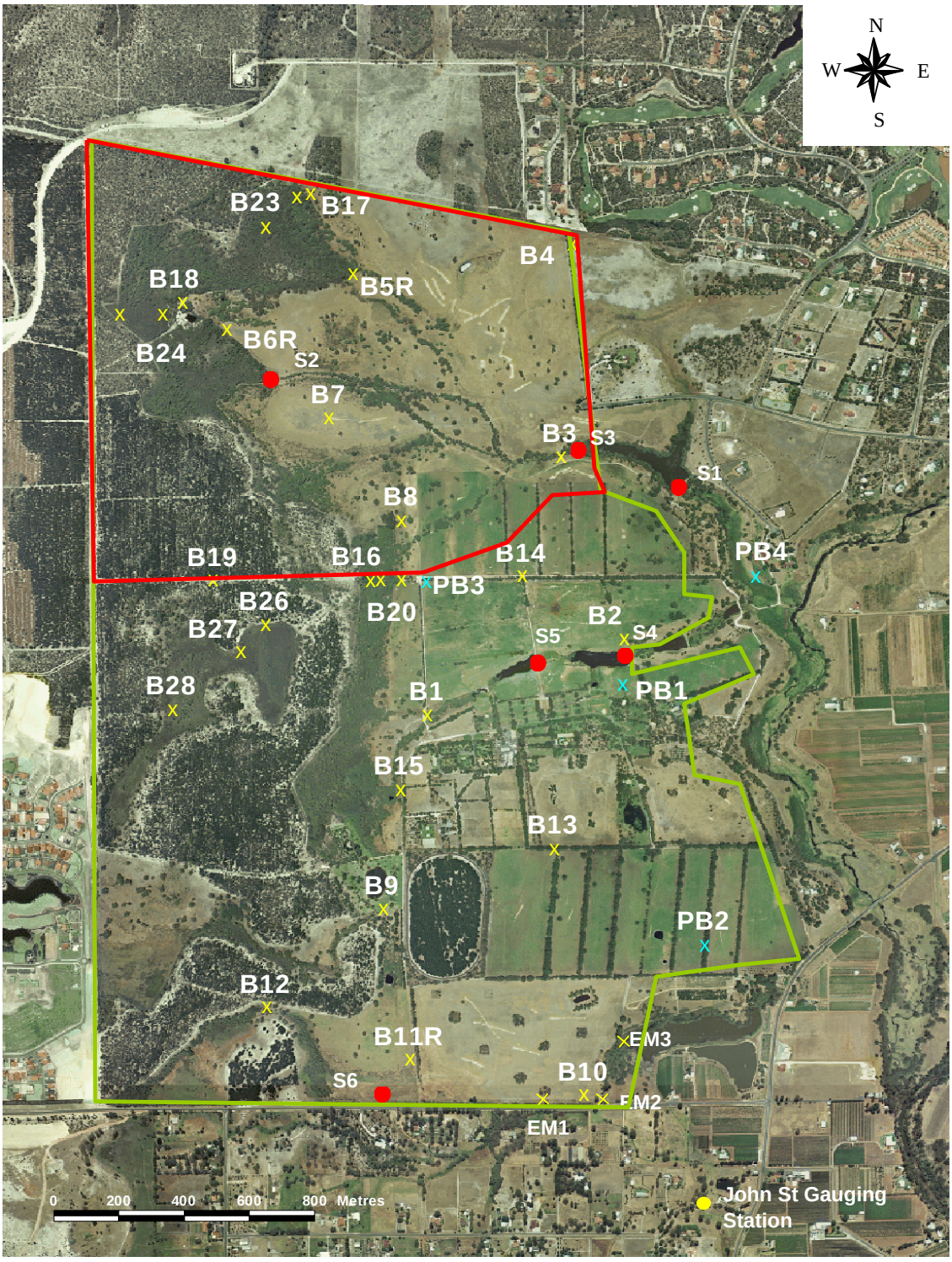
Egerton- Development Plan Two DNMP- Appendix A

Figure A2: 1995 DNMP Drainage Scheme



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Job No. J3718

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Egerton- Development Plan Two DNMP Appendix A
Figure A1: DP2 Location

VALE

DEVELOPMENT PLAN 2 OPEN SPACE LANDSCAPE STRATEGY

Data Source: McNally Newton Landscape Architects 2006

JDA Consultant Hydrologists

Job No. J3718

Scale: Not to Scale

Multiplex Development Operations Ltd

Vale -Development Plan Two DNMP Appendix A

Figure A3: Proposed Detention Areas

Table A1 **Northwest Creek Pre-Development- Basin Data**

Basin	Pervious Catchment Area	Cumulative Catchment Area	Contributing area	Cumulative contributing Area	Basin area
	(ha)	(ha)	(ha)	(ha)	(ha)
N1	40	40	0	0	
N2	13	53	0	0	
N3	24	24	4	4	
N4	34	34	34	34	
N5	2	36	2	36	
N6	9	9	9	9	
N8	64	88	38	42	
N9	38	224	99	125	
N10	99	323	224	224	1.75
	323				

Table A2 **Northwest Creek Pre-Development- Basin Outlets**

Basin	Culvert Invert	No. Of Culverts	Culvert Diameter	Spillway Crest	Spillway Length
	(mAHD)		(m)	(mAHD)	(m)
N10	nil	nil	nil	17.2	2

Dam crest at 17.5 m AHD (100 m long) modelled as spillway

Table A3 **Northwest Creek Pre-Development- Basin Flood Modelling**

Basin	10yr			100yr		
	Peak Inflow	Peak Outflow	Maxi Water Level	Peak Inflow	Peak Outflow	Maxi Water Level
	(m^3/s)	(m^3/s)	(mAHD)	(m^3/s)	(m^3/s)	(mAHD)
N10	3.6	3.6	17.57	8	7.77	17.62

Table A4 **Northwest Creek DP2 Basin Data**

Basin	Pervious Catchment Area (ha)	Impervious Catchment Area (ha)	Impervious Catchment Area (ha)	(EIA) (ha) 10 year	Cumulative EIA (ha) 10 year	Basin Area (ha)	Basin invert m AHD
NW1	22.00	5.60	4.48	11.08	11.08	0.20	26.5
NW2	0.00	6.70	5.36	5.36	16.44	0.18	24.0
NW3	10.80	3.00	2.40	5.64	5.64	0.08	27.5
NW4	0.00	3.00	2.40	2.40	8.04	0.10	25.0
NW5	0.00	4.75	3.80	3.80	3.80	0.10	23.0
Horse Shoe	0.00	5.65	4.52	4.52	4.52	0.00	35.0
NW6	0.00	23.50	18.80	18.80	51.60	0.32	18.6
N10	56.00	0.00	0.00	16.80	68.40	1.75	---

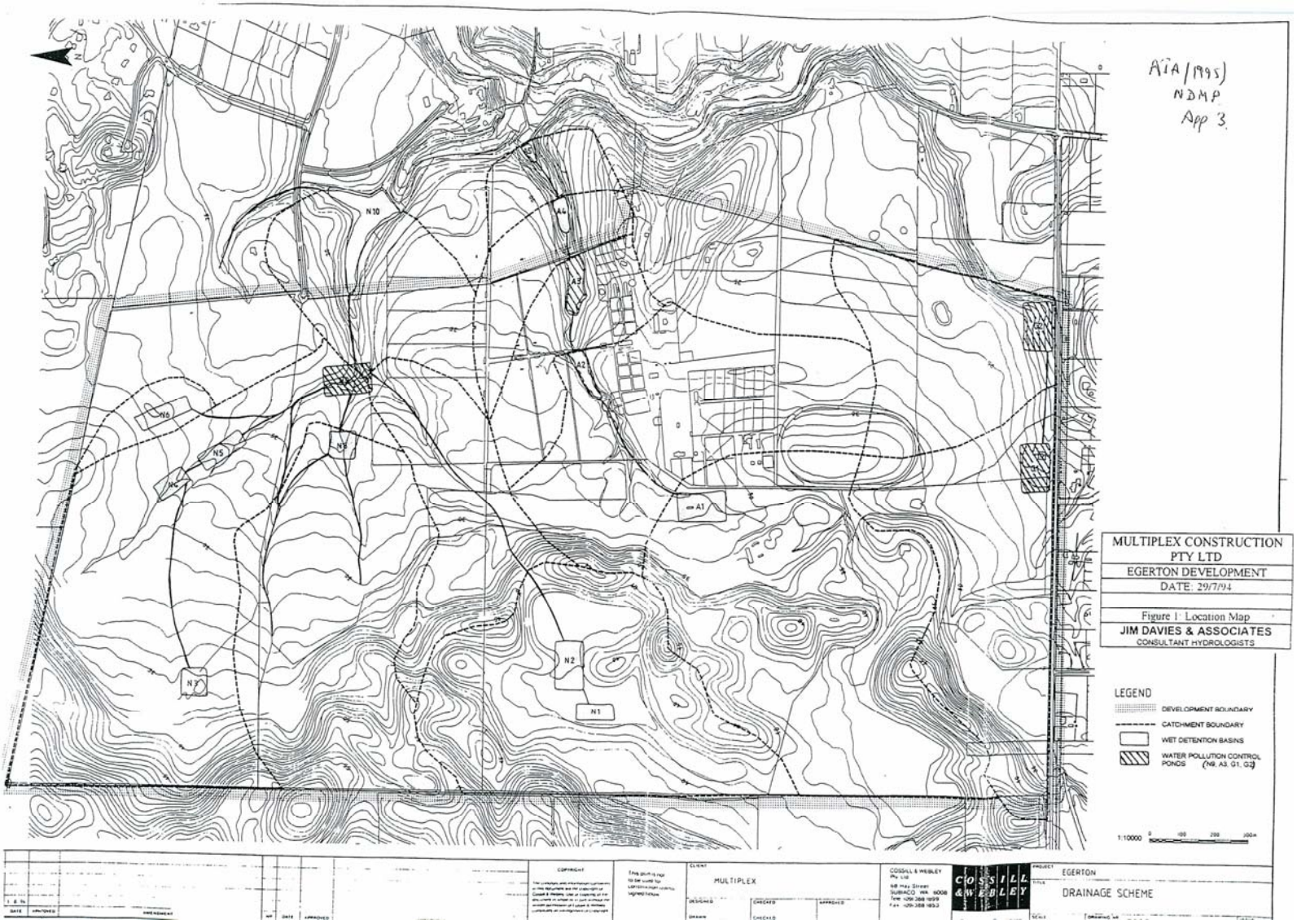
Table A5 **Northwest Creek DP2 Basin Outlets**

Basin	Culvert Invert m AHD	No. Of Outlets	Diameter m	Spillway invert m AHD	Spillway length m	Spillway invert m AHD	Spillway length m
NW1	26.5	2	0.3	26.953	5		
NW2	24	2	0.3	24.500	5		
NW3	27.5	2	0.3	28.000	5		
NW4	25	2	0.3	25.500	5		
NW5	23	2	0.3	23.200	5		
Horse Shoe	35	2	0.3	36.600	10		
NW6	18.6	3	0.3	18.800	10		
N10	nil	nil	nil	17.200	2	17.5	100

Table A6 **Northwest Creek DP2 Basin Flood Modelling**

Basin	10yr			100yr		
	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Maxi Water Level (mAHD)	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Maxi Water Level (mAHD)
NW1	0.71	0.27	26.952	0.80	0.31	26.955
NW2	0.89	0.26	24.500	1.17	0.26	24.500
NW3	0.42	0.27	28.000	0.73	0.27	28.000
NW4	0.49	0.26	25.500	0.47	0.26	25.500
NW5	0.40	0.40	23.284	0.60	0.58	23.324
Horse Shoe	1.23	0.10	35.320	1.85	0.10	35.437
NW6	3.33	1.85	19.000	4.25	2.10	19.000
N10	2.90	2.73	17.552	3.95	3.84	17.571

ANNEXURES



A'TA/1995)
NDMP
App 3.

Table 4: Northwest Creek: Detention Basin Data

Basin Number	Local Catchment area (ha)	Cumulative area (ha)	Basin area (ha)	Ground Level (mAHD)
N1	40	40	0.4	36.0
N2	13	53	1.2	35.0
N3	24	24	1.0	35.0
N4	34	58	0.2	27.5
N5	2	60	0.4	25.5
N6	9	9	0.8	27.5
N8	64	64	0.1	23.5
N9	38	224	2.4	21.0

Table 5: Northwest Creek: Detention Basin Outlet Arrangements

Basin number	Spillway level (mAHD)	Spillway width (m)	Number of piped culverts	Culvert invert level (mAHD)	Culvert diameter (m)
N1	36.30	3	-	-	-
N2	35.30	4	-	-	-
N3	34.50	3	-	-	-
N4	27.50	*	2	26.00	0.5
N5	25.50	*	3	24.00	0.5
N6	25.50	*	1	25.00	0.5
N8	24.00	3	-	-	-
N9	22.50	*	2	20.00	0.5

Table 6: Northwest Creek : Detention Basin Flood Parameters

Basin number	10 yr ARI			100 yr ARI			
	Peak inflow (m3/s)	Peak outflow (m3/s)	Max water level (mAHD)	Compensating volume (m3)	Peak inflow (m3/s)	Peak outflow (m3/s)	Max water level (mAHD)
N1	1.9	1.0	36.6	1500	2.9	1.8	36.8
N2	1.2	0.8	35.5	3500	2.8	1.3	35.6
N3	0.6	0.3	34.7	2500	1.3	0.5	34.7
N4	0.9	0.8	26.8	2000	2.0	1.3	27.4
N5	0.9	0.8	24.6	3000	1.3	1.1	24.8
N6	0.1	0.1	25.2	2000	0.3	0.1	25.3
N8	1.7	1.4	24.4	500	2.7	2.4	24.6
N9	2.5	1.4	21.5	26000	4.2	1.9	22.2

Table 10 : Pre-development Peak Flows Estimated with the Rational Method

Catchment	Catchment Area (ha)	Time of Concentration (hrs)	10 yr ARI			100 yr ARI		
			Runoff Coefficient	Rainfall Intensity (mm/hr)	Peak Outflow (m3/s)	Runoff Coefficient	Rainfall Intensity (mm/hr)	Peak Outflow (m3/s)
Aviary Creek to A3	134	2	0.2	18.2	1.4	0.3	28.8	3.2
Northwest Creek to N9	224	3	0.2	13.9	1.7	0.3	21.8	4.1
Gnangara Creek to G2	97	2	0.2	18.2	1.0	0.3	28.8	2.3

Appendix B

Nutrient Input Modelling

NiDSS Modelling- Current Landuse

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**11,115**
Reduction due to WSUD (kg/yr)	**0**
Percentage Overall Reduction	**0.0%**
Pecentage Development Reduction	**0.0%**
Cost of Selected Program ($/kg/yr)	**$0**

○ Total Phosphorus

◉ Total Nitrogen

Catchment Name Egerton DP2
Option Description Current Landuse
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	0.0%	lower density residential areas (excludes road reserve area)
Residential : ~R35	0.0%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	0.0%	maintainance of verge by landowners
Road Reserves : Major	0.0%	maintainance of verge by local authority
POS : Active	0.0%	ovals, grassed areas
POS : Passive / Basins	35.0%	native vegetation, airstrip, unfertilised areas
Rural : Pasture	65.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	0.0%	town centre etc

Total Residential	**0.0%**
Total Area	**100.0%**

Nutrient Input Without WSUD

Residential	Garden	0.00	kg/net ha/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Lawn	0.00		0.00		0		0.0%
	Pet Waste	0.00		0.00		0		0.0%
	Car Wash	0.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
POS	Garden/Lawn	73.40	kg/ha POS/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Pet Waste	0.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Road	Major Roads	29.36	kg/ha RR/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
Reserve	Minor Roads	132.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Rural	Pasture	60.00	kg/ha Rural/yr	39.00	kg/gross ha/yr	11,115	kg/yr	100.0%
	Poultry Farms	175.00		0.00		0		0.0%
	Residential (R2.5/R5)	15.20		0.00		0		0.0%
	Sub Total			39.00		11,115		100.0%
			Total	**39.00**	kg/gross ha/yr	**11,115**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☐ Native Gardens (Lots - Garden) ☐ Native Gardens (Lots - Lawn) ☐ Native Gardens (POS) ☐ Street Sweeping
☐ Community Education : Fertiliser ☐ Community Education : Pet Waste ☐ Community Education : Car Wash

Education Effectiveness 0%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (POS)	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Fertiliser	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	0%	0.00	0	0.0%	$0	$0	$0.0
Totals		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☐ Gross Pollutant Trap ☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	0%	0.00	0	0.0%	$0	$0	$0.0
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	0.00	0	0.0%
Nutrient Input : Rural Area	39.00	11,115	100.0%

	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	$0	$0	$0.0
Removal via In-Transit Control	$0	$0	$0.0
Total Removal	$0	$0	$0.0

Net Nutrient Input	**39.00**	**11,115**	**100.0%**

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type (1,2)	2	TN	0%	% of total residential area as ~R15
Ave lots/net ha		0.0	0%	% of total residential Area as ~R35
Discount Rate	6%			

Community Education Information

"Who Cares About the Environment ?" (NSW EPA, 2000) Survey
17% stated environment one of two most important issues for govt to address
Of these 27% stated water as most important environmental issue
17% stated education most important issue to protect environment
Impact assumed to reduce fertiliser applications to minimum rates

Fertiliser Application Information/Assumptions

Lots assumed fertilised by property owner
Minor Road Reserves fertilised by property owner (verge assumed 40% road reserve)
Major Road Reserves fertilised by local authority (verge assumed 40% road reserve)
Active POS fertilised by local authority
Passive POS not fertilised
Rural Land Use and Poultry Farms have no reductions due to WSUD applied

Pet Waste

Data Source

Pets per lot and disposal via JDA Survey (2001)
TP & TN application via Gerritse at al (1991)
Cost Estimate via JDA. Distribution cost and frequency is for brochure, bag cost is for POS's

Application Rates

	TN (kg/yr)	TP (kg/yr)	TN or TP specified	Survey Results Pets Per Lot R15	Survey Results Pets Per Lot R35	R zoning specified
Cats	0.90	0.20	0.90	0.24	**0.16**	0.00
Sml Dogs	2.75	0.70	2.75	**0.12**	**0.16**	0.00
Med Dogs	5.50	1.40	5.50	**0.16**	**0.08**	0.00
Lge Dogs	8.25	2.10	8.25	**0.19**	0.00	0.00

Waste Disposal

	R15	R35	R zoning specified
Lot	35%	0%	0%
POS	6%	**12%**	0%
Bins	59%	88%	0%

Cost Data

Distribution	$1.00	per house
Frequency	2	years
Bag Costs	$2.50	per 100 bags

Cost Calculation

Total Residential Area	-	ha
Total Number of Lots	-	
Area to Apply	-	ha
Number of Lots to Apply	-	
Number of Dogs	-	
Disposing in POS	-	
POS bags per year	-	
Cost of bags per year	$0	
Cost of mailout per year	$0	
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Car Wash

Data Source

Frequency based on JDA Survey (2001)
TN/TP based on Polyglaze Autowash data via CRC for Freshwater Ecology (Canberra)
Cost Estimate via JDA. Distribution cost and frequency is for brochure

Application Rates & Washing Frequency

Car wash detergent TN kg/wash	Car wash detergent TP kg/wash	TN or TP specified	Washing Frequency (one car every x weeks) R15	Washing Frequency (one car every x weeks) R35	R zoning specified
0.00009	0.00033	0.00009	2	**4.5**	0.00

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	-	
Cost of mailout	$0	per year
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Lot Fertiliser

Data Source

Mean Fertiliser Applications via JDA survey (2001)
% garden and lawns estimated via Aerial photography JDA(2001) for various suburbs with similar zonings
Minimum Fertiliser Applications via product recommended application data

Application Rates

	Fertiliser mean application kg TN/sqm/yr	Fertiliser mean application kg TP/sqm/yr	TN or TP specified
Garden	**0.059**	**0.027**	0.05900
Lawn	**0.033**	**0.005**	0.03300

	Fertiliser min application kg TN/sqm/yr	Fertiliser min application kg TP/sqm/yr	TN or TP specified
Garden	0.010	0.003	0.01000
Lawn	0.009	0.001	0.00900

	Education Campaign Fertiliser Reduction kg TN/sqm/yr	Education Campaign Fertiliser Reduction kg TP/sqm/yr	TN or TP specified	% redn
Garden	0.049	0.024	0.04900	83%
Lawn	0.024	0.004	0.02400	73%

Garden and Lawn Areas

	R15	R35	R zoning specified
% garden	0.11	0.03	0.00
% lawn	0.28	0.07	0.00

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	-	
Cost of mailout	$0	per year
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

POS Fertiliser

Data Source

Application rates based on City of Armadale application to active POS areas in years 1996-2000

Application Rates

	Fertiliser mean application kg TN/ha POS/yr	Fertiliser mean application kg TP/ha POS/yr	TN or TP specified
POS	73.4	2.6	73.40

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Rural Land Use Fertiliser

Data Source

Estimates via Gerritse et al (1992) for pasture

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha Rural/yr	kg TP/ha Rural/yr	specified
Rural	60	20	60.00

Poultry Farms

Data Source

Estimates via Gerritse (et al) 1992
Based on 14000 hens on 42 ha property

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha farm/yr	kg TP/ha farm/yr	specified
Poultry	175	75	175.00

Street Sweeping

Data Source

Street Sweeping Revisited - Nutrients and Metals in Particle Size Fractions of Road Sediment
from two major roads in Perth (Davies & Pierce 1999), Water 99 Joint Congress Brisbane
Cost based on Davies & Pierce (1998), $55/km

Estimated Removal Rate
(assumes no WSUD upstream)

	Potential Reduction (kg/gross ha/yr)		TN or TP	reduction due to upstream
	TN	TP	specified	WSUD
Sweeping	0.75	0.35	0.75	0%

Cost Data

Cost	$55.00	$/km
Frequency	6	times per year

Cost Calculation

Cost	$0	$/gross ha/yr
Area to Apply	0.0	ha
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Note : Street sweeping applied to developed areas only - not existing rural land use areas not to be developed

In-Transit Controls - Stormwater Nutrient Load

Data Source

Nutrients in Perth Urban Surface Drainage Catchments Characterised by Applicable Attributes, Tan (1991)

Data Used to Calculate Nutrients in Stormwater Available for Removal by In-Transit Controls
Removal quantities are for no WSUD and are reduced in calcs based on upstream measures used

Estimated Stormwater Nutrient Load
(assumes no WSUD upstream)

			TN or TP
			specified
Typical Phosphorus Stormwater Load (Perth Urban Areas)	0.40	kg/gross ha/yr	
Typical Nitrogen Stormwater Load (Perth Urban Areas)	2.53	kg/gross ha/yr	2.53

Gross Pollutant Trap

Data Source

Approximate average retention value via JDA(2001) - GeoTrap Laboratory Test Report
Based on GeoTrap, Humesceptor, Downstream Defender, CDS
Cost of GPT's via CRC report 98/3 (Allison, Chiew and McMahon) April 1998

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
GPT	35%	50%	35%

Cost Data

Capital Cost	$1,880	per ha
Maintenance	$72	per ha/year

Cost Calculation

Area to Apply	0.0	ha
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Note : GPT's applied to developed areas only - not existing rural land use areas not to be developed

Water Pollution Control Pond

Data Source

TP removal efficiency and cost via Henley Brook Drive WPCP Conceptual Design (JDA,1997)
TN efficiency via Managing Urban Stormwater Treatment Techniques (NSW EPA 1997)

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
WPCP	35%	50%	35%

Cost Data

Capital Cost	$1,800,000	
Maintenance	$25,000	per year
Removal	34	kg TP/year

Cost Calculation

Cost per kg	$884	per kg
Removal	0.0	kg/year
Capital Cost	$0	
Operating	$0	
Total PV Cost	$0	

Note : WPCP's applied to developed areas only - not existing rural land use areas not to be developed

NiDSS Nutrient Removal Calculator

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type Total Nitrogen

Catchment Summary of Nutrient Removal due to Source Controls

Without WSUD 0.00 kg/gross ha/yr via developed area
11115 kg/yr

Component	Checkbox Result	% Area to Apply Removal to	Level before Removal	Potential Removal	Adopted Removal (kg/gross ha/yr)
Native Gardens (Lots-Garden)	FALSE	0%	0.00	0.00	0.00
Native Gardens (Lots-Lawn)	FALSE	0%	0.00	0.00	0.00
Native Gardens (POS)	FALSE	0%	0.00	0.00	0.00
Education Campaign - Fertiliser	FALSE	0%	0.00	0.00	0.00
Education Campaign - Pet Waste	FALSE	0%	0.00	0.00	0.00
Education Campaign - Car Wash	FALSE	0%	0.00	0.00	0.00
Street Sweeping	FALSE	0%	0.00	0.00	0.00
Gross Pollutant Traps	FALSE	0%	0.00	0.89	0.00
Water Pollution Control Pond	FALSE	0%	0.00	0.89	0.00

Education Campaign Fertiliser Reduction

	Fertiliser Applied No WSUD kg/gross ha/yr	Removed due to Native Gardens kg/gross ha/yr	Available for further reduction	% applied reduction to min level	education campaign effectiveness	reduction kg/gross ha/yr
Garden	0.00	0.00	0.00	83%	0%	0.00
Lawn	0.00	0.00	0.00	73%	0%	0.00
Road Reserve Minor	0.00	0.00	0.00	73%	0%	0.00
					Total	0.00

Nutrient Removal via In-Transit Controls

Stormwater Load Available for Removal (ie no WSUD) 2.530 kg/gross ha/yr

	reduction due to WSUD upstream	adjusted rate to use
Gross Pollutant Traps	0.00%	2.530
Water Pollution Control Pond	0.00%	2.530

NiDSS : WSUD Option Summary

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Catchment Name Egerton DP2

Catchment Area 285 ha

Total Phosphorus Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	45	5,882	5,927	0	5,927	17.1	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	5,843	288	6,131	0	6,131	17.7	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	5,843	288	6,131	2,864	3,267	9.4	46.7%	49.0%	$72.5

Total Nitrogen Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	1,270	17,646	18,916	0	18,916	54.7	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	27,258	1,093	28,351	0	28,351	81.9	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	27,258	1,093	28,351	11,709	16,642	48.1	41.3%	43.0%	$19.1

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	3,705
Reduction due to WSUD (kg/yr)	0
Percentage Overall Reduction	0.0%
Pecentage Development Reduction	0.0%
Cost of Selected Program ($/kg/yr)	$0

(•) Total Phosphorus
( ) Total Nitrogen

Catchment Name Egerton DP2
Option Description Current Landuse
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	0.0%	lower density residential areas (excludes road reserve area)
Residential : ~R35	0.0%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	0.0%	maintainance of verge by landowners
Road Reserves : Major	0.0%	maintainance of verge by local authority
POS : Active	0.0%	ovals, grassed areas
POS : Passive / Basins	35.0%	native vegetation, airstrip, unfertilised areas
Rural : Pasture	65.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	0.0%	town centre etc

Total Residential	0.0%
Total Area	100.0%

Nutrient Input Without WSUD

Residential	Garden	0.00	kg/net ha/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Lawn	0.00		0.00		0		0.0%
	Pet Waste	0.00		0.00		0		0.0%
	Car Wash	0.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
POS	Garden/Lawn	2.60	kg/ha POS/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Pet Waste	0.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Road	Major Roads	1.04	kg/ha RR/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
Reserve	Minor Roads	20.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
Rural	Pasture	20.00	kg/ha Rural/yr	13.00	kg/gross ha/yr	3,705	kg/yr	100.0%
	Poultry Farms	75.00		0.00		0		0.0%
	Residential (R2.5/R5)	4.00		0.00		0		0.0%
	Sub Total			13.00		3,705		100.0%
			Total	**13.00**	kg/gross ha/yr	**3,705**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☐ Native Gardens (Lots - Garden) ☐ Native Gardens (Lots - Lawn) ☐ Native Gardens (POS) ☐ Street Sweeping
☐ Community Education : Fertiliser ☐ Community Education : Pet Waste ☐ Community Education : Car Wash

Education Effectiveness 0%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (POS)	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Fertiliser	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	0%	0.00	0	0.0%	$0	$0	$0.0
Totals		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☐ Gross Pollutant Trap ☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	0%	0.00	0	0.0%	$0	$0	$0.0
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	0.00	0	0.0%
Nutrient Input : Rural Area	13.00	3,705	100.0%

	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	$0	$0	$0.0
Removal via In-Transit Control	$0	$0	$0.0
Total Removal	$0	$0	$0.0

Net Nutrient Input	**13.00**	**3,705**	**100.0%**

NiDSS Modelling- DP2 with no WSUD

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**15,744**
Reduction due to WSUD (kg/yr)	**0**
Percentage Overall Reduction	**0.0%**
Pecentage Development Reduction	**0.0%**
Cost of Selected Program ($/kg/yr)	**$0**

○ Total Phosphorus

◉ Total Nitrogen

Catchment Name Egerton DP2
Option Description Residential Development
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	6.9%	lower density residential areas (excludes road reserve area)
Residential : ~R35	53.6%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	9.4%	maintainance of verge by landowners
Road Reserves : Major	5.0%	maintainance of verge by local authority
POS : Active	6.6%	ovals, grassed areas
POS : Passive / Basins	16.8%	native vegetation, airstrip, unfertilised areas
Rural : Pasture	0.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	1.8%	town centre etc

Total Residential **60.5%**
Total Area **100.0%**

Nutrient Input Without WSUD

Residential	Garden	23.08	kg/net ha/yr	13.97	kg/gross ha/yr	3,980	kg/yr	25.3%
	Lawn	31.00		18.76		5,346		34.0%
	Pet Waste	1.63		0.99		281		1.8%
	Car Wash	0.04		0.02		6		0.0%
	Sub Total			33.73		9,613		61.1%
POS	Garden/Lawn	73.40	kg/ha POS/yr	4.84	kg/gross ha/yr	1,379	kg/yr	8.8%
	Pet Waste	42.44		2.80		797		5.1%
	Sub Total			7.63		2,176		13.8%
Road	Major Roads	29.36	kg/ha RR/yr	1.47	kg/gross ha/yr	418	kg/yr	2.7%
Reserve	Minor Roads	132.00		12.41		3,536		22.5%
	Sub Total			13.88		3,955		25.1%
Rural	Pasture	60.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	175.00		0.00		0		0.0%
	Residential (R2.5/R5)	15.20		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**55.24**	kg/gross ha/yr	**15,744**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☐ Native Gardens (Lots - Garden) ☐ Native Gardens (Lots - Lawn) ☐ Native Gardens (POS) ☐ Street Sweeping
☐ Community Education : Fertiliser ☐ Community Education : Pet Waste ☐ Community Education : Car Wash

Education Effectiveness 0%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (POS)	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Fertiliser	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	0%	0.00	0	0.0%	$0	$0	$0.0
Totals		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☐ Gross Pollutant Trap ☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	0%	0.00	0	0.0%	$0	$0	$0.0
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	55.24	15,744	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	$0	$0	$0.0
Removal via In-Transit Control	$0	$0	$0.0
Total Removal	$0	$0	$0.0

Net Nutrient Input	**55.24**	**15,744**	**100.0%**

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type (1,2)	2	TN	11%	% of total residential area as ~R15
Ave lots/net ha		32.7	89%	% of total residential Area as ~R35
Discount Rate	6%			

Community Education Information

"Who Cares About the Environment ?" (NSW EPA, 2000) Survey
17% stated environment one of two most important issues for govt to address
Of these 27% stated water as most important environmental issue
17% stated education most important issue to protect environment
Impact assumed to reduce fertiliser applications to minimum rates

Fertiliser Application Information/Assumptions

Lots assumed fertilised by property owner
Minor Road Reserves fertilised by property owner (verge assumed 40% road reserve)
Major Road Reserves fertilised by local authority (verge assumed 40% road reserve)
Active POS fertilised by local authority
Passive POS not fertilised
Rural Land Use and Poultry Farms have no reductions due to WSUD applied

Pet Waste

Data Source

Pets per lot and disposal via JDA Survey (2001)
TP & TN application via Gerritse at al (1991)
Cost Estimate via JDA. Distribution cost and frequency is for brochure, bag cost is for POS's

Application Rates

	TN (kg/yr)	TP (kg/yr)	TN or TP specified	Survey Results Pets Per Lot R15	Survey Results Pets Per Lot R35	R zoning specified
Cats	0.90	0.20	0.90	0.24	**0.16**	0.17
Sml Dogs	2.75	0.70	2.75	**0.12**	**0.16**	0.16
Med Dogs	5.50	1.40	5.50	**0.16**	**0.08**	0.09
Lge Dogs	8.25	2.10	8.25	**0.19**	0.00	0.02

Waste Disposal

	R15	R35	R zoning specified
Lot	35%	0%	4%
POS	6%	**12%**	11%
Bins	59%	88%	85%

Cost Data

Distribution	$1.00	per house
Frequency	2	years
Bag Costs	$2.50	per 100 bags

Cost Calculation

Total Residential Area	172	ha
Total Number of Lots	5,642	
Area to Apply	-	ha
Number of Lots to Apply	-	
Number of Dogs	-	
Disposing in POS	-	
POS bags per year	-	
Cost of bags per year	$0	
Cost of mailout per year	$0	
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Car Wash

Data Source

Frequency based on JDA Survey (2001)
TN/TP based on Polyglaze Autowash data via CRC for Freshwater Ecology (Canberra)
Cost Estimate via JDA. Distribution cost and frequency is for brochure

Application Rates & Washing Frequency

Car wash detergent TN kg/wash	Car wash detergent TP kg/wash	TN or TP specified	Washing Frequency (one car every x weeks) R15	Washing Frequency (one car every x weeks) R35	R zoning specified
0.00009	0.00033	0.00009	2	**4.5**	4.21

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	-	
Cost of mailout	$0	per year
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Lot Fertiliser

Data Source

Mean Fertiliser Applications via JDA survey (2001)
% garden and lawns estimated via Aerial photography JDA(2001) for various suburbs with similar zonings
Minimum Fertiliser Applications via product recommended application data

Application Rates

	Fertiliser mean application kg TN/sqm/yr	Fertiliser mean application kg TP/sqm/yr	TN or TP specified
Garden	**0.059**	**0.027**	0.05900
Lawn	**0.033**	**0.005**	0.03300

	Fertiliser min application kg TN/sqm/yr	Fertiliser min application kg TP/sqm/yr	TN or TP specified
Garden	0.010	0.003	0.01000
Lawn	0.009	0.001	0.00900

	Education Campaign Fertiliser Reduction kg TN/sqm/yr	Education Campaign Fertiliser Reduction kg TP/sqm/yr	TN or TP specified	% redn
Garden	0.049	0.024	0.04900	83%
Lawn	0.024	0.004	0.02400	73%

Garden and Lawn Areas

	R15	R35	R zoning specified
% garden	0.11	0.03	0.04
% lawn	0.28	0.07	0.09

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	-	
Cost of mailout	$0	per year
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

POS Fertiliser

Data Source

Application rates based on City of Armadale application to active POS areas in years 1996-2000

Application Rates

	Fertiliser mean application kg TN/ha POS/yr	Fertiliser mean application kg TP/ha POS/yr	TN or TP specified
POS	73.4	2.6	73.40

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Rural Land Use Fertiliser

Data Source

Estimates via Gerritse et al (1992) for pasture

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha Rural/yr	kg TP/ha Rural/yr	specified
Rural	60	20	60.00

Poultry Farms

Data Source

Estimates via Gerritse (et al) 1992
Based on 14000 hens on 42 ha property

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha farm/yr	kg TP/ha farm/yr	specified
Poultry	175	75	175.00

Street Sweeping

Data Source

Street Sweeping Revisited - Nutrients and Metals in Particle Size Fractions of Road Sediment
from two major roads in Perth (Davies & Pierce 1999), Water 99 Joint Congress Brisbane
Cost based on Davies & Pierce (1998), $55/km

Estimated Removal Rate
(assumes no WSUD upstream)

	Potential Reduction (kg/gross ha/yr)		TN or TP	reduction due to upstream
	TN	TP	specified	WSUD
Sweeping	0.75	0.35	0.75	0%

Cost Data

Cost	$55.00	$/km
Frequency	6	times per year

Cost Calculation

Cost	$60	$/gross ha/yr
Area to Apply	0.0	ha
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Note : Street sweeping applied to developed areas only - not existing rural land use areas not to be developed

In-Transit Controls - Stormwater Nutrient Load

Data Source

Nutrients in Perth Urban Surface Drainage Catchments Characterised by Applicable Attributes, Tan (1991)

Data Used to Calculate Nutrients in Stormwater Available for Removal by In-Transit Controls
Removal quantities are for no WSUD and are reduced in calcs based on upstream measures used

Estimated Stormwater Nutrient Load
(assumes no WSUD upstream)

			TN or TP
			specified
Typical Phosphorus Stormwater Load (Perth Urban Areas)	0.40	kg/gross ha/yr	
Typical Nitrogen Stormwater Load (Perth Urban Areas)	2.53	kg/gross ha/yr	2.53

Gross Pollutant Trap

Data Source

Approximate average retention value via JDA(2001) - GeoTrap Laboratory Test Report
Based on GeoTrap, Humesceptor, Downstream Defender, CDS
Cost of GPT's via CRC report 98/3 (Allison, Chiew and McMahon) April 1998

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
GPT	35%	50%	35%

Cost Data

Capital Cost	$1,880	per ha
Maintenance	$72	per ha/year

Cost Calculation

Area to Apply	0.0	ha
Total PV Cost	$0	
Removal	0.0	kg/year
Cost per kg	$0	

Note : GPT's applied to developed areas only - not existing rural land use areas not to be developed

Water Pollution Control Pond

Data Source

TP removal efficiency and cost via Henley Brook Drive WPCP Conceptual Design (JDA,1997)
TN efficiency via Managing Urban Stormwater Treatment Techniques (NSW EPA 1997)

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
WPCP	35%	50%	35%

Cost Data

Capital Cost	$1,800,000	
Maintenance	$25,000	per year
Removal	34	kg TP/year

Cost Calculation

Cost per kg	$884	per kg
Removal	0.0	kg/year
Capital Cost	$0	
Operating	$0	
Total PV Cost	$0	

Note : WPCP's applied to developed areas only - not existing rural land use areas not to be developed

NiDSS Nutrient Removal Calculator

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type Total Nitrogen

Catchment Summary of Nutrient Removal due to Source Controls

Without WSUD 55.24 kg/gross ha/yr via developed area
15744 kg/yr

Component	Checkbox Result	% Area to Apply Removal to	Level before Removal	Potential Removal	Adopted Removal (kg/gross ha/yr)
Native Gardens (Lots-Garden)	FALSE	0%	55.24	13.97	0.00
Native Gardens (Lots-Lawn)	FALSE	0%	55.24	18.76	0.00
Native Gardens (POS)	FALSE	0%	55.24	4.84	0.00
Education Campaign - Fertiliser	FALSE	0%	55.24	0.00	0.00
Education Campaign - Pet Waste	FALSE	0%	55.24	0.00	0.00
Education Campaign - Car Wash	FALSE	0%	55.24	0.00	0.00
Street Sweeping	FALSE	0%	55.24	0.75	0.00
Gross Pollutant Traps	FALSE	0%	55.24	0.89	0.00
Water Pollution Control Pond	FALSE	0%	55.24	0.89	0.00

Education Campaign Fertiliser Reduction

	Fertiliser Applied No WSUD kg/gross ha/yr	Removed due to Native Gardens kg/gross ha/yr	Available for further reduction	% applied reduction to min level	education campaign effectiveness	reduction kg/gross ha/yr
Garden	13.97	0.00	13.97	83%	0%	0.00
Lawn	18.76	0.00	18.76	73%	0%	0.00
Road Reserve Minor	12.41	0.00	12.41	73%	0%	0.00
					Total	0.00

Nutrient Removal via In-Transit Controls

Stormwater Load Available for Removal (ie no WSUD) 2.530 kg/gross ha/yr

	reduction due to WSUD upstream	adjusted rate to use
Gross Pollutant Traps	0.00%	2.530
Water Pollution Control Pond	0.00%	2.530

NiDSS : WSUD Option Summary

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Catchment Name Egerton DP2

Catchment Area 285 ha

Total Phosphorus Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	45	5,882	5,927	0	5,927	17.1	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	5,843	288	6,131	0	6,131	17.7	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	5,843	288	6,131	2,864	3,267	9.4	46.7%	49.0%	$72.5

Total Nitrogen Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	1,270	17,646	18,916	0	18,916	54.7	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	27,258	1,093	28,351	0	28,351	81.9	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	27,258	1,093	28,351	11,709	16,642	48.1	41.3%	43.0%	$19.1

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**3,524**
Reduction due to WSUD (kg/yr)	**0**
Percentage Overall Reduction	**0.0%**
Pecentage Development Reduction	**0.0%**
Cost of Selected Program ($/kg/yr)	**$0**

(●) Total Phosphorus
( ) Total Nitrogen

Catchment Name	Egerton DP2	
Option Description	Residential Development	
Catchment Area	285	ha

Land Use Breakdown

Residential : ~R15	6.9%	lower density residential areas (excludes road reserve area)		
Residential : ~R35	53.6%	higher density residential areas (excludes road reserve area)		
Road Reserves : Minor	9.4%	maintainance of verge by landowners		
Road Reserves : Major	5.0%	maintainance of verge by local authority		
POS : Active	6.6%	ovals, grassed areas		
POS : Passive / Basins	16.8%	native vegetation, airstrip, unfertilised areas		
Rural : Pasture	0.0%	general pasture		
Rural : Residential ~R2.5/R5	0.0%	low density	Total Residential	**60.5%**
Rural : Poultry	0.0%	specific high nutient input land use	Total Area	**100.0%**
Commercial/Industrial	1.8%	town centre etc		

Nutrient Input Without WSUD

Residential	Garden	10.56	kg/net ha/yr	6.39	kg/gross ha/yr	1,821	kg/yr	51.7%
	Lawn	4.70		2.84		810		23.0%
	Pet Waste	0.41		0.25		70		2.0%
	Car Wash	0.13		0.08		23		0.7%
	Sub Total			9.56		2,725		77.3%
POS	Garden/Lawn	2.60	kg/ha POS/yr	0.17	kg/gross ha/yr	49	kg/yr	1.4%
	Pet Waste	10.64		0.70		200		5.7%
	Sub Total			0.87		249		7.1%
Road	Major Roads	1.04	kg/ha RR/yr	0.05	kg/gross ha/yr	15	kg/yr	0.4%
Reserve	Minor Roads	20.00		1.88		536		15.2%
	Sub Total			1.93		551		15.6%
Rural	Pasture	20.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	75.00		0.00		0		0.0%
	Residential (R2.5/R5)	4.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
			Total	**12.36**	kg/gross ha/yr	**3,524**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☐ Native Gardens (Lots - Garden) ☐ Native Gardens (Lots - Lawn) ☐ Native Gardens (POS) ☐ Street Sweeping
☐ Community Education : Fertiliser ☐ Community Education : Pet Waste ☐ Community Education : Car Wash

Education Effectiveness 0%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	0%	0.00	0	0.0%	$0	$0	$0.0
Native Gardens (POS)	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Fertiliser	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Pet Waste	0%	0.00	0	0.0%	$0	$0	$0.0
Community Education : Car Wash	0%	0.00	0	0.0%	$0	$0	$0.0
Street Sweeping	0%	0.00	0	0.0%	$0	$0	$0.0
Totals		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☐ Gross Pollutant Trap ☐ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	0%	0.00	0	0.0%	$0	$0	$0.0
Water Pollution Control Ponds	0%	0.00	0	0.0%	$0	$0	$0.0
Total		**0.00**	**0**	**0.0%**	**$0**	**$0**	**$0.0**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	12.36	3,524	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	$0	$0	$0.0
Removal via In-Transit Control	$0	$0	$0.0
Total Removal	$0	$0	$0.0

Net Nutrient Input	**12.36**	**3,524**	**100.0%**

NiDSS Modelling- DP2 with WSUD
Scenario 1

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**15,744**
Reduction due to WSUD (kg/yr)	**6,151**
Percentage Overall Reduction	**39.1%**
Pecentage Development Reduction	**39.1%**
Cost of Selected Program ($/kg/yr)	**$35**

○ Total Phosphorus

◉ Total Nitrogen

Catchment Name Egerton DP2
Option Description Residential Development
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	6.9%	lower density residential areas (excludes road reserve area)		
Residential : ~R35	53.6%	higher density residential areas (excludes road reserve area)		
Road Reserves : Minor	9.4%	maintainance of verge by landowners		
Road Reserves : Major	5.0%	maintainance of verge by local authority		
POS : Active	6.6%	ovals, grassed areas		
POS : Passive / Basins	16.8%	native vegetation, airstrip, unfertilised areas		
Rural : Pasture	0.0%	general pasture		
Rural : Residential ~R2.5/R5	0.0%	low density	Total Residential	**60.5%**
Rural : Poultry	0.0%	specific high nutient input land use	Total Area	**100.0%**
Commercial/Industrial	1.8%	town centre etc		

Nutrient Input Without WSUD

Residential	Garden	23.08	kg/net ha/yr	13.97	kg/gross ha/yr	3,980	kg/yr	25.3%
	Lawn	31.00		18.76		5,346		34.0%
	Pet Waste	1.63		0.99		281		1.8%
	Car Wash	0.04		0.02		6		0.0%
	Sub Total			33.73		9,613		61.1%
POS	Garden/Lawn	73.40	kg/ha POS/yr	4.84	kg/gross ha/yr	1,379	kg/yr	8.8%
	Pet Waste	42.44		2.80		797		5.1%
	Sub Total			7.63		2,176		13.8%
Road	Major Roads	29.36	kg/ha RR/yr	1.47	kg/gross ha/yr	418	kg/yr	2.7%
Reserve	Minor Roads	132.00		12.41		3,536		22.5%
	Sub Total			13.88		3,955		25.1%
Rural	Pasture	60.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	175.00		0.00		0		0.0%
	Residential (R2.5/R5)	15.20		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**55.24**	kg/gross ha/yr	**15,744**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☑ Native Gardens (Lots - Garden) ☑ Native Gardens (Lots - Lawn) ☑ Native Gardens (POS) ☑ Street Sweeping
☑ Community Education : Fertiliser ☑ Community Education : Pet Waste ☑ Community Education : Car Wash

Education Effectiveness 25%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	40%	5.59	1,592	10.1%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	30%	5.63	1,604	10.2%	$0	$0	$0.0
Native Gardens (POS)	30%	1.45	414	2.6%	$0	$0	$0.0
Community Education : Fertiliser	100%	6.38	1,819	11.6%	$0	$2,821	$1.6
Community Education : Pet Waste	100%	0.95	270	1.7%	$0	$3,984	$14.8
Community Education : Car Wash	100%	0.01	2	0.0%	$0	$2,821	$1,801.2
Street Sweeping	100%	0.48	136	0.9%	$0	$16,929	$124.1
Totals		**20.48**	**5,836**	**37.1%**	**$0**	**$26,555**	**$4.6**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☑ Gross Pollutant Trap ☑ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	100%	0.56	159	1.0%	$526,638	$20,169	$326.0
Water Pollution Control Ponds	100%	0.55	156	1.0%	$1,868,592	$25,953	$883.5
Total		**1.11**	**315**	**2.0%**	**$2,395,229**	**$46,122**	**$602.5**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	55.24	15,744	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	$0	$26,555	$4.6
Removal via In-Transit Control	$2,395,229	$46,122	$602.5
Total Removal	$2,395,229	$72,676	$35.2

Net Nutrient Input	**33.66**	**9,593**	**60.9%**

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type (1,2)	2	TN	11%	% of total residential area as ~R15
Ave lots/net ha		32.7	89%	% of total residential Area as ~R35
Discount Rate	6%			

Community Education Information

"Who Cares About the Environment ?" (NSW EPA, 2000) Survey
17% stated environment one of two most important issues for govt to address
Of these 27% stated water as most important environmental issue
17% stated education most important issue to protect environment
Impact assumed to reduce fertiliser applications to minimum rates

Fertiliser Application Information/Assumptions

Lots assumed fertilised by property owner
Minor Road Reserves fertilised by property owner (verge assumed 40% road reserve)
Major Road Reserves fertilised by local authority (verge assumed 40% road reserve)
Active POS fertilised by local authority
Passive POS not fertilised
Rural Land Use and Poultry Farms have no reductions due to WSUD applied

Pet Waste

Data Source

Pets per lot and disposal via JDA Survey (2001)
TP & TN application via Gerritse at al (1991)
Cost Estimate via JDA. Distribution cost and frequency is for brochure, bag cost is for POS's

Application Rates

	TN (kg/yr)	TP (kg/yr)	TN or TP specified	Survey Results Pets Per Lot R15	R35	R zoning specified
Cats	0.90	0.20	0.90	0.24	**0.16**	0.17
Sml Dogs	2.75	0.70	2.75	**0.12**	**0.16**	0.16
Med Dogs	5.50	1.40	5.50	**0.16**	**0.08**	0.09
Lge Dogs	8.25	2.10	8.25	**0.19**	0.00	0.02

Waste Disposal

	R15	R35	R zoning specified
Lot	35%	0%	4%
POS	6%	**12%**	11%
Bins	59%	88%	85%

Cost Data

Distribution	$1.00	per house
Frequency	2	years
Bag Costs	$2.50	per 100 bags

Cost Calculation

Total Residential Area	172	ha
Total Number of Lots	5,642	
Area to Apply	172	ha
Number of Lots to Apply	5,642	
Number of Dogs	1,502	
Disposing in POS	170	
POS bags per year	46,526	
Cost of bags per year	$1,163	
Cost of mailout per year	$2,821	
Total PV Cost	$66,399	
Removal	269.6	kg/year
Cost per kg	$15	

Car Wash

Data Source

Frequency based on JDA Survey (2001)
TN/TP based on Polyglaze Autowash data via CRC for Freshwater Ecology (Canberra)
Cost Estimate via JDA. Distribution cost and frequency is for brochure

Application Rates & Washing Frequency

Car wash detergent TN kg/wash	TP kg/wash	TN or TP specified	Washing Frequency (one car every x weeks) R15	R35	R zoning specified
0.00009	0.00033	0.00009	2	**4.5**	4.21

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	5,642	
Cost of mailout	$2,821	per year
Total PV Cost	$47,013	
Removal	1.6	kg/year
Cost per kg	$1,801	

Lot Fertiliser

Data Source

Mean Fertiliser Applications via JDA survey (2001)
% garden and lawns estimated via Aerial photography JDA(2001) for various suburbs with similar zonings
Minimum Fertiliser Applications via product recommended application data

Application Rates

	Fertiliser mean application kg TN/sqm/yr	kg TP/sqm/yr	TN or TP specified
Garden	**0.059**	**0.027**	0.05900
Lawn	**0.033**	**0.005**	0.03300

	Fertiliser min application kg TN/sqm/yr	kg TP/sqm/yr	TN or TP specified
Garden	0.010	0.003	0.01000
Lawn	0.009	0.001	0.00900

	Education Campaign Fertiliser Reduction kg TN/sqm/yr	kg TP/sqm/yr	TN or TP specified	% redn
Garden	0.049	0.024	0.04900	83%
Lawn	0.024	0.004	0.02400	73%

Garden and Lawn Areas

	R15	R35	R zoning specified
% garden	0.11	0.03	0.04
% lawn	0.28	0.07	0.09

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	5,642	
Cost of mailout	$2,821	per year
Total PV Cost	$47,013	
Removal	1819.2	kg/year
Cost per kg	$2	

POS Fertiliser

Data Source

Application rates based on City of Armadale application to active POS areas in years 1996-2000

Application Rates

	Fertiliser mean application kg TN/ha POS/yr	kg TP/ha POS/yr	TN or TP specified
POS	73.4	2.6	73.40

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Rural Land Use Fertiliser

Data Source

Estimates via Gerritse et al (1992) for pasture

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha Rural/yr	kg TP/ha Rural/yr	specified
Rural	60	20	60.00

Poultry Farms

Data Source

Estimates via Gerritse (et al) 1992
Based on 14000 hens on 42 ha property

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha farm/yr	kg TP/ha farm/yr	specified
Poultry	175	75	175.00

Street Sweeping

Data Source

Street Sweeping Revisited - Nutrients and Metals in Particle Size Fractions of Road Sediment
from two major roads in Perth (Davies & Pierce 1999), Water 99 Joint Congress Brisbane
Cost based on Davies & Pierce (1998), $55/km

Estimated Removal Rate
(assumes no WSUD upstream)

	Potential Reduction (kg/gross ha/yr)		TN or TP	reduction due to upstream
	TN	TP	specified	WSUD
Sweeping	0.75	0.35	0.75	36%

Cost Data

Cost	$55.00	$/km
Frequency	6	times per year

Cost Calculation

Cost	$60	$/gross ha/yr
Area to Apply	280.1	ha
Total PV Cost	$282,150	
Removal	136.4	kg/year
Cost per kg	$124	

Note : Street sweeping applied to developed areas only - not existing rural land use areas not to be developed

In-Transit Controls - Stormwater Nutrient Load

Data Source

Nutrients in Perth Urban Surface Drainage Catchments Characterised by Applicable Attributes, Tan (1991)

Data Used to Calculate Nutrients in Stormwater Available for Removal by In-Transit Controls
Removal quantities are for no WSUD and are reduced in calcs based on upstream measures used

Estimated Stormwater Nutrient Load
(assumes no WSUD upstream)

			TN or TP specified
Typical Phosphorus Stormwater Load (Perth Urban Areas)	0.40	kg/gross ha/yr	
Typical Nitrogen Stormwater Load (Perth Urban Areas)	2.53	kg/gross ha/yr	2.53

Gross Pollutant Trap

Data Source

Approximate average retention value via JDA(2001) - GeoTrap Laboratory Test Report
Based on GeoTrap, Humesceptor, Downstream Defender, CDS
Cost of GPT's via CRC report 98/3 (Allison, Chiew and McMahon) April 1998

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
GPT	35%	50%	35%

Cost Data

Capital Cost	$1,880	per ha
Maintenance	$72	per ha/year

Cost Calculation

Area to Apply	280.1	ha
Total PV Cost	$862,790	
Removal	158.8	kg/year
Cost per kg	$326	

Note : GPT's applied to developed areas only - not existing rural land use areas not to be developed

Water Pollution Control Pond

Data Source

TP removal efficiency and cost via Henley Brook Drive WPCP Conceptual Design (JDA,1997)
TN efficiency via Managing Urban Stormwater Treatment Techniques (NSW EPA 1997)

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
WPCP	35%	50%	35%

Cost Data

Capital Cost	$1,800,000	
Maintenance	$25,000	per year
Removal	34	kg TP/year

Cost Calculation

Cost per kg	$884	per kg
Removal	156.3	kg/year
Capital Cost	$1,868,592	
Operating	$25,953	
Total PV Cost	$2,301,136	

Note : WPCP's applied to developed areas only - not existing rural land use areas not to be developed

NiDSS Nutrient Removal Calculator

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type Total Nitrogen

Catchment Summary of Nutrient Removal due to Source Controls

Without WSUD 55.24 kg/gross ha/yr via developed area
15744 kg/yr

Component	Checkbox Result	% Area to Apply Removal to	Level before Removal	Potential Removal	Adopted Removal (kg/gross ha/yr)
Native Gardens (Lots-Garden)	TRUE	40%	55.24	13.97	5.59
Native Gardens (Lots-Lawn)	TRUE	30%	49.65	18.76	5.63
Native Gardens (POS)	TRUE	30%	44.03	4.84	1.45
Education Campaign - Fertiliser	TRUE	100%	42.58	6.38	6.38
Education Campaign - Pet Waste	TRUE	100%	36.19	0.95	0.95
Education Campaign - Car Wash	TRUE	100%	35.25	0.01	0.01
Street Sweeping	TRUE	100%	35.24	0.48	0.48
Gross Pollutant Traps	TRUE	100%	34.76	0.56	0.56
Water Pollution Control Pond	TRUE	100%	34.21	0.55	0.55

Education Campaign Fertiliser Reduction

	Fertiliser Applied No WSUD kg/gross ha/yr	Removed due to Native Gardens kg/gross ha/yr	Available for further reduction	% applied reduction to min level	education campaign effectiveness	reduction kg/gross ha/yr
Garden	13.97	5.59	8.38	83%	25%	1.74
Lawn	18.76	5.63	13.13	73%	25%	2.39
Road Reserve Minor	12.41	0.00	12.41	73%	25%	2.26
					Total	6.38

Nutrient Removal via In-Transit Controls

Stormwater Load Available for Removal (ie no WSUD) 2.530 kg/gross ha/yr

	reduction due to WSUD upstream	adjusted rate to use
Gross Pollutant Traps	37.07%	1.592
Water Pollution Control Pond	38.08%	1.567

