SHIRE of CAPEL

SOUTH EAST CAPEL
Local Structure Plan

Appendices

09045
May 2014

APPENDICES

APPENDIX 1:

Copies of Certificates of Titles

REGISTER NUMBER	
1/D33988	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

WESTERN AUSTRALIA

RECORD OF CERTIFICATE OF TITLE

VOLUME **1336** FOLIO **192**

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 1 ON DIAGRAM 33988

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

PATRICIA MAY ASPINWALL OF LOT 1 GOODWOOD ROAD, CAPEL
(T H243347) REGISTERED 6 OCTOBER 1999

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1336-192 (1/D33988).
PREVIOUS TITLE:	1131-585.
PROPERTY STREET ADDRESS:	LOT 1 GOODWOOD RD, CAPEL.
LOCAL GOVERNMENT AREA:	SHIRE OF CAPEL.

ORIGINAL – NOT TO BE REMOVED FROM OFFICE OF T

CT 1336 0192 F

Application A596394 WESTERN AUSTRALIA

Volume 1131 Folio 585

1336 192

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

DATED 27th November, 1972

REGISTRAR OF TITLES

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Wellington Location 2426 and being Lot 1 the subject of Diagram 33988, delineated and coloured green on the map in the Third Schedule hereto.

FIRST SCHEDULE (continued overleaf)

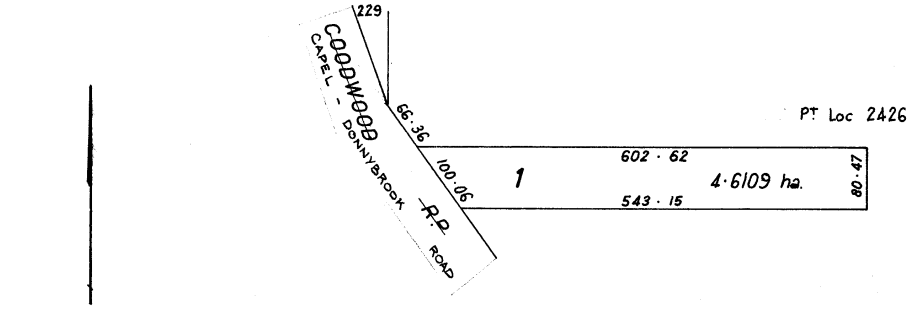
~~Thomas Jamieson, Farmer and Phyllis Barron Jamieson, Married Woman, both of Capel, as joint tenants.~~

SECOND SCHEDULE (continued overleaf)

NIL

REGISTRAR OF TITLES

THIRD SCHEDULE



Scale 1: 7500

B.A.K.

NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

90971/8/71-30M-O/SOL

LT. 37

FIRST SCHEDULE (continued) NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	INITIALS
Alfred Lewis Ward, Labourer and Maureen Ann Ward, Married Woman, both of Capel, as joint tenants.	Transfer	C216793	15.9.81	11.57		
Robert Edwin Scott and Jan Marie Scott both of 65 Orr Street, Maddington, as joint tenants.	Transfer	E340260	12.4.90	15.56		
The correct address of the registered proprietors is now Lot 1 Goodwood Road, Capel.	By	E542213	7.2.91	10.17		
Patricia May Aspinwall of Lot 1 Goodwood Road, Capel.	Transfer	H243347	6.10.99	14.42		

SECOND SCHEDULE (continued) NOTE: RULING THROUGH AND SEALING WITH THE OFFICE SEAL INDICATES THAT AN ENTRY NO LONGER HAS EFFECT. ENTRIES NOT RULED THROUGH MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	INITIALS	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	INITIALS
Mortgage	E340261	to Home Building Society.	12.4.90	15.56			Discharged	F232230	29.6.93		
Mortgage	E542213	to Esanda Finance Corporation Ltd.	7.2.91	10.17			Discharged	F232229	29.6.93		
Mortgage	F232231	to National Australia Bank Ltd.	29.6.93	8.58			Discharged	H243346	6.10.99		
Mortgage	F232232	to Esanda Finance Corporation Ltd.	29.6.93	8.58			Discharged	G777989	30.4.98		

CERTIFICATE OF TITLE VOL. 1336 192

WESTERN AUSTRALIA

REGISTER NUMBER	
2426/DP250881	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	**7/7/2004**

RECORD OF CERTIFICATE OF TITLE

VOLUME **2066** FOLIO **820**

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 2426 ON DEPOSITED PLAN 250881

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

ROSS MILLAR JAMIESON OF POST OFFICE BOX 13, CAPEL
(T I929322) REGISTERED 24 JUNE 2004

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE.
2. I929323 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA REGISTERED 24.6.2004.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: 2066-820 (2426/DP250881).
PREVIOUS TITLE: 1681-336.
PROPERTY STREET ADDRESS: LOT 2426 GOODWOOD RD, CAPEL.
LOCAL GOVERNMENT AREA: SHIRE OF CAPEL.

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF WELLINGTON LOCATION 2426 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT 2426 ON DEPOSITED PLAN 250881 ON 24-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.
NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

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ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF TITLES

Application G101272

Volume 1681 Folio 336

WESTERN AUSTRALIA

REGISTER BOOK
VOL. FOL.
CT 2066 820

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 14th February, 1996

REGISTRAR OF TITLES

OFFICE OF TITLES WESTERN AUSTRALIA

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of Wellington Location 2426, delineated on the map in the Third Schedule hereto.

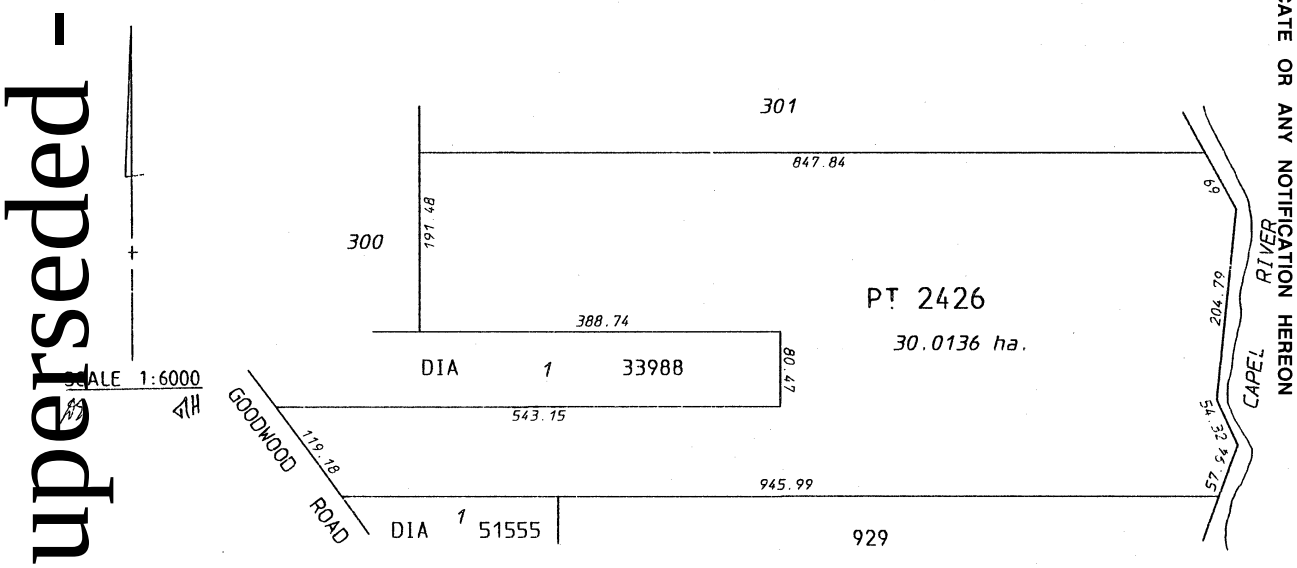
FIRST SCHEDULE (continued overleaf)

Ross Millar Jamieson and Stephanie Joan Jamieson both of Lexden Park, 72 Jamieson Street, Capel, as tenants in common in equal shares.

SECOND SCHEDULE (continued overleaf)

1. ~~MORTGAGE E45594 to Citibank Savings Ltd. Registered 13.3.89 at 15.35 hrs.~~
   Discharged G278777 12.9.96 HR
2. ~~MORTGAGE E443518 to Citibank Savings Ltd. Registered 10.9.90 at 15.55 hrs.~~
   Discharged G278779 12.9.96 HR
3. ~~MORTGAGE E796119 to Citibank Savings Ltd. Registered 28.1.92 at 15.12 hrs.~~
   Discharged G278778 12.9.96 HR
4. MORTGAGE E796123 to Commonwealth Bank of Australia. Registered 28.1.92 at 15.12 hrs.
5. MORTGAGE E796124 to Commonwealth Bank of Australia. Registered 28.1.92 at 15.12 hrs.

THIRD SCHEDULE



NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

LT. 37

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	CERT. OFFICER
The correct address of the registered proprietors is now Post Office Box 13, Capel.	By	G844436	9.7.98	9.00		

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
Mortgage	G844436	to Commonwealth Bank of Australia.	9.7.98	9.00							

CERTIFICATE OF TITLE VOL. 2066 FOL. 820

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ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF TITLES

Application G101271

Volume 2066 Folio 817

WESTERN AUSTRALIA

REGISTER BOOK
VOL. FOL.
CT 2066 818

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

Page 1 (of 2 pages) VOL. 2066 FOL. 818

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 14th February, 1996

REGISTRAR OF TITLES

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

ESTATE AND LAND REFERRED TO

Estate in fee simple in portion of each of Wellington Locations 619 and 2426 and being Lot 300 on Diagram 89381, delineated on the map in the Third Schedule hereto.

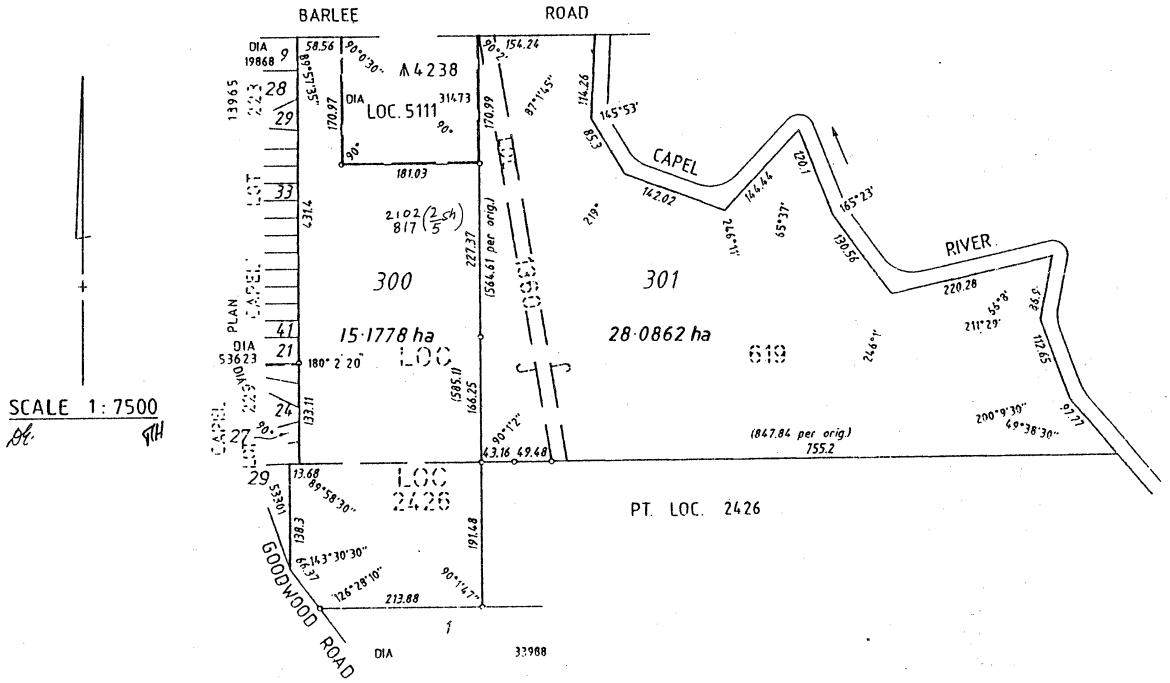
FIRST SCHEDULE (continued overleaf)

Carribean Investments Pty Ltd of care of Brandsma & Crockett, 6 Kings Park Road, West Perth.

SECOND SCHEDULE (continued overleaf)

1. ~~MORTGAGE G101273 to Citibank Ltd. Registered 14.2.96 at 15.59 hrs.~~
   Discharged G278781 12.9.96
2. ~~MORTGAGE G101274 to Citibank Ltd. Registered 14.2.96 at 15.59 hrs.~~
   Discharged G278781 12.9.96
3. ~~MORTGAGE G101275 to Citibank Ltd. Registered 14.2.96 at 15.59 hrs.~~
   Discharged G278780 12.9.96
4. ~~MORTGAGE G101277 to Commonwealth Bank of Australia. Registered 14.2.96 at 16.01 hrs.~~
   Discharged G420813 21.4.97
5. ~~MORTGAGE G101276 to Commonwealth Bank of Australia. Registered 14.2.96 at 16.01 hrs.~~
   Discharged G420814 21.4.97

THIRD SCHEDULE



NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	CERT. OFFICER
Two undivided fifth shares to Vol 2102 Fol 817.	Transfer	G420815	21.4.97	15.06		

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER

CERTIFICATE OF TITLE VOL. 2066 FOL. 818

WESTERN AUSTRALIA

REGISTER NUMBER	
301/D89381	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
3	**7/7/2004**

RECORD OF CERTIFICATE OF TITLE

VOLUME **2066** FOLIO **819**

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 301 ON DIAGRAM 89381

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

CARRIBEAN INVESTMENTS PTY LTD OF CARE OF BRANDSMA & CROCKETT, 6 KINGS PARK ROAD, WEST PERTH

(A G101271) REGISTERED 14 FEBRUARY 1996

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. G101277 MORTGAGE TO COMMONWEALTH BANK OF AUSTRALIA REGISTERED 14.2.1996.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	2066-819 (301/D89381).
PREVIOUS TITLE:	2066-817.
PROPERTY STREET ADDRESS:	LOT 301 BARLEE RD, CAPEL.
LOCAL GOVERNMENT AREA:	SHIRE OF CAPEL.

LT. 37

ORIGINAL—NOT TO BE REMOVED FROM OFFICE OF TITLES

Application G101271

Volume 2066 Folio 817

WESTERN AUSTRALIA

REGISTER BOOK
VOL. FOL.
CT 2066 819

CERTIFICATE OF TITLE

UNDER THE "TRANSFER OF LAND ACT, 1893" AS AMENDED

I certify that the person described in the First Schedule hereto is the registered proprietor of the undermentioned estate in the undermentioned land subject to the easements and encumbrances shown in the Second Schedule hereto.

Dated 14th February, 1996

REGISTRAR OF TITLES

OFFICE OF TITLES WESTERN AUSTRALIA

ESTATE AND LAND REFERRED TO

Estate in fee simple in Wellington Location 1360 and portion of Wellington Location 619 together being Lot 301 on Diagram 89381, delineated on the map in the Third Schedule hereto. As to the said Location 1360 only: limited however to the natural surface and therefrom to a depth of 609.6 metres.

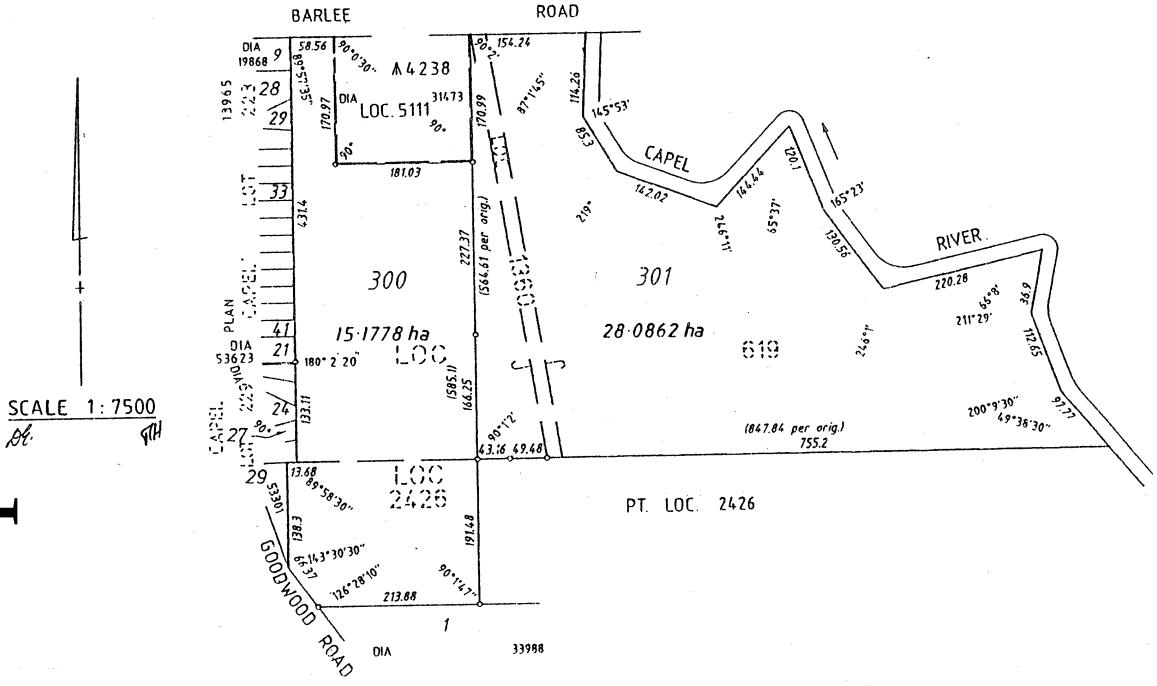
FIRST SCHEDULE (continued overleaf)

Carribean Investments Pty Ltd of care of Brandsma & Crockett, 6 Kings Park Road, West Perth.

SECOND SCHEDULE (continued overleaf)

1. ~~MORTGAGE G101273 to Citibank Ltd. Registered 14.2.96 at 15.59 hrs.~~ Discharged G278781 12.9.96
2. ~~MORTGAGE G101274 to Citibank Ltd. Registered 14.2.96 at 15.59 hrs.~~ Discharged G278781 12.9.96
3. ~~MORTGAGE G101275 to Citibank Ltd. Registered 14.2.96 at 15.59 hrs.~~ Discharged G278780 12.9.96
4. MORTGAGE G101277 to Commonwealth Bank of Australia. Registered 14.2.96 at 16.01 hrs.
5. MORTGAGE G101276 to Commonwealth Bank of Australia. Registered 14.2.96 at 16.01 hrs.

THIRD SCHEDULE



NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS.

PERSONS ARE CAUTIONED AGAINST ALTERING OR ADDING TO THIS CERTIFICATE OR ANY NOTIFICATION HEREON

LT. 37

FIRST SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

REGISTERED PROPRIETOR	INSTRUMENT NATURE	INSTRUMENT NUMBER	REGISTERED	TIME	SEAL	CERT. OFFICER

SECOND SCHEDULE (continued) NOTE: ENTRIES MAY BE AFFECTED BY SUBSEQUENT ENDORSEMENTS

INSTRUMENT NATURE	INSTRUMENT NUMBER	PARTICULARS	REGISTERED	TIME	SEAL	CERT. OFFICER	CANCELLATION	NUMBER	REGISTERED OR LODGED	SEAL	CERT. OFFICER
Mortgage	G844435	to Commonwealth Bank of Australia.	9.7.98	9.00							

CERTIFICATE OF TITLE VOL. 2066 FOL. 819

APPENDIX 2:

Flora and Remnant Vegetation Survey

Bennett Environmental Consulting Pty Ltd
A.B.N. 18 091 826 765

PO Box 341, KALAMUNDA 6926
Tel: (08) 9293 2998 ~ Mobile 0429329980
Email: ebennett@cygnus.uwa.edu.au

FLORA AND VEGETATION LOT 300 LOCS 619 & 246 LOT 301 WELLINGTON LOC 1360,PT WELLINGTON LOC 2426 CAPEL, WESTERN AUSTRALIA

Dr Eleanor Bennett of Bennett Environmental Consulting Pty Ltd undertook a survey of the above site on 18th October 2005. The report of that survey was a comprehensive flora and vegetation assessment that included the vegetation units present, their condition, species (including weeds) within each unit and a map of the vegetation units and vegetation condition. In addition a listing of taxa along the Capel River was also provided. No subsequent survey has been undertaken of the site.

The owner was concerned about maintaining the conservation value of some of the site which had been fenced off from stock. As a result this bushland was in better quality and in addition he had undertaken some plantings to further enhance its environmental value. With the proposed development of the site this fenced area is to be retained and enhanced by revegetation. It adjoins the conservation area of the Capel River. Another section of the site at the north west is also to be included in the conservation area beside the Capel River.

Most of the site proposed for development is cleared or with scattered trees and was in a completely degraded with some small areas in good condition.

No threatened species were recorded at the site although an extensive search was undertaken for *Drakaea elastica* in the *Kunzea glabrescens* areas. Plants of this threatened species had been recorded in a similar vegetation, not far from this site, and still in the Shire of Capel. However the vegetation at this site was not as damp as where *Drakaea elastica* was located.

The two remnant vegetation units at the site were:

- Low Woodland A of *Eucalyptus marginata* subsp. *marginata, Agonis flexuosa* var. *flexuosa, Corymbia calophylla* and *Xylomelum occidentale* over Open Scrub of *Kunzea glabrescens* over Low Heath D dominated by *Hibbertia hypericoides;* and
- Low Forest B of *Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Kunzea glabrescens* over Open Low Scrub B of *Melaleuca thymoides* over Herbs dominated by weeds.

Neither of these vegetation units are threatened ecological communities.

A desktop review of this 2006 report together with the plans for the proposed development of the site was undertaken in 2012. The important ecological unit at the site is the Capel River and the surrounding vegetation, which is to be left as a conservation area. A list was prepared in the 2005 report of taxa along the Capel River at the site. There are several endemic taxa, including sedges, ferns, shrubs and trees that can be used to rehabilitate the river. Local nurseries should be utilised to propagate more of these plants using separation of those currently along the river. In addition seed can be collected from the trees and shrubs then propagated on for planting. The tree cover was generally good but is mainly the understorey that needs to be enhanced.

As there are no threatened species or threatened ecological communities recorded from the site this project does not trigger the Environmental Protection and Biodiversity Conservation Act, 1999 (Department of Sustainability, Environment, Water, Populations and Communities, 2012).

Dr Eleanor Bennett
Director, 20th December 2012

FLORA AND VEGETATION
LOT 300 LOCS 619 & 246
LOT 301 WELLINGTON LOC 1360,
PT WELLINGTON LOC 2426
CAPEL, WESTERN AUSTRALIA

Prepared for:
TME
Bunbury

Prepared by:
Bennett Environmental Consulting Pty Ltd

Sollya heterophylla

PO Box 341
KALAMUNDA 6926

19th January 2006

STATEMENT OF LIMITATIONS

Scope of Services

This report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Eleanor Bennett ("the Author"). In some circumstances a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services.

Reliance on Data

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, the Author has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

Environmental Conclusions

In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

Report for Benefit of Client

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of the Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

Other Limitations

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report. The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.

INDEX

SUMMARY

Bennett Environmental Consulting Pty Ltd was commissioned by TME Bunbury to undertake a vegetation and flora survey of Lot 300 Locs 619 & 246, Lot 301 Wellington Loc 1360 and Pt Wellington LOC 2426. It is proposed to develop a section adjoining the current housing, the remainder will be retained as its current use.

The vegetation complex at the site is Southern River (Heddle 1980) of which less than the required 30% remains with remnant vegetation. The vegetation condition of most of the site varied between good and degraded with a small area of remnant vegetation that had been fenced off from cattle by the owner, recording a vegetation condition of very good. This indicates that although less than 30% of the particular vegetation complex remains that surveyed where it is proposed to extend the development is not worthy of conservation.

Three vegetation units were identified at the site.

i. Low Woodland A of *Eucalyptus marginata* subsp. *marginata, Agonis flexuosa* var. *flexuosa, Corymbia calophylla* and *Xylomelum occidentale* over Open Scrub of *Kunzea glabrescens* over Low Heath D dominated by *Hibbertia hypericoides* over Very Open Low grass and Very Open Low Sedges.

This was the vegetation unit recorded in the fenced remnant vegetation.

ii. Low Forest B of *Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Kunzea glabrescens* over Open Low Scrub of *Melaleuca thymoides* over Herbs dominated by **Romulea rosea* and **Hypochaeris glabra* and/or Low Grass of **Briza maxima*.

This vegetation unit was restricted to two areas at the site.

iii. Open Low Woodland A to Low Forest A of *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* over Tall Grass and Low Grass of pasture species.

This was the dominant vegetation at the site as it was that associated with the pasture.

A total number of 41 vascular plant families, 111 genera and 145 taxa were recorded during the survey which was undertaken on 18th October 2005. Eight vascular plant families, Poaceae, Papilionaceae, Orchidaceae, Anthericaceae, Asteraceae, Proteaceae, Myrtaceae and Stylidiaceae represented 54.5% of the total number of taxa, 51.4% of the total number of genera and 19.5% of the total number of families.

In the bushland remnants the vegetation condition varied between good and degraded. The fenced area adjacent to the house, which is not included in the proposed development, was in very good condition. The majority of the area was paddocks where pasture species were dominant. The vegetation condition of these areas varied between degraded to completely degraded.

1. INTRODUCTION

1.1 Background

Bennett Environmental Consulting Pty Ltd was contracted by TME at Bunbury to undertake a flora and vegetation survey of Lot 300 Wellington Locs 619 & 246, Lot 301 Wellington Loc 1360, Pt Wellington Loc 2426, Capel. The eastern boundary of this property is adjacent to the Capel River. The property is bounded to the west by the Capel Primary School and houses, to the south west by Goodwood Road, to the south by farming properties, to the east by the Capel River and to the north by an access road to the property.

There was very little remnant vegetation remaining at the site. Mostly the site is currently used to graze cattle.

1.2 Scope of Works

The requirements for this project were to:

i. Record the vegetation units and associated species at all the areas nominated.
ii. Search for Declared Rare and Priority Flora.
iii. Undertake an overview of the vegetation along the Capel River adjacent to the study area.

2. REGIONAL METHODOLOGY

2.1 Geology and Landform

The climate is a warm Mediterranean with a winter precipitation of 600-1000mm with 5-6 dry months per year.

Churchward *et al.* (1980) described the soils of the Swan Coastal Plain. There is an alluvial terrain along the eastern fringe of the Swan Coastal Plain. The Serpentine River Unit was formed on older alluvium in conditions of ponding, which is reflected in the fine textures and poor internal drainage of the soils. The Swan Unit, which is along present stream courses, is of younger origin. These are red earths and duplex soils.

Mapping of the soil/vegetation units has been prepared by the Department of Agriculture (2001). With these maps it is possible to home in on the individual lots. The survey area is included in the Bassendean System B1 Phase and B2 Phase. The edge of the Capel River, which is technically outside of the area studied, is included in the Pinjarra System P1a Phase. These mapping units are contrary to those of Churchward *et al*. (1980).

These are described by Department of Agriculture (2001) as:

- **Bassendean B1 Phase** - Extremely low to very low relief dunes, undulating sandplain and discrete sand rises. Deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m.
- **Bassendean B2 Phase** - Flat to very gently undulating well drained sandplain on the surface. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1-2 m.
- **Pinjarra System P1a Phase** - Flat to very gently undulating plain. Imperfect to poorly drained and generally not susceptible to salinity. Deep acidic mottled yellow duplex soils. Shallow pale sand to sandy loam over clay.

2.2 Vegetation

The Interim Biogeographical Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995) recognises 85 bioregions. The IBRA is used as the common unit to compare biological and biophysical attributes. Bioregions represent a landscape based approach to classifying the land surface and each region is defined by a set of major environmental influences, which shape the occurrence of flora and fauna and their interaction with the physical environment. The study area is in the Swan Coastal Plain (SWA2 – Swan Coastal Plain Subregion). The Swan Coastal Plain Subregion has a very high degree of species diversity (Mitchell et al., 2002)

Prior to the above classification Beard (1980) classified the vegetation of Western Australia. Western Australia was divided into three main Botanical Provinces, Southwest, Eremaean and Northern. Capel is within the Drummond Subdistrict of the Darling Botanical District within the Southwest Botanical Province (Beard, 1990). The Drummond Botanical Subdistrict is mainly *Banksia* Low Woodland on leached sands with *Melaleuca* swamps where ill-drained. Woodlands of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata* subsp. *marginata*) and Marri (*Corymbia calophylla*) occur on less leached soils. Beard (1981) mapped the vegetation as *Corymbia calophylla* Woodlands (e3Mi). Shepherd *et al.* (2002) have determined the pre-European and current extent of the vegetation associations described by Beard. In addition they have assessed the percentage of each remaining, the amount in IUCN reserves and the percentage in other reserves. The pre-European area is estimated to be 275380ha; the current extent is 32451ha; percentage remaining vegetated 11.8% of which 18% is in conservation.

Heddle *et al*. (1980) in their study of the Darling System mapped the vegetation of the study area in the Southern River Complex with the Capel River in the Swan Complex.

- The Southern River Complex consists of an Open Woodland of *Corymbia calophylla, Eucalyptus marginata* subsp. *marginata* and *Banksia* species on the elevated areas and a fringing Woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* along the streams. South of the Murray River *Agonis flexuosa* var. *flexuosa* occurs in association with *Eucalyptus rudis – Melaleuca rhaphiophylla* (Heddle *et al.* (1980).
- The Swan River Complex is dominated by a Woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* with localized occurrences of Low Open Forest of *Casuarina obesa* and *Melaleuca cuticularis* (Heddle *et al.* (1980).

Southern River and Swan complexes are included in the Pinjarra Plain of which 7% remains vegetated (Department of Environmental Protection, 2000). Within the Greater Bunbury Region) there is 16% of the Swan Complex and 11% of the Southern River complex remaining vegetated. These percentages are below the 30% target of that present pre-1750 (Environmental Protection Authority, 2003 and Commonwealth of Australia, 2001).

3 METHODS

Field work was undertaken on 18th October 2005. The remnant vegetation was surveyed using the methods set out in the EPA Guidance No 51 (2004). All possible tracks were driven and transects walked through the remnant bushland. Each vegetation unit identified was recorded. A 10m x 10m quadrat was set up using a compass and placed due N,S,E,W. All quadrats were temporary with the 4 pegs being removed at the end of the data collection.

The vegetation, flora and weed surveys were conducted concurrently. For each quadrat, the following was recorded in the field:

- GPS reading (WGS84, equivalent to Geocentric Datum of Australia 1994 (GDA94)) at NW corner.
- Digital photograph taken at the NW corner.
- Soil type.

- Presence, size and type of any outcropping rocks.
- Topography – eg. ridge, upper slope, middle slope, lower slope, drainage line, minor creek, major creek, wetland.
- Aspect where this is applicable.
- Litter.
- Vegetation condition using the scale (Keighery, 1994).
- Presence of any Declared Rare or Priority Flora or other significant flora.
- Additional information including dieback, age since fire, predators, erosion, weeds, grazing, tracks etc.
- All species were listed together with their percentage cover within the quadrat and average height.

The area outside of the quadrat was also surveyed to record additional (opportunistic) species for that vegetation unit. All species unknown in the field were collected, pressed and identified later using appropriate keys and by comparison with collections housed at the Western Australian Herbarium. A collection of each Rare or Priority Flora was made and forms will be completed and sent to the Rare Flora section of the Department of Conservation and Land Management. The pressed and dried specimens will be sent to the Western Australian Herbarium for inclusion in their collection.

4. RESULTS

4.1 Number of Taxa

A total number of 41 vascular plant families, 111 genera and 145 taxa were recorded from the remnant bushland during the survey. The dominant plant families were:

Poaceae with 15 taxa, 9 of which were weeds;
Papilionaceae with 14 taxa of which 3 were weeds;
Orchidaceae with 11 taxa of which 1 was a weed;
Anthericaceae with 10 taxa none of which were weeds;
Asteraceae with 8 taxa of which 5 were weeds; and
Proteaceae, Myrtaceae and Stylidiaceae with 7 taxa none of which were weeds.

These 8 families represent 54.5% of the total number of taxa, 51.4% of the total number of genera and 19.5% of the total number of vascular plant families recorded from the survey area.

4.2 Vegetation Units

There were three remnant vegetation units identified at the site. In addition large areas consisted of pasture species with scattered trees. The vegetation units are described using the vegetation classification of Muir (1977) and are followed by the abbreviation used in Appendices B and D.

Table 1. Vegetation Classification (from Muir 1977)

LIFE FORM / HEIGHT CLASS	Canopy Cover			
	DENSE 70 % - 100%	**MID DENSE 30% - 70%**	**SPARSE 10% - 30%**	**VERY SPARSE 2% - 10%**
Trees > 30 m	Dense Tall Forest	Tall Forest	Tall Woodland	Open Tall Woodland
Trees 15 – 30 m	Dense Forest	Forest	Woodland	Open Woodland
Trees 5 – 15 m	Dense Low Forest A	Low Forest A	Low Woodland A	Open Low Woodland A
Trees < 5 m	Dense Low Forest B	Low Forest B	Low Woodland B	Open Low Woodland B
Mallee tree form	Dense Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee shrub form	Dense Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2 m	Dense Thicket	Thicket	Scrub	Open Scrub
Shrubs 1.5 – 2 m	Dense Heath A	Heath A	Low Scrub A	Open Low Scrub A
Shrubs 1 - 1.5 m	Dense Heath B	Heath B	Low Scrub B	Open Low Scrub B
Shrubs 0.5 – 1 m	Dense Low Heath C	Low Heath C	Dwarf Scrub C	Open Dwarf Scrub C
Shrubs 0 - 0.5 m	Dense Low Heath D	Low Heath D	Dwarf Scrub D	Open Dwarf Scrub D
Mat plants	Dense Mat Plants	Mat Plants	Open Mat Plants	Very Open Mat Plants
Hummock grass	Dense Hummock Grass	Mid-Dense Hummock Grass	Hummock Grass	Open Hummock Grass
Bunch grass > 0.5 m	Dense Tall Grass	Tall Grass	Open Tall Grass	Very Open Tall Grass
Bunch grass < 0.5 m	Dense Low Grass	Low Grass	Open Low Grass	Very Open Low Grass
Herbaceous spp.	Dense Herbs	Herbs	Open Herbs	Very Open Herbs
Sedges > 0.5 m	Dense Tall sedges	Tall Sedges	Open Tall Sedges	Very Open Tall Sedges
Sedges < 0.5 m	Dense Low Sedges	Low Sedges	Open Low Sedges	Very Open Low Sedges
Ferns	Dense Ferns	Ferns	Open Ferns	Very Open Ferns
Mosses, liverworts	Dense Mosses	Mosses	Open Mosses	Very Open Mosses

Low Woodland A of *Eucalyptus marginata* subsp. *marginata, Agonis flexuosa* var. *flexuosa, Corymbia calophylla* and *Xylomelum occidentale* over Open Scrub of *Kunzea glabrescens* over Low Heath D dominated by *Hibbertia hypericoides* over Very Open Low Gass and Very Open Low Sedges. **Af Hh** (Quadrats CAP1 and CAP2)

Low Forest B of *Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Kunzea glabrescens* over Open Low Scrub B of *Melaleuca thymoides* over Herbs dominated by **Romulea rosea* and **Hypochaeris glabra* and/or Low Grass of **Briza maxima*. **BaMt**. (Quadrats 3 and 5)
This vegetation unit was restricted to two areas at the site.

Open Low Woodland A to Low Forest A of *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* over Tall Grass of **Avena barbata* over Low Grass of **Cynodon dactylon*. (Quadrat 4 and pasture areas). **CcAf**
This was the dominant vegetation at the site. The trees varied between *Eucalyptus marginata* subsp. *marginata, Banksia attenuata, Melaleuca preissiana, Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* depending upon position on landscape, soil moisture and vegetation unit prior to clearing.

None of these vegetation units are listed as Threatened Ecological Communities (Mitchell *et al*., 2002).

4.3 Vegetation Condition

Using the vegetation condition of Keighery (Table 2) the vegetation condition recorded for each quadrat is listed in Table 3.

Table 2. Vegetation Condition Classification (Keighery, 1994)

Rating	Description	Explanation
1	Pristine	Pristine or nearly so, no obvious signs of disturbance.
2	Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
3	Very Good	Vegetation structure altered, obvious signs of disturbance.
4	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
5	Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
6	Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

Table 3. Vegetation condition of quadrats

Rating	Quadrats
3	CAP2
4	CAP3
4-5	CAP1, CAP5
5-6	CAP4
6	Paddocks

The fenced area of quadrat CAP2 included remnant bush areas in very good vegetation condition. This is adjacent to the house and is not included in the proposed development. All of the other areas surveyed were in good to degraded condition. To retain these in conservation and to restore them to very good or better condition would be very time consuming and costly.

4.4 Weeds

A total of 35 weeds (24.3%) of the total number of taxa) were recorded during the survey, all of which have been determined as weeds by the Department of Conservation and Land Management (1999). In addition three cultivated species and a group of unidentifiable grasses were also recorded. The rating allocated to each weed by CALM is based on three criteria:

Invasiveness – ability to invade natural bushland in good to excellent condition or ability to invade waterways.

Distribution – wide current or potential distribution including consideration of known history of wide spread distribution elsewhere in the world.

Environmental impacts – Ability to change the structure, composition and function of ecosystems. In particular an ability to form a monoculture in a vegetation community.

Ratings indicate the following.

High indicates this weed is prioritised for control and/or research ie prioritising funding to it.

Moderate indicates control or research effort should be directed to it if funds are available, however it should be monitored (possibly a reasonably high level of monitoring).

Mild indicates monitoring of the weed and control where appropriate.

Low indicates that this species would require a low level of monitoring.

Table 4. Weeds recorded during the survey classified according to CALM (1999)

SCIENTIFIC NAME	COMMON NAME	CALM RATING	INVASIVENESS	IMPACTS
**Asparagus asparagoides*	Bridal creeper	High	✓	✓
**Bromus diandrus*	Great brome	High	✓	✓
**Ehrharta calycina*	Perennial veldt grass	High	✓	✓
**Freesia* hybrid	Freesia	High	✓	✓
**Romulea rosea*	Guildford grass	High	✓	✓
**Sparaxis bulbifera*	Harlequin flower	High	✓	✓
**Watsonia bulbillifera*	Bugle lily	High	✓	✓
**Zantedeschia aethiopica*	Arum lily	High	✓	✓
**Anagallis arvensis*	Pimpernel	Moderate	✓	
**Arctotheca calendula*	Cape weed	Moderate	✓	
**Avena barbata*	Bearded oat	Moderate	✓	
**Briza maxima*	Blowfly grass	Moderate	✓	
**Briza minor*	Shivery grass	Moderate	✓	
**Crassula glomerata*		Moderate	✓	
**Cynodon dactylon*	Couch grass	Moderate	✓	
**Disa bracteata*	South African orchid	Moderate	✓	
**Ehrharta longiflora*	Annual veldt grass	Moderate	✓	
**Hordeum leporinum*	Barley grass	Moderate	✓	
**Hypochaeris glabra*	Flat weed	Moderate	✓	
**Orobanche minor*	Lesser broomrape	Moderate	✓	
**Sonchus oleraceus*	Sow thistle	Moderate	✓	
**Trifolium subterraneum*	Subterraneum clover	Moderate	✓	
**Ursinia anthemoides*	Ursinia	Moderate	✓	
**Ornithopus compressus*	Yellow serradella	Mild		
**Oxalis corniculata*	Yellow wood sorrel	Mild		
**Oxalis glabra*		Mild		
**Oxalis pes-caprae*	Sour sob	Mild		
**Petrorhagia dubia*	Velvet pink	Mild		
**Acacia iteaphylla*	Flinders Range wattle	Low		
**Cotula turbinata*	Funnel weed	Low		
**Lolium perenne*	Perennial rye grass	Low		
**Trifolium angustifolium*		Low		
**Erica* sp.	Erica	Cultivated		
**Rosmarinus officinalis*		Cultivated		
**Westringia fruticosa*	Westringia	Cultivated		

4.5 Significant Species

Species of flora are defined as rare or priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Conservation and Land Management recognised these threats of extinction and consequently applied regulations towards population and species protection. Rare Flora are gazetted under subsection 2 of section 23F of the Wildlife Conservation Act (1950) and therefore it is an offence to "take" or damage rare flora without approval from the Minister for the Environment.

Table 5. Code and description of Rare and Priority Flora categories

Code	Code Declared Rare and Priority Flora Categories
R	DRF (Declared Rare Flora) -Extant Taxa. Taxa, which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection.
X	DRF (Declared Rare Flora) -Presumed Extinct Taxa. Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently.
1	Priority One -Poorly Known Taxa. Taxa, which are known from one or a few (generally <5) populations, which are under threat.
2	Priority Two -Poorly Known Taxa. Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat.
3	Priority Three -Poorly Known Taxa. Taxa, which are known from several populations, at least some of which are not believed to be under immediate threat.
4	Priority Four -Rare Taxa. Taxa which are considered to have been adequately surveyed and which whilst being rare, are not currently threatened by any identifiable factors.

Table 5 presents the definitions of Declared Rare and the four Priority Flora ratings under the Wildlife Conservation Act (1950) as extracted from Department of Conservation and Land Management (2005). Table 6 presents the definitions of the threatened species under the Environmental Protection and Diversity Conservation Act, 1999 (Environment Australia, 2005).

Table 6. Categories of Threatened Flora Species (Environmental Protection and Biodiversity Conservation Act, 1999)

Code	Code Declared Rare and Priority Flora Categories
Ex	Extinct Taxa which at a particular time if, at that time, there is no reasonable doubt that the last member of this species has died.
ExW	Extinct in the Wild Taxa which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
CE	Critically Endangered Taxa which at any particular time if, at that time, it is facing an extremely high rest of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
E	Endangered Taxa, which is not critically endangered, and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
V	Vulnerable Taxa which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
CD	Conservation Dependent Taxa which at a particular time if, at that time, the species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Prior to undertaking the field work a list of the known Declared Rare and Priority Flora for the coordinates, 33^0 32' - 33^0 36' S and 115^0 32' - 115^0 35' E was obtained from the Department of

Conservation and Land Management. This resulted in six Declared Rare Flora, 1 Priority 1 Flora, 3 Priority 2 Flora, 13 Priority 3 Flora and 6 Priority 4 Flora. These species are listed in Table 7 together with a brief description of the plant.

Table 7. Declared Rare and Priority Flora recorded for the Capel area

SPECIES	CODE	DESCRIPTION
Caladenia busselliana	R	Tuberous, perennial, herb, 0.2–0.3 m high. Fl. green, yellow, cream, Sep–Oct. Sandy loam. Winter-wet swamps.
Caladenia huegelii	R	Tuberous, perennial, herb, 0.25–0.6 m high. Fl. green, cream, red, Sep–Oct. Grey or brown sand, clay loam.
Chamelaucium roycei ms	R	Bushy shrub, 0.3–1.5 m high. Fl. white, pink, Aug–Dec. Sandy clay, clay, lateritic soils. Winter-wet flats, swamps, stream banks.
Diuris drummondii	R	Tuberous, perennial, herb, 0.5–1.05 m high. Fl. yellow, Nov–Jan. Low-lying depressions, swamps.
Drakaea elastica	R	Tuberous, perennial, herb, 0.12–0.3 m high. Fl. red, green, yellow, Oct–Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps.
Verticordia densiflora var. *pedunculata*	R	Erect to spreading shrub, 0.3–0.6 m high. Fl. pink, white, Dec–Jan. Grey/yellow sand, sandy loam. Winter-wet low-lying areas.
Amperea micrantha	2	Low, spreading, bushy perennial, herb, 0.1–0.3 m high. Fl. brown, Oct–Nov. Sandy soils.
SPECIES	**CODE**	**DESCRIPTION**
Mitreola minima	2	Slender, erect annual, herb, 0.025–0.04 m high. Fl. white, Oct–Dec. Grey sand. Peaty swampy areas.
Trichocline sp. Treeton (B.J. Keighery & N. Gibson 564)	2	Tuberous, perennial, herb, to 1.6 m high. Sand over limestone, sandy clay over ironstone. Seasonally wet flats.
Acacia semitrullata	3	Slender, erect, pungent shrub, (0.1–)0.2–0.7(–1.5) m high. Fl. cream, white, May–Oct. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas.
Boronia tetragona	3	Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink, red, Oct–Dec. Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland.
Chamaescilla gibsonii	3	Clumped tuberous, herb. Fl. blue, Sep. Clay to sandy clay. Winter-wet flats, shallow water-filled claypans.
Chordifex gracilior	3	Rhizomatous, erect perennial, herb, 0.3–0.5 m high. Fl. brown, Sep–Dec. Peaty sand. Swamps.
Eryngium ferox ms	3	Erect, open tuberous, herb, 0.1–0.3 m high. Fl. green, Nov. Grey to brown loamy to sandy clay, brown cracking clay. Winter-wet flats, swamps, dried claypans, ridges.
Isopogon formosus subsp. *dasylepis*	3	Low, bushy or slender, upright, non-lignotuberous shrub, 0.2–2 m high. Fl. pink, purple, red, Jun–Dec. Sand, sandy clay, gravelly sandy soils over laterite. Often swampy areas.
Lasiopetalum membranaceum	3	Multi-stemmed shrub, 0.2–1 m high. Fl. pink, blue, purple, Sep–Dec. Sand over limestone.
Pultenaea pinifolia	3	Erect, slender shrub, 1–3 m high. Fl. yellow, orange, Oct–Nov. Loam or clay. Floodplains, swampy areas.
Rhodanthe pyrethrum	3	Erect, slender annual, herb, 0.05–0.2 m high. Fl. white, yellow, Oct–Dec. Clay, sandy clay. Winter-wet depressions, clay pans, swamps.
Stylidium leeuwinense	3	Erect perennial, herb, to 0.45 m high, leaves appressed, tile-

		like, spiral, lacking mucro. Fl. red, purple, Feb–May. Black sandy soil. Swampy heathland.
Synaphea hians	3	Prostrate or decumbent shrub, 0.15–0.6 m high, to 1 m wide. Fl. yellow, Jul–Nov. Sandy soils. Rises.
Tetratheca parvifolia	3	Small shrub, 0.2–0.3 m high. Fl. pink, Oct.
Verticordia attenuata	3	Shrub, 0.4–1 m high. Fl. pink, Dec–May. White or grey sand. Winter-wet depressions.
Acacia flagelliformis	4	Rush-like, erect or sprawling shrub, 0.3–0.75(–1.6) m high. Fl. yellow, May–Sep. Sandy soils. Winter-wet areas.
Anthotium junciforme	4	Open, erect to prostrate perennial, herb, 0.05–0.4 m high, leaves linear to terete, 0.5–1 mm wide; flowering stems 12–40 cm long. Fl. blue, violet, purple, Nov–Mar. Sandy clay, clay. Winter-wet depressions, drainage lines.
Aponogeton hexatepalus	4	Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white, Jul–Oct. Mud. Freshwater: ponds, rivers, claypans.
Caladenia speciosa	4	Tuberous, perennial, herb, 0.35–0.6 m high. Fl. white, pink, Sep–Oct. White, grey or black sand.
Franklandia triaristata	4	Erect, lignotuberous shrub, 0.2–1 m high. Fl. white, cream, yellow, brown, purple, Aug–Oct. White or grey sand.
Thysanotus glaucus	4	Caespitose, glaucous perennial, herb, 0.1–0.2 m high. Fl. purple, Oct–Mar. White, grey or yellow sand, sandy gravel.

No Declared Rare or Priority Flora were located during the survey although considerable time was spent searching areas in the better condition. Declared Rare and Priority Flora had previously been located in similar vegetation units, but where the soil was moister

4.6 Capel River Vegetation

As a Foreshore Management Plan was requested by the Environmental Protection Authority (2005) an opportunistic list of species from several areas was recorded. Most of the river foreshore is degraded but there were occasional patches of vegetation in better condition. The section of the river below the dam on the property surveyed included the largest number of native taxa and was in the better condition. Appendix B lists the species located during the survey.

The tree canopy was generally in excellent condition and is the necessary habitat for many of the listed native taxa. There were occasional large patches of Maiden hair fern (*Adiantum aethiopicum*), which is not the form in cultivation in home gardens. Some areas of the river itself had a reasonable cover of sedges, which varied according to the dampness of the soil where they occurred. *Baumea articulatum* and *Lepidosperma effusum* occurred on the edge of the river where the soil was permanently moist. The *Juncus* species and *Baumea juncea* grew higher up the bank where the soil was not constantly damp.

Most of the bank was covered in a dense grassland or herbland of weeds, four of which are rated by CALM as high (Department of Conservation and Land Management, 1999). These weeds are ensuring that the river bank is not being eroded and should not be removed unless a rehabilitation plan is to be introduced. Weed removal and planting of trees, shrubs etc need to be undertaken concurrently to ensure the stability of the banks and the health of the river.

5. EPA REQUIREMENTS

The Environmental Protection Authority (EPA) required that Guidance Statement 10 (Environmental Protection Authority, 2003) be followed to assess the environmental potential of the area. The points are addressed below.

- The site is in the vegetation complex, Southern River of which 7% of the pre-1750 area remains as bushland in Swan Coastal Plain and 11% of the original area within the Bunbury Greater Region. This is below the 30% required by the EPA.
- The vegetation units in good to degraded and completely degraded condition are proposed to be developed for housing. The remnant vegetation in very good condition is not to be developed.
- There were no Declared Rare or Priority Flora recorded from the site.
- A total of 41 vascular plant families, 111 genera and 145 taxa were recorded from the site, of which 34 taxa were not endemic.
- The tree canopy of the remnant bushland was highly modified with only small areas of the original canopy cover remaining. Plantings of non-endemic trees has occurred over many years.
- The area of remnant bushland proposed for development is less than the Urban Bushland Strategy's lowest preferred area limit of 20ha (EPA, 2003).
- The remnant vegetation is of an irregular shape. Elongate remnants are stated by the EPA (2003) to have value as connecting links, but the more extended are the remnants the greater their susceptibility to weed invasion and disturbance.
- There is limited linkage with adjoining vegetation to the Capel River. The other linkage is with paddocks developed as pasture. There are therefore limited possibilities to develop 'linkage areas' through the restoration of ecological communities.
- The land is currently used for cattle grazing.
- The EPA is guided by the following points when an area is selected:
  A large remnant is preferable to a small one – the site is less than the preferred 20ha;
  A compact shape is preferred - the site is an irregular shape; and
  the site is an isolated area, with limited potential to be linked to other natural areas.

6. DISCUSSION

Only a section of the property surveyed is proposed for development, most is to be retained for its present use. The remnant vegetation in the better condition, close to the current home, is to be retained and is not included in the proposed development. This area is presently fenced to exclude stock.

The area proposed for development is adjacent to current housing development on the western side of the survey area. The remnant vegetation in that area varied from good to degraded and included many pasture cleared areas. Although the vegetation unit is representative of Southern River Complex of which less than the required 30% remains it is in poor condition and development should be allowed. The owner should be encouraged to continue enhancing the remnant bushland close to the house, which he has fenced from stock. This area had the vegetation in the best condition.

None of the vegetation units identified at the site were Threatened Ecological Communities and no Declared Rare or Priority Flora were recorded during the survey.

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APPENDIX A

Quadrat Data

LEGEND

sp.	Species, used where plants cannot be identified beyond genus
subsp.	Subspecies
var.	Variety
affin.	Closest to that species
Hybrid	Where 1 or more species have interbred, often under cultivation
*	Introduced species, weed
ms	Manuscript name, as yet the name has not been published

QUADRAT CAP1

Location: Adjacent to the house
Datum: Easting - 367394 Northing – 6285641
Soil type: Brown sandy loam
Topography: Above Capel River
Field Vegetation Description: Open Woodland of *Corymbia calophylla* over Very Open Low Woodland of *Agonis flexuosa* var. *flexuosa* over lower storey of mixed species, including weeds
Vegetation Condition: 4 - 5
Other Notes: Most of the **Asparagus asparagoides* plants have rust on the leaves

TAXA	HEIGHT (cm)	% COVER
Agonis flexuosa var. *flexuosa*	1400	2
**Asparagus asparagoides*	Twiner	1
Austrostipa tenuifolia	90	5
Briza maxima	10	1
Caesia micrantha	70	1
Cheilanthes austrotenuifolia	30	<1
Conostylis aculeata	25	1
Corymbia calophylla	1400	70
Dichopogon preissii	15	5
Drosera stolonifera subsp. *stolonifera*	15	2
Hardenbergia comptoniana	Twiner	5
Hibbertia hypericoides	25	1

Hypocalymma robusta	50	1
**Hypochaeris glabra*	5	1
Kennedia prostrata	5	1
Kunzea glabrescens	120	1
Leucopogon propinquus	25	1
**Oxalis glabra*	5	5
Sowerbaea laxiflora	30	1
Tetraria octandra	70	5
Tetrarrhena laevis	15	5
Tricoryne elatior	70	<1
Xanthorrhoea preissii	90	1
**Acacia iteaphylla*	Opportunistic	
**Avena barbata*	Opportunistic	
Bossiaea linophylla	Opportunistic	
Cyathochaeta avenacea	Opportunistic	
Daviesia physodes	Opportunistic	
**Erica* sp.	Opportunistic	
**Freesia* hybrid	Opportunistic	
Lepidosperma squamatum	Opportunistic	
Macrozamia riedlei	Opportunistic	
Orthrosanthus laxus	Opportunistic	
**Oxalis corniculata*	Opportunistic	
Phyllanthus calycinus	Opportunistic	
**Rosmarinus officinalis*	Opportunistic	
**Sonchus oleraceus*	Opportunistic	
**Sparaxis bulbillifera*	Opportunistic	
Stypandra glauca	Opportunistic	
**Westringia fruticosa*	Opportunistic	
**Zantedeschia aethiopica*	Opportunistic	

QUADRAT CAP2

Location: Fenced area to the west of the house
Datum: Easting - 367393 Northing – 6285477
Soil type: Grey sand
Topography: Upper slope
Field Vegetation Description: Very Open Woodland of *Eucalyptus marginata* subsp. *marginata* and *Corymbia calophylla* over Very Open Low Woodland of *Xylomelum occidentale* and *Kunzea glabrescens* over Open Low Shrubland dominated by *Hibbertia hypericoides*
Vegetation Condition: 3
Other Notes: Previously grazed but now fenced by owner. In some sections the *Kunzea glabrescens* cover was 10-20%. Owner has planted into this area

TAXA	HEIGHT (cm)	% COVER
Acacia stenoptera	30	<1
Adenanthos meisneri	40	2
Agonis flexuosa var. *flexuosa*	1000	5
Anigozanthos manglesii	90	1
Astroloma pallidum	20	1
Bossiaea eriocarpa	40	1
**Briza maxima*	10	5
Burchardia umbellata	70	1
Caladenia flava	10	<1
Chamaescilla corymbosa	10	3
Conostephium pendulum	30	1
Conostylis aculeata subsp. *aculeata*	20	1
Craspedia uniflora	90	1
Dasypogon bromeliifolius	15	3

Daviesia physodes	120	3
Desmocladus fascicularis	15	2
Drosera pallida	Twiner	<1
Drosera stolonifera subsp. *stolonifera*	15	1
Eucalyptus marginata subsp. *marginata*	1200	5
Gompholobium capitatum	25	<1
Hibbertia hypericoides	60	40
Hibbertia racemosa	30	1
Hovea trisperma	40	<1
Hypocalymma robusta	70	2
Jacksonia sparsa	120	1
Kunzea glabrescens	400	5
Lagenophora huegelii	40	3
Laxmannia minor	20	3
Lomandra nigricans	40	<1
Lyginia barbata	70	5
**Petrorhagia dubia*	40	<1
Philotheca spicatus	50	2
Phlebocarya ciliata	20	<1
Phyllanthus calycinus	50	<1
Poa drummondiana	70	<1
Pterostylis vittata	70	<1
Pyrorchis nigricans	5	1
Sowerbaea laxiflora	60	1
Stylidium amoenum	40	1
Stylidium brunonianum	20	<1
Stylidium piliferum	15	1
Trachymene pilosa	10	<1
Tripterococcus brunonis	70	1
Xylomelum occidentale	800	5
Acacia extensa	Opportunistic	
Acacia huegelii	Opportunistic	
**Acacia iteaphylla*	Opportunistic	
Agrostocrinum scabrum	Opportunistic	
Allocasuarina humilis	Opportunistic	
**Anagallis arvensis* var. *arvensis*	Opportunistic	
**Asparagus asparagoides*	Opportunistic	
Austrodanthonia acerosa	Opportunistic	
Austrostipa campylachne	Opportunistic	
Austrostipa tenuifolia	Opportunistic	
**Avena barbata*	Opportunistic	
Banksia attenuata	Opportunistic	
**Briza minor*	Opportunistic	
**Bromus diandrus*	Opportunistic	
Caesia micrantha	Opportunistic	
Cartonema philydroides	Opportunistic	
Centrolepis glabra	Opportunistic	
Corymbia calophylla	Opportunistic	

**Cotula turbinata*	Opportunistic	
Crassula colorata	Opportunistic	
**Crassula glomerata*	Opportunistic	
**Disa bracteata*	Opportunistic	
Drosera erythrorhiza	Opportunistic	
**Ehrharta calycina*	Opportunistic	
**Ehrharta longiflora*	Opportunistic	
Elythranthera brunonis	Opportunistic	
Eriochilus dilatata	Opportunistic	
Gompholobium tomentosum	Opportunistic	
Hemiandra pungens	Opportunistic	
Hypolaena exsulca	Opportunistic	
Isolepis marginata	Opportunistic	
Jacksonia furcellata	Opportunistic	
Kennedia prostrata	Opportunistic	
Lepidosperma squamatum	Opportunistic	
Leucopogon propinquus	Opportunistic	
Lomandra hermaphrodita	Opportunistic	
Lomandra purpurea	Opportunistic	
Macrozamia riedlei	Opportunistic	
Melaleuca thymoides	Opportunistic	
Microtis media	Opportunistic	
Monotaxia huegelii	Opportunistic	
Nuytsia floribunda	Opportunistic	
**Orobanche minor*	Opportunistic	
Orthrosanthus laxus	Opportunistic	
Patersonia umbrosa subsp. *umbrosa*	Opportunistic	
Petrophile linearis	Opportunistic	
Phyllangium paradoxum	Opportunistic	
Podolepis suaveolens	Opportunistic	
**Romulea rosea*	Opportunistic	
Scaevola calliptera	Opportunistic	
**Sonchus oleraceus*	Opportunistic	
**Sparaxis bulbillifera*	Opportunistic	
Stirlingia latifolia	Opportunistic	
Stylidium calcaratum	Opportunistic	
Stylidium schoenoides	Opportunistic	
Tetraria octandra	Opportunistic	
Tetrarrhena laevis	Opportunistic	
Thelymitra crinita	Opportunistic	
Thelymitra sp.	Opportunistic	
Thysanotus patersonii	Opportunistic	
**Trifolium angustifolium*	Opportunistic	
**Ursinia anthemoides*	Opportunistic	
**Watsonia bulbillifera*	Opportunistic	
Xanthosia huegelii	Opportunistic	

QUADRAT CAP3

Location: Adjacent to house
Datum: Easting - 367443 Northing – 6285521
Soil type: Pale grey sand
Topography: Upper slope
Field Vegetation Description: Open Woodland of *Banksia attenuata* and *Kunzea glabrescens* over Herbland of *Dasypogon bromeliifolius*
Vegetation Condition: 4
Other Notes: Small section only on the house side of CAP2

TAXA	HEIGHT (cm)	% COVER
Acacia huegelii	30	1
Austrostipa compressa	20	3
Banksia attenuata	1000	30
**Briza maxima*	20	50
Burchardia umbellata	90	5
Caladenia flava	15	1
Chamaescilla corymbosa	10	3
Conostylis aculeata	25	1
Dasypogon bromeliifolius	50	10
Dichopogon preissii	50	3
**Disa bracteata*	20	1
Drosera erythrorhiza	5	1
Drosera pallida	Twiner	<1

Hibbertia hypericoides	50	1
**Hypochaeris glabra*	5	10
Jacksonia furcellata	40	1
Jacksonia sparsa	50	1
Kunzea glabrescens	1000	35
Lyginia barbata	70	4
Microtis media	30	<1
Pyrorchis nigricans	5	1
**Romulea rosea*	25	10
Sowerbaea laxiflora	50	3
**Ursinia anthemoides*	40	5
Xanthosia huegelii	25	<1
Agonis flexuosa var. *flexuosa*	Opportunistic	
Austrostipa campylachne	Opportunistic	
Banksia grandis	Opportunistic	
Bossiaea eriocarpa	Opportunistic	
Gompholobium capitatum	Opportunistic	
Hypocalymma robusta	Opportunistic	
Kennedia prostrata	Opportunistic	
Lepidosperma squamatum	Opportunistic	
Petrophile linearis	Opportunistic	
Phlebocarya ciliata	Opportunistic	
Pteridium esculentum	Opportunistic	
Stirlingia latifolia	Opportunistic	
Tripterococcus brunonis	Opportunistic	

QUADRAT CAP4

Location: Paddock above the river
Datum: Easting - 367641 Northing – 6285534
Soil type: River loam
Topography: Middle slope
Field Vegetation Description: Woodland of *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* over Grassland of weeds
Vegetation Condition: 5-6

TAXA	HEIGHT (cm)	% COVER
Agonis flexuosa var. *flexuosa*	1200	0-50
**Avena barbata*	100	60
**Bromus diandrus*	70	20
Corymbia calophylla	1400	0-40
**Cynodon dactylon*	5	60
**Hordeum leporinum*	20	3
**Sparaxis bulbillifera*	40	5
**Lolium perenne*	Opportunistic	
**Trifolium subterraneum*	Opportunistic	
**Anagallis arvensis* var. *arvensis*	Opportunistic	
**Arctotheca calendula*	Opportunistic	
**Asparagus asparagoides*	Opportunistic	
Banksia attenuata	Opportunistic	

Banksia ilicifolia	Opportunistic	
**Briza maxima*	Opportunistic	
**Briza minor*	Opportunistic	
**Cotula turbinata*	Opportunistic	
**Crassula glomerata*	Opportunistic	
**Disa bracteata*	Opportunistic	
**Ehrharta calycina*	Opportunistic	
**Ehrharta longiflora*	Opportunistic	
Eucalyptus marginata subsp. *marginata*	Opportunistic	
**Hypochaeris glabra*	Opportunistic	
Melaleuca preissiana	Opportunistic	
**Oxalis glabra*	Opportunistic	
**Oxalis pes-caprae*	Opportunistic	
**Petrorhagia dubia*	Opportunistic	
**Romulea rosea*	Opportunistic	
**Sonchus oleraceus*	Opportunistic	
**Trifolium angustifolium*	Opportunistic	
**Ursinia anthemoides*	Opportunistic	
Xylomelum occidentale	Opportunistic	

QUADRAT CAP5

Location: On north western side of the property
Datum: Easting - 366843 Northing – 6285508
Soil type: Grey sand
Topography: Flat
Field Vegetation Description: Woodland of *Eucalyptus marginata* subsp. *marginata* and *Banksia attenuata* over Tall Shrubland of *Kunzea glabrescens* over Very Open Low Shrubland of mixed species
Vegetation Condition: 4-5
Other Notes: Cattle graze area. Along the edge of the paddock *Corymbia calophylla* over weeds

TAXA	HEIGHT (cm)	% COVER
Acacia huegelii	20	5
**Arctotheca calendula*	15	2
Banksia attenuata	800	15
Burchardia umbellata	70	1
Caesia micrantha	30	<1
Caladenia flava	10	<1
Caladenia latifolia	30	<1
Chamaescilla corymbosa	15	<1
Dasypogon bromeliifolius	20	3
Daviesia physodes	70	1
Eucalyptus marginata subsp. *marginata*	800	15
Hibbertia hypericoides	30	1

**Hypochaeris glabra*	5	20
Jacksonia furcellata	120	1
Jacksonia sparsa	80	1
Kunzea glabrescens	400	10
Lagenophora huegelii	20	<1
Laxmannia minor	10	3
Melaleuca thymoides	110	3
Nuytsia floribunda	700	5
**Ornithopus compressus*	10	<1
**Romulea rosea*	30	40
Stylidium brunonianum	25	1
Stylidium calcaratum	5	<1
Stylidium piliferum	15	1
**Ursinia anthemoides*	40	1
Acacia stenoptera	Opportunistic	
Agonis flexuosa var. *flexuosa*	Opportunistic	
Amperea simulans	Opportunistic	
Austrodanthonia acerosa	Opportunistic	
Austrostipa tenuifolia	Opportunistic	
Banksia grandis	Opportunistic	
Banksia ilicifolia	Opportunistic	
**Briza maxima*	Opportunistic	
Conostylis aculeata	Opportunistic	
Corymbia calophylla	Opportunistic	
Craspedia uniflora	Opportunistic	
Crassula colorata	Opportunistic	
Dampiera linearis	Opportunistic	
Daviesia preissii	Opportunistic	
Desmocladus fascicularis	Opportunistic	
**Disa bracteata*	Opportunistic	
Drosera stelliflora	Opportunistic	
Drosera stolonifera subsp. *stolonifera*	Opportunistic	
Elythranthera brunonis	Opportunistic	
Hemiandra pungens	Opportunistic	
Hibbertia racemosa	Opportunistic	
Lepidosperma squamatum	Opportunistic	
Lomandra hermaphrodita	Opportunistic	
Lyginia barbata	Opportunistic	
**Orobanche minor*	Opportunistic	
Petrophile linearis	Opportunistic	
**Petrorhagia dubia*	Opportunistic	
Phlebocarya ciliata	Opportunistic	
Phyllangium paradoxum	Opportunistic	
Pterostylis recurva	Opportunistic	
Pyrorchis nigricans	Opportunistic	
**Sonchus oleraceus*	Opportunistic	
Stylidium carnosum	Opportunistic	
Stylidium repens	Opportunistic	

Stylidium schoenoides	Opportunistic	
Thelymitra sp.	Opportunistic	
Thysanotus patersonii	Opportunistic	
Thysanotus thyrsoideus	Opportunistic	
Xylomelum occidentale	Opportunistic	

APPENDIX B

Taxa Recorded from Banks of Capel River

LEGEND

sp.	Species, used where plants cannot be identified beyond genus
subsp.	Subspecies
var.	Variety
affin.	Closest to that species
Hybrid	Where 1 or more species have interbred, often under cultivation
*	Introduced species, weed
ms	Manuscript name, as yet the name has not been published

No quadrat was monitored on the bank of the Capel River. A species list was prepared as the Environmental Protection Authority (2005) required that a Management Plan be prepared for the Capel River foreshore.

Above are two photographs taken to illustrate some of the variation noted along the bank of the river where it adjoins the property surveyed.

FAMILY	TAXA	CALM RATING WEEDS
ADIANTACEAE	*Adiantum aethiopicum*	
ARACEAE	**Zantedeschia aethiopica*	High
ASPARAGACEAE	**Asparagus asparagoides*	High
ASTERACEAE	*Sonchus hydrophilus*	
CENTROLEPIDIACEAE	*Centrolepis glabra*	
CYPERACEAE	**Carex divisa*	Moderate
	Baumea articulata	
	Baumea juncea	
	Isolepis setiformis	
	Lepidosperma effusum	
	Lepidosperma tetraquetrum	
DENNSTAEDTIACEAE	*Pteridium esculentum*	
IRIDACEAE	**Sparaxis bulbillifera*	High
JUNCACEAE	**Juncus articulatus*	
	Juncus gregiflorus	
LOBELIACEAE	*Lobelia alata*	
MIMOSACEAE	*Acacia pulchella*	
	Paraserianthes lophantha subsp. *lophantha*	
MYRTACEAE	*Agonis flexuosa* var. *flexuosa*	
	Astartea affin. *fascicularis*	
	Corymbia calophylla	
	Eucalyptus rudis	
OXALIDACEAE	**Oxalis pes-caprae*	Mild
	**Oxalis purpurea*	Mild
PAPILIONACEAE	*Callistachys lanceolata*	
	Chorizema cordatum	
	Kennedia prostrata	
POACEAE	**Bromus diandrus*	High
	**Cynodon dactylon*	Moderate
	**Ehrharta longiflora*	Moderate
	**Pennisetum clandestinum*	Moderate
	**Poa annua*	Mild
RANUNCULACEAE	**Ranunculus muricatus*	Low

Taxa listed here are not included in the main body of the report as the Capel River was outside of the survey brief.

