Attachment 1

Blacktown Local Planning Panel advice

Blacktown Local Planning Panel

PLANNING PROPOSAL ADVICE

DATE OF DETERMINATION	26 October 2018
PANEL MEMBERS	Sue Francis, Chair Jenny Rudolph, Independent expert Mary-Lynne Taylor, Independent expert Melissa Rodewald, Ward 2 community representative
APOLOGIES	Nil
DECLARATIONS OF INTEREST	Nil

Public meeting held at Blacktown City Council, Committee Rooms 2 and 3 on 26 October 2018, opened at 10.34 am and closed at 12.12 pm.

PLANNING PROPOSAL

1. F18/961: Planning Proposal to amend *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* to reconfigure the existing suite of land use zones within the southern portion of the Schofields Precinct, and make consequential amendments to the floor space ratio, residential density, land reservation acquisition and height of buildings maps at Lot 998 DP 1232920 Veron Road, Schofields.

PANEL ADVICE

The Panel considered the assessment report on the matter and the material presented at the Panel meeting.

The Panel adjourned during the meeting to deliberate on the matter and formulate a resolution.

The Panel provided the following advice for the Planning Proposal described above:

- The Panel is satisfied that the Planning Proposal meets strategic and site merit tests.
- The Panel supports the matter proceeding to Gateway Determination, however recommend that Council review the necessity of the SP2 Road located adjacent to the rail corridor to be so zoned and whether it needs to be a classified road or service road which could be accommodated within the residential zone.

PANEL MEMBERS
Sue Francis (Chair)
Jenny Rudolph (Independent expert)
Mary-Lynne Taylor (Independent expert)
Melissa Rodewald (Ward 2 community representative)

Attachment 2

Report to Council

SHORT MINUTES : Ordinary Meeting MEETING DATE: 12.12.18 ENCL.NO.

PD3.3 - DD380118 - Planning Proposal – DHA landholding, Schofields Precinct F18/961

MOTION (Cr Bleasdale/Cr Bunting)
1. Prepare and forward a Planning Proposal to the Department of Planning and Environment requesting a Gateway Determination to amend State Environmental Planning Policy (Sydney Region Growth Centres) 2006 as described in this report.
2. Implement any conditions attached to a Gateway Determination issued by the Greater Sydney Commission.
3. Advise the proponent that Recommendations 1 and 2 do not imply or guarantee that the Planning Proposal will ultimately be supported. Council's final determination of the proposal will occur when Council resolves to adopt the Planning Proposal following exhibition and consideration of all relevant matters and submissions.
4. Prepare and exhibit a draft amendment to the Blacktown City Council Growth Centre Precincts DCP Schedule 5 (Schofields Precinct) figures, including the Indicative Layout Plan, to incorporate the consequential amendments.
5. It be noted that Mr. D. Youens, on behalf of the applicant, was received by the Planning, Development, Historical & Assets Committee meeting between 6.59 pm and 7.09 pm. **CARRIED**

COUNCIL DIVISION:
Supported: Cr JG Diaz, Cr JM Diaz, Cr Griffiths, Cr Brillo, Cr Benjamin, Cr Santos, Cr Israel, Cr Bleasdale, Cr Bunting, Cr Camilleri & Cr Bali.
Absent: Cr Quilkey, Cr Singh, Cr Gillies & Cr Collins.

REFERRED TO: DPD FOR: Attention DATE: 18.12.18

COMMITTEE: Planning, Development, Historical & Assets MEETING DATE: 12.12.18 ENCL.NO.

PD3.3
DD380118 - Planning Proposal – DHA landholding, Schofields Precinct F18/961
RECOMMENDATION
1. Prepare and forward a Planning Proposal to the Department of Planning and Environment requesting a Gateway Determination to amend State Environmental Planning Policy (Sydney Region Growth Centres) 2006 as described in this report.
2. Implement any conditions attached to a Gateway Determination issued by the Greater Sydney Commission.
3. Advise the proponent that Recommendations 1 and 2 do not imply or guarantee that the Planning Proposal will ultimately be supported. Council's final determination of the proposal will occur when Council resolves to adopt the Planning Proposal following exhibition and consideration of all relevant matters and submissions.
4. Prepare and exhibit a draft amendment to the Blacktown City Council Growth Centre Precincts DCP Schedule 5 (Schofields Precinct) figures, including the Indicative Layout Plan, to incorporate the consequential amendments.
5. It be noted that Mr. D. Youens, on behalf of the applicant, was received by the Planning, Development, Historical & Assets Committee meeting between 6.59 pm and 7.09 pm.

COMMITTEE DIVISION:
Supported: Crs Colins, Griffiths, Bleasdale & Israel
Absent: Cr Camilleri

COMMITTEE RECOMMENDATION
ADOPTED
ORDINARY MEETING
12 DEC 2018

EXCEPTION

WITHOUT CHANGE

REFERRED TO: DPD FOR: Attention DATE: 13.12.18

PD051218 3.3. DD380118 - Planning Proposal – DHA landholding, Schofields Precinct

Director: Glennys James, Director Design & Development
Author: Wint KhinZaw
File: F18/961

Division is required

Topic

Planning Proposal to amend *State Environmental Planning Policy (Sydney Region Growth Centres) 2006* within the southern portion of the Schofields Precinct in the North West Growth Area.

Analysis

Defence Housing Australia submitted a request to prepare a Planning Proposal to amend the Growth Centres SEPP as it applies to its landholdings in the southern portion of the Schofields Precinct. The proposal seeks to reconfigure the existing suite of land use zones and make consequential amendments to the land reservation acquisition, height of buildings, floor space ratio and residential density maps. The proposal also includes consequential amendments to the Growth Centres DCP Schedule 5 (Schofields Precinct) figures, including the Indicative Layout Plan (ILP).

The proposal is a result of DHA's urban design review and specialist studies in response to policy changes that have taken place since planning for the Schofields Precinct was finalised in 2012. This includes the Department of Education's desire to provide smaller school sites that are co-located with active open space and plans by Council to include a regional netball facility on the RE1 Public Recreation zoned land.

The overall urban design outcome sought by DHA is supported, but with minor zoning changes as described in this report and removal of the FSR control that applies to part of the site.

The Planning Proposal was reported to the Blacktown Local Planning Panel meeting of 26 October 2018 for advice in accordance with the Local Planning Panels Direction on Planning Proposals. The Panel supported the recommendation of Council officers.

Attachment/s

1. Location map **[DD380118.1]**
2. Existing, proposed by applicant and our intended Land Zoning, Height of Buildings, Residential Density, Land Reservation Acquisition and Floor Space Ratio maps **[DD380118.2]**
3. Existing, proposed by applicant and our intended Indicative Layout Plan (ILP) **[DD380118.3]**
4. Blacktown Local Planning Panel advice to Council **[DD380118.4]**

Report Recommendation

1. Prepare and forward a Planning Proposal to the Department of Planning and Environment requesting a Gateway Determination to amend State Environmental Planning Policy (Sydney Region Growth Centres) 2006 as described in this report.
2. Implement any conditions attached to a Gateway Determination issued by the Greater Sydney Commission.
3. Advise the proponent that Recommendations 1 and 2 do not imply or guarantee that the Planning Proposal will ultimately be supported. Council's final determination of the proposal will occur when Council resolves to adopt the Planning Proposal following exhibition and consideration of all relevant matters and submissions.
4. Prepare and exhibit a draft amendment to the Blacktown City Council Growth Centre Precincts DCP Schedule 5 (Schofields Precinct) figures, including the Indicative Layout Plan, to incorporate the consequential amendments.

Key reasons

1. **Improved urban design outcome**

   a. The proposal seeks to amend the urban structure of the southern portion of the Schofields Precinct, resulting in an improved urban design outcome. The improvements include the expansion of Reserve 980 to facilitate a regional scale netball facility, consolidation of the local centre, a town park and the school site to create a centralised civic precinct, relocation and expansion of local parks to accommodate better connected local open space and reconfiguration of the road network and residential structure to improve access, street activation, allotment structure and solar orientation.

   b. We also propose the removal of the Floor Space Ratio (FSR) control that applies to the future local centre as there is already a height of building controls in place. We often find that FSR and height to not match under the Growth Centres SEPP. We consider that height and other companion detailed development controls in the DCP can adequately determine the desired building form and development outcome.

2. **Extended use of Reserve 980**

   a. The proposal seeks to increase the area of Reserve 980 from 11.9 ha to 12.7 ha to accommodate a regional netball facility and to realign the main north-south sub-arterial road (Aerodrome Drive) to run along the western boundary of the reserve. The proposed changes will improve utilisation of the reserve, will assist in managing visitation associated with the regional netball facility and will allow for residential interface with the playing fields through the low speed collector road.

3. **Relocation and reconfiguration of school site**

   a. The school site is proposed to be reduced in area from 4.42 ha to 2.05 ha and be relocated to adjoin Reserve 980 and the local centre. The revised school design proposes joint use of facilities, with active open space and parking located within Reserve 980, allowing for efficiencies in the use of land. The proposed consolidation of the local centre, a new town park and potential primary school site connected to Reserve 980 is beneficial as it creates a centralised civic precinct for the community.

   b. The Applicant originally proposed the orientation of the SP2 Infrastructure (Educational Establishment) zone east-west opposite the B2 Local Centre zone. The Department of Education advised that it preferred the future school site to be oriented north-south along the collector road, to avoid potential conflicts between future drop-off/pick-up zones and an activated town centre 'main street'.

   c. The proposed zoning map promotes the Department of Education's preferred orientation of the school. The final arrangement of the school site orientation, design and interface with Reserve 980 and the local centre will be subject to ongoing discussions with the Government, DHA and Council, to ensure that useable open space on Reserve 980 and an integrated 'centre' of the estate is achieved. This could mean the future arrangement of zones may change slightly as a result of further design considerations.

4. **Local open space network**

   a. The proposed amendments to the local open space network are intended to achieve site responsive outcomes, with larger local parks located centrally within residential areas and integrated with drainage channels. The proposal will provide a dual function by managing stormwater and delivering linear green connections.

   b. The Applicant proposes to rezone a small open space area from RE1 Public Recreation to R2 Low Density Residential adjacent to the railway line in the south of the Precinct. This open space is intended to serve the residential population in that part of the site. Its rezoning will result in future residents being without access to open space within 400 m of their home. Our recommendation is that this RE1 Public Recreation zone remains, but in a slightly different location to improve accessibility.

5. **Modified road network**

   a. The road network and hierarchy for the Precinct is proposed to integrate with the surrounding road network to ensure that community assets are accessible for future residents, surrounding communities and visitors.

   b. The Applicant's proposal includes a request to remove a future collector road zoned SP2 Infrastructure (Local Road) along the eastern boundary of the site, to be replaced with a series of interconnected collector roads through the site within the R2 Low Density Residential zone. We support the modified road network except for the removal of the collector road along the railway line, as it provides an important link to facilitate accessibility in the event that buses replace trains during periods of track work. We recommend that this road be retained as a collector road within the SP2 Infrastructure (Local Road) zoning to ensure it is delivered.

Supporting analysis

1. **Residential density**

   a. The proposal seeks to reduce the area with a minimum residential density of 30 dwellings per hectare to 25 dwellings per hectare. The proposed residential structure maintains the provision of higher densities around amenity areas, by applying the 25 dwellings per hectare density bands to land adjoining Reserve 980, the school site, local centre, town park and in the south-eastern corner of the site in proximity to Quakers Hill Town Centre and Railway Station.

   b. The proposed increase in R2 Low Density Residential zoned land and the proposed changes to minimum residential density provisions will result in an increase of 23 dwellings and 69 persons. The increase in yield will generate a minor increase in Section 7.11 contributions.

2. **Height of buildings**

   a. The proposal does not seek any changes to the 9 m building height control that applies to the site. The Height of Buildings map will also reflect the revised location for the local centre and maintain the existing 14 m height limit that applies to the B2 Local Centre zone.

3. **Co-location of schools and parks**

   a. **Investigations into shared use opportunities**

      i. Council has entered a Memorandum of Understanding (MOU) with the Department of Education so that opportunities to share school facilities and Council facilities can be explored.

      ii. Joint use arrangements will likely focus on the shared use of sports fields, car parking, school multi-purpose/basketball courts, school halls and multi-function meeting/community rooms associated with halls and libraries.

      iii. It is early in the process and there is a long way to go before we can determine what facilities will be delivered in the school and on the park, what facilities we can potentially share and the funding agreements from each party.

      iv. Further information will be presented to Council for consideration once the possible proposals have been identified.

   b. **Update on potential shared use projects**

      i. Farmland Drive Public School (previously referred to as Alex Avenue Public School)

         - With a forecast opening date of Term 1, 2021, the Department of Education has advised that this will be the next public school to open in the North West Growth Area. We are therefore focussing on this project to determine possible joint use opportunities in schools across the North West.
         - This involves the coordination of the early schematic designs for the school and Reserve 885 (2 sports fields for cricket and rugby league, amenities building, car parking, playground).

      ii. Schofields Primary School, adjacent to Reserve 980 (future home of Blacktown City Netball Association)

- The Department of Education is not actively progressing design of this school. We are however progressing matters to ensure our requirements inform the eventual school design. Incorporated within Defence Housing Australia's Planning Proposal for its landholding in the Schofields Precinct, we are working with Blacktown City Netball Association and Netball NSW to capture the facility needs and desires of netball.
- In capturing the desire for future indoor netball courts and general indoor space, we have reapplied for grant funding and we are also investigating the synergies the proposed school hall may present.
- There is high potential that this school will be included as part of the MOU between Council and the Department of Education.

4. **Proposed draft DCP amendment**

   a. In addition to the amendments to the Growth Centres SEPP, the proposal also includes site-specific amendments to *Blacktown City Council Growth Centre Precincts Development Control Plan (DCP) 2016.* The amendment to Schedule 5 of the DCP incorporates consequential amendments to relevant figures only, with no amendments to the objectives or controls of the DCP. We will prepare the draft DCP in detail to support exhibition of the Planning Proposal following the Gateway Determination.

Context

1. **Details of the subject land**

   a. The subject site comprises the southern half of the Schofields Precinct in the North West Growth Area (NWGA). The overall site area of the intended Planning Proposal is 135.6 ha, held in single ownership by DHA. The site represents approximately 30% of the total area of the Schofields Precinct.

   b. The northern part of the site is just outside the 800 m walking catchment to Schofields Railway Station and future local centre. A small portion of the southern part of the site is within 800 m walking catchment of Quakers Hill Railway Station and existing local centre.

   c. The surrounding locality is undergoing a significant transformation, with several urban developments either planned, under construction or completed. Adjacent to the south is the Nirimba Education Precinct that provides the community with proximity to tertiary education opportunities.

2. **Applicant's proposal**

   a. The Applicant's proposal is the outcome of an urban design review which focused on the existing land use distribution and road pattern, to identify opportunities for improvement and to facilitate the delivery of an urban structure that responds to key features on the site.

   b. The Applicant's proposal seeks to incorporate the following changes to the Schofields Precinct Plan:

      i. Reconfigure and expand the largest open space area (Reserve 980) to allow for a regional scale netball facility.

      ii. Relocate and reduce the size of the primary school site to 2 ha on the basis of co-location with Reserve 980.

iii. Create a civic centre and community hub through centralisation of the local centre, primary school site, introduction of a town park and revised location of Reserve 980 to adjoin these uses, providing active open space and parking.

iv. Refine the road hierarchy and network to incorporate Aerodrome Drive running along the western boundary of Reserve 980.

v. Reconfigure local roads and the residential structure to achieve improved allotment structure and solar orientation.

vi. Focus medium and higher residential densities around the local centre and open space areas.

vii. Realign drainage channels to achieve improved stormwater conveyance and dual function drainage channels that are integrated with parks.

viii. Accommodate additional drainage basins to enhance stormwater management.

3. Blacktown Local Planning Panel advice

a. Our intended Planning Proposal varies to a minor degree from the Applicant's submitted proposal. It was reported to the Blacktown Local Planning Panel meeting on 26 October 2018 for advice in accordance with the Local Planning Panels Direction – Planning Proposals.

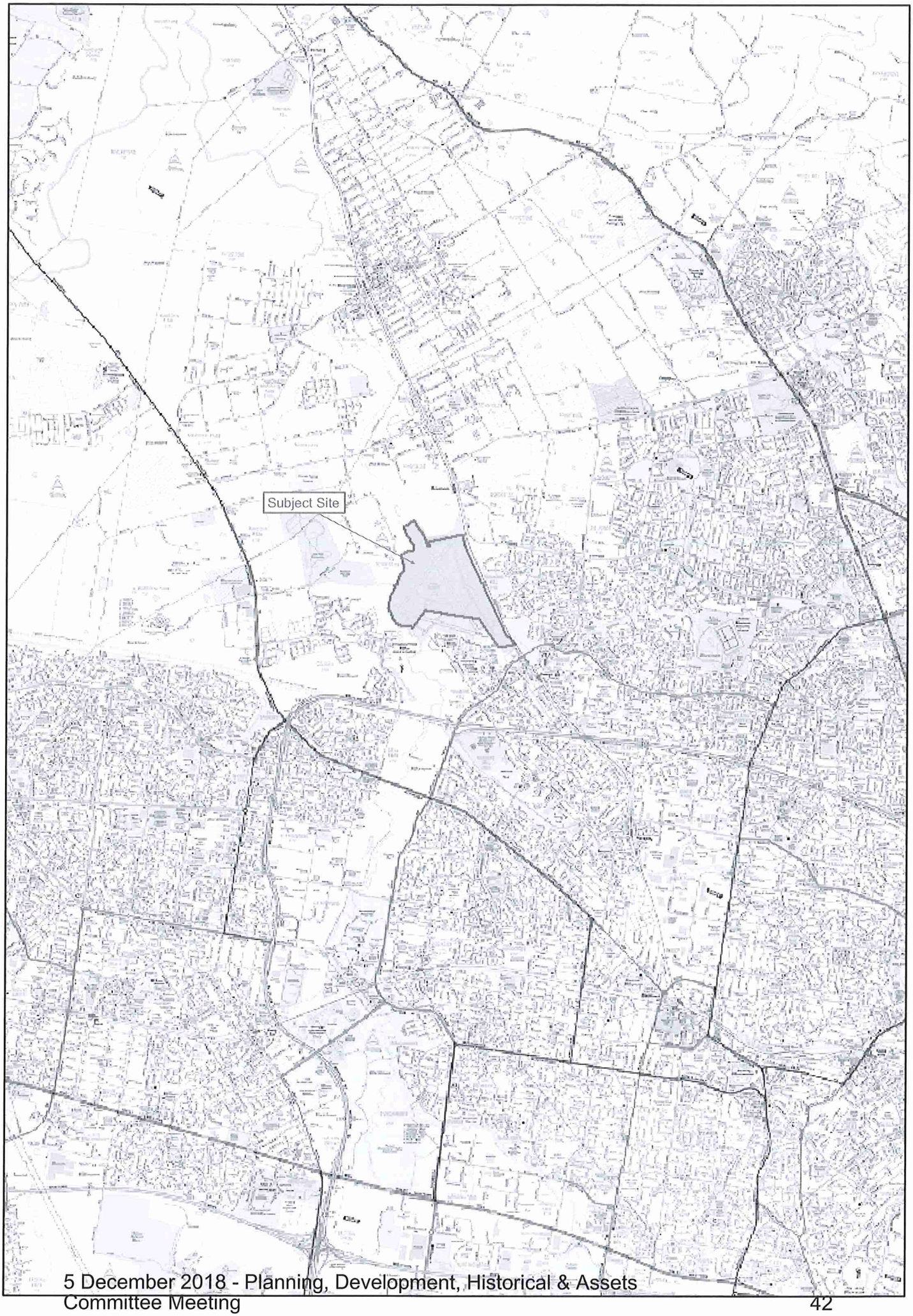
b. The Panel is satisfied that the proposal meets strategic and site merit tests. The panel supported the matter proceeding to Gateway Determination, however, recommended that Council review the necessity of the SP2 Infrastructure (Local Road) zone located adjacent to the rail corridor and whether it needs to be a classified road or a service road which could be accommodated within the residential zone.

c. Consultation will occur with Roads and Maritime Services and CityRail as to the necessity for a parallel classified road adjoining the rail corridor.

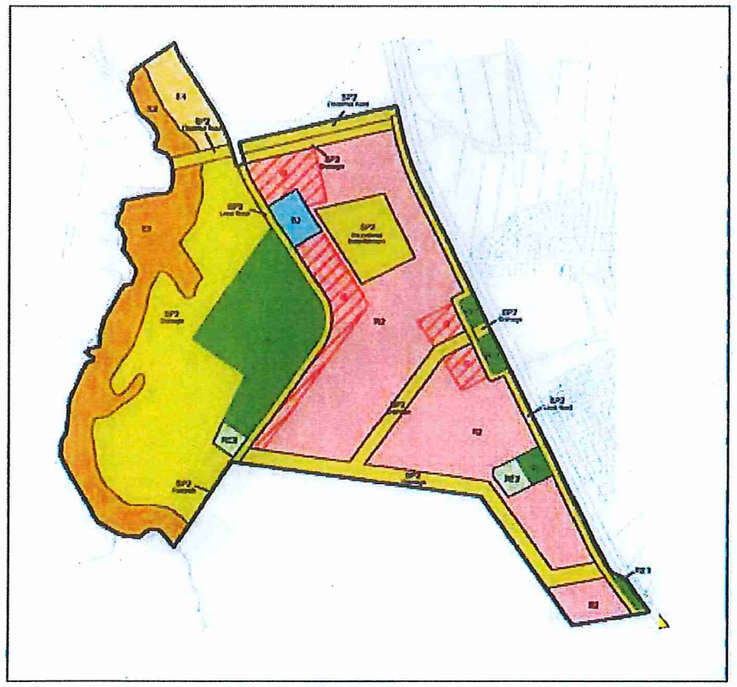
End of report

Attachment DD380118.1

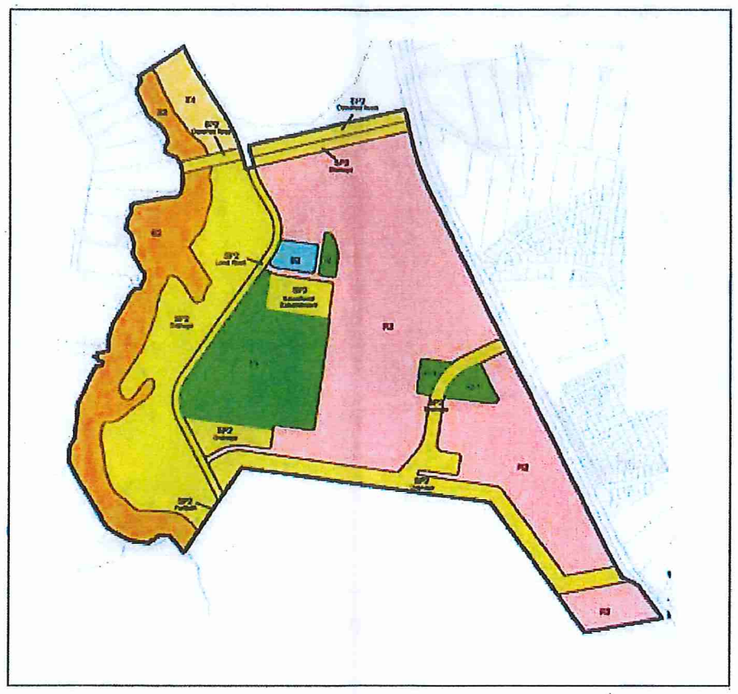
LOCATION MAP



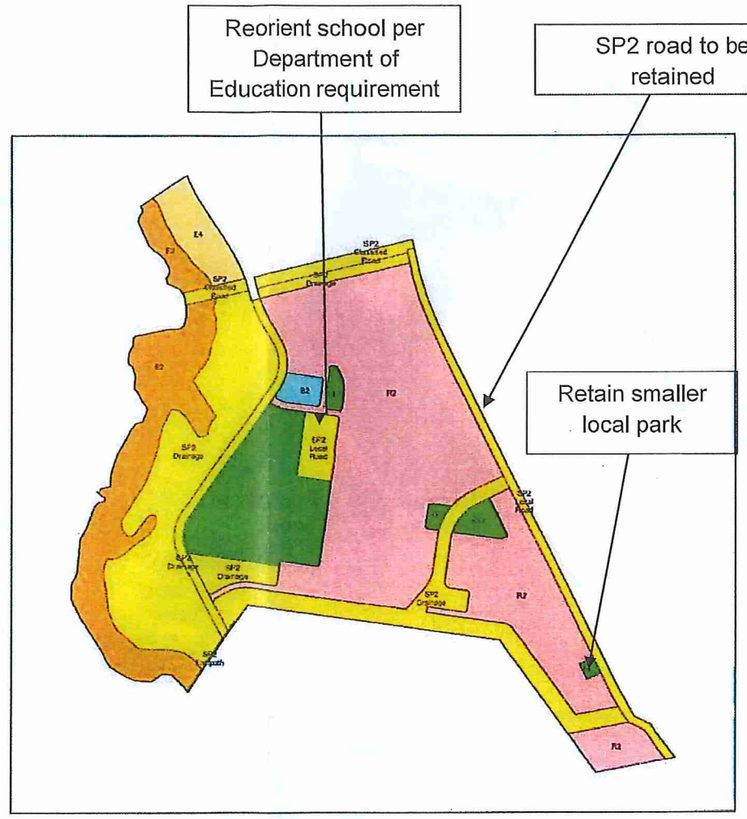
Land zoning map for DHA land holding



Existing zones



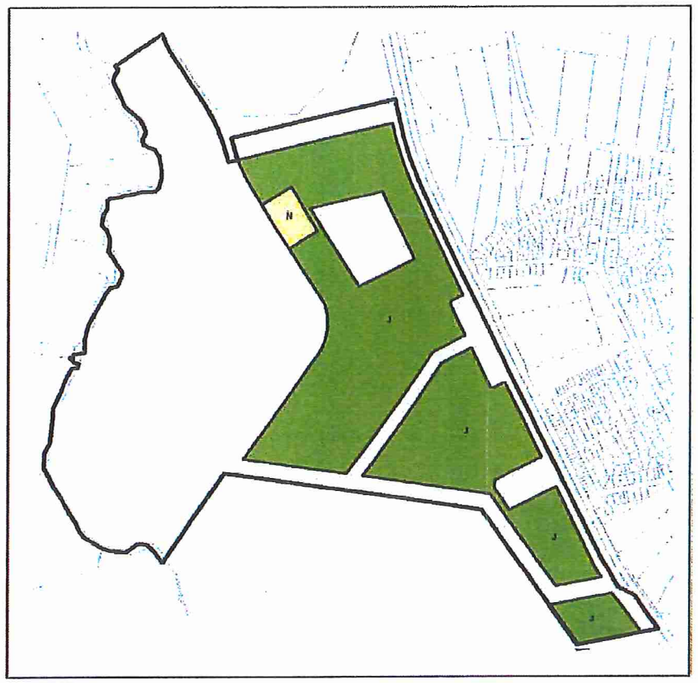
Applicant's proposal



Our intended proposal

- B2 Local Centre
- E2 Environmental Conservation
- E4 Environmental Living
- R2 Low Density Residential
- RE1 Public Recreation
- SP2 Infrastructure

Height of buildings map for DHA land holding



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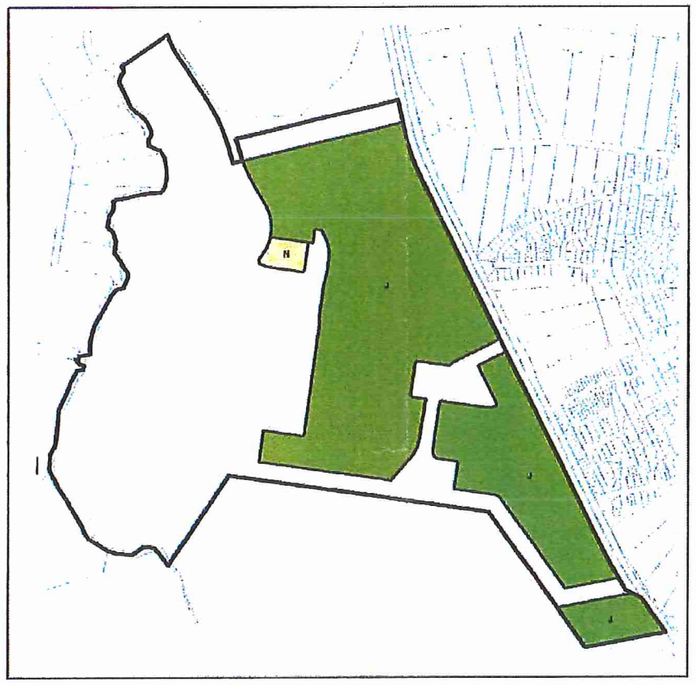
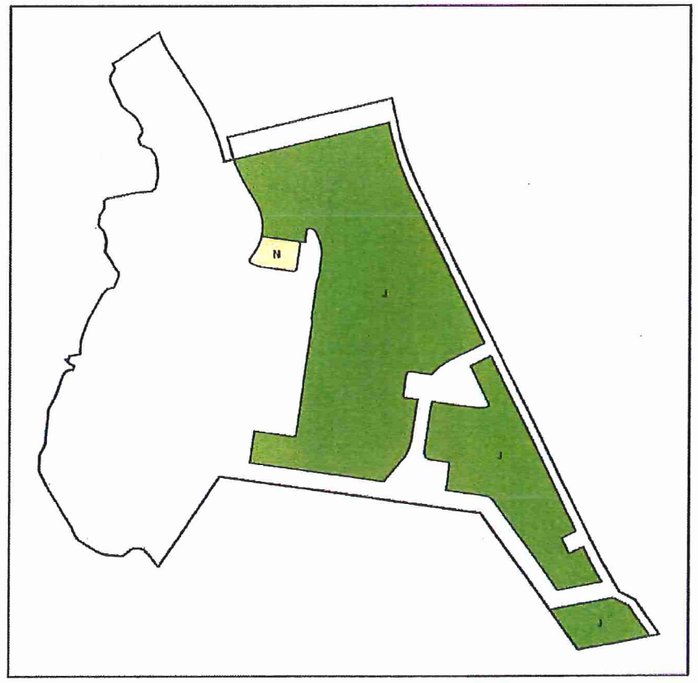


Applicant's proposal



Our intended proposal

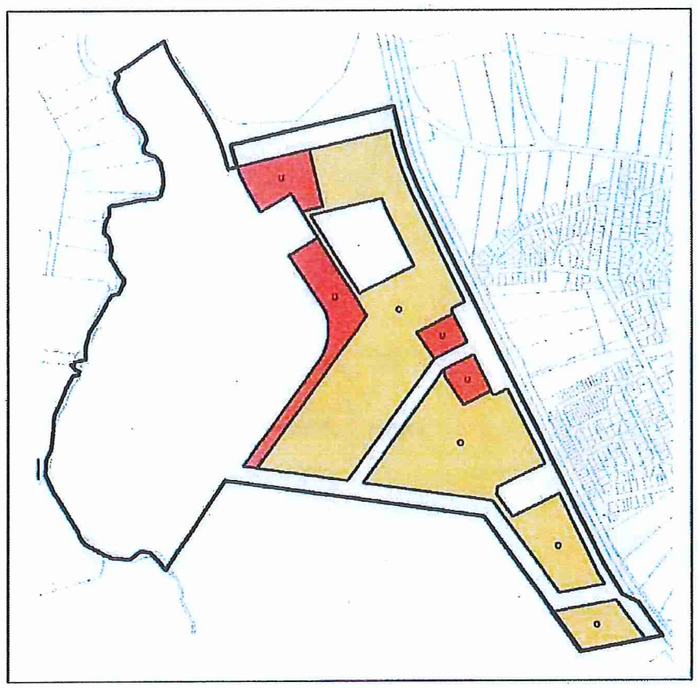
DHA Landholding

Maximum Building Height (m)

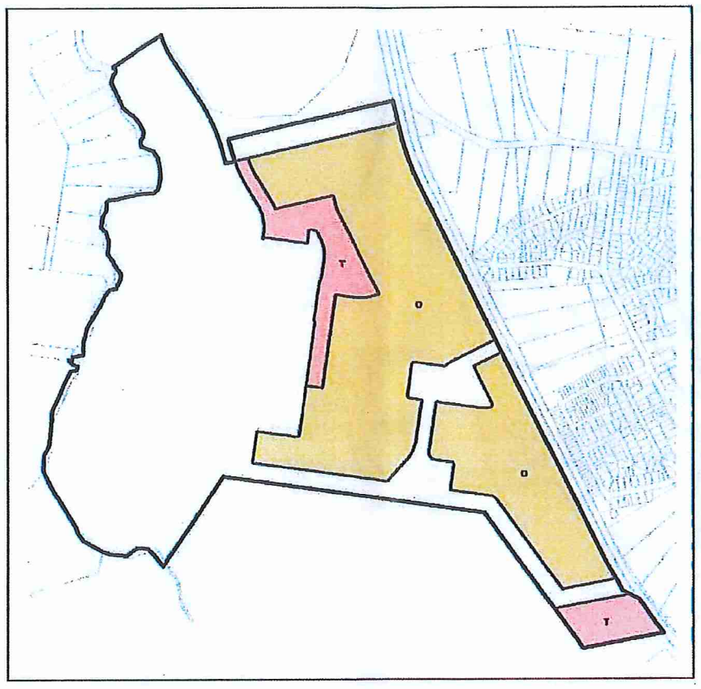
J 9

N 14

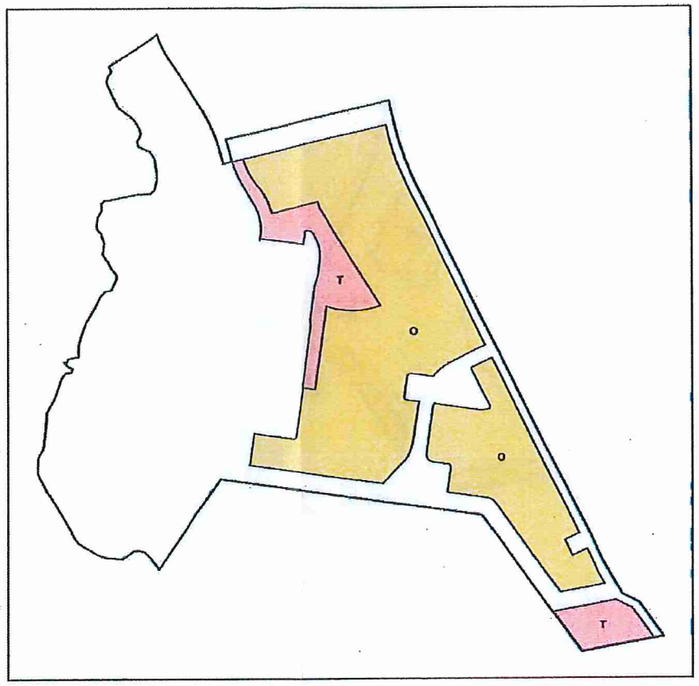
Residential density map for DHA land holding



Existing zones



Applicant's proposal



Our intended proposal

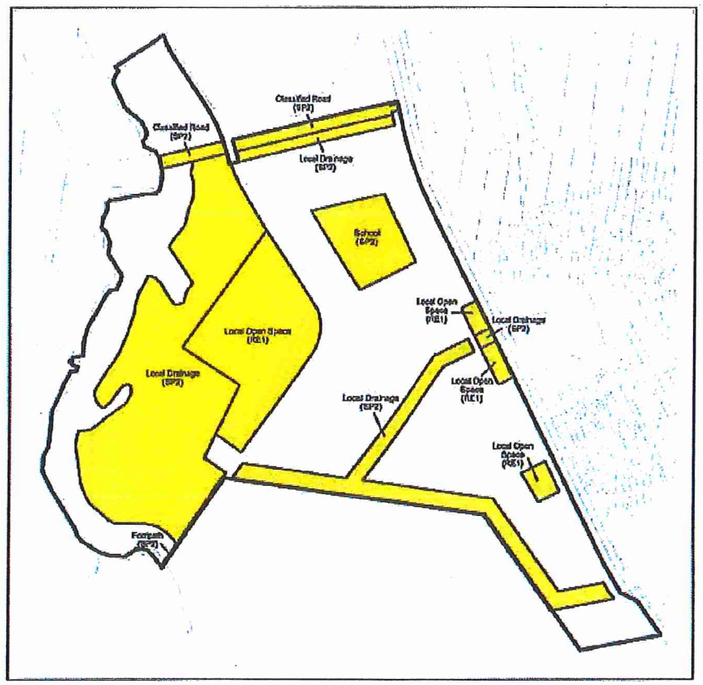
DHA Landholding

O 15

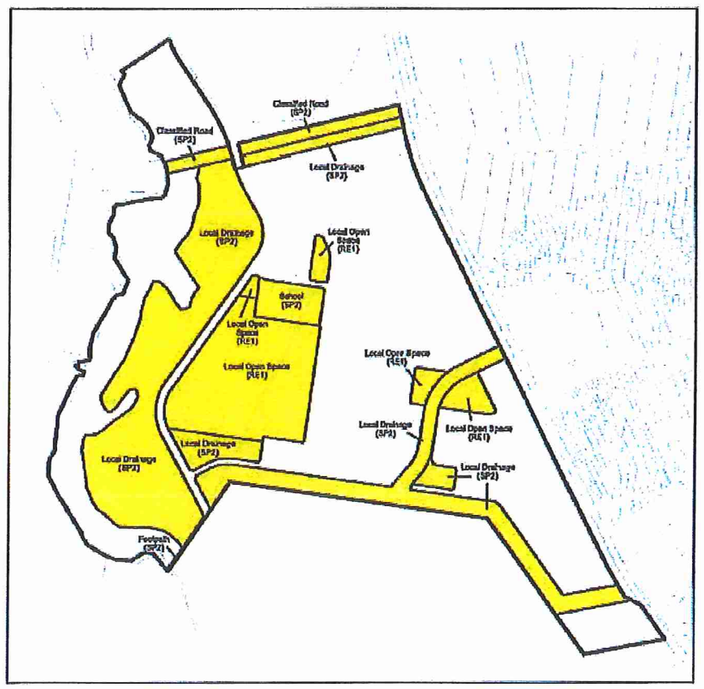
T 25

U 30

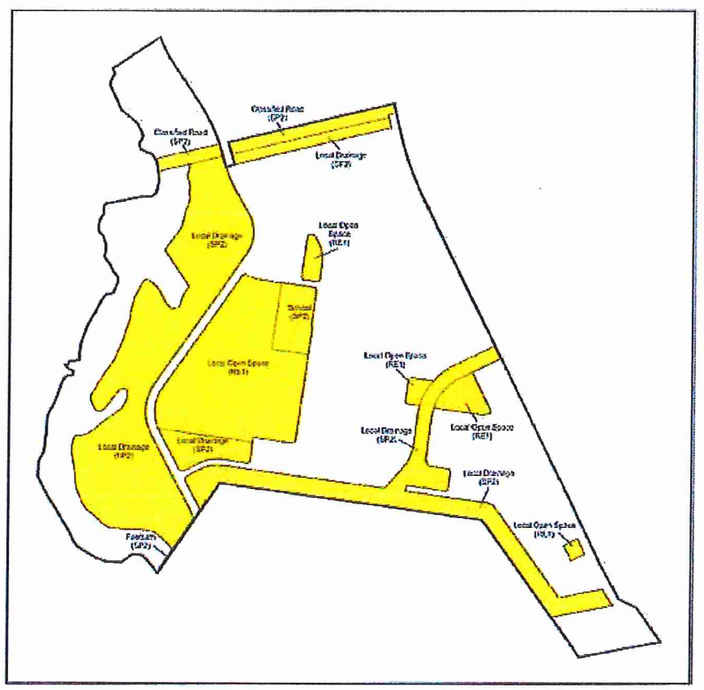
Land reservation acquisition map for DHA land holding



Existing zones



Applicant's proposal



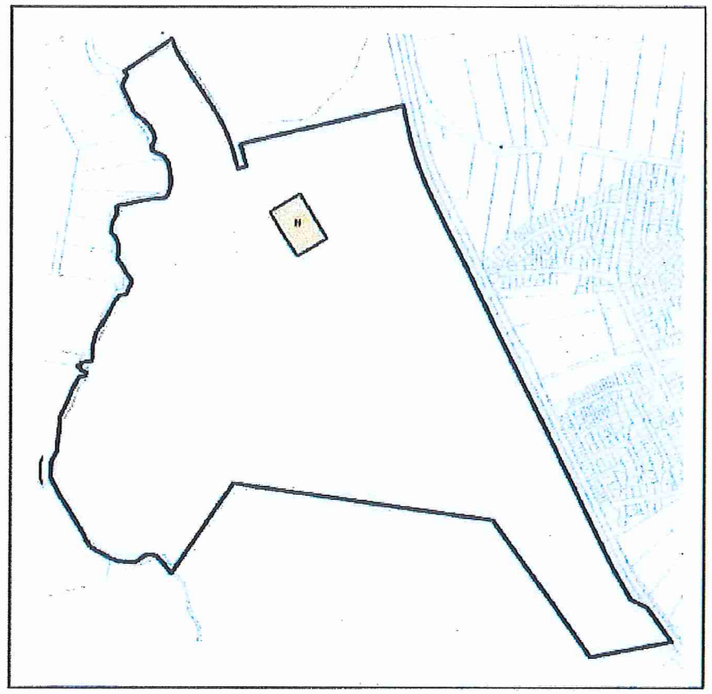
Our intended proposal

DHA Landholding

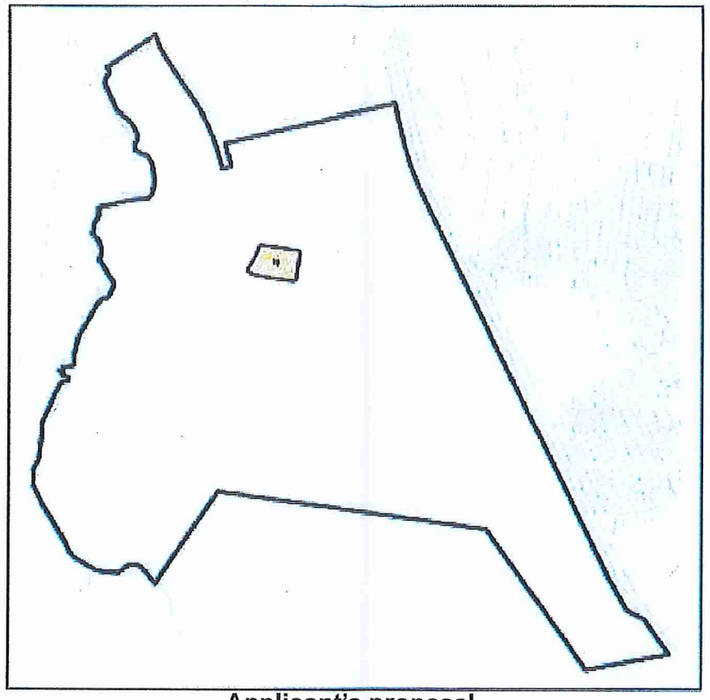
Reservation Acquisition

- Classified Road (SP2)
- Local Road (SP2)
- Local Drainage (SP2)
- Local Open Space (RE1)
- Footpath (SP2)
- School (SP2)

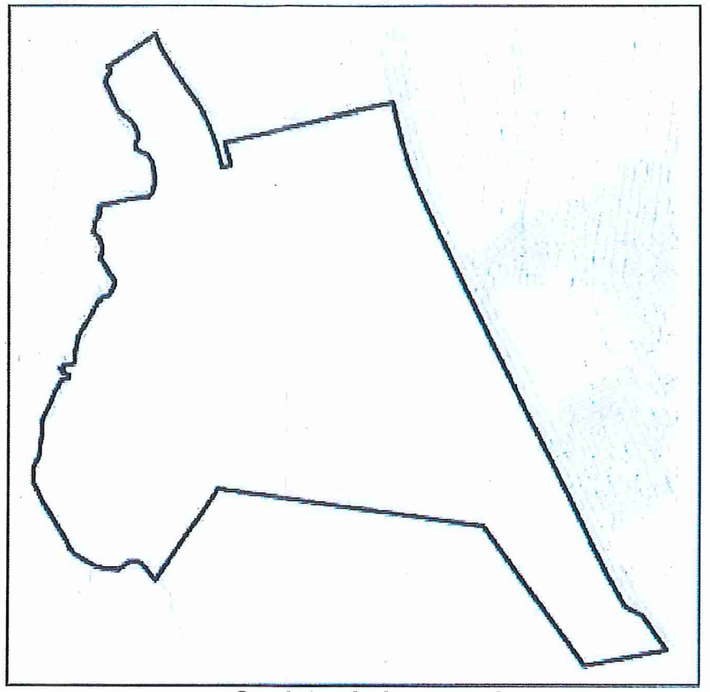
Floor space ratio map for DHA land holding



Existing zones



Applicant's proposal



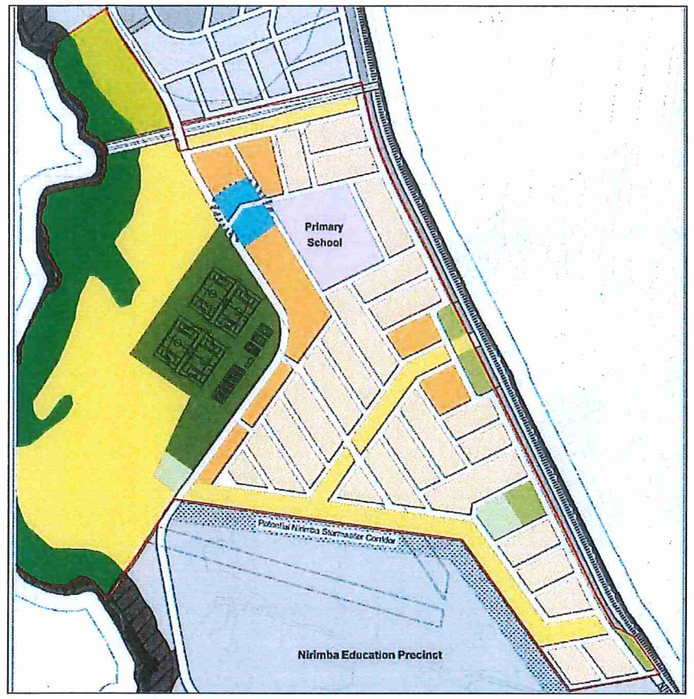
Our intended proposal

DHA Landholding

Maximum Floor Space Ratio (n:1)

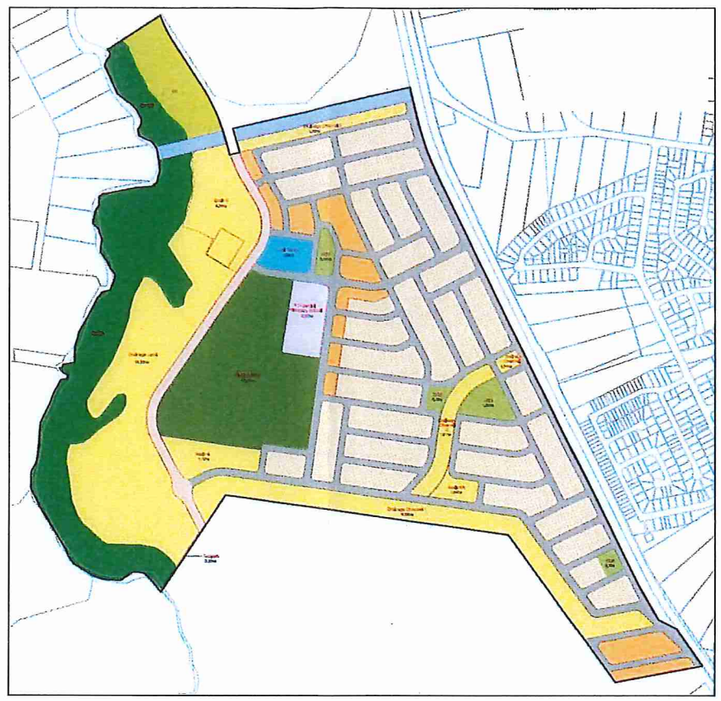
N 1

Existing, proposed and intended Indicative Layout Plan (ILP)



Existing ILP

Applicant's proposed ILP



Our intended ILP

Blacktown City Council

Blacktown Local Planning Panel
PLANNING PROPOSAL ADVICE

DATE OF DETERMINATION	26 October 2018
PANEL MEMBERS	Sue Francis, Chair Jenny Rudolph, Independent expert Mary-Lynne Taylor, Independent expert Melissa Rodewald, Ward 2 community representative
APOLOGIES	Nil
DECLARATIONS OF INTEREST	Nil

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The Panel adjourned during the meeting to deliberate on the matter and formulate a resolution.

The Panel provided the following advice for the Planning Proposal described above:

- The Panel is satisfied that the Planning Proposal meets strategic and site merit tests.
- The Panel supports the matter proceeding to Gateway Determination, however recommend that Council review the necessity of the SP2 Road located adjacent to the rail corridor to be so zoned and whether it needs to be a classified road or service road which could be accommodated within the residential zone.

Blacktown City Council

PANEL MEMBERS
Sue Francis (Chair)
Jenny Rudolph (Independent expert)
Mary-Lynne Taylor (Independent expert)
Melissa Rodewald (Ward 2 community representative)

Attachment 3

Existing and Proposed SEPP Maps

NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Land Zoning Map - LZN

Zone

B1	Neighbourhood Centre	IN2	Light Industrial
B2	Local Centre	R1	General Residential
B4	Mixed Use	R2	Low Density Residential
B5	Business Development	R3	Medium Density Residential
B6	Enterprise Corridor	R4	High Density Residential
B7	Business Park	RE1	Public Recreation
E2	Environmental Conservation	RE2	Private Recreation
E3	Environmental Management	RU6	Transition
E4	Environmental Living	SP2	Infrastructure
IN1	General Industrial		Subject Site

Special Provisions

- A - Low Density Residential (multi-dwelling housing) - Appendix 4, Clause 2.5
- B - Riverstone Scheduled Lands - Appendix 4, Clause 6.8
- C - Green and Gold Bell Frog Habitat - Appendix 4, Clause 6.9
- D - Additional Uses - Appendix 3, Clause 6.5
- E - Additional permitted uses. (Clause 13)
- F - Take away food & drink premises permitted with consent - Appendix 5, (Schedule 1, Clause 1)
- G - Low Density Residential (multi-dwelling housing) - Appendix 7, Clause 2.5
- H - Transport Corridor Investigation Area - Appendix 7, Clause 6.10
- I - Transport Corridor - Appendix 12, Clause 6.10
- J - Food and drink premises - Apendix 12 (Schedule 1, Clause 1)
- K - Landfill works - Appendix 12 (Schedule 1, Clause 2)
- L - Gas processing system and associated plant and eqipment - Appendix 12 (Schedule 1, Clause 3)
- M - Residential flat building - Appendix 4 (Schedule 1, Clause 2)
- N - Transport Corridor Investigation Area - Appendix 4, Clause 6.10

Growth Centre Boundaries

- North West Growth Centre Boundary
- North West Growth Centre Precinct Boundary

Original SEPP Zones

- Environment Conservation
- Public Recreation - Regional

Cadastre

Cadastre 01/06/18 © Blacktown City Council

EXISTING

N

Projection: GDA 1994 MGA Zone 56

0 200 Metres

Scale: 1:8,000 @ A3

NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Land Zoning Map - LZN

Zone

B1	Neighbourhood Centre	IN2	Light Industrial
B2	Local Centre	R1	General Residential
B4	Mixed Use	R2	Low Density Residential
B5	Business Development	R3	Medium Density Residential
B6	Enterprise Corridor	R4	High Density Residential
B7	Business Park	RE1	Public Recreation
E2	Environmental Conservation	RE2	Private Recreation
E3	Environmental Management	RU6	Transition
E4	Environmental Living	SP2	Infrastructure
IN1	General Industrial		Subject Site

Special Provisions

- A — Low Density Residential (multi-dwelling housing) - Appendix 4, Clause 2.5
- B — Riverstone Scheduled Lands - Appendix 4, Clause 6.8
- C — Green and Gold Bell Frog Habitat - Appendix 4, Clause 6.9
- D — Additional Uses - Appendix 3, Clause 6.5
- E — Additional permitted uses. (Clause 13)
- F — Take away food & drink premises permitted with consent - Appendix 5, (Schedule 1, Clause 1)
- G — Low Density Residential (multi-dwelling housing) - Appendix 7, Clause 2.5
- H — Transport Corridor Investigation Area - Appendix 7, Clause 6.10
- I — Transport Corridor - Appendix 12, Clause 6.10
- J — Food and drink premises - Apendix 12 (Schedule 1, Clause 1)
- K — Landfill works - Appendix 12 (Schedule 1, Clause 2)
- L — Gas processing system and associated plant and eqipment - Appendix 12 (Schedule 1, Clause 3)
- M — Residential flat building - Appendix 4 (Schedule 1, Clause 2)
- N — Transport Corridor Investigation Area - Appendix 4, Clause 6.10

Growth Centre Boundaries

- North West Growth Centre Boundary
- North West Growth Centre Precinct Boundary

Original SEPP Zones

- Environment Conservation
- Public Recreation - Regional

Cadastre

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PROPOSED

N

Projection: GDA 1994 MGA Zone 56

0 200 Metres

Scale: 1:8,000 @ A3

NSW GOVERNMENT Planning & Infrastructure

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Height of Building - HOB

LEGEND

Maximum Builiding Height (m)

A	0
C	5
I	8.5
J	9
K	10
M	12
N	14
O	16
P	18
P1	17
P2	17.5
P3	18.5
R	21
S	24
T1	26
T2	28

Subject Site

Growth Centre Boundaries

North West Growth Centre Boundary

North West Growth Centre Precinct Boundary

Cadastre

Cadastre 31/01/17 © Blacktown City Council

EXISTING

N

Projection: GDA 1994
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NSW GOVERNMENT Planning & Infrastructure

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
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T1	26
T2	28
	Subject Site

Growth Centre Boundaries

North West Growth Centre Boundary

North West Growth Centre Precinct Boundary

Cadastre

Cadastre 31/01/17 © Blacktown City Council

PROPOSED

N

Projection: GDA 1994
MGA Zone 56

0 200 Metres

Scale: 1:8,000 @ A3

NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Residential Density Map - RDN

Dwelling Density (per hectare)

C	5
K	10
L	11
M	12.5
O	15
P	18
Q	20
T	25
U	30
V	35
W	40
X	45

Subject Site

Growth Centre Boundaries

North West Growth Centre Boundary

North West Growth Centre Precinct Boundary

Cadastre

Cadastre 05/12/17 © Blacktown City Council

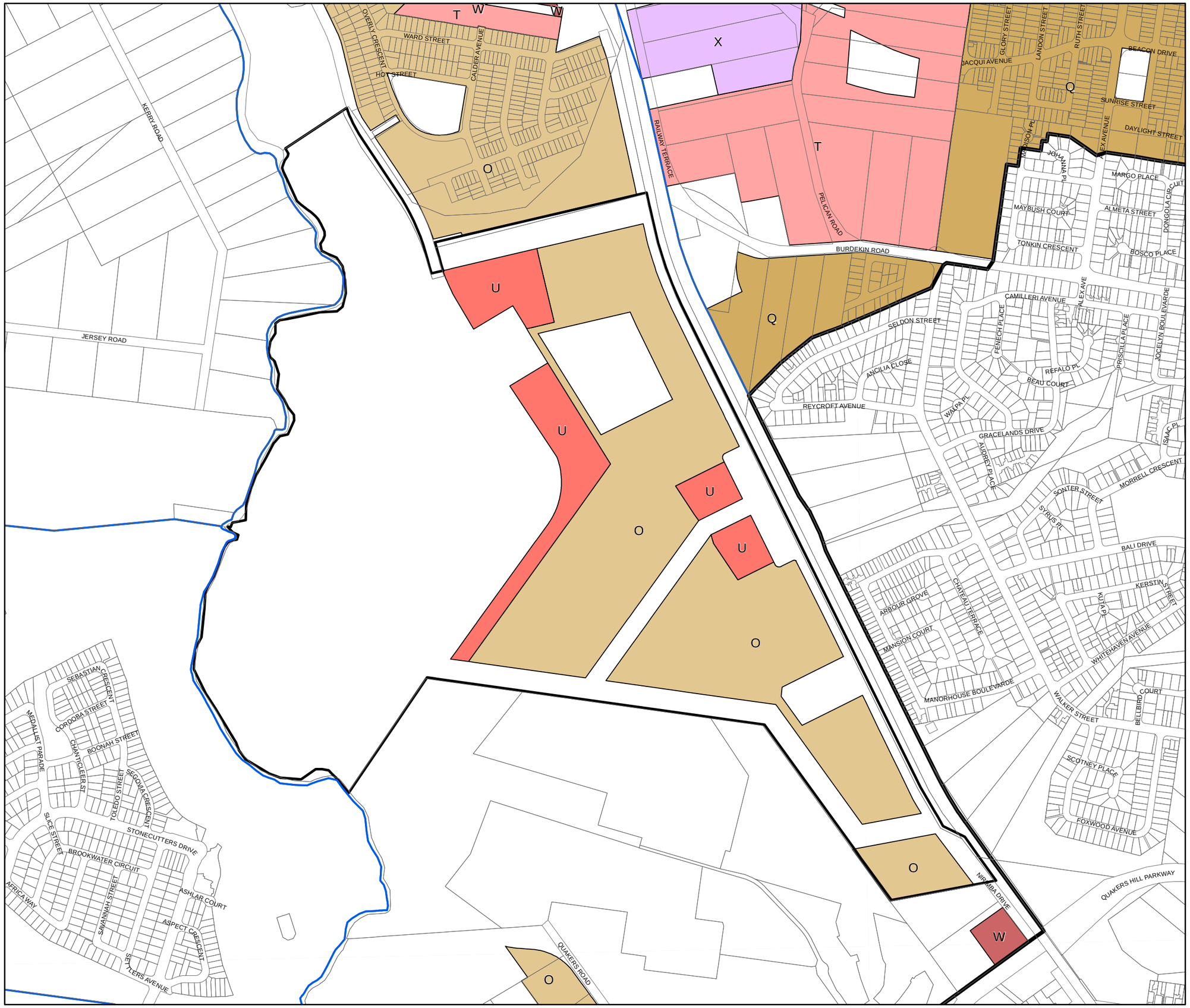
EXISTING

N

0 200 Metres

Scale: 1:8,000 @ A3

Projection: GDA 1994
MGA Zone 56



NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Residential Density Map - RDN

Dwelling Density (per hectare)

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L	11
M	12.5
O	15
P	18
Q	20
T	25
U	30
V	35
W	40
X	45

Subject Site

Growth Centre Boundaries

North West Growth Centre Boundary

North West Growth Centre Precinct Boundary

Cadastre

Cadastre 05/12/17 © Blacktown City Council

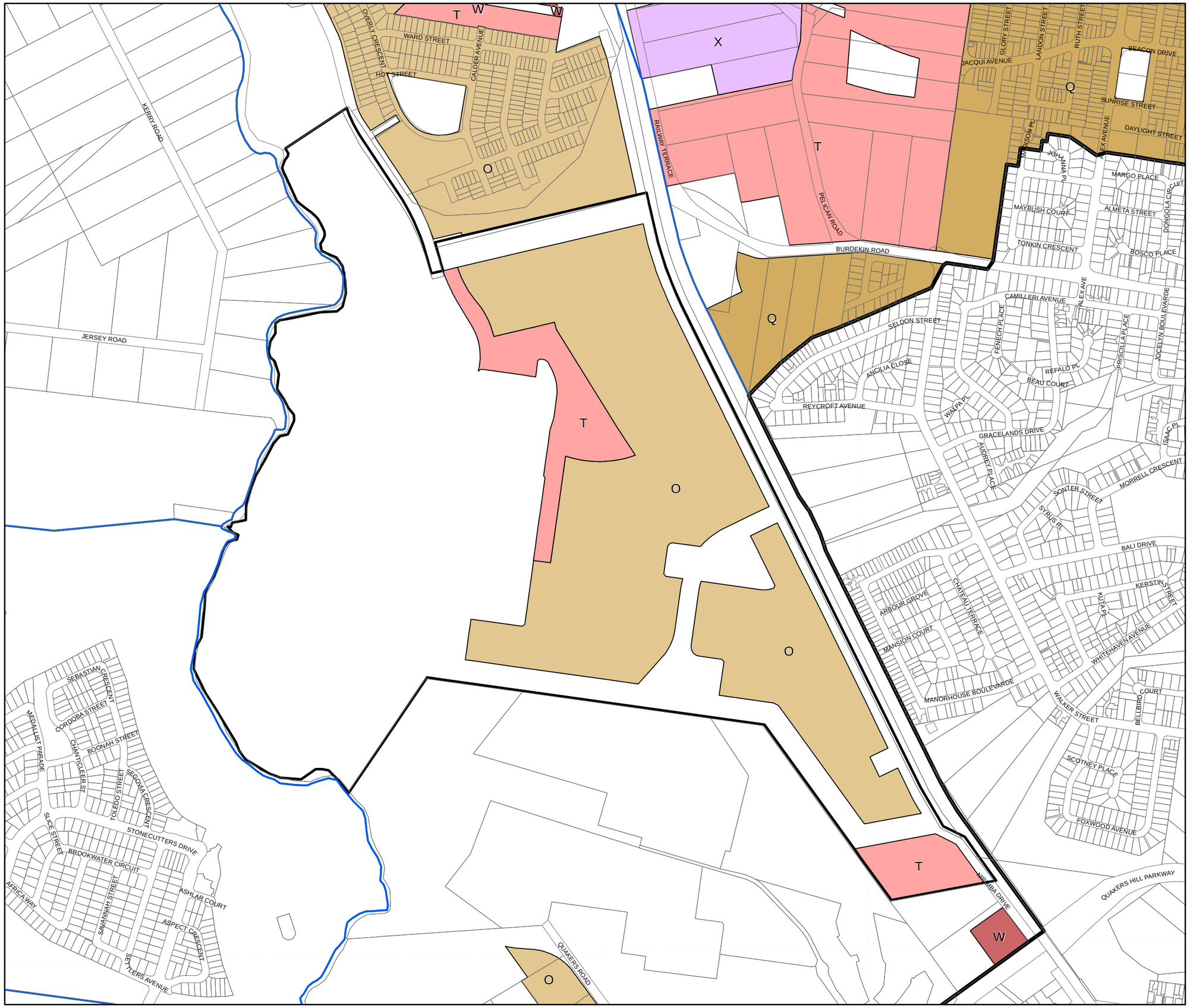
PROPOSED

N

0 200 Metres

Scale: 1:8,000 @ A3

Projection: GDA 1994
MGA Zone 56



NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Land Reservation Acquisition Map - LRA

LEGEND

Land ReservationAcquisition

- Classified Road (SP2)
- Classified Road Wildening (SP2)
- Community Centre (SP2)
- Environmental Conservation (E2)
- Footpath (SP2)
- Local Drainage (SP2)
- Local Open Space (RE1)
- Local Road (SP2)
- Local Road Wildening (SP2)
- Public Creation - Local (E2)
- Pumping Station (SP2)
- Railway (SP2)
- School (SP2)
- Trunk Drainage (SP2)
- Subject Site

Growth Centre Boundaries

- North West Growth Centre Boundary
- North West Growth Centre Precinct Boundary

Cadastre

- Cadastre 05/12/17 © Blacktown City Council

EXISTING

N

0 200 Metres

Scale: 1:8,000 @ A3

Projection: GDA 1994
MGA Zone 56

Drainage (SP2)
Local Drainage (SP2)
Community Centre (SP2)
Local Drainage (SP2)
Local Drainage (SP2)
Local Drainage (SP2)
Local Open Space (RE1)
Local Open Space (RE1)
Local Open Space (RE1)
Local Open Space (RE1)
Classified Road (SP2)
Railway (SP2)
Local Drainage (SP2)
Local Drainage (SP2)
Local Road (SP2)
Local Drainage (SP2)
School (SP2)
Local Open Space (RE1)
Local Drainage (SP2)
Local Open Space (RE1)
Local Drainage (SP2)
Local Road (SP2)
Local Drainage (SP2)
Local Open Space (RE1)
Local Open Space (RE1)
Local Open Space (RE1)
Footpath (SP2)
Local Road(SP2)
Local Open Space (RE1)
Local Drainage (SP2)

KERRY RD
JERSEY RD
BURDEKIN RD
PELICAN RD
GRIMA ST
GLORY ST
LANDON ST
RUTH ST
JACQUI AVE
BEACON DR
MADELINE CCT
ALEX AVE
CLOUD ST
MADISON PL
MARGO PL
MAYBUSH CT
ALMETA ST
DONGOLA CCT
TONKIN CR
BOSCO PL
SELDON ST
HENECH PL
GRACELANDS DR
PRISCILLA PL
JOCELYN BVD
REF ALO PL
ANCILIA CL
BEAU CT
REYCROFT AVE
WALPA P CAMILLERI AVE
AUDREY PL
ISAAC PL
MORRELL CR
SYRUS PL
SONTEE ST
BALI DR
KERSTIN ST
KUTA PL
ARBOUR GR
CHATEAU TCE
WALKER ST
MANSION CT
WHITEHAVEN AVE
MANORHOUSE BVD
BELLBIRD CT
SCOTNEY PL
FOXWOOD AVE
QUAKERS HILL PKWY
NIRIMBA DR
SEBASTIAN CR
TOLEDO ST
SEGOVIA CR
STONECUTTERS DR
SLICE ST
BROOKWATER CCT
AFRICA WAY
SAVANNAH ST
SETTLERS AVE
STONECUTTERS DR
ASPECT CR
QUAKERS RD

NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Land Reservation Acquisition Map - LRA

LEGEND

Land ReservationAcquisition

- Classified Road (SP2)
- Classified Road Wildening (SP2)
- Community Centre (SP2)
- Environmental Conservation (E2)
- Footpath (SP2)
- Local Drainage (SP2)
- Local Open Space (RE1)
- Local Road (SP2)
- Local Road Wildening (SP2)
- Public Creation - Local (E2)
- Pumping Station (SP2)
- Railway (SP2)
- School (SP2)
- Trunk Drainage (SP2)

Subject Site

Growth Centre Boundaries

North West Growth Centre Boundary

North West Growth Centre Precinct Boundary

Cadastre

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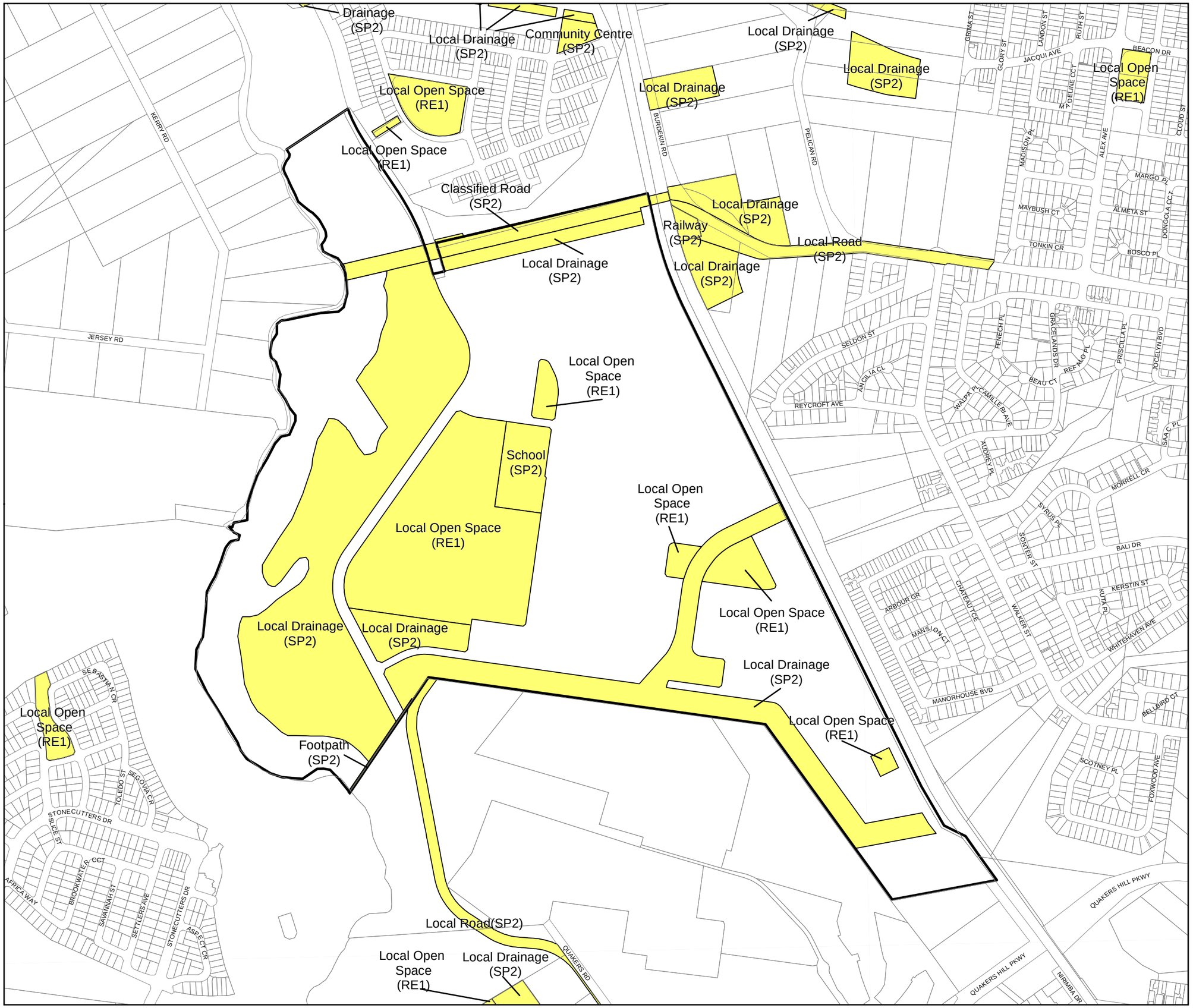
PROPOSED

N

0 200 Metres

Scale: 1:8,000 @ A3

Projection: GDA 1994
MGA Zone 56



NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Floor Space Ratio Map - FSR

Maximum Floor Space Ratio (n:1)

- B 0.4
- D 0.5
- F 0.6
- H 0.7
- I 0.75
- N 1
- P 1.2
- S 1.5
- T 2
- U 2.75
- V 3
- W 3.5
- Subject Site

Growth Centre Boundaries

- North West Growth Centre Boundary
- North West Growth Centre Precinct Boundary

Cadastre

Cadastre 31/01/17 © Blacktown City Council

EXISTING

N

0 200 Metres

Scale: 1:8,000 @ A3

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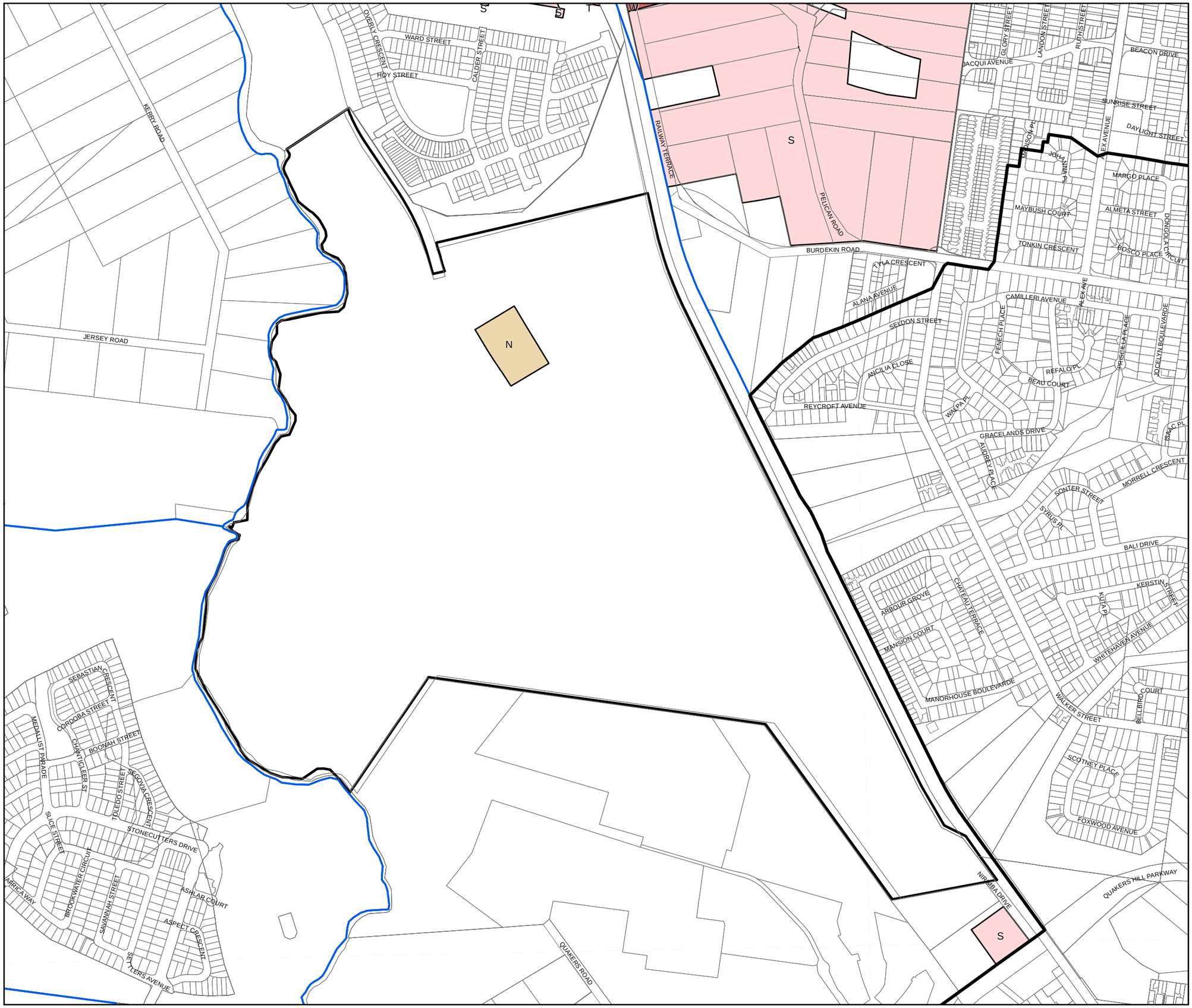
MGA Zone 56



NSW GOVERNMENT Planning & Environment

State Environmental Planning Policy (Sydney Region Growth Centres) 2006

North West Growth Centre
Floor Space Ratio Map - FSR

Maximum Floor Space Ratio (n:1)

B	0.4
D	0.5
F	0.6
H	0.7
I	0.75
N	1
P	1.2
S	1.5
T	2
U	2.75
V	3
W	3.5

Subject Site

Growth Centre Boundaries

North West Growth Centre Boundary

North West Growth Centre Precinct Boundary

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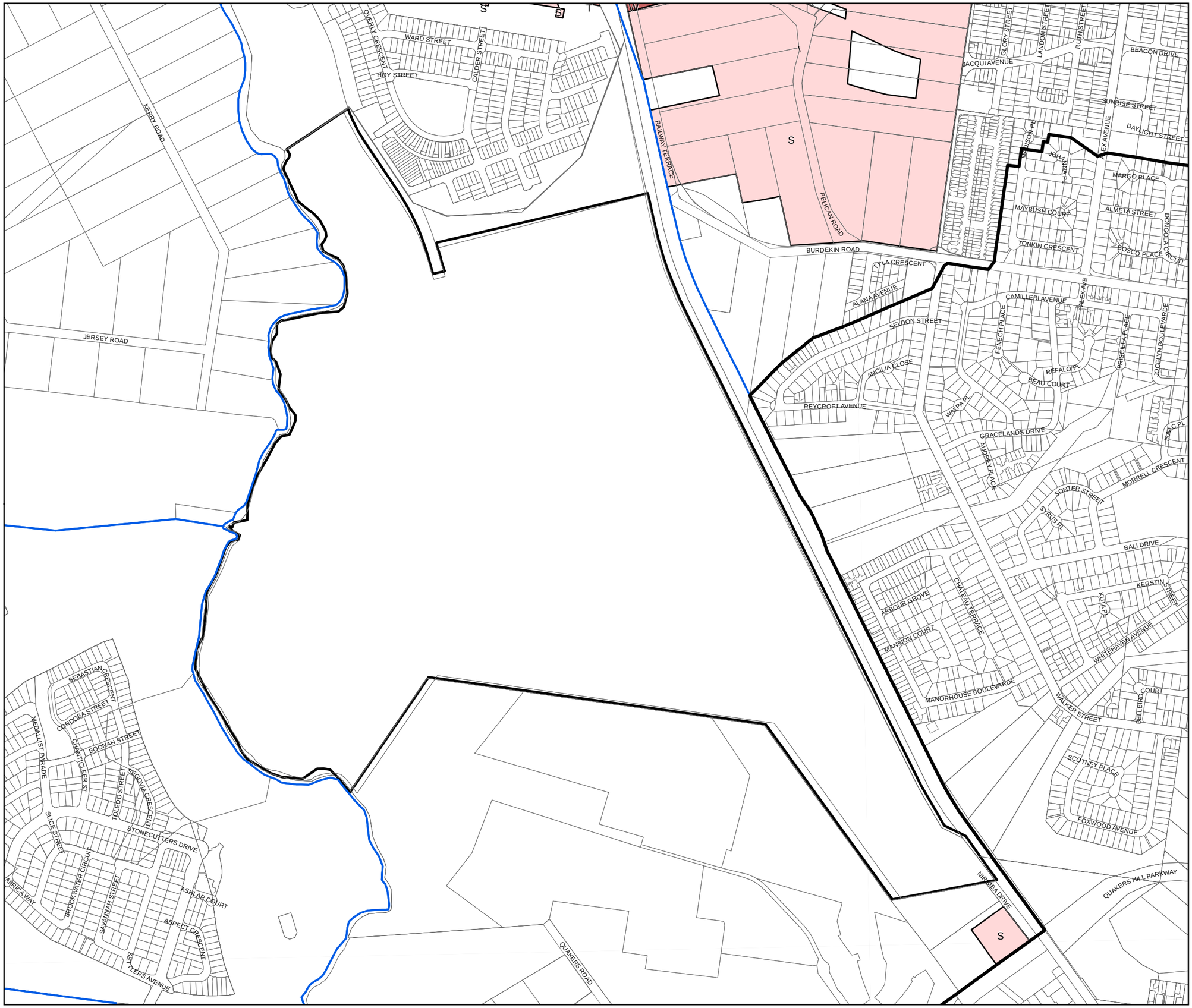
PROPOSED

N

Projection: GDA 1994
MGA Zone 56

0 200 Metres

Scale: 1:8,000 @ A3



Attachment 4

Landscape and Visual Analysis

SCHOFIELDS

Draft Landscape and Visual Report | April 2018 | Revision D

MCGREGOR COXALL

Project Client:	Defence Housing Australia
Project Name:	Schofields
Project Number:	603SYD

Revision:	Status:	Date:	By:	Checked:
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C	Draft	22.12.2017	PM	JM
D	Draft	11.04.2018	PM	BN

Studio:	Sydney
Report Contact:	Julia Manrique/ Paul McAtomney
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Disclaimer

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Channel 01 5
Channel 02 5

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Mustang Drive* 7

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LANDSCAPE CONCEPT

Overview

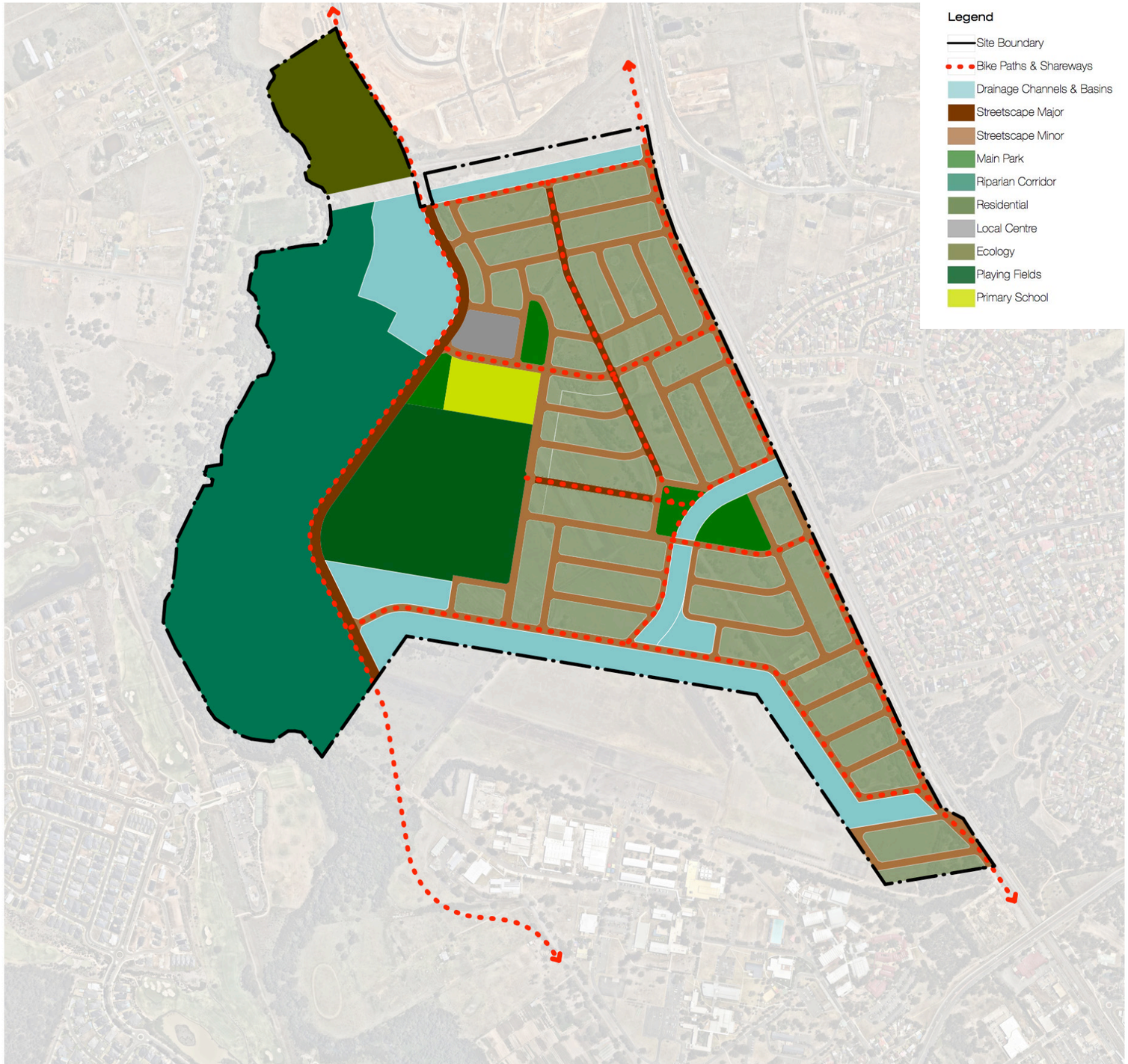
The Schofields landscape concept aims to create a benchmark residential project for Western Sydney. It will achieve this by working with the location, the presence of water and its retention as an asset.

The overall landscape approach for this new residential development is to create a place that enriches the living experience by engaging residents with nature, promoting a healthy lifestyle and providing opportunities within the development for the people to gather, play and engage in social interaction within a safe environment.

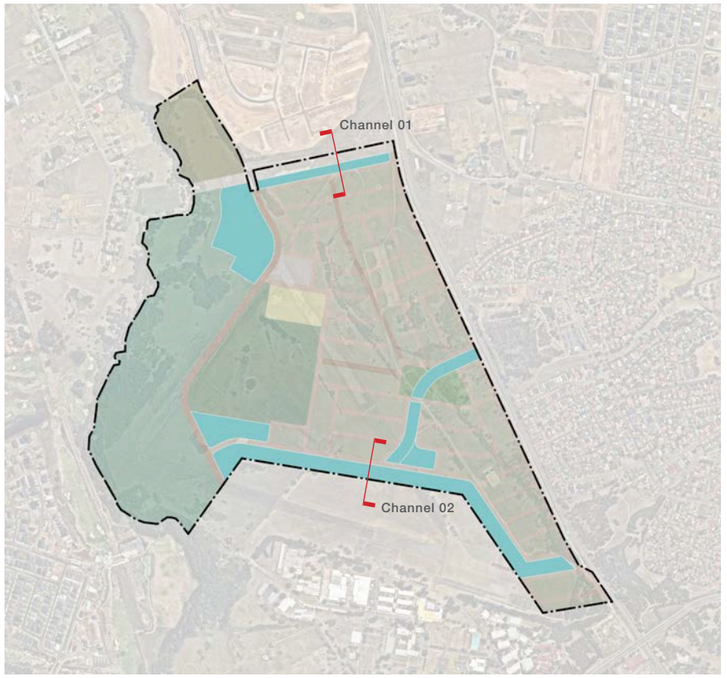
The presence of water a key component of the development and will be showcased in basins and the drainage channels. Central to the concept is the definition of landscape opportunities in these channels and the spaces surrounding them whether it is the Main Park or residential streets. Once the channels have been established, these movement systems will connect the site both internally and to it's surrounding communities. Most importantly, it will provide a valuable ecological resource for the local communities and for the wildlife.

Key Points

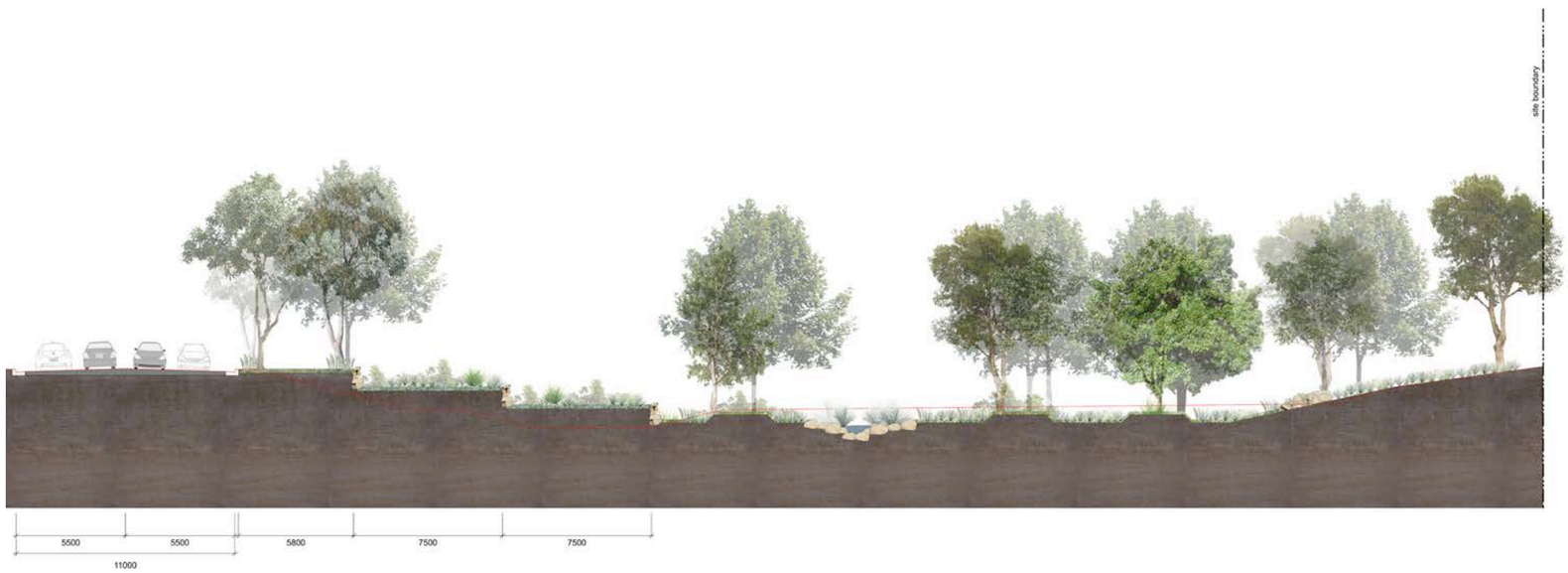
- Water as a key design component of the major open spaces
- Safe balance of vehicular traffic, cyclist, and pedestrian connectivity
- Strategic distribution of open space within the site
- Engagement with water, biodiversity, and corridors



DRAINAGE CHANNELS



Channel 01



Channel 02

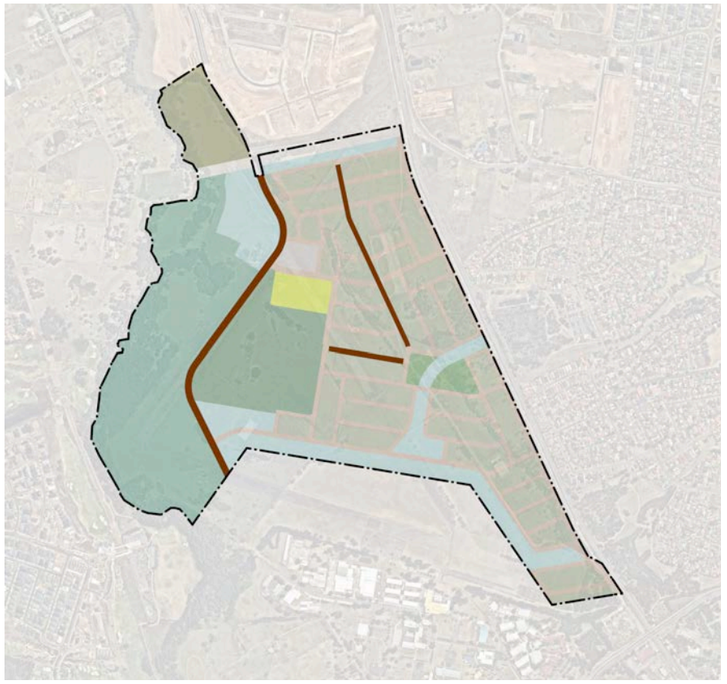
Overview

Typical of drainage channels, the volume requirements established a considerable trapezoidal wide section with a low flow channel in the middle. Channel section 01 presents the opportunity to provide an urban edge designed for to the residents while the other side of the low flow channel will be heavily planted as a wild buffer to the future road. The design intention for channel section 02 is to provide an open space area adjacent to the residents. This will be achieved by consideration of the channels batter as a space that can be occupied. This strategy also contains and controls the scale of the channel to be more domestic while framing the space.

Key Points

- De-engineering the channels
- Acquiring open space by narrowing the cross sections and steepening the batters
- Utilise edge opportunities to channels

STREETSCAPE MAJOR



Overview

The residential streetscapes will provide a safe balance between traffic, cyclists and pedestrian movement. The street hierarchy establishes two different categories—major and minor streets—depending on their roles as connectors within the site. The major streets are considered to be:

- Aerodrome Drive*
- Lancaster Avenue*
- Mustang Drive*

The aim is to provide clarity to this street hierarchy through a range of street sections, paving types, planting and lighting strategies.

* Note: Road names subject to relevant approval

Aerodrome Drive* & Lancaster Avenue*

Given its main role as a connector, this street design is a slightly different character than the rest of the internal residential streets. The street section will, therefore, include the standard 1.5m concrete footpath portion and an additional 1m asphalt strip in order to achieve the 2.5m total shared path but with different materiality.

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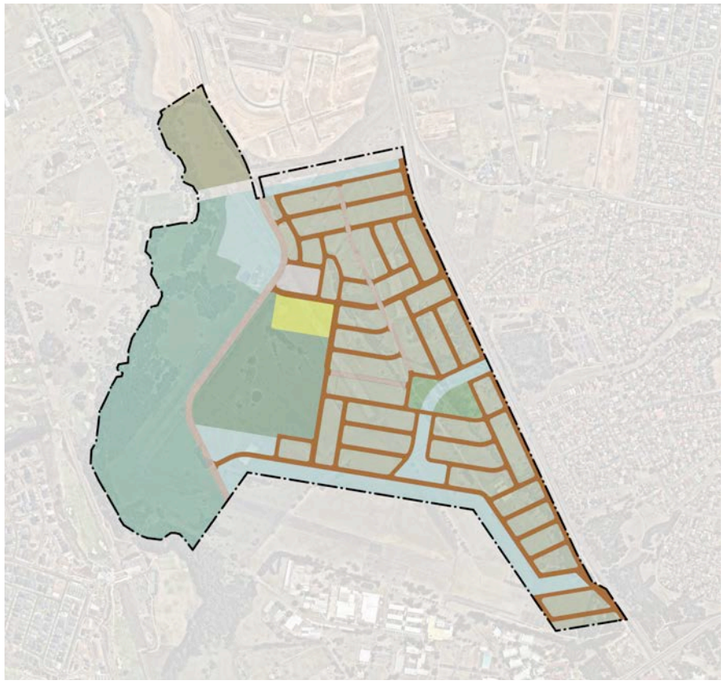
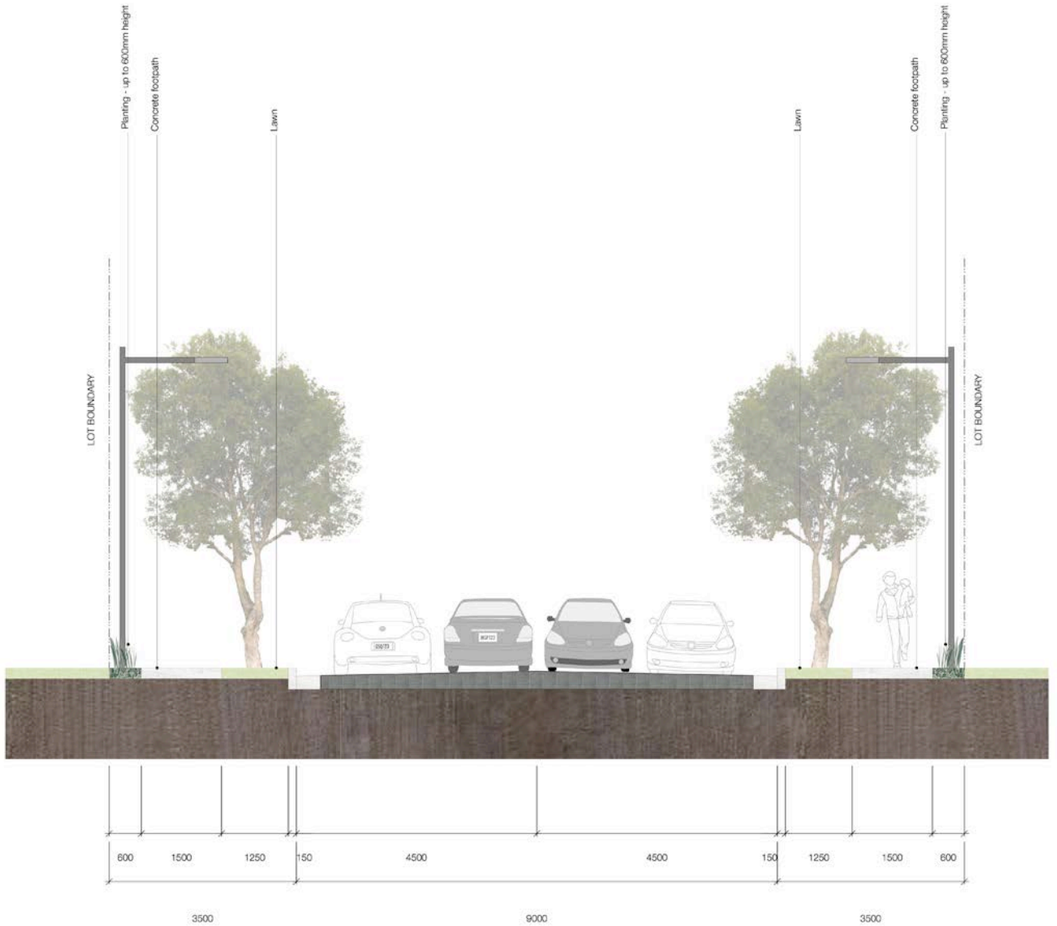
Mustang Drive*

Although this could be seen as standard road section, there is an opportunity to enhance the character of it by choosing the right planting mix for both the median and the planting verges. This new sub-arterial road along the development incorporates a generous 4m planting median.

STREETSCAPE MINOR





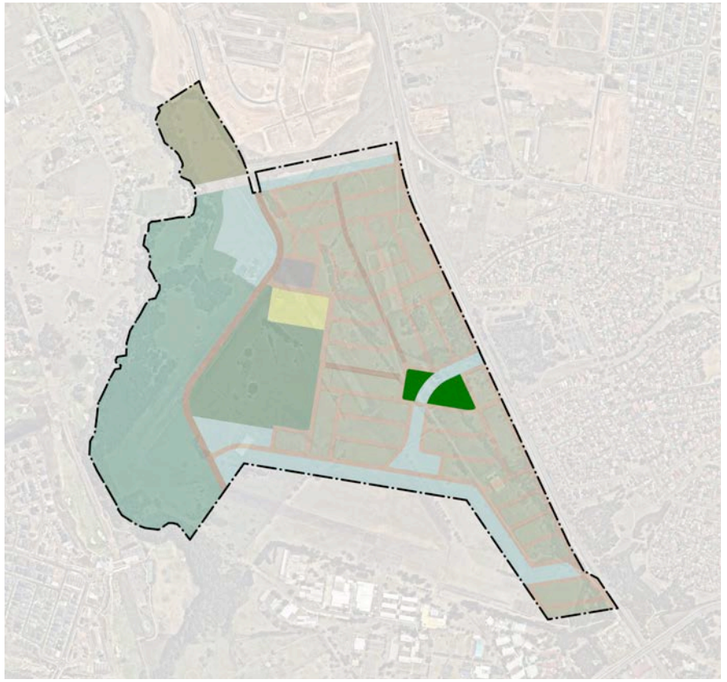
Overview

The minor streetscapes consist of a 13m street section (3.5m footpath - 9m carriage way - 3.5m footpath). It is intended that these street proportions will achieve a balance between traffic and pedestrian movement. The reduction of vehicular speeds and generously proportioned and planted footpaths will aid in achieving this. Each street will have an individual street tree and planting mix to assist in defining their character.

Key Points

- Enhance pedestrian presence on the street
- Unique planting for each street

MAIN PARK



1 Sloping lawn along channel

2 Aerodrome Square

3 The Orchard

4 "The Lawn"

5 Playground

6 Shelters

7 Low flow channel

8 Mass planting

9 Landcaster Dr

10 Potential Indigenous Interpretation

11 Entry Plaza

12 Channel Crossing

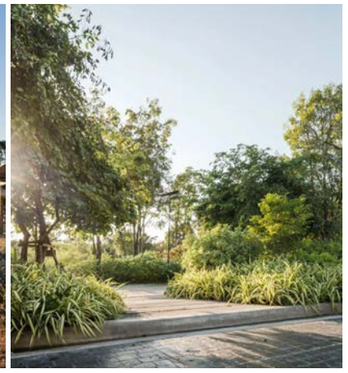
Overview

The Main Park is the site's largest, providing almost 1 hectare of open space. It's size and central location within the development present an opportunity for the park to act as a community hub. The intention behind the scheme for the Main Park is to draw in residents from within the development and increase of a sense of community. A variety of facilities and amenities have been included within smaller and larger spaces to provide flexibility for a range of user groups, while the pathways and plantings that surround the playground and shelters create a sense of enclosure and intimacy within a larger context.

Key Points

- Almost 1ha of open space
- Functioning heart of the development
- Community gathering point

6



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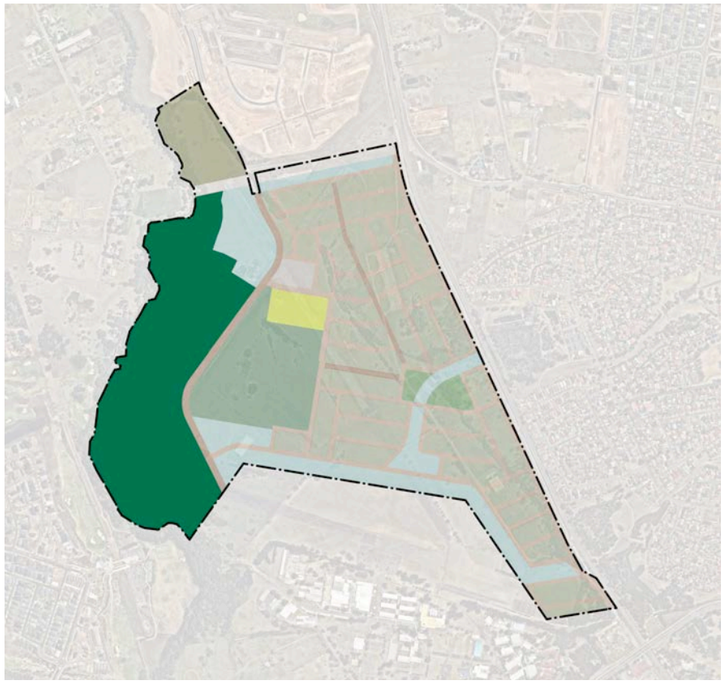
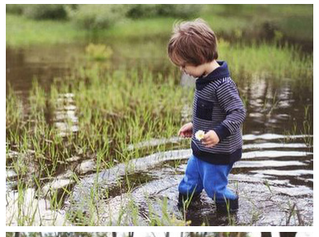
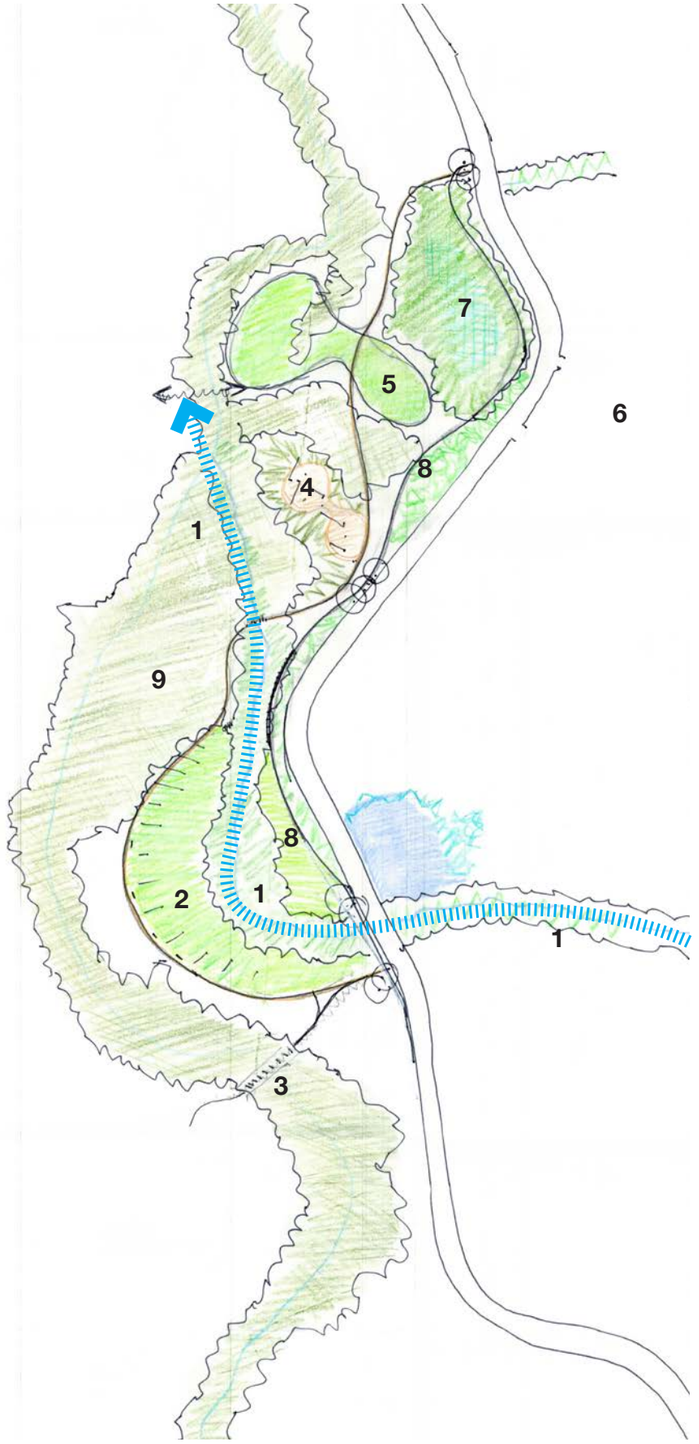
4

5

RIPARIAN CORRIDOR & DRAINAGE LANDS







1 Drainage channel

2 "The Sloping Lawn"

3 Connection to Stonecutters Ridge golf course across Eastern Creek

4 Nature interactive/play area

5 Open grassland [possible overflow carpark]

6 Existing substation

7 Bio-retention basin

8 Path along parklands

9 Ecological corridor to be enhanced

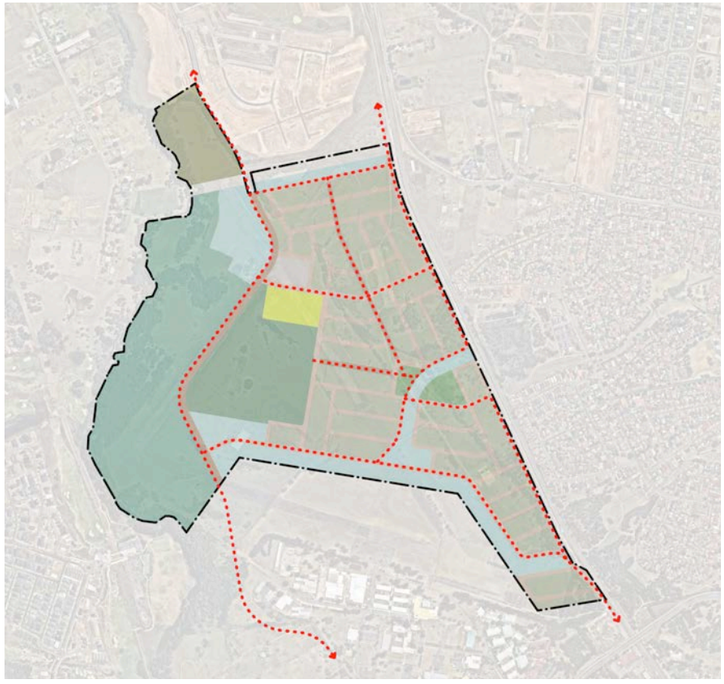
Overview

The intention for the riparian corridor and drainage lands is to enhance the nature of the existing ecological corridor. This provides an opportunity to improve access for both the general public and local residents. This will provide a space where a natural and unmanicured landscape can be enjoyed, away from the built-up surrounds. Existing trees will be retained where possible and incorporated into the drainage channel and open grasslands. A varied landscape will be achieved, providing educational possibilities and an ideal setting for passive recreation via walks paths and trails.

Key Points

- Retention of the ecological corridor and valves
- Passive recreation area
- Natural, low maintenance planting

BIKE PATHS & SHARE WAYS



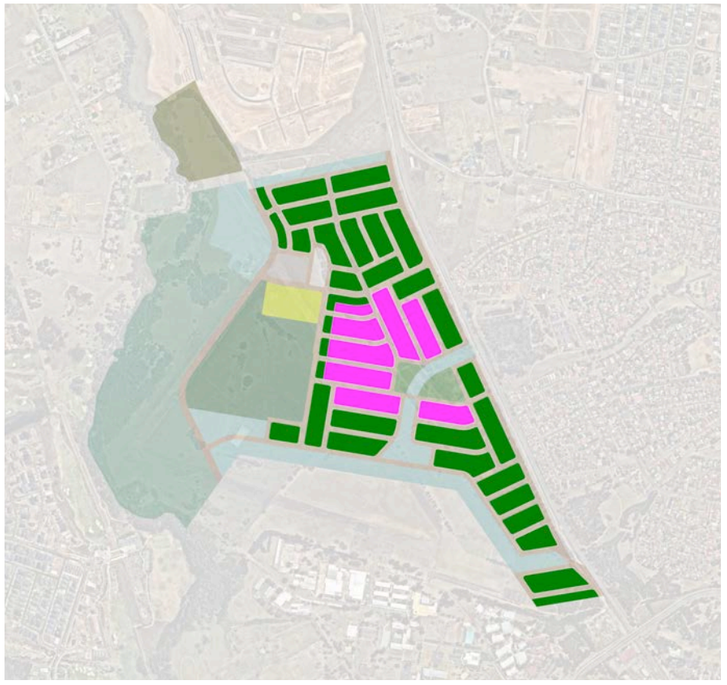
Overview

The strategic incorporation of bikes and shareways through the site present a means of not only ensuring connectivity within the development but also of integrating the development with it's surrounding context. The paths and shareways aim to enhance the connection to parks and open spaces within and around the development. They link with a broader network of pathways to extend connectivity east-west, to other parks, and to both Quakers Hill and Schofield's rail stations.

Key Points

- Integrate with the development
- Ensure connectivity with both the development and regional context
- Extend connectivity east-west
- Connect the stations

RESIDENTIAL



Site Periphery

Layered | Drifting | Diverse

Site Centre

Framed | Orderly | Seasonal

Overview

The residential landscape presents an opportunity to expand on the rich natural parks and canals within the area. The intention is to further engage the residents with nature and strengthen the developments role as an ecological resource for wildlife. This can be achieved through dense native planting, and the provision of seating and narrow pathways throughout, allowing residents the ability to interact with and appreciate the gardens.

Key Points

- Areas of dense native planting drifitng in from site periphery
- More orderly and legible planting towards site centre
- Public access via intimate pathways
- An ecological extension of surrounding parklands

LOCAL CENTRE

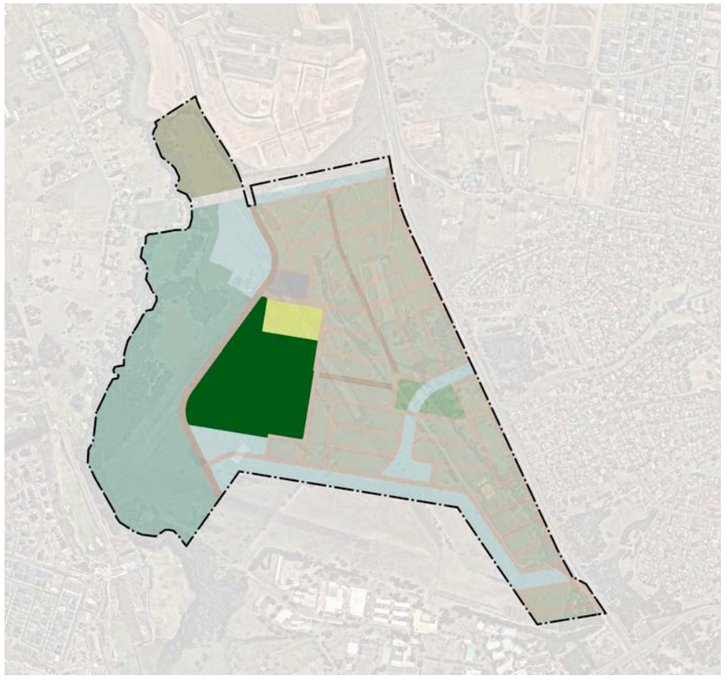
Overview

The local centre presents an opportunity to encourage social activity within the development area. Through the provision of informal seating, an urban plaza, and open lawns, the space can facilitate a range of activities and programs such as exercise groups and markets. Such activities can begin to draw on residents from the surrounding areas, further embedding the development within the larger regional area.

Key Points

- Open, multipurpose space to encourage a variety of activity
- Integration of both softscape and paving areas
- Provision of flexible seating

THE PLAYING FIELDS



Overview

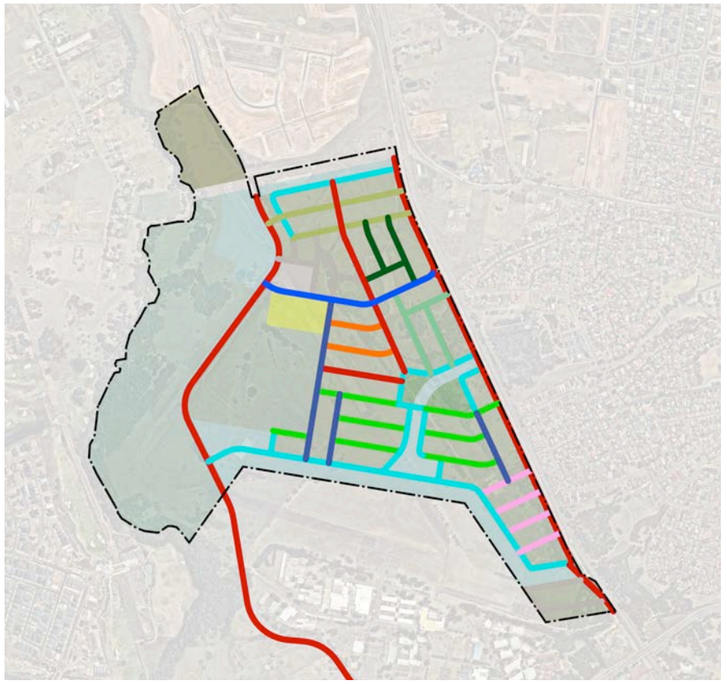
The playing fields present an opportunity to provide the site with a large range of amenities. Feasibility studies have been undertaken to ensure that the area meets all the requirements and that accommodates all the required activities comfortable within the space as well as the car parking.