NiDSS : WSUD Option Summary

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Catchment Name Egerton DP2

Catchment Area 285 ha

Total Phosphorus Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	45	5,882	5,927	0	5,927	17.1	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	5,843	288	6,131	0	6,131	17.7	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	5,843	288	6,131	2,864	3,267	9.4	46.7%	49.0%	$72.5

Total Nitrogen Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	1,270	17,646	18,916	0	18,916	54.7	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	27,258	1,093	28,351	0	28,351	81.9	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	27,258	1,093	28,351	11,709	16,642	48.1	41.3%	43.0%	$19.1

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**3,524**
Reduction due to WSUD (kg/yr)	**1,642**
Percentage Overall Reduction	**46.6%**
Pecentage Development Reduction	**46.6%**
Cost of Selected Program ($/kg/yr)	**$121**

(●) Total Phosphorus
( ) Total Nitrogen

Catchment Name Egerton DP2
Option Description Residential Development
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	6.9%	lower density residential areas (excludes road reserve area)		
Residential : ~R35	53.6%	higher density residential areas (excludes road reserve area)		
Road Reserves : Minor	9.4%	maintainance of verge by landowners		
Road Reserves : Major	5.0%	maintainance of verge by local authority		
POS : Active	6.6%	ovals, grassed areas		
POS : Passive / Basins	16.8%	native vegetation, airstrip, unfertilised areas		
Rural : Pasture	0.0%	general pasture		
Rural : Residential ~R2.5/R5	0.0%	low density	Total Residential	**60.5%**
Rural : Poultry	0.0%	specific high nutient input land use	Total Area	**100.0%**
Commercial/Industrial	1.8%	town centre etc		

Nutrient Input Without WSUD

Residential	Garden	10.56	kg/net ha/yr	6.39	kg/gross ha/yr	1,821	kg/yr	51.7%
	Lawn	4.70		2.84		810		23.0%
	Pet Waste	0.41		0.25		70		2.0%
	Car Wash	0.13		0.08		23		0.7%
	Sub Total			9.56		2,725		77.3%
POS	Garden/Lawn	2.60	kg/ha POS/yr	0.17	kg/gross ha/yr	49	kg/yr	1.4%
	Pet Waste	10.64		0.70		200		5.7%
	Sub Total			0.87		249		7.1%
Road	Major Roads	1.04	kg/ha RR/yr	0.05	kg/gross ha/yr	15	kg/yr	0.4%
Reserve	Minor Roads	20.00		1.88		536		15.2%
	Sub Total			1.93		551		15.6%
Rural	Pasture	20.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	75.00		0.00		0		0.0%
	Residential (R2.5/R5)	4.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**12.36**	kg/gross ha/yr	**3,524**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☑ Native Gardens (Lots - Garden) ☑ Native Gardens (Lots - Lawn) ☑ Native Gardens (POS) ☑ Street Sweeping
☑ Community Education : Fertiliser ☑ Community Education : Pet Waste ☑ Community Education : Car Wash

Education Effectiveness 25%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	40%	2.56	729	20.7%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	30%	0.85	243	6.9%	$0	$0	$0.0
Native Gardens (POS)	30%	0.05	15	0.4%	$0	$0	$0.0
Community Education : Fertiliser	100%	1.63	463	13.2%	$0	$2,821	$6.1
Community Education : Pet Waste	100%	0.24	68	1.9%	$0	$3,984	$59.0
Community Education : Car Wash	100%	0.02	6	0.2%	$0	$2,821	$491.2
Street Sweeping	100%	0.20	57	1.6%	$0	$16,929	$298.0
Totals		**5.54**	**1,580**	**44.8%**	**$0**	**$26,555**	**$16.8**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☑ Gross Pollutant Trap ☑ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	100%	0.11	31	0.9%	$526,638	$20,169	$1,646.1
Water Pollution Control Ponds	100%	0.11	31	0.9%	$1,637,993	$22,750	$3,911.8
Total		**0.22**	**62**	**1.8%**	**$2,164,631**	**$42,919**	**$2,769.7**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	12.36	3,524	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

				Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	5.54	1,580	44.8%	$0	$26,555	$16.8
Removal via In-Transit Control	0.22	62	1.8%	$2,164,631	$42,919	$2,769.7
Total Removal	5.76	1,642	46.6%	$2,164,631	$69,474	$121.4
Net Nutrient Input	**6.60**	**1,882**	**53.4%**			

NiDSS Modelling- DP2 with WSUD
Scenario 2

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**15,744**
Reduction due to WSUD (kg/yr)	**8,105**
Percentage Overall Reduction	**51.5%**
Pecentage Development Reduction	**51.5%**
Cost of Selected Program ($/kg/yr)	**$23**

○ Total Phosphorus

◉ Total Nitrogen

Catchment Name Egerton DP2
Option Description Residential Development
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	6.9%	lower density residential areas (excludes road reserve area)		
Residential : ~R35	53.6%	higher density residential areas (excludes road reserve area)		
Road Reserves : Minor	9.4%	maintainance of verge by landowners		
Road Reserves : Major	5.0%	maintainance of verge by local authority		
POS : Active	6.6%	ovals, grassed areas		
POS : Passive / Basins	16.8%	native vegetation, airstrip, unfertilised areas		
Rural : Pasture	0.0%	general pasture		
Rural : Residential ~R2.5/R5	0.0%	low density	Total Residential	**60.5%**
Rural : Poultry	0.0%	specific high nutient input land use	Total Area	**100.0%**
Commercial/Industrial	1.8%	town centre etc		

Nutrient Input Without WSUD

Residential	Garden	23.08	kg/net ha/yr	13.97	kg/gross ha/yr	3,980	kg/yr	25.3%
	Lawn	31.00		18.76		5,346		34.0%
	Pet Waste	1.63		0.99		281		1.8%
	Car Wash	0.04		0.02		6		0.0%
	Sub Total			33.73		9,613		61.1%
POS	Garden/Lawn	73.40	kg/ha POS/yr	4.84	kg/gross ha/yr	1,379	kg/yr	8.8%
	Pet Waste	42.44		2.80		797		5.1%
	Sub Total			7.63		2,176		13.8%
Road	Major Roads	29.36	kg/ha RR/yr	1.47	kg/gross ha/yr	418	kg/yr	2.7%
Reserve	Minor Roads	132.00		12.41		3,536		22.5%
	Sub Total			13.88		3,955		25.1%
Rural	Pasture	60.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	175.00		0.00		0		0.0%
	Residential (R2.5/R5)	15.20		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**55.24**	kg/gross ha/yr	**15,744**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☑ Native Gardens (Lots - Garden) ☑ Native Gardens (Lots - Lawn) ☑ Native Gardens (POS) ☑ Street Sweeping
☑ Community Education : Fertiliser ☑ Community Education : Pet Waste ☑ Community Education : Car Wash

Education Effectiveness 33%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	50%	6.98	1,990	12.6%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	50%	9.38	2,673	17.0%	$0	$0	$0.0
Native Gardens (POS)	50%	2.42	689	4.4%	$0	$0	$0.0
Community Education : Fertiliser	100%	7.14	2,036	12.9%	$0	$2,821	$1.4
Community Education : Pet Waste	100%	1.25	356	2.3%	$0	$4,356	$12.2
Community Education : Car Wash	100%	0.01	2	0.0%	$0	$2,821	$1,364.6
Street Sweeping	100%	0.38	109	0.7%	$0	$16,929	$155.9
Totals		**27.56**	**7,854**	**49.9%**	**$0**	**$26,927**	**$3.4**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☑ Gross Pollutant Trap ☑ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	100%	0.44	126	0.8%	$526,638	$20,169	$409.3
Water Pollution Control Ponds	100%	0.44	124	0.8%	$1,487,933	$20,666	$883.5
Total		**0.88**	**251**	**1.6%**	**$2,014,571**	**$40,835**	**$644.5**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Nutrient Input : Residential Area without WSUD	55.24	15,744	100.0%			
Nutrient Input : Rural Area	0.00	0	0.0%			
Removal via Source Control	27.56	7,854	49.9%	$0	$26,927	$3.4
Removal via In-Transit Control	0.88	251	1.6%	$2,014,571	$40,835	$644.5
Total Removal	28.44	8,105	51.5%	$2,014,571	$67,762	$23.3
Net Nutrient Input	**26.80**	**7,638**	**48.5%**			

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type (1,2)	2	TN	11%	% of total residential area as ~R15
Ave lots/net ha		32.7	89%	% of total residential Area as ~R35
Discount Rate	6%			

Community Education Information

"Who Cares About the Environment ?" (NSW EPA, 2000) Survey
17% stated environment one of two most important issues for govt to address
Of these 27% stated water as most important environmental issue
17% stated education most important issue to protect environment
Impact assumed to reduce fertiliser applications to minimum rates

Fertiliser Application Information/Assumptions

Lots assumed fertilised by property owner
Minor Road Reserves fertilised by property owner (verge assumed 40% road reserve)
Major Road Reserves fertilised by local authority (verge assumed 40% road reserve)
Active POS fertilised by local authority
Passive POS not fertilised
Rural Land Use and Poultry Farms have no reductions due to WSUD applied

Pet Waste

Data Source

Pets per lot and disposal via JDA Survey (2001)
TP & TN application via Gerritse at al (1991)
Cost Estimate via JDA. Distribution cost and frequency is for brochure, bag cost is for POS's

Application Rates

	TN (kg/yr)	TP (kg/yr)	TN or TP specified	Survey Results Pets Per Lot R15	R35	R zoning specified
Cats	0.90	0.20	0.90	0.24	**0.16**	0.17
Sml Dogs	2.75	0.70	2.75	**0.12**	**0.16**	0.16
Med Dogs	5.50	1.40	5.50	**0.16**	**0.08**	0.09
Lge Dogs	8.25	2.10	8.25	**0.19**	0.00	0.02

Waste Disposal

	R15	R35	R zoning specified
Lot	35%	0%	4%
POS	6%	**12%**	11%
Bins	59%	88%	85%

Cost Data

Distribution	$1.00	per house
Frequency	2	years
Bag Costs	$2.50	per 100 bags

Cost Calculation

Total Residential Area	172	ha
Total Number of Lots	5,642	
Area to Apply	172	ha
Number of Lots to Apply	5,642	
Number of Dogs	1,502	
Disposing in POS	170	
POS bags per year	61,414	
Cost of bags per year	$1,535	
Cost of mailout per year	$2,821	
Total PV Cost	$72,602	
Removal	355.8	kg/year
Cost per kg	$12	

Car Wash

Data Source

Frequency based on JDA Survey (2001)
TN/TP based on Polyglaze Autowash data via CRC for Freshwater Ecology (Canberra)
Cost Estimate via JDA. Distribution cost and frequency is for brochure

Application Rates & Washing Frequency

	Car wash detergent TN kg/wash	TP kg/wash	TN or TP specified	Washing Frequency (one car every x weeks) R15	R35	R zoning specified
	0.00009	0.00033	0.00009	2	**4.5**	4.21

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	5,642	
Cost of mailout	$2,821	per year
Total PV Cost	$47,013	
Removal	2.1	kg/year
Cost per kg	$1,365	

Lot Fertiliser

Data Source

Mean Fertiliser Applications via JDA survey (2001)
% garden and lawns estimated via Aerial photography JDA(2001) for various suburbs with similar zonings
Minimum Fertiliser Applications via product recommended application data

Application Rates

	Fertiliser mean application kg TN/sqm/yr	kg TP/sqm/yr	TN or TP specified
Garden	**0.059**	**0.027**	0.05900
Lawn	**0.033**	**0.005**	0.03300

	Fertiliser min application kg TN/sqm/yr	kg TP/sqm/yr	TN or TP specified
Garden	0.010	0.003	0.01000
Lawn	0.009	0.001	0.00900

	Education Campaign Fertiliser Reduction kg TN/sqm/yr	kg TP/sqm/yr	TN or TP specified	% redn
Garden	0.049	0.024	0.04900	83%
Lawn	0.024	0.004	0.02400	73%

Garden and Lawn Areas

	R15	R35	R zoning specified
% garden	0.11	0.03	0.04
% lawn	0.28	0.07	0.09

Cost Data

Distribution	$1.00	per house
Frequency	2	years

Cost Calculation

Number of Lots	5,642	
Cost of mailout	$2,821	per year
Total PV Cost	$47,013	
Removal	2035.6	kg/year
Cost per kg	$1	

POS Fertiliser

Data Source

Application rates based on City of Armadale application to active POS areas in years 1996-2000

Application Rates

	Fertiliser mean application kg TN/ha POS/yr	kg TP/ha POS/yr	TN or TP specified
POS	73.4	2.6	73.40

NiDSS Core Data & Cost Calculations

Nutrient Input Decision Support System
Version 2.0 March 2005

Rural Land Use Fertiliser

Data Source

Estimates via Gerritse et al (1992) for pasture

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha Rural/yr	kg TP/ha Rural/yr	specified
Rural	60	20	60.00

Poultry Farms

Data Source

Estimates via Gerritse (et al) 1992
Based on 14000 hens on 42 ha property

Application Rates

	Fertiliser mean application		TN or TP
	kg TN/ha farm/yr	kg TP/ha farm/yr	specified
Poultry	175	75	175.00

Street Sweeping

Data Source

Street Sweeping Revisited - Nutrients and Metals in Particle Size Fractions of Road Sediment
from two major roads in Perth (Davies & Pierce 1999), Water 99 Joint Congress Brisbane
Cost based on Davies & Pierce (1998), $55/km

Estimated Removal Rate
(assumes no WSUD upstream)

	Potential Reduction (kg/gross ha/yr)		TN or TP	reduction due to upstream
	TN	TP	specified	WSUD
Sweeping	0.75	0.35	0.75	49%

Cost Data

Cost	$55.00	$/km
Frequency	6	times per year

Cost Calculation

Cost	$60	$/gross ha/yr
Area to Apply	280.1	ha
Total PV Cost	$282,150	
Removal	108.6	kg/year
Cost per kg	$156	

Note : Street sweeping applied to developed areas only - not existing rural land use areas not to be developed

In-Transit Controls - Stormwater Nutrient Load

Data Source

Nutrients in Perth Urban Surface Drainage Catchments Characterised by Applicable Attributes, Tan (1991)

Data Used to Calculate Nutrients in Stormwater Available for Removal by In-Transit Controls
Removal quantities are for no WSUD and are reduced in calcs based on upstream measures used

Estimated Stormwater Nutrient Load
(assumes no WSUD upstream)

			TN or TP
			specified
Typical Phosphorus Stormwater Load (Perth Urban Areas)	0.40	kg/gross ha/yr	
Typical Nitrogen Stormwater Load (Perth Urban Areas)	2.53	kg/gross ha/yr	2.53

Gross Pollutant Trap

Data Source

Approximate average retention value via JDA(2001) - GeoTrap Laboratory Test Report
Based on GeoTrap, Humesceptor, Downstream Defender, CDS
Cost of GPT's via CRC report 98/3 (Allison, Chiew and McMahon) April 1998

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
GPT	35%	50%	35%

Cost Data

Capital Cost	$1,880	per ha
Maintenance	$72	per ha/year

Cost Calculation

Area to Apply	280.1	ha
Total PV Cost	$862,790	
Removal	126.5	kg/year
Cost per kg	$409	

Note : GPT's applied to developed areas only - not existing rural land use areas not to be developed

Water Pollution Control Pond

Data Source

TP removal efficiency and cost via Henley Brook Drive WPCP Conceptual Design (JDA,1997)
TN efficiency via Managing Urban Stormwater Treatment Techniques (NSW EPA 1997)

Estimated Removal Rate

	Percentage Removal		TN or TP
	TN	TP	specified
WPCP	35%	50%	35%

Cost Data

Capital Cost	$1,800,000	
Maintenance	$25,000	per year
Removal	34	kg TP/year

Cost Calculation

Cost per kg	$884	per kg
Removal	124.4	kg/year
Capital Cost	$1,487,933	
Operating	$20,666	
Total PV Cost	$1,832,362	

Note : WPCP's applied to developed areas only - not existing rural land use areas not to be developed

NiDSS Nutrient Removal Calculator

Nutrient Input Decision Support System
Version 2.0 March 2005

Analysis Type Total Nitrogen

Catchment Summary of Nutrient Removal due to Source Controls

Without WSUD 55.24 kg/gross ha/yr via developed area
15744 kg/yr

Component	Checkbox Result	% Area to Apply Removal to	Level before Removal	Potential Removal	Adopted Removal (kg/gross ha/yr)
Native Gardens (Lots-Garden)	TRUE	50%	55.24	13.97	6.98
Native Gardens (Lots-Lawn)	TRUE	50%	48.26	18.76	9.38
Native Gardens (POS)	TRUE	50%	38.88	4.84	2.42
Education Campaign - Fertiliser	TRUE	100%	36.46	7.14	7.14
Education Campaign - Pet Waste	TRUE	100%	29.32	1.25	1.25
Education Campaign - Car Wash	TRUE	100%	28.07	0.01	0.01
Street Sweeping	TRUE	100%	28.06	0.38	0.38
Gross Pollutant Traps	TRUE	100%	27.68	0.44	0.44
Water Pollution Control Pond	TRUE	100%	27.24	0.44	0.44

Education Campaign Fertiliser Reduction

	Fertiliser Applied No WSUD kg/gross ha/yr	Removed due to Native Gardens kg/gross ha/yr	Available for further reduction	% applied reduction to min level	education campaign effectiveness	reduction kg/gross ha/yr
Garden	13.97	6.98	6.98	83%	33%	1.91
Lawn	18.76	9.38	9.38	73%	33%	2.25
Road Reserve Minor	12.41	0.00	12.41	73%	33%	2.98
					Total	7.14

Nutrient Removal via In-Transit Controls

Stormwater Load Available for Removal (ie no WSUD) 2.530 kg/gross ha/yr

	reduction due to WSUD upstream	adjusted rate to use
Gross Pollutant Traps	49.89%	1.268
Water Pollution Control Pond	50.69%	1.247

NiDSS : WSUD Option Summary

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Catchment Name Egerton DP2

Catchment Area 285 ha

Total Phosphorus Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	45	5,882	5,927	0	5,927	17.1	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	5,843	288	6,131	0	6,131	17.7	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	5,843	288	6,131	2,864	3,267	9.4	46.7%	49.0%	$72.5

Total Nitrogen Input : Summary of Options

	Option	Development Input kg/year	Rural Input kg/yr	Total Input kg/yr	WSUD Reduction kg/yr	Net Input kg/yr	Input Rate kg/ha/yr	Reduction due to WSUD: Overall Reduction %	Reduction due to WSUD: Development Reduction %	Cost of Reduction $/kg/yr
1	Existing Land Use	1,270	17,646	18,916	0	18,916	54.7	0.0%	0.0%	$0.0
2	Proposed Land Use - No WSUD	27,258	1,093	28,351	0	28,351	81.9	0.0%	0.0%	$0.0
3	Proposed Land Use - With WSUD	27,258	1,093	28,351	11,709	16,642	48.1	41.3%	43.0%	$19.1

NiDSS

Nutrient Input Decision Support System
Version 2.0 March 2005

JDA Consultant Hydrologists

Report Date : 25-Jul-06

Egerton DP2	
Total Nutrient Input - No WSUD (kg/yr)	**3,524**
Reduction due to WSUD (kg/yr)	**2,046**
Percentage Overall Reduction	**58.1%**
Pecentage Development Reduction	**58.1%**
Cost of Selected Program ($/kg/yr)	**$85**

(●) Total Phosphorus
( ) Total Nitrogen

Catchment Name Egerton DP2
Option Description Residential Development
Catchment Area 285 ha

Land Use Breakdown

Residential : ~R15	6.9%	lower density residential areas (excludes road reserve area)
Residential : ~R35	53.6%	higher density residential areas (excludes road reserve area)
Road Reserves : Minor	9.4%	maintainance of verge by landowners
Road Reserves : Major	5.0%	maintainance of verge by local authority
POS : Active	6.6%	ovals, grassed areas
POS : Passive / Basins	16.8%	native vegetation, airstrip, unfertilised areas
Rural : Pasture	0.0%	general pasture
Rural : Residential ~R2.5/R5	0.0%	low density
Rural : Poultry	0.0%	specific high nutient input land use
Commercial/Industrial	1.8%	town centre etc

Total Residential **60.5%**
Total Area **100.0%**

Nutrient Input Without WSUD

Residential	Garden	10.56	kg/net ha/yr	6.39	kg/gross ha/yr	1,821	kg/yr	51.7%
	Lawn	4.70		2.84		810		23.0%
	Pet Waste	0.41		0.25		70		2.0%
	Car Wash	0.13		0.08		23		0.7%
	Sub Total			9.56		2,725		77.3%
POS	Garden/Lawn	2.60	kg/ha POS/yr	0.17	kg/gross ha/yr	49	kg/yr	1.4%
	Pet Waste	10.64		0.70		200		5.7%
	Sub Total			0.87		249		7.1%
Road	Major Roads	1.04	kg/ha RR/yr	0.05	kg/gross ha/yr	15	kg/yr	0.4%
Reserve	Minor Roads	20.00		1.88		536		15.2%
	Sub Total			1.93		551		15.6%
Rural	Pasture	20.00	kg/ha Rural/yr	0.00	kg/gross ha/yr	0	kg/yr	0.0%
	Poultry Farms	75.00		0.00		0		0.0%
	Residential (R2.5/R5)	4.00		0.00		0		0.0%
	Sub Total			0.00		0		0.0%
		Total		**12.36**	kg/gross ha/yr	**3,524**	kg/yr	**100.0%**

Residential Areas (R15-R35) : Nutrient Removal via Source Control

☑ Native Gardens (Lots - Garden) ☑ Native Gardens (Lots - Lawn) ☑ Native Gardens (POS) ☑ Street Sweeping
☑ Community Education : Fertiliser ☑ Community Education : Pet Waste ☑ Community Education : Car Wash

Education Effectiveness 33%

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Native Gardens (Lots - Garden)	50%	3.20	911	25.8%	$0	$0	$0.0
Native Gardens (Lots - Lawn)	50%	1.42	405	11.5%	$0	$0	$0.0
Native Gardens (POS)	50%	0.09	24	0.7%	$0	$0	$0.0
Community Education : Fertiliser	100%	1.81	516	14.6%	$0	$2,821	$5.5
Community Education : Pet Waste	100%	0.31	89	2.5%	$0	$4,356	$48.9
Community Education : Car Wash	100%	0.03	8	0.2%	$0	$2,821	$372.2
Street Sweeping	100%	0.16	45	1.3%	$0	$16,929	$378.7
Totals		**7.01**	**1,997**	**56.7%**	**$0**	**$26,927**	**$13.5**

Residential Areas (R15-R35) : Nutrient Removal via In-Transit Control

☑ Gross Pollutant Trap ☑ Water Pollution Control Pond

	% Area of Influence	Removal kg/gross ha/yr	Removal kg/yr	Removal %	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Gross Pollutant Traps	100%	0.09	25	0.7%	$526,638	$20,169	$2,096.0
Water Pollution Control Ponds	100%	0.09	24	0.7%	$1,286,394	$17,867	$3,911.8
Total		**0.17**	**49**	**1.4%**	**$1,813,032**	**$38,036**	**$2,996.5**

Net Nutrient Input

	kg/gross ha/yr	kg/yr	%
Nutrient Input : Residential Area without WSUD	12.36	3,524	100.0%
Nutrient Input : Rural Area	0.00	0	0.0%

	Capital Cost $	Operating Cost $/yr	Cost $/kg/yr
Removal via Source Control	$0	$26,927	$13.5
Removal via In-Transit Control	$1,813,032	$38,036	$2,996.5
Total Removal	$1,813,032	$64,962	$84.9

Net Nutrient Input	**5.19**	**1,478**	**41.9%**

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APPENDIX THREE

Wetland Management Plan, Development Plan Two Area - North West Wetland and Creek Lines

MULTIPLEX ENERGY

VALE
WETLAND MANAGEMENT PLAN

(DEVELOPMENT PLAN TWO AREA – NORTH WEST WETLAND AND CREEKLINES)

VERSION 4

MARCH 2006

REPORT NO: 2006/026

ATA Environmental
environmental scientists

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1. INTRODUCTION

1.1 Background

The Vale property is located about 20km from Perth in the Northeast Corridor, adjacent to the Swan Valley (Figure 1).

The rezoning of 537ha of land at Vale (formerly called Egerton) from Urban Deferred to Urban was formally assessed as a Consultative Environmental Review (CER) by the Environmental Protection Authority (EPA) in 1994 (Alan Tingay and Associates, 1994).

The EPA concluded that the proposal to rezone the land was environmentally acceptable and recommended that the Minister for the Environment approve the rezoning proposal. The EPA identified three environmental issues:

- Management of water quality and quantity to protect the Swan River, Ellen Brook and wetlands on site.
- Protection of flora and fauna including the Southern Brown Bandicoot and possible presence of the Western Swamp Tortoise.
- Retention of the wetland functions on the site.

The Minister for the Environment subsequently approved the proposed rezoning subject to a number of conditions to be satisfied at various stages of the development. One of these conditions was the preparation and implementation of a Wetland Management Strategy.

The Egerton Wetland Management Strategy (Alan Tingay & Associates, 1995) was approved by the Minister for the Environment in June 1995 (Appendix 1). The Strategy identified the boundaries of the wetland areas to be retained and described the broad principles for management. The Strategy designated Management Priority Areas within the wetlands according to their proposed functions within the urban environment as follows:

- Conservation;
- Special Conservation;
- Passive Recreation; and
- Drainage.

The Management Priority Areas as delineated in the Egerton Wetland management Strategy (Alan Tingay and Associates, 1995) are shown in Figure 2.

The Strategy required the preparation of more detailed Wetland Management Plans as a part of the subdivision planning for areas adjacent to the wetlands. The wetlands requiring management plans included:

- the mid-west wetland;
- the north-south linear wetland;
- the north-west wetland; and
- the creeklines.

Development of the Vale has commenced with the stages of Development Plan One (DP1) area in the south western portion of the property under construction. Planning is underway

for the Development Plan Two area, which is located directly to the north of DP1 in the north western portion of the property.

This wetland management plan has been prepared for the wetland located in the north west corner of the property (the North West wetland) and the drainage lines that run in an easterly direction towards the Heritage listed dam and Ellen Brook. The drainage lines and the wetland are within the Development Plan Two area as indicated in Figure 3 (Chappell & Lambert, 2006). This plan was prepared subsequent to approval of the CER, and in conjunction with a Drainage and Nutrient Management Plan (JDA, 2006). This Wetland Management Plan report is intended to form part of the Development Plan Two submission to the City of Swan.

1.2 Objectives

This report has been prepared as a requirement of the approved Wetland Management Strategy. The Wetland Management Strategy was prepared as a Condition (M4.1) of Ministerial approval for the Egerton rezoning proposal. The required commitment in the Wetland Management Strategy is as follows:

"It is recommended therefore, that prior to subdivision approval, detailed Wetland Open Space Management Plans be prepared by the developer to the satisfaction of the Shire of Swan. It is envisaged that this will entail the preparation of four separate plans i.e., the north-west wetland, the north-south linear wetland, the mid-west wetland and the creek lines. The subdivision approvals to which this recommendation applies only relate to those which, during construction, will have a direct impact on any of the wetland Open Space areas".

The two areas relevant to this condition with in the Development Plan Two area are the North West wetland and the creek lines. It should be noted that the wetland boundaries illustrated in Figure 6 of this management plan are based on those shown in the approved Egerton Wetland Management Strategy (Alan Tingay and Associates, 19995) and not on the current mapping provided in the *Geomorphic Wetlands Swan Coastal Plain* dataset.

The North West wetland is located in the north-western corner of Development Area Two and has an area of approximately 33ha. The three creek lines are located in the central portion of Development Area Two. The two northern creek lines drain the northern and southern portions of the northwest wetland while the third creek line drains an area to the south of the north-west wetland. All three creek lines flow into the heritage dam to the east of the Development Area 2 area. The creek lines were delineated in the Egerton Wetland Management Strategy as Multiple Use areas. These multiple use areas (including creek lines and surrounds) encompass a total area of approximately 11ha.

The management plan proposes measures to manage the environmental attributes of the wetland and creek lines as well as recommending measures to accommodate the human amenity and drainage functions of the wetland and creek lines within the urban Public Open Space environment.

The proposed human use of the North West wetland and drainage lines will be a combination of passive recreation and limited access to conservation areas. Paths through parts of the wetland areas and across creek lines will provide access through the Open Space from residential to commercial and educational nodes as well as to sportsgrounds and schools.

Urbanisation in the vicinity of the wetlands will introduce many pressures associated with increased human use of the area. For example, the incidence of bushfires in areas used by people is likely to increase in frequency due to arson and general carelessness. Therefore, management and facilities to such pressures will be necessary.

Environmental issues that will need to be addressed in the development and management of the Egerton Open Space wetlands are:

- Protection of the Egerton Seepage/ 'Mound Spring'.
- Protection of populations of the Priority 5 Southern Brown Bandicoot (*Isoodon obesulus*).
- Prevention of loss of vegetation diversity through weed invasion.
- Fire control and access for fire fighting personnel and vehicles.
- Access paths and boardwalks through dryland and wetland areas. Access controls at Open Space perimeter.
- Refuse and litter disposal.
- Control of pests including introduced feral animals and dieback.
- Facilities to be provided for human users.
- Post-development rehabilitation and maintenance.
- Research and education.
- Drainage.

2. EXISTING ENVIRONMENT

2.1 Climate

The area has a Mediterranean climate, with mild wet winters and hot dry summers. Due to the distance of the subject land from the coast, the maximum average temperatures are slightly higher and the minimum average temperatures are slightly lower than those experienced in closer proximity to the ocean. The hottest months are January and February and rain falls primarily in the winter months.

Seasonal wind patterns consist of a moderate south-easterly during the mornings in summer, with a moderate south-westerly in the afternoon. The winter pattern reflects the synoptic flow. For example, a North Westerly wind would be expected preceding a cold front, and westerlies and then south westerlies would be expected following a cold front.

2.2 Soils, Landform and Topography

The superficial geology of the Vale Site is illustrated in Figure 4. The Guildford Formation outcrops in the eastern sections of the property, overlain to variable degrees by a veneer of Bassendean Sand. This formation consists of pebbly, brown silt, with some laterite quartz and granitic pebbles. In the western section of the property, the Guildford Formation is overlain by Bassendean Sand of Aeolian origin (Gozzard, 1986). The north western area of the property contains occasional peaty clays of lacustrine origin with variable sand content.

There are three main geomorphic units at the Vale:

- Bassendean Dunes;
- Alluvial flood plains; associated with drainage lines; and
- Lacustrine marshes; located in interdunal swales.

The most elevated area of the property is along the north western boundary at 61mAHD. The western third of the property is dominated by prominent ridges which generally run north to south with undulations forming swales between the dunes. To the east the topography is less steep, with the elevation dropping gradually to between 25m and 16mAHD along the eastern boundary.

The ground surface of the North West wetland ranges from 41mAHD along the western margin to 29mAHD in the east which indicates a drop in ground level between the eastern and western edges of the wetland of approximately 12m. Three creek lines link to the eastern side of the North West wetland and flow in an easterly direction. The surface level of the creek lines range from 29m AHD at their western extent near the North West wetland to 20mAHD at the eastern extent of the Development Plan Two area.

2.3 General Hydrology

Vale is located between the Gnangara Mound and Ellen Brook and includes areas of shallow groundwater, groundwater discharge areas and streams. Groundwater at Vale is discharged to ground surface in certain areas, and forms streams which flow to Ellen Brook.

2.4 Groundwater

Groundwater is present at the Vale as a shallow or superficial aquifer and it has formed, and is replenished by infiltration of rainwater.

The superficial aquifer under the Vale is a component of a much larger groundwater system that underlies the Bassendean Sand Formation on the Swan Coastal Plain between the Swan River northwards to near Gingin Brook. This large aquifer is known as the Gnangara Mound, a large part of which is a major source of public water supply for the Perth Metropolitan Region.

The surface of the groundwater (i.e. the water table) under Vale is at a variable depth below the ground surface depending on the surface topography. For example, in the north west corner of Vale property, ground surface elevations are in the order of 60m AHD while the water table is at about 40m AHD. In the south-east corner of the property the ground level is 25m AHD while the watertable is at about 20m AHD. As the groundwater results from rainfall, the water table fluctuates by about 1 to 1.5m according to the season, with peak levels from September to October and minimum levels from April to May.

The pre-development AAMGL for the North West wetland has been determined by JDA Consultant Hydrologists (2003) as ranging from 37mAHD along the western margin to 29.5mAHD on the eastern margin. The pre-development AAMGL for the creeklines ranges between 29mAHD near the western extent of the creeklines to approximately 20mAHD towards the eastern extent.

In 1994 and 1995 28 groundwater monitoring bores were installed on the Egerton property. These have been monitored monthly between 1994 – 1996 and 1999 – 2001 and every second month subsequent to 2001. A summary report for these monitoring periods has been prepared by JDA Consultant Hydrologists (JDA, 2006). Maximum water levels for the bores varied between 24.4mAHD in the most eastern bore and 36.1mAHD in the most western bore. Water levels indicate a groundwater flow from east to west with an average gradient of 0.0153m/m. Low pH (<5) has been recorded in some bores, generally in close proximity to wetland areas and salinity is generally fresh to brackish. Monitoring has not revealed an increasing or decreasing trend in groundwater levels and nutrient analysis do not reveal trends for any of the parameters analysed (JDA, 2006).

Groundwater contours are shown in Figure 5.

2.5 Wetlands and Creeklines

The wetland that is included in this management plan is identified as the North West wetland. The North West wetland is classified as a sumpland which is recognized as seasonally inundated basin with seasonally waterlogged margins (Hill *et al.*, 1996).

The North West wetland lies to the immediate east of the base of the Bassendean dunes at the junction of the Bassendean Dune System and the Guildford Formation. The wetland is fed by groundwater seeping out from the base of the dunes and onto the heavier Guildford Formation on the plain. The North West wetland feeds into three creek flowing in an easterly direction, eventually draining into North West creek and the Heritage dam further to the east. Water levels in the North West wetland are relatively static throughout the year as a result of the constant groundwater input and regulated outflow through the creeks.

The central section of the wetland contains heath vegetation and a freshwater seepage area previously known as the 'Mound Spring' and also known as a 'Tumulus Spring' or 'Egerton Seepage'. The seepage area is located on a hill slope and drains via overland flow into a creek line. This creek line has been diverted into a man made dam which was previously used as a water source for farming purposes. The overflow from the dam enters the central creek line which subsequently results in constant flow down the central creek line towards the Heritage dam.

The North West wetland and drainage lines are currently not protected under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992*. However, the wetland and the drainage lines are being considered for protection in the *Revised Draft Environmental Protection (Swan Coastal Plain Wetlands) Policy and Regulations 2004* (EPA, 2004a).

Under the approved 1995 Wetland Management Strategy (Alan Tingay and Associates, 1995), the North West wetland was classified as a Resource Enhancement wetland. However, subsequent to the 1995 approval, the majority of the North West wetland (components UFI8796 and UFI8941) was re-classified as a Conservation Category wetland (Hill *et al*, 1996; Government of Western Australia, 2004). The remaining portion of the North West wetland (UFI8940) was re-classified as a Multiple Use Category wetland.

Under the approved 1995 Egerton Wetland Management Strategy (Alan Tingay and Associates, 1995), the creek lines are classified as a Multiple Use Palisplain. However, subsequent to the 1995 approval the creek lines and surrounding area was re-classified as a Resource Enhancement Category wetland (Hill *et al*, 1996; Government of Western Australia, 2004).

While it is acknowledged that the *Geomorphic Wetlands Swan Coastal Plan* dataset delineates the boundaries of the wetlands within the Vale development area on the basis of scientific studies and is endorsed by the EPA, the 1995 Ministerial approval of the urban rezoning over the land and the subsequent approval of the Egerton Wetland Management Strategy (Alan Tingay and Associates, 1995) overrides any subsequent revision to wetland management categories or amendment to the lakes EPP.

The management categories and objectives for wetlands as described by Hill *et al.* (1996) are outlined in the table below.

TABLE 1
WETLAND MANAGEMENT CATEGORIES & OBJECTIVES

Management Category	General Description of Wetlands	Management Objectives
Conservation Wetlands	Wetlands which support high levels of attributes and functions.	To preserve wetland attributes and functions through reservation in national parks, crown reserves, state owned land and protection under environmental protection policies.
Resource Enhancement wetlands	Wetlands that have been partly modified but still support substantial functions and attributes.	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in crown reserves, state or local government owned land and by environmental protection policies, or in private property by sustainable management.
Multiple Use Wetlands	Wetlands with few attributes, which still provide important wetland functions.	Use, development and management should be considered in the context of water (catchment/strategic drainage planning), town

Management Category	General Description of Wetlands	Management Objectives
		(land use) and environmental planning through land care.

From *Wetlands of the Swan Coastal Plan Volume 2b* (Hill *et al.*, 1996)

The boundary of the North West wetland was delineated through the CER process by Alan Tingay & Associates based on wetland vegetation and surface contours (Section 5.4 WMS, Alan Tingay and Associates, 1995). The wetland boundary was defined using guidelines established by the EPA (1994) and were approved by the EPA when the EPA recommended approval for the rezoning proposal and by the Minister for the Environment through clearance of the condition related to the Wetland Management Strategy. The boundary of both the wetland and creek lines were relatively easy to delineate due to the sharp change in surface contour and associated vegetation types.

The boundary of the approved North West wetland is shown in Figure 6. The North West wetland encompasses approximately 33ha in area and is classified as a Resource Enhancement Category Sumpland. The creek lines are part of a larger Multiple Use Category Palusplain.

2.6 Vegetation

2.6.1 Vegetation Complexes

Heddle *et al.* (1980) identified the vegetation within the Development Plan Two area as a transition between the Bassendean Complex - North and the Southern River Complex. The Bassendean Complex - North consists predominantly of Low Open Forest and Low Woodland of *Banksia* sp – *Eucalyptus todtiana* to Low Woodland of Melaleuca sp and sedgelands which occupy the moister sites. The Southern River Complex consists predominantly of Low Open Forest and Low Woodland of *Corymbia calophylla – Eucalyptus marginata - Banksia* species with fringing woodland of *E. rudis – Melaleuca rhaphiophylla* along creek beds.

The Bassendean Complex - North vegetation complex has 54% of its original extent remaining in the Perth Metropolitan Area. Approximately 29% of the original extent is currently protected in secure reserves. This is above the minimum target established in Bush Forever (Government of Western Australia, 2000).

The Southern River Complex has 17% of its original extent remaining in the Perth Metropolitan Area. Approximately 6% of the original extent is currently protected in secure reserves. This is below the minimum target established in Bush Forever (Government of Western Australia, 2000).

2.6.2 Vegetation Associations and Condition

The remnant vegetation of the Egerton property was surveyed as part of the preparation of the Consultative Environmental Review (CER) prepared in 1994 (Alan Tingay & Associates, 1994).

The northern portion of the North West wetland is dominated by a *Melaleuca preissiana/ Eucalyptus rudis* Closed Forest with *Banksia littoralis* and a *Pericalymma ellipticum* Closed Heath which is very dense in parts. The northern portion of the wetland also contains patches

of *Pericalymma ellipticum* Closed Heath, *Hypocalymma angustifolium* Closed Heath, *Melaleuca preissiana* Low Woodland and *Eucalyptus rudis* Open Forest. The southern portion of the North West wetland is domainted by *Melaleuca preissiana* Low Woodland over *Agonis linearifolia* Closed Heath, *Hypocalymma angustifolium* Closed Heath, *Pericalymma ellipticum* Closed Heath and *Astartea fascicularis* Closed Heath. The mid section of the North West wetland associated with the seepage area is dominated by *Astartea fascicularis/ Hypocalymma angustifolium* Closed Heath.

The creek lines contain scatted trees and patches of remnant vegetation interspersed with pasture areas. The northern creek line is dominated by patches of *Melaleuca rhaphiophylla/ Eucalytpus rudis* Closed Forest. The central creek line is dominated by *Corymbia calophylla* Woodland over *Astartea fascicularis* Closed Heath and *Juncus pallidus* Sedgeland. *Melaleuca preissiana* Low Woodland and *Melaleuca rhaphiophylla/Eucalyptus rudis* Low Closed Forest with patches of *Melaleuca preissiana* Low Woodland. The southern creek line contains areas dominated by *Melaleuca preissiana* Low Open Woodland over *Juncus pallidus* sedgland and *Astartea fascicularis* Closed Heath. The eastern portion of the southern creek line is dominated by *Juncus pallidus* Sedgeland.

According to the vegetation condition rating scale outlined in Bush Forever (Western Australian Government, 2000), the condition of vegetation within the North West wetland is generally considered to be Excellent. The condition of the northern and central creek lines is considered to be Degraded to Good and the condition of the southern creek line is considered to be Good. The vegetation condition rating scale outlined in Bush Forever is detailed in Table 2.

TABLE 2
VEGETATION CONDITION RATING SCALE

Pristine Pristine or nearly so, no obvious signs of disturbance.
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.
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.
Completely Degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising

weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

The vegetation types and condition associated with the wetland and creek lines is indicated in Figure 7.

The dryland areas surrounding the North West wetland and creek lines predominantly consist of cleared areas and areas of pine plantation. An area to the west and north west of the North West wetland contains remnant Banksia vegetation.

2.6.3 Vegetation Significance

Using the information from the survey conducted for the CER in 1994 and referencing the species to those contained in Gibson *et al.* (1994), the vegetation within the survey area is inferred as corresponding most closely with Floristic Community Type (FCT) 11. According to Gibson *et al.*, (1994), FCT 11 – Wet forests and woodlands is well reserved within the Swan Coastal Plain. FCT 11 is not listed as a TEC at the State or Commonwealth level.

The vegetation of the seepage area or 'Mound Spring' has been identified as Assemblages of Plants and Invertebrate Animals of Tumulus (Organic Mound) Springs of the Swan Coastal Plain, (EPBC Act, 2000 Assemblages of Plants and Invertebrate Animals of Tumulus (Organic Mound) Springs of the Swan Coastal Plain is identified as being Critically Endangered by English and Blyth (1997) and Endangered under the EPBC Act (2000).

2.7 Fauna

A fauna survey by Alan Tingay & Associates (1994b) identified the presence of the Southern Brown Bandicoot (*Isoodon obesulus*) within all the wetlands at Egerton. Bandicoots are listed by CALM as Priority 5 - Taxa in Need of Monitoring. I.e. Taxa which are considered to have been adequately surveyed or for which sufficient knowledge is available and which are considered not currently threatened or in need of special protection but could if present circumstances change.

No Bandicoots were identified within the creek lines as these areas lack the dense vegetation required for Bandicoot habitat. Section 4.8 of this report provides information on the management and monitoring of the bandicoots within the North West wetland according to the Egerton Bandicoot Management Strategy that was approved in June 1995 by the Minister for the Environment.

A search of the Egerton wetlands for the potential presence of the endangered Western Swamp Tortoise was undertaken in 1995 by Chelonia Enterprise. This survey did not record the Western Swamp Tortoise in any of the wetlands on the Egerton property. The Ministerial conditions that related to surveys for the tortoise were therefore considered met by the Minister in June 1995.

A study of the invertebrate fauna of seepage areas in the Ellenbrook area including the seepage located within the DP2 area was undertaken in 1994 (Jasinska and Knott, 1994). The study found that the Egerton seepage within DP2 contained a particularly rich and diverse invertebrate faunal assemblage. A new Genus of monotypic amphipod was identified at the Egerton seepage during the study and the seepage area was recommended for further study and conservation protection.

3. WETLAND MANAGEMENT ISSUES AND MEASURES

3.1 General

The design and management of the Development Plan Two Area will focus on maintaining the natural attributes and values the area supports particularly in relation to the North West wetland. The Development Plan Two area will also need to provide for some passive recreation and drainage elements. Development of this area will create similar pressures on the wetland and creek line as other urban development areas in the Perth Metropolitan Region. However there are some important physical and biological characteristics specific to the Development Plan Two area that need to be considered so that the objectives of the Wetland Management Plan can be achieved. Areas need to be incorporated into the DP2 area that caters for anticipated public use, which contain amenities appropriate for the open space/wetlands and which protect the key environmental features of the wetland and creeklines.

There are six different categories of open space proposed for the Vale Development Two Area including:

- Bush Forever Conservation (including Special Conservation);
- Conservation;
- Drainage Open Space/Multi-Use Corridors;
- Large parks;
- Passive recreation areas; and
- District Open Space.

The distribution of these open space categories is shown in Figure 8. The categories which relate to the North West wetland and drainage lines are based on the original categories outlined in the Wetland Management Strategy (Alan Tingay and Associates, 1995).

3.2 General Management Principles

The retention of native vegetation within an urban setting provides an important function, enhancing the urban environment and providing opportunities for improving the community's appreciation and understanding of the bushland flora, vegetation and associated fauna. In this way, while conservation of the flora and fauna values of the bushland will be the management priority, the bushland will also function as an educational and passive recreational resource for the local and broader community.

The approved Egerton Wetland Management Strategy (Alan Tingay & Associates, 1995) identified the boundaries of the wetland areas to be retained and described the broad principles for management of the wetland areas. The Strategy designated Management Priority Areas within the wetlands according to their proposed functions within the urban environment as follows:

- Conservation;
- Special Conservation;
- Passive Recreation; and
- Drainage.

The Management Priority Areas within the Development Plan 2 area are discussed in the sections below.

3.2.1 Conservation Areas

Wetland areas at Egerton which have a conservation priority are those that contain only slightly disturbed vegetation. These areas support the Southern Brown Bandicoot and a wide range of other fauna.

Controlled public access to these areas will be necessary to prevent deterioration of the conservation values. Access paths and boardwalks through the Open Space will where practicable follow fence lines and tracks already present in the area. Passive recreational pursuits including walking, bird watching and nature studies will be suitable activities in most areas.

Conservation areas will not be used for drainage infrastructure purposes but may be appropriate to accommodate overland flow of good quality stormwater.

The majority of the North West wetland is identified as a Conservation area within the approved Wetland Management Strategy (Alan Tingay and Associates, 1995) including the majority of Bush Forever Site 22 (Egerton Mound Spring and Adjacent Bushland, EllenBrook)

To the south of the North West wetland a linear conservation area provides a link through to the North - South linear wetland within the Development Plan One area.

3.2.2 Special Conservation Areas

The seepage area commonly known as the ‘mound spring’ has been identified as the area of most significance in the Egerton wetlands. The seepage area is located within the central section of the North West wetland within Bush Forever Site 22 Egerton Mound Spring and Adjacent Bushland. The seepage area contains plant species and invertebrate fauna which are unusual and highly susceptible to damage by trampling. It is therefore proposed that an area be adequate fenced to keep the general public out. The unusual nature of the seepage means that it would make an excellent nature study area for local schools and tertiary institutions.

3.2.3 Passive Recreation

The wetland system has the potential to be a valuable and unique opportunity for passive recreational pursuits. Such activities could include nature walks, bird watching and picnic areas.

Some of these activities are suitable within conservation areas on a limited basis. However, the main focus for passive recreation should be centred on grassed picnic areas created near the existing dam area and adjacent to the creeklines. An additional area for passive recreation is located within a raised central area adjacent to drainage lines near Millhouse road as indicated in Figure 8.

The approved Egerton Wetland Management Strategy (Alan Tingay & Associates, 1995) identified two areas within the North West wetland suitable for informal picnic areas. Further site investigations indicate that these passive recreation areas (as indicated in the Wetland Management Strategy) would be better placed in a more publicly accessible and viewable location outside the wetland area.

3.2.4 Drainage

The post development drainage system at Egerton is required to accommodate surface drainage from urban areas and subsoil drains, while also preventing deterioration of wetlands, eutrophication of Ellen Brook and the Swan River, control of peak flows into downstream water bodies and maintain the predevelopment drainage lines on site. In accordance with the Stormwater Management Manual (Department of Environment, 2004), emphasis will be placed on nutrient control at source.

The principal feature of the drainage system is the incorporation of wet detention basins and drainage swales along existing creek lines. The three creek lines will receive water from the catchments within the DP2 area. The creeklines are delineated as drainage/multiple use areas in Figure 8.

These areas are intended to comprise drainage swales, detention basins, pathways and remnant vegetation.

3.3 Bush Forever Site 22 – Egerton Mound Spring and Adjacent Bushland, Ellenbrook

The Egerton Structure Plan (ODP 50) Review (2004) delineated Bush Forever Site 22 Egerton Mound Spring and Adjacent Bushland, Ellenbrook though a Negotiated Planning Solution. Bush Forever Site 22 comprises the central and northern portion of the North West wetland and includes an area for ‘Conservation’ as well as the ‘Special Conservation’ area delineated in the Egerton Wetland Management Strategy.

It is intended that the area comprising Bush Forever Site 22 be retained as natural bushland and vested with the Western Australian Planning Commission or some other appropriate State Government level management body such as the Department of Environment and Conservation or the Whiteman Park Board. The management of Bush Forever Site 22 is discussed in Section 4 below.

4. NORTH WEST WETLAND AND CONSERVATION LINK

4.1 Access and Facilities

The North West wetland will be retained as a naturally vegetated area in accordance with the requirements of the approved Wetland Management Strategy (Alan Tingay and Associates, 1995). A Development Plan 2 Open Space Landscape Strategy has been prepared for the North West wetland by McNally Newton Landscape Architects (2006). The Strategy is shown in Appendix 2.

Access to the wetland will be limited to the provision of a few paths that traverse the wetland to enable strategic access across the wetland and link the neighbourhoods either side of the wetland. The location of these paths will be determined onsite and chosen so as to minimally disrupt the existing vegetation.

Footpaths will be kept to road reserves where possible and utilise any existing tracks (if available) to minimise the clearing of the existing vegetation. This path system will link into the surrounding residential subdivision through pram ramps in accordance with City of Swan standards. Footpaths will cater for disabled access to Australian Standards. Footpaths surrounding the wetland area will be 2.1m in width, which allows for maintenance and/or fire vehicle access. They will consist of washed aggregate concrete with a 3% black oxide colour mix. Footpaths should be installed following the commencement of the civil construction to the surrounding subdivision, in accordance with the installation of the landscaped areas within adjacent POS areas.

Access paths through the wetland area itself will comprise raised boardwalks where necessary to avoid inundation of path areas and disruption of overland flow. Any boardwalked areas will be designed in accordance with the City of Swan requirements.

The majority of the wetland will be bounded by a road separating the wetland and the surrounding subdivision. In areas where the road will be higher than the wetland area a retaining wall will be constructed to prevent encroachment into the wetland area.

Fencing will be installed around the wetland area to prevent indiscriminate access from the path system and the access tracks that traverse the wetland itself. Standard rural field gates to the City of Swan standards will enable access of maintenance and emergency vehicles. These gates will be locked at all times. Final fencing detail will be determined in conjunction with the City of Swan. Gates will be constructed of galvanised steel (in accordance with City of Swan rural field gate detail). Temporary fencing should be installed at the periphery of the wetland prior to the commencement of civil construction to the surrounding subdivision. Temporary fencing should be replaced with the conservation fencing at the time of access being granted to the landscape contractor and works associated with the landscaped edge. Vehicle access gates should also be installed at the time of installation of the conservation fencing.

The ‘mound spring’ or seepage area is designated as a Special Conservation area and no pedestrian access is proposed. The Special Conservation area will be fenced to prevent indiscriminate access and access paths traversing the North West wetland will be directed away from the area. Fencing on the southern, western and eastern sides of the seepage area will be practical on existing tracks. However fencing on the northern side would require clearing of dense vegetation in the North West wetland. The provision of fencing around the entire seepage area is therefore impractical. Fencing on the southern, western and eastern

sides of the seepage in addition to the retaining walls and fencing of access paths though the North West wetland is considered adequate to discourage access into the seepage area.

Interpretative signage is proposed to be located at strategic points along the boardwalk and pathways. The signage will provide the local community and visitors with information relating to the wetland environment, orientation and advice on user restrictions. Additional interpretative signage could be located around the dam and its surrounds and within the passive recreation area. The signage will be constructed with mild steel/brass base plate mounted on Toodyay stone style plinths and will have concrete footings. Where signage is to occur on the boardwalk construction will be of mild steel framework mounted directly onto the boardwalk. Interpretative Signage should be installed following the construction of the footpaths.

A linear conservation corridor has been provided to link the southern portion of the North West wetland with the North - South wetland within Development Plan One. This area is largely to be retained as natural vegetation with pedestrian access paths provided as shown in Appendix 2. As the link contains a large amount of cleared pasture, significant revegetation with wetland species will be required.

Three areas of landscaped POS abut the wetland area. Two of these POS areas (LP3 and LP4 in Figure 8) are located in upland areas along the northern boundary of the North West wetland. These areas are intended to comprise grassed areas and remnant vegetation. The third POS area will be located in the vicinity of the existing dam near the 'mound spring' or seepage area and will comprise of grassed areas, remnant vegetation and the existing dam. It is recommended that the dam be retained within POS although recontouring may be required for safety purposes. It is recommended that curbing be installed at the POS/wetland boundaries to prevent grass species from invading the wetland area. A lookout area may be located in either LP3 or LP4 with interpretative signage and views over the North West wetland area.

Recycled materials will be utilised in landscaping works wherever possible.

4.2 Drainage

No drainage features are proposed within the North West wetland in accordance with the approved Wetland Management Strategy (Alan Tingay and Associates, 1995).

A low point exists in the south western portion of the North West wetland to the south of the Special Conservation area. At this low point stormwater from the surrounding subdivision area is proposed to be piped away from the North West wetland. The pipe system will accommodate 1:10 year flood event. For flood events greater than 1:10 year and where a 1:10 year or greater flash storm event occurs, stormwater is proposed to enter the North West wetland via overland flow. Due to the need for retaining walls adjacent to the wetland in this area, stone pitching is proposed at the base of the retaining wall within the road reserve to prevent erosion.

4.3 Water Quality

The North West wetland is on a gradual slope and as such does to contain any above-ground water apart from the few narrow creek lines that occur within the wetland. As a consequence there are few, if any, surface water quality issues normally associated with the basin wetland. However, water from the wetland area enters the creek lines which eventually flow into Ellen

Brook and the Swan River therefore nutrient and other contaminants entering the shallow groundwater must be avoided or minimised to reduce the potential for negative impacts on the wetland and creek systems.

A regular street sweeping program, to be initiated and maintained during the housing construction phase of the development (and undertaken by the City of Swan thereafter), will result in a reduction in the levels of nutrients entering the dampland, and minimise the majority of sediments, heavy metals and hydrocarbons entering the system.

Fertiliser application and irrigation of surrounding turfed areas will be kept to the minimum required for healthy growth. Regular mowing of grassed areas, and the removal of cuttings from the site, will assist the removal of nutrients.

A high Phosphorous Retention Index (PRI) substrate will be installed or incorporated into the soil, as a matter of Environmental Best Practice, prior to the laying of turf in proposed areas of passive recreation. Only slow release, low phosphorous fertiliser will be applied to turfed areas, and no animal manure soil conditioners will be used.

In accordance with the Egerton Wetland Management Strategy (Alan Tingay and Associates, 1995), a commitment has been made to undertake monthly monitoring of groundwater levels and groundwater quality from bores located within the North West wetland and other bores installed within the DP2 area. There are 5 existing bores within the North West wetland. The water levels within these bores have been monitored on a monthly basis by JDA since 2003.

Following the approval of the Drainage and Nutrient Management Plan (JDA, 2006) a Drainage and Nutrient Management Program will be devised. The Drainage and Nutrient Management Programme for DP2 will detail the location of additional bores to be installed within the DP2 area. Monitoring prescribed under the Drainage and Nutrient Management Program will be undertaken for the duration of the development and for ten years following urbanization (JDA, 2006). Water quality parameters that will be analysed include electrical conductivity, pH, temperature, total phosphorous, total nitrogen, total kjeldahl nitrogen, nitrate, nitrate, ammonia and filterable reactive phosphorous.

Annual monitoring reports for the existing North West wetland bores and the bores installed for the Drainage and Nutrient Monitoring Program will be submitted to the Department of Environment and Conservation and to the City of Swan.

Further detail on monitoring will be provided in the Drainage and Nutrient Management Plan prepared for the Development Plan 2 area (JDA, 2006).

4.4 Revegetation/Rehabilitation

The vegetation within the North West wetland area is generally in Excellent condition with little requirement for revegetation. Revegetation will be undertaken however, in areas that are degraded and areas that are unavoidably disturbed in association with works to create access paths. Revegetation will also be required in parts of the Conservation link to the south of the North West wetland.

Existing vegetation will be augmented with additional planting or transplantation of local species. Species to be used will depend on the levels of inundation. An indicative list of species suitable for rehabilitation works is given in Table 3.