APPENDIX C

Taxa listed under vegetation units

LEGEND

ABBREVIATION	DESCRIPTION
AfHh	Low Woodland A of *Eucalyptus marginata* subsp. *marginata, Agonis flexuosa* var. *flexuosa, Corymbia calophylla* and *Xylomelum occidentale* over Open Scrub of *Kunzea glabrescens* over Low Heath D dominated by *Hibbertia hypericoides* over Very Open Low Grass and Very Open Low Sedges
BaMt	Low Forest B of *Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Kunzea glabrescens* over Open Low Scrub B of *Melaleuca thymoides* over Herbs dominated by **Romulea rosea* and **Hypochaeris glabra* and/or Low Grass of **Briza maxima*
CcAf	Open Low Woodland A to Low Forest A of *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* over Tall Grass of **Avena barbata* over Low Grass of **Cynodon dactylon*
sp.	Species, used where plants not flowering
*	weed
subsp.	subspecies
var.	variety
affin.	closest to the species listed
?	unsure if this is the correct species as the plant was not flowering or fruiting
hybrid	not a naturally occurring species

FAMILY	TAXA	AfHh	BaMt	CcAf
ADIANTACEAE	*Cheilanthes austrotenuifolia*	+		
ANTHERICACEAE	*Agrostocrinum scabrum*	+		
	Caesia micrantha	+	+	
	Chamaescilla corymbosa	+	+	
	Dichopogon preissii	+	+	
	Laxmannia minor	+	+	
	Sowerbaea laxiflora	+	+	
	Stypandra glauca	+		
	Thysanotus patersonii	+	+	
	Thysanotus thyrsoideus		+	
	Tricoryne elatior	+		
APIACEAE	*Trachymene pilosa*	+		
ARACEAE	**Zantedeschia aethiopica*	+		
ASPARAGACEAE	**Asparagus asparagoides*	+		+
ASTERACEAE	**Arctotheca calendula*		+	+
	**Cotula turbinata*	+		+
	Craspedia uniflora	+	+	
	**Hypochaeris glabra*	+	+	+
	Lagenophora huegelii	+	+	
	Podolepis suaveolens	+		
	**Sonchus oleraceus*	+	+	+
	**Ursinia anthemoides*	+	+	+
CARYOPHYLLACEAE	**Petrorhagia dubia*	+	+	+
CASUARINACEAE	*Allocasuarina humilis*	+		
CENTROLEPIDACEAE	*Centrolepis glabra*	+		
COLCHICACEAE	*Burchardia umbellata*	+	+	
COMMELINACEAE	*Cartonema philydroides*	+		
CRASSULACEAE	*Crassula colorata*	+	+	
	**Crassula glomerata*		+	+
CYPERACEAE	*Cyathochaeta avenacea*	+		
	Isolepis marginata	+		
	Lepidosperma squamatum	+	+	
	Tetraria octandra	+		
DASYPOGONACEAE	*Dasypogon bromeliifolius*	+	+	
	Lomandra hermaphrodita	+	+	
	Lomandra nigricans	+		
	Lomandra purpurea	+		
DENNSTAEDTIACEAE	*Pteridium esculentum*		+	
DILLENIACEAE	*Hibbertia hypericoides*	+	+	
	Hibbertia racemosa	+	+	
DROSERACEAE	*Drosera erythrorhiza*	+	+	
	Drosera pallida	+	+	
	Drosera stelliflora		+	
	Drosera stolonifera subsp. *stolonifera*	+	+	

FAMILY	TAXA	AfHh	BaMt	CcAf
EPACRIDACEAE	*Astroloma pallidum*	+		
	Conostephium pendulum	+		
	Leucopogon propinquus	+		
ERICACEAE	**Erica* sp.	+		
EUPHORBIACEAE	*Amperea simulans*		+	
	Monotaxis huegelii	+		
	Phyllanthus calycinus	+		
GOODENIACEAE	*Dampiera linearis*		+	
	Scaevola calliptera	+		
HAEMODORACEAE	*Anigozanthos manglesii*	+		
	Conostylis aculeata subsp. *aculeata*	+	+	
	Phlebocarya ciliata	+	+	
IRIDACEAE	**Freesia* hybrid	+		
	Orthrosanthus laxus	+		
	Patersonia umbrosa subsp. *umbrosa*	+		
	**Romulea rosea*	+	+	+
	**Sparaxis bulbillifera*	+		+
	**Watsonia bulbillifera*	+		
LAMIACEAE	**Rosmarinus officinalis*	+		
	**Westringia fruticosa*	+		
	Hemiandra pungens	+	+	
LOGANIACEAE	*Phyllangium paradoxum*	+	+	
LORANTHACEAE	*Nuytsia floribunda*	+	+	
MIMOSACEAE	*Acacia extensa*	+		
	Acacia huegelii	+	+	
	**Acacia iteaphylla*	+		
	Acacia stenoptera	+	+	
MYRTACEAE	*Agonis flexuosa* var. *flexuosa*	+	+	+
	Corymbia calophylla	+		+
	Eucalyptus marginata subsp. *marginata*	+	+	+
	Hypocalymma robusta	+	+	
	Kunzea glabrescens	+	+	
	Melaleuca preissiana			+
	Melaleuca thymoides	+	+	
ORCHIDACEAE	*Caladenia flava*	+	+	
	Caladenia latifolia		+	
	**Disa bracteata*	+	+	+
	Elythranthera brunonis	+	+	
	Eriochilus dilatata	+		
	Microtis media	+	+	
	Pterostylis recurva		+	
	Pterostylis vittata	+		
	Pyrorchis nigricans	+	+	
	Thelymitra crinita	+		
	Thelymitra sp.	+	+	
OROBANCHACEAE	**Orobanche minor*	+	+	

FAMILY	TAXA	AfHh	BaMt	CcAf
OXALIDACEAE	**Oxalis corniculata*	+		
	**Oxalis glabra*	+		+
	**Oxalis pes-caprae*			+
PAPILIONACEAE	*Bossiaea eriocarpa*	+	+	
	Bossiaea linophylla	+		
	Daviesia physodes	+	+	
	Daviesia preissii		+	
	Gompholobium capitatum	+	+	
	Gompholobium tomentosum	+		
	Hardenbergia comptoniana	+		
	Hovea trisperma	+		
	Jacksonia furcellata	+	+	
	Jacksonia horrida		+	
	Kennedia prostrata	+	+	
	**Ornithopus compressus*		+	
	**Trifolium angustifolium*	+		+
	**Trifolium subterraneum*			+
POACEAE	**Avena barbata*	+		+
	Austrodanthonia acerosa	+	+	
	Austrostipa campylachne	+	+	
	Austrostipa compressa		+	
	Austrostipa tenuifolia	+	+	
	**Briza maxima*	+	+	+
	**Briza minor*	+		+
	**Bromus diandrus*	+		+
	**Cynodon dactylon*			+
	**Ehrharta calycina*	+		+
	**Ehrharta longiflora*	+		+
	**Hordeum leporinum*			+
	**Lolium perenne*			+
	Poa drummondiana	+		
	Tetrarrhena laevis	+		
PRIMULACEAE	**Anagallis arvensis* var. *arvensis*	+		+
PROTEACEAE	*Adenanthos meisneri*	+		
	Banksia attenuata	+	+	+
	Banksia grandis		+	
	Banksia ilicifolia		+	+
	Petrophile linearis	+	+	
	Stirlingia latifolia	+	+	
	Xylomelum occidentale	+	+	+
RESTIONACEAE	*Hypolaena exsulca*	+		
	Lyginia barbata	+	+	
	Desmocladus fascicularis	+	+	
RUTACEAE	*Philotheca spicatus*	+		
STACKHOUSIACEAE	*Tripterococcus brunonis*	+	+	

FAMILY	TAXA	AfHh	BaMt	CcAf
STYLIDIACEAE	*Stylidium amoenum*	+		
	Stylidium brunonianum	+	+	
	Stylidium calcaratum	+	+	
	Stylidium carnosum		+	
	Stylidium piliferum	+	+	
	Stylidium repens		+	
	Stylidium schoenoides	+	+	
XANTHORRHOEACEAE	*Xanthorrhoea preissii*	+		
	Xanthosia huegelii	+	+	
ZAMIACEAE	*Macrozamia riedlei*	+		

APPENDIX D

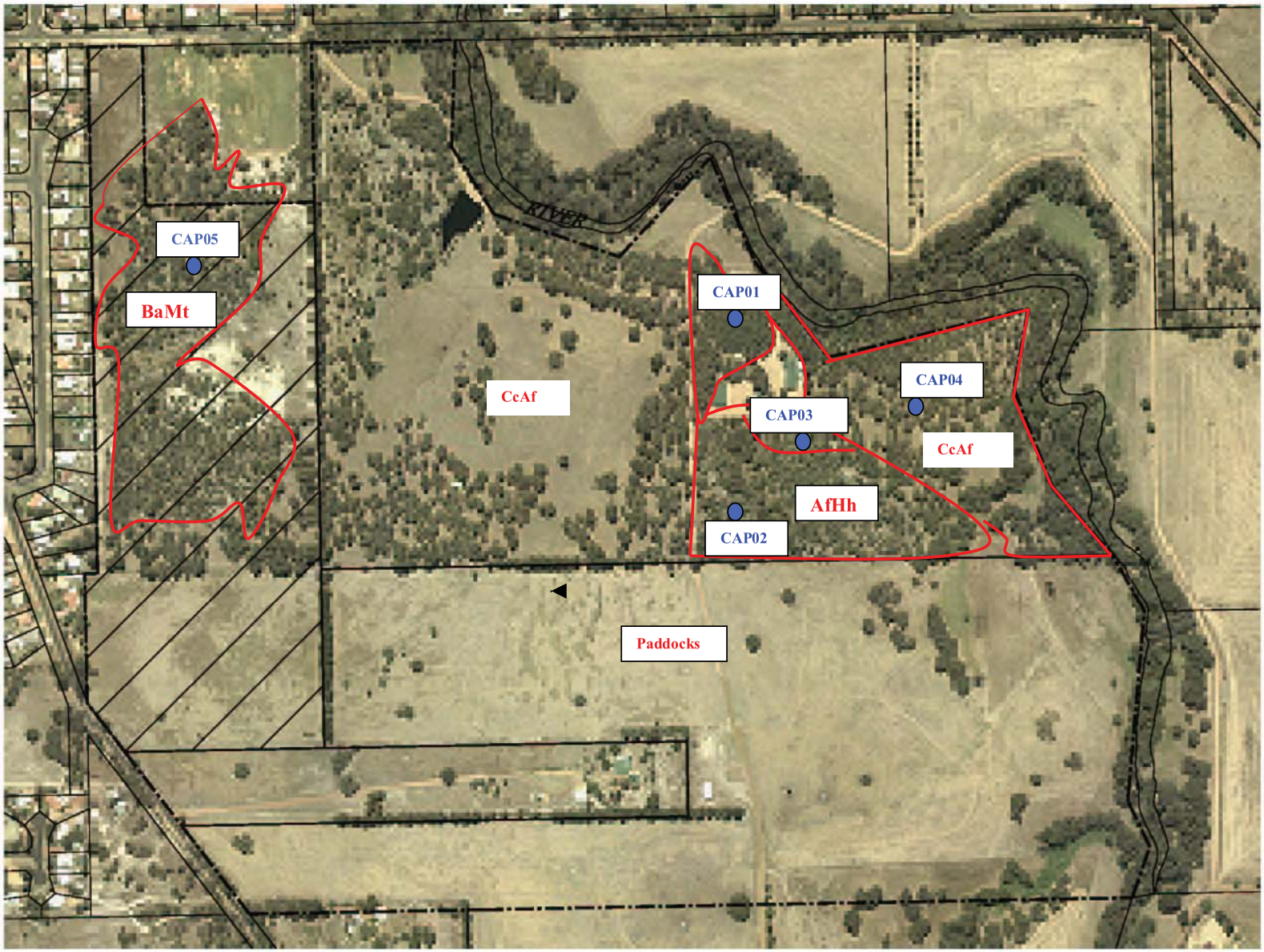
Maps

1. Location of Quadrats and Vegetation Units
2. Remnant Vegetation
3. Vegetation Condition

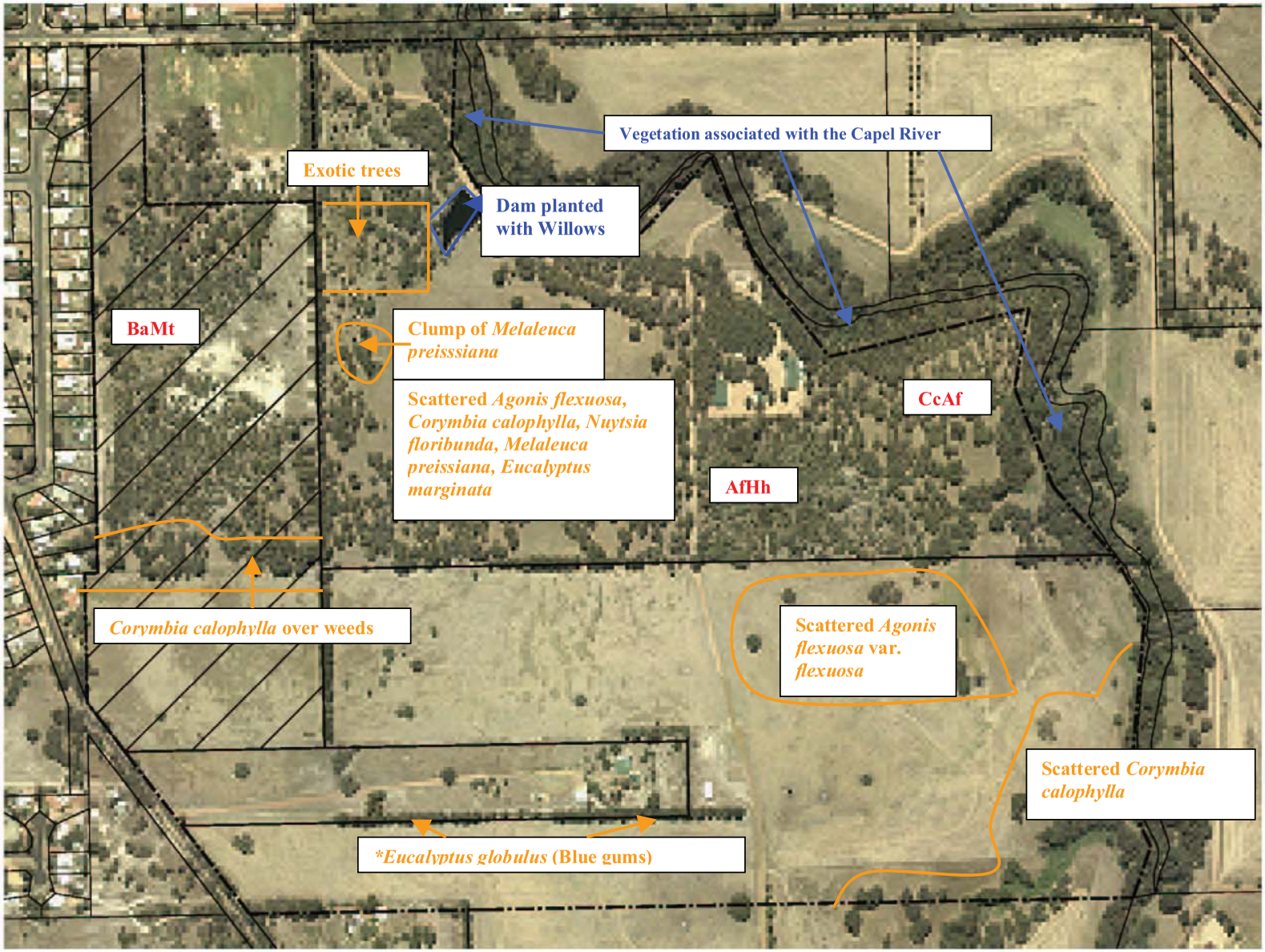
LEGEND

ABBREVIATION	DESCRIPTION
AfHh	Low Woodland A of *Eucalyptus marginata* subsp. *marginata, Agonis flexuosa* var. *flexuosa, Corymbia calophylla* and *Xylomelum occidentale* over Open Scrub of *Kunzea glabrescens* over Low Heath D dominated by *Hibbertia hypericoides* over Very Open Low Grass and Very Open Low Sedges
BaMt	Low Forest B of *Eucalyptus marginata* subsp. *marginata, Banksia attenuata* and *Kunzea glabrescens* over Open Low Scrub B of *Melaleuca thymoides* over Herbs dominated by **Romulea rosea* and **Hypochaeris glabra* and/or Low Grass of **Briza maxima*
CcAf	Open Low Woodland A to Low Forest A of *Corymbia calophylla* and *Agonis flexuosa* var. *flexuosa* over Tall Grass of **Avena barbata* over Low Grass of **Cynodon dactylon*
3	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
4	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.
5	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.
6	Completely degraded

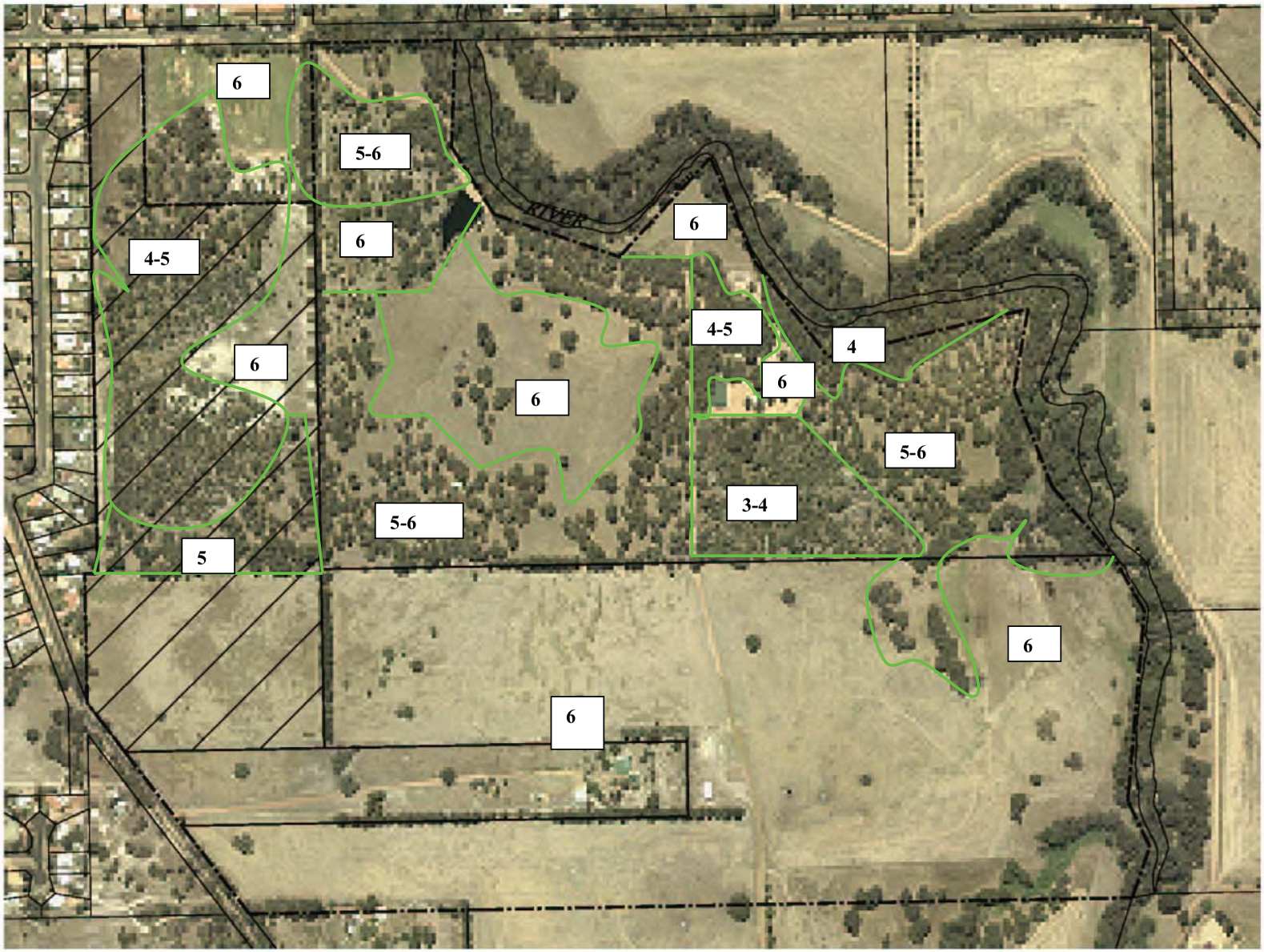
Map 1. Location of quadrats (blue) and vegetation units (red). Hatched area only to be developed.



Map2. Remnant vegetation



Map 3. Vegetation Condition



APPENDIX 3:

Capel Western Ringtail Possum Management Report

Western Ringtail Possum

(*Pseudocheirus occidentalis*)

Management Plan

Lot 1, Lot 300, Lot 301 & Pt Loc 2426

(Wellington Land District)

CAPEL

JULY 2010

Version 4

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DISCLAIMER

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The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

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The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

1. INTRODUCTION

This following Western Ringtail Possum (WRP - *Pseudocheirus occidentalis)* Management Plan has been prepared for Lots 1, 300, 301 and Pt Loc 2426 Capel. The development site is centred on approximately 33.562596° S and 115.569943° E (GDA94) (Figure 1) and has a total area of about 78ha.

The proposal area was previously identified as containing WRP habitat and WRP individuals (Harewood 2005). Where potential impact on Western Ringtail Possum habitat is anticipated developers are required, as part of the planning approval process (via the Western Australian Planning Commission - WAPC), to prepare a WRP management/mitigation plan. Advice on acceptable management measures is provided to the WAPC and proponents by the Department of Environment and Conservation (DEC).

Western Ringtail Possums are listed as specially protected (Schedule 1 - Fauna that is rare or is likely to become extinct) under the Western Australian Wildlife Conservation Act (*WC Act 1950*) and as threatened (Vulnerable) under the federal Environment Protection and Biodiversity Conservation Act (*EPBC Act 1999*). The species distribution has reduced dramatically since European settlement for a number of reasons. Currently, in the general south west area, ongoing loss of habitat is the main threatening process. The management strategies adopted to help maintain the existing populations in the region are aimed at minimising the impact of all types of land development on WRP populations.

Projects that are likely to have a significant impact on WRPs may also require referral to the federal Department of Environment, Water, Heritage and the Arts (DEWHA) for review and approval to ensure compliance with the EPBC Act.

1.1 DEVELOPMENT PROPOSAL

It is proposed to subdivide the existing lots into a numerous smaller lots at densities ranging from R20 to R2.5 including two “Conservation Lots”. About 20.9 ha (~27%) of the site will be retained as Public Open Space (POS, including a Foreshore and Drainage Reserve (Figure 3).

No other development plans currently exist though it can be assumed that subsequent to subdivision approval houses/buildings will be constructed on some or all of the lots over time. This construction along with associated infrastructure will potentially require the clearing of vegetation, some of which represents existing WRP habitat.

The development of the site has been subdivided into Stages, numbered 1 to 4 as shown in Figure 3. The stages correspond to the existing lot boundaries, details of which are provided in Table 1 below.

Table 1: Development Staging and Areas

Stage	Lot Number	Area (ha)
1	300	15.178
2	1	4.688
3	Pt 2426	30.027
4	301	28.086
Total		77.979

1.2 SCOPE OF WORKS

The WRP management plan is required to build upon initial recommendations made within the Level 1 fauna assessment report completed on November 2005 (Harewood 2005).

The main aims of the management plan are to detail how habitat loss and development impact upon WRPs is to be managed and mitigated through both the site works process and in the long term. Consideration will also be given to the intended role of the foreshore reserve as an ecological corridor. In addition to the DEC, the management plan must also suit requirements of the Shire of Capel.

The DEC have indicated what matters needed to be addressed, if possible, in WRP management plans (DEC 2009). These are:

- WRP and drey locations (from previous surveys);
- How clearing will occur;
- Contractor undertaking clearing;
- Scheduling of clearing;
- How WRP will be managed during clearing including details of planned retention, natural dispersal or translocation; and.
- What monitoring is to occur and the timeframe it will be undertaken.
- Details on landscaping/revegetation that will offset WRP habitat loss.

The WRP assessment reported on as part of this management plan has followed closely the recommended procedures and requirements of DEC's Development Planning Guidelines for WRPs (DEC 2009). The aim of the survey work was to determine as accurately as possible the number and distribution of WRPs utilising the area to allow the determination of the potential impact of the proposed development and enable recommendations for development planning and WRP management to be formulated.

The assessments have included:

- Two daytime surveys to locate and record dreys (and other potential Daytime refuge sites), scats and individual WRPs;
- Determination of the amount and quality of WRP habitat on site and adjacent areas;
- Data and photographs of the current WRP habitat extent and quality;
- Land tenure of adjacent and nearby WRP habitat;
- Identification of potential habitat linkages within the proposed development site and with adjacent or nearby habitat;
- Three night time surveys to locate and record the distribution and abundance of WRPs within the study area;

1.3 FIELD SURVEY METHODOLOGY

Diurnal inspections of the site were carried out with the principal aim of documenting the habitat type with respect to its suitability for WRPs, while at the same time recording of the location of dreys or other potential sites for refuge and actual WRP individuals. Photographs representing typical vegetation at the site were also taken. The diurnal searches involved a series of close spaced traverses on foot using a GPS for guidance and as a data recorder.

The abundance of scats was recorded under the canopy of potential foraging habitat along each traverse. At each point about a minute was spent searching for WRP scats. Locations where only a few scats were observed (say 1 to 5) were rated as low density. Scat abundance above this was rated at high density. This is a somewhat subjective analysis and is also affected by groundcover (e.g. dense grass can hide scats). Despite these limitations the data was collected to provide additional data to help determine usage patterns across the site.

The nocturnal counts involved systematic searching of the site by way of close spaced traverses on foot, using a head torch (with 6V incandescent bulb) with the aim of detecting individual WRPs or their eye shine. The nocturnal counts were carried out using a GPS for guidance and as a data recorder.

2. WRP SURVEY CONSTRAINTS

The effectiveness of survey work will vary from site to site and can be dependent on factors such as the total area surveyed, topography, access, location, vegetation type and density, weather, the season in which the survey work was undertaken, equipment used and the experience of the person carrying out the survey. Results obtained for some sites can be complicated by the fact that a proportion of the WRPs can have home ranges that cross one or more lot boundaries and significant variations in nocturnal counts may reflect this. There is also an element of luck involved in detecting possums. The consequences of identified survey limitations should however be considered in the context within which the results will be used.

The assessment reported on here has included two diurnal inspections to categorise vegetation and search for evidence of WRPs and three, non-consecutive nocturnal counts aimed at locating WRPs within the development site. Some of the trees on site appear to contain hollows or other features suitable for WRPs to use for daytime refuge, it is however not possible to detect all these features from ground level. The potential exists for some of the WRPs identified on site during the nocturnal counts to take refuge during the day in vegetation located off site, as suitable habitat is present in adjoining areas, especially along the Capel River. The number of WRPs observed represents the minimum number of WRPs that were using the site for some purpose at the time of each survey.

The aim of the survey work reported on here was to provide sufficient information to allow for an assessment of the impact of the development on WRPs utilising the site. It is the Author's opinion, taking into account the limitations encountered, that the survey was conducted to a standard suitable for its intended use and complies with the requested scope of works.

3. WESTERN RINGTAIL POSSUM ASSESSMENT

3.1 WESTERN RINGTAIL POSSUM HABITAT

3.1.1 WRP Habitat within Development Site

The vegetation within the development site was examined on the 1st November, 2005 and again on the 16th of April, 2009.

The extent of the broadly defined fauna habitats within the study area are shown in Figure 4 with a description of each given below. More specific detail on the composition of each bush remnant can be found within the flora report (BEC 2006).

1. **Marri *(Corymbia calophylla*) Open Woodland:** Parkland cleared Marri is present over areas of pasture in the northern half of the study area. Most trees are relatively young and contain no hollows. Occasional Peppermints, Banksia, Flooded Gum and *Nuytsia floribunda* are also present. This area of vegetation represents dispersal and marginal foraging/refuge habitat for WRPs. Quality is generally marginal due to lack of species diversity, understory and wide spacing's between trees. Canopy coverage in areas of Marri Open Woodland ranges from 0% to 40% (BEC 2006).

2. **Peppermint (*Agonis flexuosa)* Open Woodland:** Several small patches of Peppermint dominated, parkland cleared woodland are present in certain areas of the property. Most have a limited extent but still provides potential Western Ringtail Possum habitat. No understorey is present and a groundcover of grasses and weed species is present. Canopy coverage in areas of Peppermint Open Woodland ranges from 0% to 40% (BEC 2006).

3. ***Banksia attenuata* Open Woodland over *Kunzea glabrescens* and mixed low shrubs:** Present in two separate areas. The western area has been open to grazing and has, as a consequence, a degraded understorey. The eastern area has been fenced from stock for some time and has denser understorey and leaf litter present. Also contains common emergent Jarrah (*Eucalyptus marginata)* with scattered Peppermint, *Nuytsia floribunda,* Woody Pear (*Xylomelum occidentale*) and rare Marri. Represents WRP habitat due to presence of a variety of known foraging species (e.g. Peppermint, Jarrah, *Nuytsia*, *Kunzea*) in addition to refuge and dispersal opportunities. Canopy coverage varies considerably. BEC notes canopy coverage of only 45% (for tree and tall shrub species) in Lot 300. Areas in Lot 301 with dense *Kunzea* had canopy coverage up to 65% though nearby areas with little *Kunzea* and sparse Jarrah and Marri fell to 20% (BEC 2006).

4. **Marri *(Corymbia calophylla*) and Peppermint (*Agonis flexuosa)* Open Woodland:** Consists of a combination of Marri and Peppermint trees in varying densities. Some areas parkland cleared while others (fenced areas) have groundcover and understorey. Occasional, Banksia, Flooded Gum (typically nearer the Capel River) and *Nuytsia floribunda* are also present. Represents WRP habitat due to presence of preferred foraging species (e.g. Peppermint and *Nuytsia*) in addition to refuge and dispersal

opportunities though quality varies. Canopy coverage of main tree species about 70% in area examined in detail (BEC 2006).

5. **Planted Eucalypts and other species:** Several windbreaks and areas of planted Eucalypts and other species of trees and shrubs (some endemic) are present around the study area. Maybe used in some cases for dispersal habitat but quality and/or location poor.

6. **Cleared Pasture –** Cleared farmland with a mixture of introduced pasture grasses, clovers, weeds and degraded sedgelands. This area also contains scattered trees of various species (*Agonis flexuosa, Corymbia calophylla, Eucalyptus* sp, *Melaleuca* sp. and exotics). These areas cannot be considered to represent WRP habitat.

3.1.2 WRP Habitats adjacent to Development Site

The extent of remnant vegetation adjacent to the study area is shown in Figure 1 and Figure 5. The most significant area of WRP habitat is represented by vegetation along the Capel River which borders the proposal area along its western side for about 1.5km.

The vegetation communities present along the Capel River are listed in the River Action Plan (RAP) prepared by Geocatch (1999). The native vegetation of the Capel River riparian zone is, due to intense historical disturbance, now generally limited to medium to large shrubs and larger trees. Native herbs and small shrubs are restricted to areas of little or no disturbance. The vegetation communities identified by Geocatch that are likely to occur along the Capel River adjacent to the study area include:

- Flooded Gum *Eucalyptus rudis* woodland over *Astartea fascicularis*, Swamp Peppermint *Agonis linearifolia* scrub.
- Marri *Corymbia calophylla* forest over soapbush *Trymalium floribundum*, heart-leaf poison *Gastrolobium bilobum* scrub, and sword-sedges *Lepidosperma spp*.
- Peppermint *Agonis flexuosa*, Marri *Corymbia calophylla* woodland.
- Freshwater paperbark *Melaleuca rhaphiophylla*, Flooded Gum *Eucalyptus rudis* open woodland.

The flora and vegetation assessment by BEC noted that most of the river foreshore is degraded but there were occasional patches of vegetation in better condition (BEC 2006). The section of the river below the dam on the property

surveyed included the largest number of native taxa and was in the better condition. The tree canopy was generally in excellent condition.

3.1.3 Habitat Linkages

Linkage between vegetation remaining in the northern section of the site is relatively continuous though its function in this regard has been compromised by sections of parkland cleared vegetation having common gaps in the canopy. In these areas transient WRPs would frequently need to come to ground to continue progress to suitable remnant habitat patches in certain directions.

The vegetation on site does not represent a significant linkage between potential WRP habitats in adjoining areas to the north, south or west as vegetation is not continuous outside of the study area in these directions. The most significant linkage in the general area is the Capel River of which the study site forms a node of WRP habitat (see Figure 5).

The Capel River is one of 16 ecological linkages identified by the EPA in its assessment of the Greater Bunbury Region Scheme (EPA 2003, WAPC 2000). In broadly identifying the various linkages the EPA took into consideration that the existing corridors of remnant vegetation could provide a focus for the restoration of ecological communities and landscape rehabilitation between and around the remaining remnants in this section of the Swan Coastal Plain.

The proposed foreshore reserve (Figure 3) will aid in the long term conservation of this section of the Capel River and ensure its function as an ecological linkage is maintained in line with the EPAs intentions. The proposed revegetation along the foreshore reserve will enhance its function as a significant ecological linkage in this section of the coastal plain.

3.2 DIURNAL SITE INSPECTIONS

A daytime survey of the site was conducted on foot on the 1st November, 2005 and again on the 16th of April, 2009. The aims of the surveys were to document the presence of dreys, hollows, scats and individual WRPs.

Observations made during the daytime surveys are shown in Figure 6 and 8. In total 10 dreys were located within the project area during the 2005 survey. An additional four dreys were located within the Capel River reserve directly adjacent to the study area boundary. Three WRPs were sighted during the day survey, one alive and two dead specimens (fox kills).

Seven dreys were found within the study area during the most recent day survey. Eight “habitat” trees were also observed that contain hollows that are potentially suitable for WRPs to use as day time refuges. It should be noted

that other hollows or similar features in trees may be present but were not detected. Some of the buildings on site may also be used for daytime refuge.

WRP scats found to be widespread across the study area in the areas of habitat most likely to be used by WRPs on a regular basis (Figure 8). Scats were typically absent or very hard to find in the parkland cleared Marri stands.

3.3 NOCTURNAL COUNTS

Night time surveys were carried out over the study area on the 1st November 2005, the 21st and 27th April, 2009. The nocturnal counts were carried out with the aim of documenting the distribution and abundance of WRPs within the study area.

Figure 7 shows the location of WRPs sightings made during the night survey carried out in 2005. Eight Western Ringtail Possums were located within the study area during the course of the night survey. A further eight were found within the Capel River reserve directly adjacent to the study area boundary. Seven Common Brushtail Possums were also observed within the area surveyed.

Figure 9 shows the location of WRPs sightings made during the night survey carried out on 21st April, 2009. Eleven WRPs were located within the bounds of the study area during the course of this night survey. Twenty Common Brushtail Possums were also observed inside the boundary (possibility that three individuals were counted twice – therefore possibly only 17).

Figure 10 shows the location of WRPs sightings made during the night survey carried out on 27th April, 2009. Twelve WRPs were located within the bounds of the study area during the course of this night survey. Fourteen Common Brushtail Possums were also observed inside the boundary.

3.4 WRP DISTRIBUTION AND ABUNDANCE

Based on the results it appears that at the time of the survey most recent surveys at least 12 WRPs were utilising the study area for some purpose. WRPs are favouring areas that contain a relatively diverse midstorey species of Peppermint, *Nuytsia* and/or *Kunzea* along with young Jarrah. Limited sightings of WRPs were made in the Marri Open Woodland which makes up a considerable portion of the remnant vegetation present. This is to be expected given its relatively open nature, discontinuous canopy and lack of favoured foraging species. WRPs will eat Marri but appear to target the other species listed above when present (G Harewood pers. obs.).

Density of WRPs within suitable habitat is estimated to be at least 1.25 WRPs/ha.

4. POTENTIAL IMPACTS

The most significant potential impacts on WRPs of any development are:

- Loss or modification of habitat that reduces the area available for use (this included foraging habitat and daytime refuge habitat);
- Fragmentation of habitat which inhibits the ability of WRPs to move through an area without coming to ground (i.e. loss or fragmentation of dispersal habitat);
- Altered fire regimes;
- Increased road deaths due additional traffic flow;
- Death or injury of WRPs during clearing and construction;
- Increased competition with the Common Brushtail Possums for foraging and refuge sites; and
- Increase in the number of domestic or feral predators.

The currently proposed subdivision plan is shown as Figure 3. No other development plans currently exist though it can be assumed that subsequent to subdivision approval houses/buildings will be constructed on some or all of the lots over time. Any construction will potentially require the clearing of vegetation, some of which represents existing WRP habitat.

As no development plans exist it is difficult to accurately determine the amount of WRP habitat that will be removed or retained when the entire site is ultimately developed. It can however be assumed that areas of POS will be retained as is, while roads and areas with designated R20, R30 and R40 densities will required total clearing. The proponent is aiming for the retention of at least 50% retention within the designated R2.5 areas (the larger "Conservation Lots" within Stage 4) and the proposed management plan reflects this intention.

Retention of vegetation within the R2.5 areas will be achieved by restricting clearing to pre-defined building envelopes. Additional clearing will only be allowed for compliance with bush fire regulations, construction of an access way or as otherwise approved by the Shire.

To provide an estimate of the maximum amount of WRP habitat that may be affected the extent of WRP habitat in each stage has been estimated and is detailed in Table 2 below. For the purpose of this estimate all native remnant vegetation is taken as representing potential WRP habitat (i.e. has some function as foraging and/or refuge and/or dispersal habitat). The quality of the habitat varies considerably and it could be argued that some areas do not represent WRP habitat or because of poor quality are rarely used. This however is difficult to quantify and also habitat not favoured by WRP (e.g. parkland cleared Open Marri Woodland) in this instance represents potential Black Cockatoo foraging habitat. Including all areas in the potential habitat loss estimates will make the overall assessment easier to interpret with the same net result for WRPs and Cockatoos.

The canopy cover figures have been calculated by outlining areas of vegetation, calculating areas and then assuming average canopy coverage of 60% (see BEC 2006 for specific canopy coverage percentages for vegetation units surveyed). These figures overestimate the canopy cover of WRP and Black Cockatoo habitat in most vegetated areas as typically canopy coverage is less than 60%.

Based on figures presented in Table 2 below it is estimated that a maximum of about 5.5 ha of WRP habitat will potentially be removed when the structure plan is implemented. There is scope for the retention of additional habitat within the R2.5 areas (i.e. conservation lots) and therefore habitat loss may actually be less than this figure. As mentioned not all of this vegetation represents ideal WRP habitat, but as poorer WRP habitat areas also represent Black Cockatoo foraging habitat they must be taken into account in any event.

Table 2: Stage/Lot areas and approximate WRP habitat loss/retention.

Stage	Lot	Total Area (ha)	~Area of Vegetation canopy (ha) (Assuming average 60% canopy coverage)	~Potential WRP Habitat Loss (ha)	~Potential WRP Habitat Retention (ha) (in POS or in Lots)	Comment
1	300	15.18	2.36	1.22	1.14	Assumed total clearing in development areas. Area of POS (~1.9 ha) contains WRP habitat.
2	1	4.69	0.0	0.0	0.0	
3	Pt 2426	30.03	0.42	0.20	0.22	Assumed total clearing in development areas. Areas of POS contain small amount of WRP habitat
4 (Conservation Lots)	301 (pt)	3.8	2.10	1.05	1.05	Aim is minimum 50% retention of existing vegetation.
4(Balance)	301 (pt)	24.29	8.62	3.06	5.56	Assumed total clearing in development areas. Areas of POS (~12.2ha) contains WRP habitat
Total		77.98	13.5	5.53	7.97	

5. PLANNING AND MANAGEMENT OPTIONS

Planning for the structure plan has taken into account the areas of best WRP habitat and smaller lots have in most instances been position over existing cleared areas or within vegetation unsuitable or marginal for WRPs (as foraging or refuge habitat). About 50% of the existing native remnant vegetation onsite will be retained within areas of POS.

It is understood that development of the proposal area is to occur in stages. The management of WRPs for each stage will vary depending on the anticipated impact on potential habitat and individuals. Some stages will have little or no impact on WRPs whatsoever (e.g. Stages 2 and 3) and management requirements will be minimal. The implementation of Stages 1 and 4 will result in the loss of some WRP habitat and the management plan aims to minimise this impact in the short term and offset it in the long term.

DEC will seek consideration by the developer to compensate for impacts on WRP that occur as part of a development. Where habitat loss is unavoidable it is generally required to be offset by the planting of replacement habitat, preferably at suitable locations within the subdivision itself. These offsets are to be consistent with the intent of the EPA draft Guidance Statement No.19 "Environmental Offsets" (EPA 2008) and DEWHA draft Policy Statement "Use of Environmental Offsets under the *EPBC Act 1999*" (DEWR 2007). It is anticipated that revegetation of sections of the site would also be made a condition of subdivision by the WAPC.

It should be noted that if significant impact on WRPs is deemed likely the project will require referral to the federal DEWHA to ensure compliance with the *EPBC Act 1999*. The DEWHA's primary concern with respect to listed threatened species such as the Western Ringtail Possum is habitat loss.

If the project is referred, the proponent will need to demonstrate that their project will not result in a net loss of WRP habitat if it is to gain approval. Management plans where the relocation/translocation of displaced WRPs to existing habitat is the only proposed mitigation will generally not be approved by the DEWHA. While not having a set policy of offset requirements the DEWHA are likely to request a replacement offset ratio of 3:1 for WRP habitat cleared.

6. WRP MANAGEMENT PLAN

The following management plan is largely based on DEC guidelines (DEC 2009).

The Proponent via a delegated Project Manager in charge of each stage of the development must liaise with the local DEC prior to commencement and post clearing.

The protocols detailed below assume that the translocation of individuals (i.e. removal of WRPs by DEC officers to a predetermined location, not in the vicinity of the project) has been deemed unnecessary and that individuals encountered can be herded or captured and moved short distances to suitable retained habitat (i.e. relocated). It is not known at this stage if this management option is acceptable to the DEC/DEWHA. It is however clear that for some stages little if any impact on WRPs or other fauna will occur (i.e. Stages 2 & 3).

The principal aims of the management plan outlined here is to ensure that WRP individuals are not injured or killed during site development and to reduce the potential for impact on habitat that is to be retained. Revegetation strategies are also detailed.

The management plan is comprised of the following main components

i) Contractor induction

ii) Vegetation retention

iii) Site clearing

iv) Post clearing report

v) Revegetation plan

6.1 CONTRACTOR INDUCTION

Management Strategies/Commitments

MS1 Prior to clearing, contractors will be provided with information to ensure compliance with all relevant sections of this management plan. This will include but will not be limited to details on trees that need to be retained/cleared and the likely presence and importance of Western Ringtail Possums within the site. All construction staff should be made aware that native fauna is protected. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.

6.2 VEGETATION RETENTION

Management Strategies/Commitments

MS2 Where possible retain and protect remnant vegetation on site that does not require clearing, including single, dead or isolated trees. During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained.

MS3 Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas, borrow pits etc so that previously disturbed areas are used where possible.

MS4 If reasonable and practical Contractors will be directed to:

a) Avoid impacts on tree roots – if feasible a ~3 m buffer around retained trees within which no soil disturbance can occur should be enforced;

b) Avoid branch pruning on trees that are to be retained (especially where canopy connection could be affected);

c) Avoid filling of more than a metre over pre-construction soil height around the base of trees.

MS5 Designation of building envelopes within areas designated as R2.5 density. Aim is to retain at least 50% of the vegetation in this area. No additional vegetation should be cleared within any of these allotments except for the purposes of:

a) Compliance with the requirements of the Bush Fires Act 1954 (as amended).

b) Clearing within the building envelope for a reasonable area for the construction of an approved dwelling or other building.

c) To construct an approved vehicular access.

d) For any other reason where specific written approval has first been obtained from the relevant governing body.

MS6 Building envelope selection should take into consideration the presence of hollow bearing trees, in particular those with large hollows potentially suitable for Black Cockatoos.

6.3 SITE CLEARING

Management Strategies/Commitments

MS7 **IMPORTANT: The Project Manager should Contact DEC on 9752 555 prior to any clearing commencing.** Contact with DEC should be made as soon as the date of commencement of site works is known so as to ensure the appropriate DEC personnel are notified i.e. District Manager or Planning Officer.

MS8 A suitable experienced "fauna spotter" (e.g. zoologist or fauna carer/rehabilitator) will be present on site at all times when clearing is being undertaken to supervise any animal handling and the capture of injured WRPs (and other fauna) if required.

The following clearing protocols (based on DEC recommended procedures) will be employed when and if considered relevant to the clearing/demolition task at hand.

MS9 All trees to be cleared will be inspected by the fauna spotter prior to the commencement of clearing so that appropriate methods can be

employed on trees containing or most likely to contain WRPs. Any understorey on site requiring clearing or that will be driven on will also be inspected for the presence of WRPs and Quendas.

MS10 Trees that are identified as containing WRPs may need to be left for a subsequent day when the tree may be vacant. Where possible clearing should be undertaken in a systematic manner that minimises disruption to WRPs. If there is suitable habitat adjoining the development site, a clearing pattern that encourages the movement of WRP to this habitat should be adopted.

MS11 Whether or not a Western Ringtail Possum is seen in a tree that is about to be cleared, all trees will be bumped or shaken firstly. Following this the operator and the fauna spotter will wait and observe the tree for a short time. If no WRP appears to be present then the tree will be removed, though at all times those present will remain alert to the fact that the possibility of undetected WRPs still being present remains and appropriate actions will need to be employed to ensure they are not injured.

MS12 In the event that a Western Ringtail Possum is observed in a tree that is about to be cleared and there is a tree marked for retention near the tree which is to be to be cleared then the tree will be gently lowered to the ground to enable the animal opportunity to safely evacuate. The animal/s will then be encouraged to move towards and occupy the tree that is to be retained.

MS13 If there are no trees to be retained within proximity of a tree that has a Western Ringtail Possum and it needs be cleared, then the fauna spotter will attempt to catch the animal prior to the tree being pushed down. Captured, uninjured animals should be relocated to the nearest area of suitable habitat to be retained.

MS14 Dreys will be inspected prior to clearing and possibly removed. Dreys that remain in the tree during clearing have to be checked as soon as possible as baby WRP may remain in the drey.

MS15 Stockpile practices. Cleared vegetation will not be stockpiled on site if possible. If due to logistical issues stockpiling is required, contractors involved in the removal of stockpiled material should be made aware that displaced Western Ringtail Possums may shelter within piles of vegetation and/or building material. Stockpile material should be removed in a manner that reduces the chance of injury to WRPs. If Western Ringtail Possums are found to be present in stockpiles the

fauna spotter on site should attempt to catch the animal and relocated it nearby. Dreys found should be removed from any trees that are to be stockpiled. If stockpiles are removed in the absence of the fauna spotter and a WRP is encountered then the DEC should be notified by those involved.

MS16 If practical, any chipping of cleared vegetation will be undertaken as far away from areas known to be utilised by WRPs as possible to minimise noise impacts. Where chipping will be undertaken over a number of days, it is preferred that the chipper remains in one position and vegetation is brought to the chipper as opposed to the chipper moving through the site. This is to consolidate the noise impacts in one area of the development site.

MS17 If contractors encounter injured WRP during clearing operations, then the fauna spotter will be notified immediately so that arrangements can be made for the welfare of the injured animal. The attending fauna spotter will:

a) have appropriate equipment to administer immediate emergency care to any injured/displaced WRP's (e.g. heat pack, box/cage, blankets).

b) have made prior arrangement with a carer who could care for/rehabilitate any injured animals in Busselton.

c) notify DEC's, Regional Wildlife Officer (Bunbury 9725 4300) and the DEC Busselton (Busselton 97 52 5555) of WRPs going into care.

6.4 POST CLEARING REPORT

Management Strategies/Commitments

MS18 The proponent will provide the DEC with a report (see appendix A) on the impact on WRP during the habitat removal process within 28 days of completion of each stage of clearing. This report is to detail the impact on WRP that occurred during clearing including:

- Date and times clearing was undertaken.
- Name of clearing contractor.
- Name of the suitably experienced “fauna spotter ”.

- Number of WRP Observed/Relocated.
- Location where removed WRP were relocated.
- Number of dreys observed/removed.
- Number of WRP injured/killed.
- Name of rehabilitator/veterinarian surgery who holds the injured WRP
- Was the management/mitigation plan objectives met?

6.5 REVEGETATION PLAN

It is anticipated that the developers will be required to offset any WRP habitat (area based on canopy coverage) lost due to development proceeding and is likely to be made a condition of subdivision by the WAPC. The exact extent of habitat that will require removal is unknown at this point in time but is estimated to be a maximum of about 5.5 ha (WRP and Black Cockatoo habitat combined). The exact offset requirement is also unknown at this stage. The revegetation plan should be in accordance, where possible with restoration principles outlined in Chapter 8 of the Capel River Action Plan (Geocatch 1999).

Management Strategies/Commitments

MS19 Identification/confirmation of areas of land within the POS and along road verges suitable for planting. Plantings should if possible be designed to provide links between existing vegetation and areas planned for revegetation.

MS20 Identification of suitable plant species with particular preference for species that will provide foraging and refuge habitat for WRPs (and foraging habitat for black cockatoos) Preferred foraging species for WRPs in this proposal area are Peppermint (*Agonis flexuosa*), Christmas Tree (*Nuytsia floribunda*), *Kunzea glabrescens and Jarrah (Eucalyptus. marginata).* Fast growing dense tall shrubs (e.g. some *Acacia* species) can provide good refuge habitat in the short term. Marri (*Corymbia calophylla*) and *Banksia* species are the main cockatoo foraging species present in the area and should also be a major component of any revegetation plan.

MS21 Weed control (pre-planting and seasonal spraying over three years).

MS22 Ripping and mounding of soil (typically in Autumn).

MS24 Planting (typically mid to late Winter) at a density of about 2,500 plants/ha (2 x 2m).

MS23 Maintenance of planted trees every three months in the first year and then biannually in years two and three.

MS24 Future landowners will be provided with information detailing the importance of Peppermint trees (Living with Possums pamphlet, Appendix B) for the continued survival of WRPs in the region and will be encourage to retain, maintain and/or plant Peppermint trees on their property where ever practical.

7. IMPLEMENTATION AND RESPONSIBILITIES

Table 3 summarises the management strategies and commitments from Section 6 that make up the WRP Management Plan. The Proponent (the owners of the land) will be responsible for the initial implementation of the management plan as well as the management and maintenance of any proposed revegetation for an agreed period of time (assumed at this stage to be 3 years).

Responsibilities for the implementation various sections of the Management Plan will be delegated to appointed sub-contractors at various stages, for example the Project Manager of each stage of the proposed subdivision will need to ensure clearing is carried out in accordance with the plan. Some sections will be the responsibility of the appointed fauna spotter. Despite this delegation of duties the Proponent still remains ultimately responsible and liable for non-conformance at any stage.

Some facets of the proposed revegetation strategies are illustrated in Figure 11.

Table 3: Summary of Management Commitments and Responsibilities

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Contractor Induction	**MS1** Prior to clearing, contractors will be provided with information to ensure compliance with all relevant sections of this management plan. All construction staff should be made aware that native fauna is protected. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.	Proponent/Project Stage Manager	Prior to commencement of any clearing operations	-
Vegetation Retention	**MS2** Where possible retain and protect remnant vegetation on site that does not require clearing, including single, dead or isolated trees. During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained	Proponent/Project Stage Manager	Prior to any site works	
	MS3 Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas, borrow pits etc so that previously disturbed areas are used where possible.	Proponent/Project Stage Manager	Prior to any site works	
	MS4 If reasonable and practical Contractors will be directed to: a) Avoid impacts on tree roots – if feasible a ~3 m buffer around retained trees within which no soil disturbance can occur should be enforced; b) Avoid branch pruning on trees that are to be retained (especially where canopy connection could be affected); **d)** Avoid filling of more than a metre over pre-construction soil height around the base of trees.	Proponent/Project Stage Manager	During site works	
	MS5 Designation of building envelopes within areas designated as R2.5 density. Aim is to retain at least 50% of the vegetation in this area. No additional vegetation should be cleared within any of these allotments except for the purposes of: a) Compliance with the requirements of the Bush Fires Act 1954 (as amended). b) Clearing within the building envelope for a reasonable area for the construction of an approved dwelling or other building. c) To construct an approved vehicular access. d) For any other reason where specific written approval has first been obtained from the relevant governing body	Proponent/Planner passed onto Landowner upon sale	Prior to site works but ongoing	Shire of Capel, DEC
	MS6 Building envelope selection should take into consideration the presence of hollow bearing trees, in particular those with large hollows potentially suitable for Black Cockatoos	Proponent/Planner	Prior to site works	Shire of Capel, DEC, Zoologist

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Site Clearing	**MS7** IMPORTANT: The Project Manager should Contact DEC on 9752 555 prior to any clearing commencing. Contact with DEC should be made as soon as the date of commencement of site works is known so as to ensure the appropriate DEC personnel are notified i.e. District Manager or Planning Officer	Proponent/Project Stage Manager	Prior to site works	
	MS8 A suitable experienced "fauna spotter" (e.g. zoologist or fauna carer/rehabilitator) will be present on site at all times when clearing is being undertaken to supervise any animal handling and the capture of injured WRPs (and other fauna) if required.	Proponent/Project Stage Manager	During site works	DEC
	MS9 All trees to be cleared will be inspected by the fauna spotter prior to the commencement of clearing so that appropriate methods can be employed on trees containing or most likely to contain WRPs. Any understorey on site requiring clearing or that will be driven on will also be inspected for the presence of WRPs and Quendas.	Proponent/Project Stage Manager/Fauna Spotter	Prior to and during site works	
	MS10 Trees that are identified as containing WRPs may need to be left for a subsequent day when the tree may be vacant. Where possible clearing should be undertaken in a systematic manner that minimises disruption to WRPs. If there is suitable habitat adjoining the development site, a clearing pattern that encourages the movement of WRP to this habitat should be adopted.	Proponent/Project Stage Manager/Fauna Spotter	During site works	
	MS11 Whether or not a Western Ringtail Possum is seen in a tree that is about to be cleared, all trees will be bumped or shaken firstly. Following this the operator and the fauna spotter will wait and observe the tree for a short time. If no WRP appears to be present then the tree will be removed, though at all times those present will remain alert to the fact that the possibility of undetected WRPs still being present remains and appropriate actions will need to be employed to ensure they are not injured.	Proponent/Project Stage Manager/Fauna Spotter	During site works	
	MS12 In the event that a Western Ringtail Possum is observed in a tree that is about to be cleared and there is a tree marked for retention near the tree which is to be to be cleared then the tree will be gently lowered to the ground to enable the animal opportunity to safely evacuate. The animal/s will then be encouraged to move towards and occupy the tree that is to be retained.	Proponent/Project Stage Manager/Fauna Spotter	During site works	
	MS13 If there are no trees to be retained within proximity of a tree that has a Western Ringtail Possum and it needs be cleared, then the fauna spotter will attempt to catch the animal prior to the tree being pushed down. Captured, uninjured animals should be relocated to the nearest area of suitable habitat to be retained.	Proponent/Project Stage Manager/Fauna Spotter	During site works	

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Site Clearing	**MS14** Dreys will be inspected prior to clearing and possibly removed. Dreys that remain in the tree during clearing have to be checked as soon as possible as baby WRP may remain in the drey.	Proponent/Project Stage Manager/Fauna Spotter	Prior to and during site works	
	MS15 Stockpile practices. Cleared vegetation will not be stockpiled on site if possible. If due to logistical issues stockpiling is required, contractors involved in the removal of stockpiled material should be made aware that displaced WRPs may shelter within piles of vegetation and/or building material. Stockpile material should be removed in a manner that reduces the chance of injury to WRPs. If WRPs are found to be present in stockpiles the fauna spotter on site should attempt to catch the animal and relocated it nearby. Dreys found should be removed from any trees that are to be stockpiled. If stockpiles are removed in the absence of the fauna spotter and a WRP is encountered then the DEC should be notified by those involved.	Proponent/Project Stage Manager/Fauna Spotter	During site works	
	MS16 If practical, any chipping of cleared vegetation will be undertaken as far away from areas known to be utilised by WRPs as possible to minimise noise impacts. Where chipping will be undertaken over a number of days, it is preferred that the chipper remains in one position and vegetation is brought to the chipper as opposed to the chipper moving through the site. This is to consolidate the noise impacts in one area of the development site.	Proponent/Project Stage Manager/Fauna Spotter	During site works	
	MS17 If contractors encounter injured WRP during clearing operations, then the fauna spotter will be notified immediately so that arrangements can be made for the welfare of the injured animal. The attending fauna spotter will: a) have appropriate equipment to administer immediate emergency care to any injured/displaced WRP's (e.g. heat pack, box/cage, blankets). b) have made prior arrangement with a carer who could care for/rehabilitate any injured animals in Busselton. **c)** notify DEC's, Regional Wildlife Officer (Bunbury 9725 4300) and the DEC Busselton (Busselton 97 52 5555) of WRPs going into care.	Proponent/Project Stage Manager/Fauna Spotter	During site works	DEC
Post Clearing Report	**MS18** The proponent will provide the DEC with a report (see appendix A) on the impact on WRP during the habitat removal process within 28 days of completion of each stage of clearing.	Proponent/Project Stage Manager/Fauna Spotter	Within 28 days of completion of each stage of clearing	

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Revegetation Plann	**MS19** Identification or confirmation of areas of land within the POS and along road verges suitable for planting. Plantings should if possible be designed to provide links between existing vegetation and/or areas planned for revegetation.	Proponent	Prior to and during site development	Shire of Capel, DEC, GeoCatch
	MS20 Identification of suitable plant species with particular preference for species that will provide foraging and refuge habitat for WRPs (and foraging habitat for black cockatoos) Preferred foraging species for WRPs in this proposal area are Peppermint (*Agonis flexuosa*), Christmas Tree (*Nuytsia floribunda*), *Kunzea glabrescens* and Jarrah (*Eucalyptus. marginata*). Fast growing dense tall shrubs (e.g. some *Acacia* species) can provide good refuge habitat in the short term. Marri (*Corymbia calophylla*) and Banksia species are the main cockatoo foraging species present in the area and should also be a major component of any revegetation plan.	Proponent	Prior to and during site development	Shire of Capel, DEC, GeoCatch, Landcare specialists
	MS21 Weed control (pre-planting and seasonal spraying over three years).	Proponent	Prior to and during site development – 3 year monitoring period	GeoCatch, Landcare specialists
	MS22 Ripping and mounding of soil (typically in Autumn)	Proponent	Prior to and during site development	GeoCatch, Landcare specialists
	MS23 Planting (typically mid to late Winter) at a density of about 2,500 plants/ha (2 x 2m).	Proponent	Prior to and during site development	GeoCatch, Landcare specialists
	MS24 Maintenance of planted trees every three months in the first year and then biannually in years two and three.	Proponent	Prior to and during site development – 3 year monitoring period	GeoCatch, Landcare specialists
	MS25 Future landowners will be provided with information detailing the importance of Peppermint trees (Living with Possums pamphlet, Appendix B) for the continued survival of WRPs in the region and will be encourage to retain, maintain and/or plant Peppermint trees on their property where ever practical.	Proponent then Landowner	Time of property purchase	DEC

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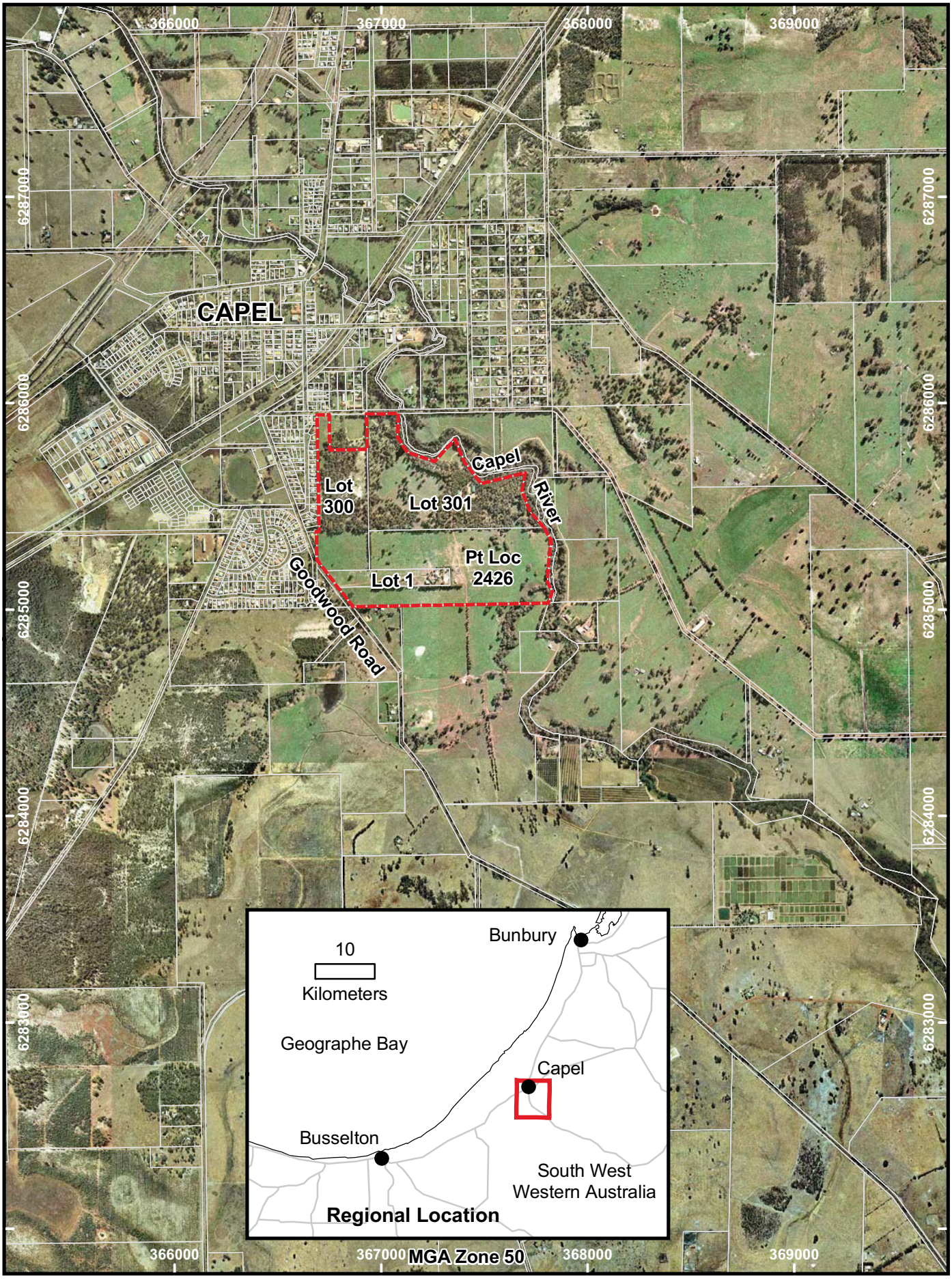
FIGURES



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary

N

0 50 100 150 200

Meters

WRP Assessment

DRAWN:G Harewood

DATE : Apr 2009

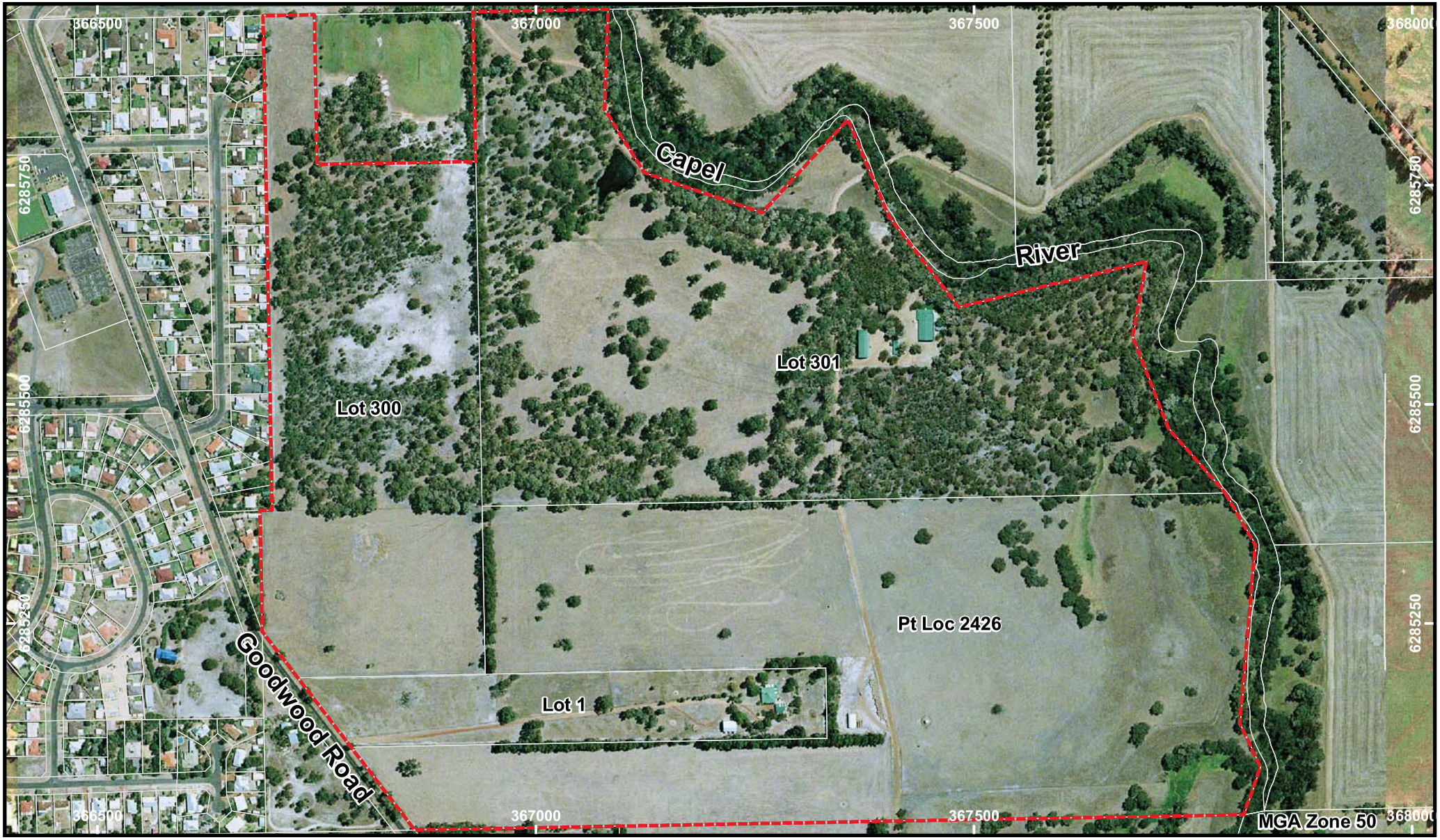
SCALE: 1: 25,000

Air Photo Date 2002

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Study Area and Surrounds

Figure: 1



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary

N

0 100 200 300 400 500

Metres

WRP Assessment

DRAWN:G Harewood

DATE : Apr 2009

SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Air Photo Study Area

Figure: 2

ENDORSED STRUCTURE PLAN - SHIRE OF CAPEL
To provide an framework for the future detailed planning at the subdivision and development stage.

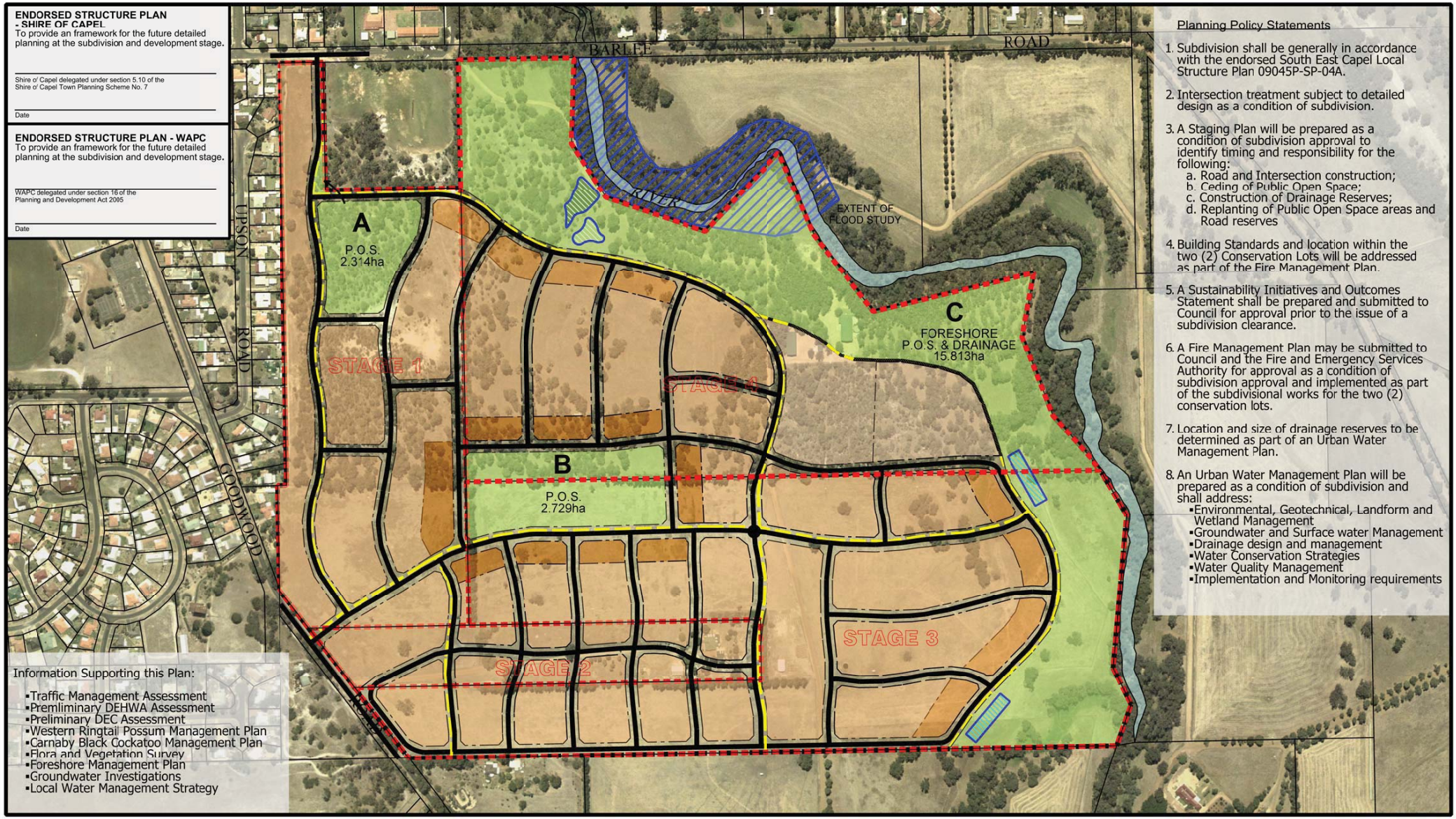
Shire of Capel delegated under section 5.10 of the Shire of Capel Town Planning Scheme No. 7

Date

ENDORSED STRUCTURE PLAN - WAPC
To provide an framework for the future detailed planning at the subdivision and development stage.

WAPC delegated under section 16 of the Planning and Development Act 2005

Date



Planning Policy Statements

1. Subdivision shall be generally in accordance with the endorsed South East Capel Local Structure Plan 09045P-SP-04A.
2. Intersection treatment subject to detailed design as a condition of subdivision.
3. A Staging Plan will be prepared as a condition of subdivision approval to identify timing and responsibility for the following:
   a. Road and Intersection construction;
   b. Ceding of Public Open Space;
   c. Construction of Drainage Reserves;
   d. Replanting of Public Open Space areas and Road reserves
4. Building Standards and location within the two (2) Conservation Lots will be addressed as part of the Fire Management Plan.
5. A Sustainability Initiatives and Outcomes Statement shall be prepared and submitted to Council for approval prior to the issue of a subdivision clearance.
6. A Fire Management Plan may be submitted to Council and the Fire and Emergency Services Authority for approval as a condition of subdivision approval and implemented as part of the subdivisional works for the two (2) conservation lots.
7. Location and size of drainage reserves to be determined as part of an Urban Water Management Plan.
8. An Urban Water Management Plan will be prepared as a condition of subdivision and shall address:
   - Environmental, Geotechnical, Landform and Wetland Management
   - Groundwater and Surface water Management
   - Drainage design and management
   - Water Conservation Strategies
   - Water Quality Management
   - Implementation and Monitoring requirements

Information Supporting this Plan:

- Traffic Management Assessment
- Premliminary DEHWA Assessment
- Preliminary DEC Assessment
- Western Ringtail Possum Management Plan
- Carnaby Black Cockatoo Management Plan
- Flora and Vegetation Survey
- Foreshore Management Plan
- Groundwater Investigations
- Local Water Management Strategy

STRUCTURE PLAN
Wellington Lots 300, 301, 1 & Pt Loc 2426 Capel

- SUBJECT LAND
- STAGE BOUNDARIES
- EXISTING CADASTRE
- CONTOURS
- STRATEGIC FIREBREAK/ WALK TRAIL (4M)
- 1:100 YEAR FLOOD PLAIN
- CAPEL RIVER
- INDICATIVE DRAINAGE RESERVE LOCATIONS
- CATCHMENT BOUNDARY
- DUAL USE PATH

62.5m 0 125 250m
1 : 2500 @ A1 or 1 : 5000 @ A3
ALL DISTANCES ARE IN METRES

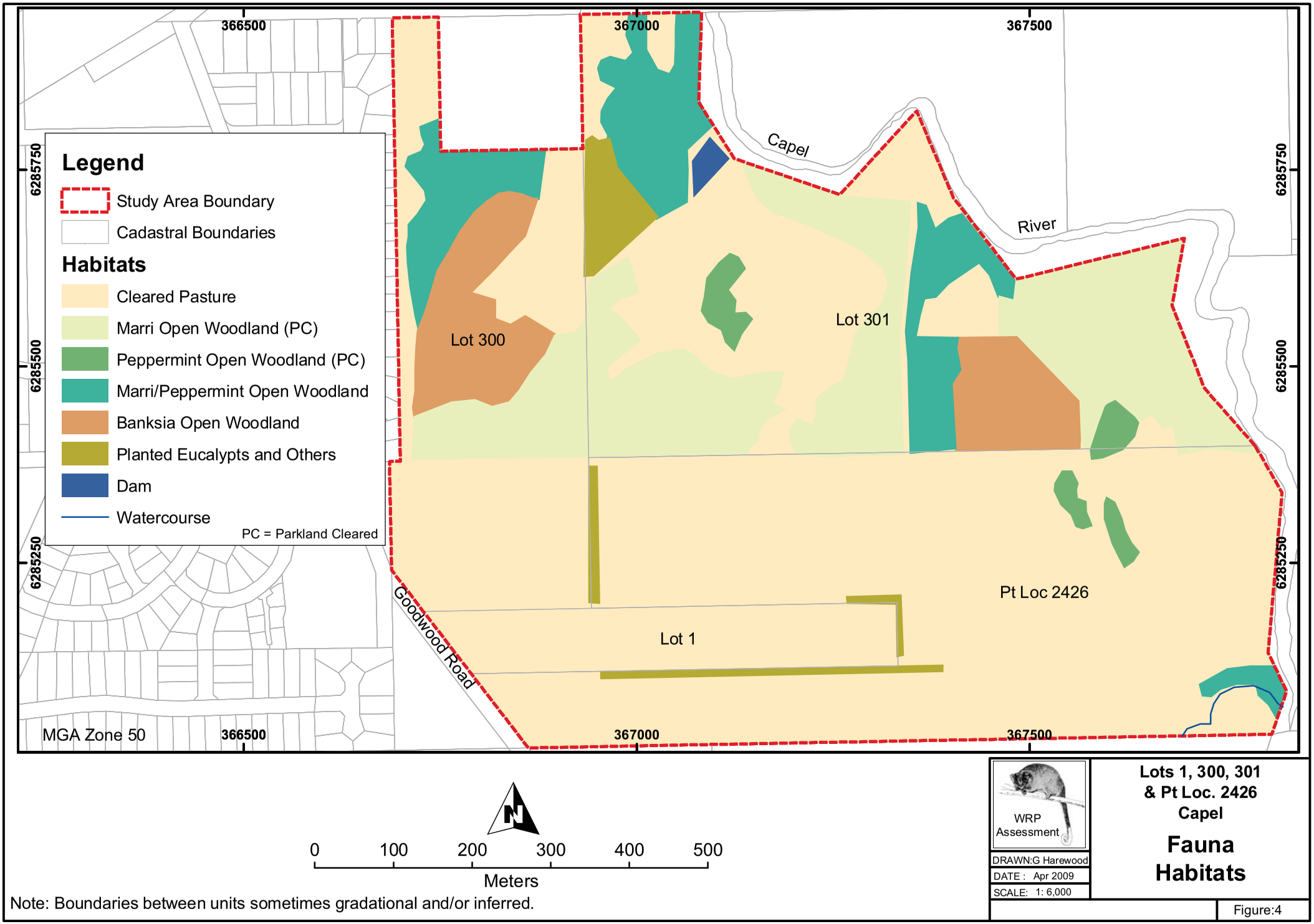
REVISION	DESCRIPTION	DRAFTER	DATE
J			
I			
H			
G			
F			
E			
D			
C			
B	Modify lot boundaries, Road widths	K.S.	19/05/2010
A	Modify lot boundaries, Policy text	J.W.	09/04/2010

ORIGINAL PLANNER:	A.R.
ORIGINAL DRAFTER:	J.W.
CREATED DATE:	02/03/2010
AERIAL DATA:	ECW
CADASTRAL DATA:	MGA
TOPOGRAPHIC DATA:	MGA

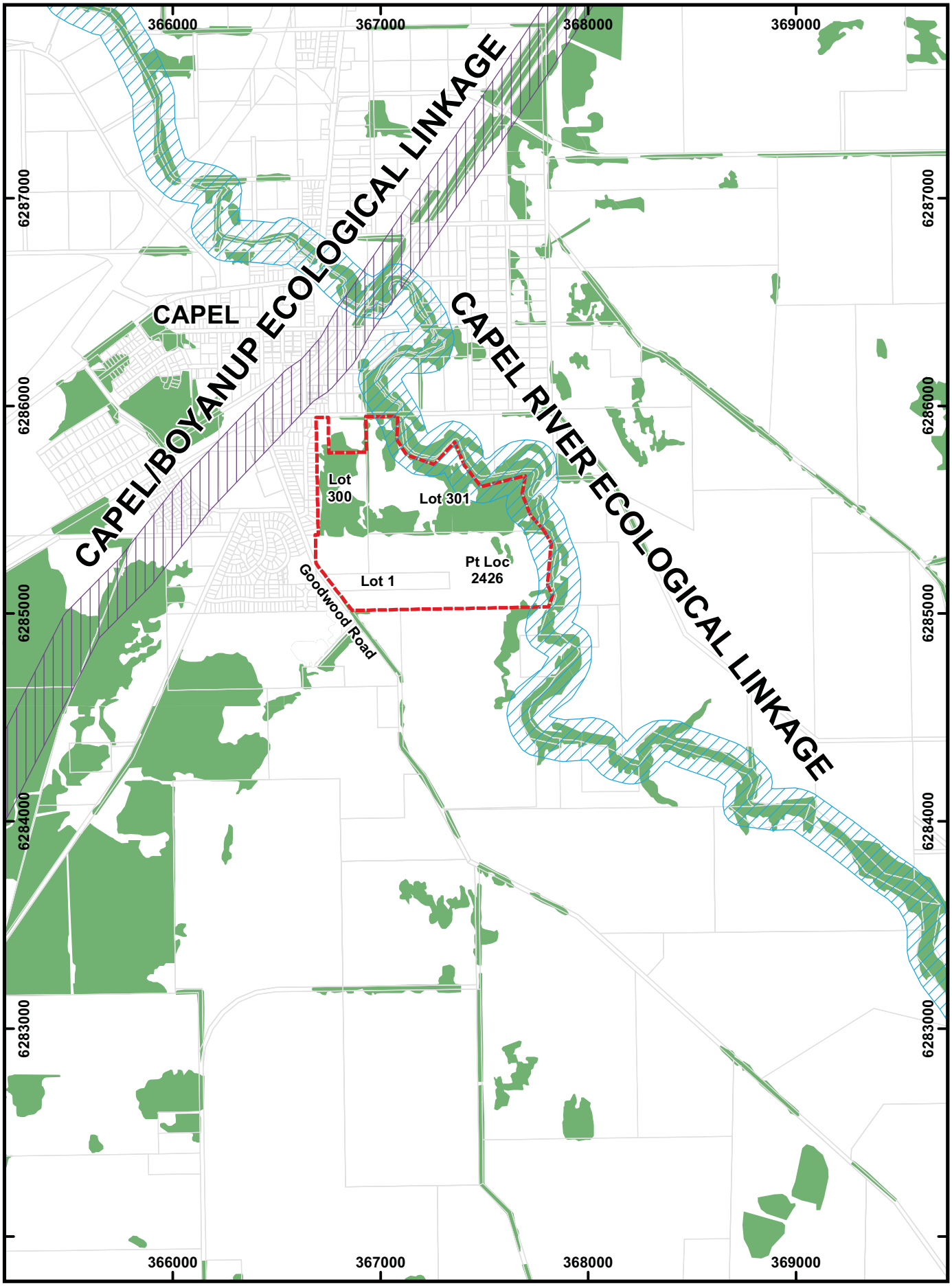
09045P-SP-04B

THIS PLAN HAS BEEN PREPARED FOR PLANNING PURPOSES.
AREAS, CONTOURS AND DIMENSIONS SHOWN ARE SUBJECT TO SURVEY.