The studies also had to take in consideration the location of the public school and how this would engage with the playing fields. For that reason the zoning and the shape has been slightly modified.

Key Points

- Primary school located in relation the town centre and local park
- Double playgrounds together and closer to the development
- Car park and netball courts adjacent to Mustang Dr to facilitate access and minimise noise.

STREET TREE CONCEPT



Overview

The Schofields landscape strategy suggests a define plant selection will assist in defining a unique character for the streets. Ultimate plant species selection will be based on site conditions, availability and detailed design considerations.

Key Points

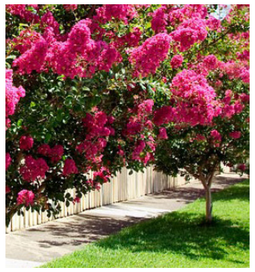
- Tree planting selection will assist in defining unique character streets
- Wayfinding and orientation
- Natives around the edges and in relation to water movement
- Exotics towards the centre of the development
- Heritage interpretation of Orchard

Waterhousia floribunda - Common Name: Weeping Lilly Pilly

Melaleuca styphelioides - Common name: Prickly-leaved Tea Tree

Melaleuca bracteata Common Name: Revolution Green Melaleuca

Tristaniopsis laurina - Common Name: Kanooka Gum



Lagerstroemia indica - Common Name: Crepe Myrtle

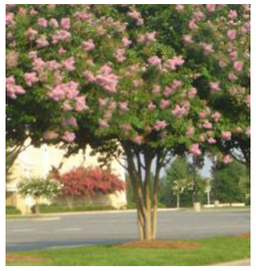
Fraxinus oxycarpa ‘Raywoodii’ - Common Name: Claret Ash

Fraxinus griffithii - Common Name: Evergreen Ash

Pyrus usseriensis - Common Name: Manchurian Flowering Pear

Ulmus glabra ‘Lutescens’ - Common Name: Golden Elm

Pistachia chinensis - Common Name: Chinese Pistachio



Lagerstroemia x faurii - Common Name: Crepe

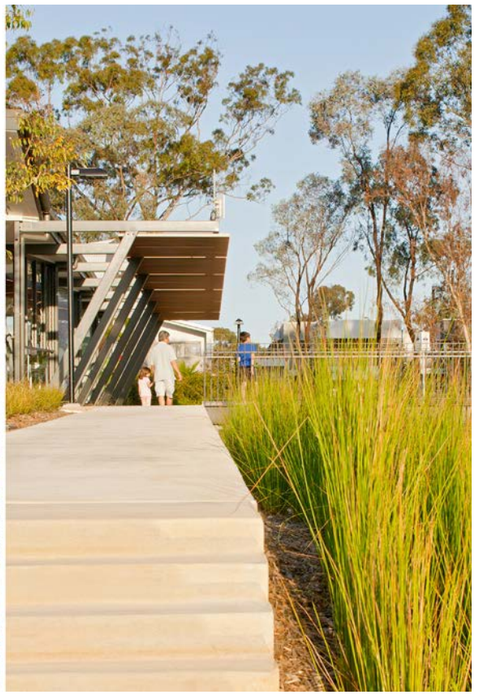
MATERIALITY

Overview

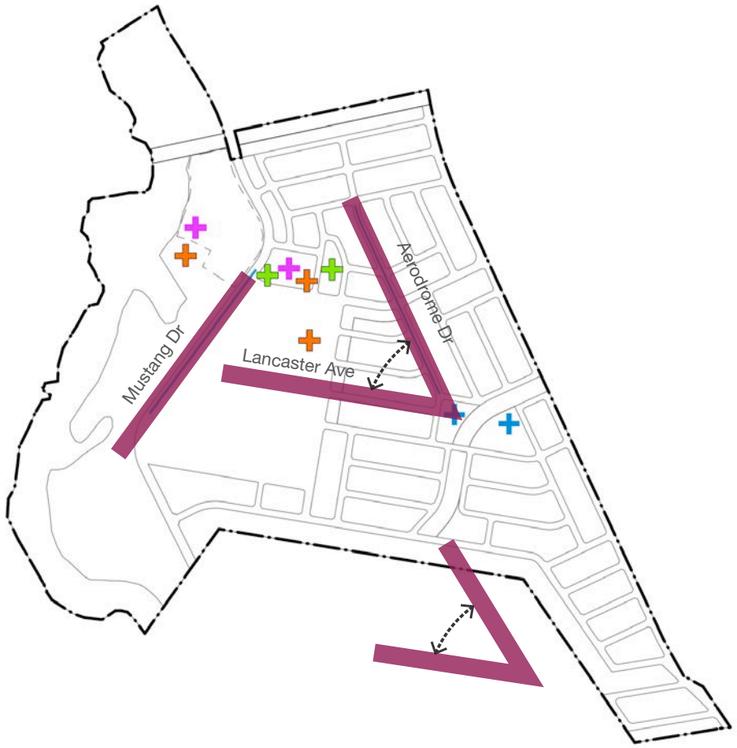
Materials for the site have been selected based on robustness and ease of maintenance. It is important that the constructed work has a high-quality finish with long life expectancy. The focus on materials will extend to ensure that all future landscape components also have a sense of delight whilst ensuring their robustness.

Key Points

- Low maintenance materials [i.e. concrete, bitumen, stabilised decomposed compacted granite, stone]
- Limited fencing
- Native grasslands



HERITAGE INTERPRETATION



Heritage Road Alignments

Overview

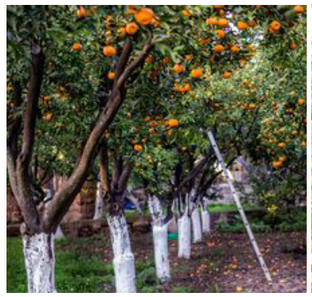
Taking into consideration GML Heritage's Interpretation Strategy, four key themes will underpin the interpretation of Schofield Aerodrome's history and significance. "*Waawaar Awaa*" will communicate the story of the original indigenous occupants of the land. "*Working The Land*" will look to the site's agrarian past as both farm and orchard. "*Life On The Land*" aims to communicate the daily life of the Pye family farm through found archeological objects. Finally, "*HMAS NIRIMBA*" looks to the site's establishment as one of the several airfields in Sydney built or taken over for military uses and for its association with the development of the Australian Navy. Mustang Drive will reflect an original runway axis. Potential locations for each theme are highlighted above.

Key Points

- Four key interpretive themes
- Public domain and major roadways are most suited for for interpretation sites
- Key spaces and streets within the development to be named after heritage themes. NOTE: Any indigenous names selected will approved by the indigenous community
- Mustang Drive runway axis alignment

Waawaar Awaa - Aboriginal Cultures Aboriginal artefact reburial site

Working The Land - Agriculture



Life On The Land - Domestic Life

HMAS NIRIMBA - Defense

Attachment 5

Open Space Needs Analysis

SCHOFIELDS PRECINCT
REZONING PLANNING PROPOSAL

OPEN SPACE NEEDS ANALYSIS

April 2018

Revision F

SCHOFIELDS PRECINCT PLANNING PROPOSAL

OPEN SPACE NEEDS ANALYSIS

APRIL 2018

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Appendix 1 – Existing ILP NDA Plan

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Appendix 5 – Concept Plan for Reserve 980

1 INTRODUCTION

This Open Space Needs Analysis has been prepared to support a rezoning Planning Proposal within the Schofields Precinct. The Planning Proposal incorporates adjustments and corrections to the existing zoning under *State Environmental Planning Policy (Sydney Region Growth Centres SEPP) 2006* (the Growth Centres SEPP) as well as the Schofields Precinct ILP and supporting DCP diagrams. The amendments apply to the portion of the Schofields Precinct owned by Defence Housing Australia (DHA).

The portion of the Schofields Precinct owned by DHA is 135.61 hectares and is referred to as Schofields South in this report. Currently, the Schofields Precinct ILP and zoning under the Growth Centres SEPP include a number of features that require review, including the oversized and poorly located primary school site, the alignment and function of higher order roads, arrangement of drainage and open space and general residential structure.

The proposed amendments to the Schofields Precinct ILP will refine the road hierarchy, drainage channel alignments, residential structure and arrangement of open space, civic uses and commercial area within the DHA landholding. The proposed outcome achieves an improved urban design outcome that responds to the recommendations of specialist consultants engaged to review the Precinct Planning reports and proposed ILP. The revised ILP also responds to the development of the surrounding land and significant transformation of the North West Priority Growth Area since the Schofields Precinct was rezoned.

This Open Space Needs Analysis addresses the provision of open space for the revised Schofields Precinct Indicative Layout Plan. The Analysis incorporates a review of the Precinct Planning process and current planning requirements to establish a methodology for reviewing the provision of passive open space and active open space within Schofields South.

The revised ILP for the Schofields Precinct has been informed by DHA's vision for Schofields South, which incorporates an integrated network of open space. Local parks are linked by the pedestrian and cycle sharepath network as well as drainage channels which have been designed to achieve naturalistic multi-purpose spaces. This outcome will deliver improved amenity for the future community that integrates the various open space elements across the site and ensures that local usage is balanced with district and regional scale facilities and attractions.

The design and location of Reserve 980, which now incorporates a regional netball facility as well as district playing fields, tennis courts, cricket pitches and an amenities building, has been considered in the context of its function as a regional and district destination as well as its role in providing an asset for the local community. This report addresses the facilities included in the Reserve 980 area in relation to changes in dwelling yield and population.

The Eastern Creek riparian corridor, zoned E2 Environmental Conservation and the adjoining drainage land zoned SP2 Infrastructure also form an important component of the open space network within the Schofields Precinct and the Blacktown local government area and more broadly within Western Sydney. The vision for Schofields South promotes access to the Eastern Creek conservation area and use of this space as a destination within the Schofields Precinct.

The local open space network and active open space facilities addressed under this Open Space Needs Analysis have been designed in consideration of the Eastern Creek riparian corridor and the amenity this space provides as a key component of the green grid for Western Sydney. However, discussion of the role of Eastern Creek in the provision of open space has been excluded from this Analysis as conservation areas are not included in the categories of open space that contribute to meeting open space provisioning targets as per industry and Blacktown City Council standards.

The vision for Schofields South is reflected in the Masterplan provided with the main body Planning Proposal report as well as the Landscaping Masterplan also provided with the main body Planning Proposal report.

2 SUBJECT SITE

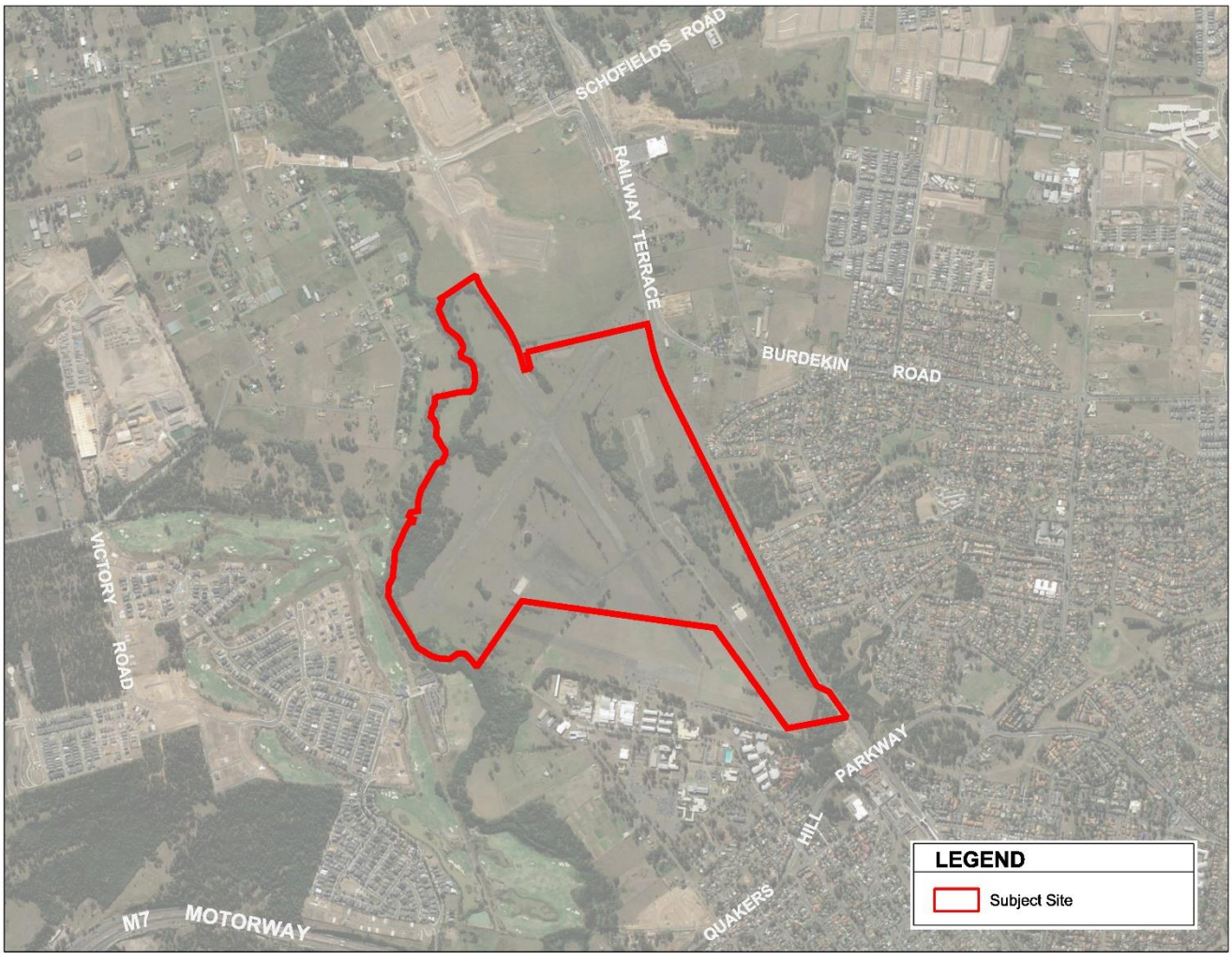
DHA's Schofields South project area is located within the southern half of the Schofields Precinct. The site incorporates the full width of the Precinct. The western side of land owned by Sydney Trains forms the eastern boundary and creekline of Eastern Creek forms the western boundary.

The southern boundary is mostly formed by the Nirmiba Education Precinct, with Quakers Hill Parkway forming the southern boundary in the south-eastern corner. The northern boundary is set by the alignment of the Burdekin Road extension.

The DHA landholding is 135.61 hectares and forms the majority of the former Schofields Aerodrome and for the purposes of this Open Space Needs Analysis will be referred to as Schofields South.

To the north of DHA's land is Stockland's Altrove development which is either constructed or under construction.

Figure 1: Schofields South Project Area



3 PLANNING CONTEXT

This Open Space Needs Analysis has considered the current planning requirements and documents relevant to the provision of open space within the Schofields Precinct in the North West Priority Growth Area. As detailed below, this report has also considered work undertaken during the Precinct Planning process for Schofields, which has informed the review process and methodology for determining open space provisioning for the revised Schofields ILP.

3.1 Schofields Precinct Planning Process

As part of the Precinct Planning process for Schofields, Elton Consulting were engaged by the Department of Planning to undertake a Demographic and Social Infrastructure Assessment which considered the community facilities, human services and open space that will be required to support the population of the future Schofields precinct. The Assessment incorporates the following:

- A review of the relevant State and Local Government policy and planning framework and best practice principles to guide the provision of social infrastructure in the Schofields precinct.
- A review of the social context for the Schofields Precinct and consideration of the likely characteristics of the future population at Schofields to assist in assessing the likely demand for social infrastructure and open space.
- A review of the availability of existing services, facilities and open space in the area and their capacity to absorb demand likely to be generated by future residents of Schofields precinct.
- An assessment of the community facilities and services likely to be required for residents of the future Schofields precinct, based on Growth Centre Commission standards and recent policies of Blacktown City Council.
- Recommendations for the provision of open space and recreation facilities within the Schofields Precinct in consideration of general trends in the demand for these spaces and Department of Planning and City of Blacktown provisioning standards.

The recommendations for the provision of open space within the Assessment are split into passive local open space (referred to as recreation open space in the Eltons Assessment) and active open space (referred to as sporting open space in the Eltons Assessment).

Local Open Space

The recommendations for the provision of local open space consider industry standards, minimum standards included in the 2006 Growth Centres Development Code and provisioning benchmarks provided by Blacktown City Council. The Assessment provides a breakdown of the different components of open space and facilities that form the 2.83 ha per 1,000 people minimum standard established in the Growth Centres Development Code.

The Assessment outlines that the minimum standard of 2.83 ha per 1,000 people for open space as established in the Growth Centres Development Code is recognised by Blacktown Council in the absence of an alternative industry standard and that Blacktown City Council require the 2.83 ha to exclude regional open space, drainage, areas of cultural significance, flood prone lands and creek lines.

Notwithstanding the minimum total open space standard established in the Growth Centres Development Code and recognised by Blacktown City Council, the Elton's Consulting Assessment recommends the provision of local open space in accordance with the Blacktown City Council benchmark of 1.9 ha per 1,000 persons. Based on the population estimates for Schofields used by Elton's, this provisioning rate equates to 18.2 hectares for a population of 9,560. Elton Consulting outline that around 12 hectares of this would be required in the form of parks with some larger parks at least 0.5 ha, and that the balance area could be used to establish civic spaces and quality linear connections.

Active Open Space

The recommendations for active or sporting open space and associated facilities are based on an analysis of facility requirements for the projected population if participation were the same as national and NSW participation levels or projected Blacktown City Council levels and benchmarks. The Assessment includes two scenarios, one based on national and NSW participation levels and the other based on projected Blacktown City Council levels. The Assessment assumes the greater demand under each scenario for the different facilities to avoid undersupply.

The total area required to accommodate the suggested sporting facilities for the Precinct is recommended to be 10ha which includes the provision of 2 double playing fields, 2 cricket pitches, 3 netball courts and 5 tennis courts.

The Elton's Assessment also provides recommendations in relation to the wider district and the provision of district and regional open space and recreation facilities. The Assessment refers to district scale demand analysis which provides indications of the type and scale of facilities required across the Riverstone, Alex Avenue, Schofields and Area 20 Precincts. Although the Elton's Assessment outlines that district sports facilities would be better suited in district centres such as Riverstone and generally require larger parcels of land, the district scale demand analysis suggests there is justification for the provision of a district or regional netball complex within the district.

It is noted that the anticipated incoming population for the Schofields Precinct used in the Elton Consulting Assessment is 9,560 which exceeds the total population included in the Schofields Precinct Section 94 Contributions Plan as discussed under Section 2.5 of this report. The population estimate in the Elton Consulting Assessment is based on a development yield of 3,300.

Design/Spatial Recommendations

In addition to provisioning recommendations, the Elton's Demographic and Social Infrastructure Assessment provides spatial recommendations for the provision of open space. In relation to formation of the local open space network, the Assessment includes principles that promote the establishment of;

- some larger parks that provide a focus for family activity and higher level play and recreation facilities (2 ha +),
- strategically located neighbourhood parks (0.5 ha +),
- smaller neighbourhood parks (0.3 ha +) to maximise accessibility, and
- dual use of drainage corridors to assist in establishing linear open space is also promoted in the Assessment.

In relation to the location and orientation of the active open space area, the Assessment promotes linking the sportsground to a school to enable shared use of the space.

The Assessment also emphasises the regional value in influencing the future development of a major linear corridor along Eastern Creek, with formalised walking and cycling corridors providing opportunities for connections to the Western Sydney Parklands, however this land does not contribute to the quantum of open space across the Precinct.

3.2 Post Exhibition Planning Report

The Department of Planning and Environment (formerly the Department of Planning and Infrastructure) prepared a post exhibition planning report on the 8 May 2012 following exhibition of an explanation of the amendments to the Growth Centres SEPP, draft SEPP maps and draft DCP and ILP. The post exhibition planning report documents the consultation process following exhibition, summarises the submissions and issues raised and reports on how the matters will be addressed in the finalisation of the Precinct Plan.

The post exhibition report details how the ILP was revised to incorporate design improvements identified during the consultation period. The design improvements included relocation of the sports field to increase land for residential development. The report also provides a plan showing the potential layout of the sports field incorporating 2 double playing fields, netball courts, tennis courts, parking and amenities.

The post exhibition report also provides details on how and why the provision of local open space was increased slightly, with modifications generally reflecting changes to the road layout and relocation of the sporting fields influencing the provision of local open space.

A second post exhibition planning report was prepared in January 2013. The Planning Report responded to submissions regarding Amendment 1 which was exhibited following changes made as detailed in the post exhibition planning report from the 8 May 2012. The second post exhibition report addressed queries regarding the calculation of lot yields based on residential density bands under the amended Growth Centre SEPP Maps.

The second post exhibition report finalised the breakdown of land uses by areas for the Schofields Precinct and lot yield estimates for residential uses based on density bands. Table 1 below reflects the land use areas for the final ILP included in the second post exhibition report.

Table 1 – Landuse Breakdown (Schofields Precinct post exhibition planning report January 2013)

Land Use	Area (and dwelling yield where relevant)
Gross site area	464.8 ha (100%)
Residential areas (Total)	196.9 ha (42.4%)
Low density residential (15d/ha)	126.3 ha = 1,892 dwellings
Medium density residential (25d/ha)	1.7 ha = 43 dwellings
Medium density residential (30d/ha)	20.1 ha = 603 dwellings
Medium to high density residential (40d/ha)	6.5 ha = 260 dwellings
Environmental living	42.3 ha = 13 dwellings
Commercial / Retail (Total)	4.7 ha (1%)
Schofields station local centre	2.7 ha
Burdekin Road local centre	1.6 ha
Grange Avenue neighbourhood centre	0.4 ha
Educational Uses (Total)	77.7 ha (16.7%)
Nirimba Education Precinct	73.3 ha
Primary School	4.4 ha
Community Uses	0.45 ha (0.1%)
Open space	31.2 ha (6.7%)
Infrastructure	92.7 ha (19.9%)
Conservation land	61.3 ha (13.2%)

As outlined under section 2.5 of this report, the areas above and corresponding lot yields are reflected in the Schofields Precinct Section 94 Contributions Plan which provides the ultimate quantum and location of open space to be provided as well as the facilities to be delivered within active open space areas.

3.3 Environmental Planning Instruments

State Environmental Planning Policy (Sydney Region Growth Centres) 2006 provides the statutory planning framework for the Growth Centres and establishes the broad planning controls and objectives for their development. It identifies the different land uses within each of the precincts including areas of designated for open space, areas of environment conservation to be protected.

Appendix 7 of the Growth Centres SEPP is the Schofields Precinct Plan and contains the planning requirements that apply over the subject site including zoning and residential density and the identification of special areas as well as objectives and controls specific to the Schofields Precinct.

This Open Space Needs Analysis has been prepared in consideration of the Growth Centres SEPP.

3.4 Policy Framework

Since the Precinct Planning Process for Schofields, the policy framework has evolved, with refined objectives and goals for State and Local Government in relation to the delivery of open space. In addressing the quantum and location of open space under the revised ILP, this OSNA has considered the objectives and actions of the various strategic planning documents applying to the Schofields South area. These include objectives to expand the linear open space network and tree canopy and considering the shared use of infrastructure and community facilities.

Our Greater Sydney 2056 - Greater Sydney Region Plan

The draft Greater Sydney Region Plan outlines how Greater Sydney will manage growth and change and guide infrastructure delivery. It sets a 40-year vision and strategy for Greater Sydney, to be implemented at a local level through District Plans. The vision is underpinned by the organisation of Sydney into a metropolis of three cities being the Western Parkland City west of the M7, a Central River City with Greater Parramatta at its heart and an Eastern Harbour City.

As outlined in the Planning Proposal, the proposed rezoning is wholly consistent with the Greater Sydney Region Plan, providing for a revised Indicative Layout Plan within the Schofields Precinct that will deliver a more sustainable and efficient urban environment that responds to the surrounding existing and planned future infrastructure corridors and services which have evolved markedly since the Schofields Precinct was rezoned in 2013.

Central City District Plan

The District Plans align with the draft Greater Sydney Region Plan and provide a 20-year plan to manage growth and achieve the 40-year vision, while enhancing Greater Sydney's liveability, productivity and sustainability into the future. It is a guide for implementing the draft Greater Sydney Region Plan at a District level and is a bridge between regional and local planning.

The Schofields Precinct is located within the Central City District which comprises the local government areas of Blacktown, Cumberland, Parramatta and The Hills.

The Central City District plan will inform local Council's plans, guide assessment of local planning proposals and inform infrastructure agencies, the development sector and wider community of expectations for growth, change and infrastructure provision within the District.

North West Priority Growth Area Land Use and Infrastructure Implementation Plan

The Land Use and Infrastructure Implementation Plan (The Implementation Plan) sets the overarching strategic plan for the North West Priority Growth Area. The Implementation Plan updates the urban structure and planning framework for the North West Priority Growth Area in consideration of the extent of urban development and increase in demand for housing that has occurred since the release of the North West Growth Centre Structure Plan in 2006.

The Implementation Plan establishes the context for the review of the strategic planning document guiding delivery of the northwest, outlining it has been prepared in response to increased demand for housing in Sydney since the release of the North West Priority Growth Area in 2006, with an additional 20,000 dwellings required in Sydney's North West, increasing the total from approximately 70,000 to 90,000.

Key considerations documented in The Implementation Plan includes consideration of open space connections in reviewing the vision for the North Wets Priority Growth Area and identifying opportunities and constraints.

The Implementation Plan reinforces the Green Grid espoused in A Plan for Growing Sydney which identifies the Eastern Creek conservation area as a potential green corridor with opportunity for connections to the northern extent of Western Sydney Parkland. Areas of local open space within the Schofields Precinct are also identified on the Open Space Connections and Green Grid Figure within the Implementation Plan. To facilitate the establishment of the green grid, the Implementation Plan outlines that opportunities for additional open space to benefit the growing population will be explored and that there will be specific regard to the social infrastructure assessment for each precinct directed at the following:

- investigating the location of planned facilities to ensure that the majority of residents are within 400m of an area of local public open space,
- investigating shared use opportunities,
- embellishment of facilities to provide playgrounds, off-leash areas, and sporting facilities.

Included in the publicly exhibited changes to the planning controls associated with the Implementation Plan, are amendments to the residential density maps within the Schofields Precinct. The amended maps would replace the 15 dwellings per hectare band with a range of 15 – 20 and replace the 30 dwellings per hectare density band with a range of 15 – 25 dwellings per hectare. This would create flexibility in the location of density across an area.

Blacktown City Council Community Strategic Plan

Our Blacktown 2036 is the current community strategic plan for Blacktown Local Government Area and outlines the directions and priorities to deliver the vision for Blacktown.

Our Blacktown 2036 contains 6 strategic directions which Council will use to meet the long term aspirations of the community. Each strategic direction contains strategies that identify how Council, along with its partners and stakeholders, will work towards achieving these aspirations. The Strategic direction are:

- A vibrant and inclusive city
- A clean, sustainable and healthy environment
- A smart and prosperous economy
- A growing city supported by accessible infrastructure
- A sporting and active city
- A leading city.

Each strategic direction is made up of a:

- Community outcome – a statement describing the kind of place the community would like Blacktown City to be
- Focus areas – a series of strategies that outline the "game plan" for achieving the community outcomes
- Our indicators – a series of community indicators, that will be tracked to measure progress towards achieving the long term community outcomes.

The provision of open space and delivery of a high level of amenity for residents within Blacktown Council is a consistent theme throughout *Our Blacktown 2036. Strategic Direction 5: A Sporting and Active City* is especially relevant to the objectives of this Open Space Needs Analysis and includes the following community outcome and focus areas:

> *Blacktown City is the recognised sporting capital of Western Sydney with world standard sporting venues and events and community participation in local sports supporting an active and healthy lifestyle.*

Focus areas:

- Provide elite sporting facilities and strong relationships to build on our culture of sporting excellence
- Implement a balanced framework for future planning of open space and recreational facilities
- Increase community participation in sporting and recreational activities.

The Indicators for Strategic Direction 5 outlines that based on a percentage of residents within 800m of open space, there is concern and that there is capacity to influence the number of people participating in regular physical activity and obesity trends.

3.5 Schofields Precinct Section 94 Contributions Plan

The Blacktown City Council *Section 94 Contributions Plan No. 24 – Schofields Precinct* outlines the provision of essential local infrastructure and baseline facilities within the Schofields Precinct in accordance with Section 94 of the *Environmental Planning and Assessment Act 1979*.

The Section 94 catchment incorporates the entire Schofields Precinct and incorporates four categories of work which are; Water Cycle Management Facilities, Traffic and Transport Management Facilities, Open Space and Recreation Facilities and Community Facilities & Combined Precinct Facilities.

The Section 94 Plan provides a contribution and contribution formulae for each category as well as a schedule of works and the estimated cost and indicative timing of delivery. To establish the contribution formulae, the Section 94 Plan provides Assumptions, Benchmarks and Standards used to determine the dwelling yield.

The Section 94 Plan outlines that the Schofields Precinct has a net development yield of 2,813 dwellings to cater for a population of approximately 8,158 residents. This is outlined under Section 1.13 of the Section 94 Plan. The Section 94 Plan also provides an additional and different development yield figure of approximately 2,954 dwellings and 8,567 residents under Section 1.14.

The benchmarks for establishing these yields are provided under Section 1.15 of the Section 94 Plan and reflect residential density bands included in the Residential Density Map under *State Environmental Planning Policy (Sydney Region Growth Centres) 2006*. The residential density benchmarks included in the Section 94 Plan are as follows:

- Low Density R2 Zone: 15 dwellings/ha
- Medium Density R3 Zone: 25 – 40 dwellings/ha

The Section 94 Plan also provides open space provision benchmarks under Section 1.15, which are as follows:

- Overall open space provision: 2.83ha/1,000 residents
- Rates for specific uses are based on the rates stipulated in the Growth Centres Development Code 2006, input from Blacktown City Council and specialist studies.

The Section 94 Plan outlines that these benchmarks were sourced from *State Environmental Planning Policy (Sydney Region Growth Centres) 2006 Amendment (Schofields Precinct)* 2012 Post Exhibition Planning Report May 2012 and (*Schofields Amendment 1*) Post Exhibition Planning Report January 2013.

Assumed occupancy rates are also provided for the purpose of calculating open space and community facility contributions. The assumed occupancy rates provided in the Section 94 Plan are summarised below.

- Dwelling houses – 2.9 Persons / Dwelling
- Dual Occupancy
    - 1 Bedroom – 1.2 Persons / Dwelling
    - 2 Bedroom – 1.9 Persons / Dwelling
    - 3 Bedroom – 2.9 Persons / Dwelling
- Integrated Housing
    - 1 Bedroom – 1.2 Persons / Dwelling
    - 2 Bedroom – 1.9 Persons / Dwelling
    - 3+ Bedroom – 2.9 Persons / Dwelling
- Other Medium Density
    - 1 Bedroom – 1.2 Persons / Dwelling
    - 2 Bedroom – 1.9 Persons / Dwelling
    - 3 Bedroom – 2.7 Persons / Dwelling

4 REVIEW PROCESS & METHODOLOGY

This section of the Open Space Needs Analysis addresses the provision of open space within the Schofields South Area. The design principles that have informed the proposed open space network are reviewed in Section 5 and discussed in further detail within the main body Planning Proposal report.

The methodology for determining the quantum of open space to be delivered within the Schofields South area incorporated use of the following information:

- Residential Density Maps for the Schofields Precinct provided in *State Environmental Planning Policy (Sydney Region Growth Centres) 2006*.
- Benchmarks established in the Schofields Precinct Section 94 Contributions Plan.
- Information available from the Precinct Planning Process, being the Demographic and Social Infrastructure Assessment prepared by Elton Consulting and the post exhibition planning reports prepared by the Department of Planning and Environment.

4.1 Land Use Changes Under the Revised ILP

As discussed in the main body Planning Proposal, the revised Schofields Precinct ILP incorporates changes to residential structure. This is partly the result of relocating and consolidating the primary school site as well as general efficiencies in the residential structure and road network. Consolidation of the school is facilitated by co-location with the playing fields and this concept is discussed in Chapter 5 of this report and throughout the main body Planning Proposal.

Net Developable Area (NDA) Plans have been prepared based on the proposed land use zoning to identify the difference in land zoned for residential purposes between the existing ILP and proposed ILP. These NDA plans are provided in Appendices 3 and 4 with this report. The changes to residential zoned land resulting from the revised ILP are tabulated in Table 3. To ensure the comparison of land areas between the existing and proposed ILP is consistent, the NDA plans incorporate half of the road reserve adjoining residential land on the existing ILP and proposed ILP.

Table 3 also shows the estimated dwelling yields for each land use zone based on the corresponding residential density under the Growth Centres SEPP. The proposed ILP incorporates a 25 dwellings per hectare residential density around amenity areas, replacing the existing 30 dwellings per hectare density band. As outlined in the main body Planning Proposal, this change in residential density is justified on the basis of moderating a slight increase in total NDA as part of the proposed ILP.

The three different residential density bands included in Table 3 are summarised below.

- R2 Low Density Residential – 15 dwellings/ha
- R2 Low Density Residential – 30 dwellings/ha (existing)
- R2 Low Density Residential – 25 dwellings/ha (proposed)

The Growth Centres SEPP does not include residential density requirements for land zoned E4 Environmental Living. Dwelling yield for environmental living allotments includes a maximum requirement only by way of the minimum lot size of 1,200m². Notwithstanding this, the Planning Proposal does not seek to change the zoning or area of land zoned E4 Environmental Living and will therefore not increase the development yield on this land. Accordingly, land zoned E4 Environmental Living has been excluded from this review process.

The dwelling yields provided in Table 3 are based on the references included in the Schofields Precinct Section 94 Contributions Plan, which outlines that dwelling yield has been based on residential density bands for the Precinct. For the purposes of establishing what the increase in residential densities are for the Schofields South area under the proposed ILP, a comparison of land zoned for residential purposes is the most accurate methodology and is consistent with the Precinct Planning process and information available in the Schofields Precinct Section 94 Contributions Plan.

Table 3 – Existing and Proposed Residential Dwelling Yields

Land Use Zone	Area Existing ILP	Existing ILP Dwellings	Area Proposed ILP	Proposed ILP Dwellings
R2 (15 d/ha)	36.6 ha	548.4 (15 d/ha)	44.88 ha	673.2 (15 d/ha)
R2 Smaller Lot Housing (30 & 25 d/ha)	10.21 ha	306.3 (30 d/ha)	8.19 ha	204.8 (25 d/ha)
Total	**46.8 ha**	**854.7**	**53.07 ha**	**878**

The revised ILP will result in a total increase of 6.3 ha of residential land within the Schofields South area. With the relevant density bands applied to each land use zone, this equates to 23.3 additional dwellings within the Schofields South area under the proposed ILP. As demonstrated in the table, the increase of 6.3 ha of NDA is moderated through the reduction in density from 30 dwellings per hectare to 25 dwellings per hectare in the high amenity areas.

To calculate the increase in population within the Schofields South area, the occupancy rates established in the Schofields Precinct Section 94 Contributions Plan were used and applied to the areas of each zone under the new ILP as shown in Table 3 above.

For both the 15 dwellings/ha and 30 dwellings/ha areas, an occupancy rate of 2.9 persons per dwelling was applied. The 3 bedroom occupancy rate was applied to ensure the upper amount of open space is delivered and in consideration of the large numbers of families that characterises the North West Priority Growth Area. This resulted in the following population estimates.

Table 4 – Existing and Proposed Population Based on Residential Density

Land Use Zone	Existing ILP Dwellings	Existing ILP Population	Proposed ILP Dwellings	Proposed ILP Population
R2 (15 d/ha) (2.9 occupancy rate)	548.4 (15 d/ha)	1,590.4	673.2 (15 d/ha)	1,952.3
Smaller Lot Housing (30 & 25 d/ha) (2.9 occupancy rate)	306.3 (30 d/ha)	888.3	204.8 (25 d/ha)	593.9
Total	**854.7**	**2,479**	**878**	**2,546**

As show in Table 4, the difference in population within the Schofields South area under the existing ILP and proposed ILP is assumed to be approximately 67 people based on residential densities applying to the different land use zones.

4.2 Provisioning Assumption

The assumptions for calculating additional open space requirements are separated into those relating to local open space and those relating to active open space.

4.2.1 Local Open Space Assumptions

The benchmarks established in the Demographic and Social Infrastructure Assessment prepared by Elton Consulting and referred to in the Schofields Precinct Section 94 Contributions Plan were used to calculate increases in the provision of local open space to accommodate increases in development yield.

As the Schofields Precinct Section 94 Plan does not include a breakdown of the minimum 2.83 ha per 1,000 people for total open space, the provision of local open space has been based on the standard of 1.9 ha per 1,000 people established in the Assessment prepared by Elton Consulting.

The current local open space items listed in the Schofields Precinct Section 94 Contributions Plan within the DHA landholding as well as the corresponding areas and required embellishment are provided in Table 5.

Table 5 – Existing Reserve numbers within in the Schofields South Area and Corresponding Areas.

Reserve Number	Area	Embellishment
981	0.5597 ha	Local Park including playground and landscaping
982	0.7420 ha	Local park adjoining Reserve 981 including landscaping
983	0.6680 ha	Local Park including playground and landscaping
Total	**1.9697**	**NA**

As Defence Housing Australia will be submitting a rezoning Planning Proposal for their land holding only, the required additional open space can only be provided within their land holding. Therefore, to measure the additional open space requirements as part of the revised ILP, Table 5 will be used as a baseline.

Table 5 shows the useable local open spaces included in the Schofields Precinct Section 94 Plan within the DHA landholding. Table 5 does not include potential open space within drainage channels or linear open space opportunities such as the strip of RE1 land adjoining the T1 Rail Line. Eastern Creek and the adjoining SP2 zoned land have also been excluded from Table 5 as this is regionally significant open space. This is consistent with the requirement for the provision of local open space to be accessible and useable.

As outlined in Chapter 5 of this OSNA, linear open space areas within the DHA landholding have been maximised in the revised ILP, with drainage channels delivering dual purpose spaces, providing drainage infrastructure and accessible open space areas.

The RE2 Private Recreation Land included in the existing ILP has not been accounted for in this OSNA. RE2 Land is not included as accessible local open space and therefore does not contribute to the provision of public local open space, nor does it provide appoint of comparison in determining the existing quantum of local open space. This is confirmed by the absence of RE2 Private Recreation Land from the Schofields Precinct Section 94 Plan.

The RE2 Private Recreation Land has been removed from the proposed ILP. Blacktown Council have established this zone is undesirable and is not the best use for the land.

4.2.2 Active Open Space Assumptions

The benchmarks for active or 'sporting' open space have also been derived from the Demographic and Social Infrastructure Assessment prepared by Elton Consulting which analysed the facility requirements for the projected population if participation were the same as national and NSW participation levels or projected Blacktown City Council levels and benchmarks.

The Assessment includes the indicative thresholds for the provision of active open space and facilities provided by the Growth Centre Commission Structure Plan and Blacktown City Council's thresholds. These are shown in Figures 1 and 2 below.

Figure 1 – GCC Community Open Space Standards

Table 12: GCC Community Open Space Standards

Type of facility	Benchmark (Number per population)	Size (Site area)
Open Space and Recreation		
Overall Open Space	2.83 ha:1,000 people	
Neighbourhood Open Space	1:2,000 people	1 ha
Local Open Space	1:10,000 people	2 ha
District Open Space	1:100,000 people	5 ha
Local Sports Ground	1:10,000 people	1 ha
District Sports Ground	1:30,000 people	2 ha
Regional Sports Ground	1:200,000 people	5 ha
Local Tennis Centre	1:10,000 people	1 ha
District Tennis Centre	1:30,000 people	1 ha
Equestrian	1:30,000 people	2 ha
Lawn Bowls	1:30,000 people	1 ha
Netball/Basketball Local	1:10,000 people	1 ha
Netball/Basketball District	1:30,000 people	2 ha
District Aquatic Centre	1:100,000 people	1 ha
Regional Aquatic/Indoor Sports Centre	1:300,000 people	2 ha

Source: Growth Centres Commission (2003) Briefing Paper to inform the Development Code

Figure 2 – BCC Open Space Benchmarks

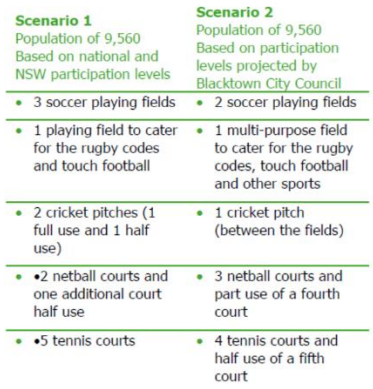
Table 13: BCC Open Space Benchmarks

Facility	Benchmark	Facility Requirement Implications for Schofields Population (based on 9,560 people)
Parks	1.9 ha per 1,000 people	18.2 ha parks
Playing fields	1: 1,850 people	5 fields full sized plus one junior field (around 8-10 ha)
Tennis courts	1: 4,000 people	2.4 tennis courts (2 courts rounded down)
Netball courts	1: 3,500 people	2.7 netball courts (3 courts rounded up)
Playgrounds	Neighbourhood - 1:500 0-11 yrs District - 1:2,000 0-11 yrs City - 1: 10,000 0-11 yrs Regional - 1: 20,000+ 0-11 yrs	1 district playground 3 neighbourhood playgrounds (Based on around 1,890 children aged 0-11 years)

The participation analysis included in The Assessment provides an indication of the sports facilities that could be required for the future population within the Precinct. Two scenarios are provided, one based on national and NSW participation levels and the other based on projected Blacktown City Council levels for a population of 9,560.

The summary of the indicative sports requirements included within the Demographic and Social Infrastructure Assessment prepared by Elton Consulting is provided below in Figure 3.

Figure 3 – Elton Consulting Indicative Sports Field Requirements



Scenario 1 Population of 9,560 Based on national and NSW participation levels	Scenario 2 Population of 9,560 Based on participation levels projected by Blacktown City Council
• 3 soccer playing fields	• 2 soccer playing fields
• 1 playing field to cater for the rugby codes and touch football	• 1 multi-purpose field to cater for the rugby codes, touch football and other sports
• 2 cricket pitches (1 full use and 1 half use)	• 1 cricket pitch (between the fields)
• •2 netball courts and one additional court half use	• 3 netball courts and part use of a fourth court
• •5 tennis courts	• 4 tennis courts and half use of a fifth court

The Assessment assumes the greater demand under each scenario for the different facilities to avoid undersupply and recommends a 10 ha area to accommodate the suggested sporting facilities for the Schofields Precinct which includes the provision of 2 double playing fields, 2 cricket pitches, 3 netball courts and 5 tennis courts. Reserve 980 was established to accommodate these recommendations.

4.3 Revised Provision of Open Space

4.3.1 Local Open Space Outcome

Consistent with the benchmark for local open space of 1.9 ha per 1,000 people, an average of 19 square meters of local open space has been applied to the estimated increase in population of 67 people based on residential densities applying to the different land use zones. An increase of 67 people within the DHA landholding results in an increase of 0.1273 ha (1,273 m²) of land required for local open space.

The areas of local open space proposed within the Schofields South area under the revised ILP are shown in Table 6. The location of these spaces is shown in Appendices 3 and discussed in Chapter 5 of this report as well as the main body Planning Proposal.

Table 6 – Proposed Open Space Items within Schofields South and Corresponding Areas

Reserve Number	Area	Proposed Embellishment
OS 1	0.58 ha	Local Centre Park - Local Park including playground and landscaping
OS 2	0.62 ha	Local Park including playground and landscaping – to be integrated with D2 Drainage Channel and OS3
OS 3	1.13 ha	Landscaping – Other items TBC – to be integrated with D2 Drainage Channel and OS2
Total	**2.33 ha**	**NA**

As demonstrated in Tables 5 and 6, the difference in the provision of local open space under the current ILP and proposed ILP is 0.3603 ha (3,603 m²). This exceeds the required increase of 0.1273 ha (1,273 m²) by 0.233 ha (2,330 m²). As such, there is sufficient local open space under the proposed ILP.

In relation to the proposed embellishments, OS 1 and OS 2 maintains the embellishments and characteristics of Reserve 981 and 982, adjoining the drainage channel. However, the proposed outcome achieves a more centralised and accessible location for these spaces. Reserve 983 has been relocated to the north adjoining the local centre.

4.3.2 Active Open Space Outcome

The proposed outcome for active open space within the DHA landholding reflects the outcomes of the Precinct Planning process, the Schofields Precinct Section 94 Plan and Blacktown City Council's expectations for the delivery of a Regional Netball Facility within the DHA land holding.

Active open space within the DHA landholding and the wider Schofields Precinct will be wholly delivered within Reserve 980. The need for Reserve 980 was established as part of the Precinct Planning process. The Elton Consulting Assessment used a population estimate of 9,560 to establish the need for a District Park 10ha in area to accommodate the suggested sporting facilities for the Schofields Precinct which includes the provision of 2 double playing fields, 2 cricket pitches, 3 netball courts and 5 tennis courts.

The 10ha District Park recommended in the Elton Consulting Assessment was increased to 11.9 ha as part of the Precinct Planning process and as reflected in the Schofields Precinct Section 94 Plan. Although the Section 94 Plan incorporates a larger area for Reserve 980 it includes a population estimate of 8,567 which is substantially lower than the 9,560 population estimate in the Elton Consulting Assessment. The differences between the Section 94 Plan and the Elton Consulting Assessment recommendations are shown below.

Table 7 – Proposed Open Space Items within Schofields South and Corresponding Areas

	Estimated Population	Reserve 980 Area	Recommended Facilities
Elton Consulting Assessment	9,560	10 ha	2 double playing fields, 2 cricket pitches, 3 netball courts and 5 tennis courts.
Schofields Precinct Section 94 Plan	8,567	11.9 ha	District Park including playing fields, amenities, lighting, car park, playground, pathway, fencing and landscaping.

The Elton Consulting population estimate of 9,560 exceeds the Schofields Precinct Section 94 Plan estimate (8,567) by 993 people while the area for Reserve 980 is greater in the Section 94 Plan by 1.9 ha. The additional 67 people resulting from the revised ILP is a small fraction of the 993 person difference between the population estimates included in the Elton Consulting Assessment which recommended a 10 ha park and the Section 94 Plan which recommends a larger area for Reserve 980 with lower population estimates.

Notwithstanding the above, the increase in population of 67 people resulting from the proposed ILP has been considered in relation to the existing requirements for Reserve 980 in the Schofields Precinct Section 94 Plan.

The Schofields Precinct Section 94 Plan requires Reserve 980 to be 11.9452 ha in area and include the following:

District Park including playing fields, amenities, lighting, car park, playground, pathway, fencing and landscaping.

With regard to the provisioning thresholds provided in the Elton Consulting Assessment (refer Figures 1 and 2 of this report), the increase in population resulting from the proposed ILP, being approximately 67 people, does not result in the need to provide additional facilities. Based on the existing population estimate for the Schofields South area being 2,478.63 (refer Table 4 of this report), the increase of 67 does not require additional netball courts, tennis courts or other facilities with higher thresholds.

Notwithstanding the above, Reserve 980 has been substantially increased in size to accommodate a Regional Netball Facility. Reserve 980 now incorporates a regional netball facility with 40 courts and approximately 800 car parking spaces. The design of Reserve 980 has been adjusted to incorporate the regional netball facility and has been increased in area from the existing 11.9 hectares to 12.79 to accommodate the Regional Netball Facility. This substantial increase in size to accommodate a Regional Netball Facility represents a major commitment from DHA to deliver active open space beyond the recommendations of the Precinct Planning process.

An Indicative Concept Plan for Reserve 980 has been prepared to support the Planning Proposal and has been included with this Open Space Needs Analysis (refer Appendix 5). As demonstrated in the Concept Plan for Reserve 980, the space maintains and/or exceeds the facilitates outlined as required in the Demographic and Social Infrastructure Assessment prepared by Elton Consulting and incorporates the regional netball facility and associated parking as well as opportunity for amenities and informal spaces.

Blacktown City Council have provided the Schofields South project team with a more detailed inventory of facilities to be included within Reserve 980. This list is shown in Table 8 below:

Table 8 – BCC Reserve 980 Facilities

Reserve 980 Sporting Facility	Reserve 980 Community Facilities	Embellishment/Pedestrian Access
4 sports fields (2 double playing fields) including lighting	Amenities Building	1500lm Pathway
40 netball courts	Car parking (800 spaces approx.)	1500lm Cycleway
4 tennis courts	Fixed club gazebos	Exercise Trail
	Playground	Interpretation Signage
	3 picnic areas	750 Boundary fencing
	3 BBQs	Informal landscaping (type 1 and 2)
	8 seating areas	Site services

The Concept Plan for Reserve 980 (refer Appendix 5) ensures these facilities will be delivered. The following key points have been considered in determining the impacts on the provision of active open space as a result of the increase in population associated with the revised ILP:

- The required size of Reserve 980 in the Schofields Precinct Section 94 Plan is larger than the recommended size in the Elton Consulting Assessment.
- The population estimates included in the Elton Consulting Assessment are substantially higher than the estimates included in the Schofields Precinct Section 94 Plan.
- The increase in population resulting from the proposed ILP is relatively small (approximately 67 people) and is the result of a refined residential structure that generally maintains the existing low density environment.
- The increase in population does not trigger additional facilities based on the thresholds established in the Precinct Planning process.
- The size of Reserve 980 has been increased from 11.9ha to 12.79 to accommodate the regional netball facility and the Concept provided in Appendix 5 demonstrates all of Councils required facilities and embellishments can be delivered.

As such, the additional population resulting from the increase in yield within the Schofields South area is not considered to justify any changes to the items included within Reserve 980.

5 OPEN SPACE LOCATION & DESIGN

The primary purpose of this Open Space Needs Analysis is to establish the required increase in open space within the Schofields Precinct resulting from proposed increases to land zoned for residential purposes.

Chapters 3 and 4 established this increase based open space provision benchmarks and population estimates. The total local open space provision under the proposed ILP exceeds the required increase based on the increased residential density and population estimates. The design of Reserve 980 has been adjusted to incorporate the regional netball facility and has been increased in area from the original 11.9 hectares to 12.79 to accommodate the Regional Netball Facility. The revised design for Reserve 980 maintains provision of the facilities under the Schofields Section 94 Plan and now provides the additional space for the Regional Netball Facility.

This section provides a summary of the open space network and outlines how the revised local open space areas and Reserve 980 achieve locational and design principles and benchmarks established in key policy documents, Precinct Planning material and the Schofields Precinct Section 94 Contributions Plan. Background documentation reviewed as part of this Open Space Needs Analysis and discussed under Chapter 2 provides a framework for guiding the spatial distribution of open space and has influenced the design of the revised ILP as discussed in further detail in the main body Planning Proposal.

5.1.1 Local Open Space Design Review

Local Open Space in the revised ILP achieves a highly accessible outcome with improved proximity for future residents in comparison to the existing ILP. The integrated network of drainage channels has been designed to achieve connections to the Collector Road sharepath network and in combination will ensure residents can easily and comfortably access the local civic precinct including Reserve 980, Schofields Station, Quakers Hill Station and the Eastern Creek Conservation area.

The Schofields South Planning proposal does not incorporate any changes to the strip of land zoned RE1 adjacent to the T1 Rail Line. This land is owned by Sydney Trains and is therefore located outside of the DHA landholding and outside of the Schofields South project area. It is also noted in the main body Planning Proposal that consultation with Sydney Trains revealed this RE1 corridor cannot currently be used as accessible local open space due to the presence of Sydney Trains' utilities and access and service requirements. Notwithstanding this, the vision for Schofields South incorporates an integrated outcome with this RE1 land to maximise pedestrian connections and linear open space opportunities within the Schofields Precinct.

OS 1 is located adjacent to the Local Centre and has been designed to facilitate a more formally landscaped 'town park' outcome that encourages passive activities and an area of respite and shade from the surrounding commercial uses and school.

OS 2 and OS 3 have been designed to facilitate an integrated outcome with the adjoining drainage channel. In combination with the channel, these two parks will provide a large centralised park area that provides a focus for family activity, consistent with the recommendations of the Demographic and Social Infrastructure Assessment prepared by Elton Consulting.

As demonstrated in the Landscape Concept prepared for the Planning Proposal, drainage channels within Schofields South have been designed to provide a dual function as linear open space areas. Dual function of drainage channels to provide open space is reinforced by the recommendations of the Demographic and Social Infrastructure Assessment prepared by Elton Consulting and the Schofields Precinct Section 94 Contributions Plan.

In relation to access to open space under the proposed ILP, it is noted that the Demographic and Social Infrastructure Assessment prepared by Elton Consulting incorporates a principle for establishing the types of spaces that are considered open space. It reads as follows:

> *'Provide some additional smaller parks if required to ensure that all residents are within 400m of useable open space (recreation, sport or linear). These parks should be at least 0.3 ha in size'.*

The proposed outcome ensures that the vast majority of future residents will be within 400m of local a local park. An Open Space Accessibility Plan (refer Appendix 4) has been prepared demonstrating how the revised ILP improves accessibility to open space for future residents.

The proposed outcome is an improvement on the existing ILP as residents in the northern portion of the DHA landholding now within 400m of the town park. The two local parks that adjoin the central drainage channel achieve a more centralised outcome than the existing location for the parks which locates them at the edge of the development along a RE1 corridor that does not exist in reality due to Sydney Trains' utilities.

It is noted that not all residents are within 400m of an area of local open space, with a small area in the south eastern corner not covered by the 400m catchment. However, the Open Space Accessibility Plan (refer Appendix 4) demonstrates that these residents are within close proximity to linear open space in the form of dual purpose drainage channels, if not local open space areas or Reserve 980 which provides playing fields, tennis courts and cricket pitches. It is also noted that the exception area is within close proximity to the Quakers town centre and Nirmiba Education Precinct which includes open space areas outside of the DHA landholding.

5.1.2 Active Open Space (Reserve 980) Design Review

Reserve 980 has been designed to maintain the requirements for this sporting facility established during the Precinct Planning Process and included in the Schofields Precinct Section 94 Contributions Plan whilst incorporating a regional netball facility. A Concept Plan has been developed and is included with this Open Space Needs Analysis (refer Appendix 5).

Inclusion of the regional netball facility has significantly influenced the design of Reserve 980 and has been a major consideration in revising the ILP. While the regional netball facility will be an asset for the broader community within Blacktown Local Government Area and the North West, the facility presents amenity considerations when planning for a future residential community.

The overarching principles which have guided the new design and location of Reserve 980 are listed below.

- Integrate the recreation area, primary school, residential areas and the neighbourhood centre.
- Incorporate a 40 court Regional Netball Facility into the recreation area, which is to also contain district playing fields, amenities buildings and cricket facilities.
- Provide an interactive and pleasant interface between the residential and the recreation areas.
- Manage traffic and parking associated with the recreation area.
- Ensure that the orientation of the recreation facilities meet the appropriate regulation.
- Incorporation of open space areas for playgrounds and informal recreation activities.

Additionally, aspects of the overall design for the revised ILP that relate to management of the regional netball facility include:

- Mustang Drive has been realigned to the western side of the recreation area to better manage traffic and traffic noise away from residents;
- The proposed Primary School and Neighbourhood Centre have been located immediately adjacent to the recreation area, along with a 'town park', to provide a focus and heart to the development;
- The Regional Netball Facility has been located adjacent to Mustang Drive to ensure traffic and parking associated with the regional playing fields and the netball facility are localised to Mustang Drive.
- The separation of the Regional Netball Facility away from residents and the proposed Primary School has been promoted to reduce impacts on residents and the school from the operation of the Facility (i.e. traffic, parking and operational noise);
- Playing fields have been located adjacent to the future residential area and the proposed school to deliver a softer interface between these land uses and to enable co-use of the playing fields by the proposed primary school;
- The orientation of the recreation facilities ensures that they are well within the regulation requirements for each recreational activity within the area.

- The recreation area has increased in size from the original 11.9ha to 12.7ha to deliver the various recreation activities to be contained in the one consolidated recreation area. The larger land area is a consequence of the need to include the Regional Netball Facility.

Another major aspect of the revised design for Reserve 980 is co-location of the playing fields with the K-6 School site. The concept of co-location is reinforced through State Government Policy, including in the objectives for Open Space within the North West Priority Growth Area Land Use and Infrastructure Implementation Plan as well as Elton Consulting's Demographic and Social Infrastructure Assessment which specifically promotes linking the sportsground to a school to enable shared use of the space.

6 CONCLUSION

This Open Space Needs Analysis provides an analysis of open space provisioning within the Schofields Precinct in the North West Priority Growth area to understand the required increase in the provision of open space for a revised Schofields Precinct ILP. The proposed ILP is the result of an urban design review within the DHA landholding referred to as Schofields South.

To establish a benchmark for determining the appropriate increase in open space, this Open Space Needs Analysis reviews relevant planning material including information during the Precinct Planning process for Schofields, the Schofields Precinct Section 94 Contributions Plan, Growth Centres SEPP and existing policy framework.

The methodology sets out a comparison between the residential land for the existing ILP and proposed residential land and the associated densities, providing an indication of the approximate increase in population. This has been used to determine the required increase in the provision of open space as per the benchmarks provided in the existing planning frameworks and applicable planning controls.

The outcome is an increase of 67 people within the DHA landholding resulting in an increase of 0.353742 ha (3,537.42 m²) of land required for local open space. As demonstrated in Tables 5 and 6 of this report, the difference in the provision of local open space under the current ILP and proposed ILP is 0.3603 ha (3,603 m²). This exceeds the required increase of 0.1273 ha (1,273 m²) by 0.233 ha (2,330 m²). As such, there is sufficient local open space under the proposed ILP.

The size of Reserve 980 has been increased from 11.9 hectares to 12.79 to accommodate the regional netball facility. The following key points have been considered in determining the impacts on the provision of open space as a result of the increase in population associated with the revised ILP:

- The required size of Reserve 980 in the Schofields Precinct Section 94 Plan is larger than the recommended size in the Elton Consulting Assessment.
- The population estimates included in the Elton Consulting Assessment are substantially higher than the estimates included in the Schofields Precinct Section 94 Plan.
- The increase in population is relatively small (approximately 186 people) and is the result of a refined residential structure that generally maintains the existing low density environment.
- The increase in population does not require the introduction of additional facilities based on the thresholds established in the Precinct Planning process.
- The size of Reserve 980 has been increased from 11.9ha to 12.7 to accommodate the regional netball facility and the Concept provided in Appendix 5 demonstrates all of Councils required facilities and embellishments can be delivered.

As such, the additional population resulting from the increase in yield within the Schofields South area is not considered to justify any changes to the items included within Reserve 980. The design of Reserve 980 also responds to the recommendations of the Precinct Planning process and Government policy through its proximity to the potential K-6 School site providing opportunity of co-use of the playing fields.

As outlined in Chapter 4, the revised location for local open space achieves an outcome that is consistent with strategic planning guidelines and recommendations provided as part of the Precinct Planning process for Schofields. Integration of local open space with dual purpose drainage channels maximises accessibility to local open space and connects larger useable open space areas with linear open space.

The intent and outcomes of this Open Space Needs Analysis are consistent with the strategic planning policy applicable to the Schofields South area. The uplift in the provision of local open space, location of open space and design of Reserve 980 to accommodate shared use arrangements and a regional netball facility are consistent with the objectives of the relevant strategic planning documentation and Council policy.

Appendix 1 - Existing ILP NDA Plan

Appendix 2 - Proposed ILP NDA Plan

Appendix 3 – Proposed ILP with Open Space Areas

Appendix 4 - Open Space Accessibility Plan

Appendix 5 - Concept Plan for Reserve 980

Attachment 6

Traffic Impact Assessment Analysis

GTAconsultants

Schofields Aerodrome Planning Proposal Transport Impact Assessment

Client //	Defence Housing Australia
Office //	NSW
Reference //	N122850
Date //	06/04/18

Schofields Aerodrome

Planning Proposal

Transport Impact Assessment

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1. Introduction

1.1 Background

Defence Housing Australia (DHA) is planning a multi-stage residential development of the former Schofields Aerodrome site located in the suburb of Schofields.

The site is located within the Schofields Precinct, which was identified by the Department of Planning and Environment as a key precinct for employment and housing growth within the greater Sydney region, as set out in the North West Growth Strategy (NWGS).

The Schofields Precinct Plan and associated Indicative Layout Plan (ILP) was finalised towards the end of 2012. Subsequently, the ILP was adopted as part of the Blacktown City Council Growth Centre Precincts Development Control Plan – Schofields Precinct in 2016 (DCP 2016).

A Stage 1 development application (DA) was lodged with Blacktown City Council (Council) in mid-2017 for the first stage of development of the Schofields Aerodrome site, located immediately south of the proposed Burdekin Road continuation. The Stage 1 DA proposal is generally in accordance with the approved ILP and DCP 2016.

Subsequently, DHA is proposing to modify the ILP to support future stages of development. The proposed modifications include the following key elements:

- lot layout
- road network
- location and type of sporting facilities
- town centre location and arrangement.

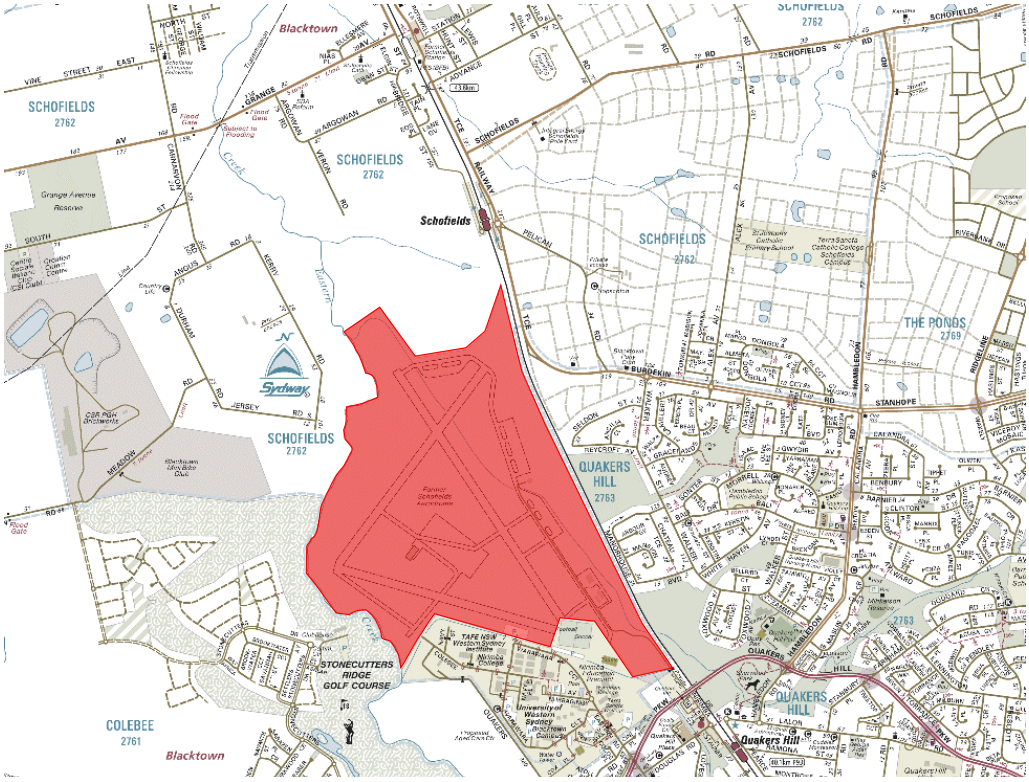
DHA engaged GTA Consultants (GTA) in March 2017 to complete a transport assessment to accompany the planning proposal submission to Department of Planning and Environment for the amended ILP.

1.2 Site Location

The site is located north-east of Quakers Hill and is bound by the rail line along the eastern boundary. The 140 hectare site is currently mostly vacant land that forms part of the former Schofields Aerodrome and RAAF Station Schofields. Areas to the north are currently a mix of rural land, low density residential, with ongoing development of residential land releases within the Precinct and its surrounds. The Western Sydney University Nirimba Precinct is located south of the site with separate access provided via Quakers Hill Parkway further to the south.

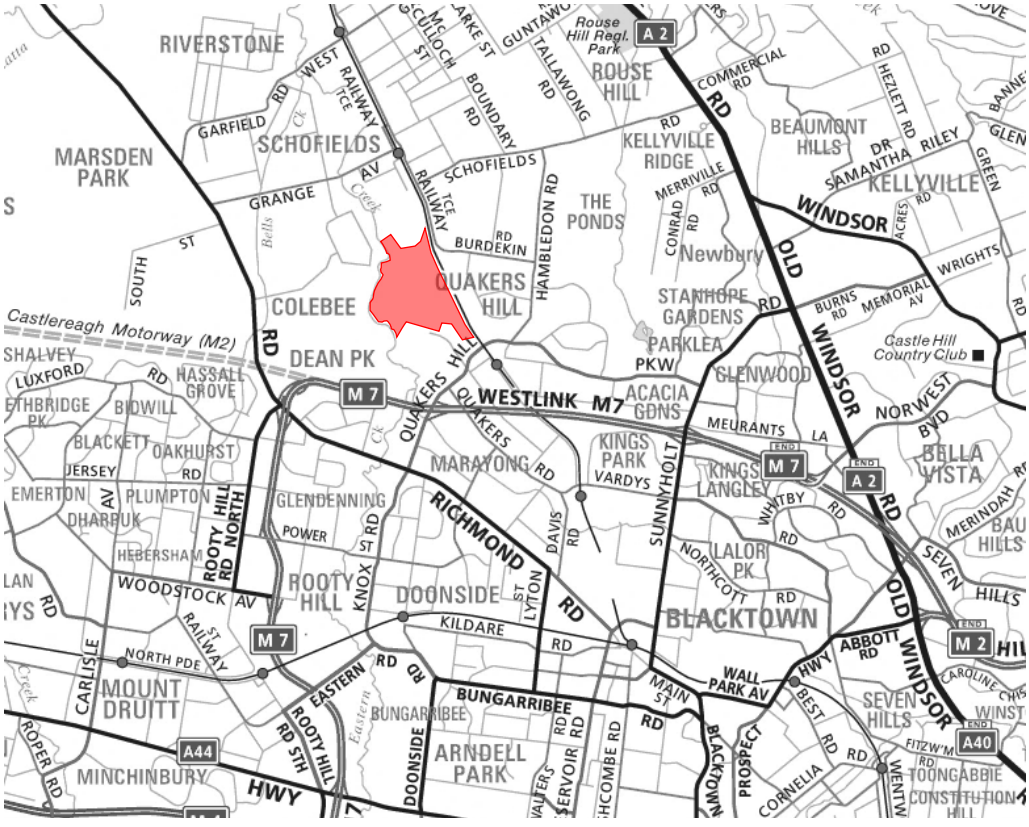
The location of the site and its surrounding environs is shown in Figure 1.1 with the regional context shown in Figure 1.2.

Figure 1.1: Schofields Aerodrome Site and Its Environs



Basemap source: Sydway

Figure 1.2: Regional Site Context



Basemap source: Sydway

1.3 Purpose of this Report

This report sets out an assessment of the anticipated transport implications of the proposed ILP modifications, including consideration of the following:

i existing transport conditions and planning context of the site and development
ii existing traffic and base year (2036) traffic conditions surrounding the site
iii the traffic generating characteristics of the Precinct
iv suitability of the internal road network and intersection treatments
v suitability of the proposed access arrangements for the Precinct
vi pedestrian and bicycle requirements
vii the transport impact of the development proposal on the surrounding road network.

This transport assessment has identified the necessary transport infrastructure improvements required in addition to those already planned and funded through the North West Priority Growth Area planning framework to accommodate the development of the Schofields Aerodrome planning proposal.

1.4 References

In preparing this report, reference has been made to the following:

- several inspections of the site and its surrounds
- Blacktown City Council Development Control Plan 2015 (DCP 2015)
- Blacktown City Council Development Control Plan 2016 Schedule 5 – Schofields Precinct (DCP 2016)
- *Schofields Aerodrome Local Centre – Retail Potential*, MacroPlanDimasi, 2017
- plans for the proposed development prepared by Design+Planning
  - Drawing Number DHASC-B-006-1, Revision I dated 19 December 2017
  - Drawing Number DHASC-5-012-1, Revision D dated 14 December 2017
- *Schofields Precinct Transport and Access Strategy,* AECOM, 2011
- other documents and data as referenced in this report.

2. Planning Context

2.1 Strategic Context

A Plan for Growing Sydney, released by the Department of Planning and Environment in December 2014, serves as the overarching strategy for metropolitan Sydney, intended to guide land use planning decisions for the next 20 years. It outlines directions and actions for accommodating Sydney's predicted population growth over this time, with key actions relating to development of greenfield areas in the north west suburbs of Sydney.

The West Central Subregion is identified as a key focus for the infrastructure investment to support extensive growth, with two Strategic Centres proposed at Marsden Park and Rouse Hill. Investigating the potential for rail connections between these centres was identified as a key priority.

The plan also identifies the need to coordinate housing and employment growth in the West Central Subregion with infrastructure delivery, while also providing these in suitable locations near public transport corridors and near new or established centres.

2.2 Regional Context

The site is located within the Schofields Precinct which forms part of the North West Priority Growth Area of Sydney defined by the Department of Planning and Environment and shown in Figure 2.1.

The area is expected to accommodate up to 90,000 homes over the next 30 to 40 years, with around 33,000 of these to be built in the next ten years and a total future population of up to 250,000 people[1].

The area is also expected to support more than 43,000 jobs including approximately 10,000 jobs at the Marsden Park District Centre. A growth corridor is also proposed between Marsden Park and Rouse Hill, as well as, located west of the Schofields Precinct.

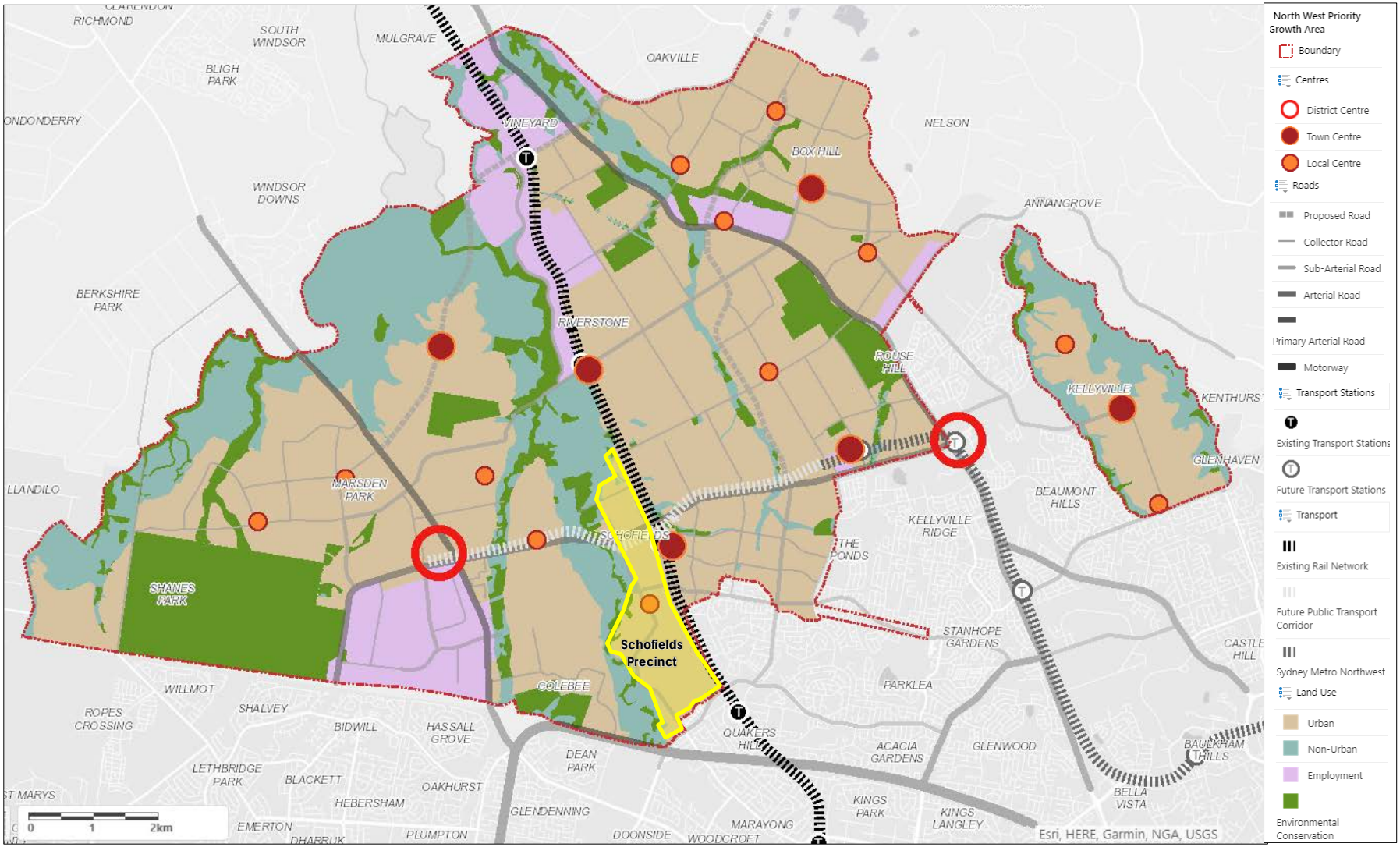
The North West Priority Growth Land Use and Infrastructure Implementation Plan sets out eight key actions to support the delivery of new homes and jobs in the area, including the following transport related actions:

- *Undertake a strategic land use review of the future public transport corridor between Rouse Hill and Marsden Park and the upgrade of Schofields Road*
- *Establish new density controls for residential land so that new communities are supported by adequate infrastructure and local councils can plan for the new population precinct plans into a single precinct plan*
- *Work with Infrastructure NSW, local councils and the NSW State Emergency Service to review planning controls for land within the Hawkesbury-Nepean Valley which includes land below the probable maximum flood (PMF) level public transport corridor between Rouse Hill and Marsden Park and the upgrade of Schofields Road*
- *Transfer planning controls into local environmental plans to make development controls more consistent[2].*

[1] http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=PGA_NW, visited 09/08/17

[2] http://www.planning.nsw.gov.au/Plans-for-your-area/Priority-Growth-Areas-and-Precincts/North-West-Priority-Growth-Area/Key-actions-and-documents

Figure 2.1: North West Priority Growth Area



Basemap source: http://webmap.environment.nsw.gov.au/PlanningHtml5Viewer/?viewer=PGA_NW, visited 09/08/17

2.3 Local Context

2.3.1 Concept Plan

The Schofields Precinct is located within the Blacktown Local Government Area (LGA) with a size of approximately 465 hectares. The Precinct is expected to accommodate approximately 3,000 new dwellings for a total population of 8,000 residents.

In 2012, the Schofields Precinct Plan was finalised and the land was rezoned for urban development including the following local facilities:

- *land for a new primary school*
- *61 hectares of conservation land*
- *31 hectares of open space and recreation areas*
- *retail space in three neighbourhood centres*
- *a potential public transport corridor linking Schofields Station to Rouse Hill*
- *upgrades to key roads*
- *improved connections to encourage walking and cycling*[3].

An Indicative Layout Plan (approved ILP) was developed for the Schofields Precinct Plan, as shown in Figure 2.2. The approved ILP includes the following key features:

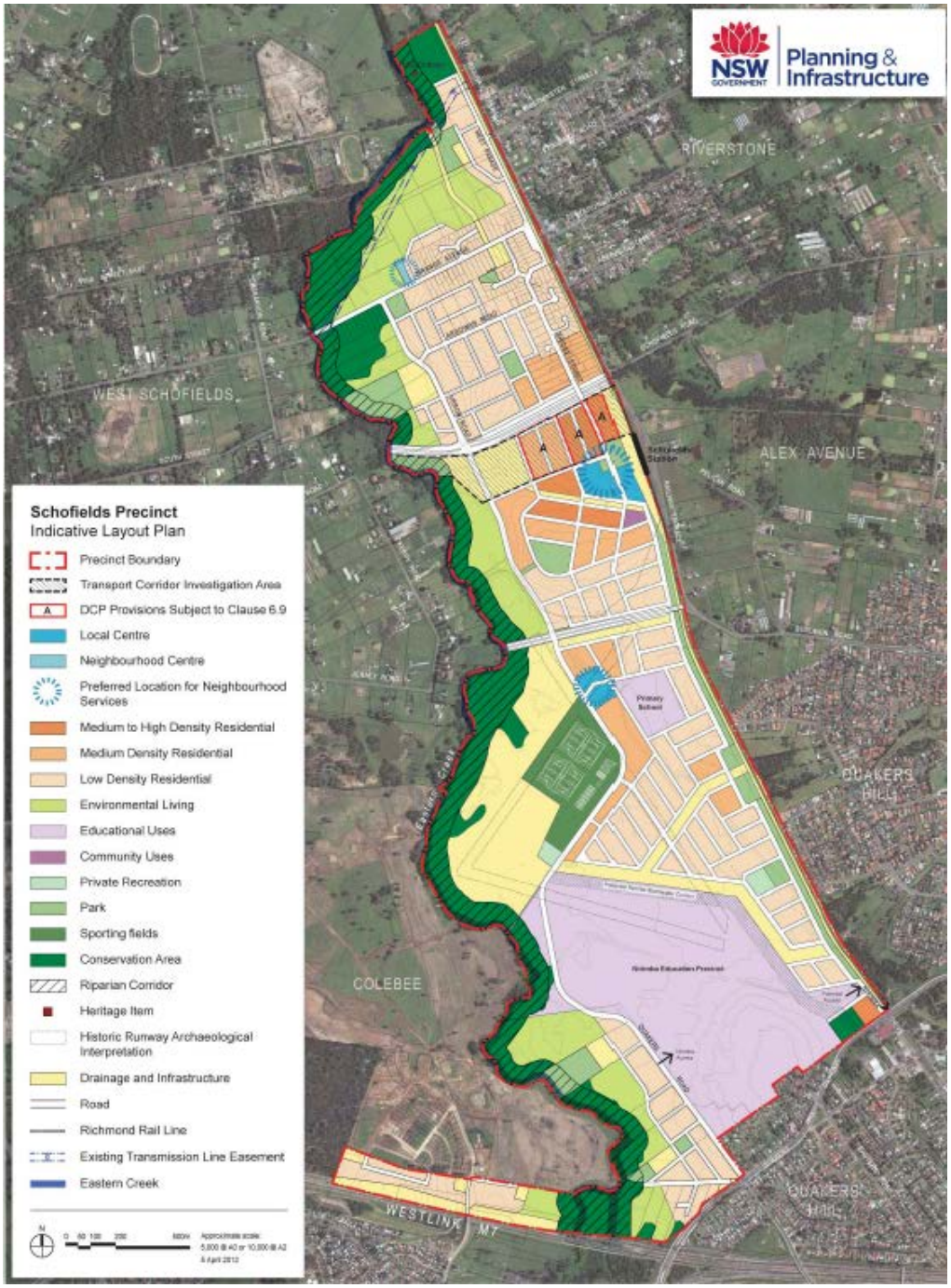
- east-west connections via Schofields Road and Burdekin Road extensions
- north-south connections via Quakers Road/ Veron Road and Nirimba Drive extensions
- three locations for town centres (neighbourhood services)
- predominately low density residential dwellings with medium density near town centres and higher densities in the Schofields Station precinct
- sporting fields located between the extended Quakers Road and Eastern Creek.

Development of the approved ILP was supported by the *Schofields Precinct Transport and Access Strategy* (AECOM, 2011) and associated traffic modelling.

A review of the traffic modelling completed appeared to forecast a higher than expected proportion of traffic from the Precinct would use the extended Nirimba Drive, despite no planned connections of the link with the Burdekin Road extension towards Townson Road or Quakers Hill Parkway.

[3] http://www.planning.nsw.gov.au/Plans-for-your-area/Priority-Growth-Areas-and-Precincts/North-West-Priority-Growth-Area/Schofields

Figure 2.2: Approved Indicative Layout Plan



Source: Schofields Precinct Plan, NSW Government Department of Planning and Infrastructure, 2012

2.3.2 Schofields Precinct DCP

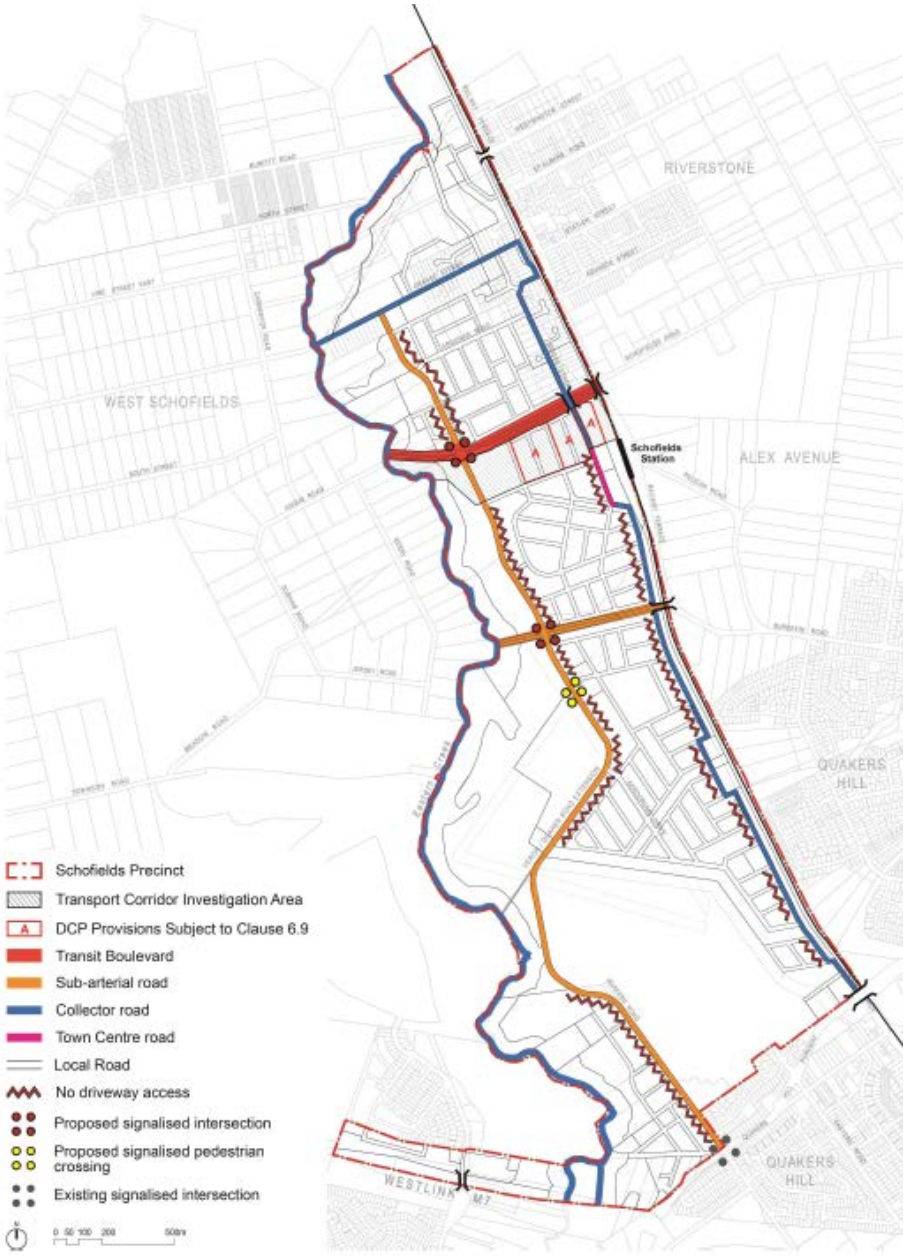
Road Network and Hierarchy

Planning controls for the Precinct were developed in 2016, with the release of the Blacktown City Council Growth Centre Precincts Development Control Plan – Schofields Precinct in 2016 (DCP 2016), which adopted the approved ILP.

The DCP 2016 sets out the road network and hierarchy for the Precinct including the extended Quakers Road to operate as a sub-arterial road linking the Precinct with Quakers Hill Parkway and the Westlink M7 Motorway further afield and the Nirimba Drive extension to operate as a collector road along the eastern side of the Precinct. Driveway access along Nirimba Drive is generally not be permitted.

The road hierarchy indicates that new signalised intersections along the extended Quakers Road would be limited to its intersections with Schofields Road and Burdekin Road.

Figure 2.3: Schofields Precinct Road Network and Hierarchy



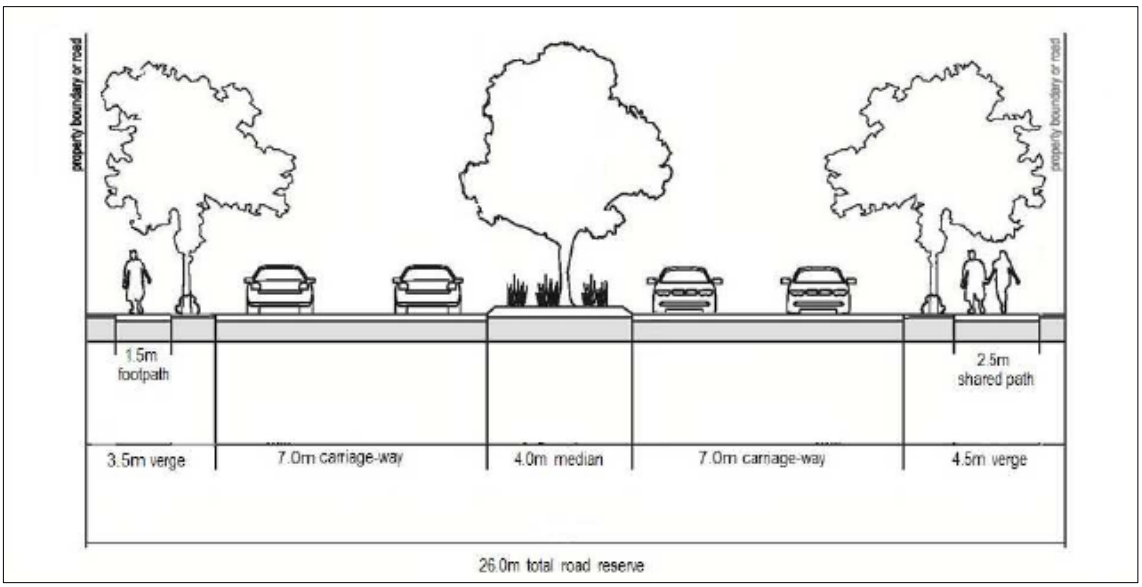
Source: Blacktown City Council Growth Centre Precincts Development Control Plan – Schofields Precinct (Part 2)

DCP 2016 also proposes that buses within the Precinct use a combination of the extended Quakers Road to the north and a local road to the south to link with Quakers Hill Station and Nirimba Drive.

Cross-Sections

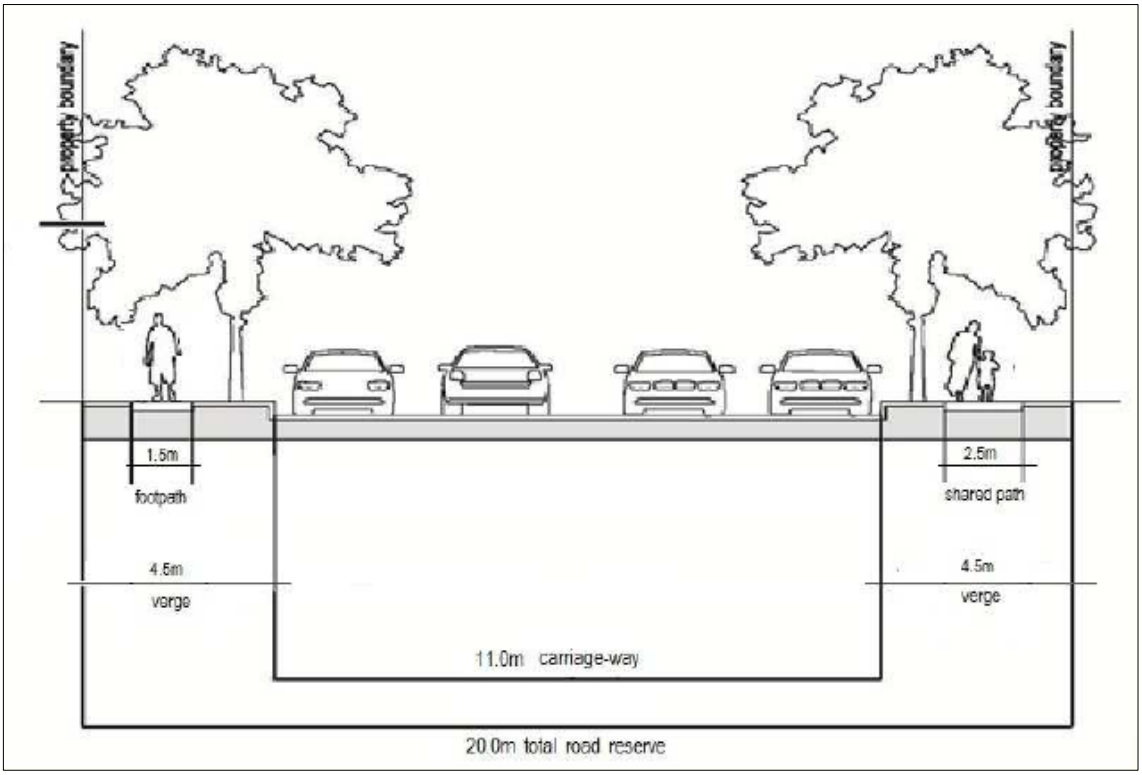
The road cross-sections presented in DCP 2016 are presented in Figure 2.4 and Figure 2.5.

Figure 2.4: Typical Sub-Arterial Road



Source: *Blacktown City Council Growth Centre Precincts Development Control Plan* (2016) Blacktown City Council and Department of Planning and Environment

Figure 2.5: Typical Collector Road



Source: *Blacktown City Council Growth Centre Precincts Development Control Plan* (2016) Blacktown City Council and Department of Planning and Environment

Pedestrian and Cyclist Network

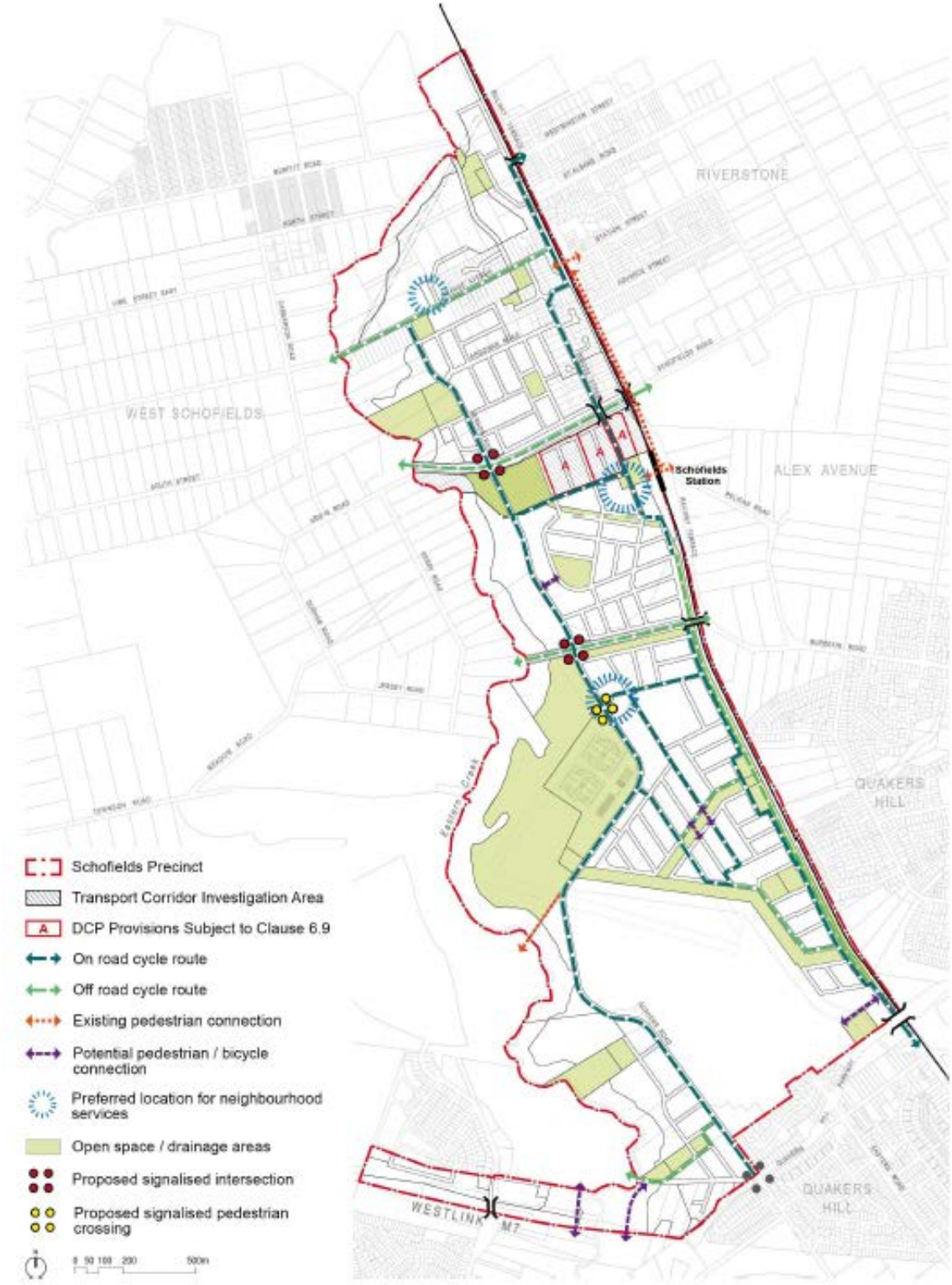
DCP 2016 indicates that a combination of on-road and on-road cycleways should be provided within the Precinct including along the following roads:

- extended Quakers Road
- extended Nirimba Drive
- extended Schofields Road
- extended Burdekin Road
- other local roads.

As shown in the cross-sections in Figure 2.4 and Figure 2.5, the off-road cycle routes would be provided in the form of 2.5 metre shared paths along sub-arterial and collector roads.

The future pedestrian and cycling network planned anticipated for the Precinct is shown in Figure 2.6.

Figure 2.6: Schofields Precinct Pedestrian and Cycling Network



Source: Blacktown City Council Growth Centre Precincts Development Control Plan – Schofields Precinct (Part 2)

3. Transport Context

3.1 Road Network

3.1.1 Existing Road Network

The surrounding road network consists of the following key roads:

- Quakers Hill Parkway
- Quakers Road
- Hambledon Road
- Burdekin Road
- Railway Terrace
- Railway Road.

Quakers Hill Parkway

Quakers Hill Parkway is a sub-arterial[4] road. Quakers Hill Parkway runs in a pre-dominantly east-west direction from the intersection with Richmond Road to Sunnyholt Road. It connects the Quakers Hill region with Richmond Road and the Westlink M7 Motorway. It is a two-way road, with two lanes in each direction. The carriageway is around 18 metres wide and is separated by a wide raised median. Quakers Hill Parkway carries around 27,600 vehicles per day[5].

Quakers Road

Quakers Road functions in two-parts currently; north of Quakers Hill Parkway it is a local road for the Western Sydney University Precinct and south of Quakers Hill Parkway is a collector road[6]. It is aligned in a pre-dominantly north-south direction leading from the Nirimba Education Precinct at the northern end towards Blacktown in the south.

As a local road, Quakers Road currently operates as a two-way road. The carriageway width is approximately six metres wide with no marking to separate directions of travel. Comparatively, the southern end of Quakers Road that operates as a collector road is two-lanes wide in each direction with a carriageway width of 12.5 metres.

Hambledon Road

Hambledon Road functions as sub arterial road and is aligned in a north-south direction. It is a two-way road, with two lanes in each direction for the southern section (between Quakers Hill Parkway and Burdekin Road), with a carriageway width of around 6.3 metres each direction separated by a median.

The northern section of Hambledon Road between Burdekin Road and Schofields Road narrows to a single lane in each direction with no median and a carriageway width of around 6.6 metres.

Burdekin Road

Burdekin Road functions as a sub-arterial road[1] and is a continuation of Railway Terrace, connecting Railway Terrace with Hambledon Road and ultimately Quakers Hill Parkway and beyond. Burdekin Road runs east-west, is two-way, with two-lanes in each direction. The

[4] Blacktown City Council (2007) *Road Hierarch – WARD 1*
[5] AECOM (2011) *Transport and Access Strategy*

carriageway is around 12.4 metres wide. Burdekin Road provides several connections through roundabouts with local and residential collector roads.

Railway Terrace

Railway Terrace functions as a sub-arterial road[1] and links areas north of Schofields Train Station with Burdekin Road and beyond. Railway Terrace runs north-south with two-way and one lane in each direction. The carriageway width varies along Railway Terrace. Along Railway Terrace are a series of intersections with residential collector and local streets. There is also kerbside parking along Railway Terrace near Schofields Train Station as well as access to the associated commuter car parks.

Railway Road

Railway Road runs south of Quakers Hill Parkway towards the Blacktown area ultimately finishing at Forbes Road in the south. Railway Road functions as a minor collector road[1] and runs predominantly north-south bypassing several major roads such as M7 Westlink, Quakers Hill Parkway and Vardys Road by way of elevation differences. Railway Road is approximately 10 metres in width and for the most part includes kerbside parking lane on either side in addition to single lanes of travel for each direction.

3.1.2 Road Network Improvements

Near the Schofields Precinct, significant infrastructure works are planned or under construction to improve connectivity for the north west region as a whole and support future development. These upgrades include the Schofields Road upgrade, as well as the recently completed Richmond Road upgrade.

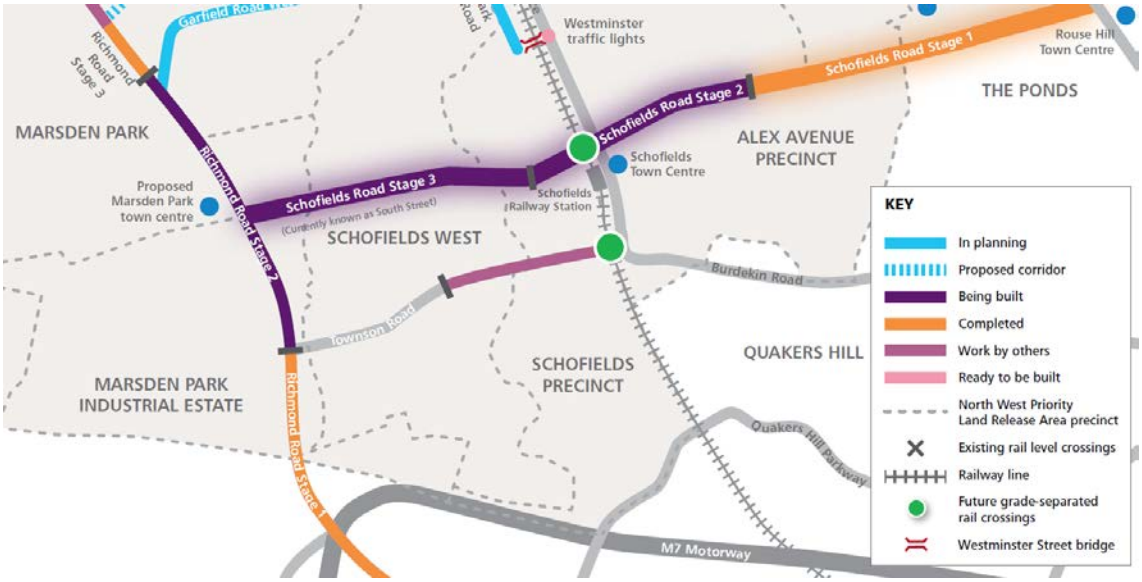
The Schofields Road upgrade will create an east-west connection between Richmond Road and Windsor Road, with improved signalised and priority controlled intersections along its length. Stage 2 and Stage 3 of the Schofields Road upgrade is currently under construction,

Stage 2 upgrades will connect Veron Road to Railway Terrace and further east. These works include the Richmond Railway Line underpass, as well as the connection with Richmond Road to the west. Stage 2 works are expected to be complete by the end of 2017.

Stage 3 works are scheduled for completion in mid-2018 and are currently underway. The Stage 3 works will connect Schofields Road to Richmond Road and will serve as an arterial road for vehicles heading to the Sydney CBD and surrounds. Stage 3 works are expected to be completed in 2018.

The Schofields Road upgrade and staging is indicatively shown in Figure 3.1.

Figure 3.1: Roads and Maritime Services - Upgrade Scheme for Schofields Precinct



Source: Roads and Maritime Services (March 2016)

Preparation of concept plan designs for the Burdekin Road extension have recently commenced. The Burdekin Road extension would establish an east-west sub-arterial road corridor extending from the current Burdekin Road/ Railway Terrace transition westbound over the Richmond Railway Line to connect with Townson Road and subsequently Richmond Road.

The Burdekin Road extension would in effect create another high-quality east-west corridor facilitating access within the region. Neither the funding details for the Burdekin Road extension nor a detailed alignment have been released.

3.2 Public Transport

3.2.1 Existing Public Transport Services

Schofields Station bus stops currently provide access to buses travelling between Blacktown and Riverstone areas, with Quakers Hill Parkway accommodating buses between St Marys/ Plumpton and Castle Hill/ Macquarie Park.

Schofields Station provides access to the T5 Cumberland Line and the T1 Western Line. These train services provide access for commuters heading towards major employment hubs such as Blacktown, Parramatta and Sydney CBD.

The Schofields Station area is to be developed into a local centre for the Schofields Precinct.

A review of the public transport currently available near the site is summarised in Table 3.1.

Table 3.1: Public Transport Provision

Service	Route #	Route Description	Location of Stop	Distance to Nearest Stop	Frequency On/Off Peak
Bus	T74	Blacktown to Riverstone via The Ponds	Schofields Train Station Bus Stop	900m	30 min./60 min.
	T75	Blacktown to Riverstone and Rouse Hill		900m	
	740	Plumpton to Macquarie Park		500m to southern edge of site	

Service	Route #	Route Description	Location of Stop	Distance to Nearest Stop	Frequency On/Off Peak
	745	St Marys to Castle Towers (Castle Hill)	Various along Quakers Hill Parkway	500m to southern edge of site	
Train	T5	Cumberland Line	Schofields Train Station	900m	Approximately 30 min. during daytime only
	T1	Western Line		900m	Roughly 30 mins

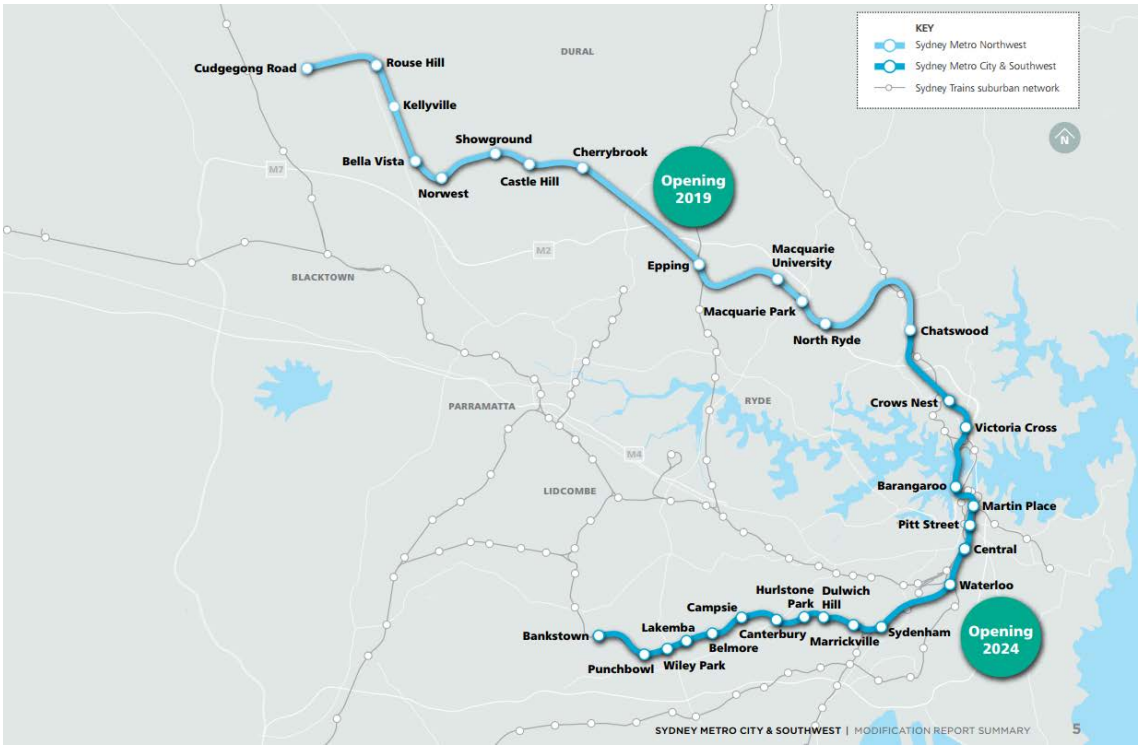
3.2.2 Sydney Metro Northwest Context

The Sydney Metro Northwest is currently under construction to connect the North West Priority Growth Area to Chatswood and other places of employment closer to Sydney CBD. Stage 1 of Sydney Metro (Northwest from Cudgegong Road to Chatswood) is due for completion in 2019 and will provide users with four minute headways during peak periods. As such, Sydney Metro Northwest will significantly improve the transport accessibility of the area, providing an attractive and realising alternative to daily private vehicle usage.

Stage 1 of Sydney Metro would connect the area to employment centres such as Rouse Hill, Norwest and Chatswood. Stage 2 works for Sydney Metro would extend to include Crows Nest, Sydney CBD and further links thereby creating an attractive and accessible link for users in the Greater Sydney region.

The proposed station closest to the Schofields Precinct will be Cudgegong Road Station and is expected to accommodate 1,000 commuter car parking spaces. The Sydney Metro Northwest connections and stations are illustrated in Figure 3.2.

Figure 3.2: Sydney Metro Corridor and Stations



Source: Sydney Metro and Transport for NSW

The introduction of Sydney Metro Northwest especially with the implementation and opening of Cudgegong Road Station would change much of the public transport in the region, especially for feeder buses. The *North West Priority Growth Area Land Use and Infrastructure Implementation Plan* (Department of Planning and Environment, 2017) indicates a focus on Schofields Station to be a key transport hub in the area. As such, the Department of Planning and Environment identified a growth corridor along Schofields Road from Rouse Hill to Marsden Park including the potential Sydney Metro Northwest link from the currently under-construction Cudgegong Road Station to Marsden Park. In the intermediate term, a higher order bus corridor is proposed along Schofields Road. The long term and intermediate public transport planning for the Precinct are summarised in Figure 3.3 and Figure 3.4.

Figure 3.3: Regional Rail Connections for North West Priority Growth Area

Source: NSW Department of Planning and Environment (2017)

Figure 3.4: Existing and Proposed Public Transport

Source: NSW Department of Planning (2017)

3.3 Pedestrian and Cycling Infrastructure

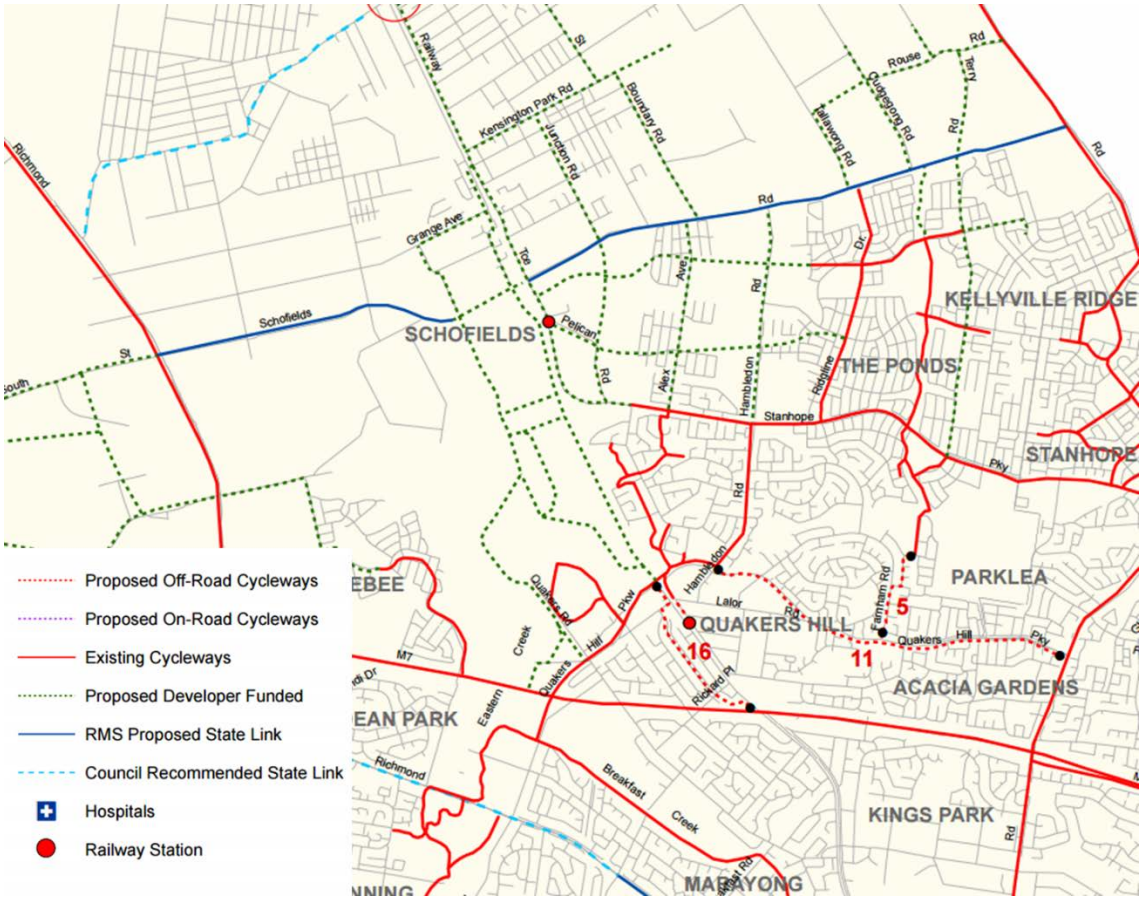
There are currently footpaths located along Veron Road, the new (not yet opened) Schofields Road and Railway Terrace.

The nearest existing cycle route to the site is located along Quakers Hill Parkway south of the site. The cycle route connects with the broader Blacktown LGA cycling network to link residents with surrounding local suburbs. The cycle route is off-road and links with the Westlink M7 cycleway which connects to Sydney CBD.

There is an intermittent stretch of cycle route along Railway Terrace and Burdekin Road that comprises a mixture of off-road cycleway and on-road cycle route. The transition to a dedicated off-road cycleway at Stanhope Parkway links residents with surrounding local suburbs and the Westlink M7 and Old Windsor Road cycleways.

Cycling routes are proposed by Council along Veron Road, Mustang Drive and Quakers Road connecting the Precinct with the surrounding cycling network, as shown in Figure 3.5.