TABLE 3
SPECIES SUITABLE FOR USE IN REHABILITATION WORKS – NORTH WEST WETLAND

Wetland Species	Dryland and Transitional Species
Melaleuca preissiana	*Eucalyptus marginata*
Melaleuca rhaphiophylla	*Banksia attenuata*
Eucalyptus rudis	*Banksia menziesii*
Astartea fascicularis	*Persoonia saccata*
Hypocalymma angustifolium	*Jacksonia furcellata*
Pericalymma ellipticum	*Stirlingia latifolia*
Juncus pallidus	*Pimelea leucantha*
Baumea articulata	*Hybanthus calycinus*
Leucopogon australis	*Nuytsia floribunda*
Scholtzia involucrata	*Xanthorrhoea preissii*
Hibbertia subvaginata	*Hibbertia hypericoides*
	Patersonia occidentalis
	Macrozamia riedlei

The revegetation and rehabilitation of degraded areas will involve two key processes;

- management of the disturbances that lead to the deterioration of the bushland such as weed control, access control, fires; and

- implementation of revegetation techniques through tube or seedling planting.

When undertaking revegetation works, seedlings will be used where possible and planted to take full advantage of winter rainfall and in densities consistent with the surrounding vegetation. Care will be taken to avoid evenly spacing seedlings or planting in rows so that a natural effect is achieved.

Wherever possible, revegetation material, including seed, should be collected from vegetation adjacent to or in the vicinity of the development to ensure the use of local provenance stock. Revegetation works will be undertaken during the winter months when rainfall will promote plant establishment. In order to maintain the wetlands in their current condition following development, the following will be required;

- control of the introduction and spread of weed species;
- maintenance of the existing native plant composition and structure;
- management of access;
- control of feral animals and domestic pets; and
- prevention and suppression of fire.

A Rehabilitation Plan for the Development Plan Two area will be commissioned, developed, finalized and implemented to the satisfaction of the City of Swan following and the relevant State Government management body following approval of this Wetland Management Plan.

Rehabilitation will need to be monitored to determine whether additional revegetation or remedial action is required. Monitoring to determine rehabilitation success will be implemented as part of the monitoring requirements of the Rehabilitation Plan. The following criteria will be used to assess the success of works undertaken as a result of Rehabilitation Plan requirements:

- Germination of native species (seedling emergence rate of between 1-5%).
- Survival of seedlings (75% survival of tubestock).
- Foliage cover (40-50% cover, excluding weeds, two years after implementation of rehabilitation).
- Species representation (one third of the species sown or planted evident in any area of $100m^2$ except areas planted with less than three species).
- An average density of about 1 plant per $1m^2$ for understorey species and one plant per $5m^2$ for larger species.
- Presence of declared weeds (no declared weeds within the rehabilitated area two years after implementation).
- Overall success of plant establishment (a subjective measure based on visual assessment of species composition, plant density and plant health. For example, an area might not meet the above criteria but has the ability to attain it. For instance an area might not contain 40-50% foliage cover but is growing well and will attain that in a few years without the need for remedial action).

If these performance criteria are not met then remedial action will be undertaken as required so that the criteria can be satisfied.

4.5 Weed Management

The introduction and spread of environmental weeds in bushland areas presents a major threat to biodiversity including the loss of native floristic diversity, vegetation structure and native fauna habitat. In addition, a predominance of annual grassy weeds in bushland areas increases the likelihood of summer fires.

In general, the condition of the vegetation in the North West wetland is Excellent with minimal weed infestation limited to the edges of the wetland. The management of environmental weeds in the North West wetland will be a two-step process:

1. a suitably qualified and experienced environmental weed manager will assess the wetland for the presence of weed species; and

2. the weed management contractor will report every six months on the status of weeds in the wetland, in particular on the success of any control methods used and the requirement for additional weeding.

The management of weeds will be detailed in prescriptive Weed Management Strategy which will be commissioned, developed, finalized and implemented to the satisfaction of the City of Swan and the relevant Stage Government management body following approval of this Wetland Management Plan.

4.6 Landscaping Implementation and Maintenance

Landscape treatments in POS areas adjacent to the North West wetland will incorporate native plantings with low nutrient and water requirements. Areas of garden beds adjacent to remnant bushland areas will be trickle irrigated to prevent overspray.

Fertiliser application and irrigation of turfed areas will be kept to the minimum required for healthy growth. Regular mowing of grassed areas, and the removal of cuttings from the site, will assist the removal of nutrients.

A high Phosphorous Retention Index (PRI) substrate will be installed or incorporated into the soil, as a matter of Environmental Best Practice, prior to the laying of turf in proposed areas of passive recreation. Only slow release, low phosphorous fertiliser will be applied to turfed areas, and no animal manure soil conditioners will be used.

Weed management will be enhanced through:

- the installation of reticulation in grassed areas so as to avoid overspray into remnant vegetation and/or rehabilitation areas;
- installation of flush curbing to delineate grassed areas from wetland conservation areas; and
- the installation of mulch in rehabilitated areas.

4.7 Vegetation Monitoring

In accordance with the Wetland Management Strategy a program will be implemented within the North West wetland to monitor vegetation quality. The program will be devised in consultation with and to the satisfaction of the City of Swan and the relevant Stage Government management body. The vegetation monitoring programme will be conducted in accordance with *Guidance Statement No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004b).

Vegetation quality will be assessed by establishing permanent monitoring transects and/or quadrats (10m x 10m in dimension) through the wetland area. The transects and/or quadrats will be located so that as much of the different vegetation types as possible are sampled. The transects will be from 50m to 100m long and species present within each 10m interval will be recorded within 10 x 10m quadrats. Tree vigour will also be assessed along the transects annually. Photographic records will be kept as a means of assessing vegetation quality. Reporting of the results to the City of Swan and the relevant State Government management body will be undertaken on an annual basis. Vegetation monitoring will be undertaken annually by the developer commencing in 2006 and continuing for a period of five years from completion of the works in the DP2 area.

The results of the vegetation quality assessments will be compared with the water level and water quality monitoring data to determine whether any observed changes in vegetation are related to changes in the hydrological regime. Twenty eight groundwater monitoring bores that were recommended in the 1995 Wetland Management Strategy for installation prior to development on the site have been installed and monitored monthly for water levels since 1995 (JDA, 2004).

4.8 Fauna Management

A fauna survey by Alan Tingay & Associates (1994b) showed that the Southern Brown Bandicoot was present at Egerton in the wetland areas and associated vegetation. It was calculated that between 20 to 60 individuals may be present at Egerton. A Bandicoot Protection Strategy was prepared as a condition of the approval for the rezoning. The strategy was prepared in consultation with CALM and was approved by the Minister for the Environment in June 1995. The strategy advocated the retention of bandicoots in the North West wetland area. Underpasses will be provided for Bandicoots at Millhouse Drive and the local road crossing the Conservation link to the north of Millhouse Drive.
Dogs and domestic cats that may prey on fauna in the wetlands are likely to live in surrounding residential areas. Foxes and feral cats may also be present or may visit the area. Although some rabbits may occur in the North West wetland the water table is too close to the surface in most areas to allow the construction of warrens.

Specific measures to control pets and other pest species will include the installation of 1.2m high fencing around the North West wetland to act as a deterrent to dogs. The fencing will be required to allow movement of Bandicoots through the wetland areas. A community awareness program will be introduced to educate residents on the sensitive nature of the local fauna and the importance of managing cat behaviour through bells, and self-imposed cat curfews. A strategy for the management of feral animals will be devised in conjunction with the Department of Environment and Conservation.

4.9 Fire Management

The residential developments in the Vale will result in the construction of houses within close proximity to public open space areas containing native vegetation. This will bring with it the risk of fire threatening property and residents. As a result the developer commits to preparing and implementing a Fire Management Plan, to reduce the risk of damage from wildfires.

The Fire Management Plan will have two principal objectives:

- to protect life and property within the proposed development from wildfires; and
- to protect the environmental values of the remnant bushland and fauna habitats at Vale.

The Fire Management Plan will aim to introduce fire protection measures such as long-term maintenance of access, strategic fire break systems, water supply, fuel reduction management and maintenance of a fire-fighting force. In addition to this the Plan will aim to deal with the long-term maintenance of the protective measures.

The Fire Management Plan will be submitted concurrently with Development Plan 2.

The relevant Stage Government management body will ensure that the Fire and Emergency Services Authority (FESA) is made aware of the environmental significance of the North West wetland area.

Access to the wetland area will be provided along the southern wetland boundary in conjunction with access paths. Access will be provided via secure gates. Footpaths within the wetland will be 2.1m in width and will cater for fire vehicle access. The Fire and Emergency Services' Midland Office will be provided with duplicate copies of the secured gate keys to enable access into the North West wetland in the event of bush fire.

Access to a water supply for fire suppression purposes will be from fire hydrants located within the road reserves that are provided to the relevant standard and agency requirements. Fire hydrants will be installed in accordance with the requirements of the Fire Management Plan. All supply sources which can be used for fire fighting purposes will be signposted.

To assure protection to the individual landowners within the estate, a management plan will be distributed to all prospective land owners within the development. In addition, a copy of the Home Owners Fire Manual, prepared by the Fire and Emergency Services authority of WA (FESA), should also be included.

Following development, FESA, in conjunction with the City of Swan, will establish a Bushfire Ready Action Group comprising members of the community including a street coordinator from each major thoroughfare in the development.

5. CREEKLINES

5.1 Access and Facilities

In accordance with the approved Egerton Wetland Management Strategy (Alan Tingay and Associates, 1995) the drainage function of the creek lines will be maintained. The creek lines will be retained within Multiple Use Corridors and District Open Space and will incorporate grassed POS areas, areas of rehabilitated native vegetation and Dual Use Paths. A Development Plan 2 Open Space Landscape Strategy has been prepared for the creek lines by McNally Newton Landscape Architects (2006). The Strategy is shown in Appendix 2.

Grassed areas with be provided within the Multiple Use Corridors, both to provide a stormwater attenuation function and to provide areas for passive recreation. The grassed areas will be placed so as to retain as much remnant vegetation as possible. In areas where swales are expected to contain water at or just below the surface for longer periods the swales will be planted with wetland species such as reeds and sedges.

A pedestrian path system will link the Multiple Use Corridors with the surrounding residential areas. All footpaths will fully cater for disabled access to Australian Standards. The footpaths will be 2.1m in width, which allows for maintenance access. They will consist of washed aggregate concrete with a 3% black oxide colour mix. Footpaths should be installed following the commencement of the civil construction to the surrounding subdivision, in accordance with the installation of the landscaped areas surrounding the creek lines.

Interpretative signage is proposed to be located at strategic points along the pathway system. The signage will provide the local community and visitors with information relating to the ecology of the creek system, the importance of nutrient control information about stormwater at Vale. The signage will be constructed with mild steel/brass base plate mounted on Toodyay stone style plinths and will have concrete footings. Interpretative Signage should be installed following the construction of the footpaths.

Park furniture and BBQ areas may be located in the passive recreation area central to the creek lines near Millhouse Drive. Park furniture will typically be constructed from mild steel flatbar and dressed hardwood timber. BBQs if utilised may include materials such as Toodyay stone and stainless steel/hardwood bench tops. Pole top POS lights will typically be constructed of steel. Park Furniture should be installed following the construction of the footpaths with the associated landscape works. Recycled materials will be used where possible.

5.2 Drainage

The urban stormwater drainage system at Vale is required to accommodate surface drainage from urban areas and subsoil drains, while at the same time preventing deterioration of wetlands, eutrophication of Ellen Brook and the Swan River, and control of peak flows into downstream water bodies.

Stormwater drainage will be directed into the creek lines via bubble-up pits. The bubble up pits will be located within drainage swales located either adjacent to the existing creek lines or created by widening the creek area itself. The dimensions of the swales will vary depending on the existing flows within the creek lines and will also be modified to allow retention of existing vegetation where possible. It is anticipated that the area required for stormwater attenuation will not exceed 4ha. As indicated in Appendix 2, an ornamental

stormwater detention basin/open water body may be required in the creek line area to obtain the overall 4ha stormwater attenuation requirement. It is anticipated that the ornamental stormwater detention basin/open water body will be located just prior to the linkage of the creek system with the Heritage dam.

Further information regarding the proposed drainage structures within the creek lines can be found in the Drainage and Nutrient Management Plan for the DP2 area (JDA, 2006).

5.3 Water Quality

There are no known water quality issues associated with the three creek lines that flow from the North West wetland into North West Creek. Nevertheless nutrient and other contaminants entering the shallow groundwater and stormwater system will be avoided or minimised to reduce the potential for negative impacts on the wetland.

A regular street sweeping program, to be initiated and maintained during the housing construction phase of the development (and undertaken by the City of Swan thereafter), will minimise the amount of nutrients, sediments, heavy metals and hydrocarbons entering the creek system.

Fertiliser application and irrigation of turfed areas surrounding the creek lines will be kept to the minimum required for healthy growth. Regular mowing of grassed areas, and the removal of cuttings from the site, will assist the removal of nutrients.

A high Phosphorous Retention Index (PRI) substrate will be installed or incorporated into the soil, as a matter of Environmental Best Practice, prior to the laying of turf in proposed areas of passive recreation. Only slow release, low phosphorous fertiliser will be applied to turfed areas, and no animal manure soil conditioners will be used.

Residential gardening practices have the greatest influence on stormwater quality within the subdivision. Delivery of stormwater to areas with drainage functions via sheet flow from adjacent flush-kerbed roadways, and through bubble-ups to the swale system is most likely the most important potential source of nutrients.

Source control, addressing residential gardening and fertilising practices through community education, has been identified as a very cost-effective and potentially significant means of addressing stormwater quality (Water and Rivers Commission, 2003).

Ultimately the effectiveness of nutrient management on individual residential lots rests with the individual residents. In order to ensure that residents are aware of the ecological setting of their residential area, and the importance of minimising nutrient contamination of the creek lines, the developer will develop a Community Education Strategy (CES) in liaison with the City of Swan to be targeted at property purchasers and residents within the subdivision. Educational material will accompany all land sales documentation, and continue to be provided periodically to all residents. The CES will be simple and explicit and will detail the following:

- the advantages of planting native gardens;
- the advantages of using composting and permaculture techniques to minimise fertiliser applications;

- guidelines for appropriate fertiliser selection and application rates, using the recently launched *Fertilise Wise Guide* (developed by the Phosphorous Action Group with support of the Swan River Trust through the Swan Canning Clean Up Programme); and

- consequences of over-application of fertilisers, including potential algal, midge and mosquito problems.

The CES will encourage purchasers and residents to think carefully in the planning stage of their gardens. The use of slow release fertilisers (non-water soluble such as fused magnesium phosphate) will need to be encouraged to minimise the potential for phosphorous and nitrogen leaching from soluble fertilisers.

In accordance with the Egerton Wetland Management Strategy (Alan Tingay and Associates, 1995), a commitment has been made to undertake monthly monitoring of groundwater levels and groundwater quality from bores located near the creek lines and other bores installed within the DP2 area. There are no bores currently within the creek line areas. It is recommended that a minimum of two addition bores be installed to monitor groundwater levels within the creek lines.

Following the approval of the Drainage and Nutrient Management Plan (JDA, 2006) a Drainage and Nutrient Management Program will be devised. The Drainage and Nutrient Management Programme for DP2 will detail the location of additional bores to be installed within the DP2 area. Monitoring prescribed under the Drainage and Nutrient Management Program will be undertaken for the duration of the development and for ten years following urbanization (JDA, 2006). Water quality parameters that will be analysed include electrical conductivity, pH, temperature, total phosphorous, total nitrogen, total kjeldahl nitrogen, nitrate, nitrate, ammonia and filterable reactive phosphorous.

Annual monitoring reports for the bores installed to monitor groundwater within the creek lines and the bores installed for the Drainage and Nutrient Monitoring Program will be submitted to the Department of Environment and Conservation and to the City of Swan.

Further detail on monitoring will be provided in the Drainage and Nutrient Management Plan prepared for the Development Plan 2 area (JDA, 2006).

5.4 Revegetation

The vegetation within the creek lines is generally in Degraded to Good condition with some areas of remnant vegetation. A large proportion of the creek line areas has been cleared and grazed. While portions of the creek line areas will be grassed for passive recreation and drainage purposes revegetation will be undertaken in areas that are intended to contain native vegetation.

It is intended that pockets of native vegetation will be retained where possible around the drainage swale infrastructure. Existing vegetation will be augmented with additional planting or transplantation of local species to provide pockets of native vegetation in landscaped areas. Species to be used will depend on the levels of inundation. An indicative list of species suitable for rehabilitation works is given in Table 4.

TABLE 4
SPECIES SUITABLE FOR USE IN REVEGETATION WORKS - CREEKLINES

Wetland Species	Dryland and Transitional Species
Melaleuca preissiana	*Eucalyptus marginata*
Melaleuca rhaphiophylla	*Banksia attenuata*
Eucalyptus rudis	*Banksia menziesii*
Astartea fascicularis	*Persoonia saccata*
Hypocalymma angustifolium	*Jacksonia furcellata*
Pericalymma ellipticum	*Stirlingia latifolia*
Juncus pallidus	*Pimelea leucantha*
Macrozamia riedlei	*Hybanthus calycinus*
Leucopogon australis	*Nuytsia floribunda*
Scholtzia involucrata	*Xanthorrhoea preissii*
Hibbertia subvaginata	*Hibbertia hypericoides*
	Patersonia occidentalis
	Baumea articulata

When undertaking revegetation works, seedlings will be used where possible and planted to take full advantage of winter rainfall and in densities consistent with the surrounding vegetation. Care will be taken to avoid evenly spacing seedlings or planting in rows so that a natural effect is achieved.

Wherever possible, revegetation material, including seed, should be collected from vegetation adjacent to or in the vicinity of the development to ensure the use of local provenance stock. Revegetation works will be undertaken during the winter months when rainfall will promote plant establishment.

5.5 Weed Management

The introduction and spread of environmental weeds in bushland areas presents a major threat to biodiversity including the loss of native floristic diversity, vegetation structure and native fauna habitat. In addition, a predominance of annual grassy weeds in bushland areas increases the likelihood of summer fires.

As the current condition of the vegetation in the creek lines is generally Degraded to Good with a high proportion of introduced species weed management will be a large factor in determining rehabilitation success. The management of environmental weeds in the wetlands will be a two-step process:

1. a suitably qualified and experienced environmental weed manager will assess the creek lines for the presence of weed species; and

2. the weed management contractor will report every six months on the status of weeds in the creek lines, in particular on the success of any control methods used and the requirement for additional weeding.

The management of weeds will be detailed in prescriptive Weed Management Strategy for the Development Plan Two area which will be commissioned, developed, finalized and implemented to the satisfaction of the City of Swan following approval of this wetland management plan.

5.6 Landscaping Implementation and Maintenance

Landscape treatments will incorporate native plantings with low nutrient and water requirements. Areas of garden beds adjacent to remnant bushland areas will be trickle irrigated to prevent overspray.

Fertiliser application and irrigation of the turfed area will be kept to the minimum required for healthy growth. Regular mowing of grassed areas, and the removal of cuttings from the site, will assist the removal of nutrients.

A high Phosphorous Retention Index (PRI) substrate will be installed or incorporated into the soil, as a matter of Environmental Best Practice, prior to the laying of turf in proposed areas of passive recreation and drainage swales. Only slow release, low phosphorous fertiliser will be applied to turfed areas, and no animal manure soil conditioners will be used.

Weed management will be enhanced through:

- the installation of reticulation in grassed areas so as to avoid overspray into remnant vegetation and/or rehabilitation areas; and
- the installation of mulch in rehabilitated areas.

It is intended that all Multiple Use areas within the Development Plan 2 area will be managed as low fuel zones and this will need to be taken into account when landscaping, rehabilitation and maintenance activities are undertaken.

5.7 Vegetation Monitoring

The vegetation within the creek line areas has been subjected to clearing and disturbance through grazing. Monitoring of areas to be rehabilitated will be detailed within the Rehabilitation Plan for the DP2 area. Accordingly no vegetation monitoring is proposed for the creek line areas.

5.8 Fauna Management

No bandicoots were found with in the creek line areas during the 1994 fauna survey of the Egerton property (Alan Tingay and Associates, 1995). Accordingly no fauna management measures are recommended for the creek line area.

TABLE 5
WETLAND MANAGEMENT: ACTIONS AND FREQUENCIES, REPORTING FRAMEWORKS AND FREQUENCIES, IMPLEMENTATION AND REPORTING RESPONSIBILITIES

Note: where shared responsibility is indicated for an aspect that may extend beyond the Developer's normal five year management period from practical completion, both the Developer and the City of Swan are listed as responsible agents. The City of Swan will assume management responsibility following handover from the Developer, which is five years after practical completion.

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.1	**Drainage Maintenance**				
T1.1.1	• Avoid sedimentation of swales and wetland (housing construction phase)	Street sweeping programme to be initiated and maintained during housing construction phase of subdivision.	Post-Construction	Monthly	Developer
T1.1.2	• Avoid sedimentation of swales and wetland (housing construction phase)	Maintenance of bubble-up pits to be carried out during housing construction phase of subdivision.	Post-Construction	As required	Developer City of Swan
T1.1.3	• Avoid sedimentation of swales and wetland (post housing construction phase)	Street sweeping programme to be initiated and maintained.	Post-Construction	Monthly	Developer City of Swan
T1.1.4	• Avoid sedimentation of swales and wetland (post housing construction phase)	Maintenance of bubble-up pits to be maintained.	Post-Construction	As required	Developer City of Swan

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.2	**Landscape Implementation**				
T1.2.1	• Achieve high quality landscaping	Implement landscaping in accordance with approved plan.	Post-Construction	Once only	Developer
T1.2.2	• Manage phosphorous leaching	Install high Phosphorous Retention Index (PRI) substrate prior to turf installation.	Post-Construction	Once only	Developer
T1.2.3	• Manage environmental weeds	Install mulch, where appropriate, to City of Swan specifications, 100mm deep.	Post-Construction	Once only, top-up as necessary.	Developer City of Swan
T1.2.4	• Manage environmental weeds	Install reticulation in grassed areas so as to avoid overspray into remnant vegetation and/or rehabilitation areas.	Post-Construction	Once only, inspect during routine maintenance.	Developer City of Swan

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.3	**Landscape Management**				
T1.3.1	• Prevent nutrient leaching	Use only slow release low phosphorous fertilisers.	Post-Construction	Ongoing. Fertiliser regime to be developed to satisfaction of City of Swan	Developer City of Swan
T1.3.2	• Prevent nutrient leaching	All lawn clippings to be removed from site.	Post-Construction	Monthly	Developer City of Swan
T1.3.3	• Manage environmental weeds	Top-up mulch to maintain 100mm depth.	Post-Construction	Ongoing	Developer City of Swan
T1.3.4	• Manage environmental weeds	Initiate and maintain weed control in grassed areas and garden beds.	Post-Construction	Monthly	Developer

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.4	**Rehabilitation of Natural Areas**				
T1.4.1	• Guarantee rehabilitation	Developer and City of Swan to sign-off on Wetland Management Plan commitments.	Following Wetland Plan Approval	Once only, prior to sign-off on Development Approval Conditions	Developer City of Swan
T1.4.2	• Guarantee rehabilitation	Developer to exchange correspondence with City of Swan to confirm commitment to rehabilitation requirements.	Following Wetland Plan Approval	Once only	Developer
T1.4.3	• Achieve high quality rehabilitation of identified disturbed areas	Commission and finalise development of Rehabilitation Plan to the satisfaction of the City of Swan. A suitably qualified and experienced environmental weed manager will assess the WMP and develop a Weed Management Strategy, to the satisfaction of the City of Swan, to be included in the Rehabilitation Plan.	Following Wetland Plan Approval	Once only	Developer
T1.4.4	• Achieve high quality rehabilitation of identified disturbed areas	Implement Rehabilitation Plan.	Post-Construction	Once only	Developer City of Swan
T1.4.5	• Achieve high quality rehabilitation of identified disturbed areas • Acquire appropriate tubestock	Commission propagation of required native tubestock (in accordance with Rehabilitation Plan and monitoring results). Provenance to be local or otherwise appropriate to the satisfaction	Post-Construction	2007 for installation in 2008	Developer City of Swan

	Objective	Initiative	Start Date	Frequency	Responsibility
		of the City of Swan.			
T1.4.6	• Manage erosion	Reduce roadside batters where appropriate, install erosion matting or similar as required to the satisfaction of the City of Swan.	Post-Construction	Once only, maintain/ repair as necessary	Developer
T1.4.7	• Monitor rehabilitation	Implement monitoring protocol to satisfaction of City of Swan.	Following Wetland Plan Approval	Once only, review as necessary	Developer
T1.4.8	• Monitor rehabilitation • Respond to monitoring	Monitor and report on success of rehabilitation programme, considering structure and composition, (as per above protocol), prescribe, to the satisfaction of the City of Swan, in-fill rehabilitation requirements for following winter planting and further planting.	Following Wetland Plan Approval	Six-monthly, to satisfaction of City of Swan	Developer
T1.4.9	• Protect rehabilitation areas from pedestrian traffic	Install fence at interface with public access areas, as detailed in Section 4.1.	Post-Construction	Once only, at time of landscape development, repair as necessary	Developer
T1.4.10	• Manage environmental weeds	Install mulch to City of Swan specifications to all areas except those subject to seasonal inundation.	Post-Construction	Once only, top-up as necessary.	Developer City of Swan
T1.4.11	• Manage environmental weeds	Initiate and maintain weed control as per the Weed Management Strategy, engaging suitably qualified and experienced environmental weed management contractor.	Post-Construction	Until 5 years following practical completion	Developer City of Swan
T1.4.12	• Manage environmental weeds	Provide report to City of Swan on implementation of the Weed Management Strategy, in particular on the success of the strategy on individual target species and priority areas.	Post-Construction	Six-monthly from date of implementation	Developer City of Swan
T1.4.13	• Manage environmental weeds	Adapt Weed Management Strategy in response to reporting on implementation.	Post-Construction	As needs	Developer City of Swan
T1.4.14	• General	Implement any other strategies/requirements prescribed in the Rehabilitation Plan and Strategy and not specifically addressed in this table.	Post-Construction	As needs	Developer City of Swan

T1.5	**Wetland Management**				
T1.5.1	• Identify changes in wetland hydrology	Maintain and monitor on a monthly basis 28 permanent monitoring bores prior to development. Additional bores to be installed post-development in locations to be agreed with the City of Swan following Drainage and Nutrient Management Program approval.	Following Wetland Strategy Approval Following approval of Drainage and Nutrient Management Program	Monthly (since 1995), subject to damage, vandalism Monthly for following bore installation	Developer DEC Developer/ DEC
T1.5.2	• Report on wetland hydrology	Annual report on groundwater levels to be submitted to City of Swan.		Annually	Developer City of Swan DEC
T1.5.3	• Address changes in wetland hydrology	Should significant increases in surface water levels (depth or period) be detected, investigate cause and develop contingency to address cause and/or impact(s).		As determined by monitoring	Developer City of Swan DEC
T1.5.4	• Monitoring of Southern Brown Bandicoots	Implementation of the strategy for protection of the Southern Brown Bandicoot within the north-south linear wetland.	Pre-Construction	Prior, during and after development*	Developer CALM
T1.5.6	• Vegetation Monitoring	Implement monitoring protocol to satisfaction of City of Swan.	Following Wetland Plan Approval	Prior, during up until 5 years following practical completion*	Developer CALM

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.6	**General Maintenance**				
T1.6.1	• Maintain rubbish-free area	Wind-blown and other rubbish to be removed from site, particularly in likely areas of collection – edges of bushland.	During and Post-Construction	Monthly	Developer City of Swan
T1.6.2	• Maintain rubbish-free area	Rubbish and debris delivered to site through stormwater drainage to be removed from collection areas around bubble-ups.	During and Post-Construction	Monthly	**Developer** City of Swan

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.7	**Nutrient Source Control**				
T1.7.1	• Reduce nutrient input from residential gardening activities	Develop a Community Education strategy that seeks to minimise nutrients inputs from residential gardening activities to shallow groundwater and stormwater runoff. Frequency of contact with residential community, and information format to be determined by the strategy.	As requested	During marketing phase of development	Developer City of Swan DoE
T1.7.2	• Reduce nutrient input from residential gardening activities	Implement a Community Education strategy that seeks to minimise nutrients inputs from residential gardening activities to shallow groundwater and stormwater runoff.	As requested	Ongoing, frequency and means of contact to be determined by the Strategy	Developer City of Swan DOE

	Objective	Initiative	Start Date	Frequency	Responsibility
T1.8	**Management Plan Review**				
T1.8.1	• Maintain Management Plan's currency	Review Wetland Open Space Management Plan.		Five years following endorsement	City of Swan
	Objective	**Initiative**	**Start Date**	**Frequency**	**Responsibility**
T1.9	**Fire Management**				
T1.9.1	• Maintain Management Plan's currency	Proposed roads, DUP's and secure gates will provide fire access to the bushland areas in the event of a fire. Fire hydrants will be installed in the road reserves adjacent to the wetland area. A Fire Management plan will be distributed to all prospective land owners within the development.	Following Wetland Plan Approval	Once only	Developer

* For the purposes of the monitoring programme, monitoring will be undertaken annually for a period of five years after the time when houses have been completed on 50% of the DP2 area or three years after the last lot is subdivided, whichever is greater.

6. IMPLEMENTATION, TIMING AND RESPONSIBILITIES

Implementation of this Wetland Management Plan will be undertaken in conjunction with drainage works, landscape works, rehabilitation works and other construction phases of the proposed development. Revegetation will commence as soon as conditions for revegetation are suitable to maximise plant establishment.

The implementation of measures outlined in this plan will be the responsibility of the developer until formal handover of the development is agreed. Following this the City of Swan will assume long-term management and maintenance responsibilities for all areas with the exception of Bush Forever Site 22 (Egerton Mound Spring and Adjacent Bushland, Ellenbrook) which will be vested with the Western Australian Planning Commission or some other appropriate body such as the Department of Environment and Conservation or the Whiteman Park Board.

6.1 Allocation of Responsibilities

The developer will be responsible for the implementation of the recommendations presented in this Management Plan, as well as the ongoing management and maintenance to the satisfaction of the City of Swan over a period of five years from practical completion. Ongoing maintenance of the POS features will be the responsibility of the developer typically for the first five calendar years following development or as agreed with the City of Swan.

Following this period, the City of Swan will assume responsibility for the management and the ongoing implementation of this Plan with the exception of Bush Forever Site 22 (Egerton Mound Spring and Adjacent Bushland, Ellenbrook).

6.2 Monitoring and Review

The implementation of management strategies detailed in this Plan will be an on-going process, which should be flexible in responding to changes in the natural environment, the recreational use of the environmental and community values. Monitoring procedures will assist in the adaptive management of the wetlands, as well as informing the progress of management.

The programme of monitoring the success of the strategies is essential for the purposes of reviewing and updating the Plan by the City of Swan in five years time. This will ensure that the objectives of the Plan are achieved and that any changes or new developments in management techniques can be incorporated.

6.2.1 Performance Monitoring

The developer will implement monitoring procedures to assess the success of management strategies addressing rehabilitation works, weed control activities, water quality and drainage management. This will allow identification of areas requiring augmentation or remedial works to be identified early and appropriately planned. In addition, the monitoring will ensure that an adequate representation of species and plant density is achieved.

6.2.2 Reporting

An annual monitoring report will be prepared for the City of Swan and the Authority managing Bush Forever Site 22 (Egerton Mound Spring and Adjacent Bushland, Ellenbrook). The monitoring report will provide results of the Bandicoot Monitoring Program, Wetland Vegetation Monitoring and the results of the B series Bore Monitoring Program undertaken by JDA Consultant Hydrologists.

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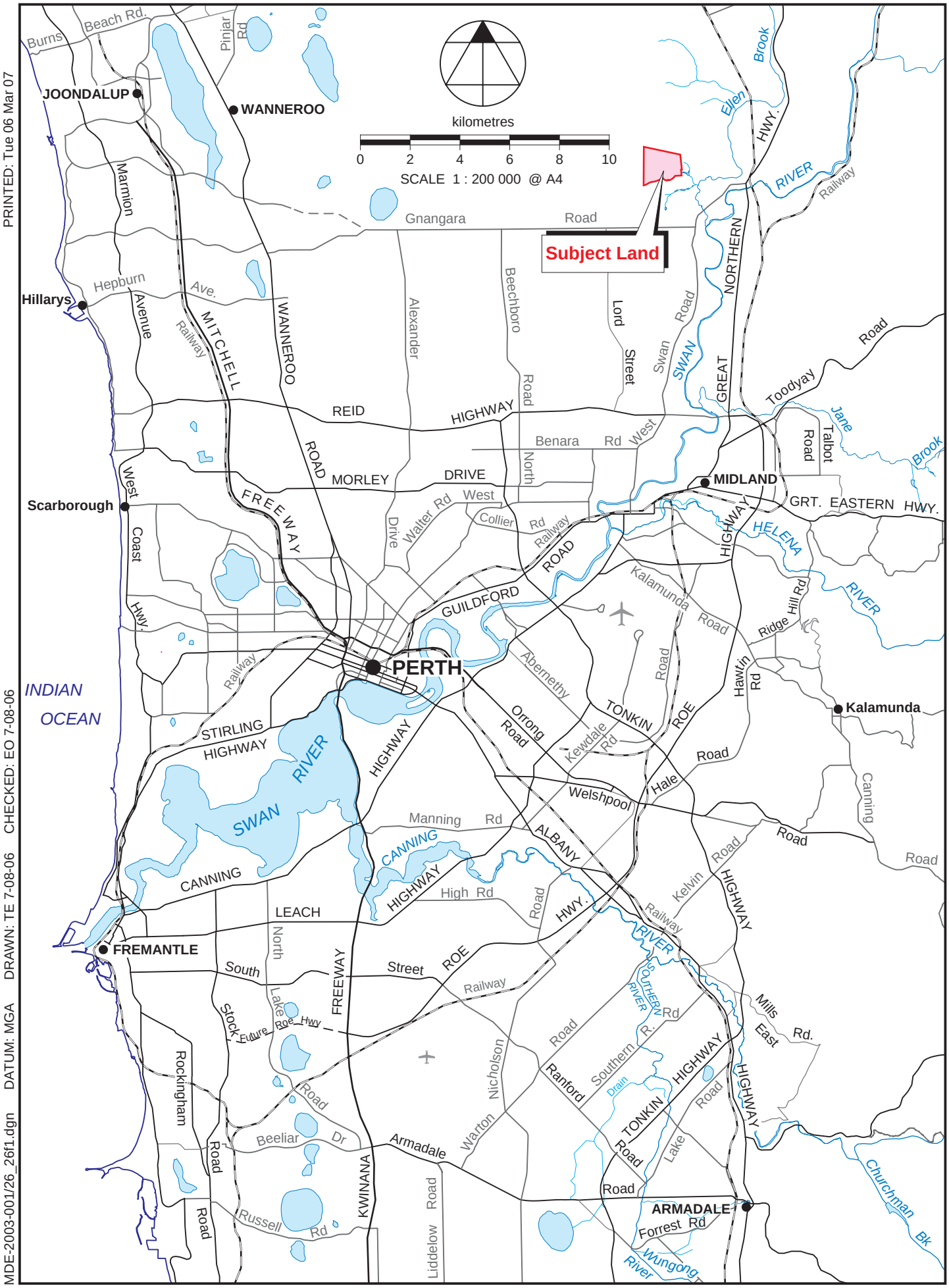
FIGURES



PRINTED: Tue 06 Mar 07 CHECKED: EO 7-08-06 DRAWN: TE 7-08-06 DATUM: MGA MDE-2003-001/26_26f1.dgn

ATA Environmental
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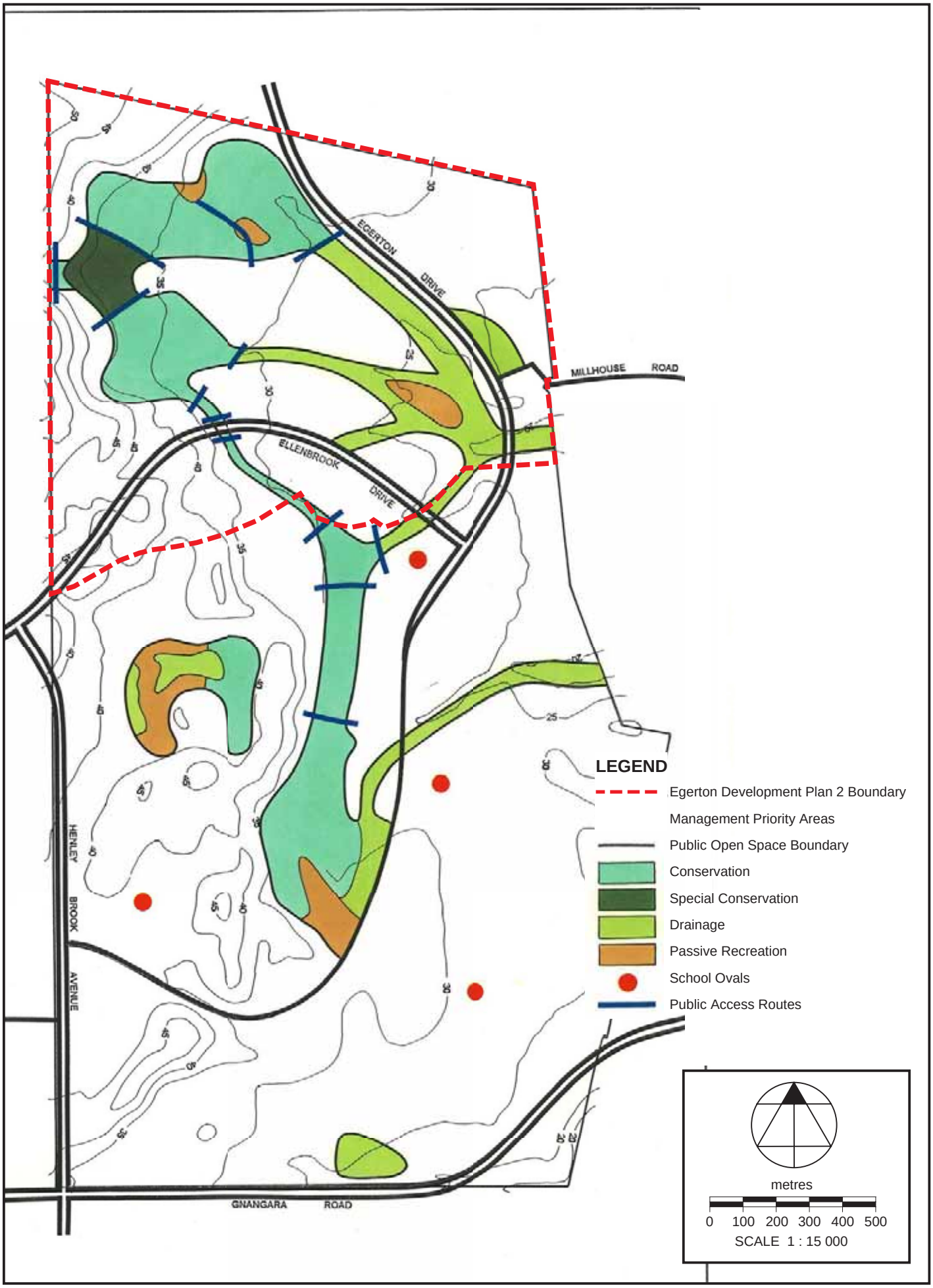
WETLAND MANAGEMENT PLAN
VALE

REGIONAL LOCATION

FIGURE 1



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MDE-2003-001/26_26F2.dgn

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WETLAND MANAGEMENT PLAN
VALE

MANAGEMENT PRIORITY AREAS (WETLAND MANAGEMENT STRATEGY, 1995)

FIGURE 2

PRINTED: Tue 17 Apr 07

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DRAWN: MR 17-04-07

DATUM: MGA

MDE-2003-001/26_26F3.dgn

metres

0 50 100 150 200

SCALE 1 : 6 000 @ A3

SOURCE: Chappell and Lambert, 14-12-2006

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environmental scientists

WETLAND MANAGEMENT PLAN
VALE
EGERTON DEVELOPMENT PLAN 2
FIGURE 3

PRINTED: Tue 06 Mar 07

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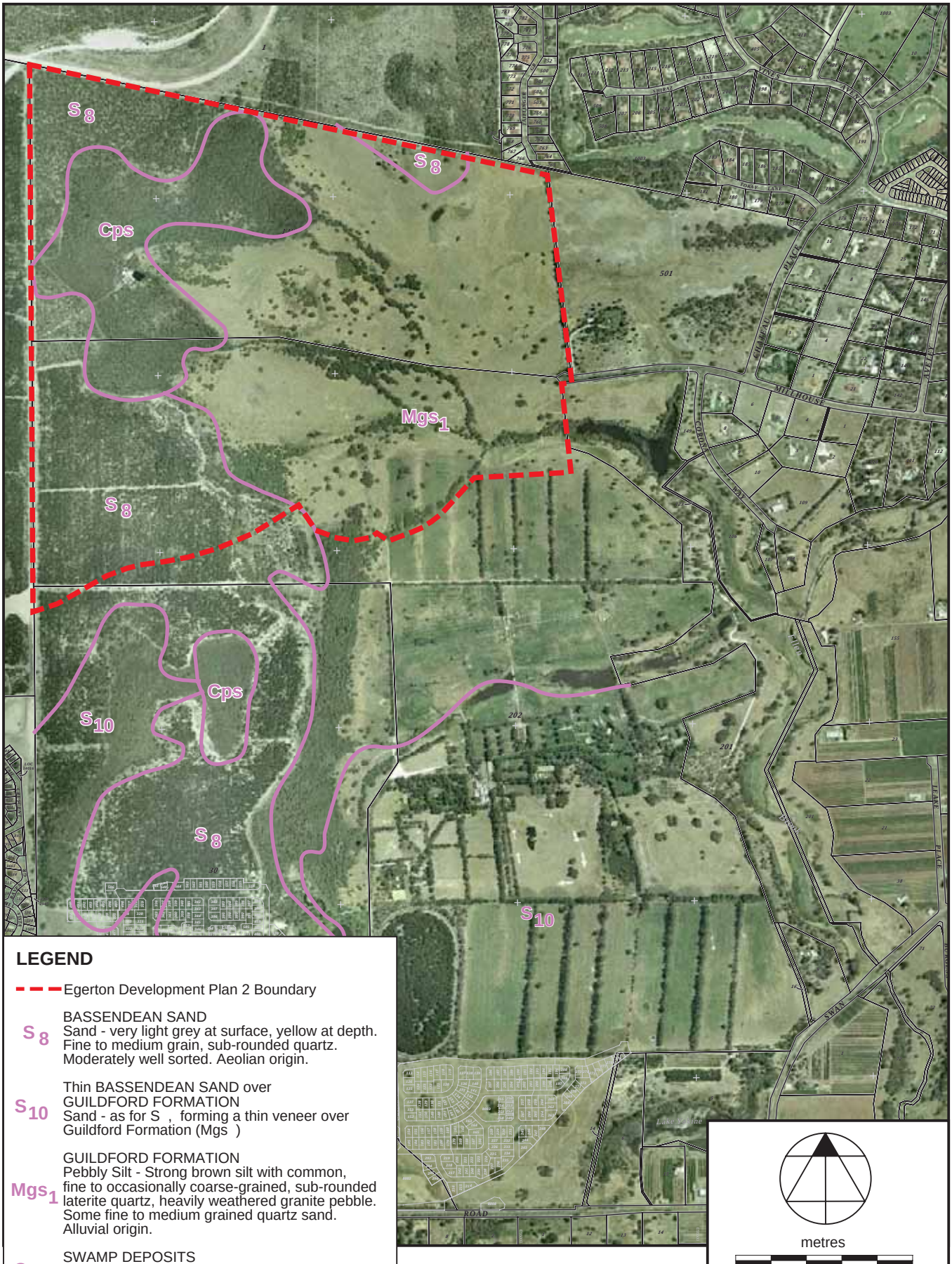
DRAWN BY: TE 7-08-06

DATUM: MGA

MDE-2003-001/26_26F4.dgn



LEGEND

- Egerton Development Plan 2 Boundary

S8 BASSENDEAN SAND
Sand - very light grey at surface, yellow at depth. Fine to medium grain, sub-rounded quartz. Moderately well sorted. Aeolian origin.

S10 Thin BASSENDEAN SAND over GUILDFORD FORMATION
Sand - as for S , forming a thin veneer over Guildford Formation (Mgs)

Mgs1 GUILDFORD FORMATION
Pebbly Silt - Strong brown silt with common, fine to occasionally coarse-grained, sub-rounded laterite quartz, heavily weathered granite pebble. Some fine to medium grained quartz sand. Alluvial origin.

Cps SWAMP DEPOSITS
Peaty Clay - dark grey & black with variable sand content. Lacustrine origin.

metres

0 100 200 300 400 500

SCALE 1 : 15 000

PHOTO & CAD SOURCE: MAPS, July 2004
GEOLOGY SOURCE: GOZZARD 1986

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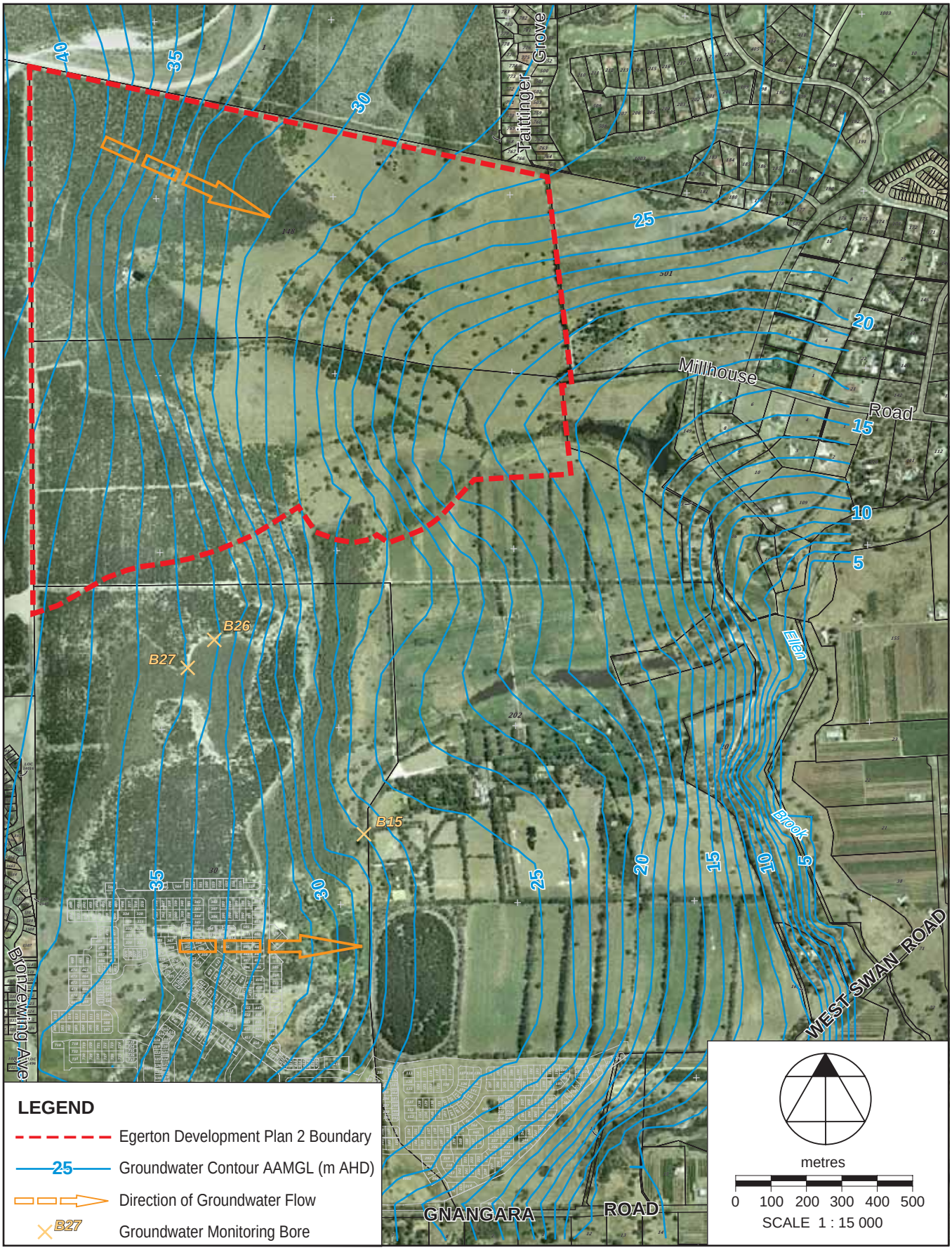
WETLAND MANAGEMENT PLAN
VALE

SUPERFICIAL GEOLOGY

FIGURE 4



PRINTED: Tue 06 Mar 07 CHECKED BY: EO 7-08-06 DRAWN BY: TE 7-08-06 DATUM: MGA MDE-2003-001/26_26F5.dgn

PHOTO & CAD SOURCE: MAPS, July 2004 ; GROUNDWATER DATA SOURCE: JDA, 2003

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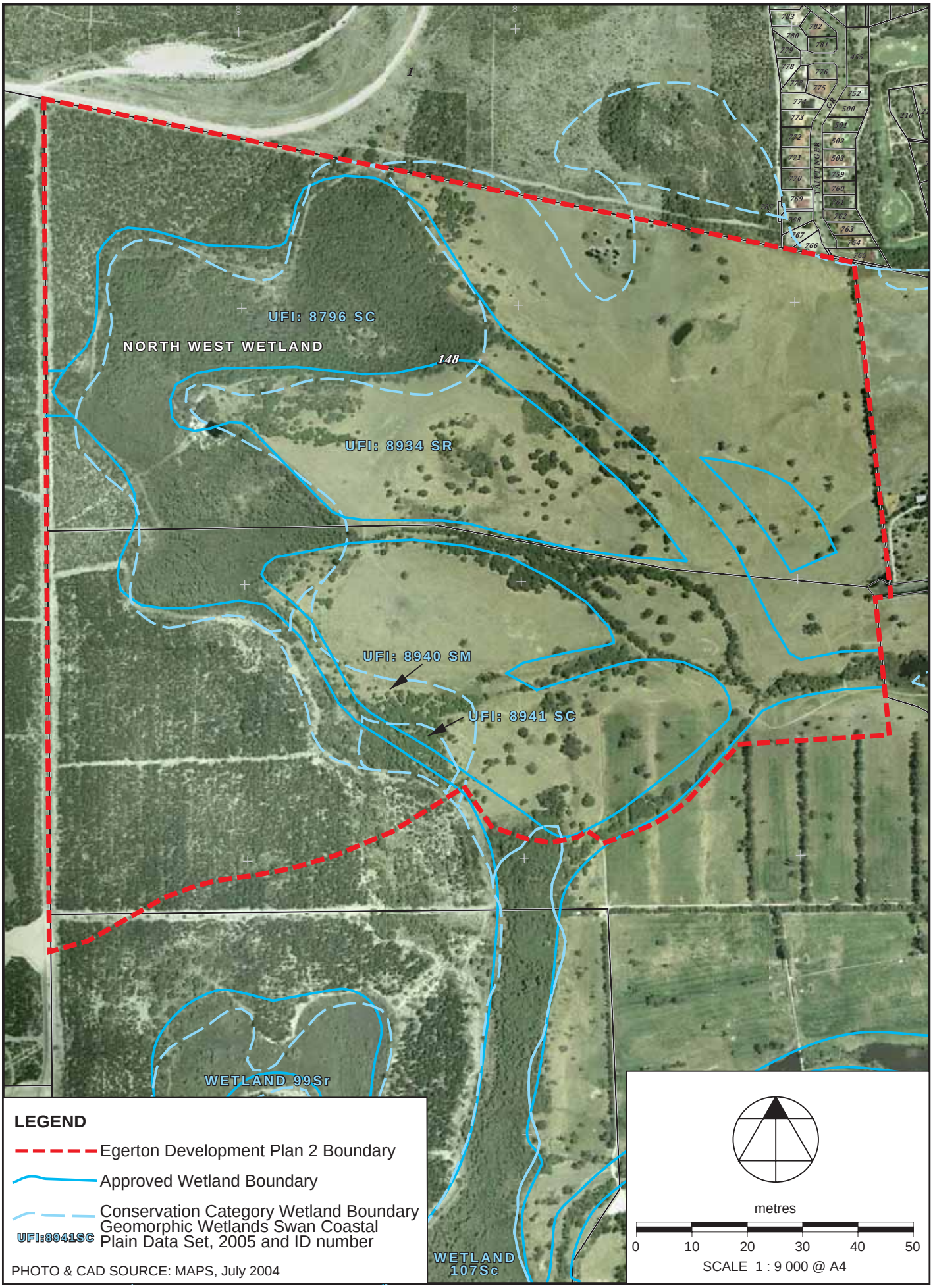
WETLAND MANAGEMENT PLAN
VALE

GROUNDWATER CONTOURS (Pre Development)

FIGURE 5



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MDE3-1/26_26F6.dgn

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WETLAND MANAGEMENT PLAN
VALE

APPROVED WETLAND BOUNDARIES

FIGURE 6

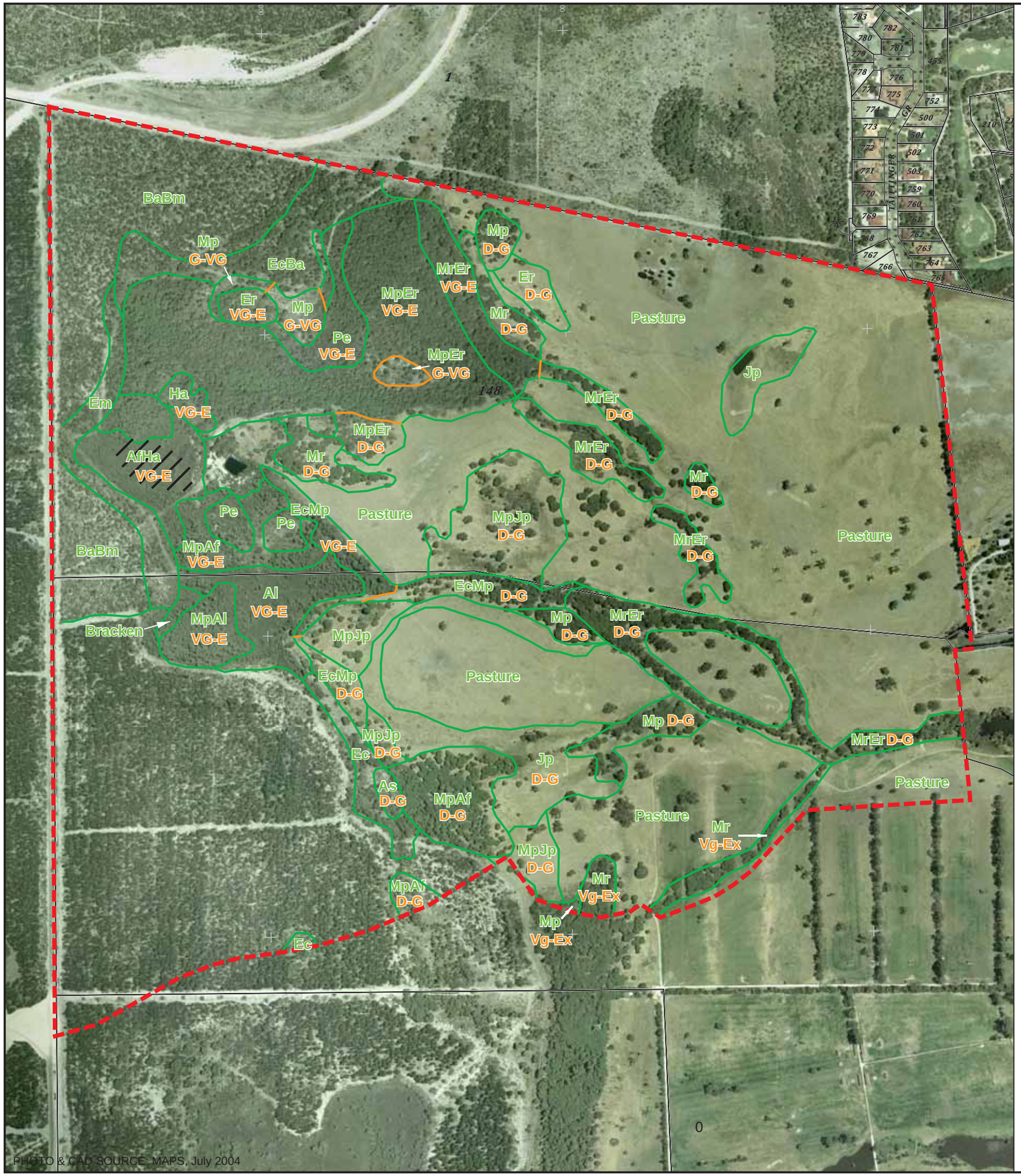

PHOTO & CAD SOURCE: MAPS, July 2004

metres

0 50 100 150 200

SCALE 1 : 7 000 @ A3

LEGEND

- Egerton Development Plan 2 Boundary
- Seepage Area
- Vegetation Type Boundary
- Vegetation Condition Boundary

VEGETATION TYPES

DAMPLAND/HEATHS

Pe	*Pericalymma ellipticum* Closed Heath
Al	*Agonis linearifolia* Open Heath over *Juncus pallidus* Sedgeland
Af	*Astartea fascicularis* Closed Heath
AfHa	*Astartea fascicularis/Hypocalymma angustifolium* Closed Heath
Ha	*Hypocalymma angustifolium* Closed Heath

DAMPLAND/FORESTS, WOODLANDS AND HEATHS

Er	*Eucalyptus rudis* Open Forest
MpEr	*Melaleuca pressiana/Eucalyptus rudis* Closed Forest with *Banksia litoralis*
Mp	*Melaleuca preissiana* Low Woodland
MpJp	*Melaleuca preissiana* Low Open to Low Woodland over *Juncus pallidus Sedgeland*
MpAl	*Melaleuca preissiana* Low Open to Low Woodland over *Agonis linearifolia* Closed Heath
MpAf	*Melaleuca preissiana* Low Open Woodland over *Astertea fascicularis* Closed Heath
As	*Acacia saligna* Low Woodland over *Agonis linearifolia* Open Heath
Jp	*Juncus pallidus* Sedgeland

SUMPLAND AND CREEKS/FORRESTS, WOODLANDS AND SEDGELANDS

Mr	*Melaleuca rhaphiophylla* Low Closed Forest
MrEr	*Melaleuca rhaphiophylla/Eucalyptus rudis* Low Closed Forest
EcMp	*Eucalyptus calophylla* Woodland over *Melaleuca pressiana* Low Woodland
Bar	*Baumea articulata* Closed Sedgeland

OTHER VEGETATION TYPES

Dry / Woodlands

BaBm	*Banksia attenuata/B. menziesii* Low Open Woodland

Transitional/woodlands and Sedgelands

Ec	*Eucalyptus calophylla* Woodland
EcBa	*Eucalyptus calophylla/Banksia attenuata* Woodland
Em	*Eucalyptus marginata* Woodland

WETLAND VEGETATION CONDITION

(Legend Source: BUSH FOREVER Govt. of W.A.)