Thompson McRobert Edgeloe (08) 9791 4411 www.tme.net.au



Note: Boundaries between units sometimes gradational and/or inferred.



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary

N

0 250 500 750 1,000

Metres

MGA Zone 50

WRP Assessment

DRAWN:G Harewood

DATE : June 2009

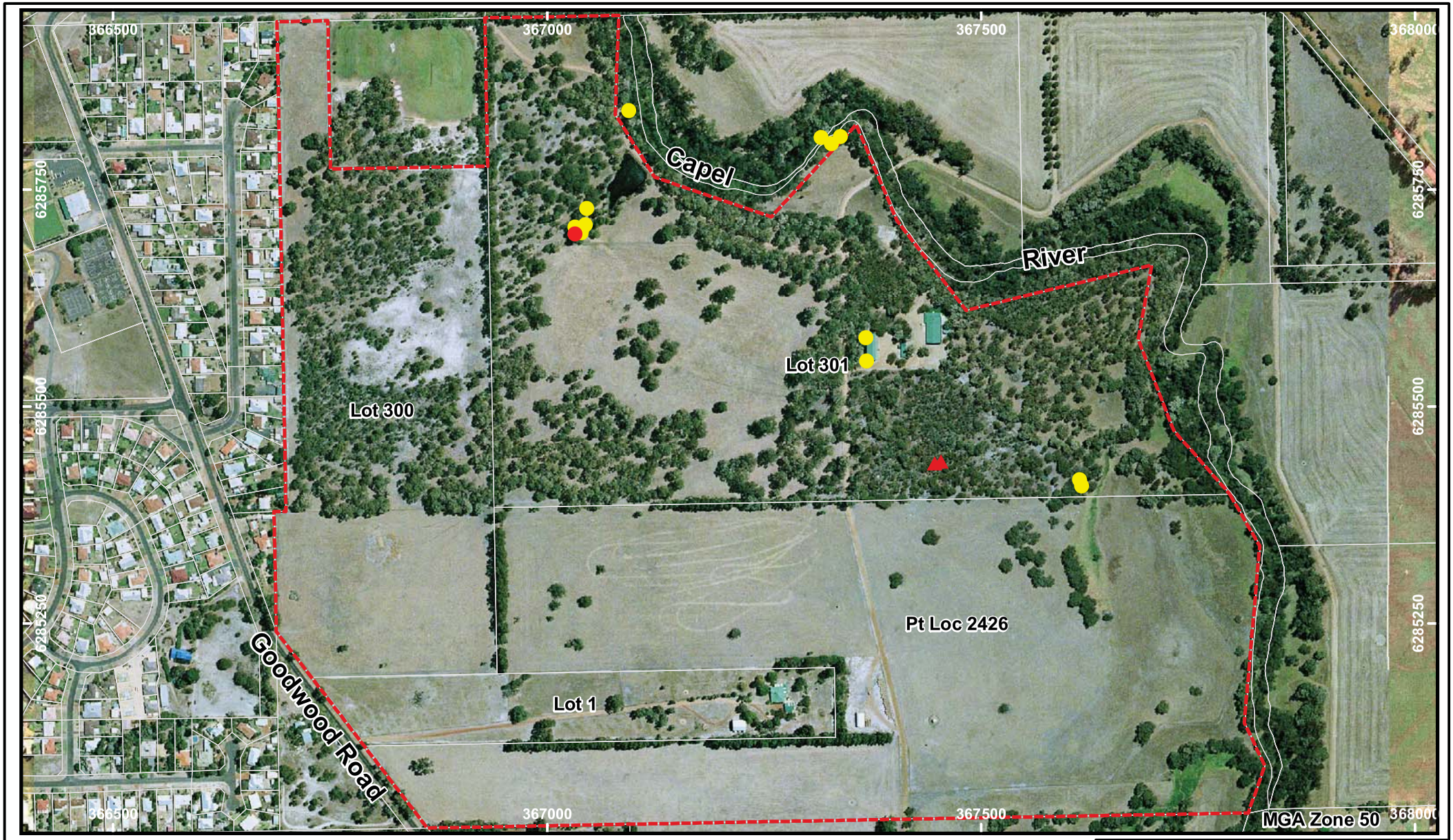
SCALE: 1: 25,000

From EPA (2003)

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Remnant Vegetation and Ecological Linkages

Figure: 5



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary
- Drey
- WRP
- WRP dead

0 100 200 300 400 500

Metres

WRP Assessment

DRAWN:G Harewood

DATE : Apr 2009

SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Diurnal Inspection 1st Nov 2005

Figure: 6

Legend

- Study Area Boundary
- Cadastral Boundaries (existing)
- WRP
- Common Brushatil Possum

0 100 200 300 400 500

Metres

WRP Assessment

DRAWN:G Harewood

DATE : Apr 2009

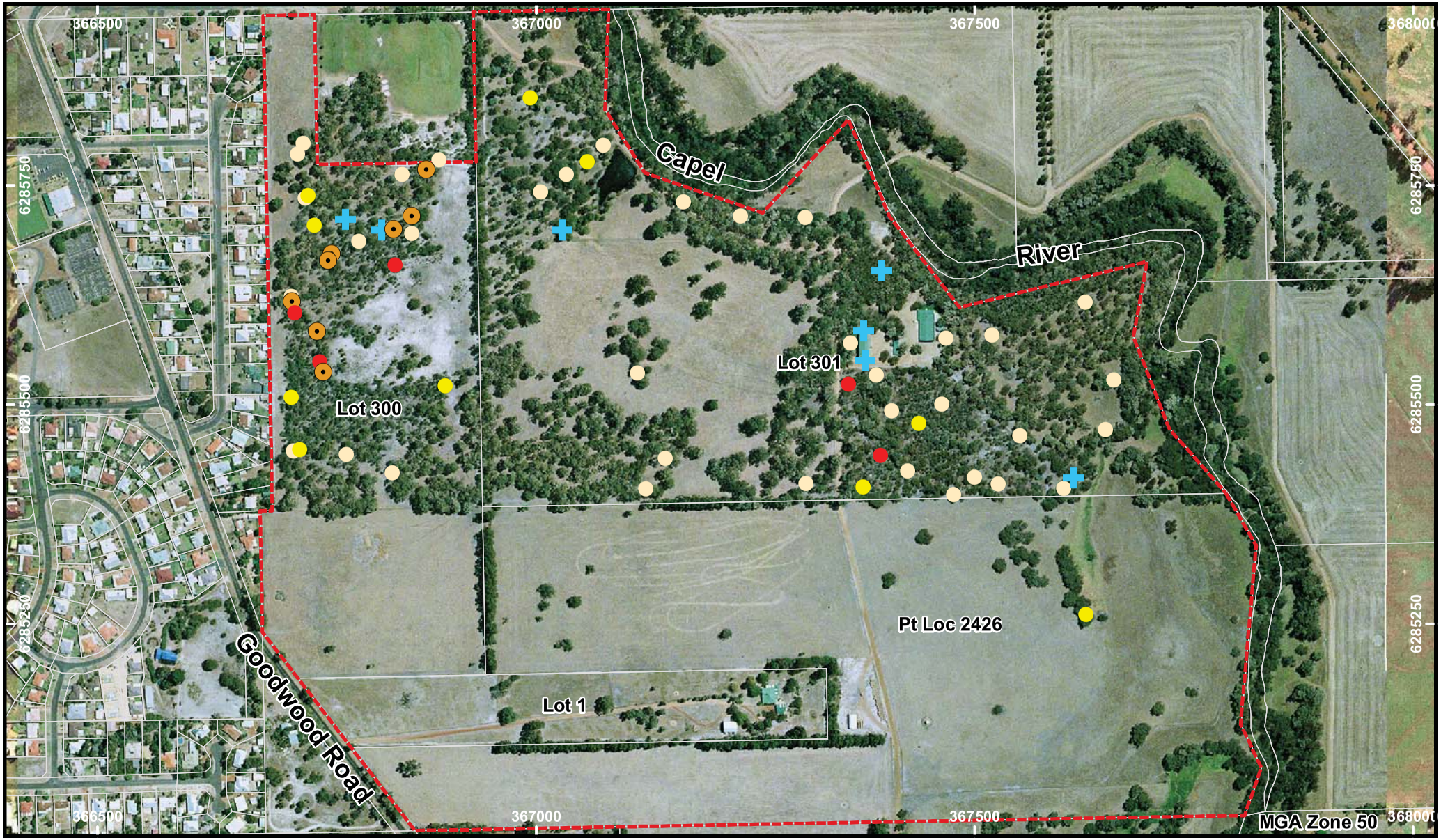
SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Nocturnal Count 1st Nov 2005

Figure: 7



Legend

- Study Area Boundary
- Cadastral Boundaries (existing)
- No WRP Scats Observed
- Low Density WRP Scats
- High Density WRP Scats
- WRP Drey
- Habitat Tree

0 100 200 300 400 500
Metres

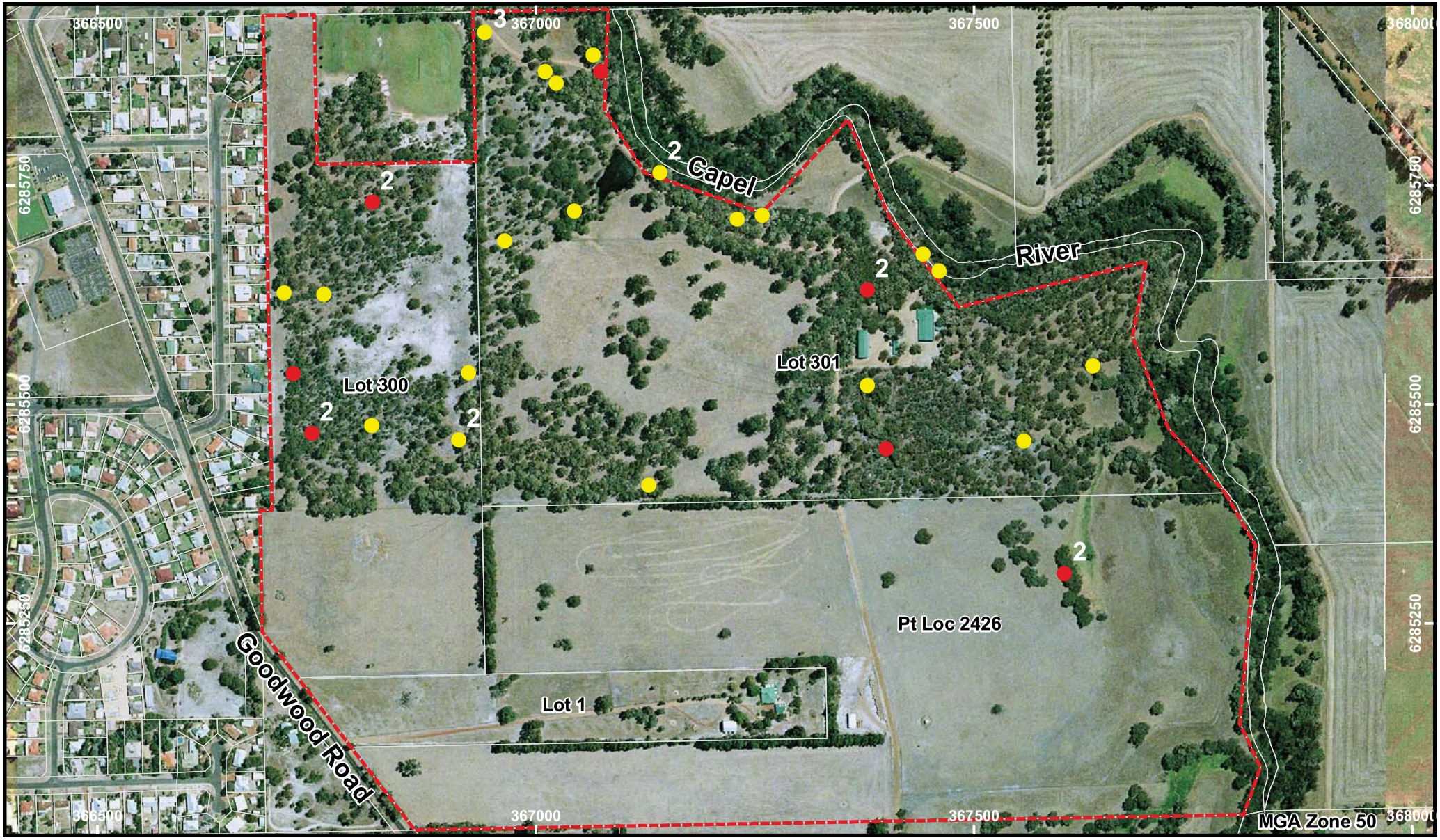
WRP Assessment

DRAWN:G Harewood
DATE : Apr 2009
SCALE: 1: 6,000
Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Diurnal Inspection 16th April 2009

Figure: 8



Legend

- Study Area Boundary
- Cadastral Boundaries (existing)
- WRP
- Common Brushtail Possum

0 100 200 300 400 500

Metres

WRP Assessment

DRAWN:G Harewood

DATE : Apr 2009

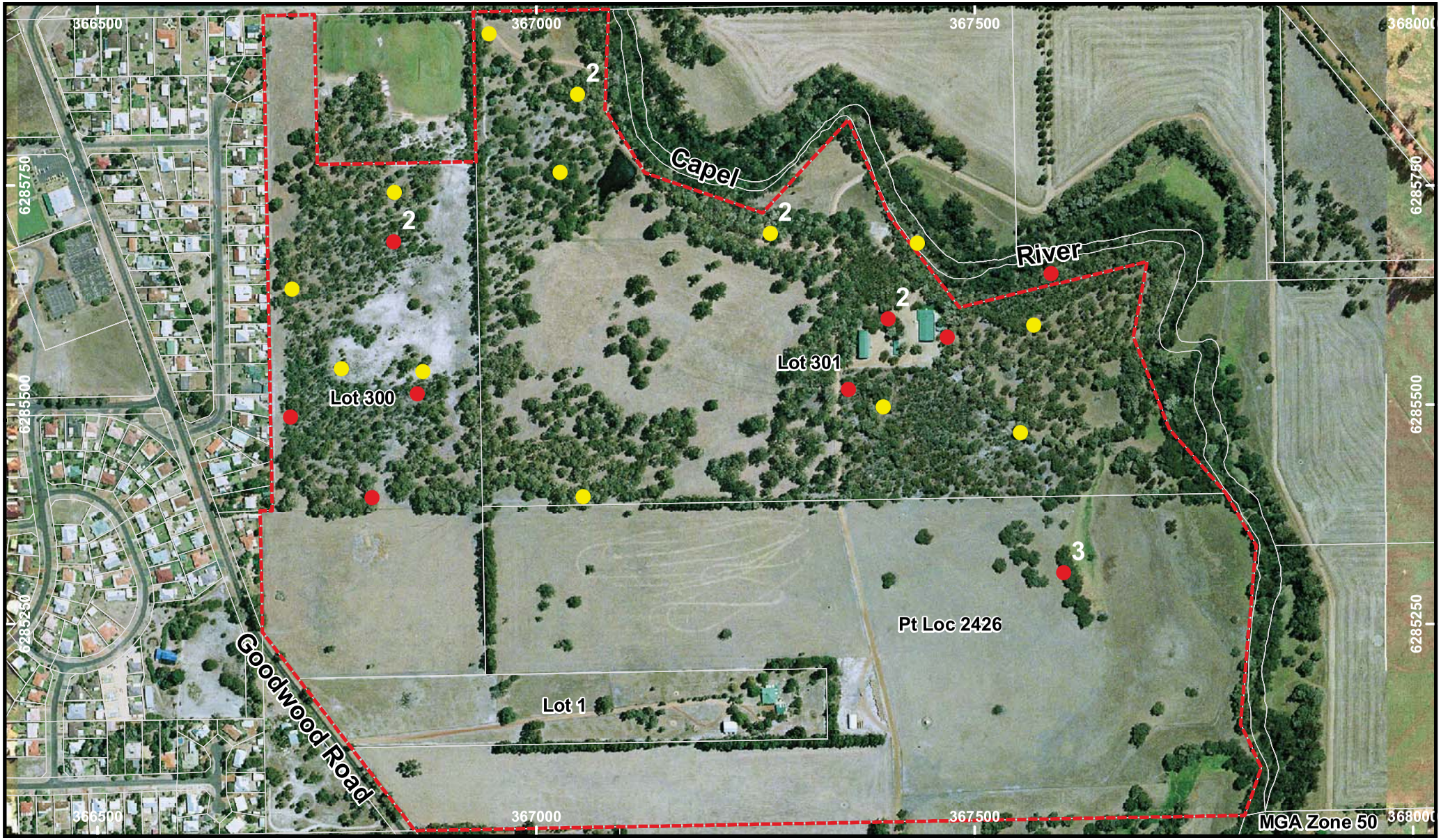
SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Nocturnal Count 21st April 2009

Figure: 9



Legend

- Study Area Boundary
- Cadastral Boundaries (existing)
- WRP
- Common Brushtail Possum

N

0 100 200 300 400 500

Metres

WRP Assessment

DRAWN:G Harewood

DATE : Apr 2009

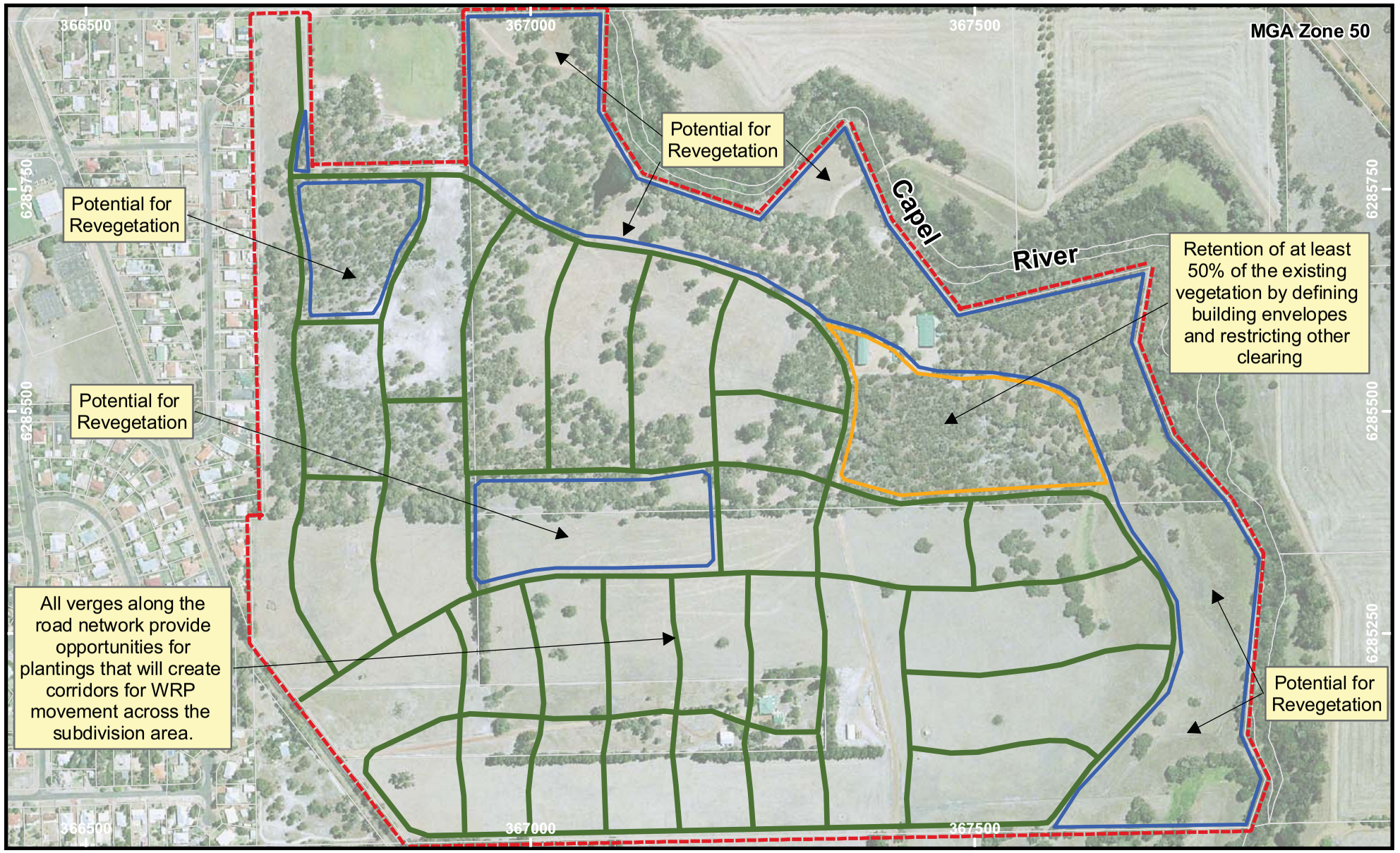
SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Nocturnal Count 27th April 2009

Figure: 10



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary
- R2.5 Boundary
- POS Boundaries
- Proposed Roads

N

0 100 200 300 400 500

Metres

WRP Assessment

DRAWN:G Harewood

DATE : July 2010

SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Areas of Potential Vegetation Retention and Revegetation

Figure: 11

PLATES

Plate 1: Parkland Cleared Marri Open Woodland – Lot 301

Plate 2: Parkland Cleared Peppermint Open Woodland – Lot 2426

Plate 3: Banksia Low Open Woodland over Kunzea Tall Shrubland – Lot 300

Plate 4: Marri Woodland over Peppermint Low Woodland – Lot 301

Plate 5: Planted Eucalypts – Lot 301

Plate 6: Pasture Lot 1 & Loc 2426

APPENDIX A

DEC POST CLEARING/DEMOLITION REPORT FORM

POST CLEARING/DEMOLITION REPORT

To be submitted to the DEC (14 Queen Street, Busselton 6280, Fax 97521432, ATTN: District Manager) within 28 days of completion of works:

Site Location:_____

Name of Owner/Developer:_____

Contact Number:_____

Was DEC notified prior to clearing/demolition?:_____

Date and times demolition/clearing was undertaken:_____

Name of clearing contractor:_____**Contact No.**_____

Name of zoologist/WRP carer:_____**Contact No.**_____

Number of WRP observed/relocated:_____

Location where WRP are relocated:_____

Number of dreys observed/removed:_____

Number of WRP injured/killed;_____

NOTE: DEC must be notified immediately if WRPs Injured or killed (ph 9752 5555)

Name of rehabilitator/Vet who holds injured WRP:_____

Contact No.:_____

Was the management/mitigation plan objectives met? YES / NO

If NO, what was the reason(s):_____

_____

_____

Other comments:_____

_____

Name of person completing this form:_____**Contact No:**_____

Signature:_____**Date:**_____

APPENDIX B

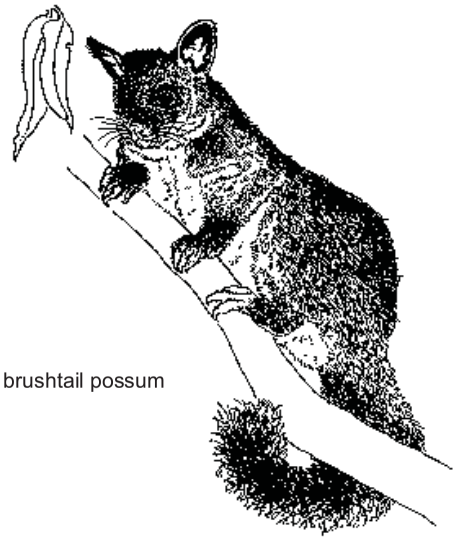
LIVING WITH POSSUMS PAMPHLET

Living with possums

The common brushtail possum (*Trichosurus vulpecula*) and to a lesser extent the western ringtail (*Pseudocheirus occidentalis*) are two native mammals that may be encountered in and around urban areas in the southwest of Western Australia. The western ringtail listed as a specially protected (threatened) species under the Wildlife Conservation Act 1950.
The western ringtail is endemic to the southwest of Western Australia and mostly restricted to coastal areas between Albany and Bunbury (see map), while the common brushtail possum is found in a wide range of habitats throughout Australia.

Biology

The western ringtail is about the size of a small cat, with soft, short fur of a charcoal grey colour, and a paler underbelly. The common brushtail possum is larger and usually silver grey in colour though this can vary to charcoal grey or brown. One obvious difference between the two species is the tail. The western ringtail has a long and slim tail with white at the end, while the common brushtail has a bushy tail with a furless strip underneath, and a black or white tip.
Possums are mainly nocturnal, resting in tree hollows or similar refuges during the day and emerging shortly after sunset to forage for food.



Common brushtail possum

Diet

Possums are mainly herbivorous, eating leaves, fruits and blossoms. In natural circumstances the diet of the western ringtail consists mostly of the foliage of trees including peppermint (*Agonis flexuosa*), jarrah and marri, while the common brushtail possum enjoys a diet of eucalypt, wattle and mistletoe foliage. In urban areas both species will readily accept fruit (apples, bananas, oranges, etc) and many types of flowering garden plants, with a particular liking for rose buds and shoots. It is quite common for possums to rapidly defoliate garden trees, in some cases almost eating them bare.

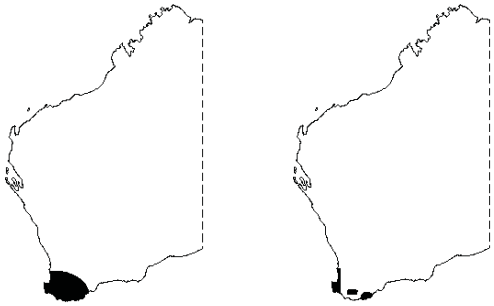
Habitat

Possums are strongly territorial, with males actively defending their home ranges using a range of guttural noises and by marking boundaries with scent glands on their chin, chest and near the anus. Territory size is generally determined by the availability of food and suitable nesting site hollows or dreys. A territory may be as small as an area of about 50 metres radius from a central location, and may contain a number of nesting sites. The territory of a possum may be home also to an adult female, and juveniles of both sexes.
Common brushtail possums are solitary by nature, although during breeding season it is possible to see a pair together. In urban areas possums may congregate in parks and gardens while feeding on food scraps.
Western ringtails are quite social, and up to eleven may occupy a home range that overlaps with the home ranges of other possums.

Breeding

Female possums breed once a year from the age of twelve months, usually at the end of autumn, although common brushtail possums have been known to breed twice a year, with a minor second breeding season in spring. Males are very active and mobile in this season, searching for mates from about April onwards. This is often noticeable by a marked increase in the number of roadkill animals observed at this time.

Former (left) and current (right) distribution of the western ringtail



Signs of possums

Brushtail possum scats (actual size)

A female will produce a single young (or occasionally twins) after a gestation period of about three weeks.
The young possum spends about five months in the mother's pouch before riding on the mother's back for another two months until it is weaned, after which it leaves its parents to find its own territory.

Living with possums

Possums have adapted well to living in and around urban areas, and often take refuge in roof cavities instead of tree hollows.
This is usually an annoying experience, since possums are very noisy at night and over long periods may produce unpleasant odours and urine stains in the ceiling. However rats and mice may also inhabit roof spaces and create a disturbance, especially during the winter months. If the roof cavity is accessible, the easiest way to determine whether it is a rat, mouse or possum that has taken up residence is to find some droppings.

Those of a possum are by far the largest, being about 2cm long and about 1cm wide. In comparison, those of a rat or mouse can be from less than 0.5cm to just over 1cm long. The lingering smell of rats and mice is quite different to that of a possum, and possums do not chew on electrical wiring as rats and mice often do.

As possums are territorial, the removal of one possum from the roof will only leave a vacant possum-smelling space for another to take up residence. By careful observation at night it should be possible to find the place that a possum uses to enter a roof, and once this has been found, possums can be discouraged from taking up residence.

Deterring possums

Block all potential access points to the roof except for the entry point that a possum has been observed using. Useful materials include sheet metal, vinyl, wood or wire netting with a mesh size smaller than 20mm, which should be fitted securely and snugly to prevent the animal from getting a claw hold and lifting the cover off the hole. Bricks are not recommended, as possums are strong and have been known to loosen mortar or move loose bricks aside. It may be necessary to trim or remove trees providing access as well.

After dusk the possum will leave the roof to go in search of food, at which stage the remaining entry point can be permanently blocked. A feeding platform may be useful for encouraging possums to a convenient observation point to confirm that a possum has left the roof and it is safe to block off the last entry point. Pieces of fruit can be provided sparingly and only while attempting to exclude a possum from the roof.

Alternatively, fit a one-way flap made out of metal or perspex to allow the possum out but not in. Cover the flap surrounds with metal to prevent possum claws from gripping and lifting the flap. If the possum proves to be elusive, contact your local Department of Conservation and Land Management (CALM) office for advice.

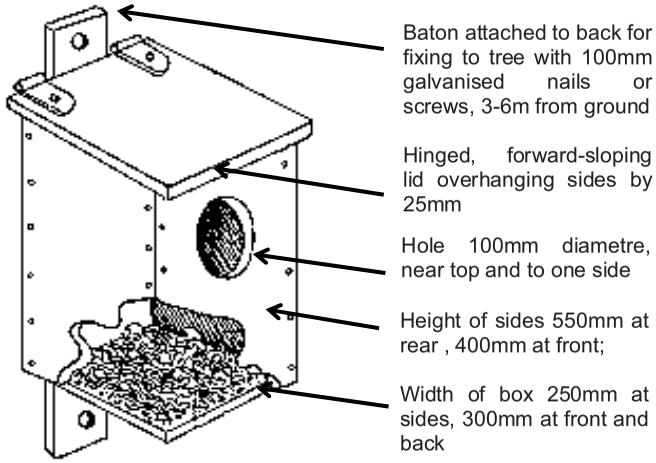
To prevent access to the roof, sheet metal can be rolled into collars approximately 60cm wide, and placed around the trunks of nearby trees at a height of about 60cm to prevent possums from climbing them. Branches overhanging the house can be trimmed.

Specially designed waterproof nest boxes can be placed in trees around the area to provide alternative nests or to encourage possums to the area. These may be simple hollow logs with one end blocked, or wooden box constructions, placed about four metres above the ground, perhaps in the fork of a tree, but facing south away from the sun. If available, possum droppings and nest material can be placed in the nest box to make it more inviting to possums. Taping a cockroach strip inside the nest box lid during spring will prevent invasion by bees.

The relocation of possums to other sites is not an acceptable option since studies have shown the survival rate of relocated possums is very low. Most are killed by foxes and dogs or hit by cars while crossing roads in search of a suitable territory.

The trapping and removal of possums from buildings should be a last resort, and licenses are required from CALM for all such activities. If there appears to be no other alternative than to trap and remove a possum, contact your nearest CALM office to discuss the options available.

A basic possum nest box design

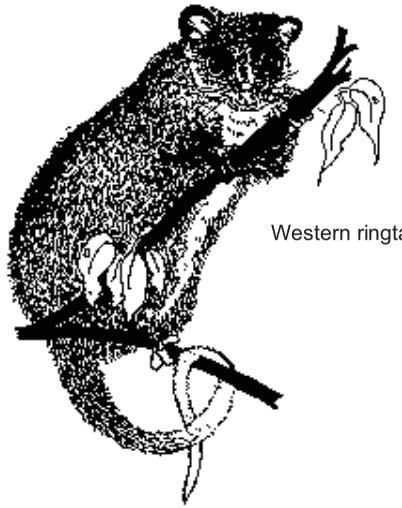


References

- "Wildlife Notes" No.4 (January 1997) *Nest Boxes for Wildlife*. Land for Wildlife Western Australia.

Prepared by C. Kemp & E. Bramwell, Land for Wildlife
Possum artwork by Louise C. Burch, Graphic Designer
Department of Conservation and Land Management WA, July 1999.
Revised November 2004.

Living with Possums



Western ringtail

A joint initiative of the Land for Wildlife scheme and the Department of Conservation and Land Management Western Australia, July 1999.

APPENDIX 4:

Capel Black Cockatoo Management Report

Black Cockatoo

Management Plan

Lot 1, Lot 300, Lot 301 & Pt Loc 2426

(Wellington Land District)

CAPEL

JULY 2010
Version 4

On behalf of:
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Prepared by:
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TABLES

FIGURES

PLATES

Note: For the purposes of this report the term Black Cockatoo is in reference to Baudin's Black Cockatoo *Calyptorhynchus baudinii*, Carnaby's Black Cockatoo *Calyptorhynchus latirostris* and the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso,*

DISCLAIMER

This fauna assessment report ("the report") has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood ("the Author"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints. In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise stated in the report, the Author has not verified the accuracy of completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of the Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

1. INTRODUCTION

The following Black Cockatoo Management Plan has been prepared for Lots 1, 300, 301 and Pt Loc 2426, Capel. The development site is centred on approximately 33.562596° S and 115.569943° E (GDA94) (Figure 1 and 2) and has a total area of about 78ha. . The aim of the management plan is to provide a mechanism to minimise the potential impact the proposal may have on Black Cockatoos as much as reasonable and practical.

The proposal area was previously identified as containing potential Black Cockatoo habitat (Harewood 2005). All three Black Cockatoo species are listed as specially protected (Schedule 1 - Fauna that is rare or is likely to become extinct) under the Western Australian Wildlife Conservation Act (*WC Act 1950*). Under the federal Environment Protection and Biodiversity Conservation Act (*EPBC Act 1999*) the Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo are listed as Vulnerable, while Carnaby's are listed as Endangered.

Projects that are likely to have a significant impact on any of the black cockatoo species also require referral to the federal Department of Environment, Water, Heritage and the Arts (DEWHA) for review and approval to ensure compliance with the EPBC Act.

1.1 DEVELOPMENT PROPOSAL

It is proposed to subdivide the existing lots into a numerous smaller lots at densities ranging from R20 to R2.5. About 20.9 ha (~27%) of the site will be retained as Public Open Space (POS, including a Foreshore and Drainage Reserve) (Figure 3).

No other development plans currently exist though it can be assumed that subsequent to subdivision approval houses/buildings will be constructed on some or all of the lots over time. This construction along with associated infrastructure will potentially require the clearing of vegetation, some of which represents potential Black Cockatoo habitat.

The development of the site has been subdivided into Stages, numbered 1 to 4 in Figure 3. The stages correspond to the existing lot boundaries, details of which are provided in Table 1 below.

Table 1: Development Staging and Areas

Stage	Lot Number	Area (ha)
1	300	15.178
2	1	4.688
3	Pt 2426	30.027
4	301	28.086
Total		77.979

1.2 SCOPE OF WORKS

The management plan is required to build upon initial broader fauna management recommendations made within the Level 1 fauna assessment report completed on November 2005 (Harewood 2005).

The main aims of the management plan are to detail how habitat loss and development impact upon Black Cockatoos is to be managed and mitigated through both the site works process and in the long term. Consideration will also be given to the intended role of the foreshore reserve as an ecological corridor. In addition to the DEC, the management plan must also suit requirements of the Shire of Capel. This management pan should be read in conjunction with the WRP management plan also prepared for the site (Harewood 2009).

The assessment has included:

- One daytime survey to locate/reassess potential nest hollows. Effort was made to determine if hollows have been used for nesting in the past or if they are in current use (if survey conducted during breeding season);
- Determination of the amount and quality of cockatoo foraging habitat on site and adjacent areas. This will include documenting evidence of actual foraging activities by each of the three black cockatoo species (recent and old);
- Data and photographs of the current cockatoo habitat extent and quality;
- Land tenure of adjacent and nearby cockatoo habitat; and
- Details on landscaping/revegetation that will offset habitat loss.

1.3 FIELD SURVEY METHODOLOGY

Diurnal inspections of the site were carried out with the principal aim of documenting the habitat type with respect to its suitability for Black Cockatoos, while at the same time recording of the location of foraging habitat, potential nest hollows, roosting sites and actual individuals. Photographs representing typical vegetation at the site were also taken. The diurnal searches involved a series of close spaced traverses on foot using a GPS for guidance and as a data recorder.

2. BLACK COCKATOO HABITAT ASSESSMENT

2.1 BLACK COCKATOO HABITAT

The vegetation within the development site was examined on the 1st November, 2005 and again on the 16th of April, 2009.

The extent of the broadly defined fauna habitats within the study area are shown in Figure 4 with a description of each given below. More specific detail on the composition of each bush remnant can be found within the flora report (BEC 2006).

1. **Marri *(Corymbia calophylla*) Open Woodland:** Parkland cleared Marri is present over areas of pasture in the northern half of the study area. Most trees are relatively young and contain no hollows. Occasional Peppermints, Banksia, Flooded Gum and *Nuytsia floribunda* are also present. This area of vegetation represents foraging habitat for Cockatoos (Marri and Banksia). No hollows large enough for Black Cockatoos to use were observed in trees of this unit. Canopy coverage in areas of Marri Open Woodland ranges from 0% to 40% (BEC 2006).

2. **Peppermint (*Agonis flexuosa)* Open Woodland:** Several small patches of Peppermint dominated, parkland cleared woodland are present in certain areas of the property. This unit does not represent Black Cockatoo habitat of any type, but only makes up a small percentage of the vegetation on site. No understorey is present and a groundcover of grasses and weed species is present. Canopy coverage in areas of Peppermint Open Woodland ranges from 0% to 40% (BEC 2006).

3. ***Banksia attenuata* Open Woodland over *Kunzea glabrescens* and mixed low shrubs:** Present in two separate areas. The western area has been open to grazing and has, as a consequence, a degraded understorey. The eastern area has been fenced from stock for some time and has denser understorey and leaf litter present. Also contains common emergent Jarrah (*Eucalyptus marginata)* with scattered Peppermint, *Nuytsia*

floribunda, Woody Pear (*Xylomelum occidentale*) and Marri. Represents potential Black Cockatoo foraging habitat due to presence of a variety of known foraging species (e.g. Banksia, Jarrah and Marri). Some dead trees (Jarrah ?), one with large hollow possibly suitable for Black Cockatoos to use.. Canopy coverage varies considerably. BEC notes canopy coverage of only 45% (for tree and tall shrub species) in Lot 300. Areas in Lot 301 with dense *Kunzea* had canopy coverage up to 65% though nearby areas with little *Kunzea* and sparse Jarrah and Marri fell to 20% (BEC 2006).

4. **Marri *(Corymbia calophylla*) and Peppermint (*Agonis flexuosa)* Open Woodland:** Consists of a combination of Marri and Peppermint trees in varying densities. Some areas parkland cleared while others (fenced areas) have groundcover and understorey. Occasional, Banksia, Flooded Gum (typically nearer the Capel River) and *Nuytsia floribunda* are also present. Represents Black Cockatoo habitat due to presence of Marri. The Author has seen Baudin's Black Cockatoo feeding on flowering Flooded Gum so this species also represents potential foraging habitat. Canopy coverage of main tree species about 70% in area examined in detail (BEC 2006).

5. **Planted Eucalypts and other species:** Several windbreaks and areas of planted Eucalypts and other species of trees and shrubs (some endemic) are present around the study area. Maybe used in some cases for temporary roosting but unlikely to represent foraging habitat. Not considered as habitat for the purpose of this report

6. **Cleared Pasture –** Cleared farmland with a mixture of introduced pasture grasses, clovers, weeds and degraded sedgelands. This area also contains scattered trees of various species (*Agonis flexuosa, Corymbia calophylla, Eucalyptus* sp, *Melaleuca* sp. and exotics). While some of the Black Cockatoo species will foraging on pasture grasses/weeds this unit is not considered as habitat for the purpose of this report.

2.2 HABITAT LINKAGES

Linkage between vegetation remaining in the northern section of the site is relatively continuous though its usefulness for some fauna species has been compromised by sections of parkland cleared vegetation having common gaps in the canopy. The most significant linkage in the general area is the Capel River of which the study site forms a node of remnant vegetation (see Figure 5).

The Capel River is one of 16 ecological linkages identified by the EPA in its assessment of the Greater Bunbury Region Scheme (EPA 2003, WAPC 2000). In broadly identifying the various linkages the EPA took into consideration that the existing corridors of remnant vegetation could provide a focus for the

restoration of ecological communities and landscape rehabilitation between and around the remaining remnants in this section of the Swan Coastal Plain.

The proposed foreshore reserve (Figure 3) will aid in the long term conservation of this section of the Capel River and ensure its function as an ecological linkage is maintained in line with the EPAs intentions. The proposed revegetation along the foreshore reserve will enhance its function as an significant ecological linkage in this section of the coastal plain.

2.3 DIURNAL SITE INSPECTION

A daytime survey of the site was conducted on foot on the 1st November, 2005 and again on the 16th of April, 2009. The aim of the surveys was to document the evidence of Black Cockatoo foraging, roosting and potential nest hollows, along with individual Cockatoos.

Observations made during the daytime survey are shown in Figure 5. Evidence of black cockatoo foraging was wide spread across the study area and was most commonly associated with Marri and to a lesser extent with Banksia. Evidence directly attributed to Baudin's Black Cockatoo was the most common along with that of the Forest Red-tailed Black Cockatoo. Evidence of Carnaby's Black Cockatoo foraging was limited to two examples (chewed Marri nuts) though it should be noted that it is not possible to distinguish between foraging evidence on Banksia between the two white-tailed species.

Both Baudin's and the Forest Red-tailed Black Cockatoos were observed on the site during the 2005 survey (Harewood 2005). While Carnaby's Black Cockatoo was not observed onsite the Author has observed them in the vicinity of Capel on several occasions in the past.

Two potential nest hollows (based on hollow entrance size alone) were found within the study area during the 2005 survey. These trees were re-examined in 2009 but no evidence of use by Black Cockatoos was found. While these hollows are of a size that would possibly allow the entry of a Black Cockatoo, the probability that they are used for this purpose is considered low and observations suggest they have not been used by Black Cockatoos in the recent past.

No evidence (past or present) of the site being use as a roost location by Black Cockatoos was found.

2.4 BLACK COCKATOO HABITAT USAGE ON SITE

Observations made during the site reconnaissance surveys suggest that much of the remnant vegetation found within the study area is suitable foraging

habitat for the Black Cockatoos. The site contains specimens of Marri, Jarrah, and Banksia, all plant types documented as potential food plants used by Black Cockatoos to some degree.

No conclusive evidence of the site being use for breeding or as a roost location by Black Cockatoos was found.

3. POTENTIAL IMPACTS

The most likely impact on Black Cockatoos of the proposal is the loss of foraging habitat. The proposal is unlikely to impact directly in individuals of the species (i.e. it is unlikely that individuals would be killed or injured during development). The currently proposed subdivision plan is shown as Figure 3. No other development plans currently exist though it can be assumed that subsequent to subdivision approval houses/buildings will be constructed on some or all of the lots over time. Any construction will potentially require the clearing of vegetation, some of which represents potential Black Cockatoo habitat - principally foraging habitat.

As no development plans exist it is difficult to accurately determine the amount of Black Cockatoo foraging habitat that will be removed or retained when the entire site is ultimately developed. It can however be assumed that areas of POS will be retained as is, while roads and areas with designated R20, R30 and R40 densities will required total clearing. The proponent is aiming for the retention of at least 50% retention within the designated R2.5 areas (the larger “Conservation Lots” within Stage 4) and the proposed management plan reflects this intention.

Retention of vegetation within the R2.5 areas will be achieved by restricting clearing to pre-defined building envelopes. Additional clearing will only be allowed for compliance with bush fire regulations, construction of an access way or as otherwise approved by the Shire.

To provide an estimate of the maximum amount of habitat that may be affected the extent of suitable vegetation in each stage has been estimated and is detailed in Table 2 below. For the purpose of this estimate all native remnant vegetation is taken as representing potential Black Cockatoo foraging habitat. The quality of the habitat varies considerably and it could be argued that some areas do not represent habitat or because of poor quality are rarely used. This however is difficult to quantify and also habitat not favoured by Black Cockatoos (e.g. Peppermint Woodland) is, in this instance, likely to represent potential WRP habitat in any event. Including all areas in the potential habitat loss estimates will make the overall assessment easier to interpret with the same net result for Black Cockatoos and WRPs.

The canopy cover figures have been calculated by outlining areas of vegetation, calculating areas and then assuming average canopy coverage of 60% (see BEC 2006 for specific canopy coverage percentages for vegetation units surveyed). These figures overestimate the canopy cover of Black Cockatoo and WRP habitat in most vegetated areas, as typically canopy coverage is less than 60%.

Table 2: Stage/Lot areas and approximate WRP habitat loss/retention.

Stage	Lot	Total Area (ha)	~Area of Vegetation canopy (ha) (Assuming average 60% canopy coverage)	~Potential WRP Habitat Loss (ha)	~Potential WRP Habitat Retention (ha) (in POS or in Lots)	Comment
1	300	15.18	2.36	1.22	1.14	Assumed total clearing in development areas. Area of POS (~1.9 ha) contains WRP habitat.
2	1	4.69	0.0	0.0	0.0	
3	Pt 2426	30.03	0.42	0.20	0.22	Assumed total clearing in development areas. Areas of POS contain small amount of WRP habitat
4 (Conservation Lots)	301 (pt)	3.8	2.10	1.05	1.05	Aim is minimum 50% retention of existing vegetation.
4(Balance)	301 (pt)	24.29	8.62	3.06	5.56	Assumed total clearing in development areas. Areas of POS (~12.2ha) contains WRP habitat
Total		77.98	13.5	5.53	7.97	

It is estimated that a maximum of about 5.53 ha of Black Cockatoo habitat will potentially be removed when the structure plan is implemented. There is scope for the retention of additional habitat within the R2.5 areas and therefore habitat loss may actually be less than this figure. As mentioned not all of this vegetation represents ideal Black Cockatoo habitat, but as poorer Black Cockatoo habitat areas also represent WRP habitat these areas must be taken into account in any event.

4. PLANNING AND MANAGEMENT OPTIONS

Planning for the structure plan has taken into account the areas of best vegetation and smaller lots have in most instances been position over existing cleared areas. About 50% of the existing native remnant vegetation onsite will be retained within areas of POS.

It is understood that development of the proposal area is to occur in stages. The management of the impact on Black Cockatoos habitat for each stage will vary depending on the anticipated impact/loss of potential habitat. Some stages will have no impact on Black Cockatoos or their habitat whatsoever (e.g. Stages 2 and 3) and management requirements will be negligible. The implementation of Stages 1 and 4 will result in the loss of some Black Cockatoo habitat and the management plan aims to minimise this impact in the short term and offset it in the long term.

As the DEC are likely to be seeking consideration by the developer to compensate for impacts on WRP habitat that occurs as part of a development, the loss of Black Cockatoo habitat should also be taken into account as part of the same process. Where habitat loss is unavoidable it is generally required to be offset by the planting of replacement habitat, preferably at suitable locations within the subdivision itself. These offsets are to be consistent with the intent of the EPA draft Guidance Statement No.19 “Environmental Offsets” (EPA 2008) and DEWHA draft Policy Statement “Use of Environmental Offsets under the EPBC Act 1999” (DEWR 2007).

It should be noted that if significant impact on Black Cockatoos is deemed likely, the project will require referral to the federal DEWHA to ensure compliance with the EPBC Act 1999. The DEWHA’s primary concern with respect to the listed Black Cockatoo species is habitat loss (mainly foraging and nesting habitat).

If the project is referred, the proponent will need to demonstrate that their project will not result in a net loss of Black Cockatoo habitat if it is to gain approval. While not having a set policy of offset requirements, the DEWHA are likely to request a replacement offset ratio of up to 10:1 for black cockatoo habitat cleared.

5. BLACK COCKATOO MANAGEMENT PLAN

The proposed Black Cockatoo Management Plan will need to be implemented concurrently with the WRP Management Plan as facets of each plan are identical and will need to be implemented at the same time during clearing operations and when revegetation is undertaken.

The principal aims of the management plan outlined here is to reduce the potential for impact on habitat that is to be retained. Revegetation strategies are also detailed.

The management plan is comprised of the following main components

i) Contractor induction

ii) Vegetation retention

iii) Site clearing

iv) Revegetation plan

5.1 CONTRACTOR INDUCTION

Management Strategies/Commitments

MS1 Prior to clearing, contractors will be provided with information to ensure compliance with all relevant sections of this management plan. This will include but will not be limited to details on trees that need to be retained/cleared and the importance of Black Cockatoo habitat retention within the site. All construction staff should be made aware that native fauna is protected. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.

5.2 VEGETATION RETENTION

Management Strategies/Commitments

MS2 Where possible retain and protect remnant vegetation on site that does not require clearing, including single, dead or isolated trees. During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained.

MS3 Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas, borrow pits etc so that previously disturbed areas are used where possible.

MS4 If reasonable and practical Contractors will be directed to:

a) Avoid impacts on tree roots – if feasible a ~3 m buffer around retained trees within which no soil disturbance can occur should be enforced;

b) Avoid branch pruning on trees that are to be retained (especially where canopy connection could be affected);

c) Avoid filling of more than a metre over pre-construction soil height around the base of trees.

MS5 Designation of building envelopes within areas designated as R2.5 density. Aim is to retain at least 50% of the vegetation in this area. No additional vegetation should be cleared within any of these allotments except for the purposes of:

a) Compliance with the requirements of the Bush Fires Act 1954 (as amended).

b) Clearing within the building envelope for a reasonable area for the construction of an approved dwelling or other building.

c) To construct an approved vehicular access.

d) For any other reason where specific written approval has first been obtained from the relevant governing body.

MS6 Building envelope selection should take into consideration the presence of hollow bearing trees, in particular those with large hollows potentially suitable for Black Cockatoos.

5.3 SITE CLEARING

Management Strategies/Commitments

MS7 A suitable experienced "fauna spotter" (e.g. zoologist or fauna carer/rehabilitator) will be present on site at all times when clearing is being undertaken to supervise any animal handling and the capture of injured fauna if required. The delegated fauna spotter will need to follow additional management procedures presented in the WRP Management Plan.

MS8 While it is considered very unlikely that any of the Back Cockatoos breed onsite, the documented breeding and fledging times of the respective species (see below) suggests that the best time to carry out clearing at the site would be around the month of April, so as to avoid the possibility of disrupting breeding individuals. It would however be feasible to check hollow utilisation by cockatoos in other months and if hollows area found not to be in use, clearing could also be carried out in this period with no risk of impacting on breeding individuals of the species in question.

Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*

J	F	M	A	M	J	J	A	S	O	N	D

Baudin's Black- Cockatoo *Calyptorhynchus baudinii*

J	F	M	A	M	J	J	A	S	O	N	D

Carnaby's Black- Cockatoo *Calyptorhynchus latirostris*

J	F	M	A	M	J	J	A	S	O	N	D

Period in which breeding is most likely to commence
Period in which fledgingcould extend to

5.4 REVEGETATION PLAN

It is anticipated that the developers will be required to offset any Black Cockatoo habitat (area based on canopy coverage) lost due to development proceeding and is likely to be made a condition of subdivision by the WAPC. The exact extent of habitat that will require removal is unknown at this point in time but is estimated to be a maximum of about 5.5 ha (WRP and Black Cockatoo habitat combined). The revegetation plan should be in accordance, where possible with restoration principles outlined in Chapter 8 of the Capel River Action Plan (Geocatch 1999).

Management Strategies/Commitments

MS9 Identification/confirmation of areas of land within the POS and along road verges suitable for planting. Plantings should if possible be designed to provide links between existing vegetation and areas planned for revegetation.

MS10 Identification of suitable plant species with particular preference for species that will provide foraging habitat for Black Cockatoos and foraging and refuge habitat for WRPs. Marri (*Corymbia calophylla*) and *Banksia* species are the main cockatoo foraging species present in the area and should also be a major component of any revegetation plan along with Jarrah (*E. marginata*). Preferred foraging species for WRPs in this proposal area are Peppermint (*Agonis flexuosa*), Christmas Tree (*Nuytsia floribunda*), *Kunzea glabrescens and Jarrah (E. marginata)*.

MS11 Weed control (pre-planting and seasonal spraying over three years).

MS12 Ripping and mounding of soil (typically in Autumn).

MS13 Planting (typically mid to late Winter) at a density of about 2,500 plants/ha (2 x 2m).

MS14 Maintenance of planted trees every three months in the first year and then biannually in years two and three.

6. IMPLEMENTATION AND RESPONSIBILITIES

Table 3 summarises the management strategies and commitments from Section 5 that make up the Black Cockatoo Management Plan. The Proponent (the owners of the land) will be responsible for the initial implementation of the management plan as well as the management and maintenance of any proposed revegetation for an agreed period of time (assumed at this stage to be 3 years).

Responsibilities for the implementation various sections of the Management Plan will be delegated to appointed sub-contractors at various stages, for example the Project Manager of each stage of the proposed subdivision will need to ensure clearing is carried out in accordance with the plan. Some sections will be the responsibility of the appointed fauna spotter. Despite this delegation of duties the Proponent still remains ultimately responsible and liable for non-conformance at any stage.

Some facets of the proposed revegetation strategies are illustrated in Figure 7.

Table 3: Summary of Management Commitments and Responsibilities

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Contractor Induction	**MS1** Prior to clearing, contractors will be provided with information to ensure compliance with all relevant sections of this management plan. All construction staff should be made aware that native fauna is protected. Personnel working on the project should not be allowed to bring firearms, other weapons or pets onsite.	Proponent/Project Stage Manager	Prior to commencement of any clearing operations	
Vegetation Retention	**MS2** Where possible retain and protect remnant vegetation on site that does not require clearing, including single, dead or isolated trees. During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained	Proponent/Project Stage Manager	Prior to any site works	

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Vegetation Retention	**MS3** Design additional project infrastructure, including access routes, vehicle and plant storage and turn around areas, borrow pits etc so that previously disturbed areas are used where possible.	Proponent/Project Stage Manager	Prior to any site works	
	MS4 If reasonable and practical Contractors will be directed to: a) Avoid impacts on tree roots – if feasible a ~3 m buffer around retained trees within which no soil disturbance can occur should be enforced; b) Avoid branch pruning on trees that are to be retained (especially where canopy connection could be affected); **a)** Avoid filling of more than a metre over pre-construction soil height around the base of trees.	Proponent/Project Stage Manager	During site works	
	MS5 Designation of building envelopes within areas designated as R2.5 density. Aim is to retain at least 50% of the vegetation in this area. No additional vegetation should be cleared within any of these allotments except for the purposes of: a) Compliance with the requirements of the Bush Fires Act 1954 (as amended). b) Clearing within the building envelope for a reasonable area for the construction of an approved dwelling or other building. c) To construct an approved vehicular access. d) For any other reason where specific written approval has first been obtained from the relevant governing body	Proponent/Planner passed onto Landowner upon sale	Prior to site works but ongoing	Shire of Capel, DEC
	MS6 Building envelope selection should take into consideration the presence of hollow bearing trees, in particular those with large hollows potentially suitable for Black Cockatoos	Proponent/Planner	Prior to site works	Shire of Capel, DEC, Zoologist
Site Clearing	**MS7** A suitable experienced "fauna spotter" (e.g. zoologist or fauna carer/rehabilitator) will be present on site at all times when clearing is being undertaken to supervise any animal handling and the capture of injured WRPs (and other fauna) if required.	Proponent/Project Stage Manager	During site works	DEC
	MS8 While it is considered very unlikely that any of the Back Cockatoos breed onsite, the documented breeding and fledging times of the respective species (see Section 5) suggests that the best time to carry out clearing at the site would be around the month of April, so as to avoid the possibility of disrupting breeding individuals. It would however be feasible to check hollow utilisation by cockatoos in other months and if found not to be in use, clearing could also be carried out with no risk of impacting on breeding individuals of the species in question.	Proponent/Project Stage Manager/Fauna Spotter	Prior to site works	DEC

Issue	Management Strategies/Commitment	Responsibility	Timing	Advice
Revegetation Plan	**MS9** Identification or confirmation of areas of land within the POS and along road verges suitable for planting. Plantings should if possible be designed to provide links between existing vegetation and/or areas planned for revegetation.	Proponent	Prior to and during site development	Shire of Capel, DEC, GeoCatch
	MS10 Identification of suitable plant species with particular preference for species that will provide foraging habitat for Black Cockatoos and foraging and refuge habitat for WRPs. Marri (*Corymbia calophylla*) and Banksia species are the main cockatoo foraging species present in the area and should also be a major component of any revegetation plan along with Jarrah (*E marginata*). Preferred foraging species for WRPs in this proposal area are Peppermint (*Agonis flexuosa*), Christmas Tree (*Nuytsia floribunda*), *Kunzea glabrescens* and Jarrah (*E. marginata*)..	Proponent	Prior to and during site development	Shire of Capel, DEC, GeoCatch, Landcare specialists
	MS11 Weed control (pre-planting and seasonal spraying over three years).	Proponent	Prior to and during site development – 3 year monitoring period	GeoCatch, Landcare specialists
	MS12 Ripping and mounding of soil (typically in Autumn)	Proponent	Prior to and during site development	GeoCatch, Landcare specialists
	MS13 Planting (typically mid to late Winter) at a density of about 2,500 plants/ha (2 x 2m).	Proponent	Prior to and during site development	GeoCatch, Landcare specialists
	MS14 Maintenance of planted trees every three months in the first year and then biannually in years two and three.	Proponent	Prior to and during site development – 3 year monitoring period	GeoCatch, Landcare specialists

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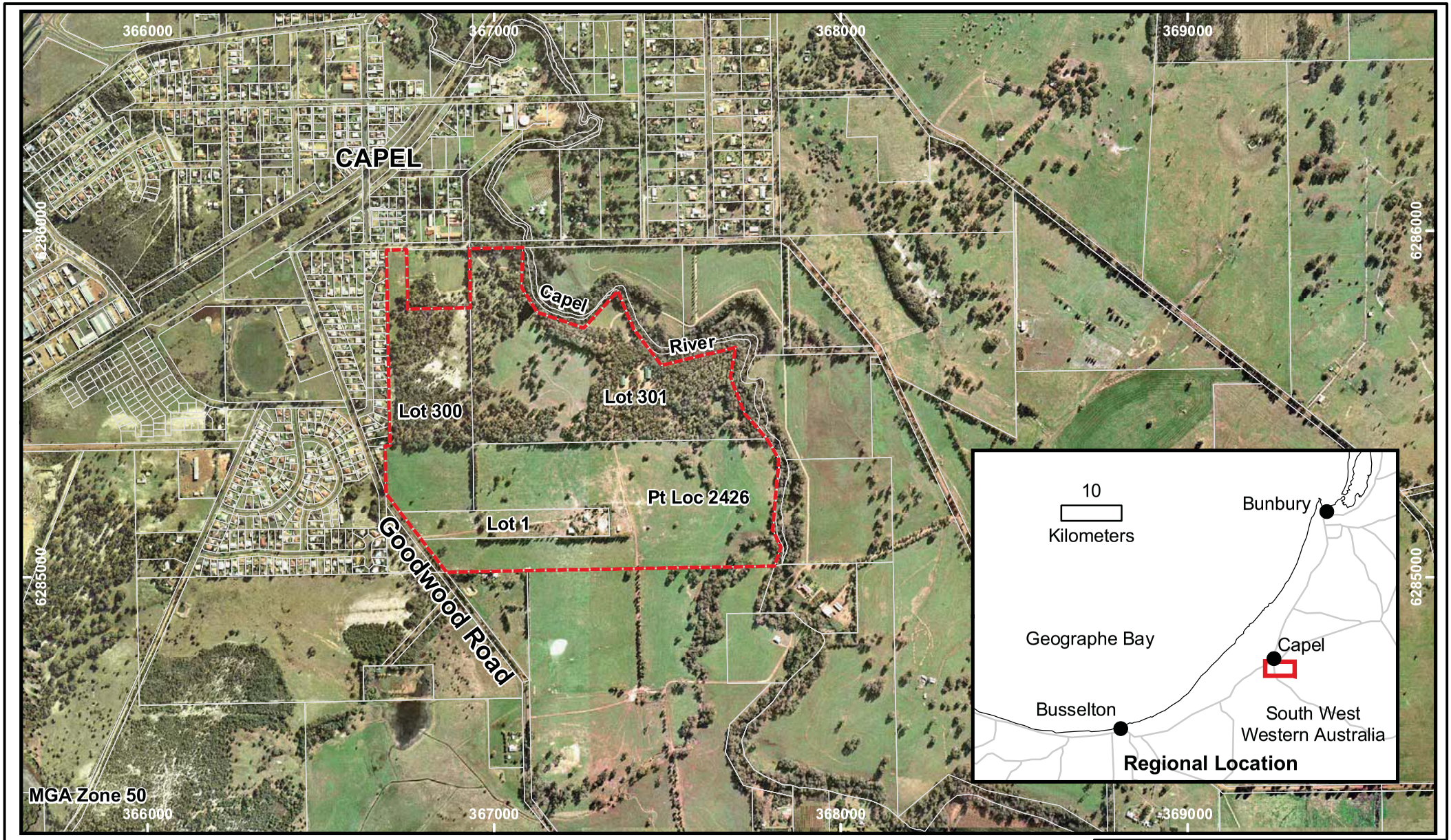
FIGURES



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary

0 300 600 900 1,200 1,500

Metres

Cockatoo Assessment

DRAWN:G Harewood

DATE : Apr 2009

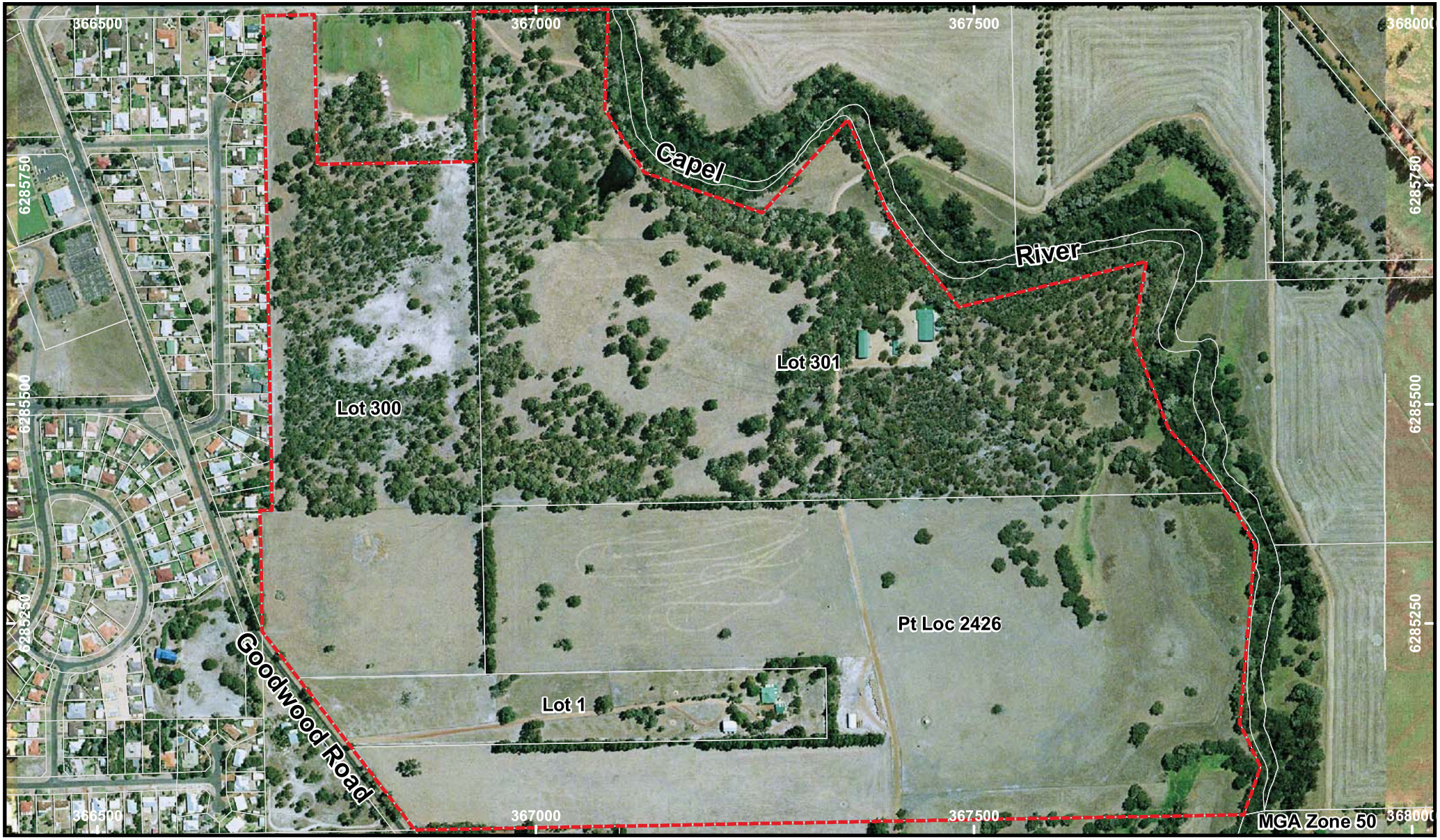
SCALE: 1: 15,000

Air Photo Date 2002

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Study Area and Surrounds

Figure: 1



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary

N

0 100 200 300 400 500

Metres

Cockatoo Assessment

DRAWN:G Harewood

DATE : Apr 2009

SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Air Photo Study Area

Figure: 2

ENDORSED STRUCTURE PLAN - SHIRE OF CAPEL
To provide an framework for the future detailed planning at the subdivision and development stage.

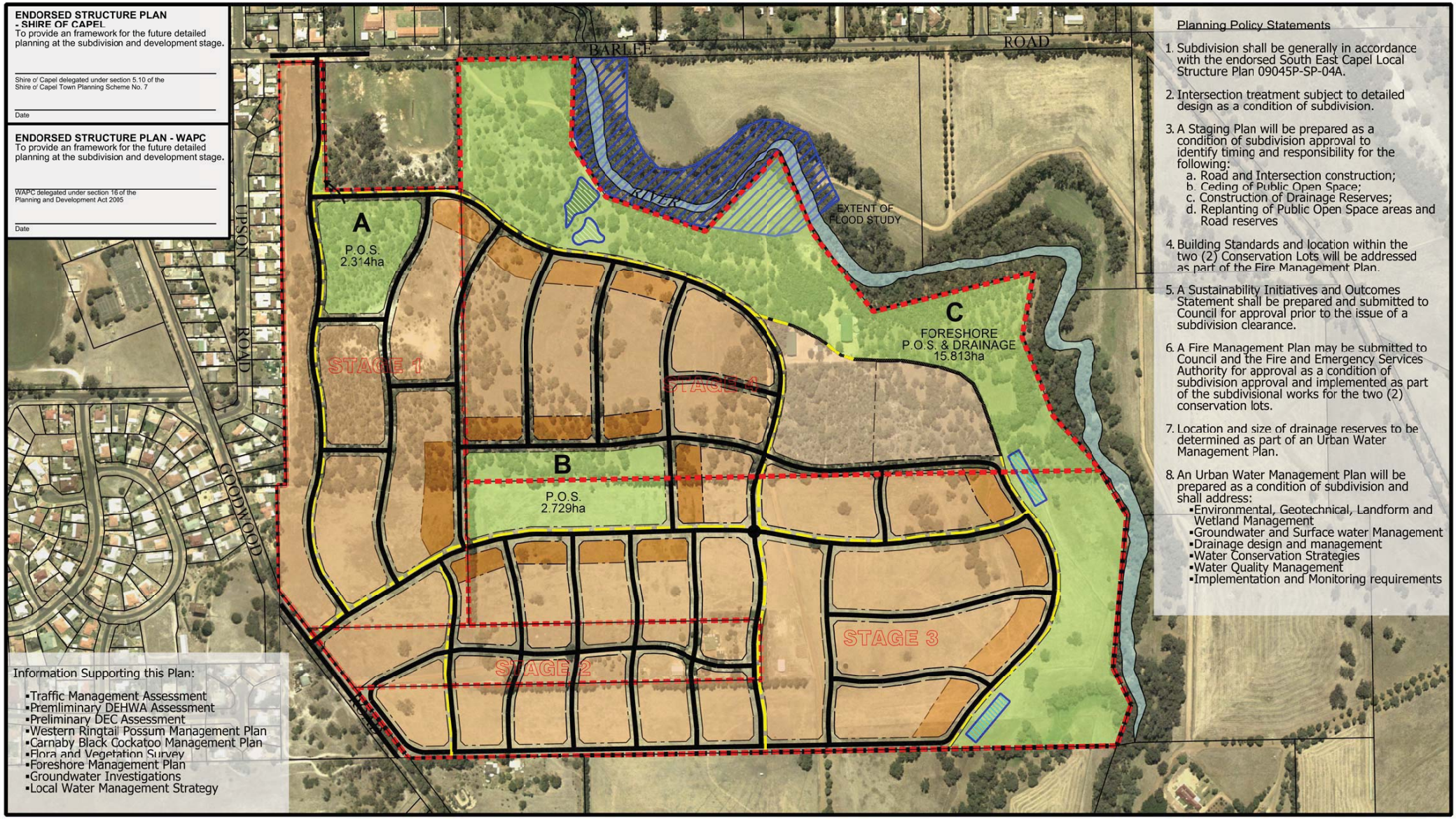
Shire of Capel delegated under section 5.10 of the Shire of Capel Town Planning Scheme No. 7

Date

ENDORSED STRUCTURE PLAN - WAPC
To provide an framework for the future detailed planning at the subdivision and development stage.