Figure 3.5: Existing and Future Cycling Network



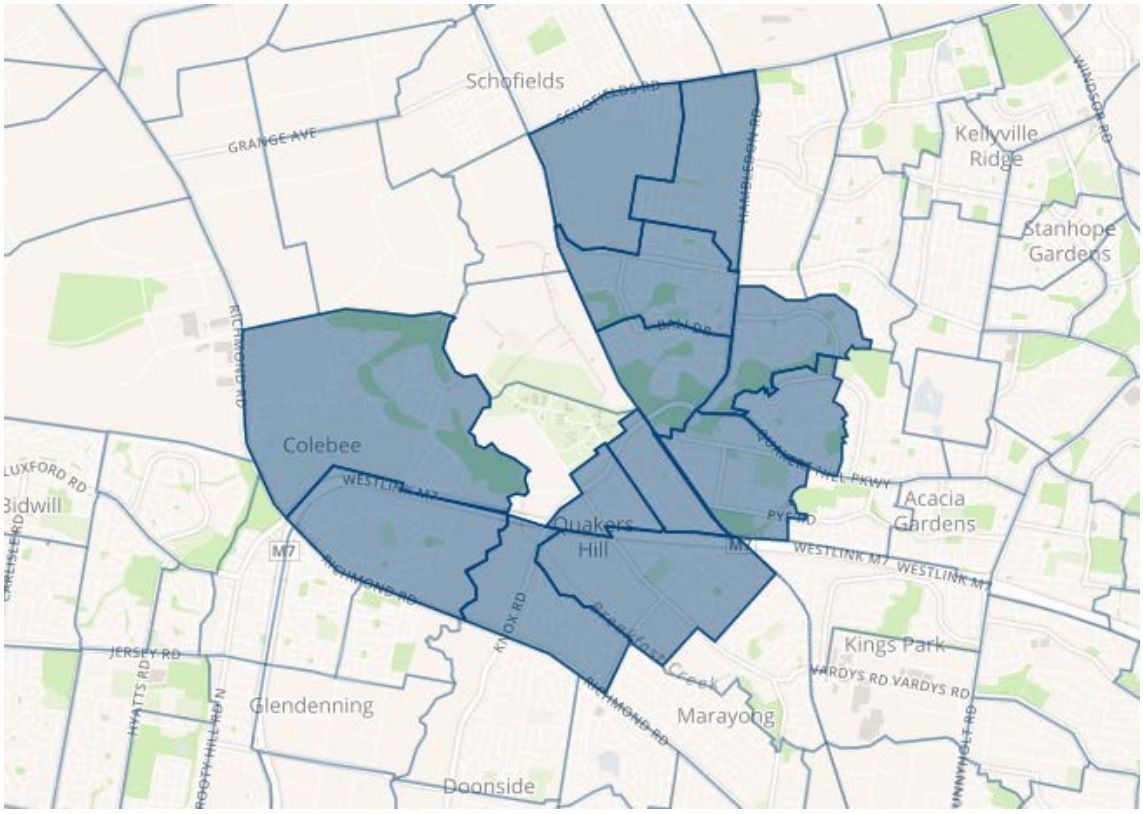
Source: Blacktown City Council 2016 Bike Plan Exiting and Future Proposed Routes

3.4 Journey to Work Data

The 2011 Census by the Australian Bureau of Statistic (ABS) has been reviewed to understand the demographic and travel demand characteristic for Travel Zones containing and surrounding the subject site.

The Travel Zones assessed to review travel behaviour for those living in the surrounding areas are shown in Figure 3.6.

Figure 3.6: Travel Zones



The Journey to Work data indicates that 13,581 people live in the selected Travel Zones. Of those that worked on the surveyed day, approximately 70 per cent travelled to work by car (including 63 per cent as vehicle drivers and 5 per cent as passengers) and approximately 20 per cent use public transport to travel to work.

The Journey to Work data indicates that the residents within the selected travel zones commute to the following top destinations:

- 15 per cent travel to the Blacktown area
- 10 per cent travel to Parramatta
- 10 per cent travel within the local surrounding area (Quakers Hill, Schofields etc.)
- 10 per cent travel to Sydney Inner City
- 10 per cent travel to the west between Mount Druitt and Penrith.

4. Proposed Indicative Layout Plan

4.1 Proposed Land Uses

The proposed redevelopment of the Schofields Aerodrome site includes 878 residential lots.

A town centre is also proposed, including the following land uses:

- primary school (two hectares) – approximately 700 students
- supermarket and associated retail – 2,000m^2 Gross leasable floor area (GLFA)
- mixture of commercial, medical centre, gymnasium and childcare centre – 1,500 square metres
- 40 netball courts
- four tennis courts
- four football fields.

The proposed development for the Schofields Aerodrome is generally consistent with the approved ILP, in terms of medium and low density residential housing, as well as the location of the town centre.

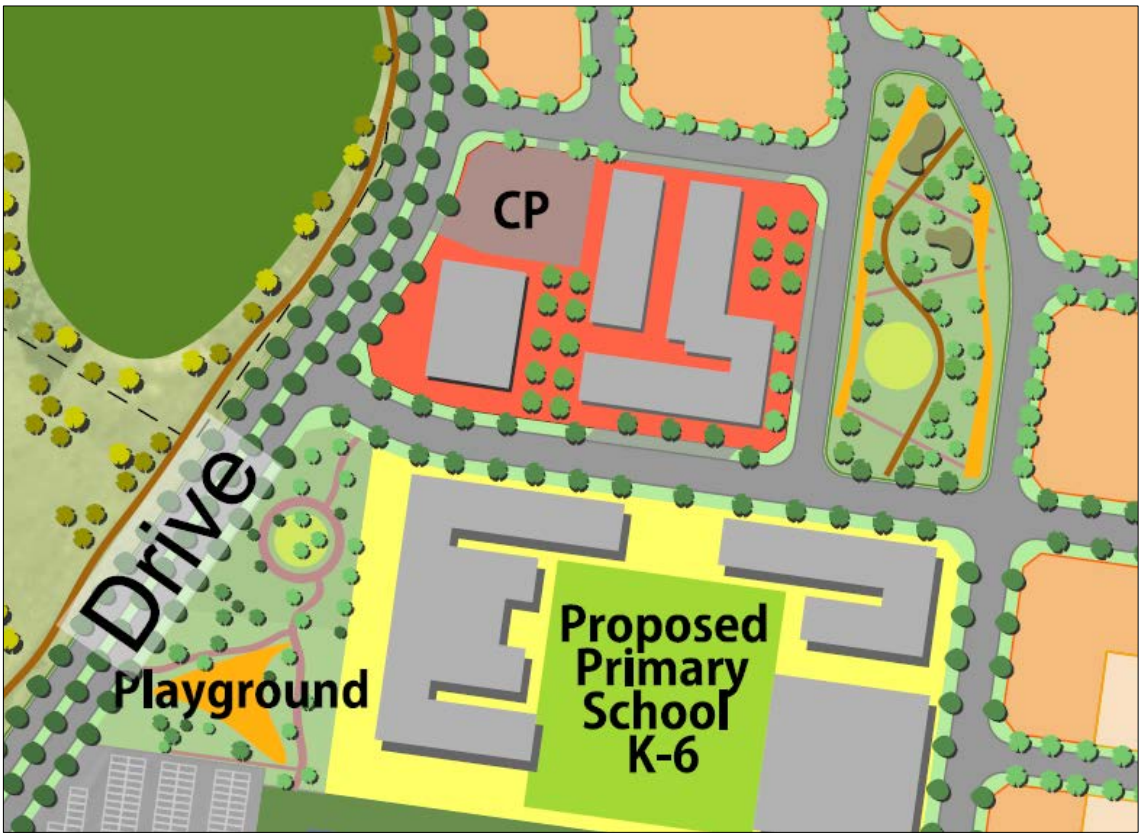
Notwithstanding this, the inclusion of the netball courts presents a deviation from the approved ILP. Furthermore, the north-south sub-arterial corridor known as Mustang Drive has been realigned to accommodate the netball courts.

The proposed (modified) ILP for the Schofields Aerodrome site is shown in Figure 4.1. The indicative town centre arrangement is shown in Figure 4.2. The town centre location would be conveniently located east of Mustang Drive, limiting unnecessary traffic circulation throughout the residential area.

Figure 4.1: Proposed ILP – Schofields Aerodrome Site

Source: Design+Planning

Figure 4.2: Proposed Town Centre



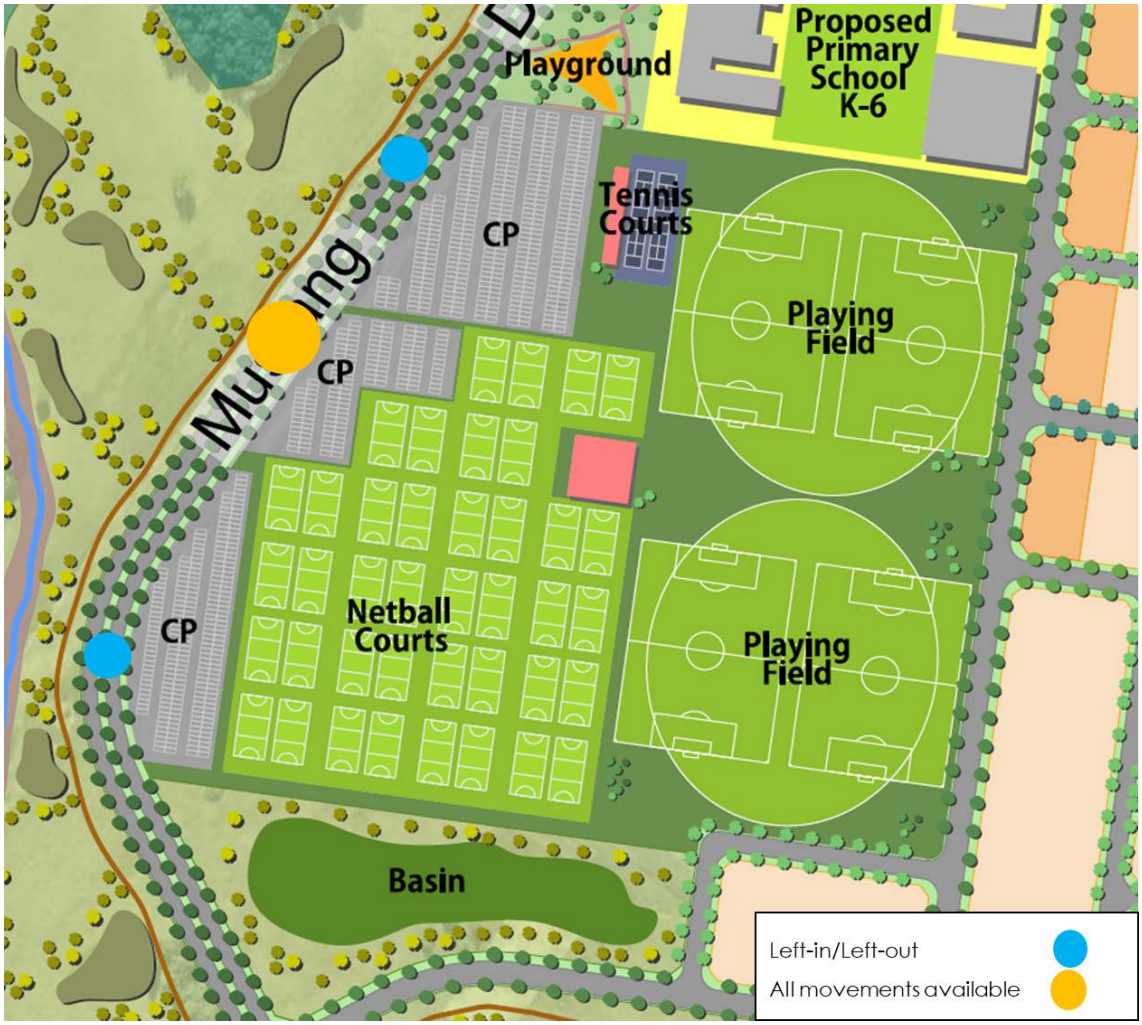
Source: Design+Planning

4.2 Sporting Facilities

The proposed playing fields, netball courts and tennis courts would collectively have regional significance due to their size. At-grade car parking is proposed in separated carparks for each of the facilities, with vehicle access generally proposed via left-in/left-out access arrangements, with one priority-controlled access provided along Mustang Drive.

The proposed layout of the sporting facilities and associated access arrangement can be seen in Figure 4.3.

Figure 4.3: Access for the Proposed Sporting Facilities



Basemap source: Design+Planning

Further development applications would suitably assess the access points and routes for the sporting facilities.

4.3 Road Network

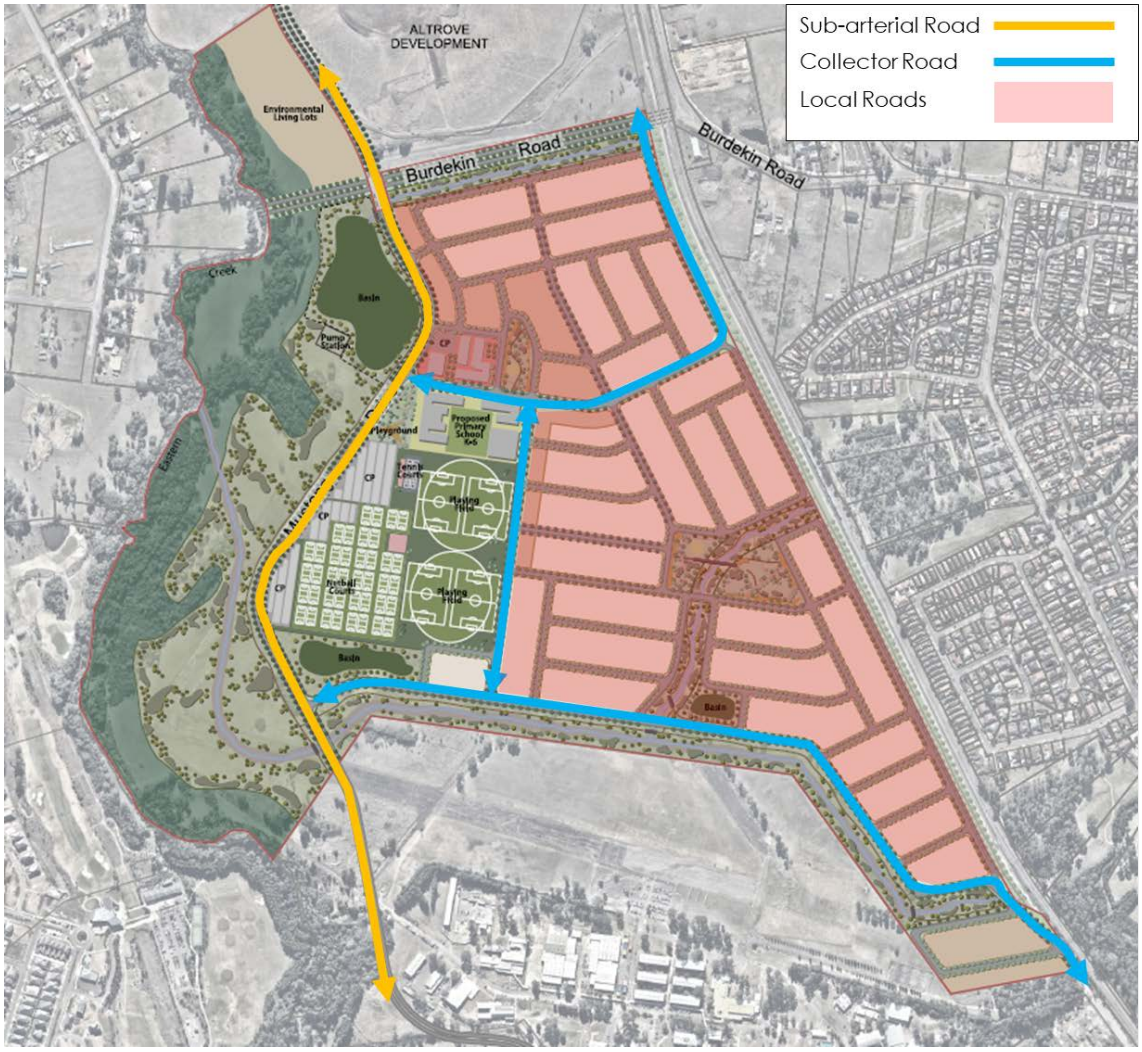
4.3.1 Layout and Configuration

Vehicle access between the developed Schofields Aerodrome site and the surrounding road network would be consistent with the approved ILP including access to the north via Schofields Road, to the east and west via the proposed extension of Burdekin Road and to the south via Quakers Road connecting to Quakers Hill Parkway.

The proposed ILP includes the realignment of the main north-south sub-arterial spine proposed as part of the approved ILP (known as Mustang Drive) to the western boundary of the site. Mustang Drive would be an extension of Quakers Road connecting Burdekin Road and Schofields Road to the north with Quakers Hill Parkway to the south.

The remaining road network would generally comprise a mixture of local and collector roads, as shown in Figure 4.4.

Figure 4.4: Proposed ILP Road Hierarchy



Basemap source: Design+Planning

The collector road network has been modified to direct traffic to and from a sole north-south sub-arterial connection, given that the Nirimba Drive/ Railway Road connection is not expected to be heavily used as a through connection or provide connectivity to the surrounding arterial road network.

The realignment of the collector road would likely result in re-distribution of traffic across the internal road network, when compared with the distributions presented in the *Schofields Precinct Transport and Access Strategy* (AECOM, 2011) which assumed a high proportion of traffic would use the collector road as a key north-south route within the Precinct. Nevertheless, drivers from the northern portions of the Schofields Precinct and beyond would still utilise the collector roads in conjunction with local roads on the eastern fringes to travel through to southern destinations. This "rat-running" would be considered a problem given the local nature and reduced flow capacity of residential streets. A combination of road cross-sections and local area traffic management such as restricted turns and slow points would deter this behaviour.

The road cross-sections for the sub-arterial and collector roads would generally be provided in accordance with the DCP 2016.

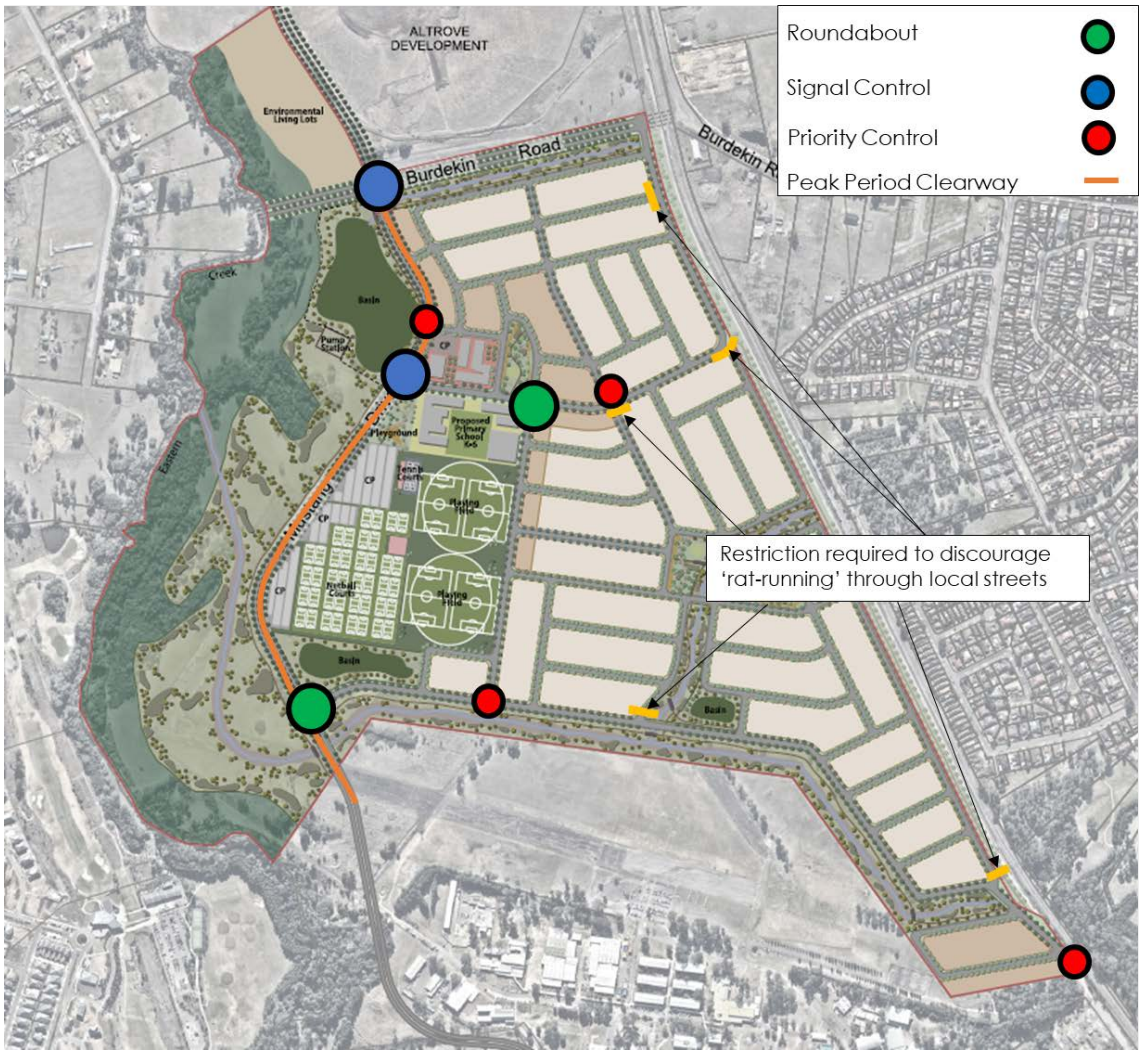
4.3.2 Internal Intersection Treatments

A mixture of roundabouts and priority controlled intersections are proposed within the site depending on the hierarchy of the roads and their location. Roundabouts are proposed at the intersection of the collector roads within the site as well as the intersection of Mustang Drive with the Nirimba Drive extension, south of the sporting facilities.

A signalised intersection is proposed on Mustang Drive near the town centre (subject to future warrants assessment), to provide pedestrian connectivity via marked foot crossings.

The proposed internal intersection treatment for Schofields Aerodrome is illustrated in Figure 4.5.

Figure 4.5: Proposed Internal Intersection Treatments



Basemap source: Design+Planning

4.4 Car Parking

Parking requirements for the various land uses proposed within the site have been sourced from the following:

- Blacktown City Council Development Control Plan 2015 (DCP 2015), where available
- *Guide to Traffic Generating Developments,* Roads and Maritime Services (Roads and Maritime), 2002 (Roads and Maritime Guide)
- *Guide to Traffic Generating Developments Updated traffic surveys TDT 2013/ 04a,* Roads and Maritime, 2002 (Roads and Maritime TDT)
- Historical traffic surveys completed at similar land uses (GTA database)
- Recent traffic surveys of a nearby multi-court netball facility.

The parking requirements for the site are summarised in Table 4.1.

Table 4.1: Parking Requirements for the Schofields Aerodrome Proposed Development

Land Use Type	Area	Source	Parking Rate	Parking Requirement
Residential	878 dwellings	DCP 2015	Up to 2 spaces per dwelling	1,756 (To be provided within individual dwellings)
Residential Total				**1,756**
Supermarket and associated retail	2,000m² GLFA	GTA Database	1 space per 25m²	80 spaces
Non-retail commercial uses	1,500m² GLFA	GTA Database	1 space 40m²	38 spaces
Netball Courts	40 courts	Survey of nearby facility	23 spaces per court	920 spaces
Tennis Courts	4 courts	Review of similar sites, GTA database and DCP 2015	3 spaces per court	12 spaces
Playing Fields	4 football fields	Review of GTA database and first principles assessment on worst case sporting event [1]	36 spaces per field	144 spaces
Public Uses Total				**1,194 spaces**

[1] Worst case sporting event is regarded to be a rugby match with 40 players, five officials and 20 spectators with a car occupancy rate of approximately 1.8 passengers per vehicle as gathered from experiences with playing fields.

Table 4.1 indicates that the development would require around 1,194 parking spaces across the various public uses in and around the proposed town centre.

Parking would also be required at a rate of two spaces per dwelling for the residential land uses, conservatively assuming that all dwellings within the Schofields Aerodrome development would have three or more bedrooms. The parking for residential dwellings would be provided in a mixture of garages and carports.

The parking requirements for primary schools has not been noted given that the NSW Department of Education has a policy that does not typically permit on-site parking for staff and/or parents at new schools. Notwithstanding this, peak parking demand at primary schools generally exceeds the parking supply, resulting in significant on-street parking demand during peak school set-down/ pick-up periods. The primary school would be conveniently located near the proposed sports facilities and their associated off-street parking. As such, high quality pedestrian connections between the school and these car parks should be provided to encourage use of the available off-street parking during peak school set-down/ pick-up periods would not typically overlap with peak parking periods associated with the sporting facilities.

Collectively, the sporting facilities would require nearly 1,080 spaces. With consideration for this, it is estimated that a proportion of this parking supply could be provided along Mustang Road (up to 300 spaces) via the implementation of off-peak on-street parking. Based on the proposed ILP,

it is anticipated that a further 800 off-street parking spaces could be provided in proximity to the sports facilities in separate carparks, as shown in Figure 4.3. in addition, some level of connectivity between these car parks would be provided to limit unnecessary circulation on the adjacent road network.

4.5 Walking and Cycling Network

Bicycle parking requirements are not stipulated by DCP 2015 or DCP 2016 but rather an encouragement to provide bicycle end of trip facilities. As specific rates and requirements are not set out by Council it is recommended that rates nominated by NSW Planning Guidelines for Walking and Cycling or Austroads Guide to Traffic Engineering (Part 14 – Bicycle) should be adopted for town centre uses. Additionally, bicycle parking spaces need to be designed in accordance with relevant Australian Standards (AS2890.3).

The development would include a strong network of cycling and walking infrastructure to be in line with the current and proposed Blacktown City Council Bike Plan (2016). Key features of this include a strong north-south connection to Schofields Station and Quakers Hill Station on the eastern boundary of the site, as shown in Figure 4.6.

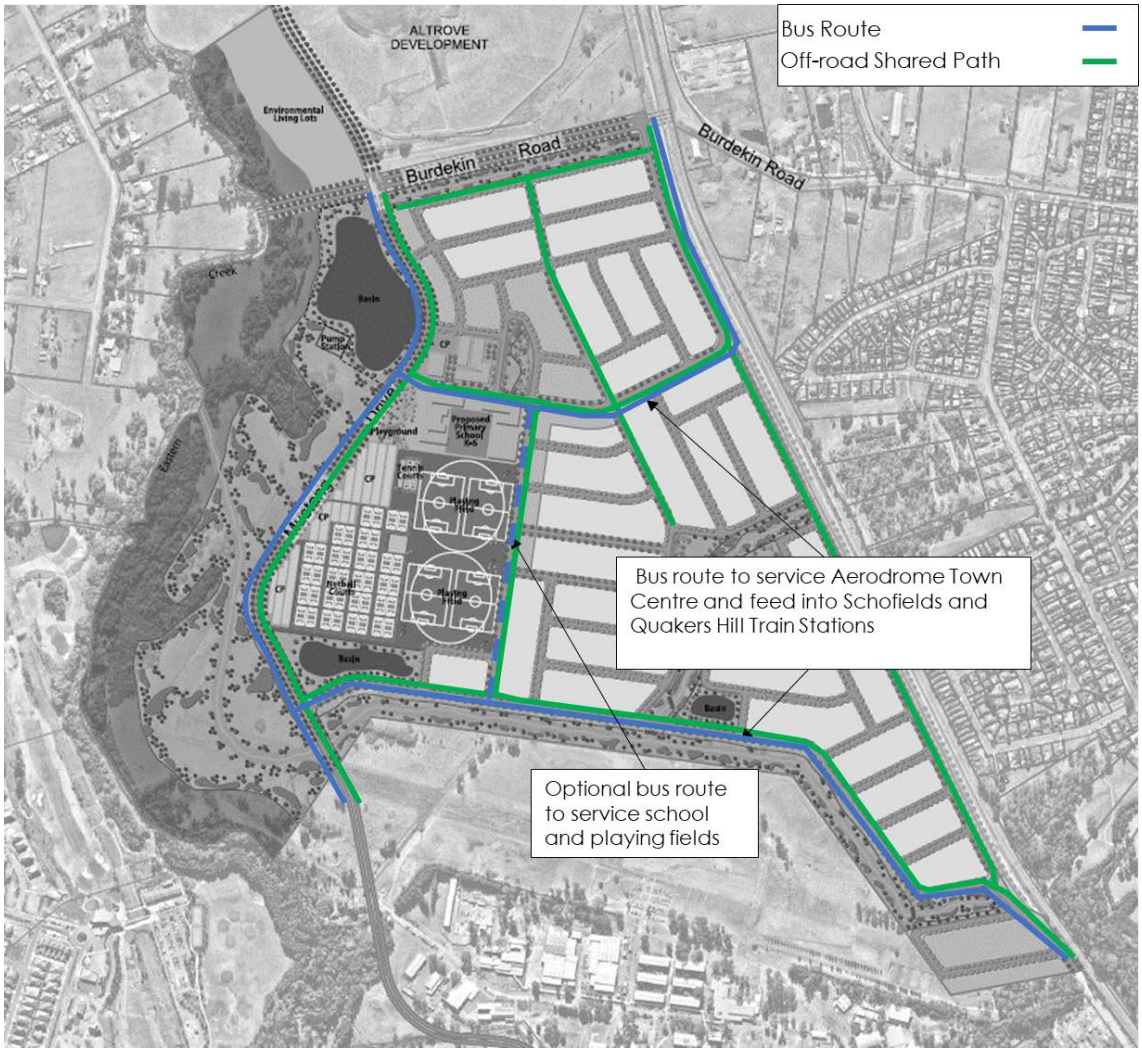
The local speed throughout the town centre area is envisaged to be between 40 to 50 kilometres per hour to activate the pedestrian space and provide connection between the retail and commercial portions with the sporting facilities south of the road.

4.6 Public Transport

The proposed ILP has been designed for feeder bus services to use the proposed sub-arterial and collector roads within the site, connecting the residential area, the town centre with the Schofields and Quakers Hill Station Precincts and regional public transport connections. The proposed ILP and in particular the reconfiguration of the proposed collector road network eliminates the need for buses to use the local road network, as indicated in the DCP 2016, and shown in Figure 4.6.

Encouraging the use of public transport and walking and cycling is central to reducing motor vehicle usage across the Precinct, especially in the context of the transport hubs at Schofields Station and future Sydney Metro stations. The proposed ILP encourages this by ensuring that most residents and town centre facilities have access to the public transport and walking and cycling network.

Figure 4.6: Proposed Public Transport and Walking and Cycling Network



Basemap source: Design+Planning

4.7 Development Staging

Staging of the proposed development is anticipated to occur in a north-to-south manner. Earlier stages would comprise development at the northern extent of the site and progressing south.

The proposed roads would also be built in a north-to-south fashion until they connect with the existing road network. The southern connections at Quakers Hill Parkway would likely occur in the final stages of the development.

5. Traffic Impact Assessment

5.1 Traffic Generation

Traffic generation estimates for the proposed development have been sourced from the following:

- *Roads and Maritime Guide*
- *Roads and Maritime TDT*
- Historical traffic surveys completed at similar land uses (GTA database)
- Recent traffic surveys of a nearby multi-court netball facility.

The traffic generation estimates for the various land uses anticipated to generate traffic during the AM, PM and weekend peak hours are set out in Table 5.1 to Table 5.3.

Table 5.1: Weekday AM Peak Hour Traffic Generation

Land Use	Area/ Dwelling Number	Traffic Generation Rate	Traffic Generation Source	Traffic Generation (vehicles per hour)
Primary School	700 Students	0.89 trips per student	GTA Database	623
Low Density Residential	878 dwellings	0.95 trips per dwelling	Roads and Maritime TDT	834
Total				**1,457**

Table 5.2: Weekday PM Peak Hour Traffic Generation

Land Use	Area/ Dwelling Number	Traffic Generation Rate	Traffic Generation Source	Traffic Generation (vehicles per hour)
Supermarket	2,000m^2 GLFA	155 trips per 1000m^2	Roads and Maritime Guide	310
Non-retail commercial use	1,500m^2 GLFA	51 trips per 1000m^2	Roads and Maritime Guide	77
Netball Courts	40 Courts	5 trips per court [1]	Survey from nearby facility	200
Tennis Courts	4 Courts	4 trips per court	Roads and Maritime Guide	16
Playing Fields	4 Fields	31.3 trips per field [2]	GTA Database	125
Low Density Residential	878 dwellings	0.99 trips per dwelling	Roads and Maritime TDT	869
Total				**1,597**

[1] based on approximately 20 per cent of weekend trip generation as surveyed at Kellyville Netball Courts
[2] based on surveys conducted for hockey fields

Table 5.3: Weekend Peak Hour Traffic Generation

Land Use	Area/ Dwelling Number	Traffic Generation Rate	Traffic Generation Source	Traffic Generation (vehicles per hour)
Supermarket	2,000m² GLFA	147 trips per 1000m²	Roads and Maritime Guide	294
Non-retail commercial use	1,500m² GLFA	51 trips per 1000m² [1]	Roads and Maritime Guide	77
Netball Courts	40 Courts	24.5 trips per court [2]	Survey from nearby facility	980
Tennis Courts	4 Courts	4 trips per court	Roads and Maritime Guide	16
Playing Fields	4 Fields	63.5 trips per field [3]	GTA Database	254
Low Density Residential	878 dwellings	0.495 trips per dwelling [4]	Roads and Maritime TDT	435
Total				**2,056**

[1] based on Thursday evening generation rate as a conservative estimate for mixed use
[2] based on surveys as conducted at Kellyville Netball Courts
[3] based on surveys conducted for hockey fields
[4] trip rate assessed by utilising weekday PM peak hour stretched over a two hour peak period

Based on the above, the Schofields Aerodrome site could generate up to 2,056 vehicles trips during a Saturday midday peak hour and 1,684 vehicle trips during any weekday evening peak hour, including linked trips, as discussed further in the following section.

5.2 Characteristic Trip Types

An important characteristic of the traffic generation of the above uses is the different types of trips which may occur. These different trip types correspond to:

- 'Primary Trips'
- 'Link-diverted trips'
- 'Non-link-diverted trips'.

Primary trips and *link-diverted trips* involve a vehicle either making a special trip or a modification of the route to an existing trip. *Non-link-diverted trips,* on the other hand, correspond to those trips which do not involve a diversion from the route that would otherwise have been taken, or in other words are trips generated by passing traffic. The important distinction here is that it is only *primary trips* and *link-diverted trips* which impact upon the external road network. *Non-link-diverted trips* are already present on the adjacent road network, and although these trips need to be considered in the design of internal road networks, access driveways, turning lanes and so on, they do not constitute additional traffic on the external road network.

The Schofields Aerodrome town centre would typically comprise specialty shops including local grocers and small cafes. As such, it is assumed that 85 per cent of the peak period trips generated by the retail component of the development would be generated by local residents and employees of the Schofields Aerodrome site or would be linked with other trips, such as work trips. 50 per cent of trips to the non-retail component have also been considered as linked and internal trips. Therefore, up to 85 vehicles trips generated by the town centre component would typically use the regional road network, while the remaining would be limited to the internal road network and/ or liked with other trips.

Likewise, some trips generated by the school are likely to be linked with work trips in the AM peak hour. It has been assumed that up to 25 per cent of school traffic would be internal to the Schofields Aerodrome Precinct with another 50 per cent likely to be linked to other trips such as

work. As such, only 25 per cent of the school trips would be considered new trips on the regional road network.

Finally, 20 per cent of residential trips have been considered as trips linked with other uses therefore 80 per cent of residential trips would be considered new trips on the regional road network.

5.3 Distribution and Assignment

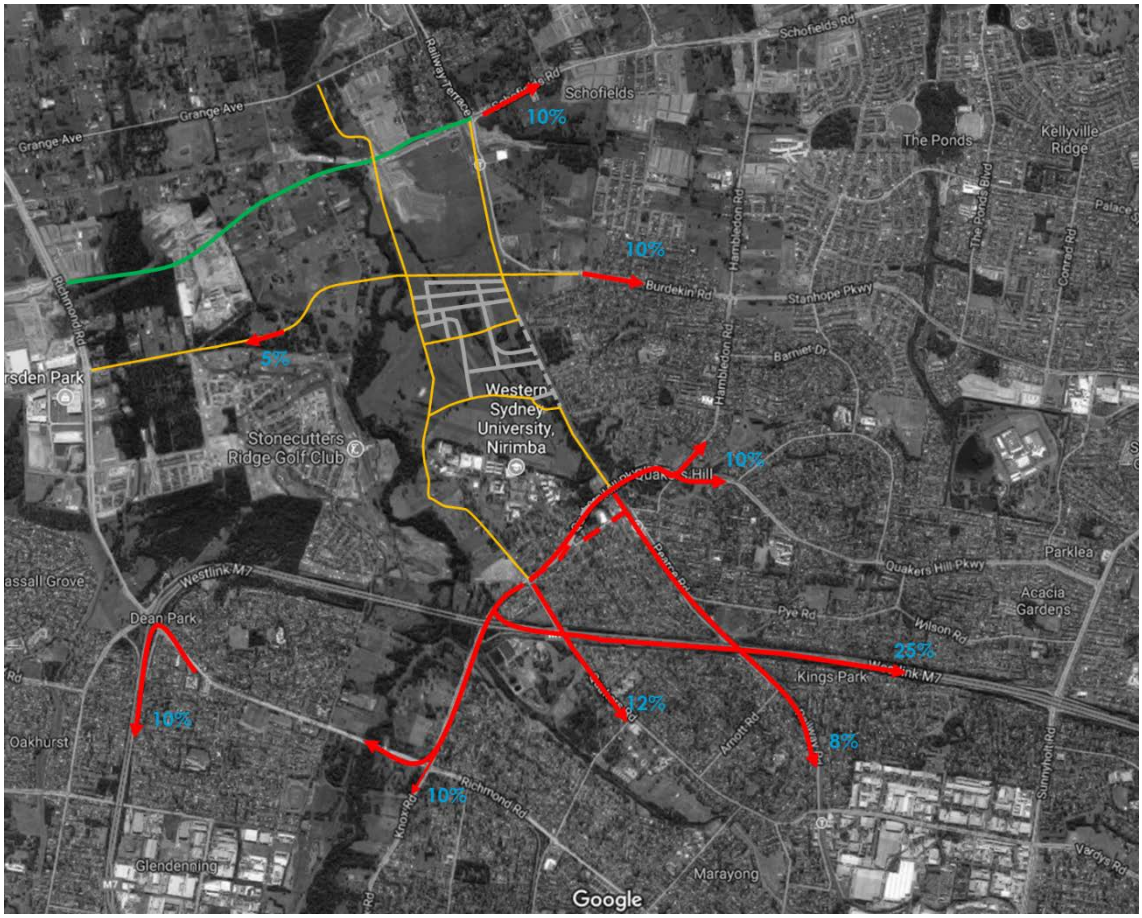
5.3.1 Schofields Aerodrome Distribution and Assignment

The directional distribution and assigned of traffic generated by the Schofields Aerodrome site would be influenced by several factors, including the following:

- configuration and connectivity of the arterial road network in the immediate surrounds
- designation of collector roads between and within the area and the arterial road network
- connections to future public transport infrastructure
- development of surrounding employment and retail centres and schools in relation to the area
- configuration of access points to the area.

Having consideration for the above, as well as the trip distributions assumed in the *Schofields Precinct Transport and Access Strategy* (AECOM, 2011) and 2011 Journey to Work data, the assumed directional distribution for the Schofields Aerodrome development is shown in Figure 5.1.

Figure 5.1: Residential Directional Traffic Distributions and Assignment from Schofields Aerodrome



Basemap Source: Google Maps

In addition, the directional split of traffic (i.e. the ratio between the inbound and outbound traffic movements) are summarised in Table 10.2 and Table 10.3 for weekday AM, PM and weekend midday peaks. It should be noted that directional distributions for land use types such as retail, public school and sporting facilities are different to residential directional distributions.

Table 5.4: Weekday AM Directional Traffic Splits

Land Use Type	Total Vehicle Trips/Peak Hour	Directional Split		Total Vehicle Trips/Peak Hour	
		In	Out	In	Out
Weekday AM Peak					
Residential	667	20%	80%	133	534
Public School	156	100%	0%	156	0
Weekday AM Total	**823**	**-**	**-**	**289**	**534**

Table 5.5: Weekday PM Directional Traffic Splits

Land Use Type	Total Vehicle Trips/Peak Hour	Directional Split		Total Vehicle Trips/Peak Hour	
		In	Out	In	Out
Weekday PM Peak					
Residential	695	70%	30%	487	208
Retail (supermarket, specialty and non-retail)	85	50%	50%	43	43
Netball Courts	241	50%	50%	121	120
Playing Fields					
Tennis Court					
Weekday PM Total	**1021**	**-**	**-**	**651**	**371**

Table 5.6: Weekend Midday Directional Traffic Splits

Land Use Type	Total Vehicle Trips/Peak Hour	Directional Split		Total Vehicle Trips/Peak Hour	
		In	Out	In	Out
Weekday PM Peak					
Residential	334	50%	50%	167	167
Retail (Supermarket and Specialty)	83	50%	50%	42	42
Netball Courts	1213	50%	50%	533	533
Playing Fields					
Tennis Court					
Weekday PM Total	**1630**	**-**	**-**	**742**	**742**

5.3.2 Approved ILP Traffic Distribution Assumptions

The traffic volumes generated by the proposed land uses within the Schofields Precinct was analysed on the surrounding road network in the *Schofields Precinct Transport and Access Strategy* (AECOM, 2011).

A breakdown of forecast traffic volumes along Mustang Drive (at the time known as Quakers Road extension) and the Nirimba Drive extension for Schofields Precinct, as well as the respective proportion of Schofields Aerodrome generation are summarised in Table 5.7.

Table 5.7: 2036 AECOM Forecasted Weekday Peak Hour Volumes

Peak Hour	Road	ILP Model Volume	Schofields Aerodrome Trips	Percentage Schofields Aerodrome Trips
AM	Nirimba Drive	848	128	15%
	Quakers Road	1439	494	34%
PM	Nirimba Drive	899	144	16%
	Quakers Road	1285	380	30%

Table 5.7 indicates that approximately 900 vehicles were forecast to travel either northbound or southbound on the Nirimba Drive extension collector road (as per the approved ILP), with most of this traffic generated by locations outside of the Schofields Aerodrome site.

With consideration for the local and regional employment hubs, as well as the arterial road network and noting that there are currently no known plans for the Nirimba Drive extension to

connect with Quakers Hill Parkway or Burdekin Road, the assumed trip distribution in the Precinct Access Strategy appears to overestimate the traffic volumes that would use this connection now.

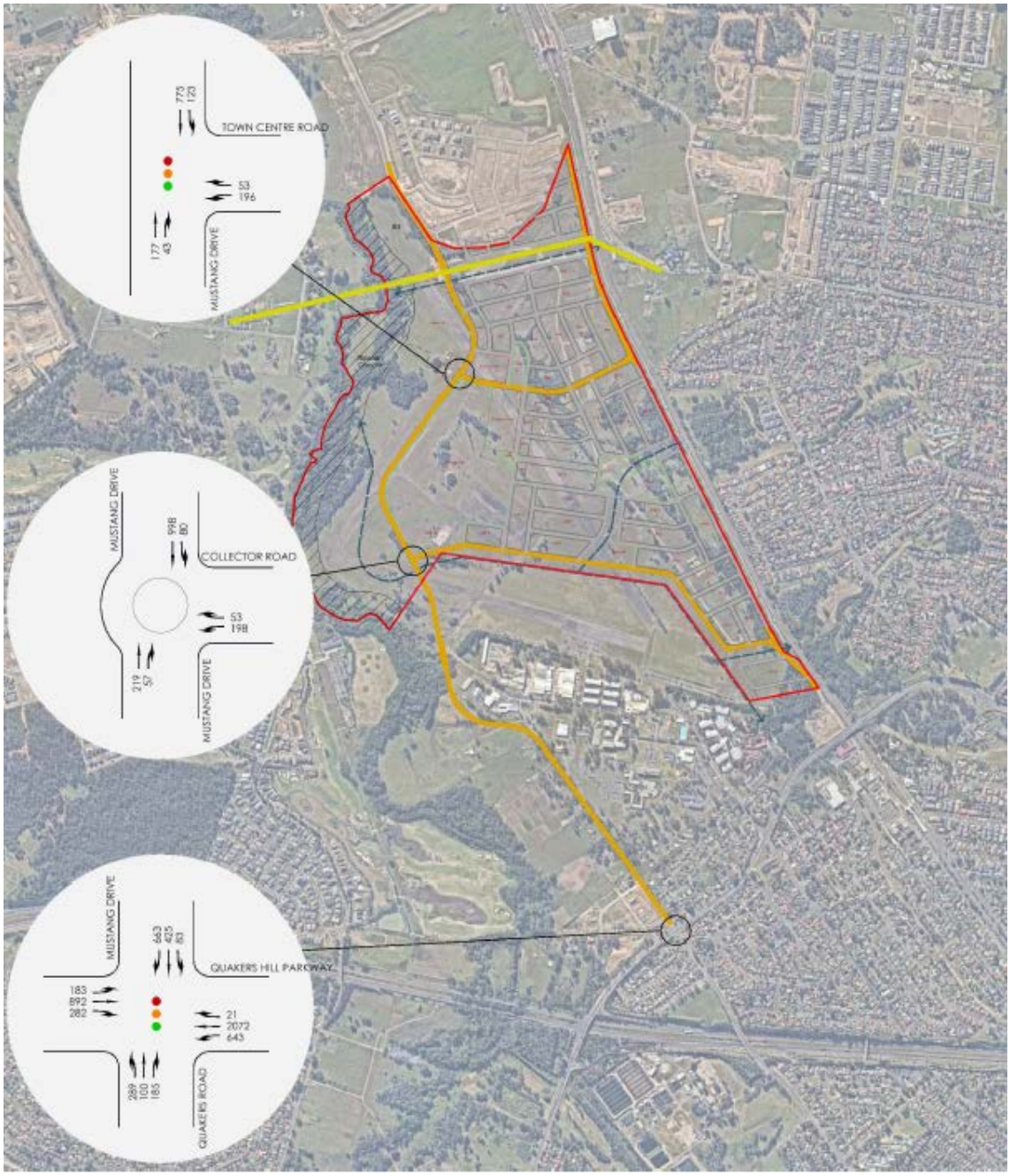
It is envisaged that approximately half of this traffic would use other connected sub-arterial roads such as Quakers Road, Schofields Road, Railway Terrace and Hambledon Road to access the surrounding road network.

Furthermore, the Proposed ILP would limit the use of the Nirimba Drive connection to Quakers Hill Parkway via the local road network (Douglas Road), which would result in a minor re-distribution of this traffic, as a result of the realigned Collector Road network in the proposed ILP.

5.3.3 Precinct Traffic Distribution

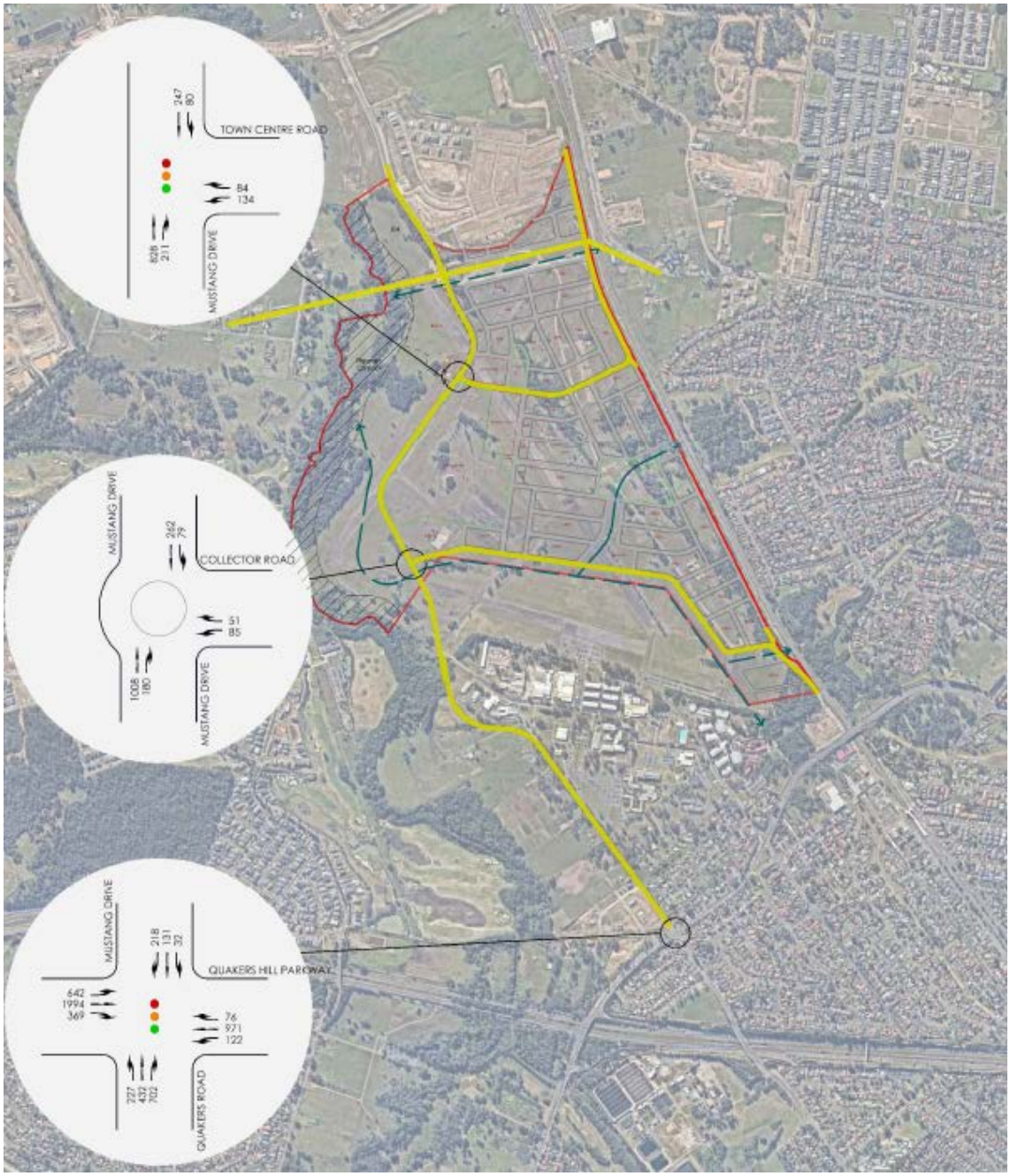
Adopting the traffic volumes presented in the Access Strategy modelling and applying the re-distribution associated with the proposed ILP, the changed assumptions regarding Nirimba Drive and the additional traffic generation associated with the modifications to sporting facilities, traffic volumes at key intersections along Mustang Drive are shown in Figure 5.2 to Figure 5.4, for the AM, PM and weekend peak hours.

Figure 5.2: AM Peak Hour Traffic Movements on Mustang Drive



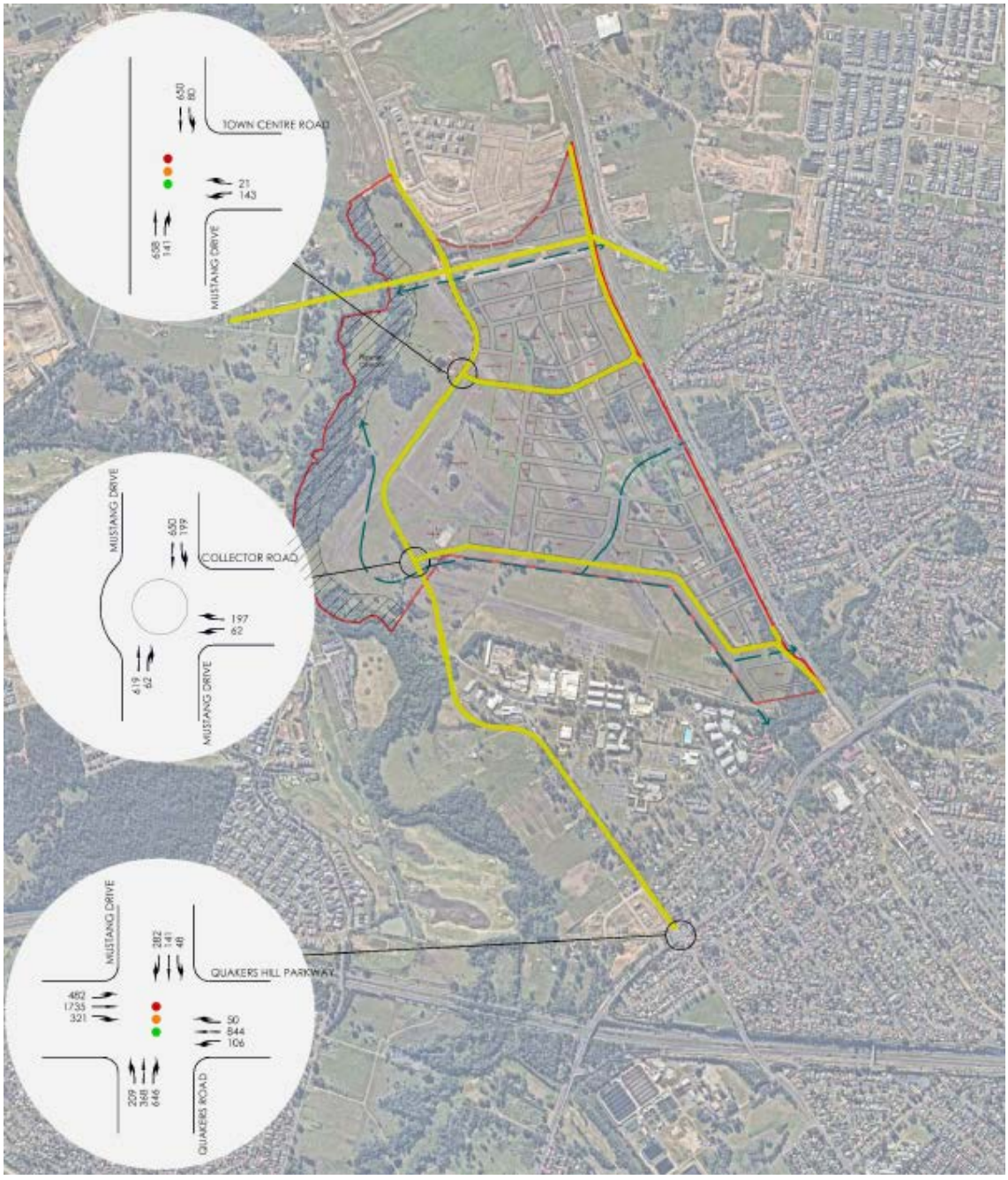
Basemap Source: Nearmap

Figure 5.3: PM Peak Hour Traffic Movements on Mustang Drive



Basemap Source: Nearmap

Figure 5.4: Saturday Midday Peak Hour Traffic Movements on Mustang Drive



Basemap Source: Nearmap

5.4 Traffic Impact

5.4.1 Volume-Capacity Ratio

In terms of mid-block capacity along Mustang Drive, *Austroads Guide to Traffic Management – Part 3: Traffic Studies and Analysis* provides typical mid-block capacities for urban roads. This is summarised in Table 5.8.

Table 5.8: Typical Mid-Block Capacity – Urban Roads

Type of Lane	One-way Mid-block Capacity (passenger car per hour)
Median or Inner Lane	
Divided Road	1,000
Undivided Road	900
Middle Lane (of a 3 Lane Carriageway)	
Divided Road	900
Undivided Road	1,000
Kerb Lane	
Adjacent to Parking Lane	900
Occasional Parked Vehicles	600
Clearway Condition	900

Source: Table 5.1 of Austroads Guide to Traffic management – Part 3: Traffic Studies and Analysis

Based on the above, Mustang Drive would be able to accommodate 1,900 vehicles per hour in a single direction (inner lane on divided road + clearway condition for kerb lane). With this in mind, diversion of through traffic from the Nirimba Drive extension (as modelled by AECOM) would result in a maximum total of 1,800 vehicles in a single peak hour and direction. Therefore, Mustang Drive, as proposed as part of the Schofields Aerodrome development, would be able to accommodate the expected traffic volumes.

Analysis of mid-block level of service (LoS) was conducted based on criteria as set out in *Schofields Precinct Transport and Access Strategy* (AECOM, 2011) and Roads and Maritime to gain an insight into the performance of the section of Mustang Drive most likely to be affected by the diversion. A summary of the LoS criteria is set out in Table 5.9.

Table 5.9: Mid-Block Level of Service Criteria

LoS	Description	Hourly Vehicle Flow	
		1 Lane	2 Lanes
A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.	200	900
B	In the zone of stable flow and drivers still have the reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is a little less than LoS A.	380	1,400
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	600	1,800
D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	900	2,200
E	Occurs when traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause break-down.	1,400	2,800

Source: Schofields Precinct Transport and Access Strategy (AECOM, 2011) based on values as supplied in Guide to Traffic Generating Developments (Roads and Maritime, 2002)

Based on the above and a maximum vehicle hourly flow of 1,800 vehicles, it can be expected that Mustang Drive would operate between LoS C and LoS D.

During weekend peaks, when kerbside parking could potentially be provided along Mustang Drive, volumes are expected to be between 1,100 vehicles and 1,300 vehicles travelling along single median lanes. This level of traffic would be regarded between LoS D and LoS E as per Austroads analysis. This kind of traffic is not expected to occur every weekend as regional sporting facilities would be expected to implement a management system to spread start times and gala days.

The collector roads as proposed for the Schofields Aerodrome development would carry traffic volumes in ranges of 300 vehicles to 400 vehicles in the AM and PM peak hours in a single direction and would not preclude access into individual allotments off the collector road. This corresponds to LoS C or better which is deemed to be acceptable as seen Table 5.9. As such, the volume-capacity ratio is not expected to be compromised by the changes to the approved ILP.

5.4.2 Intersection Operations

The operation of key intersections has been assessed using SIDRA INTERSECTION[7], a computer based modelling package which calculates intersection performance. The commonly used measure of intersection performance, as defined by Roads and Maritime, is vehicle delay. SIDRA INTERSECTION determines the average delay that vehicles encounter and provides a measure of the level of service.

Table 5.10 shows the criteria that SIDRA INTERSECTION adopts in assessing the level of service.

[7] Program used under license from Akcelik & Associates Pty Ltd.

Table 5.10: SIDRA INTERSECTION Level of Service Criteria

Level of Service (LOS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way and Stop Sign
A	Less than 14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

The key intersections assessed within this study are the following:

- Quakers Hill Parkway/ Quakers Road/ Mustang Drive
- Mustang Drive/ Nirimba Drive extension
- Mustang Drive/ Schofields Aerodrome Town Centre Road.

The above intersections were assessed based on their connection with Mustang Drive which would subsequently affect the Quakers Hill Parkway/ Quakers Road intersection. Internal intersections were not assessed as this level of detail would be more suited to being assessed at a development application stage. The operation of the above listed intersections is summarised in Table 5.11.

Table 5.11: Intersection Operation Summary

Intersection	Peak Period	Degree of Saturation (DOS)	Average Delay (sec)	95th Percentile Queue (m)	Level of Service (LOS)
Quakers Hill Parkway/ Quakers Road/ Mustang Drive	AM	0.94	58	76	E
	PM	0.92	53	455	D
	Weekend	0.88	42	288	C
Mustang Drive/ Nirimba Drive Extension	AM	0.39	5	20	A
	PM	0.67	8	57	A
	Weekend	0.51	5	30	A
Mustang Drive/ Schofields Aerodrome Town Centre Road	AM	0.56	15	76	B
	PM	0.54	12	37	A
	Weekend	0.70	13	100	A

The assessment of post-development traffic conditions along Mustang Drive at key intersections indicate that the intersections associated with Schofields Aerodrome will operate satisfactorily at a level of service (LoS) of B or better except for the Quakers Hill Parkway/ Quakers Road/ Mustang Drive intersection.

The Quakers Hill Parkway/ Quakers Road/ Mustang Drive intersection is foreseen to be at LoS E and LoS D during the AM and PM peaks respectively. Whilst, this represents an intersection nearly or at capacity, previous SIDRA Intersection models for the Quakers Hill Parkway/ Quakers Road intersection as modelled within the *Schofields Precinct Transport Access Strategy* (2011) indicated similar results. A comparison of results between the intersection operation in the Access Strategy and for the proposed ILP are presented in Table 5.12. Weekend peak results have not been

shown as the *Schofields Precinct Transport and Access Strategy* (2011) have not presented these results and therefore no comparison is available.

Table 5.12: SIDRA Comparison Table

Peak	Approach	Level of Service		Degree of Saturation		Average Delay		95th Percentile Queue	
		Proposed ILP	Approved ILP	Proposed ILP	Approved ILP	Proposed ILP	Approved ILP	Proposed ILP	Approved ILP
AM	Mustang Drive	F	F	0.94	0.93	81	75	205	169
	Quakers Hill Parkway (east)	E	E	0.94	0.95	57	58	538	503
	Quakers Road	E	E	0.84	0.94	67	70	127	124
	Quakers Hill Parkway (west)	C	C	0.88	0.96	37	35	112	98
PM	Mustang Drive	F	F	0.82	0.88	74	77	52	40
	Quakers Hill Parkway (east)	C	C	0.89	0.55	41	38	133	132
	Quakers Road	E	E	0.92	0.89	69	64	188	178
	Quakers Hill Parkway (west)	D	D	0.92	0.89	48	40	454	376

Overall, as shown in Table 5.12 delay and queue lengths are expected to increase when compared to the approved ILP. This is as a result of the assumptions relating to the use of Nirimba Drive within the approved ILP traffic modelling rather than the specifics of the proposed ILP.

These results should be viewed in the context that the assumed distribution for the proposed ILP had been added uniformly to all Schofields Aerodrome affected movements at the intersection. This produces results quite conservative in nature given the unknown distribution and assignment of the Access Strategy modelling for the approved ILP. Furthermore, a portion of the traffic originally intended for the Nirimba Drive extension has been redistributed toward Mustang Drive.

It is assumed that traffic distribution between the available north/south road links would respond to the road network design and available capacity, which is likely to be closer to the above assumptions than the available network modelling.

Consultation with Roads and Maritime has also led to a snapshot of the strategic traffic model (STM) for the Schofields area for 2016 and 2036 AM and PM peaks. Comparison between the STM, and CUBE model as used in *Schofields Precinct Transport and Access Strategy* (2011) reveals the following differences between the two models:

- The connection between Nirimba Drive extension to Railway Road is not shown in the STM.
- The Nirimba Drive extension connects to Quakers Hill Parkway in the STM as opposed to continuing underneath and through to Railway Road as it currently exists.
- the location of Mustang Drive seems to be located at Eastern Road (within the Nirimba Education Precinct) in the STM.

In addition, there is slight variation between predicted vehicle traffic volumes forecasted along the major arterial roads such as Burdekin Road, Schofields Road and Quakers Hill Parkway

between the Access Strategy modelling and the STM. This can be attributed to the age difference between the two models and available information at the time that these were both prepared.

Overall the traffic impact of the proposed ILP when considered with the approved ILP would generally be limited to minor re-distribution of traffic resulting in additional volumes along Mustang Drive, particularly during weekend peak periods. Notwithstanding this, broader assumptions regarding the Schofields Precinct access arrangements, and the particularly use of Nirimba Drive should be revisited to better understand the future operation of the surrounding road network including the Quakers Hill Parkway/ Quakers Road intersection.

6. Conclusion

DHA is proposing to modify the approved Indicative Layout Plan (ILP) which was developed for the Schofields Precinct within the North West Priority Growth Area. The proposed amendments would only be for the portion of land located within the Schofields Aerodrome site.

The amendments within the Proposed ILP are generally limited to minor modifications to the internal road network, as well as the inclusion of a larger sporting precinct, including provision of approximately 40 netball courts.

The proposal would contribute towards a number of priorities for the North West Priority Growth Area including the provision of accommodation in the north west sector of Sydney, especially with planned public transport infrastructure such as the Sydney Metro and large employment centres in the region coming online. Planned employment centres in the region include Marsden Park and Box Hill as well connectivity to previously instilled centres such as Parramatta CBD and Sydney CBD.

This report has provided an assessment of the anticipated transport implications of the Schofields Aerodrome proposed ILP.

The road network within and adjacent to the site considers the road hierarchy and proposed uses in the area to define a series of logical sub-arterial, collector and local roads. Key to this is the north-south spine known as Mustang Drive which would connect the existing Veron Road with Quakers Road and Quakers Hill Parkway.

The road network would include a series of priority-controlled, roundabout controlled and signal-controlled intersections based on expected traffic volumes, distributions and road hierarchy. Additionally, the road cross-sections proposed for the site consider the pedestrian and cyclist aspects required with respect to the proposed town centre, sporting facilities and connection to Schofields Station.

Traffic movements to and from the site has been considered as a holistic approach, given the future prospects of the North West Priority Growth Area as well as current Journey to Work Data. It is expected that Mustang Drive would carry the majority of traffic associated with the Schofields Precinct. Public transport within the site has been considered to connect residents to Schofields Train Station, Schofields Road and employment centres in the area, generally in accordance with the relevant Development Control Plans.

On the above basis, the following key notes are made with regard to the Schofields Aerodrome proposed ILP:

- The layout and design of the site would focus on the distribution of vehicle traffic along Mustang Drive as opposed to directing traffic from outside the site along collector roads thereby keeping with road hierarchy and design.
- A collector road would provide good amenity for cyclists and pedestrians near the proposed retail centre, sporting facilities and public school by way of a shared path.
- The town centre and sporting precinct would collectively require around 1,195 parking spaces.
- The intended parking provision for the town centre and sporting facilities would include a mixture of on-street and off-street parking to adequately service weekend use without impacting heavily on the residents in the vicinity.

- The proposed development is expected to generate between 1,457 and 2,058 vehicle trips during weekday and weekend peak hours. With internal and link trips this is expected to reduce to between 823 and 1,630 trips.
- It appears that traffic modelling completed for the approved ILP assumed a significant proportion of traffic with origins and destinations outside the Schofields Aerodrome site would use Nirimba Drive/ Railway Parade and its proposed extension as a collector road.
- The proposed intersections along Mustang Drive north and south of the sporting facilities are expected to operate satisfactorily during AM and PM peak periods, including consideration for a higher proportion of through traffic using Mustang Road instead of Nirimba Drive.
- Consideration has been made for the operation of the Quakers Hill Parkway/ Quakers Road intersection should additional traffic use Mustang Drive. This would result in a minor additional impact; however, intersection operation would largely remain consistent with the *Schofields Transport and Access Strategy* traffic modelling.
- It is assumed that traffic distribution between the available north/south road links would respond to the road network design and available capacity, which is likely to be closer to the above assumptions than the available network modelling.
- Further detailed assessments for key land uses including the proposed netball courts and town centre uses would completed in separate Development Applications.

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Attachment 7

Flood Impact Assessment

DRAFT

Project No: S13026

26 February 2018

Defence Housing Australia
Suite 2, Level 2/287 Elizabeth Street
Sydney NSW 2000

Attention: Jasmina Moltter

Dear Jasmina,

SCHOFIELDS AERODROME RESIDENTIAL DEVELOPMENT
REVISED FLOOD IMPACT ASSESSMENT

This letter report is submitted by BG&E Pty Limited (BG&E) who has been engaged by Defence Housing Australia (DHA) to carry out a hydrological and hydraulic investigation of Eastern creek and major overland flow through the proposed development site located at Schofields Aerodrome.

BG&E previously prepared the Flood Assessment report for the Development Application (DA) associated with bulk earthworks for the project (report dated 19/12/2016 Rev 2). The DA has been approved by Blacktown City Council.

This letter presents the results of a revised flood impact assessment based on an amended development layout and bulk earthworks design (post-DA design amendments).

1 BULK EARTHWORKS DESIGN UPDATES

Craig & Rhodes has made the following changes to the development layout and bulk earthworks design since the DA was issued:

- Realigned Mustang drive towards Eastern Creek (previously east of Playing Field area);
- Realigned major drainage Channels 1 and 2;
- Amended designs for stormwater Basins 5 and 6 and addition of Basin 6A;

Additional survey was carried out in the south-western part of the site to better represent conditions downstream of the existing culverts beneath Quakers Hill Parkway.

Further details can be found in Craig & Rhodes engineering drawings and documentation.

2 FLOOD MODEL UPDATES

The flood assessment for the site has been carried out based on hydrologic (XP-RAFTS) and hydraulic (TUFLOW) models provided by Blacktown City Council (refer BG&E 2016 report). The following updates were made to the hydrologic and hydraulic models to reflect the revised design:

- Developed case XP-RAFTS model was updated to reflect changes in local catchments and contributing areas to proposed basins and channels.
- Baseline and developed case TUFLOW models were updated to incorporate survey data near Quakers Hill Parkway.

- Developed case TUFLOW model was updated with revised bulk earthworks design TIN (imported from 12D).
- Developed case TUFLOW model was updated to include proposed culverts/pipes (refer attached Figure 13):

Figure 1 below compares the development layout under the current DA (left) and revised layout incorporating the latest design amendments (right).

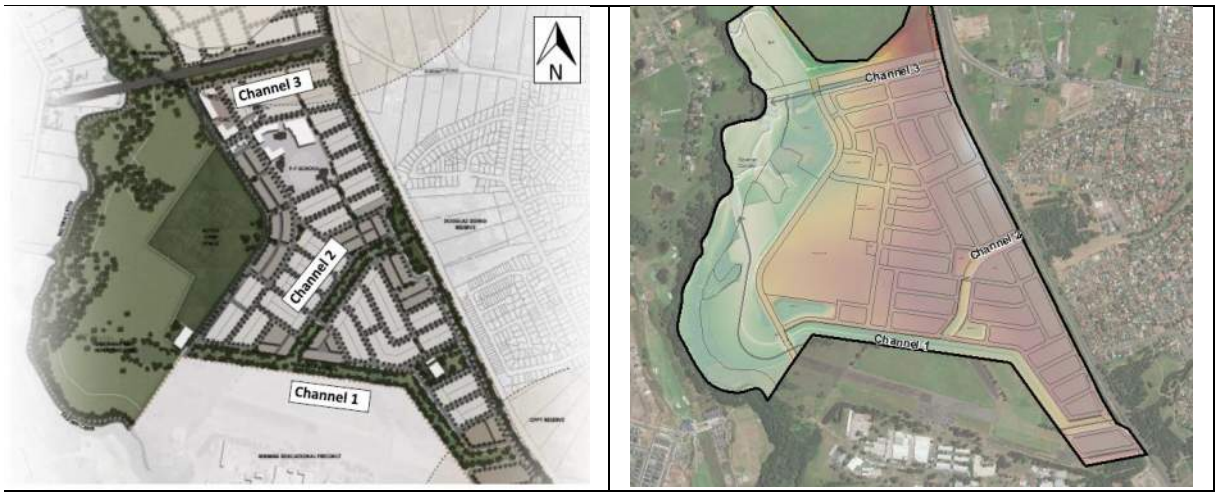


Figure 1 – Comparison of development layouts.
LEFT – master plan submitted with the report for DA; RIGHT –amended masterplan reported in this letter.

3 MODEL SCENARIOS AND EVENTS

Baseline and developed case scenario runs were carried out for the following average recurrence interval (ARI) events and storm durations. Inflows to the TUFLOW model were extracted from the XP-RAFTS baseline and developed case scenario models for each ARI and duration.

- 1 in 2 year ARI (90, 120, 540, 720 minute storm durations)
- 1 in 100 year ARI (60, 90, 120, 540, 720 minute storm durations)
- 1 in 500 year ARI (60, 90, 120, 540, 720 minute storm durations)
- PMF event (30, 60, 120 minute storm durations)
- 1 in 2 year ARI (90, 120, 540, 720 min storm durations) – smooth roughness scenario within newly developed channels assuming they won't be vegetated after construction.

Updated flood mapping is attached showing peak flood levels, depths, velocities, hazards. Flood level difference mapping is also included for the 100 year ARI event.

4 MODEL RESULTS AND DISCUSSION

Updated difference mapping show flood affectation during the 100 year ARI event is comparable to the accepted DA Flood Assessment report (refer Figure 13 attached).

Minor increases to 100 year ARI flood levels are shown in the following locations:

- Location A – water level increased up to 23mm outside tenement boundary due to earthworks in the upstream area concentrating flow. This increase has been reported in previous flood report and is localised to the creek alignment and does not extend across the width of the floodplain.
- Location B – localised increase of 25mm. This increase is within golf course and it is expected that increase is caused due to minor fluctuations in water level at this location.
- Location C – increased water level within the tenement boundary at the outlet of Channel 1. The increase is caused due to earthworks and flow diversion by Channel 1. The localised increased does not impact any properties.

- Location D – localised increase within the Nirimba site upstream of the newly designed Mustang Drive crossing of Channel 1. This increase is around 90mm outside DHA site boundary. A similar increase was shown in the previous flood assessment report which formed part of the DA.
- Location E – localised increase of around 40mm due to Mustang Drive and added culvert crossing. This increase does not affect existing development or buildings within the Nirimba site.
- Location F – localised increase up to 85mm due to Mustang drive realignment. This increase has been reported in previous DA and has been accepted.

5 CONCLUSION

BG&E has carried out updated flood modelling to incorporate the revised civil design received from Craig and Rhodes (23/01/2018). The results have been mapped on a number of figures which are attached to this letter. Flood modelling results and particularly 100 year ARI flood difference mapping (Figure 13) demonstrated that the updated design results in negligible difference compared to the bulk earthworks design approved under the current DA.

6 MODELLING ASSUMPTIONS AND LIMITATIONS

Updated flood modelling has been based on previous hydrological (XP-RAFTS) and hydraulic (TUFLOW) models and is subject to the same assumptions and limitations outlined in the BG&E Flood Assessment report issued for DA.

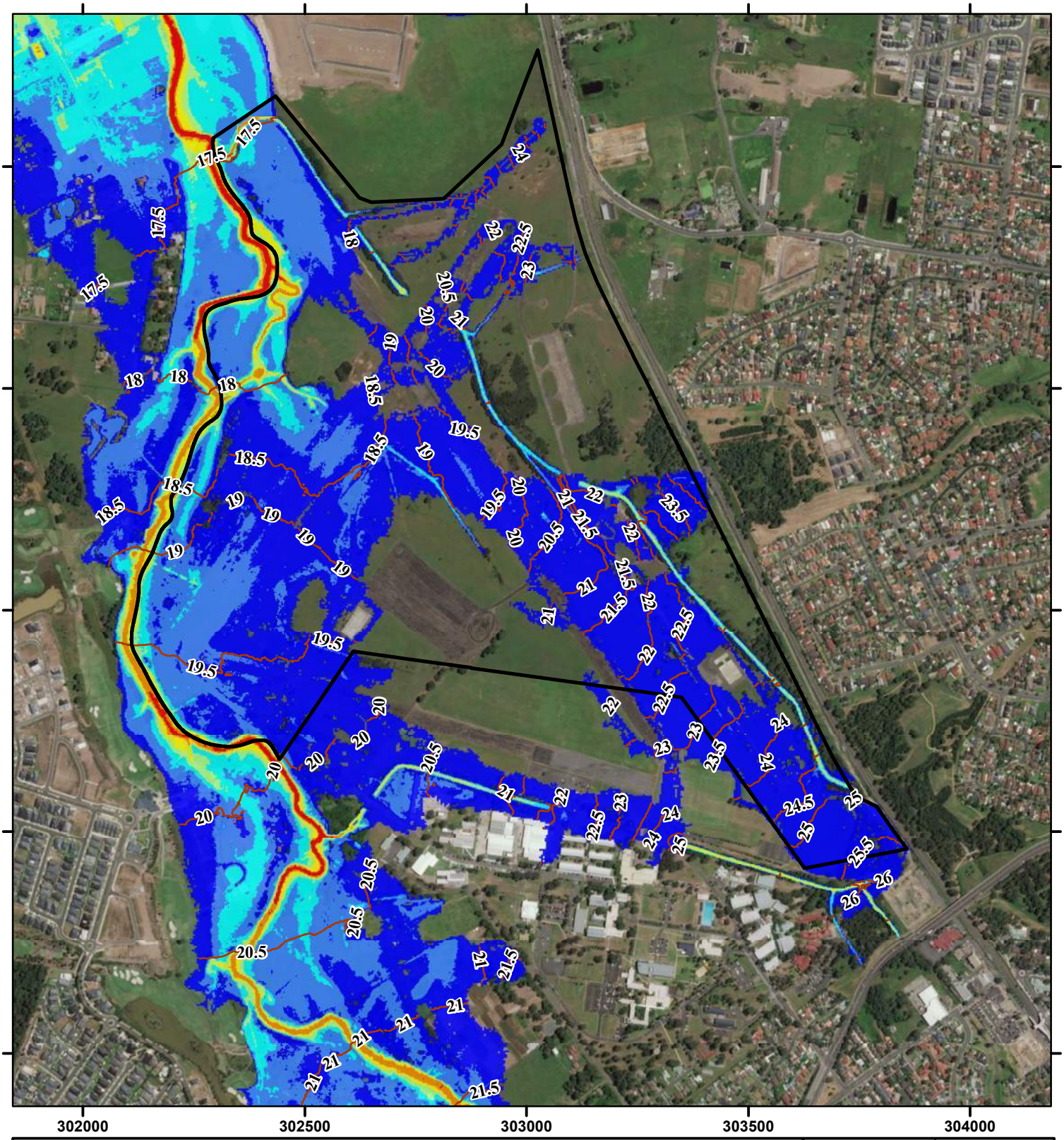
Updated modelling has been based on bulk earthworks design provided by Craig and Rhodes on 23/01/2018.

Yours faithfully
for BG&E Pty Limited

Ainis Vincevicius
Senior Water Engineer

Encl.
Updated flood mapping

Figure 1 - 2 Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

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0 0.1 0.2 0.4 Km

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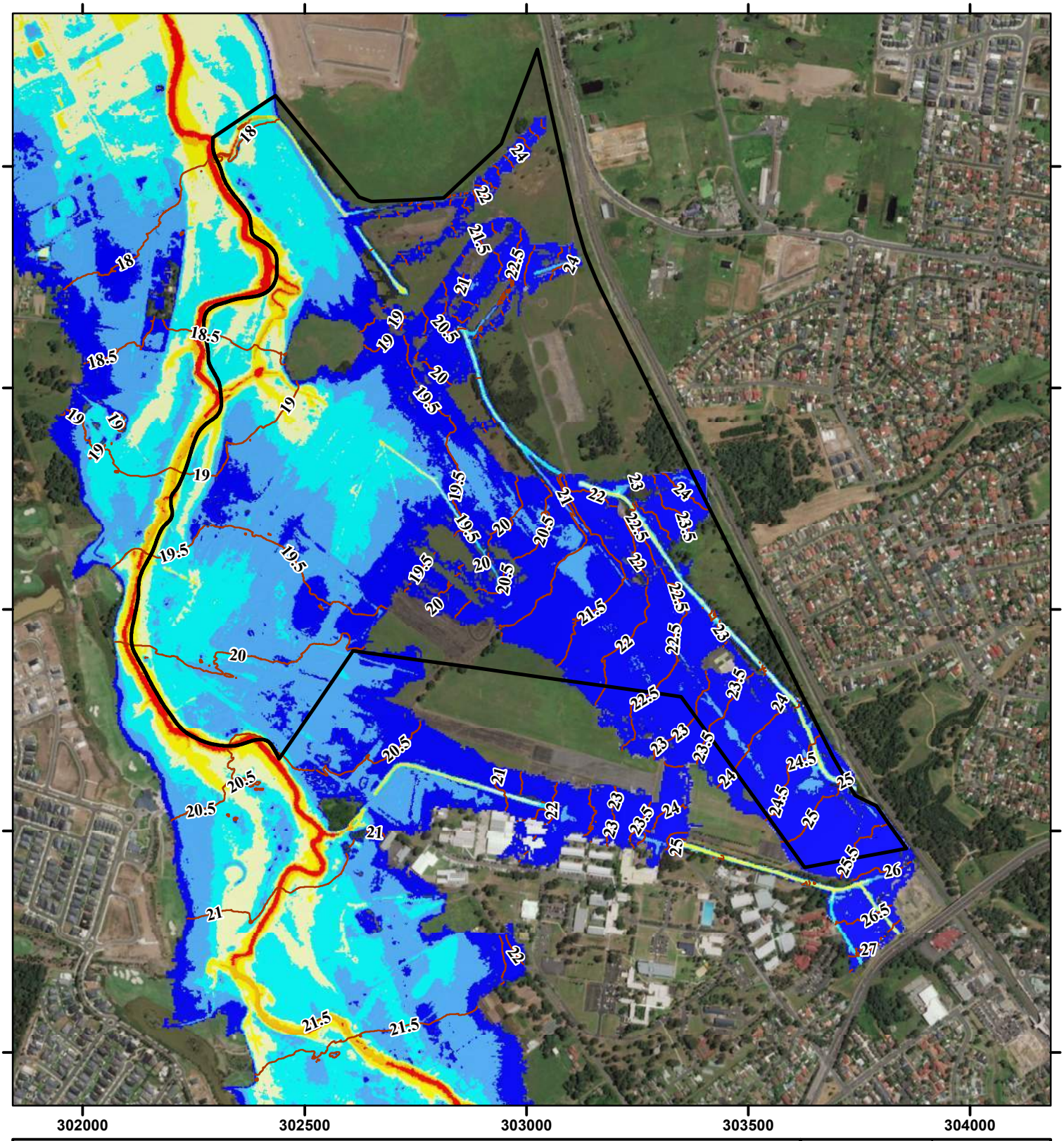
Figure 2 - 100 Year ARI Pre-Development Flood Depths and Levels



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- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

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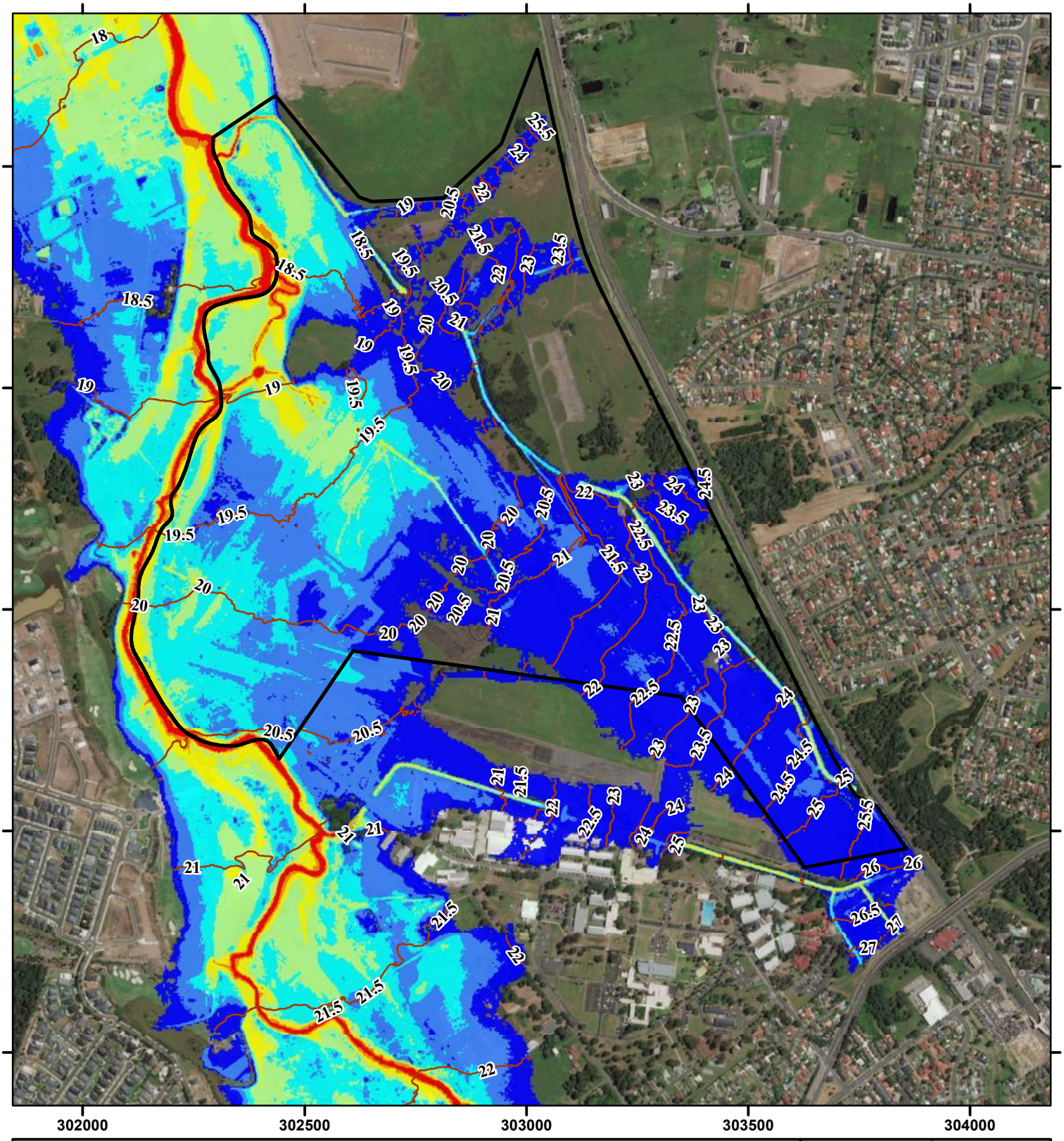
Figure 3 - 500 Year ARI Pre-Development Flood Depths and Levels



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Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
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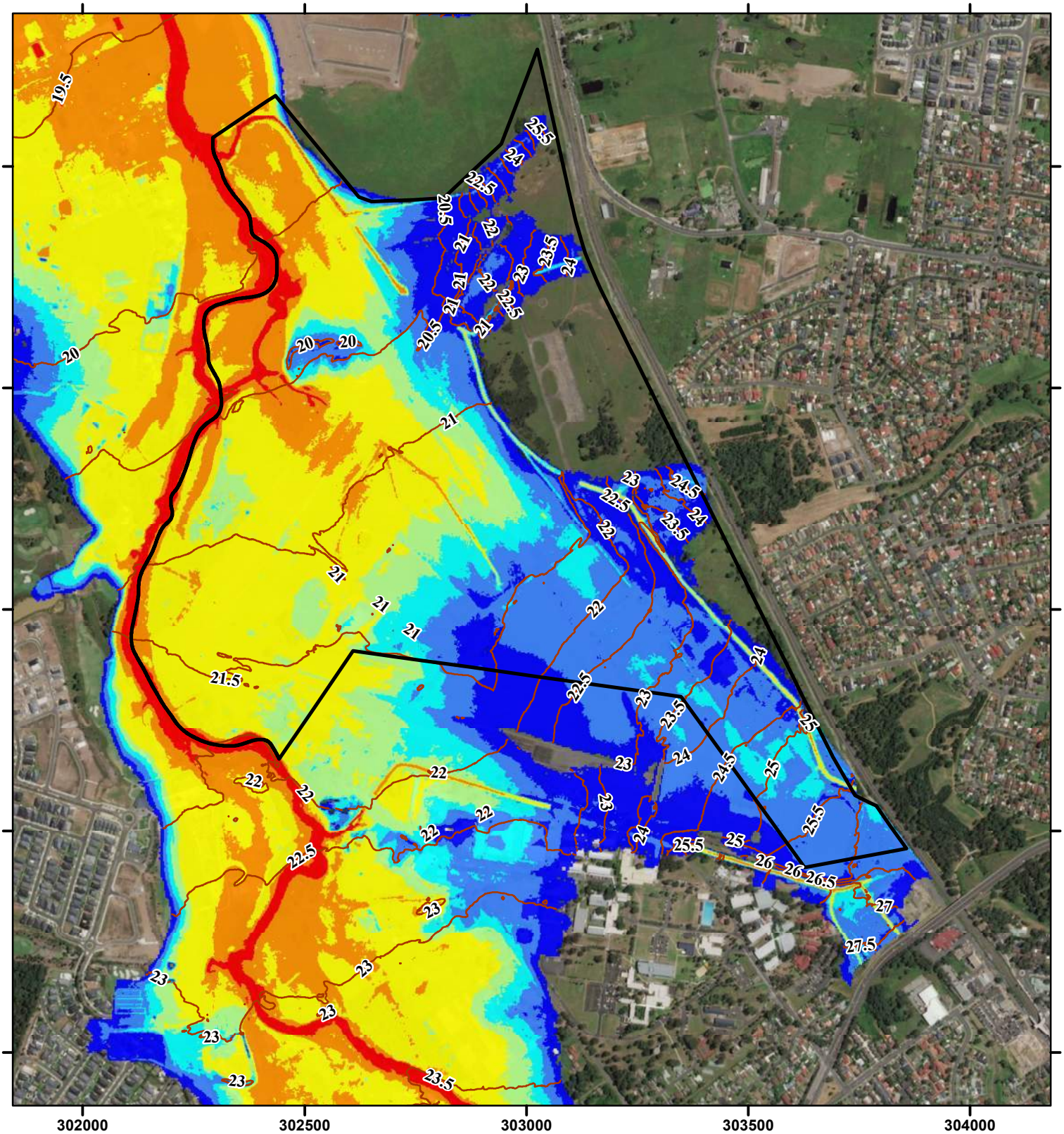
Figure 4 - PMF Year ARI Pre-Development Flood Depths and Levels



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Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
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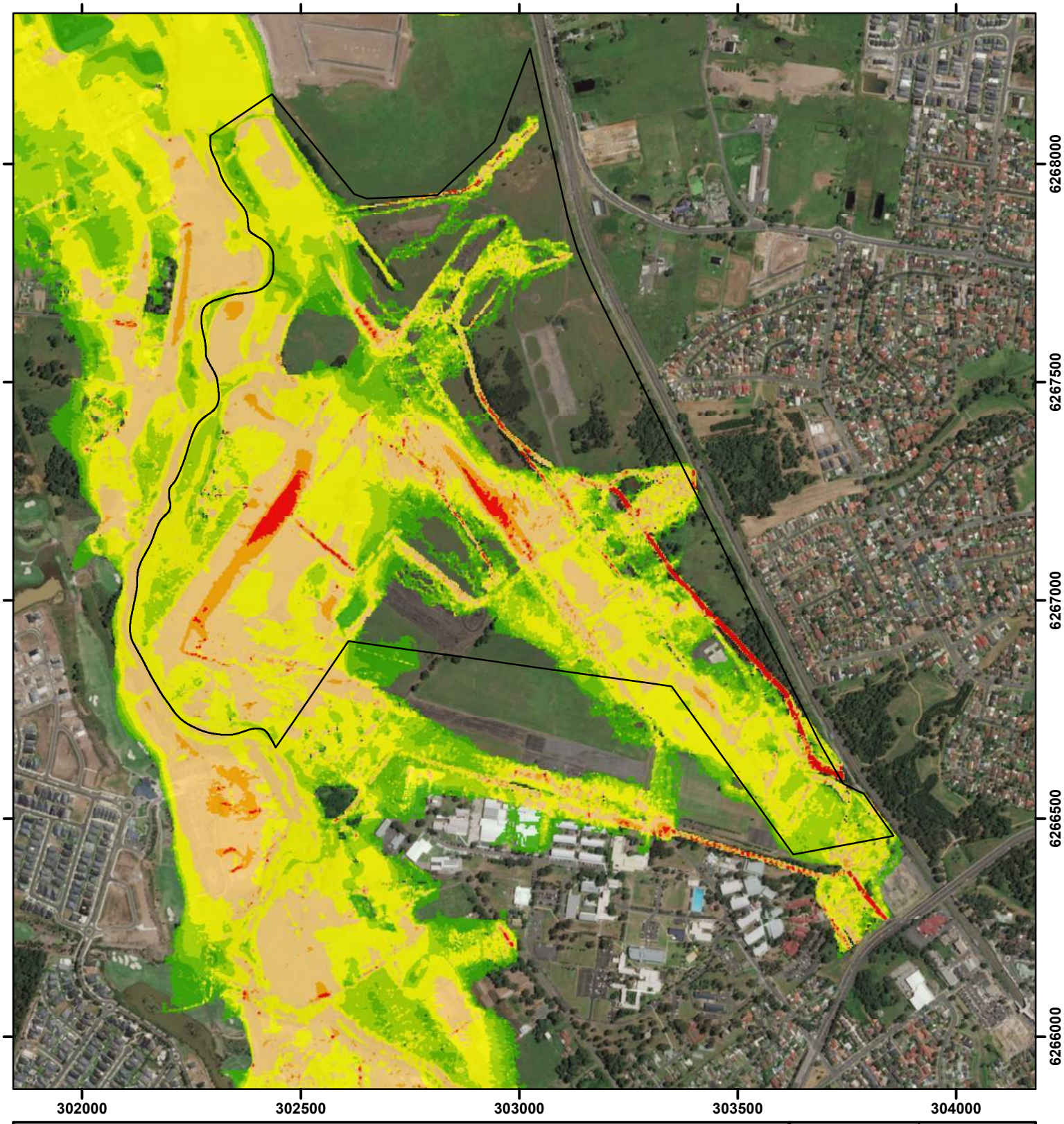
Figure 5 - 100 Year ARI Pre-Development Flood Velocities



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
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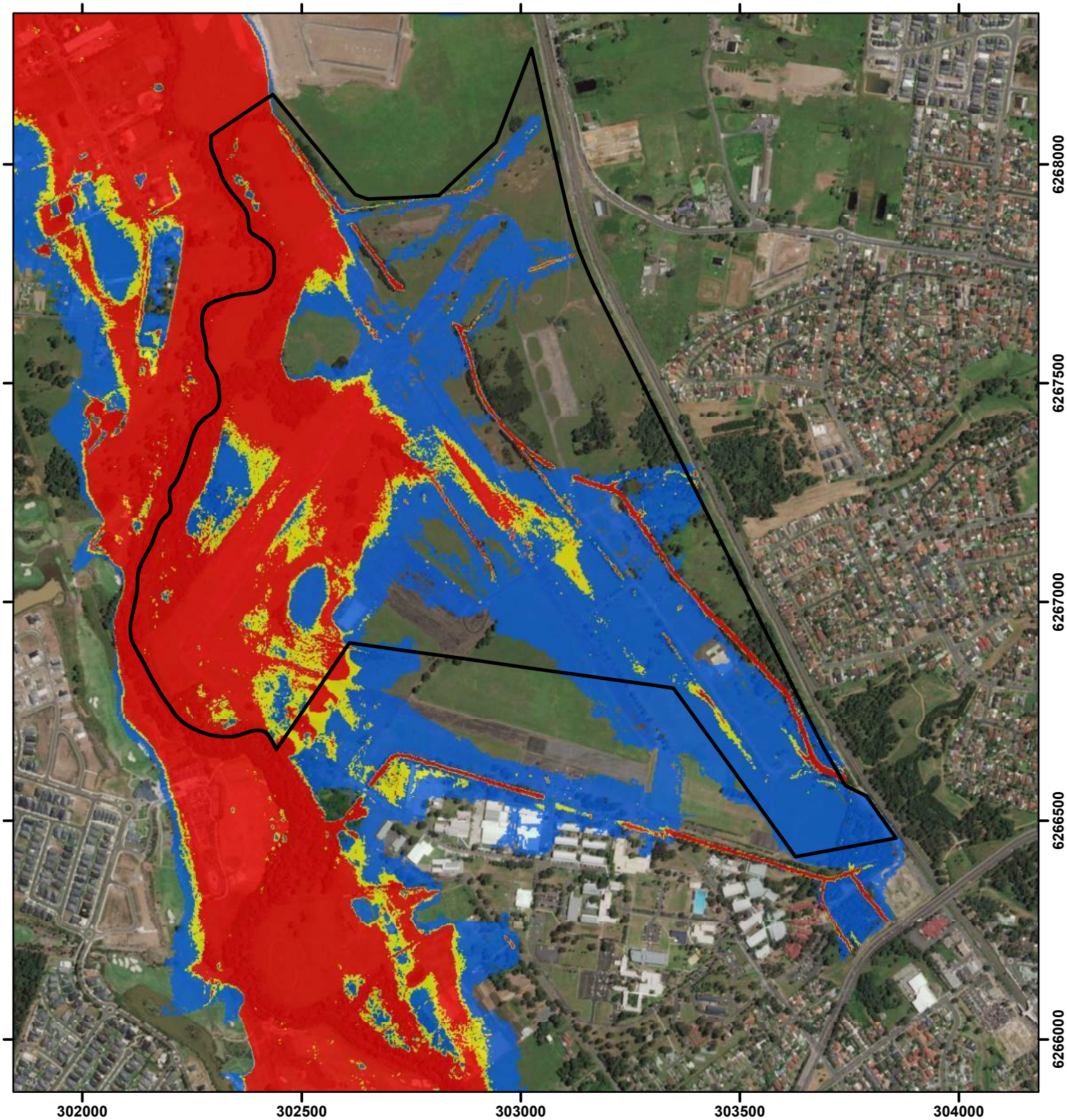
Figure 6 - 100 Year ARI Pre-Development Flood Hazard Catagories



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Hazard

- Low
- Medium
- High

Site Boundary

DRAWN	AV	PROJECT	S13026
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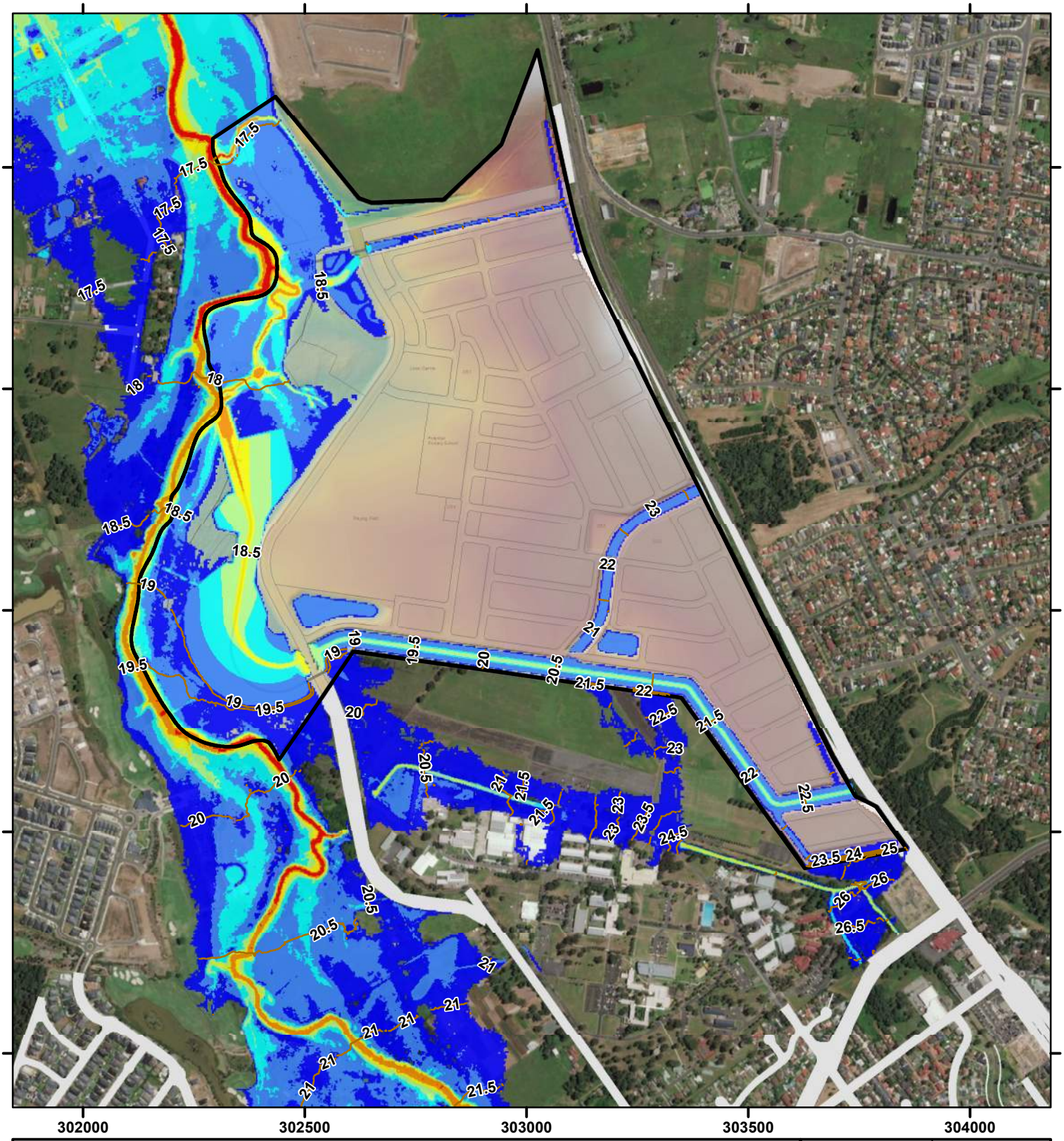
Figure 7 - 2 Year ARI Post-Development Flood Depths and Levels



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Depth (m)

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- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

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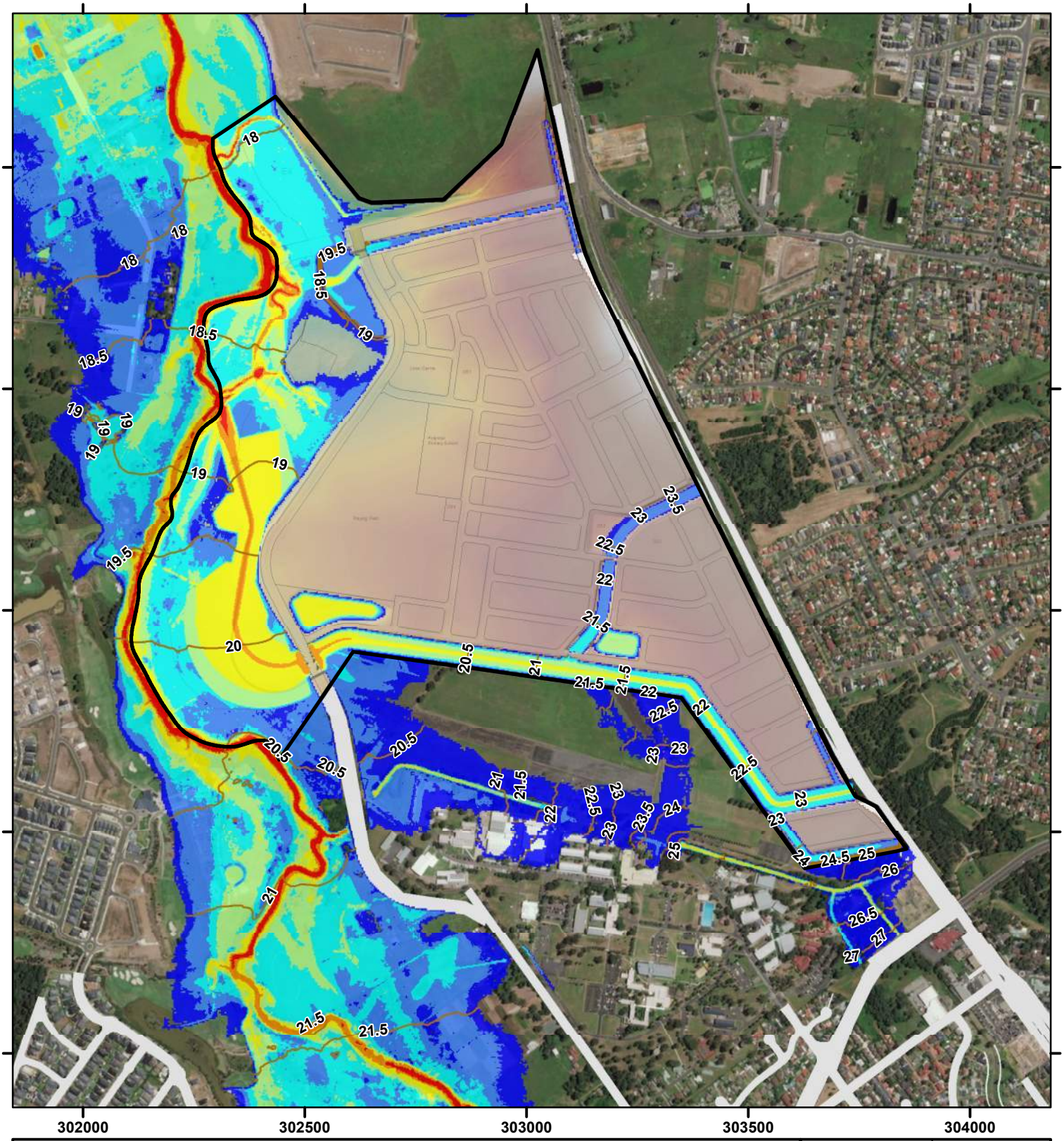
Figure 8 - 100 Year ARI Post-Development Flood Depths and Levels



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- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

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0 0.1 0.2 0.4 Km

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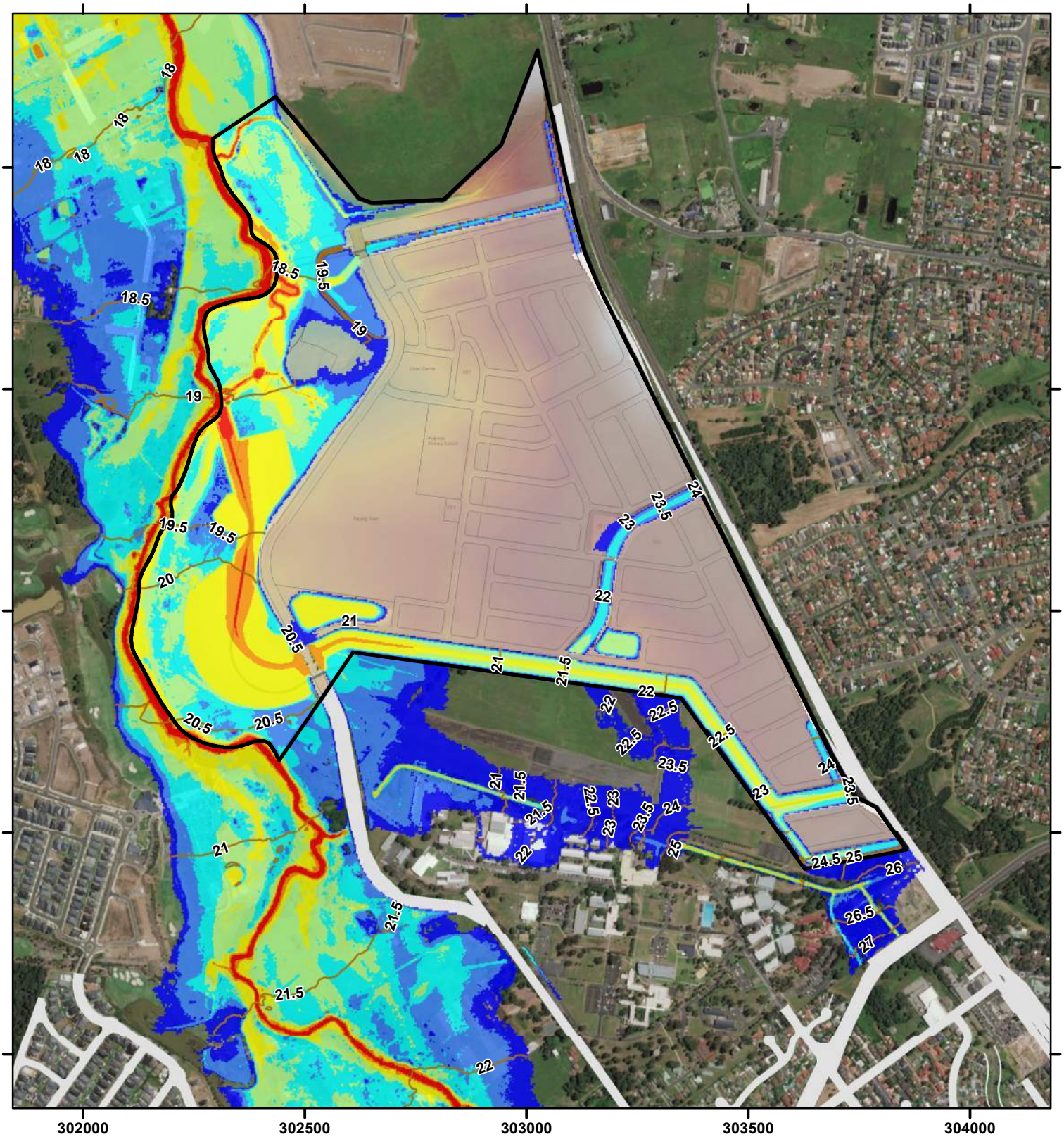
Figure 9 - 500 Year ARI Post-Development Flood Depths and Levels



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Depth (m)

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- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

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0 0.1 0.2 0.4 Km

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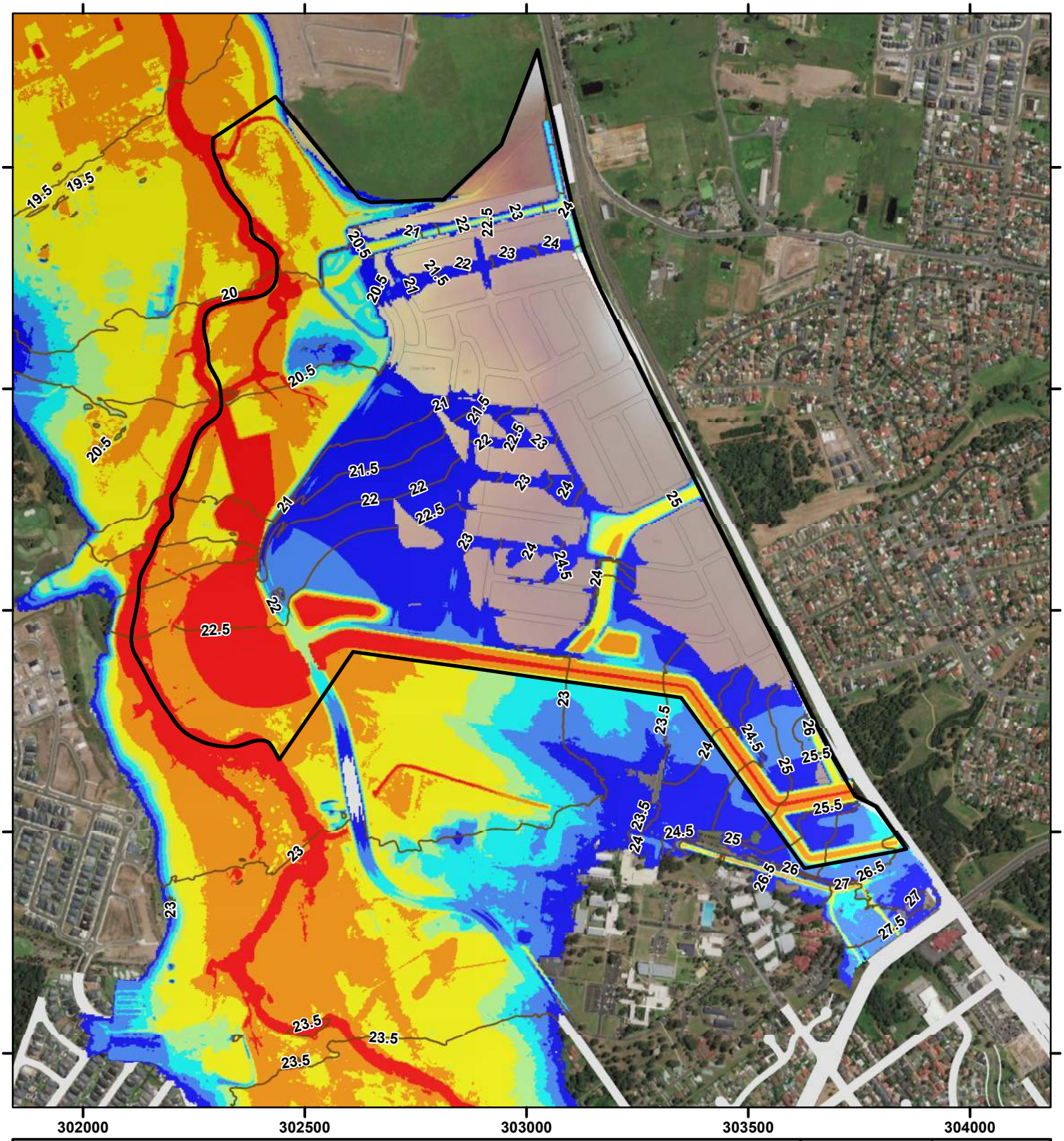
Figure 10 - PMF Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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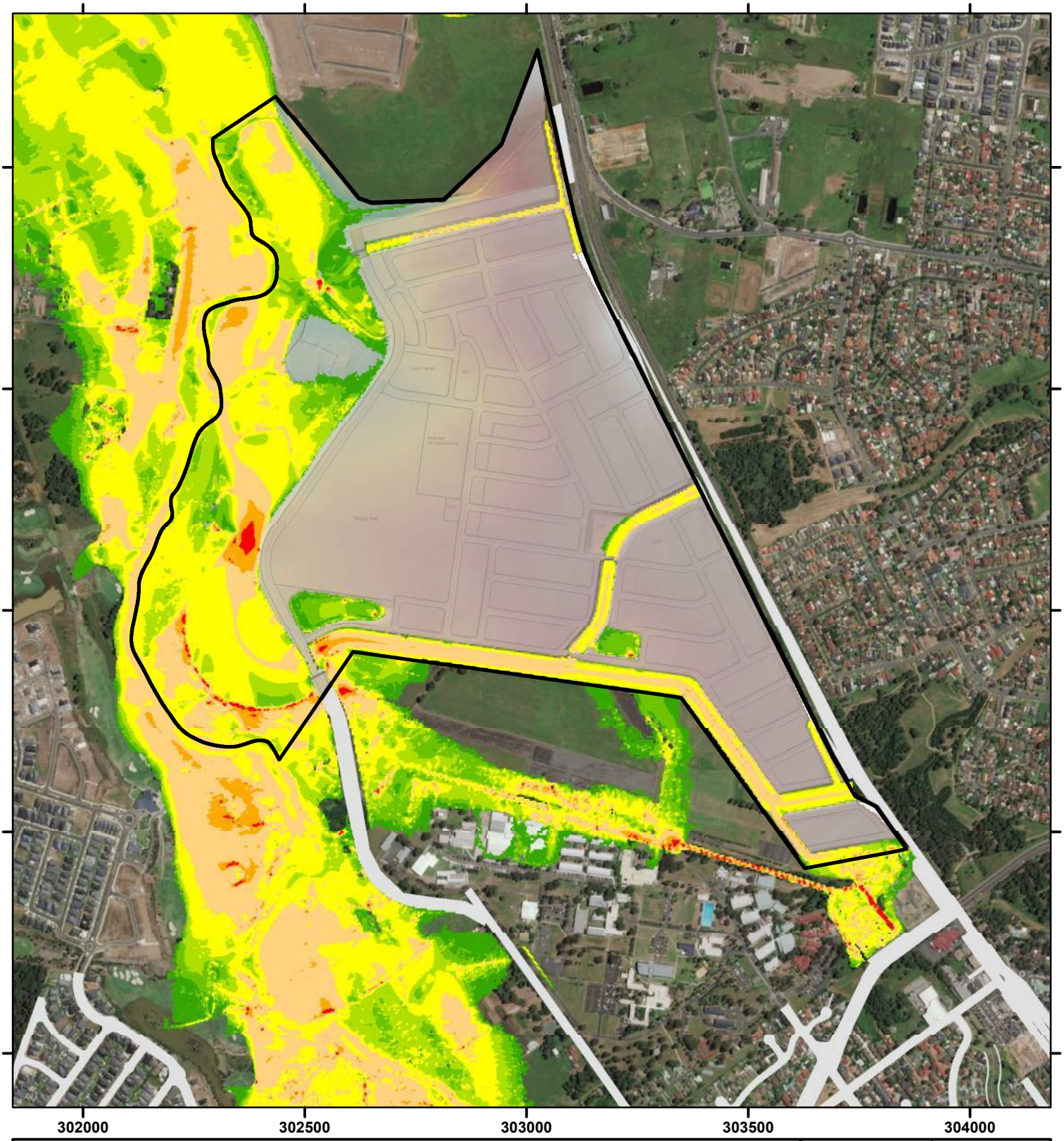
Figure 11 - 100 Year ARI Post-Development Flood Velocities



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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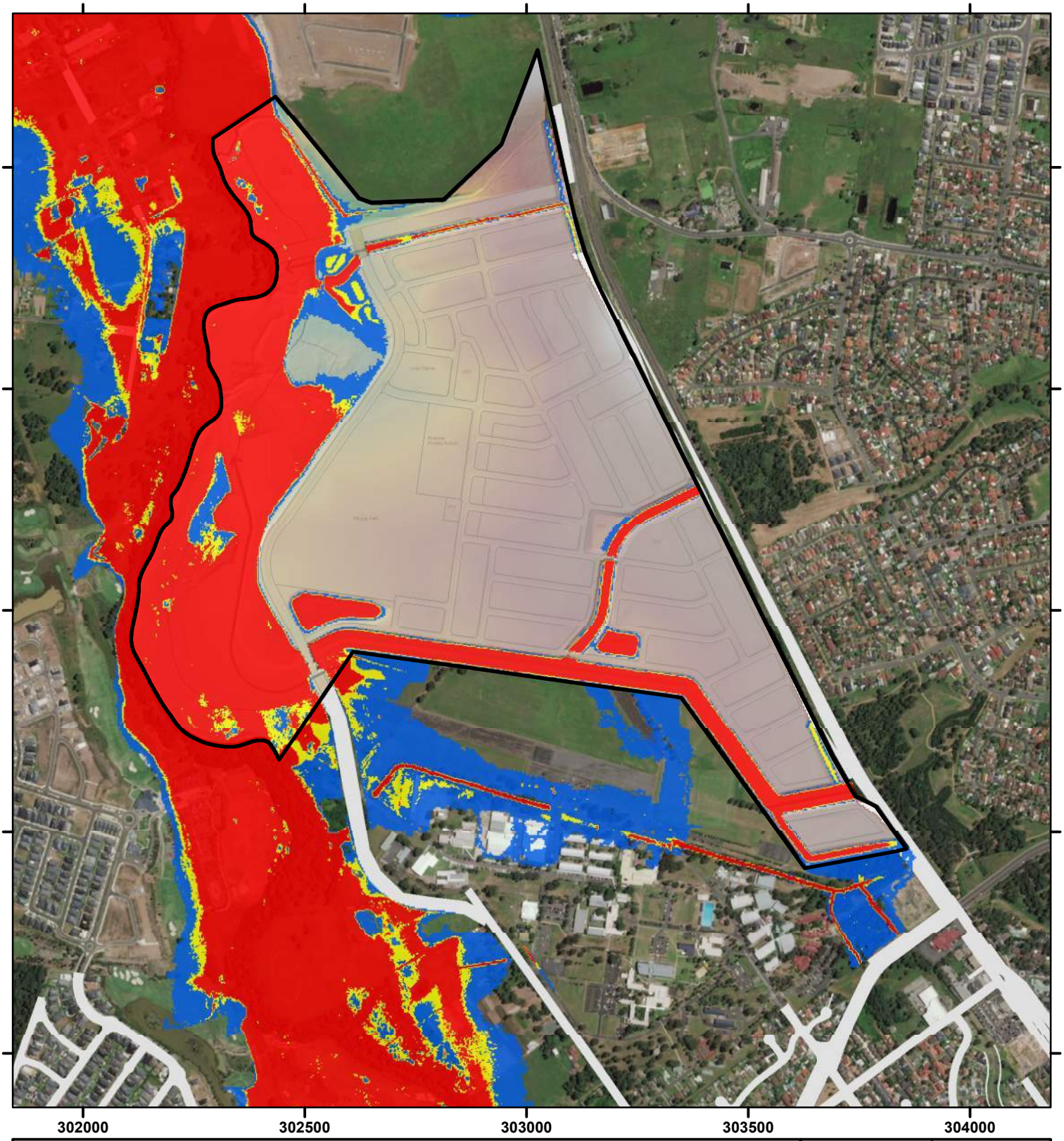
Figure 12 - 100 Year ARI Post-Development Flood Hazard Catagories



Legend

Hazard

- Low
- Medium
- High

Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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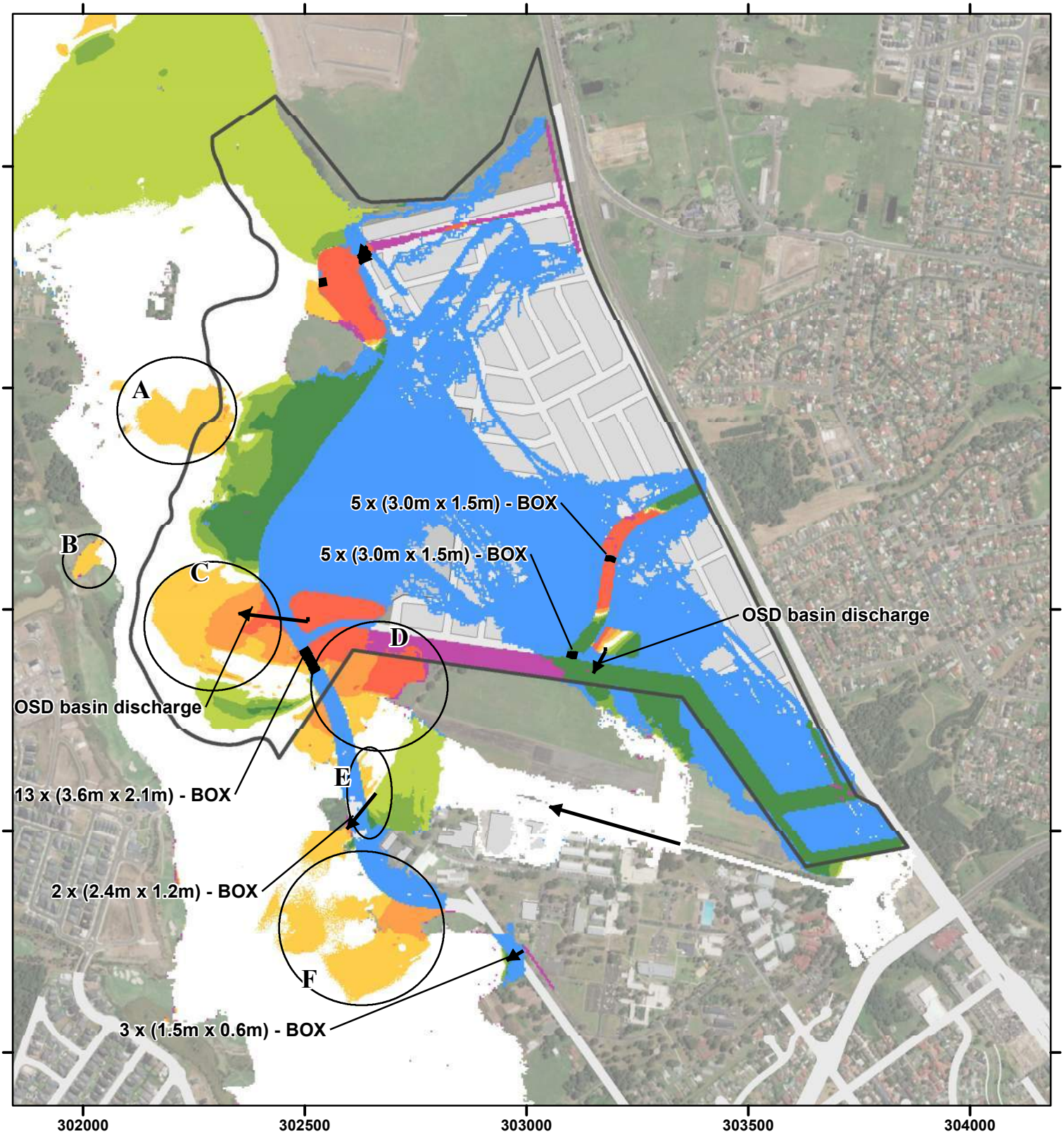
Figure 13 - 100 Year ARI Flood Level Difference Map (Post-Pre)



Legend

Difference [m]

- < -0.1
- -0.05 to -0.1
- -0.02 to -0.05
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- > 0.1
- Was Wet Now Dry
- Was Dry Now Wet
- Site Boundary
- Modelled culverts

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	23/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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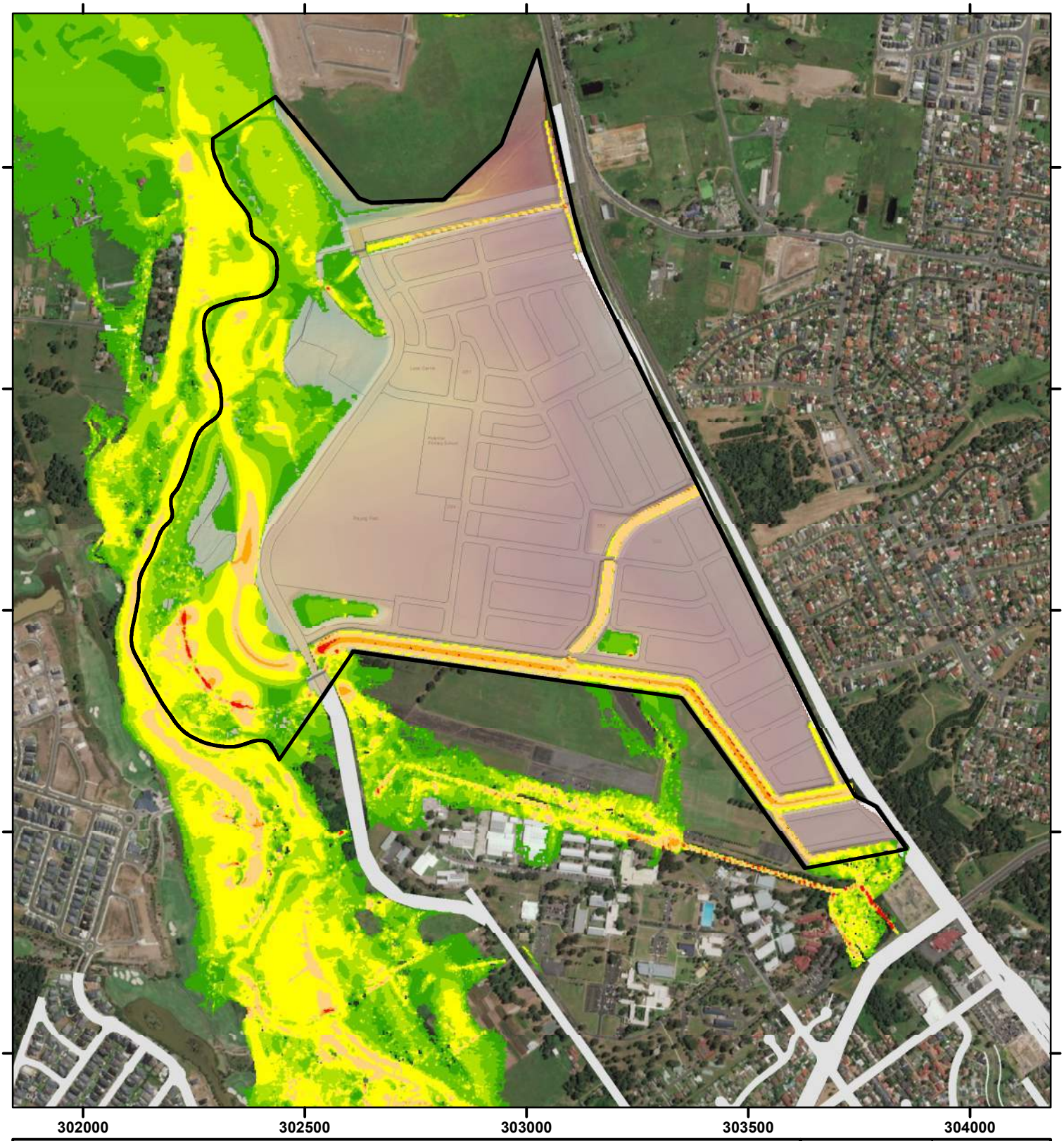
Figure 14 - 2 Year ARI Post-Development Flood Depths and Levels

(smooth roughness)



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

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0 0.1 0.2 0.4 Km

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Attachment 8

Water Cycle Management Strategy

9 March 2018

Our Reference: 1784-PP-WCMR-A

Water Cycle Management Report

Schofields Aerodrome Development

Revision A

For Defence Housing Australia

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Document Control

Revision	Details	Issue Date	Author	Reviewed
A	Issue for Review	09.08.2017	A.B.	M.V.