P	Pristine. (Not Applicable)
Ex	Excellent.
VG	Very Good.
G	Good.
Deg	Degraded.
CD	Completely Degraded. (NA)

NOTE: For full description see text.

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WETLAND MANAGEMENT PLAN
VALE

WETLAND VEGETATION TYPES AND CONDITION

FIGURE 7

PRINTED: Tue 06 Mar 07

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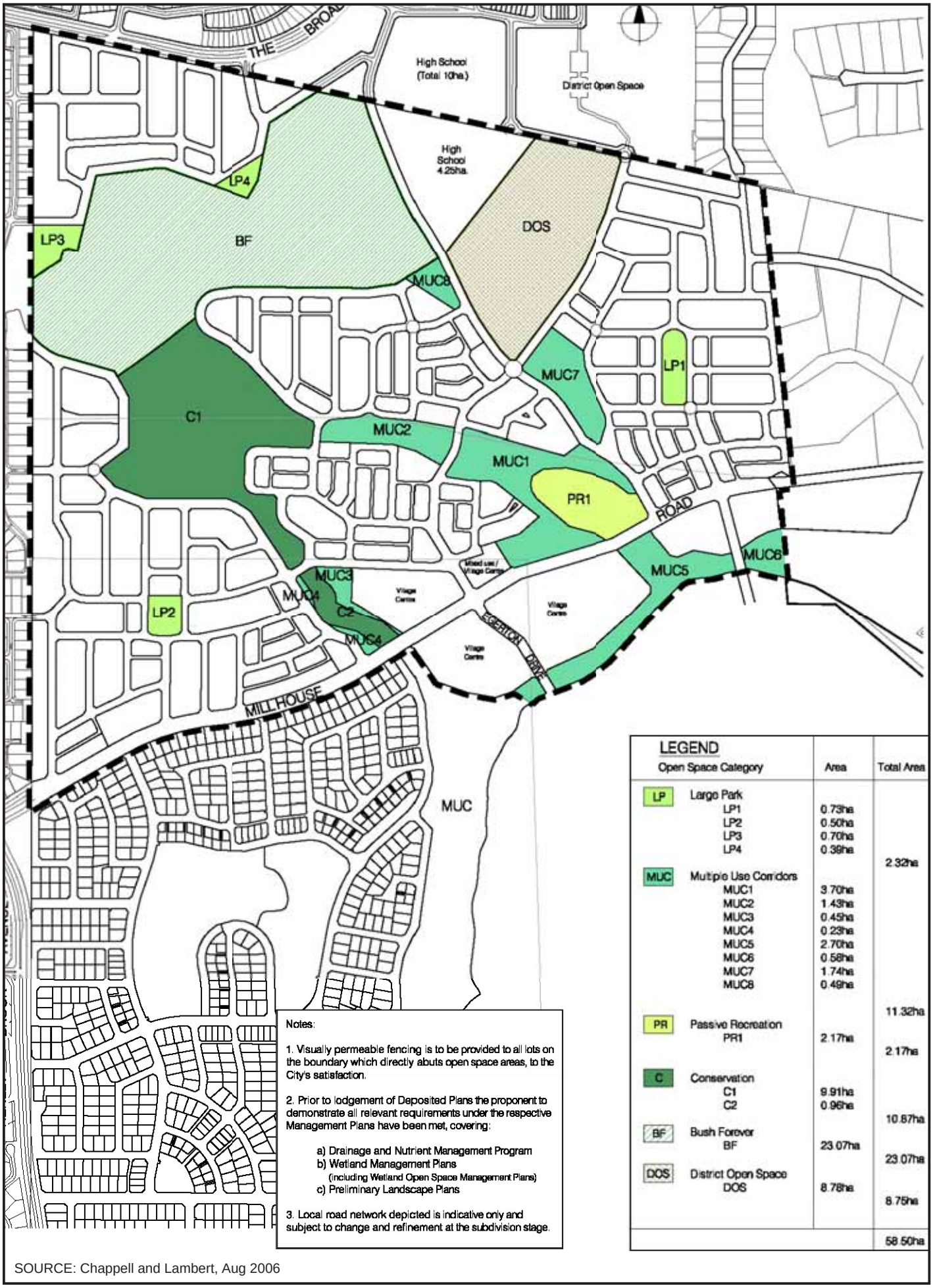
DATUM: MGA

MDE3-1/26_26F7.dgn



SOURCE: Chappell and Lambert, Aug 2006

PRINTED: Tue 06 Mar 07 CHECKED BY: EO 8-08-06 DRAWN BY: TE 8-08-06 DATUM: Not Spatially Correct MDE-2003-001/26_26F8.dgn

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WETLAND MANAGEMENT PLAN - VALE

DEVELOPMENT PLAN 2
PUBLIC OPEN SPACE LAYOUT PLAN
(Prepared by: Chappell and Lambert)

FIGURE 8

APPENDICES

APPENDIX 1

MINISTERIAL CLEARANCE FOR THE WETLAND MANAGEMENT STRATEGY

WESTERN AUSTRALIA

MINISTER FOR THE ENVIRONMENT

16249

27 JUN 1995

FAXED
DATE 27/6/95

Multiplex Construction Pty Ltd
c/o Alan Tingay & Associates
35 Labouchere Rd
SOUTH PERTH WA 6151

ATTENTION: Dr Paul van der Moezel

REZONING OF LAND FROM URBAN DEFERRED TO URBAN, EGERTON (ADJACENT TO ELLENBROOK) (831)

I write in regard to the above proposed development and the clearing of certain Environmental Conditions.

The Environmental Protection Authority has provided its advice concerning Environmental Conditions 3.2, 4.1, 4.3 & 4.5, and Commitments 2 & 3.

Accordingly I advise the following:

> The proponent for this project has met the requirements of Environmental Conditions 3.2, 4.1, 4.3 & 4.5, and Commitments 2 & 3 been superseded by Environmental Condition 3.1 & 3.2 , and 4.3 and 4.4 respectively.

Please note that the above information refers to environmental issues in the Statement. This does not remove the necessity to obtain approvals which may be required by other agencies.

Yours faithfully

Peter Foss

Hon Peter Foss MLC
MINISTER FOR THE ENVIRONMENT;
WATER RESOURCES; THE ARTS; FAIR TRADING

12th FLOOR, DUMAS HOUSE, 2 HAVELOCK STREET, WEST PERTH, 6005 TELEPHONE (09) 321 2222 FAX (09) 322 5149

APPENDIX 2

DEVELOPMENT PLAN 2 OPEN SPACE LANDSCAPE STRATEGY (PREPARED BY MCNALLY NEWTON LANDSCAPE ARCHITECTS)

NP 1

- No existing vegetation currently on site
- Formal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Native shrub species, exotic trees
- Fully irrigated
- Higher level of maintenance

NP 2

- Existing vegetation unable to retained
- Formal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Native shrub species, exotic trees
- Fully irrigated
- Higher level of maintenance

NP 3

- Retain existing vegetation currently on site where possible
- Informal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- All native plant species
- Partly irrigated
- Higher level of maintenance

* Function and Management of POS to be confirmed.

C 1

- Retention of existing vegetation with improvements where necessary to edges etc to preserve its conservation value
- Pedestrian access to controlled paths with Interpretive signage
- Pedestrian lookout structures & shelters at suitable vantage points
- Light vehicular access on pedestrian paths (emergency / maintenance)
- No facilities proposed,
- No irrigation except to residential edges where suitable
- All native species
- Low maintenance level

C 2

- Retention of existing vegetation with improvements where necessary to edges etc to preserve its conservation value
- Pedestrian access to controlled paths with Interpretive signage
- Light vehicular access on pedestrian paths (emergency / maintenance)
- No facilities proposed
- No irrigation except to residential edges where suitable
- All native species
- Low maintenance level

BF (to Department of Environment & Conservation requirements)

- Retention of existing vegetation in its current condition (no improvements proposed),
- Retention of existing natural spring, creeklines and open waterbody.
- Possible picnic facilities and shelters to degraded area around open waterbody.
- Limited pedestrian access to controlled paths with Interpretive signage to edges,
- Pedestrian lookout structures & shelters at suitable vantage points,
- No vehicular access (other than emergency),
- No facilities proposed,
- Fenced edges to restrict human and domestic animal access with fire breaks where necessary,
- No irrigation
- All native species
- Low maintenance level

PR 1

- Retention of existing significant vegetation
- Open active informal grassed recreation area
- Shade trees
- Pedestrian path links to adjacent residential areas
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Introduced and native plant species
- Fully irrigated
- Higher maintenance level

LEGEND.

- RETAINED BUSHLAND.
- TURF AREAS.
- WETLAND AREAS

MUC 1

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales/infiltration/sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes/viewing areas/informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 2

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 3

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 4

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Retention of existing significant vegetation
- Manicured landscape areas edging road verge (seating & signage nodes/viewing areas/informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Minimal irrigation use
- Minimal maintenance areas

MUC 5

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of drainage where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 6

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of drainage where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 7

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales/infiltration/sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes/viewing areas/informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Minimal irrigation use
- Minimal maintenance areas

MUC 8

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

VALE

DEVELOPMENT PLAN - Proposed Subdivision (PLAN 2 of 2)

N

6th March 2006
SCALE 1:2,500

mcnally · newton
LANDSCAPE ARCHITECTS

APPENDIX FOUR

Public Open Space Concept Plans & Maintenance Costing

BLUE TANG (WA) PTY LTD as trustee for The Reef Unit Trust ABN 44 656 153 170 trading as McNally • Newton Landscape Architects

AUSTRALIAN INSTITUTE of LANDSCAPE ARCHITECTS

mcnally · newton
LANDSCAPE ARCHITECTS

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PO Box 341
Northbridge WA 6865
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e : admin @ mnla.com.au
w : www.mnla.com.au

6th March 2007

Carol Catherwood
City of Swan
2 Midland Square
Midland WA

Re: VALE – DEVELOPMENT PLAN 2 - PUBLIC OPEN SPACE LANDSCAPE STRATEGY

Dear Carol,

Further to the Vale Development Plan 2 document submitted for the City's consideration by Chappell, Lambert & Everett, please find enclosed a public open space landscape strategy for all the open space areas contained within the Development Plan area.

Please pass a copy on to Nick del Borrello and Mark Denning at the City as required. Please note, elements of this strategy may alter over time in response to unknown development growth patterns or open space use requirements. Detailed landscape concept plans for each public open space area will be developed in conjunction with the City of Swan as Planning, Environmental and Civil Engineering parameters become finalised.

As you are aware, detailed landscape construction drawings will be submitted to the City for each open space area for Development Application approval prior to the commencement of any landscape construction works on site.

LANDSCAPE DESIGN

The strategy includes a coloured A3 masterplan based on the current planning layout that indicates all landscape areas and their POS character and expected uses. The A3 plan also provides additional text detail as to the nature of the landscape elements and areas envisaged to occur within each POS area. The project team have already undertaken a series of design reviews to consider in detail the range and types of POS designs proposed in an effort to reduce ongoing maintenance costs. MNLA would now therefore suggest that these elements and their annual costs as stated in the attached spreadsheet are within the realm of reasonable public expectation from the Cities ratepayers as well at a level which both the developer and City would wish to be provided and maintained.

LANDSCAPE PRINCIPLES and FINISHES

The following will outline briefly the intended landscape character and finishes proposed within the Vale DP2 Public Open Space areas as requested. We are of the belief that this detail is irrelevant at the Development Plan level as detailed Planning and Civil Engineering has not been completed to allow an appropriate assessment of the individual open space area's site conditions. The aim is to provide an indicative outline as to the project's expected landscape character response. All POS areas will be the subject of Development Application submission prior to any landscape works occurring on the individual open space sites. It is at this stage that a more detailed and meaningful assessment of the below principles can be accurately achieved.

Plant Selection

Shrub planting will consist predominantly of West Australian native and Australian native species. A mix of exotic and native trees will be proposed. Areas of shrub planting will be proposed using site soil and site mulch. Shrubs will be planted in a single species, mass

planting arrangement at approx 3 plants per m2. The use of root control barriers will be proposed adjacent any structures in accordance with the City's standards.

The selected turf species for all turf areas is *Kikuyu* in accordance with the City of Swan requirements. All turf shall be of high quality and installed by experienced and qualified turf suppliers / layers. Turfing will finish against hard edges for ease of maintenance.

Construction Materials

A range of construction materials are proposed for the Vale project. These are including, but no limited to the following materials.

- Reconstituted Limestone Blockwork, either cream and / or laterite coloured.
- Off-form, coloured and / or aggregate finish concrete
- Toodyay Stone and other local granite products
- Hot Dipped Galvinised & Powdercoated Metals, Cor-Ten & Stainless Steel.
- Masonry and Concrete Blockwork
- Renewable / recycled timbers
- Recycled structural plastic
- Colourbond, Mini orb and Weatherboard

Shelters

It is proposed to provide shelters in most open space areas where passive and informal active recreation are the major objective. Picnic shelters, feature arbors and the like denote a key communal gathering location within open space areas for the community. As such they are under close scrutiny. Typically passive recreation areas are clearly visible from surrounding lots and roads to encourage passive surveillance. As such shelters and arbors are a highly visible built form additional to the landscape. The shelters will be well placed to promote the desired landscape character of the development. Shelters / arbors will be adaptable to various slopes, grades or vantage points.

Fencing

Fencing will be proposed around areas of Conservation Category Wetlands (CCW) and Bush Forever sites for controlled pedestrian access. Fencing will be in accordance with the City's standard conservation style fencing and the previously approved details for this development. This detail previously has typically been a 1.2m high hot dip galvanised, powdercoated, metal post and top rail with chain link mesh attached.

Park Furniture

The provision of off-the-shelf seating and bins as approved previously for this development is proposed for public amenity. All furniture is from the Mark Cox Urban Furniture range designed and manufactured locally within Western Australia. As a result, replacement parts if required are readily and easily available.

POS path lighting is proposed around the path network that is away from the overspill lighting of the street lights. All lights are to be located adjacent to footpaths through the open space areas to provide a secure route environment in open space areas at night. Lighting shall be in accordance with previous approvals for this project consisting of standard 'Western Power decorative range' lighting to 6 metres in height to prevent vandalism.

Public Facilites

Communal facilities such as barbeques, group seating areas, and toilet facilities are to be adaptable to work separately or in concert with shelters or other built forms within public open space areas. These facilities are to be located to maximise views and comfort to the user. Where possible these facilities are to blend into their landscape surrounds but be safe and visible from adjacent areas.

All public facilities are to be constructed of robust construction materials to minimise ongoing maintenance costs. BBQ's shall be of a Christie's product as specified in the City's Landscape Design Guidelines.

Irrigation

All public open space areas to be irrigated will be undertaken in accordance with the City of Swan's Irrigation Specification and other relevant standards as outlined in the City's Landscape Design Guidelines. Irrigation plans will be submitted to the City for review and approval either at Development Application stage for individual open space areas or prior to the commencement of any landscape works on that individual open space.

Water source for landscape areas within the Vale project is from already approved and existing deep aquifer bore system. These bores will be located within Public Open Space areas for ease of maintenance access by the City's operation staff following handover.

Signage

Interpretative signage is proposed to be installed in appropriate locations along footpaths within Conservation Category Wetlands (CCW) and Bush Forever sites. This signage will provide detailed descriptions of the existing sites importance ecologically whilst also informing the community about the existing flora and fauna that can be found in these locations. All signage will be constructed in robust materials to minimise maintenance requirements. Typically this will consist of all metal construction with appropriate anti graffiti coatings in accordance with the City's specification.

Play equipment / grounds

Playgrounds and their associated equipment will be proposed in public open space areas in accordance with the principles and guidelines as establish in the City of Swan's Play Space Strategy. Formal recreational facilities such as playgrounds, fitness trails, tennis courts, hit-up walls, basketball areas, cycle and skate facilities will be from cost effective off-the-shelf structures from locally produced manufacturer's and suppliers where possible. Recreational facilities are to be located to be as visible as possible from surrounding areas to maximise visual impact and safety. All recreational facility installation and softfalls will be in accordance with relavent Australian standards, City of Swan's Landscape Design Guidelines and Play Space Strategy as mentioned previously.

ASSET MANAGEMENT PLANS

Also included for the Cities reference is completed Asset Management Plans in the City's specified and supplied format listing the anticipated landscape elements within each POS with allocated maintenance costs as nominated by the City against each landscape element for the areas provided.

You will note that an Asset Management Plan for the nominated Bush Forever area is also included for DP2. Please note, the cost of maintaining this area will not be borne by the City as proposed to date and the Asset Management Plan is for the City's information only.

As agreed with Multiplex previously, it is now the case that the developer will maintain all Public Open Space areas for five (5) years following practical completion of the landscape works for each individual open space area.

CONCLUSIONS

It is concluded through the detailed cost study undertaken and submitted to the City previously for DP2 that maintenance costs for the current planning and landscape design of the DP2 area will be approx $13,800/ha p.a. It is understood that the Cities current cost target is set at $8,000 - $10,000 per hectare, per annum. The following basic options may be suggested for broad consideration based on the cost analysis results undertaken to date (stated in no particular order).

1. The Cities target cost rate per hectare per annum is set to low and should be raised (refer other LGA comparisons as below) OR
2. Other funding contribution methods for ongoing maintenance be found and enacted OR
3. The range of facilities and services provided to the general public in the DP2 area are to excessive and must be reduced OR
4. The current maintenance requirements imposed by the City are to onerous and costly and should be reviewed OR
5. The current maintenance methods undertaken by the City be reviewed to be made more cost efficient OR
6. The total area of POS being maintained is too much for the number of lots funding its upkeep and therefore should be reduced OR
7. To varying degrees, all of the above

COMPARISONS

For the Cities reference the following relevant examples of other local government total allocated maintenance rates per hectare, per annum are stated as below.

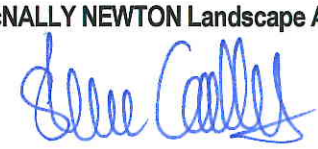
- City of Rockingham - $22,000 per ha p.a
- City of Cockburn - $15,000 per ha p.a (under review to be increased)
- City of Wanneroo - $15,000 per ha p.a
- Shire of Busselton - $13,500 per ha p.a

SUMMARY

We trust all relevant landscape and maintenance based information has been provided at this stage to allow suitable consideration of the proposals as submitted. If you require any further information or wish to discuss this please do not hesitate to contact me at anytime.

Yours sincerely,

McNALLY NEWTON Landscape Architects.



SHANE CADDY B.L. Arch (Hons)
DIRECTOR, SENIOR LANDSCAPE ARCHITECT

Cc Evan Jones / Armando Rossi — Multiplex Developments (WA) Pty Ltd
Cc Jane Bennett — Chappell, Lambert & Everett

\\Beta\Projects\CURRENT PROJECTS\Vale at Egerton\ADMIN FILES\10. Development Plan 2\City of Swan\EG DP2 Landscape Strategy Cover Letter 060307.doc

NP 1

- No existing vegetation currently on site
- Formal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Native shrub species, exotic trees
- Fully irrigated
- Higher level of maintenance

NP 2

- Existing vegetation unable to retained
- Formal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Native shrub species, exotic trees
- Fully irrigated
- Higher level of maintenance

NP 3

- Retain existing vegetation currently on site where possible
- Informal landscape design
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- All native plant species
- Partly irrigated
- Higher level of maintenance

* Function and Management of POS to be confirmed.

C 1

- Retention of existing vegetation with improvements where necessary to edges etc to preserve its conservation value
- Pedestrian access to controlled paths with Interpretive signage
- Pedestrian lookout structures & shelters at suitable vantage points
- Light vehicular access on pedestrian paths (emergency / maintenance)
- No facilities proposed,
- No irrigation except to residential edges where suitable
- All native species
- Low maintenance level

C 2

- Retention of existing vegetation with improvements where necessary to edges etc to preserve its conservation value
- Pedestrian access to controlled paths with Interpretive signage
- Light vehicular access on pedestrian paths (emergency / maintenance)
- No facilities proposed
- No irrigation except to residential edges where suitable
- All native species
- Low maintenance level

BF (to Department of Environment & Conservation requirements)

- Retention of existing vegetation in its current condition (no improvements proposed),
- Retention of existing natural spring, creeklines and open waterbody.
- Possible picnic facilities and shelters to degraded area around open waterbody.
- Limited pedestrian access to controlled paths with Interpretive signage to edges,
- Pedestrian lookout structures & shelters at suitable vantage points,
- No vehicular access (other than emergency),
- No facilities proposed,
- Fenced edges to restrict human and domestic animal access with fire breaks where necessary,
- No irrigation
- All native species
- Low maintenance level

PR 1

- Retention of existing significant vegetation
- Open active informal grassed recreation area
- Shade trees
- Pedestrian path links to adjacent residential areas
- Recreation facilities such as playgrounds, BBQ / Picnic facilities, shelters, street furniture.
- Low retaining walls as may be needed
- POS lighting
- Introduced and native plant species
- Fully irrigated
- Higher maintenance level

LEGEND.

- RETAINED BUSHLAND.
- TURF AREAS.
- WETLAND AREAS

MUC 1

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales/infiltration/sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes/viewing areas/informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 2

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 3

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 4

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Retention of existing significant vegetation
- Manicured landscape areas edging road verge (seating & signage nodes/viewing areas/informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Minimal irrigation use
- Minimal maintenance areas

MUC 5

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of drainage where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 6

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of drainage where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal rec areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

MUC 7

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales/infiltration/sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes/viewing areas/informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Minimal irrigation use
- Minimal maintenance areas

MUC 8

- Retention / recontouring / stabilisation of existing creeklines where appropriate
- Installation of linking dual use path systems as part of a greenbelt system across the development
- Inclusion of planted stormwater detention basins where necessary (swales / infiltration / sustainable practices)
- Retention of existing significant vegetation
- Feature landscape areas (seating and signage nodes / viewing areas / informal recreation areas)
- Predominantly native species with some smaller introduced feature planting areas
- Low fuel zones (manicured landscapes) to direct residential interfaces
- Minimal irrigation use
- Minimal maintenance areas

VALE

DEVELOPMENT PLAN - Proposed Subdivision (PLAN 2 of 2)

N

6th March 2006
SCALE 1:2,500

mcnally · newton
LANDSCAPE ARCHITECTS

Version 1.4

Developers Asset Management Plan (AMP)

www.swan.wa.gov.au

Instructions

This development asset management plan has been created by the City of Swan to enable it to maintain new POS areas to the level that they are initially created at. It is important that accurate information is provided to the City that so that sufficient resources can be made available for the additional POS maintenance needs.

Please input the required information into all the cells highlighted in Green. If some asset items are not applicable to this stage of development work, then leave the green cell(s) blank. If there are any asset items that are part of the development but are not listed below, please detail these under the "other" section at the bottom of the table. Where maintenance & replacement costs and design lives appear in the grey cells, these are CoS figures. If you feel as though they are not typical for the POS areas covered by this AMP, then please note your suggested values in the corresponding comments box.

When submitting your final spreadsheet, please include a diagram/drawing of the POS areas that are considered by this Asset Management Plan.

If there are any further queries, please contact Mark Denning on (08) 9267 9206.

Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Neighbourhood Park 1**
Total Area of POS/Streetscape (m^2)	**8,030**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	6,300	$0.81	$4.40	25	
	Gardens Beds	m^2	580	$3.05	$25.00	10	
	New Trees	No.	73	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	580		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2		$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	800	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	8	$160.00	$1,500.00	15	
	Tables	No.	4	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	100	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2		$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	1	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m			$25.00	20	
Lighting	Pole Lights	No.	4	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	6,880		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	73	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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If there are any further queries, please contact Mark Denning on (08) 9267 9206.

Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Neighbourhood Park 2**
Total Area of POS/Streetscape (m^2)	**5,500**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	3,350	$0.81	$4.40	25	
	Gardens Beds	m^2	1,100	$3.05	$25.00	10	
	New Trees	No.	55	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	1,100		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2		$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	840	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	6	$160.00	$1,500.00	15	
	Tables	No.	4	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	50	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2		$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	1	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m			$25.00	20	
Lighting	Pole Lights	No.	2	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	4,450		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	55	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Neighbourhood Park 3**
Total Area of POS/Streetscape (m^2)	**7,350**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	800	$0.81	$4.40	25	
	Gardens Beds	m^2	0	$3.05	$25.00	10	
	New Trees	No.	0	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	0		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	6,000	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	550	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	0				
	Benches	No.	5	$160.00	$1,500.00	15	
	Tables	No.	1	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	0		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	200	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2		$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m			$25.00	20	
Lighting	Pole Lights	No.	2	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	800		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	0	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Park 1 (P1)**
Total Area of POS/Streetscape (m^2)	**4,300**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	800	$0.81	$4.40	25	
	Gardens Beds	m^2	2,200	$3.05	$25.00	10	
	New Trees	No.	20	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	500		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	800	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	500	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	3	$160.00	$1,500.00	15	
	Tables	No.	4	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	300	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2		$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	100		$25.00	20	
Lighting	Pole Lights	No.	2	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	3,000		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	20	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 1**
Total Area of POS/Streetscape (m^2)	**38,850**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	11,655	$0.81	$4.40	25	
	Gardens Beds	m^2	3,890	$3.05	$25.00	10	
	New Trees	No.	200	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	3,890		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	19,425	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	3,880	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	2				
	Benches	No.	14	$160.00	$1,500.00	15	
	Tables	No.	8	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	2		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	800	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	150	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	4	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	25	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	15,545		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	200	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

Version 1.4

Developers Asset Management Plan (AMP)

www.swan.wa.gov.au

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If there are any further queries, please contact Mark Denning on (08) 9267 9206.

Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 2**
Total Area of POS/Streetscape (m^2)	**15,015**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	4,500	$0.81	$4.40	25	
	Gardens Beds	m^2	1,515	$3.05	$25.00	10	
	New Trees	No.	100	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	1,515		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	7,500	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	1,500	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	6	$160.00	$1,500.00	15	
	Tables	No.	2	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	800	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	150	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	8	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	6,015		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	100	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 3**
Total Area of POS/Streetscape (m^2)	**3,675**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	600	$0.81	$4.40	25	
	Gardens Beds	m^2	200	$3.05	$25.00	10	
	New Trees	No.	50	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	200		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	2,475	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	400	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	0				
	Benches	No.	3	$160.00	$1,500.00	15	
	Tables	No.	1	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	0		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.			$6,000.00	10	
	Mowing Kerbs	m	200	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	0	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	6	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	800		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	50	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 4**
Total Area of POS/Streetscape (m^2)	**3,885**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	1,700	$0.81	$4.40	25	
	Gardens Beds	m^2	200	$3.05	$25.00	10	
	New Trees	No.	20	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	200		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	1,505	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	480	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	0				
	Benches	No.	5	$160.00	$1,500.00	15	
	Tables	No.	1	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	0		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	1		$6,000.00	10	
	Mowing Kerbs	m	0	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	0	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	200		$25.00	20	
Lighting	Pole Lights	No.	6	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.	1	$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	1,900		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	20	$0.05	$20.00	10	
	Pump Electrics	No.	1	$600.00		15	
	Pumps	No.	1	$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 5**
Total Area of POS/Streetscape (m^2)	**28,350**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	9,150	$0.81	$4.40	25	
	Gardens Beds	m^2	3,615	$3.05	$25.00	10	
	New Trees	No.	350	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	3,615		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	13,350	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	1,935	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	10	$160.00	$1,500.00	15	
	Tables	No.	5	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	2		$6,000.00	10	
	Mowing Kerbs	m	300	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	150	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m^2		N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	3	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	23	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	12,765		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	350	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 6**
Total Area of POS/Streetscape (m^2)	**6,600**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	1,200	$0.81	$4.40	25	
	Gardens Beds	m^2	2,340	$3.05	$25.00	10	
	New Trees	No.	40	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	2,340		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	2,500	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	660	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	0				
	Benches	No.	5	$160.00	$1,500.00	15	
	Tables	No.	1	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	0		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	0		$6,000.00	10	
	Mowing Kerbs	m	100	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	0	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	100	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	6	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	3,540		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	40	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 7**
Total Area of POS/Streetscape (m^2)	**17,400**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	7,220	$0.81	$4.40	25	
	Gardens Beds	m^2	7,500	$3.05	$25.00	10	
	New Trees	No.	150	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	7,500		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	2,500	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	1,920	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	2				
	Benches	No.	10	$160.00	$1,500.00	15	
	Tables	No.	4	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	2		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	1		$6,000.00	10	
	Mowing Kerbs	m	500	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	150	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	0	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	1	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	2	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	12	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	14,720		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	350	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

Version 1.4

Developers Asset Management Plan (AMP)

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Multiple Use Corridor 8**
Total Area of POS/Streetscape (m^2)	**5,145**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	1,245	$0.81	$4.40	25	
	Gardens Beds	m^2	1,885	$3.05	$25.00	10	
	New Trees	No.	40	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	1,885		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	1,500	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	515	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	6	$160.00	$1,500.00	15	
	Tables	No.	2	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	0		$6,000.00	10	
	Mowing Kerbs	m	250	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	0	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	0	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	4	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	3,130		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	40	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Passive Recreation 1**
Total Area of POS/Streetscape (m^2)	**22,800**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	15,000	$0.81	$4.40	25	
	Gardens Beds	m^2	4,320	$3.05	$25.00	10	
	New Trees	No.	150	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	4,320		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	1,200	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	2,280	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	2				
	Benches	No.	8	$160.00	$1,500.00	15	
	Tables	No.	4	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	2		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	0		$6,000.00	10	
	Mowing Kerbs	m	600	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	300	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	0	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	2	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	3	$460.00	$20,000.00	20	
	Fencing/Bollards	m	0		$25.00	20	
Lighting	Pole Lights	No.	10	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	19,320		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	150	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Conservation 1**
Total Area of POS/Streetscape (m^2)	**104,500**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	0	$0.81	$4.40	25	
	Gardens Beds	m^2	14,100	$3.05	$25.00	10	
	New Trees	No.	200	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	14,100		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	75,450	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	8,000	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	1				
	Benches	No.	6	$160.00	$1,500.00	15	
	Tables	No.	2	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	1		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	5		$6,000.00	10	
	Mowing Kerbs	m	0	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	300	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	250	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	3	$460.00	$20,000.00	20	
	Fencing/Bollards	m	3,000		$25.00	20	
Lighting	Pole Lights	No.	12	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	14,100		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	200	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Conservation 2**
Total Area of POS/Streetscape (m^2)	**9,870**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	0	$0.81	$4.40	25	
	Gardens Beds	m^2	430	$3.05	$25.00	10	
	New Trees	No.	20	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	430		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	6,950	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	990	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	0				
	Benches	No.	5	$160.00	$1,500.00	15	
	Tables	No.	1	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	0		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	0		$6,000.00	10	
	Mowing Kerbs	m	0	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	0	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	0	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	1	$460.00	$20,000.00	20	
	Fencing/Bollards	m	800		$25.00	20	
Lighting	Pole Lights	No.	0	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	430		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	20	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

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Data Input

Development Name	**Vale at Aveley - Development Plan 2**
Developers Name	**Multiplex Developments (WA) Pty Ltd**
POS area	**Bush Forever**
Total Area of POS/Streetscape (m^2)	**242,235**
Number of lots in stage	

Category	Item	Unit	Quantity	Maint. Cost	Rep. Cost	Design Life	Developers Comments
Softscape	Turf	m^2	0	$0.81	$4.40	25	
	Gardens Beds	m^2	9,900	$3.05	$25.00	10	
	New Trees	No.	400	$12.00	$180.00	50	
	Existing Trees	No.		$30.00	$180.00	50	
	Mulch	m^2	9,900		$15.00	3	
	Fire Breaks	m^2		$0.13		NA	
	Retained Bushland	m^2	218,935	$0.01		NA	
Hardscape	Gravel Pathways	m^2			$30.00	35	
	Concrete Pathways	m^2	5,800	$0.24	$30.00	50	
	Asphalt Pathways	m^2		$0.24	$40.00	35	
	Bins	No.	0				
	Benches	No.	10	$160.00	$1,500.00	15	
	Tables	No.	5	$160.00	$2,500.00	10	
	Tree Grates / Surrounds	No.		$15.00	$200.00	15	
	Barbeques	No.	0		$5,000.00	15	
	Drink Fountains	No.			$800.00	5	
	Entry Statement	No.			$60,000.00	15	
	Interpretive Signage	No.	5		$6,000.00	10	
	Mowing Kerbs	m	0	N/A	$13.00	15	
	Concrete Edging	m		N/A	$20.00	15	
Waterscape	Lake/Pond Liner	m^2		N/A	$0.00		
	Subsoil Drainage	m		N/A	$0.00		
	Watercourses/Streams	m^2		N/A	$5.00	30	
Structures	Timber Bridges	m^2		$22.00	$7,000.00	20	
	Concrete/Metal Bridges	m^2	500	$2.40		50	
	Railings	m		N/A	$250.00	20	
	Retaining Walls	m	0	N/A	$300.00	50	
	Boardwalks	m^2		$4.00	$400.00	15	
	Decking	m^2		$4.00	$295.00	15	
	Playgrounds	No.	0	$1,940.00	$40,000.00	12	
	structures / artwork	No.		$1,515.00	$4,500.00	25	
	Shade Sails	No.			$0.00		
	Rotunda/Huts	No.	3	$460.00	$20,000.00	20	
	Fencing/Bollards	m	3,000		$25.00	20	
Lighting	Pole Lights	No.	0	$83.20	$5,500.00	25	
	Inground Uplighters	No.		$83.20	$1,200.00	25	
	Wall Mounted Lights	No.		$83.20	$22,000.00	25	
	Surface Mounted Floodlights	No.		$83.20			
Irrigation	Bores	No.		$1,500.00	$25,000.00	15	
	Aerators	No.					
	Reticulations Pipe	m^2	9,900		$2.40	25	
	Sprinklers	No.			$20.00	10	
	Tree Irrigation	No.	400	$0.05	$20.00	10	
	Pump Electrics	No.		$600.00		15	
	Pumps	No.		$1,500.00		10	
Other							

APPENDIX FIVE

Traffic Modelling Report

SINCLAIR KNIGHT MERZ

SKM

MULTIPLEX

Vale Development Plan Area 2

Traffic and Pedestrian Planning Report

- Final
- April 2007

Vale Development Plan Area 2

Traffic and Pedestrian Planning Report

- Final
- April 2007

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Contents

Document history and status

Revision	Date issued	Reviewed by	Approved by	Date approved	Revision type
Draft 1	19/09/2003	CAS	RJD	18/09/2003	DRAFT
Draft 2	5/11/2003	CAS	RJD	5/11/2003	DRAFT
Draft 3	17/06/2004	CAS	RJD	17/06/2004	DRAFT- updated figures
Draft 4	05/05/06	RMR	DXW		DRAFT – updated figures and revised text
Draft 4	23/06/06	RMR	EXR	23/02/06	DRAFT- revised text, cross sections and base plans
Draft 5	20/07/06	DXW	DXW	20/07/06	Client review
Draft 6	25/07/06	EXR	EXR	25/07/06	General revisions
Draft 7	08/08/06	RMR	EXR	08/08/06	Minor revisions
Draft 8	02/03/07	RMR	EXR	02/03/07	Addition of Appendix C and expansion of pedestrian plan to Ellenbrook

Distribution of copies

Revision	Copy no	Quantity	Issued to
Draft 1	1	1	Chappell & Lambert
Draft 2	1	3	Chappell & Lambert
Draft 3	1	1	Chappell & Lambert
Draft 4	1 (electronic)		jane@clplan.com
Draft 5	PDF 1	1	jane@clplan.com
Draft 6	PDF 1	1	jane@clplan.com
Draft 7	1 (electronic)		jane@cleplan.com
Draft 8	1 (electronic)		jane@cleplan.com & eleni@cleplan.com.au

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Author:	Rhiannon Russell/ Emmerson Richardson
Project manager:	David Wilkins
Name of organisation:	Multiplex
Name of project:	Vale Development Plan Area 2
Name of document:	Traffic and Pedestrian Planning Report
Document version:	Final
Project number:	DE02685

1. Introduction

Sinclair Knight Merz (SKM) has undertaken a traffic review of the Vale Development Plan Area 2. SKM has previously prepared a traffic report for the consolidated Egerton Structure Plan. This report provides further detail on this previous work with respect to Development Plan Area 2 (DP2).

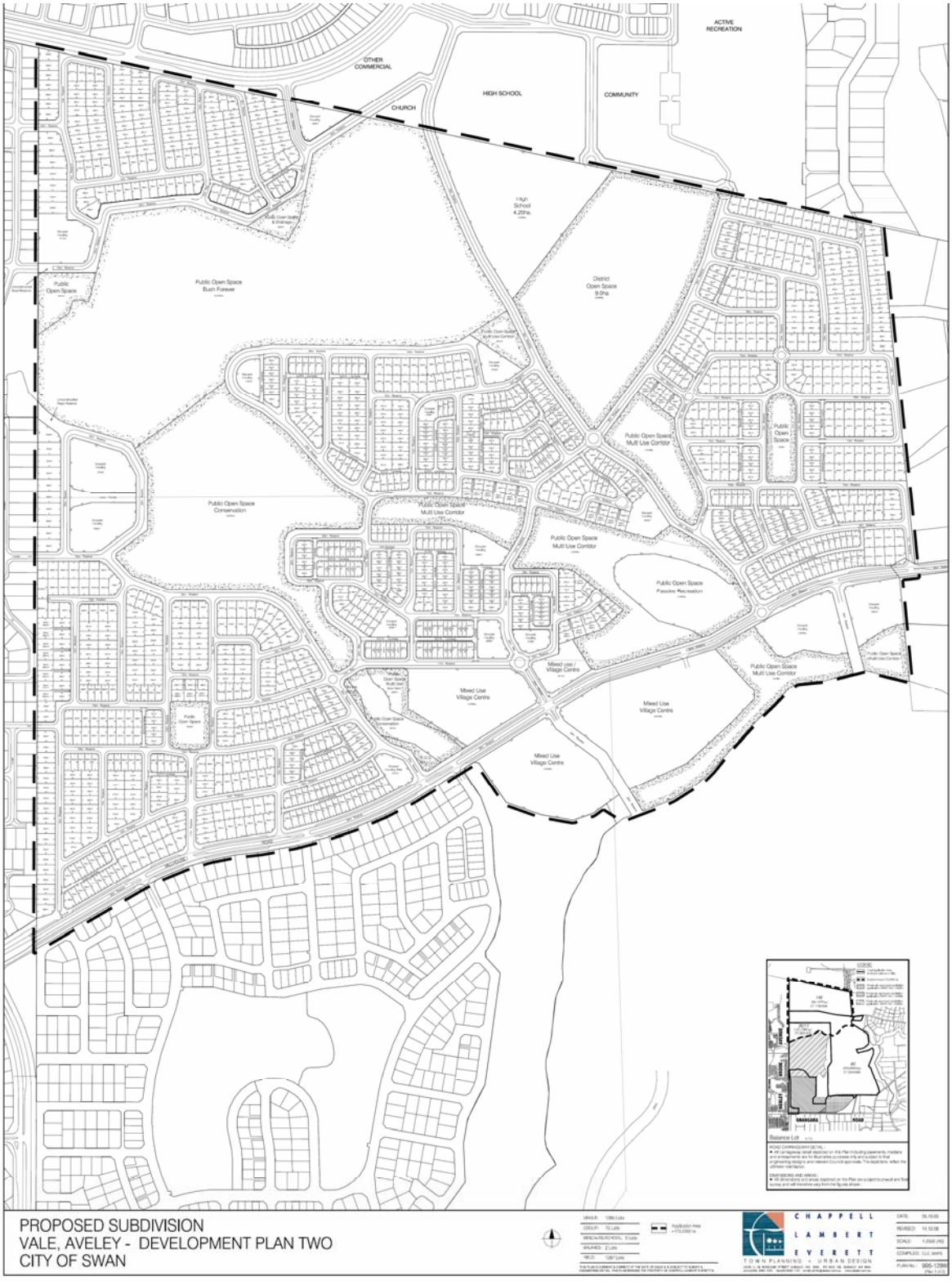
This traffic report assesses the forecast daily traffic volumes resulting from DP2 and recommends appropriate road hierarchy classifications and road cross sections. The report also discusses the provision for pedestrians, cyclists and public transport and these recommendations are reflected within the proposed cross sections (Appendix A).

2. Proposed Development

The Vale DP2 includes the following land uses:

- 1200 Residential lots
- 1 Local centre (3,000m^2 GLA assumed);
- 1 Secondary School (800 enrolments assumed).

The layout of the proposed development is shown in Figure 2.1.



- **Figure 2.1 Vale DP2 Structure Plan**

3. Transport Model

Sinclair Knight Merz has previously developed a traffic modelling tool for the Vale using the internationally recognised EMME/2 software platform. This program is used by the Department for Planning and Infrastructure in Western Australia for projects such as Future Perth, and for forecasting the patronage of the proposed Perth to Mandurah rail link.

The Vale transport model was initially developed in 1993 when Sinclair Knight Merz undertook the transport planning for the Ellenbrook and Egerton District Structure Plan. The model has been refined since that time as development plans for Ellenbrook, The Vines and Vale were developed in greater detail. The model was also recently revised to reflect the most up to date regional traffic information from Main Roads WA.

3.1 Transport Modelling Package

EMME/2 represents a road network as a series of links (roads) and nodes (intersections). The traffic generating land uses are represented as a number of zones connected to the network.

For this application, a 24-hour average weekday model has been developed. The average weekday was selected as it represents the typical activity on the local area road network. The forecast year is 2021, when full development of Egerton and the adjoining Ellenbrook is assumed to occur. The Egerton EMME/2 model has been developed for private vehicular traffic only.

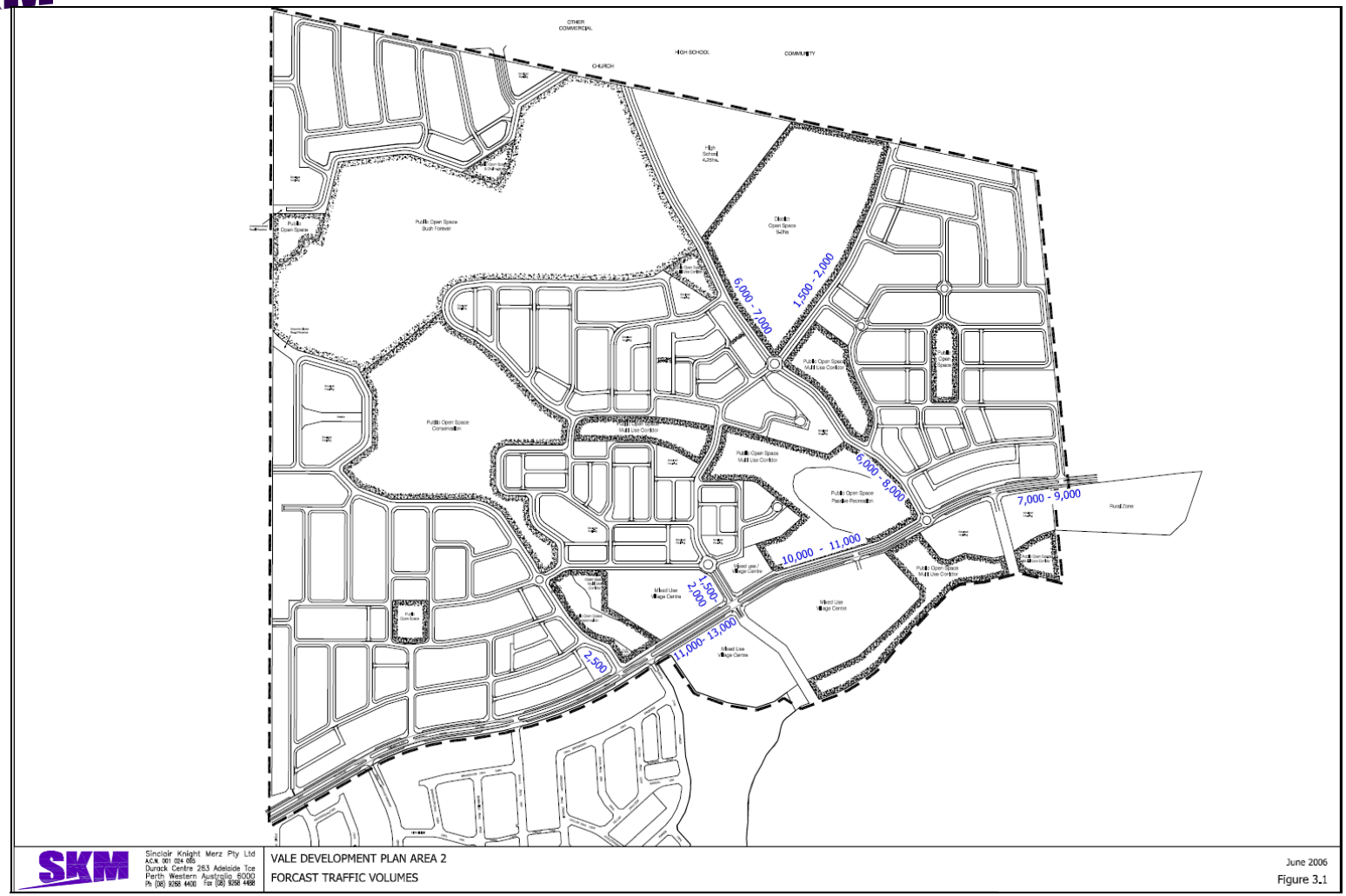
3.2 Land use Data

The following land use data was extracted from the information for Development Plan Area 2 (DP2) provided by Chappell and Lambert:

- 1200 residential lots within the urban zone;
- 1 Local centre (3000m^2 GLA assumed); and
- 1 Secondary School (800 enrolments assumed).

3.3 Forecast traffic volumes

The forecast traffic volumes predicted by the EMME/2 transport model for DP2 are shown in Figure 3.1. These traffic volumes are based on the full development of Vale and the adjoining Ellenbrook development, assumed to occur by 2021.



- **Figure 3.1 Forecast traffic volumes for DPA 2.**

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4. Road Network Assessment

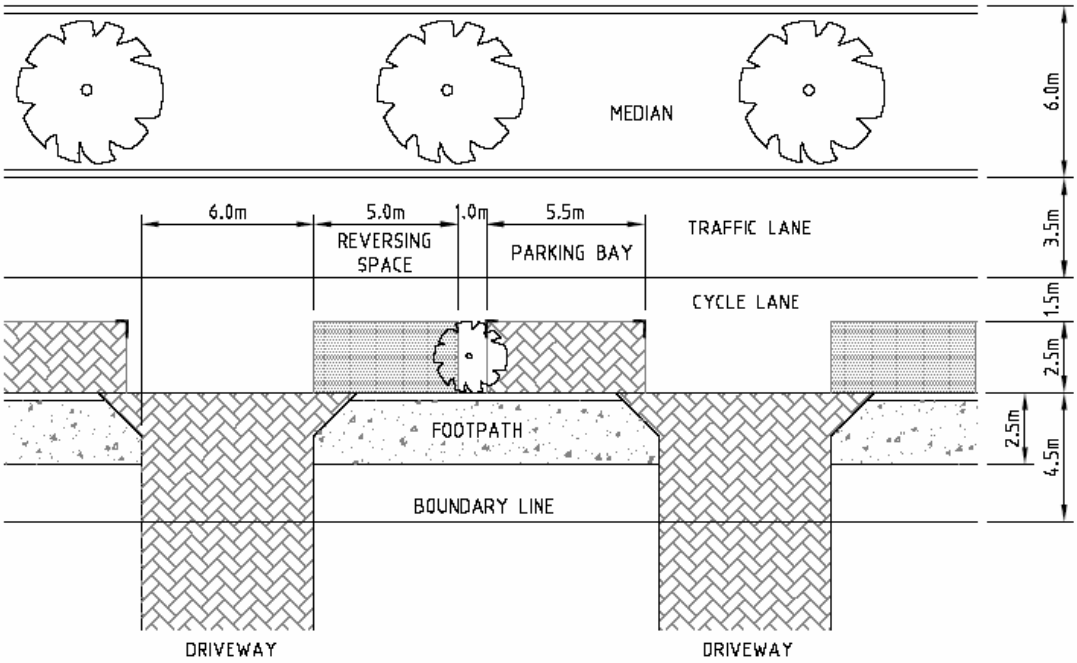
4.1 Indicative cross sections

Indicative cross sections for typical roads within Vale DP2 are provided in Appendix A, from Figure A through K. Appendix B shows the proposed location of these cross sections on the proposed road network.

Provision has been made for on-street cycle lanes along Millhouse Road and the two main north-south connecting roads. Proposed verge widths along these main streets will accommodate dual use paths and are reduced in width where they abut public open space (POS). The neighbourhood centre on Millhouse Road will have high numbers of pedestrians as well as cars and cyclists. The road will be specially designed at this location to have particular regard to context, function and adjacent land uses.

4.2 Access to lots from Millhouse Road

The section below shows indicative access to lots from Millhouse Road. Driveways will be 6 metres in width and separated by a reversing area of 5 metres, a tree and a parking bay of 5.5 metres.



- **Figure 4.1 Typical driveway layout with front access from Millhouse Road**

4.3 Forecast Traffic Volumes and Road Hierarchy

The forecast traffic volumes predicted by the EMME2 transport model for the consolidated structure plan are shown in Figure 3.1. The proposed road hierarchy is shown in Figure 4.2**.** Millhouse Road and road 1 (refer Figure 2.1) are both classified as district distributors and road 2 would function as a neighbourhood connector.

4.4 Traffic Management

The proposed road network and the location of Egerton are expected to result in very little through traffic, with the exception of Ellenbrook Drive and Millhouse Road. Consequently, traffic management should not focus on deterring through or unnecessary traffic, rather on appropriate intersection treatments and the control of vehicle speeds. The most appropriate traffic management techniques to control vehicle speeds will be discussed at the development plan stage.

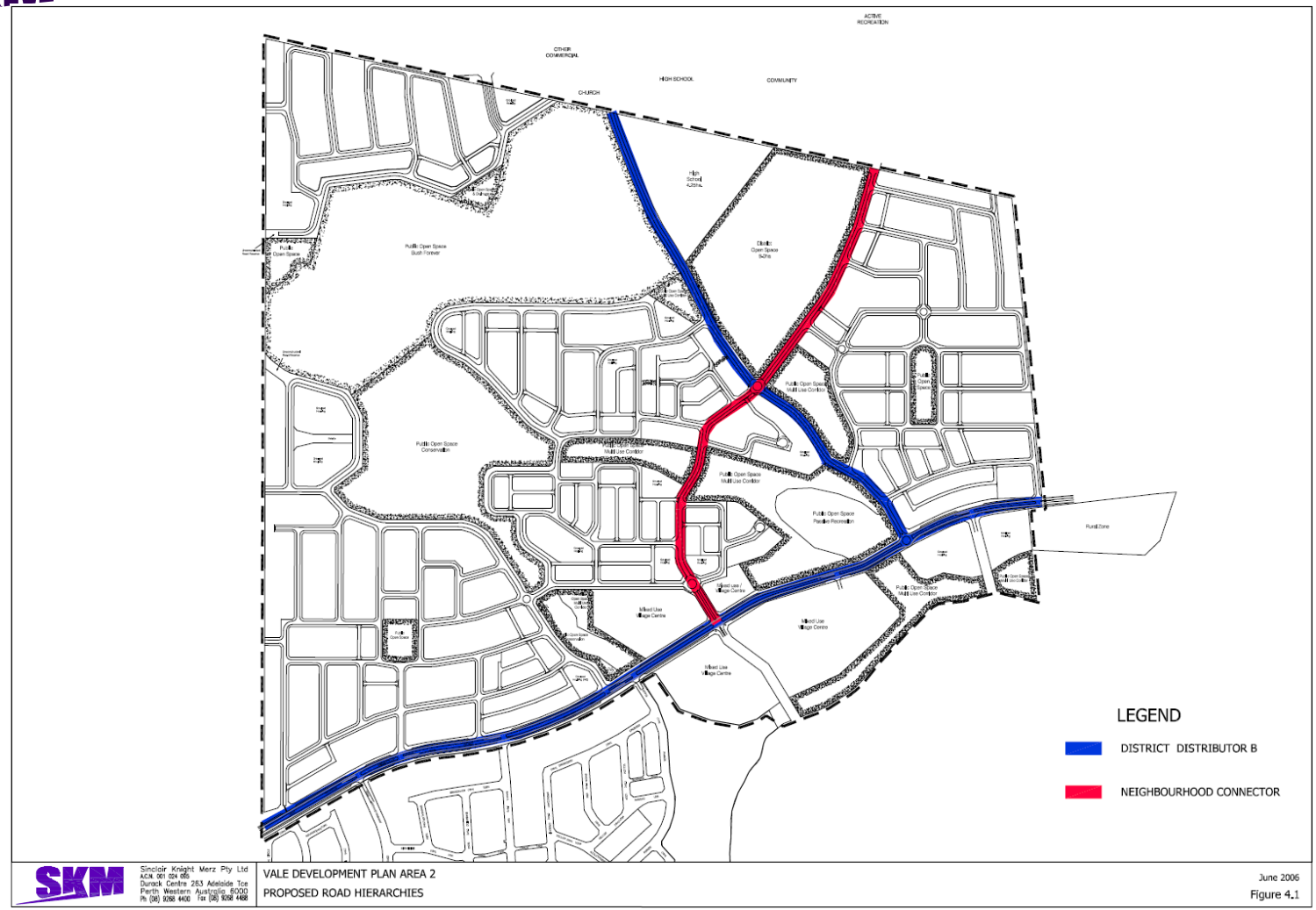
4.4.1 Intersection Control

The Structure Plan proposes roundabouts for several internal four-way intersections identified at this stage. In addition, a number of staggered intersections are proposed in place of four-way intersections, which can operate under simple GIVE WAY control.

The Promenade changes from a two lane carriageway to a single lane carriageway where it turns into Millhouse Road (at its intersection with Henley Brook Avenue). It is proposed by the developers that this intersection operate under roundabout control with a designated right turn lane from Millhouse Road and a straight through lane to accommodate the downgrading from a dual carriageway (through the Ellenbrook development) to a single carriageway (through the Vale development).

The intersection of Millhouse Road and Egerton Drive is expected to operate safely under traffic signal control.

Intersections along Millhouse Road are shown in **Appendix C**, along with cross sections for Millhouse Road and intersections that will allow U-turn movement.