WAPC delegated under section 16 of the Planning and Development Act 2005

Date



Planning Policy Statements

1. Subdivision shall be generally in accordance with the endorsed South East Capel Local Structure Plan 09045P-SP-04A.
2. Intersection treatment subject to detailed design as a condition of subdivision.
3. A Staging Plan will be prepared as a condition of subdivision approval to identify timing and responsibility for the following:
   a. Road and Intersection construction;
   b. Ceding of Public Open Space;
   c. Construction of Drainage Reserves;
   d. Replanting of Public Open Space areas and Road reserves
4. Building Standards and location within the two (2) Conservation Lots will be addressed as part of the Fire Management Plan.
5. A Sustainability Initiatives and Outcomes Statement shall be prepared and submitted to Council for approval prior to the issue of a subdivision clearance.
6. A Fire Management Plan may be submitted to Council and the Fire and Emergency Services Authority for approval as a condition of subdivision approval and implemented as part of the subdivisional works for the two (2) conservation lots.
7. Location and size of drainage reserves to be determined as part of an Urban Water Management Plan.
8. An Urban Water Management Plan will be prepared as a condition of subdivision and shall address:
   - Environmental, Geotechnical, Landform and Wetland Management
   - Groundwater and Surface water Management
   - Drainage design and management
   - Water Conservation Strategies
   - Water Quality Management
   - Implementation and Monitoring requirements

Information Supporting this Plan:

- Traffic Management Assessment
- Premliminary DEHWA Assessment
- Preliminary DEC Assessment
- Western Ringtail Possum Management Plan
- Carnaby Black Cockatoo Management Plan
- Flora and Vegetation Survey
- Foreshore Management Plan
- Groundwater Investigations
- Local Water Management Strategy

STRUCTURE PLAN
Wellington Lots 300, 301, 1 & Pt Loc 2426 Capel

- SUBJECT LAND
- STAGE BOUNDARIES
- EXISTING CADASTRE
- CONTOURS
- STRATEGIC FIREBREAK/ WALK TRAIL (4M)
- 1:100 YEAR FLOOD PLAIN
- CAPEL RIVER
- INDICATIVE DRAINAGE RESERVE LOCATIONS
- CATCHMENT BOUNDARY
- DUAL USE PATH

62.5m 0 125 250m
1 : 2500 @ A1 or 1 : 5000 @ A3
ALL DISTANCES ARE IN METRES

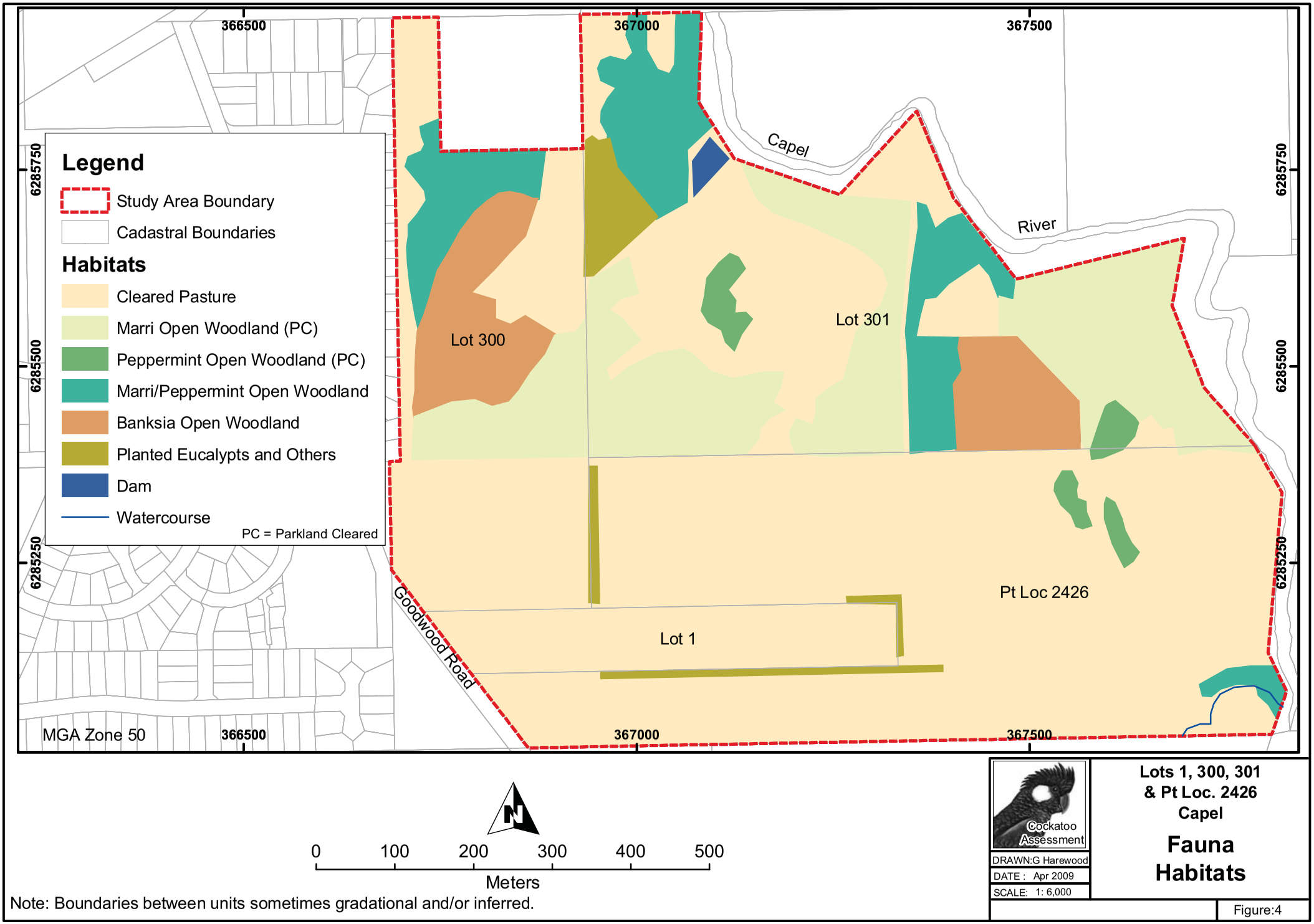
REVISION	DESCRIPTION	DRAFTER	DATE
J			
I			
H			
G			
F			
E			
D			
C			
B	Modify lot boundaries, Road widths	K.S.	19/05/2010
A	Modify lot boundaries, Policy text	J.W.	09/04/2010

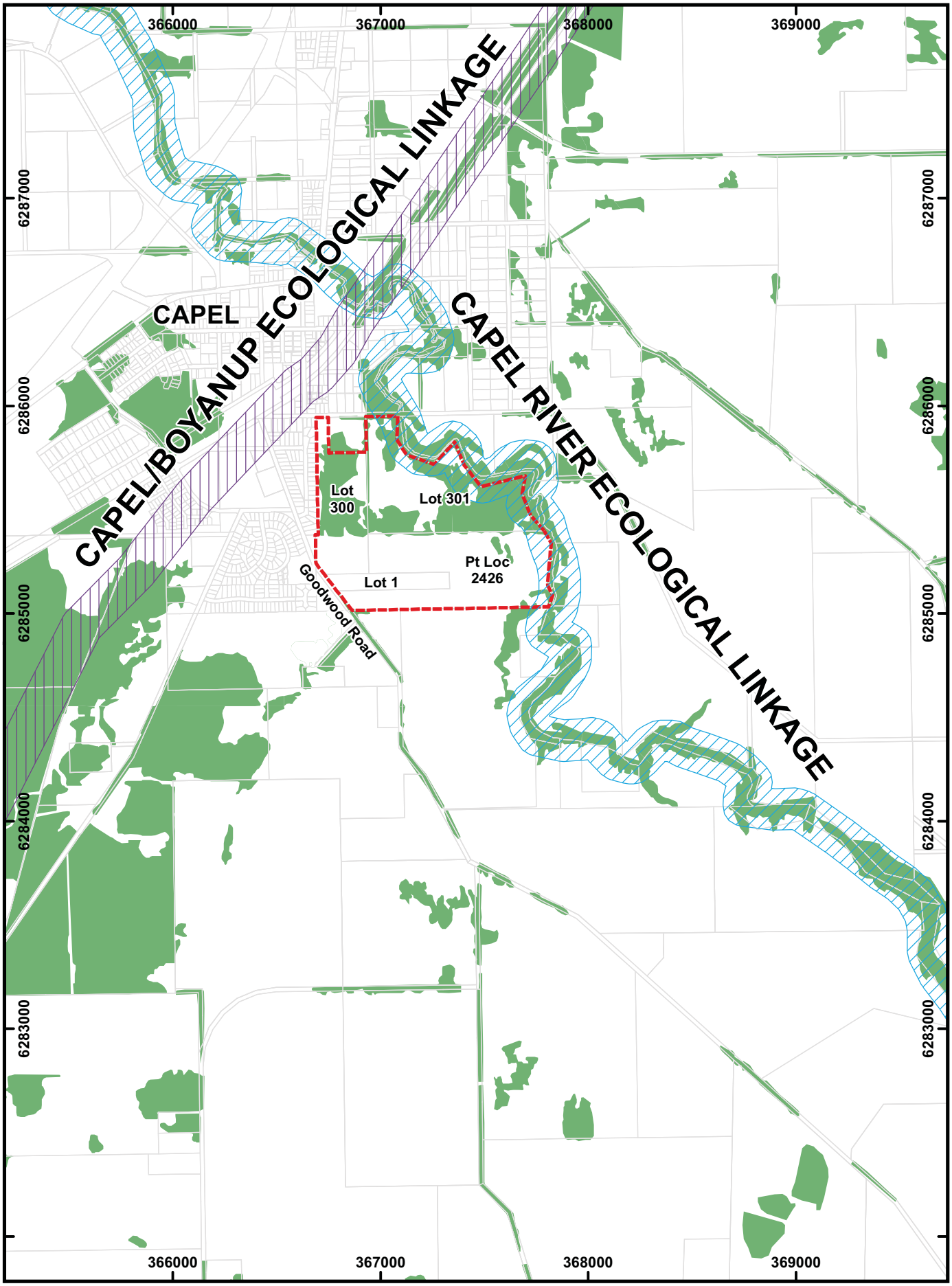
ORIGINAL PLANNER:	A.R.
ORIGINAL DRAFTER:	J.W.
CREATED DATE:	02/03/2010
AERIAL DATA:	ECW
CADASTRAL DATA:	MGA
TOPOGRAPHIC DATA:	MGA

09045P-SP-04B

THIS PLAN HAS BEEN PREPARED FOR PLANNING PURPOSES.
AREAS, CONTOURS AND DIMENSIONS SHOWN ARE SUBJECT TO SURVEY.

Thompson McRobert Edgeloe (08) 9791 4411 www.tme.net.au


366500
367000
367500
6285750
6285500
6285250
Capel
River
Lot 300
Lot 301
Pt Loc 2426
Lot 1
Goodwood Road
MGA Zone 50
Legend
Study Area Boundary
Cadastral Boundaries
Habitats
Cleared Pasture
Marri Open Woodland (PC)
Peppermint Open Woodland (PC)
Marri/Peppermint Open Woodland
Banksia Open Woodland
Planted Eucalypts and Others
Dam
Watercourse
PC = Parkland Cleared
0
100
200
300
400
500
Meters
Note: Boundaries between units sometimes gradational and/or inferred.
Cockatoo Assessment
DRAWN:G Harewood
DATE : Apr 2009
SCALE: 1: 6,000
Lots 1, 300, 301
& Pt Loc. 2426
Capel
Fauna
Habitats
Figure:4



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary

N

0 250 500 750 1,000

Metres

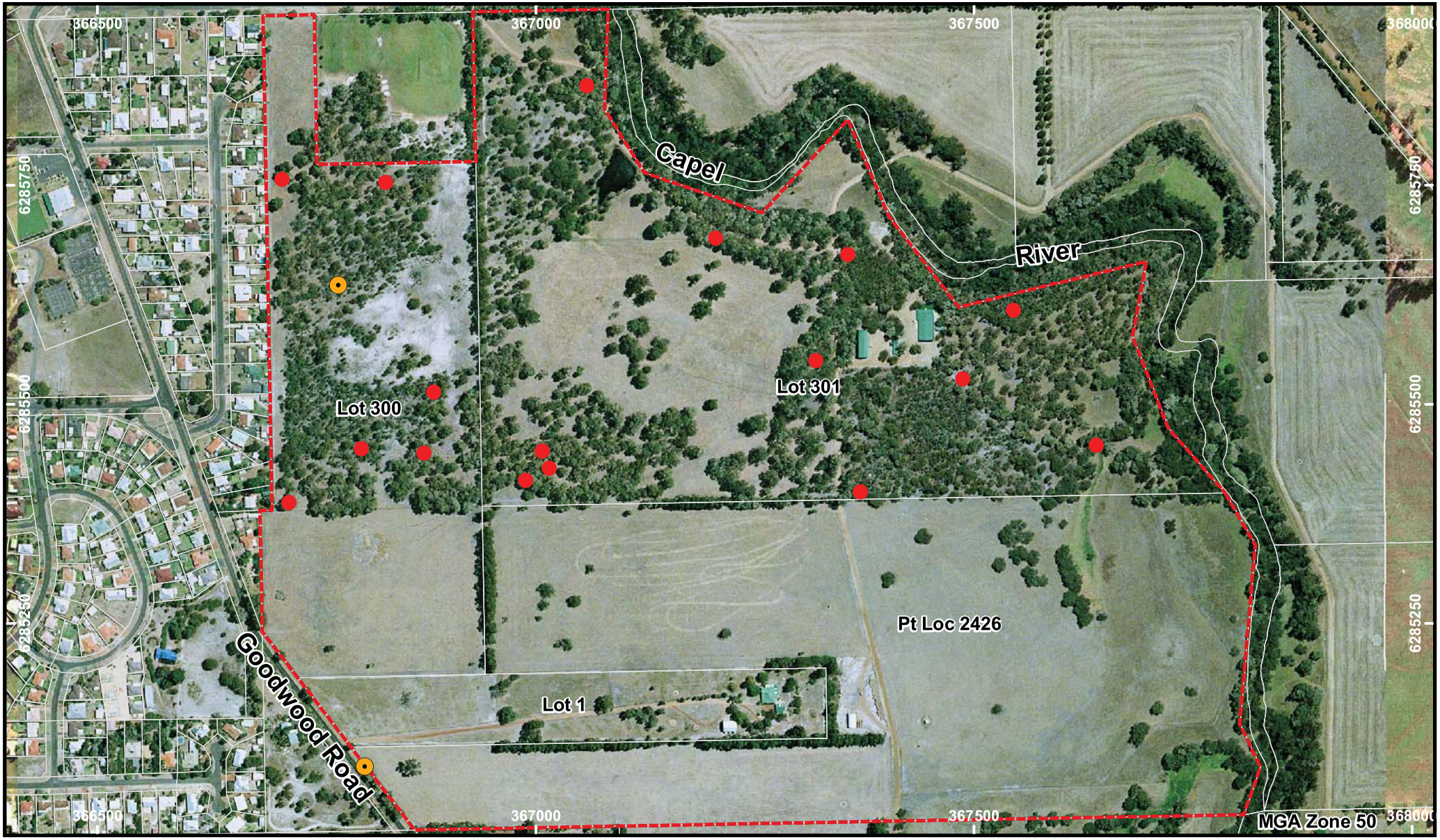
MGA Zone 50

Cockatoo Assessment

DRAWN:G Harewood	
DATE : June 2009	
SCALE: 1: 25,000	
From EPA (2003)	Figure: 5

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Remnant Vegetation and Ecological Linkages



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary
- Black Cockatoo Foraging Evidence
- Large Hollow

0 100 200 300 400 500

Metres

Cockatoo Assessment

DRAWN:G Harewood

DATE : Apr 2009

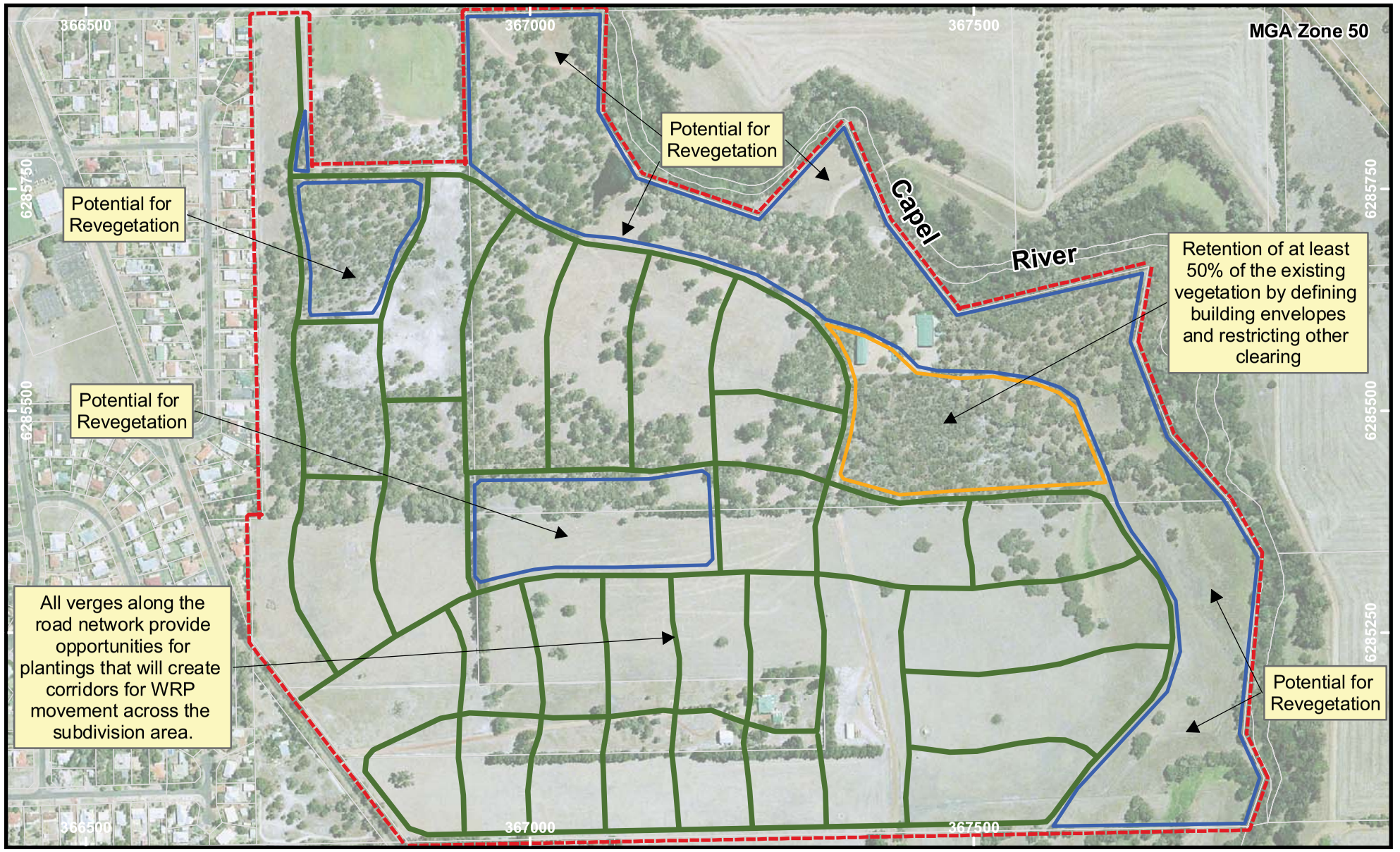
SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Diurnal Inspection 16th April 2009

Figure: 6



Legend

- Cadastral Boundaries (existing)
- Study Area Boundary
- R2.5 Boundary
- POS Boundaries
- Proposed Roads

N

0 100 200 300 400 500

Metres

Cockatoo Assessment

DRAWN:G Harewood

DATE : July 2010

SCALE: 1: 6,000

Air Photo Date 2007

Lots 1, 300, 301 & Pt Loc. 2426 Capel

Areas of Potential Vegetation Retention and Revegetation

Figure: 7

PLATES

Plate 1: Parkland Cleared Marri Open Woodland – Lot 301

Plate 2: Parkland Cleared Marri Open Woodland – Lot 300

Plate 3: Banksia Low Open Woodland over Kunzea Tall Shrubland – Lot 300

Plate 4: Marri Woodland over Peppermint Low Woodland – Lot 301

Plate 5: Evidence of Carnaby's Black Cockatoo Feeding on Marri

Plate 6: Evidence of Baudin's Black Cockatoo Feeding on Marri

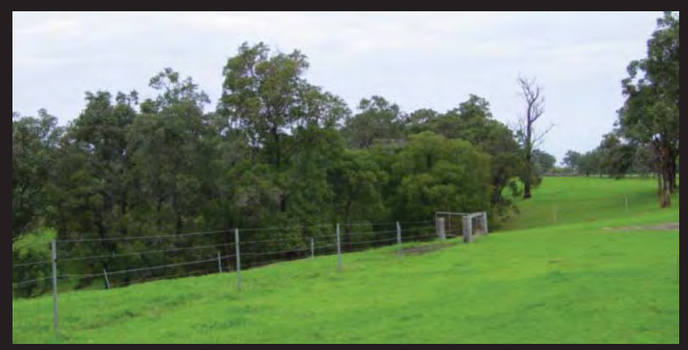
APPENDIX 5:

Local Water Management Strategy

Town Planning Management Engineering

SOUTH EAST CAPEL
Structure Plan

Local Water Management Strategy



town planning
management
engineering
environmental

09061
Decemeber 2012

Research, Design & Delivery of Sustainable Development

DOCUMENT QUALITY CONTROL

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DATE
December 2012

CHECKED BY
Brendan Oversby

DATE
Decemeber 2012

REVISION TABLE

Rev No.	PURPOSE	DATE
1	Address shire and DOW comments drainage study and latest Structure Plan included	21.01.2013
2	Council Approval for Advertising	08.03.2013
3	Amended to Shire and department of water comments	29.07.2013

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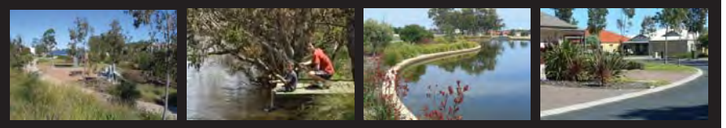


EXECUTIVE SUMMARY

The South East Capel Structure Plan Local Water Management Strategy (LWMS) articulates the range of management practices that are being considered for the proposed residential subdivision development site. The objective of this LWMS is to detail a development that manages the total water cycle in a sustainable manner. This includes water conservation, stormwater management, groundwater management and management of associated dependent ecosystems.

The Local Water Management Strategy has been prepared to support the South East Capel Structure Plan and satisfy the Shire of Capel's specific provision within their Town Planning Scheme No. 7 Appendix 16 for Amendment No. 25. The LWMS has been prepared to align with the principles and criteria of the Draft Capel Townsite District Water Management Strategy (Cardno, 2011).

The South East Capel Structure Plan is located off Goodwood Road, Capel within the Shire of Capel (the Shire) and has a total area of approximately 78.7 hectares. The subject land consists of four land parcels; being Lots 300 and 301 Barlee Road and Lots 1 and 2426 Goodwood Road, which are bounded by Barlee Road to the north, the Capel River to the east, Upson Road and Goodwood Road to the west and rural land to the south. The development adjoins the southern extent of the existing town of Capel (see *Figure 1)*.

The subject land has been extensively cleared and is currently used for agricultural purposes. The land has been used predominantly for cattle grazing. Lots 300 and 301 have retained large areas of remnant vegetation, however grazing has occurred beneath the native overstorey across these lots. Recent fencing of the native vegetation has assisted in alleviating the impacts and pressures that grazing had on the vegetation in the past.

The subject land has Multiple Use Wetlands distributed in the southern, western and eastern sections. The Capel River is adjacent to the eastern boundary of the development, with its associated floodplain located within the Structure Plan area. There is also a small intermittent stream located in the south-east corner of the subject land that is a tributary to the Capel River.

The developers are committed to the concepts and outcomes outlined within this LWMS for the South East Capel Structure Plan area. Including the implementation, monitoring and maintenance of the best management practices for stormwater designed specifically for this Structure Plan development.

PLANNING SUMMARY

The South East Capel Structure Plan design proposes to provide for a range of lot types and sizes. The base density of the subdivision will be 'Residential R20' with lots anticipated to be between 600 and 800m^2. In areas abutting public open space (POS) a density increase to 'Residential R40' and 'Residential R30' are planned. A retirement village (R40) is to be located within the development to provide a diversity of lifestyle opportunities for new residents. Two conservation style lots ('Residential R1') will be provided in the east of the development, with the objective to provide residential living with a priority to retain and conserve high quality vegetation within the lots. The building envelopes within the R1 lots will be set to minimise any disturbance to existing native vegetation. The POS and Reserve areas will provide a separation buffer for the regionally significant Capel River and existing ecological systems from the development. A Foreshore Management Plan is being developed for the foreshore reserve where the proposed development abuts the Capel River.

SUPPORTING DOCUMENTATION

The LWMS designs and models were compiled using information contained within the detailed assessments and reports undertaken for the subject land. These reports are listed below and have been included on the enclosed CD accompanying this LWMS.

- Black Cockatoo Management Plan Lot 1, 300, 301 and Part 2426 Capel. Greg Harewood
- South East Capel Structure Plan Drainage Study. TME, 2012
- Fauna Assessment (Level 1) Lot 1, 300, 301 and Part 2426 Capel. Greg Harewood, 2005
- Flora and Vegetation Lot 300, 301 and Part 2426 Capel. Bennett Environmental Consulting, 2006
- Foreshore Management Plan for South East Capel Structure Plan, Capel. TME, 2012
- South East Capel Structure Plan. TME, 2012
- Western Ringtail Possum Management Plan Lot 1, 300, 301 and Part 2426 Capel. Greg Harewood, 2009
- Winter Groundwater Level Investigation Lots 300, 301, 1 and Portion 2426 Goodwood Road, Capel. TME, 2004
- Draft Capel Townsite District Water Management Strategy. Cardno, 2011

Capel River foreshore from subject land

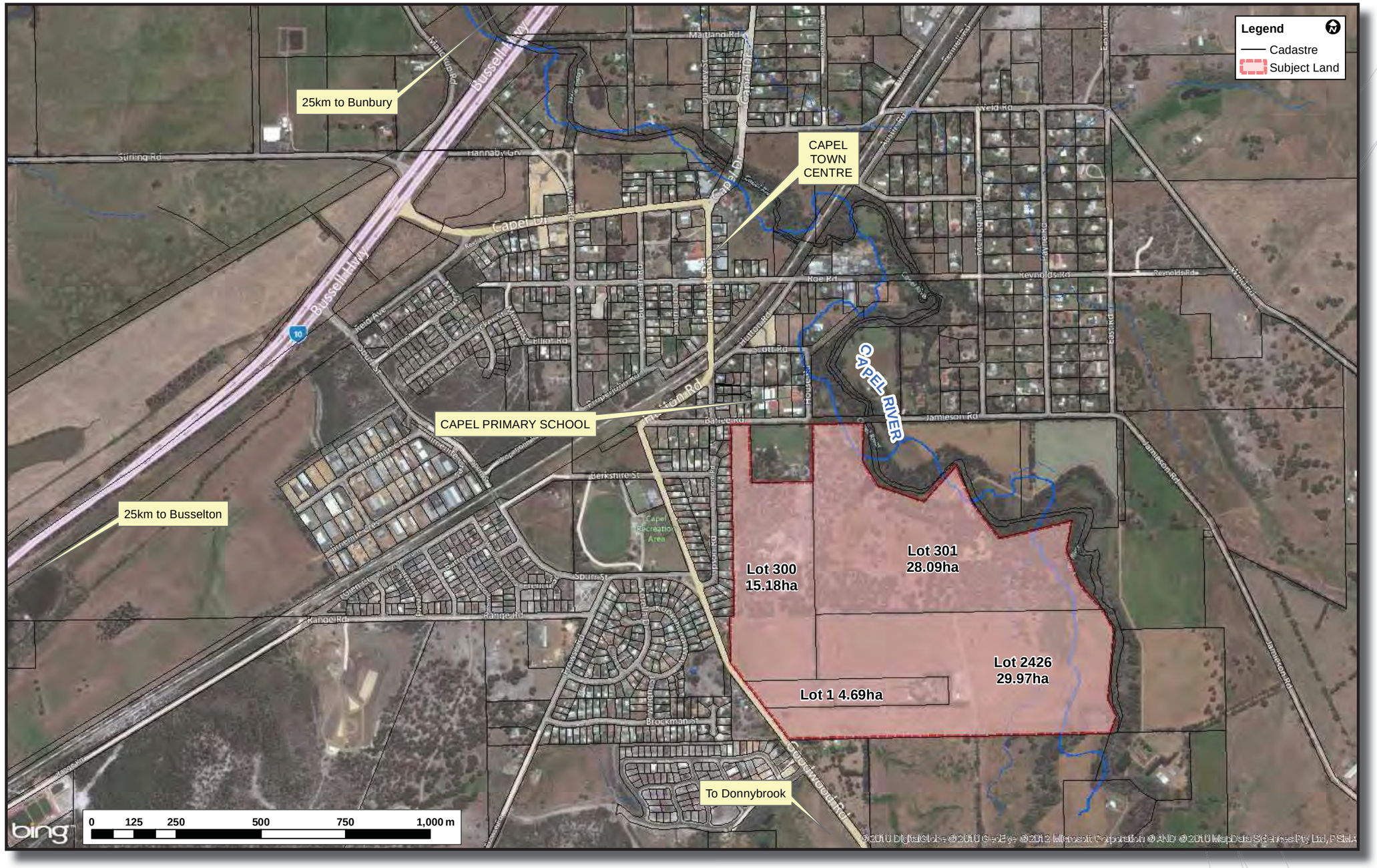
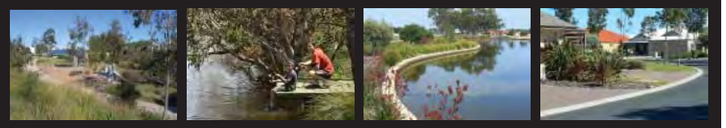


Figure 1 - Location Plan



1. KEY ELEMENTS

Water management for the South East Capel Structure Plan is based on best practice water sensitive urban designs appropriate for the site's constraints and the adjoining natural environment. This is achieved through maximising the sustainable use of water through the encouragement of water conservation and efficiency measures, managing stormwater to irrigate bioretention gardens and recharge groundwater, while reducing nutrient and sediment pollutants reaching the groundwater and surrounding ecosystems.

The proposed development site is part of the Capel River catchment. The development is located adjacent to the Capel River, which flows out to Geographe Bay. This LWMS details actions that will assist with protecting and enhancing these ecosystems through utilising best water management practices. These management practices will be linked with community awareness programs to assist households to implement their own best practice at a lot scale.

A summary of the water sensitive urban design (WSUD) elements that will be implemented within the development to achieve best management practices are outlined below, and summarised visually in the lodged Structure Plan represented in *Figure 2*. The key elements of the development outlined below achieve the objectives and design criteria identified within the DWMS.

Water Conservation

- Development to be connected to a reticulated water supply from Water Corporation;
- A target of 100KL per person per annum has been set for the residential subdivision;
- Encouragement of water efficient fixtures and fittings for all buildings constructed. A residential household on average per annum could save between 31 and 46KL inside the house alone using adequate water efficient appliances and fixtures;
- All residential lot owners will be encouraged to install a minimum 2,000 litre rainwater tank for potable and non-potable uses both inside and outside the dwellings. This sized tank could reduce the quantity of mains potable water required by a maximum of 63KL per annum;
- Provision of awareness raising material on water saving measures and benefits for new residents;
- Grey water reuse systems will be encouraged, especially to provide for garden water requirements. These systems could reduce effluent disposal in residential lots by 80 to 120KL per annum and save approximately 30KL per annum of mains potable water usage; and
- Public open spaces, multiple use corridors, bioretention units and street landscaping will have a strong focus on using locally suitable native Waterwise species. A target of 7,500KL/ha/year has been adopted for POS irrigation, based on DWMS recommendation.

Flood Protection

- All habitable floor levels on lots will be designed to maintain a minimum separation clearance of 300mm to the internal 1:100 year average recurrence interval (ARI) flood levels;
- All habitable floor levels on lots will be designed to maintain a minimum separation clearance of 500mm to the 1:100 year flood levels of the Capel River;
- Protection of buildings and infrastructure with conveyance and storage of flood waters via the open and piped drainage network and road reserves; and
- Discharge of 1:100 year flood flow rates to the Capel River via control spillways so not to cause adverse impacts on-site or downstream.

Stormwater Management

- Utilisation of WSUD to treat, store, convey, control and discharge stormwater runoff in a managed practice;
- Designs of drainage network to limit peak outflow rates from the development to comparable pre-development rates through on-site storage, infiltration and conveyance;
- Encourage non-structural best management practices;
- Installation of bioretention gardens within road reserves;
- Storage and treatment of the 1 year 1 hour event in road reserve that are as close to the source as possible;
- Construction of soak wells for each house within the imported fill, which will assist in reducing lot runoff into the stormwater network; and
- Monitoring of water quality post-development.

Water Quality and Environmental Protection

- Utilisation of water sensitive urban designs (WSUD), including bioretention gardens, detention basins, swales, and flow control devices to capture, detain, treat and convey all development runoff;
- The public open spaces will be planted predominantly with appropriate local native plants, and minimal grassed areas will be established to minimise the quantity of fertiliser application required;
- Establishment of appropriate management practices for the foreshore reserve along the Capel River, including the preparation and implementation of a Foreshore Management Plan (FMP) with a works time schedule;
- Provision of lot owners with information relating the establishment and maintenance of Waterwise and nutrient wise gardens in their required landscape areas on each development; and
- Monitoring of storm water outflow rates and quality post-development.

Groundwater Management

- Ensure development has no negative impact on the groundwater resource, or ecosystems dependent on the resource;
- Installation of sub-surface drainage pipe network at the Controlled Groundwater Level (CGL), to control groundwater from rising above this level;
- Ensure a minimum separation clearance of 1.2m from the road reserves to the CGL. This separation will further ensure that modelling of the groundwater mounding under the lots maintains a minimum 900mm separation clearance between the groundwater and lot levels;

- Pre-development monitoring of the groundwater levels and quality across the development to determine seasonal peak levels and any quality issues with the pre-existing subject land;
- Monitoring of the groundwater quality and levels across the subject land post development to identify any future detrimental impacts on the groundwater resource; and
- Use of soil amelioration products and treatment of water prior to infiltration, and ensuring that the surface water infiltrating into the groundwater is of an appropriate quality.

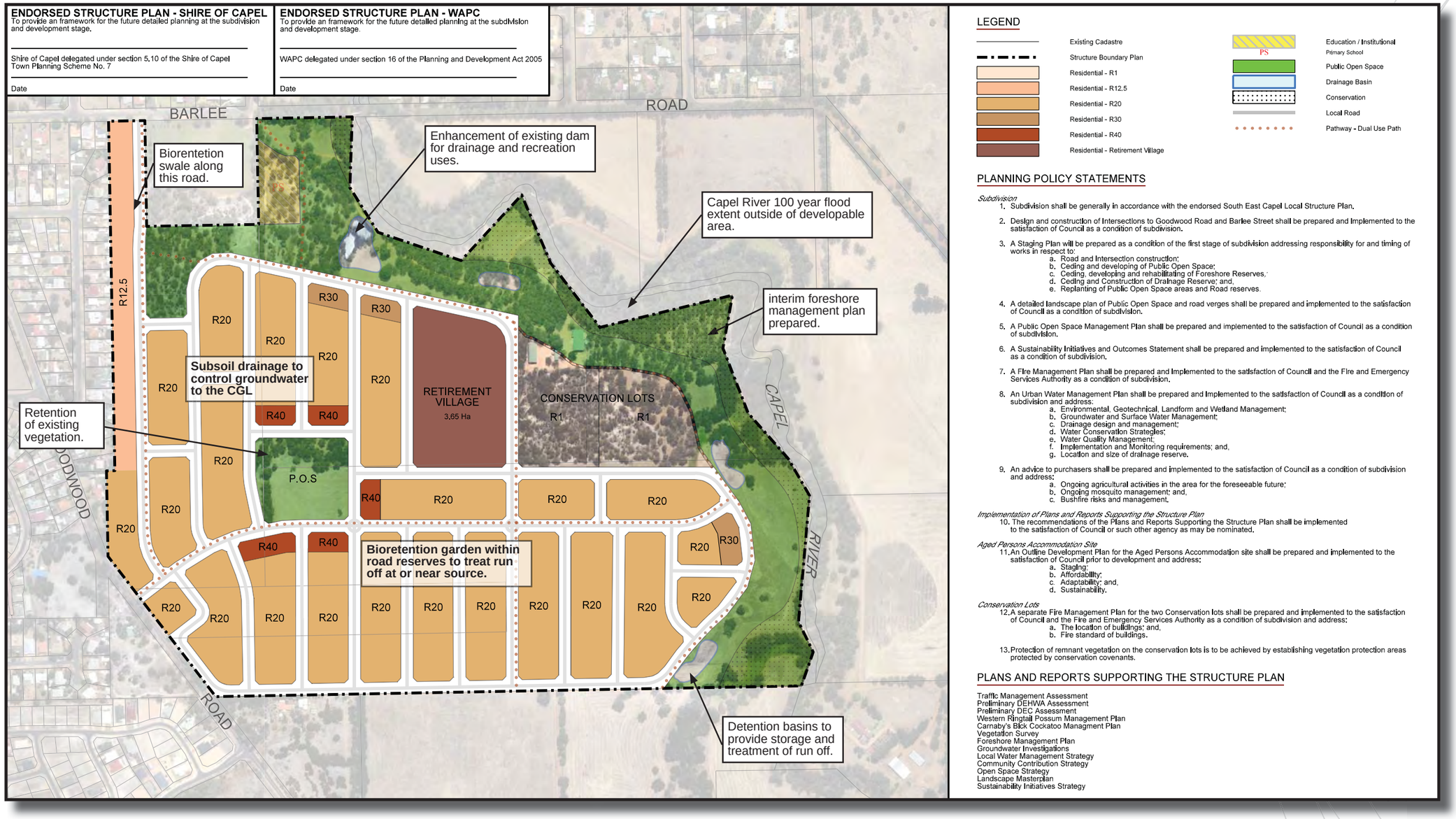
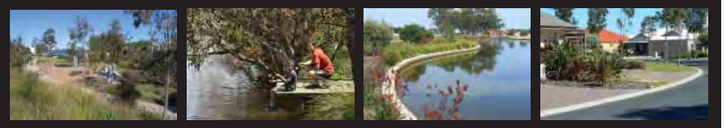


Figure 2 - Structure Plan with Key Element Notes



2. ENVIRONMENTAL

Fauna and vegetation survey reports have been prepared for the proposed subdivision site. Greg Harewood has undertaken a Level 1 Fauna Assemblage Survey Report, and management plans for the Black Cockatoos and Western Ringtail Possums. Bennett Environmental Consulting (BEC) has undertaken and prepared the Flora and Vegetation Survey Report. Furthermore the Environmental Protection Authority (EPA) undertook a site visit on the 8th March 2008 and provided comments regarding the site's environmental values.

The investigations led to discussions with the Department of Environment and Conservation (DEC) and resulted in the low density (R1) zoning for the two large lots (as shown in *Figure 2*). The extent of the Reserve along the Capel River was also reached in agreement with DEC to provide protection for the conservation value remnant native vegetation in that area.

TME undertook a site visit in June 2012 to investigate and determine any significant changes to the site's environmental conditions. The investigation included plant species and habitat identification, weed identification and impact, identification of any fauna values, identification of any possible waterway habitats and any incidental observations.

Wetlands
Multiple use classified wetlands occupy approximately 22.5 hectares, or 29 % of the subject land within the proposed development according to the Department of Environment and Conservation's (DEC) geomorphic wetlands dataset (see *Figure 3c*). Multiple use wetlands have few attributes which still provide important wetland functions and may provide only localised environmental values, predominantly to avifauna. Appropriate land use planning and the inclusion of best management practices in the development that are consistent with the principles of total water cycle management should ensure that appropriate measures outlined in *State Planning Policy 2.9 Water Resources (2006)* are followed.

There are three types of Multiple Use classified wetlands within the subject land.

1. Palusplain – seasonally waterlogged land on a flat terrain. Located predominantly in the south and western corner of the subject land. Approximately 20.4ha of the proposed development subject land.
2. Dampland – seasonally waterlogged land within a basin. Approximately 1.4ha in size and located in the western section of Lot 2426.
3. Floodplain – seasonally inundated land on a flat. Located within the 1:100 year annual recurrence interval (ARI) flood event, and approximately 0.8ha in size.

Capel River
The Capel River is adjacent to the development's eastern boundary. The vegetation within the riparian zone could be considered as good to excellent, with the higher quality vegetation along the narrow floodplain immediately either side of the river's channel. The vegetation is dominated by a thick native grass species layer of *Microlaena stipoides* (Weeping Grass) and *Adiantum aethiopicum* (Common Maidenhair) under a canopy of *Eucalyptus rudis* (Flooded Gum). There are areas along the bank covered in a dense grassland or herb land of weeds, and weeds were present over the majority of the river's length.

The EPA commented on an area near the dam, as "it is possible that this vegetation is close to that of the original vegetation of the River".

The Capel River has been identified by the EPA in the Greater Bunbury Region Scheme as a regionally significant riverine ecological linkage, and the subject land is also in the vicinity of the regionally significant east-west Capel/Boyanup ecological linkage.

The Capel River is cultural significant for the southwest Aboriginal communities. The river is very important both in a practical and spiritual sense. The Capel River is a registered mythological and historical Aboriginal site (Site ID 20061), and has open access and no restrictions placed upon the site.

Fauna
The subject land has large portions that are cleared or degraded and consequently the diversity of fauna species has reduced dramatically since prior to disturbance. Habitat degradation has occurred from partial clearing, altered fire regimes and predation by introduced species. The site was found to provide suitable habitat for a number of bird species. The presence of three significant fauna species was also recorded at the site, the threatened Western Ringtail Possum (*Pseudocheirus occidentalis*), the vulnerable Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and the vulnerable Forest Red-tailed Black Cockatoo (*C. banksii naso*). Management plans for these species have been prepared (*see Figure 3a*).

Vegetation
Approximately 67% (approximately 52.1ha) of the subject land contains cleared pasture land or planted vegetation, where the vegetation condition varies from degraded to completely degraded. There is also approximately 25.8ha (approximately 33 %) of remnant vegetation on the subject land, which varies in vegetation condition from excellent to degraded.

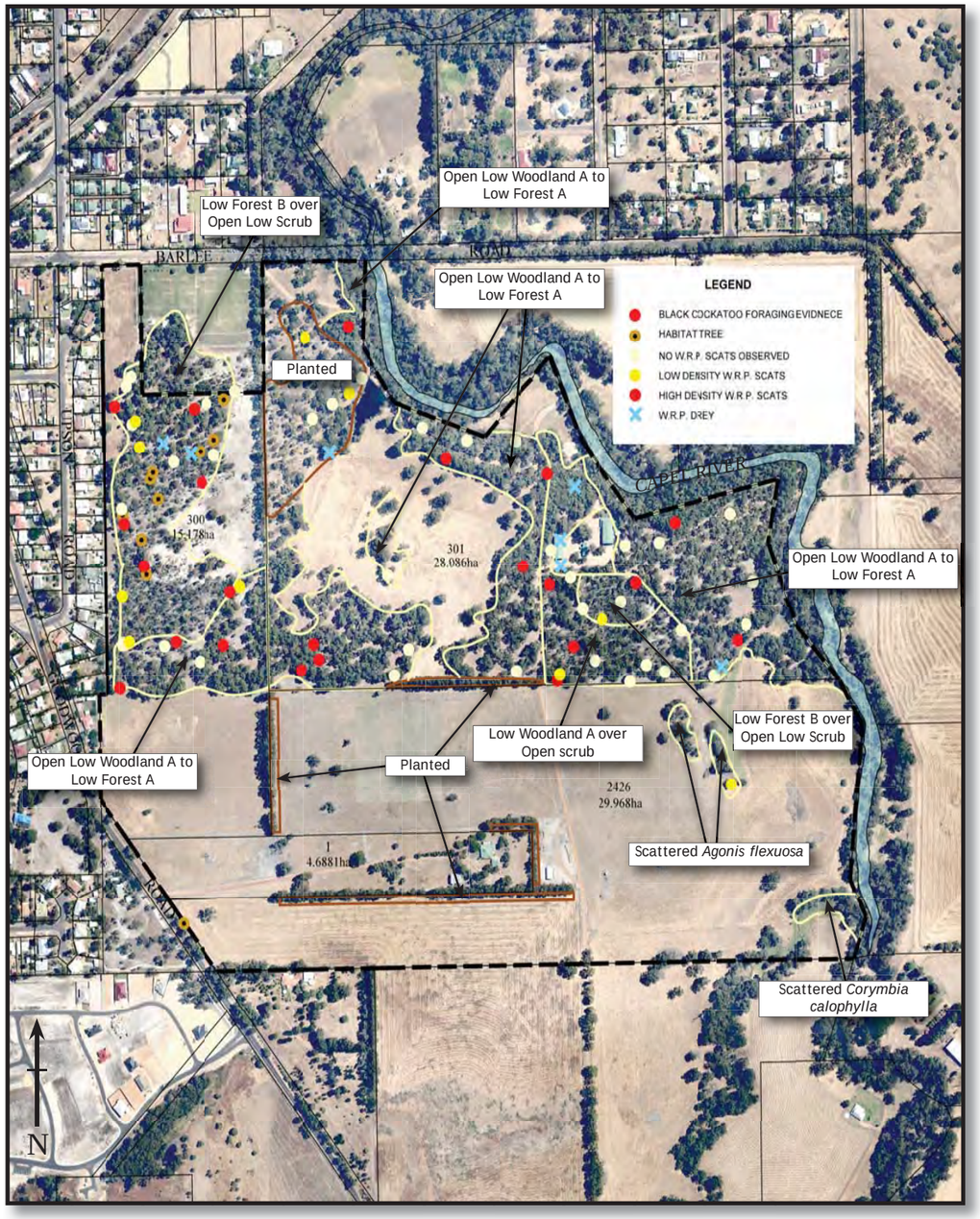
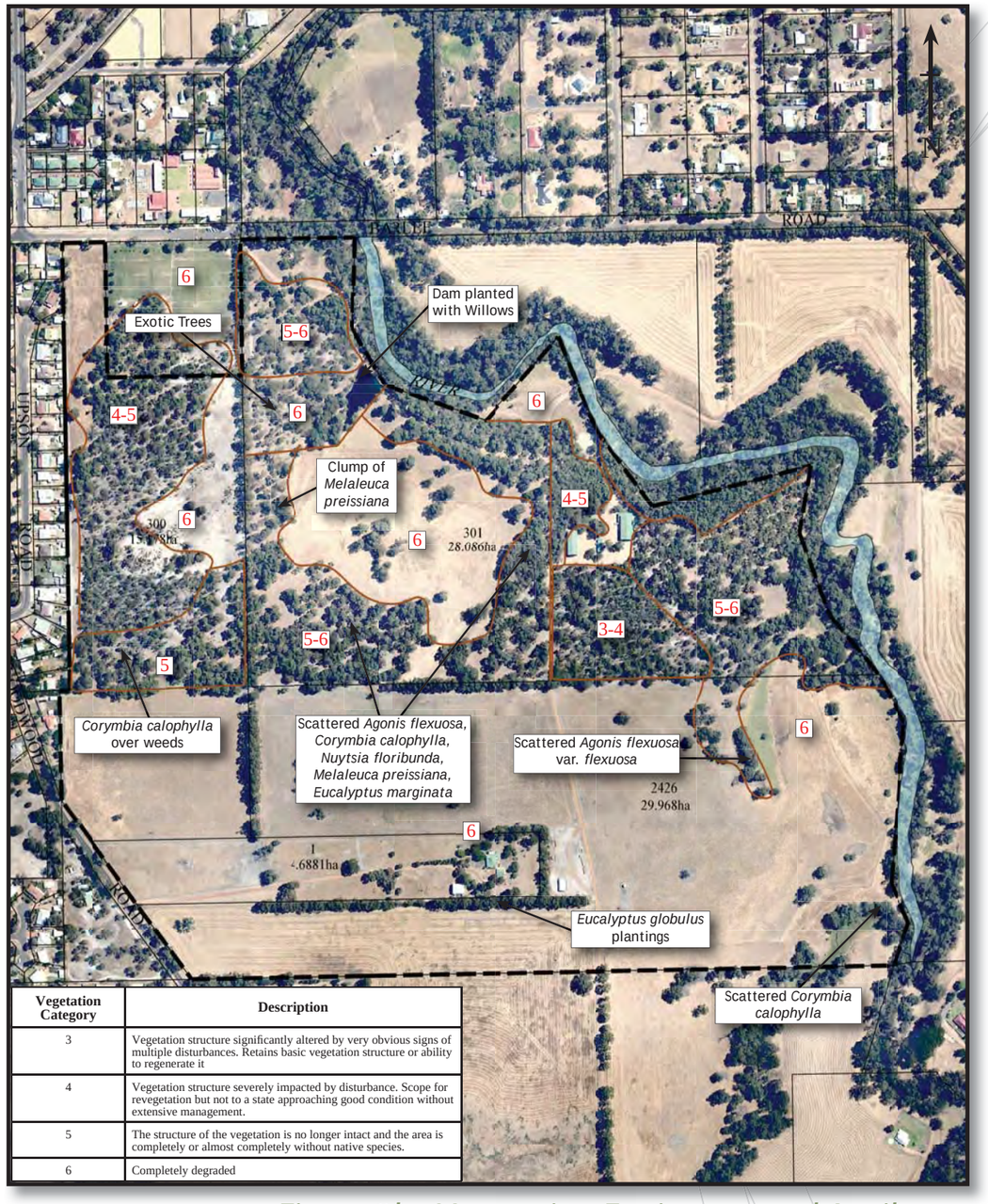
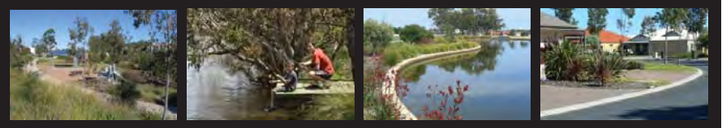


Figure 3a - Fauna Environmental Attributes



Vegetation Category	Description
3	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it
4	Vegetation structure severely impacted by disturbance. Scope for revegetation but not to a state approaching good condition without extensive management.
5	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.
6	Completely degraded

Figure 3b - Vegetation Environmental Attributes



Three vegetation units were identified in the Flora and Vegetation Survey on the subject land (see *Figure 3b* for their locations):

(1) Low Woodland A of *E. marginata*, *Agonis flexuosa*, *Corymbia calophylla* and *Xylomelum occidentale* over Open Scrub of *Kunzea glabrescens* over Low Heath D dominated by *Hibbertia hypericoides* over Very Open Low Grass and Sedges.

(2) Low Forest B of *E. marginata*, *Banksia attenuata*, *K. glabrescens* over Open Low Scrub of *Melaleuca thymoides* over Herbs dominated by the weedy species *Romulea rosea* and *Hypochaeris glabra* and/or Low Grass of the weed species *Briza maxima*.

(3) Open Low Woodland A to Low Forest A of *C. calophylla* and *A. flexuosa* over Tall Grass and Low Grass of pasture species.

The Capel River was not assessed in the survey. The river vegetation is discussed within the Capel River sub-section.

Weeds were observed across the majority of the subject land, with 8 highly rated invasive environmental weeds recorded (listed below). There is a full list of weeds recorded at the site in the Flora and Vegetation Report and Foreshore Management Plan for the subject land.

The 8 highly rated invasive environmental weeds recorded were:

1. *Asparagus asparagoides* (Bridal Creeper)
2. *Bromus diandrus* (Great Brome)
3. *Ehrharta calycina* (Perennial Veldt Grass)
4. *Freesia* hybrid
5. *Romulea rosea* (Guildford Grass)
6. *Sparaxis bulbifera* (Harlequin Flower)
7. *Watsonia meriana* var. *bulbillifera* (Bugle Lily)
8. *Zantesdeschia aethiopica* (Arum Lily)

Very good condition Low Jarrah woodland within fenced area

Section of the Capel River adjoining the subject land

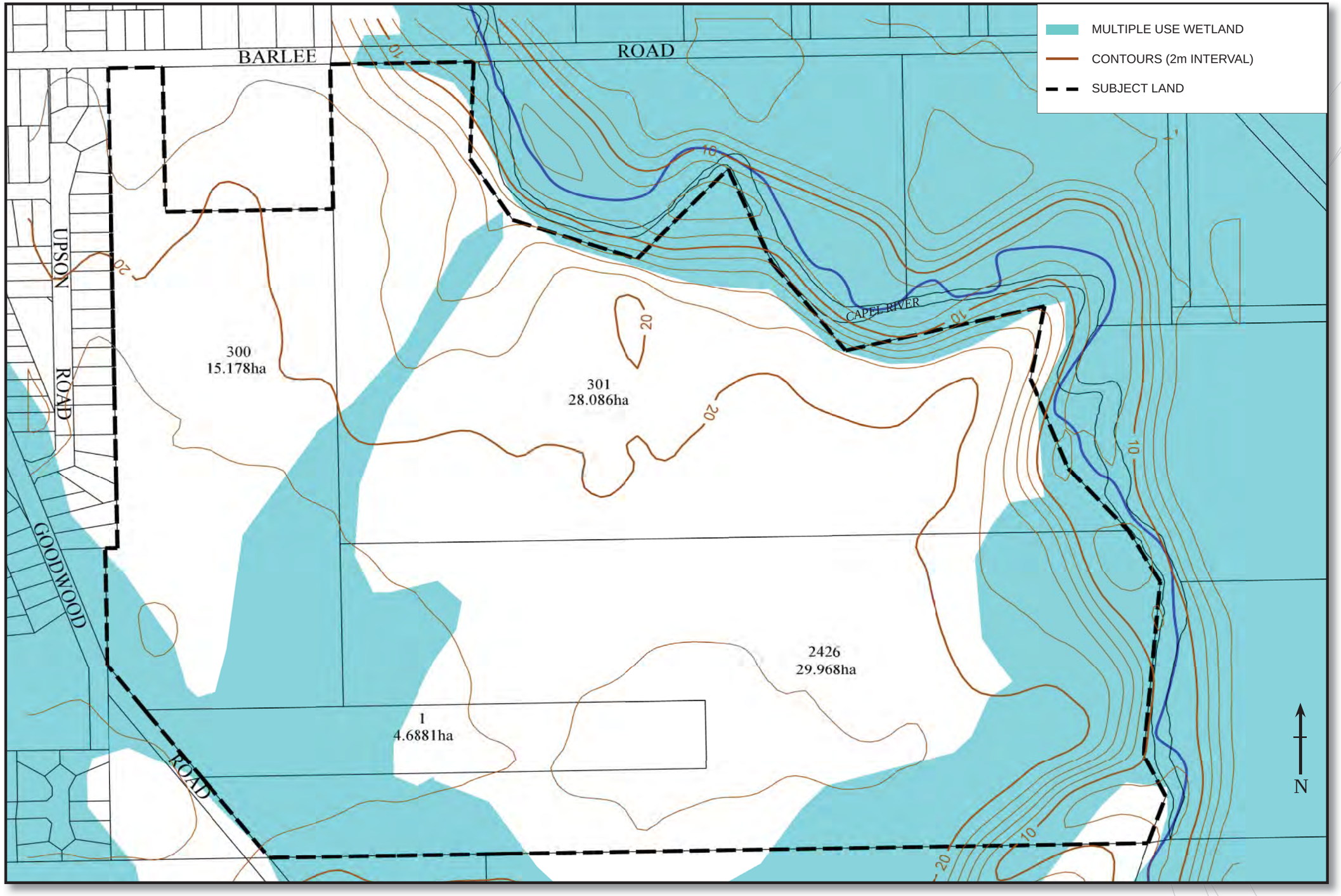
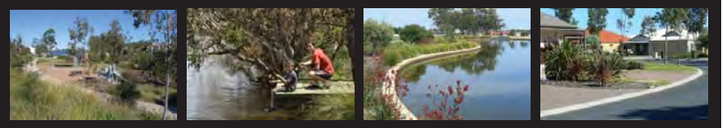


Figure 3c - Geomorphic Wetlands (DEC)



3. GEOTECHNICAL

No geotechnical investigation of the site has currently been undertaken. A groundwater level investigation in 2004 did provide basic soil profile information at 13 test pit sites to a maximum depth of 1.5 m across the subject land. The location of the test pits and field permeability tests are illustrated on *Figure 4B*. A geotechnical investigation will be undertaken as the planning stage progresses to support detailed drainage and Urban Water Management Plans.

Soil Type
The test pit records indicated that the soils were similar to the descriptions provided by the Department of Agriculture and Food for the subject land. Grey and yellow sands were found across most the site, with sandy-clayey soils observed below the sandy soils at most test pits. Excavations at three pits were recorded with a comment "Refusal (coffee rock)", at varied depths.

The Department of Agriculture and Food describes the land as:

- **Bassendean B1 Phase:** Extremely low to very low relief dunes, undulating sand plain and discrete sand rises. Deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater then 2m. This area is located in the north-west corner of the subject land.
- **Bassendean B2 Phase:** Flat to very gently undulating well drained sand plain on the surface. Deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1 to 2m. This occupies the majority of the subject land outside of B1.
- **Pinjarra P10:** Gently undulating to flat terraces adjacent to major rivers, but below the general level of the plain, with deep well drained uniform brownish sands or loams subject to periodic flooding. This occurs predominantly adjacent or within the Capel River.

The following soil-landscape subsystem classifications only occur on small areas of the subject land, but some of the Capel River and the land adjacently east of the river are described as:

- **Pinjarra P1a Phase:** Flat to very gently undulating plain. Imperfect to poorly drained and generally not susceptible to salinity. Deep acidic mottled yellow duplex soils. Shallow pale sand to sandy loam over clay. Located along the Capel River and upon land adjacent to the east of the river.
- **Pinjarra P6c Phase:** Very gently undulating alluvial terraces and fans. Moderate to moderately well drained uniform friable brown loams, or well structured gradational brown earths. Located within the seasonal watercourse in the south-east corner of the subject land. The land will not outside the development area.
- **Bassendean B1b Phase:** Very low relief dunes of undulating sand plain with deep bleached grey sandy A2 horizons and pale yellow B horizons. Located in the south-west corner of the development.

Acid Sulphate Soils (ASS)
The Department of Environment and Conservation (DEC) acid sulphate soil risk mapping has classified the site predominantly as a moderate to low disturbance risk area (within 3 metres of the surface). The definition from DEC regarding this ASS classification is; generally the ASS are highly localised or sporadic within this classification, and if ASS is present it may be close to the surface or buried by many metres of alluvium or windblown sand. Most landforms under this classification are not expected to contain ASS.

The land surrounding the Capel River and the two seasonal watercourses that link to the Capel River have been classified as high to moderate disturbance risk, within 3 metres of the surface (see *Figure 4A*). In these environments ASS can be widespread or sporadic. They may be very close to the surface or buried below many metres of alluvium or windblown sand. Base sediments of estuaries, rivers, creeks and lakes are also considered areas of high risk of ASS occurrence.

No formal investigation into ASS on the subject land has been undertaken. Detailed ASS investigations and management plans may be required prior to any subdivision approvals.

Phosphorus Retention Index (PRI)
The PRI for the site has not been tested. The Bassendean subsystems generally have a low risk of phosphorous loss (medium to high PRI), however the Pinjarra P10 subsystem has a 32% potential for extreme loss (low PRI) and 8% potential for very high loss (low to medium PRI). Majority of the Pinjarra subsystem is within the Capel River Reserve area, however investigations of PRI and dewatering may be required for drainage basins within this area.

PRI testing is recommended by the Department of Water because of the extent and density of development for the structure plan and the potential increases of total nutrient loads.

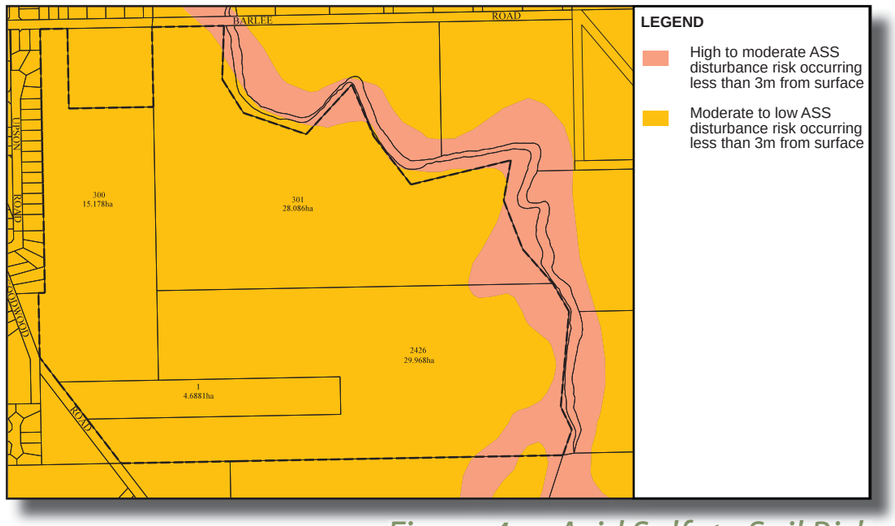


Figure 4a - Acid Sulfate Soil Risk

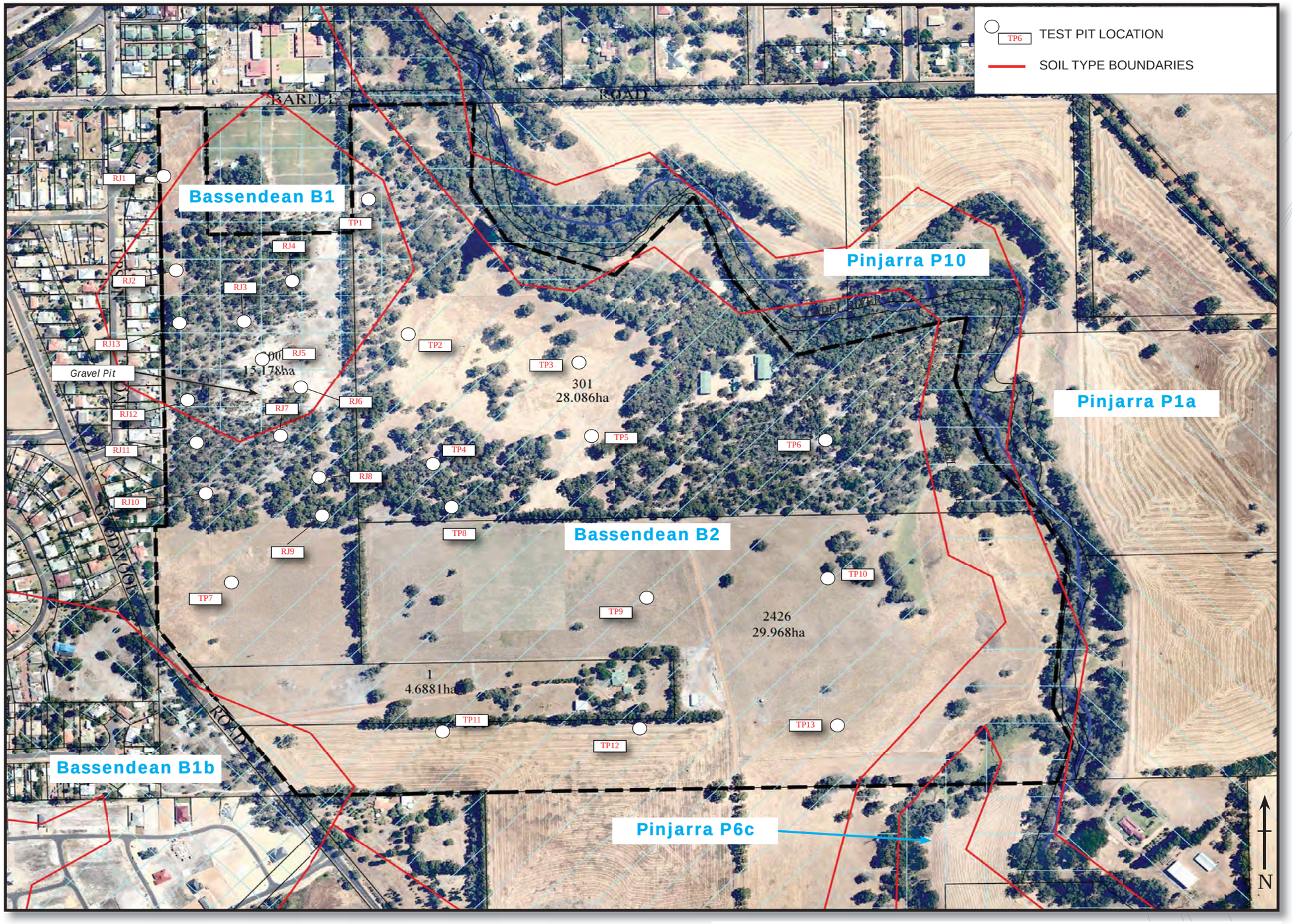
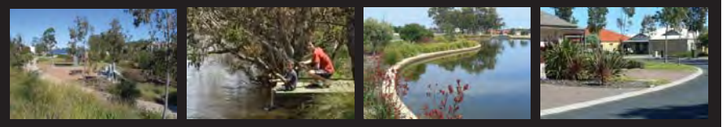


Figure 4b - Geotechnical Characteristics



4. LANDFORM

The South East Capel Structure Plan site is comprised predominantly of gently undulating land, with a general north-east facing slope towards the Capel River. The river valley is well defined, with a moderate to steep embankment clearly distinguishing the valley from the uplands.

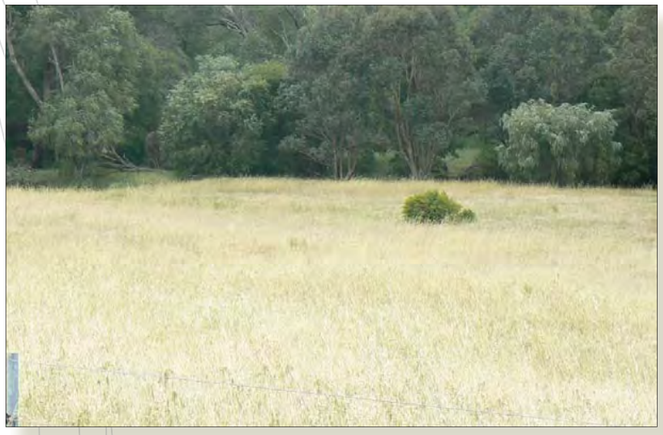
The upland areas across the development site have an elevation variation of approximately 5 metres, with the highest land approximately 24m AHD and the lowest land outside of the river valley, approximately 19m AHD (see *Figure 5*). The general slope across the upland area is facing east or north-east into the Capel River. A small section in the far west and in the north-west of the site, Lot 300, has slopes that face north-west with a gentle gradient away from the Capel River.

The Capel River is adjacent to the eastern boundary of the development, and flows generally in a northerly direction. It is ultimately the current drainage point for the majority of the site. There are two small floodplains on the river within the development site, which have very little remnant vegetation, and a defined vegetated floodway along the remainder of the river adjacent to the subject land.

The land within the river's floodway is narrow and relatively flat, then rises moderately steeply up the embankment and onto the gently undulating uplands of the development site. The embankments into the Capel River are predominantly east or north-east facing.

There are three small seasonal watercourses within the development site (see Figure X). The largest of which is located in the south-east corner of the site, and is a tributary of the Capel River. The valley has a steep embankment, with a narrow dominant channel surrounded by a broad floodway.

To the north of this watercourse there is another seasonal watercourse, which is dependent on groundwater expressions within the dampland wetland. This is a direct tributary to the Capel River. The third watercourse is a small area of a gently sloped depression located in the north of the site, within Lot 301. This depression forms a channel for groundwater expressed at the surface, and flows north-east into the dam located within Lot 301, and is on the verge of the Capel River valley.



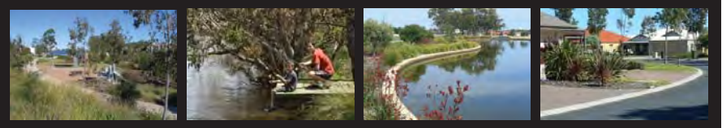
Floodplain located in the south of subject land

Dampland in the foreground with Agonis flexuosa along the edge of the dampland

General upland cleared land across the subject land

Steep slopes down from the upland into the southern seasonal watercourse

Figure 5 - Landform Characteristics



5. SURFACE WATER (PRE-DEVELOPMENT)

The South East Capel Structure Plan area is adjacent to the Capel River. The Capel River catchment is 653km2, of which approximately 60 per cent is cleared. The catchment has experienced a decline in annual rainfall since the 1970s, consistent with the trend in many locations in the south west of WA. Flow-duration analysis at the Capel Railway Bridge (approximately 1.3 km downstream of the subject land) suggests that the river is a steady perennial watercourse with large groundwater contributions. The Capel River is part of the larger Geographe Bay catchment.

Hydrology investigations in 2008 into the Capel River (DoW, 2008) at the Railway Bridge documented that the stream flow is highly seasonal, with 90% of the mean annual flow of approximately 45GL occurring from June to October. A lag period of approximately a month was observed between the peak rainfall and peak flow, which suggests a large soil storage capacity influences flows. Groundwater contributions were predominantly from the Leederville Aquifer and groundwater is the dominant source of flow for this section of the river between January and March.

There are three seasonal watercourses located on the subject land, they are listed below and *Figure 6* visually depicts the watercourses and other surface water features onsite.

1. A seasonal watercourse with groundwater contributions in the south east corner of the subject land within a valley consisting of steep embankments, a broad floodway and a narrow main channel. The watercourse's source is a Sump land south west of the subject land, and traverse cleared agricultural land before reaching the subject land. The confluence of the watercourse with the Capel River abuts the development's south east boundary.
2. A low flowing seasonal watercourse with predominantly groundwater contributions from the Dampland on the subject land. The watercourse is a small flat channel that meanders into the Capel River. The Dampland is a basin within the landscape that is seasonally waterlogged. *Threskiornis molucca* (Australian White Ibis) and *T. spinicollis* (Straw-necked Ibis) were observed foraging on the Dampland during a field investigation in November 2009, but no surface water was present at that time.
3. A seasonal watercourse channel of groundwater expressed at the surface in the north of the subject land. A slight depression in the landscape channels the water into the dam on Lot 300. The dam in the north of the subject land is perennial, with the source being predominantly this watercourse. The existing access track for the property is used as the dam wall with the only discharge from an outlet pipe located on the Capel River side of the road. The discharge from the pipe has altered the landscape and vegetation downhill because the natural path of the water has been altered. There was active and past erosion observed at the outlet, however the presence of vegetation and a rock wall has minimised the impact of the erosion.

A 1:100 year ARI flood study was supplied by the Department of Water for the entire subject land, shown in *Figure 6*. The steep sides that contain the Capel River adjacent to the subject land limit the flood extent to predominantly within the Capel River valley. The two floodplains within the subject land are the only areas affected by the 100 year ARI flooding, and these will be included within either the Foreshore Reserve or Public Open Space.