1 Executive Summary

1.1 Project Objective

Craig and Rhodes have been engaged by Defence Housing Australia to prepare a Water Cycle Management Report to support the proposed development/rezoning/masterplan at Schofields Aerodrome Development (the site). This strategy has been prepared to conform with statutory requirements and industry best practice for stormwater management.

The proposed development is located in the Schofields Precinct, and it is noted that the Water Cycle Management Strategy Incorporating Water Sensitive Urban Design Techniques report prepared by J. Wyndham Prince (JWP) (2012) has proposed a water cycle strategy for the entire precinct including the site.

The overall water cycle management objectives for the site were identified as follows:

Environmental – Provision of appropriately designed, functional water quality facilities, salinity management, retention of existing trees, habitat revegetation and ecosystem enhancement; limitation of downstream discharge peaks and velocities; soft bioengineering treatments to reflect natural stream functions; ecologically sustainable; adopt principles of total catchment management and water sensitive urban design; conform with statutory water quality requirements; maintenance of environmental flows and inundation patterns in creeks and wetlands.

Urban Amenity – Provision of a water cycle management strategy that identifies and controls limits of flood affectation; provision of aesthetic design forms that enhance urban amenity and address proposed adjacent land uses (residential, recreational and transport); views into and out of drainage corridors (security, public safety, amenity); water quality (visual amenity and public health).

Engineering Considerations – Effective management and control of peak discharges, discharge velocities, and flood levels above pre-development and ecologically sustainable levels; industry best practice technical analysis of catchment hydrology and system hydraulic performance, soft sustainable bioengineering treatments, delineation of flood extents and identification of flood risk and appropriate public safety measures to deal with the identified risks (flood evacuation)

Economics – Provision of a cost effective, functional trunk drainage system that optimises performance, keeps maintenance costs and requirements to an acceptable level, keeps land take to a minimum, provides maximum value for expenditure of public monies, and focuses on ecological sustainability.

1.2 Statutory Requirements

The recommendations contained in the following guidelines have been considered as part of the master planning process for the Schofields Aerodrome and immediately adjacent areas:

- Growth Centres Development Code (2006)
- Blacktown City Council Growth Centre Precincts Development Control Plan (2016)

- Blacktown City Council Engineering Guide for Development (2005)
- Blacktown City Council Development Control Plan (2015) – Part J Water Sensitive Urban Design and Integrated Water Cycle Management
- Department of Environment, Climate Change and Water Technical Guidelines
- Australian Rainfall and Runoff (1987)
- Australian Rainfall and Runoff (2016)

1.3 Methodology

The main tasks involved in preparing this strategy included:

- Review of the JWP report and statutory requirements to identify water quality and water quantity objectives and targets that have been proposed for the site.
- Water quality analysis for the proposed development to determine post development pollutant loads and evaluate the performance of proposed water quality treatment techniques.
- Identify a suitable treatment train to address water quality and water quantity objectives for the proposed development.

1.4 Proposed Water Cycle Strategy

It is proposed to generally adopt the strategies as approved and outlined in the Water Cycle Management Strategy Incorporating Water Sensitive Urban Design Techniques report prepared by J. Wyndham Prince (JWP) (2012). The JW Prince report considered a range of techniques and options including:

Water Quantity: Regional and Local detention basins and below ground storage tanks (public & private).

Water Quality: A range of on-lot, street level and subdivision scale treatment measures not limited to vegetated swales, sand filters, bio-retention systems, wetlands and rainwater tanks.

Each technique was evaluated and compared with consideration based on Environmental, Social, Economic, Maintenance and Engineering criteria. A number of techniques were identified as unsuitable or inefficient when compared with alternate techniques.

The most suitable combination of options as proposed by JWP includes:

Water Quality A treatment train consisting of:

On-Lot Treatment:

- appropriate waterwise landscaping practices with consideration of soil characteristics
- Implementation of water efficient fittings and appliances in dwellings
- Minimisation of impervious areas
- BASIX compliant water tanks

- An appropriate level of on-lot treatment measure within landuses other than low density residential

Street Level Treatment:

- Proprietary Gross Pollutant Traps

Subdivision Level Treatment:

- Large scale bio-retention basins in public reserves

Water Quantity

- Combination of both off-line and on-line detention storage basins for larger flows (2 and 100 year ARI) located adjacent to and within riparian corridors
- Limiting the post-development stream forming flow duration so that it is no more than 3-5 times that of the pre-development stream forming flow duration
- Stormwater harvesting for reuse on sports fields, parks and other public reserve areas where possible

The proposed layout indicating the locations for water quality and water quantity treatments for the Schofields Aerodrome is included in Reference DHASC-B-006-1 from Design & Planning in Appendix B. Alternate WSUD elements within the streetscape (roadside swales and bio-retention systems) are not proposed for the development within the Schofields Aerodrome.

1.5 Conclusion

The water cycle management strategy for the Schofields Aerodrome development provides the basis for the detailed design and development of the site to ensure that the following objectives for stormwater management are achieved:

Environmental:

Existing vegetation within the trunk drainage corridor is retained where possible; existing water bodies with ecological value are retained; downstream and in-channel frequent discharge peaks and velocities are limited to lessen scouring, erosion, siltation and flora and fauna impacts; water quality elements proposed to remove gross pollutants and nutrients from the urban catchments; lessens the impact of ecological health and biodiversity within the riparian corridors.

Urban Amenity:

Limits of flooding 1% AEP affectation have been defined and future development can conform with requirements for freeboard and public safety; quality passive recreational amenity can be provided for the incoming community.

Engineering Considerations:

Peak discharges for frequently occurring storms, peak velocity and flood levels controlled to conform with Council's technical requirements; water quality elements provided to conform with performance and maintenance requirements.

Economics:

The water cycle management strategy is functional; delivers the required technical performance, lessens environment degradation and pressure on downstream ecosystems and infrastructure and provides for a 'soft' sustainable solution for stormwater management within the Schofields Aerodrome release area.

2 Introduction

The Schofields Aerodrome is located in the suburb of Schofields within the Blacktown LGA and part of the Schofield Precinct in the North West Growth Centre. The site consists of approximately 102 hectares.

This report details the procedures, resources used, and the results of studies undertaken by Craig and Rhodes in developing a Water Cycle Management Strategy that incorporates the principles of Water Sensitive Urban Design (WSUD) to support the rezoning process for the proposed development.

The objective of this report is to review and identify appropriate options for the control of the quantity and quality of stormwater leaving the site, and to identify some details of the proposed structures. The proposed options will generally be in accordance with the recommendations set out in the JWP report.

The report addresses engineering considerations whilst placing a strong focus on conserving and enhancing the bio-diversity, ecological health and positive water quality benefits within the existing riparian corridors to provide an integrated natural resource for the incoming residents.

The study involved the following tasks:

- Review relevant statutory guidelines.
- Review JWP report.
- Undertake a water quality analysis and determine minimum treatment device areas required to achieve Blacktown City Council and Department of Environment and Climate Change water quality targets.
- Undertake a stream erosion index assessment to ensure the post development stream forming flow is no greater than 3-5 times the pre development flow.
- Prepare preliminary engineering concept designs for measures required to achieve the water quantity and quality objectives.

3 The Existing Environment

3.1 The Site

The Schofields Aerodrome is located immediately west of the Blacktown-Richmond railway to the north of the Nirimba Education Precinct. Eastern Creek forms the western boundary of the site.

The majority of the development extents has been cleared of structures and consists primarily of grasslands. A small amount of bushland remains within the Eastern Creek riparian corridor.

The location of the Schofields Aerodrome site is indicated on Figure A.

3.2 Existing Drainage Configuration

The entire site drains directly to Eastern Creek or towards it via overland flow paths.

There are a number of significant catchments located upstream of the development site along the southern and eastern boundaries. The upstream catchments are shown in Figure B.

A number of drainage channels have been created on the Aerodrome land to divert old creek lines away from the runways. A number of culverts link the drainage channels under the runways. A drainage channel has also been constructed adjacent to the northern extents of the Nirimba Education Precinct to the south of the development site.

The existing drainage configuration and flow directions within the Schofields Aerodrome site are shown in Figure C.

3.3 The Proposed Development

As part of the Precinct Planning process, and Indicative Layout Plan (ILP) was prepared and identified the various land uses proposed for the site.

The land use for the Aerodrome site included low and medium density residential, educational centres, parks and sporting fields with associated drainage and infrastructure land. The current approved ILP is included in Appendix A.

It is proposed to modify the approved ILP within and immediately adjacent to the Schofields Aerodrome development site.

The proposed ILP covers approximately 86 hectares. This ILP will involve the creation of over 1000 residential allotments, construction of 3 detention basins, water quality bio-retention systems, turf lined swales and channels, and the construction and dedication of new roads. The water quantity and water quality management elements for the proposed works will be constructed adjacent to the Eastern Creek riparian corridor or the proposed drainage reserves within the Schofields Aerodrome site.

The proposed ILP is included in Appendix B.

4 Development Guidelines, Opportunities and Constraints

The following guidelines were considered in developing the Water Cycle Management and Water Sensitive Urban Design (WSUD) strategy for the proposed development of the Schofields Aerodrome.

4.1 Growth Centres Development Code

The Growth Centres Development Code (Ref. 1) identifies the following matters for consideration with regard to Water Sensitive Urban Design and stormwater management:

- Stormwater management strategies should be based on the objectives and principles of Water Sensitive Urban Design. They should promote water reuse and maximise potable water conservation;
- Existing waterways and riparian zones should be conserved and enhanced where possible;
- Stormwater management strategies should be developed and implemented in a manner which considers and addresses potential salinity hazards;
- Stormwater management strategies should be adopted by the ILP to maximise efficient use of land and facilitate adequate allocation of land for stormwater management purposes;
- The ILP should be planned, designed and undertaken in a manner which allows for appropriate control of erosion and sediment pollution;
- A treatment train approach should be used, incorporating structural stormwater treatment measures at the primary, secondary and tertiary levels as necessary to comply with the stormwater management targets;
- The design of stormwater management systems should be integrated with the planning of road layout and design, given the potential benefits of incorporating suitable WSUD elements into road corridors;
- Stormwater reuse, retention and detention strategies should be used to minimise changes to the hydrological (or flow) regime of receiving waterways;
- Urban stormwater should not be discharged to areas of native bushland unless such discharge cannot be avoided. High levels of stormwater treatment and flow retention or detention should be implemented where such a discharge occurs to limit soil erosion and weed growth within areas of native vegetation;
- Management of stormwater should be considered on a subcatchment basis to employ source control techniques in preference to highly centralised ‘end-of-pipe’ treatment measures wherever practicable;
- Trunk drainage routes and dual carriageways should be aligned where possible, to allow use of centre medians for WSUD drainage systems;

- WSUD drainage systems may be incorporated into other roads and streets, where practicable and compatible with other design issues, including safety requirements of the relevant Road Authority;
- Any development within the 1:100 ARI flood level and the PMF should be designed to provide for emergency access;
- Critical infrastructure, such as major roads and rail, are to be located above the 1:100 flood level wherever possible;
- Evacuation routes that continually rise from residential properties to higher land should be provided.

4.2 Blacktown City Council Growth Centre Precincts Development Control Plan

The Blacktown City Council Growth Centre Precincts DCP identifies the following objectives with regard to flowing and water cycle management:

- To manage the flow of stormwater from urban parts of the Precinct to replicate, as closely as possible, pre-development flows
- To define the flood constraints and standards applicable to urban development in the Precinct
- To minimise the potential of flooding impacts on development

4.3 Office of Environment and Heritage

The Office of Environment and Heritage (OEH) (formerly the Department of Environment, Climate Change and Water) has set guidelines for stormwater quality from urban developments in their Interim Recommended Parameters for Stormwater Modelling – North-West and South-West Growth Centres (Ref. 3). This document nominates quantitative post construction phase stormwater management objectives for the reduction of various pollutants for a range of new developments. The retention criteria for the site are nominated as follows:

Pollutant	Pollutant Removal Target
Total Suspended Solids	85% of average annual load for particles 0.5mm or less
Total Phosphorus	65% retention of average annual load
Total Nitrogen	45% retention of average annual load
Gross Pollutants	90% retention of material greater than 5mm

Table 1 - WSUD Retention Criteria

The OEH guidelines also nominate a 'stream erosion index' target of 3.0 – 5.0, where the stream erosion index is defined as the post-development duration of flows greater than the 'stream-forming flow' divided by natural duration of flows greater than the 'stream-forming flow'. For the purposes of these objectives, the 'stream forming flow' is defined as 25% of the 2-year flow rate estimated for the catchment under pre-development conditions.

4.4 Blacktown City Council DCP 2015 Part J

Although the Water Sensitive Urban Design and Integrated Water Cycle Management DCP is not the governing document for the Growth Centres Precinct, which the Aerodrome land falls under, it has been considered during the preparation of this Water Cycle Management Strategy.

Blacktown City Council's Water Sensitive Urban Design and Integrated Water Cycle Management DCP aims to:

- Protect and enhance natural watercourses and their associated ecosystems and ecological processes
- Minimise potable water demand and wastewater generation
- Minimise stream erosion by matching the post-development runoff regime to the pre-development or natural water runoff regime
- Mitigate the impacts of development on groundwater, particularly in saline groundwater environments
- Ensure any changes to the existing groundwater regime do not adversely impact upon any other properties and the environment
- Integrate water cycle management measures into the landscape and urban design to maximise amenity
- Minimise the potential impacts of development and other associated activities on the aesthetic, recreational and ecological values of receiving waters
- Minimise soil erosion and sedimentation resulting from site disturbing activities
- Ensure the principles of ecologically sustainable development are applied in consideration of economic, social and environmental values in water cycle management

4.4.1 Water Conservation

- New residential dwellings are to demonstrate compliance with State Environmental Planning Policy – Building Sustainability Index (BASIX)
- In non-residential developments, dual reticulation for non-potable uses such as toilet flushing, laundry and irrigation must be installed
- For an water use within the public open space, an alternate water source must be identified to meet at least 80% of all demand.

4.4.2 Stormwater (Water Quality and Waterway Stability)

- Reduction of post-development average annual load of gross pollutants (>5mm) by 90%
- Reduction of post-development average annual load of Total Suspended Solids (TSS) by 85%
- Reduction of post-development average annual load of Total Phosphorus (TP) by 65%
- Reduction of post-development average annual load of Total Nitrogen (TN) by 45%
- Reduction of post-development average annual load of Total Hydrocarbons by 90%
- The post-development duration of stream forming flows shall be no greater than 3.5 times the pre-development duration of stream forming flows with a stretch target of 1
- Minimisation of impervious areas that are directly connected to the stormwater drainage system

4.5 New South Wales Office of Water Requirements

A Riparian and Aquatic Assessment was prepared as part of the overall Schofield Precinct Water Cycle Management Report prepared by J. Wyndham Prince.

It stated that Eastern Creek is a Category 1 stream, and the un-named tributaries within the Precinct are classified as Category 2 and 3 watercourses.

It is proposed to align the watercourses through the Schofields Aerodrome development area to reflect what is thought to be the original watercourse alignments.

A screenshot from the JWP report showing the water course categories is shown in Appendix C.

4.6 Salinity

Salinity is the accumulation of mineral salts in the soil, groundwater and surface waters. Dry land salinity results when these soluble salts are transported to the surface by rising water table. Groundwater can also transport these soluble salts and emerge as saline seepage in low lying areas.

Salinity can lead to degraded vegetation, weed invasion, a decline in soil structure and in some cases, structural damage to buildings.

4.6.1 Salinity and Groundwater Control Measures

A Land Capability, Salinity and Contamination Assessment has not been undertaken as part of this proposal, however the report and recommendations from the original WSP Environmental and Energy report have been adopted and summarised below.

Additional development specific geotechnical studies should be undertaken, particularly where filling of the floodplain is proposed

Surface soils at the channels were typically non-saline, while subsoils were typically non-saline to moderately saline

Surface soils located away from the channels were typically non-saline to a depth of 0.5 metres. Deeper soils were slightly saline to moderately saline.

The moderate to high salinity concentrations in groundwater indicate that there is potential for increase in salinity impacts on the upper soil profile should changes to the hydrological cycle result in an increase of the water table.

Surface soils are general non-sodic to sodic and sub-surface soils are classified as highly sodic.

Salinity management measure should be implemented for the Schofields Aerodrome re-development in accordance with the recommendations outlined in the WSP Environmental and Energy Report and the WSROC Western Sydney Salinity Code of Practice.

4.7 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design (WSUD) aims to minimise the impacts of urban development and maximise the multiple use benefits of a stormwater system.

Australian Runoff Quality (ARQ) identifies the objectives of WSUD to include:

- Reducing potable water demand through water efficient appliances, rainwater and greywater reuse.
- Minimising wastewater generation and the treatment of wastewater to a standard suitable for effluent reuse opportunities and/or release to receiving waters.
- Treating urban stormwater to meet water quality objectives for reuse and/or discharge to surface waters.
- Preserving the natural hydrological regime of catchments.

ARQ also identifies WSUD as the adoption of the following planning and design approaches that integrate the following opportunities into the built form of cities and towns:

- Detention, rather than rapid conveyance of stormwater.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- The use of vegetation of filtering purposes.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for various uses.

4.8 Stormwater Management Objectives

4.8.1 Overall Objectives

JW Prince (JWP) outlined the following as objectives for the site stormwater management. These objectives will be applied to the proposed residential subdivision for the land within the extent shown on the proposed rezoning extents.

Environmental

- The provision of appropriately designed and functional water quality treatment systems and facilities;
- the limitation of discharge peaks and velocities into downstream waterways;
- maintenance of environmental flows to downstream ecosystems.

Urban Amenity

- The provision of a water cycle management system that identifies and controls the limits of flood affectation and provision of aesthetic designs that enhance amenity of the area.

Engineering Considerations

- The effective management and control of peak discharges and velocities utilising detention.
- Managing water quality with best practice methodologies and system design.

Economics

- The provision of a cost effective and functional site drainage system that optimises the performance;
- provides maximum value for expenditure; and
- keeps on-going maintenance requirements to a minimum.

4.8.2 Specific Development Objectives

JWP has recognised the following objectives that are in line with Ecologically Sustainable Development (ESD). These objectives will be considered with the current proposal.

- Preserve the ecological integrity of the identified riparian zones.
- Restrict development to be above the 1% AEP flood level.
- Incorporate water sensitive urban design principles within the development.
- Ensure that post-development water quality complied with Council's and the Office of Environment and Heritage's requirements.
- Provision of a sustainable aquatic environment that preserves the potential for creating habitat for locally indigenous flora & fauna.

- Minimise Council's maintenance requirements for open space, litter control structures, and nutrient and sediment removal devices.
- Enhance the biodiversity, ecological heath and positive water quality benefits within the Eastern Creek corridor to provide an integrated natural resource for the incoming residents.

4.9 Opportunities

With the design of an urban drainage scheme, it is desirable to utilise the naturally occurring physical and environmental assets of the site where possible to maximise the quality of the ultimate living environment. It particular water should be recognised as an important resource that enhances an area that is accessible to the whole community.

For the land adjacent to the Schofields Aerodrome precinct there are opportunities to:

- Maintain, rehabilitate and enhance the Eastern Creek riparian corridor;
- Maximise habitat retention along the riparian corridor;
- Integrate open space areas and riparian corridors; and
- Incorporate water reuse schemes to irrigate the proposed public reserves and playing fields wherever possible.

4.10 Constraints

There are constraints that have been identified for the development. These constraints include:

- Relatively flat topography which requires filling to raise developable area above the 1% AEP flood levels;
- Flows from large upstream catchments to the east and south of the site are to be conveyed through the site;
- Water quality and quantity objectives will require allocation of land for stormwater control structures;
- Existing soil and groundwater salinity constraints;
- Water use activities that can cause unnatural charging of groundwater and create rising water tables (e.g. over-irrigation of public areas and sporting fields); and
- Areas of the site that are below the regional and local PMF Flood levels. Evacuation and flood safety will be considered

5 Water Cycle Management Strategy Concept

The Water Cycle Management Strategy for the redevelopment of the Schofields Aerodrome precinct has been prepared with consideration of the requirements and guidelines listed in Section 4 of this report.

The proposed strategy is generally in accordance with the current approval for the area with minor amendments to facilitate that proposed layout for the redevelopment. The current strategy was focused on mitigating the impacts of the development on the total water cycle and maximising the environmental, social and economic benefits by utilising responsible and sustainable stormwater management practices.

5.1 Water Quality Management Options

There is a range of stormwater management techniques and options that were considered by JWP for the management of nutrients and suspended solids discharging from the site.

Detailed explanations for each of the options can be found in Section 6 of the *Water Cycle Management Strategy incorporating Water Sensitive Urban Design Techniques* (JWP 2012).

We have provided a brief explanation of each of those used within the proposed redevelopment extents.

5.1.1 Vegetated Swales and Buffers

Swales are generally vegetated depressions that are used for the conveyance of stormwater runoff from impervious areas. They can assist with:

- Removing sediments by filtration through vegetated surfaces;
- Reducing runoff volumes (by promoting infiltration to the sub soils);
- Delaying runoff peaks by reducing flow velocities.
- Vegetated swales are typically linear and shallow and used as an alternative to kerb and gutter along roadways. Vegetated swales are not suited to residential development lands due to the large number of driveway culvert crossings, safety concerns, and significant maintenance requirements.
- Vegetated swales may be considered for use within median islands of collector roads where driveway crossings are not as prevalent.
- Vegetated swales may also be used to convey stormwater flows within recreational areas and precincts as well as carparking for these areas.

5.1.2 Bio-retention Systems

Bio-retention systems consist of a filtration media bed with either a gravel or sandy loam media with an extended detention zone typically from 100-300mm deep. A bio-retention system is designed to detain and treat the first flush flow from the upstream catchments.

Regional bio-retention systems are proposed within each of the regional detention basins to treat the first flush flows and remove nutrients from stormwater runoff prior to discharging into downstream waters.

Bio-retention systems are effective in treating pollutants from urban development's when used in conjunction with other water quality improvement devices within an overall treatment train.

5.1.3 Rainwater Tanks

Rainwater tanks are sealed tanks designed to contain rainwater collected from the roofs of dwelling and park buildings. The water collected in these rainwater tanks provides the following functions:

Use of water as a substitute for mains water supply for toilet flushing, laundry and irrigation;

Provide some detention storage when additional storage above the overflow is provided, therefore reducing peak flows and reducing downstream velocities.

Rainwater tanks are effective in removing suspended solids and a small amount of nutrient pollutants. They are also effective in reducing the overall runoff volume, particularly when plumbed for internal use.

5.2 Proposed Stormwater Control Strategy

The stormwater management strategy proposed for the site focuses on minimising the impacts of the development on the water cycle while maximising the economic, social and environmental benefits. These benefits will be achieved through responsible and sustainable management practices of stormwater.

It is critical to consider the ecological sustainability of the Eastern Creek Riparian corridor located adjacent to the site. To meet the stormwater quality targets for Eastern Creek, a "treatment train" approach has been considered where the various pollutant types are removed from the water column by a number of stormwater quality improvement devices (SQIDs) acting in series.

5.2.1 Water Efficiency

On Lot Treatment

- The implementation of water efficient fittings and appliances in all proposed dwellings (dual flush toilets, AAA rated shower heads and water efficient taps and plumbing);
- Minimisation of impervious areas through the acceptable development controls;
- The provision of rainwater tanks on each allotment, along with the implementation of water efficient devices to satisfy the requirements of BASIX

5.2.2 Water Quality

On Lot Treatment for Medium / High Density Residential (and Commercial)

The previous Water Cycle Management Strategy by J Wyndham Prince proposed that all development other than low density residential and public Council road, water quality

treatment is to be provided for each site through a community title or similarly appropriate managed scheme. It is proposed to adopt this approach within the land that has been rezoned.

Street Level Treatments

Traditional stormwater drainage systems rely on gross pollutant trap (GPT) devices as a primary water quality treatment to remove litter, vegetative matter, free oils and grease and coarse sediment prior to discharge to downstream treatment devices (secondary and tertiary type). They can take the form of trash screens or litter control pits, pit basket inserts and wet sump gross pollutant traps.

J Wyndham Prince has discussed with Blacktown City Council the preferred primary water quality treatment systems to be used within the Schofields land development area. Council has a preference for end of line proprietary GPT's for the primary treatment of stormwater control over pit inlet filter baskets due to a greater maintenance burden that will be borne by Council with the pit inlet filter baskets over end of the line treatment devices.

Subdivision / Development Treatment

Regional "raingardens" systems and linear bio-retention swales are proposed within the development. Raingardens are large scale, non-linear bio-retention systems.

The raingardens / bio-retention swales within the development will be appropriately sized to achieve the nutrient reduction targets as proposed within Blacktown City Council Water Sensitive Urban Design (WSUD) and Integrated Water Cycle Management DCP for the development site.

The raingardens and bio-retention swales will also provide attenuation of the first flush flows to reduce the risk of stream erosion with the Eastern Creek Riparian corridor. The location of the raingardens and bio-retention swales for the development are shown in Figure 4.

J Wyndham Prince suggests that alternate forms of WSUD elements within the streetscape may be used, however it is not proposed to utilise alternate WSUD elements from those previously mentioned.

5.2.3 Water Quantity

Subdivision / Development Treatment

Detention Basins

Peak storm flow attenuation up to and including the 100 year ARI event will be addressed through the provision of regional online and offline detention storages located within the development precinct extents.

Stream Erosion Index

Limiting the post-development stream forming flow duration so that it is no more than 3-5 times that of the pre-development stream forming flow duration.

5.2.4 Overall Strategy

J Wyndham Prince has identified the key features for the proposed strategy for the Schofields Precinct. These features will be incorporated in the revised rezoning for the Schofields Aerodrome land.

Social:

- Integration of Bio-retention raingarden systems with the overall landscape strategy for the development to create an integrated-natural resource for the incoming and wider community
- Enhanced visual amenity (views out of and through the riparian corridor)
- Flood affectation and public safety issues identified and controlled
- Provision of aesthetic soft design forms that enhance urban and environmental amenity

Environmental:

- Limited downstream and in-channel discharge peaks and velocity to avoid scouring, siltation and flora and fauna impacts
- Enhanced ecological health and biodiversity within the riparian corridors
- Provision of gross pollutant traps and bio-retention systems to achieve water quality capable of sustaining Eastern Creek aquatic ecosystems
- Limitation of frequent wetting flows and peak velocities to avoid creek bed/bank erosion and sedimentation. Peak storm flow attenuation is addressed through the provision of regional and local detention basins within the Schofields Aerodrome land
- A holistic and interdisciplinary approach to the management of urban salinity, using and approach to construction, stormwater management, building and landscaping practices, consistent with the WSROC Western Sydney Salinity Code of Practice and in accordance with the recommendation by WSP Environment and Energy.
- Provision of extensive deep rooted vegetation in strategic areas to intercept ground water glows and generate natural groundwater discharge processes (evapotranspiration)
- Extensive revegetation of allotments, streetscapes, and bio-retention systems to manage urban salinity and provide habitat
- Provision of reticulated recycled water or rainwater tanks within the development to reduce reliance on potable water supplies by using recycled water as a resource

Economic:

- Minimisation of land take consistent with the achievement of environmental and social objectives
- Proposed water quality improvement measure that keep recurrent maintenance tasks and costs to a minimum

The proposed water cycle management strategy for the Schofield Aerodrome redevelopment is functional, delivers the required technical performance, reduces environmental degradation and pressure on downstream ecosystems and infrastructure and provides for a 'soft' sustainable solution for stormwater management consistent with the provisions for the entire Schofields land release area. The water cycle management concept is illustrated in Figure 4.

5.3 Litter and Sediment Control

Local drainage through the Schofields Aerodrome re-development should be filtered to remove litter and coarse sediment from the water column prior to discharging to the downstream drainage systems, raingardens and riparian corridors. Devices include inlet pit filter baskets, cast in situ and precast gross pollutant traps as well as wet sump and self-cleansing units.

It is our understanding from the J Wyndham Prince report that Blacktown City Council has a preference to not adopt pit filter inserts on a large scale within the development precinct. It is proposed to provide proprietary gross pollutant trap structures to capture litter, vegetative matter and coarse sediment prior to discharge to the downstream treatment devices.

It is expected that all inlets to the proposed raingardens and detention basins shall have gross pollutant traps installed.

5.4 Raingarden/Bio-retention Systems

There are three raingardens that are proposed within the development site of the Schofields Aerodrome.

The raingardens consist of an organic sandy loam bed (0.5m) which will be densely vegetated with native sedges and/or grasses contained within Council's approved plants list. These raingardens would be designed to receive, convey and treat flows up to approximately the six (6) month ARI flow from the upstream catchments.

Treatment of stormwater by the raingardens is attained by the temporary detention of the flows, direct filtration and nutrient stripping by bio-films which establish on the surface of the media bed. The organic sandy loam bed and plant system minimises evapo-transpiration losses and the raingardens will be design to prevent seepage loses and to avoid groundwater salinity impacts.

The proposed raingardens which service the proposed development will have an extended detention zone of 300mm which will service the first flush and base flows from the urban development. The filter areas of the raingardens vary depending on the extent of on-lot treatment within the upstream sub-catchment. As there are a number of areas that are to be zoned for commercial and medium density residential, these areas will provide on-lot treatment of stormwater to Blacktown City Council requirements in accordance with the Growth Centres Development Control Plan.

The raingardens have been sized using MUSIC modelling of the catchment. Additional performance of the stormwater quality treatment proposed for the development is presented in Section 7 of this report and indicative concept layouts have been provided in the appendices.

It is recommended that the raingardens should be utilised as sedimentation control ponds prior to the completion of the construction and housing phases of the development site draining to the basins. Once sediment loads have reduced from construction levels, these raingardens should be commissioned to provide water quality improvement as designed.

Maintenance for the raingarden would typically involve the replacement of plants, weed control within the basin filter media, repair of erosion of filter media, and the removal of localised sediment build up, particularly around basin inlets.

5.5 Water Quantity Management

Blacktown Council has advised that GHD is preparing a catchment study for the precinct to assess the requirements of the detention basins. Initial reports have indicated that the basins within the Schofields Aerodrome precinct are not required for stormwater quantity. However Council has indicated that until this document has been approved by Council, the proposed basins within the catchment shall be designed and constructed as permanent basins.

It is proposed to design these basins as the area is developed and constructed as required to maintain Council's existing stormwater detention requirements until the GHD report has been approved for the area.

Stormwater quantity management for the Schofields Aerodrome precinct is achieved through the provision of three (3) detention basins. One of the proposed basins (Basin 5) is online with the remaining two (2) detaining flows from the Schofields Aerodrome precinct.

The performance of these basins is described in Section 8.

5.6 Construction Stage

Erosion and sediment control measures should be implemented during the construction phases of the Schofields Aerodrome precinct in accordance with the requirements of Blacktown City Council and the guidelines set out by Landcom (the Blue Book).

As raingardens are sensitive to the impact of sedimentation, these sediment control measures should be maintained until the majority of site building works are complete.

5.7 Long Term Management

Regular maintenance of the raingardens and gross pollutant traps is required to control weeds, remove rubbish and to monitor plant establishment and health within the raingardens. Any sediment build up on the surface of the filter media will need to be removed to maintain the design standard of stormwater treatment.

Proper management and maintenance of the water quality control systems shall ensure the long term functional treatment of the stormwater generated by the catchment. A general Operation and Maintenance Manual for the stormwater treatment systems has been included with this report, however site-specific manuals shall be prepared as each stage of the Schofields Aerodrome precinct is developed and basins are constructed.

6 Hydrologic Analysis & Flood Modelling

A hydrologic analysis of the catchment has been undertaken by BG&E in the preparation of the Flood Modelling for the catchment.

The initial flood impact assessment report prepared by BG&E was submitted as part of the Bulk Earthworks Development Application (DA-15-00999). This report was subsequently approved by Council.

BG&E has revised this flood impact assessment based on the rezoning application and has reported the following “Flood modelling results and particularly 100 year ARI flood difference mapping demonstrated that the updated design results in negligible difference compared to the bulk earth works design approved under the current DA”.

Additional details regarding the hydrologic and hydraulic analyses can be found in their report (ref. S13026 dated 26 Feb, 2018) and included in Appendix C of this report.

7 Water Quality Analysis

The water quality analysis for the Schofield Aerodrome precinct rezoning was undertaken using the software MUSIC (Modelling for Urban Stormwater Improvement Conceptualisation) Version 6. This modelling software was developed by the Cooperative Research Centre (CRC) for Catchment Hydrology which is based at the Monash University and first released in 2002. Version 6.2 was released in May 2016.

The model allows for a number of features relevant to the development to be assessed:

- Model the potential nutrient reduction benefits of gross pollutant traps, raingardens (bio-retention systems), infiltration systems, and it incorporates mechanisms to model stormwater reuse as a treatment technique.
- Provides mechanisms to evaluate the removal of key nutrients to attain the desired water quality objectives.
- Allows for a Stream Erosion Index assessment.

The MUSIC modelling was undertaken to ensure that the proposed water quality treatment system for the Schofields Aerodrome precinct will result in the reduction of pollutant loads being discharged from the proposed development to meet the designated Council and Best Practice water quality targets.

7.1 Catchments

Due to the size of the catchment draining to the regional raingardens, the site was broken down into a number of smaller sub-catchments and a MUSIC model was prepared to represent the proposed stormwater treatment system for each of the sub-catchments. The catchments have been shown in Figure 6. The breakdown of the catchments is summarised in the following table and a screenshot of the MUSIC model showing the arrangements of the proposed stormwater treatment system is shown in Figure 7.

Catchment Type	Imperviousness	Contributing Area	Area
Stockland Development Site (Adjoining to the North of future Burdekin Road)			
Roof (to RWT)	100%	27.5%	2.625
Roof	100%	27.5%	2.625
Driveway	100%	10.0%	0.955
Other Impervious	100%	20.0%	1.909
Pervious	0%	15.0%	1.432
Roads	95%		3.743

Basin 5 – Low Density			
Roof (to RWT)	100%	27.5%	4.889
Roof	100%	27.5%	4.889
Driveway	100%	10.0%	1.778
Other Impervious	100%	20.0%	3.555
Pervious	0%	15.0%	2.666
Roads	95%		13.921
Basin 5 – Medium Density			
Roof (to RWT)	100%	30.0%	1.220
Roof	100%	30.0%	1.220
Driveway	100%	7.5%	0.305
Other Impervious	100%	17.5%	0.712
Pervious	0%	15.0%	0.610
Basin 5 – Commercial & School			
Roof (to RWT)	100%	40.0%	1.217
Roof	100%	40.0%	1.217
Driveway	100%	5.0%	0.152
Other Impervious	100%	5.0%	0.152
Pervious	0%	10.0%	0.304
Basin 5 – Open Space			
Pervious	10%		8.744

Basin 6 – Low Density			
Roof (to RWT)	100%	27.5%	1.586
Roof	100%	27.5%	1.586
Driveway	100%	10.0%	0.577
Other Impervious	100%	20.0%	1.154
Pervious	0%	15.0%	0.865
Roads	95%		4.644
Basin 6 – Open Space			
Pervious	10%		8.233
Basin 6A – Low Density			
Roof (to RWT)	100%	27.5%	2.693
Roof	100%	27.5%	2.693
Driveway	100%	10.0%	0.979
Other Impervious	100%	20.0%	1.959
Pervious	0%	15.0%	1.469
Roads	95%		5.457
Bypass – Medium Density			
Roof (to RWT)	100%	30.0%	0.526
Roof	100%	30.0%	0.526
Driveway	100%	7.5%	0.131
Other Impervious	100%	17.5%	0.307
Pervious	0%	15.0%	0.263
Roads	95%		1.131
Bypass – Open Space / SP2			
Pervious	10%		4.894

Table 2 - WSUD Catchments

In accordance with Blacktown City Council's Water Sensitive Urban Design and Integrated Water Cycle Management Development Control Plan (2015), and Council's MUSIC modelling guidelines, the post-development conditions were modelled with a mixture of roof, roads, other impervious and pervious areas with appropriate fraction imperviousness.

The majority of the urbanised areas within the catchment will discharge to Eastern Creek after treatment within the regional raingardens. The smaller areas bypassing the raingardens will be compensated for by oversizing the gardens in the areas that are able to be treated by the raingardens. All stormwater runoff will be treated with a gross pollutant trap as a minimum prior to discharge to Eastern Creek.

7.2 Rainfall Data

MUSIC can utilise rainfall data based on the following timesteps:

- 6 minutes;
- 12 minutes;
- 30 minutes;
- Hourly;
- 3 hourly;
- 6 hourly;
- 12 hourly; and
- Daily

MUSIC recommends that the timestep be chosen based on the time of concentration for the smallest sub catchment within the model, or estimating the shortest expected duration of detention time within the proposed treatment measures. We have adopted a 6-minute timestep for the catchment.

Blacktown City Council has provided a 10 year period of rainfall to be used within the MUSIC model. The representative period and station is as follows:

Station No.	Location	Years of Record	Type of Date
67033	Liverpool	1967 - 1976	6 minutes

Table 3 - Adopted Rainfall Data

7.3 Pollutant Loading Rates

The Blacktown City Council Draft MUSIC Modelling Guidelines outlines the parameters that have been derived for use within the Blacktown LGA. These numbers have been derived for the Western Sydney region from model calibration studies.

The following parameters have been adopted within the MUSIC model prepared as part of this Water Cycle Management Report.

Parameter	Adopted Value
Rainfall Threshold (mm/day)	1.40
Soil Storage Capacity (mm)	170
Initial Storage (% of Capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient – a	210.0
Infiltration Capacity Exponent – b	4.70
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	4
Daily Deep Seepage Rate (%)	0.0

Table 4 - MUSIC Rainfall-Runoff Parameters

Land Use		Total Suspended Solids (Log_{10} mg/L)		Total Phosphorus (Log_{10} mg/L)		Total Nitrogen (Log_{10} mg/L)	
		Storm Flow	Base Flow*	Storm Flow	Base Flow*	Storm Flow	Base Flow*
Roof	Mean	1.30	1.20	-0.89	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Road (incl. Driveway)	Mean	2.43	1.20	-0.30	-0.85	0.34	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Other Impervious	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Pervious	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12

Table 5 - MUSIC Source Node Parameters

The above values are consistent with those nominated in Blacktown City Council's WSUD Developer Handbook and Part J of the Development Control Plan.

7.4 Treatment Device Performance

A number of difference devices are proposed for treating stormwater runoff generated by the proposed development.

7.4.1 Rainwater Tanks

As the vast majority of the development site is low density residential, which are likely to require rainwater tanks under BASIX requirements, Blacktown City Council's Draft Music Modelling Manual requests that a rainwater tank of volume 2.5kL be supplied per dwelling but modelled as a 2.0kL tank per dwelling.

A maximum of 50% of any roof area within the catchment is assumed to drain to the rainwater tank.

The adopted reuse within the rainwater low density residential areas has been modelled as per the Blacktown City Council Draft MUSIC Modelling Manual. As the final lot sizing will be governed by the SEPP and the Development Control Plan, it is assumed that all lots will be less than 320m^2 as a conservative estimate. This gives the smallest level of reuse within the proposed development.

The adopted reuse rates are as follows:

	Demand per Dwelling
Daily Demand (kL/day)	0.08
Annual Demand (kL/year)	25

Table 6 - Non-potable Demand

The rainwater tanks for the medium density and commercial areas have been excluded from the current modelling prepared as part of this report, but reuse targets would be expected as per BASIX for the medium density residential and the Council requirements for the commercial.

7.4.2 Gross Pollutant Traps

It is proposed to provide gross pollutant traps sized for the relevant catchments prior to discharging into the raingardens and drainage reserves.

Blacktown City Council approved nodes have been adopted for the MUSIC model. It is proposed to provide continuous-deflection systems (CDS) for the inlets to the raingardens. These devices will be sized for the appropriate treatment requirements and flow rates for the upstream catchment draining to the device.

7.4.3 Bio-retention Basins and Swales

The proposed bio-retention systems (raingardens) are shown on Figure 4. The design input assumptions that have been adopted for the raingardens are presented in Table 7. These values have been adopted in accordance with Blacktown City Council's Draft MUSIC Modelling Guidelines.

Parameter	k (m/yr)	C* (mg/L)
Total Suspended Solids	8000	20.000
Total Phosphorus	6000	0.130
Total Nitrogen	500	1.400
Filter Media Soil Type	Loamy Sand	

Table 7 - Raingarden Parameters

7.5 Pollutant Load Estimates

Total annual pollutant load estimates and overall reduction results from the MUSIC model for the proposed development, incorporating the proposed treatment devices in Section 7.4, are outlined in Table 8.

Pollutant	Post-Development without Treatment (kg/yr)	Post-Development with Treatment (kg/yr)	Overall Reduction (%)
Total Suspended Solids	108,000	15,400	85.8
Total Phosphorus	206	66.2	67.8
Total Nitrogen	1,340	614	54.3
Gross Pollutants	15,100	185	98.8

Table 8 - MUSIC Summary Table

7.6 Discussion of Modelling

Modelling results demonstrating the performance of the proposed water quality management strategy for the proposed development, as summarised in Table 8, indicates that this proposed strategy will meet the water quality requirements specified within the Growth Centre Development Code, OEH's water quality objectives and Blacktown City Council's development guidelines.

8 Water Quantity Analysis

The water quantity analysis for the Schofield Aerodrome precinct rezoning was undertaken using the RAFTS Methodology built into the premium version of DRAINS. This modelling software was developed utilising the Laurenson Method and is undergoing on-going development.

The model allows for stormwater runoff volumes and flow rates for the upstream catchments draining through and generated from the development site to be assessed.

The DRAINS/RAFTS modelling was undertaken to ensure that the peak discharges from the proposed development of the Schofields Aerodrome precinct will not have a negative impact by increasing flow discharge rates downstream of the development and exacerbating flood impacts within Eastern Creek.

8.1 Methodology

A DRAINS/RAFTS model was prepared to assist with the sizing of the stormwater detention basins proposed as part of the development of the Schofields Aerodrome precinct.

The following table is a summary of the inputs used within the model:

Parameter	Value
Impervious Area Initial Loss (mm)	1.5
Impervious Area Continuing Loss (mm/hr)	0
Pervious Area Initial Loss (mm)	15
Pervious Area Continuing Loss (mm/hr)	2.5
B_x	1

Table 9 - RAFTS Input Parameters

The DRAINS/RAFTS model was used to size the basins to accommodate the extent of the development that will drain to the basins. Small areas of the catchment bypass these detention basins, and the proposed basins will allow for these areas to bypass without increasing the overall discharge from the development.

Rainfall intensities for the model were adopted from Blacktown Council's Engineering Guide for Development.

8.2 Catchments

Due to the size of the overall catchment, as well as the number of detention basins proposed, the site was broken down into a number of smaller sub-catchments and the DRAINS/RAFTS model prepared to represent the sub-catchments as shown in Figure D. The breakdown of the sub-catchments utilised in the DRAINS/RAFTS model is summarised in the following table. The table summarises both pre- and post-development conditions.

Catchment Name	Area (ha)	Pre-Development Imperviousness (%)	Post-Development Imperviousness (%)	Notes
Stockland	13.36	5	85	
Burdekin	50.49	5	5	Detention Basins (E1.2 & E1.5) are proposed for this catchment under S94 CP20 – Riverstone & Alex Avenue Precincts
Stg 1-3	44.50	17	85	
Stg 4-6	18.65	17	85	
Stg 7	15.91	17	85	
Stg 8	2.19	17	85	

Table 10 - Stormwater Drainage Catchments Summary

As noted in the table above, the catchment entering the drainage channel adjacent to the future Burdekin Road has already undergone stormwater quantity management to reduce the flows to predevelopment discharges as outlined in the Riverstone and Alex Avenue Water Cycle Management Plan (GHD, 2010) prepared as part of the precinct planning for this area upstream of the development site.

8.3 Basin Summary

To cater for the increased peak discharges as a result of increasing the imperviousness of the catchment, it is proposed to provide three (3) stormwater detention basins throughout the development.

The following tables summarise the performance of the detention basins for a range of ARI events up to and including the 100-year ARI event.

ARI	Pre-Development Discharge (m^3/s)	Post-Development Discharge (m^3/s)	Required Volume (m^3)
2	4.54	4.25	
5	6.70	4.52	
10	7.92	5.33	
20	9.98	7.02	
50	12.10	9.13	
100	14.00	10.90	20,100

Table 11 - Basin 5 Detention Basin Summary

ARI	Pre-Development Discharge (m^3/s)	Post-Development Discharge (m^3/s)	Required Volume (m^3/s)	
			Basin 6	Basin 6A
2	2.37	1.87		
5	3.67	2.08		
10	4.56	2.20		
20	5.86	2.36		
50	7.17	2.51		
100	8.39	2.68	12,000	5,600

Table 12 - Basin 6 & 6A Detention Basin Summary

8.4 Discussion of Modelling

Modelling for the detention basins has been carried out using the RAFTS (Runoff Analysis and Flow Training Simulation) model within the premium version of DRAINS. This methodology utilises a non-linear runoff routing model developed by Laurenson.

9 Waterway Stability Management and Stream Erosion Index

9.1 Introduction

The former Department of Environment, Climate Change and Water (now the Office of Environment and Heritage (OEH)), Blacktown City Council and the Sydney Metropolitan Catchment Management Authority (SMCMA) have recently released draft guidelines outlining techniques to address the risk of stream erosion from the urbanisation of catchments.

Stream erosion is assessed using a measure of the increase in the relative frequency in flows from the site greater than the identified 'stream forming flow' resulting from urbanisation of the catchment. This measure is referred to as the Stream Erosion Index. The stream erosion index assessment is considered to be an appropriate means of assessing and addressing the impacts of urbanisation on the frequency of regular flows to the riparian corridor.

The stream erosion index is defined by the OEH as the post development duration of flows greater than the 'stream forming flow' divided by the natural duration of flows greater than the 'stream forming flow'. Blacktown City Council has adopted the 'stream forming flow' to be 25% of the 2 year ARI flow rate due to the dispersive nature of typical local clay soils, and is more conservative than the OEH approach.

The OEH guidelines recommend a stream erosion index of between 3.5-5, while Council's WSUD and Integrated Water Cycle Management DCP recommends an index of no greater than 3.5.

9.2 Modelling

The MUSIC model developed for the proposed development was utilised and modified to determine the stream erosion index at each discharge point from the site, based on the methods outlined in the SMCMA Draft NSW MUSIC Modelling Guidelines (2010) and Blacktown City Council's Developer Handbook for Water Sensitive Urban Design (2013).

Similarly, as for the water quality assessment, the subcatchments were split into nodes representing the roofs, roads, other impervious area and pervious areas, with appropriate fraction imperviousness values based on proposed land use categories, consistent with the water quality modelling described in Section 0. The nodes representing the various water quality elements were incorporated in the model, also consistent with the water quality modelling.

The pre-development scenario was added to obtain the pre-development flows. The subcatchment areas were defined based on the post-development catchment areas to allow for direct comparison of flows with the post-development model. All pre-development subcatchments were assigned a 0% fraction imperviousness value.

Generic nodes were added to the end of each pre- and post-development subcatchment treatment train to model the flow transfer and calculate the annual volume of flow above the critical flow for both cases.

9.3 Stream Forming Flow and Stream Erosion Index

The 2 year ARI flow for each subcatchment was determined using Rational Method calculations. The 'stream forming flow' was determined adopting 25% of the 2 year ARI flow rate, and the Stream Erosion Index was calculated and outlined in the following table.

Catchment	Area (ha)	Pre Dev 2 Year ARI Flow (m^3/s)	25% of 2 year ARI Flow (m^3/s)	Pre Dev Outflow (ML/yr)	Post Dev Outflow (ML/yr)	SEI
Site	86.896	4.129	1.032	36.1	61.4	1.70

Table 13 - Stream Erosion Index Calculation

9.4 Discussion of Modelling

Modelling results indicate that the Stream Erosion Index is approximately 1.7 for when adopting 25% of the 2 year ARI flow rate as the 'stream forming flow' for the catchment. This value is well within the targets outlined by the OEH and Blacktown City Council. The provision of the on-site detention basins within the proposed development will assist in minimising impact of urbanisation on downstream waterways.

10 Summary & Conclusion

This Water Cycle Management Report has been prepared for the Schofields Aerodrome Development to support the rezoning of the site. The strategy has been prepared to conform with relevant statutory requirements and industry best practice for stormwater management in the relevant catchments and generally in concurrence with the previous strategy outlined by JW Prince.

The water cycle management strategy consists of treatment trains utilising on-lot treatment, street level treatment and subdivision treatment measures. The individual elements proposed for the proposed development consists of:

1. GPT units
2. Bioretention & detention basins
3. Drainage channels

The provision of water quality treatment devices within the proposed development will ensure that post development stormwater discharge will meet the water quality requirements specified within the Growth Centre Development Code, OEH's water quality objectives and Blacktown City Council's development guidelines.

The provision of WSUD elements within the proposed development will assist in minimising impact of urbanisation on downstream waterways and comply with Stream Erosion Index targets required by the OEH and Blacktown City Council.

With regards to flooding, BG&E has demonstrated that the proposed rezoning has negligible impact from that which has been currently accepted by Council as part of the bulk earthworks development application (DA-15-00999).

The proposed Water Cycle Management Strategy for the developed site provides a basis for the detailed design and development of the site to ensure that the environmental, urban amenity, engineering and economic objectives for stormwater management and site discharge will be achieved.

Master Plan
SCHOFIELDS

NORTH

40 0 80 160 240 320 400 metres

Ref: DHASC-B-006-1	Date: 19/12/2017	Revision: I	Scale: 1:4,000@A1

Note: All areas and dimensions subject to detailed survey

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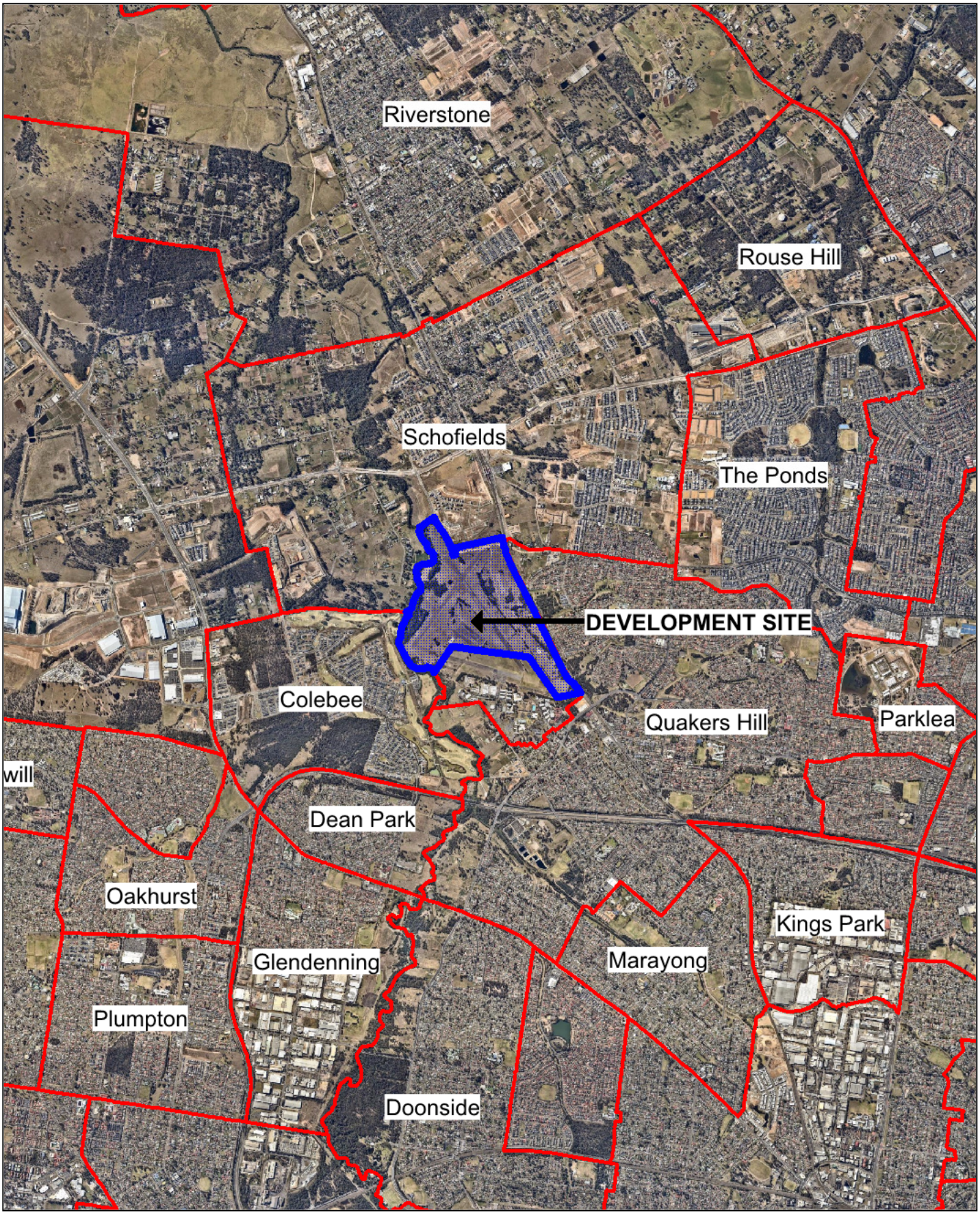
11 References

1. Blacktown City Council (2005) *Engineering Guide for Development*
2. Blacktown City Council (2015) *Delivery of S94 Stormwater Infrastructure by Developers in the North West Growth Centre*
3. Blacktown City Council (2013) *Developer Handbook for Water Sensitive Urban Design*
4. Blacktown City Council (2015) *Blacktown Development Control Plan – Part J Water Sensitive Urban Design and Integrated Water Cycle Management*
5. Engineers Australia (1987), *Australian Rainfall & Runoff: A Guide to Flood Estimation*
6. Geosciences Australia (2016) *Australian Rainfall & Runoff: A Guide to Flood Estimation*
7. Sydney Metropolitan Catchment Management Authority (2010) *Draft NSW MUSIC Modelling Guidelines.*

Figures



Title:

Site Locality

Figure: **A**

Rev: **A**

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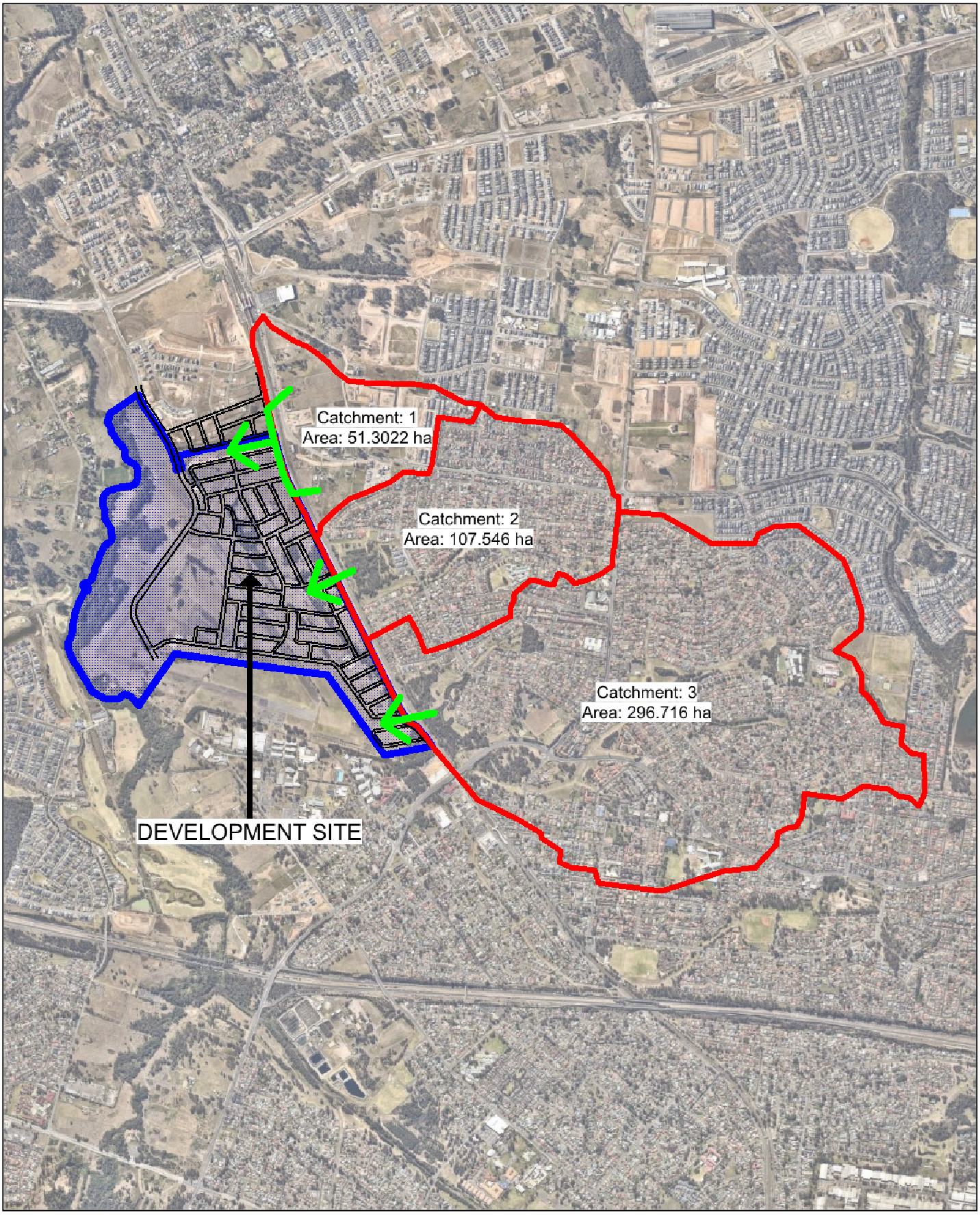

Title:

Upstream Catchment Plan

Figure: **B**

Rev: **A**

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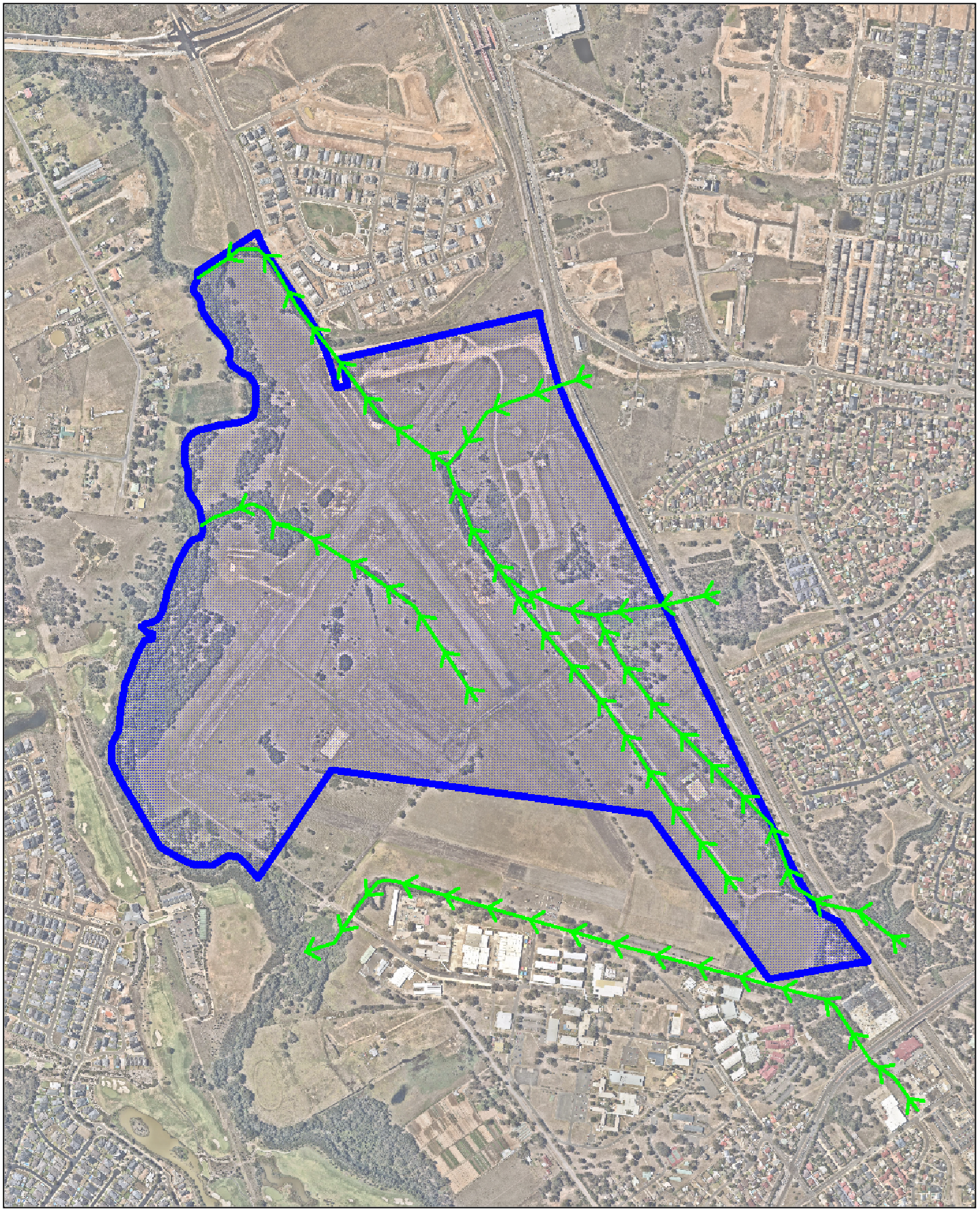

Title:

Existing Flow Paths

Figure: **C**

Rev: **A**

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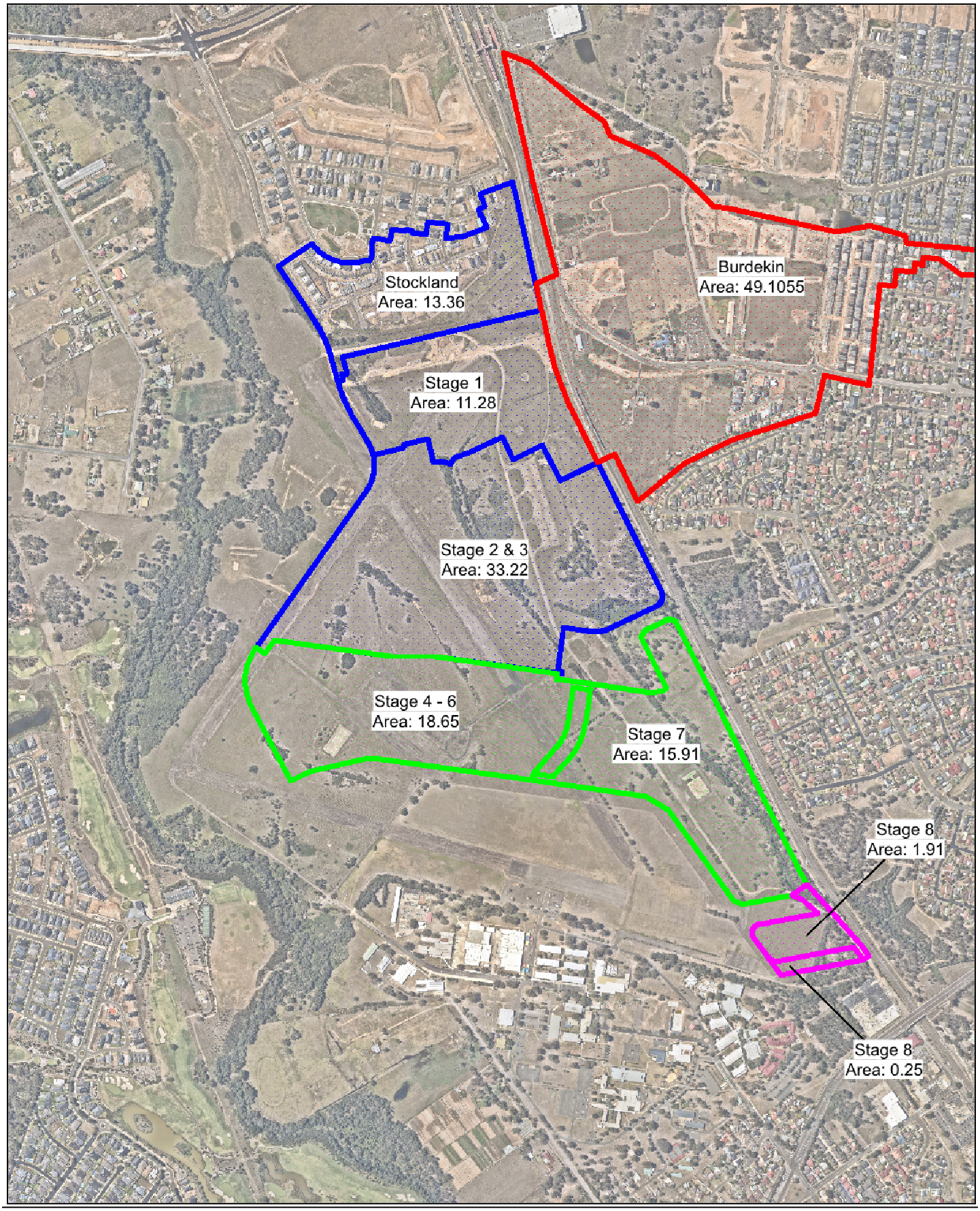

Title:

RAFTS Catchments

Figure: **D**

Rev: **A**

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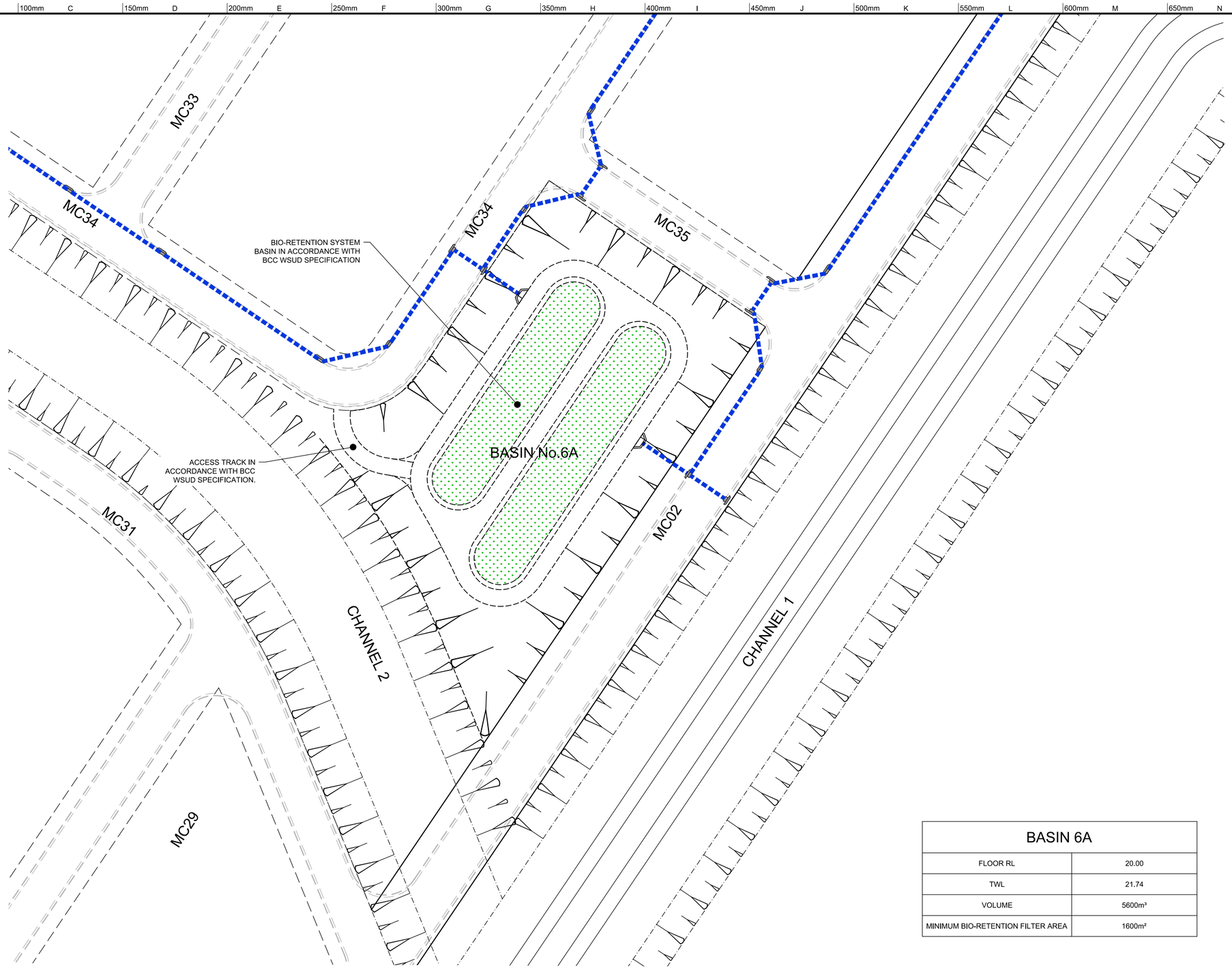

PLAN
1:500

BASIN 6A	
FLOOR RL	20.00
TWL	21.74
VOLUME	5600m³
MINIMUM BIO-RETENTION FILTER AREA	1600m²

NOTE:
STORMWATER NETWORK INDICATIVE ONLY
AND SUBJECT TO DETAILED DESIGN.

0 5 10 15 20 30 40 50m
1:500

FOR INFORMATION ONLY

REV	DATE	AMENDMENT DESCRIPTION
A	08.03.18	ISSUED FOR INFORMATION

DIAL 1100 BEFORE YOU DIG

DHA Defence Housing Australia

Project:
SCHOFIELDS AERODROME DEVELOPMENT
BULK EARTHWORK

Principal: DEFENCE HOUSING AUSTRALIA

Scale	Date	Council Ref.
1:500	21.7.2017	
	Datum AHD	L.G.A. BLACKTOWN CITY COUNCIL

Calc's	Drawn.	Proj.Man.	Client Ref:
S.W.	J.H.	F.C.	

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Drawing Title
BASIN 6A
LAYOUT PLAN

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1784	1784C-SK-0144	A

CAD REF: Z:\1784C\CAD\PLANS\SKETCHES\1784CSK0144.DWG - A1 - DATE PRINTED: 8/03/2018 4:24:49 PM

A1

VERON ROAD

MUSTANG

MC15

MC22

MC13

DRIVE

MC00

MC01

ACCESS TRACK IN ACCORDANCE WITH BCC WSUD SPECIFICATION.

ACCESS TRACK IN ACCORDANCE WITH BCC WSUD SPECIFICATION.

EXISTING SEWER LINE

BURDEKIN ROAD (FUTURE)

BIO-RETENTION SYSTEM BASIN IN ACCORDANCE WITH BCC WSUD SPECIFICATION

BASIN No.5

CHANNEL 3

EASTERN CREEK

BASIN 5	
FLOOR RL	18.60
TWL	19.49
VOLUME	20100m³
MINIMUM BIO-RETENTION FILTER AREA	4100m²

PLAN
1:500

NOTE:
STORMWATER NETWORK INDICATIVE ONLY AND SUBJECT TO DETAILED DESIGN.

0 5 10 15 20 30 40 50m
1:500

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REV	DATE	AMENDMENT DESCRIPTION
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DHA Defence Housing Australia

Project:
SCHOFIELDS AERODROME DEVELOPMENT
BULK EARTHWORK

Principal: DEFENCE HOUSING AUSTRALIA
Scale: 1:500
Date: 21.7.2017
Datum: AHD
Council Ref.
L.G.A. BLACKTOWN CITY COUNCIL
Calc's: S.W.
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Drawing Title: BASIN 5 LAYOUT PLAN

C&R Ref. 1784
Drawing Ref. 1784C-SK-0142
Revision A

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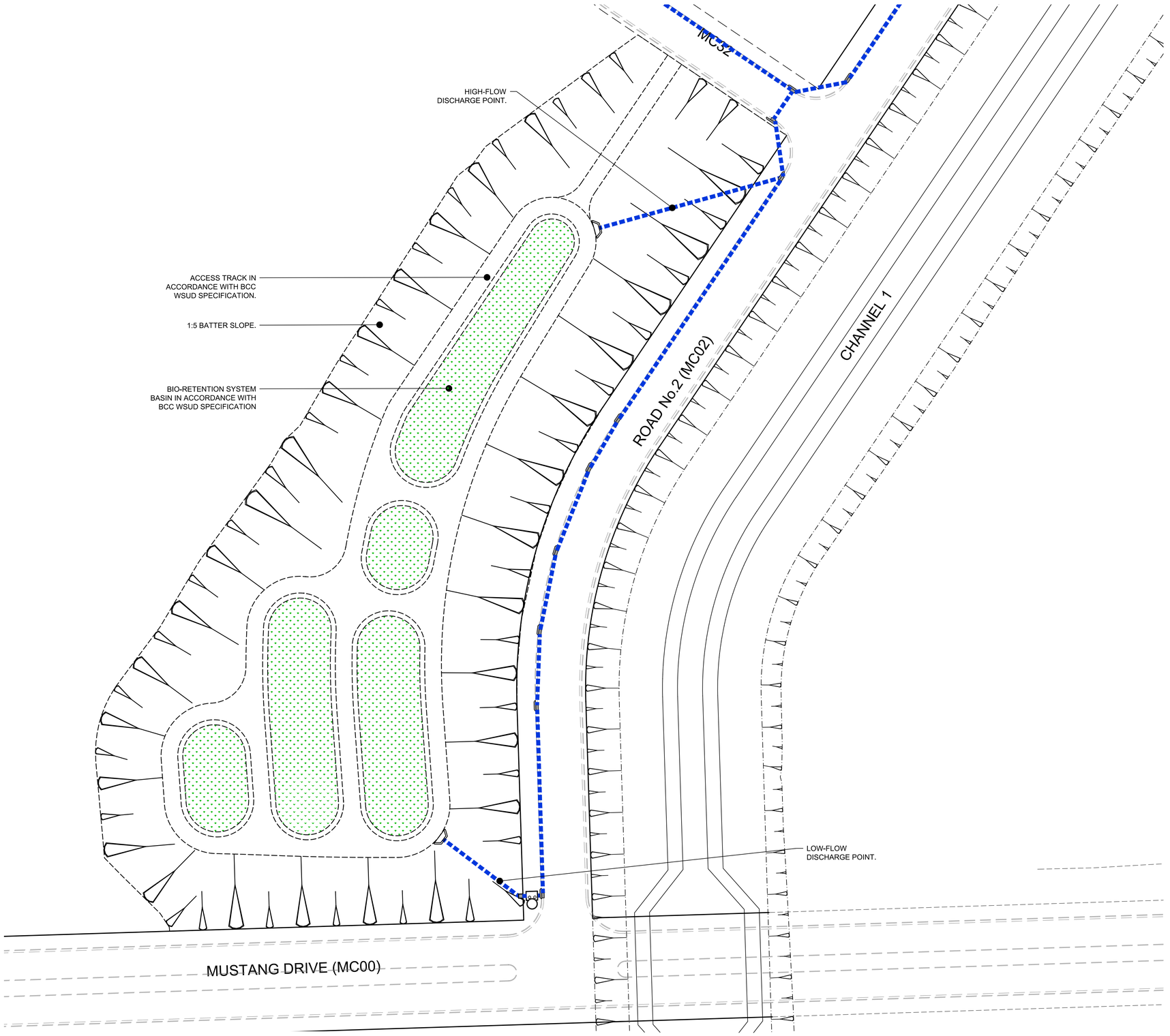

PLAN
1:500

BASIN 6	
FLOOR RL	18.45
TWL	19.89
VOLUME	12000m³
MINIMUM BIO-RETENTION FILTER AREA	3000m²

NOTE:
STORMWATER NETWORK INDICATIVE ONLY
AND SUBJECT TO DETAILED DESIGN.

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1:500

FOR INFORMATION ONLY

REV	DATE	AMENDMENT DESCRIPTION
A	08.03.18	ISSUED FOR INFORMATION

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DHA Defence Housing Australia

Project:
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BULK EARTHWORK

Principal: DEFENCE HOUSING AUSTRALIA

Scale	Date	Council Ref.
1:500	21.7.2017	
	Datum AHD	L.G.A. BLACKTOWN CITY COUNCIL

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Drawing Title
BASIN 6
LAYOUT PLAN

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0143	A

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Appendix A – Existing Approved Indicative Layout Plan

NSW GOVERNMENT | Planning & Infrastructure

Schofields Precinct
Indicative Layout Plan

- Precinct Boundary
- Transport Corridor Investigation Area
- A — DCP Provisions Subject to Clause 6.9
- Local Centre
- Neighbourhood Centre
- Preferred Location for Neighbourhood Services
- Medium to High Density Residential
- Medium Density Residential
- Low Density Residential
- Environmental Living
- Educational Uses
- Community Uses
- Private Recreation
- Park
- Sporting fields
- Conservation Area
- Riparian Corridor
- Heritage Item
- Historic Runway Archaeological Interpretation
- Drainage and Infrastructure
- Road
- Richmond Rail Line
- Existing Transmission Line Easement
- Eastern Creek

N

0 50 100 200 500m

Approximate scale:
5,000 @ A0 or 10,000 @ A2
5 April 2012

Appendix B – Proposed Indicative Layout Plan

Master Plan
SCHOFIELDS

NORTH

40 0 80 160 240 320 400 metres

Ref: DHASC-B-006-1	Date: 19/12/2017	Revision: I	Scale: 1:4,000@A1

Note: All areas and dimensions subject to detailed survey

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Appendix C – Revised Flood Impact Assessment

DRAFT

Project No: S13026

26 February 2018

Defence Housing Australia
Suite 2, Level 2/287 Elizabeth Street
Sydney NSW 2000

Attention: Jasmina Moltter

Dear Jasmina,

SCHOFIELDS AERODROME RESIDENTIAL DEVELOPMENT
REVISED FLOOD IMPACT ASSESSMENT

This letter report is submitted by BG&E Pty Limited (BG&E) who has been engaged by Defence Housing Australia (DHA) to carry out a hydrological and hydraulic investigation of Eastern creek and major overland flow through the proposed development site located at Schofields Aerodrome.

BG&E previously prepared the Flood Assessment report for the Development Application (DA) associated with bulk earthworks for the project (report dated 19/12/2016 Rev 2). The DA has been approved by Blacktown City Council.

This letter presents the results of a revised flood impact assessment based on an amended development layout and bulk earthworks design (post-DA design amendments).

1 BULK EARTHWORKS DESIGN UPDATES

Craig & Rhodes has made the following changes to the development layout and bulk earthworks design since the DA was issued:

- Realigned Mustang drive towards Eastern Creek (previously east of Playing Field area);
- Realigned major drainage Channels 1 and 2;
- Amended designs for stormwater Basins 5 and 6 and addition of Basin 6A;

Additional survey was carried out in the south-western part of the site to better represent conditions downstream of the existing culverts beneath Quakers Hill Parkway.

Further details can be found in Craig & Rhodes engineering drawings and documentation.

2 FLOOD MODEL UPDATES

The flood assessment for the site has been carried out based on hydrologic (XP-RAFTS) and hydraulic (TUFLOW) models provided by Blacktown City Council (refer BG&E 2016 report). The following updates were made to the hydrologic and hydraulic models to reflect the revised design:

- Developed case XP-RAFTS model was updated to reflect changes in local catchments and contributing areas to proposed basins and channels.
- Baseline and developed case TUFLOW models were updated to incorporate survey data near Quakers Hill Parkway.

- Developed case TUFLOW model was updated with revised bulk earthworks design TIN (imported from 12D).
- Developed case TUFLOW model was updated to include proposed culverts/pipes (refer attached Figure 13):

Figure 1 below compares the development layout under the current DA (left) and revised layout incorporating the latest design amendments (right).

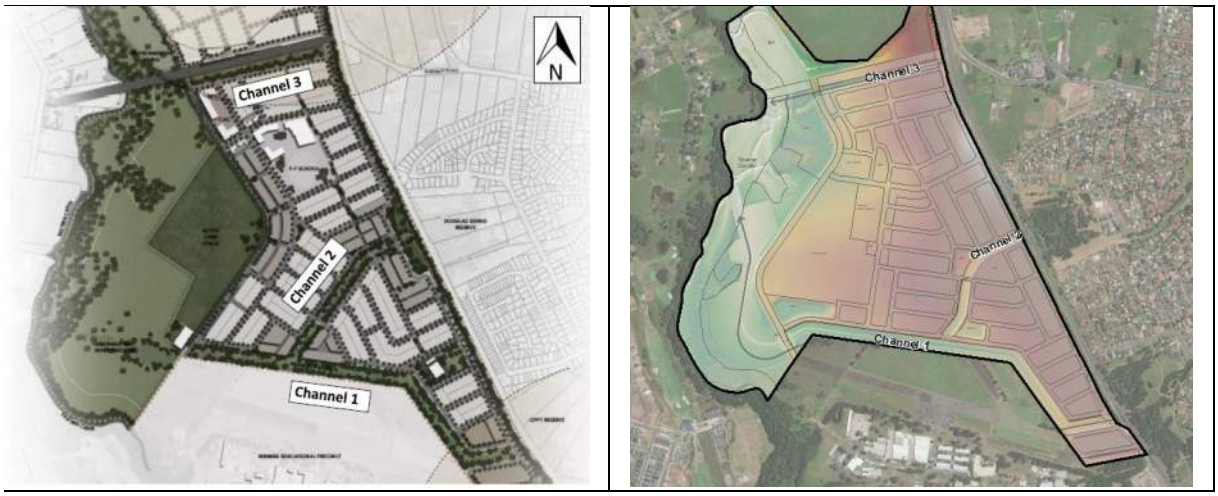


Figure 1 – Comparison of development layouts.
LEFT – master plan submitted with the report for DA; RIGHT –amended masterplan reported in this letter.

3 MODEL SCENARIOS AND EVENTS

Baseline and developed case scenario runs were carried out for the following average recurrence interval (ARI) events and storm durations. Inflows to the TUFLOW model were extracted from the XP-RAFTS baseline and developed case scenario models for each ARI and duration.

- 1 in 2 year ARI (90, 120, 540, 720 minute storm durations)
- 1 in 100 year ARI (60, 90, 120, 540, 720 minute storm durations)
- 1 in 500 year ARI (60, 90, 120, 540, 720 minute storm durations)
- PMF event (30, 60, 120 minute storm durations)
- 1 in 2 year ARI (90, 120, 540, 720 min storm durations) – smooth roughness scenario within newly developed channels assuming they won't be vegetated after construction.

Updated flood mapping is attached showing peak flood levels, depths, velocities, hazards. Flood level difference mapping is also included for the 100 year ARI event.

4 MODEL RESULTS AND DISCUSSION

Updated difference mapping show flood affectation during the 100 year ARI event is comparable to the accepted DA Flood Assessment report (refer Figure 13 attached).

Minor increases to 100 year ARI flood levels are shown in the following locations:

- Location A – water level increased up to 23mm outside tenement boundary due to earthworks in the upstream area concentrating flow. This increase has been reported in previous flood report and is localised to the creek alignment and does not extend across the width of the floodplain.
- Location B – localised increase of 25mm. This increase is within golf course and it is expected that increase is caused due to minor fluctuations in water level at this location.
- Location C – increased water level within the tenement boundary at the outlet of Channel 1. The increase is caused due to earthworks and flow diversion by Channel 1. The localised increased does not impact any properties.

- Location D – localised increase within the Nirimba site upstream of the newly designed Mustang Drive crossing of Channel 1. This increase is around 90mm outside DHA site boundary. A similar increase was shown in the previous flood assessment report which formed part of the DA.
- Location E – localised increase of around 40mm due to Mustang Drive and added culvert crossing. This increase does not affect existing development or buildings within the Nirimba site.
- Location F – localised increase up to 85mm due to Mustang drive realignment. This increase has been reported in previous DA and has been accepted.

5 CONCLUSION

BG&E has carried out updated flood modelling to incorporate the revised civil design received from Craig and Rhodes (23/01/2018). The results have been mapped on a number of figures which are attached to this letter. Flood modelling results and particularly 100 year ARI flood difference mapping (Figure 13) demonstrated that the updated design results in negligible difference compared to the bulk earthworks design approved under the current DA.

6 MODELLING ASSUMPTIONS AND LIMITATIONS

Updated flood modelling has been based on previous hydrological (XP-RAFTS) and hydraulic (TUFLOW) models and is subject to the same assumptions and limitations outlined in the BG&E Flood Assessment report issued for DA.

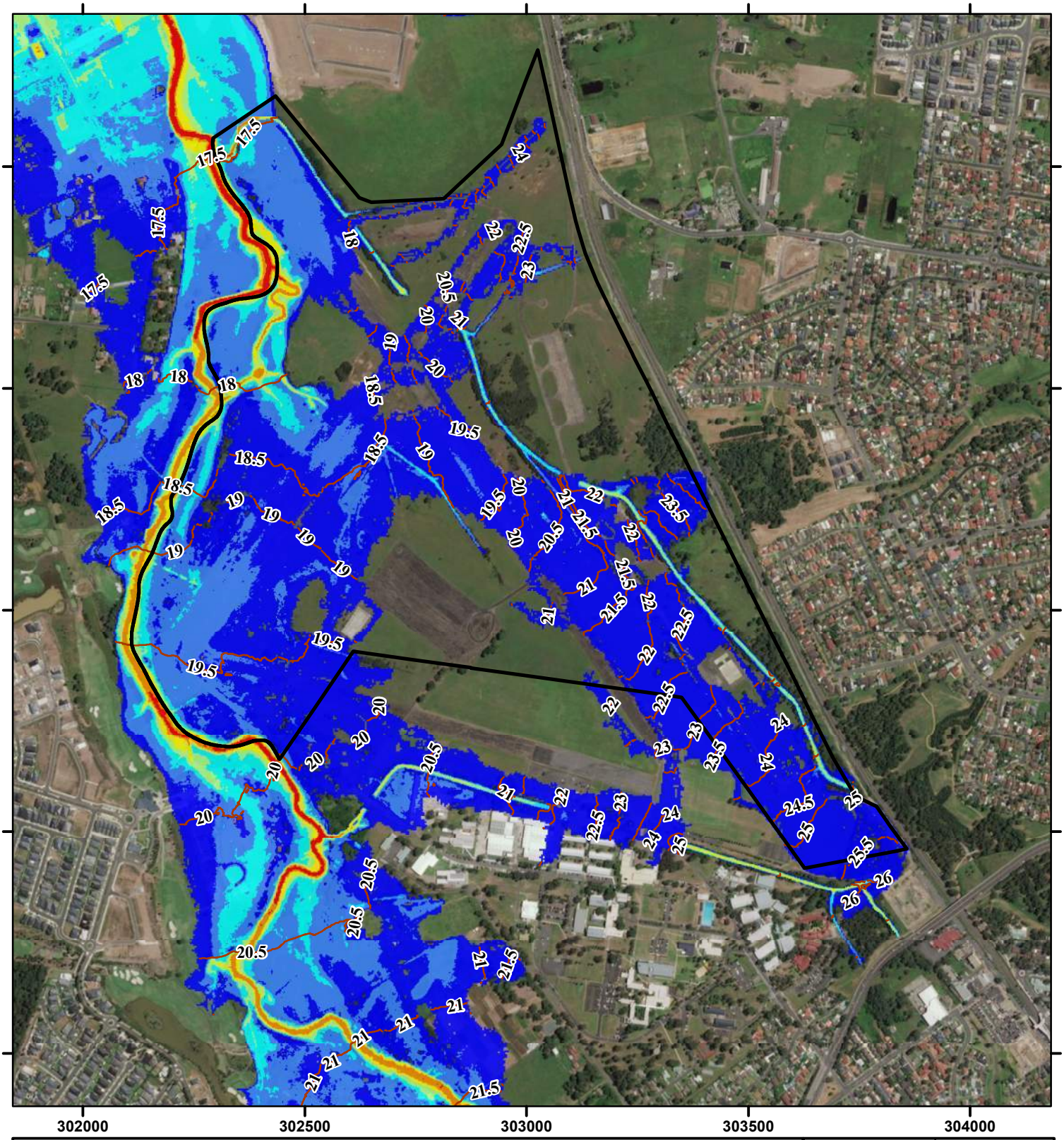
Updated modelling has been based on bulk earthworks design provided by Craig and Rhodes on 23/01/2018.