- **Figure 4.2 Proposed road hierarchies for DPA 2.**

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5. Cyclists and Pedestrians

5.1 Principles

The general principles for the provision of routes for pedestrians and cyclists are:

- Walking is the best mode of transport for short trips. The impact of using cars for these trips is such that walking should be encouraged.
- Pedestrian trips are the most common mode of transport, but also the most neglected.
- The bicycle is a convenient and viable transport mode, particularly for trips of between one and seven kilometres.
- Bicycle usage continues to increase and there is a responsibility for designers and engineers to provide for their use in the planning and design of urban areas.
- The bicycle is an economical mode of transport and the only reasonably available mode for certain sectors of the population. Where cycling is not possible these groups will be disadvantaged.
- Walking is the most common means of travel to and from public transport and should be given priority to ensure safe and convenient access to public transport modes.
- A safe, low speed, pedestrian-friendly environment should be created within the village centre.
- The vast majority of pedestrian and bicycle trips are for transport purposes, i.e. to get from A to B, not for recreation. Consequently, in providing for these trips fast convenient travel should be the first priority, with equal importance being given to safety considerations.

As with the earlier version of the Structure Plan, provision has been made for cyclists on each of the road types as determined by Bikewest, Austroads Guidelines and forecast traffic volumes. Pedestrian and cycle routes are outlined in **Figure 5.1.**

5.2 Provision for cyclists and pedestrians

District Distributors require on-road provision for cyclists. These can be either on-road bicycle lanes (recommended width 1.2 m where indented parking is also provided or 1.5m without parking). On-street cycle lanes are also recommended for the Neighbourhood Connector (road 2).

On local access roads it is envisaged that cyclists will share the roadway with motorists due to the low traffic volumes (less than 3,000 vpd) and small speed differential (assisted by the introduction of the 50 kph speed limit in built up areas).

Where land use permits, it is becoming common practice for a shared use path (path to be 2.5 m) to be provided on both sides of a District Distributor road and along at least one side of a neighbourhood connector (with a 1.5m footpath on the other side). However, shared use paths are usually not appropriate in front of shops, retail and café precincts. Provision has been made within the cross sections (Appendix A) for a shared use path along at least one side of the neighbourhood connector (road 2).

Footpaths should be provided along at least one side of all streets within the development, except very minor local access streets. These paths have a minimum recommended width of 1.5 m.

5.3 Connection to surrounding development

The proposed shared use path along both sides of Millhouse Road will connect to the already constructed shared use paths extending from the Ellenbrook development (along both sides of Millhouse Road). The extension of the shared use path along Millhouse through The Vale development has been shown on the Ellenbrook district bike and shared use path plan.

- **Figure 5.1 proposed pedestrian and cyclist routes.**

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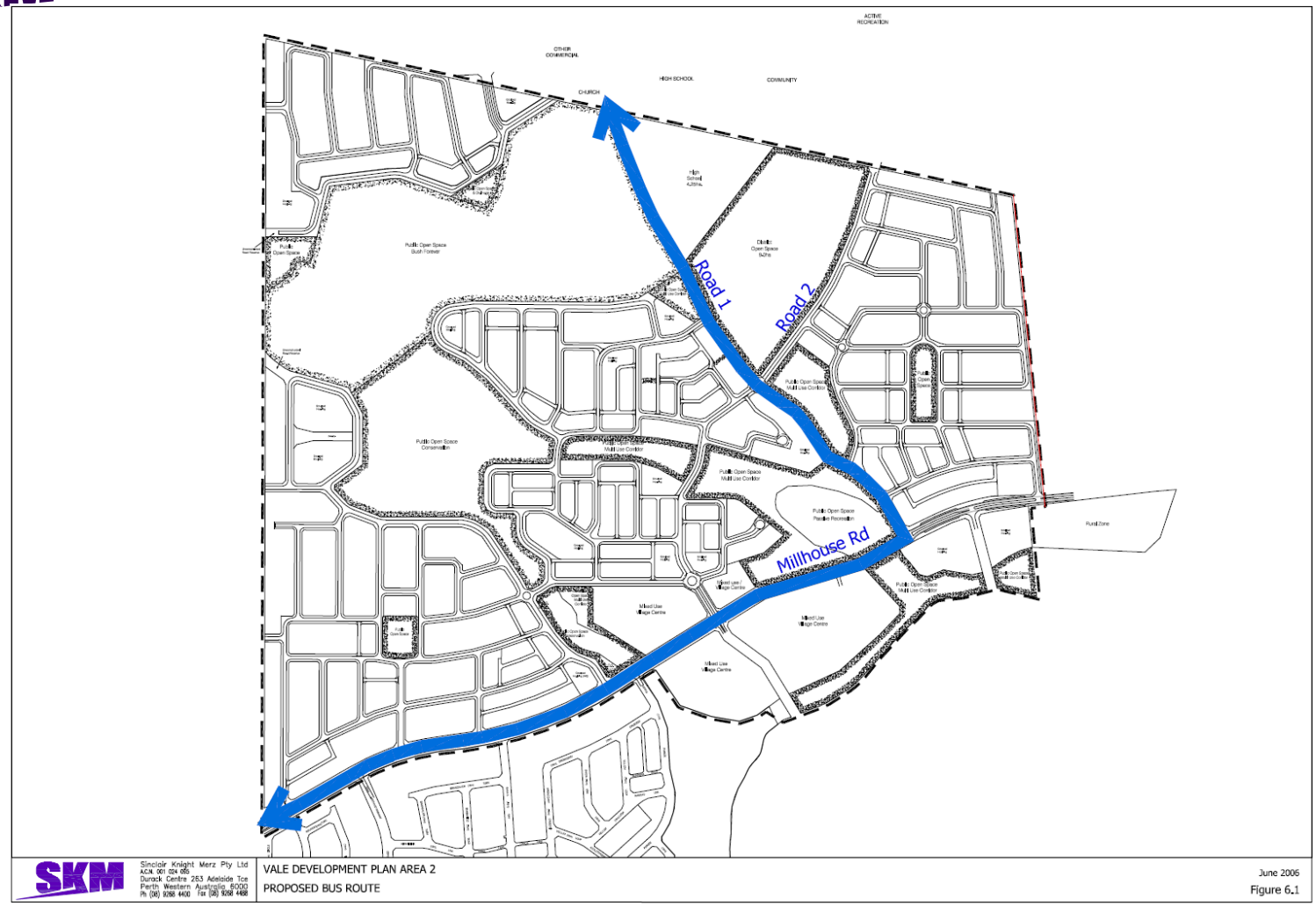
6. Public Transport

The cross sections provided in Appendix A for Neighbourhood Connectors and District Distributor roads feature road pavements widths suitable for accommodating bus routes (i.e. pavement width of at least 3.4 m for a one-lane carriageway).

Transperth bus route planners have identified potential routes within DP2. These routes are shown in Figure 6.1 and are shown to travel along the District Distributors and Neighbourhood Connector.



- **Figure 6.1 Proposed bus route for DPA 2.**

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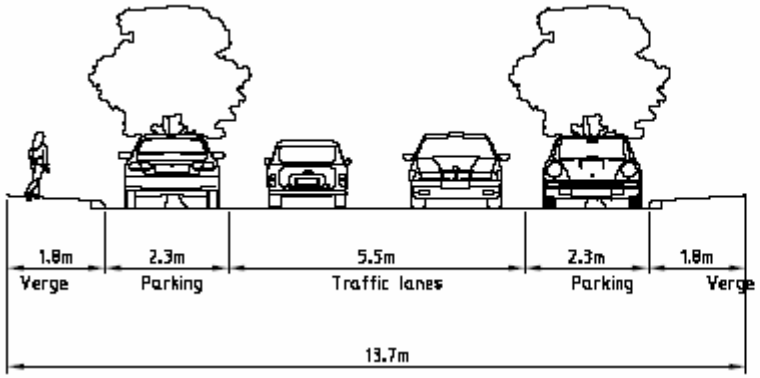
7. Summary

The major outcomes of this report are discussed below:

- The proposed road network and the location of Egerton are expected to result in very little through traffic, with the exception of Ellenbrook Drive and Millhouse Road.
- Traffic volumes in the order of 11,000 vpd-13,000 vpd are forecast for Millhouse Road to the west.
- Traffic volumes in the order of 7,000 vpd – 9,000 vpd are forecast for Millhouse Road to the east.
- Traffic volumes between 6,000 vpd and 8,000 vpd are forecast for the main north-south District Distributor.
- Other streets classified as neighbourhood connectors within the area have forecast traffic volumes between 1,500 vpd and 2,500 vpd.
- The Structure Plan proposes roundabouts for several internal four-way intersections identified at this stage. In addition, a number of staggered intersections are proposed in place of four-way intersections, which can operate under simple GIVE WAY control.
- The intersection of Millhouse Road and Egerton Drive is expected to operate safely under traffic signal control.
- Provision has been made for cyclists with on-street cycle lanes along the District Distributors and the Neighbourhood Connector.
- On local access roads it is envisaged that cyclists will share the roadway with motorists due to the low traffic volumes (less than 3,000 vpd) and small speed differential (assisted by the introduction of 50 kph speed limits in built up areas).
- Shared use paths are recommended for both sides of the District Distributors and at least one side of Neighbourhood Connectors.
- The Neighbourhood Connector and District Distributor roads are wide enough to accommodate bus routes.

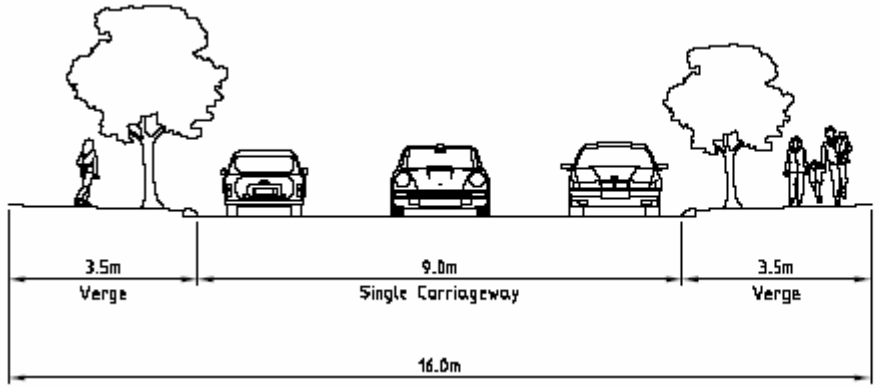
Appendix A Indicative cross sections



- **Figure 7.1 Cross section A**

A

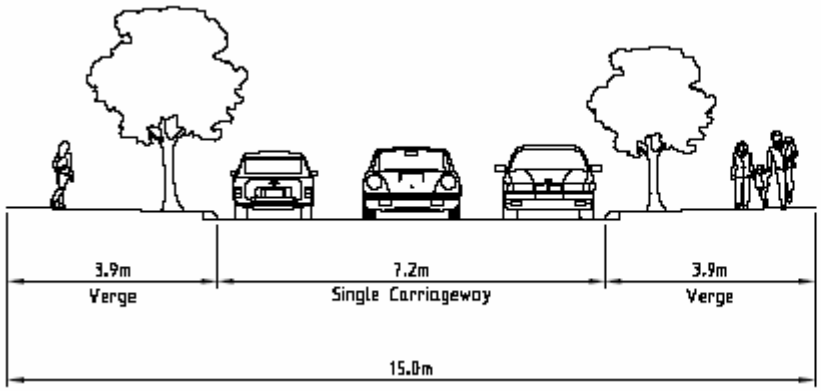
- Standard single lots
- Minor access road
- Formal parking (indented)
- Local residential street parking
- Minimal traffic



- **Figure 7.2 Cross section B**

B

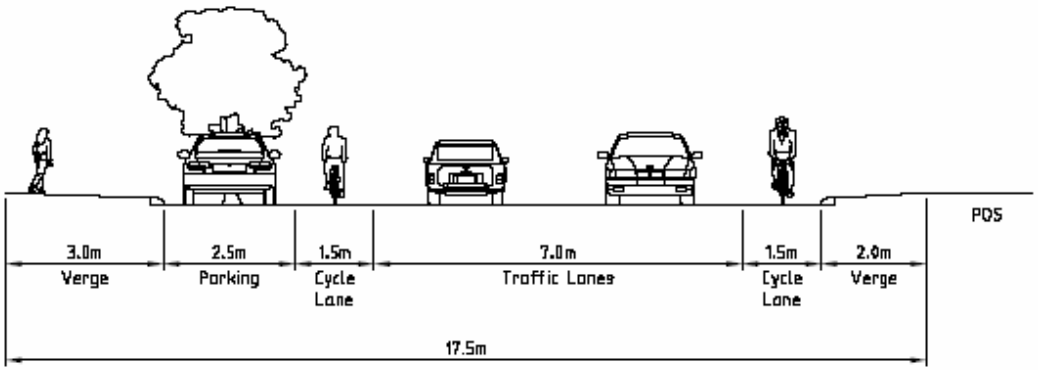
- No cycle lane
- Informal parking
- Access Street



C

- Standard single lots
- No cycle lane
- Informal parking (staggered)
- Minor access road

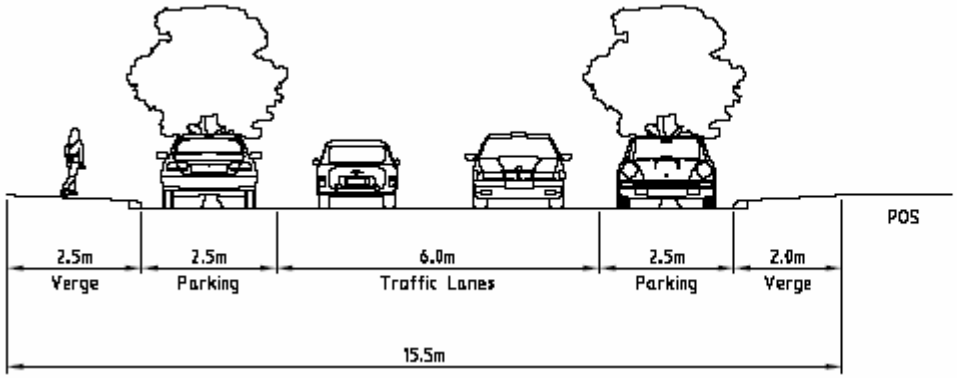
- **Figure 7.3 Cross section C**



D

- The two main N-S connecting roads would have cycle lanes
- Road abutting High School and P.O.S
- Where abutting P.O.S, verge can be reduced to 2.0m
- Neighbourhood connector or higher volume road

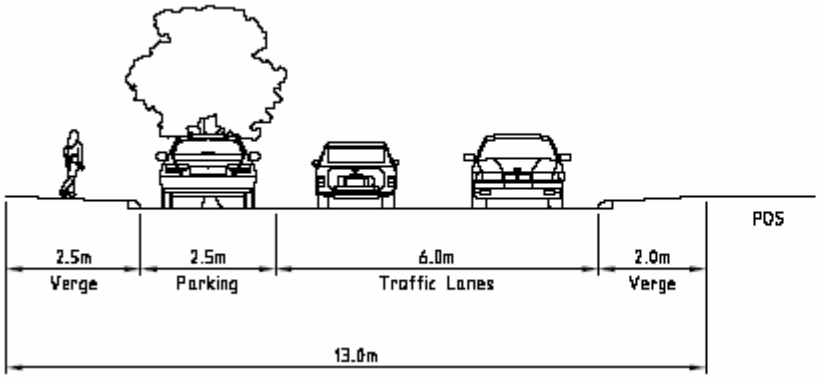
- **Figure 7.4 Cross section D- with a median introduced at intersections**



E

- Road abutting P.O.S.
- Indented Parking
- Minor access street
- Low traffic volumes

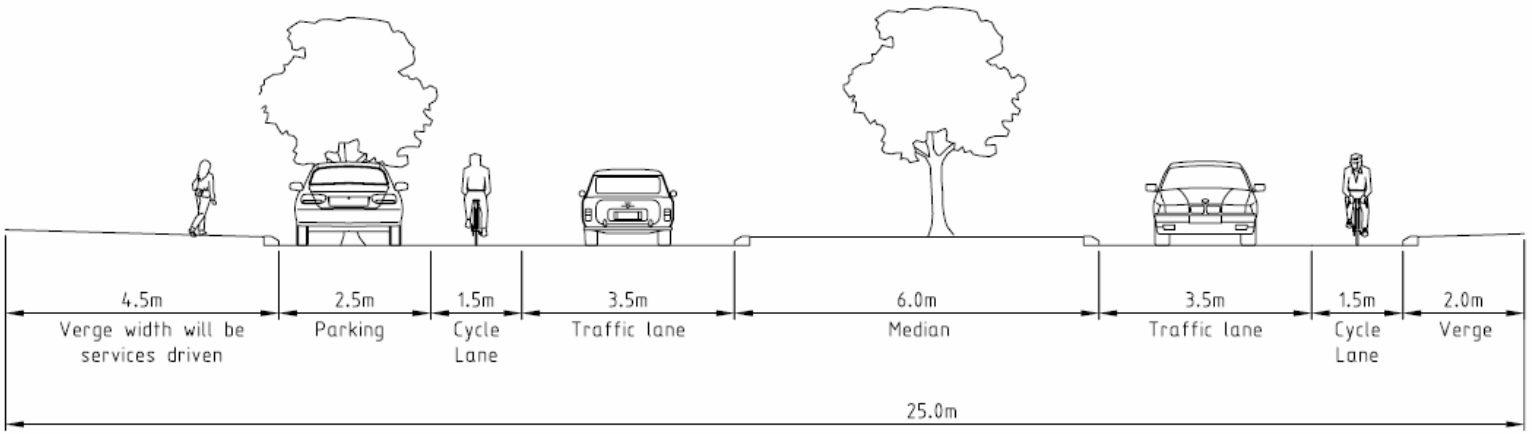
- **Figure 7.5 Cross section E**



F

- Road abutting P.O.S.
- Parking one side
- Minor access street
- Low traffic volumes

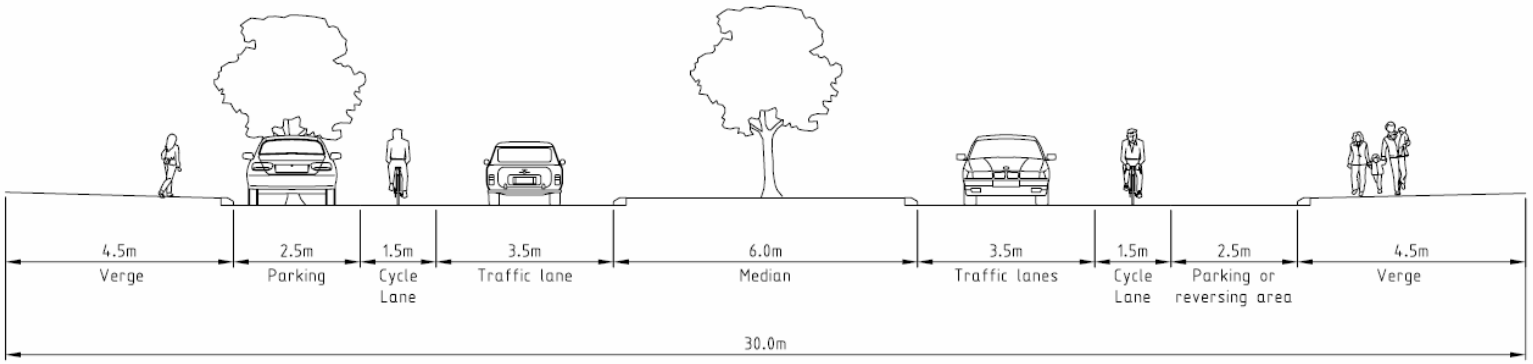
- **Figure 7.6 Cross section F**



G

- Millhouse Rd
- Next to P.O.S.
- Buses
- Cycle Lanes

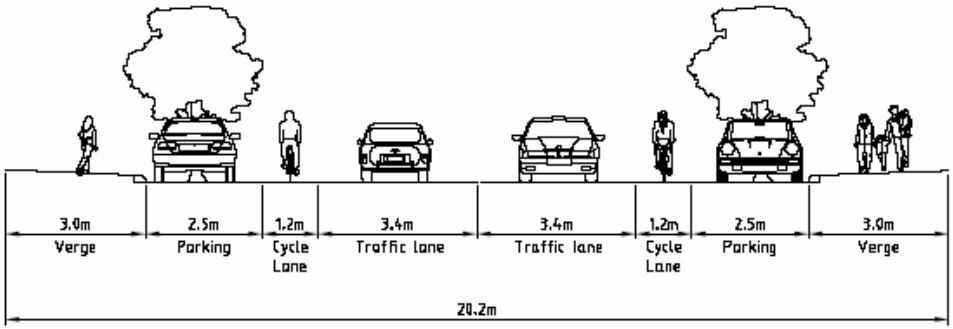
- **Figure 7.7 Cross section G**



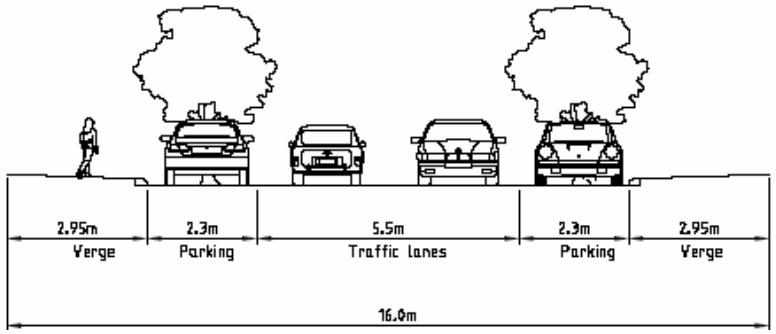
H

- Millhouse Rd
- Fronting Residences
- Buses
- Cycle Lanes

- **Figure 7.8 Cross section H**



- **Figure 7.9 Cross section I**



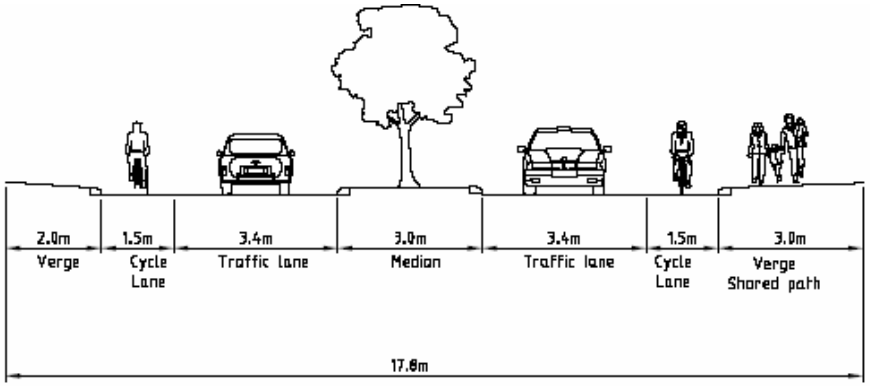
- **Figure 7.10 Cross section J**

I

- Neighbourhood Connector
- Indented parking
- Pavement width accomadates buses
- Cycle Lanes
- No Median

J

- Minor access street
- Alternative cross-section to 'A' where 1.8m verges are considered too small.

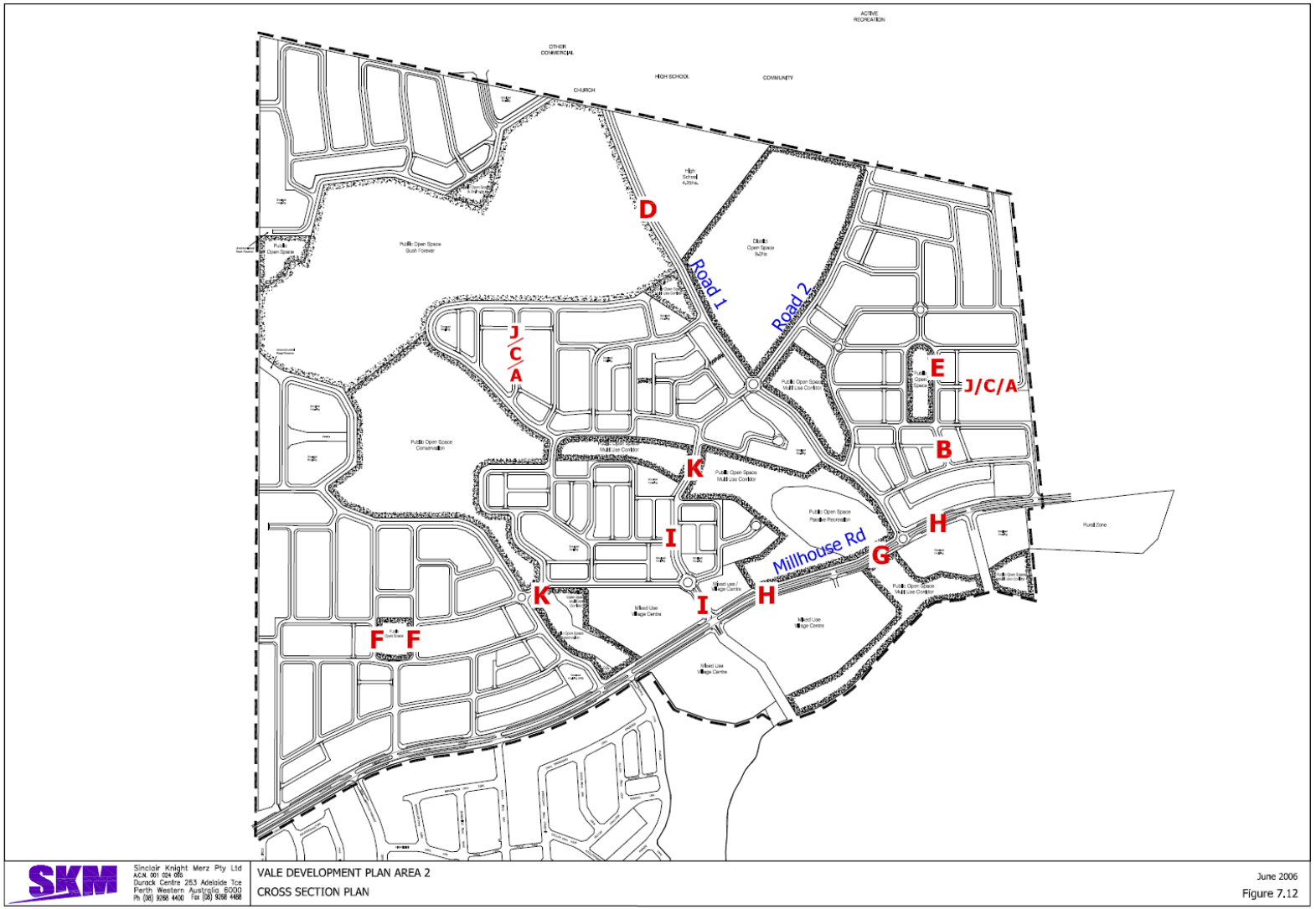


K

- Neighbourhood Connector where flanked on both sides by P.O.S.
- Cycle Lanes
- Median to allow pedestrian crossings
- Pavement width accomadates buses

Figure 7.11 Cross section K

Appendix B Cross Section Plan



- **Figure 7.12 Cross section plan**

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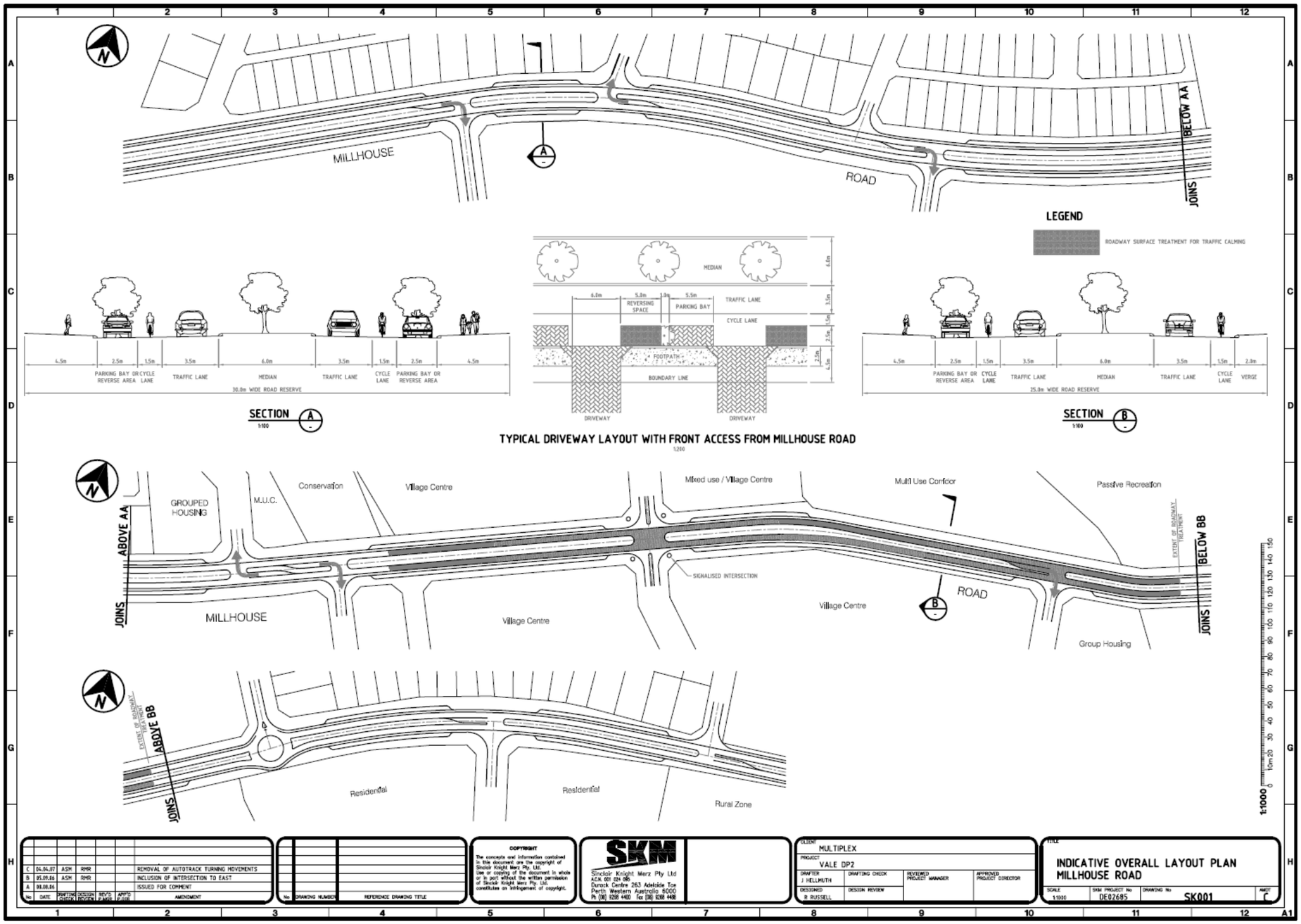
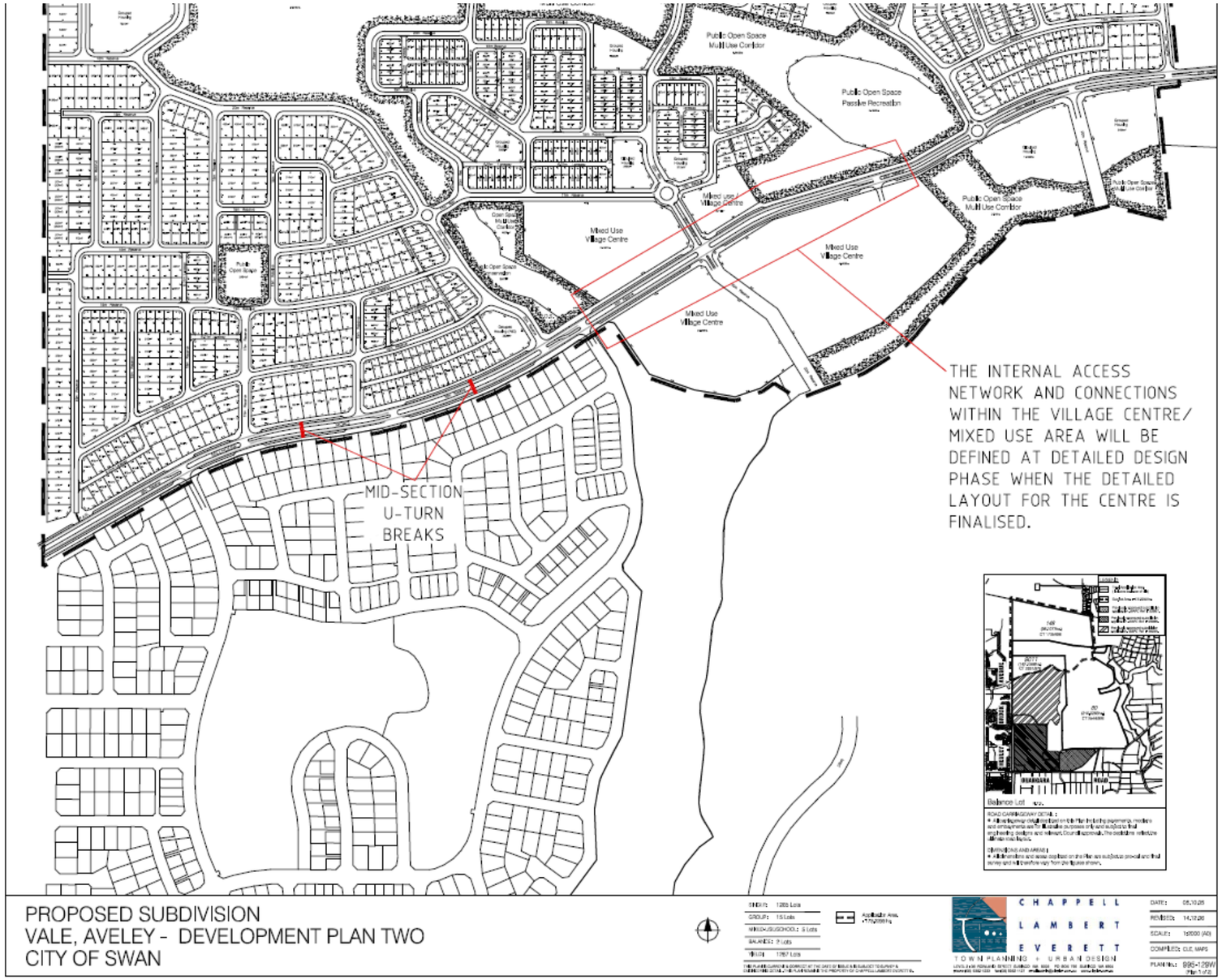
Appendix C Millhouse Road Access



- **Figure 7.13 Intersections and access from Millhouse Road**



- **Figure 7.14 Including permitted U-turn movements**

APPENDIX SIX

Updated Centres Strategy (July 2006)

VALE STRUCTURE PLAN REVIEW

Centres Strategy Update

Prepared for Chappell Lambert Everett

July 2006

Land Use Design Strategy Economics Research

SHRAPNEL URBAN PLANNING

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Contents

1 INTRODUCTION

In August 1999, as part of a major structure plan review process, SHRAPNEL URBAN PLANNING prepared a Centres Strategy[1] for the Vale project area (then known as "Egerton"). In 2003 SHRAPNEL URBAN PLANNING was requested by Chappell & Lambert to update the previous Centres Strategy, based on a modified structure plan for the Vale area[2].

Since then, a more detailed structure planning process has resulted in some modifications to the 2003 version, including a review of the potential dwelling unit yields of the Vale project area. In the 2003 Centres Strategy it was estimated that the total yield for the Vale area would be 4,969 dwelling units. The most recent estimate, however, represents a reduction of more than 500, to a total of 4,432 dwelling units.

A reduction of more than 500 dwelling units within the Vale project area affects the retail floorspace potential of the area's centres. The purpose of this short report is therefore to update the estimate for the retail floorspace of the two neighbourhood centres proposed in the Vale structure plan area. This report does not seek to fully replace the 2003 strategy, but to simply update those parts of it necessary to explain the revised conclusions regarding retail floorspace potential within the two proposed Vale neighbourhood centres.

2 MODELLING & ANALYSIS

Retail modelling for this review was carried out at two levels: Regional and Local. The region-wide centres model applies to the project area and beyond and was used to confirm the overall retail potential of neighbourhood centres within the Vale project area (Model MRZ 697), taking account of all competing floorspace. The local model covers the Vale project area only and was used to estimate the retail floorspace potential of the individual neighbourhood centres within the project area.

2.1 Regional Model

The regional model was fully updated with the revised dwelling unit yield/ population estimates for the Vale project area. The model also includes the dwelling unit yield/ population and retail floorspace estimates in the most recent structure planning for Albion, located to the south of Ellenbrook/ Vale. The updated regional model output sheet is presented in Figure R-01 on the following page.

[1] Egerton Structure Plan Review Centres Strategy; SHRAPNEL URBAN PLANNING; August 1999
[2] Egerton Structure Plan Review; Updated Centres Strategy; SHRAPNEL URBAN PLANNING; November 2003

Datasets >>>		26Fd$	26NonFd$									
MR Zone	SUBURB	Reg / Dist Centre Name	IND Area IND Name	Food sqm	Non-Food sqm	Total sqm	Food Sales 2001$	Food Sales/sqm	Non-Food Sales 2001$	Non-Food Sales/sqm	Total Sales 2001$	Total Sales/sqm
697	ELLENBROOK	**VALE N'HOODS**	-	3,000	4,000	7,000	19,240,023	$6,413	17,060,162	$4,265	36,300,185	$5,186
698	ELLENBROOK	ELLENBROOK 1	-	18,500	46,500	65,000	104,536,104	$5,651	201,504,774	$4,333	306,040,877	$4,708
694	ELLENBROOK	ELLENBROOK	-	5,000	5,000	10,000	30,021,281	$6,004	19,288,418	$3,858	49,309,699	$4,931
328	BASKERVILLE	-	-	0	0	0	0	na	0	na	0	na
693	ELLENBROOK	-	-	3,500	1,500	5,000	17,205,267	$4,916	6,958,711	$4,639	24,163,979	$4,833
695	BULLSBROOK	-	-	200	50	250	1,091,003	$5,455	180,521	$3,610	1,271,523	$5,086
696	BELHUS	-	-	200	50	250	785,934	$3,930	145,874	$2,917	931,808	$3,727
704	HENLEY BROOK	-	-	470	201	671	1,609,180	$3,424	506,296	$2,514	2,115,477	$3,151
705	HENLEY BROOK	-	-	800	100	900	4,735,961	$5,920	369,581	$3,696	5,105,542	$5,673
706	HENLEY BROOK	-	-	0	0	0	0	na	0	na	0	na
Regional & District Only				***23,500***	***51,500***	***75,000***	***$134.6***	***$5,726***	***$220.8***	***$4,287***	***$355.4***	***$4,738***
Totals & Average for Selected Zone Set				31,670	57,401	89,071	$179.2	$5,659	$246.0	$4,286	$425.2	$4,774
Nhood Only (excludes Regional, District, Industrial)				8,170	33,901	34,071	$44.7	$5,467	$25.2	$744	$69.9	$2,051
							(million)		(million)		(million)	

NB: These are calculated figures from a statistics-based "Retail Potentials" model, which is used for particular forms of comparative analysis.
Therefore, actual sales and floorspace performances may differ from those above, depending on various external physical and social factor

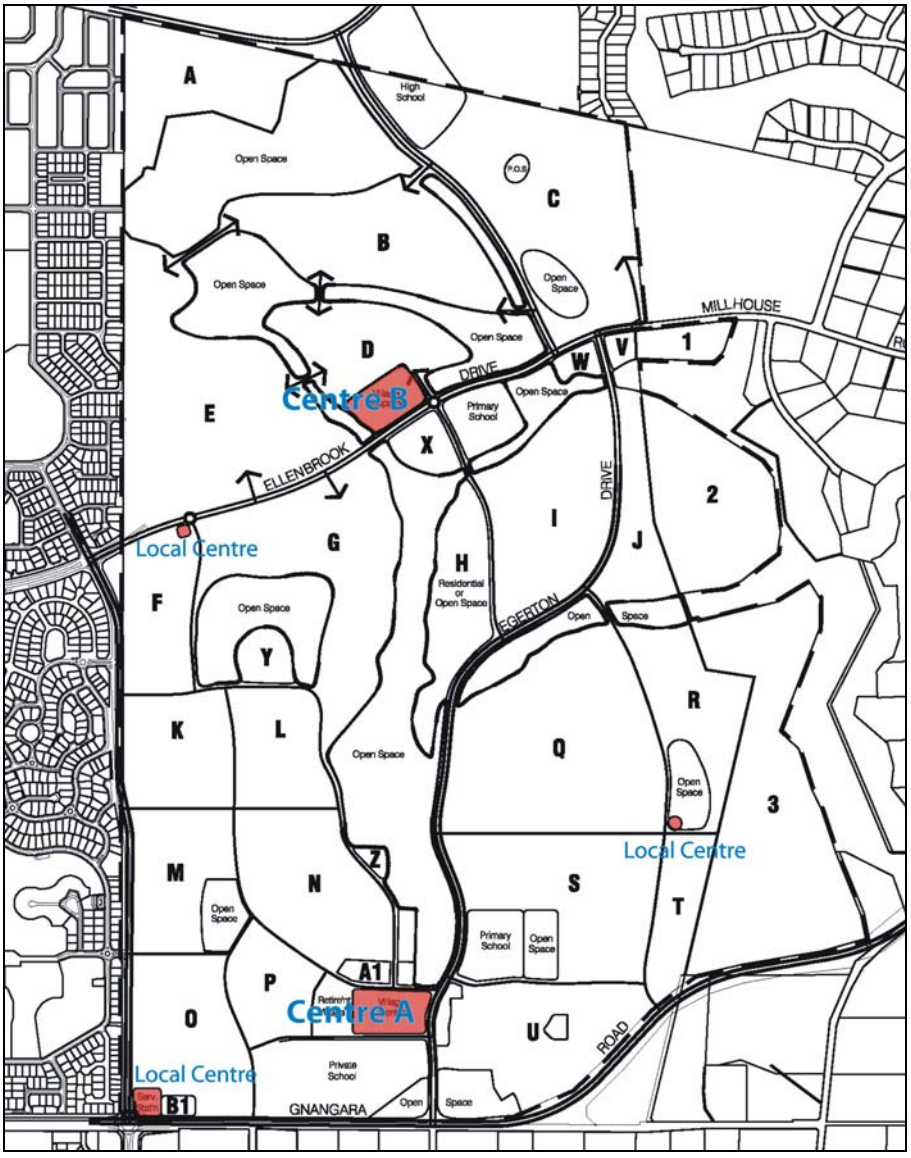
Figure R-01

This modelling indicates that with a total provision of 7,000 sqm of retail floorspace, the Vale neighbourhood centres would average an estimated Total Sales performance of $5,186 per sqm per annum (right-most column in Figure R-01). This would be a satisfactory performance. The equivalent Ellenbrook performance estimates are lower, due mainly to the high quantity of retail floorspace planned in the Ellenbrook regional and neighbourhood centres.

2.2 Local Model

Having established an overall quantity of neighbourhood/ local retail floorspace that would work satisfactorily in the Vale project area a local model was used to assign floorspace to the individual neighbourhood centres: Centre 'A' and Centre 'B'. This was achieved by allocating the retail floorspace potential of each small residential cell within Vale to one or other of the two centres. These residential cells are illustrated in Figure 1.

Figure 1 Residential Cells in Vale Project Area



Source: Chappell Lambert Everett

The results of the local modelling are presented in Figure L-01. These indicate that, with the modified dwelling unit yield estimates, Centre A has a retail floorspace potential of approximately 3,400 sqm, while Centre B has a retail floorspace potential of approximately 2,900 sqm.

2.3 Centre Classifications

The City of Swan Commercial Centres Strategy designates both of the Vale neighbourhood centres as "medium" sized neighbourhood centres, i.e. with a retail floorspace range of 3,500 to 4,500 sqm. During preparation of the previous Centres Strategy for the Vale, modelling at the time proved this classification and the associated retail floorspace range to be appropriate, and they were adopted for the purposes of the earlier Strategy.

However, the recent modelling, which incorporates a lower dwelling unit yield for Vale clearly indicates that a "Medium" classification of the Vale centres would now be excessive.

It is therefore recommended that the two neighbourhood centres in the Vale be re-classified as "Small" neighbourhood centres, i.e. with a retail floorspace range of 1,500 to 3,500 sqm.

Such a classification would not only better reflect the most recent modelling, but the associated retail floorspace range would offer better potential for the flexibility necessary for the centres' developers to respond to the particular market conditions prevailing at the time actual centre development is being seriously considered.

ITEM	**INPUTS**		**OUTPUTS**
Avg Ann HHld Retail Spend	$22,256		
Leakage	57%		
Turnover ($/sqm/ann)	$6,000		
Overall Potential (sqm)		>>>>>>>>>>>>>>>>>	7,000
Other Centres sqm	-		
Floorspace for Distribution (sqm)		>>>>>>> (control total)	7,000
Average Study Area NLA per Capita (sqm)			0.53

		Occ.		Potential	Assignment Prop			Floorspace	
Zone	**Lots**	**Ratio**	**Population**	**($Million)**	**External**	**Centre A**	**Centre B**	**Centre A**	**Centre B**
A	149	2.75	410	$1.41	1	0	0	-	-
B	202	2.75	556	$1.91	0.2	0	0.8	-	255
C	310	2.75	853	$2.94	0.2	0	0.8	-	392
D	151	2.75	415	$1.43		0	1	-	238
E	406	2.75	1,117	$3.85	0.1	0	0.9	-	577
F	119	2.75	327	$1.13	0.2	0.4	0.4	75	75
G	260	2.75	715	$2.46		0.2	0.8	82	329
H	114	2.75	314	$1.08		0.3	0.7	54	126
I	106	2.75	292	$1.00		0.2	0.8	33	134
J	88	2.75	242	$0.83		0.2	0.8	28	111
K	127	2.75	349	$1.20	0.2	0.8	0	160	-
L	121	2.75	333	$1.15		0.9	0.1	172	19
M	97	2.75	267	$0.92	0.2	0.8	0	123	-
N	194	2.75	534	$1.84		1	0	306	-
O	143	2.75	393	$1.36	0.2	0.8	0	181	-
P	78	2.75	215	$0.74		1	0	123	-
Q	363	2.75	998	$3.44		0.8	0.2	459	115
R	125	2.75	344	$1.18		0.7	0.3	138	59
S	212	2.75	583	$2.01		1	0	335	-
T	75	2.75	206	$0.71		1	0	118	-
U	190	2.75	523	$1.80		1	0	300	-
V	20	2.75	55	$0.19		0.1	0.9	3	28
W	28	2.75	77	$0.27		0.1	0.9	4	40
X	100	2.75	275	$0.95		0	1	-	158
Y	45	2.75	124	$0.43		0.7	0.3	50	21
Z	13	2.75	37	$0.13		1	0	21	-
A1	26	2.75	72	$0.25		1	0	41	-
B1	12	2.75	34	$0.12		1	0	20	-
RV	100	1.20	120	$0.95		1	0	158	-
1	7	3.00	21	$0.07		0.1	0.9	1	10
2	150	3.00	450	$1.42		0.3	0.7	71	166
3	300	3.00	900	$2.84		0.8	0.2	379	95
Total	4,432	2.74	12,147	$42.00				3,437	2,948
Control Total Adjustment/ Cross-Check						***OK***		***3,437***	***2,948***

Figure
L-01

APPENDIX SEVEN

Report on Engineering Aspects Associated with Development Plan Two

MULTIPLEX ACUMEN VALE LANDOWNER PTY LTD

VALE URBAN DEVELOPMENT

REPORT ON ENGINEERING ASPECTS ASSOCIATED WITH DEVELOPMENT PLAN 2

APRIL 2007

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1. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd, Consulting Engineers, and it summarises the results of investigations undertaken by the firm, to date, of the engineering aspects of urban development of the Vale Development Plan 2 (DP2) area.

The investigations have been based on the Vale Development Plant Two, 2006 – Figure 1 prepared by Chappell Lambert Everett (995-166G). The plan covers the area of urban zoned land north of Millhouse Road the northern extremity of the Vale landholding.

This report details the requirements for siteworks, earthworks, roadworks, drainage, sewerage reticulation, water supply and other public utility services to facilitate urban development as they relate to the DP2 proposal.

2. SITE DESCRIPTION

The DP2 area is varied in its topography and vegetation. The west of the Site consists of elevated sand dunes from which views to the Darling Range may be achieved. A Bush Forever and Conservation area separate this western dunal system from lower lying flatter land

To the east of this higher ground, there are areas of low, heavily treed wetlands which form a low-lying swale that generally runs north-south across the property. There are a number of small streams that traverse the site and flow in an easterly direction to the Ellen Brook watercourse.

Surface levels vary in the undulating topography from peaks of up to RL 40 metres AHD in the west down to RL 23 metres adjacent to the stream tributaries. The dunal system comprises a series of ridges with steep side slopes, of up to 1:2 flattening to more gentle grades of 1:50 to the east.

Most of the land has been cleared for pine plantations, on the higher sand dunes while remnant vegetation located within the conservation and Bush Forever areas has been retained.

A preliminary geotechnical investigation of the Vale landholding was carried out in October 1993 by Coffey Geosciences. A more detailed investigation is to be carried out by Coffeys of the site. Coffey's have indicated that the site consists of Bassendean dune Sands to the west, while the developable land to the east consists of Bassendean dunal sands overlying Guildford formation. The Bush Forever, Conservation areas and creek lines consist of either Guildford Formation or swampy peaty deposits.

The sands which make up the area to the west are free draining and suitable for urban development.

Jim Davies and Associates have estimated preliminary average annual maximum ground water levels, as part of the drainage management planning work for the Vale project. The investigation and current bore logs indicate that groundwater is generally close to the existing ground surface within the lower parts of the site and the wetland areas.

3. SITEWORKS & EARTHWORKS

Jim Davies & Associates (JDA) has forecast the average annual maximum groundwater levels (AAMGL's) following the development of the landholding. These levels, together with preliminary information provided by Coffey Geosciences, have been adopted as a basis of the assessment of the siteworks & earthworks requirements for development.

Using JDA's AAMGLs, and based on the existing ground conditions, the siteworks required for the implementation of urban development are expected to include the following:

1. The removal of the peaty sands within the lower dampland areas which are to be developed and replacement with sand.
2. The reshaping of the western sand dunes to create level building lots where possible. This could be achieved through a combination of terracing between retaining walls and bulk earthworks. Terracing would allow greater elevation of lots although this would require high retaining walls.

The earthworking of the dunes would need to tie into the earthworks levels of Ellenbrook to the west and the design levels to the north. This tieing in may require a combination of terracing and sloping lots for proposed larger lots adjacent to Ellenbrook.

The earthworking would also need to either tie into the existing levels or construct retaining walls adjacent to the surrounding the Bush Forever and conservation areas to be retained within the site as there is to be no battering into these areas.

Within the eastern lower lying areas half of the site, the finished surface levels will need to be designed to provide an adequate cover of sand over the Guildford formation to suit the required class of building foundations. Coffey Geosciences have recommended a minimum cover of 1.5-2 metres to ensure 'A' class foundation conditions as per AS 2870.1.

A minimum clearance between the forecast post-development AAMGL's and the finished surface of development lots will need to be provided. Again Coffey Geosciences have recommended this to be 1.2 – 1.5 metres such that soakwell drainage on the lots may be provided.

It may be possible for the lots to be left with less clearance to the underlying Guildford Formation, though this would result in a higher site classification and the connection of lots to the road drainage system. Both options will be evaluated at the detailed design stage.

In areas where the pre-development AAMGL's are less than 1.5 metres below the finished surface sub-soil drainage may be installed and the minimum clearances would be achieved by filling, where necessary, above those levels. This approach aims at reducing the volume of filling required within the lower parts of the site.

Topsoil will be stripped with the top 100mm which contains the organics and seed being reused within landscaped open space areas, District Open Space and respread at 80mm maximum thickness on all lots except four packs and cottage lots, due to it being beneficial for the soil and in line with sustainability principals. The topsoil at a natural depth greater than 100mm will be blended with fill material in accordance with the Coffey Geoscience requirements and used as fill as has occurred in DP1.

In general it is expected that the western dunal lots will be a cut-to-fill exercise with no imported fill required for the construction of these lots. East of this area however, it is anticipated that some importation of clean sand fill material will be required to gain sufficient cover to existing groundwater and the Guildford Formation soils.

4. ROADS INFRASTRUCTURE

An assessment of the traffic and transport planning aspects of the Vale Urban Development has been carried out by Sinclair Knight Merz, and is reported separately.

In general this makes recommendations for the development road network of district distributors, neighbourhood connectors, access streets and laneways, in terms of cross-sectional elements, pedestrian and cyclist provisions, public transport, etc.

In all cases these standards are consistent with the Liveable Neighbourhoods Community Design Code and will ensure adequate provision in the Development Plan for engineering services, street trees (where required), pedestrian and cyclist facilities and car parking.

The engineering design of the development roads will be in accordance with the Community Design Code and the requirements of the City of Swan. This will include the provision of traffic calming measures, to contain vehicle speeds, and road pavement and landscaping treatments aimed at creating a high quality residential environment and improved safety, as well as a high standard of access.

Construction of the development roads will be staged to suit the rate and pattern of development of the Development Plan area.

Vale falls within the City of Swan's policy area for "Subdividers Contributions – Henley Brook Drive (North) and Millhouse Road". This policy relates to the requirements for subdividers in certain urban cells of the north east corridor to contribute financially to the upgrading of district distributor roads Henley Brook Drive (north) and Millhouse Road. All lots within DP2 will incur this per lot cost.

The construction of Millhouse Road and Egerton Drive will be carried out in accordance with the "Egerton Infrastructure Construction Memorandum of Understanding" between City of Swan and Multiplex Acumen Vale Landowner Pty Ltd as detailed on Chappell Lambert Everett plan number 995-530 (revised 18/4/06).

5. DRAINAGE INFRASTRUCTURE

The proposed strategy to manage drainage and nutrients within the Vale development is outlined in the "Egerton Nutrient and Drainage Management Plan" (DNMP) prepared by Alan Tingay & Associates et. al. (1995) (referred to here as the 1995 DNMP). It received Ministerial Approval in 1995.

The 1995 DNMP proposed a series of drainage compensating basins located along existing tributaries that fed to a proposed water pollution control pond at the existing Heritage Dam site to the south-east of the DP2 area. The current drainage strategy incorporates the same methodology, with a system of detention basins located within designated multiple use corridors that will control post development flow from the development to pre development levels. The drainage strategy is detailed in DP2 DNMP (JDA Consultants 2006).

The use of the multiple use corridor upstream of the Heritage Dam as a Water Corporation owned and operated detention basin will need to be confirmed as part of the detailed design process for DP2. It is expected that maintenance of the detention basins below the 1 in 10 year ARI flood level and its connection to downstream receiving system, will be the responsibility of the Water Corporation.

For flood and water quality management purposes, the 1995 DNMP proposed a drainage scheme managed by a network of wet detention and infiltration basins in the upper catchments, and Water Pollution Control Ponds (WPCP's) at the catchment outlet where discharge to an external water body occurred.

Under this approach, it was proposed that a network of a piped/swale system draining to detention storages (compensating basins) be used to manage surface drainage. The piped/swale system would be able to cater for the 1 in 5 year storm event, with overland flow paths to the storages for larger events. The storages were designed with discharge compensated to pre-development levels, for events up to a 1 in 100 year storm.

Groundwater levels are managed by a subsoil drainage system that limits the peak rise in groundwater. Sub-soil drains would be incorporated where clearance between groundwater and building levels is inadequate.

For water quality management within the development, the 1995 DNMP's main focus was on surface water with sole reliance on WPCP's located at the catchment outlet. These WPCP's were designed according to specific environmental criteria at the time.

Advancements in the water quality field suggest that sole reliance on WPCP's located at the catchment outlets are not necessarily the most efficient and effective way of controlling stormwater quality. New initiatives adopted for Development Plan 1, suggest that the main focus shall be on non-structural source controls which include land-use planning (POS and landscape design), education campaigns, balanced planting regimes and street sweeping. Structural controls such as stormwater pollutant traps, swales and detention storages will also be utilised.

Where possible, drainage flows will be dispersed into swales, soakwells and infiltration trenches to maximise groundwater recharge and reduce surface runoff. This approach will however, be limited to the higher, sandy areas of the site where infiltration capacity is adequate. Detention basins will be landscaped within the existing multiple use corridors and within public open space areas. The detention basins will be linked by a system of trunk drainage channels comprising existing watercourses, upgraded to suit, or underground pipelines.