Dam in the north-east of the subject land (looking to the west from the track above the Capel River)

Discharge pipe from the dam into the Capel River gully

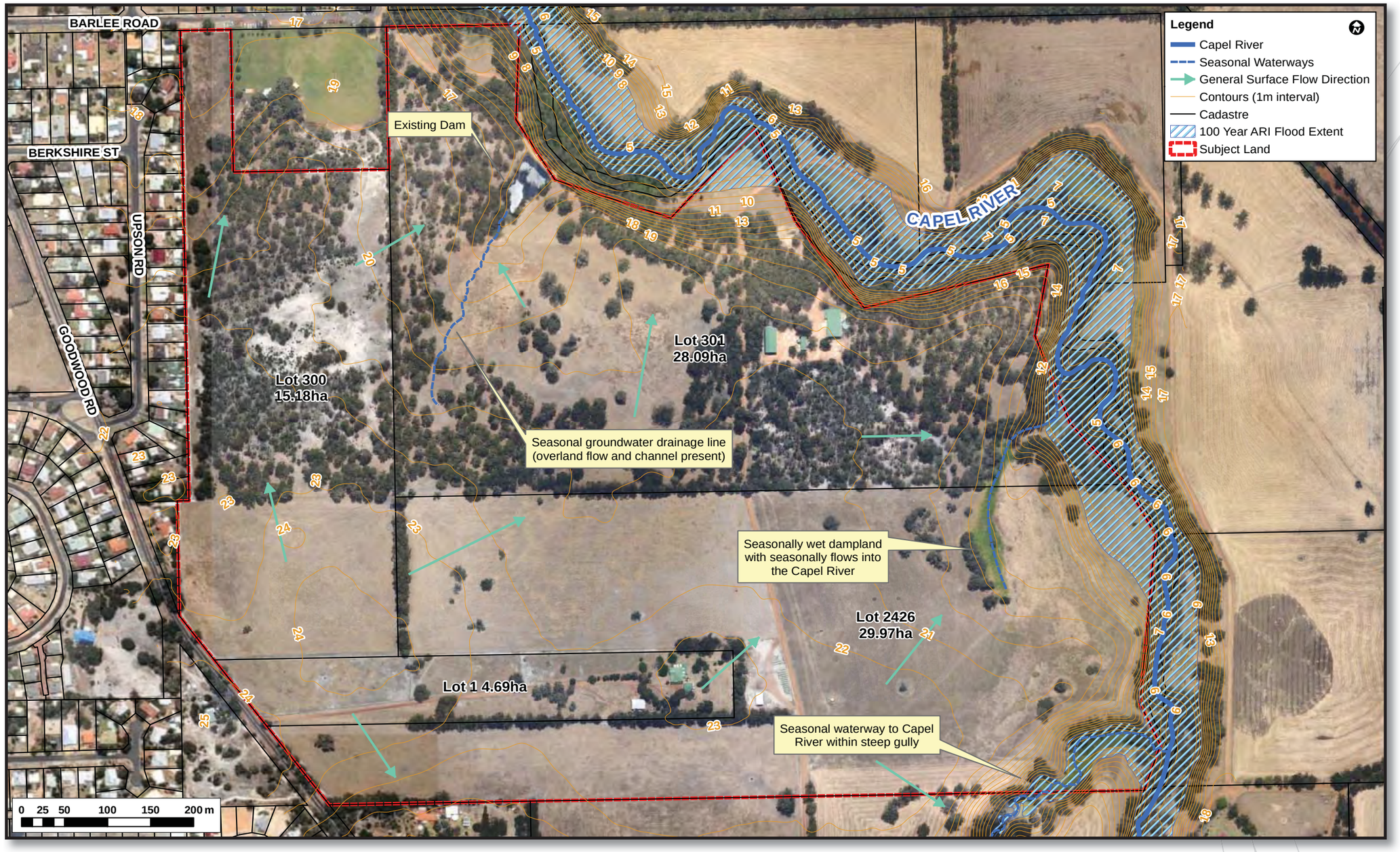
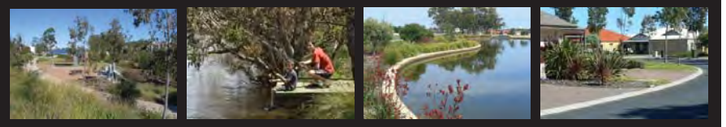


Figure 6 - Surface Water Characteristics



6. GROUNDWATER (PRE-DEVELOPMENT)

Groundwater levels were initially investigated in 2001 by Thompson Consulting Surveyors. 13 monitoring bores were installed on the northern section of Lot 300. A further 13 test pits were excavated and surveyed across the remainder of the subject land in 2004, and 9 of the 13 monitoring bores installed were remeasured. In 2012 TME commenced a groundwater levels and quality monitoring program that involved 13 sites to determine baseline data for the land pre-development. The original and new monitoring bore sites and test pit locations are illustrated on *Figure 7*.

The initial investigation by Thompson Consulting Surveyors involved three readings taken between August and September 2001. The depth to groundwater levels varied across the Lot, with a seasonal peak groundwater level (SPGL) of 280mm below natural surface level (BNSL) recorded at monitoring bore RJ1 in late August and in September 2001. Six of the monitoring bores had no groundwater present within their holes.

The 2004 groundwater measurements at the same monitoring bores were undertaken in late September. The 2004 winter rainfall was close to average, however the September rainfall was below average. The SPGL was 650mm BNSL at monitoring bores RJ1 and RJ2, and no groundwater was recorded within bore RJ4.

The test pit groundwater observations occurred in late September 2004. The groundwater levels on Lot 2426 ranged from 1500mm below the surface in the western section to 500mm below the surface in the eastern section, with the majority of the sites being recorded with a groundwater level lower then 1000mm. No groundwater was observed on 4 of the 7 pits on Lot 301, with levels around 1000mm recorded in the uplands in the south-west and a groundwater level of 500mm below the surface just south of the dam.

From the 2004 results and in comparison to the Department of Water (DoW) monitoring bores in 2004 the preliminary engineering requirements determined that the groundwater levels observed from the test pits should be adjusted 100mm higher as basis for the SPGL for the subject land. The current groundwater levels monitoring program for the subject land will provide current information relating to the seasonal groundwater level peaks. The past data and DoW bore will be investigated in conjunction with the groundwater levels monitoring programme to determine the correlation and relationships present. The 2012 results have been included on Figure 7, however due to the low rainfall during that year they are suggested to not be an accurate representation of long-term average levels for the subject land. Monitoring will continue throughout 2013 to refine the baseline levels and quality for the land.

The Dampland wetland located in the east of the subject land, and the lands uphill of the dam in the north were both identified as expressing groundwater at the surface during certain periods of the year. Both areas were identified in the September 2004 groundwater level investigation as having groundwater within 500mm of the surface, and incurring heavy infiltration of water into the excavated pits.

The general direction of the groundwater flow is towards the Capel River as shown by the groundwater contours modelled in *Figure 7*. The groundwater contours and depth to the seasonal peaks will be revised at the completion of the current monitoring program. All quality results will be analysed and compared to relevant ANZECC and Department of Water trigger values. The sandy to clay soils and gentle slopes indicate that limited infiltration of rainfall into a deeper groundwater aquifer is most probable.

Deeper Aquifers

The subject land is within the Busselton - Capel Groundwater area, and the Busselton – Capel Superficial and Leederville aquifers sub area, and the Busselton - Yarragadee aquifer sub area (DoW, 2009b). The Capel River receives significant contributions to water flow from the Leederville Aquifer, and groundwater contributions are the dominant source of flow between January and March. The South West Groundwater Allocation Plan (DoW, 2009c) recognises the importance of the hydrogeological influences on the Capel River and is classified as Management Zone 5. An implication of the Management Zone is that a maximum groundwater allocation of 10,000KL per year from a draw point within 500m of the Capel River is allowed only. The Superficial aquifer is fully recharged and saturated during the winter months in the sub-area. The depth of the Leederville Aquifer in the sub-area ranges from 15 to 200m below the ground level (or below the Superficial Aquifer).

The Busselton – Yarragadee aquifer is fully allocated (DoW, 2009b) and correspondence with Julian Woodward, at the Department on the 4th April 2013 provided information that the Leederville aquifer had 377ML available and the Superficial aquifer had 2,562ML available. The quality and quantity of groundwater available across the superficial aquifer is variable and may not be reliable below the subject land.

Land uphill of the dam, where groundwater is close to or expresses at the surface (the grass was green in this section compared to brown across the majority of the subject land at the time of the photo – 20th November 2009)

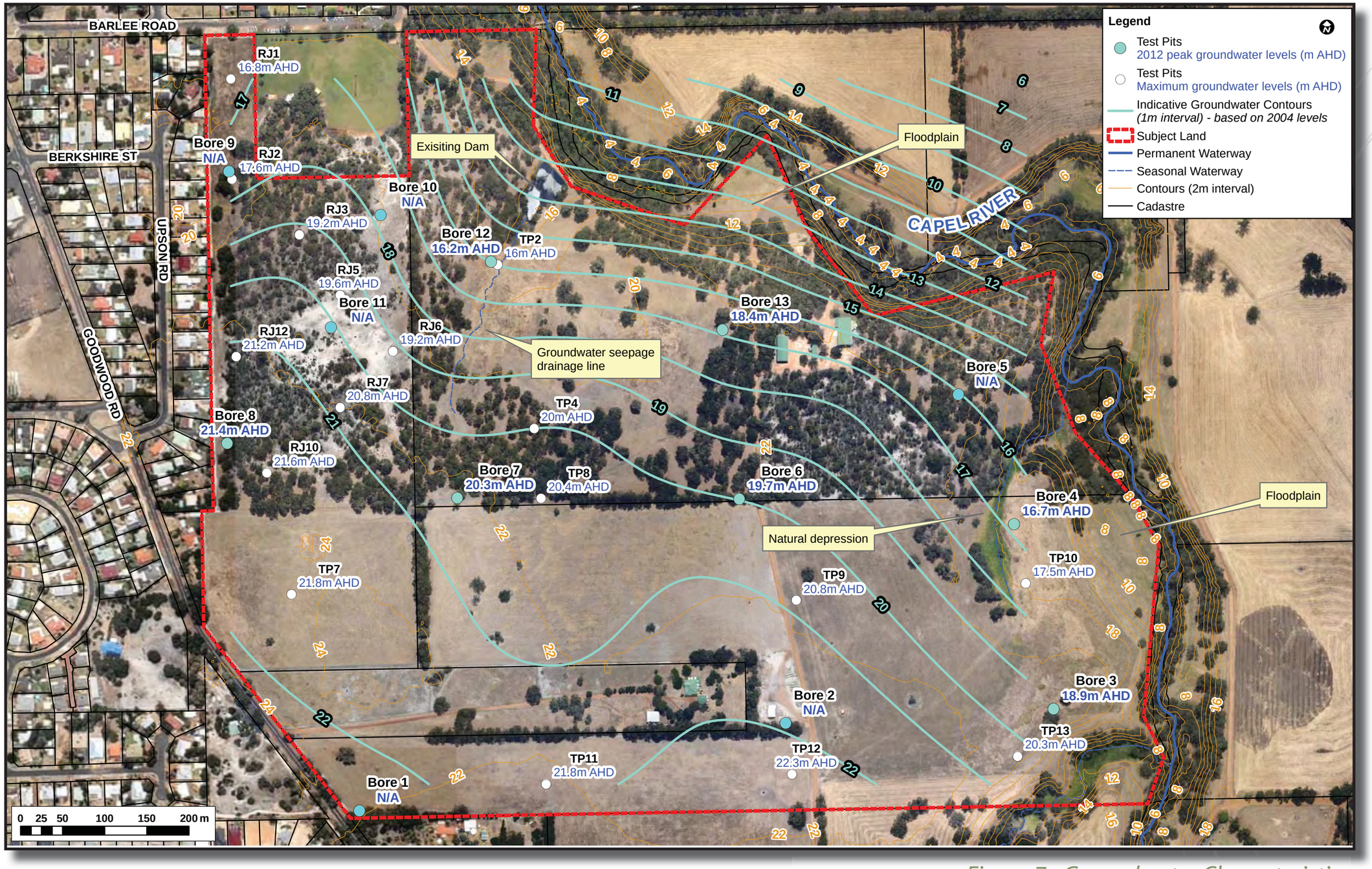
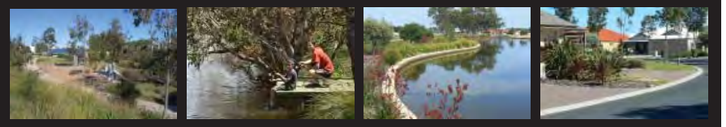


Figure 7 - Groundwater Characteristics



7. WATER DEPENDENT ECOSYSTEMS MANAGEMENT

The main water dependent ecosystem (WDE) influenced by the South East Capel Structure Plan (SECSP) area is the Capel River. Other ecosystems include areas of multiple use wetlands, a seasonal watercourse and a dam. Stormwater will be managed so that the significant WDE areas retain receiving hydrologic regimes comparable to pre-development.

Figure 8 displays the designs at the Structure Plan level to ensure best management practices are developed for water dependent ecosystems within and influenced by the SECSP area.

The development area is within the Capel River catchment and is subject to the Vasse Wonnerup Wetlands and Geographe Bay Water Quality Implementation Plan (WQIP). The LWMS commits the development to incorporating actions outlined in the prioritised nutrient action table within the WQIP. These actions aim to address the challenges for nutrient management within the Capel River, and include:

- Undertaking awareness programs to ensure community recognition of existing values.
- Ensuring that the development incorporates water sensitive urban design.
- Applying a not net increase approach to managing nutrient loads from the development.
- Continued monitoring of the development sub catchment to assess changes in nutrient status.

The Capel River catchment has been identified as a Protection Catchment in the WQIP, which means that the catchment current net nutrient loads are within the acceptable range for the Swan Coastal Plain however proper management of the water resource and nutrient loads is required to ensure that future impacts do not increase the net nutrient loads.

Water quality of the stormwater will be improved through treatment in bioretention units and adoption of WSUD elements to ensure that water is treated to meet water quality guidelines adopted by the WQIP, which are the generic concentrations for the Swan Coastal Plain. These include the water discharged from the site containing quantities not in excess of 0.1 mg/L for total phosphorus and 1.0mg/L for total nitrogen.

Capel River

Water released into the Capel River will mimic pre development flows. This will be achieved by the use of water sensitive urban designs throughout the development. The water will be treated to meet water quality guidelines set out by the Department of Water. More details on drainage management can be found in the drainage management strategy sections.

A foreshore management plan will be produced for the development area, providing details on strategies to protect and enhance the appropriate wetland and watercourse environments. It will include details and schedules for rehabilitation of native vegetation along the edges of the Capel River. The foreshore reserve varies in width from approximately 70 to 200m, and occupies approximately 16ha. Liaison with the Shire of Capel was not capable of reaching an agreement on the vesting of the Foreshore Reserve. The Shire advised that the Capel River is predominantly classified as Regional Open Space under the Greater Bunbury Regional Scheme and that discussions with the Shire will be required to determine the vesting of Foreshore Reserve at the subdivisional stage. The final boundary of the Foreshore Reserve will be determined at the subdivisional stage. Discussions with the Shire and other relevant authorities need to finalise the vesting of the Reserve prior to the next planning and water management stage.

Geographe Bay

The Capel River discharges into Geographe Bay, which supports extensive and diverse seagrass meadow ecosystems that provide vital habitat for fish and other marine fauna. The Bay is a highly valued recreational site too. Capel River currently has good water quality flowing into the Bay, however the urban development expansion of Capel was mentioned in the Draft Water Quality Improvement for Vasse Wonnerup Wetlands and Geographe Bay report as posing potential risks to increased nitrogen and phosphorus loads for Capel River. The water sensitive urban design employed on site will help to reduce the amount and concentration of contaminants flowing into the Bay from the Capel River.

Wetlands

Approximately 26 % (20.4 ha) of the site, especially in the south east and west corners of the subject land, is mapped as Palusplain Multiple Use Wetland by DEC Geomorphic Wetlands dataset classification. There are also two other wetland types within the subject land. In the western section of Lot 2426 there is a Dampland Multiple Use Wetland. The other wetland classification present is a Floodplain Multiple Use Wetland in the north of Lot 301.

The Floodplain wetland is located fully within the foreshore reserve and will be rehabilitated as part of the foreshore management plan. Much of the Palusplain wetland will be included within the residential development area; however the area within the foreshore reserve will be rehabilitated. Further details are outlined in the foreshore management plan for this site.

The Dampland is proposed to be included within the residential development area. Appropriate engineering designs will be employed to ensure that the management of this groundwater expression is suitable for building and infrastructure guidelines.

Ephemeral wetlands or 'dry' basins may be constructed to provide a final treatment train and attenuation functions for the drainage network. The designs would include rock bunds to maximise storage and provide cascades for the outfall. The ephemeral wetland or 'dry' basin will be designed and constructed according to the Stormwater Management Manual for WA design guidelines and in consultation with the Department of Water and Shire of Capel. The basins are shown within a joint Reserve of POS and Drainage. The Department of Water's policy requires all drainage structures, including the existing dam that will be used for detention, to be situated outside of the Foreshore Reserve, as shown in *Figure 8*. Discussions at the subdivision stage are recommended to reach a satisfactory arrangement for the vesting of the different reserves (Foreshore, POS, and Drainage). The size of the Foreshore Reserve encompasses a 30m from the Capel River's riparian vegetation. Discussions will be required to ensure that Reserve design satisfies reserve management, recreational, drainage and provides maximum benefits for the environment. Further details will be provided in future Urban Water Management Plans for the different stages of the SECSP.

It is important that flows mimic pre-development flows and water quality meets the Department of Water guidelines, as the Capel River is a regionally significant watercourse for agricultural, cultural, recreational, social and environmental resources downstream of the subject land. The utilisation of water sensitive urban designs throughout the development will assist in maintaining and conserving these resources.

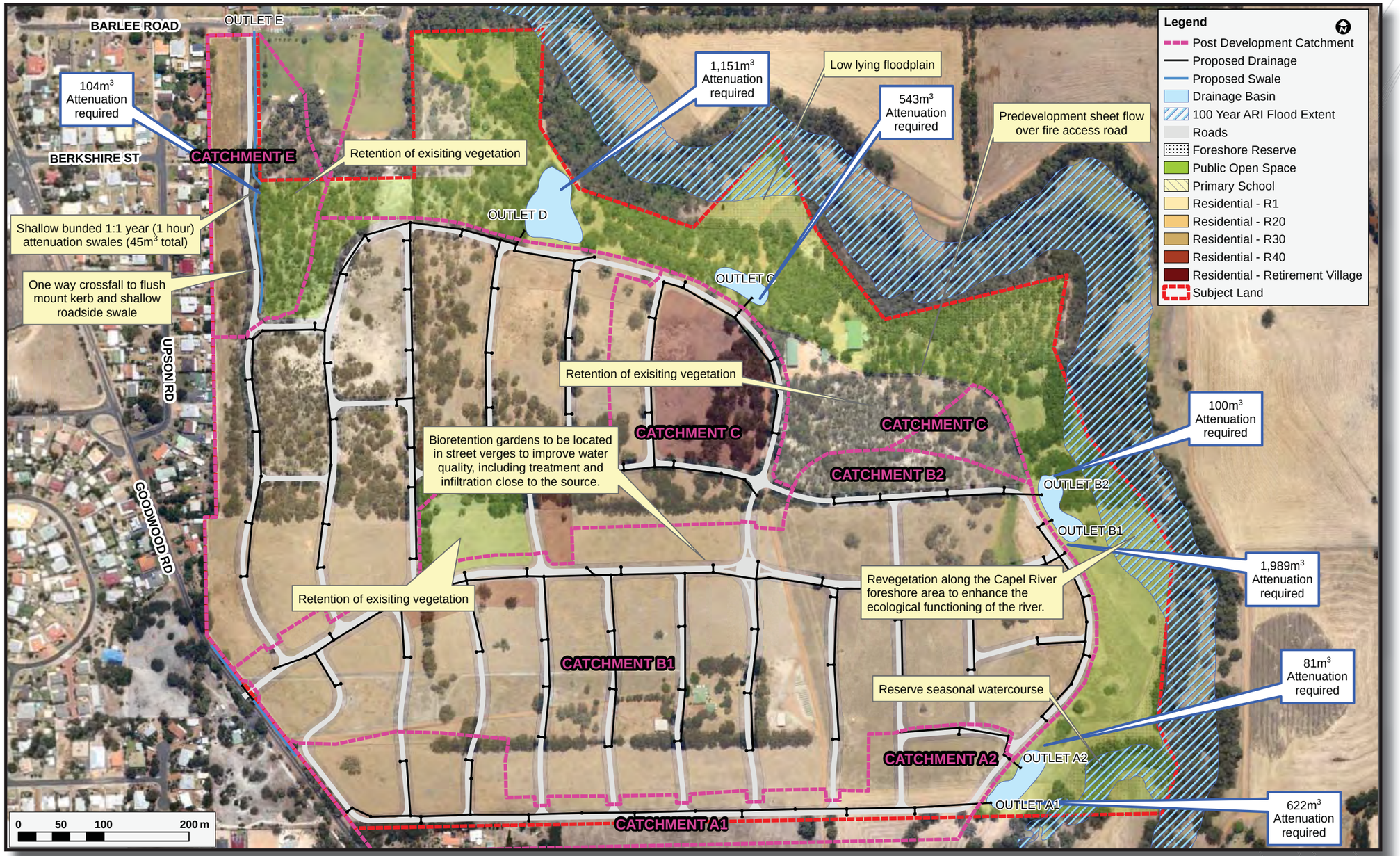
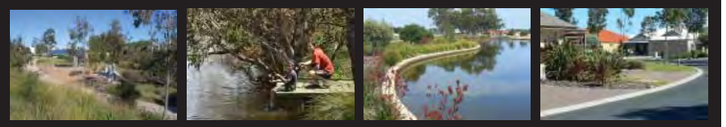


Figure 8 - Water Dependent Ecosystem Plan



8. GROUNDWATER MANAGEMENT STRATEGY

The focus of groundwater management for the South East Capel Structure Plan area is to maintain groundwater as close as possible to existing levels, while maintaining separation from infrastructure. Furthermore groundwater will be managed to achieve a high water quality.

Maintaining a separation of 1.2m minimum between buildings and maximum groundwater level will be achieved through two main methods.

The first method proposed involves using porous clean fill sand over the site where it is required to achieve adequate separation between the groundwater level and the developments key infrastructure. Appropriate fill materials and depth will be required to be determined at the subdivision stage to ensure an appropriate building soil classification is achieved regardless of groundwater depth. A detailed geotechnical and groundwater investigation will be undertaken prior to any development of the site to determine actual fill levels and soil building classifications. Seepage points will also be identified as part of this monitoring. If any are located, appropriate engineering will be used as necessary to alleviate any impacts on infrastructure

The sand fill proposed for the subject area should have a high permeability to allow water to easily infiltrate down to the original soil layer. Some of this water will then penetrate further into the natural soils below while the excess will move laterally and horizontally via the subsurface perforated pipe drainage systems. These subsurface perforated pipe systems will control groundwater rise to the existing groundwater levels, as it will direct excess water rising into the pipes to the drainage network.

Subsurface perforated pipes are easiest to install along road reserves. The pipes will be set at the agreed upon controlled groundwater level, which will be determined at the completion of the current monitoring program, to assist with controlling groundwater levels rising above this level. This will be complemented by no fill to be used within the POS areas to allow the natural drainage lines and vegetation located in the POS areas to continue to hold the groundwater at their current levels.

Preliminary fill investigations identified that there will be sufficient requirements for fill across tohe development to allow for the roof runoff to be directed to soak wells. Their location will need to satisfy the Shire and subdivision building guidelines in relation to separation distances from house foundations and fence footings. The soak wells will direct excess water collected from rooves into the groundwater for infiltration purposes.

The South West Groundwater Areas Allocation Plan has classified the Capel River area as Management Zone 5. The management risk identified is that groundwater abstraction should be managed to avoid impact on groundwater base flow in the Capel River, and there is a limit on the maximum groundwater allocation of 10 mega litres per year from a draw point within 500m of the river. Any draw points (bores) within 500m of the river would need to be metered to ensure that the limit is achieved each year.

By maintaining the groundwater at a level similar to the current level, this development will have minimal impact on the groundwater dependent ecosystems that rely on water from the site. The main ecosystem that relies on groundwater flow from the subject land is the Capel River.

Groundwater Quality Management

Groundwater quality will be improved through the use of soil amelioration products incorporated into the development, including bioretention gardens and detention basins. As water moves through these gardens and into the soil profile, nutrients are bound to the soil amelioration products that remove excess nutrients and other contaminants. The sub-soil pipes will use the stormwater pipes and there will be treatment at the discharge point in the bioretention basins that will be planted, however no filter media will be under the basins. Depending on the groundwater quality sampling results from the current program treatment prior to discharge into the detention basins would be discussed and investigated at the UWMP stage.

The bioretention gardens will only be constructed where no restriction on access to private residential lots is compromised. The gardens will provide treatment for the 1:1 year event feeding catchment and allow for storm water to infiltrate into the groundwater. The design of the bioretention gardens consist of a coarse gravel or mulch surface layer, soil amelioration layer and a 500mm amended soil media layer that will filter out many of the nutrients and sediments that could impact upon the groundwater quality. A transition layer of coarse sand or geo-textiles will separate the filter layer from the drainage pipes below the gardens. The cross section shown in *Section 9 - Drainage Management Strategy Overview* is the basis for the typical bioretention garden design. The bioretention gardens will be designed and constructed according to the latest *FAWB Adoption Guidelines for Filter Media in Biofiltration Systems (2009*) and the *Stormwater Management Manual for WA (DoW, 2007)* design guidelines. The graphs provided in *Figure 9* demonstrate the potential capabilities of bioretention gardens in the removal of total phosphorus, total nitrogen and total suspended sediments, and provide the reasoning for adopting bioretention gardens to assist in the protect of groundwater quality.

Depending on the availability of available locations for bioretention gardens there may be a requirement to use amended soils and/or bioretention systems in the detention basins for different catchments. The requirement for nutrient removal practices will be determined at the detailed engineering stage and will be determined on the risk to the receiving basin.

No commercial stock or crops will be permitted within the SECSP area after construction is completed. This may result in a reduction of nutrient inputs to the land, as current and past land practices have seen the land used for agricultural practices, including irrigation, fertiliser application and cattle grazing. The leaching of contaminants to the groundwater and waterways could be less if nutrient and water wise practices encouraged by the development are implemented throughout the subdivision.

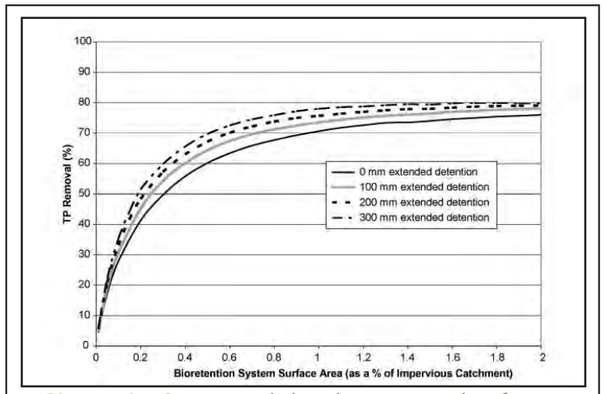
Best practices on gardens is very important as recent research (Kitsios and Kelsey, 2008) has suggested that even if WSUD is implemented an increase in nutrient loads would be expected from a new development largely because of landowners using fertilisers on their lawns and gardens. To alleviate the impact all lot owners will be provided information on Waterwise and nutrient wise practices in their gardens. Minimal grassed areas for gardens and in public open spaces will also be encouraged.

Monitoring

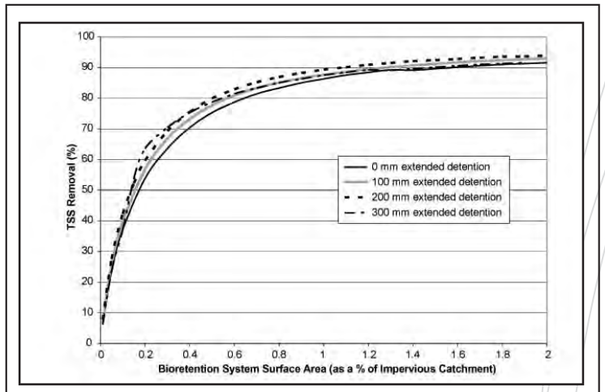
Monitoring groundwater level and quality bores have been installed and will be monitored for the minimum of 2 winters, and a groundwater monitoring report will be produced at the completion of the monitoring period. Groundwater levels and quality will be monitored further if the requirement is deemed necessary.

Streetside bioretention garden that filter water prior to infiltration to the groundwater

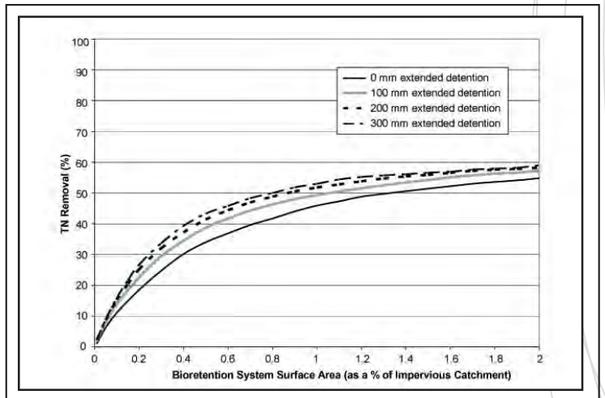
Bioretention swale in multiple use corridor that receives and transports groundwater as well as being an area of infiltration to groundwater.



Bioretention System total phosphorus removal performance



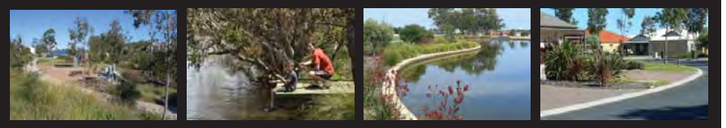
Bioretention System total suspended solids removal performance



Bioretention System total nitrogen removal performance

Figure 9 - Bioretention Removal Performance

(Source - DoW Stormwater Management Manual)



9. DRAINAGE MANAGEMENT STRATEGY OVERVIEW

The objectives of the drainage management of surface flows for the South East Capel Structure Plan area are to mimic as close as possible the pre-development flows leaving the subject land and treating the necessary volumes before the water is discharged to receiving water bodies. Stormwater discharged into the groundwater will similarly incorporate designs to mimic as close as possible the pre-development infiltration volumes and reduce nutrient and sediment loads entering the groundwater resource.

The primary objective of the 1:1 year annual recurrence interval (ARI) event drainage designs are to treat the stormwater to reduce nutrients and sediments prior to any discharge to the natural system. The priority for storm events above the 1:1 year are to control the flow of drainage water throughout the subdivision and release the water from the subdivision, whilst not creating any impacts to surrounding infrastructure.

The following three sections discuss and provide further details on how water is proposed to be treated and conveyed in three different ARI scenarios. Also catchment boundaries, discharge points and volumes of flow are depicted within the respective sections plans.

A – Up to and including the 1:1 year event

B – The 1:5 year storm event

C – The 1:100 year flood event

Non-structural controls discussed in the Stormwater Management Manual of WA (2007) will be further investigated at subdivisional stages to determine appropriate and effective controls that can be implemented as part of the best management practice designs at the different stages of the development. Possible non-structural controls that may be implemented in the future have been outlined in the implementation section of the LWMS. (see *Table 6*)

A preliminary drainage study has been undertaken for the proposed development to provide assurances to design and calculations. Detailed drainage drawings will be required at the subdivision stages. The South East Capel Drainage Study (TME, 2012) should be referred to for detailed drawings and calculations used throughout this LWMS.

Bubble up pit in Bioretention Unit

Bioretention swale

Mosquito Management

Midges and mosquitoes both cause significant nuisances, affecting lifestyles, the local economy and can be vectors for viruses and disease. The detention basins within the proposed development will be located, designed and managed to minimise the breeding of midges and mosquitoes, and limit the potential for contact between them and residents.

A preliminary assessment of the midge and mosquito risk posed by the detention basins was undertaken using the *Chironomid midge and mosquito risk assessment guide for constructed water bodies* (Midge Research Group of WA, 2007). The preliminary risk rating is low with a score less than 24, which is described as "unlikely to produce midge or mosquitoes in sufficient numbers so as to create a nuisance or pose a health risk." The detention basins for the proposed development will attain a score between 13 and 24 according to the risk matrix to be a low risk for mosquitoes and midges.

Further measures to reduce the risks from mosquitoes from the retention and detention treatments within the development are that stormwater will infiltrate and/or discharge within 96 hours between November and May. This will prevent pooling of water for longer than four days, which is the critical timeframe to prevent the completion of the aquatic (larval) stages of the mosquito life cycle. This is in accordance with mosquito management guidelines for the *Stormwater Management Manual of WA (DoW, 2007) and Better Urban Water Management (WAPC, 2008)*.

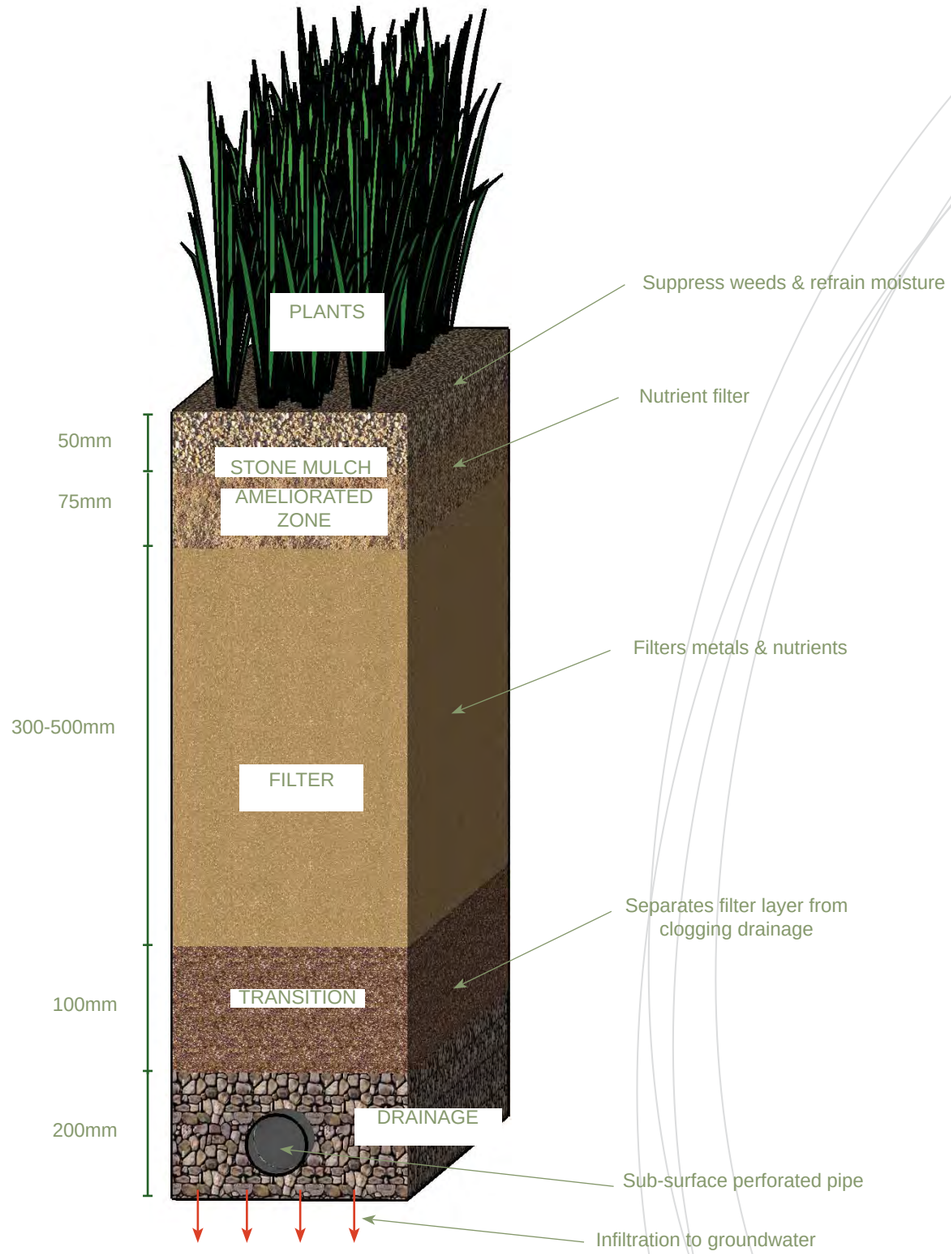
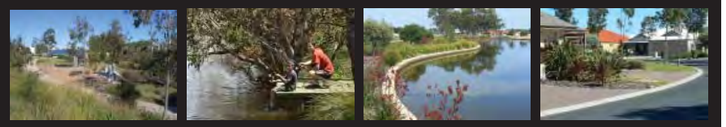


Figure 10 - Typical Bioretention Garden Cross - Section



9A. DMS - 1:1 YEAR EVENT

The drainage management system for the South Capel Structure Plan area has been designed to capture and provide treatment up to the 1 in 1 year average recurrence interval (ARI) event, which effectively captures approximately 99% of all stormwater flow.

The drainage catchment, drainage points and flow volumes for a 1 in 1 year ARI event are shown in *Figure 10*. The stormwater drainage network will utilise a combination of bioretention gardens and traditional pit and pipes to store and infiltrate stormwater for the 60 minute interval during the 1 in 1 year ARI event. A bioretention swale will be constructed in the north-west only to provide storage and infiltration capacities for the 1:1 year storm event for catchment E (see *Figure 10*). *Table 1* summarises the runoff coefficients, storage volumes and the approximate number of pits and/or bioretention gardens required for each of the post development catchments..

There are two main directions that drainage water will take in the proposed area; infiltration to the groundwater and surface run off. To deal with these different flow paths two separate treatment trains have been designed.

Infiltration to Groundwater

The majority of the water that falls on pervious surfaces in the development area will infiltrate through to the shallow groundwater because of the high hydraulic conductivity of the imported clean, free draining, cohesionless sand fill required over the site. The fines content of the fill should be restricted to less than 5% to promote drainage across the site.

To ensure adequate separation of the infrastructure over the controlled groundwater level (CGL) is achieved, fill will be required at varied depths across the development. This is to meet the requirement of the Department of Water's guidelines for runoff treatment and storage of the 1 year 1 hour event on lots and within road reserves.

Subsoil pipes have been designed to control the groundwater levels and ensure soakage at the source and the conveyance of treated flows to the minor network.

Rainwater tanks for each household that are sized 2 to 3KL as a minimum will be encouraged for the development. Overflow from these or direct runoff from rooves of houses will be directed to lot infiltration soak wells. The base of the soak wells will be installed above the CGL. Water that enters the soak wells will infiltrate into the soil profile and ultimately into the groundwater. The Shire of Capel does not have a local policy regarding soak well requirements on new residential lots, however the Shire is interested in on-site retention by residents within soak wells and including a requirement in the relevant planning approval for a property, such as building design guidelines. There is no direct link between roof runoff and the street drainage network.

Surface Flow

For the majority of the site, water flowing off impervious surfaces, including roads, pathways and driveways, and excess runoff from pervious areas will be directed to the edge of the roads. Here it will flow into bioretention gardens sized at 2% of the impervious feeding catchment or alternative drainage capture and conveyance systems in agreement with the Shire, where appropriate. The bioretention gardens will only be located where they will have minimal impact on private residential lots.

Bioretention gardens and the bioretention swale will not require a separate gross polutnat trap, as stipulated in the Draft DWMS for Capel. For alternative drainage systems, such as traditional stormwater pits or tree pits, there may be a need for pre-treatment of gross pollutants to minimise the quantity of large debris entering the stormwater network. Beneath the pits will be soak wells designed to attenuate the 1:1 year 1 hour events and allow for on-site infiltration. An overflow pipe will connect the soak wells to each other across the network to allow for conveyance in larger stormwater events.

The bioretention gardens will be designed according to the latest *FAWB Adoption Guidelines for Filter Media in Biofiltration Systems (2009)* and the *Stormwater Management Manual for WA (DoW, 2007)* guidelines and will be capable of treating all flows up to the 1:1 year flood event. The bioretention gardens will infiltrate water through a filter media designed to remove nutrients and suspended solids. Water then infiltrates to the groundwater or moves into the perforated pipe below the bioretention garden. This water is then directed to the drainage network for the development, where either the water will infiltrate into the groundwater system or be conveyed to a dry detention basin or ephemeral wetland within a drainage reserve adjacent to the Capel River.

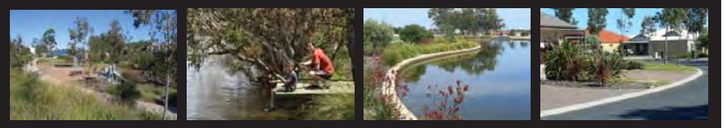
10300E South East Capel Structure Plan Area

1:1year (1hour) Bioretention Garden Parameters

Catchment	Road Surface Area (m2)	Intensity (1:1yr - 1hr) mm/hr	Required Storage (m3)	Storage Depth (m)	Effective Width (m)	Total Effective Length (m)	Approx Length/ Garden (m)	Approx No. Gardens/ Catchment	Remarks
A	8520	16.1	137	0.3	3	152	6	25	Place upstream of SEPs
B	24330	16.1	392	0.3	3	435	6	73	Place upstream of SEPs
C	5430	16.1	87	0.3	3	97	6	16	Place upstream of SEPs
D	14700	16.1	237	0.3	3	263	6	44	Place upstream of SEPs
E	2800	16.1	45	0.3	3	50	6	8	Bioretention in roadside swales

Table 1 - 1 in 1 Year Drainage Parameters

Figure 11 - Drainage Management - 1:1 ARI Event



9B. DMS - 1:5 YEAR EVENT

The drainage management system for the South East Capel Structure Plan area has been designed to manage the 1:5 year ARI event utilising a pipe system and detention basins (or ephemeral wetlands). The main functions during events up to the 1:5 year events are to convey the excess water into the drainage network and away from the roads and house lots. The drainage system is designed to slow the water flow, allow for partial infiltration of water, and discharge water out of the development over an extended period at specified flow rates into the Capel River foreshore area and into the groundwater.

Five post development catchments have been designated for the current structure plan, and these catchments had preliminary investigations undertaken to determine the flows and volumes generated, and the attenuation requirements for a 1:5 year event. Detailed drainage drawings will be required to be undertaken prior to subdivision. The catchments, flows, volumes and attenuation basins are illustrated in *Figure 12*. The full drainage study, including drawings, plans and calculation tables, is on the CD of attachments.

Flood waters will flow along the roads, flood out the bioretention gardens and/or other stormwater infrastructure and flow into the side entry pits directly downstream of the gardens. The water overflow will be conveyed to detention basins via a subsoil drain pipe system.

A swale will be located only within the road verges in the north west of the development (see *Figure 11*). A swale was required as the water could not be directed to a detention basin at the catchments outlet. Therefore a swale system is beneficial in this area because it flattens the peak flood flows and provides storage along the length of the swale. A detention basin will be constructed along the swale's length to increase storage capabilities. However

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Stormwater that infiltrates to the groundwater during a 1:5 year storm event will have minimal effect on the flood peak. However, later expressions through seepage into the perforated subsoil pipe system may occur. This may extend the period of time that water will continue to move through the subsurface pipe network, although at a much reduced rate.

It is not an objective of managing 1:5 storm events to treat for quality, but the soak wells, bioretention gardens, and swale will allow for some trapping and settling of suspended sediments, especially after the flood peak has passed. This is due to the slowing of water near the surfaces of the swale from the in-stream and bank vegetation, and the residence time in the detention basins. The bioretention gardens and detention basins will also assist with sediment capture and nutrient removal.

9C. DMS - 1:100 YEAR EVENT

The South East Capel Structure Plan area has been designed to safely convey the 1:100 year ARI flood event so that impacts on infrastructure, the environment and people's safety are minimised. The 1:100 year flood event will predominantly be conveyed via the road reserves and the drainage network, including a swale in the north west, and detention basins adjacent to the Capel River. The drainage network within the development area will flow at capacity with excess water flooding the adjoining road reserves and public open space land. The roads and development will be designed to allow a safe flood route and maintain a minimum clearance of 300mm from the development's flood levels. Furthermore a 500mm separation distance between the Capel River flood levels and habitable floor levels will be included in the development's design. Some roads will be partially flooded but remain serviceable for emergency vehicles.

The Capel River 1:100 year flood event is contained predominantly within the Capel River's valley floodplain, as shown by the Department of Water flood modelling in *Figure 11*. The two floodplains and the low lying land in the south-east corner will be inundated during the 1:100 flood. The land adjacent to the Capel River will be contained within a Foreshore and Public Reserve system, with the width varying from 70 to 200m, providing a considerable buffer between the Capel River flood extent and the developable land. *Figure 12* illustrates that the drainage storage areas required for each catchment within the subject land and illustrates the capabilities of the basins to store the 1:100 year ARI events with a spillway overflow to manage discharges.

There is no requirement to store the entire 1:100 year ARI flood event on the subject land, however the drainage designs will ensure that pre-development outflows from the subject land mimic post development discharges in a 1:100 year ARI flood event. To mimic the outflows spillway controls will be constructed on the basins to mitigate the flow regimes to pre-development rates. A single spillway on large basins could be utilised or a series of cascading spillways on numerous smaller basins. The final design will depend on the terrain and Shire preferences, however the design must satisfy the storage requirements and flow regimes identified in *Figure 12* and within the Drainage Study (see CD of attachments).

Road Bioretention unit at capacity

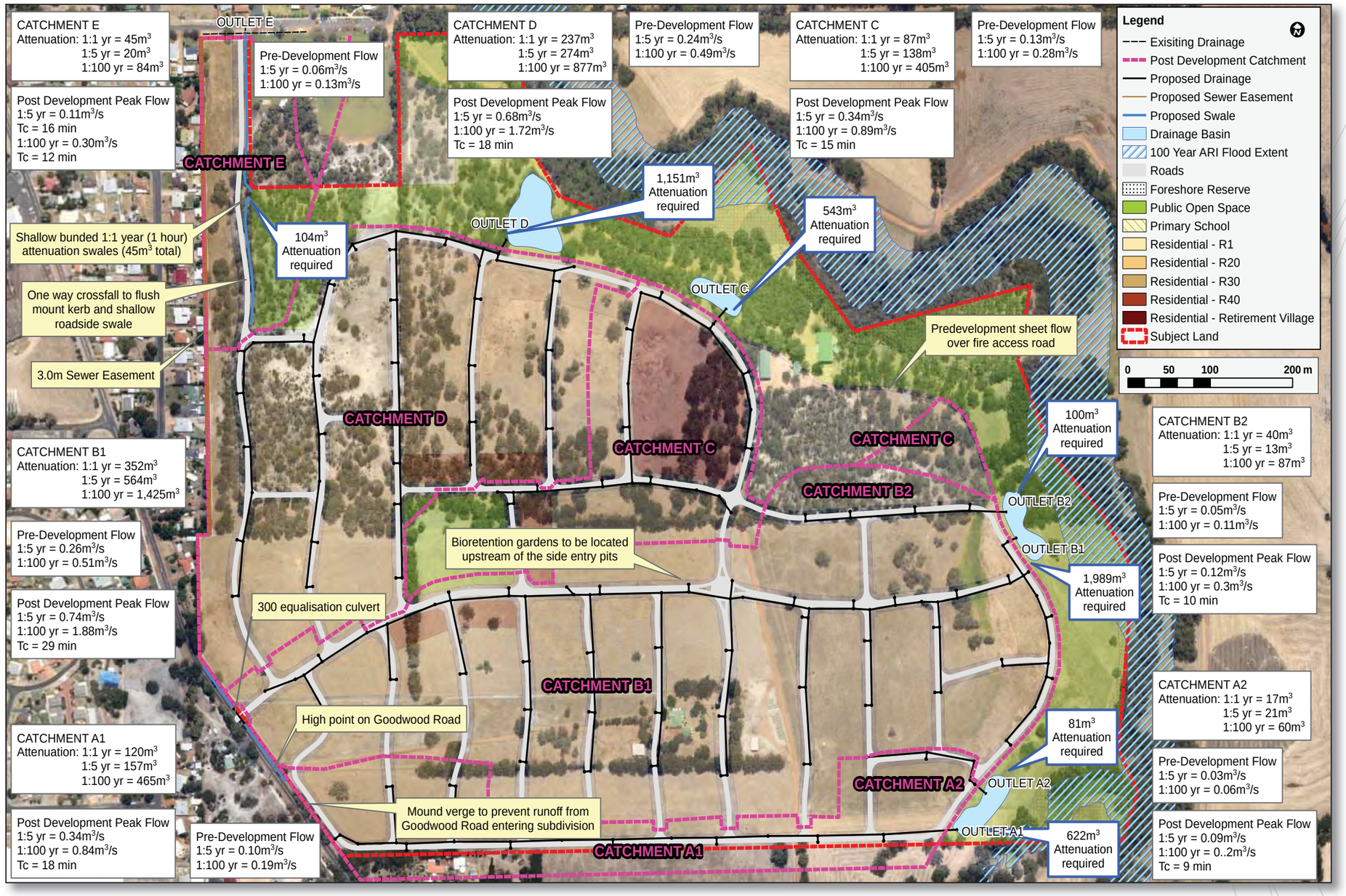
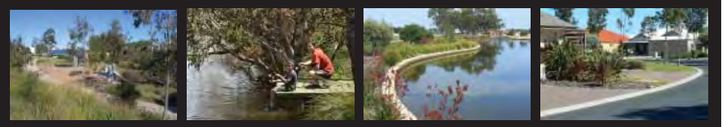


Figure 12 - Drainage Management - 1:5 Year Event & 1:100 Year Event



10. WATER SERVICES

Water Supply from Mains Potable

Reticulated mains water supply is available for the subject land with extensions and upgrades required to the services off Barlee and Goodwood Road, and Hawley Parkway for the residential development (see *Figure 13*). Gary Crowd from the Water Corporation confirmed these details on the 8th November 2012 (email enclosed within CD of attachments), and it was further noted that an extension of the 200 diameter main will be required from the corner of Goodwood Road and Spurr Street, at a yet to be determined stage of development to provide services for the excess lots within the development. A more detailed assessment with the Water Corporation will be undertaken at the relevant future planning stages of the development.

The majority of water used both within and outside the house will be from the mains potable source. Using the State Water Plan annual target, a total of 230KL of mains potable water will be used per household, of which 150KL will be used inside and 80KL for gardens and other outside uses.

Landscape Plan

A landscape master plan has been prepared for the Structure Plan (see *Figure 13*).The plan demonstrates the concept of the development to minimise lawn areas and the selection of appropriate plant species to minimise irrigation requirements (see *Table 2*). The indigenous mass planting areas identified in *Figure 13* will only require irrigation for establishment, and only the roll-on turf areas will require ongoing irrigation. The irrigation for establishment of the natives will be sourced from licensed groundwater allocations. An application to extract at least 40ML from Leederville aquifer will be made by the developer within the next 12 months. This allocation would provide sufficient water for the construction water requirements, plant establishment irrigation and ongoing irrigation of turfed POS. The finalised landscape plan will satisfy the *Shire's Urban Landscape Strategy 2011*, including the water conservation measures.

Sewerage Outflow

The subject land is within the catchments of land capable of being connect to Water Corporations sewer network. The north-western portion of the site is located within the catchment of the existing Capel Drive WWPS and the capacity exists in this facility to service the relevant portion of the subject land. The southern portion of the development is within the new Hawley Parkway WWPS catchment and there is the capacity to service this portion of the development. The north-eastern portion of the site, bordered by the Capel River, is within the planned catchment of a new Type 10 WWPS designated Pump Station D, located adjacent to the Capel River in the north western corner of the catchment. The new pump station will be located outside of the Capel Rivers 100 year flood extent and have adequate vertical separartion from the flood level;(see *Figure 13 for an indicative location of the pump station)* This WWPS is planned to pump to a DN225 sewer in House Road (see *Figure 13* for map of existing network).Discussions with the Water Corporation will continue at the subdivisional stage to determine details regarding provision of reticulated sewerage disposal services.

There are no plans at this point to bring the treated wastewater back into the structure plan area. However, further discussions will be undertaken with the Water Corporation to ensure the systems utilised are capable of any potential future reuse of recycled treated waste water from Water Corporation treatment facilities. On average 150KL per annum could be sent to the sewer from each household.

Trees

SPECIES	COMMON NAME	MATURE HEIGHT
Acacia saligna	Golden wreath wattle	4m
Agonis flexuosa	WA Peppermint	10 m
Allocasuarina fraseriana	Sheoak	15 m
Banksia attenuata	Slender banksia	10 m
Banksia grandis	Bull banksia	8 m
Banksia ilicifolia	Holly-leaved banksia	8 m
Banksia littoralis	Swamp banksia	10 m
Casuarina obesa	Swamp sheoak	10 m
Corymbia calophylla	Marri	30 m
Eucalyptus gomphocephala	Tuart	30 m
Eucalyptus marginata	Jarrah	15 m
Eucalyptus patens	Blackbutt	15 m
Eucalyptus rudis	Flooded gum	25 m
Melaleuca incana	Grey honey myrtle	4m
Melaleuca cuticularis	Saltwater paperbark	10 m
Melaleuca preissiana	Modong	15 m
Melaleuca raphiophylla	Freshwater paperbark	10 m
Nuytsia floribunda	Christmas tree	10 m
Xylomelium occidentale	Woody pear	4m

Shrubs

SPECIES	COMMON NAME	MATURE HEIGHT
Calostachys lanceolatum	Greenbush	4 m
Melaleuca incana	Grey honey myrtle	4 m
Melaleuca uncinata	Broombush	4 m
Acacia dentifera		3 m
Agonis linearifl ora	Swamp peppermint	3 m
Banksia sessilis	Parrot bush	3 m
Hakea prostrata	Harsh hakea	3 m
Labichea lanceolata	Tall Labichea	3 m
Melaleuca latteriflora	Gorada	3 m
Melaleuca tertifolia	Banbar	3 m
Melaleuca viminea	Mohan	3 m
Oxylobium lineare	River pea	3 m
Kunzea ericafolia	Spearwood	2.5m
Astartea fascicularis	Tea tree	2 m
Boronia heterophyla	Pink boronia	2 m
Calothamnus quadrifidus	One-sided bottlebrush	2 m
Grevillia vestita		2 m
Myoporum carariodes	Slender myoporum	2 m
Viminaria juncea	Swishbush	2 m
Grevillia diversifolia	Valley grevillea	1.5 m
Acacia pulchella	Prickly Moses	1.5 m
Calothamnus latoralis	Swamp one-sided bottlebrush	1.5 m
Eriostemon spicatus	Pepper and salt	1.5 m
Kunzea recurva		1.5 m
Melaleuca laterita	Robin redbreast bush	1.5 m
Regilia inops	Mouse bush	1.5 m
Hypocalymma angustifolium	White myrtle	1 m

Ground Covers

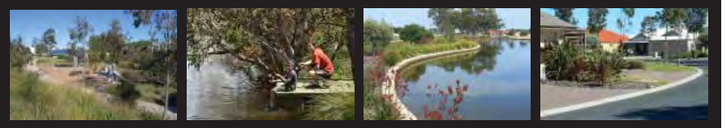
SPECIES	COMMON NAME	MATURE HEIGHT
Arthopodium capillipes	Chocolate lily	0.5m
Billardiera candida	Wedding creeper	climber
Billardiera coeruleopunctata		climber
Hardenbergia comptoniana	Native wisteria runner	climber
Kennedia prostrata	Red runner	runner
Petrophile linearis	Pixie mops	0.5 m

Sedges and Tussocks

SPECIES	COMMON NAME	MATURE HEIGHT
Agrostocrinum scabrum	Blue-eyed reed	0.7 m
Anigozanthos viridis	Green kangaroo paw	0.5m
Baumea articulata	Jointed rush	0.9 m
Dianella revoluta	Flax Lily	0.5 m
Juncus kraussii	Sea rush	0.7 m
Lepidosperma gladiatum	Coastal sword sedge	1.5 m
Lepidosperma effusum	Inland sword sedge	0.7 m
Leptocarpus coangustatus	Twine rush	0.7 m
Orthrosanthos laxus	Morning iris	0.4 m
Patersonia occidentalis	Western iris	0.4m

Table 2 - Landscape Species List

Figure 13 - Water Services Network and Landscaping Plan



11. WATER CONSERVATION STRATEGY

The State Water Plan of 2007 has set a target for water usage in Western Australia to 100 kilolitres per person a year. This target has been adopted for the proposed South East Capel Structure Plan (SECSP) area.

The following water conservation use strategy makes the following assumptions:

1. Average large house roof catchment area = 250m^2
2. Average occupancy per household = 2.6 people (2011 Capel census)

With these assumptions, the target water usage per house is averaged to 230KL per annum. The Water Corporation's Options for Our Water Future (2008) provide comparative data to the average Perth household water use of 246KL per annum since 2002, the average household usage peaked in 2000/01 to approximately 290KL per annum.

To achieve this reduction, a number of water conservation strategies will be encouraged. These measures will both reduce overall water usage as well as specifically reduce potable mains water.

The table in *Table 3* illustrates water savings that can be made in comparison to 'normal' and average water using devices, based on data collected between 1998 and 2001 from Perth households (Loh & Coghlan, 2003). Builders and house owners will be encouraged to install water efficient devices and participate in the water conservation methods outlined in *Table 3* to achieve the potential savings. Information will be provided to lot purchasers informing them about Waterwise devices and practices. The Water Corporation have numerous brochures aimed at informing home owners about water saving ideas, money saved from being Waterwise, how to create a variety of Waterwise garden types and garden tips for different regions in Western Australia.

Source average Perth household usage between 1998 and 2001 (Loh & Coghlan, 2003).

Water Efficiency Measure	Approximate Average Water Saving per Household per Annum (KL)		
Automatic Front Loader Washing Machine	10	to	13
Water Efficient Shower Head	6	to	12
Tap Aerators	15	to	22
Dual Flush Toilet	7	to	11
Waterwise Gardens	50	to	200
Total Water Savings	**88**	**to**	**258**

Table 3. Water Saving Measures for Households

Rainwater Tanks

Houses will be encouraged to install rainwater tanks, with a level controlled air gap, to reduce the quantity of water consumption from the water mains. The predominant encouragement of their use will be for garden and outdoor purposes. Outdoor water usage in Perth households is slightly below 50% of total water usage, and in Bunbury the average household outdoor water usage is approximately 40%.

For modelling rainwater runoff and capture the following data and assumptions were made:

- Average tank size of 3000L
- Rainfall figures between 2002 and 2011 derived from the Capel and Capel North Bureau of Meteorology weather stations.
- Average roof catchment percentage value of 50% (125m^2).
- Daily security of 75% each year.
- Efficiency of collection value of 0.85 (85% efficiency).
- Loss associated with absorption and wetting of surface value of 24mm per year.
- First flush value of 0.2L per m^2.

Encouraging the installation of an average tank in the SECSP area could potentially capture a maximum collection volume of approximately 26KL per annum for each household.

As the installation of rainwater tanks has not been mandated for the subdivision the volumes have been shown as alternative factors in the modelled water balance volumes (*Figure 13*).

Onsite Infiltration and Stormwater Discharge

Excess roof runoff will be directed to a property connection soak well, if a 3000L rainwater tank was installed the volume directed to property connection soak wells could be potentially reduced by 26KL per annum. The soils at the site are suggested to predominantly infiltrate all of the runoff water into the soil profile and groundwater below. Runoff from the gardens and hard surfaces around the house will be directed predominately to the road drainage network discussed in the drainage management sections. The remainder will infiltrate into the soil and groundwater within the lot.

Waterwise Garden and Other Outside Usage

The water savings from planning and implementing Waterwise gardens and practicing other outdoor Waterwise techniques can vary from approximately 50 to 200KL per household per annum.

Natural rainfall alone should be sufficient to maintain Waterwise gardens once established. However additional water for gardens, in particular lawns, and other outdoor use has been factored into the SECSP area water balance model. To achieve the necessary target of 230KL per household per annum, an achievable target of 80KL per annum has been allocated to garden and other outside usage. The installation of a rainwater tank could be used to supplement or possibly even substitute for the use of mains potable water for usage on garden and other outdoor requirements.

Lot owners will be encouraged to only use lawns where they will be made practical and minimise the area covered. Waterwise gardens will be encouraged through various landscape information packages. Educational material raising awareness of Waterwise gardens will be offered to new residents, including the Water Corporation's Garden Tips for the South West brochure.

Greywater Use

Greywater use is a possibility for the development residential area. However, as it will not be mandated, it has only been shown in the water balance model as possible alternative volumes. Greywater, if well managed, could provide for most if not all of the Waterwise garden's water needs. This would reduce the amount going to the effluent disposal system by 45 - 120KL per annum, as well as saving up to 80KL per annum of mains potable water.

Groundwater and Bores

It is envisaged that only a small percentage of lots may have domestic bores installed, and that the predominant use of bore water on the development will be by the Shire of Capel for POS irrigation. Bores into the superficial aquifers are a possibility, however the quality and quantity of the water is uncertain in many areas of the site, further limiting the potential use by land owners. Further investigations will be required when landscaping plans and stages are produced, to ascertain the volume of groundwater required and available for the POS within the development.

Landscaping

Landscaping will use suitable native species in streetscape plantings, including bioretention gardens. The bioretention gardens will effectively utilise the harvesting of stormwater to irrigate trees and other plants in the streetscape. The POS landscaping will implement strategies that minimise the quantity of irrigation required within the subject land, including minimal lawn areas, mulching, regular maintenance, low use of slow release fertilisers and retention/planting of native species. A Master Landscape Plan has been developed for the Structure Plan to detail the species and management practices to be undertaken throughout the development to minimise water use. The MasterLandscape Plan (see *Figure 12)*, including a species list (see *Table 2*), is included on the CD of attachments.

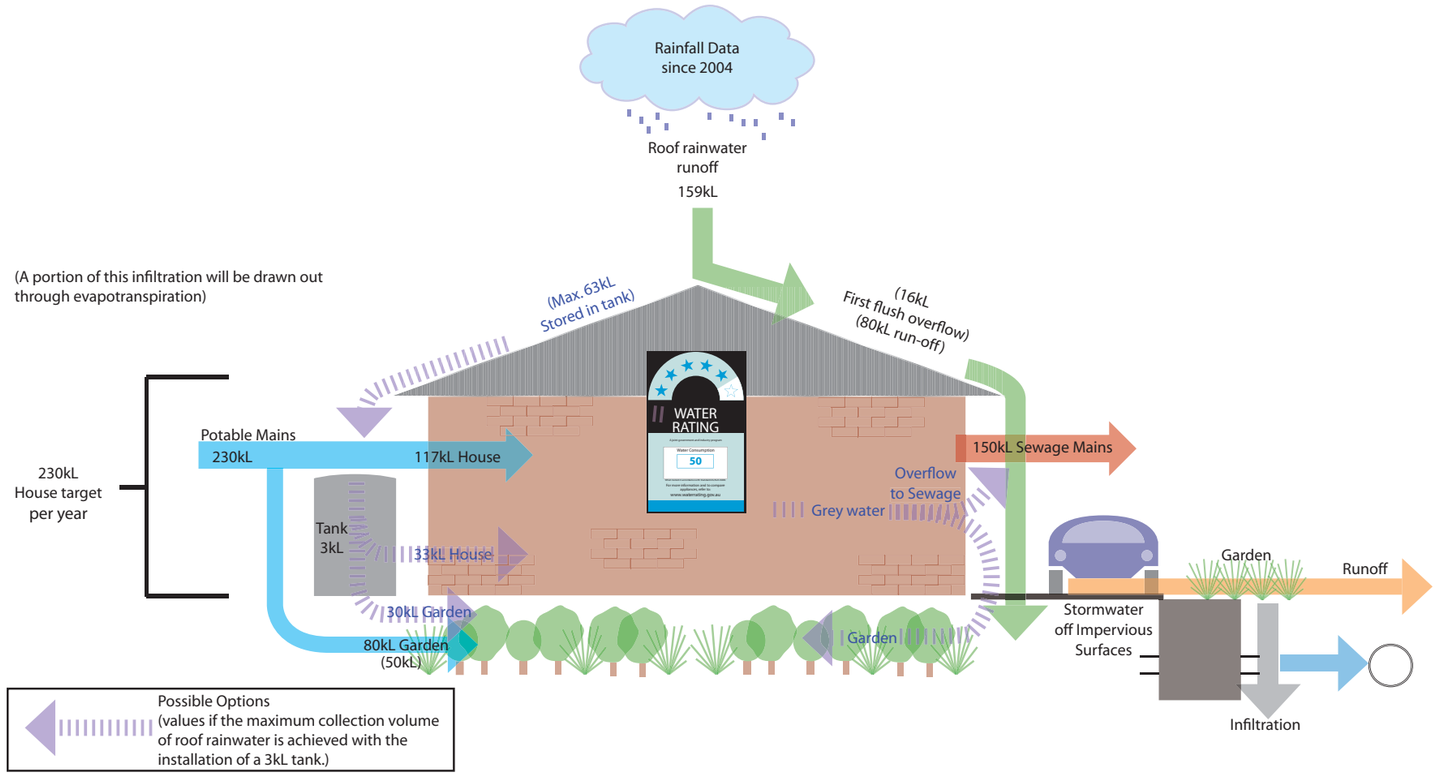
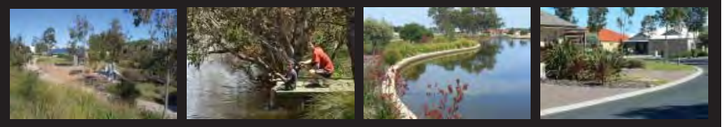


Figure 14 - Water Conservation Strategy



12. SURFACE WATER QUALITY MANAGEMENT

The South East Capel Structure Plan (SECSP) area will utilise a range of best management practices to manage water quality across the site. The major practice will be the implementation of water sensitive urban designs (WSUD) to manage stormwater for up to 1:5 year storm events. Most of the other management practices involve minimising the quantity of nutrients added to the surface and ground water within the proposed subdivision. The primary source of nutrients associated with reticulated sewerage residential developments is from fertilisers applied to public open space (POS) and residential gardens. Management strategies for the area will concentrate on managing practices on POS and residential gardens.

Bioretention Gardens

Bioretention gardens will be constructed within the road reserves of the Structure Plan area where they will not impede the access to private residential lots. The gardens will be sized to 2% of each impervious feeding catchment. The bioretention gardens will be designed and constructed according to the latest F*AWB Adoption Guidelines for Filter Media in Biofiltration Systems (2009)* and the *Stormwater Management Manual for WA (DoW, 2007)* design guidelines and in consultation with the Shire engineers.

A standard bioretention garden will be planted with appropriate native species, which should only require irrigation during the initial 2 to 3 years of establishment, depending on the seasons. They should require no fertiliser application and irrigation demands should be met by stormwater alone, after this initial establishment period. The gardens will be designed to assist in the removal of nutrients and sediments from stormwater before the water reaches the groundwater. The indicative design for the gardens composes course gravel or mulch surface layer, then a soil amelioration layer with a filter media 500mm thick and with an average particle size of 0.5mm of amended soils. A plastic root barrier will also be incorporated to provide a vertical separation layer from surrounding soils to assist in maintaining adequate moisture levels for species planted in the gardens and assist with nutrient reduction. A transition layer of coarse sand or geo-textiles will separate the filter layer from the drainage pipes below the gardens. A cross section of the typical bioretention garden design is shown in section a *Drainage Management Strategy Overview*. The plants will also assist with nutrient absorption because of the surface area provided by their roots for the formation of bio-films and nutrient uptake.

Bioretention gardens have been demonstrated to achieve a 50% decrease in nitrogen, 80% decrease in phosphorus and a 90% decrease in total suspended soils (Stormwater Management Manual, DoW 2007). The graphs shown on *Figure 9* within the Groundwater Management section illustrate the potential removal performance of total solid sediments, total nitrogen and total phosphorus by a bioretention garden under certain conditions.

Dry Detention Basins (Bioretention)

Dry detention basins have demonstrated effectiveness in removing particulate-based contaminants and sediments from stormwater runoff, but lower effectiveness for the treatment of soluble pollutants where biological uptake of nutrients is required. The hydraulic effectiveness of a dry detention basin or ephemeral wetland for removing nutrients, sediments and pollutants from stormwater runoff is reflected in the interaction of three factors: detention period, inflow characteristics and storage volume. *Table 4* illustrates the potential removal efficiencies of a dry detention basin and ephemeral wetland in south-west Western Australian conditions.

Public Open Space Landscaping & Management

Grassed areas within POS will be kept to a minimum. The following nutrient management techniques should be used for the proposed development:

- Retention of existing and native vegetation;
- Encouragement of native vegetation plantings in public areas;
- Selection of grass species that minimise fertiliser and irrigation usage;
- Use of phosphorous free and slow release fertilisers where possible; and
- Minimal application of appropriate fertilisers.

Household Nutrient Management

The majority of the fertilisers that will be used within the proposed development will be on land managed by householders. To assist in the management of their quality management all lot purchasers will be provided with information regarding Waterwise and nutrient wise practices. Information contained within publications, such as Water Corporation's Gardening Tips for the South West provide valuable information in a simplistic style that gives landowners information relating to garden designs, soil improvement, mulching, lawn establishment and a list of Waterwise plant species. The developer will use available information from government agencies and other sources to provide a landscape educational package.

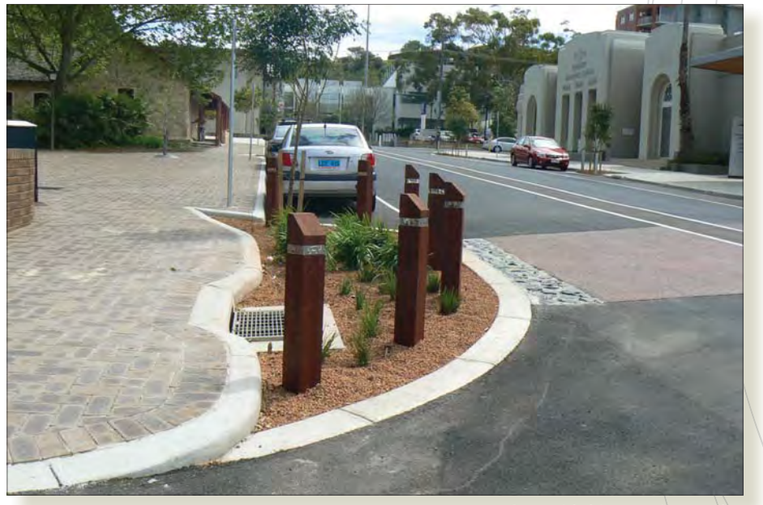
No commercial stock or crops will be permitted within the SECSP area after construction is completed. This may result in a reduction of nutrient inputs to the land, as current and past land practices have seen the land used for agricultural practices, including irrigation, fertiliser application and cattle grazing. The leaching of contaminants to the groundwater and waterways could be less if nutrient and water wise practices encouraged by the development are implemented throughout the subdivision.

Pollutant	Sedimentation Basins Expected Removal	Comments
Litter	>95%	Subject to appropriate hydrologic control. Litter and coarse organic matter should ideally be removed in an aerobic environment prior to the wetland, to reduce potential impacts on biological oxygen demand.
Total suspended solids	50-80%	Depends on particle size distribution.
Total nitrogen	20-60%	Depends on speciation and detention time.
Total phosphorus	50-75%	Depends on speciation and particle size distribution. Will be greater where a high proportion of phosphorus is particulate.
Coarse sediment	>95%	Subject to appropriate hydrologic control
Heavy metals	40-70%	Quite variable, dependent on particle size distribution, ionic charge, attachment to sediment (vs % soluble), detention time, etc.

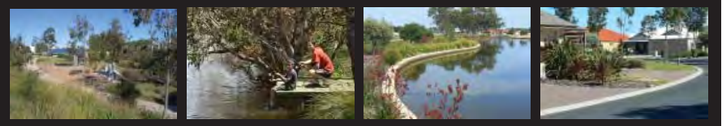
Table 4 - Typical Pollutant Removal Efficiencies

Source: Fletcher et al. (2003)

End of street bioretention unit



Streetside bioretention garden



13 - MONITORING REQUIREMENTS

PRE-DEVELOPMENT

Pre-development groundwater levels monitoring for the subject land has involved preliminary monitoring of groundwater levels. Further monitoring investigations of groundwater levels and quality over two winter periods is being undertaken and will be completed prior to any subdivision and urban water management plans. Groundwater monitoring bores have been installed on the site to provide an adequate sample to model peak seasonal levels and enable quality analysis. The superficial groundwater levels and quality within these bores will be measured and recorded on a regular basis.

Groundwater quality testing is being undertaken currently. The monitoring undertaken will adhere to the Australian Standard AS/NZ 5667 series of Water Quality Sampling Guidance Notes and a National Association of Testing Authorities accredited laboratory to undertake the water quality testing of samples.

CONSTRUCTION PHASE

Installation of drainage control structures will occur ahead of the construction phase of the development. This will include the use of water sensitive urban design techniques such as sediment curtains, hydro-mulching and temporary detention basins to maintain the quality of the water leaving the development area during construction. The collection pits will be monitored for any damage, including sediment build up and litter accumulation during, and at the completion of, construction to ensure the pit's effectiveness is not diminished post-development.

POST DEVELOPMENT

Routine monitoring within the LWMS area that checks the status of key functional WSUD elements will be undertaken to ensure they meet specified design requirements, ensuring the inlet and outlet structures are free of debris, and that the vegetative cover of the systems is maintained.

Monitoring of the established WSUD elements operations can provide important insights on the likely performance of them in pollution reduction and stormwater management functionality. Inspection of the WSUD elements will be undertaken by the developer until an agreed upon time between developers and the Shire (a minimum of 12 months after the completion of works) and should occur every three months. *Table 5* provides a more detailed list of the particular items to monitor and the purpose of monitoring, the trigger signs that require immediate action and the maintenance action required.

Compared to traditional engineered structures for stormwater runoff management, the WSUD elements will only require minimal routine maintenance and these are generally of a landscape maintenance nature. The most common maintenance is the removal of debris and siltation. The most time intensive period of maintenance for a vegetated WSUD system is during plant establishment (which typically includes two growing seasons), when supplementary watering, plant replacement and weeding may be required. The WSUD elements will be constructed and utilised in different stages so that the functions of the WSUD elements are protected from elevated pollutant loads generated from a developing catchment.