Yours faithfully
for BG&E Pty Limited

Ainis Vincevicius
Senior Water Engineer

Encl.
Updated flood mapping

Figure 1 - 2 Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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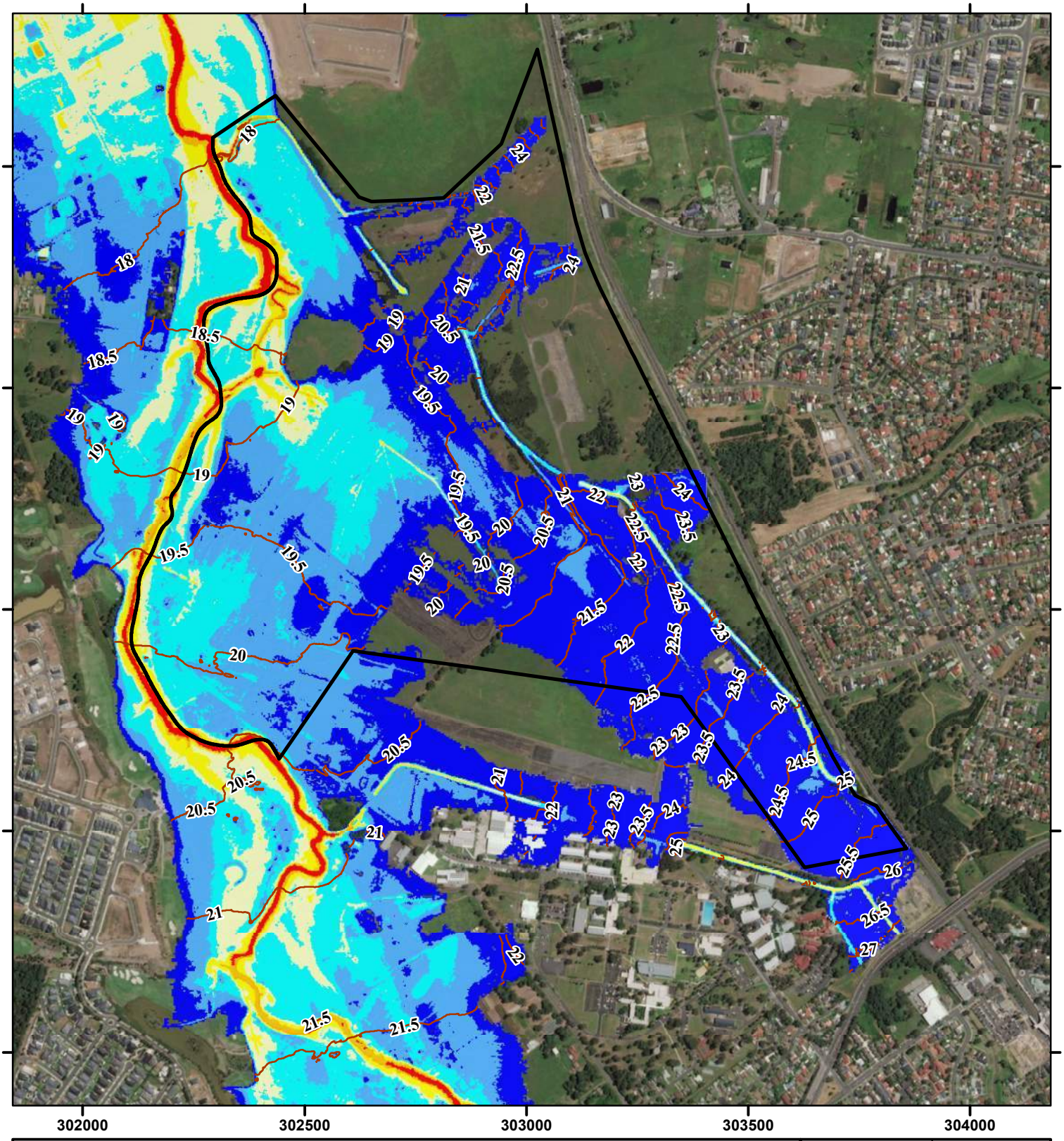
Figure 2 - 100 Year ARI Pre-Development Flood Depths and Levels



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Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

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0 0.1 0.2 0.4 Km

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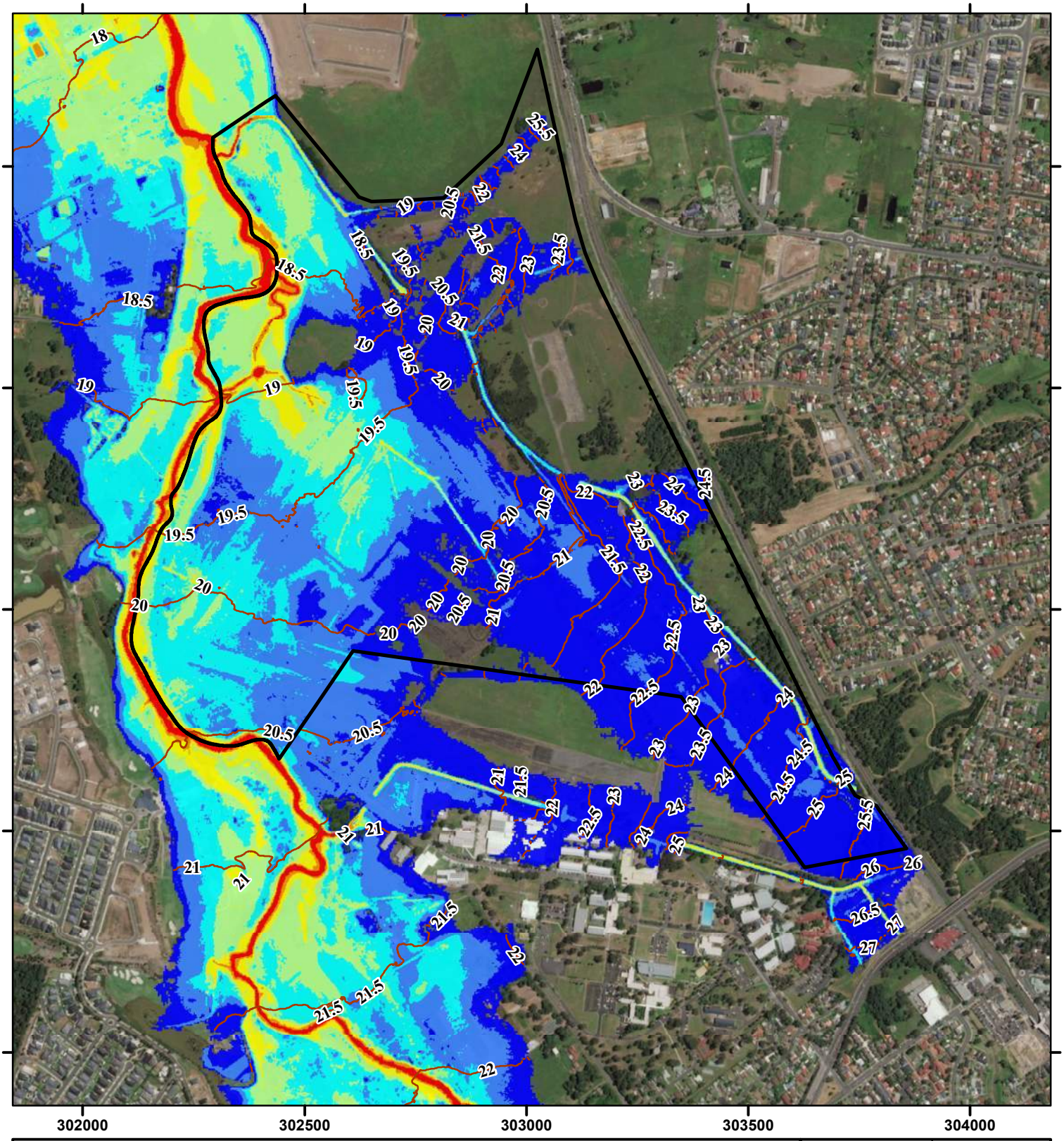
Figure 3 - 500 Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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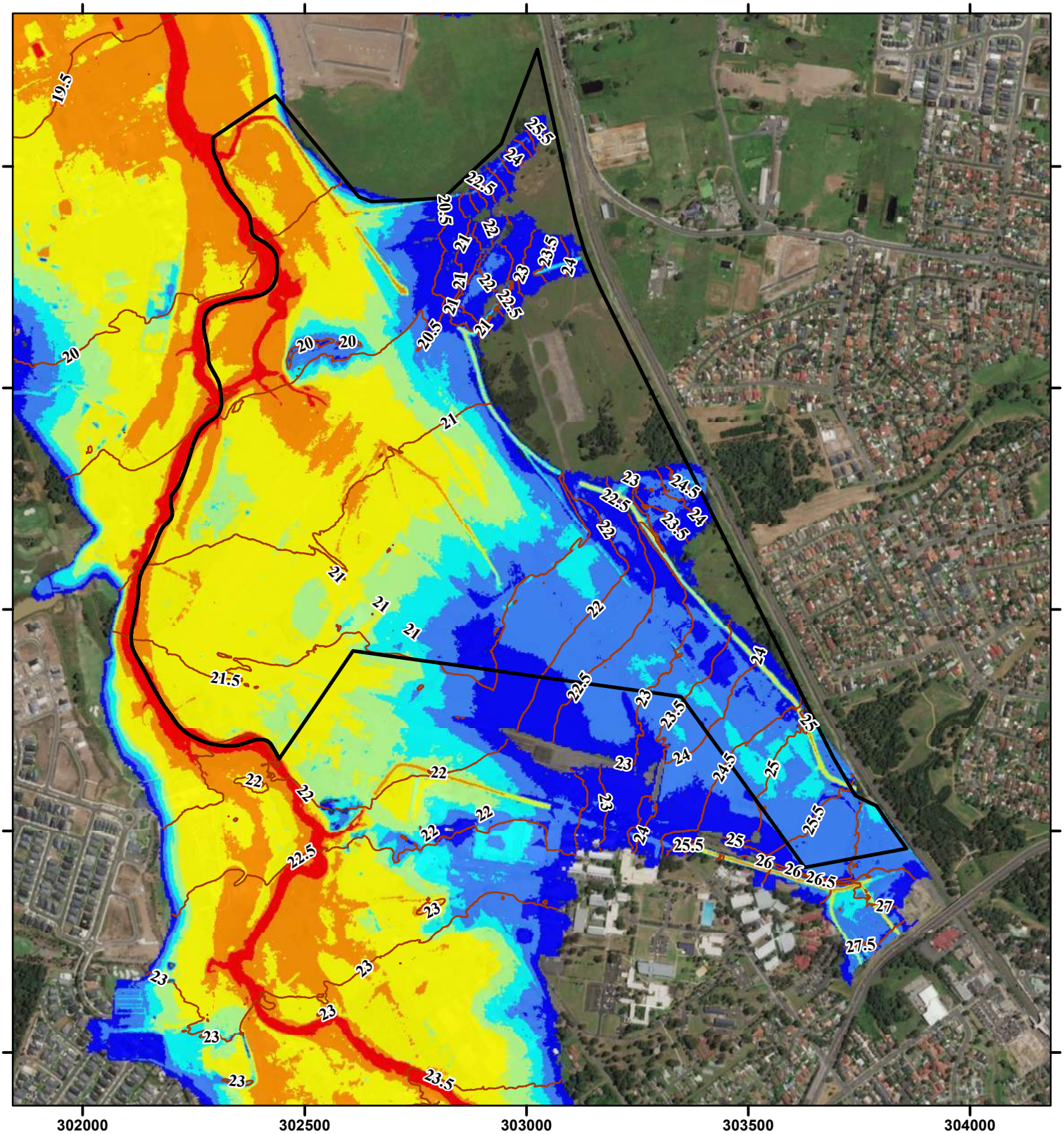
Figure 4 - PMF Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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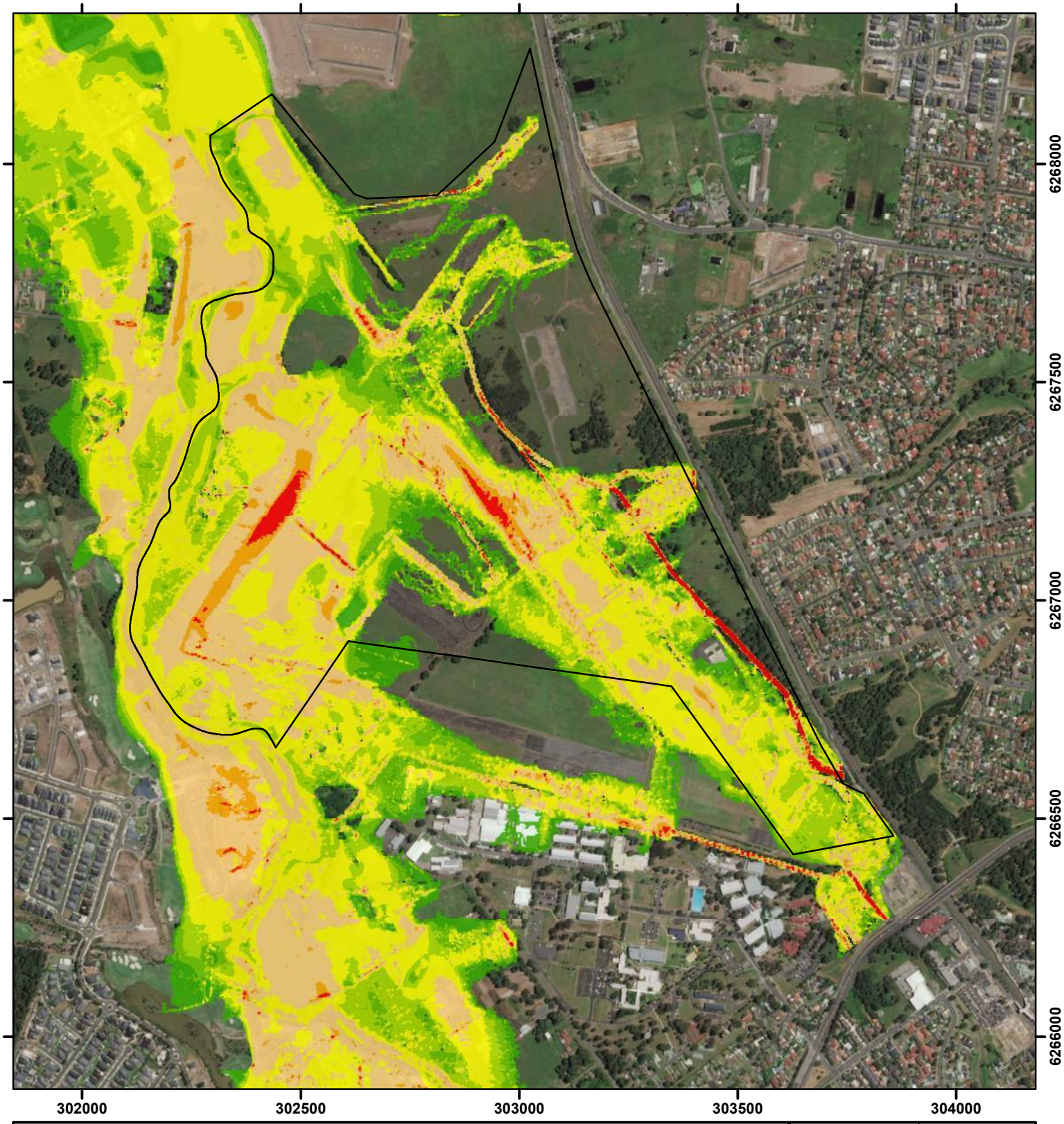
Figure 5 - 100 Year ARI Pre-Development Flood Velocities



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

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0 0.1 0.2 0.4 Km

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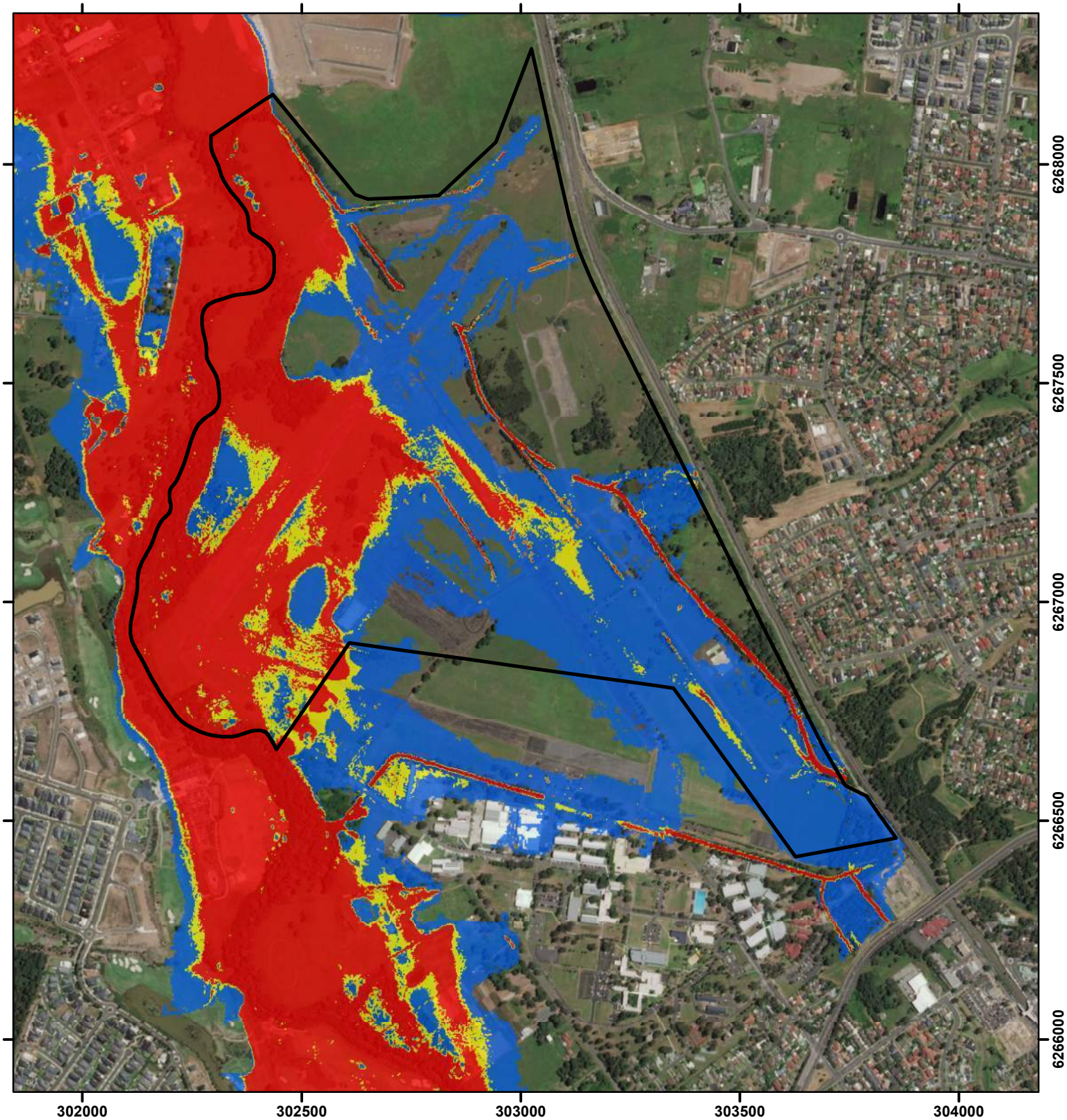
Figure 6 - 100 Year ARI Pre-Development Flood Hazard Catagories



Legend

Hazard

- Low
- Medium
- High

Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	20/11/2017
APPROVED	BS		

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0 0.1 0.2 0.4 Km

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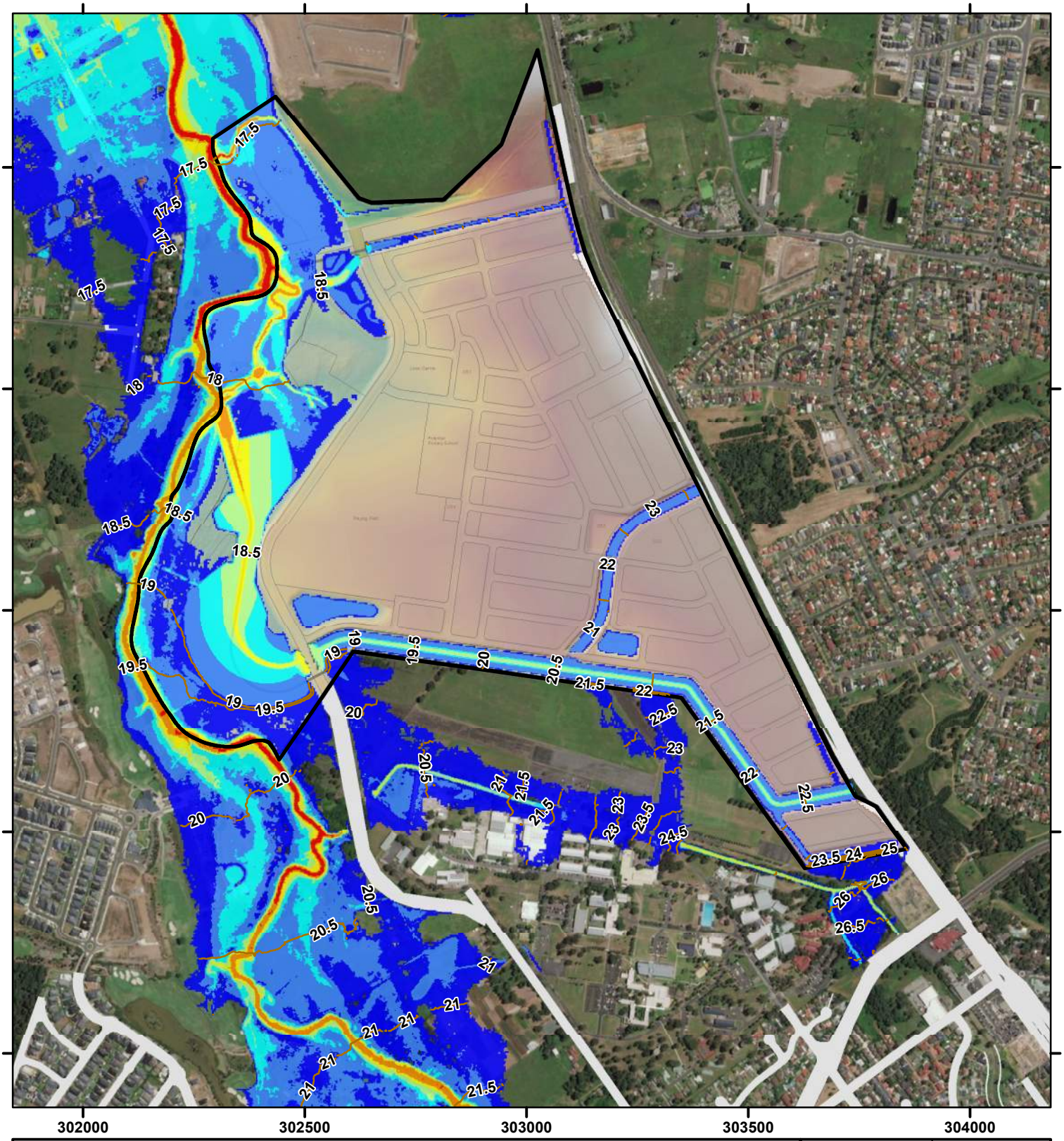
Figure 7 - 2 Year ARI Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

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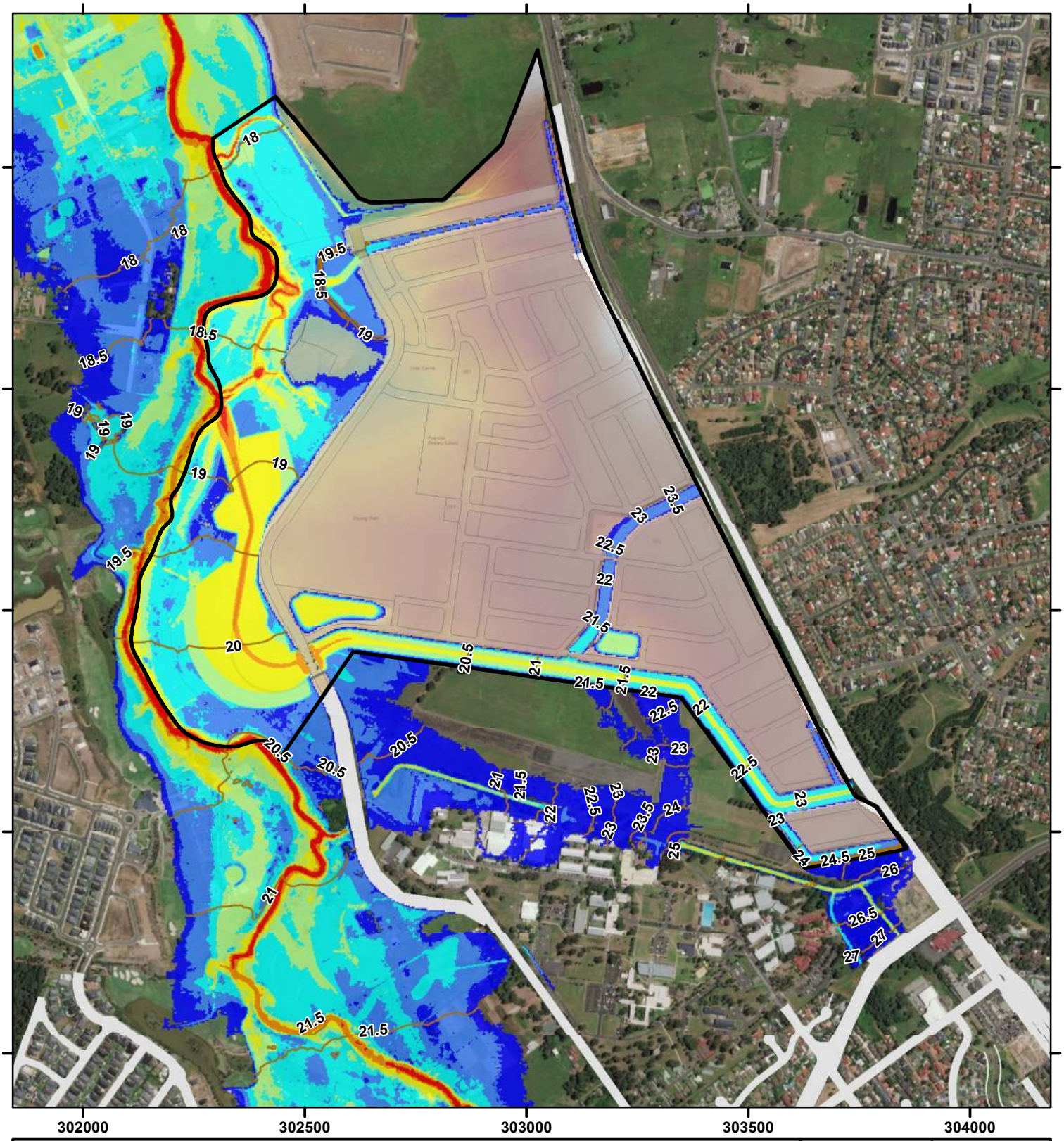
Figure 8 - 100 Year ARI Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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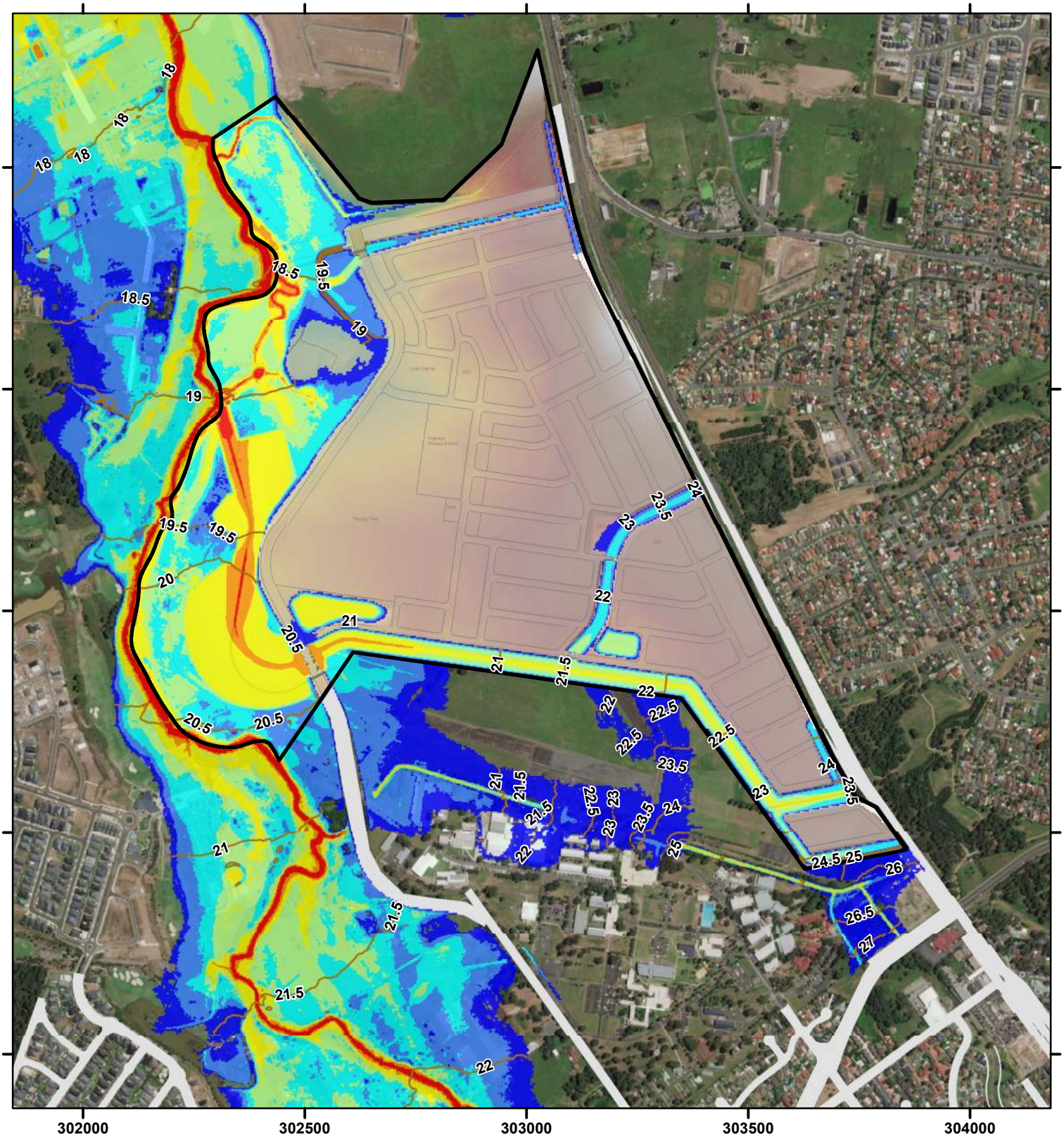
Figure 9 - 500 Year ARI Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

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0 0.1 0.2 0.4 Km

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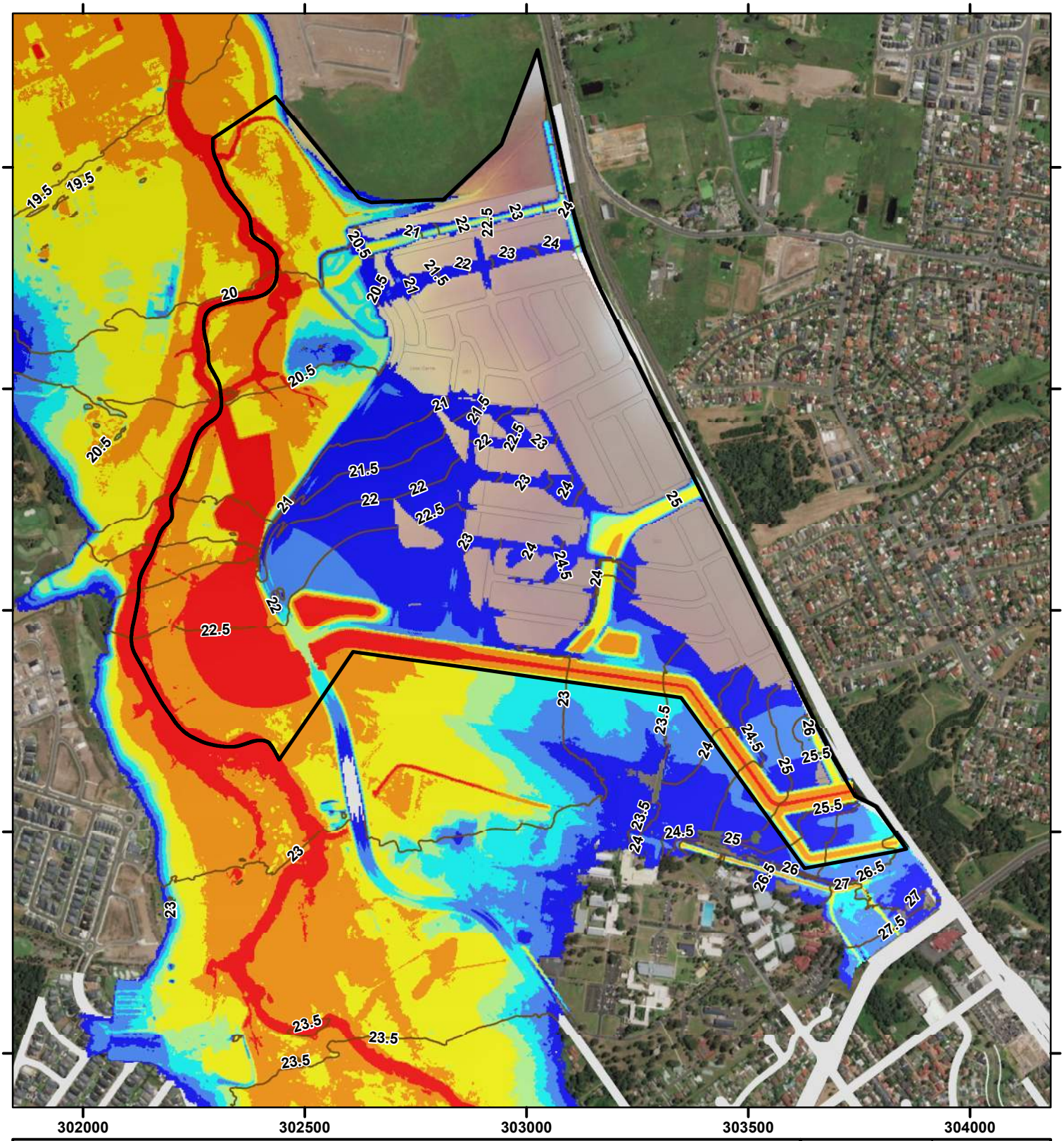
Figure 10 - PMF Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
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N

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0 0.1 0.2 0.4 Km

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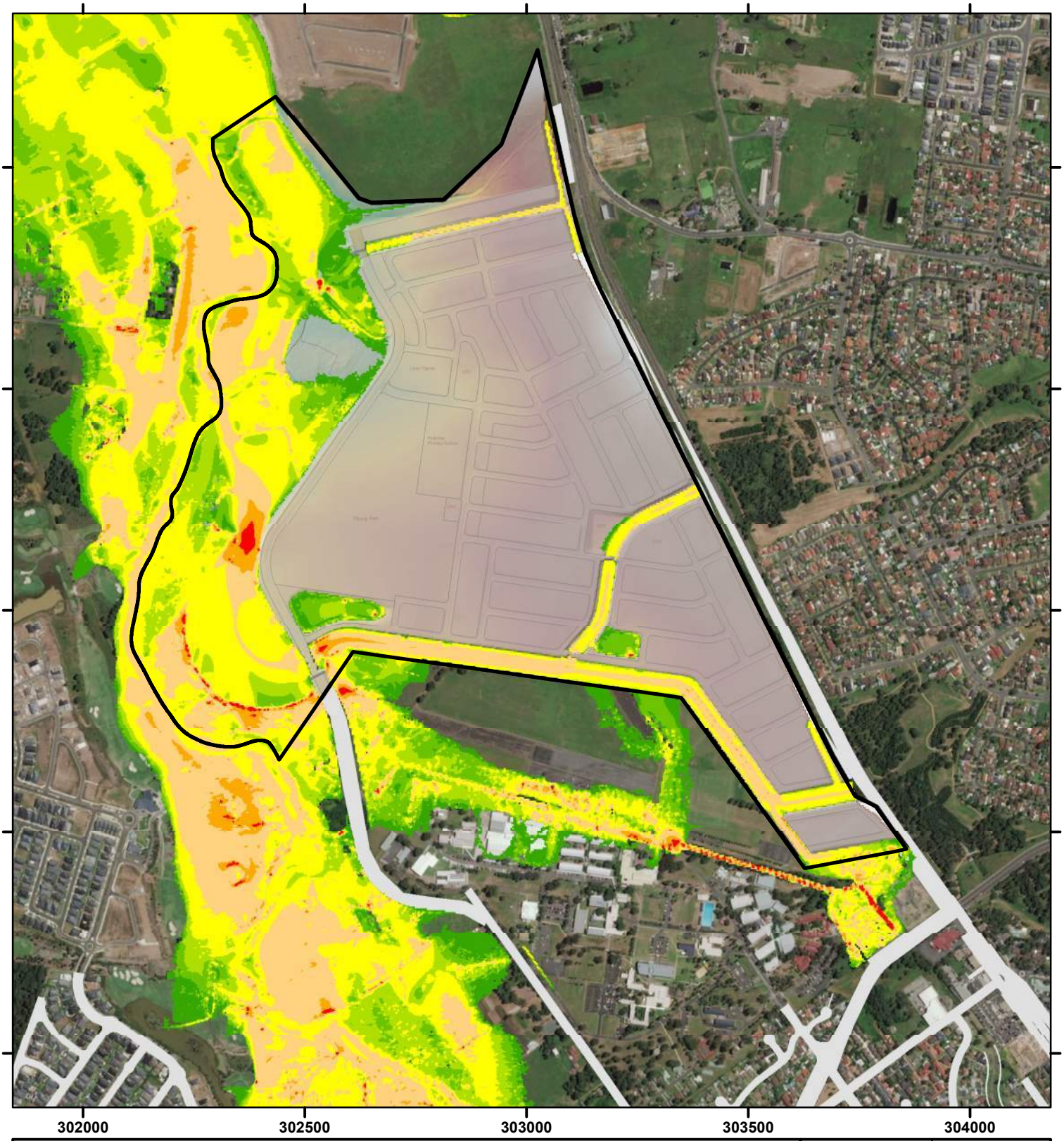
Figure 11 - 100 Year ARI Post-Development Flood Velocities



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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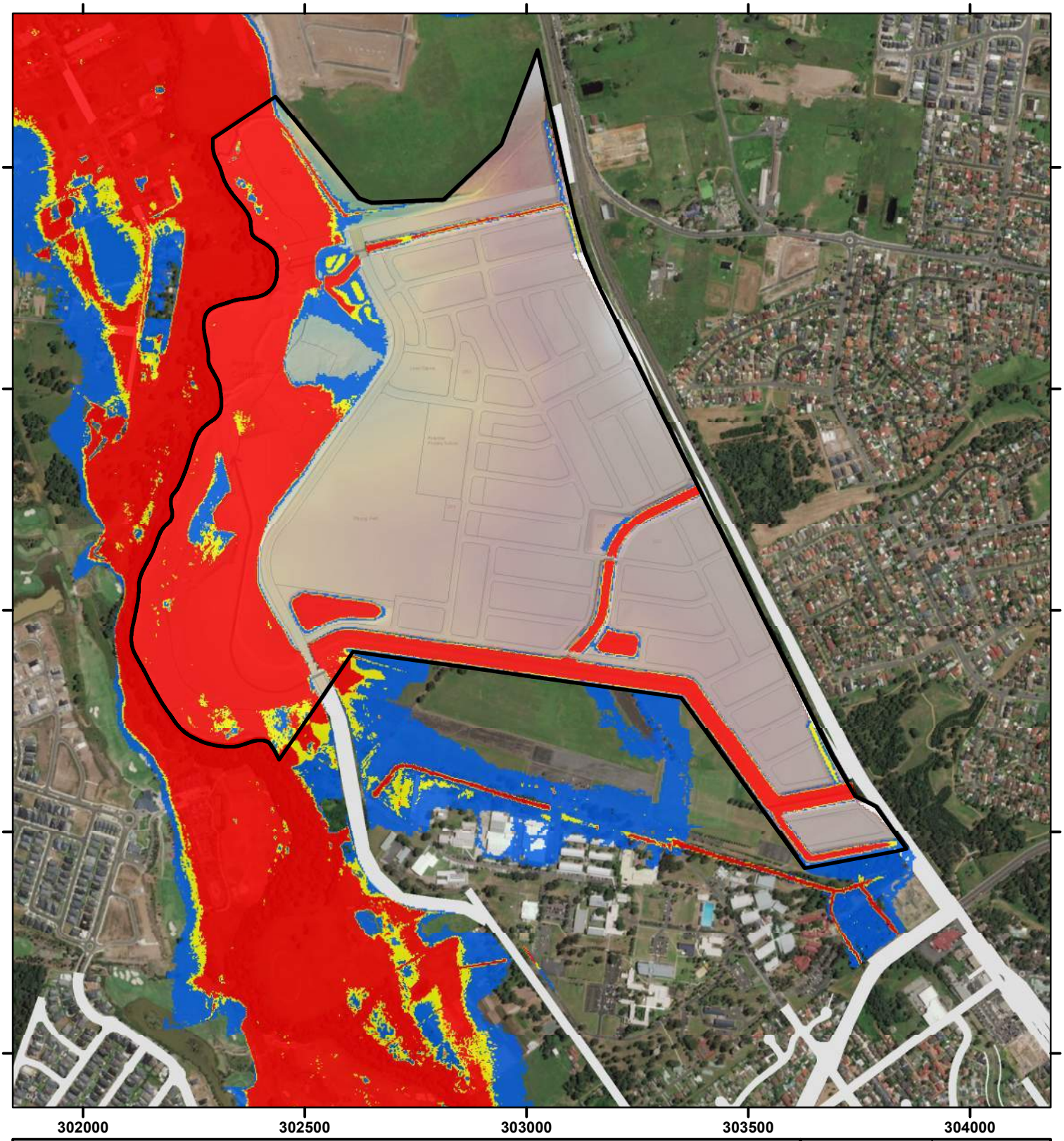
Figure 12 - 100 Year ARI Post-Development Flood Hazard Catagories



Legend

Hazard

- Low
- Medium
- High

Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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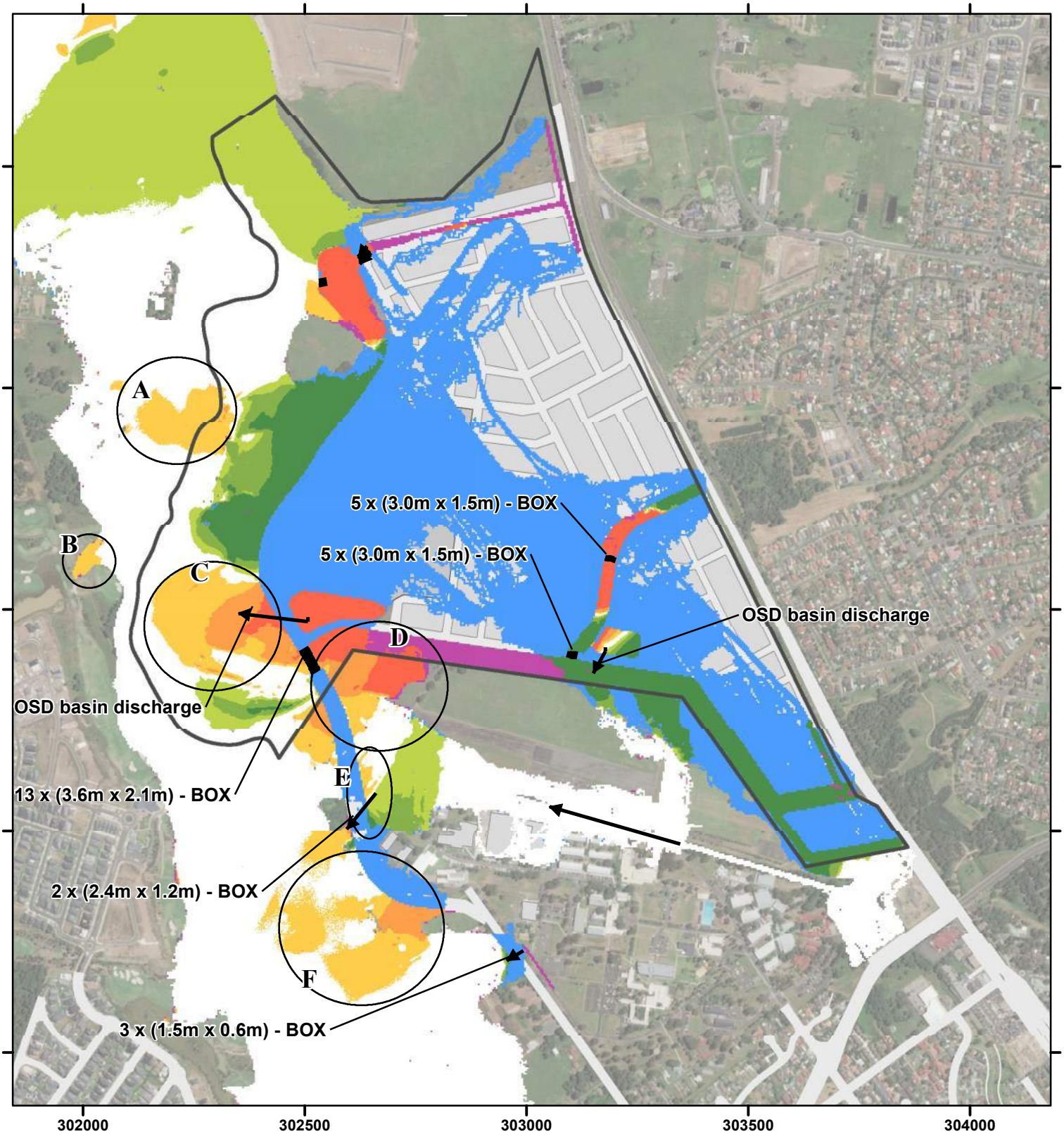
Figure 13 - 100 Year ARI Flood Level Difference Map (Post-Pre)



Legend

Difference [m]

- < -0.1
- -0.05 to -0.1
- -0.02 to -0.05
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- > 0.1
- Was Wet Now Dry
- Was Dry Now Wet
- Site Boundary
- Modelled culverts

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	23/02/2018
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0 0.1 0.2 0.4 Km

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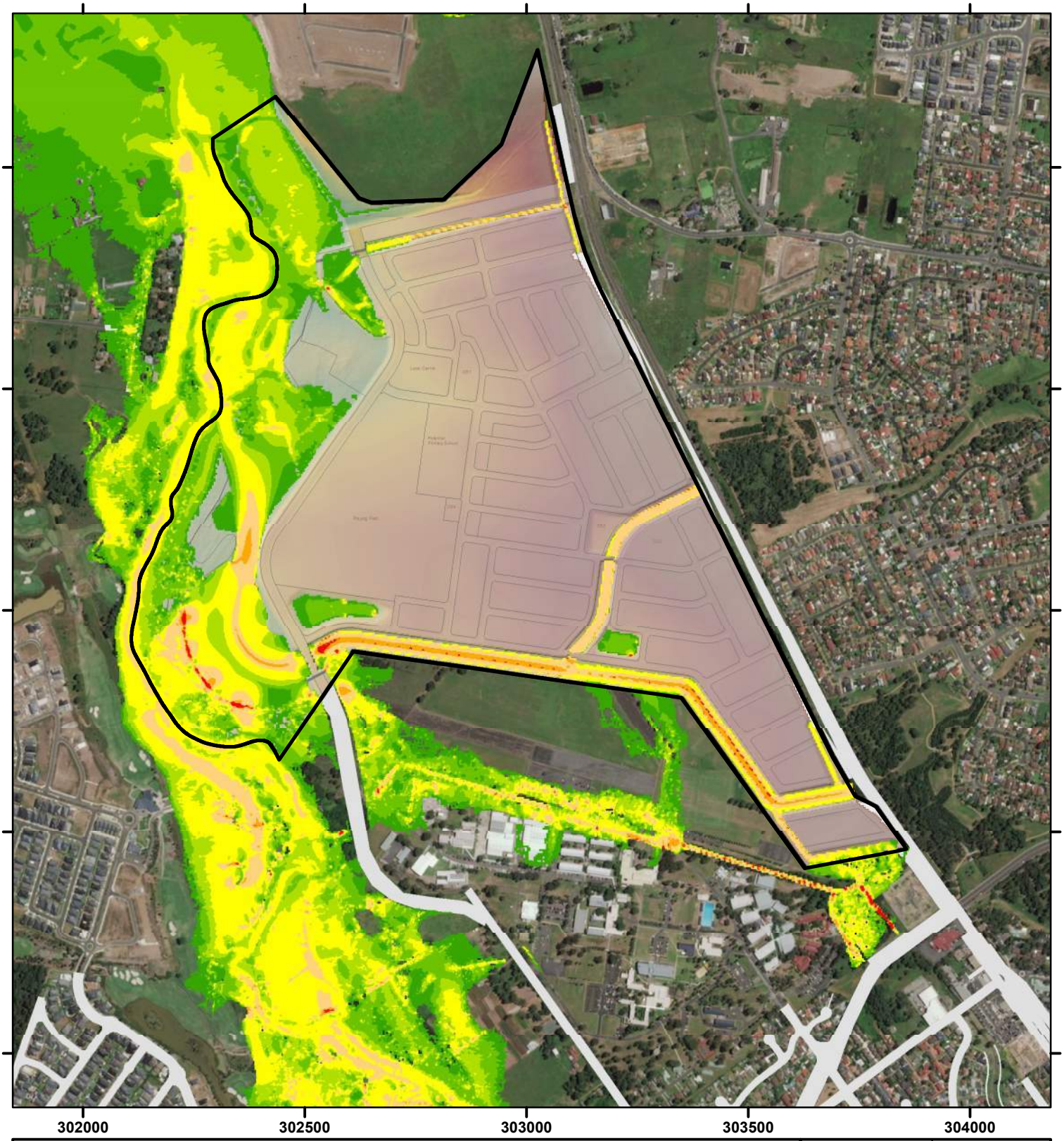
Figure 14 - 2 Year ARI Post-Development Flood Depths and Levels

(smooth roughness)



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	26/02/2018
APPROVED	BS		

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0 0.1 0.2 0.4 Km

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Attachment 9

Retail Analysis Report

Schofields Aerodrome

Local Centre – Retail potential

March 2017

MacroPlanDimasi

MacroPlan Dimasi

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GOLD COAST
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ADELAIDE
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Adelaide SA 5000
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Perth WA 6000
(08) 9225 7200

Prepared for: Defence Housing Australia

MacroPlan Dimasi staff responsible for this report:

James Turnbull, Senior Manager – Retail

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Executive summary

This report presents an independent assessment of the scale, mix, timing and optimal location of the B2 - Local Centre that forms part of the Defence Housing Australia (DHA) Schofields Aerodrome residential estate within the Schofields precinct, which forms part of Sydney's North West Priority Growth Area (NWPGA). Our key findings are as follows:

Site location and context

- The Schofields Aerodrome estate forms part of the broader Schofields precinct, one of the 11 precincts that comprise the NWPGA in outer metropolitan Sydney, approximately 45 – 50 km from the Sydney CBD.

- Major road upgrades are currently underway in the immediate locality, with Schofields Road being extended to the west, beneath the railway line, to West Schofields and ultimately connecting with Marsden Park. Burdekin Road will also be upgraded in the future, connecting the Schofields precinct with the Alex Avenue precinct in to the east of the rail line.

- The Schofields precinct is earmarked to support around 2,950 new dwellings over the longer term according to the NSW DPE. The DHA Schofields Aerodrome estate is planned to accommodate more than 1,000 new dwellings of which around 220 dwellings are to be retained for its own provisioning purposes. The project is planned to be developed over the period 2018 to 2025. Stockland is the other major landowner in the precinct and could potentially deliver around 1,000 dwellings in its Altrove Estate.

- The Schofields precinct is planned to accommodate two local centres, i.e. the Schofields Station Local Centre and the Schofields Aerodrome Local Centre (i.e. subject site) as well as one neighbourhood centre in the northern part of the precinct (Refer Map 1.2).

Potential trade area

- The Schofields Aerodrome estate forms part of the broader Schofields precinct, one of the 11 precincts that comprise the NWPGA in outer metropolitan Sydney, approximately 45 – 50 km from the Sydney CBD.

- The main trade area population was estimated at 9,100 in 2016, with no residents in the key primary sector – given its previous use as an aerodrome. We estimate that the main trade area population to reach 25,600 persons by 2036, with the key primary sector population expected to reach 4,250 persons once developed (including the DHA estate).

Recommendations

- The proximity of the Schofields Town Centre, which contains an existing full-line Woolworths supermarket, with Coles planning to open a store by 2019, will significantly limit the potential scale of the offer at the subject site.

- In the short-term, residents of the DHA estate will be served by Schofields Woolworths and Greenway Village for convenience based retail facilities, while over the longer term these centres will also be the primary large supermarket locations, potentially with additional facilities provided at West Schofields and/or at Alex Avenue.

- We do not expect the Schofields Station Local Centre to evolve into a retail centre of great significance in the foreseeable future, given its proximity to Schofields Town Centre which will be easily accessible via Schofields Road. It is possible that this centre could establish more as a street/strip based retail precinct.

- In summary, we recommend a local centre, at an Inboard Location within the estate, of around 3,500 sq.m including 2,000 sq.m of retail floorspace, including a 1,000 – 1,200 sq.m supermarket, and around 1,500 sq.m of non-retail floorspace.

- We recommend around 1,500 sq.m of non-retail uses including a small medical centre; a gym; small scale office/commercial space; and a childcare centre.

Introduction

This report presents an independent assessment of the scale, mix, timing and optimal location of the B2 - Local Centre that forms part of the Defence Housing Australia (DHA) Schofields Aerodrome residential estate within the Schofields precinct, which forms part of Sydney's North West Priority Growth Area (NWPGA).

This report has been prepared in accordance with instructions received from DHA to assist with the Masterplanning of the residential estate and, more specifically, the local centre.

This report is presented in six sections as follows:

- **Section 1** presents an overview of the regional and local context of the Schofields Aerodrome estate and the wider NWPGA, then summarises the proposed plans for the Schofields Aerodrome estate and the broader Schofields precinct.

- **Section 2** examines the trade area that could potentially be served by retail/commercial facilities in the Schofields Aerodrome Local Centre; then provides estimates of current and anticipated dwelling and population levels within this trade area; analyses the socio-demographic profile of the future population; and assesses the current and future retail expenditure volumes generated by the trade area population.

- **Section 3** reviews the surrounding retail/centres hierarchy of relevance to proposed retail/commercial facilities at the Schofields Aerodrome Local Centre, including all planned and proposed centres of relevance.

- **Section 4** provides estimates of retail floorspace demand generated by the main trade area population, and then assesses the potential supportable scale, mix and timing of the Local Centre within the Schofields Aerodrome estate. This analysis has regard to two potential locations for the Local Centre and provides case studies of small local centres in comparable greenfield locations across metropolitan Sydney and Australia.

Section 1: Site context and proposed plans

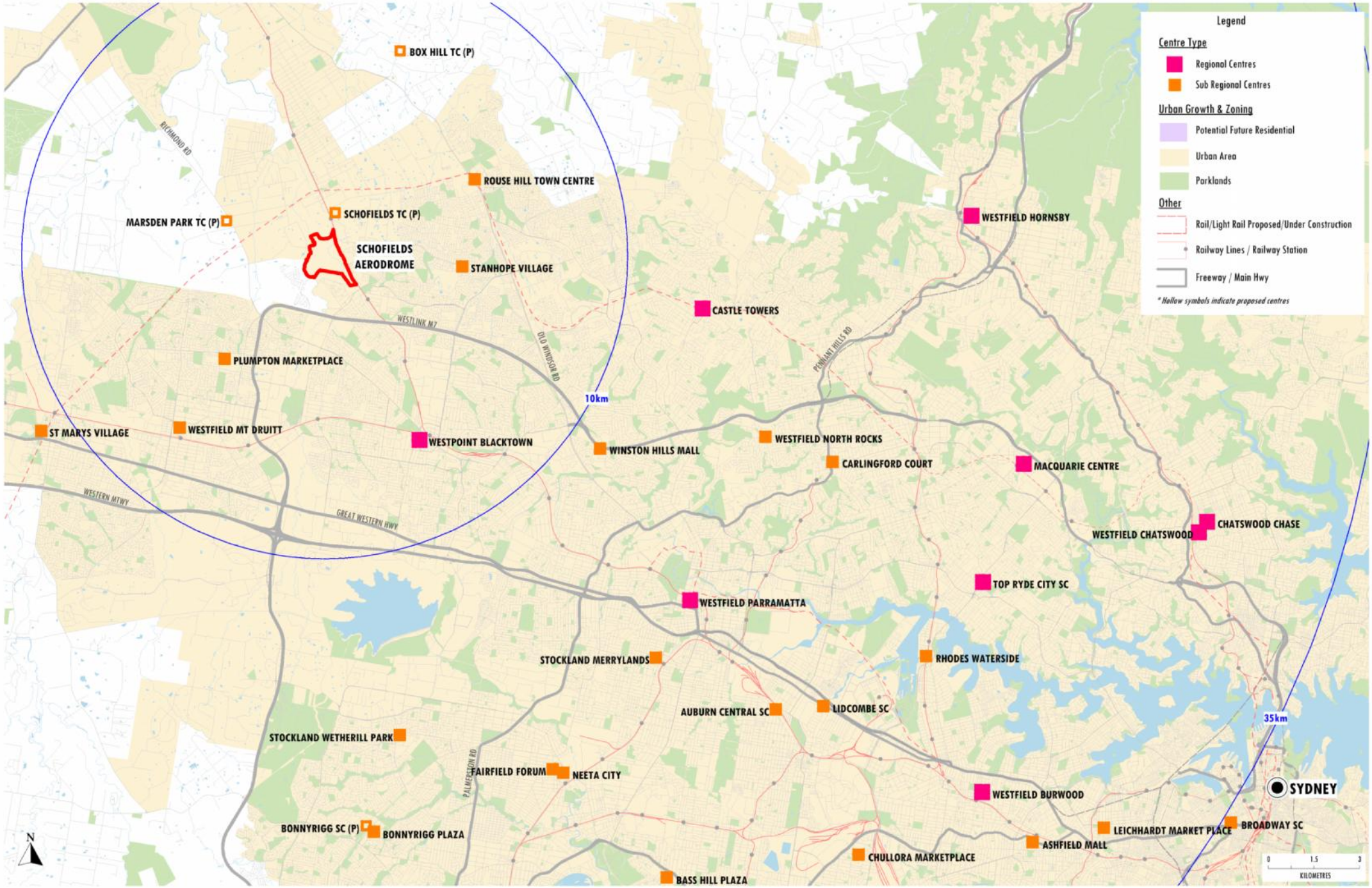
This section of the report presents an overview of the regional and local context of the Schofields Aerodrome estate and the wider NWPGA, then summarises the proposed plans for the Schofields Aerodrome estate and the broader Schofields precinct.

1.1 Site and regional context

The Schofields Aerodrome estate forms part of the broader Schofields precinct, one of the 11 precincts that comprise the NWPGA in outer metropolitan Sydney, approximately 45 – 50 km from the Sydney CBD (refer Map 1.1). Furthermore, significant additional residential dwelling growth is occurring, and will continue to occur, in areas located just beyond the technical boundary of NWPGA, including precincts such as Colebee (nearby) and The Gables north of Box Hill.

Most of the precincts in the NWPGA have now been either rezoned, or released for detailed planning (and subsequent rezoning). Shanes Park has not yet been released for future planning, while only part of the adjacent West Schofields precinct has released for future planning, through the precinct acceleration protocol (PAP). The Riverstone East precinct was recently on exhibition and Marsden Park North is currently undergoing detailed planning.

As shown on Map 1.2, the Schofields precinct is bordered by the West Schofields precinct, which was ear-marked to support in the order of 2,000 dwellings in the dated 2006 NW Growth Centre Masterplan. We understand that a larger dwelling outcome is likely to be achieved within this precinct as it is currently undergoing the PAP, given the shift in residential preferences towards higher density living and (more affordable) smaller lots, as well as potential new rail infrastructure and major road upgrades. The West Schofields precinct is expected to support some neighbourhood/local centre type facilities over the long term as the population critical mass establishes in this precinct.



Map 1.1: Schofields Aerodrome Local Centre

Regional context

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Map 1.2: Schofields Aerodrome Local Centre

Local context

MacroPlanDimasi

To the immediate north, the Schofields precinct is bound by the Riverstone East precinct, which could potentially contain up to 5,300 new dwellings once developed to capacity over the longer term.

The Alex Avenue precinct is located to the immediate east of the Schofields precinct and could potentially support up to 6,300 new dwellings. The Schofields Town Centre is located on the eastern side of the railway line and is earmarked to eventually support around 25,000 - 30,000 sq.m of retail and commercial floorspace. The centre currently includes a large Woolworths supermarket with several supporting specialty tenants and an approval exists for a Coles supermarket based development on the adjacent site to the north, which is expected to be developed in the next few years.

More broadly, the Alex Avenue precinct is earmarked to contain a village centre (i.e. a B2 – Local Centre) as well as 1 – 2 neighbourhood centres (i.e. B1 – Neighbourhood Centre) over the longer term.

To the south of the Schofields Aerodrome site is the Nirimba education precinct which includes a Western Sydney University campus, as well as a TAFE NSW campus and Wyndham College. We understand that a connection will be made through to this area from the Schofields Aerodrome subject site over the medium term (i.e. the proposed north-south road through the estate, on which the local centre will be located, will extend to Quakers Road).

Major road upgrades are currently underway in the immediate locality, with Schofields Road being extended to the west, beneath the railway line, to West Schofields and ultimately connecting with Marsden Park. Burdekin Road will also be upgraded in the future, connecting the Schofields precinct with the Alex Avenue precinct in to the east of the rail line.

The Schofields Aerodrome estate is situated in a highly accessible location. Following road upgrades currently under construction, the estate will be accessible from Schofields Road to the north and to the south via Quakers Road and ultimately Quakers Hill Parkway.

Development in the nearby Marsden Park Industrial Precinct is now well advanced with several large format retail tenants now open, establishing the locality as a regionally significant shopping destination, including Bunnings, IKEA, Aldi, and a Lindt Factory Outlet. A Costco Warehouse is due to open mid-2017 and there is a 19,000 sq.m Home Hub homemaker centre now open, having been developed by LaSalle Investment Management.

In the surrounding area, strong housing growth is occurring at Greenway, Townson Road and Stonecutters Ridge (which has been boosted by new road connections).

1.2 Schofields

The Schofields precinct is earmarked to support around 2,950 new dwellings over the longer term according to the NSW DPE. Stockland is the other major landowner in the precinct and could potentially deliver around 1,000 dwellings in its Altrove Estate.

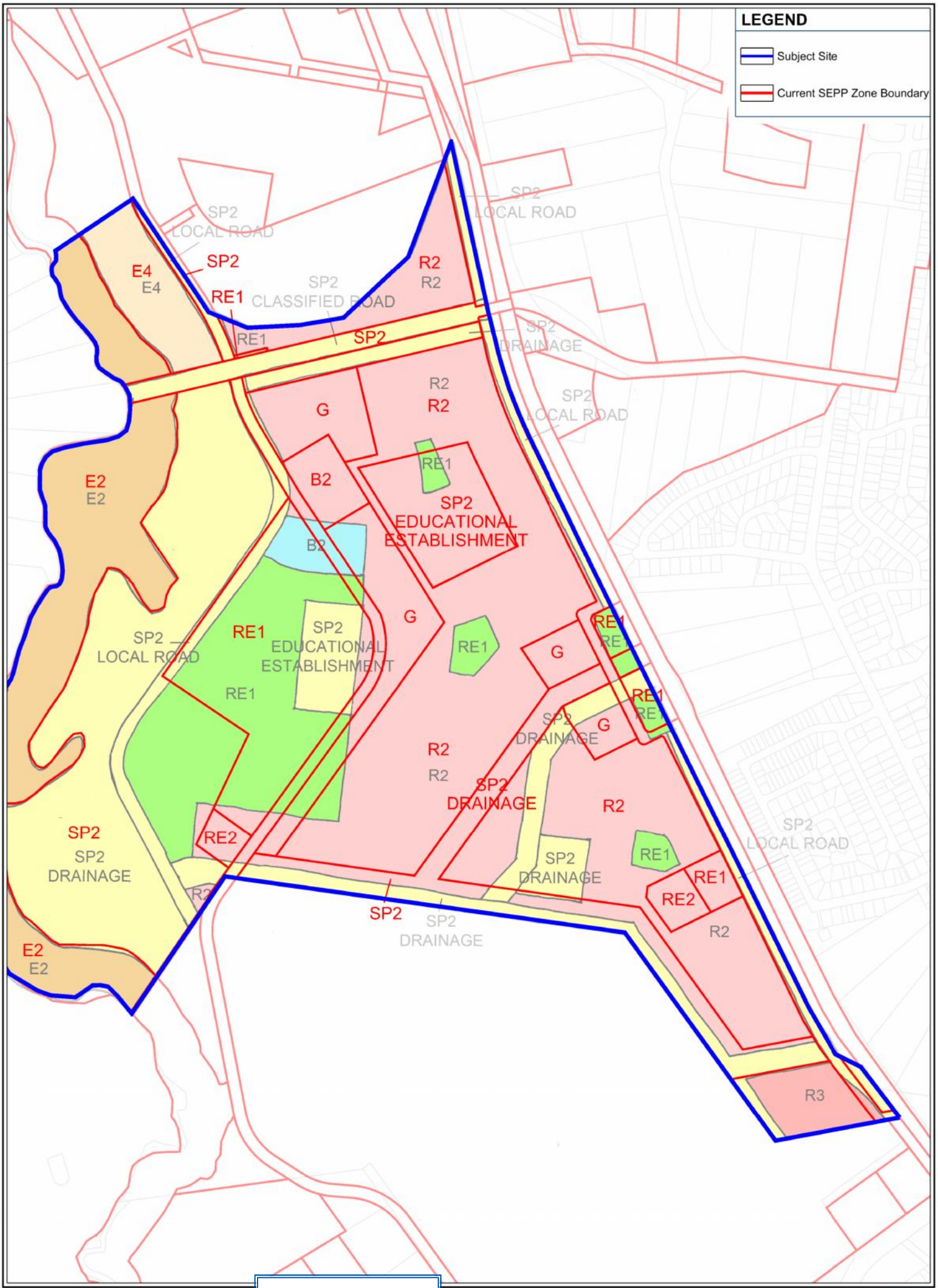
The Schofields precinct is planned to accommodate two local centres, i.e. the Schofields Station Local Centre and the Schofields Aerodrome Local Centre (i.e. subject site) as well as one neighbourhood centre in the northern part of the precinct (Refer Map 1.2).

The B2 – Local Centre within the Schofields Aerodrome estate is ear-marked to support up to 5,600 sq.m of retail and commercial floorspace, according to the Schofields precinct DCP, while the large Schofields Station Local Centre (which is very close to the Schofields Town Centre) is allowed up to 13,600 sq.m of retail and commercial floorspace. There is a small B1 – Neighbourhood centre identified in the north of the Schofields precinct on Grange Avenue.

1.3 Proposed DHA plans

The DHA Schofields Aerodrome estate is planned to accommodate more than 1,000 new dwellings of which around 220 dwellings are to be retained for its own provisioning purposes. The project is planned to be developed over the period 2018 to 2025.

A local centre was approved at an internalised location within the precinct when the site was officially gazetted in 2012. The B2 – Zoned local centre abuts the key north-south road through the estate and is situated to the north of a proposed school. Preliminary/indicative plans propose an alternative inboard location with the centre located adjacent to other community facilities and sports fields with frontage to the key north-south road (Refer Figure 1.1).



Zone Comparison
SCHOFIELDS

Figure 1.1

30 0 60 120 180 240 300 metres

Ref: DHASC-1-004-1 | Date: 22/08/2016 | Revision: A | Scale: 1:3,000@A1

Note: All areas and dimensions subject to detailed survey

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Section 2: Trade area analysis

This section of the report examines the trade area that could potentially be served by retail/commercial facilities in the Schofields Aerodrome Local Centre; then provides estimates of current and anticipated dwelling and population levels within this trade area; analyses the socio-demographic profile of the future population; and assesses the current and future retail expenditure volumes generated by the trade area population.

2.1 Trade area definition

The extent of the trade area or catchment that is served by any shopping centre, or retail facility, is shaped by the interplay of a number of critical factors. These factors include:

- The relative attraction of the centre, in comparison with alternative competitive retail facilities. The factors that determine the strength and attraction of any particular centre are primarily its scale and composition (in particular the major trader or traders that anchor the centre); its layout and ambience; and car parking, including access and ease of use.
- The proximity and attractiveness of competitive retail centres. The locations, compositions, quality and scale of competitive retail facilities all serve to define the extent of the trade area which a shopping centre is effectively able to serve.
- The available road network and public transport infrastructure, which determine the ease (or difficulty) with which customers are able to access a shopping centre.
- Significant physical barriers which are difficult to negotiate, and can act as delineating boundaries to the trade area served by an individual shopping centre.

The trade area which could potentially be served by potential retail facilities within the Schofields Aerodrome Local Centre has regard to:

i. The existing Woolworths Schofields and planned future development of the Schofields Town Centre and the planned smaller centre in the Schofields precinct.

ii. The planned future centres in the Alex Avenue precinct.

iii. Potential new retail facilities in the West Schofields precinct.

iv. The Greenway convenience centre which is currently under construction.

v. The planned retail facilities at Marsden Park Industrial Estate (i.e. Aldi), Greenway (i.e. Woolworths) and Marsden Park more generally (i.e. future Strategic Centre).

vi. The existing and planned road network, in particular the new east-west connections and the north-south road through the estate.

Map 2.1 illustrates the potential trade that could be served by the Schofields Aerodrome Local Centre. We consider the potential trade area would generally be the same at an inboard location (either at or near the current locality in the planning scheme) as for a location on Burdekin Road given the short distance (around 200 – 300m) between the alternative locations.

The **main trade area** is defined to include a primary sector and four secondary sectors, defined as follows:

- The **primary sector** includes the DHA Schofields Aerodrome estate and is generally bounded by the creek to the west, the rail line to the east and the Nirimba education precinct to the south.
- The **secondary north sector** includes the Stockland Altrove estate and the rest of the defined Schofields precinct to the north, generally bounded by the creek.

- The **secondary east sector** includes part of the Alex Avenue precinct and some of the established population around Quakers Hill. This area is only relevant once the Burdekin Road extension is completed.

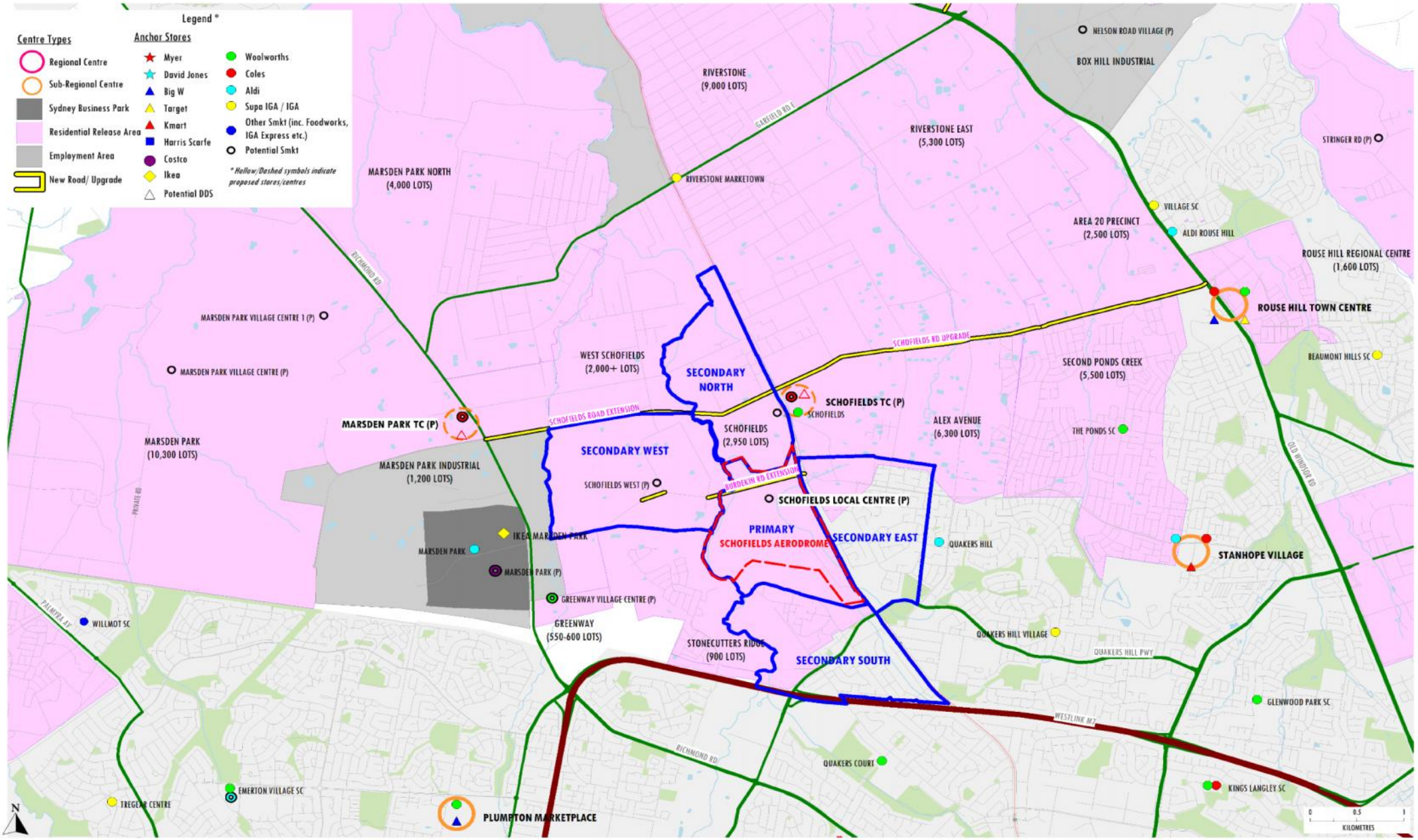
- The **secondary south sector** includes the southern part of the Schofields precinct including the Nirimba education precinct and is generally bounded by the M7 to the south and the Stonecutters Ridge estate to the west. This precinct becomes relevant only once the southern road connection is completed.

- The **secondary west sector** includes the West Schofields precinct, which generally only becomes relevant once the two precincts are connected via Burdekin and Jersey Road/Townson Road. This precinct would be relevant until it provided its own retail facilities.

The secondary east sector generally only comes into consideration once the Burdekin Road extension is completed, which would also make the secondary west sector more relevant. Te secondary south sector comes into consideration once the Quakers Road connection is made via the north-south road through the estate.

The key difference associated with the alternative site locations is that we expect an Inboard location could potentially generate slightly higher market shares from the defined main trade area due to the likelihood of a lighted intersection being provided near the centre, affording access from both directions along the key north-south road through the estate.

Whereas, the In-board Local Centre Main Trade Area might draw around 10% of its business from beyond the trade area, the Burdekin Road main trade area could potentially generate 10 - 15% (i.e. 12.5%) due to its visible prominence, although access may be an issue.



Map 2.1: Schofields Aerodrome Local Centre

Trade area and competition

MacroPlanDimasi

2.2 Trade area population

Table 2.1 details the current and projected population levels within the main trade area over the period 2006 to 2036. This information has been collected from a range of sources, including the following:

- Australian Bureau of Statistics Census of Population and Housing (2006 and 2011);
- Australian Bureau of Statistics Dwelling Approvals Data (2011–16);
- Australian Bureau of Statistics Estimated Residential Population Data (ERP) (2011-15);
- NSW Department of Planning and Environment Household and Population Projections (2014);
- NSW Bureau of Transport Statistics (BTS) population projections (2014 release);
- Other investigations of future residential development, undertaken by this office.

There are two main residential estates within the Schofields precinct, which are expected to drive future growth in the identified main trade area include:

- **Stockland's Altrove Estate**: which is currently being developed and is expected to yield more than 1,000 dwellings upon completion. We have assumed an approximate take-up rate in this estate of around 100 – 150 dwellings per annum from 2016 onwards.
- **DHA's Schofields Aerodrome site:** which is expected to accommodate around 1,000 – 1,200 dwellings upon completion. As indicated the project is planned to be developed in 7 stages between 2018 and 2025. We have therefore assumed an approximate dwelling take-up rate of around 150 dwellings per annum over this time period.
- The **secondary east sector** includes a small part of the **Alex Avenue precinct** around Burdekin Road and the rail line.
- Some additional residential development is expected in the **secondary south sector** within the technical boundary of the Schofields precinct (west of the Nirimba education precinct).

- The southern part of the **West Schofields precinct** could potentially yield between 1,000 and 2,000 dwellings, depending on the outcomes of the PAP that is currently underway.

The main trade area population was estimated at 9,100 in 2016, with no residents in the key primary sector – given its previous use as an aerodrome. Having regard to the above residential estates, we estimate that the main trade area population to increase to around 19,000 persons by 2026, and reach 25,600 persons by 2036, equivalent to an annual average growth rate of 5.3%, or around 800 persons per annum.

Table 2.1
Schofields Aerodrome trade area population, 2006-2036*

	Estimated population				Forecast population			
Trade area sector	2006	2011	2016	2018	2021	2026	2031	2036
Primary	0	0	0	0	1,350	3,350	3,850	4,250
Secondary sectors								
• North	420	500	550	850	2,050	3,800	4,300	4,700
• East	4,920	4,960	5,110	5,250	5,550	6,050	6,550	7,050
• South	2,910	2,990	3,140	3,180	3,240	3,340	3,740	4,140
• West	300	260	310	330	930	2,430	3,930	5,430
Total secondary	8,550	8,710	9,110	9,610	11,770	15,620	18,520	21,320
Main trade area	**8,550**	**8,710**	**9,110**	**9,610**	**13,120**	**18,970**	**22,370**	**25,570**

	Average annual growth (no.)						
Trade area sector	2006-11	2011-16	2016-18	2018-21	2021-26	2026-31	2031-36
Primary	0	0	0	450	400	100	80
Secondary sectors							
• North	16	10	150	400	350	100	80
• East	8	30	70	100	100	100	100
• South	16	30	20	20	20	80	80
• West	-8	10	10	200	300	300	300
Total secondary	32	80	250	720	770	580	560
Main trade area	**32**	**80**	**250**	**1,170**	**1,170**	**680**	**640**

	Average annual growth (%)						
Trade area sector	2006-11	2011-16	2016-18	2018-21	2021-26	2026-31	2031-36
Primary	0.0%	0.0%	0.0%	0.0%	19.9%	2.8%	2.0%
Secondary sectors							
• North	3.5%	1.9%	24.3%	34.1%	13.1%	2.5%	1.8%
• East	0.2%	0.6%	1.4%	1.9%	1.7%	1.6%	1.5%
• South	0.5%	1.0%	0.6%	0.6%	0.6%	2.3%	2.1%
• West	-2.8%	3.6%	3.2%	41.3%	21.2%	10.1%	6.7%
Total secondary	0.4%	0.9%	2.7%	7.0%	5.8%	3.5%	2.9%
Main trade area	**0.4%**	**0.9%**	**2.7%**	**10.9%**	**7.7%**	**3.4%**	**2.7%**

**As at June*
Source: ABS Census 2011; NSW Department of Planning and Environment 2016; MacroPlan Dimasi

2.3 Socio-demographic profile

Table 2.2 presents a summary of the socio-demographic profile of the main trade area population based on data from the 2011 ABS Census of Population and Housing, compared against the metropolitan Sydney and Australian averages. While the 2016 ABS Census was recently undertaken, detailed data will not be available until 2018, thus the most recent available information on the socio-demographic profile of the main trade area population is from the 2011 ABS Census.

As at 2011, there were no people living in the primary sector and a limited population in the secondary west sector and secondary north sectors. It is likely that the future population in these areas will be more similar to the established areas around Stanhope Gardens, The Ponds and Rouse Hill (similar to the secondary east sector). Later in our report when estimating the available retail expenditure, we use a 'proxy area' consisting of the areas around to more accurately estimate the likely retail expenditure potential of these residents.

The key highlights in relation to the socio-demographic profile of the main trade area population as at 2011 are as follows:

- The average household income of the main trade area population is marginally below the metropolitan Sydney average. The secondary east sector is particularly affluent, with per household income levels at 9% above the metropolitan Sydney average. We expect average incomes in the primary, secondary north and secondary west sectors in particular to increase over time.
- The average age of the main trade area population (32.6 years) significantly less than the Sydney average of 37.1 years. There is an above average proportion of children in the trade area (24%) and a below average proportion of residents aged over 60 (11.9% v 18%).
- The home ownership level of the main total trade area population, at 73.3%, is above the Sydney average (66.8%). This proportion is expected to increase with the new population moving to newly developed residential dwellings in the main trade area.

- The proportion of Australian born residents across the main trade area (65.5%) is slightly higher than the metropolitan Sydney average of 63.6%. Asian born residents make up the largest share of main trade area residents born overseas (19%), particularly in the secondary south sector.
- Traditional families (i.e. couples with dependent children) account for 55.8% of main trade area households, which is well above the Sydney metropolitan average of 48.2%. There is an under-representation of couples with no children (14.5%) and lone person households (3.3%).

In summary, the main trade area population consists of a young population living in traditional family units in their early life stages, with large average household sizes, earning average household incomes. This demographic profile, relative to the broader Sydney population, is expected to continue to prevail as the population expands in the main trade area in the future, although we expect average incomes to improve, particularly in the less populated parts of the trade area.

Table 2.2
Schofields Aerodrome main trade area - socio-demographic profile, 2011

Census item	Primary* sector	Secondary sectors North	East	South	West	Main TA	Syd Metro avg.	Aust. avg.
Per capita income	$0	$30,510	$34,044	$27,027	$25,323	$31,172	$37,441	$34,467
Var. from Syd Metro benchmark	*-100.0%*	*-18.5%*	*-9.1%*	*-27.8%*	*-32.4%*	*-16.7%*		
Avg. household income	$0	$88,479	$110,132	$84,354	$70,905	$98,493	$101,090	$88,205
Var. from Syd Metro benchmark	*-100.0%*	*-12.5%*	*8.9%*	*-16.6%*	*-29.9%*	*-2.6%*		
Avg. household size	0.0	2.9	3.2	3.1	2.8	3.2	2.7	2.6
Age distribution (% of population)								
Aged 0-14	0.0%	16.2%	26.4%	20.2%	25.8%	23.7%	19.2%	19.3%
Aged 15-19	0.0%	11.0%	8.4%	7.2%	7.5%	8.1%	6.3%	6.5%
Aged 20-29	0.0%	15.8%	12.8%	17.3%	12.3%	14.5%	14.8%	13.8%
Aged 30-39	0.0%	12.3%	17.1%	16.0%	12.3%	16.3%	15.3%	13.8%
Aged 40-49	0.0%	17.3%	16.9%	12.4%	13.5%	15.2%	14.3%	14.2%
Aged 50-59	0.0%	12.3%	10.1%	13.2%	11.1%	11.3%	12.2%	12.8%
Aged 60+	0.0%	15.2%	8.4%	13.7%	17.5%	10.9%	18.0%	19.6%
Average age	0.0	36.3	31.1	34.3	34.6	32.6	37.1	37.9
Housing status (% of households)								
Owner (total)	0.0%	71.5%	79.2%	64.0%	70.7%	73.3%	66.8%	68.7%
• Owner (outright)	0.0%	31.6%	20.9%	26.0%	44.0%	24.0%	31.1%	32.9%
• Owner (with mortgage)	0.0%	39.9%	58.3%	38.0%	26.7%	49.3%	35.7%	35.8%
Renter	0.0%	28.5%	20.6%	35.7%	29.3%	26.5%	32.4%	30.4%
Other	0.0%	0.0%	0.2%	0.3%	0.0%	0.2%	0.8%	0.9%
Birthplace (% of population)								
Australian born	0.0%	83.8%	71.1%	52.0%	78.6%	65.5%	63.6%	74.0%
Overseas born	0.0%	16.2%	28.9%	48.0%	21.4%	34.5%	36.4%	26.0%
• Asia	0.0%	2.4%	14.7%	29.7%	4.4%	18.9%	15.5%	8.6%
• Europe	0.0%	10.9%	6.5%	7.5%	11.4%	7.3%	10.6%	10.5%
• Other	0.0%	2.9%	7.6%	10.8%	5.7%	8.4%	10.3%	7.0%
Family type (% of households)								
Couple with dep't children	0.0%	44.1%	63.0%	46.9%	50.2%	55.8%	48.2%	45.3%
Couple with non-dep't child.	0.0%	12.7%	7.7%	13.3%	12.1%	10.1%	9.1%	7.7%
Couple without children	0.0%	15.6%	13.6%	16.2%	17.7%	14.8%	20.1%	23.0%
One parent with dep't child.	0.0%	13.9%	8.6%	12.2%	7.0%	10.1%	8.5%	9.2%
One parent w non-dep't child.	0.0%	4.7%	2.6%	5.0%	2.3%	3.6%	3.9%	3.5%
Other family	0.0%	1.2%	0.6%	0.8%	1.4%	0.7%	1.2%	1.1%
Lone person	0.0%	7.8%	3.8%	5.6%	9.3%	4.9%	9.0%	10.2%

**No population as at 2011.*
Source: ABS Census of Population & Housing, 2011; MacroPlan Dimasi

2.4 Retail expenditure

MacroPlan Dimasi estimates retail expenditure capacity generated by the main trade area residents based on MarketInfo data, sourced from Market Data Systems (MDS), which utilises a detailed micro simulation model of household expenditure behaviour for all residents of Australia. The model takes into account information from a wide variety of sources including the regular ABS Household Expenditure Surveys, national accounts data, Census data and other information. We consider MarketInfo data to be an accurate measure of available retail expenditure and it is widely relied on in the retail industry.

Total retail expenditure is detailed in a number of categories, as follows:

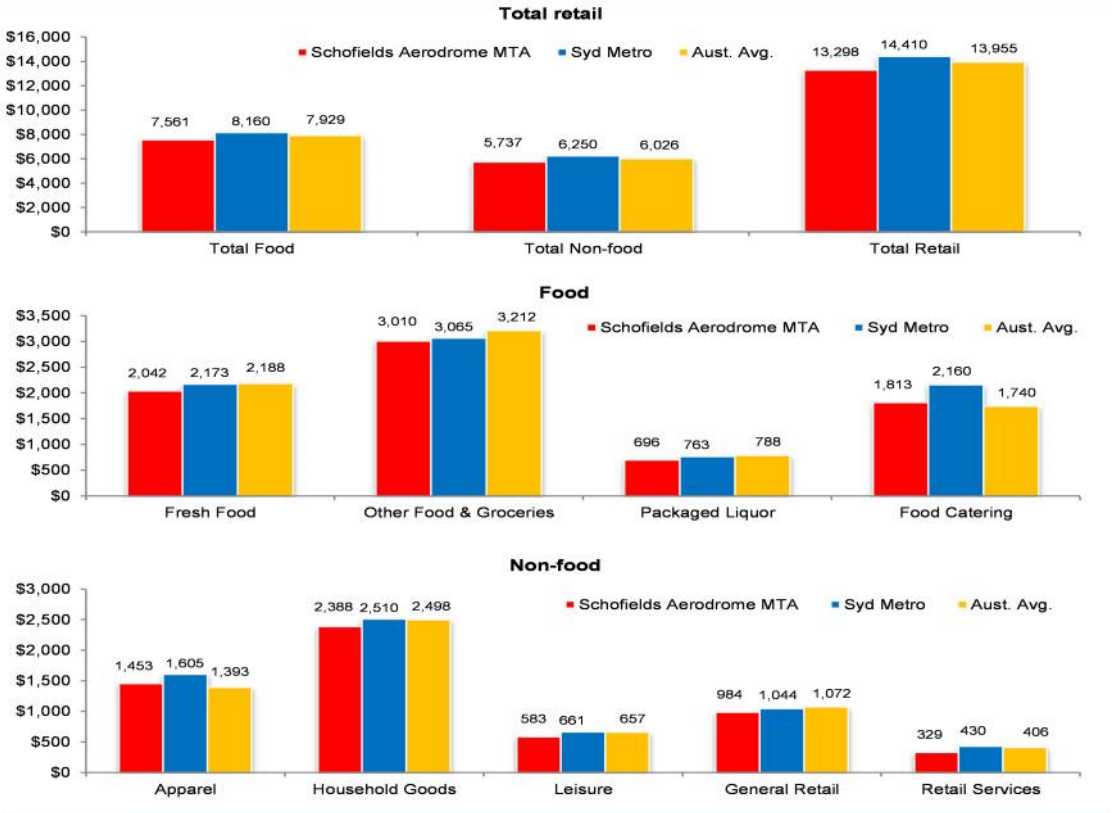
- Take-home food and groceries – goods typically sold in supermarkets and specialty fresh food stores.
- Packaged liquor – packaged beer, wine and spirits such as those purchased at bottle-shops and liquor outlets.
- Food catering – cafes, take-away outlets and restaurants, including liquor consumed on such premises.
- Apparel – clothing, footwear, fashion and accessories.
- Household Goods – giftware, electrical, computers, furniture, homewares, and hardware goods.
- Leisure – sporting goods, music, DVDs, games, books, newsagents and film processing/photography.
- General Retail – pharmaceutical goods, cosmetics, toys, florists, mobile phones.
- Retail Services – retail services such as key cutting, shoe repairs, hair and beauty.

Chart 2.1 shows the potential retail expenditure capacity per person for residents of the main trade area for the year FY2015/16, having regard to the spending characteristics of the proxy region identified in sub-section 2.3, and compares these estimates with the average for metropolitan Sydney and Australia. Expenditure estimates are presented inclusive of GST. The following points are noted:

- Estimated retail expenditure per capita is around 7 - 8% below the metropolitan Sydney average. However, due to the high average household size of the main trade area population relative to Sydney (17% larger), estimated retail expenditure per household is 8% above average.

- Per capita expenditure on fresh food and other food and groceries, key categories of relevance to supermarkets, is around 3 – 4% lower than the Sydney average.

Chart 2.1
Schofields Aerodrome main trade area - retail expenditure per person, 2015/16*



*Including GST
Source: MarketInfo; MacroPlan Dimasi

Table 2.3 presents estimates of total retail expenditure generated by the main trade area population, by trade area sector, over the period 2016 to 2036. Retail expenditure forecasts are presented inclusive of GST and in constant 2015/16 dollars (i.e. inflation is excluded from the analysis).

The retail expenditure market is expected to grow from about $121 million in 2016 to $431 million ($2016) by 2036, at an average annual growth rate of 6.6% (including a real growth assumption but excluding inflation).

The total retail expenditure capacity of primary sector residents is expected to grow to $51 million ($2016) by 2026 and to $76 million by 2036 ($2016).

Table 2.4 presents estimates of expenditure for the main trade area by retail category, over the period 2016 to 2036. FLG expenditure (i.e. expenditure on take-home food and groceries including packaged liquor), a key category of relevance for supermarkets is estimated at $52 million in 2016, and accounts for 43% of all retail expenditure in the trade area. Main trade area FLG expenditure is forecast to increase to $187 million by 2036, reflecting average annual growth of 6.6%.

Table 2.3
Schofields Aerodrome main trade area - retail expenditure ($M), 2016-2036*

Year ending June	Primary sector	Secondary sectors North	East	South	West	Main TA
2016	0.0	8.2	69.9	37.9	4.6	120.6
2018	0.0	11.7	72.8	39.1	5.0	128.7
2021	15.0	28.0	78.9	41.0	12.4	175.2
2026	50.5	59.0	90.1	44.2	36.5	280.4
2031	65.7	73.5	102.2	51.5	64.8	357.5
2036	76.2	84.4	115.2	59.7	95.2	430.7
Average annual growth ($M)						
2016-2036	3.8	3.8	2.3	1.1	4.5	15.5
Average annual growth (%)						
2016-2036	n.a.	12.3%	2.5%	2.3%	16.4%	6.6%

**Constant 2015/16 dollars & including GST*
Source: MarketInfo; MacroPlan Dimasi

Table 2.4
Schofields Aerodrome main trade area - retail expenditure by category ($M), 2016-2036*

Year ending June	FLG	Food catering	Apparel	Household goods	Leisure	General retail	Retail services	**Total retail**
2016	52.1	16.4	13.2	21.7	5.3	8.9	3.0	120.6
2018	55.7	17.8	14.0	23.1	5.6	9.4	3.2	128.7
2021	75.6	24.6	18.9	31.4	7.6	12.7	4.4	175.2
2026	120.8	40.5	29.8	50.2	11.9	20.1	7.2	280.4
2031	154.5	53.2	37.2	63.5	14.9	25.1	9.2	357.5
2036	186.8	65.9	43.9	75.9	17.5	29.6	11.1	430.7
Average annual growth ($M)								
2016-2036	6.7	2.5	1.5	2.7	0.6	1.0	0.4	15.5
Average annual growth (%)								
2016-2036	6.6%	7.2%	6.2%	6.5%	6.2%	6.2%	6.8%	6.6%

**Constant 2015/16 dollars & including GST*
Source: MarketInfo; MacroPlan Dimasi

Retail expenditure category definitions:

- FLG: take-home food and groceries, as well as packaged liquor.
- Food catering: expenditure at cafes, take-away food outlets and restaurants.
- Apparel: clothing, footwear, fashion accessories and jewellery.
- Household goods: giftware, electrical, computers, furniture, homewares and hardware goods.
- Leisure: sporting goods, music, DVDs, computer games, books, newspapers & magazines, stationery and photography equipment.
- General retail: pharmaceutical goods, cosmetics, toys, florists, mobile phones and pets.
- Retail services: hair & beauty, optical goods, dry cleaning, key cutting and shoe repairs.

Section 3: Competition assessment

This section of the report reviews the surrounding retail/centres hierarchy of relevance to proposed retail/commercial facilities at the Schofields Aerodrome Local Centre, including all planned and proposed centres of relevance.

3.1 Existing competition

Table 3.1 details the existing retail facilities of relevance to retail facilities being developed at the Schofields Aerodrome Local Centre, while the previous Map 2.1 illustrates the locations of these facilities as well as the planned centres in the region. There are three existing sub-regional centres in the surrounding region, summarised as follows:

- **Stanhope Village** is a 16,000 sq.m sub-regional shopping centre located to the east of the Schofields Aerodrome Local Centre. The centre is anchored by a Kmart dds, as well as Coles and Aldi supermarket and contains around 65 – 70 specialty shops including retail and non-retail tenants. According to SCN this centre achieved MAT of $153 million in 2015, placing it 3rd of all 'Little Guns' across Australia.

- **Plumpton Marketplace**, which is located south-west of the Richmond Road/M7 intersection is a sub-regional centre located to the south-west of the Schofields Aerodrome Local Centre. The centre includes 16,200 sq.m of retail GLA, anchored by a Big W discount department store (dds) and a Woolworths supermarket, and around 60-65 specialty shops. According to Shopping Centre News (SCN) this centre achieved annual turnover (MAT) of $152 million in the year to July 2015, placing it 6th of all 'Little Guns' across Australia.

- **Rouse Hill Town Centre** is the dominant retail facility serving the NWPGA (albeit beyond the technical boundary) and is a large sub-regional shopping centre located to the north-east of the subject site along Schofields Road. The centre contains around 56,600 sq.m of retail floorspace and is anchored by Big W, Target, Woolworths, Coles, and contains more than 200 specialty and mini-major tenants. The centre is planned to undergo a

major expansion over the short-medium term, which is detailed further in sub-section 3.2 of this report.

- **Woolworths Schofields** is a small neighbourhood convenience centre of around 4,500 sq.m, which includes four tenancies; a Woolworths supermarket, a BWS liquor store, a Terry White Chemist and a H Café pad site. There are also 5 - 6 shops just north of the centre in a small retail precinct on Railway Parade. Woolworths Schofield is a relatively new centre, which opened in 2014, and the centre forms part of the broader Schofields Town Centre (which is discussed further in sub-section 3.2)

- **The Ponds SC** is a large neighbourhood shopping that opened in late 2014, to serve the needs of residents of The Ponds residential estate and comprises a Woolworths supermarket and around 20 specialty retailers, of which around 10 are food catering based retailers.

- To the east of the rail line, in **Quakers Hill** (north of the M7) there is a standalone Aldi supermarket of around 1,300 sq.m located on Hambleton Road and the small IGA anchored **Quakers Hill Shopping Village**, which contains around 2,500 sq.m of retail floorspace.

- South of the M7, there is the Woolworths anchored **Quakers Court Shopping Centre** of around 5,000 sq.m, which contains 10-12 specialty shops, and **Woodcraft Village**, a Coles anchored shopping centre, with around 8-10 specialty shops, totalling 4,500 sq.m.

- To the north is **Riverstone Marketown,** which is a tired, run-down retail asset located near the Riverstone railway station which contains around 2,300 sq.m of retail floorspace including a small IGA supermarket. There is also around 1,000 sq.m of street/strip retail in the town centre.

Table 3.1
Schofields Aerodrome - schedule of competing retail facilities

Centre	Retail GLA (sq.m)	Major traders
Sub-regional shopping centres		
Stanhope Village	16,000	Kmart, Coles, Aldi
Plumpton Marketplace	16,000	Big W, Woolworths
Rouse Hill	*61,600*	
• Rouse Hill TC (existing)	56,600	Big W, Target, Woolworths, Coles
• Other	5,000	Aldi, IGA
• Rouse Hill TC (p)	29,000	Big W, Target, Woolworths, Coles
Nearby neighbourhood shopping centres		
Schofields Town Centre	*4,500*	
• Schofields TC	4,500	Woolworths
• Schofields TC (p)	1,600	
• Schofields Coles Stg1	5,000	Coles (p)
The Ponds SC	7,000	Woolworths
Quakers Hill		
• Quakers Hill Aldi	1,500	Aldi
• Quakers Hill Village	2,500	IGA
Quakers Court	5,100	Woolworths
Riverstone Town Centre	*2,000*	
• Riverstone Marketown	2,000	IGA
• Riverstone Marketown (p)	11,000	Supermarkets (p)
• Future potential (p)	25,000	Possible DDS (p)
Sydney Business Park	*50,000+*	
• Syd Business Park*	70,000+	IKEA, Bunnings, Aldi, Home Hub
• Syd Business Park (u/c)	13,600	Costco

**Includes ex-Masters box which is likely to be re-tenanted by retail*
Source: Property Council of Australia; MacroPlan Dimasi

3.2 Proposed competition

This sub-section of the report outlines the proposed competitive retail developments of relevance to proposed retail facilities at the Schofields Aerodrome Local Centre. The following competitive retail developments in the surrounding region are noted:

- The **Schofields Aerodrome Local Centre** is the subject of this report, and is earmarked to support up to 5,600 sq.m of retail and commercial space according to the DCP for the precinct.

- There is one other centre identified within the Schofields precinct, identified as the **Schofields Station Local Centre**, located to the west of Schofield train station, which allows for a maximum of 13,600 sq.m of retail and commercial floorspace. Given the centre's proximity to the Schofields Town Centre, which will support both Coles and Woolworths supermarkets in the short-term, and the ultimate potential for the town centre to support around 30,000 – 40,000 sq.m, we do not expect a significant retail outcome at this centre for a very long time. This is particularly the case, following the extension of Schofields Road westwards across the railway line.

- **Schofields Town Centre** is planned to accommodate around 30,000 – 40,000 sq.m of retail/commercial floorspace over the long term, potentially including DDS and at least two supermarkets. The Woolworths Schofields centre already forms part of this town centre, and there are plans for an additional 1,600 sq.m of speciality space to be added to the Woolworths Schofield asset.

- Coles owns a site within the town centre at the intersection of Schofields Road and Railway Terrace, for which it has DA approval for a Stage 1 development consisting of a 4,200 sq.m Coles supermarket and around 700 sq.m of specialty space. We have assumed this development is completed by mid-2019 (i.e. first year of trade FY 2019/20). A Stage 2 expansion for a further 1,200 sq.m has conceptual approval and is subject to DA approval.

- A neighbourhood centre is planned in the centre of the **Alex Avenue** precinct, although we expect this will evolved over the longer term as there are several supermarkets located nearby and an Aldi store at Quakers Hill.

- Two neighbourhood centres are identified in the **Schofields West** precinct according to the NWGC Structure Plan. The West Schofields (part) precinct is currently undergoing the precinct acceleration protocol (PAP). We note that the original NWGC Structure Plan outlined a centres hierarchy that contained a network of neighbourhood centres that were intended to serve walkable catchments, which is not necessarily what the market wants to delivery nor what consumers want. It is possible that the two neighbourhood centres in the West Schofields precinct could be consolidated into one larger Local Centre, as this precinct goes through more detailed planning.

- The Home Hub homemaker centre is now open and a **Costco retail warehouse** is now under construction within the **Sydney Business Park**, and is due to open mid-2017. Directly across Richmond Road to the east is a proposed Woolworths anchored development called **Greenway Village Centre**, which is also under construction.

- The Greenway Village Centre is a planned neighbourhood centre which will serve the developing residential population of Colebee, Greenway, Marsden Park and to a lesser extent, Schofields. The Woolworths centre will consist of a 3,600 sq.m Woolworths supermarket and 800 sq.m of supporting specialty floorspace, and is expected to open in mid-late 2017. There is another small development with childcare, medical, and small scale specialty retail adjacent to the Greenway Village Centre, also under construction.

- The **Marsden Park Town Centre** is a planned Major Centre which could support up to 30,000 – 40,000 sq.m of retail and commercial floorspace over the long term, to be anchored by at least one DDS and at least two supermarkets. This centre is expected to evolve over the long term, but is likely to include supermarket based retail in the early stages of its evolution. Three neighbourhood/local centres are also earmarked within the Marsden Park precinct. We expect a first stage of development to occur within the Marsden Park Town Centre sometime around 2020 or so.

- We have assumed a full-line supermarket is developed at **Cudgegong Road/Area 20** around 2022 (i.e. first year FY2022/23), with this precinct expected to accommodate up to 4,500 new dwellings over the long term.

- **The Rouse Hill Town Centre** is a designated Major Centre in the NWPGA and has in-principle approval for around 100,000 sq.m of retail floorspace, i.e. the centre has approval to almost double in size. While there is no official DA lodged for an expansion of this centre, a major $300 million expansion of the centre has been announced by GPT to coincide with the new Sydney Metro Northwest and major increases in residential dwelling construction in the locality. The proposed expansion is expected to add around 29,000 sq.m of floorspace including a new department store. GPT has indicated that this expansion will be completed during 2019.

- **Riverstone Town Centre** is a planned sub-regional centre that is intended to accommodate 20,000 – 30,000 sq.m of retail floorspace. Riverstone Marketown forms part of this town centre, and has DA approval for an 11,000 sq.m net increase in retail GLA including two new supermarkets. We understand that this development will not occur until bridge access is provided across the rail line to alleviate potential traffic congestion. This centre is expected to evolve into a sub-regional centre over the much longer term, beyond the forecast horizon in this report and we do not expect either of the two major supermarket operators to move to this location until well beyond 2020. A village centre is planned in **Riverstone East** but is not expected to be developed within the next decade.

Section 4: Retail and commercial potential

This section of the report provides estimates of retail floorspace demand generated by the main trade area population, and then assesses the potential supportable scale, mix and timing of the Local Centre within the Schofields Aerodrome estate. This analysis has regard to two potential locations for the Local Centre (i.e. the current location as per the planning scheme and an alternative location near Burdekin Road) and provides case studies of small local centres in comparable greenfield locations across metropolitan Sydney and Australia.

4.1 Retail floorspace demand: main trade area

To assess the potential supportable floorspace within the West Schofields precinct, we have first estimated the retail floorspace demand generated by the main trade area population using a provision per capita method. A given population generally generates demand for around 2.2 sq.m per capita of all types of retail, of which around 0.65 sq.m consists of demand for bulky goods/large format retail, which means around 1.55 sq.m is attributable to other 'traditional retail' (i.e. enclosed shopping centres, strip retail precincts, standalone supermarket facilities etc). Due to the long term planning horizon being considered, the diverse range of retail formats that exist, and the varying performance levels of certain retail categories and formats, these estimates should be considered as indicative in nature.

Table 4.1 summarises the estimated retail floorspace demand generated by the main trade area population over the period 2016 to 2036. Because of the local/neighbourhood role of the centre, we have disaggregated demand for supermarket floorspace from 'other traditional retail' floorspace demand. As shown, the population of the main trade area generates demand for around 17,800 sq.m of retail floorspace at present including demand for around 3,600 sq.m of supermarket floorspace. Main trade area supermarket floorspace demand is projected to increase to around 7,600 by 2026 and 10,200 sq.m by 2036 (including primary sector demand for around 1,700 sq.m and secondary north sector demand for around 1,900 sq.m = 3,600 sq.m combined).

Table 4.1
Schofields Aerodrome MTA - Estimated supportable floorspace (2016 - 2036)

Indicator/Category	2016	2021	2026	2031	2036	Tot. growth 2016-36
Est. population						
Primary sector	0	1,350	3,350	3,850	4,250	4,250
Secondary sectors						
• North	550	2,050	3,800	4,300	4,700	4,150
• East	5,110	5,550	6,050	6,550	7,050	1,940
• South	3,140	3,240	3,340	3,740	4,140	1,000
• West	310	930	2,430	3,930	5,430	5,120
Total secondary sectors	9,110	11,770	15,620	18,520	21,320	12,210
Main trade area	**9,110**	**13,120**	**18,970**	**22,370**	**25,570**	**16,460**
Est. retail demand per person (sq.m per capita)						
Supermarket	0.40	0.40	0.40	0.40	0.40	
Other traditional retail*	1.15	1.15	1.15	1.15	1.15	
Total traditional	**1.55**	**1.55**	**1.55**	**1.55**	**1.55**	
Supermarket floorspace demand (sq.m)						
Primary sector	0	540	1,340	1,540	1,700	1,700
Secondary sectors						
• North	220	820	1,520	1,720	1,880	1,660
• East	2,044	2,220	2,420	2,620	2,820	776
• South	1,256	1,296	1,336	1,496	1,656	400
• West	124	372	972	1,572	2,172	2,048
Total secondary sectors	3,644	4,708	6,248	7,408	8,528	4,884
Main trade area	**3,644**	**5,248**	**7,588**	**8,948**	**10,228**	**6,584**
Other traditional retail floorspace demand (sq.m)*						
Primary sector	0	2,093	5,193	5,968	6,588	6,588
Secondary sectors						
• North	853	3,178	5,890	6,665	7,285	6,433
• East	7,921	8,603	9,378	10,153	10,928	3,007
• South	4,867	5,022	5,177	5,797	6,417	1,550
• West	481	1,442	3,767	6,092	8,417	7,936
Total secondary sectors	14,121	18,244	24,211	28,706	33,046	18,926
Main trade area	**14,121**	**20,336**	**29,404**	**34,674**	**39,634**	**25,513**
Total traditional retail floorspace demand (sq.m)**						
Primary sector	0	2,633	6,533	7,508	8,288	8,288
Secondary sectors						
• North	1,073	3,998	7,410	8,385	9,165	8,093
• East	9,965	10,823	11,798	12,773	13,748	3,783
• South	6,123	6,318	6,513	7,293	8,073	1,950
• West	605	1,814	4,739	7,664	10,589	9,984
Total secondary sectors	17,765	22,952	30,459	36,114	41,574	23,810
Main trade area	**17,765**	**25,584**	**36,992**	**43,622**	**49,862**	**32,097**

**Includes all traditional retail but not supermarket demand (i.e. excluding bulky goods).*
***Includes all traditional retail (i.e. excluding bulky goods).*
Source: MacroPlan Dimasi

4.2 Supportable retail floorspace

Table 4.2 presents estimated market shares that could reasonably be expected to be achieved by retail facilities within the Schofields Aerodrome Local Centre. We have presented potential markets shares under the two potential centre location scenarios (i.e. Inboard Location and Burdekin Road location).

We have assumed that the connection with Quakers Road to the south occurs relatively early through the development of the estate, at around the same time as the development of the local centre, enabling the centre to tap the i secondary south sector more effectively. We expect that some business could be drawn from the secondary west sector in the short-term given the upgrade of Schofields Road and the extension of Burdekin Road is expected to help support (some) eastern trade, albeit limited. Without these road connections, attracting a key supermarket anchor tenant is expected to be very difficult.

As shown, supermarket market shares from the primary sector are expected to be strong and we also expect relatively solid market shares from the secondary north sector could be achieved given the road connection from this area across Schofields Road. We have accounted for new retail developments expected across the surrounding secondary sectors in the future.

Because 'other traditional retail' includes demand/spending across a range of retail formats/categories including higher order leisure shopping, dds/department store shopping, as well as convenience oriented speciality retail, the market shares are much lower than for the supermarket category.

The key distinctions between the two scenarios is that we have assumed a beyond trade area share of 10% for an Inboard Location compared with 12.5% for a Burdekin Road location although we expect similar, or indeed, slightly lower market shares from across the main trade area, due to accessibility issues related with this location.

Table 4.3 presents a summary of the supportable retail floorspace at the Schofields Aerodrome Local Centre under each scenario having regard to the market share assumptions in Table 4.2 and the retail floorspace demand modelling in Table 4.1.

As shown, due to the issues related to access from Burdekin Road in the future (i.e. there is a corridor on the southern side of the road meaning no direct access) and likely difficulties of providing a lighted intersection closer to Burdekin Road, we expect a slightly better outcome could be achieved at the Inboard Location. Although we expect only a minor difference in the amount of supportable retail floorspace under each scenario, due to the relatively close distance between the two alternative site locations as well as the proximity to a solid retail offer within the Schofields Town Centre combined with relatively small primary and secondary north sector populations which will restrict the ultimate scale of the centre. We expect the Inboard Location would likely be more successful/appropriate, due to the centralised location in the estate (i.e. the primary sector) and the ability for the centre to be served by a lighted intersection.

While we have assumed that the key north-south road connection is made with Quakers Road over the medium term, once the local centre establishes. Although our modelling indicates that the centre is too not reliant on the secondary south part of the trade area to any great extent.

Table 4.2
Schofields Aerodrome MTA - Potential market shares (2016 - 2036)

Indicator/Category	2016	2021*	2026**	2031	2036
Inboard location					
Supermarket market share					
Primary sector	35.0%	35.0%	35.0%	35.0%	35.0%
Secondary sectors					
• North	15.0%	15.0%	12.5%	10.0%	10.0%
• East	0.0%	2.5%	2.5%	2.5%	2.5%
• South	0.0%	0.0%	2.5%	3.5%	4.5%
• West	0.0%	10.0%	10.0%	5.0%	2.5%
Beyond trade area share	10.0%	10.0%	10.0%	10.0%	10.0%
Other traditional retail market share					
Primary sector	10.0%	10.0%	10.0%	10.0%	10.0%
Secondary sectors					
• North	4.3%	4.3%	3.6%	2.9%	2.9%
• East	0.0%	0.7%	0.7%	0.7%	0.7%
• South	0.0%	0.0%	0.7%	1.0%	1.3%
• West	0.0%	2.9%	2.9%	1.4%	0.7%
Beyond trade area share	10.0%	10.0%	10.0%	10.0%	10.0%
Burdekin Road location					
Supermarket market share					
Primary sector	32.5%	32.5%	32.5%	32.5%	32.5%
Secondary sectors					
• North	13.5%	13.5%	11.0%	8.5%	8.5%
• East	0.0%	2.0%	2.0%	2.0%	2.0%
• South	0.0%	0.0%	2.0%	3.0%	4.0%
• West	0.0%	9.5%	9.5%	4.5%	2.0%
Beyond trade area share	15.0%	15.0%	15.0%	15.0%	15.0%
Other traditional retail market share					
Primary sector	9.3%	9.3%	9.3%	9.3%	9.3%
Secondary sectors					
• North	3.9%	3.9%	3.1%	2.4%	2.4%
• East	0.0%	0.6%	0.6%	0.6%	0.6%
• South	0.0%	0.0%	0.6%	0.9%	1.1%
• West	0.0%	2.7%	2.7%	1.3%	0.6%
Beyond trade area share	15.0%	15.0%	15.0%	15.0%	15.0%

** Assumes that Burdekin Road extension is provided by 2021*
***Assumes that north-south road through estate and Quakers Road connection is made by 2026*
Source: MacroPlan Dimasi

Table 4.3
Schofields Aerodrome Local Centre - Estimated supportable floorspace (2016 - 2036)

Indicator/Category	2016	2021	2026	2031	2036	Tot. growth 2016-36
Inboard location						
Supermarket	37	450	945	1,008	1,091	1,055
Other traditional retail*	41	498	1,046	1,116	1,208	1,168
Total retail**	**77**	**948**	**1,990**	**2,125**	**2,300**	**2,223**
Burdekin Road location						
Supermarket	35	431	906	958	1,033	998
Other traditional retail*	39	477	1,003	1,061	1,144	1,105
Total retail**	**74**	**907**	**1,909**	**2,020**	**2,177**	**2,104**

**Includes all traditional retail but not supermarket demand (i.e. excluding bulky goods).*
***Includes all traditional retail (i.e. excluding bulky goods).*
Source: MacroPlan Dimasi

4.3 Recommended mix

Table 4.4 presents our recommended mix of retail and ancillary non-retail floorspace that could be supported at the Schofields Aerodrome Local Centre, presented for each alternative location. We make the following comments in relation to the recommended floorspace provision in the West Schofields precinct:

- Typically there is one large supermarket provided per 8,000 – 9,000 persons across Australia. By 2026, the combined primary and secondary north populations would be around 7,000 persons, which would barely be sufficient to support a full-line supermarket even if there was no surrounding competition.

- The proximity of the Schofields Town Centre, which contains an existing full-line Woolworths supermarket, with Coles planning to open a store by 2019, will significantly limit the potential scale of the offer at the subject site, i.e. a full-line supermarket outcome is very unlikely.

- In the short-term, residents of the DHA estate will be served by Schofields Woolworths and Greenway Village for convenience based retail facilities, while over the longer term these centres will also be the primary full-line supermarket locations, potentially with additional facilities provided at West Schofields and/or at Alex Avenue.

- We do not expect the Schofields Station Local Centre to evolve into a retail centre of great significance in the foreseeable future, given its proximity to Schofields Town Centre which will be easily accessible via Schofields Road.

- Under the Inboard location scenario, we recommend a local centre of around 3500 sq.m including 2,000 sq.m of retail floorspace, including a 1,000 – 1,200 sq.m supermarket, and around 1,500 sq.m of non-retail supporting uses.

- Under this scenario, we recommend around 1,500 sq.m of non-retail uses including a small medical centre; a gym; small scale office/commercial space; and a childcare centre.

- Under the Burdekin Road scenario, we expect a slightly smaller development would be sustainable.

Table 4.4
Schofields Aerodrome Local Centre - Recommended size/composition of Local Centre*

	Inboard location		Burdekin Road	
	Area (sq.m)	No. tenants	Area (sq.m)	No. tenants
Retail				
Supermarket	1,000 - 1,200	1	1,000 - 1,200	1
Specialty	900		750	
- Food	200	2 - 3	150	2 - 3
- Food catering	450	3 - 4	400	3 - 4
- Non food	250	2 - 3	200	2
Total retail	**2,000**	**8 - 9**	**1,850**	**7 - 8**
Non-retail				
Medical/allied	100	1	100	1
Other non-retail	500	2 - 5	350	2 - 5
Gym/fitness centre	400	1	400	1
Child care	500	1	500	1
Total non-retail	**1,500**	**4 - 5**	**1,350**	**4 - 5**
Total floorspace (GLA)	**3,500**	**13 - 15**	**3,200**	**12 - 14**

**Floorspace figures are presented as gross leasable area (GLA)*
Source: MacroPlan Dimasi

4.4 Potential impacts

A B2 – Local centre is already ear-marked for the Schofields precinct, with a floorspace allowance of up to 5,600 sq.m of retail and commercial floorspace. The recommended mix outlined in Table 4.4 is well within this permissible amount and thus any impacts on surrounding centres, which would be minimal anyway, would be reduced.

4.5 Case studies

This section of the report presents a summary of selected neighbourhood/local centres across Australia with small-medium sized supermarket anchors. These centres are not all in Greenfield locations, but are still considered to be relevant benchmarks upon which to draw inspiration around centre design to provide context around scale and mix

- **Breakfast Point Village Centre:** The Breakfast Point Village Centre forms part the Breakfast Point residential urban renewal project that was developed around 2006. The Village Centre is the key focal point of the estate and serves a population in excess of 7,000 persons within 1km, a population of around 4,850 when it opened in 2006.

- The centre was developed in 2006 and took 2 – 3 years to fully establish as a viable, well-trading centre. The centre is well designed and appears to trade reasonably well due its local monopoly position within the Breakfast Point estate and the critical mass of the supermarket anchor, which at 1,600 sq.m is sufficient to provide most convenience/top-up shopping items for local residents. The centre contains around 8 specialty retailers, including 4 cafes/restaurants as well as a dentist and childcare centre. In total, the centre contains around 3,100 – 3,200 sq.m of GLA including retail and non-retail tenants.

- **The Easy T centre** is a good example of a small supermarket anchored, multi-use neighbourhood centre with shop-top housing. This centre is located at Robina on the Gold Coast, at the corner of Christine Avenue and Scottsdale Drive about 1km south of the Robina Town Centre regional shopping centre. There are around 7,400 people living within 1km of the centre.

- This centre was developed in around 2006 and contains an Aldi supermarket anchor tenant of around 1,000 – 1,200 sq.m and around 25 specialty shops and around 5 – 10 non-retail tenants within the main retail asset and there are two childcare centres (inc. a Good Start Early Learning Centre) and a medical centre on either side of the centre. At the southern end of the centre there is four storey residential shop-top housing at, which is graduated to two storey residential part way across the centre.

- The medical centre was developed more recently, over the past 4 – 5 years, and also has shop-top housing of three storeys above the centre.

- **Crace Central** is a relatively new local centre built in the suburb of Crace, which is located in the northern growth area of Canberra. One of the major issues, historically, with the local centre network in Canberra has been a lack of critical mass, with particularly small supermarkets or food stores that do not provide a sufficient range of products. The Crace Central shopping centre contains a Supabarn supermarket of almost 1,500 sq.m, which is very large in local centre hierarchy in Canberra, and provides a good anchor to support around 5 specialty shops as well as a 375 sq.m gym.

- The broader Crace local centre also contains a community garden and a medical centre, and there is a seniors living complex adjacent to the centre, and there are several multi-storey residential towers in the immediate block adjacent to the town centre.

- **Ainslie local centre** is another other successful local centre in Canberra that has remained relevant, vibrant and popular over several decades. This centre contains an IGA supermarket of around 1,100 sq.m as well as 12 supporting specialty tenants as well as four non-retail tenants including a medical centre. This centre benefits from a lack of genuine competition for supermarkets but also provides a relatively good critical mass, meaning that local residents can obtain most convenience/top-up items, utilise services and go out for breakfast/coffee/lunch and dinner.

- One of the more destinational tenants at this centre is Edgars Inn, which provides coffee/breakfast from 7am Monday to Friday, and from 8am on weekends, but performs more like a pub/wine bar/restaurant from lunchtime until evenings.

- **Wilton Plaza (Bingara Gorge)** within the broader Wilton Junction growth area in outer southern Sydney is the Bingara Gorge Lendlease development which contains a small village centre called Wilton Plaza. This centre is generally ear-marked for up to 5,000 sq.m of retail floorspace, however, a full-scale supermarket is not expected to be supportable in the locality until closer to 2019 – 2020.

- Because of the isolated/segregated nature of the Wilton Junction locality, prior to the development of this centre, local residents needed to travel to Picton, Tahmoor or north to Campbelltown to undertake supermarket shopping. A small convenience based village centre was a critical element to drive residential sales within the Bingara Gorge estate and was supportable at a much earlier date than a larger centre would have been.

- The Wilton Plaza centre contains around 1,200 – 1,500 sq.m of floorspace including a 500 - 600 sq.m SPAR supermarket, as well as a BWS liquor outlet, a pharmacy, a medical centre, a bakery, a café, a pizza shop, a Chinese restaurant and a real estate agent. There is also an adjacent café over the road.

- **Red Edge Village Centre (Coomera)** is a small IGA anchored convenience centre located on the eastern side of the M1 Motorway a short distance north of the Coomera train station. This centre existed prior to the development of the Woolworths anchored Pimpama Junction neighbourhood shopping centre, which is presently the only full-scale supermarket facility on the eastern side of the M1.

- The Red Edge Village contains an IGA supermarket of around 780 sq.m and around 1,600 sq.m of retail and commercial floorspace, consisting of around 8 – 10 specialty retail and non-retail businesses. The mix includes a pharmacy, a medical centre, several cafes, restaurants & take-away shops We understand the IGA at this centre trades reasonably well (at more than $8,500 per sq.m (inc. GST)), even following the opening of Pimpama Junction in mid-2014.

- The population on the eastern side of the M1 in the Coomera growth area, including Coomera and Pimpama, is around 14,000 – 15,000 persons as at 2016, and is projected to grow significantly larger.

Attachment 10

Heritage Interpretation Strategy

GML HERITAGE

Former Schofields Aerodrome

Interpretation Strategy

Draft Report

Report prepared for Defence Housing Australia

October 2017

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Report Register

The following report register documents the development and issue of the report entitled Former Schofields Aerodrome—Interpretation Strategy, undertaken by GML Heritage Pty Ltd in accordance with its quality management system.

Job No.	Issue No.	Notes/Description	Issue Date
17-0143B	1	Draft Report	13 October 2017

Quality Assurance

GML Heritage Pty Ltd operates under a quality management system which has been certified as complying with the Australian/New Zealand Standard for quality management systems AS/NZS ISO 9001:2008.

The report has been reviewed and approved for issue in accordance with the GML quality assurance policy and procedures.

Project Manager:	Jane McMahon	**Project Director & Reviewer:**	Abi Cryerhall
Issue No.	1	**Issue No.**	1
Signature		**Signature**	
Position:	Senior Consultant	**Position:**	Senior Associate
Date:	13 October 2017	**Date:**	13 October 2017

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1.0 Introduction

1.1 Background

GML Heritage Pty Ltd (GML) has been engaged by Defence Housing Australia (DHA) to prepare a heritage interpretation strategy as part of the proposed redevelopment of the former Schofields Aerodrome at Quakers Hill (**Figure 1.1**).