Surface drainage within the subdivision areas will be via a conventional system of road gullies and underground pipes draining to the above detention basins. The pipe system will be designed to cater for run-off from minor storms with a frequency of up to 1 in 5 years with flows from less frequent major events, up to 1 in 100 years, provided for in overland floodways comprising road reserves, drainage channels and swales, linear open space, etc. Drainage detention basins will be designed to compensate, up to 1 in 100 year storm flows, such that discharge to downstream receiving waters do not exceed those which currently flow from the undeveloped site.

The City of Swan will be responsible for the maintenance and upkeep of the drainage basins above the 1:10 year water level and other non-structural source control measures such as street sweeping and the cleaning of stormwater pollutant traps and drainage pits and pipes.

The Developer has undertaken to be responsible for the following:

- Implementation of non-structural source control measures such as education campaigns, balanced planting regimes and a review of the operating and maintenance practices throughout the development.
- Groundwater level and quality monitoring for the first 10 years
- Stormwater inflow quantity and quality monitoring for the first 10 years
- Preparation of annual monitoring reports and the strategic planning for future stages of Vale. This will ensure flexibility is maintained for continual improvements in WSUD based on the monitoring outcomes from the first stages of development.

Vale lies within a Water Corporation main drainage area, hence the Water Corporation requires that drainage headworks contributions be levied on the site in accordance with the North-East Corridor Special Agreement Area rates.

6. SEWERAGE INFRASTRUCTURE

The Water Corporation of WA (WCWA) has made provision for the sewerage of the Vale development in its planning for servicing the overall north-east corridor.

The current sewer strategy for DP2 has been completed by WCWA and shows the sewerage for this area flowing east along Millhouse Road to the proposed Ellenbrook “e” Pumping Station. Current discussions with the Water Corporation have the site located in the Eastern side of DP2 adjacent to the rural lot on Millhouse Road.

Ultimately sewage from the area will be pumped via the Ellenbrook “E” Pump Station along Millhouse Road to the West and connecting into the discharge access chamber currently constructed at the intersection of Millhouse Road and The Promenade and flowing to the pump station on Gnangara Road within the Ellenbrook development near Lord Street. This pump station will ultimately pump to the Alkimos WWTP. Prior to development of the Alkimos WWTP the sewage would be pumped to the existing Beenyup WWTP.

Water Corporation have programd for the pumping station to be operational by December 2007 which is in line with the requirements to accept flow from lots developed within DP1 as well as DP2.

Sewerage within the development area will be via conventional systems of reticulated and trunk sewers. Water Corporation headworks contributions for sewerage would be levied on the Vale development in accordance with the North-East Corridor Special Agreement Area rates.

7. WATER SUPPLY

As with sewerage, WCWA has made provision for water supply to the Vale development in its planning for servicing the overall north-east corridor.

This planning is based on a local supply, from the Gnangara groundwater mound beneath the State Forest, west of Vale, supplemented ultimately by connection to the metropolitan system within the north-west corridor.

Groundwater bores within WCWA's Lexia system pump to the treatment plant and reservoir located west of Ellenbrook. Supply to the development areas will be via a network of trunk and distribution watermains linking the reservoir to a conventional system of reticulation.

Initial water supply to Ellenbrook has been provided from the existing groundwater supply system servicing The Vines development, to the north. The Water Corporation has constructed a new trunk watermain to the area from the Wanneroo Scheme. Together these supplies will service the development of both Vale and Ellenbrook pending the construction of the initial stages of the Lexia system.

Water supply to the DP2 area will be via the extension of distribution and reticulation watermains from Ellenbrook with the 600mm diameter distribution watermains located within Millhouse Road.

Water Corporation headworks contributions for water are levied on the Vale development in accordance with the North-East Corridor Special Agreement Area rates.

8. OTHER UTILITY SERVICES

8.1 Electricity Supply

Electricity supply for the DP2 area will be via an extension of the existing high voltage system in Development Plan 1. At this stage it is not expected that any sites for sub-stations, etc, other than for padmount transformers, will be required in the DP2 area.

8.2 Gas Supply

Natural gas is supplied to the Vale project via a connection to the existing Dampier-Bunbury pipeline which is located through the south-east corner of the State Forest west of Vale. This supply is currently installed in Development Plan 1 and will be extended north to DP2.

8.3 Telecommunications

Telephone supply will be extended north from the Development Plan 1 area north into DP2. Development Plan 1 is serviced via optic fibre cables along Gnangara Road from the Ellenbrook development.

Provision has also been made for MATV reticulation, through Broadcast Engineering Services within the Vale development. Under this system, pit and pipe conduit is laid and BES provide optic fibre to every lot. This facility will enable cable TV, central security, video on demand, high speed internet, intranet facilities and other information technology services.

APPENDIX EIGHT

Fire Management Plan

FIRE MANAGEMENT PLAN

The Vale Stage 2 Millhouse Road, Ellenbrook

City of Swan

March 2007

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1.0 PURPOSE OF THE MANAGEMENT PLAN

The purpose of this Bushfire Management Plan is to detail the Fire Management methods and requirements that will be implemented within the proposed subdivision. The aim of the Bushfire Management Plan is to reduce the threat to residents and fire fighters in the event of a fire within or near the subdivision and to conserve the wetland areas.

2.0 SUBDIVISION LOCATION AND DETAILS

The subject land The Vale (Lot) is located approximately 20kms from Perth in the Northeast Corridor. See Figure 1.

The land is zoned Urban with public open space, a school and a village centre within Outline Development Plan 73.

3.0 SITE DETAILS

The western half of the site is covered with Banksia woodland with some pine forest in the southern part. The remainder of the site is cleared with several wetland/creeks in the site. It is intended to manage some of the woodland as Bush Forever and multi use corridor of public open space. The pine forest will be cleared.

4.0 STATUTORY CONDITIONS

The Western Australian Planning Commission requires a fire management plan as part of the development application. This document has been prepared as part of the Wetland Management Plan.

As fire management strategies may require altering to meet changing environment and land use needs, landowners/occupiers are advised that provisions of the Bush Fires Act 1954 may still be enforced in addition to this Fire Management Plan.

Figure 1 Locality of Proposed Subdivision

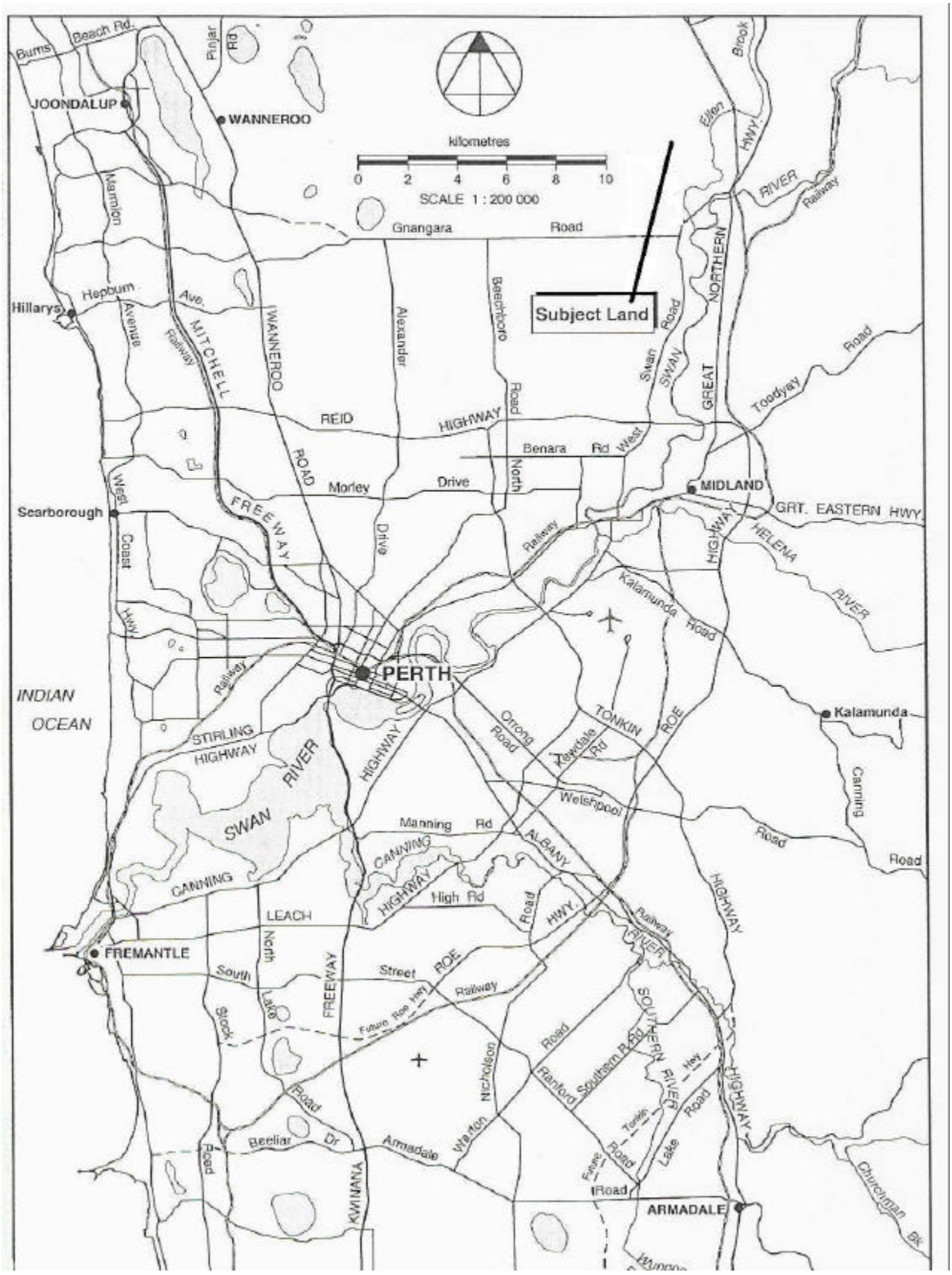
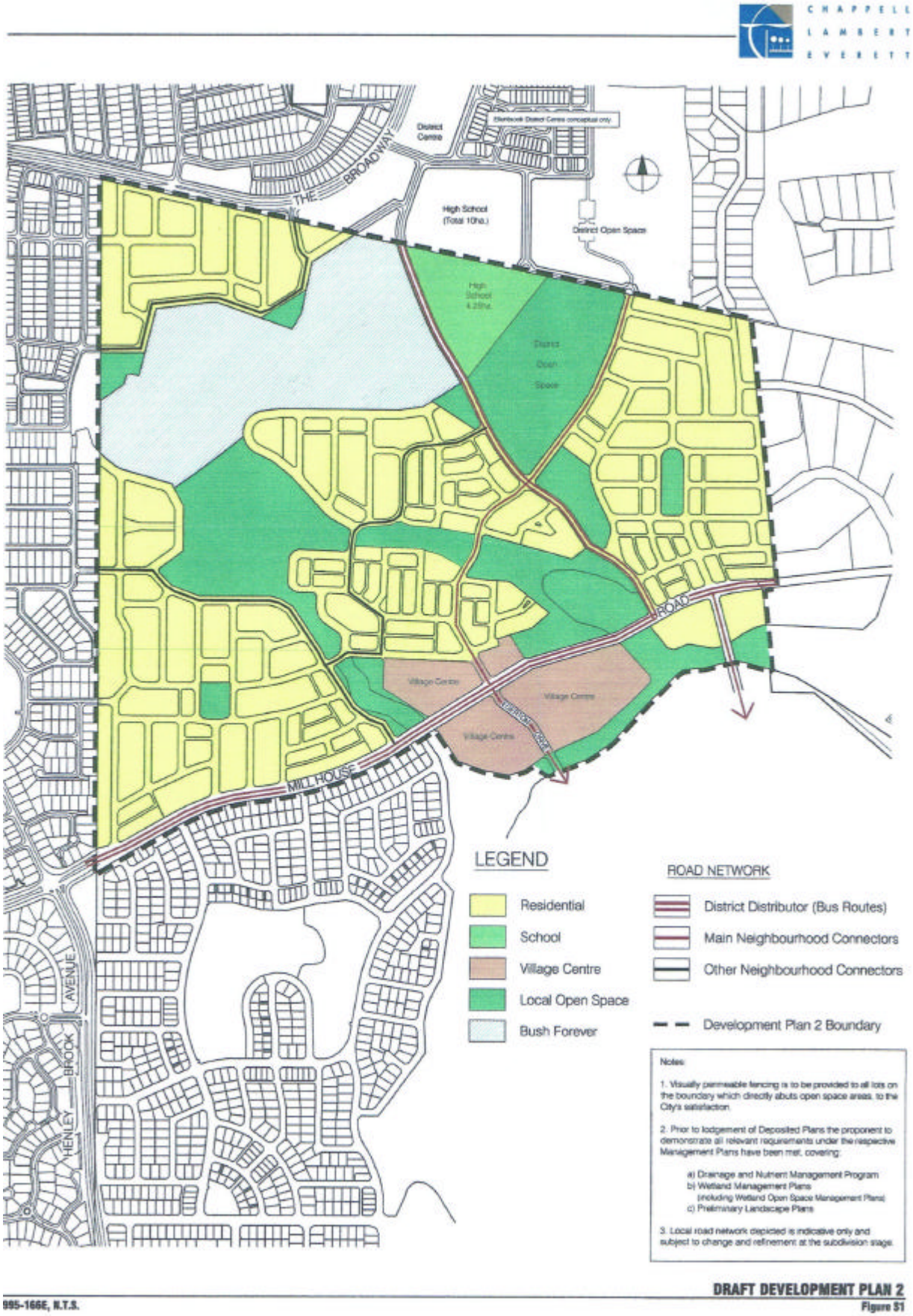


Figure 2 Concept Development Proposal.



5.0 BUSH FIRE HAZARD ASSESSMENT

The assessment of fire risk takes into account existing site conditions which include:

- Topography with particular reference to ground slopes and accessibility;
- Vegetation cover – both remnant and likely revegetation;
- Relationship to surrounding development.

The Bush Fire Hazard Assessment is Extreme in the woodland area and medium in the cleared portions. The hazard rating for the adjoining properties is extreme in remnant vegetation and medium in the cleared areas. To the west and east is Urban development. See Figure 2.

The Mediterranean climate experienced by this area is such that the majority of rain falls in late autumn through to early spring. This rainfall supports substantial vegetation growth which dries off in Summer/Autumn.

The combination of prevailing winds and dry vegetation poses a fire risk and bush fire control is considered essential for the protection of life and property, and to ensure that frequently and uncontrolled burning does not degrade existing and replanted vegetation.

Figure 3 Bush Fire Hazard Assessment – Not to scale

6.0 FIRE MANAGEMENT PLAN

The aim of the Fire Management Plan is to reduce the threat to residents and fire fighters in the event of bush fire within or near the site.

The Fire Management Plan has been developed to incorporate fire management methods.

- Sealed subdivision roads;
- Strategic firebreaks systems;
- Protection of Bush Forever & Public Open Space;
- Protection around each stage of development;
- Building Protection Zone.

6.1 FIRE PROTECTION REQUIREMENTS AROUND STAGES OF DEVELOPMENT

The main threat to each stage of development to a wildfire (bushfire) is from a fire in the pine forest or remnant vegetation threatening houses within the site.

To provide protection to residents in the various stages each stage is to contain the following bush fire protection requirements.

- A strategic firebreak is to be constructed on the outside of the development on the alignment of the internal road in the next stage. This firebreak is to be to the standard of a strategic firebreak as detailed in Section 6.4. It may be necessary in some places (very heavy sand) to lay road base to provide access for large fire appliances.

- A building protection zone is to be established between the last lots in each stage to be sold and the strategic firebreak described above. The standard of the building protection zone is detailed in Section 6.6.

- Fire hydrants are to be installed within each stage with hydrant marked as detailed in Appendix B.

6.2 FIRE PROTECTION IN UNDEVELOPED AREAS.

In the pine forest and woodland areas that have not been developed the following fire protection are required.

- Maintain existing boundary and internal firebreaks to the strategic firebreak standard as detailed in Section 6.4.

- Access from the existing development to Public Open Space and Bush For Ever is to be provided along the alignment of proposed interconnecting roads. This access is for firefighting vehicles and may have rural gates (4.3metres wide) or locked bollards installed to the satisfaction of the City of Swan to

restrict access by private vehicles into the site. This access is to be to a minimum standard as detailed in Section 6.4.

6.3 FIRE PROTECTION IN BUSH FOR EVER AND MULTI USE CORRIDOR

The Bush For Ever Land and Multi Use Corridor are to have fire protection measures implemented to adequately protect the adjoining urban development in the event that these areas will at some stage be affected by wildfire.

The fire protection requirements for the Bush For Ever and Conmservation Area are as follows.

- A road is to be constructed around the outside of the housing area to separate the housing development from the bush areas.

- Where no road separates housing development from the bush areas a minimum 2.5 metre wide trafficable surface (road base) access way is to be installed. These can be multi purpose pathways/access ways.

- A 20 metre building protection zone is to be established between the housing area and bush area to consist of public open space and/or road reserve/access way. See Section 6.6 for Building Protection Zone Standards.

The fire protection requirements for the Mulitple Use Corridors are as follows :

- Where no road separates housing development from retained bush areas a minimum 2.5 metre wide trafficable surface (road base) access way is to be installed. These can be multi purpose pathways/access ways.

- A low fuel zone consisting of a manicured landscape will be provided between the Multiple Use Corridors and adjoining residential development.

- The Multiple Use Corridors are existing creeklines which have little or no understorey (only pasture) with tree canopies over. A manicured landscape in and around the trees and creeklines will be provided in a Perry Lakes Drive/ Fraser Ave (Kings Park) parkland type environment.

- A fire hydrant is to be located at either end of the multi purpose pathway/fire access.

6.4 STRATEGIC FIREBREAK SYSTEM STANDARDS

A Strategic Firebreak is to provide access for fire fighting equipment. This firebreak must be 6 metres wide, 4 metre vertical clearance and have a 4m trafficable surface for fire fighting equipment. In some places road base material will be required due to heavy sand conditions as large fire trucks may use these firebreaks. Refer to Appendix C for Strategic Firebreak locations.

6.5 DWELLING CONSTRUCTION STANDARDS

Individual dwellings on each lot adjoining Bushland areas shall be designed and built to conform with:

- Homeowners Bush Fire Survival Manual Guidelines
- The City of Swan Specification and Requirements
- Australian Standards AS 3959 (Recommended)

Building of houses adjoining the woodland to the Australian Standard AS 3959 "Construction of Buildings in Bush Fire Prone areas" provides residents better protection against wildfires. Provided building protection zones over public land between the edge of woodland vegetation and Lot boundary comply with Section 6.6 then building of houses to Australian Standard AS3959 is optional.

Memorials are to be placed on Certificates of Title for those Lots directly adjacent to woodland areas advising future landowners of the potential bush fire risk.

Copies of the Homeowners Bush Fire Survival Manual or other suitable documentation will be issued to each property owner by the developer of the sale of the allotment.

6.6 BUILDING PROTECTION ZONE STANDARDS

The aim of the Building Protection Zones is to reduce bush fire intensity close to dwellings, and to minimise the likelihood of flame contact with buildings.

The building protection zone is a low fuel area immediately surrounding a building.

Non flammable features such as driveways, lawn, or landscaped gardens (including deciduous trees) should form part of building protection zones. Isolated trees and shrubs may be retained within building protection zones. A building protection zone of 20 metres wide is required. It must fulfil the following conditions:

- Bush Fire fuels must be maintained below a height of 50mm in height.
- The spacing of trees should 15 metres apart to provide for a 5 metre separation between crowns.
- All tree branches must be removed for a minimum of 2 metres from building eaves.
- All leaves, tall grass, and clearing slash of trees must be removed from within the building protection zone area.
- Dry Grass is be trimmed and maintained to no more than 50mm
- The aim must be to maximize the area of non-flammable ground cover, especially the area abutting the buildings.

- Building Protection Zone and Hazard Separation Zones are to be installed prior to any dwelling construction commencing.

Definition. Bush fire fuels**.** Under the Bush Fire Act "bush" is defined to include "trees, bushes, plants, stubble, scrub, and undergrowth of all kind whatsoever whether alive or dead and whether standing or not standing"

7.0 WATER FOR FIRE FIGHTING.

The site is to have mains water installed and fire hydrants are to be installed at 200metre intervals and are to be identified by standard pole and/or road markings by the Developer. See Appendix B for Hydrant Markings.

8.0 SUMMARY

8.1 Developer's Responsibility

Prior to subdivision being given Final approval by the Western Australian Planning Commission the developer shall be required to carry out works described in Section 6 and 7 of this Fire Management Plan.

The Developer will be required to maintain these works until the development is complete or the ownership of the Woodlands change or as detailed in the development agreements with the City of Swan.

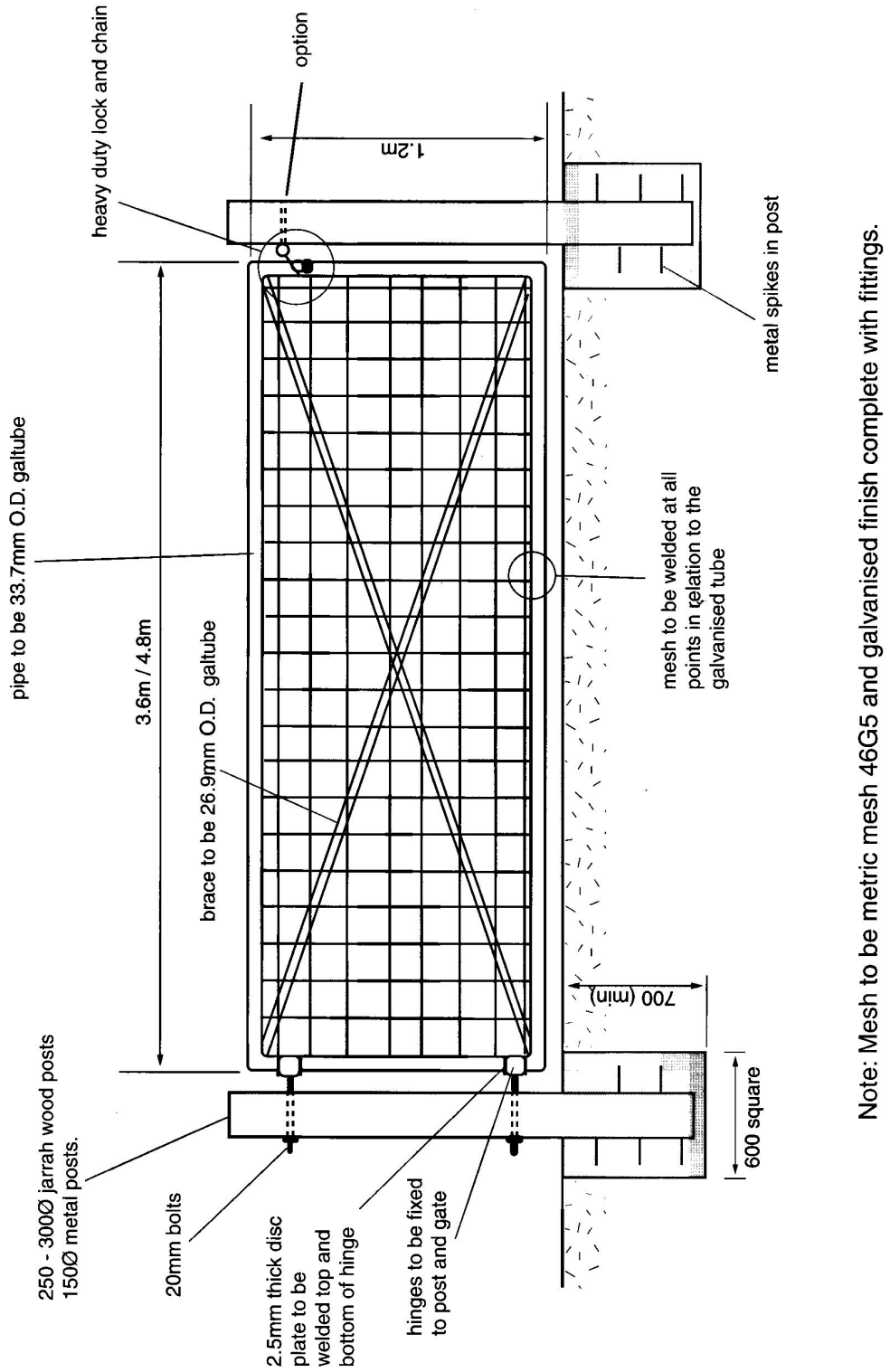
8.2 City of Swan's Responsibility

The responsibility for compliance with the law rests with individual property owners and occupiers and the following conditions are not intended to unnecessarily transfer some to the responsibilities to the City of Swan.

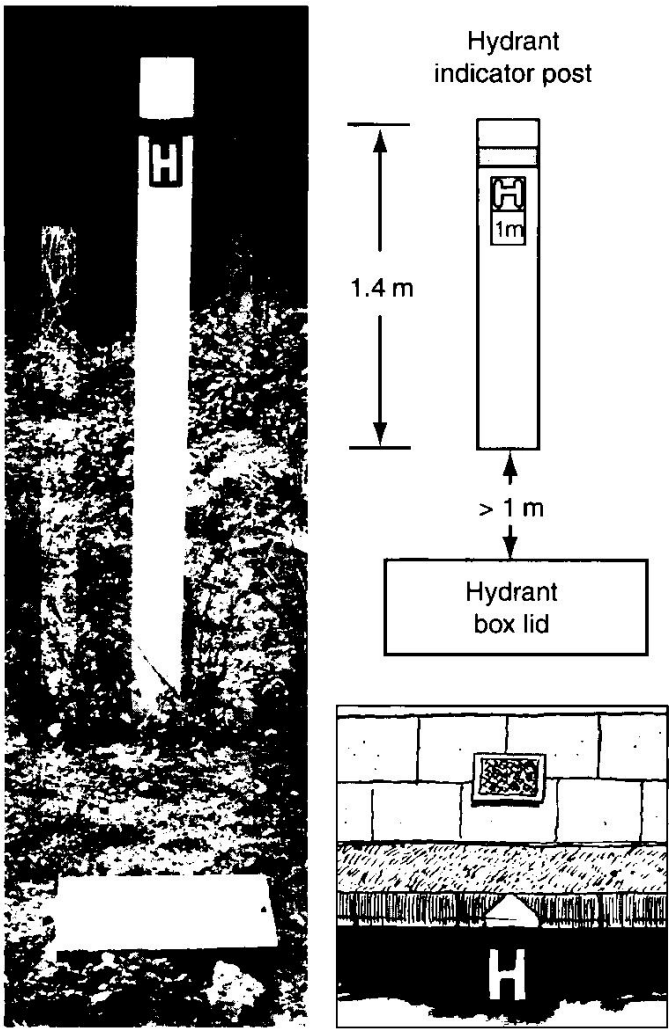
The City of Swan shall be responsible for:

- Developing and maintaining District Fire Fighting Facilities
- Maintaining in good order the condition equipment and apparatus for fire fighting purposes.
- Maintaining a supply of G13 locks to be made available at cost to relevant landowners on request. Keys to these lock are held by Fire Brigades and CALM fire appliances.

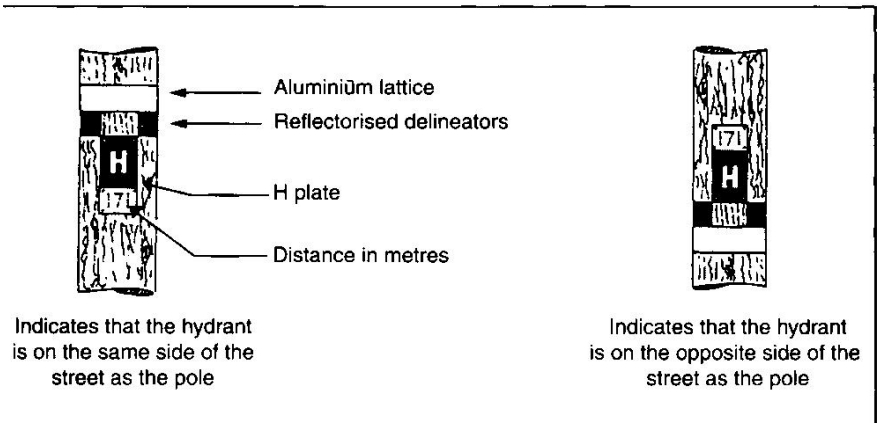
Appendix A Gate Design.



Appendix B Fire Hydrant Markings

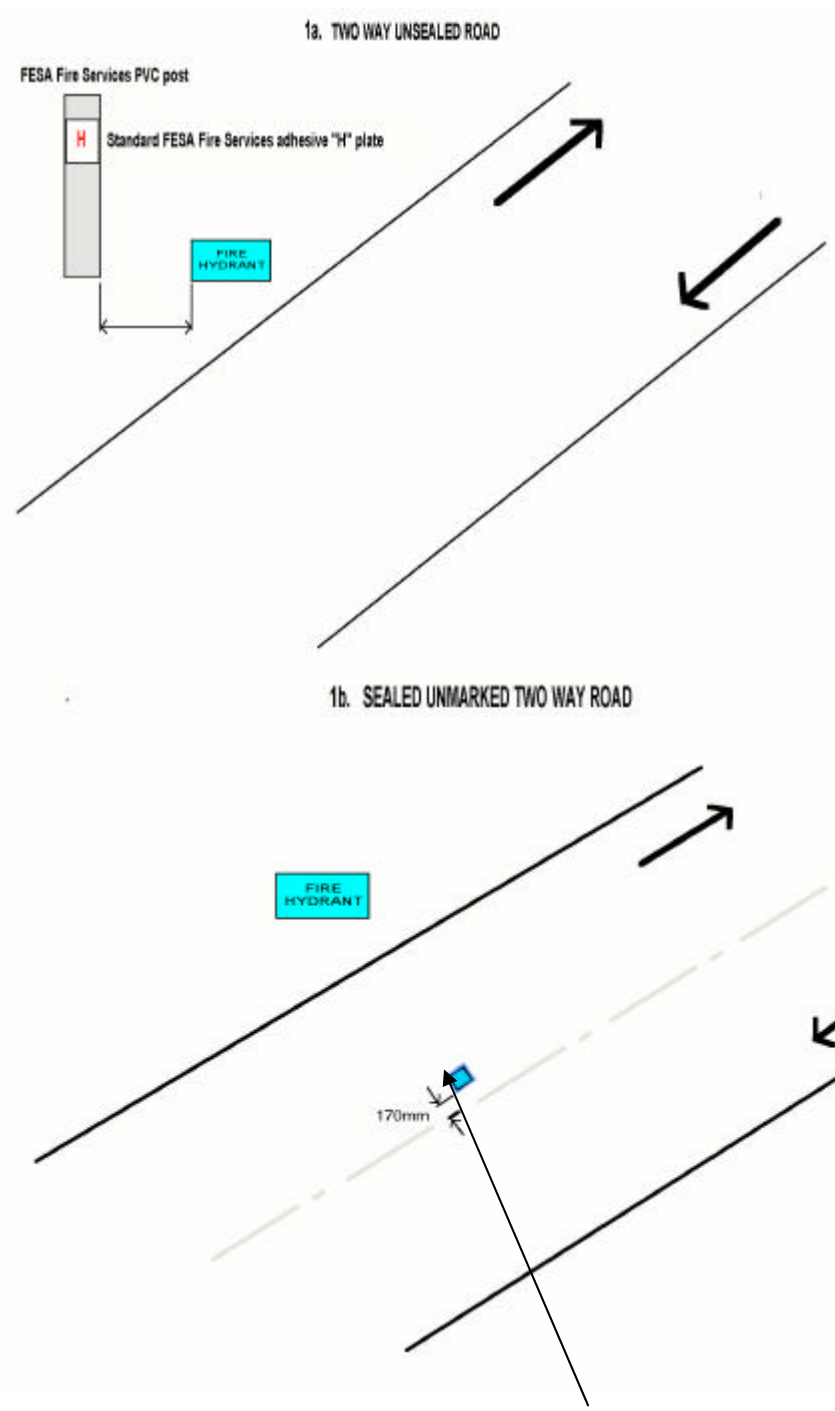


Hydrant indicators post.



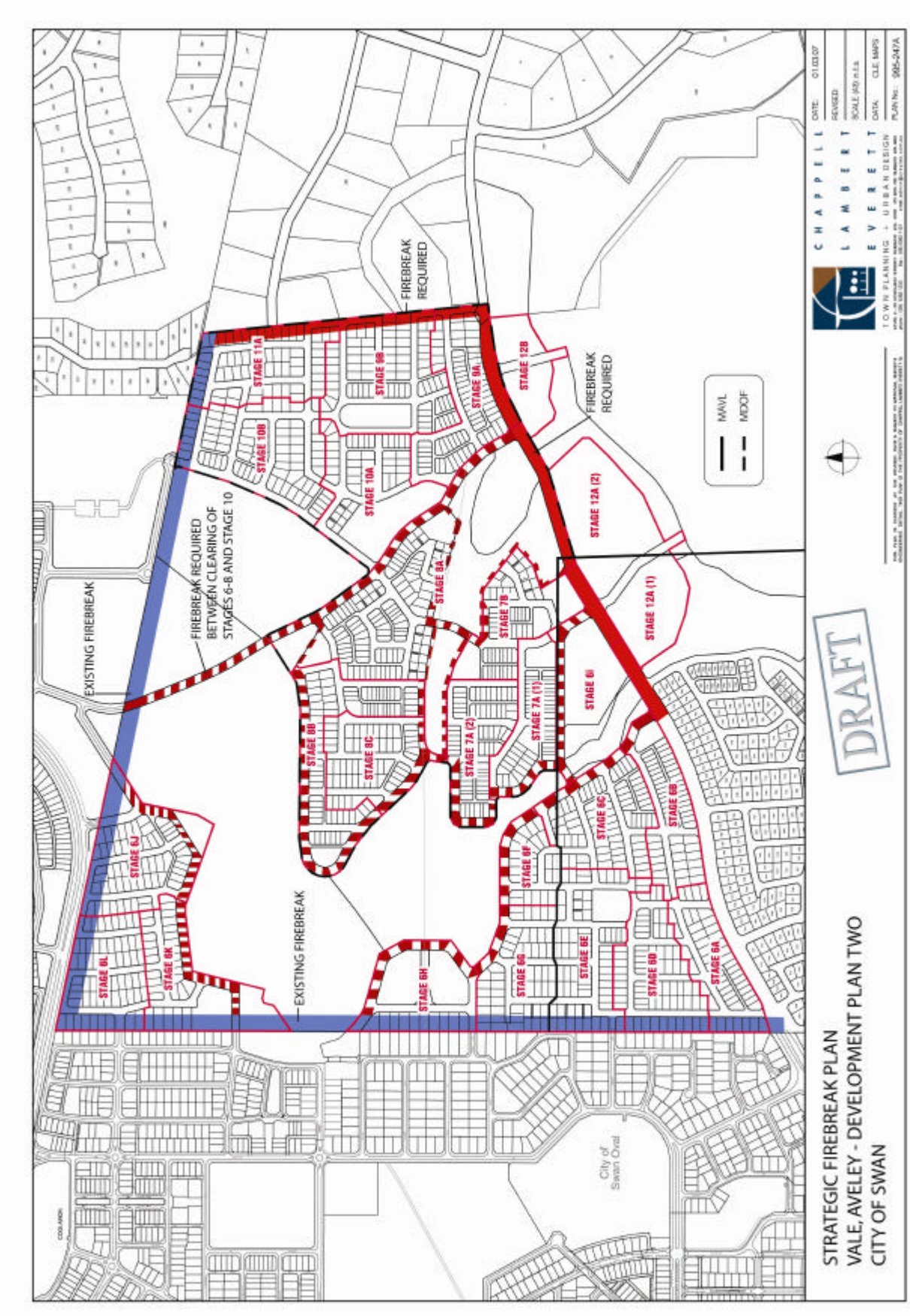
BLUE RAISED RETROREFLECTIVE PAVEMENT MARKER & HYDRANT INDICATING GUIDLINES

The implementation of the blue raised retro reflective pavement marker (RRPM's) and new hydrant indicating regime is designed to provide greater ability for fire fighters to readily identify fire hydrant locations, particularly at night or where smoke affects visibility.



Blue raised retro-reflective pavement marker

Appendix C Strategic Firebreak Locations



Stockland

Fire Management Plan Addendum DP2 – Vale, Aveley

May 2013

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Fire Management Plan Addendum
DP2 – Vale, Aveley

May 2013

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File:	Stockland		
Version	Prepared by	Reviewed by	Approved by
1	Sue Brand	James Westh (Stockland) Luke Summers (NAC)	Luke Summers

Contents

1.0 Introduction

During 2007, a Fire Management Plan was prepared by FirePlan WA for the Vale Stage 2 Millhouse Road, Ellenbrook (2007) that described the various fire management activities that would be applied within the development. This Fire Management Plan was endorsed by the City of Swan in 2007 and has been implemented throughout development of the Vale Development Plan Two (DP2) area to date. As standards and requirements relating to fire management have changed in the intervening years, a need has been identified by the City of Swan to update key plan components to ensure the ongoing development meets current expectations and requirements for fire management. Natural Area Consulting (NAC), a division of Natural Area Holdings Pty Ltd, has prepared this document as an addendum to the original endorsed fire management plan and will describe adjusted fire management requirements for nominated precincts within the DP2 development area.

2.0 DP2 – Precincts 1 and 2

Precinct 1 of the DP2 development site occurs to the north of Millhouse Road and extends as far as the Vines and the City of Swan district open space that is currently undergoing development (2013). Precinct 2 occurs south of Millhouse Road and north of the DP3 development area. The predevelopment bushfire hazard assessment for Precincts 1 and 2 is provided in Figure 1. Vegetation with an extreme hazard rating includes wetland areas to the west and north east, with moderately rated vegetation to the west, north and east. As the development proceeds, vegetation will be cleared and landscaped, adjusting the level of vegetation on site, and thus the hazard level (Figure 3). The justification for the post-development hazard assessment is provided in Figure 4.

2.1 Northern Boundary – Precinct 1

The northern portion of Precinct 1 includes a number of lots that abut the Stockland property boundary and vegetation immediately to the north in the City of Swan District Open Space (DOS). While clearing will occur within portions of the DOS, an area of vegetation extending north –south along the western boundary of existing properties within the Vines will remain, and is rated by the City of Swan as having a moderate bushfire hazard. Those lots within Precinct 1 immediately abutting the vegetated portion have been assigned a BAL 29 building construction rating as a result of that proximity (Figure 2). The lots will include an 8 m building exclusion zone extending south from the Stockland property boundary. A 6 m wide low fuel zone will be created by Stockland along the southern boundary of the DOS, and will include the pruning or removal of trees and the slashing of lower vegetation. Works will occur during subdivision works and will be undertaken in consultation with and under the management of the City of Swan. All other lots within a 100 m radius of the vegetation have been assigned a BAL 12.5 building construction rating.

2.2 Eastern Boundary – Precinct 1

Existing buildings to the east of Precinct 1 include a vegetated area that has been assigned a moderate bushfire hazard rating by the City of Swan (Figure 1). All lots within 100 m of this vegetation have been assigned a BAL 12.5 building construction rating (Figure 2). Note that the current line of trees that follow the boundary fence will be removed to accommodate the sewer and the road.

2.3 Precinct 2

Those lots within Precinct 2 south of Millhouse Road and north of DP3 are in proximity of vegetation that has been rated by the City of Swan as having a bushfire hazard level of moderate or extreme. A BAL 12.5 building construction level has been assigned to affected lots (Figure 2). An area of Public Open Space (POS) shown on Figure 3 will be landscaped and with the vegetation maintained at a level that maintains the bushfire hazard rating as low. Landscaping in other vegetated areas, such as portions of the wetland to south west, will also reduce the bushfire hazard level from moderate or extreme to low, and be maintained as low in future.

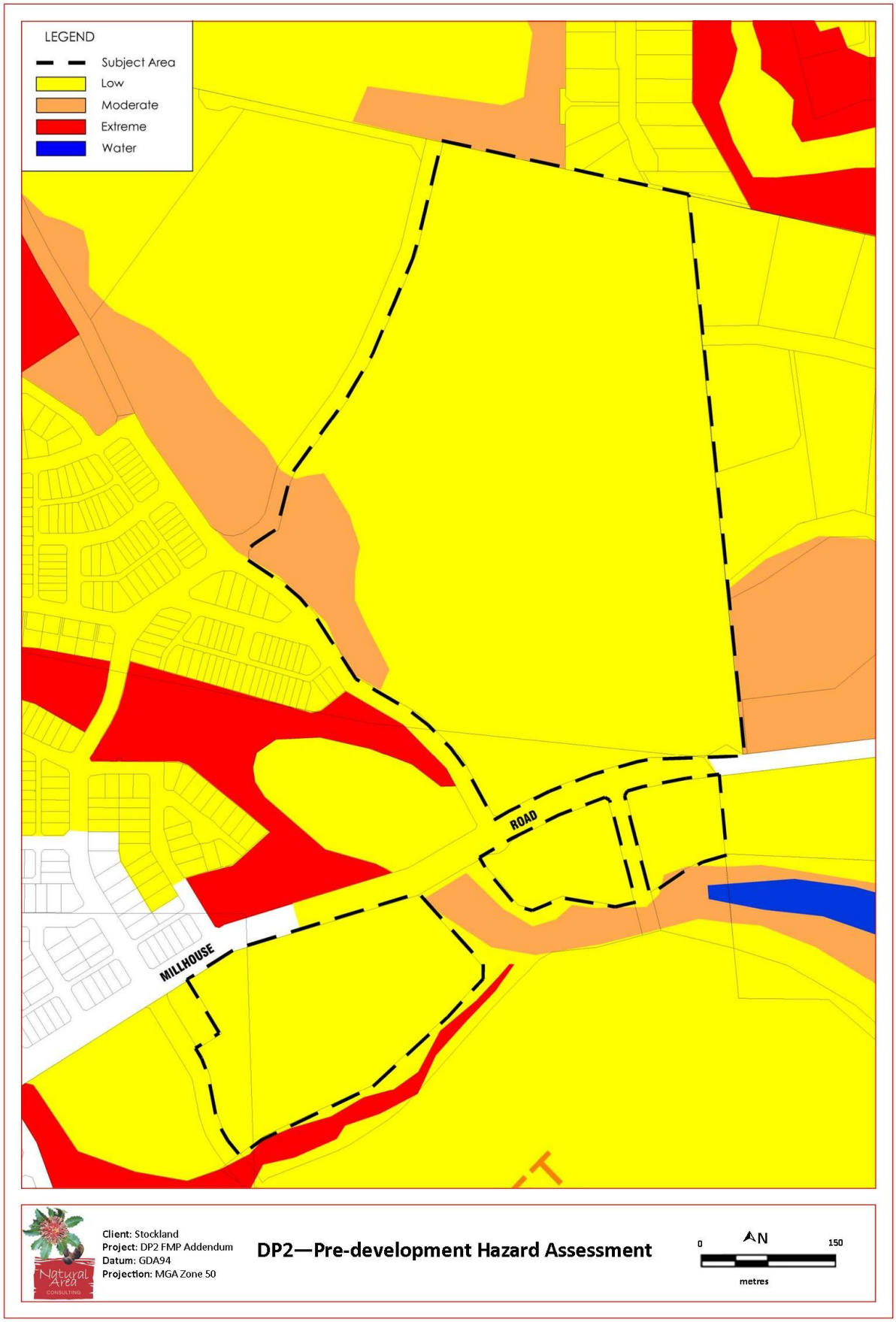

Figure 1: DP2 – Pre-development Hazard Assessment

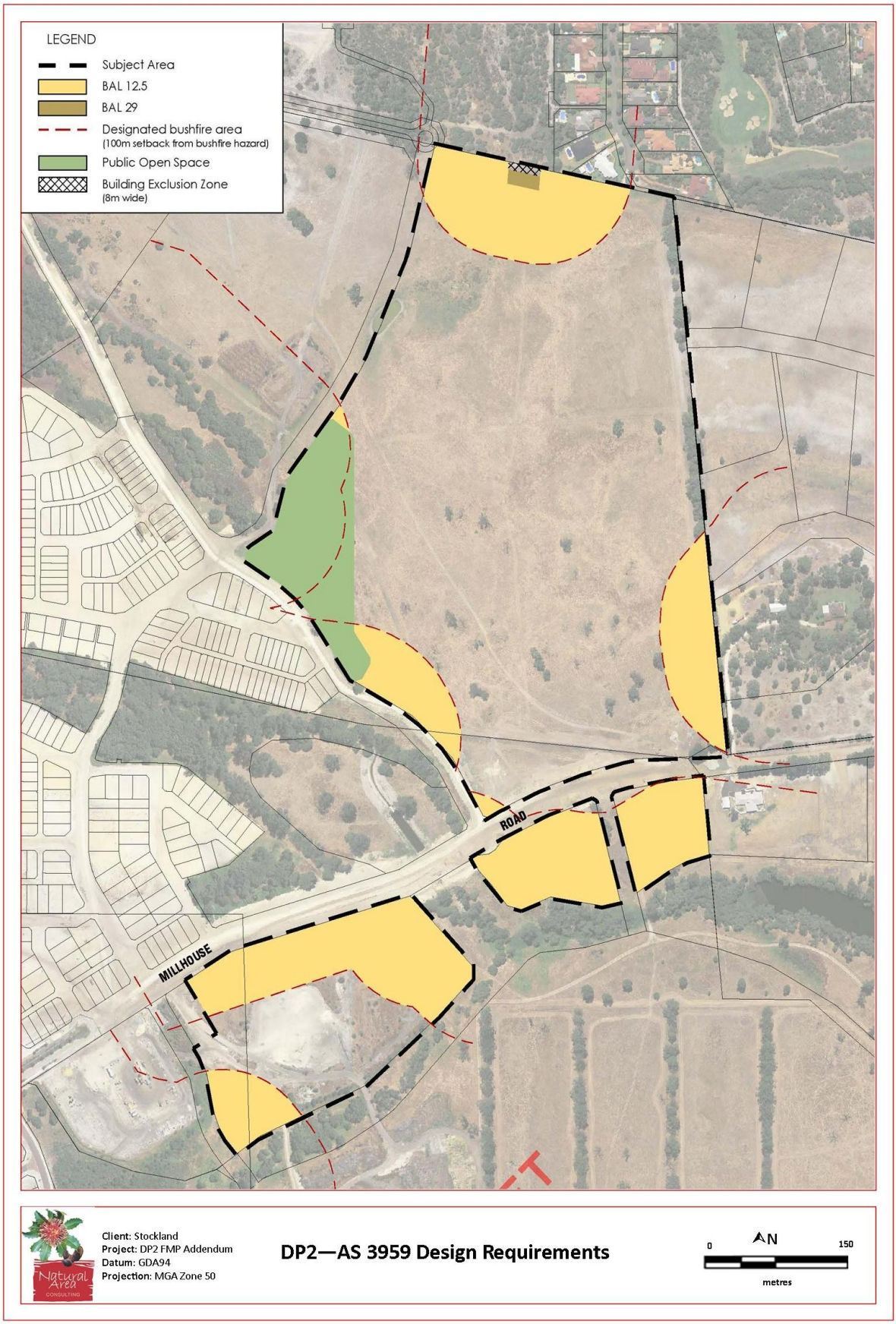

Figure 2: DP2 – AS 3959 Design Requirements

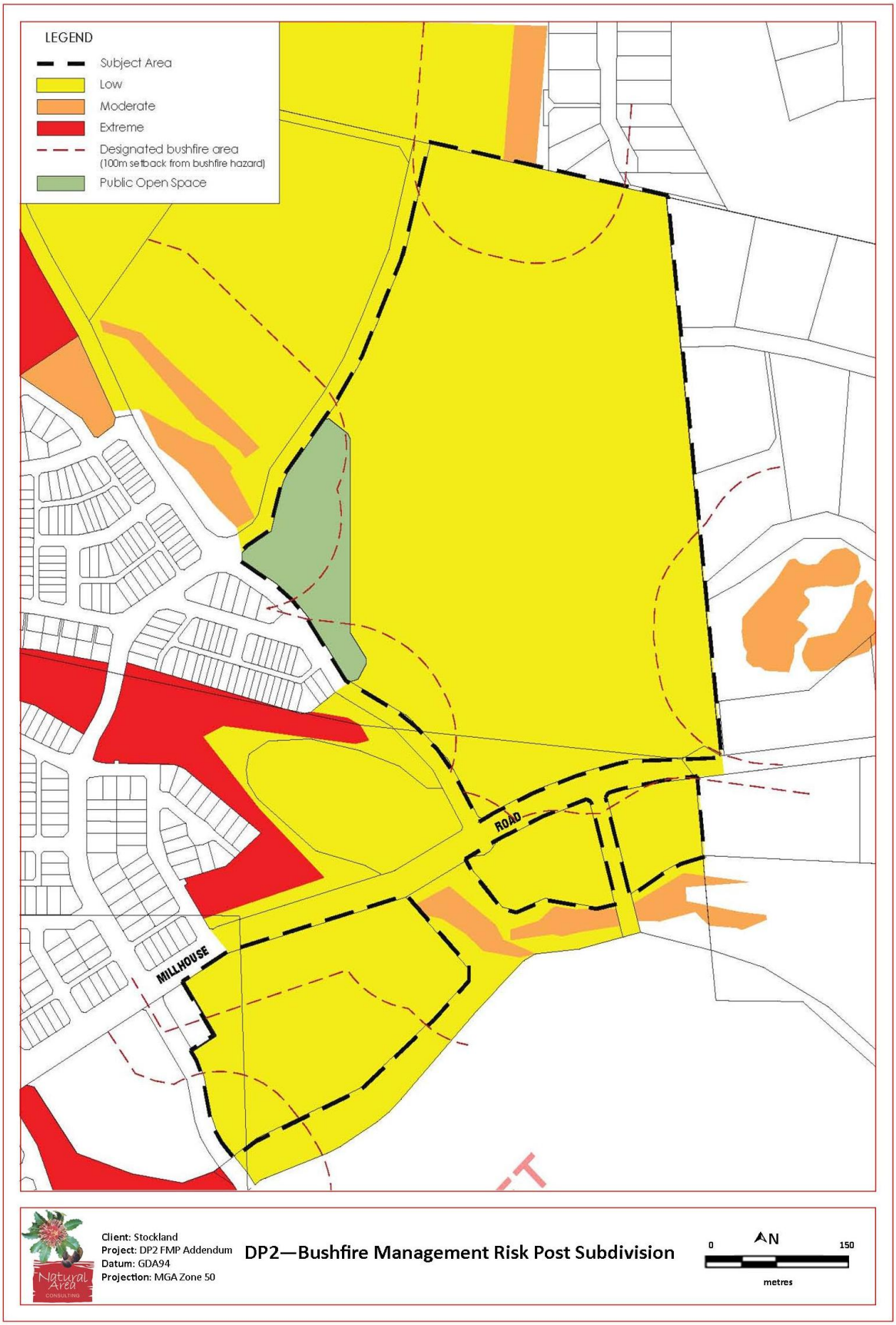

Figure 3: DP2 – Bushfire Management Risk – Post Subdivision

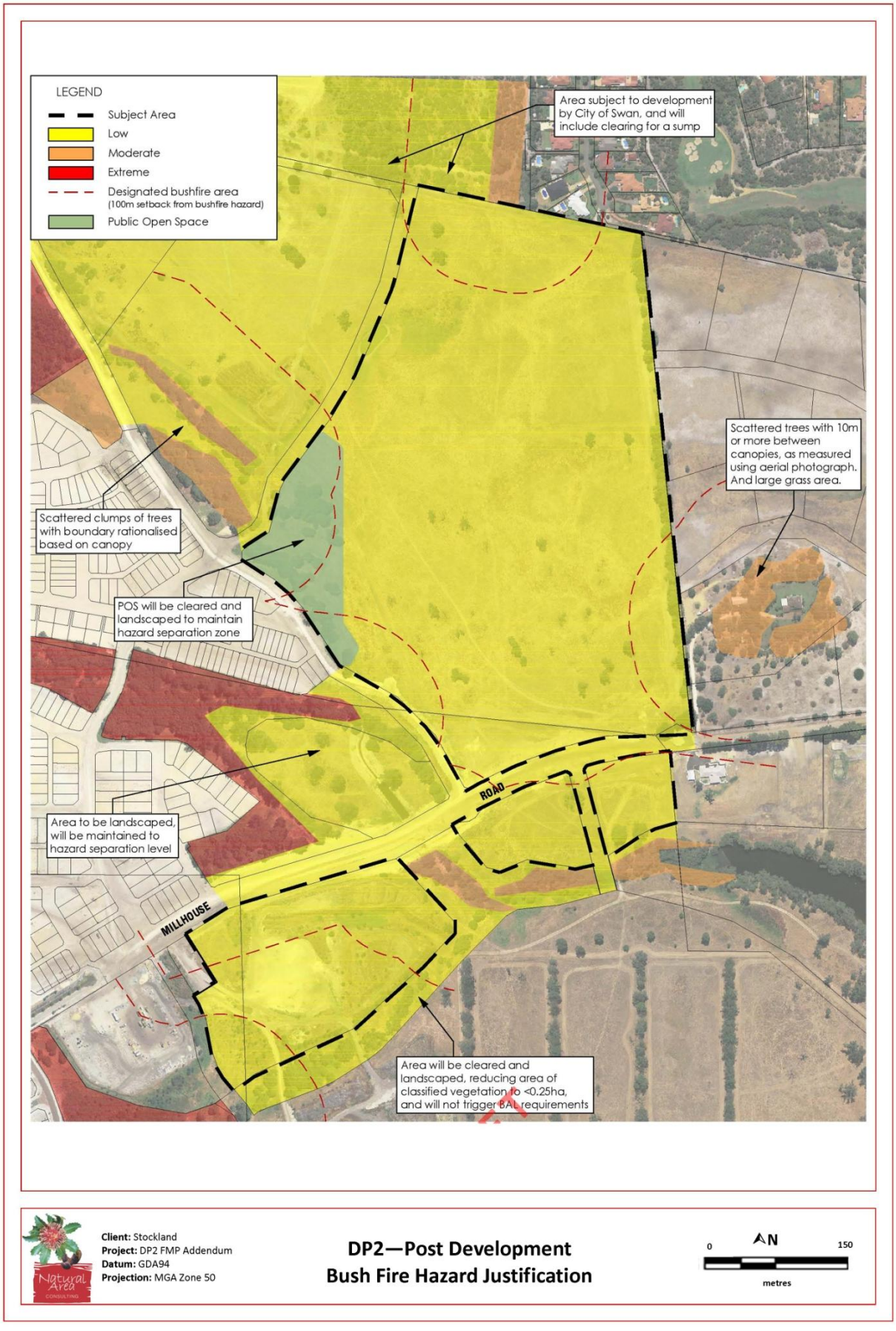

Figure 4: DP2 – Post Development Bush Fire Hazard Justification

3.0 References

AS 3959 – 2009 *Construction of Buildings in Bushfire-Prone Areas*, Standards Australia, NSW.

FirePlan WA, (2007), *Fire Management Plan – The Vale Stage 2 Millhouse Road, Ellenbrook*, unpublished report originally prepared for Brookfield-Multiplex.

APPENDIX NINE

Aboriginal Heritage Survey

REPORT OF AN ABORIGINAL HERITAGE SURVEY

EGERTON HOUSING PROJECT

Prepared for

ALAN TINGAY AND ASSOCIATES

by

D. Lantzke BSc (Hons)
and
M. Hammond BSc (Hons)

MCDONALD, HALES AND ASSOCIATES PTY LTD
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November 1993

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SUMMARY AND RECOMMENDATIONS

In September 1993, McDonald, Hales and Associates Pty Ltd was commissioned by Alan Tingay and Associates to conduct an archaeological and ethnographic survey for Aboriginal sites at Egerton in the Swan Valley. It is proposed to subdivide this land and develop it for residential housing purposes.

As a result of the archaeological survey, one previously unrecorded artefact scatter and scarred tree were located. **It is recommended** that steps be taken in the planning process to incorporate Aboriginal Heritage considerations into the development strategy and thus avoid any disturbance of the artefact scatter and the swamp. **This is the preferred option of the Aboriginal Informants consulted.**

Should it be necessary to disturb this scatter then it will be necessary to obtain permission under *Section 18* of the *Aboriginal Heritage Act (1972-1980)* prior to any disturbance, partial or total, taking place.

As a result of the ethnographic survey, two previously unrecorded ethnographic campsites and one previously unrecorded mythological site were located. In addition one previously recorded ethnographic site (Ellen Brook) is situated in the PDA. **It is recommended that a protection or buffer zone should be planned along all the banks of the wetland areas**. Such a buffer around the main swamp should include the camping locale and the artefact scatter.

It is also recommended that the camping locale **not be disturbed** if at all possible. **Should this not be possible** then **it will be necessary** for the proponent to obtain permission under *Section 18* of the *Aboriginal Heritage Act (1972-1980)* prior to any disturbance of these areas taking place.