It is recommended that vegetated WSUD elements are monitored by personnel with floristic knowledge and/or qualifications as they will be capable of identifying evasive species within the natively vegetated WSUD systems. Furthermore, personnel in charge of monitoring should have a good understanding of principles and the functional design of the WSUD elements and the treatment system. The maintenance activities prompted through monitoring activities will generally require coordination between landscape and civil services.

Maintenance inspections for the entire stormwater network, including traditional and WSUD structures, should be scheduled to be conducted after a significant storm event (mobilises sediments and coarse material). Inspections should focus on ponding time for the different systems, unequal surface flow distribution and scouring.

Post development monitoring of groundwater levels and quality will be required. Furthermore surface water quality discharges from the development area will require monitoring.

PERFORMANCE MONITORING

Performance monitoring of WSUD elements via detailed water sampling and testing for contaminant concentrations has not been planned at the structure plan level. Further details regarding performance monitoring will be undertaken at the Urban Water Management Plan stage. Surrogate performance monitoring should be undertaken as a cost effective measure. Indicators should be developed to provide cost effective methods to evaluate the adequacies of the operation and performance of WSUD elements. It could be assumed that if the WSUD elements operate in accordance to the designs then it can be expected that they are delivering the desired management objectives.

REPORTING

All information collected from monitoring programs will be recorded and provided in an agreed upon report format that is prepared by the developer, and submitted to the Department of Water and the Shire, where applicable. Reports, including data tabulations and trend analysis, to be submitted for review by the Shire and DoW to compare monitoring results with target design and performance criteria to ascertain what, if any, further actions may be required, and will provide ongoing assessment of the suitability of monitoring and reporting strategies. If a trigger value for a contingency action is reached, a more detailed report on the occurrence, its impact and proposed action to prevent recurrence is to be compiled by the developer and submitted to the Shire and DoW.

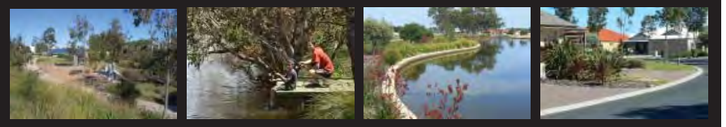
14 - RECOMMENDATIONS

The following monitoring actions and identification of additional studies is recommended for the subject land to ensure the maintenance and improvement of the hydrological environment.

- **Groundwater Levels Monitoring** - Further monitoring investigations of groundwater levels and quality over a period of two winters, is currently being undertaken and will be completed prior to any urban water management plans (UWMP). Groundwater monitoring bores have been installed across the entire site to provide adequate coverage. The superficial groundwater levels and quality within these bores will be measured and recorded on a regular basis.
- **Geotechnical and Acid Sulphate Soil Investigation** - The UWMP's will require a geotechnical investigation to determine soils conditions, phosphorous retention index, fill specifications and potential implications of Acid Sulphate Soils.
- **Acid Sulphate Soil Management Plan & Dewatering Plan** – The requirement of these plans will depend on the ASS investigations and the influence of any fill or excavation requirements for development.
- **Stormwater Drainage Management Designs** – The UWMP's will require detailed drainage drawings across the subject land at subdivisional stages to ensure the WSUD principles and best management practices are incorporated in all stages of the development.
- **Water and Sewerage Infrastructure Plans** - The UWMP's will require a servicing plan to demonstrate how these services will be provided to the subject land.

Function	Item to Monitor	Purpose of Monitoring	Trigger for Immediate Action	Maintenance Action Required	Monitoring Frequency	Responsibility
PRE-DEVELOPMENT						
Groundwater	Levels	To provide a base line and to support existing data to determine the AAMGL (natural surface level) and/or seasonal peaks.	Not Applicable	Not Applicable	Monthly from June 2012 to November 2013	Developer
	Quality	To provide a base line regarding legacy nutrient concentrations.	A parameter (other than TN, TP, Al, or Fe) exceeds the ANZEEC Guideline trigger values for south west Australia.	Investigate and identify source of contaminant. Undertake appropriate responses to rectify the contamination. More detailed assessments may be required.	Four samples at peak low and high times between June 2012 and November 2013	Developer
CONSTRUCTION PHASE & POST-DEVELOPMENT						
Drainage Management Systems	Structural Effectiveness (inlets, traps and outlets)	Inspection for debris, litter and sediments surrounding structural components.	Debris, litter or sediments causing blockages or impairing functions.	Remove any debris or blockages. Inspect system for any erosion related issues.	Every 3 months (and after significant events)	Developer until handover to the Shire
	Erosion	Inspection for erosion.	Presence of severe erosion or erosion impairing functions.	Investigate, identify and rectify the cause of the erosion. Replace filter media as required.	Every 3 months (and after significant events)	Developer until handover to the Shire
	Sediment and Silt Build Up	Inspection for sediment and silt accumulation within pits, on the surface of bioretention systems and within basins.	Accumulation of large volumes of sediments and/or silts in pits or on the surface (according to City standards).	Investigate, identify and stabilise cause of sediment source. Remove accumulated sediments and replace filter media or plants removed.	Every 3 months (and after significant events)	Developer until handover to the Shire
	Compaction	Inspection of filter media for compaction, including compaction caused by vehicle movements.	Water remains ponding longer than designed in bioretention system after a storm event.	Investigate cause of compaction. If localised, remove top 500mm of filter media, break up the filter and then return to system without any compaction. If extensive seek expert advice.	Every 3 months	Developer until handover to the Shire
	Weeds	Inspection for the presence of weeds.	Weeds are noxious or highly invasive or if weeds cover more than 25% of area.	Manual removal or targeting herbicide application, with waterway approved products.	Every 3 months	Developer until handover to the Shire
	Plant Condition	Inspection of vegetation health and cover, and presence of dead plants.	Plants dying or a pattern of plant deaths.	Investigate cause of plant deaths and rectify. Infill plantings may be required.	Every 3 months	Developer until handover to the Shire
	Organic Litter	Inspection for the presence of organic litter (e.g. leaves) on surface.	Litter coverage is thick or extensive, or detracting from the visual appearance of the system.	Investigate source of litter and undertake appropriate response, e.g. alter landscaping maintenance practices, community education). Remove litter.	Every 3 months (and after significant events)	Developer until handover to the Shire
	Rubbish/Litter	Inspection for the presence of litter.	Litter is blocking structures or detracting from the visual appearance of the system.	Identify source of litter and undertake appropriate responses. Remove litter.	Every 3 months (and after significant events)	Developer until handover to the Shire
	Surface Water Quality	Sampling of water quality (TSS, TN & TP) at development drainage discharge (outlet) points.	0.1mg/L for TP and 1.0mg/L for TN (Leschenault WQIP) and ANZEEC Guidelines for remainder of parameters.	Investigate and identify source of contaminant. Undertake appropriate responses to rectify the contamination. More detailed assessments may be required.	2 storm events per year (minimum) at Fees Road and at the discharge point from the latest stage of development.	Developer (Shire will determine their program after handover)
POST-DEVELOPMENT						
Groundwater	Quality	To determine post-development quality and testing to be done at sub-soil discharge points. Identify any changes in the base line quality post development.	0.1mg/L for TP and 1.0mg/L for TN (Leschenault WQIP) and ANZEEC Guidelines for remainder of parameters. Any parameters that values increase compared to pre-development values.	Investigate and identify source of contaminant. Undertake appropriate responses to rectify the contamination. More detailed assessments may be required.	Annual sampling	Developer (Shire will determine their program after handover)
	Levels	Monitoring required to confirm that the sub-soil drainage system is operating as designed.	Levels exceeding controlled groundwater level.	Undertake appropriate responses to address the issue. More detailed assessments may be required.	Annual sampling	Developer (Shire will determine their program after handover)
Surface Water	Quality	To determine post-development quality. Testing to be done at discharge points from the detention basins.	0.1mg/L for TP and 1.0mg/L for TN (Leschenault WQIP) and ANZEEC Guidelines for remainder of parameters.	Investigate and identify source of contaminant. Undertake appropriate responses to rectify the contamination. More detailed assessments may be required.	Annual sampling	Developer (Shire will determine their program after handover)
Foreshore Reserve	Rehabilitation	To determine success of weed and erosion controls, and revegetation practices (see Interim Foreshore Management Plan for details).	Weed and erosion controls are ineffective. High mortality rates in planting.	Investigate reasons for ineffective practices and adapt practices (see Interim FMP for details).	See schedule in Interim FMP.	Developer until handover to vesting authority

Table 5 - Monitoring & Maintenance Schedule



15. IMPLEMENTATION PLAN

The developer is committed to establishing the drainage network for the subdivision, and the Shire will become responsible for the ongoing maintenance of the stormwater infrastructure after a mutually agreed period. The non-structural controls listed in Table 1 provide guidance on proposed practices and these will be detailed ay UWMP and subdivision stage.

Implementation of the South East Capel Local Water Management Strategy (LWMS) will continue over an extended period of time due to the size of the structure plan area, the multi-stage development phases and the rate of expansion predicted for Capel.

The structure plan area is designated be released in four subdivision stages, starting in the west and moving anti-clockwise. The first stage is likely to be developed a minimum of 18 months to 2 years after the Structure Plan is approved. To implement the multitude of best management practices discussed in this LWMS the responsibility for construction, maintenance and education has been outlined below.

Commitments by Developers

- To assist with engineering design and protection of water and environmental resources, groundwater level and quality monitoring will continue for at least the next two winters. Currently being undertaken by TME on behalf of the landowners. A Groundwater Monitoring Report will be produced after two winters of monitoring.
- Undertaking a geotechnical investigation study, including acid sulphate soils and phosphorus retention tests, over the subject land.
- Construction of the stormwater drainage systems.
- The design and construction of secured water services for potable water supply and wastewater in agreement with the Water Corporation at the subdivision stages.
- The planting of vegetation within the bioretention units with appropriate locally native plants. The maintenance of the plants within the units is the developer's responsibility until handover to the Shire.
- Appropriate fill used across the site.
- Planting of native vegetation where appropriate, outside of private lots. Water sensitive landscaping of the POS areas will be undertaken as lots close to the POS are released.
- Provide lot owners with information regarding Waterwise practices inside and outside the house.
- Provide lot owners with information regarding nutrient wise practices and designs for gardens.
- Prepare and implement an interim Foreshore Management Plan for the Capel River adjoining the Structure Plan. The broad concepts of the reserves management and interactions with the residential interface will be outlined in the plan. The plan will require finalisation at a later stage when specific drainage designs and subdivisional plans are similarly finalised.
- Finalise a vesting authority for the Foreshore Reserve.
- Urban Water Management Plans (UWMP) will accompany all relevant subdivision development proposals covered by this LWMS, as part of the subdivision conditions. The UWMP's will compliment the objectives of the LWMS and provide more detailed drawings that are relevant to water management for that portion of the land being developed.
- Drainage control structures will be installed ahead of the construction phase of the subdivision development. Water sensitive urban design techniques such as sediment curtains, hydro mulching and temporary detention basins will be used to maintain the quality of the water leaving the development area during construction.
- Adhere to the management strategies and conditions outlined in the Black Cockatoo and Western Ringtail Possum Management Plans.

Shire of Capel

- Responsibility for the maintenance of the stormwater systems installed, including the maintenance of plants in bioretention units, after a mutually agreed upon time period after construction.
- Ongoing encouragement of Waterwise and nutrient wise practices for residents.

LEVEL	PROPOSED PRACTICE
Construction	
Erosion, dust, drainage, nutrient and sediment management controls and any further construction management practices required by the Shire	Developer implement approved management plans for each aspect. The Shire to approve and enforce plans.
Maintenance	
Street sweeping/cleansing	Developer will carry out during construction and any agreed upon maintenance period. The Shire will maintain after this time.
Maintenance of stormwater network	Developer will carry out during construction and any agreed upon maintenance period (see Table 9 for structural practices). The Shire will maintain after this time.
Road and pavement repairs	Developer will carry out during construction and any agreed upon maintenance period. The Shire will maintain after this time.
Maintenance of road and drainage reserves	Developer will carry out during construction and any agreed upon maintenance period. The Shire will maintain after this time.
Management of foreshore reserve	Developer will implement rehabilitation program and maintenance for a 5 year period or as agreed upon within the Foreshore Management Plan.
Education and Participation Programs	
Training of landowners on applied stormwater designs	Information packages provided to land owners. The developer in conjunction with the Shire possible organise community workshops.
Encouraging Waterwise practices, use of water efficient appliances and fittings, rainwater tank use and greywater reuse.	Information packages provided to lot owners regarding all aspects of Waterwise uses and practices, and brochures from rainwater tank and greywater reuse commercial suppliers.
Encouraging participation of community in aspects of stormwater management	Inform residents of a Shire contact in regards to any issues or comments.

Table 6 - Non structural Controls

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APPENDIX 6:

Foreshore Management Plan

Town Planning Management Engineering

Interim Foreshore Management Plan

SOUTH EAST CAPEL Structure Plan




town planning
management
engineering
environmental

Research, Design & Delivery of Sustainable Development

08092
January 2013

DOCUMENT QUALITY CONTROL

AUTHOR	DATE
Peter Jones	03/12/2012
CHECKED BY	**DATE**
Brendan Oversby	03/12/2012

VERSION TABLE

Version No.	Purpose	Date
1	Submission to Department of Water (DoW) and Shire of Capel.	
2	Resubmission with DoW and Shire comments addressed for council approval and advertising.	08/03/2013

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PH: (08) 9791 4411

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1. INTRODUCTION

TME Town Planning Management Engineering Pty Ltd (TME) has prepared this Interim Foreshore Management Plan (FMP) to identify the Foreshore Protection Area and propose management recommendations for the protection, conservation and rehabilitation of the Capel River Foreshore Reserve along the development boundary.

1.1. Study Area

The South East Capel Structure Plan is located on Lots 1 and 2426 Goodwood Road, and Lots 300 and 301 Barlee Road in Capel. The Capel River (vacant crown land) is adjacent to Lots 301 and 2426, along the eastern boundary of the development site. The ownership details for all the lots involved are listed in *Table 1*.

Lot	Plan	Road	Landowner	Area (ha)
1	P250881	Goodwood Road, Capel	Ross Jamieson	30.03
300	D89381	Barlee Road, Capel	Caribbean Investments Pty Ltd	15.18
301	D89381	Barlee Road, Capel	Caribbean Investments Pty Ltd	28.06
2426	D33988	Goodwood Road, Capel	Patricia Aspinwall	4.61

Table 1 – Landowner Details

The Structure Plan prepared is to satisfy the Outline Development Plan (ODP) requirements of the Shire of Capel Town Planning Scheme Number 7 (TPS), which also identify the requirement for a FMP in Section 5.10.5 (e) under specific provisions 19c.

The Capel River catchment is approximately 653km^2 and flows generally in a north-west or western direction towards the Indian Ocean. The general geomorphology of the river along the boundary of the development has a well defined dominant channel within a deep floodplain valley.

The Structure Plan land is mapped in *Figure 1*, which also provides a regional context for the Capel River and the important regional ecological linkages it provides.

1.2. Supporting Documentation

The following subject land reports were utilised to assist with the preparation and recommendations of the Interim FMP:

- Bennett Environmental Consulting. 2006. *Flora and Vegetation Investigation*.
- Harewood, Greg. 2005. *Fauna Assessment (Level 1)*.
- Harewood, Greg. 2009. *Black Cockatoo Management Plan*.
- Harewood, Greg. 2009. *Western Ringtail Possum Management Plan*.
- TME. 2013. *South East Capel Structure Plan*.
- TME. 2013. *South East Capel Structure Plan Local Water Management Strategy*.
- White, Kirrily and Comer, S. 1999. *Capel River Action Plan*.

Figure 1 - Site Context Map

2. MANAGEMENT OBJECTIVES

At this planning stage the objectives focus on the identification of the foreshore protection area (FPA) and ensure that sufficient land is set aside to protect the foreshore area, vegetation and water quality.

2.1. Aims

The overarching aims of the Interim FMP are to:

- Prepare recommendations for the development and implementation of a management plan to ensure protection of the foreshore and river's water quality, vegetation and fauna.

- Prepare guidelines for the development and implementation of a rehabilitation management plan to enhance the native foreshore ecological functions.

2.2. Objectives

The specific objectives for the major management areas are:

2.2.1. Landscape Protection

- Maintain and enhance existing native foreshore vegetation within the FPA;
- Minimise the disturbance to the natural environment of the reserve from subdivision construction works;
- Provide a mechanism for restoration and rehabilitation of the FPA; and
- Construct fences along the FPA, where applicable and/or practical.

2.2.2. Recreation and Public Access

- Provide limited and controlled recreational opportunities that are compatible with the on-site natural environment; and
- Enhance the recreational value of the subject land and wider locality, where appropriate and/or necessary.

2.2.3. Conservation

- Protect and improve the ecological systems within the reserved areas to maintain natural conservation values.

2.2.4. Drainage

- Use best management practices to treat stormwater that is generated within the development; and
- Controlled release of 1:5 year and 1:100 year annual recurrence interval (ARI) events at pre-development rates from drainage infrastructure in to the foreshore.

2.2.5. General

- Provide a mechanism to ensure that weed and fire controls are consistent with the above aims and objectives;
- Provide a clear boundary demarcation for the Public Open Spaces (POS), Foreshore and Drainage Reserves, and remainder of the residential development;
- Incorporate sensitive fire management controls within or adjacent to the Foreshore Reserve;
- Encourage landowner awareness and participation in the long-term management of the FPA; and
- Encourage developer and community involvement in catchment wide management activities for the Capel River to ensure the sustainability of the FPA and the river system.

Capel River foreshore protection area (the river's water body is visible in the background in the centre of the photo).

3. CULTURAL AND HERITAGE VALUES

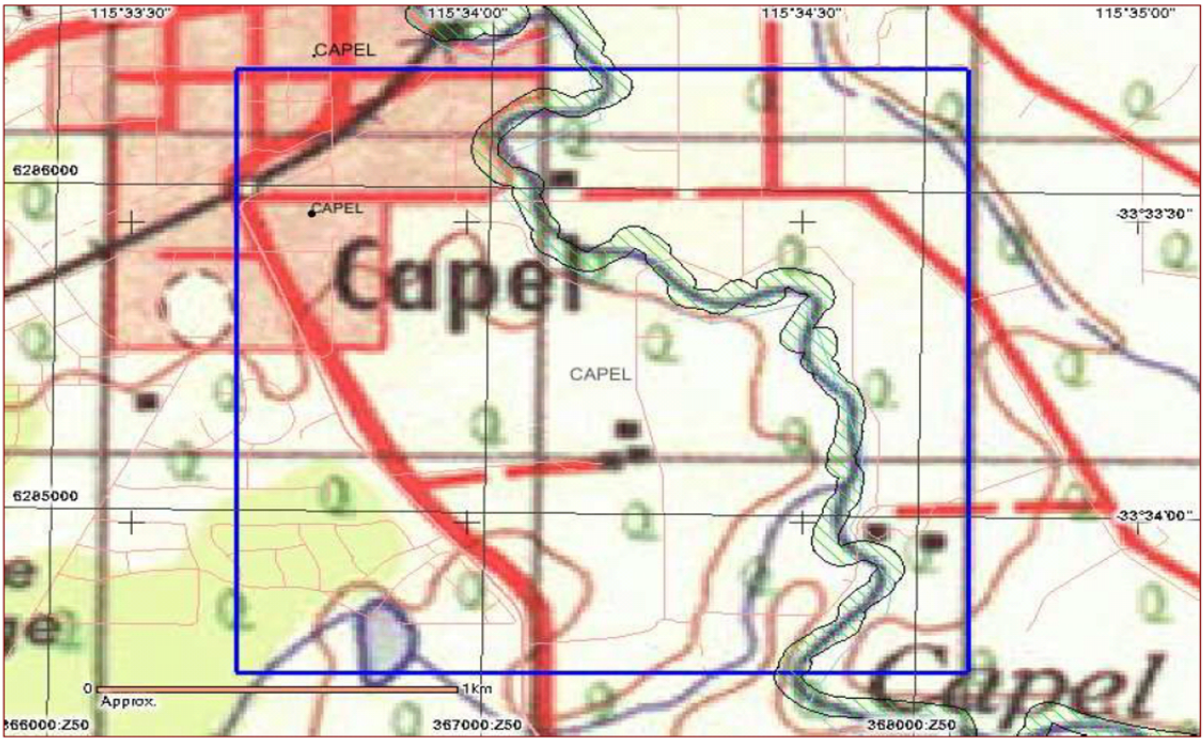
The Capel River is culturally significant and important physically and spiritually for the southwest Aboriginal communities. The entire Capel River is registered as a mythological and historical Aboriginal site (Site ID 20061). The brief summary of site has been included below (*Figure 2*) and documents that the site is open access with no restrictions.

The Capel River flows through the town of Capel after the development, and in the town a large rehabilitation and recreation program has been undertaken along the banks of the river. The river is also used for canoe and kayaking activities, including the annual Capel Descent kayak race.

Government of Western Australia
Department of Indigenous Affairs

Aboriginal Heritage Inquiry System
Register of Aboriginal Sites

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
20061	P	O	N	Capel River	Mythological, Historical		*Registered Informant names available from DIA.	380593mE 6276614mN Zone 50 [Reliable]	



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For further important information on using this information please see the Department of Indigenous Affairs' Terms of Use statement at http://www.dia.wa.gov.au/Terms-Of-Use/

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Figure 2 – Department of Indigenous Affairs Heritage Inquiry System output.

4. BIOPHYSICAL ENVIRONMENT

The Capel River has been identified by the Environmental Protection Agency (EPA) in the Greater Bunbury Region Scheme as a regionally significant riverine ecological linkage, and the subject land is also in the vicinity of the regionally significant east-west Capel/Boyanup ecological linkage (see *Appendix 1*).

The land to the south and east of the study area is used primarily for agricultural purposes, predominantly grazing for dairy cattle. Access to the Capel River has largely been fenced off along the adjacent properties, however cattle were observed within the southern creek gully during a field investigation. The land to the north east is used for small scale agricultural purposes. The land to the north-west has retained most of the native vegetation and the land is not heavily used.

4.1. Climate

The Capel region experiences a Mediterranean climate with hot dry summers and mild wet winters. The closest Bureau of Meteorology site to the subject land is 2.7km north-west at Capel North. The annual average rainfall is approximately 650mm, with 84% of the rainfall occurring over 6 months (April to September). The long-term trend for rainfall in Capel shows a general declining trend and this is expected to continue given climate change predictions for the south west region of Western Australia. *Figure 2* graphically displays the yearly rainfall, and averages. The mean maximum daily temperatures range from approximately 17°C in July to 30°C in February in Capel.

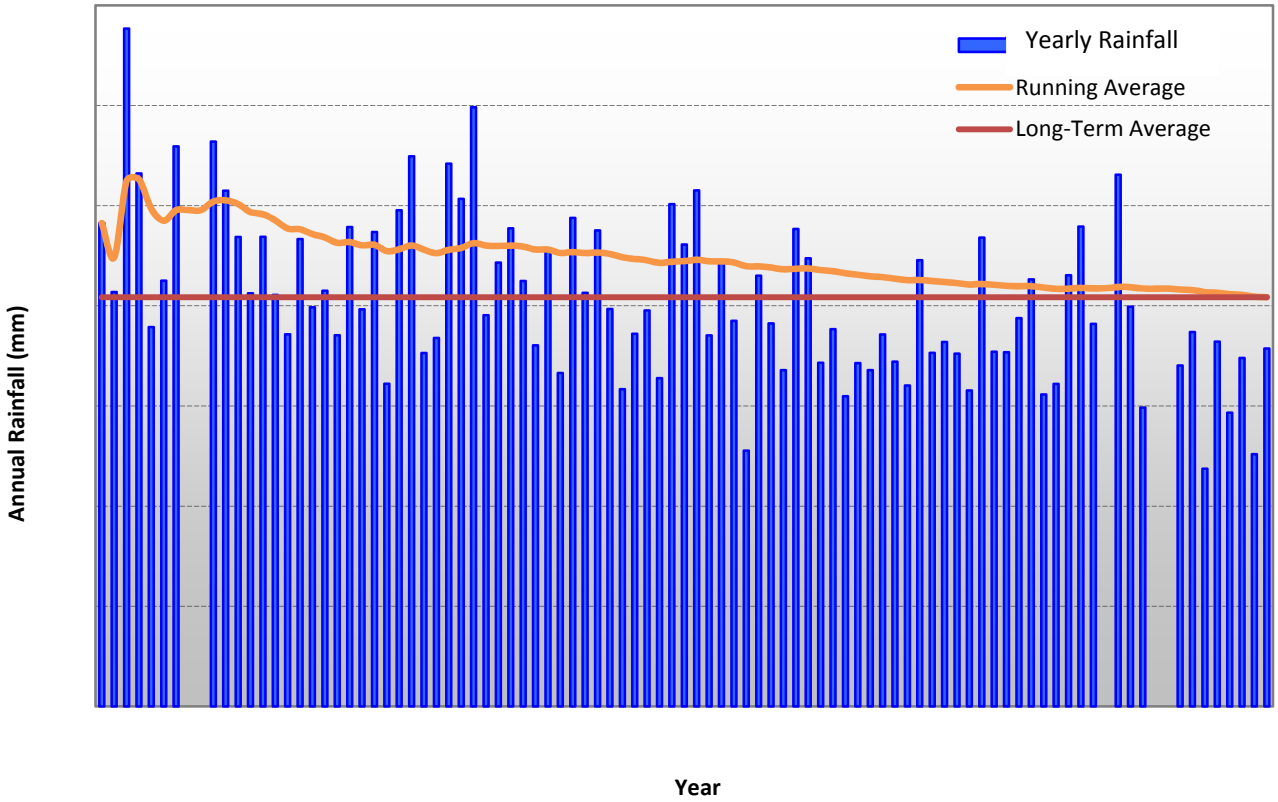

Figure 3 – Capel Rainfall
(Source: Bureau of Metegrology sites 9516 and 9992)

4.2. Landform and Topography

The land is gently undulating outside of the foreshore area with steep slopes into the river's gully. The slopes are only moderate in the central region where the land forms a floodplain to the south of the incised main channel. There are floodplains on either side of the river's main banks. The biophysical environmental map displays the contour information for the subject land and foreshore area.

A moderate to steep gully is present in the south-east of the subject land, which has a seasonal water course along the floor. The gully's topography is illustrated by the photo. The vegetation on the slope is pasture grasses, which persist into the valley floor under a scattered distribution of *Eucalyptus rudis* (Flooded Gum) along the channel's banks.

Slopes down to the seasonal waterway in the south-east corner (looking down from subject land).

The soil landscape subsystem predominantly along the Capel River for this section is the Pinjarra P10 system. This is characterised by:

> "Gently undulating to flat terraces adjacent to major rivers, but below the general level of the plain, with deep well drained uniform brownish sands or loams subject to periodic flooding."

4.3. Geology and Soils

According to the Capel 50,000 map series the Capel River and floodplain in the south-east corner compromise of gravelly sandy silts, with sands predominantly on the land outside of the river system on the subject land. The Department of Agriculture and Food soil landscape subsystems describe the land adjacent to the Capel River as Bassendean B2 Phase, which have deep bleached grey sands with a pale yellow B horizon or a weak iron-organic hardpan 1 to 2m. The Capel River is within the Pinjarra P10 Phase, which compromises of well drained deep uniform brownish sands and/or loams that are subject to periodic flooding.

The Department of Environment and Conservation (DEC) acid sulphate soil (ASS) risk mapping has classified the site predominantly as a moderate to low disturbance risk area (within 3 metres of the surface). The land surrounding the Capel River and the two seasonal watercourses that link to the Capel River have been classified as high to moderate disturbance risk, within 3 metres of the surface. In these environments ASS can be widespread or sporadic. They may be very close to the surface or buried below many metres of alluvium or windblown sand. Base sediments of estuaries, rivers, creeks and lakes are also considered areas of high risk of ASS occurrence.

4.4. Drainage and Hydrology

Predominantly the water generated on the subject land flows towards the Capel River through groundwater and surface water movements. The section of the Capel River adjacent to the subject land is generally flowing from the south to the north. Further details on the site's drainage can be found in the *South East Capel Structure Plan Local Water Management Strategy* (TME, 2013).

An existing dam is located in the north of the foreshore area. The dam is fed by a groundwater drainage line to the south-west, and will be utilised as a detention basin post-development. The dam is scenic with *Salix* spp. (willows), lily pads and planted *Eucalyptus* species surround the dam. In the north-east of the subject land there are also planted *Acacia* and *Eucalyptus* species.

4.5. Channel Geomorphology

The dominant main channel, floodway and valley embankment of the Capel River are predominantly outside of the subject land boundary, however are essential in the management of the foreshore. The river valley and flood fringe is generally vegetated with *Eucalyptus rudis* (flooded gum) and *Corymbia calophylla* (marri) over a predominantly native species understorey. The form of the Capel River study area consists of long narrow meandering channels, with a degrading river valley. Remedial action has previously been undertaken in several sections to exclude livestock from the river. Numerous sites with erosion and scouring were observed (see *Figure 4*).

The foreshore of the Capel River along the gentle slopes and flats was generally degraded, with little or no understorey and severe weed invasion noted. The foreshore n the north was slightly less degraded with only some erosion recorded, but weeds were still observed.

There are also two floodplains located on the subject land that will be predominantly included within the FPA, or within the Public Open Space (POS) barrier. *Figure 4* shows the location of these floodplains that have been classified as Multiple Use Floodplain and Palusplain wetlands by DEC

Geomorphic Wetland mapping. The floodplains are largely devoid of native vegetation, with grass species predominantly present.

Cleared southern floodplain (foreground) with the Capel River riparian vegetation in background.

4.6. Fauna and Habitat

The subject land has large portions that are cleared or degraded, which has consequently reduced the diversity of fauna species since human disturbances. Habitat degradation has occurred from partial clearing, altered fire regimes and predation by introduced species. The site was found to provide suitable habitat for a number of bird species. The presence of three significant fauna species was also recorded at the site, the threatened western ringtail possum (*Pseudocheirus occidentalis*), the vulnerable Baudin's black cockatoo (*Calyptorhynchus baudinii*) and the vulnerable forest red-tailed black cockatoo (*C. banksii naso*). Separate management plans for these species have been prepared.

A fauna assessment in 2005 investigated the potential fauna at the development study area and surrounding area, including the Capel River. The potential fauna of conservation significance that was considered likely or observed within the foreshore area included:

- *Geotria australis* (pouched lamprey)
- *Ardea alba* (great egret)
- *Ardea ibis* (cattle egret)
- *Calyptorhynchus banksii naso* (forest red-tailed black cockatoo)
- *Calyptorhynchus latirostris* (Carnaby's black cockatoo)
- *Calyptorhynchus baudinii* (Baudin's black cockatoo)
- *Ninox connivens* (barking owl)
- *Tyto novaehollandiae* (masked owl)
- *Merops ornatus* (rainbow bee-eater)
- *Phascogale tapoatafa* (southern brush-tailed phascogale)
- *Isoodon obesulus fusciventer* (quenda)

- *Pseudocheirus occidentalis* (western ringtail possum)
- *Falsistrellus mackenziei* (western false pipistrelle)
- *Hydromys chrysogaster* (water rat)

Forest red-tailed black cockatoo.

4.7. Vegetation

The vegetation within the foreshore area is considered as 'good' to 'excellent', with the higher quality vegetation along the narrow floodplain immediately either side of the river's channel. The vegetation is dominated by a thick native grass species layer of *Microlaena stipoides* (weeping grass) and *Adiantum aethiopicum* (common maidenhair) under a canopy of *Eucalyptus rudis* (flooded gum). There are areas along the bank covered in a dense grassland or herb land of weeds. Weeds were present over the majority of the river's length. A full list of flora species, including weeds observed within the study area during field investigations is in *Appendix 2*.

The EPA commented on an area near the dam, as "it is possible that this vegetation is close to that of the original vegetation of the river".

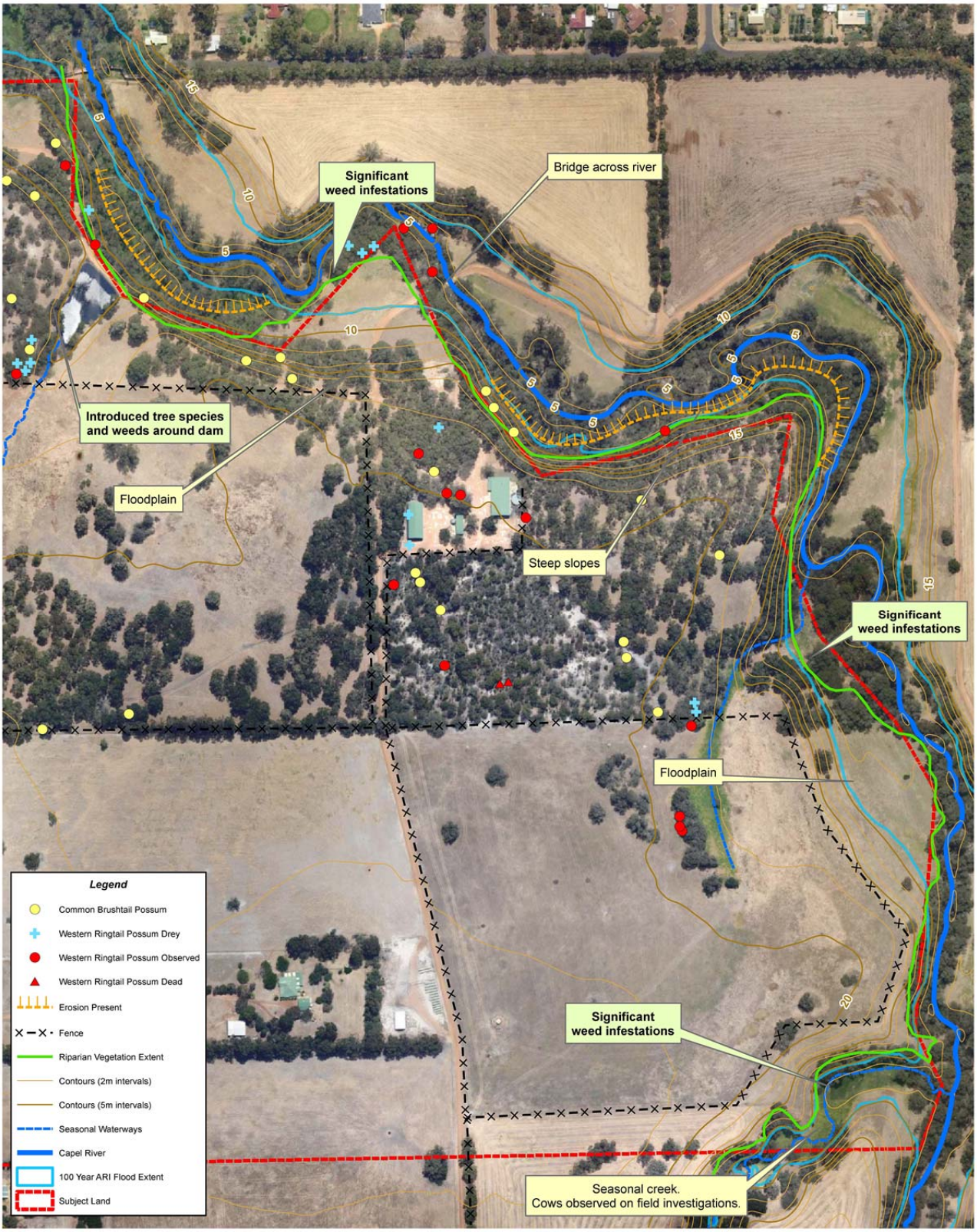

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Figure 4 – Foreshore Site Condition Map

5. MANAGEMENT ISSUES

The Capel River has been subject to vegetation clearing, livestock access, erosion and nutrient enrichment from and around the subject land in the past. The FPA and Interim Foreshore Management Plan (FMP) will support the retention, protection and where necessary rehabilitation of an appropriate vegetated buffer and management of land use activities, including best urban water management practices.

For management to be successful in the long-term, each of the management issues identified below must be addressed in a coordinated manner and involve the key stakeholders.

5.1. Foreshore Reserve Creation and Vesting

The Interim FMP delineates a boundary for the Foreshore Reserve based on the biophysical environment and management practices. At the detailed subdivision stages the Foreshore Reserve boundary will be finalised in accordance with practical management boundaries and the biophysical assessments.

Foreshore Reserves are difficult to coordinate vesting for because the reserve encompasses the land within the Structure Plan, which will have a formal reserve created, and the Vacant Crown Land for the Capel River. Therefore the varied land tenure makes it difficult for vesting authorities when multiple landowners are involved. Furthermore because the Capel River is zoned as Regional Open Space under the Greater Bunbury Regional Scheme the Shire of Capel, who would normally be a Foreshore Reserve vested authority, have advised that they may not be responsible.

A vesting authority is required to be finalised at the subdivision stage, and the final decision may influence the long-term management, maintenance and monitoring of the Foreshore Reserve. The final FMP should be prepared after the vesting authority is known to determine the most appropriate management strategies for the protection, conservation and restoration of the Capel River foreshore protection area.

5.2. Rehabilitation and Maintenance

The FPA has had impacts from previous and present agricultural practices, including livestock grazing, trampling, erosion and weed invasion. This has led to environmental degradation to the majority of the remnant vegetation within the FPA. The banks along the Capel River have erosion and scouring present (see *Figure 4*).

5.3. Protection and Conservation

The FPA potentially hosts a range of fauna species, some of which are of special conservation significance, including the black cockatoo species and the western ringtail possum. Protection and where possible, enhancement of the different habitats within the FPA is necessary for the continued support of current native fauna and provide habitat colonisation from surrounding native fauna.

5.4. Drainage Management

Drainage from South East Capel Structure Plan residential areas requires management strategies to ensure that the runoff and stormwater do not adversely impact on the FPA, especially the water quality and quantity. Detentions basins will be located within Drainage Reserves, which will be adjacent to the Foreshore Reserve in certain locations. The drainage designs will ensure that no 1:1 year runoff from the development is discharged to the foreshore area as treatment will occur at or near the source throughout the development via the use of appropriately sized and designed bioretention gardens. The 1:5 year and 1:100 year events will have controlled released flow rates via spillways from detention basin, at pre-development flow rates.

5.5. Fire

The FPA is a considerable fire risk from fires that start within the FPA and fires migrating in from surrounding areas, because of the high fuel loads present and the areas of remnant vegetation presently on the site. The rehabilitation programs proposed for the Foreshore Reserve will increase the fire risks. For houses located towards the top of the embankment, there will be a requirement for careful consideration to be given when selecting plant species so as to limit the potential of fire impacting upon any built infrastructure, and spreading into retained remnant native vegetation.

5.6. Weeds and Feral Animals

Within the foreshore area there are no native plant communities that have not been invaded by introduced weeds. The weed burden over most of the site is heavy and will require considerable effort to control. While the native vegetation is showing some signs of resilience currently to weed invasion, any type of disturbance is likely to greatly increase the weed populations in the FPA. The Capel River Action comments that in foreshore areas, removal or control of weeds must be completed with great care, and that the erosive power of water requires consideration when planning a weed management strategy. Particular weeds of note in the FPA are:

- Bridal Creeper;
- Blue Periwinkle;
- Arum Lily;
- Soursob; and
- Exotic Grasses (Kikuyu, Winter Grass and Couch)

An occupied fox den was observed in 2005 and several dead western ringtail possums were recorded in the vicinity of the den too. The fox den may no longer be occupied, but control strategies for foxes and rabbits should be carried out, if required, on the land adjacent to and within the FPA to minimise impacts that these feral animals have on the native flora and fauna.

5.7. Recreation and Access

The public presently have very limited access to the foreshore area as it is located on private property. Post development will increase the accessibility of the FPA and the Capel River from the subject land. A multiple-use path will also be established along the POS reserve that is adjacent to the Foreshore Reserve. The POS and path network will provide greater recreational facilities and options to the community, however this also increases the access. Appropriate control mechanisms need to be considered for managing recreation and limiting access.

The existing bridge (river crossing) and farm track along the Capel River, west of the existing buildings, will be retained and incorporated into the landscape and foreshore designs. The track and river crossing will be multiple use paths that are available for recreational purposes only. The Department of Water will not support the retention of the river crossing if the Shire is not the vested authority and/or a maintenance commitment is not guaranteed by the vesting authority.

5.8. Community

Currently there are no community based management group that are specifically established to assist in the management of the Capel River foreshore at this site. Such groups can be instrumental in implementing local projects and assisting government agencies in the management of environmentally sensitive areas. GeoCatch and the Department of Water are currently developing a management plan for the Capel River, and they have implemented management projects in the past to assist in the management and encouraged public involvement in the Capel River. The Capel River Action Plan released in 1999 provided a broad scale approach to management issues and remedial actions required along the river.

6. MANAGEMENT RECOMMENDATIONS

6.1. Consultation

The major stakeholders were consulted in the preparation of the Interim FMP and, where indicated, further consultation should be undertaken with a final FMP.

6.1.1. Department of Water (DoW)

The Department at the Interim FMP stage were mainly interested in the identification of the foreshore protection area (FPA) and ensuring that sufficient land is set aside for the protection of the foreshore area, vegetation and water quality of the Capel River. The rationale for the delineation of the Foreshore Reserve should be based upon the biophysical characteristics to determine appropriate protection and management.

The Department also were interested in a vesting authority being identified for the Foreshore Reserve, which unfortunately at the Interim FMP stage has not been achieved due to external circumstances. The Department will not accept ceding of the Foreshore Reserve.

R1. Delineation of final Foreshore Reserve to be determined on biophysical characteristics and manageable boundaries.

6.1.2. Department of Environment and Conservation (DEC)

The Department was consulted during the preparation of the Interim FMP and their interests were primarily with the requirements of revegetation and habitat replacement, in accordance with the management recommendations of the Western Ringtail Possum Management Plan (Harewood, 2009a) and Black Cockatoo Management Plan (Harewood, 2009b). DEC accepted that the Foreshore Reserve will provide offsets for habitat loss via rehabilitation, however DEC will require consultation with the preparation of the final FMP to review in conjunction with the detailed *Revegetation and Landscaping Management Plan* that will be required to be prepared at the subdivision stage.

R2. DEC to be consulted when preparing the final FMP to ensure it complements and is consistent with the Revegetation and Landscaping Plan.

6.1.3. Shire of Capel

The local government authority for the FPA is the Shire of Capel. The Shire did not provide any specific comments for the Interim FMP, instead commented on broad scale environmental issues for the whole development. The following advice given was for the revegetation of relevant areas and management of the environment should be undertaken as per DoW, DEC and FESA recommendations.

The Shire was also consulted in regards to vesting of the Foreshore Reserve, however the Council is in the process of discussing their procedures and position on the management and ceding of Foreshore Reserves throughout the Shire. No resolution was reached on the Shire's position for accepting the vesting of this Foreshore Reserve. Further consultation will be required with the Shire to determine a vesting authority for the Foreshore Reserve, and subsequently the appropriate

management strategies in accordance with the long-term management capabilities of the vesting authority.

R3. The Foreshore Reserve to be ceded free of cost as part of the subdivision.

R4. The vesting authority of the Foreshore Reserve to be resolved prior to the final FMP at the subdivision stage.

6.1.4. Department of Fire and Emergency Services

Broad advice was provided in regards to the FPA and Interim FMP by the Department. The requirement for the preparation of a Fire Management Plan was raised, and other recommendations are listed below.

R5. A two metre wide limestone multiple use path (with one metre shoulders) to be constructed along the 'Residential R1' lots northern and eastern boundaries. This path will allow for access of 'fast attack' fire fighting vehicles.

R6. All access should be from subdivision roads that comply with 'Planning for Bushfire Protection AS3.4.3'.

R7. The development to be serviced with a reticulated water supply and fire hydrants in accordance with the 'Planning for Bushfire Protection AS3.5.1 and 3.5.2'.

6.2. Erosion and Accretion

Erosion and scouring was noted along sections of the Capel River bank. If engineering controls are to be considered a detailed investigation of river geometry upstream and downstream of the study area would be required to ensure no adverse impacts upon the river's hydrological influences.

R8. Preparation and implementation of a weed removal and control program along the river banks, which is supplemented by revegetation of the banks with appropriate native species to stabilise soils and reduce overland flows.

6.3. Drainage Management

Drainage from new residential areas will be managed with water sensitive urban designs (WSUD) and best management urban water practices in accordance with the *Stormwater Management Manual of WA* (DoW, 2009). The drainage designs ensure that no 1:1 year runoff from the development is discharged directly into the FPA, and treatment of runoff will occur in bioretention gardens at or close to the source throughout the development. The 1:5 year and 1:100 year events will control release flows at pre-development rates via a spillway system.

R9. No direct stormwater runoff from residential development to the FPA.

R10. Treatment of all stormwater less than and including the 1:1 year ARI events through bioretention systems.

R11. No drainage basins to be located within the Foreshore Reserve.

R12. Regular and long-term maintenance of the development's stormwater network to ensure system effective treats and manages runoff from the development.

6.4. Vegetation

A Landscape Master Plan has been prepared to address the revegetation and habitat creation criteria for the subject land (see *Appendix 3*). The existing Capel River has remnant native vegetation along the banks, and the purpose of revegetation within the FPA will be to promote native vegetation and enhance the extent of the native vegetation extent away from the river.

R13. Revegetation should commence after adequate weed control and management is achieved.

R14. Revegetation should be prioritised in sections where erosion and scouring are issues, especially where weed control may increase the risks.

R15. Intensive revegetation 30m from the top of the Capel River's bank and/or riparian vegetation extent. The intensity and extent of the revegetation is dependent on the funding and commitments of the vesting authority.

R16. Revegetation species should be selected to compliment and consist of existing native vegetation. The species should include a mixture of trees, shrubs and groundcovers. Appendix 4 provides a guide on appropriate species for revegetation.

6.5. Fauna and Habitats

The Department of Environment and Conservation requires specific revegetation plans throughout the development to offset the habitat loss caused by the development. Separate management plans have been prepared and approved for the black cockatoo and western ringtail possum (see *CD of Attachments* for full reports).

R17. Implementation of the black cockatoo and western ringtail possum management plans.

R18. Inclusion of appropriate species in the Foreshore Reserve to offset fauna habitat loss caused by the development of the subject land.

6.6. Ecological Linkage

The objective of Interim FMP is to protect, conserve and enhance the regionally significant riverine ecological Capel River linkage. The recommendations throughout the Interim FMP will assist the study area achieving this objective, specifically Recommendations 13 to 18.

6.7. Weed and Feral Animal Control

The Capel River Action comments that in foreshore areas the removal and/or control of weeds must be undertaken with due diligence and ensure that erosion caused by the removal of any vegetation within a riverine system is considered when planning the weed management strategy.

R19. Preparation and implementation of appropriate weed control strategies. A brief overview of proposed weed control practices for weeds of note within the FPA are documented in Appendix 5.

R20. Determine extent of feral animal impacts on the FPA.

R21. Prepare and implement, if necessary, strategies to control specific feral animals. The Department of Agriculture and Food should be consulted to determine control options.

6.8. Fire Management

A fire management plan will be prepared at a relevant subdivision stage. For the strategic framework of the structure plan the standard fire protection measures outlined in the *Planning for Bushfires* will be incorporated. A few specific recommendations for the foreshore are listed below.

R22. Development to be serviced with reticulated water and incorporated in accordance with Planning for Bushfire Protection AS3.5.1 and 3.5.2.

R23. Areas that are not revegetated, including existing native vegetation, are to be slashed in spring and on a needs basis.

R24. All residential lots less than 2,024m^2 will be required to remove all inflammable material from the whole of the land except living vegetation as per Shire Bush Fire Orders.

R25. On lots greater than 2,024m^2 a three metre wide fire break is required inside and along external boundaries of the land. All other grass remaining on the property is to be slashed to a maximum height of 100mm. On the vertical plane side of the fire break the trees are to pruned to a minimum height of five metres.

R26. A twenty metre low fuel zone around all buildings on the land is required.

6.9. Recreation and Public Access

The multiple use path network will provide public access and recreation uses for residents. The adjacent POS will also include areas for barbeques, picnics and playgrounds. The retention of the existing river crossing bridge is dependant on the vesting authority's commitment.

R27. Construction, where required, of uniform open rural style fencing along the boundary of private lots and the POS and/or Foreshore Reserve.

R28. Exclusion of all vehicles, except maintenance and emergency vehicles, from the Foreshore Reserve with the use of appropriate measures, including fences, bollards and/or similar barriers.

R29. Removal of any non-essential infrastructure from within the Foreshore Reserve, such as unnecessary fencing.

R30. Creation of a multiple use path outside of the Foreshore Reserve and active POS adjacent to the Foreshore Reserve.

R31. Retention of existing track adjacent to the Capel River for management and recreation purposes.

R32. Retention of the river crossing bridge for recreational purposes, if the vesting authority guarantees maintenance.

6.10. Community Involvement

The developer, Shire of Capel and the vesting authority are encouraged to engage the community. They should also provide leadership and assistance in the establishment and organisation of community groups focused on the Capel River foreshore area.

R33. Encourage the involvement of the community and new residents in catchment wide management activities.

R34. Encourage the involvement of the community and new residents in the implementation of the FMP, including long-term maintenance, management and monitoring programs.

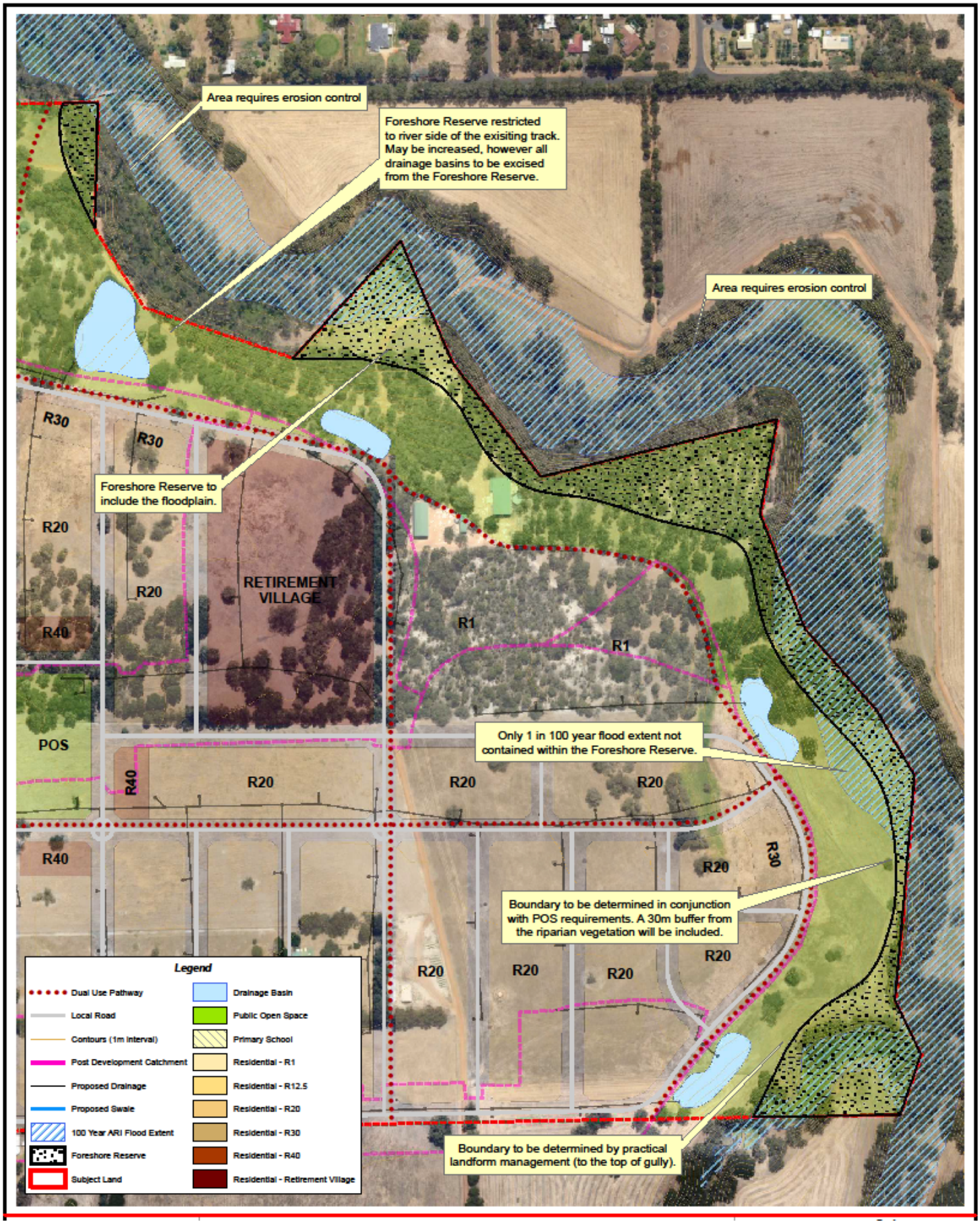

Figure 5 – Foreshore Protection Area Management Recommendations

7. FUNDING AND RESOURCES

7.1. Establishment (5 Years)

The developer of the South East Capel Structure Plan area is committed to a five year/five season's rehabilitation, maintenance and monitoring agreement for the Foreshore Reserve. The commitment to implementing the final Foreshore Management Plan (FMP) will be effective from the date of first works undertaken in accordance with the approved final FMP. The understanding of any work should be proportional to the size and extent of the subdivision stage. Maintenance by the developer will be limited to:

- Weed and feral animal control;
- Erosion control (non-engineering);
- Grass slashing;
- Multiple use path construction;
- Fence construction (where appropriate); and
- Revegetation.

7.2. Developers Other Commitments

The work carried out under the final FMP does not include the standard maintenance arrangements that will be negotiated for other engineering works that are beyond the scope and influence of the FMP.

Any commitments by the developer regarding the revegetation and habitat creation work required as part of the black cockatoo and western ringtail possum management plans will be incorporated in the responsibilities and management commitments detailed in the Revegetation and Landscaping Management Plan to be prepared for the South East Capel development.

7.3. Long-term Maintenance Responsibilities

The long-term and ongoing maintenance, rehabilitation and replanting of the Foreshore Reserve will be the responsibility of the vested authority following the initial maintenance and monitoring period. Discussions between the Shire, State authorities and the developer will need to be undertaken to decide on the vesting authority for the Foreshore Reserve prior to the preparation of the final FMP.

Community input is desirable for ongoing implementation of the FMP and long-term management of Foreshore Reserve. Community involvement would assist in establishing a degree of community pride and support for the management of natural assets and the Capel River within their neighbourhood. The developer is encouraged to engage the community, the Geographe Catchment Council and the Shire of Capel in the creation and initial rehabilitation work for the Foreshore Reserve. The vested authority is also encouraged to engage the community in the ongoing maintenance, monitoring and management of the Foreshore Reserve to achieve a successful outcome for the Capel River Foreshore Reserve that is long-term.

8. IMPLEMENTATION SCHEDULE

The Interim FMP aims were to prepare management recommendations for the identified foreshore protection area (FPA) to protect the foreshore and river's water quality, vegetation and fauna habitat. The Interim FMP also was to provide guidelines for a proposed implementation schedule for a rehabilitation management plan to enhance the native foreshore ecological functions.

The Interim FMP is not the final plan or schedule for the management of the Foreshore Reserve, a detailed and finalised FMP will be required upon identifying a vesting authority and with subdivision details available. The Interim FMP should be used as the guidelines to determine appropriate management strategies based on the vesting authority and final Foreshore Reserve delineation.

The recommendations and management schedule for the Foreshore Reserve should be implemented in two phases:

Phase One: The construction and implementation of management works at the time of subdivision for land adjoin the POS and Foreshore Reserve land. Management works to be undertaken at this phase include activities such as, weed control and revegetation.

Phase Two: The monitoring and maintenance of the Foreshore Reserve by the responsible authority. The developer will be the responsible authority for the establishment period (5 years), and after this time the vested authority will become the long-term responsible authority.

A proposed implementation schedule for the FPA management strategies has been provided in *Appendix 6*.

9. REVIEW

9.1. Interim FMP

This FMP is only 'Interim' and is not an approved final FMP. An interim FMP has been developed at this particular planning stage, Outline Development Plan, to identify and delineate an foreshore protection area requirement for the Foreshore Reserve on the subject land. The Interim FMP has investigated the biophysical environment of the foreshore area, identified management issues and proposed recommendations for the management of the Foreshore Reserve. A final FMP is required because of the concept planning stage the process is presently at and the need for a vesting authority to be finalised. Furthermore, the final Foreshore Reserve will depend on detailed subdivision plans that are not available at this stage, and for the land adjacent to the Capel River it will be up to 5 years before any plans are available. The final FMP will need to determine appropriate management recommendations based on those prepared for the Interim FMP.

9.2. Foreshore Reserve Management

The Foreshore Reserve management plan will require regular reviews to ensure that the maintenance, monitoring and management programs are achieving the objectives of the Foreshore Reserve. The first review of the final FMP should be carried out prior to the developer's commitment expires. Adaptive management practices should be identified to assist in the development of remedial actions or alternative practices.

The review of the FMP upon handover to the vested authority will be dependent on funding and resources available. Ideally the FMP should be reviewed five years after the handover, and determine future review timeframes within that review. If the community is involved the costs of a review and on-going monitoring programs could be considerably reduced, and would also allow for remedial actions to be implemented in a more immediate manner.

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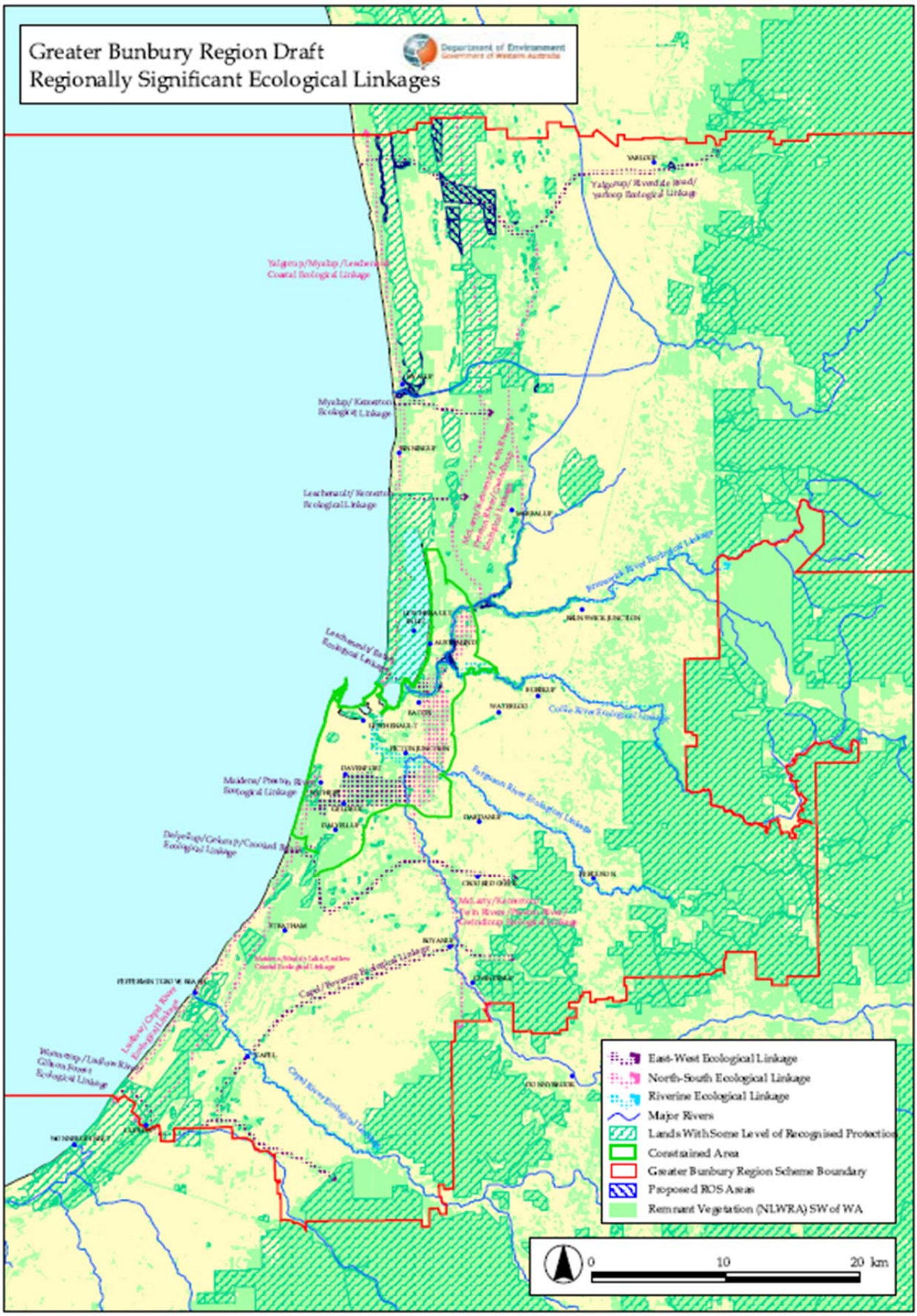
APPENDIX 1 – GREATER BUNBURY REGIONALLY SIGNIFICANT ECOLOGICAL LINKAGES MAP


Greater Bunbury Region Draft
Regionally Significant Ecological Linkages
Department of Environment
Government of Western Australia
East-West Ecological Linkage
North-South Ecological Linkage
Riverine Ecological Linkage
Major Rivers
Lands With Some Level of Recognised Protection
Constrained Area
Greater Bunbury Region Scheme Boundary
Proposed ROS Areas
Remnant Vegetation (NLWRA) SW of WA
0
10
20 km

APPENDIX 2 – LIST OF FLORA SPECIES RECORDED WITHIN STUDY AREA

FAMILY	TAXA	COMMON NAME
Adiantaceae	*Adiantum aethiopicum*	Common Maidenhair
Apocynaceae	**Vinca major*	Blue Periwinkle
Araceae	**Zantesdeschia aethiopica*	Arum Lily
Asparagaceae	**Asparagus asparagoides*	Bridal Creeper
Asteraceae	*Sonchus hydrophilus*	Native Snowthistle
Campanulaceae	*Lobelia anceps*	Angled Lobelia
Centrolepidaceae	*Centrolepis glabra*	Smooth Centrolepis
Cyperaceae	*Baumea articulata*	Jointed Rush
	Baumea juncea	Bare Twigrush
	**Carex divisa*	Divided Sedge
	Ficinia nodosa	Knotted Club Rush
	Isolepis cernua var. setiformis	
	Lepidosperma effusum	Spreading Sword-sedge
	Lepidosperma tetraquetrum	
Dennstaedtiaceae	*Pteridium esculentum*	Bracken
Fabaceae	*Acacia pulchella*	Prickly Moses
	Paraserianthes lophantha subsp. lophantha	Albizia
Iridaceae	*Patersonia spp.*	Patersonia
	**Sparaxis bulbifera*	Harlequin Flower
	Watsonia spp.	Watsonia
Juncaceae	**Juncus articulatus*	Jointed Rush
	Juncus gregiflorus	
Myrtaceae	*Agonis flexuosa var. flexuosa*	Peppermint
	Astartea fascicularis	
	Corymbia calophylla	Marri
	Eucalyptus rudis	Flooded Gum
Oxalidaceae	**Oxalis pes-carpe*	Soursob
	**Oxalis purpurea*	Largeflower Wood Sorrel
Papilionaceae	*Callistachys lanceolata*	Wonnich
	Chorizema cordatum	
	Hardenbergia comptoniana	Native Wisteria
	Kennedia prostrata	Scarlet Runner
Poaceae	**Bromus diandrus*	Great Brome
	**Cynodon dactylon*	Couch
	**Ehrharta longiflora*	Annual Veldt Grass
	Microlaena stipoides	Weeping Grass
	**Pennisetum clandestinum*	Kikuyu Grass
	**Poa annua*	Winter Grass
Ranunculaceae	**Ranunculus muricatus*	Sharp Buttercup
Solanaceae	**Solanum linnaeanum*	Apple of Sodom

* Symbolises that the species is introduced to Western Australia.

APPENDIX 3 – LANDSCAPE MASTERPLAN AND SPECIES LIST

LEGEND

- existing trees to be retained / removed
- proposed trees (refer plant schedule for species)
- indigenous mass planting (irrigated)
- foreshore rehabilitation (non-irrigated)
- roll-on turf (irrigated)
- earth mounding
- stormwater bioretention basin
- shade structure / playground
- dual use path / boardwalk
- dryland grass (non-irrigated)

note: non-irrigated planting to be installed in early winter

Trees

SPECIES	COMMON NAME	MATURE HEIGHT
Acacia saligna	Golden wreath wattle	4m
Agonis flexuosa	WA Peppermint	10 m
Allocasuarina fraseriana	Sheoak	15 m
Banksia attenuata	Slender banksia	10 m
Banksia grandis	Bull banksia	8 m
Banksia ilicifolia	Holly-leaved banksia	8 m
Banksia littoralis	Swamp banksia	10 m
Casuarina obesa	Swamp sheoak	10 m
Corymbia calophylla	Marri	30 m
Eucalyptus gomphocephala	Tuart	30 m
Eucalyptus marginata	Jarrah	15 m
Eucalyptus rudis	Flooded gum	25 m
Melaleuca incana	Grey honey myrtle	4m
Melaleuca preissiana	Modong	15 m
Melaleuca rapiophylla	Freshwater paperbark	10 m
Xylomelum occidentale	Woody pear	4m

Shrubs

SPECIES	COMMON NAME	MATURE HEIGHT
Agonis linearifolia	Swamp peppermint	3 m
Banksia sessilis	Parrot bush	3 m
Hakea prostrata	Harsh hakea	3 m
Melaleuca teriifolia	Banbar	3 m
Melaleuca viminea	Mohan	3 m
Boronia heterophyla	Pink boronia	2 m
Calothamnus quadrifidus	One-sided bottlebrush	2 m
Myoporum caraibides	Slender myoporum	2 m
Viminaria juncea	Swishbush	2 m
Grevillia diversifolia	Valley grevillea	1.5 m
Acacia pulchella	Prickly Moses	1.5 m
Calothamnus lateralis	Swamp one-sided bottlebrush	1.5 m
Eriostemon spicatus	Pepper and salt	1.5 m
Kunzea recurva		1.5 m
Melaleuca lateria	Robin redbreast bush	1.5 m
Hypocalymma angustifolium	White myrtle	1 m

Ground Covers

SPECIES	COMMON NAME	MATURE HEIGHT
Arthropodium capillipes	Chocolate lily	0.5m
Billardiera candida	Wedding creeper	creeper
Billardiera coeruleopunctata		creeper
Kennedia prostrata	Red runner	creeper
Petrophile linearis	Pixie mops	0.5 m

Sedges and Tussocks

SPECIES	COMMON NAME	MATURE HEIGHT
Agrostocrinum scabrum	Blue-eyed reed	0.7 m
Anigozanthos viridis	Green kangaroo paw	0.5m
Baumea articulata	Jointed rush	0.9 m
Dianella revoluta	Flax Lily	0.5 m
Juncus kraussii	Sea rush	0.7 m
Lepidosperma gladiatum	Coastal sword sedge	1.5 m
Lepidosperma effusum	Inland sword sedge	0.7 m
Orthrosanthos laxus	Morning iris	0.4 m
Patersonia occidentalis	Western iris	0.4m

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SCALE 1:5000 @ A3

0 25 50 75 100 125 150 175 200m

SOUTH EAST CAPEL STRUCTURE PLAN

TME Town Planning Management Engineering Pty Ltd

LANDSCAPE MASTER PLAN

SK01- A

APPENDIX 4 – SPECIES RECOMMENDED BY THE CAPEL RIVER ACTION PLAN FOR REVEGETATION ALONG STUDY AREA OF CAPEL RIVER

HABIT	HABITAT	SPECIES	COMMON NAME	PROPAGATION	FLOWERING TIME	NOTES
TREE	Floodplain & Upland	*Agonis flexuosa var. flexuosa*	Peppermint	Seed sown in Autumn or Spring. Direct seed, plant or cutting.	Spring and early Summer	Striking hormone will assist propagation of cuttings
	Floodplain & Upland	*Corymbia calophylla*	Marri	Seed or planting	Summer to Spring	
	Upland	*Eucalyptus marginata*	Jarrah	Seed or direct seeding	Spring	
	River channel & Floodplain	*Eucalyptus patens*	Swan River Blackbutt	Seed or direct seeding	Spring to Summer	
	River channel & Floodplain	*Eucalyptus rudis*	Flooded Gum	Seed or planting	Autumn to Spring	Plant seed in Spring
	River channel & Floodplain	*Paraserianthes lophantha*	Albizia	Grow from seed or seedling	Winter and early Spring	Collect seed pods early to mid-Summer. Scarify seeds or immerse in hot water
SHRUB	Floodplain & Upland	*Acacia pulchella*	Prickly Moses	Seed	Winter to Spring	Scarify or soak seed before sowing
	River channel & Floodplain	*Acacia urophylla*		Seed	Autumn to Spring	Scarify or soak seed before sowing
	Floodplain & Upland	*Anigozanthos viridis*	Green Kangaroo Paw	Seed	Summer	
	River channel & Floodplain	*Callistachys lanceolata*	Wonnich	Seed	Spring and early Summer	Scarify or soak seed before sowing
	Floodplain	*Chorizema ilicifolium*	Holly Flame Pea	Seed	Spring to early Summer	
	River channel & Floodplain	*Gastrolobium ebracteolatum*		Seed	Spring to mid-Summer	Scarify or soak seed before sowing
	Floodplain & Upland	*Leucopogon propinquus*		Seed or seedling	Late Summer to Winter	Can be difficult to propagate
	Upland	*Persoonia longifolia*	Snottygobble	Seed	Late Spring to Summer	Difficult to propagate

RUSH	Floodplain	*Baumea articulata*	Jointed Rush	Seed or division	Spring to early Summer	Best results with results with rhizome transplantation in Winter
	River channel & Floodplain	*Bolboschoenus caldwellii*	Marsh Club-rush	Seed germination	Spring	Germinate seed immediately after collection
	River channel & Floodplain	*Ficinia nodosa*	Knotted Club Rush	Direct seeding	Spring to late Summer	Seed matures late in summer to early Autumn
	River channel & Floodplain	*Juncus pallidus*	Pale Rush	Seed	Spring	
SEDGE	River channel & Floodplain	*Lepidosperma effusum*	Spreading Sword-sedge	Seedlings	Spring	
	River channel & Floodplain	*Lepidosperma tetraquetrum*		Seedlings	Mid-winter to Summer	
CREEPER	River channel & Floodplain	*Clematis pubescens*	Common Clematis	Seed or cutting	Winter to late Spring	Fresh seed required for successful germination
	Floodplain & Upland	*Hardenbergia comptoniana*	Native Wisteria	Seed	Winter to Spring	
	Upland	*Kennedia coccinea*	Coral Vine	Seed	Spring to early Summer	

APPENDIX 5 – WEED CONTROL PRACTICE GUIDELINES

The foreshore area has had weeds introduced and present across the whole landscape. The weed burden over most of the site is heavy and will take considerable effort to control. While the native vegetation is showing some signs of resilience currently to weed invasion, any type of disturbance is likely to greatly increase the weed populations in this area. The Capel River Action comments that in foreshore areas, removal or control of weeds must be completed with great care, and that the erosive power of water requires consideration when planning a weed management strategy. This appendix provides a brief summary on the guidance for effective control practices on some of the most prolific weeds present within the subject area. The Department of Agriculture and Food's (DAFWA) Declared Plant Control Handbook has also been included on the *CD of Attachments* (Appendix 2 within that document provides a calendar of operations for weed controls).

Bridal Creeper

Herbicides have been the most effective method of control. However, because Bridal Creeper often grows in areas of native vegetation, it is particularly important to avoid contact with desirable plants or soil near tree root zones. Isolated plants can be treated with a recommended herbicide applied by spot spraying (CRC 2003). Recommended herbicides by DAFWA are Metsulfuron and Glyphosate.

For larger infestations a controlled fire in early autumn can remove all understorey vegetation and improve access for later spraying before the first autumn rains. As well as improving the effectiveness of herbicide application, fire may help to destroy Bridal Creeper seed and the dense tuber mat. However, use of fire requires permission from government authorities and its frequent use may endanger the survival of many native plant populations (CRC 2003).

Corporative Research Centre (CRC) for Australian Weed Management. 2003. *Weed Management Guide for Bridal Creeper*

Blue Periwinkle

A range of strategies is needed to minimise the impacts of periwinkle on biodiversity and to prevent it from spreading. Small infestations of Blue Periwinkle can be manually removed. Care should be taken to remove all stems and roots to minimise regeneration. Material should also be disposed of carefully to prevent any spreading from stem fragments (CRC 2008).

Larger patches should be removed in stages from the edges, folding the runners inwards towards the weed as work progresses. Cleared areas where the soil has been disturbed will be prone to invasion by periwinkle regrowth or other weeds. The main herbicide treatment for periwinkle in native vegetation is foliar spray of actively growing plants using systemic, non-residual herbicide. Generally spring is the recommended season for spraying. Native plants need to be shielded from contact with the herbicides. A follow up spot spraying of stem and root growth, and seedling regeneration is best undertaken between 6 to 12 months after initial treatment. Periwinkle is not listed on the label of any registered herbicide in Australia (CRC 2008).