This Interpretation Strategy (IS) is required under Conditions of Consent of Development Application DA/15/00999 issued by Blacktown City Council (BCC).

Condition 3.5.4 states:

> *Additional recommendations and a report after the test excavation and archaeological review of the Pye Farm site should include a detailed interpretive plan and implementation requirements should be submitted and approved by Council prior to the release of a construction certificate. In addition to interpretive requirements, recommendations for the storage, stockpiling, management and long term display / housing of artefacts found must be made. Where possible if large stone or brick elements are found that need to be removed, consideration should be given to their reuse in interpretive landscaping in the future.*

Condition 2.6.1 includes the following note:

> *Note: post occupation aboriginal heritage of the area should be considered as part of the interpretive works with the permission of the aboriginal consultant team and be included within future development applications.*

Condition 8.9.1 states:

> *Boundary markers outlining the runways in a manner that enables visual interpretation of long runs of the runways are to be provided at the completion of the final road works and site establishment.*

We also note that a further condition of consent regarding interpretation of the archaeological works undertaken at the site is likely to be included in the Section 140 Salvage Excavation Permit for the site.

This IS addresses the diverse range of heritage values present at the site, including Aboriginal and European archaeology, military and intangible heritage. Results from previous studies and recent archaeological investigations are incorporated. Recommendations regarding types and preferred locations of interpretive initiatives are included, fulfilling condition 3.5.4 and the release of the construction certificate. Further works for the implementation of this strategy will be undertaken in conjunction with archaeological post-excavation reporting and ongoing design development for the site.

1.2 Previous Studies

Previous studies undertaken for the subject site have been used in the preparation of this report. These include:

- Schofields Precinct—Non-Indigenous Heritage Assessment, prepared by Godden Mackay Logan (GML) in January 2011 for DHA (2011 HA);
- Former Schofields Aerodrome, Nirimba Drive, Quakers Hill—Heritage Impact Statement, prepared by AHMS (now Extent) in May 2015 for DHA (2015 HIS);
- Former Schofields Aerodrome, Nirimba Drive, Quakers Hill—Historical Archaeological Research Design, prepared by Extent in December 2016 for DHA (2016 ARD); and

- Former Schofields Aerodrome—Archaeological Testing Results and Research Design—Draft Report, August 2017.

GML has undertaken historical archaeological test excavations at the subject site to identify areas of archaeological sensitivity. Further archaeological salvage is proposed to be undertaken where impacts to significant archaeological remains cannot be avoided during development. GML has also undertaken Aboriginal test and salvage excavations across five areas within the site.

The preliminary results from these excavations have been integrated into section 2.0 of this report.

1.3 Interpretation Planning Methodology

Interpretation is an essential part of the heritage conservation process. The active interpretation of heritage places supports the recognition and understanding of a site's values and significance by owners and the community.

This report is based on the philosophical approach to conservation described by the Burra Charter[1] and the 2005 Interpretation Policy and Guidelines prepared by the Heritage Council.[2] Both these publications emphasise the value of a thematic approach in providing a historical framework for focusing interpretation opportunities.

Key interpretation principles applicable to the study area include:

- engagement with the Aboriginal community to ensure culturally appropriate outcomes, and suitable recognition of the study area's history;
- ensuring that interpretive devices are accessible and compatible with the functions of development;
- ensuring the interpretive strategies respond to the audience and their use or development area;
- ensuring the interpretive initiatives proposed are well integrated into the architectural intent of the new development and associated landscaping; and
- planning for continuing maintenance and regular review of interpretive media.

Following the review and approval of this report by DHA, the draft strategy will be provided to the local Aboriginal community for input and comment. The final report will be amended to reflect the outcomes of this consultation, and a final report submitted to BCC.

Subsequent stages of interpretive planning will include:

- development of select interpretive media and content; and
- implementation of select interpretive initiatives.

1.4 Author Identification

This IS has been prepared by Jane McMahon, Senior Heritage Consultant, and reviewed by Abi Cryerhall, Senior Associate.

Figure 1.1 The approximate location of the former Schofields Aerodrome is circled in red. (Source: Google Maps with GML overlay 2017)

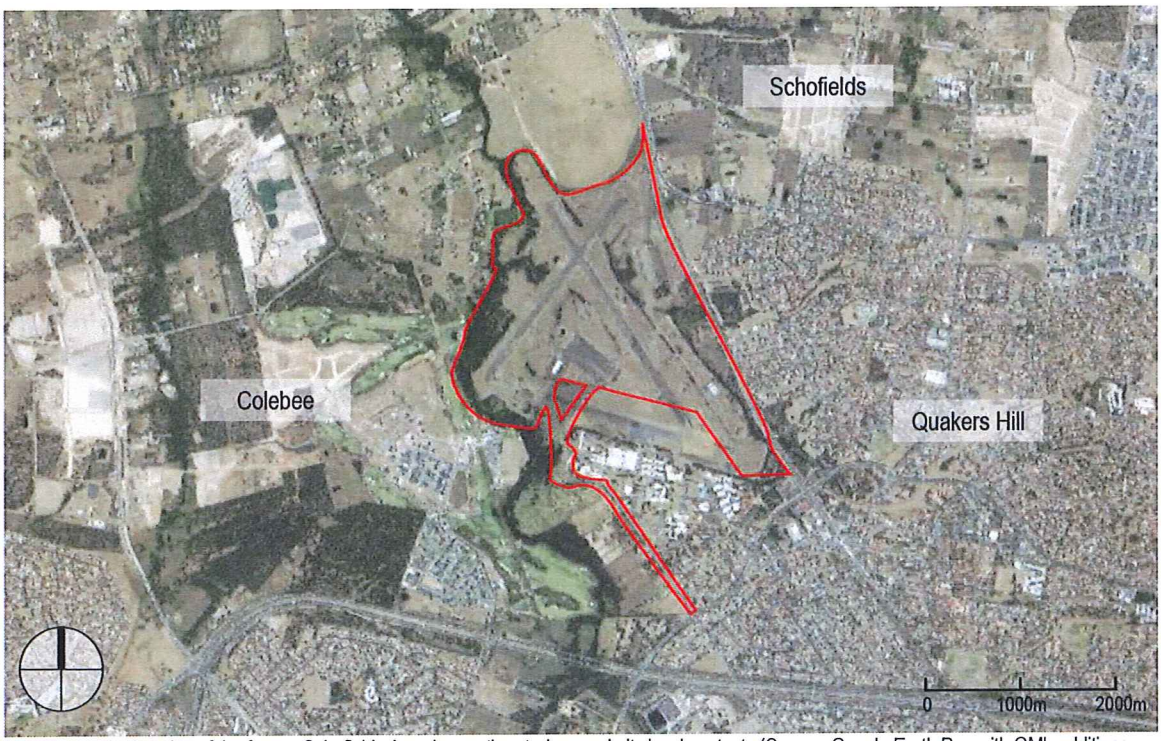


Figure 1.2 The location of the former Schofields Aerodrome, the study area, in its local context. (Source: Google Earth Pro, with GML additions 2017)

1.5 Endnotes

[1] Australia ICOMOS Inc, *The Burra Charter: the Australia ICOMOS Charter for Places of Cultural Significance 2013*, Australia ICOMOS Inc, Burwood, VIC.

[2] NSW Heritage Office, 2005 *Heritage Interpretation Policy* and *Interpreting Heritage Places and Items Guidelines*, endorsed by the Heritage Council.

2.0 Interpreting former Schofields Aerodrome

2.1 Introduction

This section synthesises the research and investigations undertaken to date—including documentary, photographic and archaeological sources—to identify the themes, stories and resources that are available to guide interpretation planning at the former Schofields Aerodrome.

2.2 Interpretive Themes and Stories

Themes are a simple and effective organisational tool for planning interpretation. They provide a structure for ordering and connecting a place's significance and natural and cultural values to key stories and visitor experiences. A thematic structure is important as it ensures that interpretation is coherent, memorable and accessible to visitors. From a visitor perspective, themes provide a mechanism that helps them remember, learn and enjoy. Generally, any more than four to five themes makes connecting to and comprehending a place more challenging for visitors. If unstructured by themes, interpretation and visitor experiences can become overwhelming, with too many topics or ideas to absorb.

The themes that have been developed for the former Schofields Aerodrome site are based on the history and heritage values of the place. They reflect the resonant and enduring ideas from the past and connect with values, interests and the kinds of experiences that contemporary visitors are looking to engage in and enjoy. The themes enable the history and heritage of the site to be presented in a way that 'doesn't feel like history or heritage' but which has meaning and relevance to today's diverse communities.

This report utilises the state historical themes developed by the NSW Heritage Division,[1] and associated national framework of nine theme groups developed by the Australian Heritage Commission.

2.2.1 Interpretive Themes

The proposed interpretive themes for the former Schofields Aerodrome are:

- Waawaar Awaa—Aboriginal Cultures
- Working the Land—Agriculture
- Life on the Land—Domestic Life
- HMAS NIRIMBA—Defence

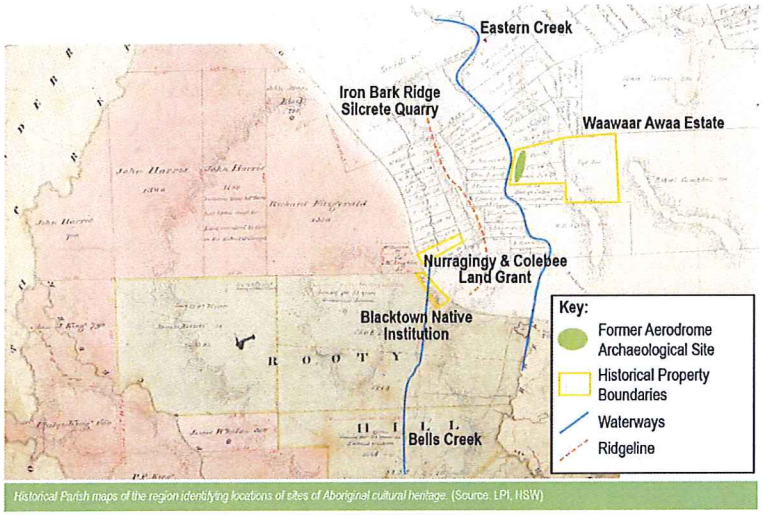
Waawaar Awaa—Aboriginal Cultures

The study area lies within the traditional lands of the Darug people. This theme will communicate some of what we know about the First Peoples of this area—how they knew, valued and inhabited their Country and used the land's rich natural resources. The local availability of silcrete from a nearby quarry was an important source of material for use in tools and trade with other groups, who periodically converged across the country, to exchange goods, hunt, fight, feast, arrange marriages, resolve disputes, and share information. The vast majority of archaeological evidence found in the area is stone, with nearly 15 000 artefacts found in the study area produced during the manufacture of stone tools.

From the early 1800s, European settlement expanded westward through the area, but the Aboriginal community remained in this area. For this reason, the site retains a number of highly significant sites which speak to the resilience and continuing connections between community and Country. This theme will communicate the relevance of this site within the wider context of early Aboriginal and colonial relations in this region, and Governor Macquarie's ill-fated and misguided attempts to 'civilise' Aboriginal people, including the Nurragingy and Colebee land grant, and Blacktown Native Institution.

Historical sources record the cordial relationship between the Pye family and the local Aboriginal community in this early period of settlement, including the renaming of the farm to reflect the local language, 'Waawaar Awaa', meaning fresh water.

Preliminary analysis of the artefact assemblage excavated in the property's orchard indicates that these may represent part of a contact-period assemblage. The artefacts suggest that the Aboriginal community continued to access and camp at traditional locations, despite the introduction of European pastoralism, and demonstrates experimentation with the new materials the Europeans had brought with them



Historical Parish maps of the region identifying locations of sites of Aboriginal cultural heritage. (Source: LPI, NSW)

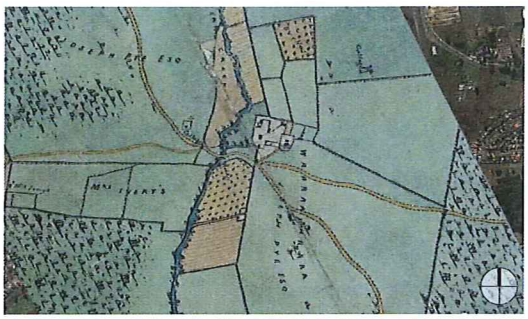
Exarnle of Aboriginal silcrete artefact. (Source: GML Heritage)

Working the Land—Agriculture

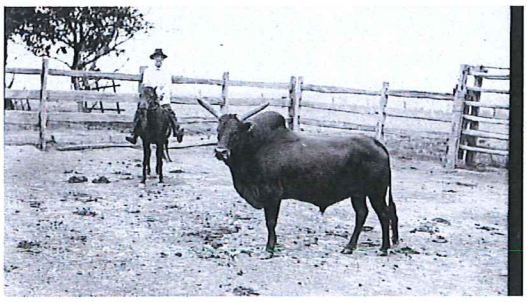
For over 100 years, the Pye family owned and farmed the land, known variously as Liberty Hall, Liberty Estate and then Waawaar Awaa. Granted the land in 1816, ex-convict John Pye, and his son Joseph, used convict labour to clear the land and establish a farm and orchards.

> *... It consists of 870 acres, 60 of which are stumped, and 670 enclosed in Paddocks, and in luxurious cultivation. It is well watered, being at the Banks of an extensive Creek. There is a good garden, dwelling-house, farm, out-houses, and newly-planted garden and orchard, of 5 acres.*[2]

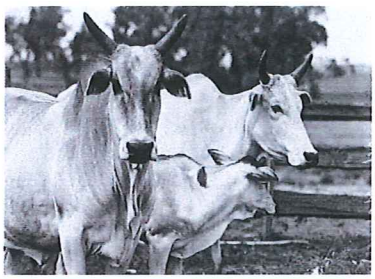
This theme communicates the story of life on the early frontiers of European settlement, and of working the land. The orchard at Waawaar Awaa was highly successful, with the orangery in particular producing prized China and common oranges that were awarded at the Floral and Horticultural Show in 1845.[3] Fed by a system of no less than seven-and-a-quarter miles of drain pipes, the orangery covered more than 20 acres planted with 1400 orange trees. The unsual cattle breed Zebu, were also bred and raised on the property.



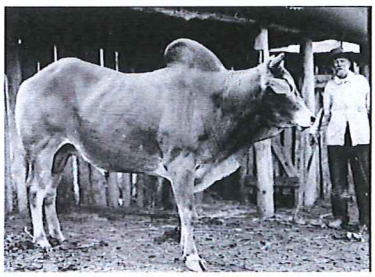
Plan of part of the Windsor District contained between Old Richmond Road and the road from Windsor (Source: LPI NSW) prepared by J Musgrave in 1842)



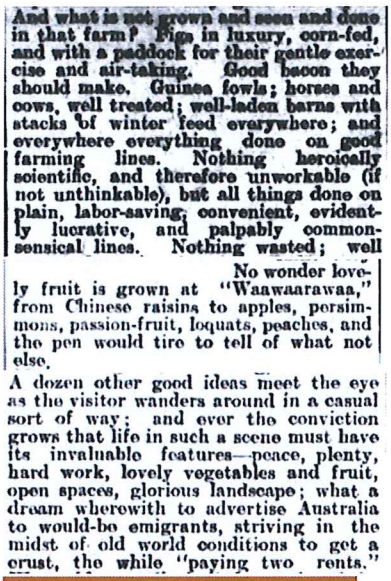
J Pye and a bull in the cattleyards at Waawaawaa in 1931' (Source: National Library of Australia)



Zebu cattle and calf at Waawaarawaa in 1931. (Source: National Library of Australia)



Zebu cattle and calf at Waawaarawaa in 1931. (Source: National Library of Australia)



And what is not grown and seen and done in that farm? Figs in luxury, corn-fed, and with a paddock for their gentle exercise and air-taking. Good bacon they should make. Guinea fowls; horses and cows, well treated; well-laden barns with stacks of winter feed everywhere; and everywhere everything done on good farming lines. Nothing heroically scientific, and therefore unworkable (if not unthinkable), but all things done on plain, labor-saving, convenient, evidently lucrative, and palpably commonsensical lines. Nothing wasted; well

No wonder lovely fruit is grown at "Waawaarawaa," from Chinese raisins to apples, persimmons, passion-fruit, loquats, peaches, and the pen would tire to tell of what not else.

A dozen other good ideas meet the eye as the visitor wanders around in a casual sort of way; and over the conviction grows that life in such a scene must have its invaluable features—peace, plenty, hard work, lovely vegetables and fruit, open spaces, glorious landscape; what a dream wherewith to advertise Australia to would-be emigrants, striving in the midst of old world conditions to get a crust, the while "paying two rents."

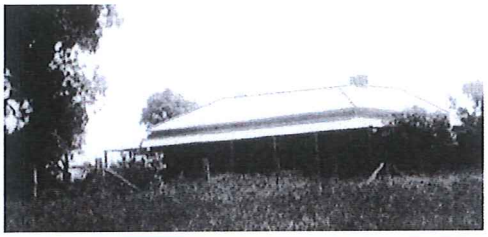
Account of the produce and practices at Waawaarawaa in 1910 (Source: *The Cumberland Argus and Fruitgrowers Advocate*, 4 June 1910, 12.)

Life on the Land—Domestic Life

With a prosperous estate, the Pye family quickly overcame the shame of their convict past and joined the early Sydney aristocracy. The estate was described as 'a centre of culture, British tradition and good living'.[4] Joseph bred and sold racehorses, kept foxhounds—the first in Australia—and would host events for the Sydney Hunt Club. This theme will communicate the story of daily life on the Pye family farm, including the successes, scandals, celebrations and eventual sale of the family farm in 1938.

Little archaeological evidence of the original homestead and its occupants was found at the site, except a concrete-lined cistern that would have provided water at the farm—but detailed historical records supplement our knowledge of the family. Further excavation at the site and analysis of remains uncovered today may provide insights into this aspect of the site's history

Archaeological remains of the nearby tenant farmers' cottage provide an insight the other side of life at Waawaarawaa through the lives of the Pye family's employees. Little historical information is recorded about the adaptations people made to life on the frontier of the settlement. Archaeological salvage excavation at the cottage site may provide further evidence for this theme.



The Pye Homestead, Waawaarawaa (or Waawaar Awaa). (Source: Ron Rob, 1993, *Flight of the Pelican*, Picnic Point, NSW: Tugiri Books, p 6)

JJ Pye photographed at Waawaarawaa in 1931. (Source: National Library of Australia, 027544)

Leslie Water Pye, well-known cricketer in his time, 1906. (Source: *The Sydney Mail and New South Wales Advertiser*, 3 January 1906, 36)

Concrete-rendered brick beehive cistern, located at the north end of the 'North Woods'. (Source: GML Heritage)

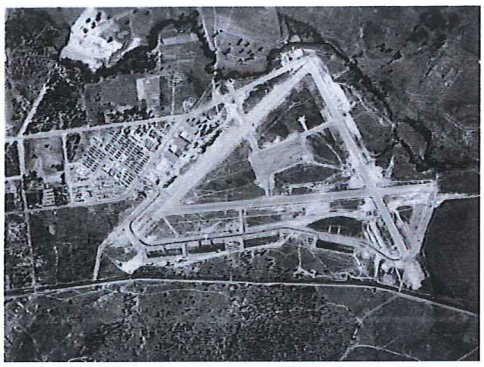
HMAS NIRIMBA—Defence

During WWII, the Langlade's Dairy property was commandeered by the government for use as a satellite aerodrome—RAAF Station Schofields. From 1944 it was loaned to Royal Navy's Air Arm for use as a Mobile Naval Air Base (MONAB), HMAS NABTHORPE. Between 1944 and 1994 it had a number of names and uses—recommissioned as HMAS NABSTOCK, then HMAS ALBATROSS II and finally, HMAS NIRIMBA. After WWII, it held other uses, housing new migrants from Europe in 1949 and converting to a racing circuit in 1958. At one stage of its life, it even held a hangar for blimps. Remnants of the airstrip still remain, along with infrastructure and machinery from this era.

This theme communicates the significance of the Schofields aerodrome for its association with the developments of the Australian Navy and the growing national commitment to self-sufficiency in defence capability in the years following WWII. The site was established as one of several airfields in Sydney built or taken over for military uses WWII and it has associations with the various wartime emergency works undertaken in Sydney, and across NSW.

Men standing ouside temporary accomodation of RNAS Schofields Station Flight. (Source: Royal Navy Research Archive, SF22)

Corsair during take off at HMAS Nabthorpe. (Source: Royal Navy Research Archive, SF42)



Aerial photograph of the aerodrome in 1946. (Source: LPI NSW)

Men of digging ditches and preparing tent accommodation at RAAF, Schofields. (Source. Royal Navy Research Archive, SF25)

The Schofields signpost. (Source: R Robb, 1993, *Flight of the Pelican*, HMAS Nirimba Welfare Committee, Quakers Hill.)

The Swan breweries blimp, also called bondy's blimp, in the 1980s. (Source: R Robb, 1993, *Flight of the Pelican*, HMAS Nirimba Welfare Committee, Quakers Hill.

2.2.2 Interpretive Stories

There are a diverse range of stories related to the history and significance of the former Schofields Aerodrome. This IS connects the overarching interpretive themes identified above to a select range of stories that can be conveyed through interpretation.

The table below shows the relationship between the interpretive themes and a selection of the key stories identified for the former Schofields Aerodrome.

Interpretive Theme	Key Stories
Waawaar Awaa	Potential stories for this theme include: • Darug Country—the traditional land of the Darug people, providing insight into traditional Aboriginal culture of the Cumberland Plain. • Early European and Aboriginal people interactions and encounters, and archaeological evidence. • *Resilience*—contemporary Aboriginal community connections to Schofields, and the region.
Working the Land—Agriculture	Potential stories for this theme include: • The establishment of agriculture in the region, including the prized orchards.
Life on the Land—Domestic Life	Potential stories for this theme include: • Experiences of life on the frontier,for both the Pye family and their workers, through archaeological evidence. • The lives of the rural aristocracy, overcoming convict associations, and emulation of British traditions in Australian contexts.
HMAS NIRIMBA—Defence	Potential stories for this theme include: • *For King and Country*—Connections between the early Australian military and efforts to support British interests through the establishment of MONAB III. • *Making of the Nation*—stablishing the Australian Navy and defence forces as an independent nation. • *Serving at Schofelds Aerodrome*—learning about the multiple defence units that were based on the site, and its role as an education facility. • *'Join Together, Train Together, Embark Together, Fight Together'*—delving into the stories of the men and women who trained, socialised at and were deployed from Headland Park during the twentieth century, including day-to-day lives.

2.3 Resources for Interpretation

To interpret the history and significance of former Schofields Aerodrome, it is necessary to identify the resources available that can communicate the key themes and stories of the site to visitors. These include resources such as:

- Archives—a range of archival material has been collected as part of the previous studies. The archival sources provide a range of historical sources, including plans, photographs and newspaper articles.

- Archeological excavation—A range of archaeological material relating the the Aboriginal and European occupants of the site have been recovered during recent excavations at the site. The identification and excavation of Aboriginal archaeological deposits, including hearths, ground ovens and stone-based sites (from extraction quarries to primary manufacture, retooling and use locations) could provide further information about how Aboriginal people lived in, managed and used this area.
- Archaeolocial remains in situ—During excavations, a number of large structural remains were identified. Of these, the concrete-lined cistern used by the Pye family during the Waawaar Awaa farm period will be conserved on site. This provides an opportunity to present and interpret the practice of archaeology and the types of remains revealed.
- Government records—there is a range of documentation that relate to the military phase of use, including photographs, letters, meeting minutes, and files.
- Personal records—such as journals, letters, photographs, objects, and personal recollections of the site during its military use.
- Secondary sources—such as books, printed and online, histories, and heritage reports.
- Associated people— An ongoing process of consultation with the local Aboriginal community has been undertaken as part of the AHIP application process for the development proposal. Aboriginal community input into the ACHAR has allowed their knowledge and understanding of the study area to be utilised as a source of material for use in interpretation. Further input and feedback from the Aboriginal community will be integrated into interpretation planning for the site.

2.4 Audiences for Interpretation

Accessible interpretation of heritage values will help to ensure the history and significance of this area is appreciated by specific identified audiences, visitors and the wider community into the future. Interpretation is most successful when it is targeted specifically to audience needs in terms of orientation, information and known audience behaviour.

Based on the residential nature of the proposed development, projected audience groups include:

- residents of the new development, predicted to be mostly first-home buyers and younger families with children;
- relatives and friends visiting residents; and
- members of the public using the community facilities at the local centre.

2.5 Opportunities

The proposed development is predominately residential development, with a range of publicly accessible spaces including a playing field, local centre, and primary school.

The roadways and these areas of public domain would be the most suitable areas for interpretation, as they will be accessible to the widest audience. There are also areas within the former Schofields Aerodrome where regular users and visitors will have an opportunity to appreciate interpretation, such as along the boundary of the riparian corridor.

2.6 Endnotes

1 NSW Heritage Office, 2001 'New South Wales Historical Themes', Sydney.
2 *The Sydney Gazette and New South Wales Advertiser*, 7 November 1825, p 4.
3 *The Sydney Morning Herald*, 25 September 1845, p 3.
4 AHMS, Former Schofields Aerodrome, Nirimba Drive, Quarters Hill, Heritage Impact Statement, prepared for Defence Housing Australia, 2015.

3.0 Interpretive Initiatives

3.1 Introduction

A range of interpretive initiatives have been identified to communicate themes and key stories about the former Schofields Aerodrome's history and significance. The identified initiatives are based on our review of previous studies, the preliminary analysis of archaeological remains and post-excavation research opportunities, and the potential audiences and visitor engagement. To provide a consistency of approach where themes and stories extend beyond the site's boundaries, the initiatives are also informed by proposed or completed interpretive initiatives within surrounding developments.

The initiatives are intended to help inform the interpretive direction before proceeding to detailed development for both design and content. As such, the initiatives will be subject to further client review and refinement. Further, it is not anticipated that all initiatives will be required or necessary. However, the scale, physical qualities and extent of the landscape and its features lends itself to a range of onsite interpretive initiatives that will enhance visitor understanding and appreciation of the history of this place, while complementing and contributing to the urban character and design principles of the new development.

3.2 Potential Interpretive Initiatives

The proposed initiatives are:

- Street alignments—This has already been implemented, with the alignment of streets seeking to match those of the original runways.
- Street naming—The use of significant names and words associated with the history of the site is a way of providing the subdivision with names that are unique, site specific and that respond to its physical, historical or cultural character.
- Interpretive landscaping;
- Interpretation of archaeological remains;
- Interpretive playground;
- Super graphics;
- Education program and kits; and
- Interpretive panels and signage.

3.3 Interpretive Landscaping/Furniture

Interpretive landscaping and furniture would add amenity to and enrich the experience of key locations within the public domain.

Opportunities

It could consist of subtle and informal integration of heritage content and themes into the landscaping of the public domain and streets, for example, with boundary markers.

Formal elements could consist of a series of landscaped destinations that contain informal seats and benches, such as adjacent to the riparian corridor. Seating along the footpath or walking track would allow residents and visitors to stop and rest, while appreciating the natural landscape preserved in this area. This would also provide an opportunity to connect the development area with adjacent developments along Eastern Creek.

Seating and landscape elements within other areas of the public domain, such as the local centre and playing fields, would provide necessary amenity, while creating opportunities for engagement with more explicit interpretive initiatives.

Materiality

Interpretive elements could be integrated into furniture and landscaping though painting, routing, etching or casting interpretive words and motifs into the material, and through the form and arrangement of landscaping and furniture elements.

The selection of materiality should be informed by, and reflect the rural and industrial character of the site during the two major phases of its historical occupation—the Waawaar Awaa estate and the Schofields aerodrome—forming a creative response to key aspects of this historical landscape.

- STORIES/THEMES: Waawaar Awaa, and HMAS NIRIMBA.
- AUDIENCE DEMOGRAPHIC TYPES: Children, families, residents, walkers, visitors.
- AUDIENCE ENGAGEMENT TYPES: Skimmers.
- LOCATION: Across the site at key locations within the public domain.
- COST: Moderate.
- IMPLEMETATION: To be developed in collaboration with landscape architects, with heritage input.

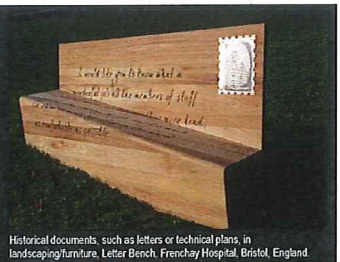
Gateway and plaza entry marker, MLK Boulevard, Portland, USA.

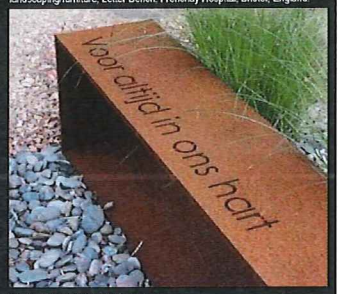
Landscape and location marker incorporating public art, Centennial Park.

Concrete seating with steel inlay, Austin, USA.

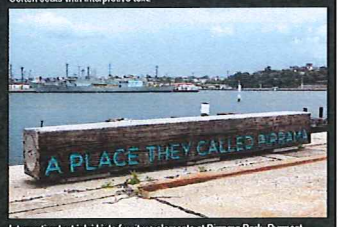
Paddington reservoir gardens, incorporating heritage fabric within landscaping.

Garden-bed edges with etched historical quotes, The Dairy precinct, Parramatta Park.


Historical documents, such as letters or technical plans, in landscaping/furniture, Letter Bench, Frenchay Hospital, Bristol, England.



Corten seats with interpretive text.



Interpretive text inlaid into furniture elements at Pirrama Park, Pyrmont.

3.4 Interpretation of archaeological remains

Conservation and integration of archaeological remains provides a tangible connection of the past within the new development.

The conservation of archaeological remains, such as the brick cistern, excavated during the archaeological investigations provides an opportunity for audiences to see and feel objects from the past, and to learn about an aspect of the former residents' daily lives.

Artefacts and smaller archaeological remains are well suited to fixed displays in secure locations with opportunities for longer engagement times. Contextual information can be provided with the displays to assist audiences understanding and provide deeper learning.

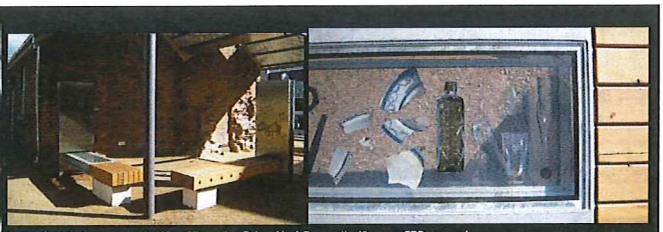
Creative integration of the objects within public spaces will ensure they maintain relevance, and are aesthetically appealing to a wider range of people, from casual passers-by to those more deliberately engaged.

- STORIES/THEMES: Working the land and life on the land.
- AUDIENCE DEMOGRAPHIC TYPES: Children, families, shoppers.
- AUDIENCE ENGAGEMENT TYPES: Skimmers to engaged readers.
- LOCATION: Within the local centre and vicinity.
- COST: Moderate to high.

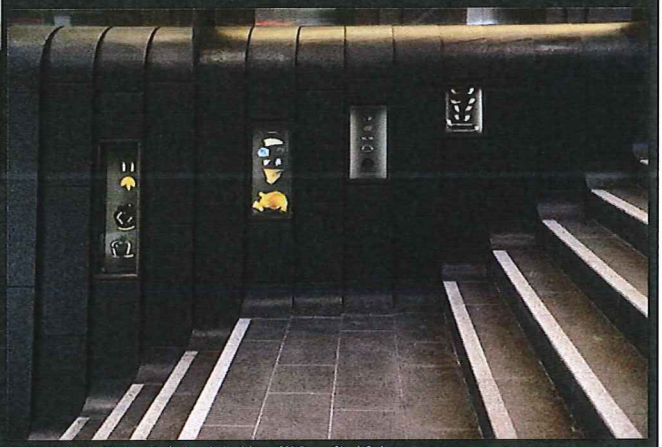
Signage incorporating archaeological remains, Legion House, Sydney.

Conservation and interpretation of intact portion of the Tank Stream, GPO Sydney.

Detail of signage incorporating archaeological remains, Legion House, Sydney.



Archaeological relics conserved within public seating, Bakers Yard, Parramatta. (Source: <FRD.com.au>)



Artefacts displayed within the walls of a through-site stairway, 200 George Street, Sydney.

3.5 Interpretive Playground

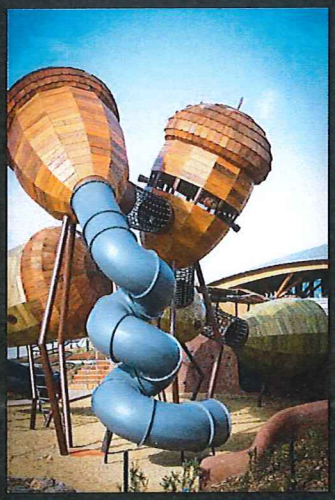
Interpretive play equipment and nature play structures at any proposed playground(s) would allow children to engage with the themes and stories of the place.

If a children's playground is proposed within the playing fields or other greenspaces within the development, interpretive play equipment could be integrated into the design. Depending on the locations selected, equipment that interprets different aspects of Aboriginal cultural heritage or European history could be considered.

- STORIES/THEMES: All.
- AUDIENCE DEMOGRAPHIC TYPES: Children, families, carers.
- AUDIENCE ENGAGEMENT TYPES: Skimmers.
- LOCATION: Within the playing fields area.
- COST: High.

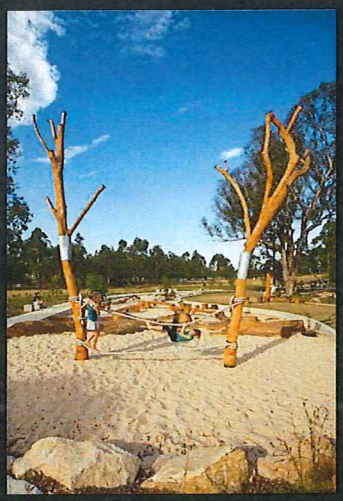
Defence-themed playground equipment would engage children in the themes of the place. (Source: Sydney Harbour Federation Trust)s

INTERPRETIVE PLAY EQUIPMENT



Play equipment based on native botanical forms such as banksias, Pod Playground, The National Arboretum, ACT)

INTERPRETIVE NATURE PLAY



Natural materials such as logs and rocks integrated into playgrounds. (Source: Above: Lizard Log Park, Western Sydney, McGregor Coxall;

Human Nests. (Source: Jayson Fann)

Bug magnifier equipment in a playground allowing children to investigate elements from the landscape. (Source: Wicksteed Playgrounds)

3.6 Super graphics

Imagery and content incorporated into the walls and surfaces of the public domain provide a contemporary and informal alternative to traditional signage.

This initiative provides an opportunity for integrating interpretation throughout the interior fitout of the local centre, and can incorporate a range of historical resources, including historical and archaeological records: images-maps, plans, photographs, or artefacts. Interpretation on glass and walls in the main lobby and thoroughfares could communicate more detailed stories about the historical stories of the site.

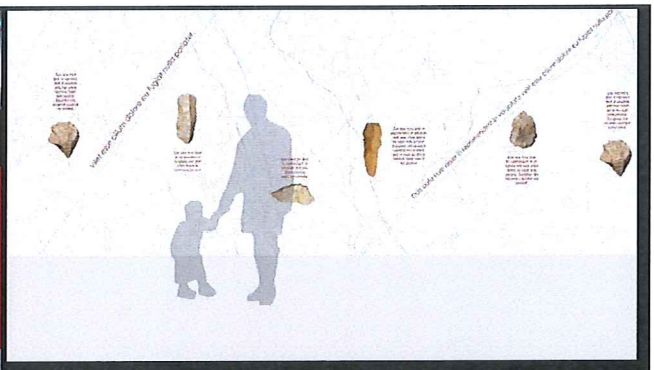
Large-scale historical imagery and text could be worked into the designs to engage those using the space, particularly staff, visitors and residents.

The imagery/text could be transferred to the glass or wall surfaces by decal or by etchings into the glass.

- STORIES/THEMES: Waawaar Awaa, and HMAS NIRIMBA.
- AUDIENCE DEMOGRAPHIC TYPES: staff and visitors, residents.
- AUDIENCE ENGAGEMENT TYPES: Skimmers to engaged readers.
- LOCATION: Within the local centre.
- COST: Low.

Repeated graphic motifs relating to archaeology and history of the site, Sydney harbour YHA, The Rocks.

Interpretive decals on glass meeting room walls communicates stories of the site, while also providing some privacy screening at Sydney Water offices, Parramatta.



Example of a large-scale graphic integrating a range of historical sources and images of artefacts.

Interpretive super graphic installed within unpaid concourse at Newtown Station, Sydney.

3.7 Ground inlays

Incorporating interpretive inlays into the footpaths within the public domain would be an effective way of subtly bringing interpretive stories to a range of audiences.

The new subdivision has been laid out to approximately interpret the alignment of the aerodrome runways. Additional markers to identify this to audiences are required as a condition of consent for the development.

This initiative can be developed as a consistent motif in multiple locations across the site. This would also provide a consistent approach to the interpretation of the historical landscape used at the nearby Cobebee Nuringungy land grant.

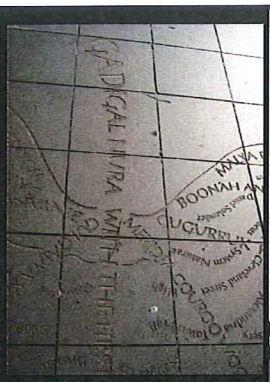
Using a subtle approach, the inlays could be made distinct from the surrounding stone through use of materials techniques such as bricks, tiles, concrete, deep etching, brass and stainless steel.

The inlays could feature oral history quotes or a historical image/plan of the site. As well as evoking stories through words and images, a distinctive visual language—reflective of the site's historical character—could be evoked through the selection of materials, typography and/or inlay patterns.

THEMES: HMAS NIRIMBA.

LOCATIONS: Aerodrome runway alignments, key nodes within playing fields, forecourt of local centre

AUDIENCES: All.



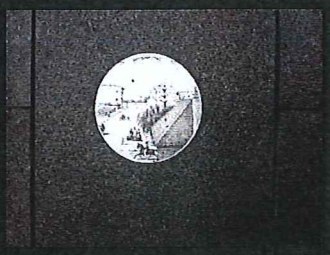
Etched pavement. Solander Park.

Kamay, Botany Bay National Park.

Historical imagery ground inlays, Melbourne Town Hall.

Historical text and imagery inlaid in concrete and brass, Darling Walk, Sydney.

Ground inlays of historical imagery and text in the public domain of a retail precinct. 140 William Street. Perth.



Historical images etched into aluminium, public forecourt, 1 Bligh Street, Sydney.

3.8 Education Program and Kits

A series of education kits and family activities that explore one or more themes within the site and the local area could be developed in line with the NSW Department of Education curriculum. These could be used in the new school to be constructed on site.

The kits would be developed for key learning ages and integrate research and digital outputs developed for other interpretive devices such as podcasts with archaeologists and other specialists, video, maps, and historical images. Worksheets and activities would help facilitate student research and enquiry. This could be supported with teacher-led on-site activities for local schools.

- STORIES/THEMES: All stories.
- AUDIENCE DEMOGRAPHIC TYPES: Local school groups, families.
- LOCATION: Available online.
- COST: Moderate.

Sources: Top left: <wideopenspaces.com>; Bottom left: <deverpost.com>; Top right: <fr.vidyo.com>; Bottom right: <netsafe.org.nz>

3.9 Interpretive Panels and Signage

Consistent and cohesive interpretive signage across the new subdivision would help visitors navigate and understand key interpretive themes/stories.

Signage is one of the key media through which static information is conveyed. Text, maps, rules, behaviours, logos and imagery are often included. Signage should be used judiciously to avoid visual clutter and confusion. It is not appropriate to use signage to present complex and detailed histories or stories.

Signage should be installed in key locations (entry points, decision points, interpretive nodes, recreational spaces, key trails) where visitors are likely to see it and with ample surrounding space so people can feel comfortable stopping.

Types of signage that should be considered are:

1. *Interpretive Signage*—The content should be shaped by the interpretive themes to convey significant meanings and values. The text should be concise and get to the heart of the story with immediacy. It should communicate feelings, be more visceral and more 'alive'. Direct quotes from primary sources are preferable to a historical summation or timeline as firsthand accounts create curiosity and interest by stimulating direct connections between visitors and people in the past.
2. *Tactile Interpretive Signage*—Some signage elements could be inquiry based. For example, views framed with elements for rubbings and for touching.
3. *Feature Signage*—This type of signage would be used to identify and highlight interpretive stories at key locations, such as the archaeological remains within the site.

- STORIES/THEMES: All.
- AUDIENCE DEMOGRAPHIC TYPES: Children, families, residents, walkers.
- AUDIENCE ENGAGEMENT TYPES: Skimmers, delvers, divers.
- LOCATION: Across the site at key locations such as features of interest, and walking trails.
- COST: Moderate

Signage and wayfinding in complementary materials, Toorale National Park.

Interpretive signage integrating illustrations, sculpture elements, mapping and text content on a Corten base. (Source: Longwood Botanical Gardens)

Signage that combines wayfinding with interpretation on a Corten base structure. (Source: Barcelona Points of Historical Interest)

Signage relating to the historical development of the site installed at the entry to IKEA, Tempe.

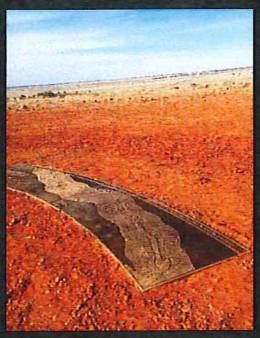
3. TACTILE INTERPRETIVE SIGNAGE PRECEDENTS

Buehler Enabling Garden. (Source: Accessible Gardens for All)

A cut-out sign is used to 'place' a paddle steamer on the Murray-Darling River at Toorale National Park.

Signage with tactile inlays/relief.

Transparent signage mounted on landscaping elements, Kamay Botany Bay National Park.



Ground inlaid signage to complement topography and views, Toorale National Park.

Transparent signage mounted on landscaping elements, Kamay Botany Bay National Park.

4.0 Implementation

4.1 Introduction

The finalisation and implementation of this IS will require a staged process of review and input from the various stakeholders for the project. These have been outlined below to assist with the project planning.

4.1.1 Project Team Review

This report would be provided to the project team within DHA, and the landscape architects for review. Comment and input would be sought from the landscape architect for the project to confirm their preferred interpretive initiatives.

4.1.2 Consultation with the local Aboriginal community

Following the review of this draft report by DHA and the project team, opportunity for input would be provided to the local Aboriginal community. This report would be provided to the community with an invitation to comment on or amend the stories relating to the Aboriginal stories of this place, and the ways in which they should be told.

The mechanism for this consultation would be the existing stakeholder consultation list established during the archaeological investigation, in accordance with the NSW Aboriginal Cultural Heritage consultation requirements for proponents.

4.1.3 Council Review and Approval

The final report would be amended for the outcomes of the collaboration with the project team regarding preferred initiatives, and the recommendations and comments of the Aboriginal community representatives.

The final report would be submitted to BCC for final review and approval under Condition 3.5.4.

4.1.4 Implementation

The implementation of interpretation involves several separate but interrelated tasks. Whilst some of these will vary depending on the type of interpretive initiative, the main ones allowed for in the development of interpretation include:

- confirmation of preferred initiatives to proceed to concept design
- any detailed research, such as post excavation analysis of archaeological remains;
- preparation of interpretive content (including signage/panel text and selection of imagery);
- concept design of interpretives, image/photographic and interpretive elements;
- design development;
- applications for copyright clearances and securing reproduction rights;
- design documentation (preparation of print ready artwork, shop drawings etc)—signage, landscaping, playground equipment;
- engineering advice (as necessary); and

- supply, construction and installation of all interpretive and architectural elements.

Attachment 11

Flora and Fauna Review

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

Darren Youens
Senior Development Manager
Defence Housing Association
Suite 202, Level 2
287 Elizabeth Street Sydney 2000

Our Reference: 8428

19 December 2017

Dear Darren,

RE: Schofields Precinct – Proposed Amendment of Precinct Plan - Flora and Fauna Report

Eco Logical Australia (ELA) was engaged by Defence Housing Australia to provide a flora and fauna assessment of land within the Schofields Precinct that is to be affected by a Planning Proposal. The site is surrounded by land that was previously assessed and approved for impact under a bulk earthworks DA. Figure 1 shows these areas.

Figure 1 shows three areas:

- Biodiversity Certified land which does not require further assessment of impacts to endangered ecological communities or threatened species
- Land previously assessed in *ELA (2015) Schofields Aerodrome – Bulk Earthworks – Flora and Fauna Assessment for Defence Housing Australia*.
- Study Area for this assessment

Biodiversity Certification (TSC Act 1995 and Biodiversity Conservation Act 2016)

The study area for this assessment is not located on Biodiversity Certified Land (**Figure 1**). Therefore future development on the site must consider impacts to biodiversity, endangered ecological communities and threatened species and determine whether a significant impact may occur.

On 25 August 2017, the *Biodiversity Conservation Act 2016* took effect and the *Threatened Species Conservation Act 1995* was repealed. The *Biodiversity Conservation (Savings and Transitional) Regulation* **2017** provides a transitional period of 6 months so that any development application lodged by the 25 February 2018 is to be assessed under the former planning provisions, i.e. s5A of the EP&A Act 1979. Eco Logical Australia understands that the eventual DA for the subject site will be lodged after the 25 February 2018 and therefore the DA will be assessed in accordance with the new BC Act 2016.

As shown on Figure 2, the study area for this assessment contains a very small patch (0.1ha) of regenerating alluvial woodland which is listed as Riverflat Eucalypt Forest – an endangered ecological community under the BC Act 2016.

The BC Act has three thresholds for determining whether an impact will be significant – and therefore whether the Biodiversity Offset Scheme will apply. The thresholds for a significant impact are contained in the following table. Clearing of the vegetation in the study area will not exceed any of these thresholds.

7.2(1)	***For the purposes of this Part, development or an activity is likely to significantly affect threatened species if:***	
7.2(1)(a)	*it is likely to significantly affect threatened species or ecological communities, or their habitats, according to the test in section 7.3*	The loss of 0.1ha of regenerating alluvial woodland (River flat eucalypt forest – an endangered ecological community) will not place this community at risk of local extinction. An extensive area of this community is being protected and rehabilitated in the nearby riparian zone. The impact is therefore not significant based on this criteria.
7.2(1)(b)	*the development exceeds the biodiversity offsets scheme threshold if the biodiversity offsets scheme applies to the impacts of the development on biodiversity values, or*	There are two thresholds in the regulations: • Impacting 0.25 ha of native vegetation on land with a minimum lot size of less than 1 ha; • Impacting on land mapped as 'Biodiversity Value Map'. The study area contains 0.1 ha of native vegetation and therefore the 0.25ha threshold will not be breached. The 0.1 ha is not shown on the Biodiversity Value map and therefore the impact will not be significant based on this criteria.
7.2(1)(c)	*it is carried out in a declared area of outstanding biodiversity value*	There are only two areas declared to be of outstanding biodiversity value: the Wollemi Pine habitat and the Penguin habitat at Manly. The study area is not located in an area of outstanding biodiversity value and therefore the impact will not be significant based on this criteria.

It is worth noting that the study area is intended to be biodiversity certified land at some point in the future. Following approval of a Precinct Plan, the Department of Planning & Environment and the OEH's intention was to update the Biodiversity Certified land maps so that all lands other than those contain Native Vegetation Protection, are biodiversity certified. This is evidenced in the Schofields Biodiversity Certification Assessment Report exhibited with the draft Precinct Plan. The update has not yet occurred, however clearly this was the intention. When the update does occur, impacts to native vegetation within the study area will not require assessment.

Sydney Region Growth Centres SEPP 2006

The Sydney Region Growth Centres SEPP Appendix 7 Schofields Precinct Plan contains controls for the clearing of Existing Native Vegetation and Native Vegetation Retention Areas as shown on the Native Vegetation Protection Map. The subject site does not contain vegetation mapped in either of these categories and therefore these clauses are not relevant to the site and any future development on it.

Commonwealth Strategic Assessment (EPBC Act)

On 28th February 2012, the Commonwealth Minister for the Environment announced that the program of development activities within the Growth Centres was approved under the EPBC Act Strategic Assessment process. Specifically, all actions associated with the development of the Western Sydney Growth Centres as described in the Sydney Growth Centres Strategic Assessment Program Report (Nov 2010) have been assessed at the strategic level and approved in regards to their impact on the following Matters of National Environmental Significance:

- World Heritage Properties
- National Heritage Places
- Wetlands of International Importance
- Listed threatened species and communities
- Listed migratory species

These decisions indicate that the Commonwealth is satisfied that the conservation and development outcomes that will be achieved through the Western Sydney Growth Centres Program will satisfy their requirements for environmental protection under the EPBC Act. Provided that development activity proceeds in accordance with the Growth Centres requirements (such as the Biodiversity Certification Order, the Growth Centres SEPP and DCPs, Growth Centres Development Code etc.) there is no requirement to assess the impact of development activities on Matters of National Environmental Significance within the Growth Centres and no requirement for referral of activities to the Commonwealth Department of Environment.

Conclusion

The study area contains small patches of native vegetation, totalling 0.1ha. The vegetation is a regenerating form of alluvial woodland. The loss of the vegetation is not significant and had the biodiversity certification maps been update promptly following precinct planning, would not have required assessment at all.

Should you have any questions on this matter, please contact me on (02) 8536 8668.

Yours sincerely

David Bonjer

Senior Consultant

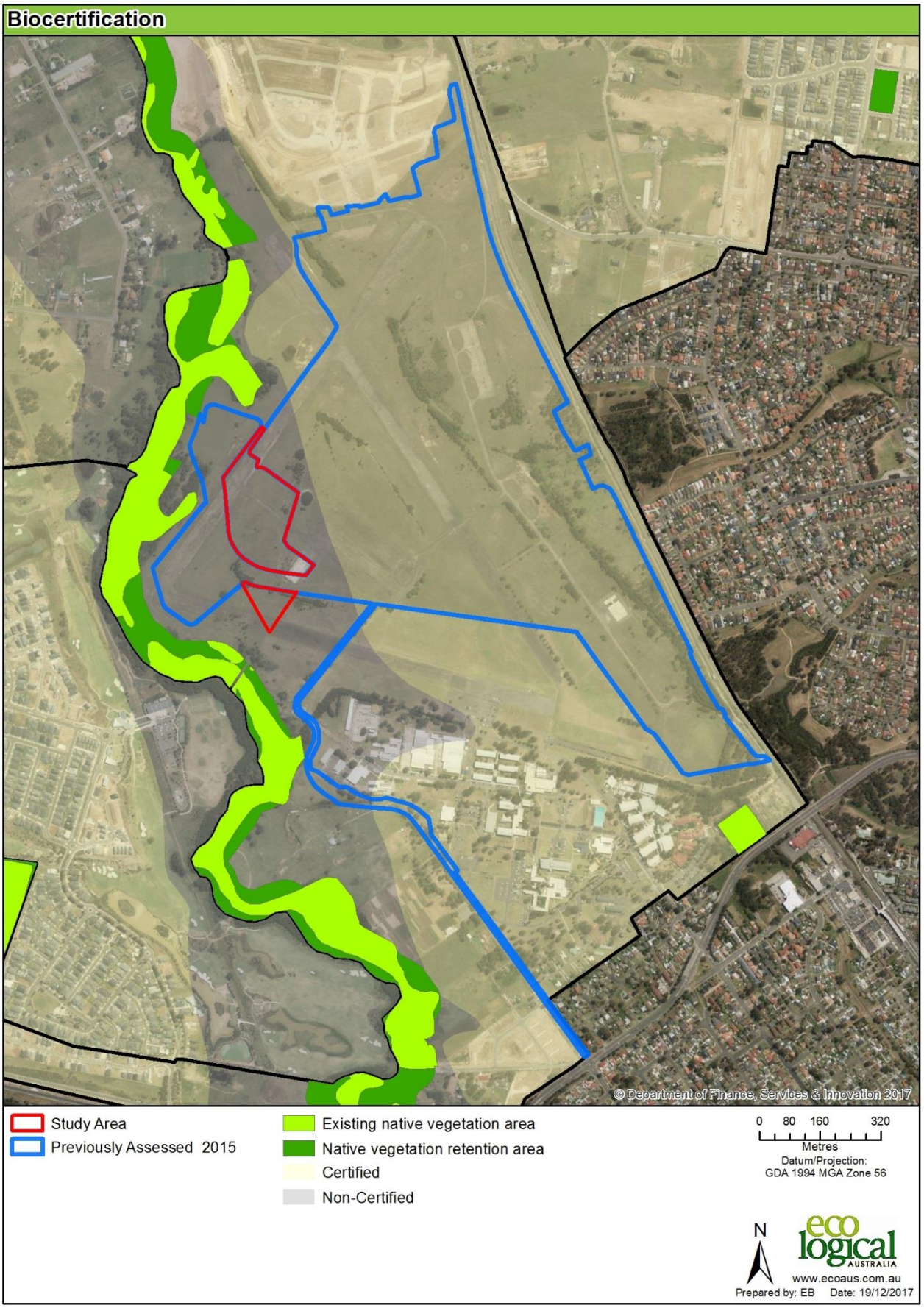


Figure 1: Location of the site in relation to biodiversity certified lands and previous assessment for bulk earthworks

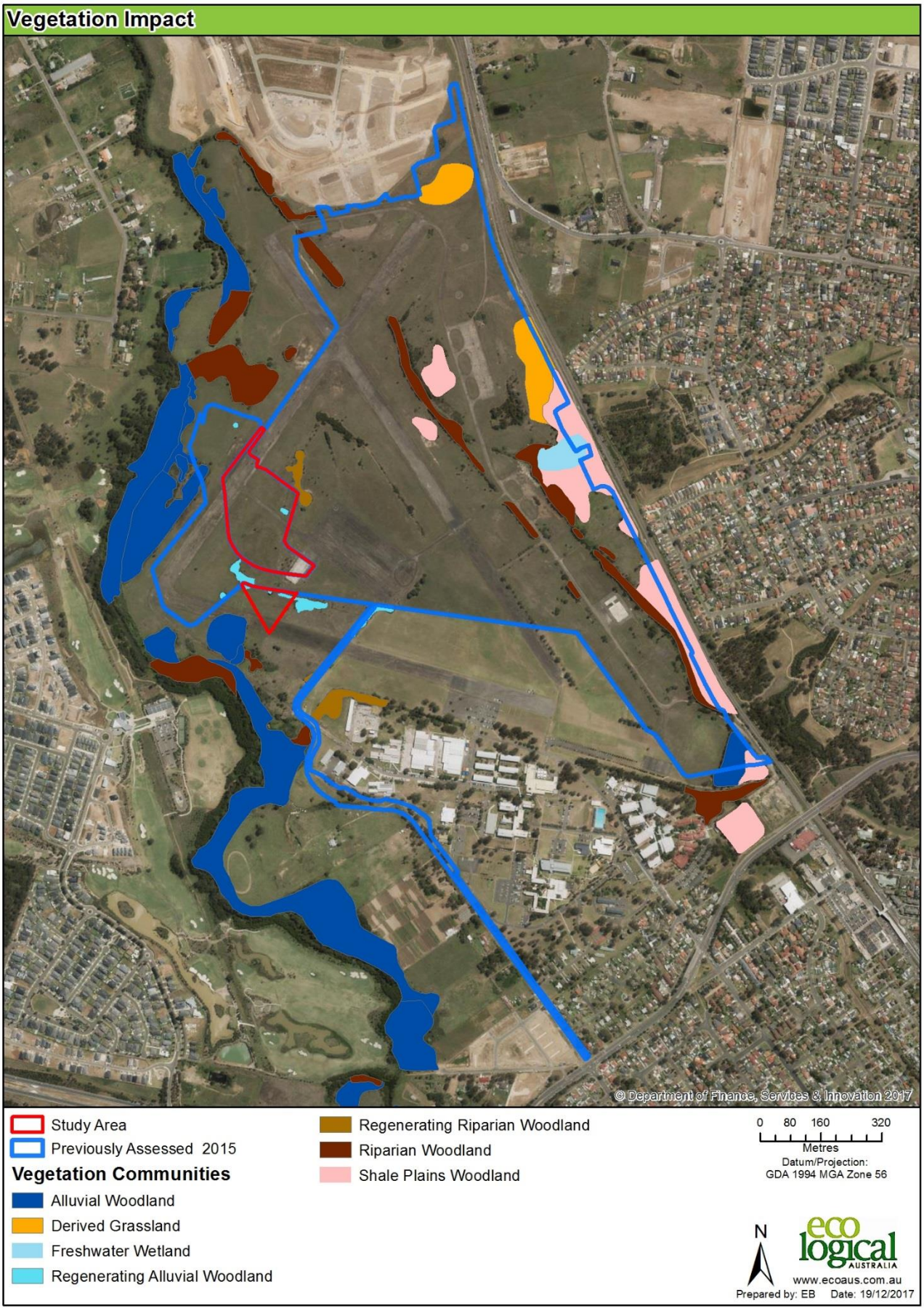


Figure 2: Native Vegetation on site

Attachment 12

Letter of Endorsement from DET re school location

NSW GOVERNMENT | Education

DOC17/467920

Mr Nigel McAndrew
Director
Design+Planning
GPO Box 1778
Sydney 2001

Dear Mr McAndrew

Re: Schofields Precinct – Potential School Site

Thank you for your correspondence dated 26 February on behalf of your client Defence Housing regarding the proposed school site in the Schofields precinct.

We confirm that the 90 degree rotation of the proposed school site is acceptable to the department as per the attached draft Indicative Layout Plan (ILP).

We reiterate that the identification of a school site on the ILP does not guarantee the construction of a school as this will be based solely on actual student demand and the capacity in existing schools. There may be an opportunity to advance the development of the school through dedication of the school site through State Infrastructure Contributions (SIC).

Should you require any further information please contact Lesley Moodie, Director Schools Planning on 9561 8255 or via email Lesley.moodie2@det.nsw.edu.au

Yours sincerely

John Neish
Group Director, Planning and Strategy
5th March 2018

LEGEND

DHA Landholding

	Area
Local Open Space	2.30ha
Playing Field	12.79ha
Local Community Centre	1.04ha
School	2.04ha
Drainage / Basin	32.91ha
Road Reserve (Collector/ Local)	20.49ha
Road Reserve (Burdekin Rd)	2.30ha
Road Reserve (Mustang Dr)	2.52ha
Riparian	17.65ha
E4	3.67ha
GR General Residential	32.32ha
SL Small Lot General Residential	5.58ha
TOTAL	**135.61ha**

Cell Structure Plan - Proposed ILP
SCHOFIELDS

NORTH

40 0 80 160 240 320 400 metres

Ref: DHASC-2-007-4 | Date: 18/11/2017 | Revision: E | Scale: 1:4,000@A1

Note: All areas and dimensions subject to detailed survey

P (02) 9290 3636
E admin@dp-aus.com.au
W www.dp-aus.com.au
PO Box 1778 SYDNEY NSW 2001
Suite 801 / 171 Clarence Street SYDNEY NSW 2000

design+ PLANNING

NSW GOVERNMENT | Education

DOC17/467920

Mr Nigel McAndrew
Director
Design+Planning
GPO Box 1778
Sydney 2001

Dear Mr McAndrew

Re: Schofields Precinct – Potential School Site

Thank you for your correspondence dated 9 May on behalf of your client Defence Housing regarding the revised location of the proposed future primary school in the Schofields precinct.

As discussed at the meeting of 28 April the Department is supportive of the revised school location in the attached Indicative Layout Plan (ILP). The key improvements include:

- The location adjacent to playing fields and open space allows the proposed school site to be planned on a 2 hectare site
- Promotes potential shared use opportunities with Council including playing fields, parking and school hall
- Zoning of the school site to SP2 is acceptable in this location

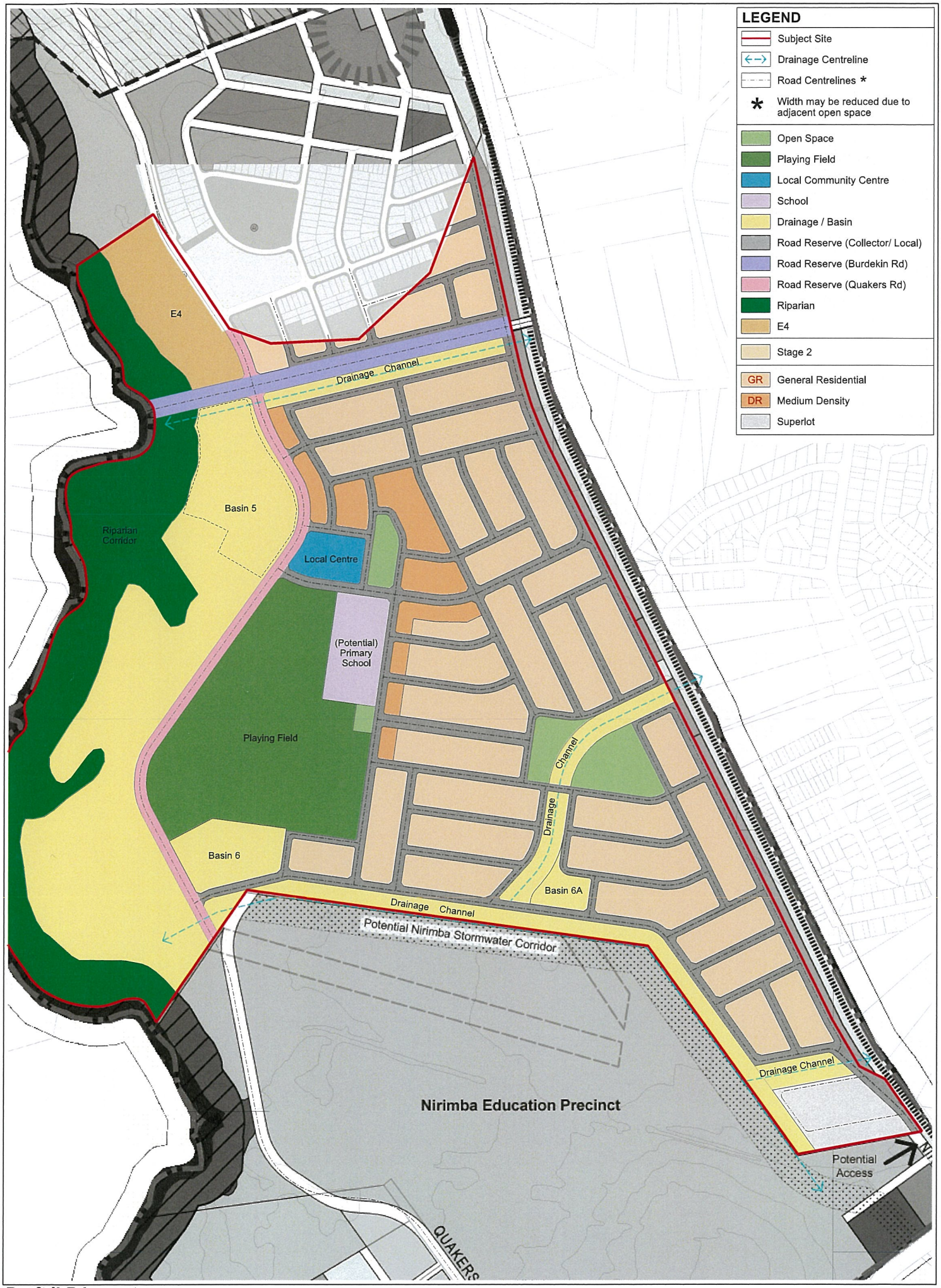
We reiterate that the identification of a school site on the ILP does not guarantee the construction of a school as this will be based solely on actual student demand and the capacity in existing schools. There may be an opportunity to advance the development of the school through dedication of the school site through State Infrastructure Contributions (SIC).

We request that you advise your client to reword reference to the provision school on their website for the precinct to avoid unrealistic expectations for the public which results in ongoing issues for the Department.

Should you require any further information please contact Lesley Moodie, Director Schools Planning on 9561 8255 or via email Lesley.moodie2@det.nsw.edu.au

Yours sincerely

John Neish
Group Director, Planning and Strategy
18th May 2017



Draft ILP Layout

SCHOFIELDS

DRAFT

NORTH

30 0 60 120 180 240 300 metres

Ref: DHASC-5-005-1 | Date: 03/05/2017 | Revision: A | Scale: 1:3,000@A1

Note: All areas and dimensions subject to detailed survey

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Attachment 13

Utility Services Capacity Assessment

11 December 2017

Schofield South Rezoning Application

Servicing Strategy Letter

1.1 Existing Services

Servicing searches of the site indicate that the land is generally not burdened by any large services requiring consideration as part of the development of the site.

1.1.1 Sewer (Waste Water)

The site is free of any major sewer mains.

SWC via their sub-contractor is currently constructing a series of trunk sewer mains under project 3-WW-AA-03 and project 3-WW-SC-02 on the northern portion of the site. These mains are part of the overall Riverstone Wastewater lead-in system.

1.1.2 Potable Water

The site is free of any major water mains.
The site has a series of existing private watermains once used to service the Aerodrome facilities. These services will be demolished as part of the Bulk Earthworks operations.

1.1.3 Electrical

The site is free of any underground electrical cables.
The site has a series of redundant overhead poles and cables which were once used to service the Aerodrome facilities. These services will be demolished as part of the Bulk Earthworks operations.

1.1.4 Telecommunications

The site is free of any main telecommunication cables.

1.2 Proposed Services

1.2.1 Electricity

Endeavour Energy has advised that there is sufficient capacity in the existing high voltage (HV) feeder SC1238 in the vicinity of the Altrove (Stockland) development to the north of the site to service the proposed Stage 1 and 2 of the subdivision. In order to supply future Stages 3 to 7, a new 11kV feeder is to be established from Schofields Zone Substation and the specific details of feeder routes and connection points will be determined at the detail design stage of each stage.

Refer to copy of Endeavour Energy's Supply Offer dated 23/6/17.

Internal electrical reticulation will be provided within the development via Endeavour Energy's standard electrical supply network of underground cables and sub stations.

1.2.2 Potable Water

Feasibility advice from Sydney water indicates that the subdivision may be serviced from the existing 600mm watermain within the Altrove (Stockland) development (Veron Rd) to the site with drinking water.
Internal water main reticulation will be provided within the development via Sydney Water's standard water supply requirements.

1.2.3 Sewer

Sydney Water has advised that the waste water (sewer) trunk mains currently being installed by SWC within the site as part of the Riverstone Wastewater lead-in system have capacity to service Stage 1 subdivision.
All later stages will require the construction of SP1202 and rising main discharging to the 900mm Riverstone Carrier for a distance of 2.5km to the north. Sydney Water current timing for completion of the pumping station will be 2018.

Refer to copy of Sydney Water's Feasibility Letter dated 27 March 2017.

1.2.4 NBN (Telecommunications)

NBN Co has advised that NBN telecommunication services can be supplied to the site as it falls within the NBN fibre footprint.

An application to NBN (AYCA-476I3B) has been made for the servicing of the development.

1.2.5 Site Servicing

As no dwellings are proposed as part of this application, the servicing of the super lots will make provisions to allow for the future connections of dwellings.

31 March 2017

Endeavour Energy Ref: ENL2789 – 2017/00671/001
Customer Ref:

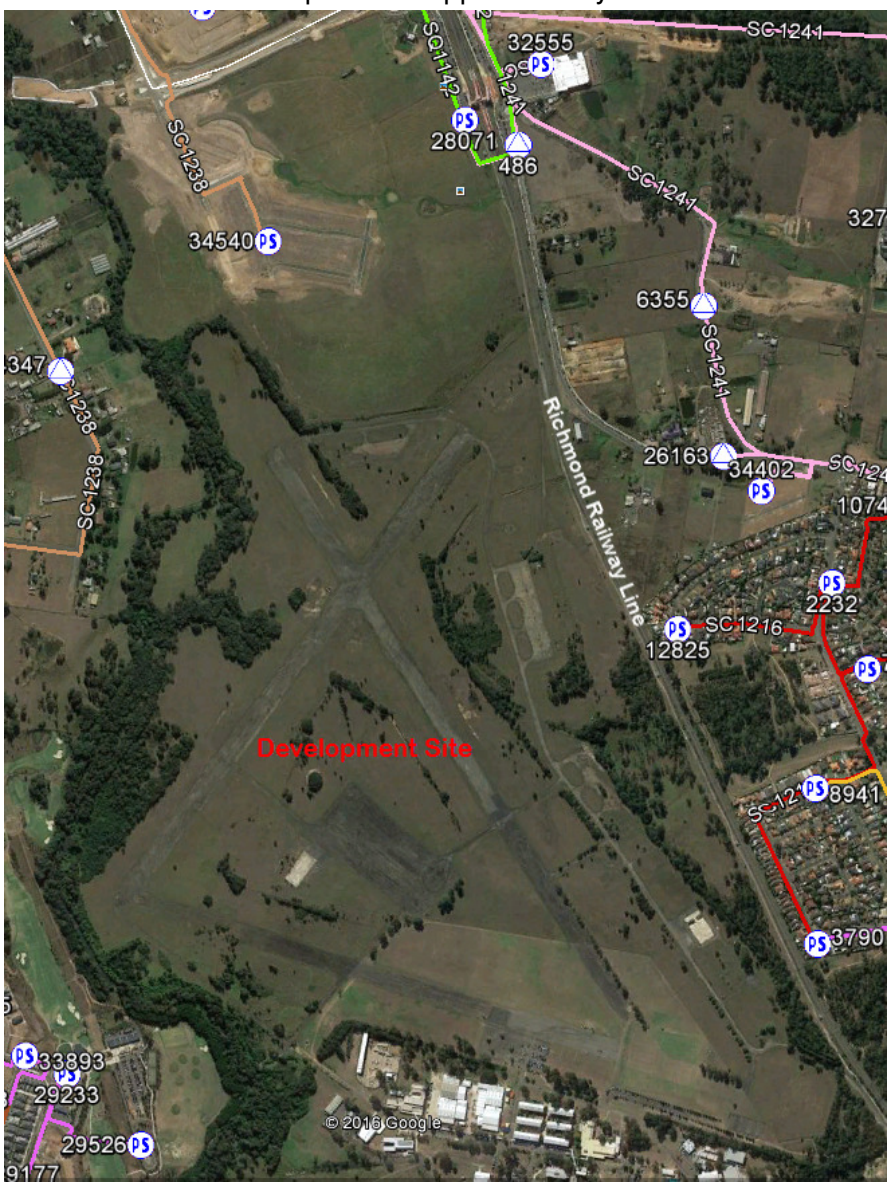
Craig & Rhodes Pty Ltd
PO Box 233
EPPING NSW 1710

Dear Debbie Staggs

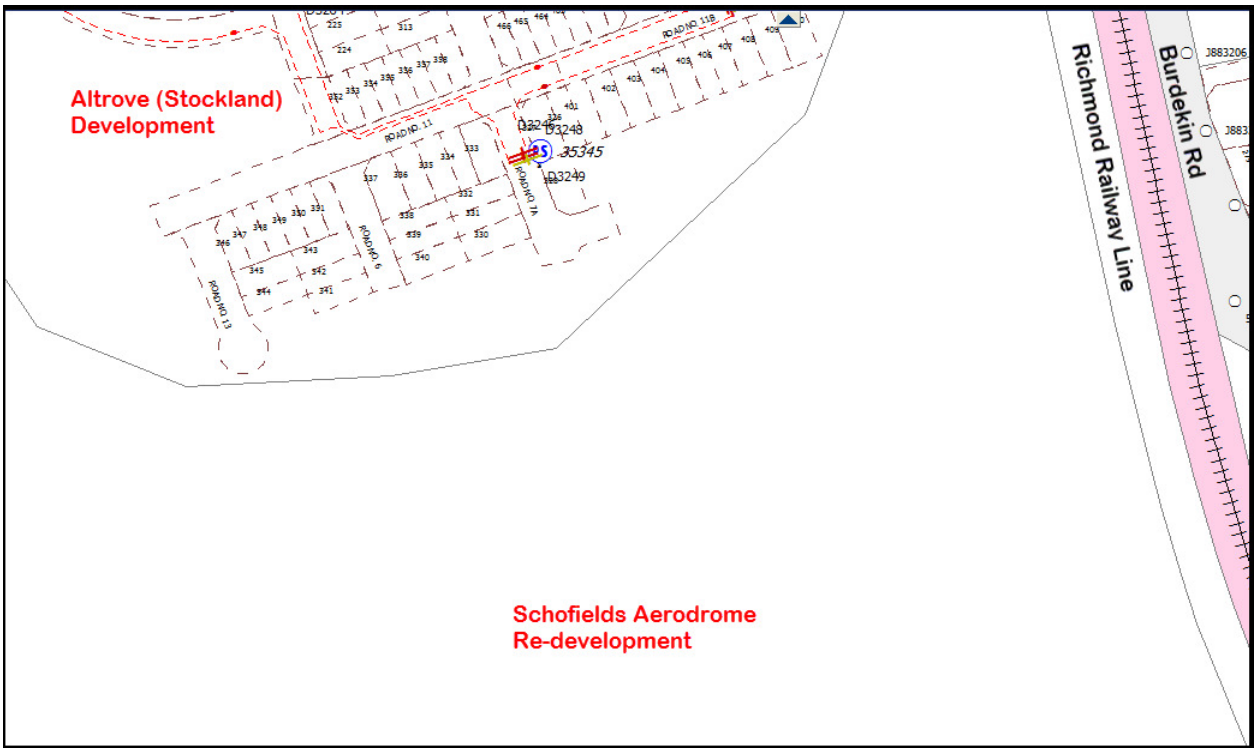
ENL2789 – CONNECTION OF LOAD APPLICATION QUAKERS HILL PARKWAY, SCHOFIELDS

Thankyou for your enquiry regarding the proposed 1,127 lot residential development at the above mentioned address. The enquiry has been registered under our reference number ENL2789, please quote this number for all future correspondence.

Endeavour Energy Acknowledges the proposed subdivision development consists of residential lots, local shops, primary school, open space areas and a 12 Hectare sports field. The development will have 7 stages in total with stage 2 to be developed first and will require supply by early 2018. The following stages will commence development at approximately 12 month intervals.



Preliminary analysis indicates the total estimated load for the development is 5.1MVA (diversity included). Therefore Stages 1 and 2 can connect to the existing network from HV feeder SC1238 which is currently servicing the Altrove (Stockland) development to the north, refer to HV map below. In order to supply future Stages 3 to 7, a new 11kV feeder is to be established from Schofields Zone Substation and the specific details of feeder routes and connection points will be determined at design stage of each project.



In order to commence with the electrical reticulation of the subdivision, you will be required to submit an application for subdivision to CWAdmin@endevourenergy.com.au for processing, application form attached. All works will be customer funded contestable works.

Please note that the advice provided is in response to an enquiry only and does not constitute a formal method of supply. Also capacity is not reserved and all future individual applications will be assessed based on the available network capacity at the time of applying for load.

Should you have any enquiries regarding your application please do not hesitate to contact the undersigned.

Yours faithfully

Timothy Vergara
CONTESTABLE PROJECT MANAGER (STRATEGIC)
Ph: 02 9853 7921 Fax: 02 9853 7926
Email: Timothy.Vergara@endeavourenergy.com.au

Case Number: 161257

27 March 2017

Defence Housing Australia
C/- Metrowater Management

FEASIBILITY LETTER

Developer:	**Defence Housing Australia**
Your reference:	**1784**
Development:	**Lot 400 DP1171596 Nirimba Drive, Quakers Hill**
Development Description:	**Proposed staging plan attached which shows the yield for each stage. The total site will yield 1159 residential lots. a local shopping centre, primary school, sports field and several smaller open space areas. Construction of the first stage is planned to begin late 2018 with the following stages being delivered at the rate of one each year.**
Your application date:	**17 February 2017**

Dear Applicant

This Feasibility Letter (Letter) is a guide only. It provides general information about what Sydney Water's requirements could be if you applied to us for a Section 73 Certificate (Certificate) for your proposed subdivision. **The information is accurate at today's date only.**

If you obtain development consent for that subdivision from your consent authority (this is usually your local Council) they will require you to apply to us for a Section 73 Certificate. You will need to submit a new application (and pay another application fee) to us for that Certificate by using your current or another Water Servicing Coordinator (Coordinator).

Sydney Water will then send you either a:

- Notice of Requirements (Notice) and Developer Works Deed (Deed) or
- Certificate.

These documents will be the definitive statement of Sydney Water's requirements.

There may be changes in Sydney Water's requirements between the issue dates of this Letter and the Notice or Certificate. The changes may be:

- if you change your proposed development eg the development description or the plan/ site layout, after today, the requirements in this Letter could change when you submit your new application; and

- if you decide to do your development in stages then you must submit a new application (and pay another application fee) for each stage.

You have made an application for specific information. Sydney Water's possible requirements are:

- The following information is provided to assist in planning the servicing needs of the proposed subdivision, based on the information supplied:

- Strategic investigation shows that the trunk water and wastewater systems have adequate capacity to service the development area. The land within this application was considered as part of the planning for the Schofields precinct. Indicative connection locations are shown in Figure 1.

- The subdivision will be serviced via extensions from the existing 600mm watermain within Stocklands subdivision. Depending on timing of the subdivision connection points may be closer, in Mustang Drive and/or along the road adjacent to the railway land.

- To service Stage 1 and a portion of Stage 2, wastewater extensions will be required from the 300mm currently under construction traversing Stage 2 of the subdivision adjacent to Drainage Channel 3. All later stage will require the construction of SP1202 and rising main discharging to the 900mm Riverstone Carrier a distance of 2.5 km to the north. The timing of delivery of the pumping station by Sydney Water is expected by late 2018.

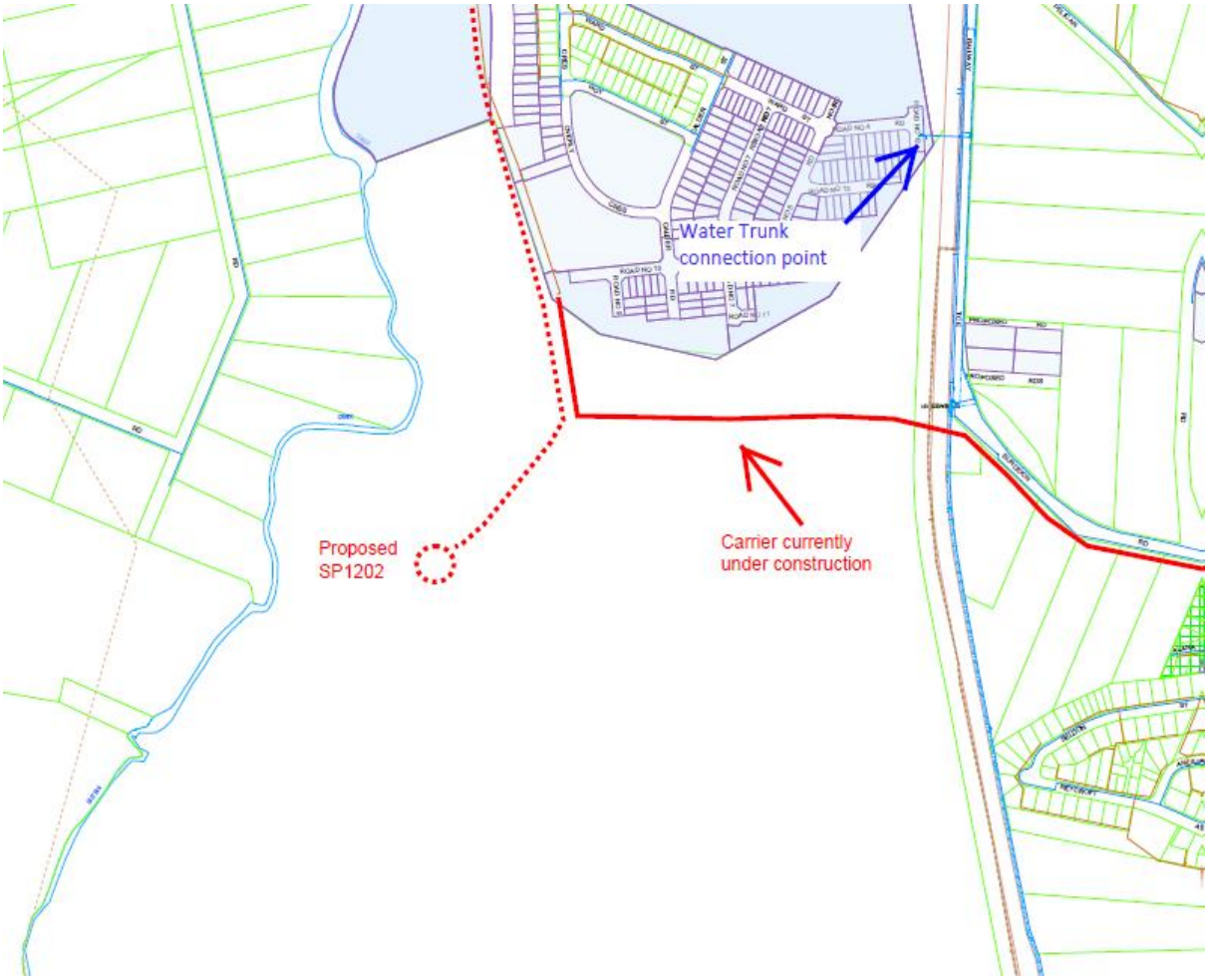
- To assist in determination of Sydney Waters requirements as part of the Section 73 application phase, a Service Brief covering concept options should be prepared and submitted as part of the application.

- These concept options will need to include development layout plans, demand forecasting, staging, timing, proposed asset extensions. The options should take into consideration the needs of the total catchment.

- Depending on the complexity of options due to local conditions, your Water Service Coordinator may advise that it is necessary to engage a range of service providers to complete the concept options documentation.

- This advice is not a formal approval of our servicing requirements. Formal requirements for servicing the development will be determined as part of the Section 73 application. More information about the Section 73 application process is available on our web page in the Land Development Manual.

Figure 1: Water and Wastewater network connection locations.



OTHER THINGS YOU MAY NEED TO DO

Shown below are other things you need to do that are NOT a requirement for the Certificate. They may well be a requirement of Sydney Water in the future because of the impact of your development on our assets. You must read them before you go any further.

Approval of your building plans

Please note that your building plans must be approved. This can be done at Sydney Water Tap in™. Visit www.sydneywater.com.au > Plumbing, building & developing > Building > Sydney Water Tap in™ or call 13 20 92.

This is not a requirement of the Certificate but the approval is needed because construction/ building works may impact on existing Sydney Water assets (e.g. water and sewer mains). In any case, these works MUST NOT commence until Sydney Water has granted approval.

Your Coordinator can tell you about the approval process including:

- Possible requirements;
- Costs; and
- Timeframes.

Note: You must obtain our written approval before you do any work on Sydney Water's systems. Sydney Water will take action to have work stopped on the site if you do not have that approval. We will apply Section 44 of the *Sydney Water Act 1994.*

Disused Sewerage Service Sealing

Please do not forget that you must pay to disconnect all disused private sewerage services and seal them at the point of connection to a Sydney Water sewer main. This work must meet Sydney Water's standards in the Plumbing Code of Australia (the Code) and be done by a licensed drainer. The licensed drainer must arrange for an inspection of the work by a NSW Fair Trading Plumbing Inspection Assurance Services (PIAS) officer. After that officer has looked at the work, the drainer can issue the Certificate of Compliance. The Code requires this.

Soffit Requirements

Please be aware that floor levels must be able to meet Sydney Water's soffit requirements for property connection and drainage.

Fire Fighting

Definition of fire fighting systems is the responsibility of the developer and is not part of the Section 73 process. It is recommended that a consultant should advise the developer regarding the fire fighting flow of the subdivision and the ability of Sydney Water's system to provide that flow in an emergency. Sydney Water's Operating Licence directs that Sydney Water's mains are only required to provide domestic supply at a minimum pressure of 15 m head.

A report supplying modelled pressures called the Statement of Available pressure can be purchased through Sydney Water Tap in™ and may be of some assistance when defining the fire fighting system. The Statement of Available pressure, may advise flow limits that relate to system capacity or diameter of the main and pressure limits according to pressure management initiatives. If mains are required for fire fighting purposes, the mains shall be arranged through the water main extension process and not the Section 73 process.

Large Water Service Connection

A water main are available to provide your subdivision with a domestic supply. The size of your subdivision means that you will need a connection larger than the standard domestic 20 mm size.

To get approval for your connection, you will need to lodge an application with Sydney Water Tap in™. You, or your hydraulic consultant, may need to supply the following:

- A plan of the hydraulic layout;

- A list of all the fixtures/fittings within the property;
- A copy of the fireflow pressure inquiry issued by Sydney Water;
- A pump application form (if a pump is required);
- All pump details (if a pump is required).

You will have to pay an application fee.

Sydney Water does not consider whether a water main is adequate for fire fighting purposes for your development. We cannot guarantee that this water supply will meet your Council's fire fighting requirements. The Council and your hydraulic consultant can help.

Disused Water Service Sealing

You must pay to disconnect all disused private water services and seal them at the point of connection to a Sydney Water water main. This work must meet Sydney Water's standards in the Plumbing Code of Australia (the Code) and be done by a licensed plumber. The licensed plumber must arrange for an inspection of the work by a NSW Fair Trading Plumbing Inspection Assurance Services (PIAS) officer. After that officer has looked at the work, the drainer can issue the Certificate of Compliance. The Code requires this.

Other fees and requirements

The requirements in this Notice relate to your Certificate application only. Sydney Water may be involved with other aspects of your development and there may be other fees or requirements. These include:

- plumbing and drainage inspection costs;
- the installation of backflow prevention devices;
- trade waste requirements;
- large water connections and
- council fire fighting requirements. (It will help you to know what the fire fighting requirements are for your subdivision as soon as possible. Your hydraulic consultant can help you here.)

No warranties or assurances can be given about the suitability of this document or any of its provisions for any specific transaction. It does not constitute an approval from Sydney Water and to the extent that it is able, Sydney Water limits its liability to the reissue of this Letter or the return of your application fee. You should rely on your own independent professional advice.

END

Attachment 14

Additional information submitted in response to a request from Council

Our Ref: 180831_Response Letter BCC

31 August 2018

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SYDNEY NSW 2000
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SYDNEY NSW 2001
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Blacktown City Council
62 Flushcombe Road
BLACKTOWN NSW 2148

ATTENTION: WINT KHINZAW

Dear Wint,

RE: RESPONSE TO COUNCIL'S COMMENTS ON THE DHA SCHOFIELDS PRECINCT PLANNING PROPOSAL

I refer to your letter from 12 June 2018 which identified a number of matters to be addressed following a preliminary review of the Planning Proposal submitted by Defence Housing Australia (DHA) for their land holding located within the Schofields Precinct. As you understand, the Planning Proposal has been submitted to achieve an improved urban design outcome that accommodates a regional netball facility, co-locates the school site with the playing fields and refines the road network and residential structure within the DHA Landholding.

Following a meeting with Council staff on 4 July 2018 at which we clarified the matters included in Council's letter, the project team has revised the relevant parts of the Planning Proposal and provided additional detail where required. The table included in this letter addresses each of the matters included in Council's letter and refers to Appendices where relevant.

It is acknowledged that the Planning Proposal is supported 'in principle' by Council and that the Proposal will continue to move forward for consideration by the Blacktown Local Planning Panel (BLPP). It is understood that the Planning Proposal will be reviewed by the Blacktown Local Planning Panel at the meeting on 13 September 2018. It is also understood that the process of resolving the matters raised by Council in your letter will not delay the progress of the Planning Proposal, with the final refinements being accommodated through the Gateway process.

DHA are committed to working with Council to ensure the best outcome for the DHA landholding is achieved and encourage Council to continue to advance the Planning Proposal to the next Council meeting following the advice from the Local Planning Panel.

The project team consider the information included with this letter to adequately addresses Council's comments and achieve an outcome that can be progressed to the next possible Council meeting.

A revised version of the proposed ILP and a number of other plans specifically referred to in Council's letter are submitted as Appendices with this Letter. It is proposed that following consideration of this response by Council and the Blacktown Local Planning Panel, all other plans requiring amendment (including all DCP and LEP plans and figures) can be amended to reflect the final agreed outcome and corresponding layout. The Planning Proposal report will also be amended for exhibition to reflect refinements and revised consultant assessments.

Table 1 on the following page addresses the comments included in Council's letter from 12 June 2018. The attachments to Council's letter included a number of additional comments which have been responded to at the end of Table 1.

Table 1 – Response to Council Comments

BCC Comment	Comments / Response
Residential Density	
1. The Planning Proposal would result in a minor dwelling increase in R2 zoned residential area. Your proposal seeks to balance/moderate this increase by reducing the density from 30 dwellings per hectare to 25 dwellings per hectare on land with higher amenity or proximity to transport node, for example adjoining Civic Centre and the land in the south eastern corner close to Quakers Hill Town Centre and the train station. 2. The Planning Proposal should be consistent in this regard with the draft SEPP amendment exhibited by the OPE proposing maximum density caps for R2 zones to ensure this control achieves the intended results.	As discussed at the meeting on 4 July 2018 and outlined on Page 65 of the Planning Proposal report, the proposed changes to residential density are consistent with the exhibited Growth Centres SEPP amendments and North West Priority Growth Area Land Use and Infrastructure Implementation Plan. The changes to the Growth Centres SEPP exhibited by the Department of Planning include amended residential density mapping where the 15 dwellings per hectare density band is replaced with a density range of 15 – 20 and the 30 dwellings per hectare density band is replaced with a range of 15 – 25 dwellings per hectare. The proposed reduction from 30 dwellings per hectare to 25 dwellings per hectare within the DHA land holding ensures all residential areas will be within the Department of Planning's exhibited density range of 15 – 25 dwellings per hectare for the DHA landholding. If the changes to the residential density maps are gazetted prior to the Planning Proposal progressing through the Gateway Approval process, a transition to the exhibited density ranges is encouraged.
Traffic & Access	
The proposed deletion of the original ILP collector road along the eastern boundary (adjacent to rail line) is **not supported**. This collector road was included to provide a continuous bus service during rail track maintenance along the railway line.	GTA have prepared a response to this comment which is included in their letter provided as Appendix 1 to this letter.
Generally, we do not support openings in the central median along sub-arterial roads on safety grounds. Aerodrome Drive is a sub-arterial road and a break in the median / all movement turning point is shown at Appendix 16 Figure 3.1 "Precinct Road Network and Hierarchy". This is not included in the traffic report. There is no justification given for this opening in the median.	GTA have prepared a response to this comment which is included in their letter provided as Appendix 1 to this letter. Craig & Rhodes have also prepared a concept design for the break in the median which is included as Appendix 2 to this letter and referred to in GTA's letter.
Section 4.3.2 of the traffic impact assessment proposes the following intersection treatments. Further information / detail is required as follows: a) 1 new roundabout and 1 new priority control intersection along Aerodrome Drive (refer Figure 4.5). The Traffic report does not provide	GTA have prepared a response to this comment which is included in their letter provided as Appendix 1 to this letter.

justification for the proposed intersection controls. b) The installation of traffic signals is subject to future warrants assessment. Details are required as to who will undertake assessment and what will be the intersection control until the time warrants are issued. c) A roundabout at the junction of the two new collector roads near the proposed primary school. This roundabout can work only if marked pedestrian crossings are provided on both collector roads frontage of the school. d) The Traffic report indicates restrictions are required at various intersections to discourage "rat run" with the revised road network (refer Figure 4.5). Details are needed for what type of restrictions they are. e) The Traffic report refers to SIDRA assessment of various intersections (Table 5.11 Intersection Operation Summary) but no details are provided. We require the input assessment from which this summary is drawn.	
4. Section 4.4 Car Parking: a) The proposed Sporting facilities at Reserve 980 require around 1080 car parking spaces. Up to 300 spaces are proposed to be provided along Aerodrome Drive which is a sub-arterial road. No stopping restrictions are generally provided along sub-arterial roads and Aerodrome Drive will not be an exception. b) No parking is associated with the school. This creates extra demand for parking along the nearby streets.	GTA have prepared a response to this comment which is included in their letter provided as Appendix 1 to this letter. In addition, the Reserve 980 Concept Designs submitted with this letter (refer Appendix 3) demonstrate that the proposed Reserve 980 area is capable of achieving parking requirements in combination with the overflow parking area on the western side of Aerodrome Drive. Craig & Rhodes has prepared a concept plan for the overflow parking area that identifies a location and access point for the overflow parking area in consideration of stormwater basin designs (refer Appendix 4). The overflow parking area will be conveniently located near the proposed signalized intersection on Aerodrome Drive. It is noted that the access point for the overflow parking area will only allow for left in and left. The roundabout to the south allows south bound vehicles to return north along Aerodrome Drive to access the overflow parking area.
5. Bus routes should be included after discussion with Transport for NSW.	Noted.
6. Walking and cycling networks appear to be satisfactory subject to	Noted.

the proposed footpath and shared paths are complying with relevant standards and guidelines.	
Open Space Provision	
1. CP24 has adopted a provision ratio of 2.83 hectares of usable open space per 1,000 persons. Therefore, to be consistent, we do not support adopting Elton's code 1.9 hectares per 1,000 persons in this planning proposal.	As discussed at the meeting on 4 July 2018, the proposed ILP incorporates an overall increase in land zoned for open space. The Schofields Precinct Section 94 (now Section 7.11) Contributions Plan includes the following open space areas within the DHA landholding: • Reserve 980 – 11.9 ha • Reserve 981 – 0.5597 ha • Reserve 982 – 0.7420 ha • Reserve 983 – 0.6680 ha • Total – 13.8697 The combined open space area under the proposed ILP including Reserve 980 as well as OS1, OS2, OS3 and OS4 is 14.68 ha, as shown on the proposed ILP submitted with this letter (refer Appendix 5). This is an increase in open space of 0.81 ha. The NDA plans submitted with this letter (refer Appendices 6 and 7) demonstrate that the proposed ILP will result in an increase in population of approximately 26 people (9 additional dwellings with an occupancy rate of 2.9). The increase in population has been calculated using residential density bands consistent with the methodology referred to in the Schofields Precinct Contributions Plan. The increase in population of 26 requires an increase in open space of 735m² using the benchmark of 2.83 hectares per 1,000 people. As such, the proposed ILP will achieve substantially more open space than required.
2. The RE1 parks are to be provided within 400m of residential zoning. The small lot residential area at the south-eastern corner of the site is about 800m away from the nearest local park. Drainage channel in the form of unusable linear open space is not acceptable to serve this residential pocket.	The proposed ILP has been amended to incorporate a park in the south eastern corner of the DHA landholding to ensure that all residents are within 400m of a local park. All parks achieve the minimum requirement of 3,000m². The amended ILP is enclosed with this letter (refer Appendix 5).
3. Irregular shape parks / open spaces should be avoided where possible, particularly in the vicinity of Local Centre and the school.	Regular shaped parks have been delivered. All parks have been designed to contribute to achieving a legible and permeable street network that facilities access to open space and an interface with residential and commercial areas that facilitates passive surveillance. While some of the proposed parks have slightly curved edges, they do not result in an outcome that would facilitate concealed spaces or unmaintainable areas.
4. Parking location / arrangement for large events mode at the regional RE1 site (e.g. State Championships)	As discussed at the meeting on 4 July 2018, sufficient parking is available within the DHA landholding to accommodate the large events mode. The traffic report submitted with the Planning Proposal outlines that

must be confirmed. We suggest DHA liaise with Nirimba campus or using drainage land on western side of Aerodrome Drive in order to free up extra area in Reserve 980. We are concerned the required community facilities will not fit in Reserve 980 with the current 'event mode' quantity of car parking shown in Reserve 980. 'Event mode' car parking solutions should be provided elsewhere e.g. Nirimba campus or SP2 drainage land.	approximately 1080 parking spaces will be required for the 'event mode' within Reserve 980. An overflow parking area has been identified on the western side of Aerodrome Drive which can accommodate approximately 200 car spaces. Craig & Rhodes has identified this space in consideration of surrounding stormwater drainage infrastructure (refer Appendix 4). The overflow parking area is located within close proximity to the Local Centre and northern point of Reserve 980 which allows for pedestrian access via the signalized intersection planned for the junction of the Local Centre collector road and Aerodrome Drive. In combination with the overflow parking area, the proposed space for Reserve 980, which is 0.64ha larger than the existing space, can accommodate the required event mode parking spaces. This is demonstrated in the Reserve 980 Concepts enclosed with this letter (refer Appendix 3).
5. The impact of noise and traffic congestion on the residential blocks adjacent to the sports fields and netball courts during weekly competitions should be addressed.	Noise attenuation measures will be proposed following investigation undertaken as part of future development applications. In regards to congestion, the traffic report prepared by GTA and submitted with the Planning Proposal addresses movements on the road network associated with Reserve 980.
6. We encourage DHA to investigate and propose a solution to provide a public connection along the Eastern Creek riparian corridor, e.g. a Right of Carriageway over private properties in E4 Environmental Living backing onto Eastern Creek. Stockland is considering the same to the north. These efforts should be coordinated.	Noted. This will be subject of future development applications. No changes to the E4 Environmental Living zone is proposed as part of the rezoning and an easement can be considered in the future.
7. Only an indicative review has been undertaken of the Reserve 980 concept plan. We look forward to developing the concept plan for this reserve once the above comments have been addressed by DHA.	Since discussing Council's comments on Reserve 980 at the meeting on 4 July 2018, the project team has prepared an additional two options for Reserve 980 and school site. At the meeting on 4 July 2018, Council requested that DHA consider re-configuring the location of the primary school site to extend along the entire northern boundary of Reserve 980 and therefore result in a longer and narrower school site. This concept was considered by the Department of Education, DHA and the project team and was discussed at a meeting with Council on 6 August 2018. At the meeting it was highlighted that the longer, narrower school site would result in a poor urban design outcome for the Local Centre interface to the north and within the school site. The narrow school site outcome would also cut off north south connectivity between Reserve 980 and the Local Centre. This outcome has been discouraged by the Department of Education as the narrow school site would require the delivery of a single multi storey building resulting in poor solar access, undesirable play spaces within the school site

	and a bulk and scale that is inconsistent with the surrounding residential and commercial areas. We acknowledge that Council are seeking the most regular shape possible for Reserve 980, however this preference forces the creation of poor outcomes adjoining Reserve 980, especially to the north, and for the school site. We note that Council expressed concern on the creation of the triangular parcel of land between the school site and Aerodrome Drive (refer Option 1 in Appendix 3). This space is quite large when viewed at a more appropriate scale and provides an opportunity to connect the Local Centre and Reserve 980 as well as people crossing Aerodrome Drive at the signalized intersection planned for the junction of the Local Centre collector road and Aerodrome Drive. The dimensions of this space are included with the Reserve 980 Concepts submitted with this Letter (refer Appendix 3), to provide a scale for Council's reference. The shape of Reserve 980 should be considered in the context of the alignment of Aerodrome Drive which is influenced by the Eastern Creek Conservation Area and adjoining drainage land and within the context that the area of Reserve 980 is significantly increased under the proposed ILP (from 11.9ha to 12.58ha). As such, the two options enclosed with this Letter (refer Appendix 3) present the most suitable locations for the school site and provide an illustration of how the facilities within Reserve 980 can be delivered. Both Option 1 and Option 2 incorporate a rectangular school site that allows for a variety of buildings and internal open space as preferred by the Department of Education. Both Options ensure that the school site addresses the Local Centre and Reserve 980 and facilitate north south connectivity between Reserve 980, the school site and Local Centre as well as the signalized intersection which will provide access to Eastern Creek and the overflow parking area. It is requested that Council identify their preference noting that the project teams preference is for Option 1.
8. We do not accept any reductions of verge widths, all verges widths should be in line with NWGC DCP. The applicant should provide required road verge widths including street tree plantings, landscaping and pathways.	The proposed ILP has been amended to incorporate full verge widths across the DHA landholding.
9. The trunk drainage channels are high hazard flash flood environments and entry into these should not be encouraged as an open space use.	The proposed ILP does not encourage or discourage entry into the drainage channels. Notwithstanding this, reference to the use of drainage channels as linear open space areas will be removed from the Planning Proposal and opportunities for delivery of linear open space will be addressed in the preparation of future development applications.

Flood and Stormwater Management Strategy	
1. The proposed strategy is not clearly explained or summarised as to what is actually to be proposed. There are errors and inconsistencies in the report and numerous figures are missing.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).
2. There is no comparison of the current strategy to the previously adopted strategy. Any changes in detention volume, stormwater treatment areas, GPTs, culvert, channels should be documented and explained.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).
3. The strategy describes the use of linear bio-retention swales but these are not shown anywhere in the report.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).
4. An amended strategy/report is required to provide: a) Model data files to assess the details for the water quality modelling, detention modelling and trunk drainage channel sizing. b) Details of the proposed land form and how this has changed from the previous version(s). c) Updated concept design sketches with sufficient information such as existing and design levels, typical sections to verify that sufficient land has been allowed to fit the required facilities. d) Details of flood evacuation and any associated evacuation routes and how the proposed landform and road network facilitates these requirements.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).
5. The flood modelling results for existing conditions appear to be higher than our latest flood mapping (2016). The flood modelling does not show the impacts of the Hawkesbury River back water which results in significantly higher flood levels than the local catchment flow results shown. Both sets of modelling results are required as the flood evacuation response needs to address the regional flooding conditions as well.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).

6. An emergency egress route should be provided across channel 2 at the Richmond Railway line as evacuation to the north is likely to be the better option than to the south.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9). The amended ILP submitted with this Letter (refer Appendix 5) incorporates a local road crossing over Drainage Channel 2 which achieves the recommended emergency egress route.
7. The flood increases at Locations D & E require owners (Nirimba Campus) consent. There may be written acceptance of this previously issued that may need to be updated. The flood increase at Location F must be resolved as part of the subdivision design work (refer Figure 13 of Flood Impact Assessment).	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).
8. Council is progressing its reduced detention basin strategy. Given how tight Basins 6 & 6A land areas are they may require the strategy to be adopted to support the current land areas. It is expected that Council strategy will be resolved in the next few months.	Craig & Rhodes has prepared a revised Water Cycle Management Report which addresses the comment (refer Appendix 9).
9. There are inconsistencies in the report figures and DCP figures.	All DCP figures will be amended to reflect the revised drainage strategy once this letter and the supporting information has been considered by Council and feedback has been received.
10. The Planning Proposal does not address the drainage channel connection to Eastern Creek which goes through ENV. Ecological Australia has prepared an offset strategy for this impact and the SEPP NVP mapping should be updated as part of this planning proposal to capture these changes.	The Offset Strategy prepared by EcoLogical Australia will be submitted with the Planning Proposal. The Planning Proposal does not seek to change the land identified as Existing Native Vegetation or Native Vegetation Retention on the Growth Centres Native Vegetation Protection Map. Any future development application will address offsetting of the ENV required to deliver the channel connection into Eastern Creek. The Offset Strategy is enclosed with this Letter (refer Appendix 10).
11. The width adjustment of the northern SP2 zoned area for Burdekin Road extension may create issues for the railway crossing as there is an existing electrical substation on the east side of the railway. To ensure the road alignment sufficiently clear the substation a sketch drawing showing the transitions and the proposed alignment is required.	The zoning map will no longer include a reduced width for Burdekin Road. A 36m corridor will be maintained for Burdekin Road as shown on the plan submitted as Appendix 8 with this Letter. At the meeting with Council on 4 July 2018, it was also requested that a plan be prepared demonstrating the southern boundary of the Burdekin Road corridor clears the existing substation to the east. Notwithstanding that the Planning Proposal no longer incorporates any amendment to the zoning for Burdekin Road, the plan included as Appendix 8 with this Letter demonstrates the southern boundary of the road is north of the substation.
12. The report refers to non-standard local road cross sections of a central road. If any new road sections are proposed specifically for this precinct, the plans and cross sections of these	The non-standard local road referred to in the report is not considered to require an amendment to the Schofields Schedule of the Blacktown Growth Centers DCP. The local road referred to maintains a 9m carriageway and 3.5m verges on both sides of the road incorporating street trees and pedestrian footpaths.

roads with dimensions are required to be shown in site specific DCP schedule for our proper assessment as part of draft DCP amendment. (see Attachment for mark-ups).	The variation allows for the widening of the footpath to a shareway and planting of the street tree on the residential side of the shareway within the 3.5m verge area. The minor variation is consistent with the objectives of Section 3.4 Movement Network in the DCP as demonstrated in Stage 1 (DA 17-01226) which approved the local road configuration referred to in the Planning Proposal.

Response to Comments Included in Council's Attachments

Council's letter from 12 June 2018 includes a number of comments in the attachments. These comments are addressed below:

- Stormwater Strategy Mark-Ups – These have been addressed in the revised Water Cycle Management Report (refer Appendix 9).
- Mark-up of GIS and proposed zoning boundary overlay:
    - SP2 Zone for Burdekin now maintains 36m. Southern boundary of SP2 zone is as per existing zoning.
    - ILP now incorporates full verge widths for all roads including those adjoining open space.
    - Aerodrome Drive zone width is now 26m.
    - Roundabouts are accounted for in the revised ILP and revised zoning plans will reflect this once feedback is received from Council.
    - The southern drainage channel has been offset from the DHA boundary to achieve the width shown on the existing zoning plan (50m).
- DCP diagrams will be amended to reflect the revised Water Cycle Management Report once feedback from Council is received.
- The ILP has been amended to incorporate a crossing of Drainage Channel 2 closer to the eastern boundary of the DHA landholding to allow for an improved emergency evacuation route. Once feedback from Council is received, the DCP diagrams will be amended to reflect this outcome as part of the revised Planning Proposal package.
- The ILP has been amended to reflect the proposed roundabout locations. Once feedback from Council is received, the DCP diagrams will be amended to reflect this outcome as part of the revised Planning Proposal package.

Should you have any questions relating to the package, please feel free to contact myself or Joe Gillies on (02) 9290 3636.

Yours faithfully
DESIGN+PLANNING

P.P.

NIGEL MCANDREW
DIRECTOR

APPENDIX 1 – GTA TRAFFIC LETTER

Reference: #N122850

30 August 2018

Defence Housing Australia (DHA)
Suite 2, Level 2/287 Elizabeth Street
SYDNEY NSW 2000

Attention: Jasmina Molter (Development Manager)

Dear Jasmina

RE: SCHOFIELDS AERODROME PRECINCT REDEVELOPMENT PLANNING PROPOSAL RESPONSE TO COUNCIL COMMENTS

The Traffic Impact Assessment (TIA) for the Schofields Aerodrome Precinct redevelopment (GTA Consultants, 4 May 2018) was submitted as part of a planning proposal to alter the approved Indicative Layout Plan (ILP) within the southern portion of the Schofields Precinct in May 2018. This letter has been prepared to address comments raised by Blacktown City Council (BCC) and should be read in conjunction with the TIA report. The Council comments received are reproduced below, with responses and additional information provided as appropriate.

Revised ILP - Changes to Collector Road Layout

BCC Comment:

The proposed deletion of the original ILP collector road along the eastern boundary (adjacent to the rail line) is not supported. This collector road was included to provide a continuous bus service during rail track maintenance along the railway line.

The original ILP collector road (Nirimba Drive/ Railway Road connection) along the eastern boundary was documented and assessed formed as part of the *Schofields Precinct Transport and Access Strategy* (AECOM, 2011). The road was modelled as a through link between Bridge Road in the north and Quakers Hill Station (and beyond) in the south. The following points should be noted with respect to the original ILP collector road:

- The rationale for a collector road in this location is unclear and not explained in the Transport and Access Strategy.
- The alignment does not have an appropriate local road catchment, given the railway line adjacent which halves the available catchment. It also does not directly connect to higher-order (sub-arterial) road(s) as would typically be the role of a collector road.
- The Strategy notes that "*these* [collector] *roads should be designed to accommodate public transport routes*", however the local bus route is identified as being predominantly along Aerodrome Drive.
- A regular route bus service parallel to the rail line along the eastern boundary is unlikely to be provided in future as his effectively forms a duplication of public transport services which is not consistent with public transport planning best practice.
- Analysis of the traffic modelling indicates that only around 15 per cent of the forecast collector road traffic volumes would be local traffic with an origin or destination in the Schofields Aerodrome site. Through traffic should use the higher-order road network; in this case, Aerodrome Drive.

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- The available road corridor for Nirimba Drive, adjacent to the Quakers Inn, is problematic and is likely to be sensitive in terms of traffic volumes, noise and safety in the future.
- A linear road directly adjacent to the rail line would have required local area traffic management devices to reduce travel speeds and improve safety. Local area traffic management devices such as speed humps and chicanes are generally not conducive to bus travel.

Ultimately, providing a through-linking collector road along the eastern boundary could result in a transfer of traffic from the north-south sub-arterial road to the collector road which is not considered the intention of the ILP. In response to the above and the need to provide a collector road that best services day-to-day operation of the precinct, the original ILP collector road was realigned to connect with the neighbourhood centre, school and Reserve 980 sporting facilities, noting the following:

- The realignment of the collector road directs any through traffic back towards Aerodrome Drive, preserving residential amenity in the vicinity of the rail corridor.
- The realignment of the collector road allows any future regular route bus services on the local road network to effectively service the neighbourhood centre within the Schofields Aerodrome redevelopment, thereby connecting more land uses along the route as well as servicing residents on the eastern side of the development.
- The infrequent rail replacement bus services could use the realigned collector road, maintaining the same northern and southern connection points, with only minor impacts to travel time and distance.

Notwithstanding the above, a continuous road along the eastern boundary has be reintroduced to address flood evacuation and would be available for rail replacement bus services if required.

Reserve 980 Access from Aerodrome Drive

BCC Comment:

Generally, we do not support openings in the central median along sub-arterial roads on safety grounds. Aerodrome Drive is a sub-arterial road and a break in the median/ all movement turning point is shown at Appendix 16 Figure 3.1 "Precinct Road Network and Hierarchy". This is not included in the traffic report. There is no justification given for this opening in the median.

Reserve 980 access arrangements are shown in Figure 4.3 of the TIA, these include two left-in, left-out intersections and a median break allowing all turning movements. The central median break for Reserve 980 allows right turn movements into the sports facilities, limiting the need for additional travel distances and circulation through local streets for visitors from the south.

The proposed access arrangements have been assessed further and it is recommended that Council allow an unsignalised right turn movement into Reserve 980, which can be easily accommodated within the median. The corresponding right turn out would not be provided, with drivers able to turn left and use the roundabout to the south for accessing northern destinations.

Whilst the sports facilities can be expected to be in use throughout the week, it is expected that the highest use would occur during weekends, especially on Saturdays. Previous experience indicates that overall Saturday peak hour traffic volumes for sub-arterial roads will be similar to those during weekday peak periods, however, a more even split in traffic direction thus allowing safe and efficient use of the right-in, left-out movements.

The proposed median break for the right-in, left-out access to the sports facilities can be seen as a concept design in Attachment 1 with supporting discussion. This concept design for the median break includes an approximately 50-metre-long right-turn bay on the south approach.

Traffic Signal Warrants

BCC Comment:

The installation of traffic signals is subject to future warrants assessment. Details are required as to who will undertake assessment and what will be the intersection control until the time warrants are issued.

A preliminary traffic signal warrants assessment has been conducted for the intersection of Aerodrome Road and the town centre collector road, based on the ultimate development scenario. This scenario assumes full development, with Aerodrome Drive completed and connecting between Quakers Hill Parkway and Schofields Road.

Traffic volumes expected at this intersection have been assessed against Roads and Maritime Services traffic signals warrants for traffic demand, which are as follows:

For each of four one-hour periods of an average day:

i The major road flow exceeds 600vehicles/hour in each direction.

ii The minor road flow exceeds 200vehicles/hour in one direction.

The AM and PM peak hour volumes expected at the intersection are shown in Figure 1 and Figure 2. These represent two separate hours within a day (AM and PM peak hours) however, a review of a similar function sub-arterial road (Richmond Road) indicates that the peak hour to peak period factor is generally about 0.5 for sub-arterial roads. As such, hourly volumes for the peak two hours along Aerodrome Drive can be expected to be similar to the peak hour volumes shown in Figure 1 and Figure 2. Weekend peak hour volumes have also been estimated, as shown in Figure 3. The traffic signal warrants have been assessed based on the above assumptions with a checklist summarised in Table 1.