The proponents are reminded of their obligation under *Section 15* of the *Aboriginal Heritage Act (1972-1980)* to report any artefactual material that may be discovered during the course of the development.

SECTION ONE: INTRODUCTION

1.1 Introduction and Consultancy Brief

In October 1993, McDonald, Hales and Associates Pty Ltd was commissioned by Alan Tingay and Associates to conduct an archaeological and ethnographic survey for Aboriginal sites at Egerton in the Swan Valley. It is proposed to subdivide this land and develop it for residential housing purposes. McDonald, Hales and Associates have undertaken a number of Aboriginal Heritage Studies in the general area, including surveys of Ellenbrook Estate (Smith & McDonald 1989, McDonald & Murphy 1991a) and the Sanwa Vines Resort (McDonald & Murphy 1991b).

The archaeological survey was conducted by D. Lantzke and L. Collard between 13-15 October. The ethnographic survey was conducted by M. Hammond. This involved an on-site inspection of the area with five key Aboriginal informants and interviews with 11 other informants. As a result of the survey one archaeological site, two ethnographic camping sites and one mythological site were identified.

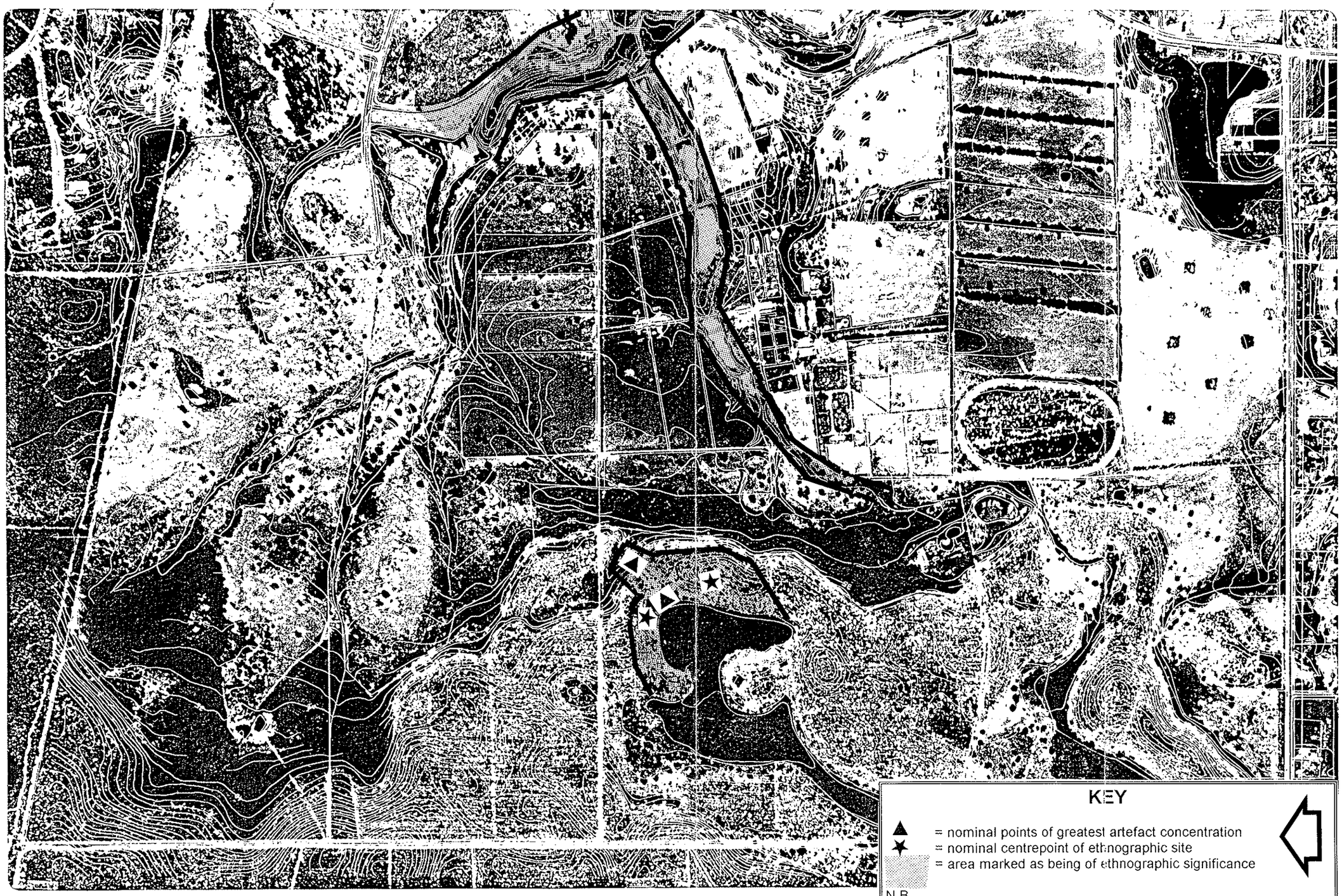
Throughout this report, the term "site" is used to denote a collection of artefacts or place reported as having past or contemporary significance to Aboriginal people. It is intended only as a descriptive, and in no way is intended or designed to preempt the final decision of the Aboriginal Cultural Material Committee (ACMC) in regards to the findings presented.

1.2 Environment and Land Integrity

The proposed development area (PDA) is located in the Shire of Swan, a non-urban region with large areas of state forest and rural land, the latter being dominated by viticulture (Strawbridge 1988). The Shire of Swan has an extensive history of human occupation, both Aboriginal and European (Bourke 1987). The PDA consists of approximately 580 hectares of farmland, pine plantation and swampland, and is located to the north of Gnangara Road, west of Ellen Brook and east of the proposed Ellenbrook Estate development (Figure 1).

1.2.1 Climate

The Swan Coastal Plain experiences what is described as a 'warm Mediterranean' climate. This is characterised by a dry summer with an average maximum of 30° C and a minimum of 18° C, and a wet winter with 875 mm of rainfall per annum, mostly between the months of May and September (Beard 1982).



KEY

▲ = nominal points of greatest artefact concentration
★ = nominal centrepoint of ethnographic site
= area marked as being of ethnographic significance

N.B.
Only areas mentioned by informants are indicated on the map. Owing to the inability of the informants to provide precise details of site boundaries, best approximations are delimited by black borders.

Figure 1: Map of PDA showing areas of Aboriginal Heritage significance.

In the past there have been a number of climatic fluctuations although these are insecurely dated and poorly understood (Wyrwoll 1979). To generalise, however, wetter conditions are believed to have prevailed between 40,000 and 20,000 years BP. From 20,000 years BP to approximately 10,000 years BP there was a period of increased aridity which reached its peak around 17,000 years BP (Bowler 1977). There were a number of minor oscillations in climatic conditions following post-glacial amelioration, with present day climatic conditions being achieved in the last few thousand years. It is not entirely clear how the changing climatic regime affected vegetation patterning on the Swan Coastal Plain. The sea level has also fluctuated considerably within this time period and the coastline is believed to have stabilised in its present position around 6,500 years BP (Glover 1984).

1.2.2 Vegetation

The majority of the PDA has been subject to clearing and pastoral use. Consequently much of the vegetation consists of introduced species such as *Ehrharta calycina*. Pine plantation covers a large proportion of the PDA that has not been cleared for farming purposes.

Native vegetation characteristic of the study area is dominated by a *Banksia* low woodland. The canopy generally consists of *Banksia attenuata*, *B. menziesii* and *B. illicifolia*. The eucalypts, *Eucalyptus marginata* and, *E. todtiana* in the northern portions of the Bassendean Sands form a discontinuous upper canopy. Other subdominant species include *Casuarina frazerana* and *Nuytsia floribunda*.

Since the canopy cover is incomplete, sufficient light reaches the woodland floor to allow the growth of a dense understorey of sclerophyll shrubs. These include *Kunzea restilla*, *Hypocalymma angustifolium*, *Verticordia* spp., *Macrozamia riedlei* and *Xanthorrhoea preissii*.

Around the margins of rivers, swamps and other areas of seasonally inundated land this vegetation is largely replaced by more hydrophilic species. *Eucalyptus rudis* and *Melaleuca* spp. (paperbark) are the dominant tree species in this complex and form a fringing woodland around the water bodies. Sedgelands of *Typha* spp., *Baumea* spp. and *Leptocarpa* spp. occur along the base of stream lines and across more constantly damp ground (Beard 1981; Heddle 1979).

1.2.3 Geology

The PDA lies within the Swan Coastal Plain which forms part of the Perth Basin (Wilde & Low 1978). The base rock of the Yilgarn Block visible on the Darling Scarp, lies beneath Phanerozoic Sedimentary deposits on the plain (Biggs *et al.* 1980).

The Swan Coastal Plain is further divided into varying geomorphic zones, including the Bassendean Dune system upon which most of the PDA is located. This system represents an old coastal dune system and consists of low ridges which run parallel to the coast. It is made up of highly leached Quaternary, white and grey quartz sands. These, of mixed aeolian and marine origin, are generally acidic and have a well developed humus or iron pan layer above the limestone bedrock. In the swales, swamps and lakes are common and these, where sufficiently deep, have a basal layer of sediment known as Herdsman Peat (McArthur & Bettenay 1960; Biggs *et al.* 1980).

To the north-east, comprising a small proportion of the study area, is a second unit, the Pinjarra Plain. This is an alluvial deposit zone of silts and hillwash gravels carried from the Darling Ranges and foothills by rivers and streams. Deposits build up over a great length of time forming terraces of considerable age (Chappell 1983) along the lower reaches of such rivers as the Swan, the Helena and their larger tributaries. These deposits generally take the form of red and yellow earths along with yellow duplex soils. Lenticular interbeds and mixtures of sand, clay and conglomerate occur irregularly throughout the matrix. The sand component ranges from very fine to medium grained, but small amounts of coarser material are present (McArthur & Bettenay 1960).

West of the present coastline and running parallel to it, is an outcropping of Eocene sedimentary strata. This strata is believed to be the source of the bryozoan or fossiliferous chert artefacts that occur in many stone artefact assemblages on the Swan Coastal Plain. Owing to the fact that these sources were inundated by rising sea-levels approximately 6,500 years BP it is possible to use the presence of chert in artefact assemblages as a temporal marker (Glover 1984).

SECTION TWO: ARCHAEOLOGICAL SURVEY

2.1 Archaeological Background

The Swan Coastal Plain has been the subject of a long term systematic archaeological research programme (Hallam 1972, 1977 & 1987). This project involved an extensive survey for sites, a number of excavations and a comprehensive study of historical records. Since 1972, over 600 sites have been recorded on the Swan Coastal Plain allowing Hallam (1987) to characterise the patterning and nature of archaeological assemblages on the Coastal Plain.

Using the geomorphic units described for the Swan Coastal Plain, Hallam (1987) found that the greatest density of sites occurs on the Bassendean Sands System and the Pinjarra Plain. By comparison, site densities on the geomorphic zones closer to the coast are of a much lower magnitude. While it has not yet been clearly determined why this is the case, it has been suggested that there is an abundance of resources associated with the chain of swamps and wetlands that occur within the Bassendean Sands unit (Hallam 1987; Strawbridge 1988).

Hallam (1987) also defined four chronological phases for sites on the Swan Coastal Plain, based on the nature of their assemblages. Early Phase sites contained fossiliferous chert artefacts; Middle Phase sites contained backed artefacts and flat adzes; Late Phase sites comprised quartz rich assemblages with a high proportion of chips; and Final Phase sites which include worked glass and ceramics. Hallam (1987) notes that it is possible for artefact scatters to be counted in more than one phase. Despite problems associated with this categorising of sites, it remains the best means of organising archaeological data on the Swan Coastal Plain.

A search of the site register in the Department of Aboriginal Sites (DAS) revealed that 50 archaeological sites have been previously recorded within a three kilometre radius of the PDA. Eight of the above sites are in the immediate vicinity of the PDA, six on the Swan River alluvial plain, including the Upper Swan Site (S0999) one of the oldest dated sites in Australia; and two on the Bassendean Sands system. **No previously recorded sites are situated within the PDA.**

A number of systematic archaeological investigations have been undertaken in the areas immediately adjacent to the PDA. These include surveys at Ellenbrook Estate (Smith & McDonald 1989; McDonald & Murphy 1991a; McDonald, Smith, Murphy & Lantzke 1993), a proposed water pipeline route across Ellen Brook (Veth 1989) and

a survey of The Mews, Sanwa Vines Resort (McDonald & Murphy 1991b). The results of these investigations form the framework within which the study was undertaken.

These surveys had noted that much of the Ellen Brook area had suffered considerable disturbance, mostly in the form of clearing, pine plantation, farming and sand quarry activities. Disturbance was such that the two previously recorded sites (S00724 & S00725) located on the Bassendean Sands had been destroyed as a result of quarry activity. S00725 had been described as a major artefact scatter (>100 artefacts) containing elements indicative of Early, Middle and Late Phase occupation. S00724 was described as a minor site (<100 artefacts) with elements dating it to the Middle and Late Phases of occupation (Veth 1989). Two small sites were located to the north of the PDA near Ellen Brook (Veth 1989; McDonald & Murphy 1991b). Both sites consisted almost exclusively of small (<15 mm) quartz chips, although a single piece of mylonite was found at both sites. No formal implements or other temporal markers were present that would allow these sites to be assigned to a phase of occupation.

The results of these previous surveys tend to suggest that the area to the west of Ellen Brook was occupied on an ephemeral basis or for task specific activities rather than long term habitation. It would appear that past Aboriginal usage of the area concentrated on the Swan River and immediately adjacent swamps on the southern side of the PDA. The northern portion is described as a more marginal environment with smaller wetlands and streams on which people could rely (Murphy & McDonald 1991b). This study allows the opportunity to further test these conclusions about the area.

2.2 Survey Methodology

The PDA was divided into a number of target zones largely based on vegetation and topography. Given the different geomorphic contexts of each of these units and the significantly different amounts of land disturbance experienced by each, different survey strategies were employed for each target zone.

Flat cleared paddocks make up a large proportion of the PDA; however, at the time of the survey surface visibility was severely restricted owing to grass coverage. Consequently the survey concentrated on devegetated sandy patches and vehicle tracks in the paddocks when inspecting these areas. It is estimated that 25% of the

grassed paddocks were traversed and inspected, although it must be stressed that the overall surface visibility within these regions was very low (<1%).

Areas of pine plantation constitute the next highest proportion of the PDA. Transects on foot were made through these areas at intervals of approximately 50 metres. Although surface visibility around the margins of the pine forest was generally good (50%-70%) these areas are highly disturbed. In the midst of the pine plantation visibility was more restricted (<10%) owing to a thick carpet of pine detritus on the ground.

The remaining areas were encompassed by tracts of native vegetation which had a limited surface visibility owing to the presence of dense undergrowth throughout. There has been much debate in the archaeological literature concerning the relative effectiveness of different survey techniques and sampling strategies within areas of low visibility and/or accessibility (e.g. Anderson 1984; Bowdler 1983; Byrne 1983a-d; Chartkoff 1978; Cosgrove 1990; Coster 1979; Egloff 1984; Ferguson 1985; Lewarch & O'Brien 1981; Schiffer, Sullivan & Klinger 1978; Sullivan & Bowdler 1984; Vinnicombe 1980, 1984). Some researchers have suggested that attempts to sample by probabilistic methods in areas of extremely low visibility should be abandoned, and that existing disturbed and/or cleared areas be primarily targeted for survey (e.g. Ferguson 1985; Schiffer, Sullivan & Klinger 1978; Strawbridge 1982). Consequently it was considered that an intensive survey along sandy tracks, fence lines, drainage ditches and other cleared areas would be the most appropriate strategy for examining these areas. These features criss-cross much of the PDA and intersect with all the vegetational and topographical zones identified for this survey. Visibility in these areas was excellent, ranging between 75% and 90% and in spite of the level of disturbance.

Based on conclusions reached by Hallam (1987) about site patterning on the Swan Coastal Plain, it was considered that the margins of the swamps were the areas most likely to contain any archaeological material. Accordingly, considerable attention was paid to them when surveying the PDA. Parallel transects at approximately 5 metre intervals were made along the shorelines. Surface visibility varied between 30% and 80% generally averaging close to 60% for most of the area covered. The level of disturbance around the swamps became progressively greater and greater with increasing distance from the shorelines. Survey in the swamp itself was not undertaken as it was considered highly unlikely to yield any

finds. Vegetation coverage in the swamps was extensive and what little ground that was exposed was extremely muddy.

2.3 Survey Results

As a result of the survey, one previously unrecorded site was located (Figure 1). This site consists of a sparse scatter of stone artefacts located around the shore of a swamp. Artefacts were found extending 70-80 metres along the shore and up to 30 metres away from the swamp. Artefacts were located in a large water run-off ditch extending away from the swamp, and also at the base of the hill (Plates 1 & 2). Approximately 30 artefacts were identified, of which a sample of 17 was recorded in detail. The majority of the artefacts consisted of quartz debitage although three pieces of chert and three pieces of mylonite were also located. Artefact details are provided below (details of artefact classification are provided in Appendix 1).

Artefact Description	*Raw Material*	*Length (mm)*	*Width (mm)*	*Thickness (mm)*	*Platform Width (mm)*	*Platform Thickness (mm)*	*Comments*
FF	quartz	18	12	3	-	-	
BF	quartz	15	8	4	crushed	crushed	
Debris	quartz	11	6	3	-	-	
FF	quartz	9	6	3	-	-	
Debris	quartz	8	4	4	-	-	
BF	quartz	22	15	7	crushed	crushed	
FF	quartz	6	5	1	-	-	
core frag	quartz	34	30	14	-	-	4 flake scars
CF	chert	24	15	6	12	4	cortex
BF	chert	9	9	2	4	2	
CF	quartz	13	11	2	10	2	
CF	mylonite	30	23	10	30	18	2 flake scars
CF	quartz	17	11	5	11	3	
CF	quartz	22	19	8	crushed	crushed	
CF	chert	11	9	3	7	3	
CF	mylonite	18	11	4	3	2	
core frag	mylonite	18	15	9	-	-	3 flake scars

All artefacts would appear to be associated with the leached Bassendean Sands System. Although there is possibly subsurface material present, previous excavation work at sites situated on Bassendean Sands have shown consistently that such sites are extremely disturbed and difficult to date (Bowdler *et al.* 1991).

Also located at the base of the hill was a scarred tree, identified by Informant One (Plate 3 & 4). The scar is elliptical in shape, measuring approximately 1.5 metres in length and approximately 0.6 m at its maximum width. The cause of the scarring in largely indeterminable: it may have been the result of the removal of wood or bark

PLATE 1: Location of main concentration of artefacts -

PLATE 2: Drainage ditch extending away from swamp -

PLATE 3: Scarred tree located at base of slope -

PLATE 4: Drainage ditch at base of slope where more artefacts were located -

for the manufacture of wooden implements, or it may have been a marker of some sort. The age of the scar, likewise, is indeterminate; Informant 1 suggested that it was made before European settlement and certainly the tree would appear old enough to support the notion that it could be that old. However, if the scarring is as old as Informant 1 suggests, then it would be expected that the scar would be higher up the trunk of the tree.

No archaeological material was located at the swampy areas at the northern end of the PDA. No archaeological material was discovered in the grassy paddocks or in the pine plantation, except where this intersected with the north-western side of the swamp.

2.4 Discussion and Recommendations

The archaeological material located as a result of the archaeological survey consists of a low density, sparse scatter of artefacts situated around the northern and western shores of a swamp. The presence of chert at the site is suggestive of an initial Early Phase occupation of the site. However, the practise of using chert as an accurate temporal indicator has recently been questioned (Schwede 1991). The absence of any formal tools makes it difficult to place the site into any other phase of occupation. However the high proportion of quartz may point to Late Phase occupation of the site.

By comparison to the sites recorded around it, the site is of a medium size. It contains more artefacts than either of the two sites located to the north on Ellen Brook, but less than either of the two previously recorded sites located to the south-west. Consequently the site is seen as reinforcing conclusions made by McDonald & Murphy (1991b) about prehistoric occupation of the Ellen Brook area. That is, strategic areas between swamplands and the Swan River were most intensively occupied as they provided the greatest diversity of resources for groups camping in the area. The more marginal areas, such those to the west of Ellen Brook were exploited on a more opportunistic basis. The location of the newly recorded site between the resource-rich area of the Swan River and the more marginal environment west of Ellen Brook reflect such a pattern.

An assessment of the significance of the newly recorded site was based upon a number of factors, including its importance to Aboriginal people, and the ability of the site address relevant research questions (Strawbridge 1988:18-20). Whilst the newly located site is not particularly outstanding as far as Swan Coastal Plain

assemblages are concerned, it is argued that owing to the destruction of sites S00724 and S00725 its archaeological significance has increased as it is one of the few remaining sites in the Ellen Brook area.

Discussions with Aboriginal informants revealed that there is considerable concern within the Aboriginal community of what is perceived as rapid destruction of Aboriginal Cultural Heritage in the Metropolitan area. It is the wish of all the Informants consulted that the site be left undisturbed. Informant 1 (see ethnographic section) also suggested that it might be worthwhile undertaking some test-pit excavations of the site. While the site does contain some potential for archaeological deposit, it has been conclusively demonstrated that excavations in Bassendean Sands are difficult to interpret and date owing to the continual reworking of the deposit (Bowdler et al. 1991).

It is recommended that a previously unrecorded artefact scatter and associated scarred tree have been located within the PDA.

It is recommended that steps be taken in the planning process to incorporate Aboriginal Heritage considerations into the development strategy and thus avoid any disturbance of the artefact scatter and the swamp. **This is the preferred option of the Aboriginal Informants consulted.**

Should it be necessary to disturb this scatter then it will be necessary to obtain permission under *Section 18* of the *Aboriginal Heritage Act (1972-1980)* prior to any disturbance, partial or total, taking place.

The proponents are reminded of their obligation under *Section 15* of the *Aboriginal Heritage Act (1972-1980)* to report any archaeological material that may be discovered during the course of the development.

SECTION 3: ETHNOGRAPHIC SURVEY

3.1 Survey Methods

The ethnographic survey was conducted by Meath Hammond and involved the following processes:

1. A review of archival material relevant to the area.
2. An inspection of the PDA with 5 principal informants.
3. Interviews with a total of 16 informants who have associations with the Upper Swan/Ellen Brook area.

The archival review involved an examination of the site files in the Department of Aboriginal Sites, McDonald Hales and Associates' extensive database on the Ellen Brook region and an examination of both published and unpublished literature applicable to the area.

McDonald, Hales and Associates have undertaken a number of ethnographic studies in the areas immediately adjacent to the PDA. These include surveys at Ellenbrook Estate (Smith & McDonald 1989; McDonald & Murphy 1991a), follow-up consultation at Ellenbrook Estate (McDonald, Smith, Murphy & Lantzke 1993), a proposed water pipeline route across Ellen Brook (McDonald & Moore 1989), a proposed bridge across Ellen Brook (McDonald 1989) and a survey of The Mews, Sanwa Vines Resort (McDonald & Murphy 1991b).

As a result of this extensive research in the Swan Valley, McDonald, Hales and Associates have undertaken consultation with Aboriginal informants knowledgeable of and having associations with the Swan Valley region. These individuals were contacted and asked if they wish to contribute to the survey. In addition they were asked if there were any other people who should be consulted about the PDA. By using this "snowball" sampling technique, the consultants were able to locate 11 other informants who wished to be consulted about the PDA. The proponents are endeavouring to consult directly with the Fringedwellers of the Swan Valley Inc., throught the offices of the Department of Aboriginal Sites.

Informant 1 is a man in his late 50's who resides in the northern metropolitan area. He has been used extensively in previous surveys of the Swan Valley. His wife, Informant 2, claims descent from *Yellowgonga*'s family. Both Informants 1 and 2 refer to themselves as *Ballarok* People. Informant 1 is the spokesperson for this

group. Informant 3 in a man in his late 60's and is very knowledgeable about Aboriginal heritage in the southwest. Informant 4 is a man in his late 40's who claims to have lived throughout the Swan Valley as a child with his grandparents and extended family. Informant 5 is the brother of Informant 4, and both men are members of the newly formed *Yhurnbroardah* Land Council. Attempts were made to locate two other potential informants, however, they could not be located.

The informants were not able to refer the consultant to any other person who might have associations with or knowledge of sites within the PDA.

3.2. Ethnographic Background

The historical and anthropological evidence suggests that at the time of British colonisation, the south-west of Western Australia was inhabited by some thirteen socio-dialectical groups (or tribes). These groups formed a distinct socio-cultural bloc. Aboriginal people in this region referred to themselves as *Nyungar*, a term of identification which is still used today by south-west Aboriginal people.

In general terms *Nyungar* individuals and families have two broad types of association with the land and specific sites:

1. religious / spiritual,
2. historical / social or biographical.

The former category includes sites which are of a mythological, ritual, ceremonial or esoteric nature. Such sites may include remnants of traditional connections to the land in existence prior to colonisation. The latter includes sites which have developed through historical and contemporary associations. The latter associations may also have a spiritual significance (Baines 1988; Trigger 1983).

The importance awarded by individual Nyungars to particular historical/social associations varies with individual and family values, interests and attitudes. In general however, many of the Nyungars with associations to the Swan Valley area consider such affiliations crucial to their cultural identity.

A review of the area's ethnographic background will not be given here in any detail. Nyungar ethnohistory, and ethnography and associations with sites, in the area have been described by the consultants and other researchers in numerous reports of site surveys in various localities of the Swan and Helena Valleys and in reports of

other research work (See for example, Baines 1984; McConnell & Dobson 1976; Locke 1990; Smith & McDonald 1989; McDonald & Murphy 1991a; McDonald & Murphy 1991b; O'Connor et al. 1985; O'Connor et al. 1989).

Aspects of the history/ethnohistory of the Swan Valley and surrounding area has also been described by Biskup (1973), Bourke (1987) and Green (1979). Fringe camping, Aboriginal settlement life and housing in the Swan Valley area has been examined by among others Robinson (1976), McDonald (1976), d'Abbs (1979), J. Wilson (1958) and K. Wilson (1958). Features of the political life of the area's Nyungar population in camps and settlements has been described in detail by Robinson (1978) and J. Wilson (1958). These last two studies illuminate the political problems which currently beset Aboriginal heritage work which in part had their origins in the politics of Nyungar community life over 40 years ago. However, it is important to note that the eastern part of the survey area was associated with *Weeip*'s band (Smith & McDonald 1989)

3.3. Ethnographic Findings

3.3.1 Archival Research

In the immediate vicinity, Ellen Brook (*Gynning*) is listed as a mythological site (S02516). It is associated, according to one group of informants, with the 'turtle'. One of the Brooks major tributaries, Ki-it Monger Creek which joins it at Bullsbrook, is also sacred. Nyungar mythology notes that Ki-it Monger (S01480) was created by a Waugal. The creek`s headwaters are in a hill in the Darling Scarp, which is reported to be the site of a ceremonial ground (S02408). There, according to myth, the Waugal laid two eggs. These fell from the hill-top and broke. The remains of the eggs are represented by quartz and ochre scatters along the valley floor. The white of the eggs (*Monger*) created the creek.

3.3.2 Field Survey Results

Three sites of ethnographic significance were located by the informants within the bounds of the PDA.

Informants 3, 4 and 5 provided specific information about camps in proximity to the main wetland/swamp area within the PDA (Figure 1). Although two separate sites were identified by the informants, the geographical propinquity of the two areas necessitates the application of the blanket term camping locale (McDonald 1976).

Despite having been interviewed separately the descriptions given by Informant 3 and Informant 4 of the camping locale are quite similar. The area was apparently used as a camp by transient Aboriginal families in the 1940s and 1950s. According to both Informants the camping locale was used by their respective families *en route* to Moora and surrounding areas. Informant 3 suggested that the area was used extensively by members of his family to collect wood for making clothes props, which were sold in the Midland-Guildford area. Informant 4 described the area as being one of many such 'occasional' camps used throughout the Swan Valley.

Informant 3 identified the presence of a *Waugal Dreaming Track* within the PDA (Figure 1). This track was specifically located along a tributary of Ellen Brook. The presence of the *Waugal* in this locality has not been recorded previously. However, as is illustrated by the following transcript, the *Waugal*, according to Nyungar Dreaming legends, is associated with all areas containing fresh water;

> Where there is water holes it is part of the legends of the *Waugal*, he is creator of the wetlands, the *Waugal* is a snake, a water snake...our legends go back into the *Waugal*, go back to prehistoric time, way back, to the creation of the Earth, he was part of making the waterways.... (Extract from transcript of *Waugal* story told by Informant 1, 14/10/93).

> ....The belief is if you touch the water you'll mess around with the *Dugarch* [*Waugal*]. You are not supposed to disturb it...fresh water was created by the snake, and of course you didn't want to disturb the snake, that was the belief, otherwise you won't get the water.... (Extract from transcription of interview with Informant 4, 28/10/93).

Despite the fact that Informant 4 refers to the creator of the wetlands as *Dugarch* and not *Waugal*, the context of the reference is clear - the wetlands are of mythological significance.

It must be noted that Informants 1, 2, 4 and 5, while not locating any specific mythological site, indicated the 'presence' of the *Waugal*, or water snake, in association with the wetland areas, including drainage features associated with Ellen Brook, contained within the PDA.

3.4 Discussion and Recommendations

It is recommended that three areas of ethnographic significance have been located within the PDA. The two campsites roughly co-incide with the newly recorded artefact scatter located by the archaeological survey team. The mythological site is associated with a tributary of Ellen Brook.

All five informants who participated in an on-site examination of the PDA expressed concern over the future of the wetland area. Informants 1 and 2 specifically stated that they would like the area conserved in its present state for the heritage of both Aboriginal and non-Aboriginal people. As the wetlands and tributaries of Ellen Brook are of mythological significance it will be necessary to consult with the local Aboriginal community prior to the development of the localities close to any area of fresh water.

It is recommended that a protection or buffer zone should be planned along all the banks of the wetland areas. Such a buffer around the main swamp should include the camping locale and the artefact scatter. Care should be taken to avoid damage to the banks and beds of the watercourses. These issues should be clarified through a fuller consultative process with the local Aboriginal community(s).

It is also recommended that the camping locale **not be disturbed** if at all possible. **Should this not be possible** then **it will be necessary** for the proponent to obtain permission under *Section 18* of the *Aboriginal Heritage Act (1972-1980)* prior to any disturbance of these areas taking place.

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APPENDIX 1: STONE ARTEFACT ASSEMBLAGE RECORDING AND ANALYSIS METHODOLOGY

The methodologies employed in the recording and analysis of stone artefact assemblages recorded during the present survey reflects a holistic approach, in which entire stone artefact assemblages, rather than individual implement classes, are the unit of analysis. A number of studies have indicated that a concentration on formal tool typologies alone is not sufficient to ascertain site function and patterns of lithic use (eg Cane 1984, Draper 1985, Hiscock 1983, 1986, O'Connell 1977, Veth 1989).

For recording and subsequent analytical purposes, artefacts were grouped, according to standard practice, into two categories; implements and waste (Figure 1). Waste includes both debitage and core categories. The classification of the stone artefact assemblages will concentrate on technological attributes shared by implement and waste categories rather than upon any presumed morphological or functional characteristics. Artefacts in the core and retouched/utilised categories, together with complete flakes, were isolated for more detailed in-field analysis.

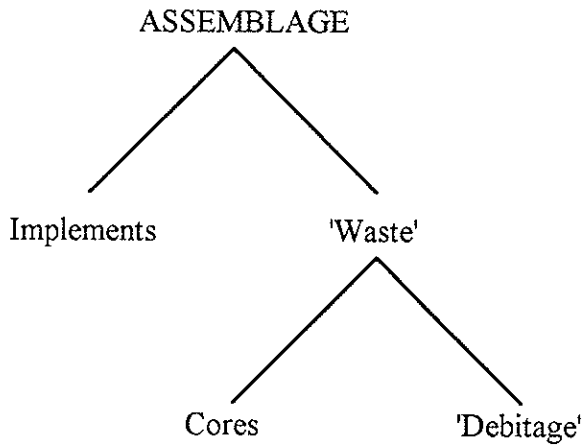

Figure 1: Simplified schema showing division of stone artefact assemblages for analysis.

a). Implement categories.

Implements are defined as any artefact showing evidence of use-wear and/or modification through deliberate reworking of the margins (Kamminga 1982). Three categories are recognised;

i. Retouched/utilised flakes (RUF).

This category covers a wide range of amorphous flakes which display secondary retouch and/or use-wear along one or more margins.

ii. Retouched/utilised cores (RUC).

These are cores that exhibit edge retouch in the form of a row of contiguous flake scars. Artefacts were classified as cores if they exhibited at least one negative flake scar and lacked a single interior surface. The presence of edge retouch on cores is a much debated issue. Replicative studies have demonstrated that damage believed to result from utilisation is identical to patterns observed in platform preparation. Additionally, stepped or undercut edges are seen to be the result of attempts to remove flakes from a core when the angle between the platform and the dorsal surface approaches ninety degrees (Flenniken and White 1985:140; Kamminga 1982). For this reason, cores with step-terminated flake scars will be excluded from this category.

iii. Retouched/utilised pieces (RUP).

This category includes artefacts displaying retouch/use-wear which have been broken during manufacture or through subsequent trampling.

b). Waste categories.

i. Debitage.

Debitage is defined as stone flakes which do not conform to the criteria defined for implement and core categories. In recent years it has become recognised that the analysis of debitage is of great utility in dealing with assemblages that contain few 'formal' tools, owing to the fact that debitage is usually present in sufficient quantities to permit statistical analyses to be undertaken. Additionally, the study of debitage can produce

> ...unique insights into aspects of cultural activity not apparent through a consideration of tools alone, such as the detection of manufacturing debris of tools removed from the assemblage and the locus of tool production, use and repair (Fish 1981:385).

The proposed system of debitage classification follows Sullivan and Rozen (1985), with modifications (*cf* O'Connor 1990). Four mutually exclusive classes of debitage are recognised, including complete flakes (CF), broken flakes (BF), flake fragments (FF), and debris. The classes are arrived at by the use of a hierarchical key based

upon the presence or absence of the following technological attributes: single interior surface, point of applied force, and margins (Figure 2).

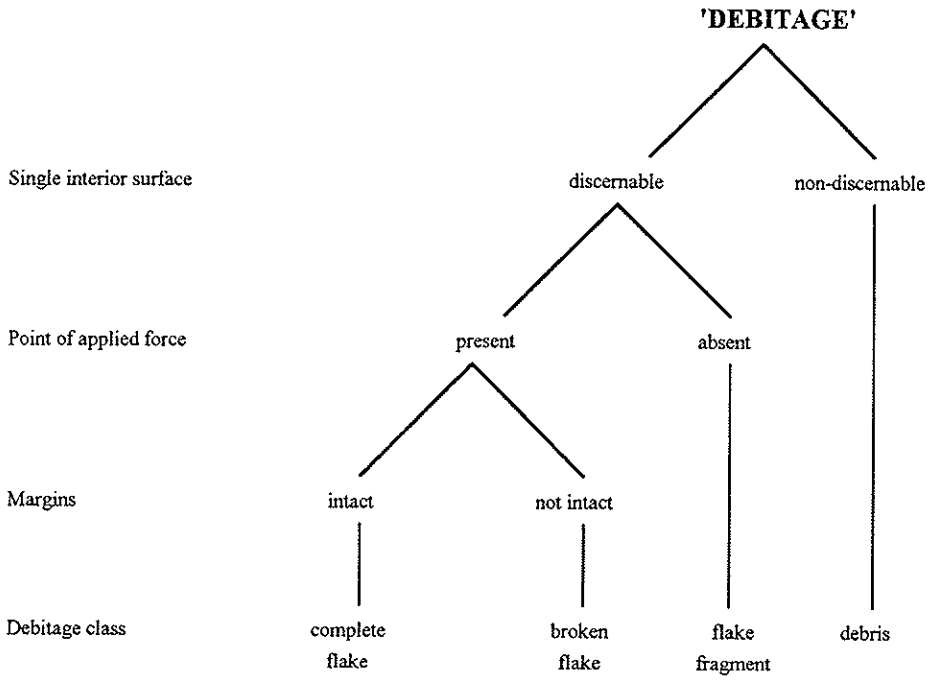

Figure 2: Technological attribute key used to define debitage classes (after Sullivan and Rozen 1985:759)

A single interior surface is indicated by features such as ripple marks, force lines and bulb of percussion. The point of applied force occurs on debitage which has intact striking platforms where these intersect the bulb of percussion.

If the striking platform is partially lost, the point of applied force is indicated by the origin of the force line radiation. Margins are considered intact if the distal end has a hinge or feather termination and if other breaks do not interfere with width measurements.

ii. Cores.

The following five classes are recognised:

Single platform (SPC).

These are cores from which flakes have been detached from a single striking platform.

Multi-platform (MPC).

These are cores from which flakes have been detached from several different platforms. These platforms may be natural surfaces or formed by flake scars, the latter indicating core rotation (Hiscock 1986:49).

Core fragments (Core frag.).

These are cores or broken cores displaying only partial negative flake scars which lack a discernible point of impact.

Bipolar Cores (BPC).

These are cores exhibiting crushing on opposing ends.

Broken Bipolar (BBPC).

These are shattered cores where only part of the crushing remains (O'Connor 1990).

Attributes Analysed.

Complete flakes.

A range of technological attributes were recorded for each complete flake in the debitage category. This suite of attributes was chosen as a prerequisite to the elucidation of artefact morphology and the nature of reduction systems employed. These attributes are to be used in conjunction with data derived from the analysis of debitage, as described above, in order to "test inferences advanced on the basis of differences in debitage [class] proportions" (Sullivan and Rozen 1985:759). The following attributes were recorded:

1. length
2. width
3. platform length
4. platform width
5. platform surface (cortical, flat, faceted, crushed)
6. number of dorsal flake scars (DFS)
7. Cortical index (cortical, part-cortical, non-cortical)

Cores.

Artefacts in the core category were recorded by maximum dimensions, together with core type, platform type and location.

Implements.

Artefacts in the implement category were recorded by their maximum dimensions. In addition, the presence and percentage (of total margin length) of use-wear and/or retouch was recorded together with its disposition. Measurements of the angle of the angle of the altered flake margin(s) and/or flake platform are expressed as an average of several readings made with a goniometer.

APPENDIX TEN

Acid Sulphate Soils Supporting Information

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22 January 2007 MDE-2006-007-ASSI-RPT_004_jb

Ms. Carol Catherwood
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Dear Carol,

RE: VALE DP2 SUPPLIMENTARY INFORMATION – ACID SULFATE SOIL INVESTIGATIONS

In accordance with the Environmental Planning Policy, please find additional information for consideration with Development Plan 2 (DP2) at Vale, Aveley. This letter outlines preliminary information regarding the location and management of acid sulfate soils (ASS).

Introduction

ATA Environmental have managed the treatment of ASS in the previous stages of Development Plan 1 (DP1) at The Vale, in accordance with the following Department of Environment (DoE) approved management plans: *Acid Sulfate Soil Investigations and Management Plan, Egerton Stage 2, Ellenbrook (ATA, 2004)* and *Acid Sulfate Soil Investigations and Management Plan, Egerton Stage 3, Ellenbrook , (ATA, 2005).*

Please note that due to the changes to the stage names by the developer post-investigations, the first ASSMP mentioned above actually refers to current Stages 2A-G as well as 3A and 3B and the later ASSMP refers to current Stages 3D, 4A-E and 5A-D in DP1 not just Stage 2 and 3 as their titles suggest.

At present another ASSMP is pending approval by the Department of Environment and Conservation (DEC) for Stage 3C prior to earthworks commencing next year and treatment of ASS and verification testing is currently on-going in Stages 4 and 5 of DP1in accordance with the approved ASSMP (ATA, 2005).

ASS treatment in DP2 will be managed using a similar strategy to treatment in Stages 4 and 5, as the soil types encountered in DP2 are the same as encountered in these previous stages.

Landscape and Soil Characteristics

At present DP2 is divided into five stages on the former Egerton property. Two stages, one north and one south of the North West wetland are

predominantly composed of Bassendean Sands Unit S_8 (Gozzard, 1983) in the form of sand dunes and have supported a pine plantation for many years. This soil type is encountered at the highest elevations in DP2 ranging from 58mAHD to 46mAHD, it is proposed that during earthworks much of this soil will be cut and used as fill on the low-lying areas, which constitute the remainder of the DP2 site. The major soil type present in these low-lying areas is Unit Mgs_1, Guildford formation and the land has been used for grazing of stock as part of the former Egerton property.

There is also a third soil type encountered in DP2 along the margins of the North West wetland and two other smaller areas being Unit Cps which can be described as a peaty clay.

DEC risk mapping for the DP2 area correlates with the three soil types as follows:

- Unit S_8 – this soil type is considered to have a moderate to low risk of acid sulfate soils; >3m below ground surface, high risk at <3m below ground surface;

- Unit Mgs_1 – this soil type is considered to have low to nil risk of acid sulfate soils; >3m below ground surface;

- Unit Cps – this soil type is considered to have a high risk of acid sulfate soils <3m below ground surface.

However, laboratory results for samples collected in these soil types at Stages 4 and 5 provide differing advice to the risk mapping for soils in Unit Mgs_1. Results from sampling in this soil type in the previous stage which is situated immediately south of the DP2 area indicate that there is a moderate risk of ASS as some samples did report net acidity concentrations above the action criterion of 0.03% Sulfur. Therefore the sampling plan will incorporate sufficient samples for an accurate classification of ASS in each of the three soil types present in DP2.

Surface and Sub-surface water characteristics

The depth of groundwater in Stage 6 is mapped in the *Perth Groundwater Atlas* (DoE, 2004) at 29mAHD, approximately 1m below ground level (BGL) in the west of the site then drops to 23mAHD (approximately 3m BGL) as it moves east across Stages 7 & 8. Groundwater flow is in an east/south-east direction towards the Ellenbrook.

In addition to shallow groundwater, surface water from the DP2 area flows into Ellen Brook via three small tributaries.

Preliminary Investigations – DP2

Methodology

All sampling and management methodology will be in accordance with DEC's *Draft Identification and Investigation of Acid Sulfate Soils and Groundwater, Acid Sulfate Soils Guidelines Series* (DEC, 2006).

Soil sampling will be conducted with reference to the DEC minimum number of sampling points for ASS areas with sample collection extending to 1m below the proposed maximum depth of disturbance. All samples collected will be field tested and at least one sample per half metre will be sent to a NATA accredited laboratory for determination of the presence or absence of net acidity.

Once net acidity has been determined and the location and depths of ASS is known an ASSMP will be produced that outlines the appropriate strategies for neutralisation of ASS and monitoring of groundwater in DP2.

At present investigations have commenced in the first stage of DP2 and preliminary advice is detailed below. Future stages of DP2 will be investigated in the same manner as this first stage.

Results

A detailed drilling program was recently conducted in Stage 6, DP2 with 44 locations drilled to at least 1m below the maximum depth of disturbance according to the Overall Sewer Strategy Plan dated 03/11/06 provided by Cossill and Webley. Approximately 1100 samples were collected and field tested to assess their acid generating capacity and the results have been used to provide this advice. It should be noted that soil field tests are used as an indicator of ASS only and cannot be substituted for laboratory analyses to determine the presence or absence of ASS. The soil field pH (pH_f) test measures the existing acidity of a soil:water paste and is used to help identify actual acid sulfate soils (AASS). The soil field peroxide test (pH_{fox}) is used to give an indication of the presence of stored or potential acid sulfate soils (PASS).

Field test results for the samples taken in Stage 6 indicate that no samples contain AASS but PASS was indicated at 37 out of 44 sample locations. On this basis Stage 6 has been divided up into estimated areas of approximate PASS depths based on the field test results only (refer to Figure 1).

Potential Impacts and Proposed Management

Treatment of ASS will be achieved by neutralisation with lime in accordance with an approved Acid Sulfate Soils Management Plan (ASSMP) for Stage 6 at a specified rate to be determined once laboratory analyses have been received and concentrations of net acidity within Stage 6 are determined.

However, for the purposes of the earthworks tender process a conservative liming rate for neutralisation of 28 kg $CaCO_3/m^3$ soil can be applied based on results from ASS in previous stages of The Vale development. It should be noted that this liming rate refers to the quantity of finely divided lime required to neutralise one cubic metre of soil to be disturbed and assumes 100% $CaCO_3$ and includes a recommended 1.5 safety factor. Liming rates will therefore need to be corrected for the $CaCO_3$ content, particle size distribution and bulk density of the material used for neutralisation.

Wherever possible excavated ASS should be treated as soon as possible (within 24 hrs), as a priority, to avoid oxidation of sulfides which will lead to sulfuric acid generation. However, if this does not occur, excavated ASS must be stockpiled on a bunded limestone pad of minimum 300mm thickness. The pad will be graded to ensure good drainage and the side will be bunded to prevent lateral migration of any acidic drainage and to divert stormwater.

If unforseen circumstances result in stockpiling of excavated untreated ASS for more than one week, or should visual observations indicate further acidification is occurring; additional measures such as spraying the stockpile with liquid lime will be required.

Once treatment of ASS has been undertaken, validation by soil sampling and laboratory analysis (ATA Environmental) will be required to assess if neutralisation has been achieved. With the approval of the Department of Environment and Conservation (DEC) reuse of neutralised ASS will

be approved by ATA within 24 hrs of sample collection based on field test results. Once neutralisation has been achieved the treated ASS can be used elsewhere on site.

If dewatering is needed to install services or other infrastructure in identified ASS areas a dewatering management plan will be required and all dewatering effluent will be managed according to the approved plan including monitoring of groundwater bores within Stage 6. ATA will provide objectives for an effective dewatering strategy within its ASSMP which the contractor can use as a template.

Please note that all operations relating to ASS undertaken by the appointed earthworks contractor will be performed in accordance with the approved ASSMP for Stage 6.

With the appropriate management strategies outlined in the ASSMP it is considered that there will be negligible impacts on surface and groundwater quality, ecosystems and biodiversity and existing land uses in the vicinity of the development. It is also considered that there would be no significant constraints in regards to engineering or infrastructure.

Timing of Future Assessment

Due to the staged nature of the development and the large area of DP2, a staged approach to ASS assessment is considered to be appropriate. Information gained from the results of each stage of assessment will be used to improve assessment methodology for future stages.

A drilling programme has recently been undertaken for DP2 Stages 7 and 8. The results of this assessment will be available after the 29th January and will be forwarded to the City of Swan as supplementary information.

If you have any queries regarding the above information please contact me on 9328 3488 or via email at jeremy.bower@ataenvironmental.com.au.

Yours Sincerely,

JEREMY BOWER
Environmental Scientist

Cc: Adrian Wong

APPENDIX ELEVEN

Precinct 1 - Explanatory Report

VALE

DEVELOPMENT PLAN TWO (ODP 155) - AMENDMENT No.2

PRECINCT 1 & 2: EXPLANATORY REPORT

FEBRUARY 2013

Stockland

CLE TOWN PLANNING + DESIGN

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DEVELOPMENT PLAN TWO (ODP 155) - AMENDMENT NO.2

PRECINCT 1 & 2: EXPLANATORY REPORT

Prepared by:

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Project No. 995Rep899A
February 2013

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PROJECT TEAM:

LANDOWNER / PROJECT MANAGER	Stockland Developments
PLANNING & URBAN DESIGN	CLE Town Planning + Design
CIVIL ENGINEERS	Cossill & Webley
ENVIRONMENTAL CONSULTANT	PGV Environmental
TRAFFIC ENGINEERS	Sinclair Knight Merz
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ENVIRONMENTAL HYDROLOGIST	Jim Davies & Associates
FIRE MANAGEMENT	Natural Area Consulting

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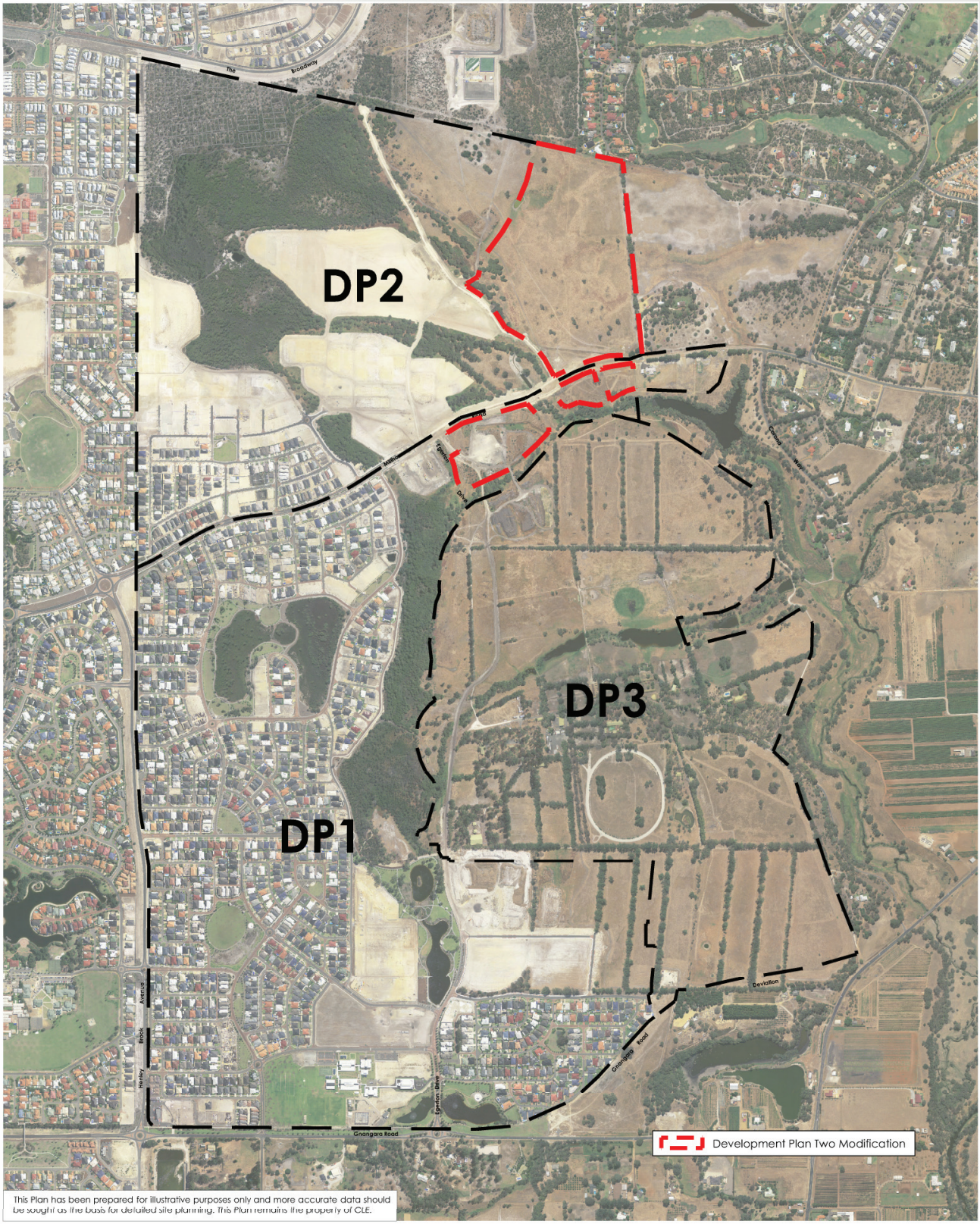


SITE PLAN

995-904A-01 (19.02.2013), nts

Vale Development Plan Two Modification : Figure 1

1.0 INTRODUCTION

The Vale Development Plan Two (ODP 155) modification, Amendment No.2, is lodged on behalf of the landowner, Stockland. The modification to ODP 155 relates to the land shown within the red hatched boundary in Figure 1 (subject land).

The purpose of the modification to ODP 155 is to provide greater flexibility, as well as a responsive and current approach, to dealing with density allocation and development standards. A minor modification to the boundary of the Multiple Use Corridor Public Open Space is also proposed resulting in an improved environmental outcome.

In summary, the ODP 155 modification proposes to:

- Reframe the approved development plan for Precinct 1 to allow the final allocation of densities to be determined against specific performance criteria at subdivision. This approach provides flexibility and responsiveness to changing market conditions as well as creating dwelling diversity and density in line with Directions 2031 and Beyond and other State strategic planning documents. The R60 coding of Precinct 2 remains unchanged.
- Incorporate a generic set of residential design code variations across Precincts 1 & 2.
- Modify the boundary alignment of the 1.74 ha multiple use corridor public open space to capture existing vegetation not previously included, resulting in an improved environmental outcome.

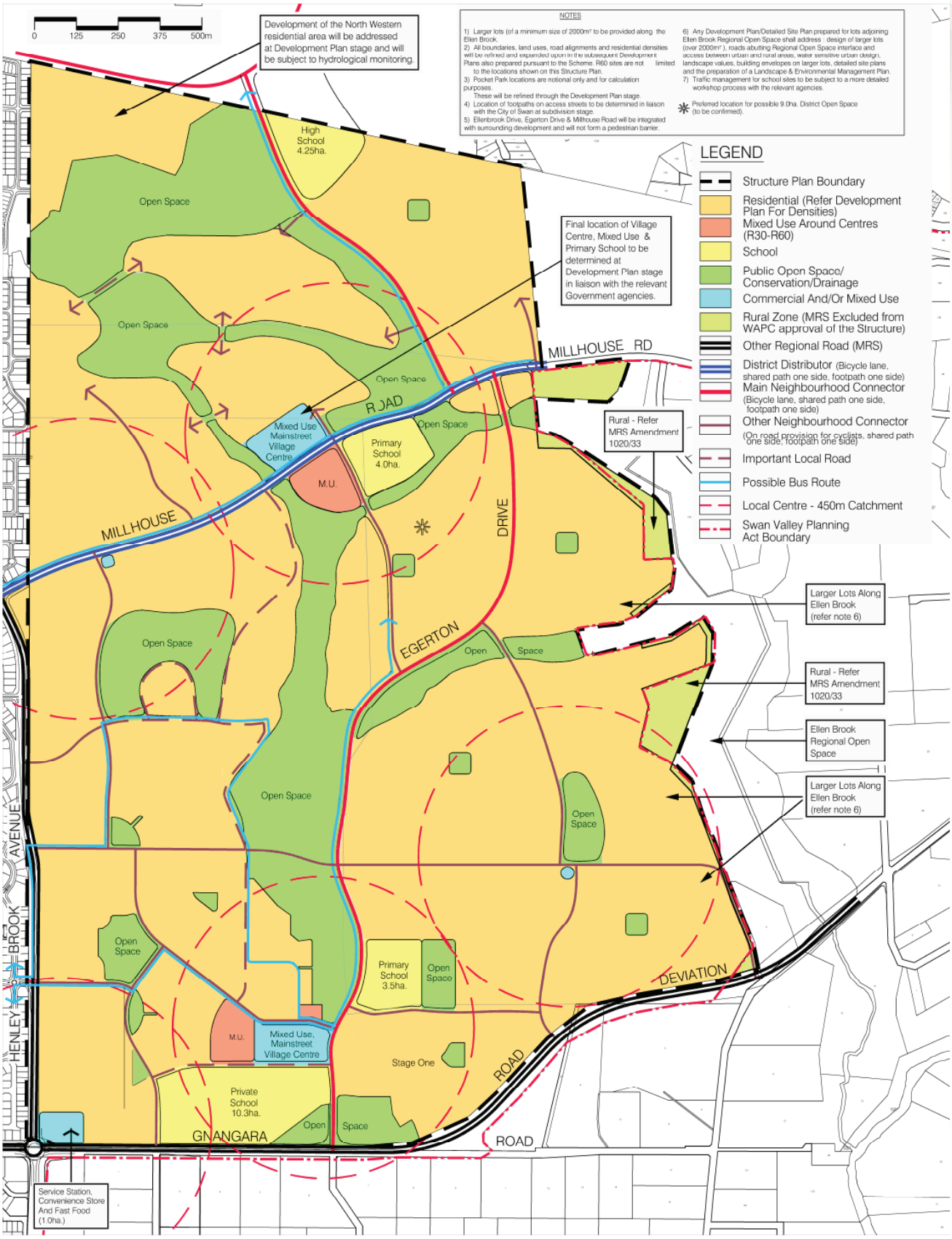
2.0 BACKGROUND AND PLANNING FRAMEWORK

The subject land is wholly contained within Lot 9061.

The background, and planning context for the Vale Estate, is provided in the current endorsed Structure Plan (ODP 50), refer Figure 3 and Development Plan Two (ODP 155), refer Figures 4-7.