Corporative Research Centre (CRC) for Australian Weed Management. 2008. *Weed Management Guide for Blue Periwinkle*.

Arum Lily

Scattered plants of Arum Lily are best removed physically, but it is important to remove all parts of the plant to stop or reduce regrowth. Larger infestations may be treated chemically. Seed production can be prevented by spraying plants before fruits ripen. Herbicides should be applied when the plants are growing actively, usually between June and October before flowering has finished. Follow-up application programs may be necessary after a year or two to treat regrowth and seedlings. The Department of Agriculture and Food recommends the following herbicides Chlorsulfuron, Metsulfuron, 2-4-D amine and Paraquat.

Soursob

Soursob is difficult to eradicate unless control methods are well timed and persistent over several years. The plant must be attacked at a critical stage in its life cycle called the old bulb exhaustion stage. This is when the food material of the old bulb is exhausted and the new bulb is not sufficiently developed to survive. Unfortunately this stage cannot be determined by looking at the aerial growth, only by digging up plants and inspecting the bulbs. Manual removal of the plants is not recommended, as it will most likely lead to spreading of the weed. Chemical control of Soursob is often the most practical option available for dense infestations in bushland.

Exotic Grasses (Kikuyu, Winter Grass and Couch)

Kikuyu, winter and couch grass has spread from surrounding gardens and pasture, and have replaced, in areas, the majority of understorey vegetation. Management of these grasses will be ongoing. Options to manage these grasses include spraying, slashing and burning. Due to the lay of the land the most applicable method will be a combination of spraying and slashing. Replanting the controlled areas with native vegetation should assist in controlling the re-establishment of the grasses after treatments. Following initial treatment a range of other options may need to be investigated by the Shire and the Department of Environment and Conservation.

APPENDIX 6 – IMPLEMENTATION SCHEDULE (INTERIM)

	Weed Control	Planting	Monitoring		Fencing	Rubbish	Slashing	Fire
			Weeds	Revegetation				
Stage 1 (Year 1: Jan - Apr)	Spray summer active species (e.g. grasses, Apple of Sodom), focusing the spray on active growth after rainfall.		Monitor success of weed control practices at the end of this period. Review weed control mechanisms, if needed.		Removal of old fences, where necessary.	Removal of any large rubbish throughout reserve.		
Stage 2 (Year 1: May - Aug)	Spray winter active species (e.g. Bridal Creeper, Arum Lily), focusing the spray on active growth after rainfall has encouraged adequate germination.	Plant areas where adequate weed control has been achieved after winter rainfall has moistened the soil. Or plant areas where there is a need to manage erosion after weed control.	Monitor success of weed control practices at the end of this period. Review weed control mechanisms, if needed.					
Stage 3 (Year 1: Sep - Dec)	Spray summer active species (e.g. grasses, Apple of Sodom), focusing the spray on active growth after rainfall. Spray spring and winter active species (e.g. Blue Periwinkle, Arum Lily, Soursob) prior to spring weed species seed set.		Monitor success of weed control practices at the end of this period. Review weed control mechanisms, if needed.	Monitor success of planting program from Stage 2. Undertake remedial actions where required, such as replanting, and review planting practices, if needed.			Slash all areas not covered by native vegetation, current revegetation or future revegetation.	
Stage 4 (Year 2: Jan - Apr)	As per Stage 1.		As per Stage 1.	As per Stage 3.				
Stage 5 (Year 2: May - Aug)	As per Stage 2.	As per Stage 2.	As per Stage 2.	As per Stage 3.				
Stage 6 (Year 2: Sep - Dec)	As per Stage 3.		As per Stage 3.	Monitor success of planting program from Stages 2 and 5. Undertake remedial actions where required, such as replanting, and review planting practices, if needed.		Monitor to determine if new rubbish has been dumped and remove any waste.	As per Stage 3.	
Stage 7 (Year 3: Jan - Apr)	As per Stage 1.		Monitor success of previous weed control and spraying. Respray or carry out further control where necessary.	As per Stage 6.				
Stage 8 (Year 3: May - Aug)	As per Stage 2.	Plant into areas that had the beaviest original weed burden and have now achieved sufficient weed control after winter rainfall has moistened the soil.	As per Stage 7.	As per Stage 6.				
Stage 9 (Year 3: Sep - Dec)	If monitoring requires, further spraying to follow instructions as per Stage 3.		As per Stage 7.	As per Stage 6.			As per Stage 3.	

	Weed Control	Planting	Monitoring		Fencing	Rubbish	Slashing	Fire
			Weeds	Revegetation				
Stage 10 (Year 4: Jan - Apr)	If monitoring requires, further spraying to follow instructions as per Stage 1.	Plant into areas that had the beaviest original weed burden and have now achieved sufficient weed control after winter rainfall has moistened the soil.		As per Stage 6.				
Stage 11 (Year 4: May - Aug)	If monitoring requires, further spraying to follow instructions as per Stage 2.	Based on monitoring further remedial planting should focus on areas where stocking is low, after the winter rainfall has mositened the soil.	As per Stage 7.	As per Stage 6, with replanting towards the end of this Stage.				
Stage 12 (Year 4: Sep - Dec)	As per Stage 9.		As per Stage 7.	As per Stage 6.			As per Stage 3.	
Stage 13 (Year 5: Jan - Apr)	As per Stage 10.		As per Stage 7.	As per Stage 6.				
Stage 14 (Year 5: May - Aug)	As per Stage 11.	As per Stage 11.	As per Stage 7.	As per Stage 11.				
Stage 15 (Year 5: Sep - Dec)	As per Stage 9.		As per Stage 7.	As per Stage 6.	Property fences to be installed before sale of lots adjacent to the POS and Foreshore Reserve. This is a responsibility of the developer irrelevant of the 5 year timeframe.	As per Stage 8.	As per Stage 3.	
Handover to Vesting Authority	Developer to provide a review of the weed control practices, outcomes, remeidal actions that have been undertaken and recommendations.	Developer to provide a review of the planting method, outcomes, remedial actions that have been undertaken and recommendations.	Vested Authority to investigate site weed control outcomes.	Vested Authority to investigate site revegetation outcomes.	All fencing for the Foreshore Reserve to be completed by the developer prior to handover.	Vested Authority to investigate site for large rubbish and waste.	Vested Authority to investigate site slashing outcomes.	Developer to satisfy all bush fire protection requirements whilst responsible for the reserve.

Please note:

- Appropriate herbicide will be used throughout the management stages to ensure compliance with approved chemicals only be used adjacent to waterways and wetlands in Western Australia.
- Weed control is considered adequate if the number of weeds is low enough that they are not have adverse effects on the success of revegetation and/or native vegetation at present and into the foreseeable future.
- To monitor weed control and planting success it is recommended that a bias random sampling method used, that is sampling is concentrated in areas where weed control and planting has occurred. The field investigations should be undertaken in four metre quadrants. The dominant species for the over and under storey should be recorded, and the approximate cover of weeds and native vegetation.
- The extent of rehabilitation works will be proportional to the size and extent of current subdivision stage.

APPENDIX 7:

Supporting Correspondence from Service Agencies

From: Phil Dixon
To: Jacky Martleton
Subject: FW: South East Capel Structure Plan
Date: Friday, 1 March 2013 1:41:38 PM

Jacky,

Response from Telstra as requested.

I have discussed this previously with Stuart. Basically, the subject land is within the NBN footprint area for Capel and therefore it can be assumed that it can be serviced. To get any more definitive information, we would need to lodge an NBN Application, and Stuart advised that it was premature for an application.

Regards

PHIL DIXON
Engineering Technical Officer
Town Planning Management Engineering

TME Town Planning Management Engineering Pty Ltd
26 Wittenoom Street, Bunbury WA 6230
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Tel: (08) 9791 4411
Fax: (08) 9791 4412
Mob: 0418 928 901
phil@tme.net.au
www.tme.net.au

From: Parker, Greg B [mailto:Greg.B.Parker@team.telstra.com]
Sent: Wednesday, 24 October 2012 2:52 PM
To: Phil Dixon
Cc: Speranza, Charles
Subject: FW: South East Capel Structure Plan

Hi Phil,
Things have changed in the manner that developments will be provided with communications – this area would be cabled by NBN. You need to familiarise yourself with all the information at the following links.
http://www.dbcde.gov.au/broadband/national_broadband_network/fibre_in_new_developments
http://www.nbnco.com.au/getting-connected/new-developments.html

Regards,
Greg Parker

Area Planner
WA Country
POST: Locked Bag 2525, Perth, WA, 6001

From: Speranza, Charles
Sent: Wednesday, 24 October 2012 11:59 AM
To: Parker, Greg B
Subject: FW: South East Capel Structure Plan

Greg,

Another request for information about a development in your area.

Regards,

Charles Speranza Area Planner
Area Planning WA | Fixed & Data Access Engineering | Telstra Operations
P 08 6224 6263 | E charles.speranza@team.telstra.com | W www.telstra.com

From: Phil Dixon [mailto:Phil@tme.net.au]
Sent: Wednesday, 24 October 2012 11:12 AM
To: Speranza, Charles
Subject: South East Capel Structure Plan

Hi Charles,

I apologise if you are not the correct person to direct this enquiry to and ask that, if this is the case, that you please forward this on to the correct person.

TME have prepared a Structure Plan for the area which comprises Lots 300 and 301 Goodwood Road and Lots 1 and 2426 Barlee Road, Capel as per the attached copy of TME Drawing No 09045P-SP-05.

Previous advice obtained from the Telstra in relation to the serviceability of the site for Telstra services has indicated that the site can be adequately serviced by extension of services from the existing developed areas adjacent to the site.

The purpose of my enquiry at this stage is to confirm that this remains the current situation and that you can foresee no circumstances that would prevent the development from progressing in accordance with this planning.

Regards

PHIL DIXON
Engineering Technical Officer
Town Planning Management Engineering

TME Town Planning Management Engineering Pty Ltd

26 Wittenoom Street, Bunbury WA 6230
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Fax: (08) 9791 4412
Mob: 0418 932 088
phil@tme.net.au
www.tme.net.au

From: Phil Dixon
To: Jacky Martleton
Subject: FW: South East Capel Structure Plan
Date: Friday, 1 March 2013 1:04:07 PM

Jacky,

Response from Water Corporation re: water & sewer

Regards

PHIL DIXON
Engineering Technical Officer
Town Planning Management Engineering

TME Town Planning Management Engineering Pty Ltd
26 Wittenoom Street, Bunbury WA 6230
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phil@tme.net.au
www.tme.net.au

From: Garry Crowd [mailto:Garry.Crowd@watercorporation.com.au]
Sent: Thursday, 8 November 2012 12:24 PM
To: Phil Dixon
Subject: FW: South East Capel Structure Plan

Good day Phil,

As you will probably have surmised, very little has changed from the previous advice given although we can offer a little more detail and updating.

The water supply remains a straight forward extension prospect mindful though of the size of the development and that immediately adjacent mains are only 100 diameter (Goodwood and Barlee Roads) and 150 diameter (Hawley Parkway). An assumption could be made that an extension of the 200 diameter main will be required, at a yet to be determined stage of development, from the closest available location being the corner of Goodwood and Spurr Roads. The 200 main would extend along the main east west road within the development to the R40 around the POS cluster for branching to 150 (looping to the aged care site as a minimum and to the south) and 100 mains elsewhere. A more detailed assessment will be made at time of subdivision in consideration of scheme constraints at that time and proposed staging.

The wastewater information is correct although the Hawley Parkway WWPS is now operational. I suggest a wording for this catchment portion of the land similar to the first dot point for the north west catchment.

If you have any further questions on this proposal or need any clarification of the above please contact me.

Garry Crowd
Land Servicing Advisor
Water Corporation
Development Services Branch
T: (08) 9791 0423 | **F:** (08) 9791 2280

From: Phil Dixon [mailto:Phil@tme.net.au]
Sent: Wednesday, 24 October 2012 10:55 AM
To: John Mighall
Subject: South East Capel Structure Plan

Hi John,

TME have prepared a Structure Plan for the area which comprises Lots 300 and 301 Goodwood Road and Lots 1 and 2426 Barlee Road, Capel as per the attached copy of TME Drawing No 09045P-SP-05.

Previous advice obtained from the Corporation in relation to the serviceability of the site for reticulated water and sewerage services indicated the following:

1. Water Supply:

The subject land can be adequately serviced from the existing water supply infrastructure by extension of mains from the adjoining residential areas. It is recognised that some upgrading of mains may be required to adequately service the development, which will be determined in liaison with the Water Corporation at the subdivision stage.

2. Sewerage:

Current Water Corporation wastewater planning indicates that the subject land falls within three defined sewer catchments.

- The north-western portion of the site is located within the catchment of the existing Capel Drive WWPS and that capacity exists in this facility to service the relevant portion of the subject land.
- The north-eastern portion of the site, bordered by the Capel River, is within the planned catchment of a new Type 10 WWPS designated Pump Station D, located adjacent to the Capel River in the north western corner of the catchment. This WWPS is planned to pump to a DN225 sewer in House Road.
- The southern portion of the site is located within the planned catchment of future WWPS 'B' in Hawley Way on the western side of Goodwood Road.

Can you please confirm that this remains the current scheme planning situation for both utilities, and that you can foresee no constraints that would prevent the development from progressing in accordance with the current planning.

Regards

PHIL DIXON
Engineering Technical Officer
Town Planning Management Engineering

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www.tme.net.au

APPENDIX 8:

Traffic Impact Assessment and Structure Plan Traffic Report

Town Planning Management Engineering

Traffic Impact Assessment

SOUTH EAST CAPEL
Structure Plan




town planning
management
engineering
environmental

09051
February 2013

Research, Design & Delivery of Sustainable Development

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APPENDICES

1 EXECUTIVE SUMMARY

TME Town Planning Management Engineering Pty Ltd (TME) has been appointed by the owners of Lots 300 and 301 Barlee Road and Lots 1 and 2426 Goodwood Road Capel to prepare an assessment of the traffic impact associated with the preparation of a Local Structure Plan and ultimate subdivision / redevelopment of the abovementioned lots, which are situated on the southern edge of the existing Capel townsite.

The subject site is located on the southern edge of the existing Capel townsite. The site is currently zoned "Urban Development Zone" under the Shire of Capel Town Planning Scheme No.7. The northern portion of the land includes the largest areas of remnant vegetation. The southern portion of the site comprised of Lots 1 and 2426 consists predominantly of cleared pasture, with some remnant vegetation adjacent to the Capel River. An existing residential dwelling is located against the eastern Boundary of Lot 1. The site is otherwise undeveloped.

The proposed subdivision is depicted in the TME Structure Plan attached as Appendix B. The proposed subdivision comprises residential development of varying densities, ranging from R1 to R40, together with a Retirement Village, areas of Public Open Space and a Foreshore Reserve.

The primary access to the site will be from Goodwood Road, on the western boundary. A secondary access will be provided via Barlee Road and House Road to the north.

The projected traffic volumes emanating from the proposed subdivision are quite modest in relative terms. The critical movements at the key intersection of Goodwood Road and the Subdivision Access Road have been assessed as operating with a Level of Service "A" – which is to say that flows will be generally free flowing with minimal queues and few delays.

All of the streets in the proposed subdivision are "Local Streets" in Liveable Neighbourhoods terminology. Figure 2 (of this report) nominates the street types and functions for the proposed subdivision based on the following categories:

Street Classification	Pavement Width (m)	Reserve Width (m)	Pathway Provision
Neighbourhood Connector (Undivided)	13.4	20	DUP
Neighbourhood Connector (Divided)	2 x 6.8	25	DUP
Access Street - Wide	7.4	18	DUP or 1.2m Path
Access Street - Standard	6.0	16	1.2m Path
Access Street - Narrow	5.5	14	Nil – Shared Pav't

A pedestrian movement network will be provided in accordance with Liveable Neighbourhoods guidelines.

2 INTRODUCTION

TME Town Planning Management Engineering Pty Ltd (TME) has been appointed by the owners of Lots 300 and 301 Barlee Road and Lots 1 and 2426 Goodwood Road Capel to prepare an assessment of the traffic impact associated with the preparation of a Local Structure Plan and ultimate subdivision / redevelopment of the abovementioned properties, on the southern edge of the existing Capel townsite.

TME is a well-established Engineering, Town Planning and Project Management consultancy with permanent offices in Bunbury, Margaret River and Perth, specialising in all aspects of land development, service infrastructure and municipal works.

3 PROPOSED DEVELOPMENT

3.1 Strategic Context

The subject site is located on the southern edge of the existing Capel townsite. The site is currently zoned "Urban Development", and incorporates a mixture of vegetated and cleared areas. The eastern boundary of Lot 1 includes a residential dwelling. The site is otherwise undeveloped.

Capel townsite currently has a population of approximately 1500 people. The Capel Townsite Strategy adopted by Council in 2008 projects an ultimate population for the townsite of 5,500 people.

The subject site was identified in the Capel Townsite Strategy as candidate for expansion as a mixed density residential cell, subject to the usual rezoning and structure planning processes. A copy of the Capel Townsite Strategy Structure Plan is attached as Appendix A.

This report assesses the impact of traffic that will be generated by the site based on the proposed redeveloped for residential use.

3.2 Subdivision Details

The proposed subdivision is depicted in the TME Structure Plan attached as Appendix B. The proposed subdivision comprises residential development of varying densities, ranging from R1 to R40, together with a Retirement Village, areas of Public Open Space and a Foreshore Reserve.

The site is located to the immediate south of the Capel Primary School, and is bounded on its eastern flank by the Capel River. The terrain is gently undulating.

3.3 Existing Road Network

The primary access to the site will be from Goodwood Road, on the western boundary. A secondary access will be provided via Barlee Road and House Road to the north.

In the southern direction, Goodwood Road is connective with agricultural land, and beyond that, Goodwood Road serves as a regional traffic link to Donnybrook. In the northern direction, Goodwood Road provides a direct connection to the Capel town centre. Goodwood Road would therefore be the choice of travel for drivers accessing remote destinations via the Bussell Highway in both the Busselton and Bunbury directions, and beyond.

There is the possibility of a third access to the site being provided through land to the immediate south. This future access would be connective with Goodwood Road. This access would only become available in the event that the land to the south is developed.

Barlee Road runs in an east-west direction, and separates the School from the associated playing field. This portion of Barlee Road has been established as a one-way road and essentially serves as a parking area between the Primary School and the playing field. The Barlee Road reserve continues beyond the Primary School along the northern boundary of the subject site, but is unmade between House Road and the Capel River.

House Road is connective with the constructed portion of Barlee Road, and runs northwards from the northern boundary of the subject site, adjacent to the Capel Primary School. The portion of House Road adjacent to the Primary School incorporates on-road parking and traffic calming. The road network beyond House Road is ultimately connective with the Capel town centre and other areas. However, the travel lines are indirect. This route would be chosen only for direct access to the school and very few other destinations.

4 TRAFFIC GENERATION AND DISTRIBUTION

4.1 Traffic Generation

Detached dwellings typically generate between 6 and 10 vehicle trips per day. The subject site is close to the local Primary School, and is walking / cycling distance from the town centre. However, the site is a considerable distance from other trip destinations. This site is typical of the region as a whole, in that it has quite limited access to public transport. On balance, an average generation rate of 8 vehicle trips per dwelling per day is considered to be reasonable for this site.

The subject site was broken down into discrete cells (five in all), and traffic generation was assessed for each of the cells based on the projected lot yields. The results are attached at Appendix C – Traffic Generation and Distribution.

4.2 Traffic Distribution

As previously described, there are three potential traffic connections from the subject site to the existing road network, namely:

- The main entry road off Goodwood Road;
- A northern connection via Barlee Road / House Road, and;
- A possible southern connection to Goodwood Road, via a future development area to the immediate south of the subject site.

Traffic from each cell has been allocated to each of these three connecting roads based on proximity of the cells, and likely destination for the trips. The results are tabulated in Appendix C, and are expressed as vehicles per day (vpd).

The majority of the projected traffic will access and egress the subject site via the main entry road off Goodwood Road. This intersection will experience the most significant traffic volumes as a result of the proposed subdivision. Other intersections within the townsite will experience only small increases in traffic as a result of the dispersal of the generated traffic around the existing road network. Therefore the impacts at these intersections will be marginal.

The operation of the main intersection with Goodwood Road has been assessed based on the following assumptions:

- The base traffic flow on Goodwood Road will be 1500 vpd as projected in the Capel Townsite Traffic Study prepared by Donald Veal Consultants in 2009.

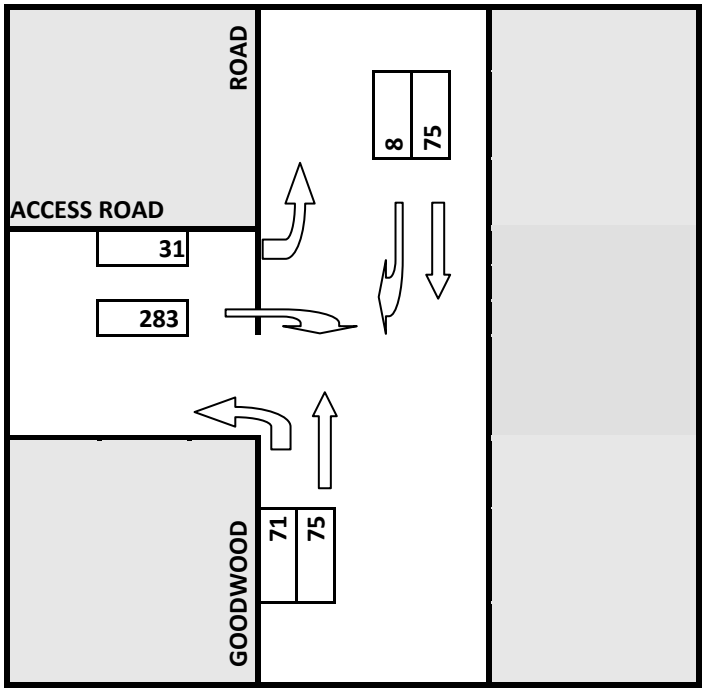
- Peak hour traffic volumes will generally be 10% of the daily projected volumes.

- The directional split at this intersection will be 90% Capel-bound and 10% Donnybrook-bound.

- Trips will be 80% outbound from the subject site in the morning peak hour, and 80% inbound in the evening peak hour.

The resultant projected intersection turning movements for the morning and evening peak hours periods are as shown in Figure 1, overleaf:

A.M. Peak Hour:



P.M. Peak Hour:

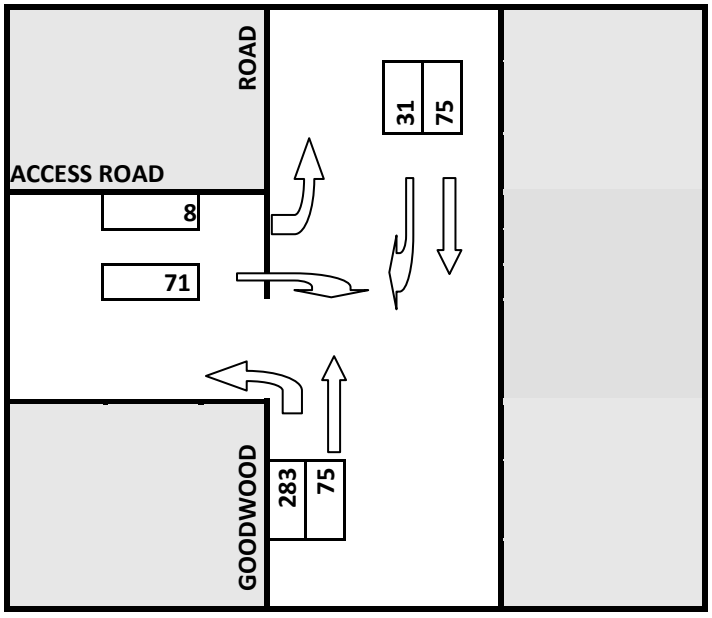


Figure 1 – Morning and Evening Peak Hour Turning Movements

Donald Veal Consultants Pty Ltd (DVC) was commissioned to access the impact of the projected traffic, using the SIDRA computer modelling package. The results of DVC's assessment are included in this report as Appendix D.

5 TRAFIC IMPACT AND MANAGEMENT

5.1 Traffic Volumes

The projected traffic volumes are quite modest in relative terms. The critical movements at the key intersection of Goodwood Road and the Subdivision Access Road have been assessed as operating with a Level of Service "A" – which is to say that flows will be generally free flowing with minimal queues and few delays.

The impact of traffic to be generated by the proposed development will therefore be negligible, and there is no requirement to upgrade any of the existing surrounding intersections, at least in so far as management of traffic volumes is concerned.

5.2 Site Access – Intersection Format

The operation of the proposed access road from a capacity viewpoint will not be a constraint. Support for the access and the layout of the intersection will be governed more by sight distance and geometric considerations.

The intersection of the proposed access road with Goodwood Road will need to be designed and constructed to Main Roads requirements. Earlier assessments for this site were referred to Main Roads for comment. The development proposals were slightly different to the current proposal. The comments provided at the time are nonetheless relevant. In summary, the previous Main Roads review noted that:

- The proposed intersection with Goodwood Road will be within the 60 kph zone. As such, uninhibited sight distances of 115m will need to be achieved in each direction;

- The projected traffic volumes are such that there will be no need for any specific right turn treatment on Goodwood Road, but a left turn slip lane into the subdivision from Goodwood Road may be warranted.

- The land is currently zoned "Urban Development". Notwithstanding the current use, any intersection treatment should be designed adopting urban type geometry, thus reflecting the proposed land use, and associated driver expectations.

Sight Distance:

The photographs below are taken looking north and south along Goodwood Road, from the location of the proposed intersection.

The observed sight distance is in excess of the required 115m sight distance in each case.

5.3 Internal Roadways

The internal roadways will be designed in accordance with the Movement Network principles outlined in Liveable Neighbourhoods.

It is noted that the Liveable Neighbourhood design principles reflect the requirements of a larger metropolitan area, and to a certain extent, assume a continuum of urban development, within a framework of Primary Distributors and Arterial roads. Capel – like any rural townsite, is finite, and the proposed development is on the extremity of the town expansion area. Nonetheless, there are a number of Liveable Neighbourhood elements that can be incorporated into the proposed subdivision to optimise the effectiveness of the movement network.

All of the streets in the proposed subdivision are "Local Streets" in Liveable Neighbourhoods terminology. Figure 2 nominates the street types and functions for the proposed subdivision based on the following categories:

Neighbourhood Connector:
The main access from Goodwood Road will serve as a Neighbourhood Connector. It is the primary vehicular access to the cell, and will carry traffic volumes in the order of 3,930 vpd.

This street will feature direct lot access, and will feature a two lane undivided carriageway, with incidental median islands at locations of high pedestrian demand, and perhaps also at the entry from Goodwood Road, as a traffic calming device and entry statement.

Access Streets:

The remainder of the streets in the proposed subdivision will serve as Access Streets. This classification covers a range of pavement and reserve widths, with pavements from 5.5metres wide to 7.5metres wide. We have defined the Access Streets into three separate tiers, (nominated as "Wide", "Standard" and "Narrow") based primarily on connectivity and functionality within the network. The following parameters are nominated:

Table 1: Local Streets – Characteristics

Street Classification	Pavement Width (m)	Reserve Width (m)	Pathway Provision
Neighbourhood Connector (Undivided)	13.4	20	DUP
Neighbourhood Connector (Divided)	2 x 6.8	25	DUP
Access Street - Wide	7.4	18	DUP or 1.2m Path
Access Street - Standard	6.0	16	1.2m Path
Access Street - Narrow	5.5	14	Nil – Shared Pav't

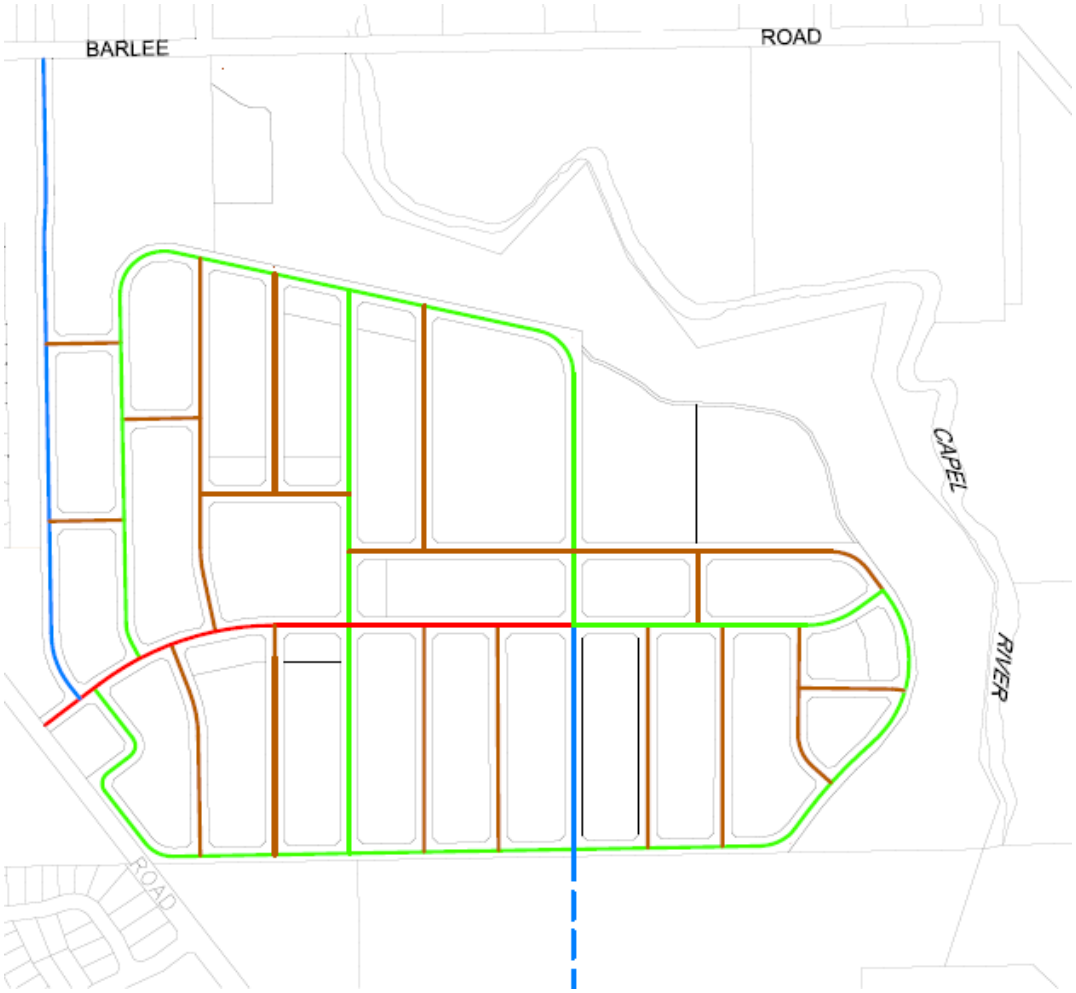
Varying pavement widths and street formats will assist with legibility for road users. It is recommended that legibility be further enhanced by the use of alternative pavement treatments and entry statements to establish intersection priorities, and to define higher order streets.

5.4 Pedestrian Movement Network

The pedestrian movement network will be provided in accordance with Liveable Neighbourhoods guidelines.

A strategic Dual Use Path (DUP) network will be established to provide linkages between the central Public Open Space area, Capel Primary School, and the Capel River Foreshore Area. The emphasis will be to provide high-quality pedestrian and cyclist amenity by maximising passive surveillance and minimising cyclist / vehicle conflicts.

Elsewhere, pedestrian paths will be provided as described in Table 1 above. It is proposed that all streets will be provided with either a DUP or a 1.2 metre-wide pedestrian pathway, with the exception of the Narrow Local Streets – where connectivity is low, and the pavements will be shared pedestrian / vehicle spaces.



LEGEND

NEIGHBOUR CONNECTOR 7.4m TO 13.4m WIDE PAVEMENT
20m TO 25m RESERVE WIDTH

WIDE ACCESS STREET 7.4m WIDE PAVEMENT
18m ROAD RESERVE

ACCESS STREET 6.0m WIDE PAVEMENT
16m ROAD RESERVE

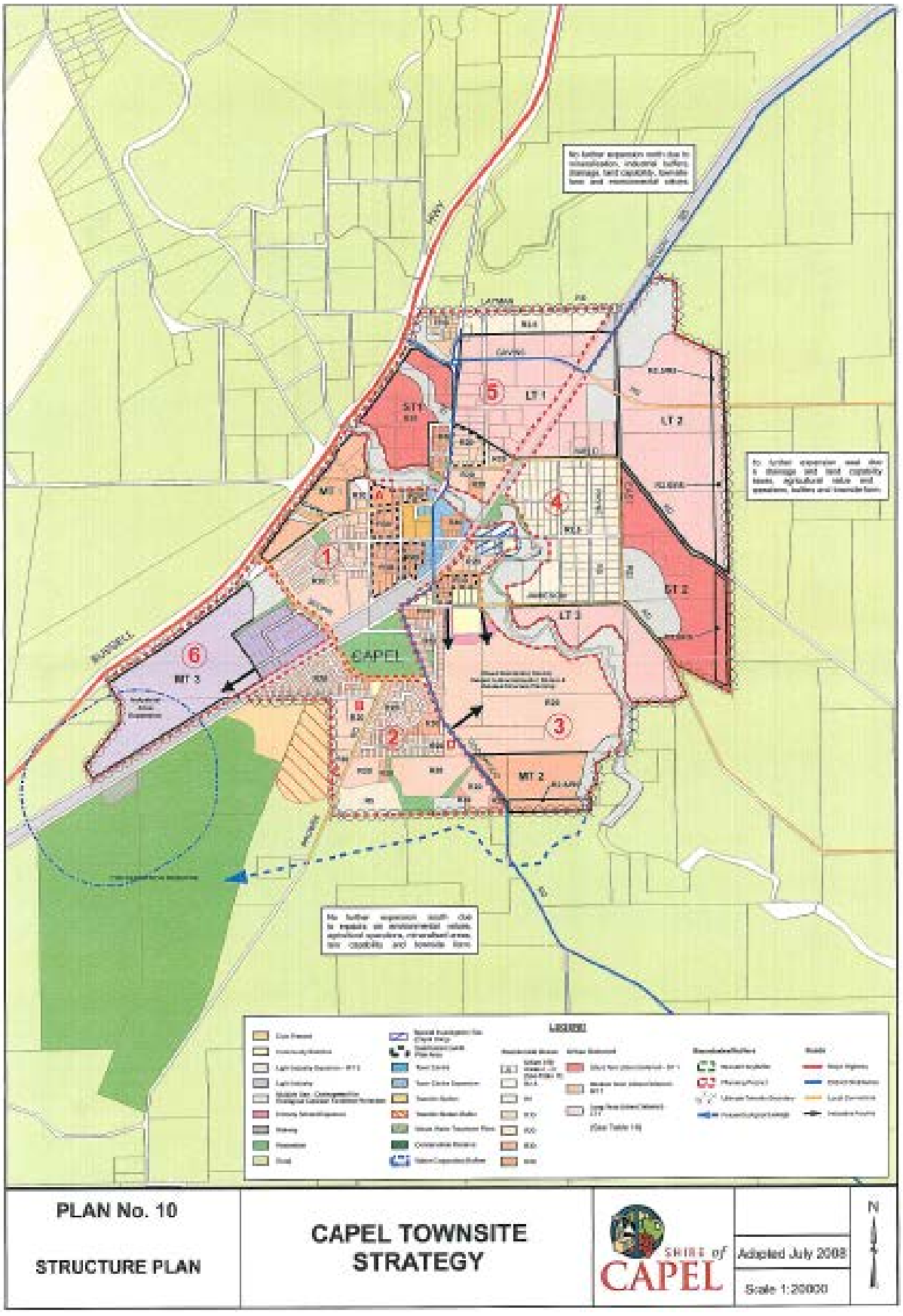
NARROW ACCESS STREET 5.5m WIDE PAVEMENT
14m ROAD RESERVE

FUTURE WIDE ACCESS STREET 7.4m WIDE PAVEMENT
18m ROAD RESERVE

Figure 2 – Recommended Internal Road Hierarchy

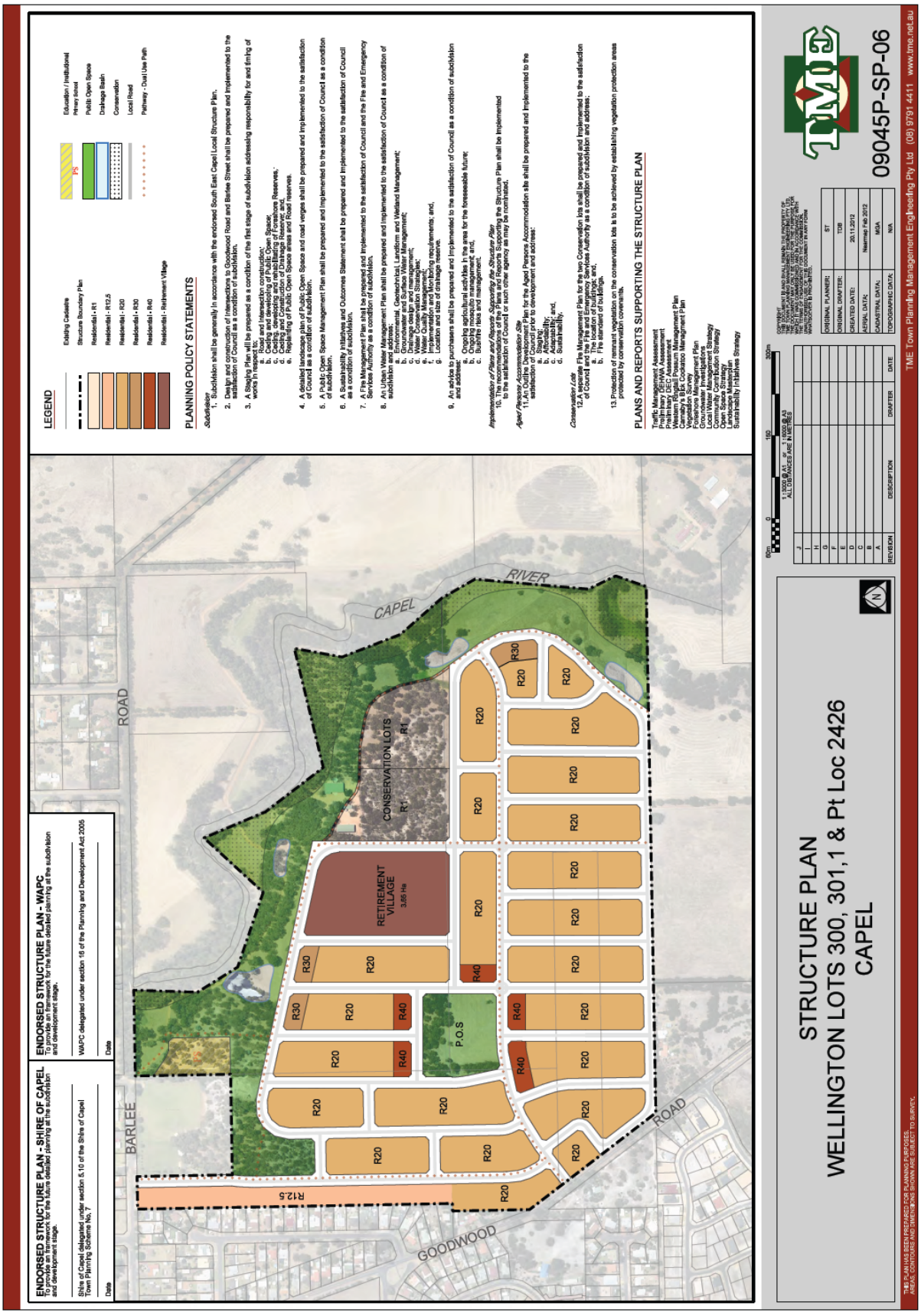
Appendix A

Capel Townsite Strategy Structure Plan


PLAN No. 10
STRUCTURE PLAN
CAPEL TOWNSITE STRATEGY
SHIRE of CAPEL
Adopted July 2008
Scale 1:20000
N
CAPEL
LT 1
LT 2
LT 3
MT 2
MT 3
ST 1
LEGEND

Appendix B

TME Structure Plan


ENDORSED STRUCTURE PLAN - SHIRE OF CAPEL
To provide an framework for the future detailed planning at the subdivision and development stage.
Shire of Capel (delegated under section 5.10 of the Shire of Capel Town Planning Scheme No. 7
Date
ENDORSED STRUCTURE PLAN - WAPC
To provide an framework for the future detailed planning at the subdivision and development stage.
WAPC delegated under section 16 of the Planning and Development Act 2005
Date
LEGEND
Existing Cadastre
Structure Boundary Plan
Residential - R1
Residential - R12.5
Residential - R20
Residential - R30
Residential - R40
Residential - Retirement Village
Education / Institutional
Private School
Public Open Space
Drainage Basin
Conservation
Local Road
Pathway - Dual Use Path
PLANNING POLICY STATEMENTS
Subdivision
1. Subdivision shall be generally in accordance with the endorsed South East Capel Local Structure Plan.
2. Design and construction of Intersections to Goodwood Road and Barlee Street shall be prepared and Implemented to the satisfaction of Council as a condition of subdivision.
3. A Staging Plan will be prepared as a condition of the first stage of subdivision addressing responsibility for and timing of works in respect to;
a. Design and Intersection construction;
b. Creation and development of Public Open Space;
c. Ceding, developing and revegetating of Foreshore Reserves;
d. Creation and development of Drainage Basins; and
e. Replanting of Public Open Space areas and Road reserves.
4. A detailed landscape plan of Public Open Space and road verges shall be prepared and implemented to the satisfaction of Council as a condition of subdivision.
5. A Public Open Space Management Plan shall be prepared and implemented to the satisfaction of Council as a condition of subdivision.
6. A Sustainability Initiatives and Outcomes Statement shall be prepared and Implemented to the satisfaction of Council as a condition of subdivision.
7. A Fire Management Plan shall be prepared and Implemented to the satisfaction of Council and the Fire and Emergency Services Authority as a condition of subdivision.
8. An Urban Water Management Plan shall be prepared and Implemented to the satisfaction of Council as a condition of subdivision and address;
a. Environmental, Geotechnical, Landform and Wetland Management;
b. Groundwater and Surface Water Management;
c. Water Conservation Strategies;
d. Water Quality Management;
e. Nutrient and Irrigation Modelling requirements; and,
f. Location and size of drainage reserve.
9. An advice to purchasers shall be prepared and Implemented to the satisfaction of Council as a condition of subdivision and address;
a. Ongoing agricultural activities in the area for the foreseeable future;
b. Ongoing odour management; and,
c. Bushfire risks and management.
Implementation of Plans and Reports Supporting the Structure Plan
10. The recommendations of the Plans and Reports Supporting the Structure Plan shall be Implemented to the satisfaction of Council or such other agency as may be nominated.
Aged Persons Accommodation Site
11. An Outline Development Plan for the Aged Persons Accommodation site shall be prepared and Implemented to the satisfaction of Council prior to development and address;
a. Bushfire;
b. Affordability;
c. Adaptability; and,
d. Sustainability.
Conservation Lots
12. A Fire Management Plan for the two Conservation lots shall be prepared and Implemented to the satisfaction of Council and the Fire and Emergency Services Authority as a condition of subdivision and address;
a. Fire separation of buildings; and,
b. Fire isolation of buildings.
13. Protection of remnant vegetation on the conservation lots is to be achieved by establishing vegetation protection areas protected by conservation covenants.
PLANS AND REPORTS SUPPORTING THE STRUCTURE PLAN
Traffic Management Assessment
Preliminary DEHWA Assessment
Western Ringtail Possum Mgt
Carnaby's BEK Cockatoo Managment Plan
Vegetation Survey
Foreshore Management Plan
Groundwater Investigations
Local Water Management Strategy
Community Contribution Strategy
Open Space Strategy
Landscape Master Plan
Sustainability Initiatives Strategy
BARLEE
ROAD
GOODWOOD
ROAD
R125
CAPEL
RIVER
CONSERVATION LOTS
R1
R1
RETIREMENT VILLAGE
3.65 Ha
P.O.S
R20
R30
R40
STRUCTURE PLAN
WELLINGTON LOTS 300, 301,1 & Pt Loc 2426
CAPEL
80m 0 160 320m
1:3200 @ A1 or 1:1600 @ A3
ALL DIMENSIONS ARE IN METRES
REVISION
DESCRIPTION
DRAFTER
DATE
ORIGINAL PLANNER: ST
ORIGINAL DRAFTER: TDB
CREATED DATE: 20.11.2012
AERIAL DATA: Nearmap Feb 2012
CADASTRAL DATA: MGA
TOPOGRAPHIC DATA: N/A
09045P-SP-06
TME TOWN PLANNING MANAGEMENT ENGINEERING
TME TOWN Planning Management Engineering Pty Ltd (08) 9791 4411 www.tme.net.au

Appendix C

Traffic Generation and Distribution


CAPEL
RIVER
ROAD
BARLEE
ROAD
GOODWOOD

Cell 1:

	Area (ha)	Lots*	Rate	v.p.d.
R 1	0.00	0	8	0
R 12.5	2.05	21	8	168
R 20	6.07	97	8	776
R 30	0.00	0	8	0
R 40	0.00	0	8	0
			Total	944

Cell 2:

	Area (ha)	Lots*	Rate	v.p.d.
R 1	0.00	0	8	0
R 12.5	0.00	0	8	0
R 20	9.25	148	8	1184
R 30	0.00	0	8	0
R 40	0.49	18	8	144
			Total	1328

Cell 3:

	Area (ha)	Lots*	Rate	v.p.d.
R 1	0.00	0	8	0
R 12.5	0.00	0	8	0
R 20	5.65	90	8	720
R 30	0.28	7	8	56
R 40	0.00	0	8	0
			Total	776

Cell 4:

	Area (ha)	Lots*	Rate	v.p.d.
R 1	4.62	2	8	16
R 12.5	0.00	0	8	0
R 20	1.87	30	8	240
R 30	0.00	0	8	0
R 40	0.00	0	8	0
			Total	256

Cell 5:

	Area (ha)	Lots*	Rate	v.p.d.
R 1	0.00	0	8	0
R 12.5	0.00	0	8	0
R 20	5.27	84	8	672
R 30	0.42	11	8	88
R 40	0.42	15	8	120
R 40**	3.65	133	3	399
			Total	1279

Notes: *In assessing the lot numbers, a factor of 80% has been applied to the maximum possible lot yield.
**Retirement Village

Traffic Generation – By Cells

	Road Link						Total v.p.d.
	North (Barlee Street)		West (Goodwood Road)		South (Future Road)		
Cell	%	v.p.d	%	v.p.d	%	v.p.d	
1	20%	189	80%	755	0%	0	944
2	5%	66	90%	1195	5%	66	1328
3	5%	39	85%	660	10%	78	776
4	10%	26	90%	230	0%	0	256
5	15%	192	85%	1087	0%	0	1279
Totals		**511**		**3928**		**144**	**4583**

Traffic Distribution

Appendix D

Donald Veal Consultants Pty Ltd
Intersection Assessment

TME

WELLINGTON LOTS 300, 301, 1 & PART LOC 2426, CAPEL

STRUCTURE PLAN TRAFFIC REPORT

July 2013

PO Box Z5578

Perth WA 6831

0413 607 779 Mobile

Issued on	31-07-2013	Amendments
Version	V2	V1 29-07 Staging review added
Reference	730	

CONTENTS

1.0 EXECUTIVE SUMMARY

Riley Consulting has been commissioned by TME to consider the traffic issues associated with the proposed development of residential land known as Wellington, to the south of Capel. Several reports have been prepared for the locality and this report utilises much of the information from those reports. The analysis undertaken in this report indicates the following:

- The structure plan area is shown to yield about 656 lots that will generate about 5,248 vehicle movements per day.

- The traffic increases from the structure plan area are proportionately large and would be considered to have an impact. However, the forecast traffic increases of the structure plan area are not shown to result in any road operating in a manner contrary to its function.

- Assessment of the local road network is undertaken cognisant of other local development (Goodwood) and acceptable Levels of Service are achieved.

- The Capel Townsite Transport Study has included the expected traffic generation of the structure plan area and adjacent residential developments. The traffic generated by the structure plan area will not affect the conclusions and recommendations of the Capel Townsite Transport Study.

- Access to Goodwood Road is shown to operate with uninterrupted flow conditions and can therefore be expected to operate with Level of Service A. The analysis is cognisant of the Goodwood development traffic forecasts.

- Appropriate road reservations and carriageway widths are proposed internally to the structure plan and an acceptable footpath network will be provided.

- It is recommended that the development of Stage 1, if accessed solely from Barlee Road, be limited to 100 lots, or 80 constructed dwellings. This level of development will maintain residential amenity on Barlee Road in accordance with *Liveable Neighbourhoods* guidelines.

2.0 THE SITE AND SURROUNDING ROAD NETWORK

The site is located to the east side of Goodwood Road and south of Barlee Road. The location of the site is shown in Figure 1.

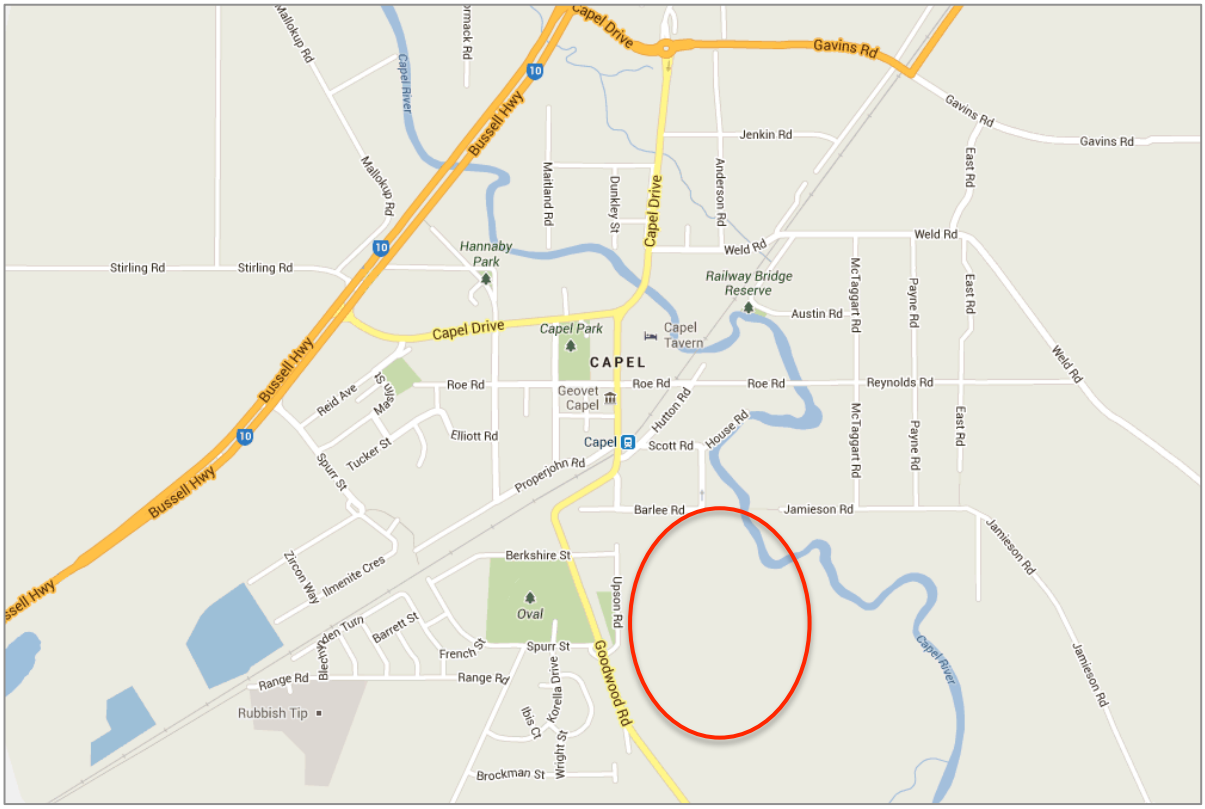


Figure 1 **Site Location** (indicative)

Roads of significance to the development site are considered below.

Bussell Highway

The Bussell Highway is a primary regional road under the control of Main Roads Western Australia (MRWA). It is constructed as a four lane divided road for most of its length. A few kilometres south of Capel, the carriageway reduces to two lanes in the vicinity of Tuart Drive.

Goodwood Road

Goodwood Road is constructed as a single carriageway road and connects to the Capel-Donnybrook Road to Donnybrook. The route is circuitous and Goodwood Road would be expected to have a localised function, although it is a district distributor. Traffic data in the Capel Townsite Transport Study (Donald Veal Consultants Pty Ltd, March 2010) indicates a

daily volume of about 900 vehicles per day (vpd). The report suggests that with full development of the locality, the forecast volume will be 1,500vpd to the south of the subject land and about 4,300vpd to the north.

Forrest Road

Forrest Road is a continuation of Goodwood Road to the town centre and is classified as a local distributor road. It provides a commercial focus street for Capel. Traffic data in the Capel Townsite Transport Study indicates a daily volume of about 3,600vpd. The report suggests that with full development of the locality, a forecast volume of 10,700vpd to the south of Capel Drive would be expected.

Capel Drive

Capel Drive is a major access road between Capel townsite and the Bussell Highway. Traffic data in the Capel Townsite Transport Study indicates a volume of about 1,800vpd. The report suggests that with full development of the locality, a forecast volume of 5,700vpd can be expected.

Barlee Road

Barlee Road is a local residential street constructed with a standard 7.2 metre wide pavement. Traffic data in the Capel Townsite Transport Study indicates a daily volume of about 138 vehicles adjacent to the Capel primary school.

The current traffic flow information shown in the Capel Townsite Transport Study is reproduced as Figure 2.

The structure plan is shown in Figure 3.

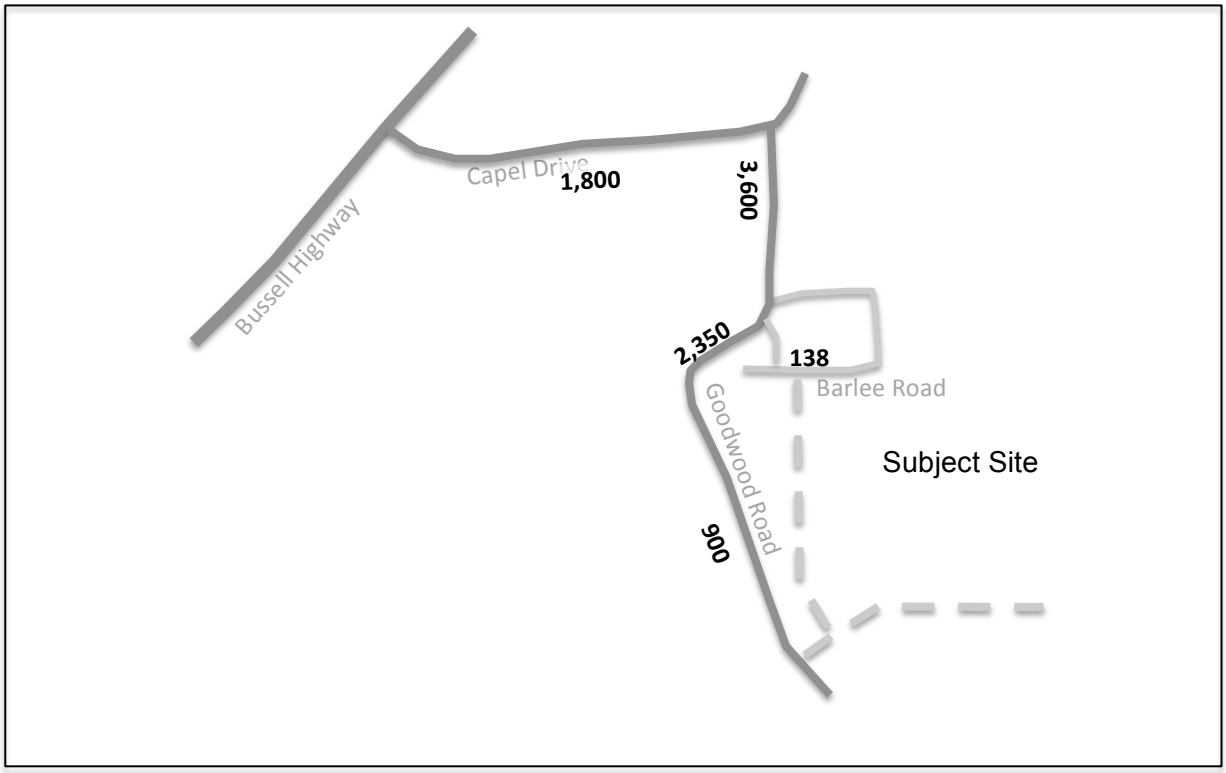


Figure 2 **Current Daily Traffic Movements (Capel Townsite Transport Study).**

Figure 3 **Proposed Structure Plan** (refer to planner for detail)

3.0 TRAFFIC GENERATION AND DISTRIBUTION

Reference to previous reports regarding the development of residential housing in Capel have utilised a trip rate of 8 trips per dwelling per day. A review of traffic flows on Korella Drive indicate a daily flow of about 565 vehicles and an approximate catchment of about 70 to 80 dwellings. The traffic flow compared to the likely catchment supports a trip rate of 8 trips per dwelling per day.

The structure plan for Wellington provides for a total of 656 residential lots, indicating that the total traffic generation from the site will be 5,248 vehicle movements per day.

The structure plan area is expected to increase local traffic by 5,248 trips per day

Distribution

The distribution of traffic generated by local residential development can be expected to primarily seek access to the Bussell Highway. Reference to the TME report suggests a split of 10% heading south on Goodwood Road and 90% heading north. Trips to the local primary school are based on the Education Department's guide of 0.35 pupils per dwelling.

Figure 4 shows the anticipated traffic movements associated with the proposed structure plan.

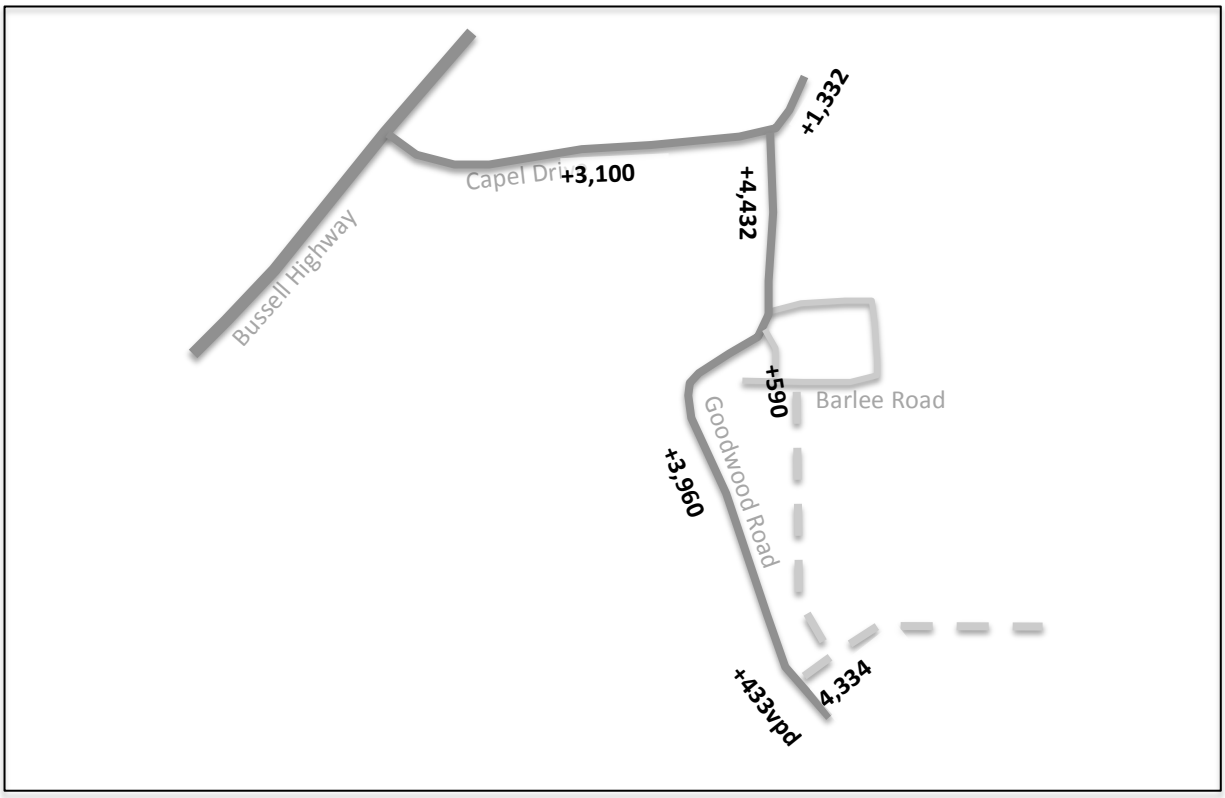


Figure 4 Forecast Increase to Daily Traffic Movements

4.0 TRAFFIC IMPACT

Figure 4 indicates the anticipated traffic increases to the local road network. It is noted that proportionately the forecast traffic increases are high, due to present day low flows. In traffic engineering terms it is recognised that daily traffic flows can vary by +/-5% and when a development increases the daily flow within this range, it is considered to have no significant impact. It is evident however, that the proposed development will have an impact.

To determine the extent of the possible impact, an assessment is made of the expected changes to current Levels of Service. The derived Level of Service is shown by road type in Appendix A. Table 1 considers the anticipated traffic generation of the site in comparison to the current daily traffic volumes.

Table 1 Impacts to Levels of Service

Road	Daily Flow	LoS	Development	Forecast	LoS
Goodwood Road south	900	A	+433	1,333	A
Goodwood Road north	2,350	A	+3,960	6,310	C
Forrest Road	3,600	B	+4,432	8,032	D
Barlee Street	200	A	+590	790	A
Capel Drive	1,800	A	+3,100	4,900	C

As stated, the traffic increases are large in comparison to the present day flows, but given that land is already zoned and identified for development, the forecast increases have previously been acknowledged.

All roads are shown to operate with good Levels of Service. Forrest Road in the centre of the town is shown to operate with Level of Service D, which is considered acceptable. As a result of the lower Level of Service, it can be expected that traffic speeds will be reduced, which may provide a positive impact to the street.

Future Traffic

Capel Townsite Transport Study reviewed the current road network and the impacts of future development based on Plan 10 of the town structure plan. Plan 10 shows the subject land as being identified for R20 density development, with some areas of higher density. An assessment is undertaken to review the proposed development and other local

developments and compare the forecast traffic flows to that of the Capel Townsite Transport Study.

Goodwood Estate

To the south of the subject land is the Goodwood Estate, which is presently being developed. The estate is expected to develop 162 dwellings that will take access to Goodwood Road and will thus impact the subject land.

Figure 5 shows the projected long term traffic flows in the locality and includes present day traffic movements, traffic generated by the Goodwood Development and traffic generated by the Wellington development.

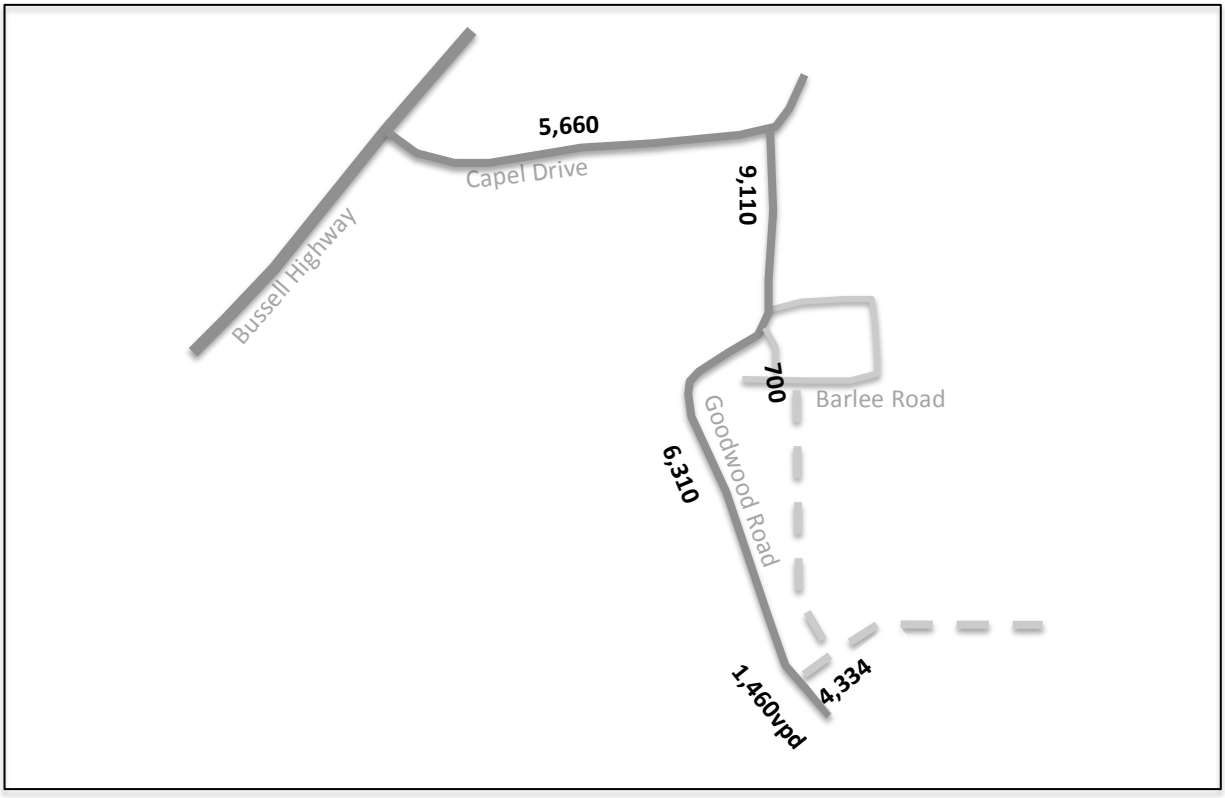


Figure 5 Long Term Traffic Forecasts – Full Development of Locality.

Table 2 considers the future traffic forecasts of all proposed development to the traffic forecasts of the Capel Townsite Transport Study.

Table 2 Impacts to Levels of Service – Full Development of Locality

Road	Forecast	LoS	DVC Report	LoS
Goodwood Road south	1,460	A	1,688	A
Goodwood Road north	6,310	C	4,200	B
Forrest Road	9,110	D	10,700	D
Capel Drive	5,660	C	5,700	C

Table 2 shows that based on the full residential development of both the Goodwood land and the subject land, future traffic forecasts are within levels identified by the Capel Townsite Transport Study. All roads are shown to operate in a manner set out by the Capel Townsite Transport Study

It is noted from the Capel Townsite Transport Study that a lower traffic demand is shown on Goodwood Road, which is most likely to point loading of traffic in the traffic model used for the Capel Townsite Transport Study.

As forecast traffic volumes are similar or less than the traffic volumes shown in the Capel Townsite Transport Study, it can be concluded that the proposed development will not affect the conclusions and recommendations of the Capel Townsite Transport Study.

As the Capel Townsite Transport Study has reviewed and analysed the operation of the district road network, there would be no need to replicate that assessment in this report.

5.0 ACCESS

Access to the proposed development will primarily be taken by a new access road directly to Goodwood Road. A secondary access to the north linking to Barlee Road is also proposed and will provide access to the local primary school.

Access to Barlee Road will be made using a standard tee intersection offset to Forrest Road in accordance with *Liveable Neighbourhoods* requirements. The structure plan indicates the access can easily conform to these requirements. Forecast traffic demands are expected to retain the traffic at less than 1,000vpd on Barlee Road and Forrest Road (south), thereby maintaining their Access Street classifications.

The intersection to Goodwood Road will need to be designed to current standards and may require approval from MRWA. The form of intersection is determined from the anticipated peak hour flows. Based on work undertaken by TME, the anticipated peak hour flows at the future intersection are attached as Appendix B. The forecast peak hour flows include traffic generated by the Goodwood development.

ACCESS OPERATION

Reference to Austroads Table 4.1 (reproduced below) indicates that with a peak hour flow of up to 330 vehicles on Goodwood Road during the morning peak and approximately 300 vehicles exiting the site access[1], uninterrupted flow conditions can be expected. Austroads advises that where uninterrupted flow conditions exist, no further analysis is warranted.

Table 4.1 — Intersection Capacity - Uninterrupted Flow Conditions

Major Road Type[1]	Major Road Flow (vph)[2]	Minor Road Flow (vph)[3]
Two-lane	400	250
	500	200
	650	100
Four-lane	1000	100
	1500	50
	2000	25

Notes:
1. Major road is through road (i.e. has priority).
2. Major road design volumes include through and turning movements.
3. Minor road design volumes include through and turning volumes.

The proposed access to Goodwood Road is shown to operate with uninterrupted flow conditions.

As discussed, the assessment is based on the long-term traffic forecasts of the locality and is cognisant of the Capel Townsite Transport Study.

[1] Based on 70% exiting the site in the AM peak.

Visibility

The key requirement at any access is the provision of visibility in accordance with Austroads standards. Based on the 60kph speed limit on Goodwood Road, intersection visibility of 115 metres is required in both directions. Figure 6 shows the visibility achieved at the location of the proposed access. It can be seen that appropriate visibility is achieved.

Figure 6 Proposed Access Visibility (Photographs provided by TME)

Turn Lane Requirements

Austroads advises that supplementary turn lanes should be provided where traffic flows dictate. A turn lane is not considered to be required where traffic flows are low and with about 330 vehicles in the peak using Goodwood Road and a maximum demand for 30 vehicles to turn right, the provision of a right turn lane is very borderline. A full turn lane treatment is not considered justified, although it is recommended that a basic treatment to widen the road pavement is provided.

The same criteria is applied to left turn lanes and Austroads would suggest that with a possible demand of 274 left turning vehicles in the peak, a left turn lane could be provided. However, the dis-benefit of a left turn lane will be a general increase in traffic speed, particularly given that following traffic is light. As the subject site is located in an urban environment where traffic speeds should be 60kph or less, it is suggested that a left turn lane is not provided. This will assist in keeping traffic speeds low approaching the access to Goodwood development further south.

Although warrants may be considered to exist, it is suggested that a left turn lane is not provided.

6.0 THE LOCAL ROAD NETWORK

The internal roadways will be designed in accordance with the Movement Network principles outlined in *Liveable Neighbourhoods*. Although this planning advice is provided for metropolitan developments, the principles apply equally to rural developments.

TME has already provided the proposed road hierarchy, which is reproduced as Figure 7.

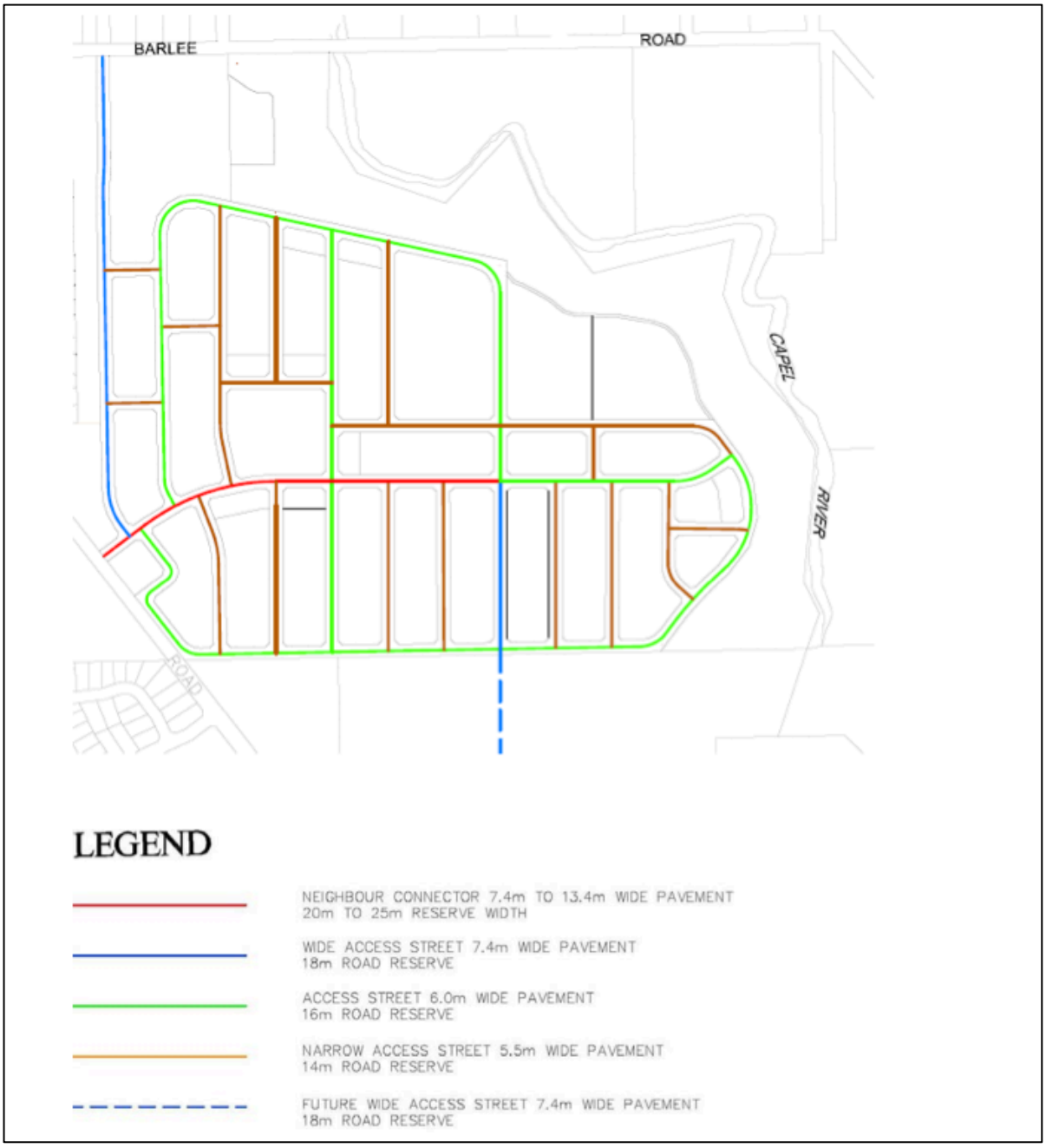


Figure 7 Wellington Structure Plan Road Hierarchy

Neighbourhood Connectors

Only the main entry to the estate from Goodwood Road would be considered as a neighbourhood connector, due to the forecast traffic demands of 4,334vpd. The forecast volume will permit direct lot access. The main entry is proposed as a single carriageway two lane road with a median provided at its intersection with Goodwood Road. A standard 20 metre wide road reservation is appropriate for this street and a standard 7.2 metre wide pavement is appropriate to cater for the forecast traffic demands.