Figure 1: AM peak hour traffic volume at Aerodrome Drive/ Town Centre Collector Road

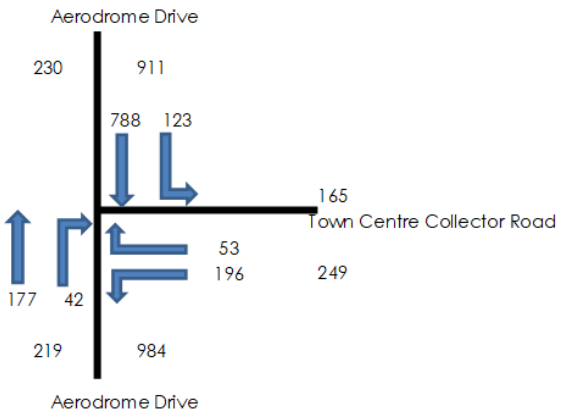


Figure 2: PM peak hour traffic volume at Aerodrome Drive/ Town Centre Collector Road

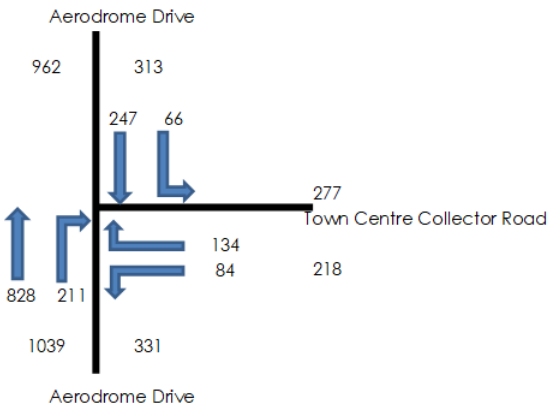


Figure 3: Weekend peak hour traffic volume at Aerodrome Drive/ Town Centre Collector Road

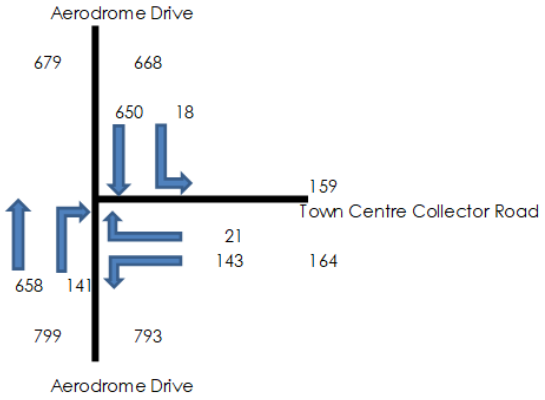


Table 1: Traffic signal warrants assessment

Warrant	AM peak two hours	PM peak two hours	Weekend peak hour
The major road flow exceeds 600 vehicles/ hour in each direction	Yes, in peak direction only	Yes, in peak direction only	Yes
The minor road flow exceeds 200 vehicles/ hour in one direction	Yes	Yes	Yes

The checklist indicates that traffic signal warrants would be met in the peak direction on Aerodrome Drive, however the lower off-peak direction traffic volume forecasts would not be as high. However, the combined two-way volumes would meet the relevant warrants and weekend peak volumes would also meet the relevant warrants. Given the strategic role of Aerodrome Drive as a connection between Schofields Road, Quakers Hill Parkway, the future Burdekin Road extension and further afield to the M7 motorway, it is likely that traffic volumes in the off-peak direction could be higher than the forecasts.

A review of sub-arterial traffic volumes for weekends indicate that peak periods are generally between four and six hours in duration. Additionally, weekend peak periods coincide with peak sporting activities, and greater patronage of the local town centre and nature reserve along the western edge. As such, strong pedestrian lines can be expected between these three land uses.

The approved Schofields Precinct ILP designates signalised pedestrian crossings on all legs at this location. As the revised ILP is generally consistent with the approved ILP in this area, the signalised pedestrian crossing, and associated signalisation of the intersection would tie the above land uses together and provide safe crossing opportunity, especially across Aerodrome Drive.

Additionally, the town centre collector road and Aerodrome Drive road cross- sections prescribe cyclist facilities, either as a shared path or cycle lane. Signalised intersections, with dedicated pedestrian and shared crossings, provide the best safety outcome when compared to alternatives such as roundabouts and priority-controlled intersections.

It is expected that Aerodrome Drive between the neighbourhood centre and the Nirimba Education Precinct would be constructed and opened as a single stage of works. At this time, it is also expected that the remainder of Aerodrome Drive to the south (connecting to Quakers Hill Parkway) would also be completed and opened, in order to provide the necessary accessibility

for Schofields Precinct residents. Prior to the completion of Aerodrome Drive, the transition from Aerodrome Drive north of the neighbourhood centre to Town Centre Collector Road would effectively be a low-speed corner, with no conflicting movements. As such, there is not expected to be any stage of development where the proposed traffic signals would operate as an interim priority-controlled intersection.

In summary:

- Traffic signals at the Aerodrome Drive/ Town Centre Collector Road were proposed in the ILP and the planning proposal is consistent in this regard.
- The forecast traffic volumes are sufficiently close to meeting the relevant traffic signal warrants that the planned traffic signals should be maintained.
- Traffic signals at this location would best address traffic management and coordination with the proposed Burdekin Road traffic signals to the north.
- Other benefits of the proposed traffic signals include pedestrian/ cyclist movement and safety, use of any overflow car parking to the west of Aerodrome Drive, safe access for all modes of transport to the adjacent school facilities and neighbourhood centre.
- Appropriate intersection staging is available such that interim intersection arrangements prior to full site development can be managed.

Other Comments Regarding Traffic and Access

Table 2: Responses to other Blacktown City Council comments

Issue	Response
Section 4.3.2 of the traffic impact assessment proposes the following intersection treatments. Further Information/ Detail is required as follows: *a) 1 new roundabout and 1 new priority control intersection along Aerodrome Drive. The traffic report does not provide justification for the proposed intersection controls.*	Intersection treatments are shown in Figure 4.5 of the TIA. Traffic signals are proposed for access to the neighbourhood centre, while a roundabout is proposed at the intersection of Aerodrome Drive and the southern east-west road. Both intersections would not operate satisfactorily as priority-controlled intersections, given the anticipated traffic volumes was assessed to not operate at acceptable levels of delay and service at this location. Signals provides pedestrian connectivity for the neighbourhood centre, while a roundabout to the south manages through traffic speeds and allows u-turn movements for sports field patrons exiting and heading north.
b) A roundabout at the junction of the two new collector roads near the proposed primary school. This roundabout can work only if marked pedestrian crossings are provided on both collector roads frontage of the school.	Noted. Schools would typically have dedicated mid-block pedestrian crossing facilities that align with school access points, with treatments dependent on forecast pedestrian movements. The pedestrian crossing facilities would be subject to a Roads and Maritime Services Warrants assessment with the crossings to be setback at least two vehicle queuing spaces from the exit of the roundabout. The design of the roundabout and any pedestrian crossings would be determined as part of Staged DAs.
c) The Traffic report indicates restrictions are required at various intersections to discourage "rat run" with the revised road network (refer Figure 4.5). Details are needed for what type of restrictions they are.	Examples of likely local area traffic management treatments have been provided in Attachment 2, however, the final details of these treatments would be confirmed at the detailed design stage or as part of an overall LATM treatment plan.
d) The Traffic report refers to SIDRA assessment of various intersections (Table 5.11 Intersection Operation Summary) but no details are provided. We require the input assessment from which this summary is drawn.	Detailed SIDRA outputs can be found in Attachment 3.

Issue	Response
Section 4.4 Car Parking: *a) The proposed Sporting facilities at Reserve 980 require around 1080 car parking spaces. Up to 300 spaces are proposed to be provided along Aerodrome Drive which is a sub-arterial road. No stopping restrictions are generally provided along sub-arterial roads and Aerodrome Drive will not be an exception.*	Overflow parking arrangements can be made within the reserve located directly west of Reserve 980, across Aerodrome Drive. The overflow parking would be an at-grade unsealed car park only utilised during expected event situations when the provided car park for Reserve 980 would not be sufficient.
b) No parking is associated with the school. This creates extra demand for parking along the nearby streets.	This is consistent with Department of Education policies, noting that the school layout is only shown very indicatively at this stage. The close proximity of the sporting facilities would easily allow sharing of car parking and therefore better utilisation throughout a typical week as sports events will not generally be held during school hours and vice versa.

I trust the above suitably addresses the comments received. Naturally, should you have any questions or require any further information, please do not hesitate to contact me in our Sydney office on (02) 8448 1800.

Yours sincerely

GTA CONSULTANTS

Brett Maynard
Director

encl.
Attachment 1 – Median Break Concept Design and Justification for Reserve 980
Attachment 2 – LATM Examples
Attachment 3 – SIDRA Outputs

Attachment 1

Median Break Concept Design and Justification for Reserve 980

Median Breaks

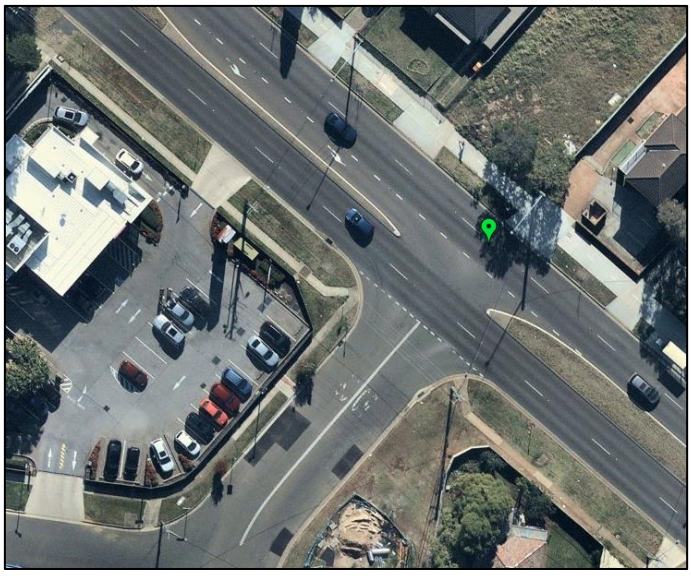
Median breaks have been proposed as part of the priority-controlled intersection to Reserve 980 to allow right turns for northbound traffic into the sports facilities. A desktop review of similar arrangements for two lane sub-arterial-type roads to allow local and development access include the following locations:

I. Development Access to Peter Brock Drive, Oran Park (refer Figure 4)
II. Richmond Road/ Tulloch Street, Blacktown (refer Figure 5)
III. Intersection of Richmond Road/ Tulloch Street, Blacktown (Figure 6)
IV. Intersection of Bossley Road/ Cowpasture Road, Bossley Park (Figure 7).

Figure 4: Intersection of Carden Street/ Peter Brock Drive, Oran Park

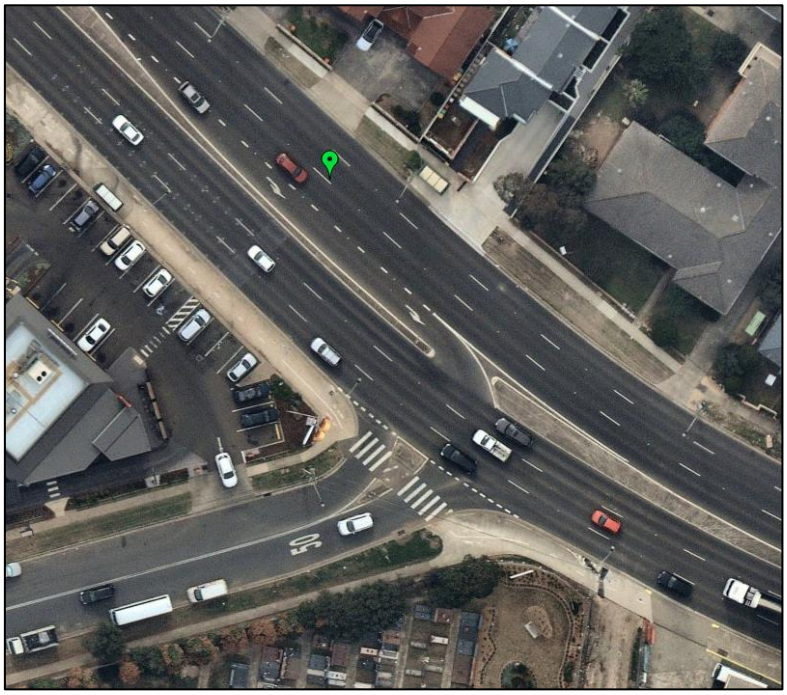
Source: Nearmap

Figure 5: Intersection of Richmond Road/ Tulloch Street, Blacktown



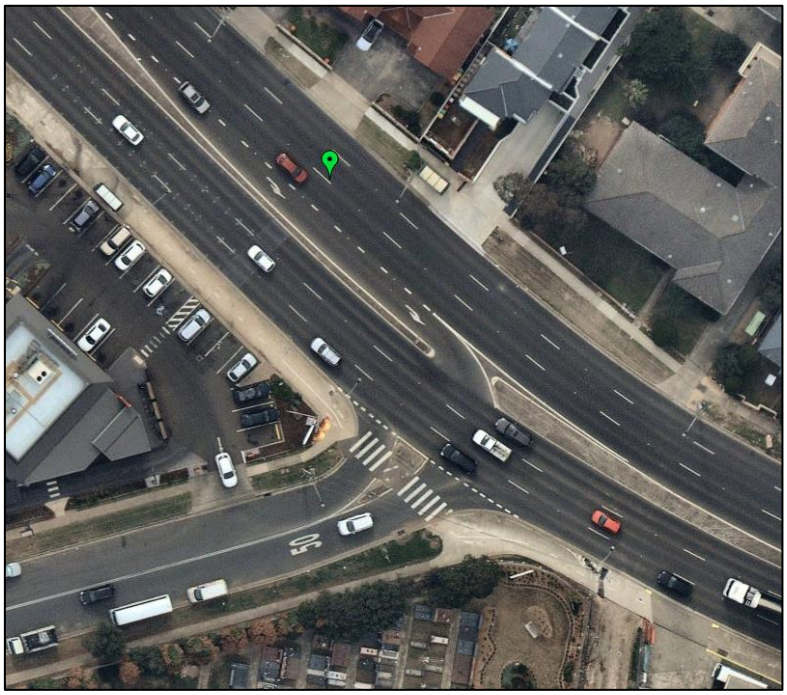
Source: Nearmap

Figure 6: Intersection of McLean Street/ Elizabeth Drive, Liverpool



Source: Nearmap

Figure 7: Intersection of Bossley Road/ Cowpasture Road, Bossley Park



Source: Nearmap

The concept design for the median break at Reserve 980 is shown below.

A1

NETBALL COURTS
(FUTURE)

SPORTS FIELD CARPARK
(FUTURE)

SPORTS FIELD CARPARK
(FUTURE)

SPORTS FIELD CARPARK
(FUTURE)

SPORTS FIELD
ENTRY DRIVEWAY.

50.0m STORAGE LENGTH

31.5m TAPER

AERODROME DRIVE (MC00)

3.5
7.0
4.0
7.0
3.5
1.0
3.0
4.0

CHANNEL 1
COMPENSATORY CUT

PLAN
1:200

1:200 @ A1

FOR INFORMATION ONLY

REV	DATE	AMENDMENT DESCRIPTION
A	21.08.18	ISSUED FOR INFORMATION

DIAL 1100 BEFORE YOU DIG

DHA Defence Housing Australia

Project:
SCHOFIELDS AERODROME DEVELOPMENT
WATER CYCLE MANAGEMENT REPORT

Principal: DEFENCE HOUSING AUSTRALIA

Scale	Date	Council Ref.
1:200	07.08.2018	
	Datum AHD	L.G.A. BLACKTOWN CITY COUNCIL

Calc's	Drawn.	Proj.Man.	Client Ref:
S.W.	J.H.	F.C.	

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Drawing Title
SPORTS FIELD
MEDIAN INTERSECTION
CONCEPT LAYOUT

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0196	A

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Attachment 2

LATM Treatments

Potential LATM Treatments

An analysis of traffic volumes and speeds will inform the selection of the most suitable traffic control device for intersection requiring local area traffic management (LATM) treatment. Two types of controls are available as part of LATM treatments; regulatory controls and geometric controls.

Regulatory controls are based on signage to regulate the movement of traffic by indicating where or when a legal requirement applies. This can be in the form of signage and/or line marking to regulate traffic movements and/ or calm traffic. Geometric controls involve physically changing the road environment to regulate traffic movement by physically slowing vehicles and increasing driver effort to prevent through traffic.

An indicative diagram of locations where LATM treatments would be required for the proposed development is presented in Figure 8. The diagram includes intersection and indicative mid-block treatments as part of the precinct LATM plan.

A summary list of LATM treatments and associated advantages and disadvantages are presented in Table 3. Graphical examples of likely LATM treatments are shown in Figure 9 to Figure 13.

Figure 8: Indicative locations for LATM treatments

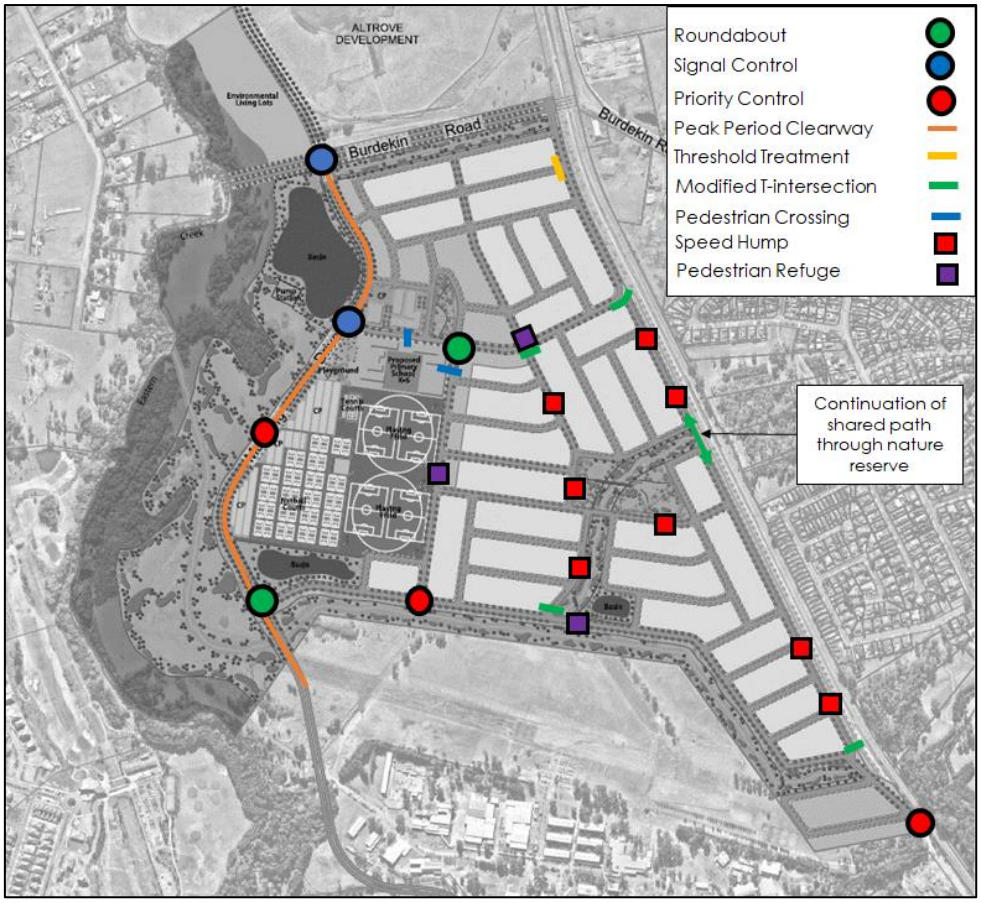


Table 3: Summary of LATM Treatments

Measure		Reduce Speeds	Reduce Traffic Volumes	Reduce Crash Risks	Increase Pedestrian Safety	Increase Bicycle Safety
Vertical Deflection Devices	Watt Profile Road Humps	✓	✓	✓	-	-
	Road Cushions	✓	✓	✓	-	✓
	Flat Top Road Humps	✓	✓	✓	-	✓
	Wombat Crossings	✓	✓	✓	✓	✓
	Raised Pavements	✓	✓	✓		✓
Horizontal Deflection Devices	Lane Narrowings/ Kerb Extension	✓	-	-	✓	-
	Slow Points	✓	✓	-	-	-
	Centre Blister Islands	✓	✓	-	✓	-
	Driveway Links	✓	✓	-	✓	✓
	Mid-Block Median Treatments	✓	-	✓	✓	✓
Diversion Devices	Full Road Closure	-	✓	✓	✓	✓
	Half Road Closure	-	✓	✓	✓	✓
	Diagonal Road Closure	-	✓	✓	✓	✓
	Modified 'T' Intersection	✓	✓	✓	✓	✓
	Left-In/ Left-Out Islands	-	✓	✓	✓	-
Other treatments	Marked Pedestrian Crossings	-	-	✓	✓	✓
	Threshold Treatments	✓	✓	✓	-	✓
	Tactile Surface Treatments	✓	-	-	-	-
	Bicycle Facilities	-	-	✓	-	✓

Source: Reproduced from Austroads – Guide to Traffic Management Part 8: Local Area Traffic Management

Figure 9: Example of raised threshold intersection treatment

Source: Google Maps (Figure 9)

Figure 10: Example of road hump

Figure 11: Example of local traffic signage

Figure 12: Example of raised pedestrian crossing (wombat crossing)

Source: Roads and Maritime Services and Austroads Guide to Local Area Traffic Management (2016)

Figure 13: Modified T-intersection

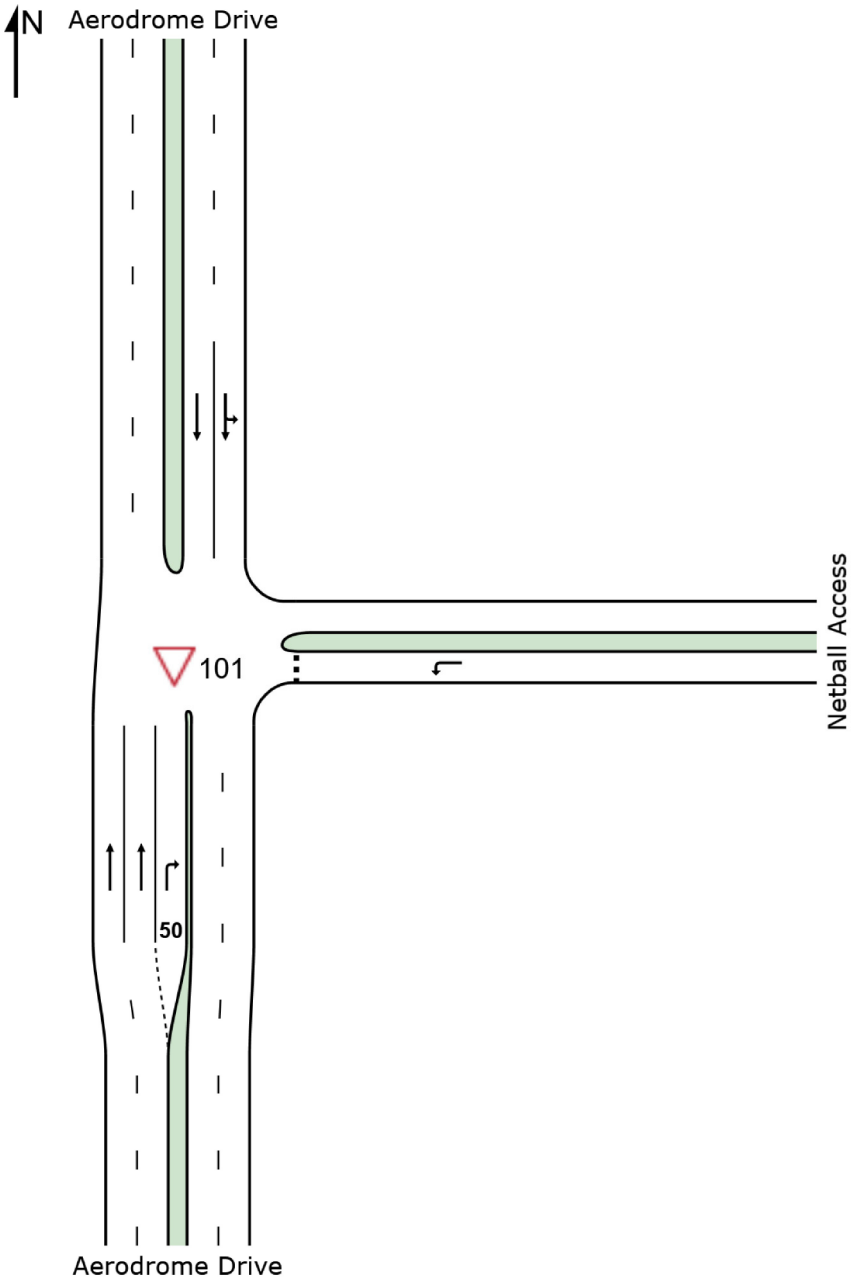
Attachment 3

SIDRA Movement Summaries

SITE LAYOUT

Site: 101 [2036 w/end peak - Middle Access/ Aerodrome Drive - Right in-left out]

New Site
Giveway / Yield (Two-Way)



LANE SUMMARY

Site: 101 [2036 PM peak - Middle Access/ Aerodrome Drive - Right in-left out - Copy]

New Site
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Aerodrome Drive													
Lane 1	546	2.0	1925	0.284	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	546	2.0	1925	0.284	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 3	64	2.0	971	0.066	100	7.3	LOS A	0.3	1.9	Short	50	0.0	NA
Approach	1157	2.0		0.284		0.4	NA	0.3	1.9				
East: Netball Access													
Lane 1	64	2.0	1161	0.055	100	0.6	LOS A	0.2	1.6	Full	500	0.0	0.0
Approach	64	2.0		0.055		0.6	LOS A	0.2	1.6				
North: Aerodrome Drive													
Lane 1	210	2.0	1895	0.111	100	1.7	LOS A	0.0	0.0	Full	300	0.0	0.0
Lane 2	213	2.0	1925	0.111	100	0.0	LOS A	0.0	0.0	Full	300	0.0	0.0
Approach	423	2.0		0.111		0.9	NA	0.0	0.0				
Intersection	1644	2.0		0.284		0.5	NA	0.3	1.9				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

LANE SUMMARY

Site: 101 [2036 w/end peak - Middle Access/ Aerodrome Drive - Right in-left out]

New Site
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows		Cap.	Deg. Satn	Lane Util.	Average Delay	Level of Service	95% Back of Queue		Lane Config	Lane Length	Cap. Adj.	Prob. Block.
	Total veh/h	HV %	veh/h	v/c	%	sec		Veh	Dist m		m	%	%
South: Aerodrome Drive													
Lane 1	342	2.0	1925	0.178	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 2	342	2.0	1925	0.178	100	0.0	LOS A	0.0	0.0	Full	500	0.0	0.0
Lane 3	320	2.0	494	0.648	100	18.7	LOS B	4.4	31.6	Short	50	0.0	NA
Approach	1004	2.0		0.648		6.0	NA	4.4	31.6				
East: Netball Access													
Lane 1	640	2.0	1131	0.566	100	2.0	LOS A	5.1	36.6	Full	500	0.0	0.0
Approach	640	2.0		0.566		2.0	LOS A	5.1	36.6				
North: Aerodrome Drive													
Lane 1	494	2.0	1863	0.265	100	3.6	LOS A	0.0	0.0	Full	300	0.0	0.0
Lane 2	510	2.0	1925	0.265	100	0.0	LOS A	0.0	0.0	Full	300	0.0	0.0
Approach	1004	2.0		0.265		1.8	NA	0.0	0.0				
Intersection	2648	2.0		0.648		3.4	NA	5.1	36.6				

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101v [2036 Weekend Peak - Southern Intersection]

New Site
Roundabout

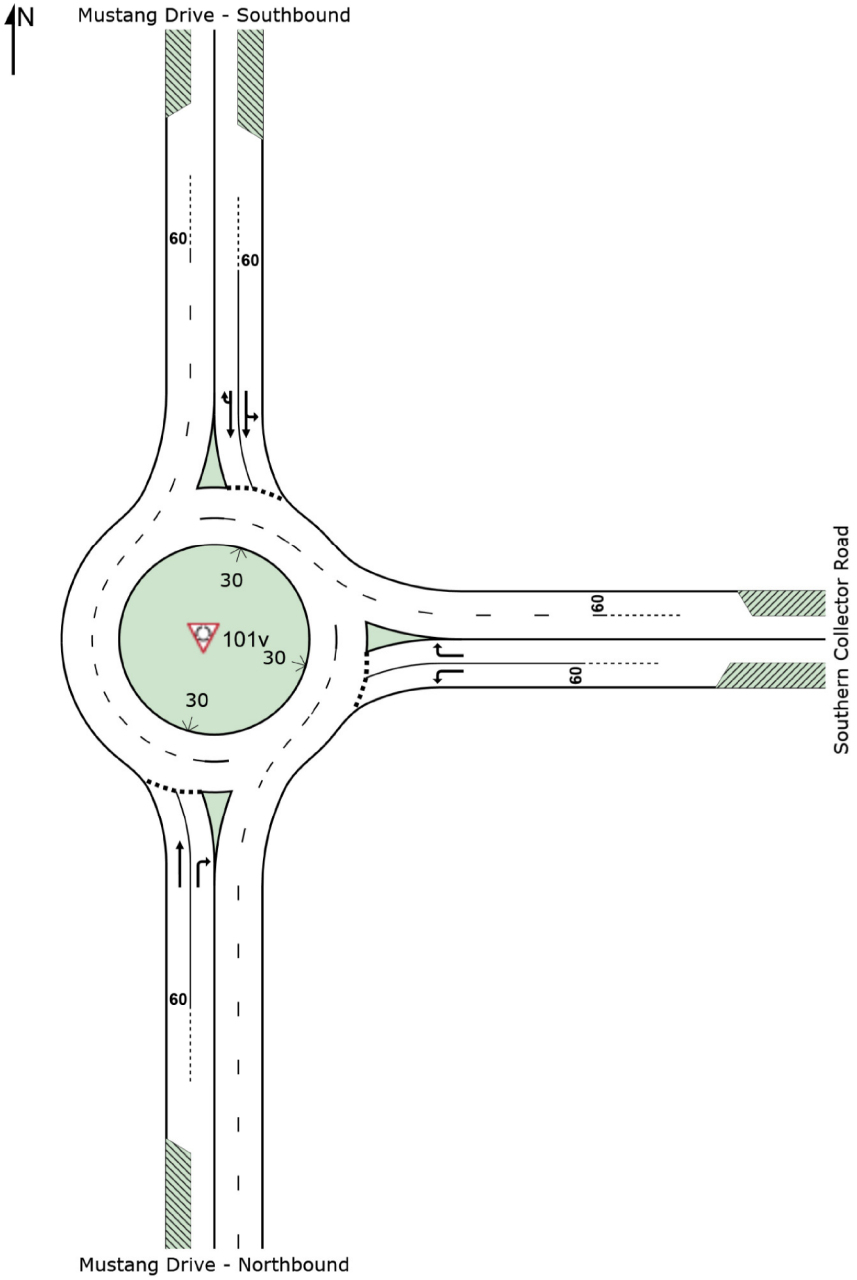
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mustang Drive - Northbound											
2	T1	652	5.0	0.675	10.9	LOS A	7.7	56.0	0.87	0.97	52.5
3	R2	65	2.0	0.109	13.8	LOS A	0.5	3.9	0.64	0.78	48.2
Approach		717	4.7	0.675	11.2	LOS A	7.7	56.0	0.85	0.95	52.1
East: Southern Collector Road											
4	L2	65	2.0	0.118	7.4	LOS A	0.5	3.6	0.68	0.79	48.9
6	R2	207	2.0	0.243	10.8	LOS A	1.2	8.6	0.69	0.86	48.4
Approach		273	2.0	0.243	10.0	LOS A	1.2	8.6	0.69	0.85	48.6
North: Mustang Drive - Southbound											
7	L2	209	2.0	0.437	3.9	LOS A	3.6	26.3	0.30	0.39	51.3
8	T1	684	5.0	0.437	3.9	LOS A	3.6	26.3	0.30	0.45	55.6
9u	U	368	2.0	0.437	12.0	LOS A	3.6	25.7	0.31	0.57	55.1
Approach		1262	3.6	0.437	6.3	LOS A	3.6	26.3	0.31	0.47	54.7
All Vehicles		2252	3.8	0.675	8.3	LOS A	7.7	56.0	0.53	0.67	53.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101v [2036 Weekend Peak - Southern Intersection]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101v [2036 PM Peak - Southern Intersection]

New Site
Roundabout

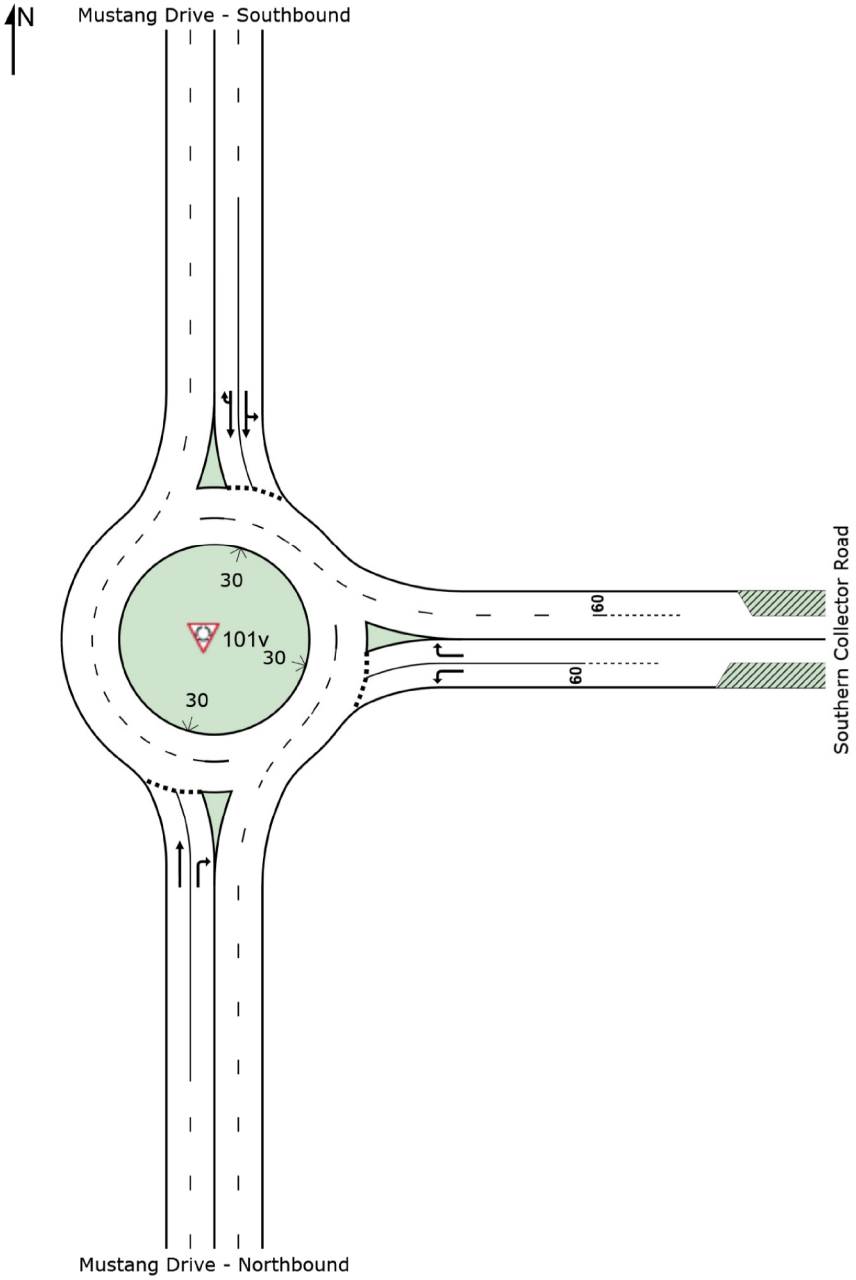
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mustang Drive - Northbound											
2	T1	1061	5.0	0.770	5.5	LOS A	9.3	68.2	0.71	0.54	54.5
3	R2	189	2.0	0.227	10.8	LOS A	1.2	8.6	0.42	0.66	49.8
Approach		1251	4.5	0.770	6.3	LOS A	9.3	68.2	0.67	0.56	53.7
East: Southern Collector Road											
4	L2	89	2.0	0.079	3.7	LOS A	0.4	2.6	0.46	0.50	50.9
6	R2	54	2.0	0.058	9.2	LOS A	0.3	1.8	0.48	0.65	49.1
Approach		143	2.0	0.079	5.7	LOS A	0.4	2.6	0.47	0.56	50.2
North: Mustang Drive - Southbound											
7	L2	83	2.0	0.195	4.0	LOS A	1.1	8.1	0.39	0.43	53.5
8	T1	276	5.0	0.195	4.2	LOS A	1.1	8.1	0.39	0.49	54.6
9u	U	118	2.0	0.195	12.6	LOS A	1.1	8.0	0.40	0.59	55.4
Approach		477	3.7	0.195	6.2	LOS A	1.1	8.1	0.39	0.51	54.6
All Vehicles		1871	4.1	0.770	6.2	LOS A	9.3	68.2	0.58	0.55	53.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101v [2036 PM Peak - Southern Intersection]

New Site
Roundabout



MOVEMENT SUMMARY

Site: 101v [2036 AM Peak - Southern Intersection]

New Site
Roundabout

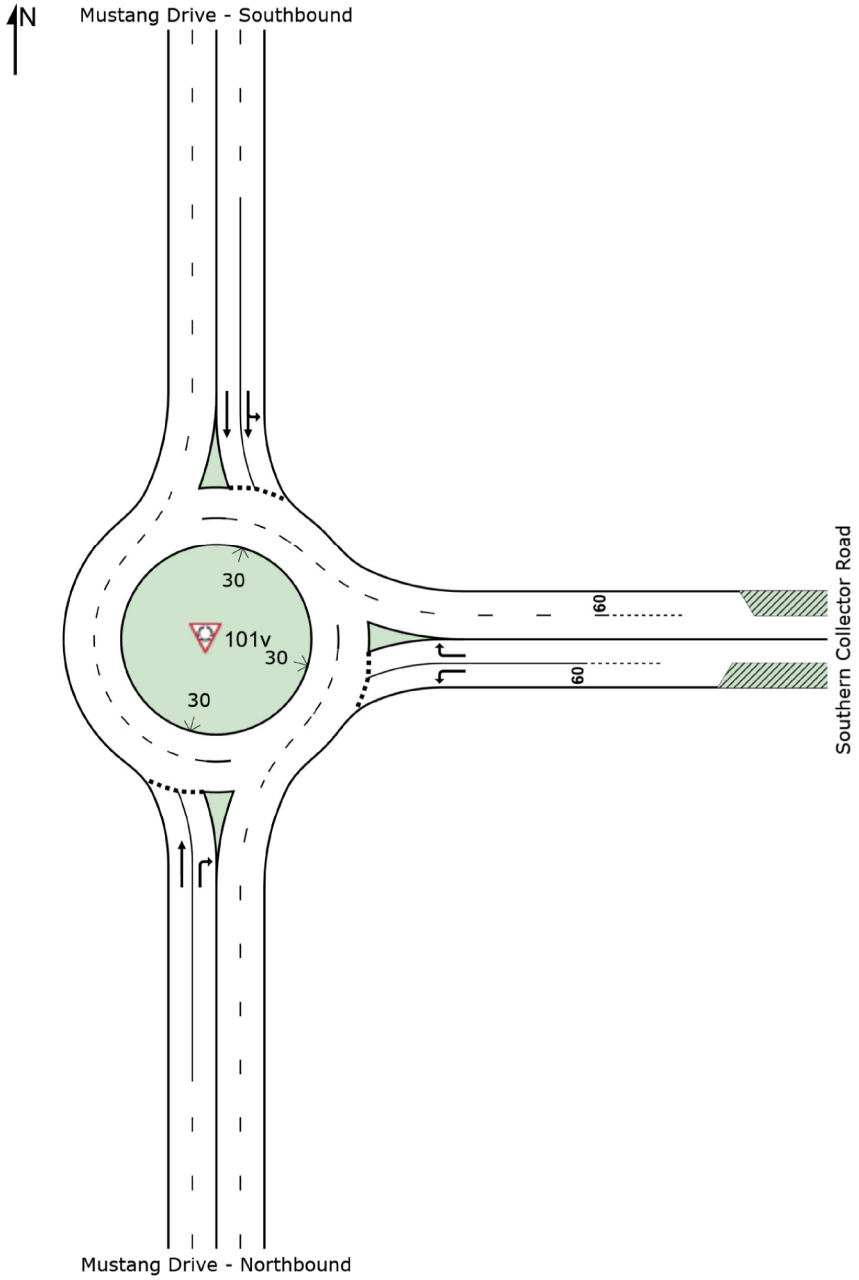
Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mustang Drive - Northbound											
2	T1	231	5.0	0.156	3.8	LOS A	1.0	6.9	0.21	0.35	57.3
3	R2	60	0.0	0.062	9.6	LOS A	0.3	2.3	0.22	0.59	50.5
Approach		291	4.0	0.156	5.0	LOS A	1.0	6.9	0.21	0.40	55.7
East: Southern Collector Road											
4	L2	208	0.0	0.233	5.5	LOS A	1.1	7.8	0.67	0.77	50.2
6	R2	56	0.0	0.102	12.4	LOS A	0.4	2.9	0.66	0.86	47.6
Approach		264	0.0	0.233	6.9	LOS A	1.1	7.8	0.66	0.79	49.6
North: Mustang Drive - Southbound											
7	L2	84	0.0	0.390	3.8	LOS A	2.7	19.5	0.24	0.37	51.5
8	T1	1051	5.0	0.390	3.9	LOS A	2.7	19.5	0.24	0.37	57.1
Approach		1135	4.6	0.390	3.9	LOS A	2.7	19.5	0.24	0.37	56.6
All Vehicles		1689	3.8	0.390	4.6	LOS A	2.7	19.5	0.30	0.44	55.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

SITE LAYOUT

Site: 101v [2036 AM Peak - Southern Intersection]

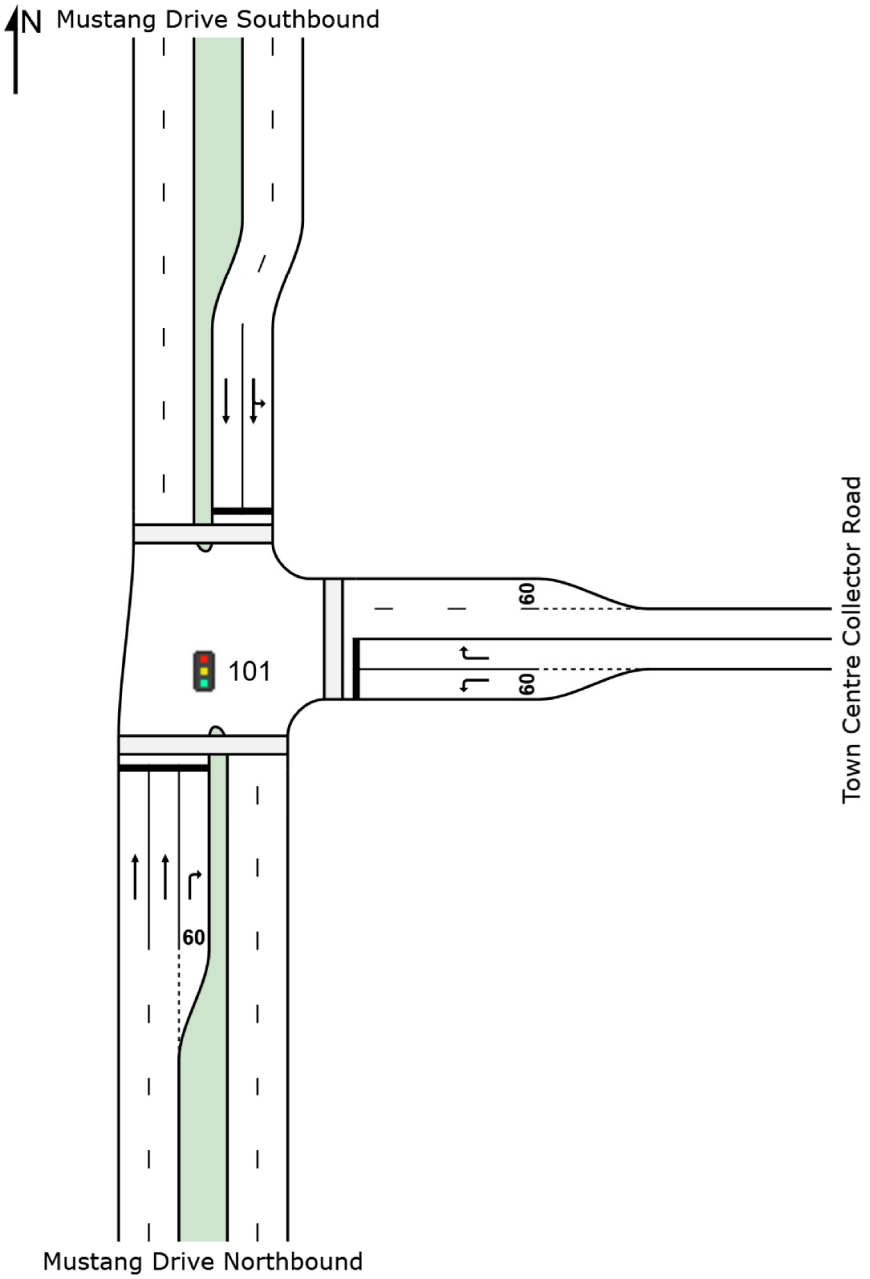
New Site
Roundabout



SITE LAYOUT

Site: 101 [2036 AM Peak - Town Centre]

New Site
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 101 [2036 AM Peak - Town Centre]

New Site
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mustang Drive Northbound											
2	T1	186	5.0	0.076	4.1	LOS A	1.0	7.3	0.39	0.31	56.2
3	R2	45	2.0	0.247	34.4	LOS C	1.3	9.4	0.96	0.73	33.2
Approach		232	4.4	0.247	10.0	LOS A	1.3	9.4	0.50	0.39	49.5
East: Town Centre Collector Road											
4	L2	206	2.0	0.322	19.1	LOS B	4.5	32.1	0.77	0.74	37.6
6	R2	56	2.0	0.203	28.7	LOS C	1.5	10.7	0.91	0.73	34.2
Approach		262	2.0	0.322	21.2	LOS B	4.5	32.1	0.80	0.74	36.8
North: Mustang Drive Southbound											
7	L2	129	2.0	0.559	18.8	LOS B	10.3	74.5	0.79	0.72	40.4
8	T1	816	5.0	0.559	13.2	LOS A	10.4	75.6	0.79	0.70	48.9
Approach		945	4.6	0.559	14.0	LOS A	10.4	75.6	0.79	0.70	47.5
All Vehicles		1439	4.1	0.559	14.7	LOS B	10.4	75.6	0.74	0.66	45.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P2	East Full Crossing	53	15.4	LOS B	0.1	0.1	0.72	0.72
P3	North Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
All Pedestrians		158	21.4	LOS C			0.84	0.84

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 101 [2036 PM Peak - Town Centre]

New Site
Signals - Fixed Time Isolated Cycle Time = 40 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mustang Drive Northbound											
2	T1	872	5.0	0.420	5.8	LOS A	5.1	37.2	0.62	0.54	54.8
3	R2	222	2.0	0.539	21.3	LOS B	4.1	29.1	0.93	0.80	41.1
Approach		1094	4.4	0.539	8.9	LOS A	5.1	37.2	0.69	0.59	51.3
East: Town Centre Collector Road											
4	L2	88	2.0	0.092	9.8	LOS A	0.9	6.2	0.52	0.66	46.5
6	R2	141	2.0	0.514	23.0	LOS B	2.8	19.8	0.96	0.79	39.7
Approach		229	2.0	0.514	17.9	LOS B	2.8	19.8	0.79	0.74	42.1
North: Mustang Drive Southbound											
7	L2	84	2.0	0.525	23.1	LOS B	3.3	23.7	0.95	0.78	41.6
8	T1	260	5.0	0.525	17.5	LOS B	3.3	24.3	0.95	0.77	46.1
Approach		344	4.3	0.525	18.8	LOS B	3.3	24.3	0.95	0.77	44.9
All Vehicles		1667	4.0	0.539	12.2	LOS A	5.1	37.2	0.76	0.65	48.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	14.5	LOS B	0.1	0.1	0.85	0.85
P2	East Full Crossing	53	14.5	LOS B	0.1	0.1	0.85	0.85
P3	North Full Crossing	53	14.5	LOS B	0.1	0.1	0.85	0.85
All Pedestrians		158	14.5	LOS B			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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MOVEMENT SUMMARY

Site: 101 [2036 Weekend Peak - Town Centre]

New Site
Signals - Fixed Time Isolated Cycle Time = 60 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Mustang Drive Northbound											
2	T1	693	5.0	0.412	5.1	LOS A	7.1	51.8	0.49	0.42	55.3
3	R2	148	2.0	0.695	36.4	LOS C	4.7	33.1	1.00	0.87	35.1
Approach		841	4.5	0.695	10.6	LOS A	7.1	51.8	0.58	0.50	50.2
East: Town Centre Collector Road											
4	L2	151	0.0	0.221	18.9	LOS B	3.1	21.6	0.73	0.73	41.7
6	R2	22	0.0	0.079	29.1	LOS C	0.6	4.1	0.89	0.69	37.3
Approach		173	0.0	0.221	20.2	LOS B	3.1	21.6	0.75	0.73	41.1
North: Mustang Drive Southbound											
7	L2	84	0.0	0.253	17.3	LOS B	3.9	27.8	0.67	0.64	44.7
8	T1	684	5.0	0.687	14.6	LOS B	13.6	99.6	0.83	0.75	48.1
Approach		768	4.5	0.687	14.9	LOS B	13.6	99.6	0.81	0.73	47.7
All Vehicles		1782	4.0	0.695	13.4	LOS A	13.6	99.6	0.70	0.62	48.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

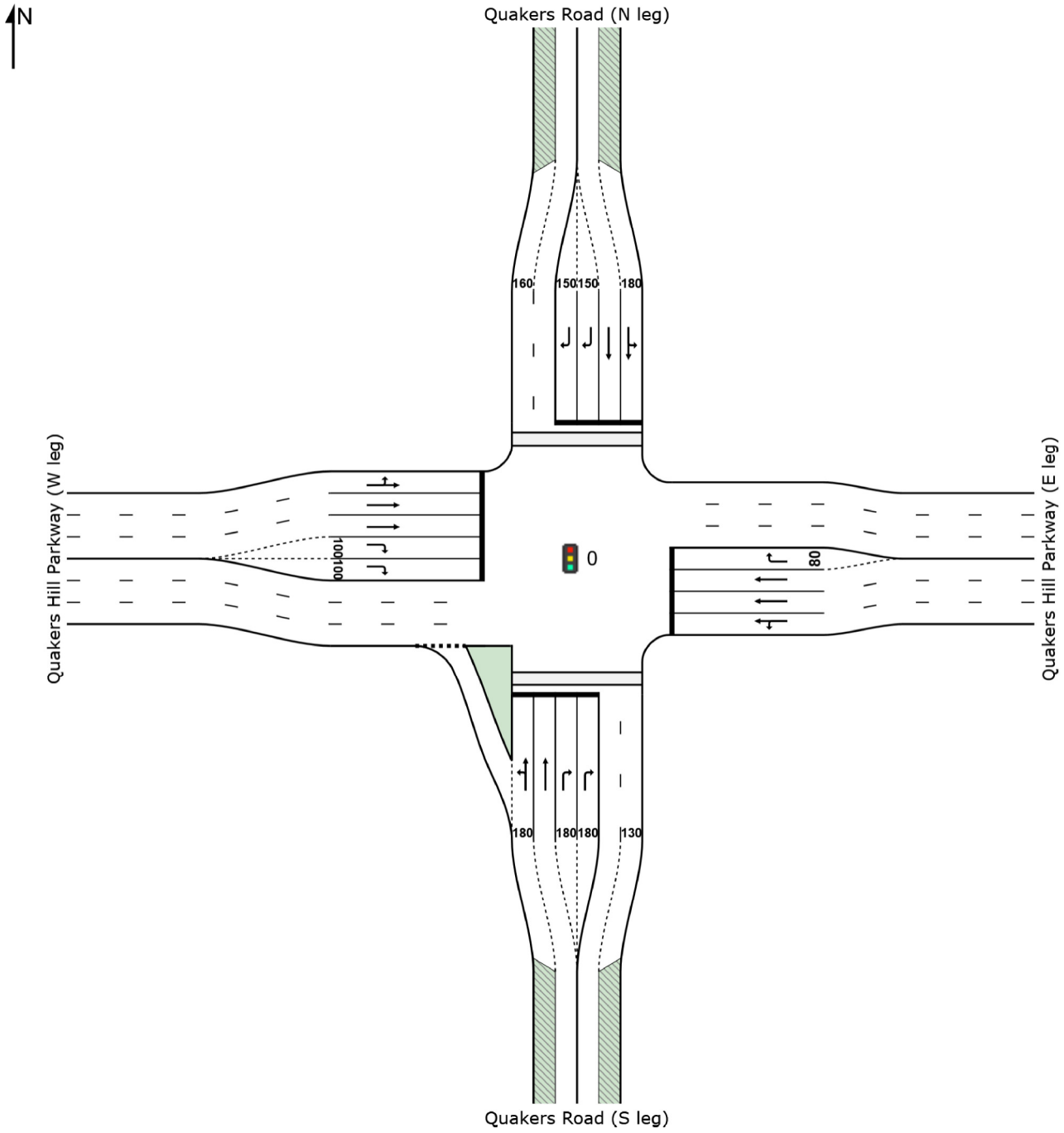
Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
P2	East Full Crossing	53	16.2	LOS B	0.1	0.1	0.73	0.73
P3	North Full Crossing	53	24.4	LOS C	0.1	0.1	0.90	0.90
All Pedestrians		158	21.6	LOS C			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

SITE LAYOUT

Site: 0 [2036 AM Peak]

Quakers Hill Parkway - Quakers Road
2036 AM Peak - with bridge
Signals - Fixed Time Isolated



MOVEMENT SUMMARY

Site: 0 [2036 AM Peak]

Quakers Hill Parkway - Quakers Road
2036 AM Peak - with bridge
Signals - Fixed Time Isolated Cycle Time = 150 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quakers Road (S leg)											
1	L2	289	2.0	0.762	50.3	LOS D	17.8	127.1	1.00	0.96	32.9
2	T1	100	2.5	0.809	73.7	LOS F	17.8	127.1	1.00	0.90	27.1
3	R2	185	2.0	0.842	90.3	LOS F	7.4	52.8	1.00	0.92	24.1
Approach		574	2.1	0.842	67.2	LOS E	17.8	127.1	1.00	0.94	28.5
East: Quakers Hill Parkway (E leg)											
4	L2	643	2.0	0.940	60.0	LOS E	75.5	537.6	1.00	1.01	30.2
5	T1	2072	2.0	0.940	56.4	LOS D	75.5	537.6	1.00	1.04	31.1
6	R2	21	0.7	0.114	72.7	LOS F	1.4	10.0	0.94	0.71	27.3
Approach		2736	2.0	0.940	57.4	LOS E	75.5	537.6	1.00	1.03	30.9
North: Quakers Road (N leg)											
7	L2	83	0.7	0.636	65.9	LOS E	15.3	108.8	0.98	0.82	29.4
8	T1	425	2.5	0.818	66.0	LOS E	21.1	151.0	0.99	0.89	28.8
9	R2	663	1.7	0.935	91.7	LOS F	28.8	204.7	1.00	1.01	23.9
Approach		1171	1.9	0.935	80.5	LOS F	28.8	204.7	1.00	0.96	25.9
West: Quakers Hill Parkway (W leg)											
10	L2	183	1.9	0.372	28.1	LOS B	15.3	108.8	0.64	0.67	41.5
11	T1	892	2.0	0.372	23.9	LOS B	15.8	112.2	0.65	0.60	42.9
12	R2	282	2.0	0.883	84.7	LOS F	13.1	93.5	1.00	0.90	25.1
Approach		1357	2.0	0.883	37.1	LOS C	15.8	112.2	0.72	0.67	37.2
All Vehicles		5838	2.0	0.940	58.3	LOS E	75.5	537.6	0.93	0.92	30.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	27.7	LOS C	0.1	0.1	0.61	0.61
P3	North Full Crossing	50	27.7	LOS C	0.1	0.1	0.61	0.61
All Pedestrians		100	27.7	LOS C			0.61	0.61

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 0 [2036 PM Peak]

Quakers Hill Parkway - Quakers Road
2036 PM Peak - with bridge
Signals - Fixed Time Isolated Cycle Time = 130 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quakers Road (S leg)											
1	L2	227	2.0	0.806	56.5	LOS D	19.6	139.7	1.00	1.01	31.6
2	T1	432	2.3	0.855	59.7	LOS E	20.6	147.2	1.00	0.99	30.2
3	R2	702	2.0	0.923	78.9	LOS F	26.4	188.2	1.00	1.01	26.0
Approach		1361	2.1	0.923	69.0	LOS E	26.4	188.2	1.00	1.00	28.1
East: Quakers Hill Parkway (E leg)											
4	L2	122	2.0	0.558	42.4	LOS C	18.7	132.9	0.87	0.78	36.1
5	T1	971	2.0	0.558	37.4	LOS C	18.7	133.2	0.87	0.76	37.1
6	R2	76	0.4	0.889	84.7	LOS F	5.5	38.8	1.00	0.95	25.1
Approach		1169	1.9	0.889	41.0	LOS C	18.7	133.2	0.88	0.78	35.9
North: Quakers Road (N leg)											
7	L2	32	0.2	0.641	73.3	LOS F	5.1	36.3	1.00	0.80	27.7
8	T1	131	2.1	0.823	71.8	LOS F	5.9	42.4	1.00	0.86	27.6
9	R2	218	1.1	0.769	74.9	LOS F	7.4	52.0	1.00	0.88	26.9
Approach		381	1.4	0.823	73.7	LOS F	7.4	52.0	1.00	0.87	27.2
West: Quakers Hill Parkway (W leg)											
10	L2	642	1.6	0.922	49.8	LOS D	64.0	454.8	0.99	1.00	33.0
11	T1	1994	2.0	0.922	46.3	LOS D	64.0	454.8	0.97	1.01	34.0
12	R2	369	2.0	0.536	54.0	LOS D	12.0	85.4	0.93	0.81	31.7
Approach		3005	1.9	0.922	48.0	LOS D	64.0	454.8	0.97	0.98	33.5
All Vehicles		5916	1.9	0.923	53.1	LOS D	64.0	454.8	0.96	0.94	32.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	24.7	LOS C	0.1	0.1	0.62	0.62
P3	North Full Crossing	50	40.1	LOS E	0.1	0.1	0.79	0.79
All Pedestrians		100	32.4	LOS D			0.70	0.70

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 0 [2036 Weekend Peak]

Quakers Hill Parkway - Quakers Road
2036 PM Peak - with bridge
Signals - Fixed Time Isolated Cycle Time = 100 seconds (Practical Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Quakers Road (S leg)											
1	L2	209	2.2	0.769	41.7	LOS C	12.9	92.0	0.99	0.97	36.1
2	T1	368	2.7	0.816	45.3	LOS D	13.0	93.4	1.00	0.96	34.2
3	R2	646	2.2	0.883	59.1	LOS E	18.1	129.1	1.00	0.99	30.3
Approach		1223	2.3	0.883	52.0	LOS D	18.1	129.1	1.00	0.98	32.3
East: Quakers Hill Parkway (E leg)											
4	L2	106	2.3	0.530	35.7	LOS C	12.8	91.6	0.87	0.77	38.7
5	T1	844	2.3	0.530	30.6	LOS C	12.8	91.6	0.88	0.76	39.8
6	R2	50	0.6	0.451	58.2	LOS E	2.5	17.9	1.00	0.74	30.6
Approach		1001	2.2	0.530	32.6	LOS C	12.8	91.6	0.88	0.76	39.1
North: Quakers Road (N leg)											
7	L2	48	0.1	0.634	57.2	LOS E	4.8	34.0	1.00	0.81	31.3
8	T1	141	1.9	0.815	55.5	LOS D	5.1	36.4	1.00	0.87	31.3
9	R2	282	0.9	0.764	57.9	LOS E	7.3	51.8	1.00	0.89	30.7
Approach		471	1.1	0.815	57.1	LOS E	7.3	51.8	1.00	0.88	30.9
West: Quakers Hill Parkway (W leg)											
10	L2	482	2.1	0.883	41.1	LOS C	40.4	288.0	0.98	0.98	36.0
11	T1	1735	2.3	0.883	37.1	LOS C	40.4	288.0	0.97	1.00	37.2
12	R2	321	2.3	0.530	45.3	LOS D	8.3	59.2	0.94	0.80	34.2
Approach		2538	2.3	0.883	38.9	LOS C	40.4	288.0	0.97	0.97	36.5
All Vehicles		5233	2.2	0.883	42.4	LOS C	40.4	288.0	0.96	0.92	35.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	26.0	LOS C	0.1	0.1	0.72	0.72
P3	North Full Crossing	50	36.2	LOS D	0.1	0.1	0.85	0.85
All Pedestrians		100	31.1	LOS D			0.79	0.79

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

APPENDIX 2 – CRAIG & RHODES CONCEPT DESIGN FOR MEDIAN BREAK

A1

NETBALL COURTS
(FUTURE)

SPORTS FIELD CARPARK
(FUTURE)

SPORTS FIELD CARPARK
(FUTURE)

SPORTS FIELD CARPARK
(FUTURE)

SPORTS FIELD
ENTRY DRIVEWAY.

50.0m STORAGE LENGTH

31.5m TAPER

AERODROME DRIVE (MC00)

3.5
7.0
4.0
7.0
3.5
1.0
3.0
4.0

CHANNEL 1
COMPENSATORY CUT

PLAN
1:200

1:200 @ A1

FOR INFORMATION ONLY

REV	DATE	AMENDMENT DESCRIPTION
A	21.08.18	ISSUED FOR INFORMATION

DIAL 1100 BEFORE YOU DIG

DHA Defence Housing Australia

Project:
SCHOFIELDS AERODROME DEVELOPMENT
WATER CYCLE MANAGEMENT REPORT

Principal: DEFENCE HOUSING AUSTRALIA

Scale	Date	Council Ref.
1:200	07.08.2018	
	Datum AHD	L.G.A. BLACKTOWN CITY COUNCIL

Calc's	Drawn.	Proj.Man.	Client Ref:
S.W.	J.H.	F.C.	

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Drawing Title
SPORTS FIELD
MEDIAN INTERSECTION
CONCEPT LAYOUT

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0196	A

C:\1784\C_21784\C_DWG\SHEETS\1784C-SK-0196.DWG - LAYOUT1 - PLOT DATE/TIME: 23/08/2018 12:33:39 PM

APPENDIX 3 – RESERVE 980 CONCEPTS

LEGEND

- Subject Site
- Creek
- Local Neighbourhood Centre
- School
- Riparian Corridor
- Environmental Living
- General Residential
- Medium Density
- Traffic Signal

Basin
Overflow Car Park (200)
Supermarket
Schofields Local Centre
Park
Park
Hall
Proposed Primary School
Tennis Courts
Amenities Building
Playing Field
Car Park (1040)
Playground
Netball Courts (40)
Playing Field
Basin
Drainage Channel 1

PLAYING FIELD MASTER PLAN - OPTION 1
SCHOFIELDS

NORTH

10 0 20 40 60 80 100 metres

Ref: DHASC-B-004C	Date: 17/08/2018	Revision: C	Scale: 1:1,000@A1

Note: All areas and dimensions subject to detailed survey

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PLAYING FIELD MASTER PLAN - OPTION 2

SCHOFIELDS

NORTH

10 0 20 40 60 80 100 metres

Ref: DHASC-B-004D	Date: 17/08/2018	Revision: C	Scale: 1:1,000@A1

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Local Centre
1.042ha

OS1
4900m²

20.20m

111.94m

5625.64m²

Potential
Primary School
2.0357ha

107.18m

80.20m

190.58m

APPENDIX 4 – OVERFLOW PARKING LOCATION

A1

N

VERON ROAD \ AERODROME DRIVE

BURDEKIN ROAD (FUTURE)

CHANNEL 3

RESIDUE LOT 4

2400 (RESIDUE LOT)

OVERFLOW CARPARK
LOCATION.
AREA = 5470m²

EUROPEAN HERITAGE
PYE FARM SALVAGE
AREA

EUROPEAN HERITAGE
WILLMINGTON ROAD
SALVAGE AREA

ISSUED FOR INFORMATION

REV	DATE	AMENDMENT DESCRIPTION
A	03.07.18	ISSUED FOR INFORMATION

DIAL 1100 BEFORE YOU DIG

DHA Defence Housing Australia

Project: SCHOFIELDS AERODROME DEVELOPMENT

Principal: DEFENCING HOUSING AUSTRALIA

Scale 1:1000	Date 18.06.18	Council Ref.	
	Datum AHD	L.G.A. BLACKTOWN CITY COUNCIL	
Calc's S.W.	Drawn. S.W.	Proj.Man. F.C.	Client Ref.

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Drawing Title: OVERFLOW CARPARK LAYOUT

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0185	A

DATE PRINTED: 30/07/2018 10:32:14 AM

APPENDIX 5 – PROPOSED ILP

LEGEND

DHA Landholding

	Area
Open Space	2.14ha
Playing Field	12.55ha
Local Community Centre	1.04ha
School	2.00ha
Drainage / Basin	32.46ha
Footpath	0.04ha
Road Reserve (Collector/ Local)	21.52ha
Road Reserve (Burdekin Rd)	2.30ha
Road Reserve (Mustang Dr)	2.92ha
Riparian	17.65ha
E4	3.67ha
GR General Residential	31.75ha
SL Small Lot General Residential	5.57ha
TOTAL	**135.61ha**

E4

Riparian

Drainage Channel 3
1.36ha

Basin 5
4.26ha

Local Centre
1.04ha

OS1
0.49ha

Potential
Primary School
2.00ha

Riparian

Drainage Land
15.53ha

Playing Field
12.54ha

Drainage
Channel 2
0.31ha

OS2
0.3ha

OS3
1.05ha

Drainage
Channel
2
1.61ha

Basin 6
1.79ha

Basin 6A
0.64ha

Drainage Channel 1
6.96ha

OS4
0.3ha

Footpath
0.05ha

Cell Structure Plan - Proposed ILP

SCHOFIELDS

NORTH

40 0 80 160 240 320 400 metres

Ref: DHASC-2-007-4	**Date:** 02/08/2018	**Revision:** K	**Scale:** 1:4,000@A1

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APPENDIX 6 – EXISTING ILP NET DEVELOPABLE AREA

LEGEND

DHA Land Holding

	Area	Dwelling Yield
Net Development Area (15 dwellings/ ha)	36.56ha	549
Net Development Area (30 dwellings/ ha)	10.21ha	306
Total Net Development Area	**46.77ha**	**855**

Drainage
Neighbourhood Centre
School
Playing Fields
Basin / Drainage
Open Space
Drainage
Open Space
Drainage
Open Space
Open Space
Drainage
Open Space

Open Space Needs Analysis - NDA Plan - Existing ILP

SCHOFIELDS

NORTH

Ref: DHASC-5-011-2	Date: 15/11/2017	Revision: C	Scale: NTS

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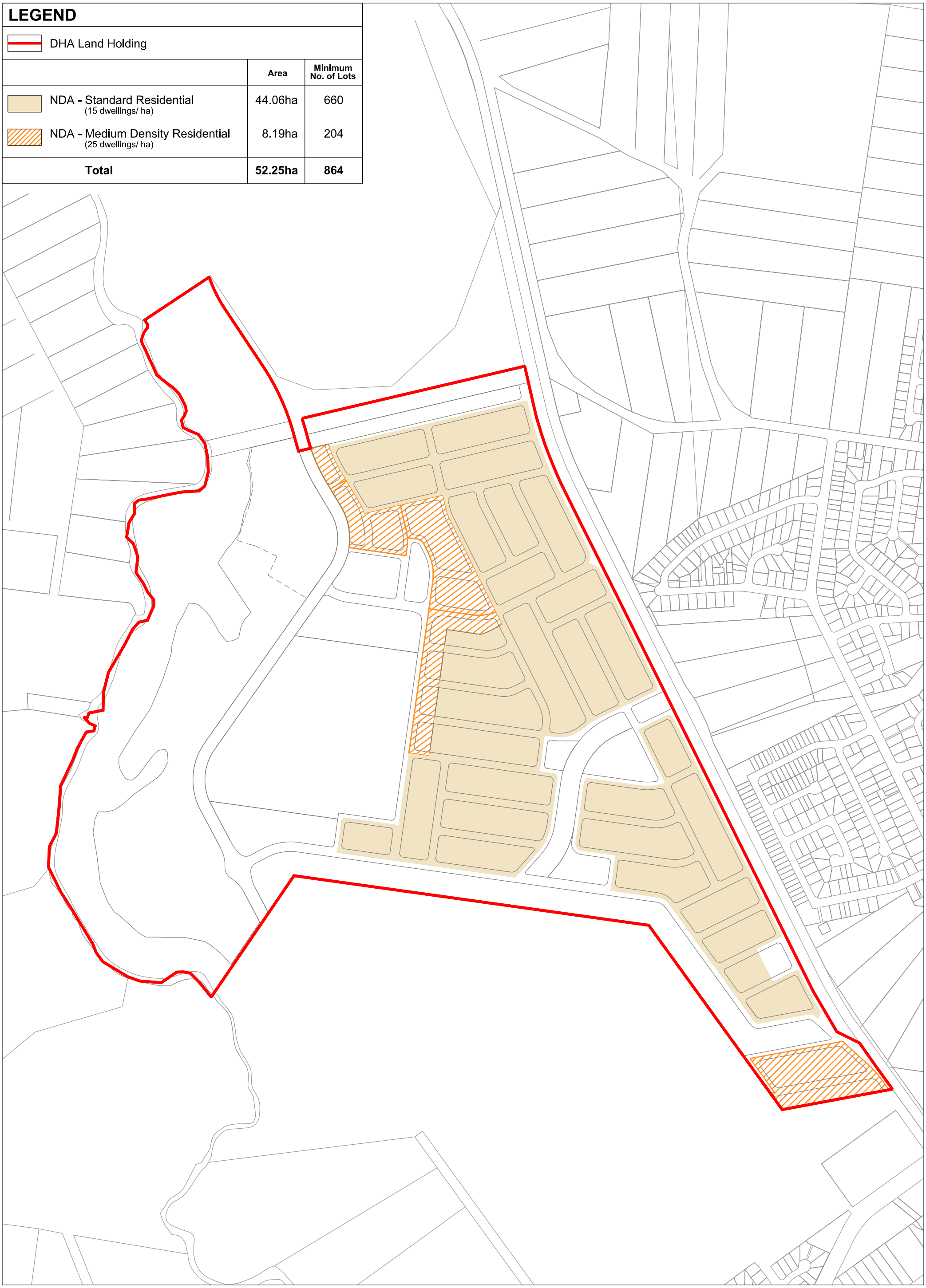
APPEDNIX 7 – PROPOSED ILP NET DEVELOPABLE AREA

LEGEND

DHA Land Holding

	Area	Minimum No. of Lots
NDA - Standard Residential (15 dwellings/ ha)	44.06ha	660
NDA - Medium Density Residential (25 dwellings/ ha)	8.19ha	204
Total	**52.25ha**	**864**



Open Space Needs Analysis - NDA Plan - Proposed ILP

SCHOFIELDS

NORTH

Ref: DHASC-5-010-1	Date: 20/08/2018	Revision: A	Scale: NTS

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APPENDIX 8 – BURDEKIN ROAD CONCEPT

DHA Landholding Boundary

Proposed Burdekin Road

36m

Blacktown

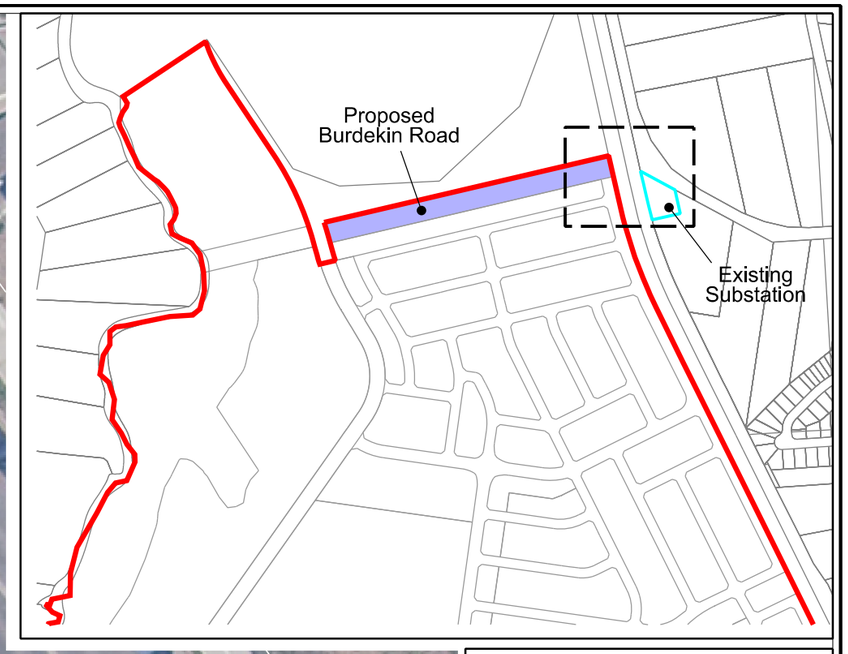
Richmond

Railway

1.7m

Railway Terrace

Existing Substation



LEGEND

- DHA Landholding
- Existing Substation
- Proposed Burdekin Road

Burdekin Road

SCHOFIELDS

NORTH

2 0 4 8 12 16 20 metres

Ref: DHASC-1-041-1	Date: 17/08/2018	Revision: A	Scale: 1:200@A1

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APPENDIX 9 – CRAIG & RHODES FLOODING AND STORMWATER LETTER

CRAIG&RHODES
TAKE THE LEAD

21 August 2018
Our Reference: 1784-PP-WCMR-B

Water Cycle Management Report

Schofields Aerodrome Development

Revision B

For Defence Housing Australia

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Document Control

Revision	Details	Issue Date	Author	Reviewed
A	Issue for Review	09.08.2017	A.B.	M.V.
B	Amended as per Council Comments	21.08.2018	A.B.	M.V.

1 Executive Summary

1.1 Project Objective

Craig and Rhodes have been engaged by Defence Housing Australia to prepare a Water Cycle Management Report to support the proposed development/rezoning/masterplan at Schofields Aerodrome Development (the site). This strategy has been prepared to conform with statutory requirements and industry best practice for stormwater management.

The proposed development is located in the Schofields Precinct, and it is noted that the Water Cycle Management Strategy Incorporating Water Sensitive Urban Design Techniques report prepared by J. Wyndham Prince (JWP) (2012) has proposed a water cycle strategy for the entire Schofields precinct including the site.

The overall water cycle management objectives for the site were identified as follows:

Environmental – Provision of appropriately designed, functional water quality facilities, salinity management, retention of existing trees, habitat revegetation and ecosystem enhancement; limitation of downstream discharge peaks and velocities; soft bioengineering treatments to reflect natural stream functions; ecologically sustainable; adopt principles of total catchment management and water sensitive urban design; conform with statutory water quality requirements; maintenance of environmental flows and inundation patterns in creeks and wetlands.

Urban Amenity – Provision of a water cycle management strategy that identifies and controls limits of flood affectation; provision of aesthetic design forms that enhance urban amenity and address proposed adjacent land uses (residential, recreational and transport); views into and out of drainage corridors (security, public safety, amenity); water quality (visual amenity and public health).

Engineering Considerations – Effective management and control of peak discharges, discharge velocities, and flood levels above pre-development and ecologically sustainable levels; industry best practice technical analysis of catchment hydrology and system hydraulic performance, soft sustainable bioengineering treatments, delineation of flood extents and identification of flood risk and appropriate public safety measures to deal with the identified risks (flood evacuation)

Economics – Provision of a cost effective, functional trunk drainage system that optimises performance, keeps maintenance costs and requirements to an acceptable level, keeps land take to a minimum, provides maximum value for expenditure of public monies, and focuses on ecological sustainability.

The above objectives are in line with the objectives for the Schofields Precinct Water Cycle Management Strategy prepared by J. Wyndham Prince for the Department of Planning and Infrastructure.

1.2 Statutory Requirements

The recommendations contained in the following guidelines have been considered as part of the master planning process for the Schofields Aerodrome and immediately adjacent areas:

- Growth Centres Development Code (2006)
- Blacktown City Council Growth Centre Precincts Development Control Plan (2016)
- Blacktown City Council Engineering Guide for Development (2005)
- Blacktown City Council Development Control Plan (2015) – Part J Water Sensitive Urban Design and Integrated Water Cycle Management
- Department of Environment, Climate Change and Water Technical Guidelines
- Australian Rainfall and Runoff (1987)
- Australian Rainfall and Runoff (2016)

1.3 Methodology

The main tasks involved in preparing this strategy included:

- Review of the JWP report and statutory requirements to identify water quality and water quantity objectives and targets that have been proposed for the site.
- Water quality analysis for the proposed development to determine post development pollutant loads and evaluate the performance of proposed water quality treatment techniques.
- Identify a suitable treatment train to address water quality and water quantity objectives for the proposed development.

1.4 Current Water Cycle Strategy

The strategies proposed under the original Water Cycle Management Strategy for the Schofields Precinct prepared by J. Wyndham Prince (2012) considered a range of techniques and options for the region including:

Water Quantity: Regional and Local detention basins and below ground storage tanks (public & private).

Water Quality: A range of on-lot, street level and subdivision scale treatment measures not limited to vegetated swales, sand filters, bio-retention systems, wetlands and rainwater tanks.

Each technique was evaluated and compared with consideration based on Environmental, Social, Economic, Maintenance and Engineering criteria. A number of techniques were identified as unsuitable or inefficient when compared with alternate techniques.

The most suitable combination of options as proposed by JWP includes:

Water Quality A treatment train consisting of:

On-Lot Treatment:

- appropriate waterwise landscaping practices with consideration of soil characteristics;
- Implementation of water efficient fittings and appliances in dwellings;
- Minimisation of impervious areas;
- BASIX compliant water tanks;

- An appropriate level of on-lot treatment measure within landuses other than low density residential;

Street Level Treatment:

- Proprietary Gross Pollutant Traps;

Subdivision Level Treatment:

- Large scale bio-retention basins in public reserves;

Water Quantity

- Combination of both off-line and on-line detention storage basins for larger flows (2 and 100 year ARI) located adjacent to and within riparian corridors;
- Limiting the post-development stream forming flow duration so that it is no more than 3.5 - 5 times that of the pre-development stream forming flow duration;
- Stormwater harvesting for reuse on sports fields, parks and other public reserve areas where possible.

1.5 Proposed Water Cycle Strategy

The proposed development for the Schofields Aerodrome incorporates a number of features from the original Water Cycle Management Strategy prepared by J. Wyndham Prince for the Schofields Precinct.

The major changes to the original Water Cycle Management Strategy include:

- Amended regional (end of line) detention basins
- A range of subdivision scale treatments including bio-retention systems within the regional detention basins;
- On-lot stormwater treatment for Medium and High Density residential developments, educational developments, and neighbourhood and local centres.

The proposed layout indicating the locations for water quality and water quantity treatments for the Schofields Aerodrome is included in Reference DHASC-B-006-1 from Design & Planning in Appendix B of this report. Alternate WSUD elements within the streetscape (roadside swales and on-lot bio-retention systems) are not proposed for the development within the Schofields Aerodrome.

1.6 Conclusion

The water cycle management strategy for the Schofields Aerodrome development provides the basis for the detailed design and development of the site to ensure that the following objectives for stormwater management are achieved:

Environmental:

Existing vegetation within the trunk drainage corridor is retained where possible; existing water bodies with ecological value are retained; downstream and in-channel frequent discharge peaks and velocities are limited to lessen scouring, erosion, siltation and flora and fauna

impacts; water quality elements proposed to remove gross pollutants and nutrients from the urban catchments; lessens the impact of ecological health and biodiversity within the riparian corridors.

Urban Amenity:

Limits of flooding 1% AEP affectation have been defined and future development can conform with requirements for freeboard and public safety; quality passive recreational amenity can be provided for the incoming community.

Engineering Considerations:

Peak discharges for frequently occurring storms, peak velocity and flood levels controlled to conform with Council's technical requirements; water quality elements provided to conform with performance and maintenance requirements.

Economics:

The water cycle management strategy is functional; delivers the required technical performance, lessens environment degradation and pressure on downstream ecosystems and infrastructure and provides for a 'soft' sustainable solution for stormwater management within the Schofields Aerodrome release area.

The water cycle management concept is shown in Figure 4.

2 Introduction

The Schofields Aerodrome is located in the suburb of Schofields within the Blacktown LGA and part of the Schofield Precinct in the North West Growth Centre. The site consists of approximately 102 hectares.

This report details the procedures, resources used, and the results of studies undertaken by Craig and Rhodes in developing a Water Cycle Management Strategy that incorporates the principles of Water Sensitive Urban Design (WSUD) to support the rezoning process for the proposed development.

The objective of this report is to review and identify appropriate options for the control of the quantity and quality of stormwater leaving the site, and to identify some details of the proposed structures. The proposed options will generally be in accordance with the recommendations set out in the JWP report.

The report addresses engineering considerations whilst placing a strong focus on conserving and enhancing the bio-diversity, ecological health and positive water quality benefits within the existing riparian corridors to provide an integrated natural resource for the incoming residents.

The study involved the following tasks:

- Review relevant statutory guidelines.
- Review JWP report.
- Undertake a water quality analysis and determine minimum treatment device areas required to achieve Blacktown City Council and Department of Environment and Climate Change water quality targets.
- Undertake a stream erosion index assessment to ensure the post development stream forming flow is no greater than 3.5 - 5 times the pre-development flow.
- Prepare preliminary engineering concept designs for measures required to achieve the water quantity and quality objectives.

3 The Existing Environment

3.1 The Site

The Schofields Aerodrome is located immediately west of the Blacktown-Richmond railway to the north of the Nirimba Education Precinct. Eastern Creek forms the western boundary of the site.

The majority of the development extents has been cleared of structures and consists primarily of grasslands. A small amount of bushland remains within the Eastern Creek riparian corridor.

The location of the Schofields Aerodrome site is indicated on Figure 1.

3.2 Existing Drainage Configuration

The entire site drains directly to Eastern Creek or towards it via overland flow paths.

There are a number of significant catchments located upstream of the development site along the southern and eastern boundaries. The upstream catchments are shown in Figure 2.

A number of drainage channels have been created on the Aerodrome land to divert old creek lines away from the runways. A number of culverts link the drainage channels under the runways. A drainage channel has also been constructed adjacent to the northern extents of the Nirimba Education Precinct to the south of the development site.

The existing drainage configuration and flow directions within the Schofields Aerodrome site have been shown as part of a Strahler Stream Index diagram in Appendix C.

3.3 The Proposed Development

As part of the Precinct Planning process, and Indicative Layout Plan (ILP) was prepared and identified the various land uses proposed for the site.

The land use for the Aerodrome site included low and medium density residential, educational centres, parks and sporting fields with associated drainage and infrastructure land. The current approved ILP is included in Appendix A.

It is proposed to modify the approved ILP within and immediately adjacent to the Schofields Aerodrome development site.

The proposed ILP covers approximately 86 hectares. This ILP will involve the creation of over 1000 residential allotments, construction of 3 detention basins, water quality bio-retention systems, turf lined swales and channels, and the construction and dedication of new roads. The water quantity and water quality management elements for the proposed works will be constructed adjacent to the Eastern Creek riparian corridor or the proposed drainage reserves within the Schofields Aerodrome site.

The proposed ILP is included in Appendix B.

4 Development Guidelines, Opportunities and Constraints

The following guidelines were considered in developing the Water Cycle Management and Water Sensitive Urban Design (WSUD) strategy for the proposed development of the Schofields Aerodrome.

4.1 Growth Centres Development Code

The Growth Centres Development Code (Ref. 1) identifies the following matters for consideration with regard to Water Sensitive Urban Design and stormwater management:

- Stormwater management strategies should be based on the objectives and principles of Water Sensitive Urban Design. They should promote water reuse and maximise potable water conservation;
- Existing waterways and riparian zones should be conserved and enhanced where possible;
- Stormwater management strategies should be developed and implemented in a manner which considers and addresses potential salinity hazards;
- Stormwater management strategies should be adopted by the ILP to maximise efficient use of land and facilitate adequate allocation of land for stormwater management purposes;
- The ILP should be planned, designed and undertaken in a manner which allows for appropriate control of erosion and sediment pollution;
- A treatment train approach should be used, incorporating structural stormwater treatment measures at the primary, secondary and tertiary levels as necessary to comply with the stormwater management targets;
- The design of stormwater management systems should be integrated with the planning of road layout and design, given the potential benefits of incorporating suitable WSUD elements into road corridors;
- Stormwater reuse, retention and detention strategies should be used to minimise changes to the hydrological (or flow) regime of receiving waterways;
- Urban stormwater should not be discharged to areas of native bushland unless such discharge cannot be avoided. High levels of stormwater treatment and flow retention or detention should be implemented where such a discharge occurs to limit soil erosion and weed growth within areas of native vegetation;
- Management of stormwater should be considered on a subcatchment basis to employ source control techniques in preference to highly centralised ‘end-of-pipe’ treatment measures wherever practicable;
- Trunk drainage routes and dual carriageways should be aligned where possible, to allow use of centre medians for WSUD drainage systems;
- WSUD drainage systems may be incorporated into other roads and streets, where practicable and compatible with other design issues, including safety requirements of the relevant Road Authority;

- Any development within the 1:100 ARI flood level and the PMF should be designed to provide for emergency access;
- Critical infrastructure, such as major roads and rail, are to be located above the 1:100 flood level wherever possible;
- Evacuation routes that continually rise from residential properties to higher land should be provided.

4.2 *Blacktown City Council Growth Centre Precincts Development Control Plan*

The Blacktown City Council Growth Centre Precincts DCP identifies the following objectives with regard to flowing and water cycle management:

- To manage the flow of stormwater from urban parts of the Precinct to replicate, as closely as possible, pre-development flows
- To define the flood constraints and standards applicable to urban development in the Precinct
- To minimise the potential of flooding impacts on development

4.3 *Office of Environment and Heritage*

The Office of Environment and Heritage (OEH) (formerly the Department of Environment, Climate Change and Water) has set guidelines for stormwater quality from urban developments in their Interim Recommended Parameters for Stormwater Modelling – North-West and South-West Growth Centres (Ref. 3). This document nominates quantitative post construction phase stormwater management objectives for the reduction of various pollutants for a range of new developments. The retention criteria for the site are nominated as follows:

Pollutant	Pollutant Removal Target
Total Suspended Solids	85% of average annual load for particles 0.5mm or less
Total Phosphorus	65% retention of average annual load
Total Nitrogen	45% retention of average annual load
Gross Pollutants	90% retention of material greater than 5mm

Table 1 - WSUD Retention Criteria

The OEH guidelines also nominate a 'stream erosion index' target of 3.0 – 5.0, where the stream erosion index is defined as the post-development duration of flows greater than the 'stream-forming flow' divided by natural duration of flows greater than the 'stream-forming flow'. For the purposes of these objectives, the 'stream forming flow' is defined as 25% of the 2-year flow rate estimated for the catchment under pre-development conditions.

4.4 Blacktown City Council DCP 2015 Part J

Although the Water Sensitive Urban Design and Integrated Water Cycle Management DCP is not the governing document for the Growth Centres Precinct, which the Aerodrome land falls under, it has been considered during the preparation of this Water Cycle Management Strategy.

Blacktown City Council's Water Sensitive Urban Design and Integrated Water Cycle Management DCP aims to:

- Protect and enhance natural watercourses and their associated ecosystems and ecological processes
- Minimise potable water demand and wastewater generation
- Minimise stream erosion by matching the post-development runoff regime to the pre-development or natural water runoff regime
- Mitigate the impacts of development on groundwater, particularly in saline groundwater environments
- Ensure any changes to the existing groundwater regime do not adversely impact upon any other properties and the environment
- Integrate water cycle management measures into the landscape and urban design to maximise amenity
- Minimise the potential impacts of development and other associated activities on the aesthetic, recreational and ecological values of receiving waters
- Minimise soil erosion and sedimentation resulting from site disturbing activities
- Ensure the principles of ecologically sustainable development are applied in consideration of economic, social and environmental values in water cycle management

4.4.1 Water Conservation

- New residential dwellings are to demonstrate compliance with State Environmental Planning Policy – Building Sustainability Index (BASIX)
- In non-residential developments, dual reticulation for non-potable uses such as toilet flushing, laundry and irrigation must be installed
- For an water use within the public open space, an alternate water source must be identified to meet at least 80% of all demand.

4.4.2 Stormwater (Water Quality and Waterway Stability)

- Reduction of post-development average annual load of gross pollutants (>5mm) by 90%
- Reduction of post-development average annual load of Total Suspended Solids (TSS) by 85%
- Reduction of post-development average annual load of Total Phosphorus (TP) by 65%

- Reduction of post-development average annual load of Total Nitrogen (TN) by 45%
- Reduction of post-development average annual load of Total Hydrocarbons by 90%
- The post-development duration of stream forming flows shall be no greater than 3.5 times the pre-development duration of stream forming flows with a stretch target of 1
- Minimisation of impervious areas that are directly connected to the stormwater drainage system

4.5 New South Wales Office of Water Requirements

A Riparian and Aquatic Assessment was prepared as part of the overall Schofield Precinct Water Cycle Management Report prepared by J. Wyndham Prince.

It stated that Eastern Creek is a Category 1 stream, and the un-named tributaries within the Precinct are classified as Category 2 and 3 watercourses.

The current methodology for categorising watercourses is the Strahler Stream Order Index. The existing water course Stream Orders have been determined to be 1 and 2 for the existing flow paths. Eastern Creek has been given an order of 4 as part of this assessment. Appendix C has been prepared showing the Strahler Stream Order index values for each of the existing flow paths through the development site.

It is proposed to align the watercourses through the Schofields Aerodrome development area to reflect what is thought to be the original watercourse alignments before development of the Schofields Aerodrome.

4.6 Salinity

Salinity is the accumulation of mineral salts in the soil, groundwater and surface waters. Dry land salinity results when these soluble salts are transported to the surface by rising water table. Groundwater can also transport these soluble salts and emerge as saline seepage in low lying areas.

Salinity can lead to degraded vegetation, weed invasion, a decline in soil structure and in some cases, structural damage to buildings.

4.6.1 Salinity and Groundwater Control Measures

A Land Capability, Salinity and Contamination Assessment has not been undertaken as part of this proposal, however the report and recommendations from the original WSP Environmental and Energy report have been adopted and summarised below.

Additional development specific geotechnical studies should be undertaken, particularly where filling of the floodplain is proposed

Surface soils at the channels were typically non-saline, while subsoils were typically non-saline to moderately saline

Surface soils located away from the channels were typically non-saline to a depth of 0.5 metres. Deeper soils were slightly saline to moderately saline.

The moderate to high salinity concentrations in groundwater indicate that there is potential for increase in salinity impacts on the upper soil profile should changes to the hydrological cycle result in an increase of the water table.

Surface soils are general non-sodic to sodic and sub-surface soils are classified as highly sodic.

Salinity management measure should be implemented for the Schofields Aerodrome re-development in accordance with the recommendations outlined in the WSP Environmental and Energy Report and the WSROC Western Sydney Salinity Code of Practice.

4.7 Water Sensitive Urban Design (WSUD)

Water Sensitive Urban Design (WSUD) aims to minimise the impacts of urban development and maximise the multiple use benefits of a stormwater system.

Australian Runoff Quality (ARQ) identifies the objectives of WSUD to include:

- Reducing potable water demand through water efficient appliances, rainwater and greywater reuse.
- Minimising wastewater generation and the treatment of wastewater to a standard suitable for effluent reuse opportunities and/or release to receiving waters.
- Treating urban stormwater to meet water quality objectives for reuse and/or discharge to surface waters.
- Preserving the natural hydrological regime of catchments.

ARQ also identifies WSUD as the adoption of the following planning and design approaches that integrate the following opportunities into the built form of cities and towns:

- Detention, rather than rapid conveyance of stormwater.
- Capture and use of stormwater as an alternative source of water to conserve potable water.
- The use of vegetation of filtering purposes.
- Protection of water-related environmental, recreational and cultural values.
- Localised water harvesting for various uses.

4.8 Stormwater Management Objectives

4.8.1 Overall Objectives

JW Prince (JWP) outlined the following as objectives for the site stormwater management. These objectives will be applied to the proposed residential subdivision for the land within the extent shown on the proposed rezoning extents.

Environmental

- The provision of appropriately designed and functional water quality treatment systems and facilities;
- the limitation of discharge peaks and velocities into downstream waterways;
- maintenance of environmental flows to downstream ecosystems.

Urban Amenity

- The provision of a water cycle management system that identifies and controls the limits of flood affectation and provision of aesthetic designs that enhance amenity of the area.

Engineering Considerations

- The effective management and control of peak discharges and velocities utilising detention.
- Managing water quality with best practice methodologies and system design.

Economics

- The provision of a cost effective and functional site drainage system that optimises the performance;
- provides maximum value for expenditure; and
- keeps on-going maintenance requirements to a minimum.

4.8.2 Specific Development Objectives

JWP has recognised the following objectives that are in line with Ecologically Sustainable Development (ESD). These objectives will be considered with the current proposal.

- Preserve the ecological integrity of the identified riparian zones.
- Restrict development to be above the 1% AEP flood level.
- Incorporate water sensitive urban design principles within the development.
- Ensure that post-development water quality complied with Council's and the Office of Environment and Heritage's requirements.
- Provision of a sustainable aquatic environment that preserves the potential for creating habitat for locally indigenous flora & fauna.

- Minimise Council's maintenance requirements for open space, litter control structures, and nutrient and sediment removal devices.
- Enhance the biodiversity, ecological heath and positive water quality benefits within the Eastern Creek corridor to provide an integrated natural resource for the incoming residents.

4.9 Opportunities

With the design of an urban drainage scheme, it is desirable to utilise the naturally occurring physical and environmental assets of the site where possible to maximise the quality of the ultimate living environment. It particular water should be recognised as an important resource that enhances an area that is accessible to the whole community.

For the land adjacent to the Schofields Aerodrome precinct there are opportunities to:

- Maintain, rehabilitate and enhance the Eastern Creek riparian corridor;
- Maximise habitat retention along the riparian corridor;
- Integrate open space areas and riparian corridors; and
- Incorporate water reuse schemes to irrigate the proposed public reserves and playing fields wherever possible.

4.10 Constraints

There are constraints that have been identified for the development. These constraints include:

- Relatively flat topography which requires filling to raise developable area above the 1% AEP flood levels;
- Flows from large upstream catchments to the east and south of the site are to be conveyed through the site;
- Water quality and quantity objectives will require allocation of land for stormwater control structures;
- Existing soil and groundwater salinity constraints;
- Water use activities that can cause unnatural charging of groundwater and create rising water tables (e.g. over-irrigation of public areas and sporting fields); and
- Areas of the site that are below the regional and local PMF Flood levels. Evacuation and flood safety will be considered

5 Water Cycle Management Strategy Concept

The Water Cycle Management Strategy for the redevelopment of the Schofields Aerodrome precinct has been prepared with consideration of the requirements and guidelines listed in Section 4 of this report.

The proposed strategy is generally in accordance with the current approval for the area with minor amendments to facilitate that proposed layout for the redevelopment. The current strategy was focused on mitigating the impacts of the development on the total water cycle and maximising the environmental, social and economic benefits by utilising responsible and sustainable stormwater management practices.

5.1 Water Quality Management Options

There is a range of stormwater management techniques and options that were considered by JWP for the management of nutrients and suspended solids discharging from the site.

Detailed explanations for each of the options can be found in Section 6 of the *Water Cycle Management Strategy incorporating Water Sensitive Urban Design Techniques* (JWP 2012).

We have provided a brief explanation of each of those used within the proposed redevelopment extents.

5.1.1 Vegetated Swales and Buffers

Swales are generally vegetated depressions that are used for the conveyance of stormwater runoff from impervious areas. They can assist with:

- Removing sediments by filtration through vegetated surfaces;
- Reducing runoff volumes (by promoting infiltration to the sub soils);
- Delaying runoff peaks by reducing flow velocities.
- Vegetated swales are typically linear and shallow and used as an alternative to kerb and gutter along roadways. Vegetated swales are not suited to residential development lands due to the large number of driveway culvert crossings, safety concerns, and significant maintenance requirements.
- Vegetated swales may be considered for use within median islands of collector roads where driveway crossings are not as prevalent.
- Vegetated swales may also be used to convey stormwater flows within recreational areas and precincts as well as carparking for these areas.

5.1.2 Bio-retention Systems

Bio-retention systems consist of a filtration media bed with either a gravel or sandy loam media with an extended detention zone typically from 100-300mm deep. A bio-retention system is designed to detain and treat the first flush flow from the upstream catchments.

Regional bio-retention systems are proposed within each of the regional detention basins to treat the first flush flows and remove nutrients from stormwater runoff prior to discharging into downstream waters.

Bio-retention systems are effective in treating pollutants from urban development's when used in conjunction with other water quality improvement devices within an overall treatment train.

5.1.3 Rainwater Tanks

Rainwater tanks are sealed tanks designed to contain rainwater collected from the roofs of dwelling and park buildings. The water collected in these rainwater tanks provides the following functions:

Use of water as a substitute for mains water supply for toilet flushing, laundry and irrigation;

Provide some detention storage when additional storage above the overflow is provided, therefore reducing peak flows and reducing downstream velocities.

Rainwater tanks are effective in removing suspended solids and a small amount of nutrient pollutants. They are also effective in reducing the overall runoff volume, particularly when plumbed for internal use.

5.2 Proposed Stormwater Control Strategy

The stormwater management strategy proposed for the site focuses on minimising the impacts of the development on the water cycle while maximising the economic, social and environmental benefits. These benefits will be achieved through responsible and sustainable management practices of stormwater.

It is critical to consider the ecological sustainability of the Eastern Creek Riparian corridor located adjacent to the site. To meet the stormwater quality targets for Eastern Creek, a "treatment train" approach has been considered where the various pollutant types are removed from the water column by a number of stormwater quality improvement devices (SQIDs) acting in series.

5.2.1 Water Efficiency

On Lot Treatment

- The implementation of water efficient fittings and appliances in all proposed dwellings (dual flush toilets, AAA rated shower heads and water efficient taps and plumbing);
- Minimisation of impervious areas through the acceptable development controls;
- The provision of rainwater tanks on each allotment, along with the implementation of water efficient devices to satisfy the requirements of BASIX

5.2.2 Water Quality

On Lot Treatment for Medium / High Density Residential (and Commercial)

The previous Water Cycle Management Strategy by J Wyndham Prince proposed that all development other than low density residential and public Council road, water quality treatment is to be provided for each site through a community title or similarly appropriate managed scheme. It is proposed to adopt this approach within the land that has been rezoned.

Street Level Treatments

Traditional stormwater drainage systems rely on gross pollutant trap (GPT) devices as a primary water quality treatment to remove litter, vegetative matter, free oils and grease and coarse sediment prior to discharge to downstream treatment devices (secondary and tertiary type). They can take the form of trash screens or litter control pits, pit basket inserts and wet sump gross pollutant traps.

J Wyndham Prince has discussed with Blacktown City Council the preferred primary water quality treatment systems to be used within the Schofields land development area. Council has a preference for end of line proprietary GPT's for the primary treatment of stormwater control over pit inlet filter baskets due to a greater maintenance burden that will be borne by Council with the pit inlet filter baskets over end of the line treatment devices.

Subdivision / Development Treatment

Regional "raingardens" systems are proposed within the development. Raingardens are large scale, non-linear bio-retention systems.

The raingardens / bio-retention swales within the development have been appropriately sized to achieve the nutrient reduction targets as proposed within Blacktown City Council Water Sensitive Urban Design (WSUD) and Integrated Water Cycle Management DCP for the development site.

The raingardens and bio-retention swales will also provide attenuation of the first flush flows to reduce the risk of stream erosion with the Eastern Creek Riparian corridor. The location of the raingardens and bio-retention swales for the development are shown in Figure 4.

J Wyndham Prince suggests that alternate forms of WSUD elements within the streetscape may be used, however it is not proposed to utilise alternate WSUD elements from those previously mentioned.

5.2.3 Water Quantity

Subdivision / Development Treatment

Detention Basins

Peak storm flow attenuation up to and including the 100-year ARI event will be addressed through the provision of regional online and offline detention storages located within the development precinct extents.

Stream Erosion Index

Limiting the post-development stream forming flow duration so that it is no more than 3.5 - 5 times that of the pre-development stream forming flow duration.

5.2.4 Overall Strategy

J Wyndham Prince has identified the key features for the proposed strategy for the Schofields Precinct. These features will be incorporated in the revised rezoning for the Schofields Aerodrome land.

Social:

- Integration of Bio-retention raingarden systems with the overall landscape strategy for the development to create an integrated-natural resource for the incoming and wider community
- Enhanced visual amenity (views out of and through the riparian corridor)
- Flood affectation and public safety issues identified and controlled
- Provision of aesthetic soft design forms that enhance urban and environmental amenity

Environmental:

- Limited downstream and in-channel discharge peaks and velocity to avoid scouring, siltation and flora and fauna impacts
- Enhanced ecological health and biodiversity within the riparian corridors
- Provision of gross pollutant traps and bio-retention systems to achieve water quality capable of sustaining Eastern Creek aquatic ecosystems
- Limitation of frequent wetting flows and peak velocities to avoid creek bed/bank erosion and sedimentation. Peak storm flow attenuation is addressed through the provision of regional and local detention basins within the Schofields Aerodrome land
- A holistic and interdisciplinary approach to the management of urban salinity, using and approach to construction, stormwater management, building and landscaping practices, consistent with the WSROC Western Sydney Salinity Code of Practice and in accordance with the recommendation by WSP Environment and Energy.
- Provision of extensive deep-rooted vegetation in strategic areas to intercept ground water glows and generate natural groundwater discharge processes (evapotranspiration)
- Extensive revegetation of allotments, streetscapes, and bio-retention systems to manage urban salinity and provide habitat
- Provision of reticulated recycled water or rainwater tanks within the development to reduce reliance on potable water supplies by using recycled water as a resource

Economic:

- Minimisation of land take consistent with the achievement of environmental and social objectives
- Proposed water quality improvement measure that keep recurrent maintenance tasks and costs to a minimum

The proposed water cycle management strategy for the Schofield Aerodrome redevelopment is functional, delivers the required technical performance, reduces environmental degradation and pressure on downstream ecosystems and infrastructure and provides for a 'soft' sustainable solution for stormwater management consistent with the provisions for the entire Schofields land release area. The water cycle management concept is illustrated in Figure 4.

5.3 Litter and Sediment Control

Local drainage through the Schofields Aerodrome re-development should be filtered to remove litter and coarse sediment from the water column prior to discharging to the downstream drainage systems, raingardens and riparian corridors. Devices include inlet pit filter baskets, cast in situ and precast gross pollutant traps as well as wet sump and self-cleansing units.

It is our understanding from the J Wyndham Prince report that Blacktown City Council has a preference to not adopt pit filter inserts on a large scale within the development precinct. It is proposed to provide proprietary gross pollutant trap structures to capture litter, vegetative matter and coarse sediment prior to discharge to the downstream treatment devices.

It is expected that all inlets to the proposed raingardens and detention basins shall have gross pollutant traps installed.

5.4 Raingarden/Bio-retention Systems

There are three raingardens that are proposed within the development site of the Schofields Aerodrome.

The raingardens consist of an organic sandy loam bed (0.5m) which will be densely vegetated with native sedges and/or grasses contained within Council's approved plants list. These raingardens would be designed to receive, convey and treat flows up to approximately the six (6) month ARI flow from the upstream catchments.

Treatment of stormwater by the raingardens is attained by the temporary detention of the flows, direct filtration and nutrient stripping by bio-films which establish on the surface of the media bed. The organic sandy loam bed and plant system minimises evapo-transpiration losses and the raingardens will be design to prevent seepage loses and to avoid groundwater salinity impacts.

The proposed raingardens which service the proposed development will have an extended detention zone of 300mm which will service the first flush and base flows from the urban development. The filter areas of the raingardens vary depending on the extent of on-lot treatment within the upstream sub-catchment. As there are a number of areas that are to be zoned for commercial and medium density residential, these areas will provide on-lot treatment of stormwater to Blacktown City Council requirements in accordance with the Growth Centres Development Control Plan.

The raingardens have been sized using MUSIC modelling of the catchment. Additional performance of the stormwater quality treatment proposed for the development is presented in Section 7 of this report and indicative concept layouts have been provided in the appendices.

It is recommended that the raingardens should be utilised as sedimentation control ponds prior to the completion of the construction and housing phases of the development site draining to the basins. Once sediment loads have reduced from construction levels, these raingardens should be commissioned to provide water quality improvement as designed.

Maintenance for the raingarden would typically involve the replacement of plants, weed control within the basin filter media, repair of erosion of filter media, and the removal of localised sediment build up, particularly around basin inlets.

5.5 Water Quantity Management

Blacktown Council has advised that GHD is preparing a catchment study for the precinct to assess the requirements of the detention basins. Initial reports have indicated that the basins within the Schofields Aerodrome precinct are not required for stormwater quantity. However Council has indicated that until this document has been approved by Council, the proposed basins within the catchment shall be designed as per the adopted Schofields Precinct approach.

It is proposed to design these basins as the area is developed and constructed as required to maintain Council's existing stormwater detention requirements until the GHD report has been approved for the area.

Stormwater quantity management for the Schofields Aerodrome precinct is achieved through the provision of three (3) detention basins. One of the proposed basins (Basin 5) is online with the remaining two (2) detaining flows from the Schofields Aerodrome precinct.

The performance of these basins is described in Section 8.

5.6 Construction Stage

Erosion and sediment control measures should be implemented during the construction phases of the Schofields Aerodrome precinct in accordance with the requirements of Blacktown City Council and the guidelines set out by Landcom (the Blue Book).

As raingardens are sensitive to the impact of sedimentation, these sediment control measures should be maintained until the majority of site building works are complete.

5.7 Long Term Management

Regular maintenance of the raingardens and gross pollutant traps is required to control weeds, remove rubbish and to monitor plant establishment and health within the raingardens. Any sediment build up on the surface of the filter media will need to be removed to maintain the design standard of stormwater treatment.

Proper management and maintenance of the water quality control systems shall ensure the long term functional treatment of the stormwater generated by the catchment. A general Operation and Maintenance Manual for the stormwater treatment systems has been included with this report, however site-specific manuals shall be prepared as each stage of the Schofields Aerodrome precinct is developed and basins are constructed.

6 Water Quality Analysis

The water quality analysis for the Schofield Aerodrome precinct rezoning was undertaken using the software MUSIC (Modelling for Urban Stormwater Improvement Conceptualisation) Version 6. This modelling software was developed by the Cooperative Research Centre (CRC) for Catchment Hydrology which is based at the Monash University and first released in 2002. Version 6.2 was released in May 2016.

The model allows for a number of features relevant to the development to be assessed:

- Model the potential nutrient reduction benefits of gross pollutant traps, raingardens (bio-retention systems), infiltration systems, and it incorporates mechanisms to model stormwater reuse as a treatment technique.
- Provides mechanisms to evaluate the removal of key nutrients to attain the desired water quality objectives.
- Allows for a Stream Erosion Index assessment.

The MUSIC modelling was undertaken to ensure that the proposed water quality treatment system for the Schofields Aerodrome precinct will result in the reduction of pollutant loads being discharged from the proposed development to meet the designated Council and Best Practice water quality targets.

6.1 Catchments

Due to the size of the catchment draining to the regional raingardens, the site was broken down into a number of smaller sub-catchments and a MUSIC model was prepared to represent the proposed stormwater treatment system for each of the sub-catchments. The breakdown of the catchments is summarised in the following table and a screenshot of the MUSIC model showing the arrangements of the proposed stormwater treatment system is shown in Figure 5.

Catchment Type	Imperviousness	Contributing Area	Area
Stockland Development Site (Adjoining to the North of future Burdekin Road)			
Roof (to RWT)	100%	27.5%	2.625
Roof	100%	27.5%	2.625
Driveway	100%	10.0%	0.955
Other Impervious	100%	20.0%	1.909
Pervious	0%	15.0%	1.432
Roads	95%		3.743

Catchment Type	Imperviousness	Contributing Area	Area
Basin 5 – Low Density			
Roof (to RWT)	100%	27.5%	4.889
Roof	100%	27.5%	4.889
Driveway	100%	10.0%	1.778
Other Impervious	100%	20.0%	3.555
Pervious	0%	15.0%	2.666
Basin 5 – Medium Density			
Roof (to RWT)	100%	30.0%	1.220
Roof	100%	30.0%	1.220
Driveway	100%	7.5%	0.305
Other Impervious	100%	17.5%	0.712
Pervious	0%	15.0%	0.610
Basin 5 – Commercial & School			
School	70%	66.0%	2.010
Commercial	95%	40.0%	1.031
Basin 5 – Open Space			
Pervious	10%		8.744
Basin 5 – Roads			
Roads (for all zones)	95%		13.921

Catchment Type	Imperviousness	Contributing Area	Area
Basin 6 – Low Density			
Roof (to RWT)	100%	27.5%	1.586
Roof	100%	27.5%	1.586
Driveway	100%	10.0%	0.577
Other Impervious	100%	20.0%	1.154
Pervious	0%	15.0%	0.865
Roads	95%		4.644
Basin 6 – Open Space			
Pervious	10%		8.233
Basin 6A – Low Density			
Roof (to RWT)	100%	27.5%	2.687
Roof	100%	27.5%	2.687
Driveway	100%	10.0%	0.977
Other Impervious	100%	20.0%	1.954
Pervious	0%	15.0%	1.466
Roads	95%		5.457
Bypass – Medium Density			
Roof (to RWT)	100%	30.0%	0.509
Roof	100%	30.0%	0.509
Driveway	100%	7.5%	0.127
Other Impervious	100%	17.5%	0.297
Pervious	0%	15.0%	0.254
Roads	95%		0.500

Table 2 - WSUD Catchment

In accordance with Blacktown City Council's Water Sensitive Urban Design and Integrated Water Cycle Management Development Control Plan (2015), and Council's MUSIC modelling

guidelines, the post-development conditions were modelled with a mixture of roof, roads, other impervious and pervious areas with appropriate fraction imperviousness.

The majority of the urbanised areas within the catchment will discharge to Eastern Creek after treatment within the regional raingardens. The smaller areas bypassing the raingardens will be compensated for by oversizing the gardens in the areas that are able to be treated by the raingardens. All stormwater runoff will be treated with a gross pollutant trap as a minimum prior to discharge to Eastern Creek.

6.2 Rainfall Data

MUSIC can utilise rainfall data based on the following timesteps:

- 6 minutes;
- 12 minutes;
- 30 minutes;
- Hourly;
- 3 hourly;
- 6 hourly;
- 12 hourly; and
- Daily

MUSIC recommends that the timestep be chosen based on the time of concentration for the smallest sub catchment within the model, or estimating the shortest expected duration of detention time within the proposed treatment measures. We have adopted a 6-minute timestep for the catchment.

Blacktown City Council has provided a 10 year period of rainfall to be used within the MUSIC model. The representative period and station is as follows:

Station No.	Location	Years of Record	Type of Date
67033	Liverpool	1967 - 1976	6 minutes

Table 3 - Adopted Rainfall Data

6.3 Pollutant Loading Rates

The Blacktown City Council Draft MUSIC Modelling Guidelines outlines the parameters that have been derived for use within the Blacktown LGA. These numbers have been derived for the Western Sydney region from model calibration studies.

The following parameters have been adopted within the MUSIC model prepared as part of this Water Cycle Management Report.

Parameter	Adopted Value
Rainfall Threshold (mm/day)	1.40
Soil Storage Capacity (mm)	170
Initial Storage (% of Capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient – a	210.0
Infiltration Capacity Exponent – b	4.70
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	4
Daily Deep Seepage Rate (%)	0.0

Table 4 - MUSIC Rainfall-Runoff Parameters

Land Use		Total Suspended Solids (Log_{10} mg/L)		Total Phosphorus (Log_{10} mg/L)		Total Nitrogen (Log_{10} mg/L)	
		Storm Flow	Base Flow*	Storm Flow	Base Flow*	Storm Flow	Base Flow*
Roof	Mean	1.30	1.20	-0.89	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Road (incl. Driveway)	Mean	2.43	1.20	-0.30	-0.85	0.34	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Other Impervious	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12
Pervious	Mean	2.15	1.20	-0.60	-0.85	0.30	0.11
	Std Dev	0.32	0.17	0.25	0.19	0.19	0.12

Table 5 - MUSIC Source Node Parameters

The above values are consistent with those nominated in Blacktown City Council's WSUD Developer Handbook and Part J of the Development Control Plan.