In summary:

- Development at Vale is covered by the requirements of an approved Consultative Environmental Review and four endorsed management plans:
  - A Wetland Management Plan (1995)
  - A Drainage and Nutrient Management Plan (1995)
  - A Bandicoot Protection Strategy (1995)
  - A Western Swamp Tortoise Assessment (1995/1997)



995-915-01 (18.12.2012), nts

EGERTON STRUCTURE PLAN REVIEW 2004
Vale Development Plan Two Modification : Figure 2

- The Egerton Structure Plan Review was endorsed by the WAPC in 2005. This document provides the overarching land use framework for development at Vale, defining the open space network, major roads, local centres and other land uses.
- Development Plan One (ODP 73) was endorsed by the WAPC in 2005 and covers the land south of Millhouse Road and west of Zanzibar Wetland. A supplement to ODP 73 was endorsed by the WAPC in 2011 to include an additional 17 hectares of land.
- Development Plan Two (ODP 155) was endorsed by the WAPC in 2007.
- Subdivision approvals have been received for the entire ODP73 and ODP155 areas.

Since lodgement and approval of the subdivision design that relates to the ODP 155 area (WAPC 133535) for 1265 lots in 2007, there has been a significant shift in market trends. Specifically there has been an increased demand for smaller lot product that enables a more affordable option for purchasers. Consequently a review of the subdivision design for the balance of land within ODP 155 has been undertaken.

The purpose of the proposed modification is to provide an appropriate and flexible framework to support future subdivision applications consistent with current State policy.

2.1 Endorsed Development Plan Two (ODP 155)

The endorsed ODP 155, as it relates to the subject area, provides for:

- Residential development with density codings ranging from R17.5 to R40.
- A 1.74 hectare Multiple Use Corridor Public Open Space (MUC7) providing both a recreation and integrated drainage function.
- A centrally located Neighbourhood Park (NP1) of 7339 m².
- A District Distributor road (Millhouse Road) abutting the southern boundary a Neighbourhood Connector road bounding the eastern edge of the subject area.

The revisions proposed in this ODP modification are relatively minor; they essentially retain the existing structure and layout of the approved Structure Plan but allow for:

- Refinement of the precise demarcation of residential density boundaries at subdivision (based on specified Local Criteria) to allow for greater housing diversity and innovation through the application of a split R-coding across the subject area.
- Variations to development standards of the Residential Design Codes to facilitate the preferred form of development, based on a range of lot products; and

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- Minor modification to the configuration of the MUC POS boundary to support the retention of additional vegetation. The area of the MUC POS at 1.74 ha is consistent with the previously endorsed area. The MUC POS is shown on Plan 1, consistent with State policy, as it is a strategic POS area serving a drainage and environmental function. It is noted, that the Neighbourhood Park is not shown on Plan 1 as it is conceptual only and will be refined at subdivision stage based on POS provision as outlined in the endorsed ODP 50 and ODP 155.

Each of these modifications is discussed in further detail in the following section.

3.0 PROPOSED MODIFICATIONS

3.1 Residential Density Coding

The endorsed ODP 155 allocates lots with an R17.5, R25, R30 or an R40 density coding, with specified density coding boundaries. This approach predetermines a subdivision outcome, and provides very little opportunity for refinement of lot and housing types at subdivision stage.

The current market conditions mean that new lot and housing typologies are being developed to meet affordable price points and market niches, as well as the Directions 2031 target of 15 dwellings per gross urban zoned hectare. Lot and housing typologies have evolved significantly in years with front loaded lots ranging from 8.5 – 20 metres wide, with varying depths and often 'salt and peppered'. There is also a tendency to 'salt and pepper' within a street block.

The current application of density coding limits lot and housing diversity within a street block. In addition where a plan is refined at subdivision stage a modification is required to the endorsed outline development plan / structure plan to accommodate a change to the density boundary (which is largely tied to lot and road configuration) resulting in an additional statutory planning process each time.

3.1.1 Precinct 1: Overview of Split Coding & Locational Criteria

The use of an R/Code range or split R30/R40/R60 coding within Precinct 1 addresses this issue and provides the necessary flexibility within the statutory framework.

The WAPC Structure Plan Guidelines (the Guidelines) require that Local Structure Plans set out density codes or ranges of codes on a structure plan map, supported by locational criteria that specify where particular density codings are to apply. Under the Guidelines

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the density coding is then allocated via a residential code plan. This approach means that a structure plan can be refined at subdivision stage to reflect market conditions, without amendment to the structure plan. The application of a split coding and allocation criteria is an innovative approach to applying residential densities to allow for the place to evolve as the locality matures.

The criteria associated with the application of each residential density coding are outlined in Table 1. The location principles applied to the criteria provide that cottage product and density sites are appropriately located adjacent to open space, primary school sites, neighbourhood centre catchments, key distributor roads and bus routes. Lower density codings are applied as a base coding and to allow an appropriate transitionary interface to adjoining areas.

TABLE 1: RESIDENTIAL DENSITY CODING CRITERIA

APPLICABLE DENSITY CODING	GENERAL LOCATION PRINCIPLES	CRITERIA
Residential R5	As per Egerton Structure Plan, directly adjoining Ellen Brook providing suitable land use transition.	Applies to land along the eastern edge of DP2 directly abutting the Ellen Brook as required by the Egerton Structure Plan Review 2004.[1]
Residential R30	Applies to majority of DP2 area supporting delivery of traditional front loaded product.	Applies as the base code to single dwelling units on lots that do not have a laneway abutting the rear boundary.
Residential R40	Located in general proximity to public open space, primary school sites, neighbourhood centre catchments, key distributor roads and bus routes.	Applies to: a) Lots abutting open space. b) Front loaded lots (no laneway) with a frontage less than 13 m. c) 4 Pack / Garden Court Lots.
Residential R60	Located in general proximity to public open space, primary school sites, neighbourhood centre catchments, key distributor roads and bus routes.	Applies to: a) All lots with a laneway abutting the rear boundary. b) Front loaded lots (no laneway) with a frontage less than 10 m. c) All corner lots served by two streets (no laneway) where a multiple dwelling is proposed. d) Lots greater than 800 m² (grouped/multiple dwelling sites).

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An R17.5 density coding adjoins the northern boundary directly adjoining residential lots within the Vines Estate. The retention of the R17.5 density coding as a transitional land use interface adjoining the Vines Estate is consistent with previous decisions of the Western Australian Planning Commission and the City of Swan.

In summary, the application of a split density coding across Precinct 1 achieves the following objectives:

- Meets WAPC density targets through innovative new solutions.
- Recognises ODP 50 density requirements.
- Enables a diversity of dwelling types in the streetscape including single, grouped and multiple dwellings.
- Enables a range of lot widths and depths providing affordability, diversity and density of lot and housing product.
- Encourages and provides incentives for multiple dwelling units.
- Achieves density in appropriate locations in close proximity to amenity and infrastructure.
- Provides a simplified approach to the application of density coding removing the need for ongoing R-Code modifications to the statutory plan where a minor change in subdivision design occurs.

The application of a split coding supports the delivery of a dwelling unit yield consistent with Directions 2031 of 15 dwelling units per gross urban zoned hectare.

A dwelling unit yield calculation based on the subdivision layout for Precinct 1 (to be lodged shortly with the Western Australian Planning Commission) provides:

- 16 dwelling units per gross urban zoned hectare.
- 30 dwelling units per site hectare.

The proposed modifications to ODP 155 support the delivery of the dwelling unit yield consistent with State and Local Policy.

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R60 Density Coding

A variation to the minimum lot size of the R60 density coding has been applied in Section 5.2.2.1 of Part 1 of this document. The minimum lot size has been reduced from 160 m² to 145 m². The variation recognises and accommodates accepted market product, specifically, the 5m wide by 29/30 deep lot size. This product offers diversity and affordability to the housing mix and the R/Code variations applied in Part 1, provides the necessary flexibility to site cover and setbacks to enable the successful build out of this product. As an accepted market product, builders have developed and adapted standard housing product to the 5m wide lot which offers both amenity for the lot owner as well as amenity to the streetscape and surrounding lots. This product is typically clustered and built out by a single builder. The ability to vary minimum lot size is established in clause 5A.1.12.3 of the Scheme.

3.1.2 Precinct 2: R Codes

The approved R Coding of Precinct 2 is R60 and remains unchanged. Subdivision applications are being prepared and lodged on the basis of the R60 coding.

3.2 Development Standards: R-Code Variations, Precincts 1 & 2

Residential design code variations and site specific development standards have been applied to Vale through the implementation of Detailed Area Plans. R-Code variations are an important tool in ensuring the delivery of quality built form and providing certainty for purchasers as the development potential of their lot.

It has however, become increasingly apparent, through a number of similar projects, that a more effective and simplified tool for applying R-Code variations is through the implementation of a generic set of R-Code variations applicable to all lots via the structure plan. The benefits of this method are:

- Consistency of provisions will improve streetscape outcomes;
- Ease of application for users, including planners, building surveyors, designers and sales representatives;
- Reduced workload for planners in preparing, assessing and approving DAP's on a stage by stage basis; and
- Greater certainty for home buyers, with adoption of standard provisions up front and consistent for all lots, in force from project commencement.

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The formulation of the DP2 R-Code variations has involved ongoing liaison and consultation with the building industry and a range of local authorities, and are largely consistent with the principles established in the Vale Development Plan Two and the Albion (Whiteman Edge) Local Structure Plan 1A.

The R-Code variations prepared as part of this modification are applied to Precincts 1 and 2 as statutory provisions of the structure plan, pursuant to clause 5A.1.12.1, in the same way zones, reserves and R-Codes are applied. Refer Tables 6 and 7 in Part 1 for the DP2 R-Code variations.

The following provides a summary of the R-Code variations applicable to Precincts 1 and 2.

Setbacks

Density Coding	Element	R-Code Requirement	DP2 R-Code Variation
R30 (Front Loaded) Frontage > 13m	Primary Street	Min 2m, Av 4m	Min 3m
	Secondary Street	Min 1.5m	Min 1.0m
R40 (Front Loaded) Frontage <13m	Primary Street	Min 2m, Av 4m	Min 3m
R60 (Rear Loaded)	Primary Street	Min 2m, Av 4m	Min 2m Veranda/Front Facade Min 1.5m
	Rear Laneway	Min 1.0m	• 0m (lots >= 8m wide) • 1m (lots < 8m wide or where there is a conflict with service infrastructure)
	Side Setbacks (major openings)	Min 1.5m	Min 1.0m

The Precinct 1 and 2 setback variations facilitate flexibility in building design as well as encouraging dwellings to address, engage and improve surveillance to the public realm. Importantly the consistency of front setbacks for R30 and R40 lots will avoid irregular setbacks on a street where there are a combination of R30 and R40 lots. The setback variations will also facilitate site cover increases and enable more efficiently sized and sited private open space ultimately improving the functionality of these outdoor spaces.

Private Open Space

Density Coding	Element	R-Code Requirement	DP2 R-Code Variation
R30	Private Open Space	Min 50%	Min 40%
R40 / R60 (Front & Rear Loaded)		Min 45%	Min 25%
		Min 45%	Min 25%

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A reduction in private open space requirements allows greater flexibility in design particularly for R40 and R60 coded dwellings. The current R-Code requirement of 45% for R40 and R60 coded areas severely limits single storey dwelling design and the ability to provide more than one dwelling on a single lot, which ultimately limits the ability to provide affordable and diverse housing product.

In order to ensure that reduced areas of private open space do not affect the quality and functionality of outdoor living spaces, additional design requirements are imposed for R40 and R60 coded dwellings. These additional design requirements provide that a variation to site cover is permitted subject to the provision of an outdoor living area:

a) With a minimum useable space of 24m², minimum dimension of 4m and may include the nominated secondary street setback area; and

b) Located adjoining the northernmost or easternmost side boundary (with the exception of corner or irregular shaped lots and where it can be demonstrated that (a) can be achieved).

As demonstrated above, the increased maximum site cover set out in Table S3.1 is not 'as of right' and is subject to the provision of an outdoor living area of 24m², where as the R-Codes would ordinarily only require 20m² for an R40 coded lot, or 16m² for an R60 lot. This ensures that the open space that is provided on these lots (where a variation to the site cover is sought) is consolidated into a larger, more useable area than what the R-Codes would otherwise require.

The benefits of increasing the maximum permissible site cover are:

- Allows for greater flexibility in home design whilst still ensuring that adequate outdoor living space is provided;
- Recognises and responds to the trend towards smaller, more affordable front loaded lot product in medium density areas;
- Promotes the efficient use of the land by allowing for boundary to boundary development thereby removing the unusable 'dead' space within side setback areas, and consolidating this space into the useable outdoor living areas;
- Removes the need for future landowners to submit development applications for minor increases in site cover, which inevitably get approved by the local authority but only after a cumbersome and costly approval process.

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Boundary Walls

Density Coding	Element	R-Code Requirement	DP2 R-Code Variation
R40 / R60 (Front & Rear Loaded)	Boundary Walls	Boundary wall permitted up to two thirds of the length of one boundary / second storey boundary walls not permitted.	Walls up to 3.5m height on both side boundaries for the length of the boundary permitted, or walls up to 6.5m height to both side boundaries up to 12m in length.

The variation to the current R-Code boundary wall provisions promotes the development of terrace style housing, enables greater flexibility in design on smaller lots where efficient use of space is critical and encourages two storey housing.

Privacy & Design for Climate

Density Coding	Element	R-Code Requirement	DP2 R-Code Variation
R40 / R60 (Front and Rear Loaded)	Visual Privacy (cone of vision) Setback	Min 4.5m – Bedrooms Min 6.0m – Other habitable rooms Min 7.5m – Unenclosed Outdoor Living Areasw	Min 4.5 for all habitable spaces including bedrooms, studies, balconies etc.
	Solar Access for adjoining sites	Development shall be designed so that its shadow only cast at midday 21 June onto any adjoining property does not exceed 35% (R40) or 50% (R60) of the site area.	Overshadowing provisions do not apply.

Greater flexibility in regards to privacy and overshadowing provisions is critical as a necessary prerequisite to achieving densities and housing diversity.

The visual privacy and overshadowing provisions of the R-Codes for lower density precincts cannot be applied to higher density precincts in the same way, without severely compromising the quality of the dwelling. For example, compliance with a 7.5m privacy setback for unenclosed outdoor living areas would preclude the provision of balconies on the majority of R60 lots which are typically too narrow to support such a setback.

At present the R-Codes permit a maximum of 35% overshadowing of the adjoining property for R40 coded lots. Assuming an east-west oriented lot, containing a modest single storey cottage with a 3m high boundary wall on southern boundary occupying two thirds of the length of the boundary (20m), the overshadowing calculation (34 degrees at winter

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solstice) equates to approximately 89m^2 of the adjoining lot to the south. For a typical 7.5m x 30m laneway lot, this equates to approximately 40% of the site area. In the event that a two storey development is proposed with 6m high boundary walls, the shadow will cover approximately 180m^2 of the adjoining lot to the south. This equates to 66% of a 7.5m lot, with shadow also impacting on the next lot to the south, or around 60% of a 10m x 30m lot.

As demonstrated above, the current R-Code provisions are inadequate to respond to this common type of medium density housing, and effectively prevent any two storey development - which is generally considered to be highly desirable – on east-west lots.

Ancillary Accommodation

Density Coding	Element	R-Code Requirement	DP2 R-Code Variation
R40 / R60 (Rear Loaded)	Ancillary Accommodation	Not permitted on lots less than 450 m²	Permitted on all lots including those less than 450 m²
		One additional car space required	No additional car space required
		Occupants limited to family members	Occupants not limited to family members

The current R-Code provisions relating to ancillary accommodation preclude the capacity for studios / granny flats in R40 / R60 coded areas limiting housing diversity and affordable housing options. The DP2 R-Code variations remove this restriction and introduce revised provisions for ancillary accommodation.

The removal of the requirement for an additional car bay for this type of accommodation removes the disincentive of onerous parking requirements and encourage innovative and affordable housing forms. It is unlikely that this type of accommodation will cause any parking concerns due to the low numbers of studio units actually constructed as well as future bus routes planned through Vale.

In addition to those R-Code variations outlined above, the DP2 variations also impose additional requirements for lots directly abutting public open space. These provisions aim at ensuring that dwellings adjoining public open space address and add value to open space areas. This includes applying appropriate setbacks and ensuring outbuildings do not undermine the amenity of the interface.

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3.3 Aged and Dependant Persons Accommodation

The Residential zoning applicable to the majority of the DP2 structure plan area, allows for the consideration and approval of aged and dependant persons accommodation as a discretionary use in accordance with the City of Swan LPS 17.

The provision of aged and dependant housing is an important and necessary element in a community. This type of medium to higher density housing allows for aging in place, creates diversity in a community and develops intergenerational communities. Vale provides an excellent location for this type of development, with strong community facilities and existing service infrastructure.

In order to ensure the appropriate siting and design of aged and dependent persons accommodation, locational and development principles are provided below.

As a guide, Aged and Dependant Persons Accommodation is recommended to be:

- Located within 400 metres from a bus route, public open space and/or local centre catchments.
- Designed to address and survey surrounding public streets through the use of visually permeable fencing and major openings.
- Integrated with surrounding land use, inclusive of pedestrian access and permeability.

The provisions of the R-Codes and Town Planning Scheme also apply to this future development.

4.0 PUBLIC OPEN SPACE

4.1 Multiple Use Corridor Boundary Realignment

A minor modification of the boundary to the MUC POS configuration also forms part of this proposal. This modification does not affect the original endorsed area of the MUC. The minor reconfiguration of the MUC results in a positive environmental outcome, consistent with the principles of the approved Wetland Management Plan endorsed as part of ODP 155. The realignment of the northern boundary of the POS results in additional retention of vegetation. A technical note has been prepared by PGV Environmental providing the relevant environmental background and confirming that the proposed modification does not adversely impact on the drainage function of the creek line contained within the MUC, refer Appendix 1.

TABLE 2: VALE DP2 MODIFICATION - PUBLIC OPEN SPACE SCHEDULE
BASED ON LIVEABLE NEIGHBOURHOODS JANUARY 2009
(Based on plan 995-857E-01)

Site Area[1]			**24.0**
Deductions[2]			
Total drainage area up to the 1:1 yr event	0.13		
Deduction - 1:1 - 1:5 total drainage area exceeding 20% of the gross open space area	0.00		
Total		**0.13**	
Gross Subdivisable Area			**23.9**
POS @ 10%		**2.38**	
Public Open Space Contribution			
Minimum 80% unrestricted POS	1.90		
Maximum 20% restricted POS able to be credited	0.47		
Unrestricted Open Space[2]			
MUC 7	1.58		
LP1	0.19		
LP2	0.29		
LP3	0.25		
Total Unrestricted Use		**2.31**	
Restricted Open Space[2]			
Drainage area between 1:1 and 1:5 year events not exceeding 20% of total open space area	0.00		
Total Restricted Use Open Space		**0.00**	
Summary			
Minimum Unrestricted POS Required	1.90		
Unrestricted Open Space Provided	2.31		
Maximum Restricted Open Space	0.47		
Restricted Open Space Provided	0.00		
Total Unrestricted & Restricted Public Open Space Provision			**2.3**
Total Public Open Space Provision as a % of Gross Subdivisable Area			**10.0%**

Notes:

1. The site area is the total area within the hatched boundary shown on Plan 995-857E-01

2. In accordance with Liveable Neighbourhoods: the area subject to indunation more frequently than a one year average recurrance interval rainfall event is not included as restricted or unrestricted open space and is a deduction from the net site area (LN R33); areas for the detention of stormwater for a greater than one year average recurrance interval up to the five year recurrance interval is restricted open space up to 20%, the area greater than 20% is a deduction (not applicable in this case) (LN R26 & Table 11); areas for the dentention of stormwater for a greater than five year average recurrance interval is within unrestricted open space (LN R25).

995POS916

4.2 Public Open Space Contribution

The realignment of the MUC POS has not impacted on the public open space contribution as the area of the MUC has remained at 1.74 ha as per the original approval. This MUC is shown on Plan 1, as it serves and environmental and drainage function and is considered strategic POS. The Neighbourhood Park shown on the original endorsed ODP of 0.73 hectares, which constitutes the balance of POS in the ODP 155 modification area, as a local park is not shown. The area of this Neighbourhood Park has been retained within future local parks, with the location and configuration of local parks to be resolved at subdivision design stage.

In addition, a Liveable Neighbourhoods Public Open Space calculation has been undertaken for the subject area, refer Table 2. This has not been undertaken for previous development plans in Vale, however, we acknowledge the need to demonstrate compliance with current policy. The LN calculation demonstrates that within the subject area the plan provides approximately 10% POS contribution. The LN calculation takes into consideration the storage of drainage within the MUC POS for 1:1 and 1:5 year events. These storage volumes for the MUC POS for the 1:1 and 1:5 year events are 0.13 and 0.16 hectares respectively. Refer Appendix 2 for JDA Hydrology technical note.

5.0 OTHER CONSIDERATIONS

5.1 Movement Network

The key distributor roads endorsed as part of ODP 155 movement network are being retained consistent with the original approval. Millhouse Road, is classified as a District Distributor road and bounds the southern boundary of the subject area and provides two access points into the subdivision area with a roundabout provided on the westernmost access point. A neighbourhood connector road bounds the western edge of the subject area and provides multiple access points into the subdivision area. Detailed information relating to the movement network within the subject area will be provided as part of a future subdivision application.

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5.2 Infrastructure and Servicing Considerations

Infrastructure and servicing has been considered as part of the preparation of the ODP 155 modification. A 450 mm gravity sewer will be located with the subject area connecting Ellenbrook to the north with the Ellenbrook "E" Pumping Station on Millhouse Road. The gravity sewer is required to be retained with public open space and / or road reserve. The ODP 155 modification does not inhibit the ability for subdivision design to accommodate the sewer line. All other servicing considerations including the provision of water, electricity, gas, telecommunications are not affected by the proposed modification. Further detailed information on infrastructure and servicing provision within the subject area will be provided as part of a future subdivision application.

6.0 CONCLUSION

The introduction of more flexible R Code provisions for the Vale Estate, within a statutory framework, provides an opportunity to deliver greater housing diversity and be responsive to market requirements. The proposed approach avoids ongoing structure plan modifications as lot and housing types change, but also provides certainty to the City, proponent and purchaser. This model is consistent with the WAPC Structure Plan Guidelines and other strategic policy.

Incorporation of variations to the R-Code development standards within the Structure Plan allows for the consistent and efficient application of basic standards, which facilitate more efficient and site-responsive development of land. These provisions apply in place of detailed area plans, reducing the statutory process requirements applicable to the development of lots within the estate. The provisions proposed have been successfully applied in estates elsewhere in the metropolitan area and are specifically tailored to the contemporary lot types developed in recent years in response to both market demands and planning policy.

Finally, the refinement of the boundary of the 1.74 ha MUC POS results in an improved environmental outcome through the retention of additional vegetation.

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FIGURES 3 - 6

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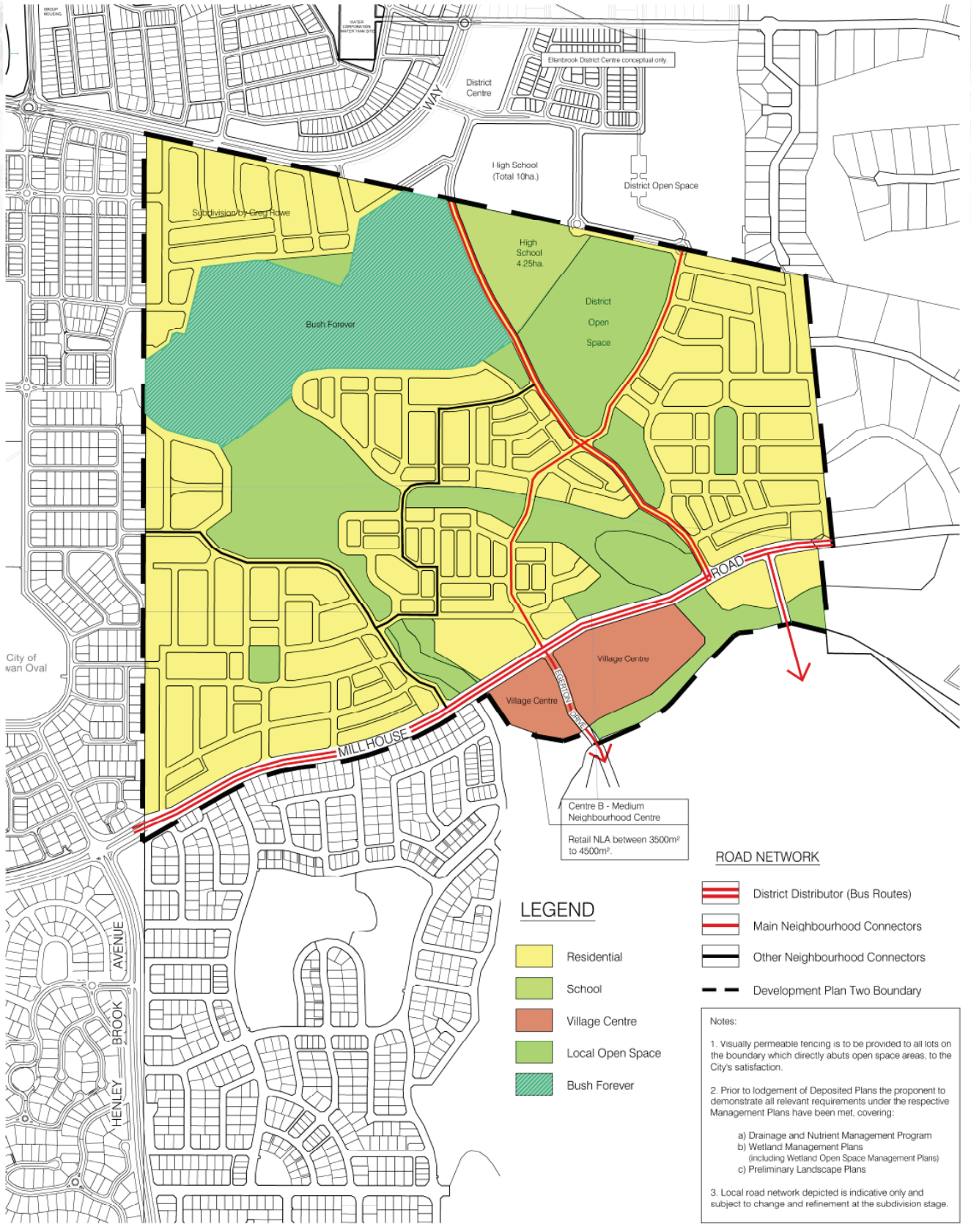

995-910-01 (18.12.2012), nts

VALE DEVELOPMENT PLAN TWO, 2008
Vale Development Plan Two Modification : Figure 3

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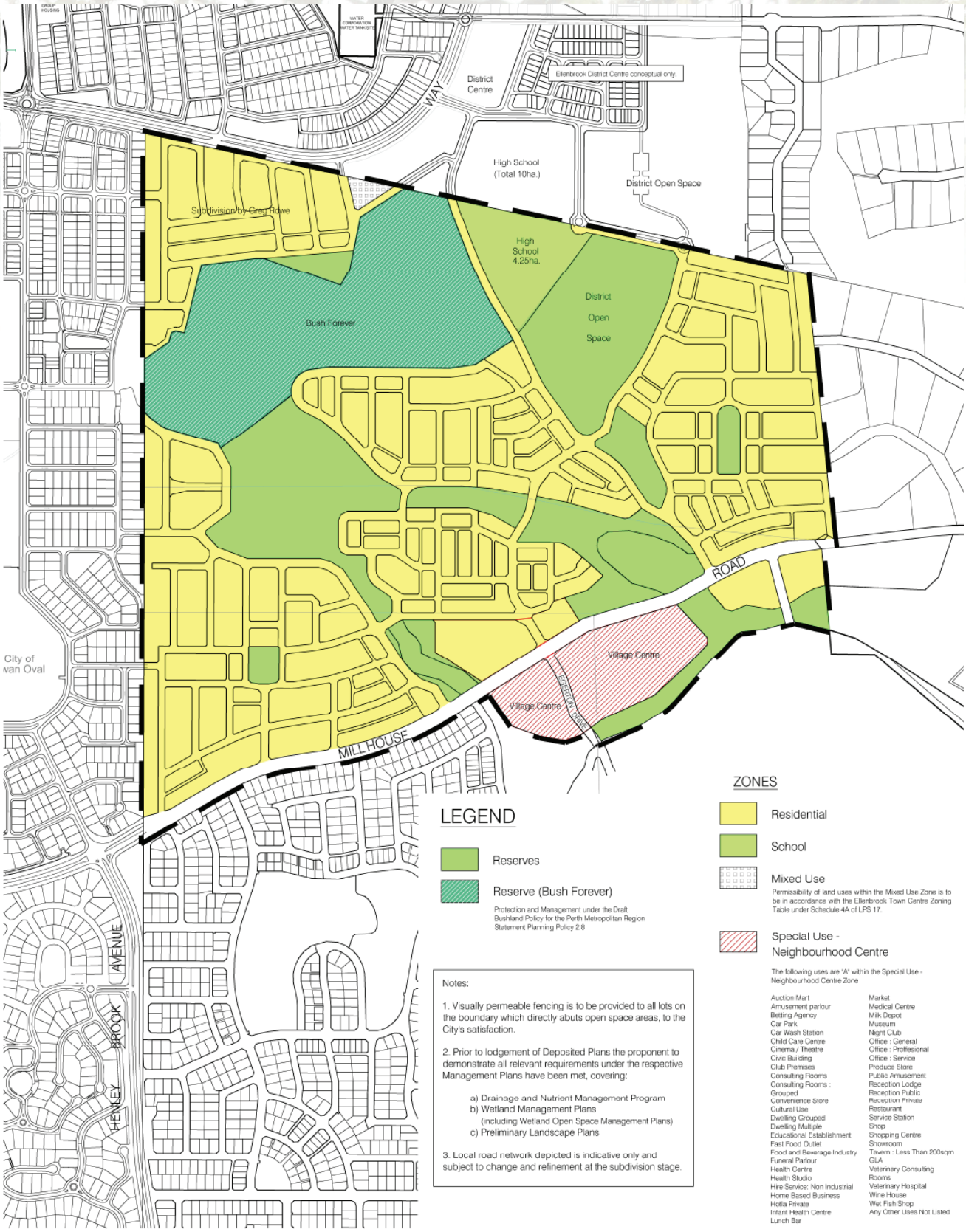

VALE DEVELOPMENT PLAN TWO, 2008 - ZONING CLASSIFICATION PLAN

995-911-01 (18.12.2012), nts

Vale Development Plan Two Modification : Figure 4

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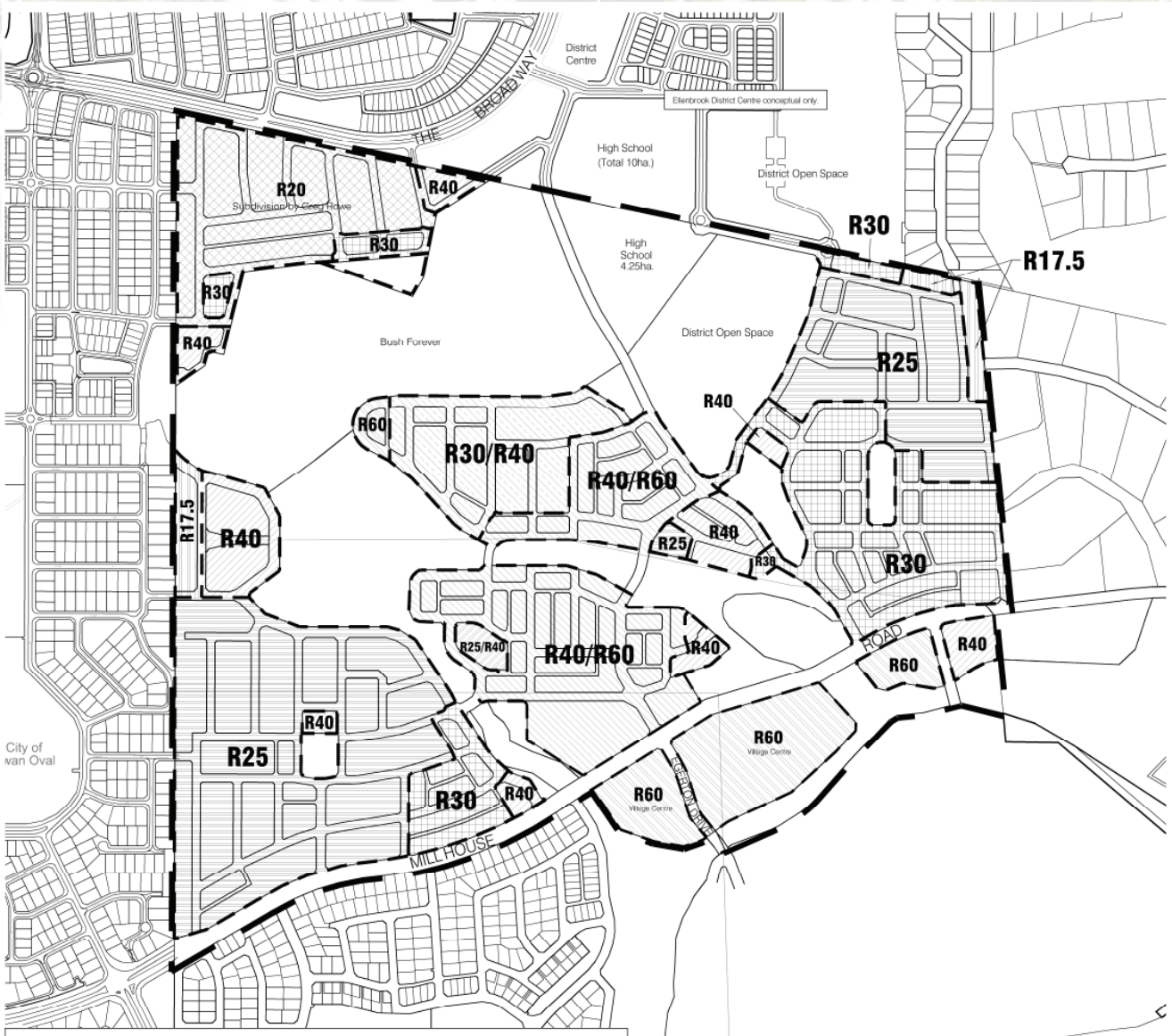

Notes:

1. Visually permeable fencing is to be provided to all lots on the boundary which directly abuts open space areas, to the City's satisfaction.

2. Prior to lodgement of Deposited Plans the proponent to demonstrate all relevant requirements under the respective Management Plans have been met, covering:

   a) Drainage and Nutrient Management Program
   b) Wetland Management Plans
      (including Wetland Open Space Management Plans)
   c) Preliminary Landscape Plans

3. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage .

Dual Coding*

Where a dual coding applies (ie R30/R40, R30/R60, R40/R60 or R25/R40) the lower code applies as the base R Coding (ie R30 or R40).

The higher code applies (ie R40 or R60) where the following conditions are satisfied:

1. The lot is a corner lot served by a street and/or laneway at both the front and side boundaries.
   The lot may also have a laneway at the rear boundary, although this is not essential to fulfil this requirement.*

2. It can be demonstrated through a Detailed Site Plan that the lot can have vehicular access to serve two or three dwellings (whichever is applicable) which:

   i. Minimises adverse impact on the streetscape; and
   ii. Can be appropriately located with regard to engineering considerations, including level differences, sightlines, truncations and on street parking.*

Not withstanding the above Grouped Housing Lots (ie lots greater than 1000m2) are coded the higher code (ie R40 or R60).

* All lots affected by the above dual coding provisions shall require a development application and are required to be developed in accordance with the approved subdivision plan WAPC Ref. 133535 (City of Swan Ref. SB007/2007), WAPC Ref. 137739 (City of Swan Ref. SB-53/2008) and WAPC Ref. 138047 (City of Swan Ref. SB-67/2008).

LEGEND

RESIDENTIAL DENSITY CODINGS

R10	R25/40*
R17.5	R30/40*
R20	R40/60*
R25	R40
R30	R60

R-Code Boundaries

VALE DEVELOPMENT PLAN TWO, 2008 - R-CODE PLAN

995-912-01 (18.12.2012), nts

FiguVale Development Plan Two Modification : Figure 5

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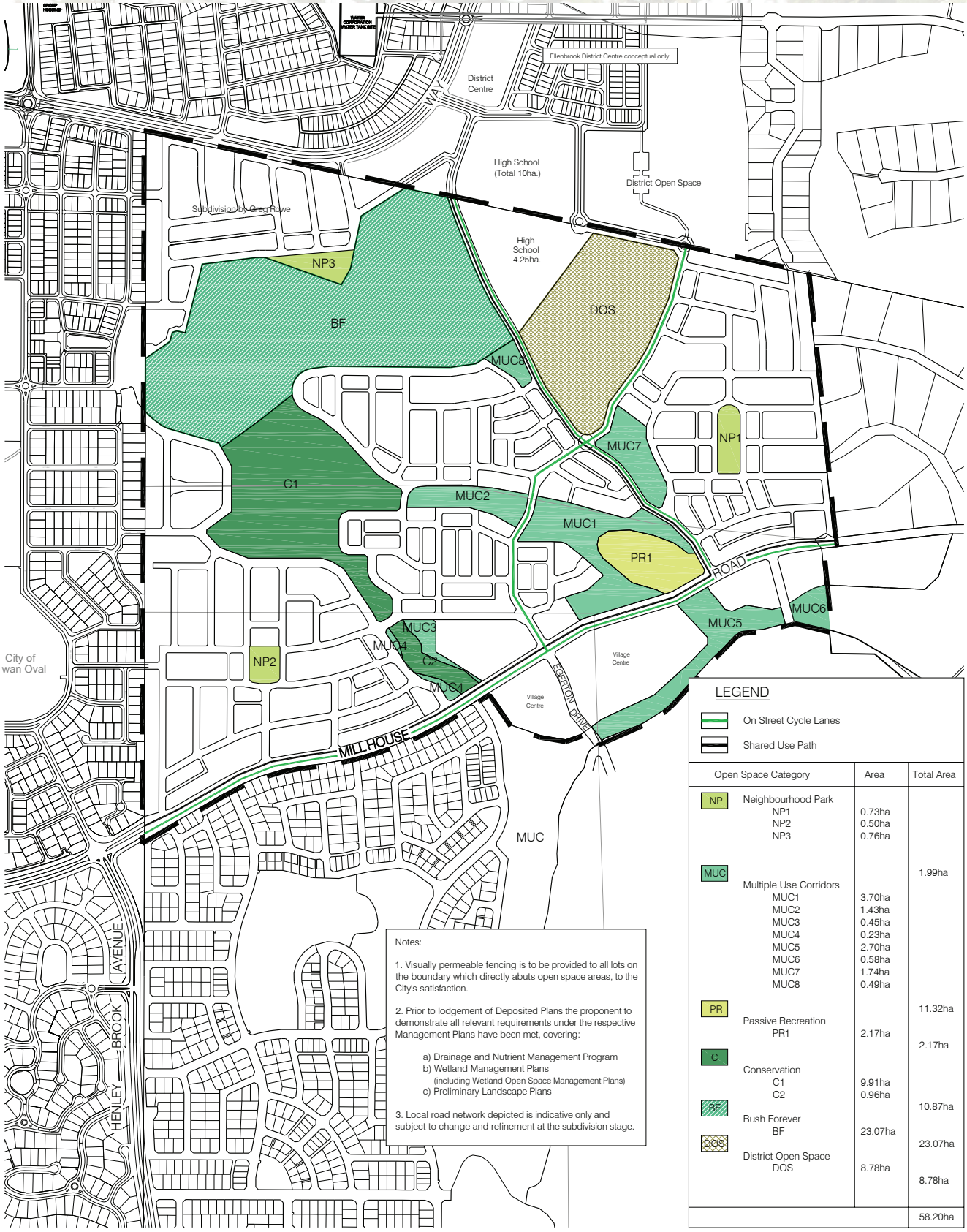

Notes:

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2. Prior to lodgement of Deposited Plans the proponent to demonstrate all relevant requirements under the respective Management Plans have been met, covering:

   a) Drainage and Nutrient Management Program
   b) Wetland Management Plans (including Wetland Open Space Management Plans)
   c) Preliminary Landscape Plans

3. Local road network depicted is indicative only and subject to change and refinement at the subdivision stage.

LEGEND

On Street Cycle Lanes

Shared Use Path

Open Space Category		Area	Total Area
NP	Neighbourhood Park		
	NP1	0.73ha	
	NP2	0.50ha	
	NP3	0.76ha	
			1.99ha
MUC	Multiple Use Corridors		
	MUC1	3.70ha	
	MUC2	1.43ha	
	MUC3	0.45ha	
	MUC4	0.23ha	
	MUC5	2.70ha	
	MUC6	0.58ha	
	MUC7	1.74ha	
	MUC8	0.49ha	
			11.32ha
PR	Passive Recreation		
	PR1	2.17ha	
			2.17ha
C	Conservation		
	C1	9.91ha	
	C2	0.96ha	
			10.87ha
BF	Bush Forever		
	BF	23.07ha	
			23.07ha
DOS	District Open Space		
	DOS	8.78ha	
			8.78ha
			58.20ha

VALE DEVELOPMENT PLAN TWO, 2008
- OPEN SPACE STRATEGY & PEDESTRIAN & CYCLE NETWORK

995-913-01 (18.12.2012), nts

Vale Development Plan Two Modification : Figure 6

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TECHNICAL APPENDICES

Appendix 1 – Technical Note – Environmental (PGV Environmental)

Appendix 2 – Technical Note – Urban Water Management (JDA Hydrology)

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Appendix 1 – Technical Note – Environmental (PGV Environmental)

pgv ENVIRONMENTAL

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Osborne Park WA 6017

ABN 44 981 725 498
Knightside Nominees Pty Ltd

7 December 2012

Eleni Thorman

CLE
PO Box 796
SUBIACO WA 6904

Dear Eleni,

RE: Vale, Aveley Stages 9-11 Subdivision

Please find following the technical note for Vale Stages 9-11 Subdivision. The proposed subdivision contains Multiple Use Corridor 7 (MUC7) which is part of the creeklines that are incorporated into the approved Wetland Management Plan for Development Plan 2 (DP2).

Approvals Background

The rezoning of 537ha of land at Vale (formerly called Egerton) from Urban Deferred to Urban was formally assessed as a Consultative Environmental Review (CER) by the Environmental Protection Authority (EPA) in 1994 (Alan Tingay and Associates, 1994). The Minister for the Environment approved the proposed rezoning with conditions, one of which was the preparation and implementation of a Wetland Management Strategy.

The Egerton Wetland Management Strategy (Alan Tingay & Associates, 1995) was approved by the Minister for the Environment in June 1995. The Strategy required the preparation of more detailed Wetland Management Plans to be approved by the City of Swan. The Wetland Management Plan for the DP2 Area for Vale was approved in April 2007 as part of the Outline Development Plan for DP2. Endorsed by the City of Swan as per the requirements of the Ministerial Statement this remains the management document under which planning in DP2 is undertaken.

DP2 Wetland Management Plan (ATA, 2006)

The Wetland Management Plan outlined measures to manage the environmental attributes of the creek lines. The Management Priorities outlined in the Wetland Management Plan indicated the primary function for the creeklines was to maintain the drainage function in the urban environment. The native vegetation within the creeklines was identified to be retained where possible.

The DP2 Wetland Management incorporated the Development Plan 2 Public Open Space Layout which showed the boundaries of the MUCs within DP2 that incorporate the creeklines. MUC7, in Stages 9-11, was shown as being 1.74ha located in the south-west corner of Stages 9-11. This layout showed roads as indicative which could be subject to refinement at subdivision stage.

Stages 9-11 Subdivision Plan

Since the preparation and endorsement for the DP2 Wetland Management Plan the subdivision design for Stages 9-11 has been finalised. The current plan shows a slight adjustment to the boundary of MUC7 compared to that shown in the 2006 Public Open Space Layout Plan in the DP2 Wetland Management Plan (Attachment 1). The POS area is the same size as shown in the Wetland Management Plan (1.74ha).

The POS has been extended to the north. The original boundary passed through the northern most group of trees which now are completely in the POS and therefore can be retained. The western boundary of the POS remains unchanged. The southern part of the POS is now narrower but the change in this boundary does not require the clearing of any additional vegetation as the area proposed to be developed is Completely Degraded.

The drainage function of the creekline is outlined in the Stages 9-11 Urban Water Management Plan and the resultant stormwater management has not been impacted within the creekline by the changes to the boundaries of MUC7.

Conclusion

The boundary of MUC7 as shown in the endorsed Wetland Management Plan has been adjusted during the detailed design of Stages 9-11. This has resulted in the following changes:

- Extension to the north of the POS to retain additional trees within the POS; and
- Narrowing of the POS to the south.

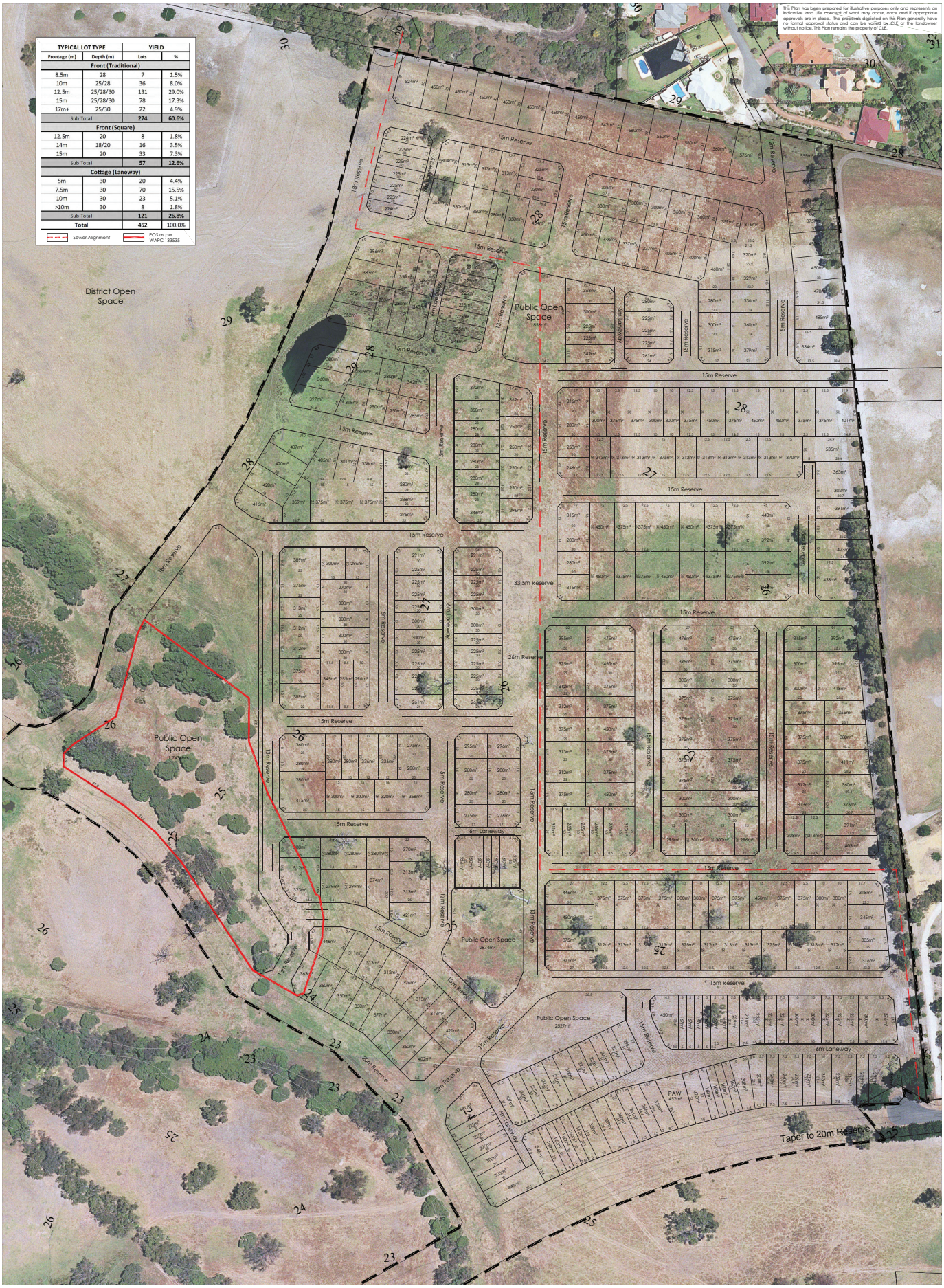
This boundary change is in alignment with the principles of the Wetland Management Plan to retain native vegetation and the drainage function of the creeklines within the DP2 Area. The change in the boundary to retain additional vegetation has resulted in an improved environmental outcome.

Yours sincerely

Jackie Hams

Environmental Consultant

Attachment 1 – Wetland Boundary and Subdivision



CLE TOWN PLANNING + DESIGN

PROPOSED SUBDIVISION (STAGES 9-11) - AERIAL IMAGERY

Vale, Millhouse Road
City of Swan

plan no: 995-857E-02
scale: 1:2,000@A3, 1:1,000@A1
date: 05.12.2012

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Appendix 2 – Technical Note – Urban Water Management (JDA Hydrology)

Jim Davies & Associates Pty Ltd
ACN 067 295 569
Suite 1, 27 York Street, Subiaco
PO Box 117, Subiaco WA 6008
Telephone (08) 9388 2436
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JDA CONSULTANT
info@jdahydro.com.au
HYDROLOGISTS
www.jdahydro.com.au

Your Ref:
Our Ref: J5213b

6 December 2012

Eleni Thorman
CLE Town Planning & Design
PO Box 796
SUBIACO WA 6904

Dear Eleni,

VALE DEVELOPMENT, AVELEY
REVIEW OF PROPOSED SUBDIVISION REDESIGN FOR STAGES 9-11

Presented below is a summary of a review undertaken to assess the hydrological impact of the proposed subdivision redesign for Vale Stages 9-11.

Background

A Drainage & Nutrient Management Programme (DNMP) for the Vale Development Two area (includes Stages 9-11) was previously prepared by JDA Consultant Hydrologists in 2007. It provided a detailed strategy to manage both groundwater and surface water quality and quantity, incorporating water sensitive urban design measures.

The stormwater management strategy in the DNMP proposed a series of swales within Multiple Use Corridors to attenuate post development flow rates to pre-development rates, and to assist in improving stormwater quality. The hydraulic model XP-STORM was used to determine the peak 1, 5, 10 and 100 year Average Recurrence Interval (ARI) flow and flood levels of the swales from the contributing surface drainage catchment.

JDA understand that the change of the proposed subdivision redesign of Stages 9-11 could impact on the groundwater and surface water management strategy which is discussed below.

Review of Proposed Subdivision Redesign

- *Groundwater Management Strategy*

Groundwater management strategy outlined in the DNMP requires sufficient clearance between the Average Annual Maximum Groundwater Level (AAMGL) and finished floor levels to be achieved by a combination of filling and subsoil drainage.

This groundwater management strategy still applies to the proposed subdivision redesign.

- *Surface Water Management Strategy*

Surface water management strategy outlined in the DNMP requires safe conveyance of stormwater via swales, and post development flow rates to be attenuated to pre-development levels. Swales are to be located within Multiple Use Corridors and inverts are not to be below AAMGL.

The Public Open Space (POS) located in the south west portion of Stages 9-11 is to contain a swale to convey stormwater. Conceptual modelling of the flood levels and extent of this swale (NW2) were presented in the DNMP. The change in the POS boundary alignment does not impact the conceptual design of this proposed swale.

Advice from Cossill & Webley (email from V.Trinh dated 30 November 2012) confirms that the surface drainage catchments and stormwater outlets from the Stages 9-11 area remain as per the DNMP. Consequently, the flood depths and swale and culvert design as presented in the DNMP (see Figure 1 attached) do not change as a result of the proposed subdivision redesign.

Conclusion

JDA review of the proposed subdivision redesign of Stages 9-11 indicates that the objectives and principles of the water management strategy presented in the DNMP (JDA, 2007) are maintained. The proposed subdivision redesign does not impact on the conceptual design of swale NW2.

Should you have any queries or would like to discuss further, please do not hesitate to contact Matthew Yan.

Yours sincerely,

JDA Consultant Hydrologists

Drainage Design

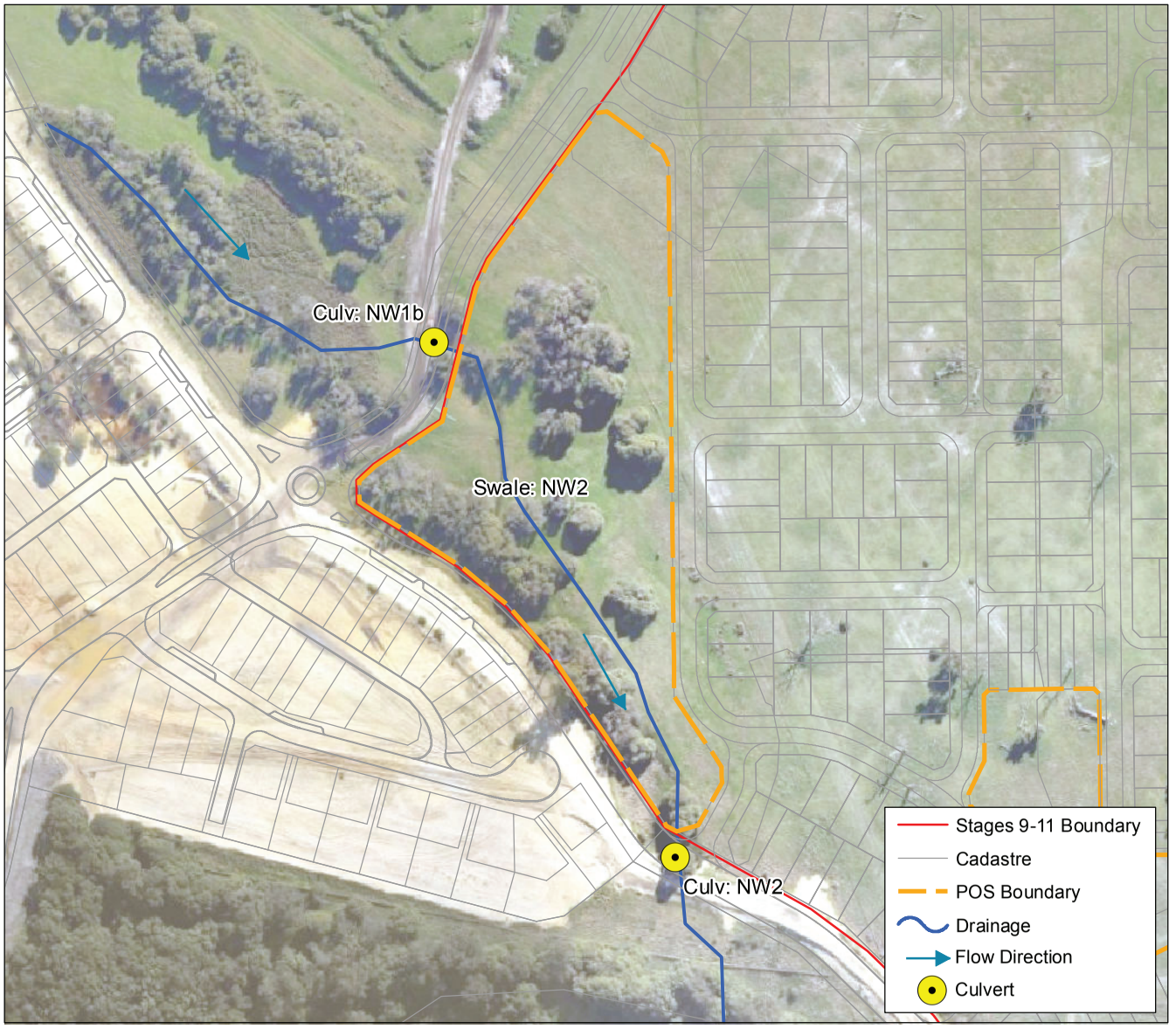
Swale: NW2

U/S invert - 25.90 mAHD
D/S invert - 24.00 mAHD
Length - 200 m
Base Width - 5 m
Flood Depth (m)

	U/S	D/S	Top Water Level Area (Ha)
100yr	0.20	0.96	0.24
10yr	0.17	0.55	0.19
5yr	0.14	0.40	0 16
1yr	0.09	0.14	0.13

Culv: NW1b
U/S invert - 26.00 mAHD
D/S invert - 25.90 mAHD
Length - 10 m
Size - 600 x 600 mm (x1) Box

Culv: NW2
U/S invert - 24.00 mAHD
D/S invert - 23.80 mAHD
Length - 10 m
Size - 450 x 300 mm (x2) Box



Data Source: CLE Town Planning & Design (2012) Sub 9-11 Redesign.dwg

JDA Consultant Hydrologists

Job No. J5213
Scale: 1:2,500 @A4

0 100 200 Metres

N

Stockland
Vale Development, Aveley

Figure 1: Review of Proposed Subdivision Redesign of Stages 9-11