It is noted that a boulevard style road may be provided to provide a greater entry statement to the development. A wider road reservation of 25 metres should be provided with minimum carriageway widths of 4.1 metres (Austroads). However, a 5 metre carriageway to each side of the median can be used and marked with a 3.5 metre traffic lane and a 1.5 metre cycle lane.

Access Streets

All streets carrying less than 3,000vpd are considered as access streets and this classification will apply to all other roads within the estate. Figure 7 shows the classification of the access streets into “wide”, “medium” and “narrow” and is based on the street connectivity and function. Table 3 identifies the pertinent requirements of each street type.

Table 3 Street Classification and requirements

Classification	Reservation	Carriageway	Paths
Neighbourhood Connector	20m	7.2m	DUP – footpaths to both sides
Access Street wide	18m	7.2m	DUP or footpath
Access Street medium	16m	6.0m	footpath
Access Street narrow	14m	5.5m	footpath

To improve the distinction between lower order and higher order access streets it is recommended to provide alternative paving and entry statements ay key intersections.

7.0 PEDESTRIANS, CYCLISTS AND PUBLIC TRANSPORT

The site is located within 600 metres of the main centre of retail / commercial activity in Capel and is a very easy walk. Footpaths are already provided to most streets in Capel and the subject site can access these paths through the internal road system. Goodwood Road is provided with a footpath between the town and Berkshire Road. A continuation of this footpath is desirable, but not required for the proposed development as pedestrians can be expected to use Forrest Road and the internal road network.

Liveable Neighbourhoods advises that a footpath should be provided to every street. However, where local roads have minimal traffic flows and do not provide for high traffic speeds, the provision of a footpath may be omitted subject to local government agreements.

Cycling

Cycling on local streets is considered acceptable where traffic flows are less than 3,000vpd. Therefore all local access streets would be considered appropriate to provide for on-street cycling. Dual Use Paths (DUP) are desirable where traffic flows are higher and thus the main access road should be provided with a DUP. It is also desirable to provide an internal cycle route for children to cycle to school. Figure 8 shows the recommended minimum DUP requirements for the subject site.

Bus Services

There are no local bus services within Capel due to the current population. However, several bus services are provided to link Capel to Bunbury, Busselton and Perth.

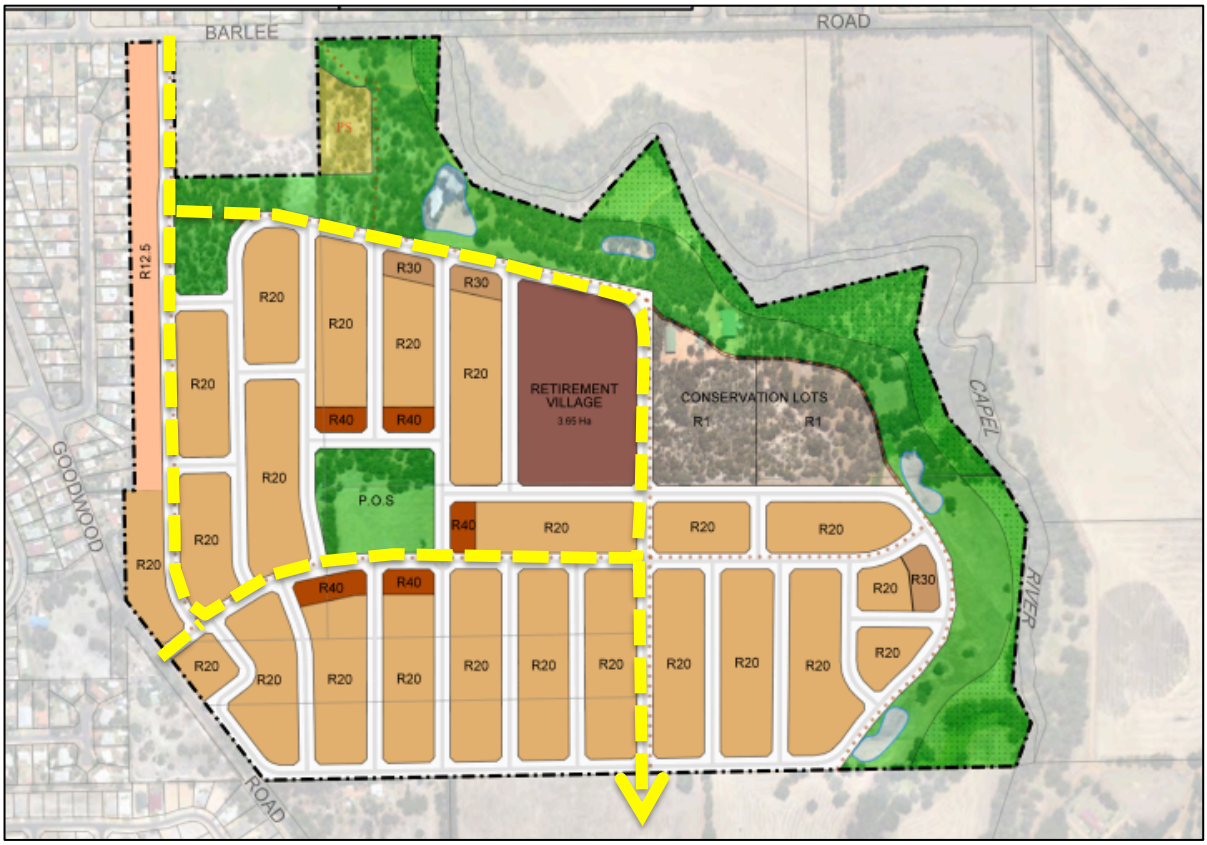


Figure 8 Recommended Dual Use Path Network

8.0 STAGING

The purpose of this staging review is to determine a level of construction that could be accessed from Barlee Road without significant impact to the residential amenity. Forrest Road north of Barlee Road is currently constructed to a higher standard and can accommodate a much higher traffic increase.

Barlee Road is presently constructed with a six metre (approximate) carriageway. Although the physical capacity would be in excess of 7,000vpd, current planning guidelines set out lower daily volumes to maintain residential amenity. *Liveable Neighbourhoods* indicates that the maximum daily traffic flow for roads with a carriageway of 5.5m to 6.0m should be 1,000vpd.

Barlee Road should not carry more than 1,000vpd as currently constructed.

It has been shown that access is to be provided to Barlee Road as part of the structure plan and with full development, the forecast traffic increase is 700vpd. Present day traffic flows on Barlee Road are shown to be 138vpd, noting that the road primarily serves the local primary school. In the longer term, it can be seen that the forecast flow on Barlee Road would be about 838vpd and current construction of Barlee Road is adequate to cater for the full development of Wellington.

Based on the current traffic count of 138vpd, the potential traffic increase on Barlee Road would be (1,000 – 138) 862vpd. Applying the standard residential trip rate of 8 trips per lot per day, the potential traffic increase would equate to (862/8) 107 new dwellings. However, Barlee Road can be expected to have fluctuating traffic flows due to Capel primary school and further assessment is provided to ensure residential amenity can be maintained prior to the construction of the Goodwood Road access.

Reference to ABS 2011 population data indicates that Capel (gazetted locality) has a total of 878 dwellings and applying the Education Departments figure of 0.35 pupils per dwelling, Capel primary school should have about 308 pupils. The recognised trip rate of 1.5 trips per student is applied indicating Capel primary school should attract (308 x 1.5) 462 vehicle movements per day. As Barlee Road provides a loop around the school, a 50/50 traffic split can be expected resulting in 231 vehicle movements using Barlee Road. With four houses

accessing Barlee Road an additional (4 x 8 trips) 32vpd could be expected. For planning purposes, Barlee Road is estimated to carry (231+32) 265vpd.

Barlee Road could carry about 263vpd.

The allowable increase to present day traffic flows would therefore be (1,000 – 263) 737vpd. On the basis of 8 trips per dwelling per day, Barlee Road could cater for the occupation of (737/8) 92 dwellings.

Barlee Road can accommodate the development of 92 new dwellings.

Recommendation

The initial stages of development are expected to take access from Barlee Road and the current road can accommodate the development and occupation of 92 dwellings whilst maintaining residential amenity.

It is recommended that the subdivision of 100 lots, or the construction of 80 dwellings be the point at which access to Goodwood Road be made.

APPENDIX A

Levels of Service by Road Type

LOS	Single Carriageway[1]	2-Lane Boulevard[2]	Dual Carriageway (4-Lanes)[3]	Dual Carriageway (4-lane Clearway)[3]
A	2,400vpd	2,600vpd	24,000vpd	27,000vpd
B	4,800vpd	5,300vpd	28,000vpd	31,500vpd
C	7,900vpd	8,700vpd	32,000vpd	36,000vpd
D	13,500vpd	15,000vpd	36,000vpd	40,500vpd
E	22,900vpd	25,200vpd[4]	40,000vpd	45,000vpd
F	>22,900vpd	>25,200vpd[4]	>40,000vpd	>45,000vpd

[1] Based on Table 3.9 Austroads - Guide to Traffic Engineering Practice Part 2

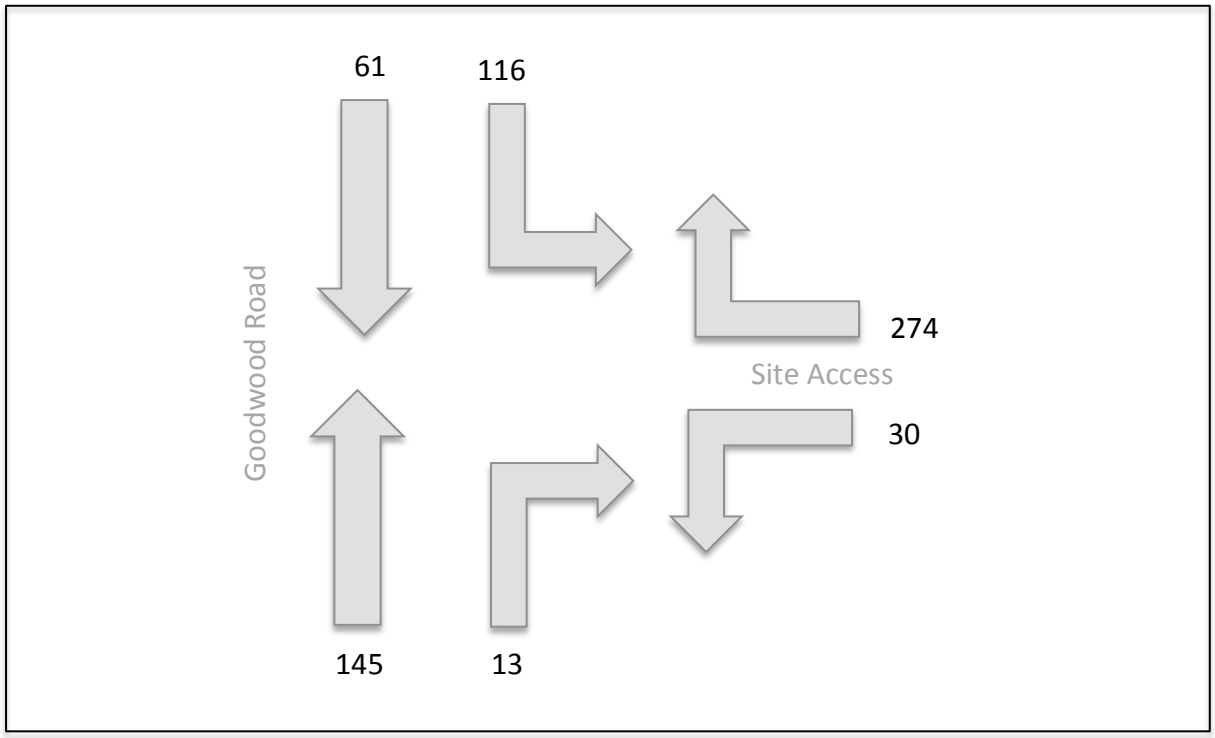
[2] Based on single carriageway +10% (supported by Table 3.1 Austroads - Guide to Traffic Engineering Practice Part 3) – Boulevard or division by medians.

[3] Based on RRR Table 3.5 - mid-block service flow rates (SF.) for urban arterial roads with interrupted flow. Using 60/40 peak split.

[4] Note James Street Guildford passes 28,000vpd.

APPENDIX B

PEAK HOUR TRAFIC FORECASTS



AM Peak Hour traffic Forecasts – assume reverse for PM Peak

APPENDIX 9:

Community Contributions Strategy

Town Planning Management Engineering

Community Contributions Strategy

SOUTH EAST CAPEL Structure Plan




town planning
management
engineering
environmental

09045
November 2012

Research, Design & Delivery of Sustainable Development

DOCUMENT QUALITY CONTROL

AUTHOR	DATE
Stuart Thompson	15.11.2012
CHECKED BY	**DATE**
Gary Barbour	15.11.2012

REVISION TABLE

No.	Purpose	Date
1	Council Approval for Advertising	05.03.2013
2	Council comments	06.08.2013

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CONTENTS

1.0 INTRODUCTION

South East Capel Structure Plan Community Contributions Strategy has been formulated at the request of the Shire of Capel to accompany the South East Capel Structure Plan.

The purpose of the strategy is to clarify the responsibilities of Council Subdividers and the developers of the structure plan area in respect to the provision of community facilities.

2.0 POLICY CONTEXT

The State Planning Policy 3.6 Development Contributions for Infrastructure was gazetted as a State Planning Policy 20th November 2009. The policy sets out the principles and considerations that apply to development contributions for the provision of infrastructure in new and established areas.

The policy supports the standard requirements for the provision of servicing infrastructure contributions, usually covered by subdivision conditions, in addition to providing a framework in which local governments can seek contributions for community infrastructure such as:

- Sporting and recreational facilities;
- Community centres;
- Child care and after school centres;
- Libraries and cultural facilities; and,
- Such other services and facilities for which development contributions may reasonably be requested, having regard to the objective scope and provisions of the policy.

The policy clearly states that contributions for the provision community infrastructure must have:

2.1 Need and the Nexus

The need for new infrastructure must be clearly demonstrated and the connection between development and the demand created should be clearly established.

2.2 Transparency

The method for calculating the development and contribution and the manner in which it is applied is clear, transparent and simple to understand and administer.

2.3 Equity

Development contributions are to be levied from all developments within the townsite expansion area and justified.

2.4 Certainty

Development contributions are clearly identified and method of accounting for escalation agreed upon at commencement of development.

2.5 Consistency

Development contributions are applied uniformly across the townsite expansion area and the methodology for applying contributions is consistent.

2.6 Efficiency

Development contributions should be justified on a whole life capital cost basis consistent with maintaining financial discipline on service providers by precluding over recovery of costs.

2.7 Right of Consultation and Review

Owners have the right to be consulted on the manner in which development contributions are determined. They also have the opportunity to seek a review by an independent third party if they believe the calculation of the costs of the contribution is not reasonable.

2.8 Accountability

There must be accountability in the manner in which development contributions are determined and expended.

SPP Policy 3.6 also requires that prior to requesting contributions for community infrastructure; local governments put in place a contribution plan in accordance with the policy and have it adopted under Council's Town Planning Scheme.

In the absence of an approved and gazetted contributions plan, the policy provides for Council and land owners within structure plan areas to enter into voluntary agreements in respect to the provision of community facilities.

3.0 DISTRICT AND TOWNSITE COMMUNITY CONTRIBUTIONS

3.1 Contribution Plan

Under Existing Policy district and townsite contributions to community facilities are required to be supported by a State Planning Policy 3.6 Development Contributions Plan for infrastructure.

The Council of the Shire of Capel is in the process of formulating a Community Contributions Plan. The finalisation date for this plan is currently unknown.

It is likely to be in the order of 3 years before the first clearances will be sought for the subdivision of lots within the South East Capel Structure Plan Area. It is highly likely that Council will have in place a contributions policy within this timeframe.

4.0 LOCAL CONTRIBUTIONS

4.1 Servicing Infrastructure

The subdivider will meet servicing infrastructure requirements in accordance with subdivision conditions.

4.2 Public Open Space

The subdivider will cede land nominated as public open space surrounding the primary school site with the first stage of subdivision.

The subdivider will cede and develop open space nominated within each subdivision application in accordance with the Public Open Space Strategy accompanying the South East Capel Structure Plan.

Public open space which is developed by the subdivider will be maintained at the cost of the subdivider for a period of 3 years.

4.3 Foreshore Reserve

The proposed foreshore reserve will be ceded to the Crown free of cost and vested in the agency nominated in the Public Open Space Strategy as adjoining land is subdivided.

Ceding of the foreshore reserve will occur in a staged manner in order that ongoing farming operations can continue.

As each portion of foreshore reserve is ceded, the relevant portions of the Foreshore Management Plan, including areas of rehabilitation, will be undertaken.

All works undertaken by the subdivider to implement the Foreshore Management Plan will be maintained for 3 years.

4.4 Intersection with Goodwood Road

The major intersection required with Goodwood Road will be constructed with the first stage of subdivision, or upon 50 lots being created if the first stage of subdivision is accessed from Barlee Road.

4.5 Links to Cycleway Network

Dual use paths along Goodwood Road and Barlee Road linking the structure plan area to the local dual use path network are to be constructed upon 50 lots being created.

APPENDIX 10:

Sustainability Outcomes and Implementation Plan

Town Planning Management Engineering

SOUTH EAST CAPEL
Structure Plan

Sustainability Outcomes and Implementation Plan





town planning
management
engineering
environmental

12120
January 2013

Research, Design & Delivery of Sustainable Development

DOCUMENT QUALITY CONTROL

AUTHOR	DATE
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CHECKED BY	**DATE**
Stuart Thompson	28.02.2013

VERSION TABLE

No.	PURPOSE	DATE
1	Submission to Shire	28.02.2013

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Figures

Tables

Introduction

TME Town Planning Management Engineering (TME) has prepared this Sustainability Outcomes and Implementation Plan (the Plan) for the South East Capel Structure Plan. The Plan is a requirement of the Capel Townsite Strategy Structure Plan Planning Policy Statements:

10. Detailed Structure Plans are to be accompanied by the following documents:

- A Sustainability Outcomes and Implementation Plan which details the targets and methods of delivery that a proponent is prepared to undertake in respect to 'Sustainability Outcomes' inclusive of:

  i. *On-site power generation;*

  ii. *On-site water capture and re-use;*

  iii. *Re-use of grey water;*

  iv. *Council housing and lot orientation for passive heating and cooling; and*

  v. *Provision of affordable housing.*

The Sustainability Outcomes and Implementation Plan has been prepared in consultation with the relevant government agencies, including the Shire of Capel, Department of Environment and Conservation (DEC), Department of Planning (DoP) and Department of Water (DoW). The developer of the Structure Plan is committed to implementing the initiatives and options outlined in this Plan to achieve the sustainability outcomes.

SITE DESCRIPTION

The subject land for the South East Capel Structure Plan (the Structure Plan) consists of Lots 300 and 301 Goodwood Road and Lots 1 and 2426 Barlee Road within Capel (see *Figure 1*). The land is adjacent to the south-eastern extent of the existing townsite of Capel. The only primary school in Capel is located adjacent to the northern boundary of the subject land, and an area has been set aside within the Structure Plan area for expansion of the school oval. The eastern boundary is bordered by the Capel River.

The Structure Plan consists predominantly of R20 lots with R30 and R40 lots located adjacent to POS. An 'Aged Care' stage within the development has also been identified. Two large R1 lots will also be created in the east, as a condition resolved with DEC to ensure that the high conservation value native forest ecosystem on-site is appropriately protected (see *Figure 1*).

A network of reserves, including a Foreshore Reserve, Drainage Reserve and Public Open Space (POS) will be established along the interface of the Capel River and the development to provide environmental protection, community opportunities and activity facilities for residents.

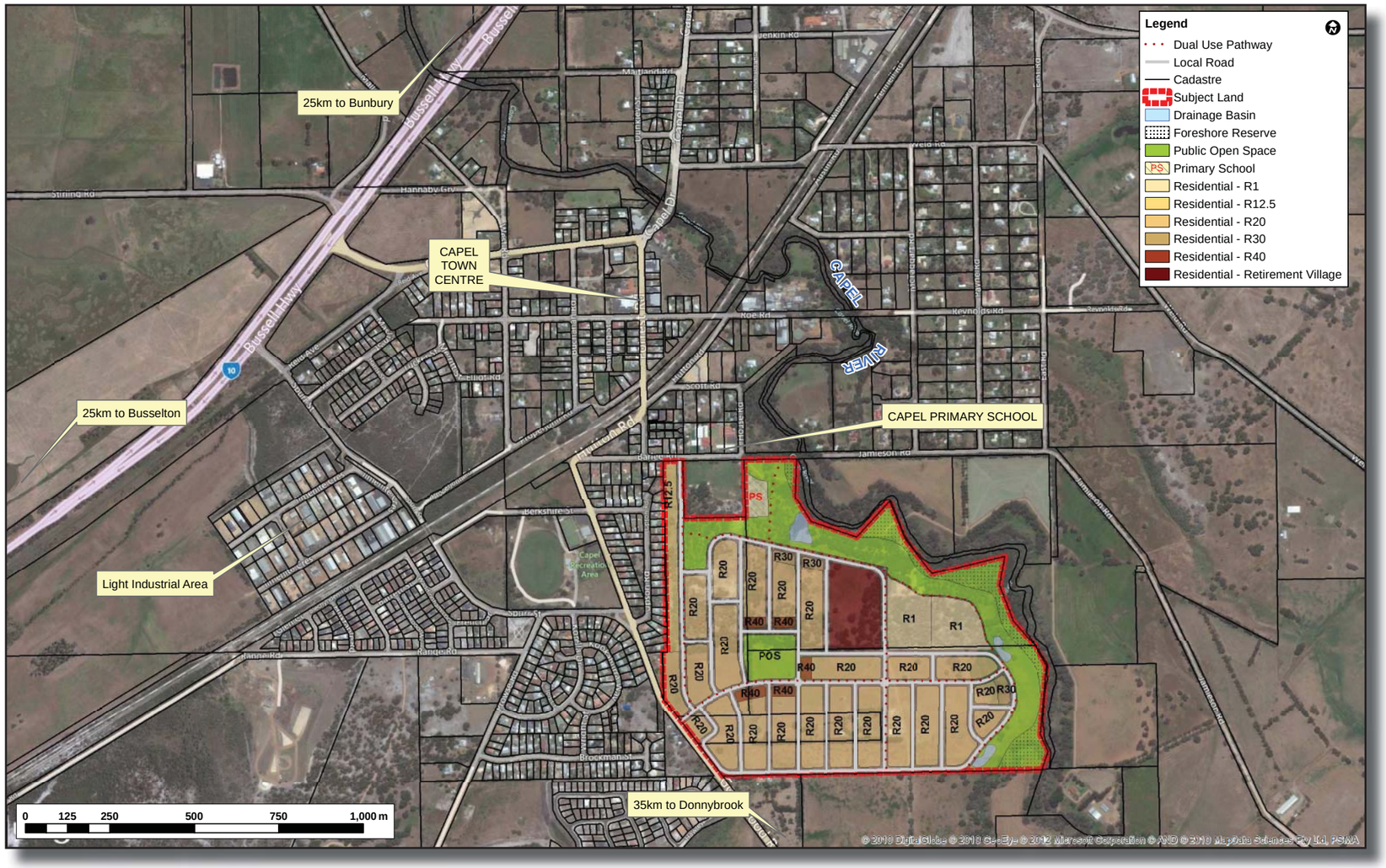


Figure 1 - Location Plan

Introduction

An extensive network of multiple-use paths will also be constructed along the Capel River and reserve systems to provide recreational opportunities for residents and the Capel community. These networks will connect to similar networks along major routes within the residential development and provide linkages to the existing networks within the town.

SUSTAINABILITY PRINCIPLES

The Structure Plan area has an objective to achieve the needs of current and future generations through the integration of practical environmental protection, social enhancement, and economic prosperity principles. The outcomes detailed with this Plan will deliver a multitude of benefits at the planning and construction phases, and the provision for a long-term sustainable lifestyle for the community in Capel.

The initiatives documented in this Plan were determined for the development to successfully achieve the seven foundation principles of the WA State Sustainability Strategy (2003):

6. Long-term economic health;
7. Equity and human rights;
8. Biodiversity and ecological integrity;
9. Settlement efficiency and quality of life;
10. Community, regions, 'sense of place' and heritage;
11. Net benefit from development; and
12. Common good from planning.

To achieve the foundation principles, the State Sustainability Strategy (SSS), provides guidance that a development should aim to reduce its ecological footprint whilst simultaneously enhance the community's quality of life. Furthermore, a development should create a sustainable balance of employment, transport, housing choice and community based options.

The development's broad sustainability initiatives will follow the guidelines of the SSS and the Liveable Neighbourhoods objectives and requirements. By undertaking the initiatives documented in this Plan, the South East Capel Structure Plan development will assist in protecting and enhancing the natural environment, provide opportunities for a sense of place in the community, enhance the economic prosperity of the town, provide a more comfortable and sustainable built form, and achieve best water management outcomes.

The Shire of Capel has adopted a strategic vision for Capel, and it is stated in the Capel Townsite Strategy as:

"To promote and facilitate the growth of the Capel townsite as a sustainable and vibrant town that is a significant settlement and economic centre within the Shire of Capel"

To achieve this vision the Townsite Strategy sets out the aims and objectives of the Shire. *Table 1* illustrates each of the aims and objectives identified by the Shire, and succinctly how the South East Capel Structure Plan actions will satisfy each.

The sustainability implementation strategy matrix, in the concluding section of this report, documents the three pillars of sustainability (economy, society and the environment) and outlines the elements of the initiatives, their objectives, measures for success, delivery and responsibility and objectives.

The Structure Plan, and its surrounds, has unique and specific characteristics and relationships that provided particular emphasis for the Sustainability Outcomes and Implementation Plan. The key elements of sustainability, listed below, are reported in further detail than provided within the matrix within the Plan:

1. Diverse housing and community lifestyle elements;
2. Water management elements; and
3. Biodiversity conservation elements.

The Structure Plan will provide opportunities for diverse, rewarding and sustainable housing options and lifestyles. To achieve these elements the development will provide encouragement of energy conservation, on-site power generation, a variety lot types, close proximity to existing services, employment opportunities and established community, and high quality amenities within the development. The strategic location, sustainable and liveable designs, and the encouragement of community within the development will maximise the opportunities and capabilities for residents to lead fulfilling and sustainable lives within the local community. These objectives are the foundation of the State Sustainability Strategy (SSS) principles.

Capel Townsite Strategy Objective	Structure Plan Action
1. *Retain and enhance Capel as a major community, administrative, economic and general activity centre within the Shire of Capel.*	Adjoins the exisiting townsite and will enrich the population of the Shire centred around the Capel town centre.
2. *Promote and safeguard the health, safety, convenience and general welfare of the residents of the townsite and surrounding area.*	Adopts principles of Liveable Neighbourhoods, including pedestrain access, recreational facilities, active POS, community engagement and accessibility.
3. *Promote the growth of the town in a manner that is sustainable and retains the existing natural and built form character.*	Sustainability Outcomes and Implementation Plan documents strategies to achieve these objectives.
4. *Enhance the character of the town through improved townscape outcomes with a focus on the town centre and a high quality of residential development and design.*	Close proximity to the town will enable for the development to rely on the exisiting town centre for the majority of services.
5. *Provide for a variety of development to meet the needs of the community with regard to housing, employment and services, and to facilitate the provision of a wide range of social and cultural facilities and services.*	A variety of housing densities and landscape locations will ensure that a diverse housing service and costing is provided. The proximity to the town centre will provide opportunities for employment, and the incorporation of reserves along the Capel River will provide opportunities for the greater Capel community.
6. *Improve pedestrian and cycle access within and around the town and ensure safe and convenient movement of people, including for pedestrians, cyclists and motorists.*	A multiple use recreational trail will be constructed adjacent to the Capel River prodiving recreational opportunities and linkage to the exisiting town's pedestrian and cycle access.
7. *Protect and enhance the natural character and environmental attributes within and surrounding the townsite with an emphasis on the Capel River, remnant vegetation and wetlands.*	A Foreshore Reserve and Management Plan will be implemented along the Capel River. The reseravation of native vegetation, including two low density lots ensure that the environmental attributes of the river and natural systems will be protected and enhanced. The utilisiation of water sensitive urban designs will benefit the groundwater resource and the Capel River.
8. *Improve the ability of the town to attract and accommodate tourists by highlighting the country village atmosphere, historical character and location as the gateway to the South West Region.*	Increasing the population may provide greater opportunities for new local businesses to be established that promote tourism.
9. *Promote and plan for accommodation and services related to the care, health and wellbeing of older people in the Capel community.*	The provision of natural reserves for activities will promote healthier lifestyles, and may be beneficial for older residents.
10. *Preserve and enhance the amenities and services of the town.*	Increased population will provide for greater ability to fund new services and amenities in town.
11. *Integrate land use and transport systems within the town and with the surrounding District and Region.*	The major through roads within the development will be designed to accommodate buses for possible future public transport systems in Capel.
12. *Promote a safe and energy efficient pattern of development.*	Follow Liveable Neighbourhood guidelines in regards to safety and passive subdivision layouts.
13. *Promote sustainable development that integrates consideration of economic, environmental and social goals.*	Increased population will provide for increased economic and social goals for the town centre. The large reserve along the Capel River and two low density lots within the development will assist environmental values.
14. *Provide clear and logical boundaries to townsite expansion to ensure protection of economic, environmental and character attributes of the town and surrounding area.*	Identified as Planning Precinct 3 within the Capel Towniste Stratetgy (2008).

Table 1 - Capel Townsite Strategy Actions

Diverse Housing & Premium Community Lifestyles

STRATEGIC LOCATION

The northern and eastern boundaries of the development adjoin the existing town site of Capel. The development would enhance the towns' role "as a major community, administrative, economic and general activity centre within the Shire of Capel" (Capel,2008) because of this location, and directs the major travel routes towards the town centre. The location will enable the development's residents to access the town centre for services, and also provide employment opportunities to the new residents that are concentrated around the town centre.

The Capel Public Primary School is located adjacent to the northern boundary of the development, and the main roads throughout the development will be designed to accommodate school buses to ensure access to high school facilities.

The adjacency to the town site provides opportunities for residents to utilise the pedestrian and cycle access designs that will be included within the development. The designs will take advantage of the location to town with an extensive network of dual use paths to encourage residents to opt for alternative transport than their cars. The dual use path network will also provide recreational and healthy lifestyle options for the surrounding Capel community, especially along the Capel River. The strategic location of the development to the existing town and houses enables the development's design to "improve pedestrian and cycle access within and around the town and ensure safe and convenient movement of people" (Capel, 2008). This will assist the development's residents to reduce their carbon footprint and promote healthy lifestyles.

Currently Capel has no public transport facilities for daily commutes, however the close location to town and the road designs of the development will ensure that any future public transport will be capable of servicing the area.

SUSTAINABLE RESIDENTIAL DESIGNS

The Structure Plan and subdivisional designs will focus on ensuring that the predominant lot orientation maximises the solar access for lots and encourages solar passive design of future houses. The design's objective is to create a subdivision that has:

- Lots predominantly shaped rectangular;
- New streets with a north-south and/or an east-west orientation; and
- Houses encouraged to be built on the southern portion of the lot allowing solar access to the northern portion.

The Structure Plan design has accommodated these objectives to allow for sustainable residential lot layouts at the subdivision stages. Further criteria to be explored at the subdivision stages include setting a standard minimum set back on lots from houses and their northern boundary, and setting a minimum set back on lots from two storey houses and their southern boundary. Both standards could be included within the subdivisions building guidelines to ensure that winter solar access is maintained for all houses within the development. Solar access and passive solar designs are important in assisting houses to achieve the 6 Star Energy Rating requirements for all new houses in Australia, and the Liveable Neighbourhoods lot layout requirements.

Sustainability designs for the development extend beyond energy demands, and include the encouragement of native and water wise gardens. The developer will implement landscape and revegetation plans of the development, with a strong focus on retaining native plants and planting local native species within the public spaces. The bioretention systems within the road reserves will also incorporate appropriate local native species. Native species are encouraged within the development to provide ecological values to the development and surrounding environments, especially the linkage with the Capel River corridor. Native species however not only provide fauna and flora value, they tend to also be more tolerant of Capel's low rainfall and sandy soils, which will reduce the requirement for irrigation and fertilisation.

Further initiatives and measures of sustainable residential designs are outlined in the matrix within *Table 4 and 5*.

DIVERSITY & AFFORDABILITY

The development will provide a variety of residential lot sizes and types that will facilitate housing diversity, choice and affordability of a range of buyers. Predominantly the residential density code for the development will be R20, however R30 and R40 lots are designed around POS and scenic outlooks along the Capel River. Two large R1 (single dwelling) lots have been designated along the Capel River that have high conservation value native vegetation present and this will be retained outside of the building footprints. An aged care R40 lot section has also been designed within the development to provide a diversity of lifestyle choices and affordability to the development.

The large areas of POS contain some remnanr mature native vegetation,the Capel River foreshore area and water features within the development will provide opportunities for higher lot prices, and more affordable lot prices further away from the river and town centre. The distribution of the POS in different sections of the development will enable a variety of prices across the subdivision and not segregate different areas of the development to similar socio-economic affordability.

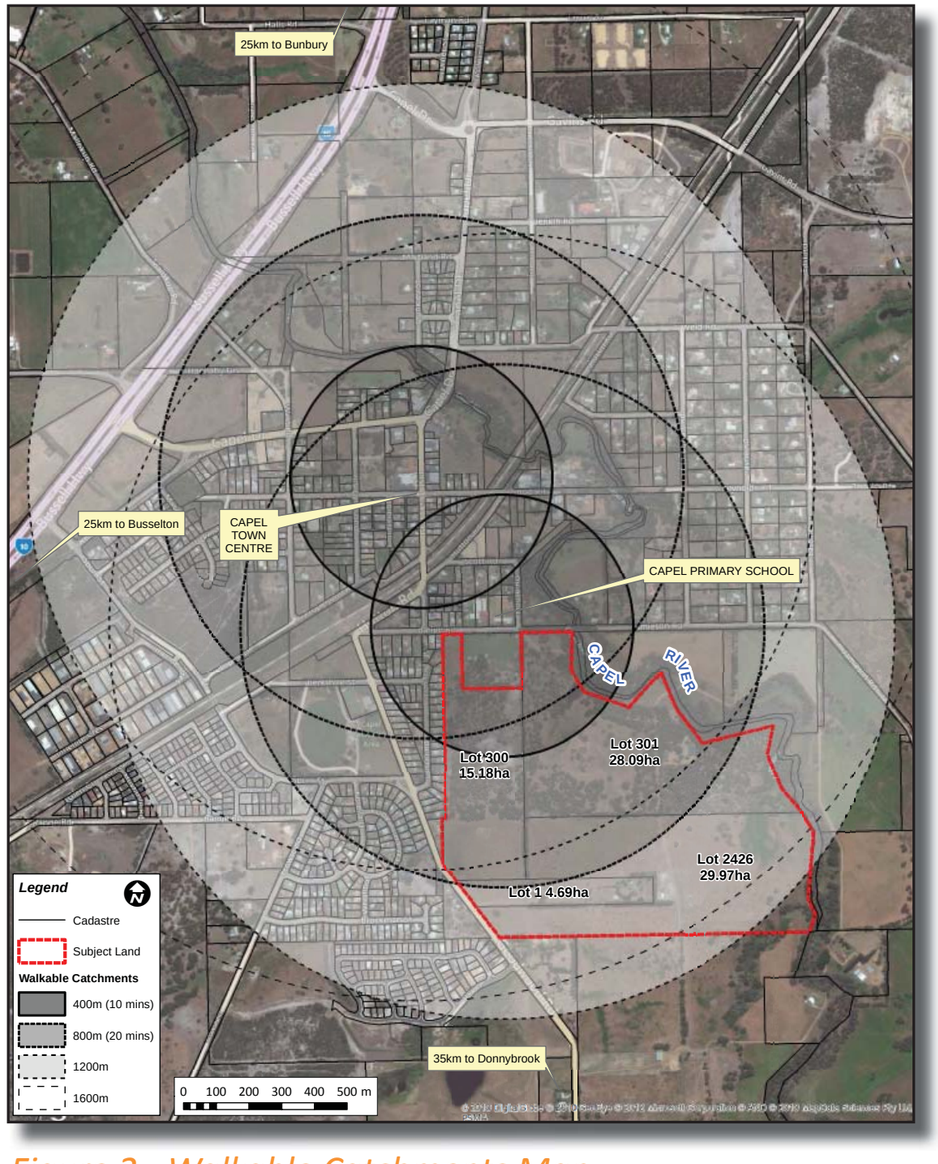


Figure 2 - Walkable Catchments Map

Diverse Housing & Premium Community Lifestyles

COMMUNITY IDENTITY

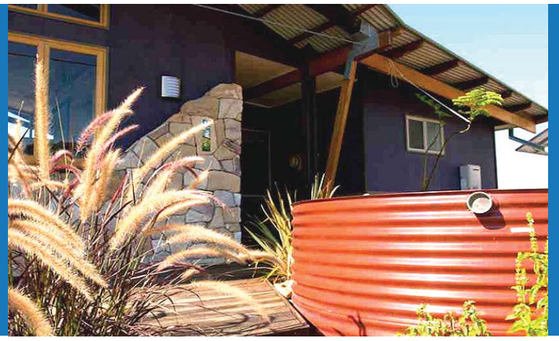
An objective of Liveable Neighbourhoods is to create sustainable communities and neighbourhoods. To achieve these objectives the development provides potential opportunities for the Structure Plan community and the wider Capel community. Opportunities arise from the:

- Diverse sustainable lifestyles that the development offers existing and new residents of Capel;
- Foreshore reserve that will be established along the Capel River and the encouragement of community groups and residents involvement with this reserve;
- Dual use path network and extensive POS for healthy lifestyles and recreation;
- Safe and an ease of movement via the designed road network; and
- Increased population providing further services and commercial opportunities for the whole community.

Further initiatives and measures of social sustainability initiatives to enhance the community of Capel are outlined in the matrix within *Table 5*.

Figure 3 - Structure Plan Diversity and Sustainability Plan

Water Management



A key aspect of sustainability within the development is managing all water resources and cycles in a manner of perpetuity and long-term conservation. There are two key aspects of water management that the Structure Plan is focused upon to achieve sustainability:

1. Water use conservation and efficiency; and
2. Water quality management.

A Draft District Water Management Strategy (Cardno, 2011) has been submitted for the Capel townsite and encompasses the Structure Plan area. To support the Structure Plan a Local Water Management Strategy (LWMS) has been prepared and submitted to the Shire and Department of Water for approval. The LWMS explores the water management of the development in further detail, including the stormwater network, water use and groundwater resource management. A summary of the key sustainability initiatives for water management within the Structure Plan are have been included, and the LWMS should be referred to for further details.

WATER USE CONSERVATION & EFFICIENCY

The main initiatives to be implemented and/or encouraged that will achieve water use conservation and improve the efficiency of water use throughout the development are:

- Reduce usage demands;
- on-site water capture and reuse;
- Water sensitive urban design (WSUD) stormwater network; and
- Greywater reuse.

REDUCE USAGE DEMANDS

The measures to be implemented to reduce the demand for scheme water consumption within the development include:

- Encourage the installation of water efficient fixtures and purchase of water efficient appliances (high WELS water rating) with the distribution of information packages informing new residents of the water, environmental and economic benefits;
- Encourage the installation and internal use of rainwater tanks with the distribution of information packages informing new residents of the water, environmental and economic benefits. Commercial rainwater tank suppliers' and installers' promotional packages will also be included for residents information;
- programs to raise awareness of reducing water usage for all residents, including information packages and potentially organisation of workshops;
- Encourage the establishment of water wise and native gardens with the provision of information and, potentially, either native species seeds or vouchers/discounts at a local nursery;
- Establish native and water wise landscapes within public areas.

The objective of these measures is to reduce the demand for water supplies within the development and to achieve water supply demands that are significantly less than traditional residential subdivisions of a similar size.

ON-SITE WATER CAPTURE & REUSE

The capture of rain water for use within the development will be highly encouraged by the developers to achieve a reduction in mains water demand. Residents will be encouraged to direct their roof runoff (at least 50% of the catchment) to rain water tanks for use inside and outside of the house. A 3kL tank, which is the most likely largest tank that would be installed, could provide a maximum collection volume of approximately 60KL per year; however this would require the household to predominantly use water from the tank inside the house during the winter months (when rainfall is highest). The internal water use target for the Structure Plan is 65KL per person per annum. A more realistic scenario would be the frequent use of the water from the tank throughout the year, and this would only provide approximately 26KL per annum of water.

WATER SENSITIVE URBAN DESIGN STORMWATER NETWORK

Stormwater runoff will be harvested with water sensitive urban designs, particularly bioretention systems. The stormwater network will provide not only a reduction in main waters demand for street verge vegetation, but also treat and infiltrate water at or close to the source of the rainfall. Treating and infiltrating rain water at or close to the source enhances the positive influences that the development would have upon the groundwater, wetland and waterway systems of the Structure Plan area and surrounds. Large detention bioretention basins will be constructed adjacent to the Capel River Foreshore Reserve, which will provide predominantly flood mitigation and management functions however water that infiltrates via the basins will be treated and slowly release water to the Capel River through natural groundwater flows and drainage.

The primary of the bioretention systems are to treat the stormwater runoff but the on-site infiltration of the runoff and the native plants will also provide environmental and hydrological benefits to the systems of the Structure Plan are and surrounds.

GREYWATER REUSE

There is the potential for reusing greywater within individual lots, however the benefits and requirements will be lot specific. The developers encourage lot purchasers to explore their options regarding greywater reuse, and will provide information regarding what they are, benefits, guidelines, approved systems and approval framework. Horizontal setbacks may limit the potential of such systems, and should be determined at the building stage. Setbacks are required from buildings, lot boundaries, roads, swimming pools, wetlands, and private bores.

All designs should be approved by the Shire of Capel, according to Department of Health guidelines prior to installation. Greywater reuse systems also require a stringent maintenance program and adherence to allowable inputs to sinks that the greywater system sources water from within the house. Specific plumbing, accredited plumbers and approved systems are required to install a greywater reuse system in Western Australia.

A sub-surface irrigation greywater reuse systems could potentially provide all of a households requirements for irrigation of lawns.



Water Management

WATER QUALITY MANAGEMENT

The main initiatives to be implemented that will effectively manage the water quality from the development are:

- Bioretention stormwater systems;
- Household nutrient management; and
- Public space nutrient management.

BIORETENTION STORMWATER SYSTEMS

The stormwater management system of the development has an objective to achieve the best management practices set out in the *Stormwater Management Manual for WA*. The practices documented in the LWMS will achieve quality treatment of the runoff water that infiltrates and discharges from the development. The treatment trains designed for the development will protect the ecological and hydrological functions of the on-site and surrounding natural environments.

The development has adopted the Department of Water's values for Total Nitrogen and Phosphorous. The remainder of the quality parameters will utilise ANZECC trigger values for lowland rivers in the south-west of Australia (ANZECC, 2000).

To achieve these water quality values the development will utilise bioretention systems throughout the development to capture, treat, convey and infiltrate stormwater runoff. All bioretention systems will be designed and constructed according to the latest *FAWB Adoption Guidelines for Filter Media in Biofiltration Systems* and the Department of Water's *Stormwater Management Manual for WA* design guidelines and in consultation with the Shire engineers. These systems will be planted with appropriate native species and the soil amelioration layers under the systems have been demonstrated to achieve significant reductions in nutrient loads, including a 50% decrease in total nitrogen, an 80% decrease in total phosphorus and a 90% decrease in total suspended soils (DoW, 2007).

A bioretention swale system will be constructed in the north-west of the development to provide treatment, conveyance, storage and infiltration. A swale was preferred in this area due to the catchment being isolated from directing flows to the drainage reserves adjacent to the Capel River, as has the majority of the Structure Plan area.

HOUSEHOLD NUTRIENT MANAGEMENT

Monitoring fertiliser applications of residents is not practical or a feasible option for the development, therefore the development will adopt an initiative to encourage native water wise gardens and educate residents about establishing and maintaining gardens with low nutrient requirements. The Water Corporation provides an excellent resource for water wise and nutrient wise gardening practices in the South West.

Establishing good soils for the gardens and lawn to grow within is the key foundation for healthy gardens and plant growth, as it will improve the garden's efficiency in utilising water and nutrients. The major soils of the development are sands, which are poor at retaining nutrients from fertilisers and therefore most fertilisers will have little assistance in gardens. Proper soil amendments, such as compost, soil conditioners, clays, gypsum, and soil wetting agents will be encouraged for residential lawns. Appropriate fertiliser programs and quantities will also be encouraged, as per Water Corporation guidelines.

PUBLIC SPACE NUTRIENT MANAGEMENT

Fertiliser and irrigation programs within the public open spaces (POS) and street verges will be initially controlled by the developer before handover to the Shire of Capel. The area of lawn within the public spaces will be kept to a minimum, and the follow nutrient management techniques will be implemented by the developer:

- Retention of existing and native vegetation;
- Encouragement of native vegetation and water wise plantings;
- Appropriate soil improvement prior to any planted landscapes;
- Selection of lawn species that minimise fertiliser and irrigation requirements;
- Use of phosphorous free and slow release fertilisers; and
- Appropriate timing and quantity of fertiliser application.

The Shire will be encouraged to adopt similar practices throughout the development to ensure that the nutrient management remains a priority and important after handover of the public spaces.

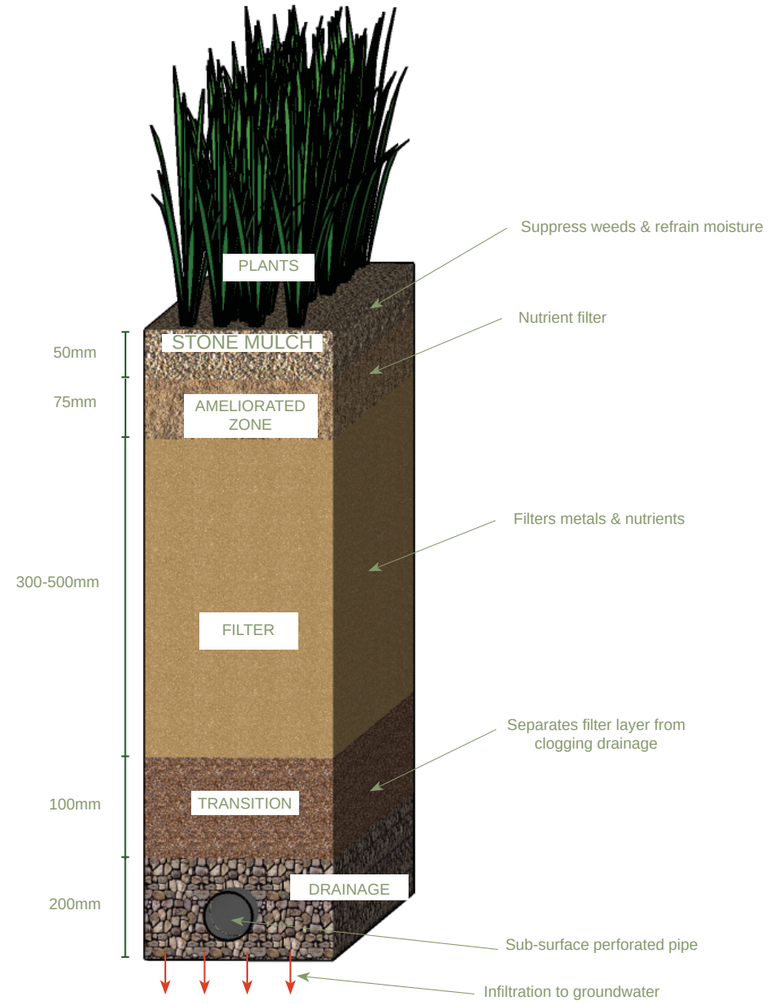
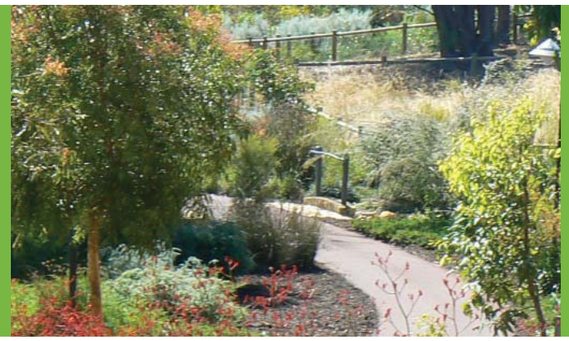


Figure 4 - Typical Bioretention Garden Cross Section

Biodiversity Conservation



The development for South East Capel has a strong focus on conserving and enhancing the environmental values of the subject land and surrounding Capel River ecosystem. The Capel River riparian vegetation is of high conservation value and has been identified by the Environmental Protection Agency (EPA) as a regionally significant riverine ecological linkage in the Greater Bunbury Region Scheme. The Capel River also has mythological and historical significance for the local indigenous people, and therefore the effective management of this ecological and cultural significant ecosystem is important for the development.

The development will manage the Capel River and surrounding environment via:

1. A Foreshore Reserve;
2. Conservation residential lots (R1);
3. Public spaces focused on native species; and
4. Household native gardens will be encouraged.

CAPEL RIVER FORESHORE RESERVE

A minimum 30m reserve from the Capel River riparian vegetation will be established within the development. A Foreshore Management Plan has been prepared, and will be implemented, for this Reserve system. The management will involve rehabilitation, revegetation, weed and vermin control, erosion mitigation and rehabilitation, fire management and protection where appropriate.

The developer is committed to a 5 year rehabilitation and maintenance management period for the Foreshore Reserve. The vesting authority that then takes on responsibility of the Reserve should only have to undertake a maintenance program after this time.

CONSERVATION RESIDENTIAL LOTS

The EPA commented on the high conservation value of the remnant native vegetation in the east of the subject land. This land has been fenced off from past and present agricultural practices on the land. In liaison with the Department of Environment and Conservation (DEC) it was decided to conserve this area of forest by designating a residential code of R1, that is only one dwelling is allowed on each of the two large R1 lots. A building envelope will be designated for each of these lots and no clearing of the native vegetation will be allowed outside of the envelope, expect for vehicular access. These lots abut the Capel River and will provide protection of the ecological functions and value of the land and adjacent ecosystems.

NATIVE SPECIES IN PUBLIC SPACES

The public spaces, including POS, street verges and stormwater infrastructure will be landscaped with native species and local native species, where suitable. These plantings will provide food, protection and shelter for birds, and habitats to support lizards, frogs and other ground dwelling fauna. Detailed species plantings and configurations will be outlined in the Landscape and Revegetation Plan, to be done at the subdivision stage.

The bioretention systems within the street verges will provide treatment of stormwater runoff and preform the function of small ephemeral wetland basins throughout the development area. These gardens and systems could potentially act as a habitat refuge and/or corridor for fauna species reliant on these seasonal inundated environments.

Native vegetation will also be retained as much as possible within the POS areas, where it is safe to do so. Protecting the native vegetation and undertaking of rehabilitation in appropriate sections will provide a wide variety of habitat values to promote biodiversity and sustain ecological communities.

HOUSEHOLD NATIVE GARDENS

The developers will encourage the establishment of native water wise gardens within residential gardens, particularly the front gardens. Information will be provided to residents informing them of the environmental and economical benefits of native gardens. The developers potentially will implement rebates or vouchers for the purchase of appropriate native species. Native species that complement the plantings in public spaces and the existing native vegetation will be encouraged, with the objective of providing food, shelter, and habitats for native fauna, and vectors for native flora species.

The aim is to also enable residents to be involved in the biodiversity conservation and enhancement of the local environment. Developing an personal appreciation and understanding of the social, aesthetic, biodiversity and ecological values of the native inspired landscapes and natural environmental systems of the residents local area is part of the strategy to building a local community and a ‘sense of place’.

Trees

SPECIES	COMMON NAME	MATURE HEIGHT
Acacia saligna	Golden wreath wattle	4m
Agonis flexuosa	WA Peppermint	10 m
Allocasuarina fraseriana	Sheoak	15 m
Banksia attenuata	Slender banksia	10 m
Banksia grandis	Bull banksia	8 m
Banksia ilicifolia	Holly-leaved banksia	8 m
Banksia littoralis	Swamp banksia	10 m
Casuarina obesa	Swamp sheoak	10 m
Corymbia calophylla	Marri	30 m
Eucalyptus gomphocephala	Tuart	30 m
Eucalyptus marginata	Jarrah	15 m
Eucalyptus rudis	Flooded gum	25 m
Melaleuca incana	Grey honey myrtle	4m
Melaleuca preissiana	Modong	15 m
Melaleuca raphiophylla	Freshwater paperbark	10 m
Xylomelum occidentale	Woody pear	4m

Shrubs

SPECIES	COMMON NAME	MATURE HEIGHT
Agonis linearifolia	Swamp peppermint	3 m
Banksia sessilis	Parrot bush	3 m
Hakea prostrata	Harsh hakea	3 m
Melaleuca tertifolia	Banbar	3 m
Melaleuca viminea	Mohan	3 m
Boronia heterophyla	Pink boronia	2 m
Calothamnus quadrifidus	One-sided bottlebrush	2 m
Myoporum cararioides	Slender myoporum	2 m
Viminaria juncea	Swishbush	2 m
Grevillia diversifolia	Valley grevillea	1.5 m
Acacia pulchella	Prickly Moses	1.5 m
Calothamnus latoralis	Swamp one-sided bottlebrush	1.5 m
Eriostemon spicatus	Pepper and salt	1.5 m
Kunzea recurva		1.5 m
Melaleuca laterita	Robin redbreast bush	1.5 m
Hypocalymma angustifolium	White myrtle	1 m

Ground Covers

SPECIES	COMMON NAME	MATURE HEIGHT
Arthopodium capillipes	Chocolate lily	0.5m
Billardiera candida	Wedding creeper	creeper
Billardiera coeruleopunctata		creeper
Kennedia prostrata	Red runner	creeper
Petrophile linearis	Pixie mops	0.5 m

Sedges and Tussocks

SPECIES	COMMON NAME	MATURE HEIGHT
Agrostocrinum scabrum	Blue-eyed reed	0.7 m
Anigozanthos viridis	Green kangaroo paw	0.5m
Baumea articulata	Jointed rush	0.9 m
Dianella revoluta	Flax Lily	0.5 m
Juncus kraussii	Sea rush	0.7 m
Lepidosperma gladiatum	Coastal sword sedge	1.5 m
Lepidosperma effusum	Inland sword sedge	0.7 m
Orthrosanthos laxus	Morning iris	0.4 m
Patersonia occidentalis	Western iris	0.4m

Table 2 - Landscape Species List

Biodiversity Conservation

LEGEND

- existing trees to be retained / removed
- proposed trees (refer plant schedule for species)
- indigenous mass planting (irrigated)
- foreshore rehabilitation (non-irrigated)
- roll-on turf (irrigated)
- earth mounding
- stormwater bioretention basin
- shade structure / playground
- dual use path / boardwalk
- dryland grass (non-irrigated)

note: non-irrigated planting to be installed in early winter

Figure 5 - Landscape Plan

Implementation Strategy




The sustainable initiatives for the development will be implemented at different time framesanning process, and different stakeholders will be responsible for th implementation of the intiatives. To Ensure that outcomes required by the required by the Shire of Capel and relevant state authorities are implemented in an timely and organised manner the following Sustainability Implementation Strategy tabls have been constructed (*see Tables 3, 4 and 5*).

Some measures will require finalisation and review at the subdivisional and construction stages to ensure compatible with the proposed subdivision stage and that they compliment existing stages. The Structure Plan area will also be subdivided over an extended time frame, and there may be requirements to review the Strategy tables in respsect to the size and extent of the proposed subdivision stage, where appropriate.

In the South East Capel Structure Plan report a detailed audit of the *Liveable Neighbourhoods* planning criteria was undertaken. An abridged version of this audit has been replicated in *Table 6* to highlight the respective sustainability, i.e. purple for the economy, green for the environment, and orange for the society.

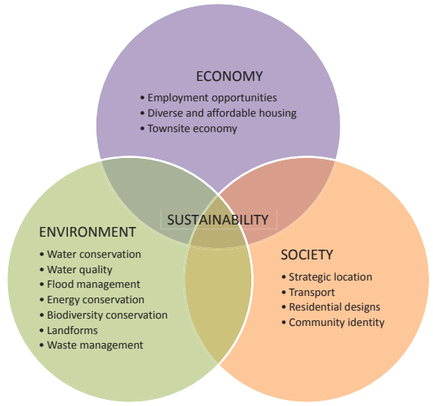


Figure 6 - Pillars of Sustainability

SUSTAINABILITY INITIATIVES				DELIVERY			RESPONSIBILITY	
PILLAR	ELEMENT	OBJECTIVE	MEASURE	STRUCTURE PLAN	SUBDIVISION	DEVELOPMENT	INITIAL DELIVERY	LONG-TERM MANAGEMENT
ECONOMY	EMPLOYMENT OPPORTUNITIES	**1.** Provide opportunities for residents in Capel community.	The close proximity to Capel townsite will ensure that the development is attractive to new residents and employees in Capel. The road and multiple use path networks will provide easy and safe transport routes to places of employment in the town.	✓	✓		Developer	Shire
		2. Provide opportunities for residents nearby.	The construction of a safe route out of the development and easy access to the Bussell Highway sets the development up 15 minutes from Bunbury and Busselton, the two major centres in the South West.	✓	✓		Developer	Shire
	DIVERSE & AFFORDABLE HOUSING	**1.** Provision of a range of residential options and costs.	A variety of residential densities, locations and an aged care housing block will provide a diversity for housing options and costs. The proximity to town, POS, lot size and views of the river will all influence the costs of the lots.	✓	✓		Developer	Shire
		2. Provision of an aged care residential facility.	A aged-care residential centre has been zoned for development in the Structure Plan.	✓	✓		Developer	Shire / Lot Owner
	TOWNSITE ECONOMY	**1.** Enhance Capel townsite's role as a major community, administrative, economic and general activity centre.	Development adjoins the existing town site of Capel, is adjacent to the Capel Primary school, and vehicular and pedestrian access is provided to town via a safe network.	✓	✓		Developer	Shire
		2. Provision of direct transport networks and connectivity to nearby services and amenities.	Roads are designed to facilitate ease of traffic flow and provide direct routes to major services, facilities and amenities. There are multiple access points to the development via roads and multiple use paths.	✓	✓		Developer	Shire
		3. Opportunities for local businesses and services to increase their customer base.	The significant increase to the population that the development would bring would also provide a larger customer base for many local businesses and services.	✓	✓		Developer	Shire

Table 3 - Sustainability Implementation Strategy (Economy)



Implementation Strategy

SUSTAINABILITY INITIATIVES				DELIVERY			RESPONSIBILITY	
PILLAR	ELEMENT	OBJECTIVE	MEASURES	STRUCTURE PLAN	SUBDIVISION	DEVELOPMENT	INITIAL DELIVERY	LONG-TERM MANAGEMENT
ENVIRONMENT	WATER CONSERVATION	**1.** Achieve the State Water Plan's 100KL target per person in a year for mains water use.	Water efficient fittings required throughout each house, and encourage the use of a rainwater tank for supplementary purposes.			✓	Lot Owner	Shire
		2. Irrigation of bioretention systems with stormwater runoff (after initial establishment).	Bioretention units have been designed so that after initial establishment the stormwater runoff alone should be sufficient for plants.		✓	✓	Developer	Shire
		3. Design of POS and landscapes to minimise the requirement for irrigation.	Use of suitable native species and xeriscaped species, complemented by retention of native vegetation. Minimal lawns, mulching, regular maintenance and low use of slow release fertilisers.		✓	✓	Developer	Shire
		4. Encourage the installation of greywater reuse systems, where appropriate.	Information brochures will be available/provided to lot owners regarding greywater reuse benefits, requirements and approval process.			✓	Developer	Lot Owner
		5. Encourage landowners to establish native and/or Waterwise gardens.	Information brochures will be available/provided to lot owners regarding native and Waterwise landscaping for houses in the South West.			✓	Developer	Lot Owner
	WATER QUALITY	**1.** Incorporation of water sensitive urban designs in the stormwater network.	Bioretention unit designs will filter out the majority of nutrients, sediments and contaminants in the stormwater runoff. A regular maintenance schedule has been provided in the LWMS to ensure the long-term functioning of the units.	✓	✓	✓	Developer	Shire
		2. Establishment of controls for stormwater network at development and construction stages.	Sediment runoff curtains, sediment traps, hydro mulching and monitoring will be undertaken during construction stages. Builders will be encouraged to have a Green Star accreditation, and owners will be provided with information regarding their responsibilities in controlling runoff from their lot during construction.			✓	Lot Owner	N/A
		3. Designs for landscaped areas (including POS) to minimise the requirement for fertilisers.	Plant selection will be determined on species that require low fertiliser application, and low water soluble fertilisers will be used only.			✓	Developer	Shire
		4. Encouragement of houses to establish gardens that require minimal fertiliser application, and/or residents follow fertiliser application guidelines.	Information brochures will be available/provided to lot owners regarding native and nutrient wise landscaping for houses in the South West.			✓	Developer	Lot Owner
	FLOOD MANAGEMENT	**1.** Provision of protection for all houses and infrastructure from 1:100 year flood risks.	The 1:100 year flood extent for the Capel River is contained within the foreshore reserve, and outside of any developable land with over 500mm vertical clearance achieved. The road designs for the 1:100 year peak will maintain a minimum vertical separation of 300mm from the finished flood levels.	✓	✓		Developer	Shire
	ENERGY CONSERVATION	**1.** Encouragement of the installation of solar panels for residents.	Documentation and brochures to be provided to lot owners. The developer may investigate opportunities for discounts and special offers from solar panel businesses.			✓	Developer	Lot Owner
		2. Encouragement of gas boosted solar hot water heating.	Brochures to be provided to lot owners. The developer may investigate potential discounts and special offers specifically for the development.			✓	Developer	Lot Owner
		3. Designs of houses to achieve at least a 6 star energy rating.	A 6 star minimum is required according to the Australian Building Code. Lot owners will be provided information regarding solar passive designs and how to reduce energy consumption in households.			✓	Shire	Lot Owner
		4. Encouragement of houses to be built on the southern portion of their lots.	Information to be provided to lot owners regarding solar passive designs, and optimal designs for houses and layouts.			✓	Developer	Lot Owner
		5. Lots to be predominantly rectangular shaped, and lots orientated predominantly with the long axis east west.	Structure Plan and Subdivision Plans will be designed to ensure that lots are predominantly rectangular in shape, and are orientated with the long axis east west.	✓	✓		Developer	N/A
	BIODIVERSITY CONSERVATION	**1.** Designs to optimise reservation of consolidated remnant native vegetation.	Structure Plan and Subdivision Plans will be designed to ensure that lots are predominantly rectangular in shape.	✓	✓		Developer	
		2. Conservation management strategies to be implemented for reserved native vegetation (including the foreshore reserve).	Structure Plan and Subdivision Plans will be designed to ensure that roads are orientated either north/south or east/west.	✓	✓		Developer	
		3. Encouragement of households to establish native gardens.	Information to be provided to lot owners regarding solar passive designs, and optimal designs for houses and layouts.			✓	Developer	Lot Owner
		4. Retention of mature native trees recommended for Western Ringtail Possum and Black Cockatoo habitats.	A variety of residential densities, locations and an aged care housing block will provide a diversity for housing options and costs. The proximity to town, POS, lot size and views of the river will all influence the costs of the lots.	✓	✓		Developer	Shire
	LANDFORM	**1.** Retain and rehabilitate, where necessary, existing natural landforms to compliment ecological functions.	The Capel River foreshore area will be rehabilitated and reserved. This includes delivery of erosion controls, planting, weeding, and fire management. Full details outlined in Interim Foreshore Management Plan.	✓	✓		Developer	Shire
	WASTE MANAGEMENT	**1.** Appropriate disposal of all waste from development.	Dust and sediment controls for construction will have to be submitted to the Shire. Waste management controls for household construction will also need to ensure waste does not impact outside of lot boundaries.		✓	✓	Builder	N/A
		2. Encouragement of builders to minimise waste and reuse building materials where possible.	These are economic incentives for builders, and building guidelines will be investigated at subdivision stage for further implementation strategies.		✓	✓	Builder	N/A

Table 4 - Sustainability Implementation Strategy (Environment)

Implementation Strategy




SUSTAINABILITY INITIATIVES				DELIVERY			RESPONSIBILITY	
PILLAR	ELEMENT	OBJECTIVE	MEASURE	STRUCTURE PLAN	SUBDIVISION	DEVELOPMENT	INITIAL DELIVERY	LONG-TERM MANAGEMENT
SOCEITY	VISUAL AMENITY & LANDSCAPES	**1.** Incorporation of native species in constructed landscapes.	Planting landscaped areas with appropriate local native species.		✓	✓	Developer	Shire
		2. Designs to optimise natural landscapes and scenery/vistas.	Reserve consolidated native vegetation areas, and retain large mature trees within POS. Higher density lots to be situated around the POS and River frontage.	✓	✓		Developer	Shire
		3. Encouragement residents to establish native gardens.	Waterwise and Nutrient wise information brochures to be made available to new lot owners that highlight the benefits of native gardens.		✓	✓	Developer	Shire
	TRANSPORT	**1.** Provision of roads that are safe.	Roads to be designed and constructed in accordance with *Liveable Neighbourhoods* and Shire requirements to ensure appropriate safety measures are achieved.	✓	✓		Developer	Shire
		2. Provision of multiple use pathways safe for pedestrian and cyclists.	An extensive network of multiple use paths that are separate to the roads, to be constructed within the development, and provide linkages to existing networks.	✓	✓		Developer	Shire
		3. Reduce the need for vehicle dependency.	Construction of a multiple use pathway network that links to existing routes, and the provision of designs to accommodate future public transport networks such as bus stops and access.	✓	✓		Developer	Shire
		4. Provision of access for public transport and facilities.	The main arterial roads have been designed to accommodate bus access and road reserves are adequately sized to include bus stops, if future bus services are established.	✓	✓		Developer	Shire
	RESIDENTIAL DESIGNS	**1.** Lots predominantly rectangular shaped.	Structure Plan and Subdivision Plans will be designed to ensure that lots are predominantly rectangular in shape.	✓	✓		Developer	
		2. New streets to have a north/south or east/west orientation.	Structure Plan and Subdivision Plans will be designed to ensure that roads are orientated either north/south or east/west.	✓	✓		Developer	
		3. Encouragement of houses to be built on the southern portion of their lots.	Information to be provided to lot owners regarding solar passive designs, and optimal designs for houses and layouts.			✓	Developer	Lot Owner
		4. Provision of a range of residential options and costs.	A variety of residential densities, locations and an aged care housing block will provide a diversity for housing options and costs. The proximity to town, POS, lot size and views of the river will all influence the costs of the lots.	✓	✓		Developer	Shire
	COMMUNITY IDENTITY	**1.** Opportunities for new and existing community groups.	Encouragement of community involvement in the ongoing maintenance and management of the Capel River foreshore area. Adjacency to the Capel Primary School will provide opportunities for parent and volunteer involvement.	✓	✓	✓	Shire	Shire / Residents
		2. Connectivity to the existing community.	Construction of multiple use pathways to the existing network will provide opportunities for the wider community to visit, interact and be utilise the resources within the new development.	✓	✓		Developer	Shire / Residents
		3. Improve opportunities to service support and local economy for the whole community.	The close proximity of the development to the existing townsite will enhance the population of Capel, and provide the opportunity for local economic growth and the requirement for improved services for the larger townsite population.	✓	✓		Developer	Shire
		4. Integration of development into the existing townsite character and lifestyle.	The residential house designs will compliment the town's character, and provide recreational and natural lifestyle choices for the wider community.		✓	✓	Developer	Shire / Lot Owners

Table 5 - Sustainability Implementation Strategy (Society)



Implementation Strategy

DETAIL	STRUCTURE PLAN REFERENCE (PAGE NO.)	COMMENT
Existing Site and Context Analysis		
• Site analysis, including topographic features	1 & 2	
• View corridors and biodiversity assets		Capel River and remnant vegetation.
• Features of cultural or heritage significance	5	Capel River.
Community Design		
• Define sense of place and/or identity of village	8	
• Design response to site and context analysis	8	*Figures 5* & *7* identify the concept design and context plan.
• Land use distribution and rationale		In accordance with *Liveable Neighbourhoods* , *Capel Townsite Strategy* and the Shire's *Public Open Space Strategy* .
• Design objectives	8	In accordance with *Liveable Neighbourhoods* and the *Capel Townsite Strategy* .
• Density targets		In accordance with the *Capel Townsite Strategy* and *Residential Design Codes of Western Australia* .
Movement Network		
• Traffic volumes and street hierarchy		Provision of 20m reserves for main arterial streets and 16m reserves for secondary streets.
• Connectivity of proposed street system		Satisfied.
• Connectivity of street system with activity nodes		Satisfied.
• Street cross-sections		In accordance with Shire standards.
• Traffic management	14	The traffic management study is in *Appendix 7* of the Structure Plan report.
• Clear network based on function, traffic volumes, vehicle speed, type, public safety and amenity	13 & 14	In accordance with *Liveable Neighbourhoods* and the *Traffic Management Assessment* (*Appendix 7*).
• Pedestrians, cyclists and disabled (including provision for safety and convenience)	9	*Figure 5* within the Structure Plan report illustrates the network.
• Accessibility to POS, shops, bus stops, primary schools, transit station		Within close proximity to POS, primary school and town centre.
Activity Centres and Employment		
• Type of centre		Capel townsite is the major community, administrative, economic and general centre for the Shire.
• Identify employment rates and opportunities (including extent, type, location and nearby opportunities)		Mineral sand mining, agriculture and industrial within the Capel Shire.
• Identify land use distribution i.e. retail, mixed use, commercial, educational institutions, government, civic entertainment, home-based business, business		The existing Capel townsite provides sufficient retail, commercial and mixed use facilities to support the proposed development. Majority of the development is proposed for residential use, with smaller areas identified for public open space, foreshore reserve and school expansion
Lot Layout		
• Lot size and variety		Majority of the subject site is identified for R20 development, there several smaller areas that focus on R30, R40 and R1 development.
• Land use description		The subject land will be used for a mixture of residential, public open space and foreshore reserve.
• Provision of and/or proximity to school site(s) in the area		Subject site is located adjacent to existing primary school.
• Density targets		The Capel Townsite Strategy indicates approximately 275 lots for this subject site. The concept design is consistent with this prediction by incorporating the recommended density codes for the site.
• Climate-responsive design		Approximately 74% of lots are proposed to be east-west facing, with the balance located in a north-south direction. The lot layout is therefore in accordance with *Liveable Neighbourhoods* policy regarding solar orientation
• Retention of existing vegetation		Approximately 67% of remnant vegetation existing on site is to be retained and enhanced as part of this Structure Plan.
• Minimise effects on local and/or nearby amenities	10 & 14	Refer to the Foreshore Management Plan (*Appendix 6*) and Traffic Management Assessment (*Appendix 7*) for more information.
Public Parkland		
• Size and distribution of public open space		POS is primarily focused adjacent to the Capel River. A neighbourhood park is provided in the centre of the development as identified for this site within the Shire of Capel's *Public Open Space Strategy*
• POS schedule (including size and distribution of active and passive)		*Figure 4* in the report satisfies the requirements of the Shire and size of the development.
• On-going management arrangements and responsibilities		To be negotiated at subdivision with the Shire.

Table 6 - Liveable Neighbourhood Audit of Structure Plan





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