6.4 Treatment Device Performance

A number of difference devices are proposed for treating stormwater runoff generated by the proposed development.

6.4.1 Rainwater Tanks

As the vast majority of the development site is low density residential, which are likely to require rainwater tanks under BASIX requirements, Blacktown City Council's Draft Music Modelling Manual requests that a rainwater tank of volume 2.5kL be supplied per dwelling but modelled as a 2.0kL tank per dwelling.

A maximum of 50% of any roof area within the catchment is assumed to drain to the rainwater tank.

The adopted reuse within the rainwater low density residential areas has been modelled as per the Blacktown City Council Draft MUSIC Modelling Manual. As the final lot sizing will be governed by the SEPP and the Development Control Plan, it is assumed that all lots will be less than 320m^2 as a conservative estimate. This gives the smallest level of reuse within the proposed development.

The adopted reuse rates are as follows:

	Demand per Dwelling
Daily Demand (kL/day)	0.08
Annual Demand (kL/year)	25

Table 6 - Non-potable Demand

The rainwater tanks for the medium density and commercial areas have been excluded from the current modelling prepared as part of this report, but reuse targets would be expected as per BASIX for the medium density residential and the Council requirements for the commercial.

6.4.2 Gross Pollutant Traps

It is proposed to provide gross pollutant traps sized for the relevant catchments prior to discharging into the raingardens and drainage reserves.

Blacktown City Council approved nodes have been adopted for the MUSIC model. It is proposed to provide continuous-deflection systems (CDS) for the inlets to the raingardens. These devices will be sized for the appropriate treatment requirements and flow rates for the upstream catchment draining to the device.

6.4.3 Bio-retention Basins

The proposed bio-retention systems (raingardens) are shown on Appendix F. The design input assumptions that have been adopted for the raingardens are presented in Table 7. These values have been adopted in accordance with Blacktown City Council's Draft MUSIC Modelling Guidelines.

Parameter	k (m/yr)	C* (mg/L)
Total Suspended Solids	8000	20.000
Total Phosphorus	6000	0.130
Total Nitrogen	500	1.400
Filter Media Soil Type	Loamy Sand	

Table 7 - Raingarden Parameters

The proposed bio-retention basin filtration media area for Basin's 5, 5A, 6 and 6A are summarised in the following table. In addition to the size proposed under this water cycle management strategy report, there is a comparison with the original J. Wyndham Prince design values.

C&R Basin Number	C&R Proposed Bio-retention Area (m^2)		JWP WCMR Basin Number	JWP Proposed Bio-retention Area (m^2)	
5	2865	3856	RG5A	2150	4100
5A	991		RG5B	1950	
6	3000	4800	RG6A	260	5460
			RG6B	1250	
6A	1800		RG6C	1550	
			RG6D	2400	

Table 8 - Bio-retention Filter Areas

While the proposed areas under this report are less than the values proposed under the J. Wyndham Prince report, this is likely due to the on-lot treatment for the medium density residential, commercial and the school precincts. J. Wyndham Prince has not made an allowance for on-lot treatment for these zones as per Blacktown Council's Development Control Plan Part J.

Treatment of these zones prior to discharge to the stormwater network reduces the pollutant load on the regional bio-retention basins and reduces the filtration media area required to meet Council's Water Sensitive Urban Design pollutant reduction targets.

6.5 Pollutant Load Estimates

Total annual pollutant load estimates and overall reduction results from the MUSIC model for the proposed development, incorporating the proposed treatment devices in Section 6.4, are outlined in Table 9.

Pollutant	Post-Development without Treatment (kg/yr)	Post-Development with Treatment (kg/yr)	Overall Reduction (%)
Total Suspended Solids	103,000	14,100	86.3
Total Phosphorus	196	60	69.3
Total Nitrogen	1,270	5.67	55.5
Gross Pollutants	14,200	4.35	99.9

Table 9 - MUSIC Summary Table

6.6 Discussion of Modelling

Modelling results demonstrating the performance of the proposed water quality management strategy for the proposed development, as summarised in Table 9, indicates that this proposed strategy will meet the water quality requirements specified within the Growth Centre Development Code, OEH's water quality objectives and Blacktown City Council's development guidelines.

The revised MUSIC modelling shows that the required bio-retention basin filtration media areas are reduced from the original J. Wyndham Prince design, however there are development areas within the precinct that will require on-lot treatment (medium density residential, commercial, and education) that was not proposed as part of the original Water Cycle Management Strategy by J. Wyndham Prince.

7 Water Quantity Analysis

The water quantity analysis for the Schofield Aerodrome precinct rezoning was undertaken using the RAFTS Methodology built into the premium version of DRAINS. This modelling software was developed utilising the Laurenson Method and is undergoing on-going development.

The model allows for stormwater runoff volumes and flow rates for the upstream catchments draining through and generated from the development site to be assessed.

The DRAINS/RAFTS modelling was undertaken to ensure that the peak discharges from the proposed development of the Schofields Aerodrome precinct will not have a negative impact by increasing flow discharge rates downstream of the development and exacerbating flood impacts within Eastern Creek.

7.1 Methodology

A DRAINS/RAFTS model was prepared to assist with the sizing of the stormwater detention basins proposed as part of the development of the Schofields Aerodrome precinct.

The following table is a summary of the inputs used within the model:

Parameter	Value
Impervious Area Initial Loss (mm)	1.5
Impervious Area Continuing Loss (mm/hr)	0
Pervious Area Initial Loss (mm)	15
Pervious Area Continuing Loss (mm/hr)	2.5
B_x	1

Table 10 - RAFTS Input Parameters

The DRAINS/RAFTS model was used to size the basins to accommodate the extent of the development that will drain to the basins. Small areas of the catchment bypass these detention basins, and the proposed basins will allow for these areas to bypass without increasing the overall discharge from the development.

Rainfall intensities for the model were adopted from Blacktown Council's Engineering Guide for Development.

7.2 Catchments

Due to the size of the overall catchment, as well as the number of detention basins proposed, the site was broken down into a number of smaller sub-catchments and the DRAINS/RAFTS model prepared to represent the sub-catchments as shown in Figure 3. The breakdown of the sub-catchments utilised in the DRAINS/RAFTS model is summarised in the following table. The table summarises both pre- and post-development conditions.

Catchment	Area (ha)	Impervious Pre-Dev (%)	Impervious Post-Dev (%)	Critical Storm Duration	Time to Peak for Critical	Notes
Stockland	13.36	5	85	15 min	10 min	
Burdekin	50.49	5	5	360 min	150 min	Detention Basins (E1.2 & E1.5) are proposed for this catchment under S94 CP20 - Riverstone & Alex Avenue Precincts
Stg 1-3	44.5	17	85	30 min	15 min	
Stg 4-6	18.65	17	85	15 min	10 min	
Stg 7	15.91	17	85	15 min	10 min	
Stg 8	2.19	17	85	15 min	10 min	

Table 11 - Stormwater Catchments Summary

As noted in the table above, the catchment entering the drainage channel adjacent to the future Burdekin Road has already undergone stormwater quantity management to reduce the flows to predevelopment discharges as outlined in the Riverstone and Alex Avenue Water Cycle Management Plan (GHD, 2010) prepared as part of the precinct planning for this area upstream of the development site.

7.3 Basin Summary

To cater for the increased peak discharges as a result of increasing the imperviousness of the catchment, it is proposed to provide three (3) stormwater detention basins throughout the development.

The following tables summarise the performance of the detention basins for a range of ARI events up to and including the 100-year ARI event.

ARI	Pre-Development Discharge (m^3/s)	Post-Development Discharge (m^3/s)	Required Volume (m^3)
2	4.54	4.25	
5	6.70	4.52	
10	7.92	5.33	
20	9.98	7.02	
50	12.10	9.13	
100	14.00	10.90	20,100

Table 12 - Basin 5 Detention Basin Summary

ARI	Pre-Development Discharge (m^3/s)	Post-Development Discharge (m^3/s)	Required Volume (m^3/s)	
			Basin 6	Basin 6A
2	2.37	1.87		
5	3.67	2.08		
10	4.56	2.20		
20	5.86	2.36		
50	7.17	2.51		
100	8.39	2.68	12,000	5,600

Table 13 - Basin 6 & 6A Detention Basin Summary

The Water Cycle Management Plan prepared by J. Wyndham Prince proposed two (2) on-site detention basins within the Schofields area precinct, the proposal by DHA introduces three (3) basins for the different catchments as determined by the proposed land form and stormwater drainage channels through the development.

The following table is a comparison between the proposed regional detention basins under this proposal with the regional detention basins as proposed by J. Wyndham Prince under the original proposal and Council as part of works under Section 94 Contributions Plan No. 24 – Schofields Precinct.

C&R Basin Number	C&R Proposed Volume	JWP WCMR Basin Number	JWP Proposed Volume
5/5A	20,100	DB5	14,800
6	12,000	DB6	33,600
6A	5,600		
Total	**37,700**	**Total**	**48,400**

Table 14 – Detention Basin Comparison Summary

7.4 Discussion of Modelling

Modelling for the detention basins was carried out using the RAFTS (Runoff Analysis and Flow Training Simulation) model within the premium version of drains. This methodology utilises the non-linear runoff-routing model developed by Eric Laurenson.

The catchments within the immediate vicinity of the basins were shown to have relatively short critical storm durations which is expected given the proposed development and channelization of the flow generated by the catchment.

The catchment from the east that discharges into Channel 3, has a regional detention basin upstream of the catchment. While this catchment has been modelled as an existing undeveloped catchment, the RAFTS model indicates that the critical storm duration of the catchment is a six-hour storm with a time to peak of approximately 150min for the catchment.

With regards to the reduced detention volume as shown in Table 14 between the Craig & Rhodes proposal versus the J. Wyndham Price proposal is that Basin DB6 appears to be an online detention basin servicing the external flows upstream of the development site. The Craig & Rhodes proposal investigates the option more aligned with the Schofields Contributions Plan No. 24 which has Basin 6 as a basin offline from the Channel 1 and servicing the localised catchment within the DHA precinct.

7.5 Removal of Basin 6A

In the event that Basin 6A is to be removed from the overall drainage concept for the proposed precinct, there will be additional uncontrolled discharge entering the channel at the confluence of Channels 1 & 2. The RAFTS model indicates that the flows generated by the development downstream of the confluence of Channels 1 & 2 would increase from and additional 2.24m^3/s to 8.42m^3/s for the 1 in 100-year ARI event. An increase of approximately 6.2m^3/s.

The existing flow proposed within Channel 1 downstream of the confluence is approximately 83.4m^3/s. With the additional 6.2m^3/s for the 1 in 100-year ARI event, the increase in water flow depths within Channel 1 is limited to an average increase of less than 50mm, with a maximum flow depth increase 127mm immediately upstream of the culverts under Aerodrome Drive. This increase in flow depth is contained within Channel 1 and does not impact on the freeboard requirements for the residential dwellings within the vicinity of Channels 1 and 2.

8 Waterway Stability Management and Stream Erosion Index

8.1 Introduction

The former Department of Environment, Climate Change and Water (now the Office of Environment and Heritage (OEH)), Blacktown City Council and the Sydney Metropolitan Catchment Management Authority (SMCMA) have recently released draft guidelines outlining techniques to address the risk of stream erosion from the urbanisation of catchments.

Stream erosion is assessed using a measure of the increase in the relative frequency in flows from the site greater than the identified 'stream forming flow' resulting from urbanisation of the catchment. This measure is referred to as the Stream Erosion Index. The stream erosion index assessment is considered to be an appropriate means of assessing and addressing the impacts of urbanisation on the frequency of regular flows to the riparian corridor.

The stream erosion index is defined by the OEH as the post development duration of flows greater than the 'stream forming flow' divided by the natural duration of flows greater than the 'stream forming flow'. Blacktown City Council has adopted the 'stream forming flow' to be 25% of the 2 year ARI flow rate due to the dispersive nature of typical local clay soils, and is more conservative than the OEH approach.

The OEH guidelines recommend a stream erosion index of between 3.5-5, while Council's WSUD and Integrated Water Cycle Management DCP recommends an index of no greater than 3.5.

8.2 Modelling

The MUSIC model developed for the proposed development was utilised and modified to determine the stream erosion index at each discharge point from the site, based on the methods outlined in the SMCMA Draft NSW MUSIC Modelling Guidelines (2010) and Blacktown City Council's Developer Handbook for Water Sensitive Urban Design (2013).

Similarly, as for the water quality assessment, the subcatchments were split into nodes representing the roofs, roads, other impervious area and pervious areas, with appropriate fraction imperviousness values based on proposed land use categories, consistent with the water quality modelling described in Section 0. The nodes representing the various water quality elements were incorporated in the model, also consistent with the water quality modelling.

The pre-development scenario was added to obtain the pre-development flows. The subcatchment areas were defined based on the post-development catchment areas to allow for direct comparison of flows with the post-development model. All pre-development subcatchments were assigned a 0% fraction imperviousness value.

Generic nodes were added to the end of each pre- and post-development subcatchment treatment train to model the flow transfer and calculate the annual volume of flow above the critical flow for both cases.

8.3 Stream Forming Flow and Stream Erosion Index

The 2-year ARI flow for the development site was determined using the probabilistic Rational Method calculations. The 'stream forming flow' was determined adopting 25% of the 2 year ARI flow rate, and the Stream Erosion Index was calculated and outlined in the following table.

Parameter	**Site**
Catchment Area (ha)	94.57
Time of Concentration (min)	44.6
2 yr Intensity (mm/hr)	36.0
Critical Flow (m^3/s)	4.202
Q_{pre} (ML/y)	40.6
Q_{post} (ML/y)	87.2
Stream Erosion Index	2.14

Table 15 - Stream Erosion Index Calculation

8.4 Discussion of Modelling

Modelling results indicate that the Stream Erosion Index is approximately 1.7 for when adopting 25% of the 2 year ARI flow rate as the 'stream forming flow' for the catchment. This value is well within the targets outlined by the OEH and Blacktown City Council. The provision of the on-site detention basins within the proposed development will assist in minimising impact of urbanisation on downstream waterways.

9 Flooding

A detailed hydrological and hydraulic investigation of Eastern Creek and the major overland flow through the development site has been undertaken by BG&E in the preparation of the Flood Modelling for the catchment.

The initial flood impact assessment report prepared by BG&E (ref. S13026.01 dated 19/12/2016 Revision 2) was submitted as part of the Bulk Earthworks Development Application (DA-15-00999). This report was subsequently approved by Council.

BG&E has revised this flood impact assessment based on the rezoning application and has reported the following "Flood modelling results and particularly 100 year ARI flood difference mapping demonstrated that the updated design results in negligible difference compared to the bulk earth works design approved under the current DA".

Additional details regarding the hydrologic and hydraulic analyses can be found in their report (ref. S13026.01 dated 10 August, 2018) and included in Appendix C of this report.

9.1 Adjusted Channel Alignment

The alignment for Channels 1 & 3 are in accordance with the alignments as proposed under the currently approved Zoning Plans and the Indicative Layout Plan (ILP) for the precinct.

It is proposed to amend the alignment for Channel 2 due to an error within the ILP and culvert location under the Richmond Railway to the east of the site.

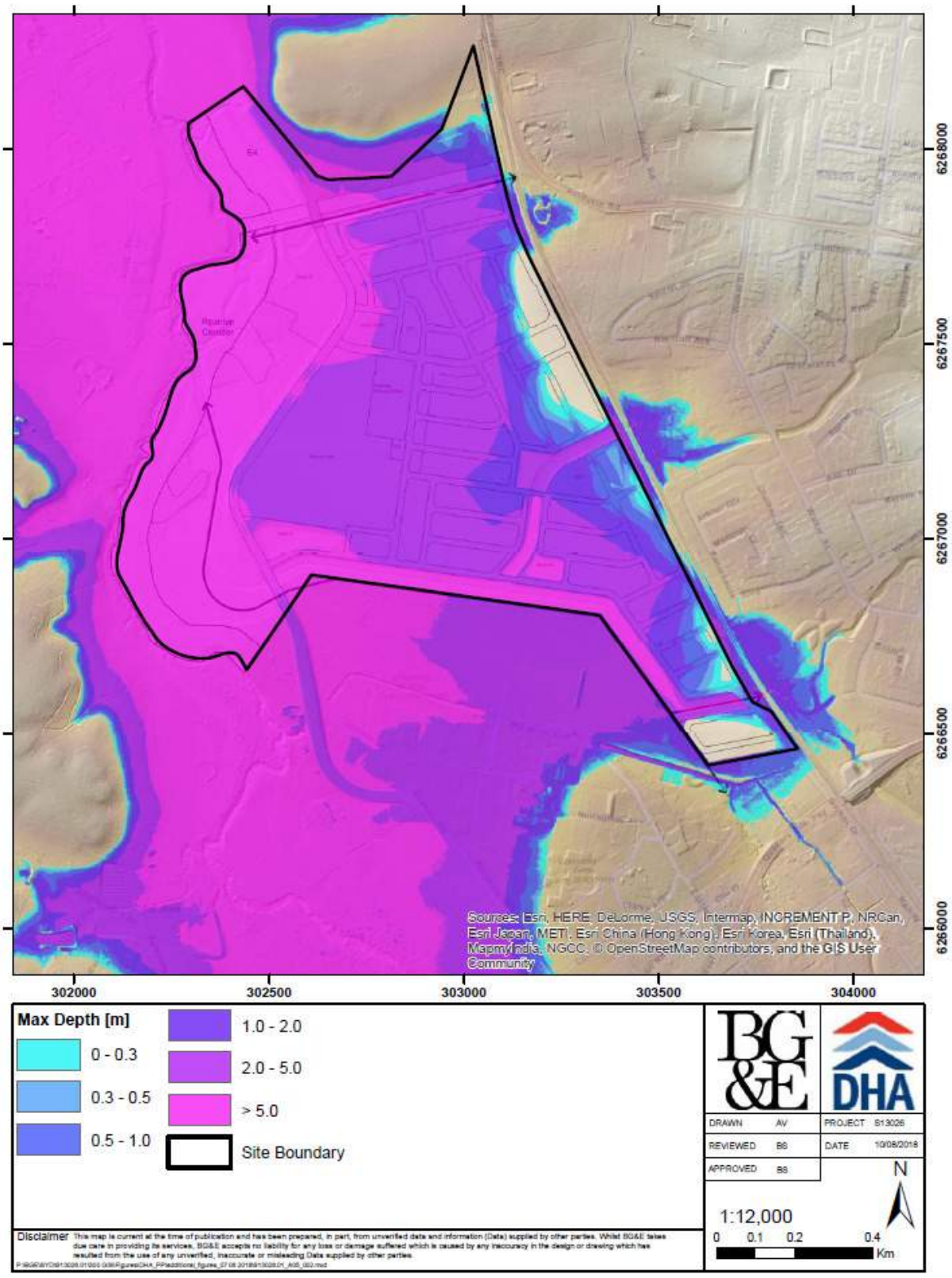
The alignment of Channel 2 as part of this precinct has been amended to the location as shown on the revised ILP in Appendix B of this report. The revised alignment for Channel 2 is based on a more appropriate alignment for the Channel with the culverts under the Richmond Railway.

9.2 Current Flood Evacuation Strategy

The safe evacuation of people from flood affected areas during a PMF event is a key consideration of the strategy. Flood evacuation needs to be identified to ensure a "continuous rising grade" can be maintained to a level above the PMF for all evacuees, with connections to the designated regional evacuation routes such as Richmond and Windsor Roads.

Portions of the development are below RL 26.4m AHD and are therefore affected by the regional Probable Maximum Flood (PMF) from the Hawkesbury Nepean River. Part of the site will also be affected by the local PMF. The Regional PMF extent for the proposed landform is shown in the following extract from the BG&E report.

Figure 17 - Regional PMF Extents and Depth (26.4mAHD)



Extract 1 - PMF Flood Extent

A precinct Flood Evacuation Strategy was prepared by Molino Stewart as part of the original Water Cycle Management Strategy. The findings and recommendations from this strategy have been incorporated in the Flood Evacuation Strategy for the DHA precinct.

The following recommendations from the Molino Stewart report were considered as part of the development:

- Ensure all new roads are above the 100-year ARI flood level and there is a rising pedestrian route (and preferably vehicular route) from every residential property to land above the regional PMF level;
- Require any development to have two storeys where there is a risk of people being overtaken by floodwaters when escaping local flooding. Require such buildings to be designed and constructed to remain structurally sound as a safe refuge in a local PMF.

9.3 Proposed Flood Evacuation Strategy

The flood evacuation strategy proposed as part of this Water Cycle Management Report incorporates flood evacuation routes being accessible up to the 500-year ARI event.

There are three key locations for evacuation within the development precinct where the evacuation routes cross major drainage channels within the precinct. Details regarding the key locations are outlined in the Revised Flood Impact Assessment prepared by BG&E (dated 10 August 2018). This is included in Appendix C.

A plan showing the proposed flood evacuation routes for the development precinct has been included in Appendix E of this report.

10 Sewer Servicing

The proposed layout for the precinct rezoning is to be serviced by a proposed sewer pumping station (SPS1202) adjacent to the proposed OSD/WSUD Basin 5 to the east of Aerodrome Drive.

The pumping station has an inlet invert of approximately RL 12.04mAHD. The location and details regarding the pumping station are shown in the concept Master Plan for the precinct in Appendix G of this report.

The proposed landform and stormwater drainage layout for the precinct has given consideration for the sewer servicing for the precinct. Concept sizing for the sewer is shown on the concept Master Plan in Appendix G.

11 Summary & Conclusion

This Water Cycle Management Report has been prepared for the Schofields Aerodrome Development to support the rezoning of the site. The strategy has been prepared to conform with relevant statutory requirements and industry best practice for stormwater management in the relevant catchments and generally in concurrence with the previous strategy outlined by JW Prince.

The water cycle management strategy consists of treatment trains utilising on-lot treatment, street level treatment and subdivision treatment measures. The individual elements proposed for the proposed development consists of:

1. GPT units
2. Bioretention & detention basins
3. Drainage channels

The provision of water quality treatment devices within the proposed development will ensure that post development stormwater discharge will meet the water quality requirements specified within the Growth Centre Development Code, OEH's water quality objectives and Blacktown City Council's development guidelines.

The provision of WSUD elements within the proposed development will assist in minimising impact of urbanisation on downstream waterways and comply with Stream Erosion Index targets required by the OEH and Blacktown City Council.

With regards to flooding, BG&E has demonstrated that the proposed rezoning has negligible impact from that which has been currently accepted by Council as part of the bulk earthworks development application (DA-15-00999).

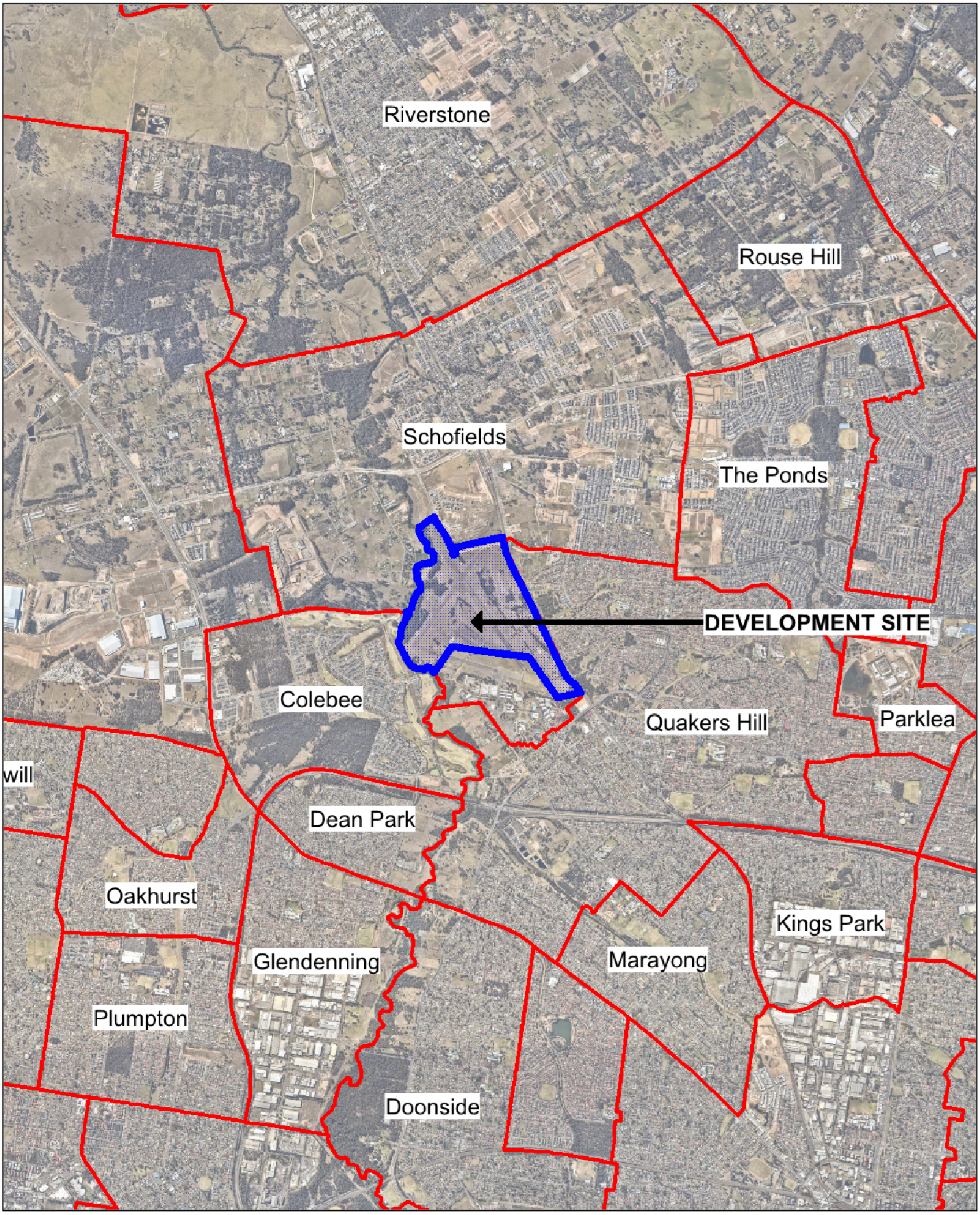
The proposed landform and stormwater layout has given due consideration to the servicing sewer servicing for the proposed development.

The proposed Water Cycle Management Strategy for the developed site provides a basis for the detailed design and development of the site to ensure that the environmental, urban amenity, engineering and economic objectives for stormwater management and site discharge will be achieved.

12 References

1. Blacktown City Council (2005) *Engineering Guide for Development*
2. Blacktown City Council (2015) *Delivery of S94 Stormwater Infrastructure by Developers in the North West Growth Centre*
3. Blacktown City Council (2013) *Developer Handbook for Water Sensitive Urban Design*
4. Blacktown City Council (2015) *Blacktown Development Control Plan – Part J Water Sensitive Urban Design and Integrated Water Cycle Management*
5. Engineers Australia (1987), *Australian Rainfall & Runoff: A Guide to Flood Estimation*
6. Geosciences Australia (2016) *Australian Rainfall & Runoff: A Guide to Flood Estimation*
7. Sydney Metropolitan Catchment Management Authority (2010) *Draft NSW MUSIC Modelling Guidelines.*

Figures



Title:
Site Locality

Figure: **1**

Rev: **A**

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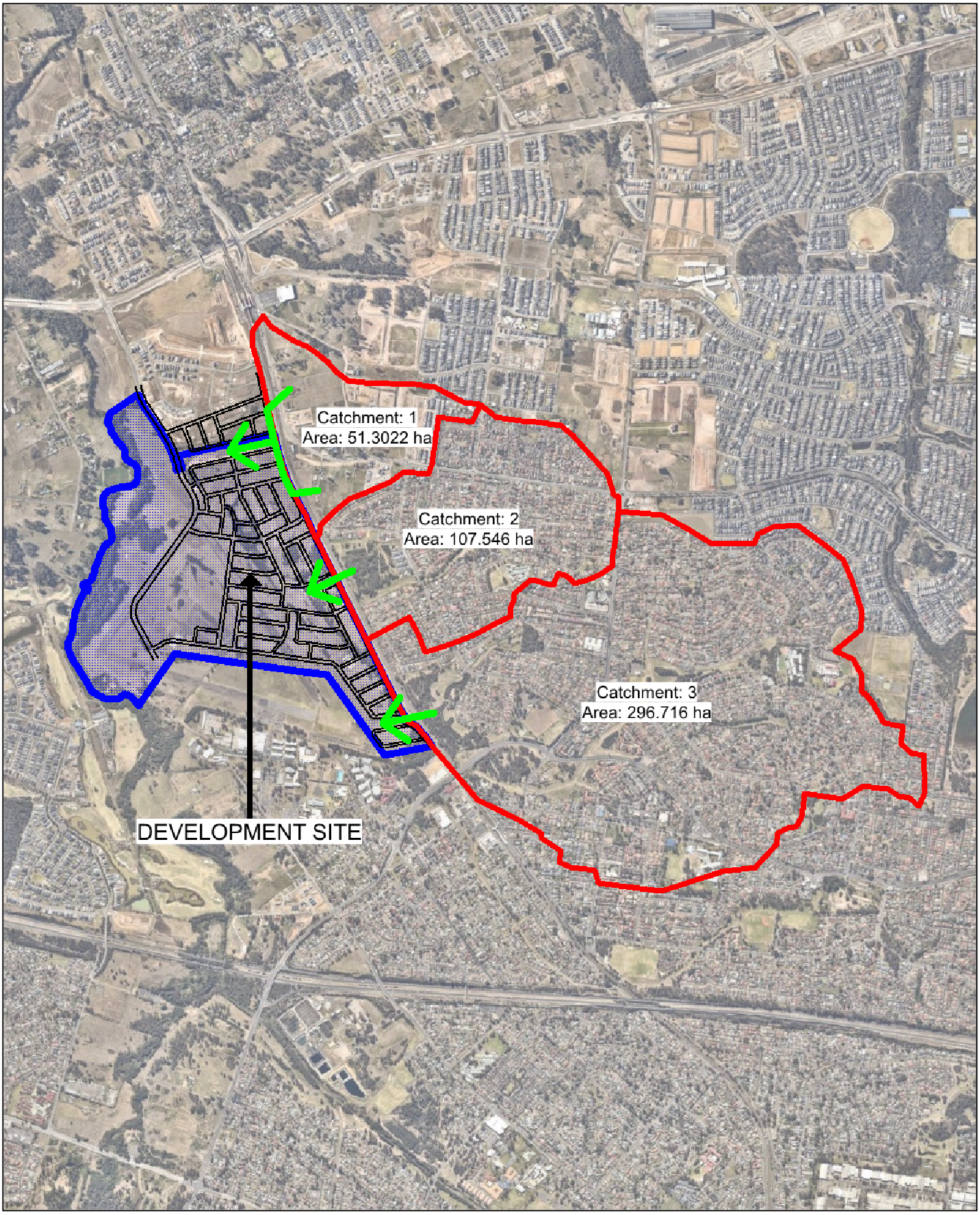

Title:
Upstream Catchment Plan

Figure: **2**

Rev: **A**

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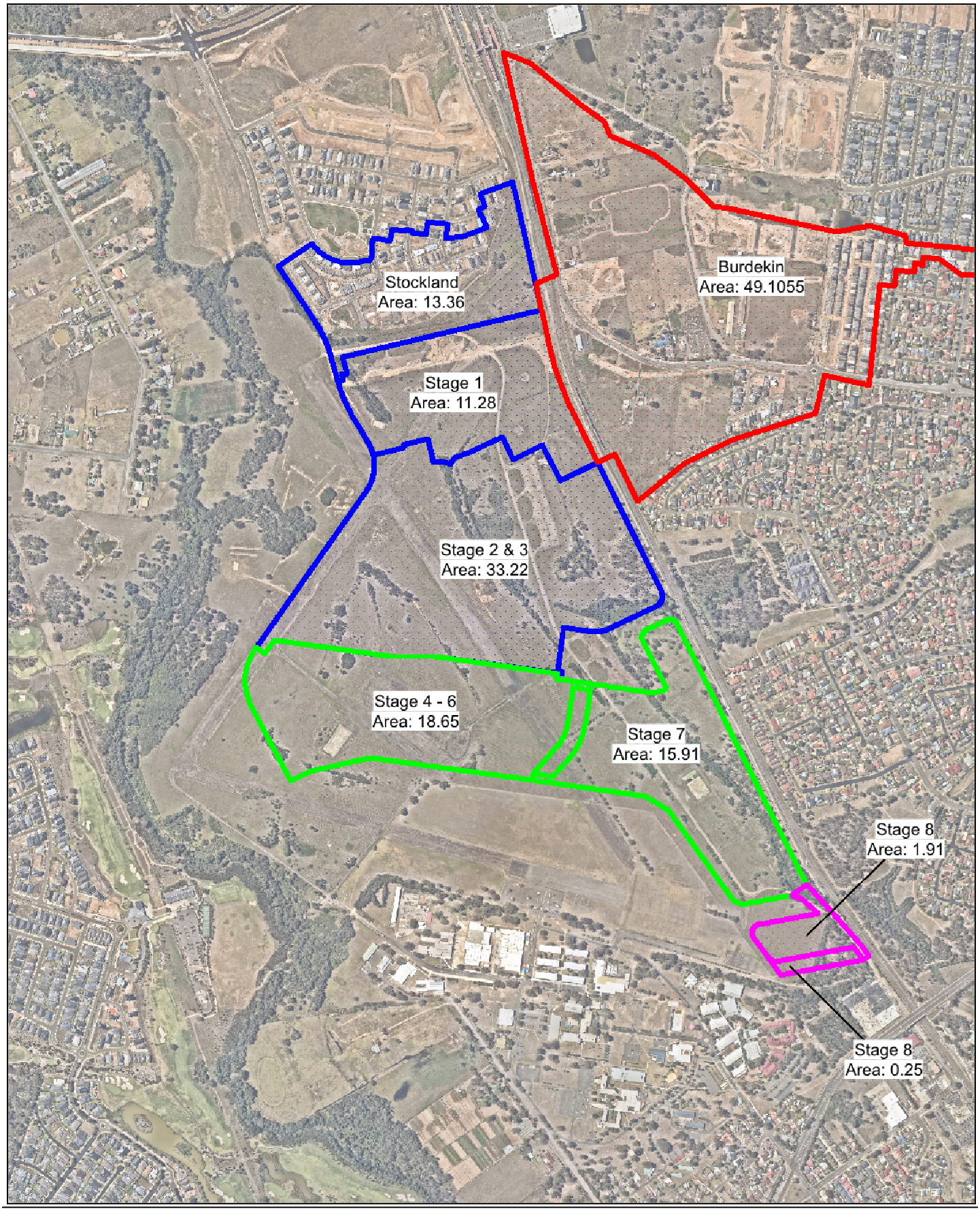

Title:

RAFTS Catchments

Figure: **3**

Rev: **A**

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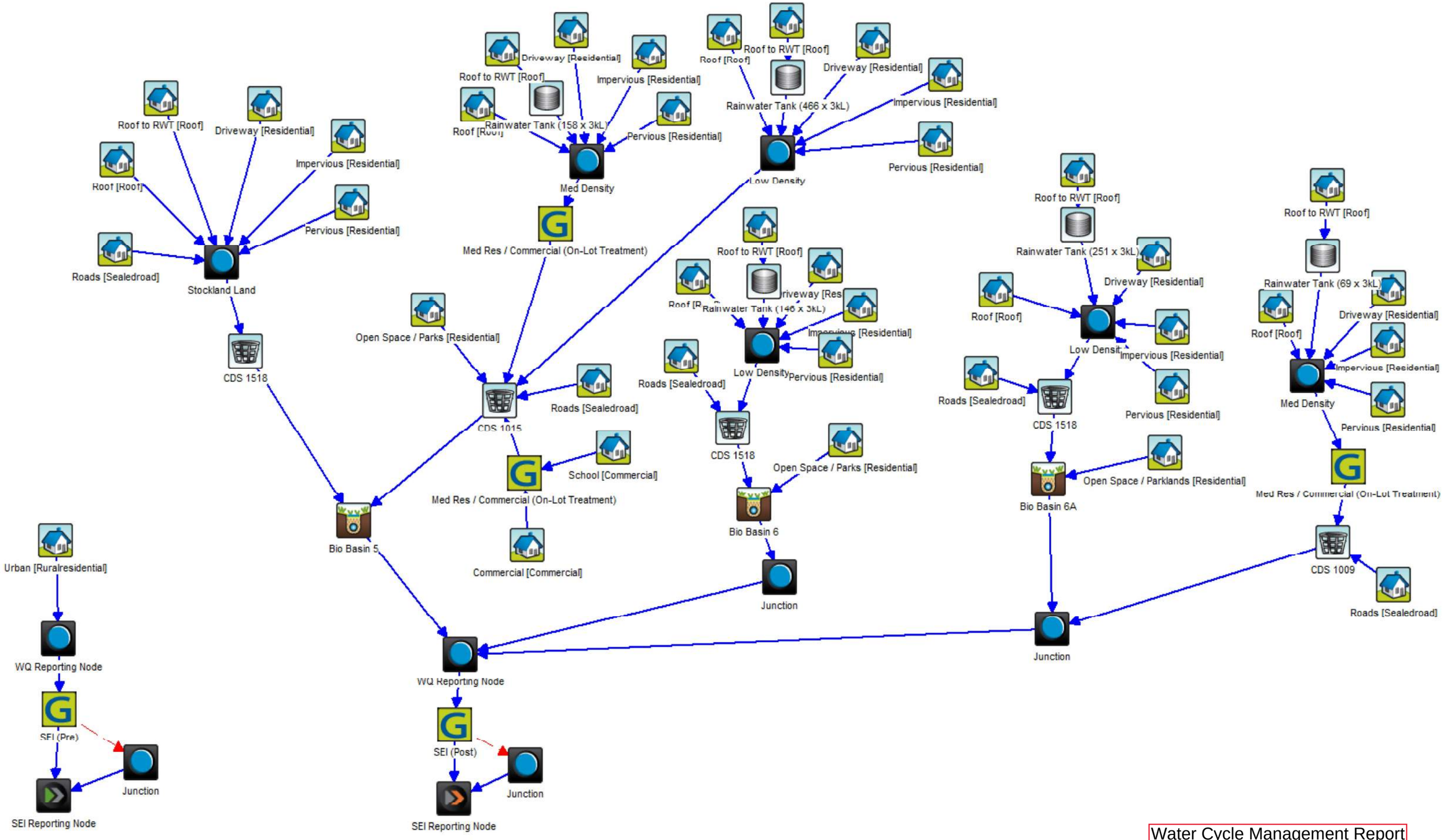

Water Cycle Management Report
MUSIC Model Layout
Figure 5

Appendix A – Current Indicative Layout Plan

NSW GOVERNMENT | Planning & Infrastructure

Schofields Precinct
Indicative Layout Plan

- Precinct Boundary
- Transport Corridor Investigation Area
- A — DCP Provisions Subject to Clause 6.9
- Local Centre
- Neighbourhood Centre
- Preferred Location for Neighbourhood Services
- Medium to High Density Residential
- Medium Density Residential
- Low Density Residential
- Environmental Living
- Educational Uses
- Community Uses
- Private Recreation
- Park
- Sporting fields
- Conservation Area
- Riparian Corridor
- Heritage Item
- Historic Runway Archaeological Interpretation
- Drainage and Infrastructure
- Road
- Richmond Rail Line
- Existing Transmission Line Easement
- Eastern Creek

N

0 50 100 200 500m

Approximate scale:
5,000 @ A0 or 10,000 @ A2
5 April 2012

Appendix B – Proposed Indicative Layout Plan

Master Plan
SCHOFIELDS SOUTH

NORTH

40 0 80 160 240 320 400 metres

Ref: DHASC-B-006-1	Date: 22/05/2018	Revision: M	Scale: 1:4,000@A1

Note: All areas and dimensions subject to detailed survey

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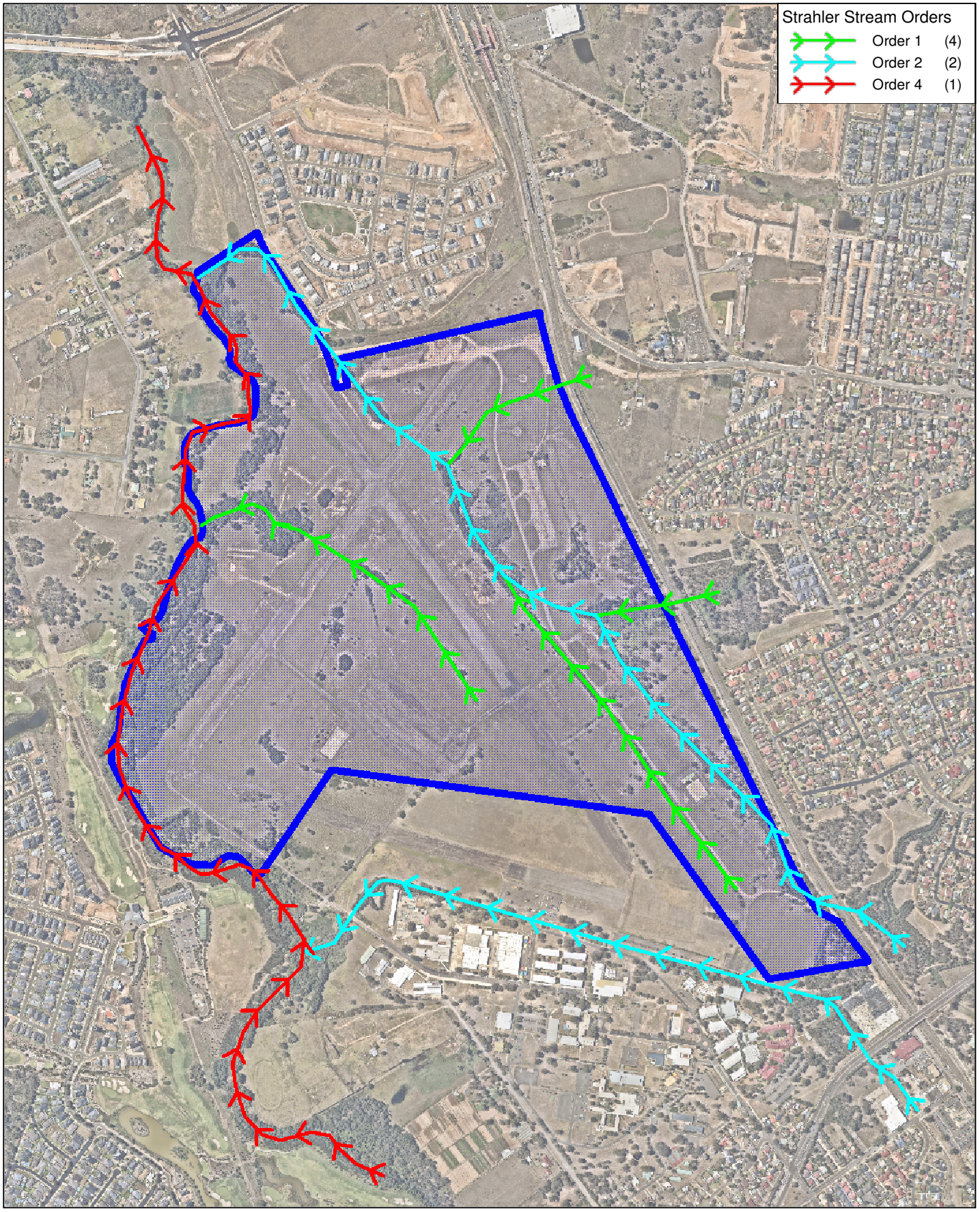
Appendix C – Strahler Stream Index



Title:
Existing Flow Paths

Figure: **C**

Rev: **B**

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Appendix D - Revised Flood Impact Assessment

Project No: S13026.01

10 August 2018

Defence Housing Australia
Suite 2, Level 2/287 Elizabeth Street
Sydney NSW 2000

Attention: Jasmina Moltter

Dear Jasmina,

SCHOFIELDS AERODROME RESIDENTIAL DEVELOPMENT
REVISED FLOOD IMPACT ASSESSMENT

This letter report is submitted by BG&E Pty Limited (BG&E) who has been engaged by Defence Housing Australia (DHA) to carry out a hydrological and hydraulic investigation of Eastern creek and major overland flow through the proposed development site located at Schofields Aerodrome.

BG&E previously prepared the Flood Assessment report for the Development Application (DA) associated with bulk earthworks for the project (report dated 19/12/2016 Rev 2). The DA has been approved by Blacktown City Council.

This letter presents the results of a revised flood impact assessment based on an amended development layout and bulk earthworks design (post-DA design amendments).

1 BULK EARTHWORKS DESIGN UPDATES

Craig & Rhodes has made the following changes to the development layout and bulk earthworks design since the DA was issued:

- Realigned Mustang drive towards Eastern Creek (previously east of Playing Field area);
- Realigned major drainage Channels 1 and 2;
- Amended designs for stormwater Basins 5 and 6 and addition of Basin 6A;

Additional survey was carried out in the south-western part of the site to better represent conditions downstream of the existing culverts beneath Quakers Hill Parkway.

Further details can be found in Craig & Rhodes engineering drawings and documentation.

2 FLOOD MODEL UPDATES

The flood assessment for the site has been carried out based on hydrologic (XP-RAFTS) and hydraulic (TUFLOW) models provided by Blacktown City Council (refer BG&E 2016 report). The following updates were made to the hydrologic and hydraulic models to reflect the revised design:

- Developed case XP-RAFTS model was updated to reflect changes in local catchments and contributing areas to proposed basins and channels.
- Baseline and developed case TUFLOW models were updated to incorporate survey data near Quakers Hill Parkway.
- Developed case TUFLOW model was updated with revised bulk earthworks design TIN (imported from 12D).

- Developed case TUFLOW model was updated to include proposed culverts/pipes (refer attached Figure 13):

Figure 1 below compares the development layout under the current DA (left) and revised layout incorporating the latest design amendments (right).

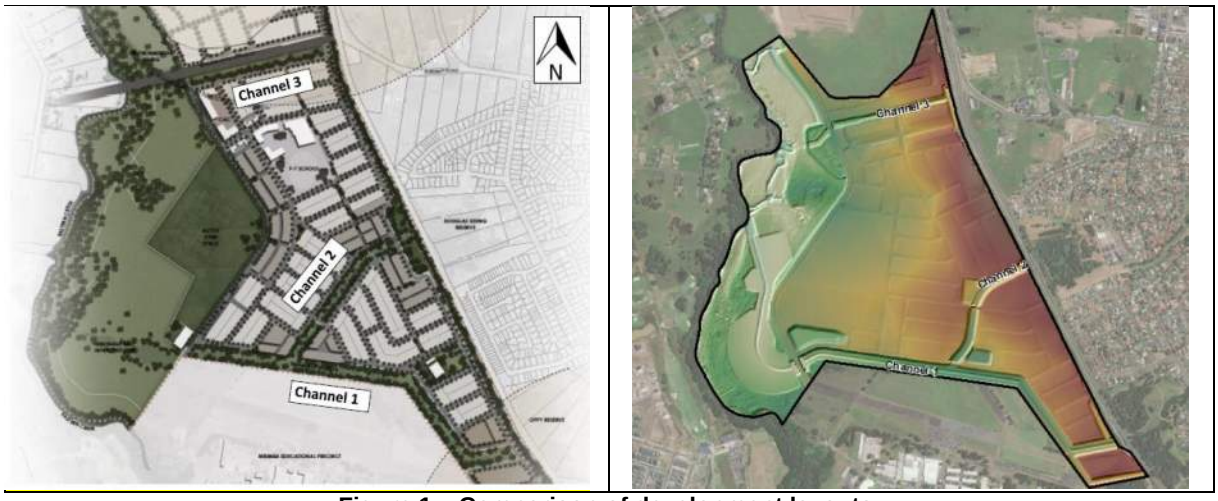


Figure 1 – Comparison of development layouts.
LEFT – master plan submitted with the report for DA; RIGHT –amended masterplan reported in this letter.

3 MODEL SCENARIOS AND EVENTS

Baseline and developed case scenario runs were carried out for the following average recurrence interval (ARI) events and storm durations. Inflows to the TUFLOW model were extracted from the XP-RAFTS baseline and developed case scenario models for each ARI and duration.

- 1 in 2 year ARI (90, 120, 540, 720 minute storm durations)
- 1 in 100 year ARI (60, 90, 120, 540, 720 minute storm durations)
- 1 in 500 year ARI (60, 90, 120, 540, 720 minute storm durations)
- PMF event (30, 60, 120 minute storm durations)
- 1 in 2 year ARI (90, 120, 540, 720 min storm durations) – smooth roughness scenario within newly developed channels assuming they won't be vegetated after construction.

Updated flood mapping is attached showing peak flood levels, depths, velocities, hazards. Flood level difference mapping is also included for the 100 year ARI event.

It is important to note that both (i) baseline and (ii) developed case scenario model runs utilised a constant water level boundary condition. The tail-water level of 17.3mAHD was applied to the downstream boundary of the model to represent the regional 100 year ARI flood level within the Hawkesbury River.

4 MODEL RESULTS AND DISCUSSION

Updated difference mapping demonstrates that flood affectation during the 100 year ARI event is comparable to the accepted DA Flood Assessment report (refer Figure 13 attached).

Minor increases to 100 year ARI flood levels are shown in the following locations:

- Location A – water level increased up to 23mm outside tenement boundary due to earthworks in the upstream area concentrating flow. This increase has been reported in previous flood report and is localised to the creek alignment and does not extend across the width of the floodplain.
- Location C – increased water level within the tenement boundary at the outlet of Channel 1. The increase is caused due to earthworks and flow diversion by Channel 1. The localised increased does not impact any properties.

- Location D – localised increase within the Nirimba site upstream of the newly designed Mustang Drive crossing of Channel 1. This increase is around 90mm outside DHA site boundary. A similar increase was shown in the previous flood assessment report which formed part of the DA. This difference has been reported and accepted by Nirimba in 2016. The most recent model run achieved smaller difference compared to 2016 figures. Refer to Figure 15 for comparison.
- Location E – localised increase of around 40mm due to Mustang Drive and added culvert crossing. This increase does not affect existing development or buildings within the Nirimba site. The increase is due to the Mustang Drive and culvert crossing underneath. Refer to Figure 15 for the comparison against the 2016 report.
- Location F – localised increase up to 85mm due to Mustang drive realignment. This increase has been reported in previous DA and has been accepted.

5 REGIONAL PMF MODEL EXTENTS AND 500 YEAR ARI FLOODING

BG&E has estimated flood extents and maximum flood depths for the regional PMF flood event from the Hawkesbury River. The assessment has been based on a constant water level surface of 26.4mAHD (derived from JWP 2012 study). It is understood that areas within the regional PMF flood extents should be able to be evacuated. Figure 17 informs which areas within the DHA site are affected by the regional PMF level of 26.4mAHD.

An Evacuation strategy for the site has been prepared by Craig and Rhodes (separate report). The proposed road located adjacent to the railway reserve provides evacuation access to areas above the regional PMF level. Evacuation routes must be accessible for the 500 year ARI event. Figure 18 shows key evacuation locations (E1, E2, E3) where the road crosses major drainage channels.

Area E1 – Based on the XP-RAFTS model provided by Council, the catchment upstream of the railway conveys a 500 year ARI peak flow of 7.3m^3/s through the railway culverts (1x375mm dia. and 1x1500mm dia.). A HY-8 model was developed to estimate the headwater level required to convey this flow through the culverts which was calculated as 26.3 mAHD. Based on LiDAR data the headwater level is below the spill level of the railway (27.0 mAHD). The railway culvert discharges into a small open channel section within the railway corridor and into a 1650mm dia. drainage pipe towards Channel 3. The capacity of 1650mm dia. pipe is estimated as 4.8m^3/s after which overtopping of the proposed road is expected to occur. 2.5m^3/s is expected to overtop the evacuation road and be conveyed west along the local roads towards Eastern Creek. Based on a broad crested weir equation this overflow would inundate the evacuation route by around 180mm (water level is 24.67mAHD, lowest crown level of the road is 24.5mAHD). The velocity over the road is 0.75m/s.

Area E2 – A bridge crossing is proposed over Channel 2. The lowest road level of the bridge is approximately 25.3 mAHD and the 500 year ARI water level within Channel 2 is 23.6 mAHD which would allow 1.7m depth for the bridge structure and pavement.

Area E3 – A bridge crossing is proposed over Channel 1. The lowest road level of the bridge is approximately 25.6 mAHD and the 500 year ARI water level within Channel 1 is 23.5 mAHD which would allow 2.1m depth for the bridge structure and pavement.

6 CONCLUSION

BG&E has carried out updated flood modelling to incorporate the revised civil design received from Craig and Rhodes (23/01/2018 and further updated with northern portion of the site to be developed by Stockland within DHA site boundary – updated on 06/2018). The results have been mapped on a number of figures which are attached to this letter. Flood modelling results and particularly 100 year ARI flood difference mapping (Figure 13) demonstrated that the updated design results in negligible difference compared to the bulk earthworks design approved under the current DA.

The evacuation route along the railway corridor is Serviceable for the 500 year ARI event. One location has minor overtopping with the maximum depth of 180 mm (at road crown) and 0.75 m/s velocity. This location is marked in Figure 18 as Area E1.

7 MODELLING ASSUMPTIONS AND LIMITATIONS

Updated flood modelling has been based on previous hydrological (XP-RAFTS) and hydraulic (TUFLOW) models and is subject to the same assumptions and limitations outlined in the BG&E Flood Assessment report issued for DA. The model is based on council supplied TUFLOW and XP-RAFTS models from JWP 2012 study.

Council has recently updated flood modelling in the area with new hydrology and more recent topography information. Updated 100 year ARI pre-development flood levels were provided by Council in order to compare pre-development flood levels used in this study (based on JWP 2012 model). 100 year ARI water level differences between the two models shown in Figure 16. Council's updated model has resulted in a reduction in 100 year ARI water levels within Eastern Creek. Minor changes to water levels are observed within the site itself from local catchments. The flood impact assessment for the Schofields site has been based on the 2012 flood models used in the precinct plan and is consistent with the approved bulk earthworks DA.

Updated modelling has been based on bulk earthworks design provided by Craig and Rhodes on 23/01/2018 and incorporates the northern portion of the site to be developed by Stockland – updated on 06/2018.

Yours faithfully
for BG&E Pty Limited

Ainis Vincevicius
Senior Water Engineer

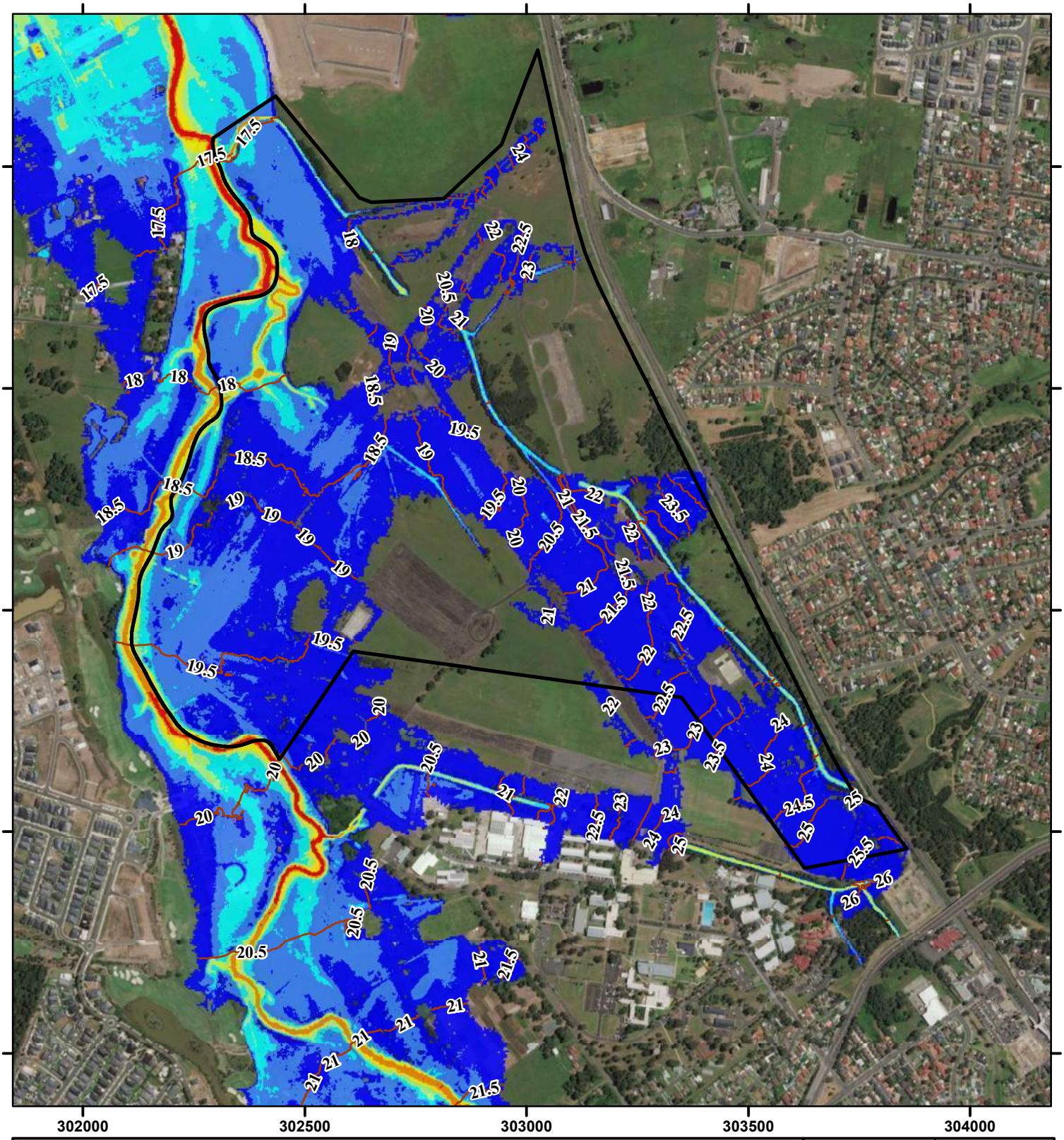
Encl.
Updated flood mapping

References:

JWP 2012 study – "Schofields Precinct Water Cycle Management Strategy Report Incorporating Water Sensitive Urban Design Techniques", J.Wyndham Prince (May, 2012)

Council 2016 flood study – Flood study and modelling undertook by Catchment Simulation Solutions in 2016 for Blacktown Council.

Figure 1 - 2 Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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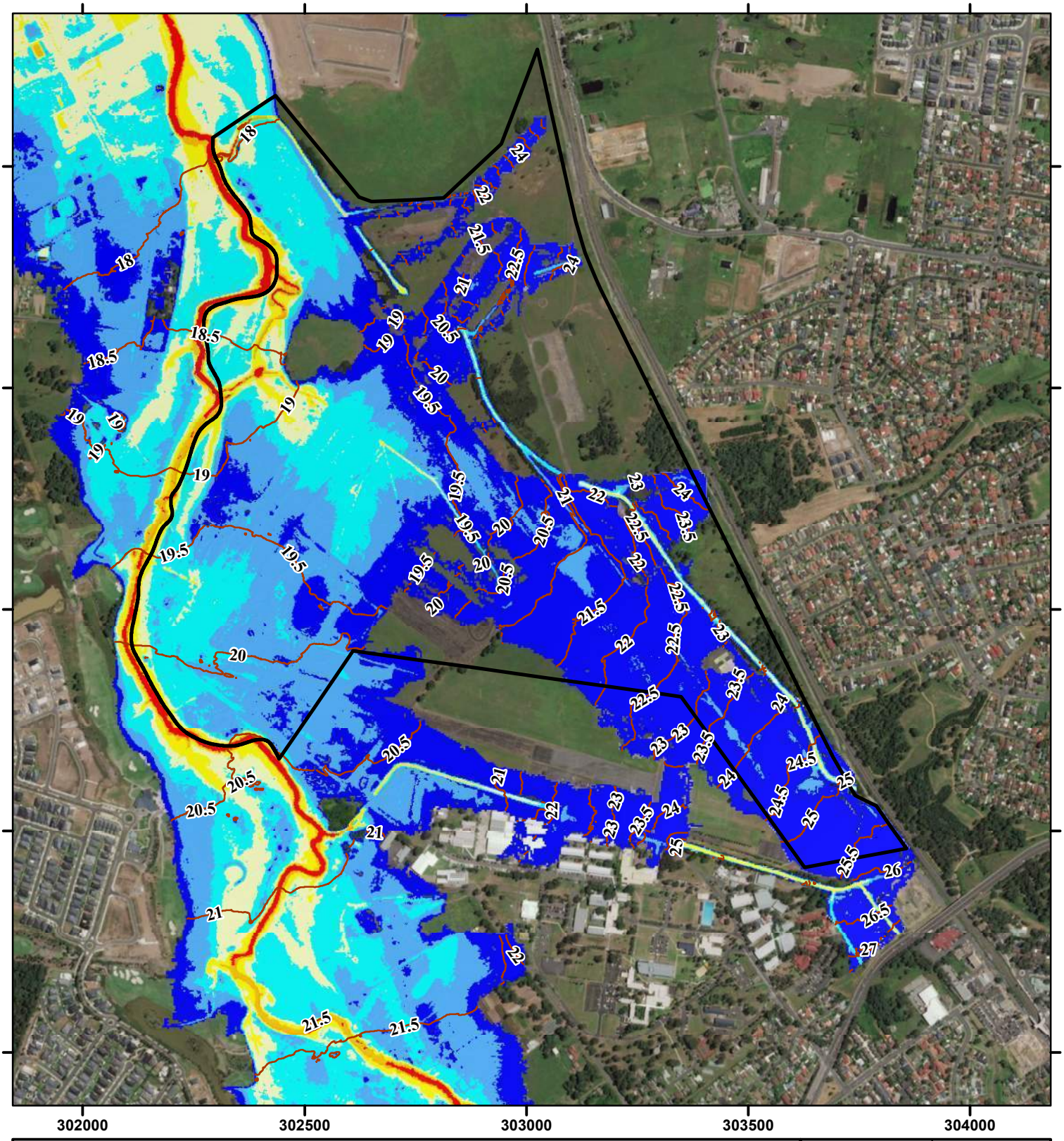
Figure 2 - 100 Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
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0 0.1 0.2 0.4 Km

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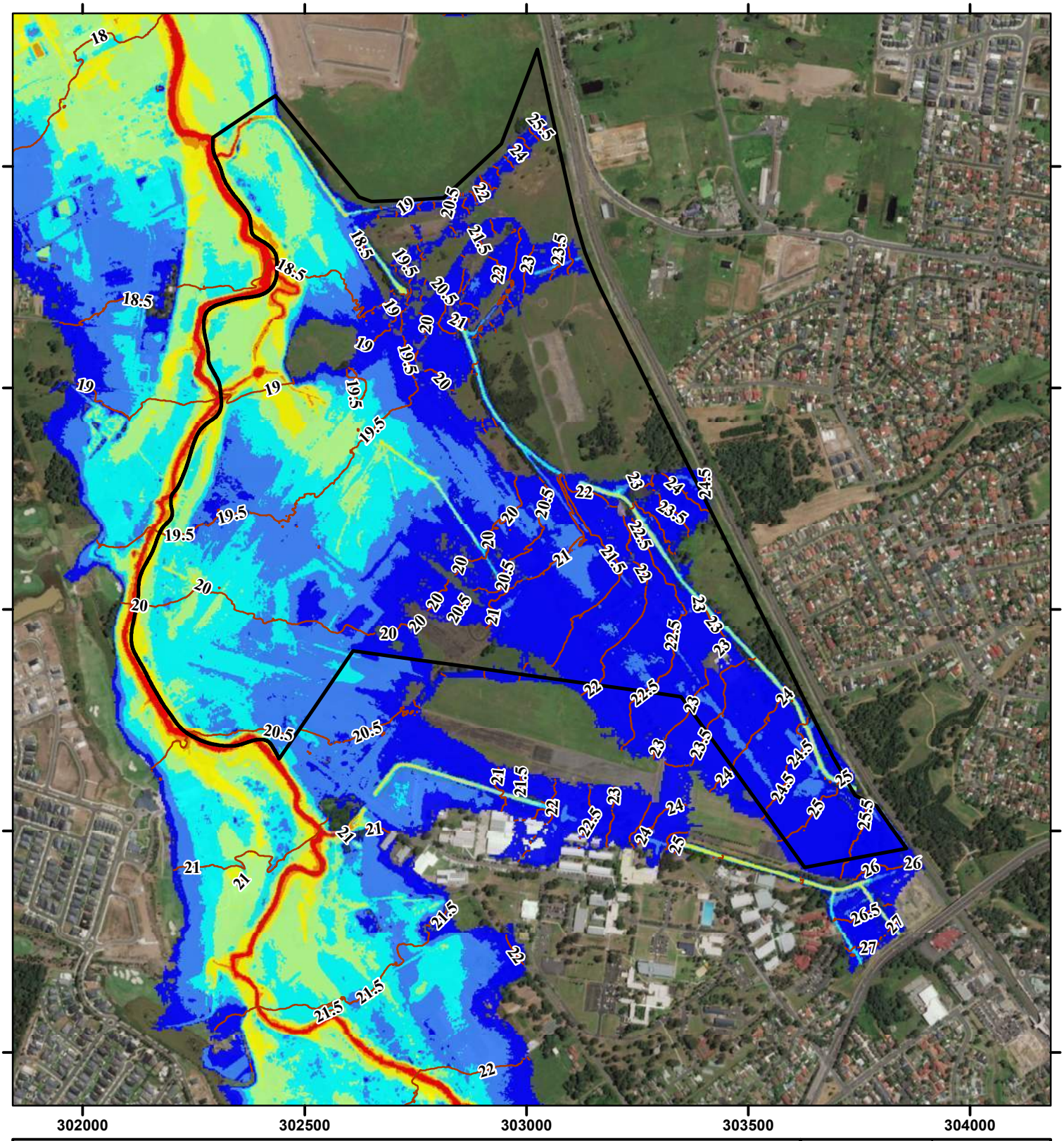
Figure 3 - 500 Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
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0 0.1 0.2 0.4 Km

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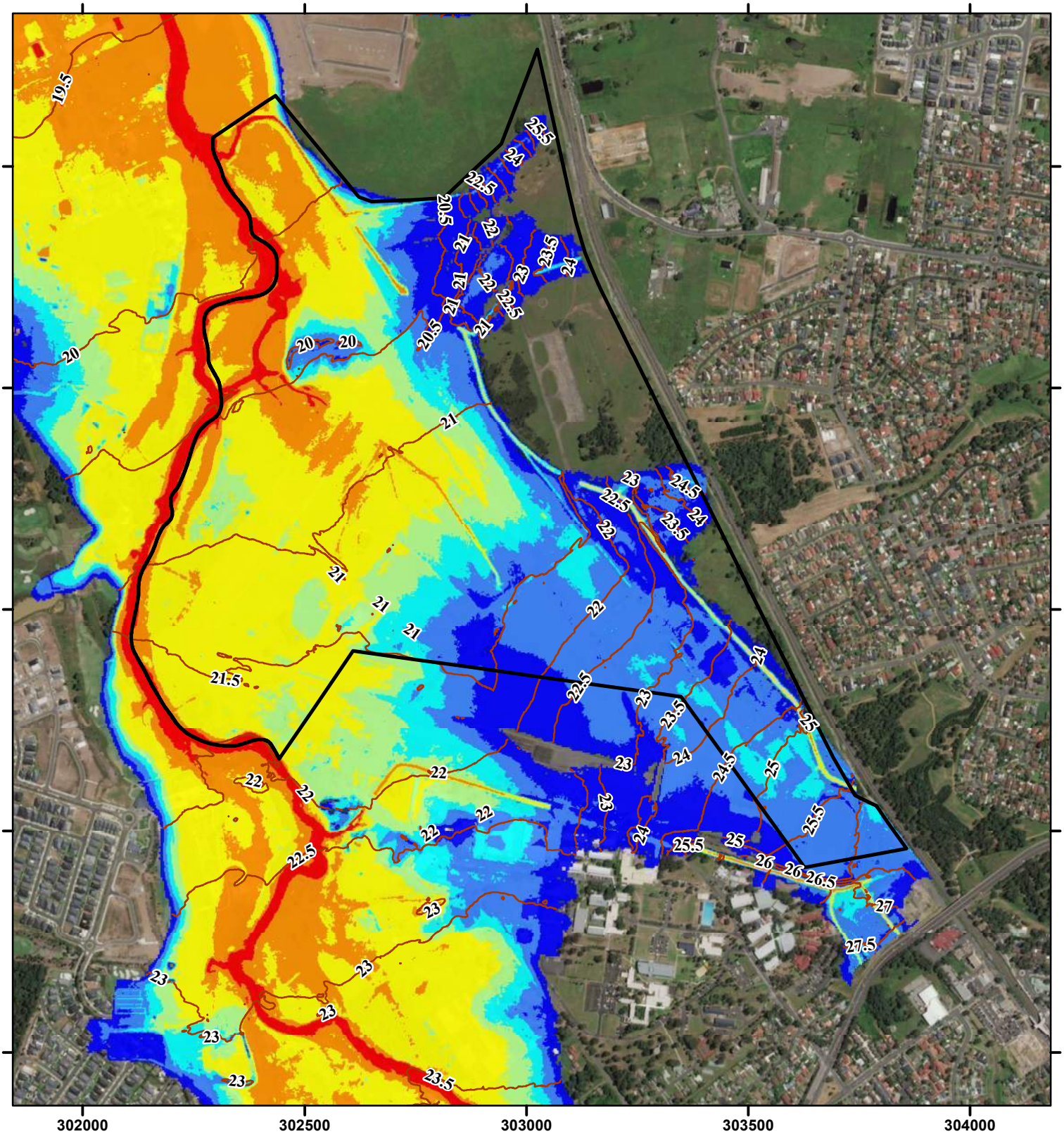
Figure 4 - PMF Year ARI Pre-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
APPROVED	BS		

N

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0 0.1 0.2 0.4 Km

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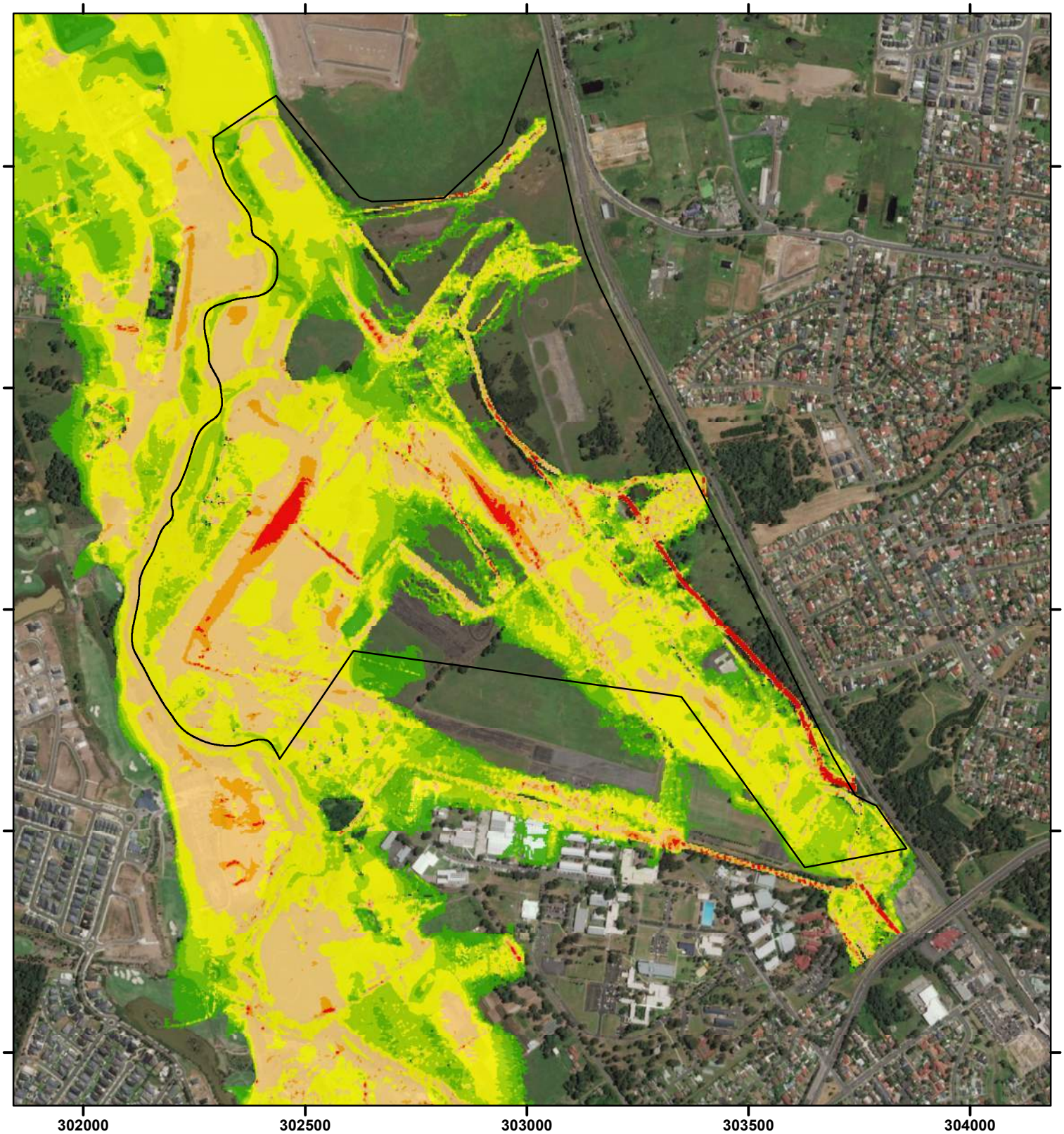
Figure 5 - 100 Year ARI Pre-Development Flood Velocities



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	21/11/2017
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N

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0 0.1 0.2 0.4 Km

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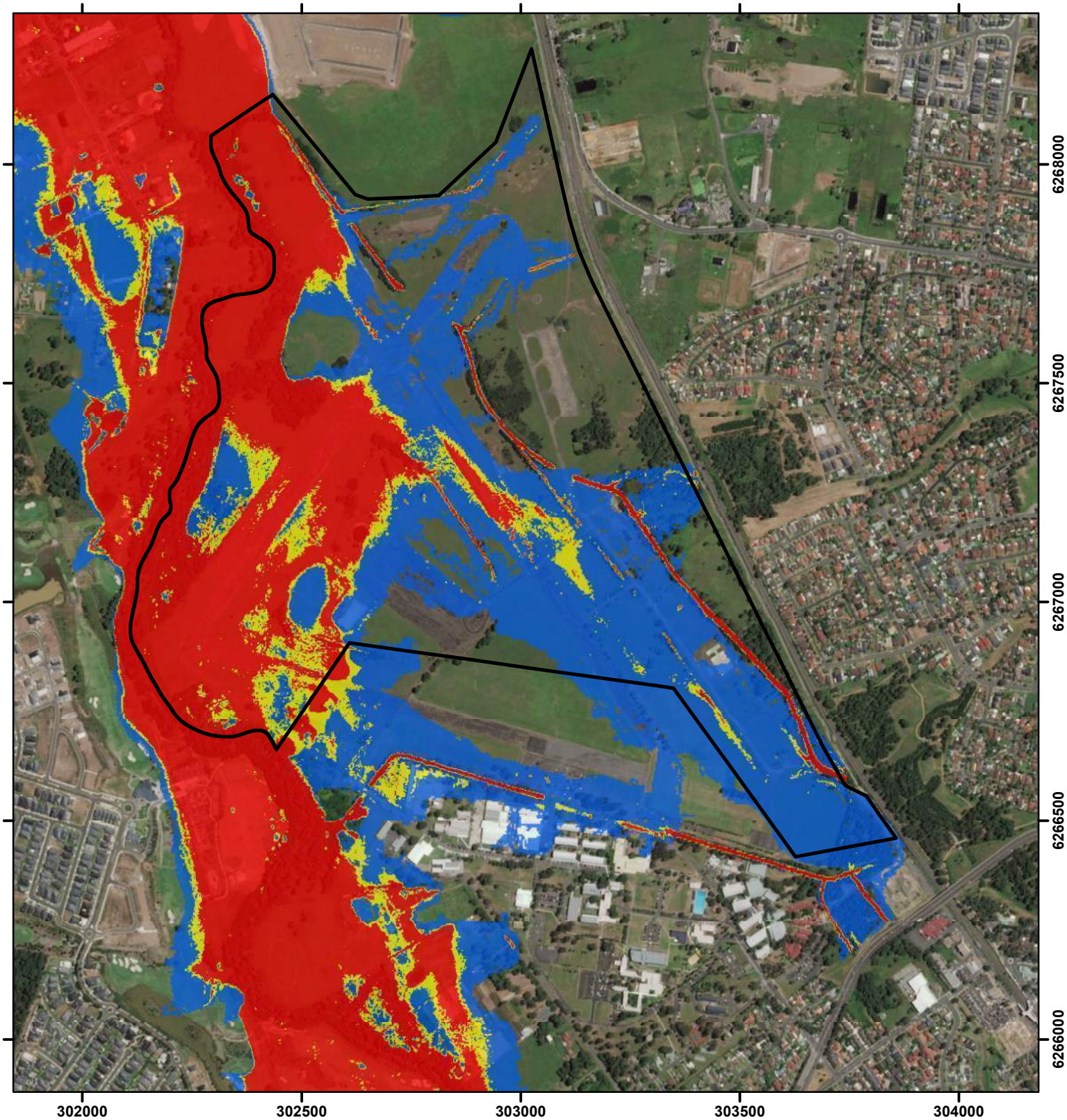
Figure 6 - 100 Year ARI Pre-Development Flood Hazard Catagories



Legend

Hazard

- Low
- Medium
- High

Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	20/11/2017
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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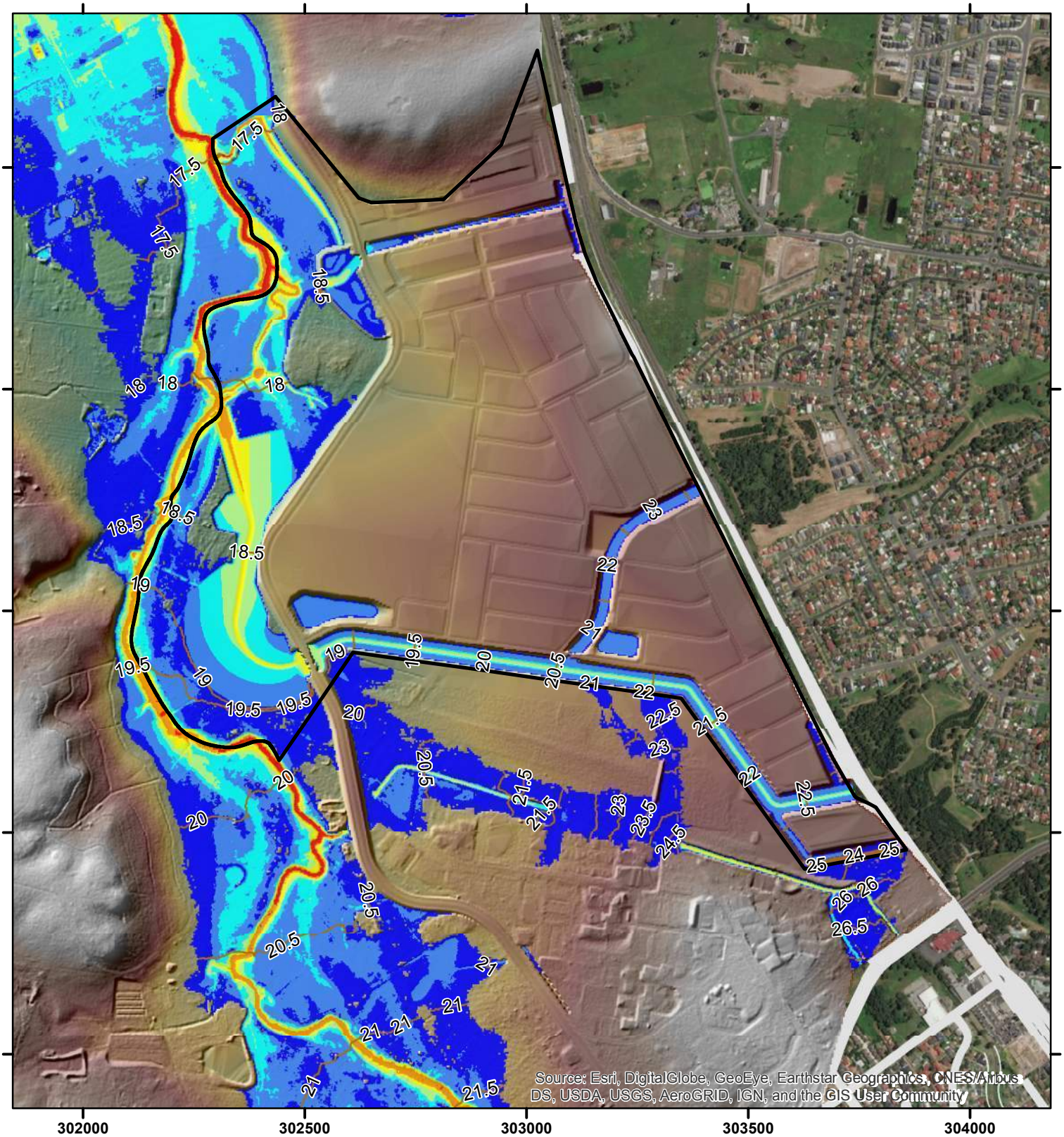
Figure 7 - 2 Year ARI Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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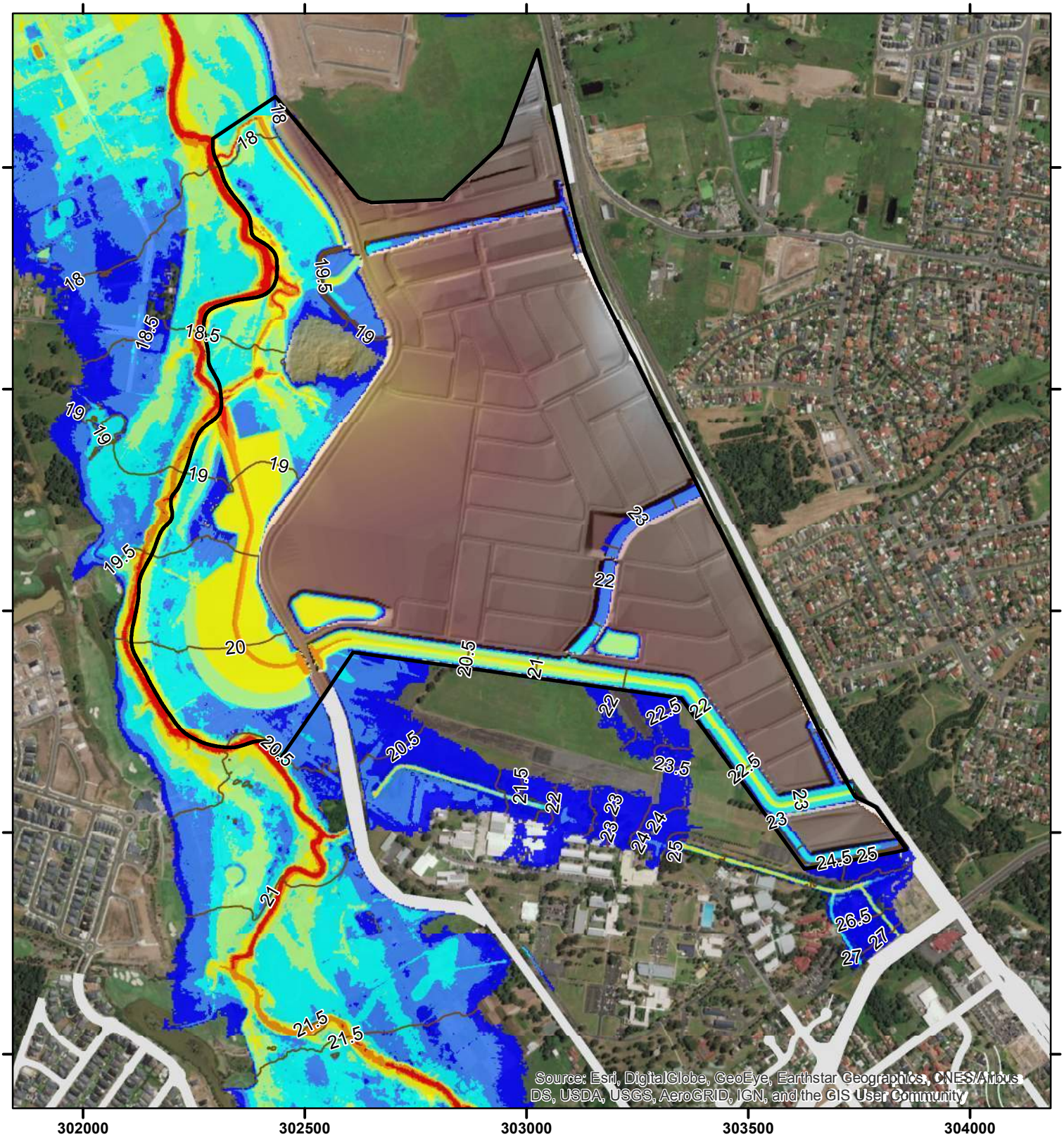
Figure 8 - 100 Year ARI Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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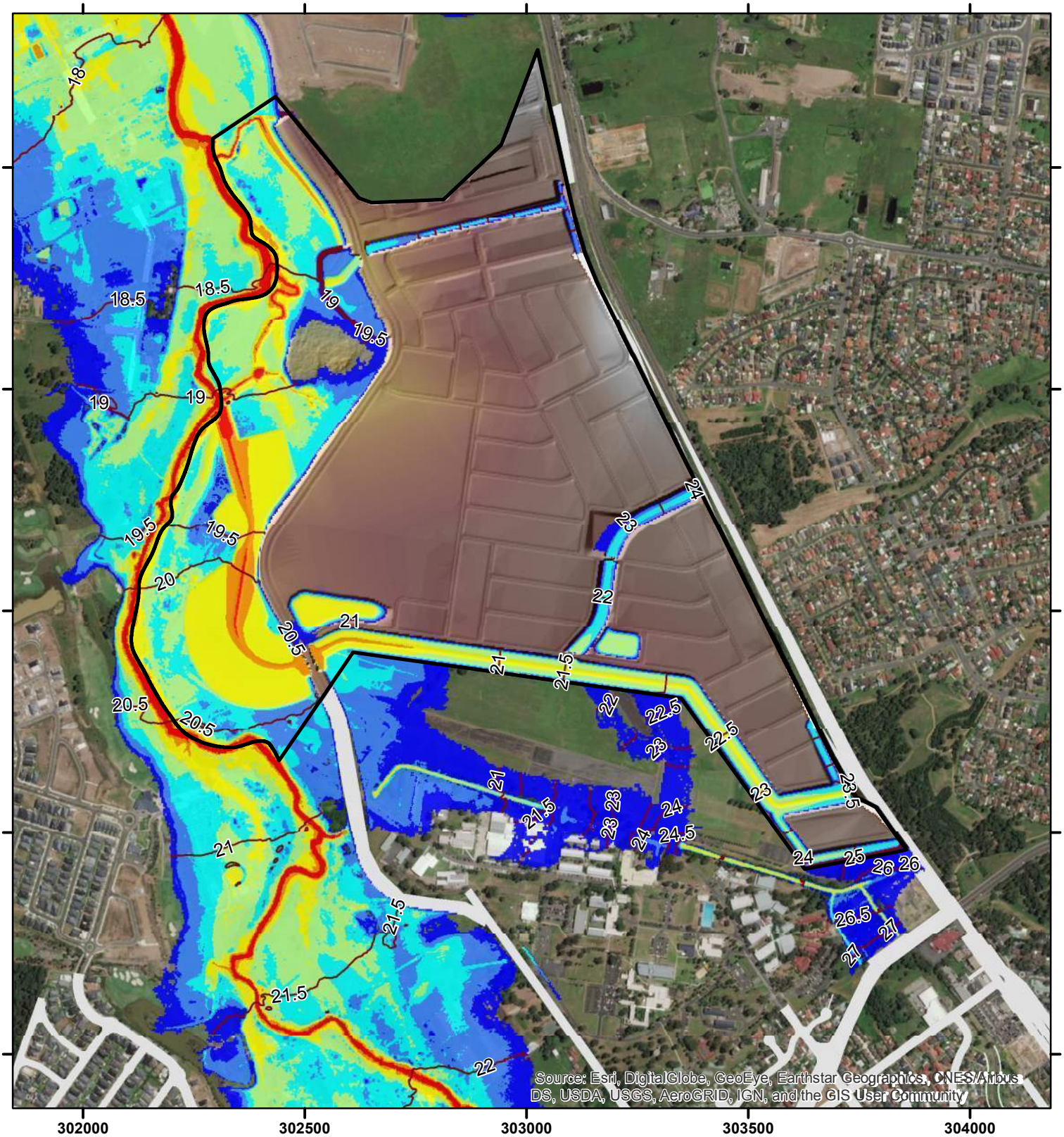
Figure 9 - 500 Year ARI Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

- Site Boundary
- Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

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0 0.1 0.2 0.4 Km

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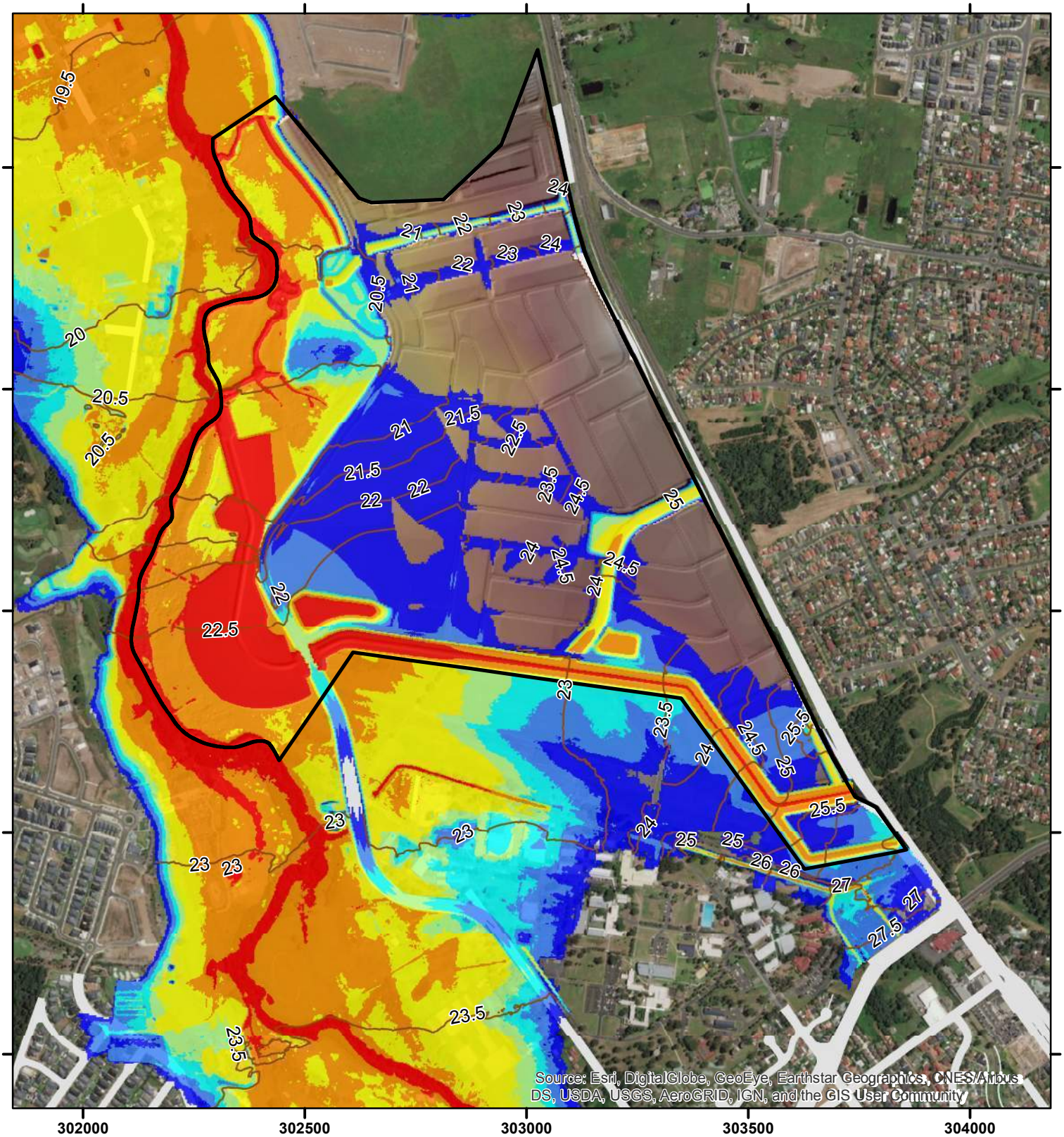
Figure 10 - PMF Post-Development Flood Depths and Levels



Legend

Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Site Boundary

Flood Level (m AHD)

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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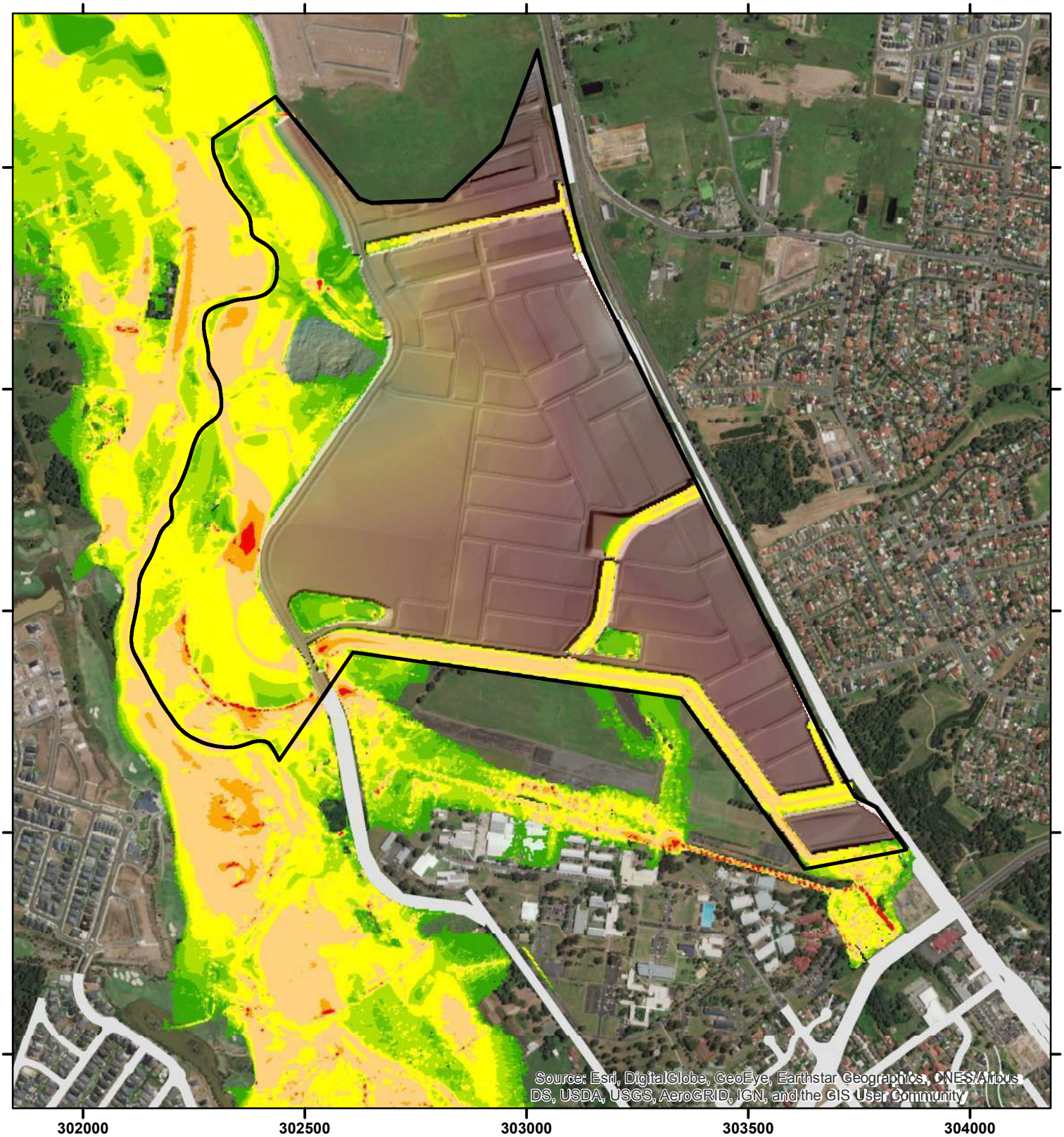
Figure 11 - 100 Year ARI Post-Development Flood Velocities



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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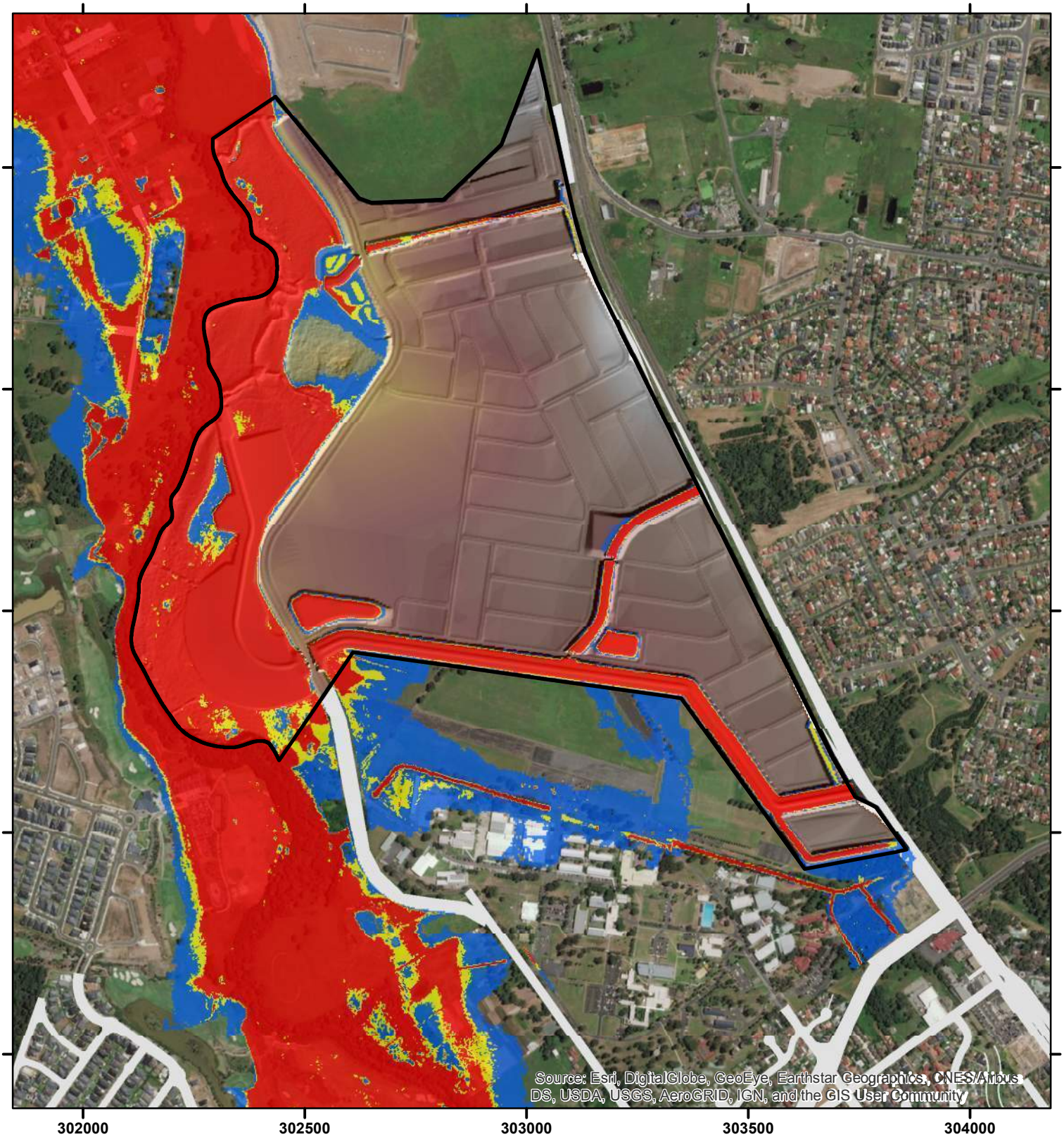
Figure 12 - 100 Year ARI Post-Development Flood Hazard Catagories



Legend

Hazard

- Low
- Medium
- High

Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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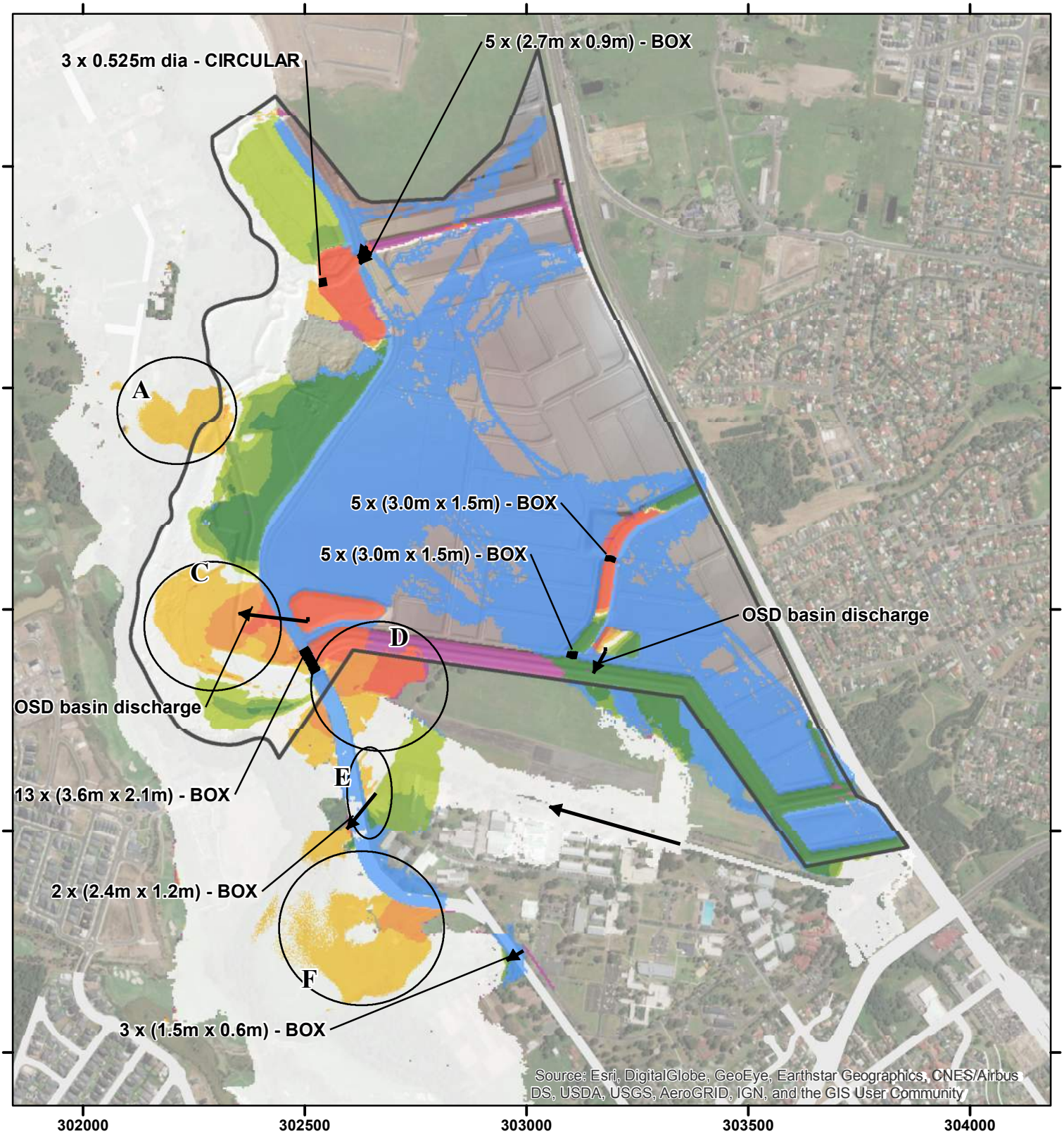
Figure 13 - 100 Year ARI Flood Level Difference Map (Post-Pre)



Legend

Difference [m]

- < -0.1
- -0.05 to -0.1
- -0.02 to -0.05
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- > 0.1
- Was Wet Now Dry
- Was Dry Now Wet
- DHA Site Boundary
- Modelled culverts

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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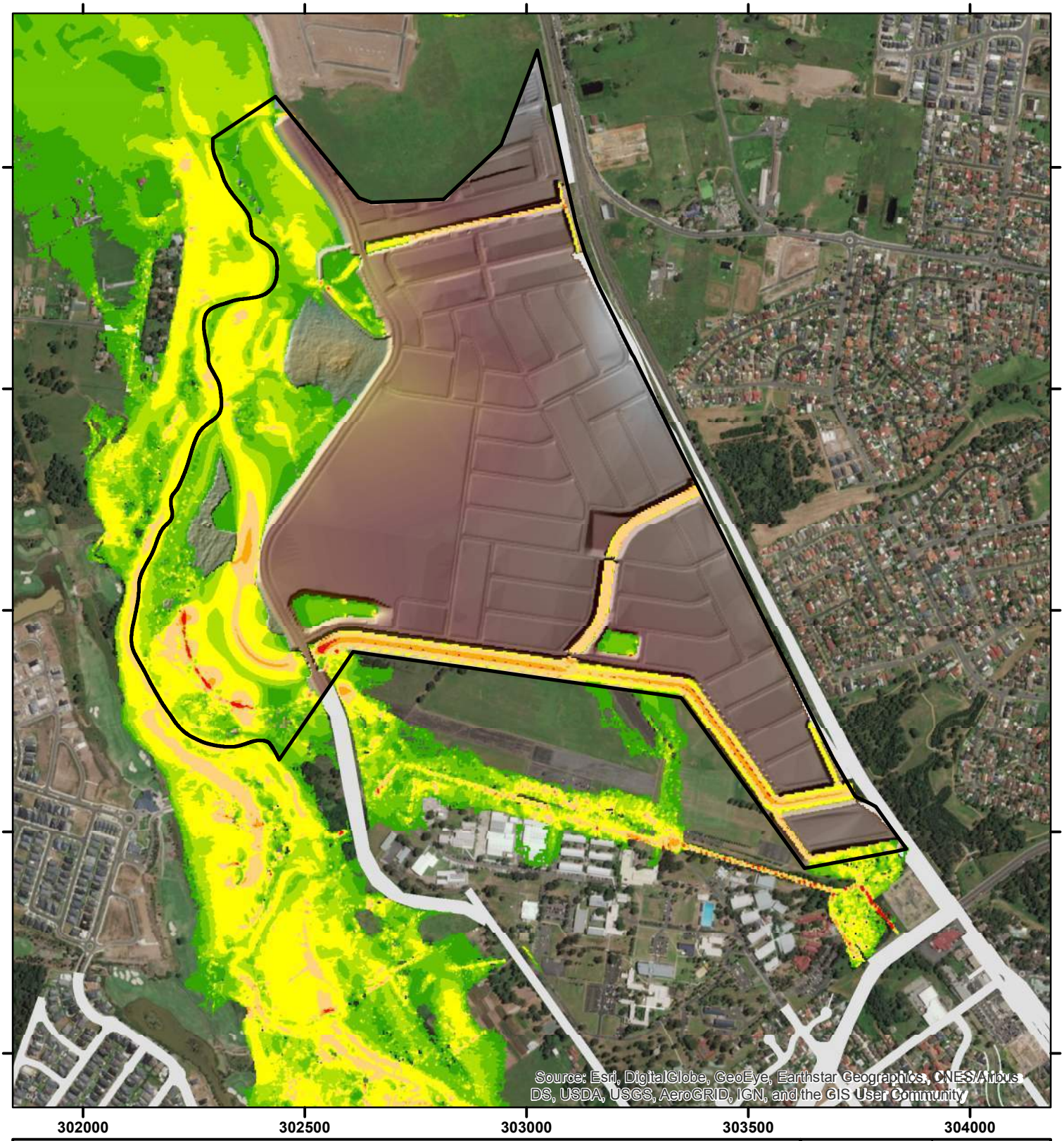
Figure 14 - 2 Year ARI Post-Development Flood Depths and Levels

(smooth roughness)



Legend

Velocity (m/s)

- 0 - 0.2
- 0.2 - 0.4
- 0.4 - 0.6
- 0.6 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- Over 2
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	2/07/2018
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N

1:12,000

0 0.1 0.2 0.4 Km

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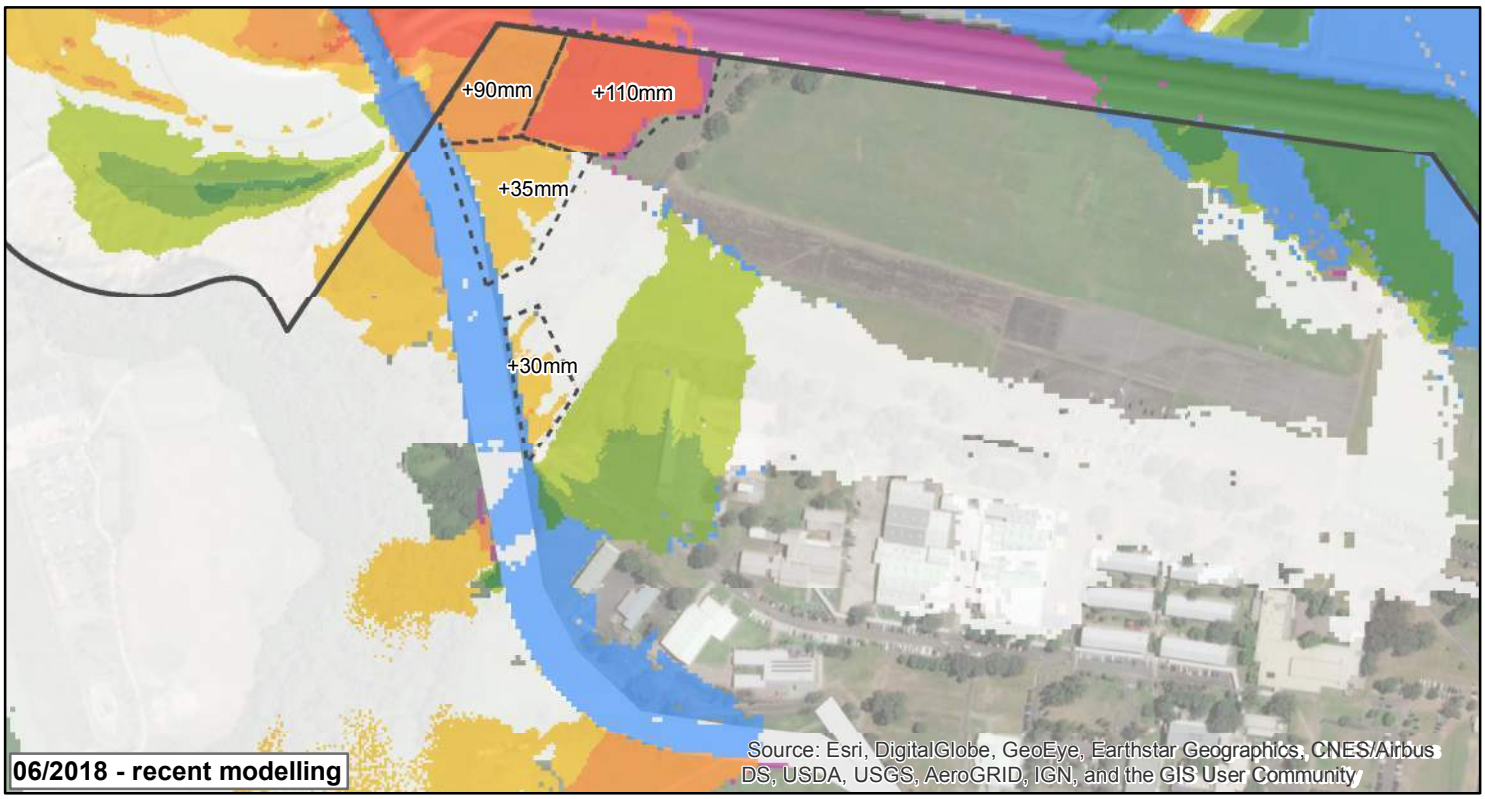
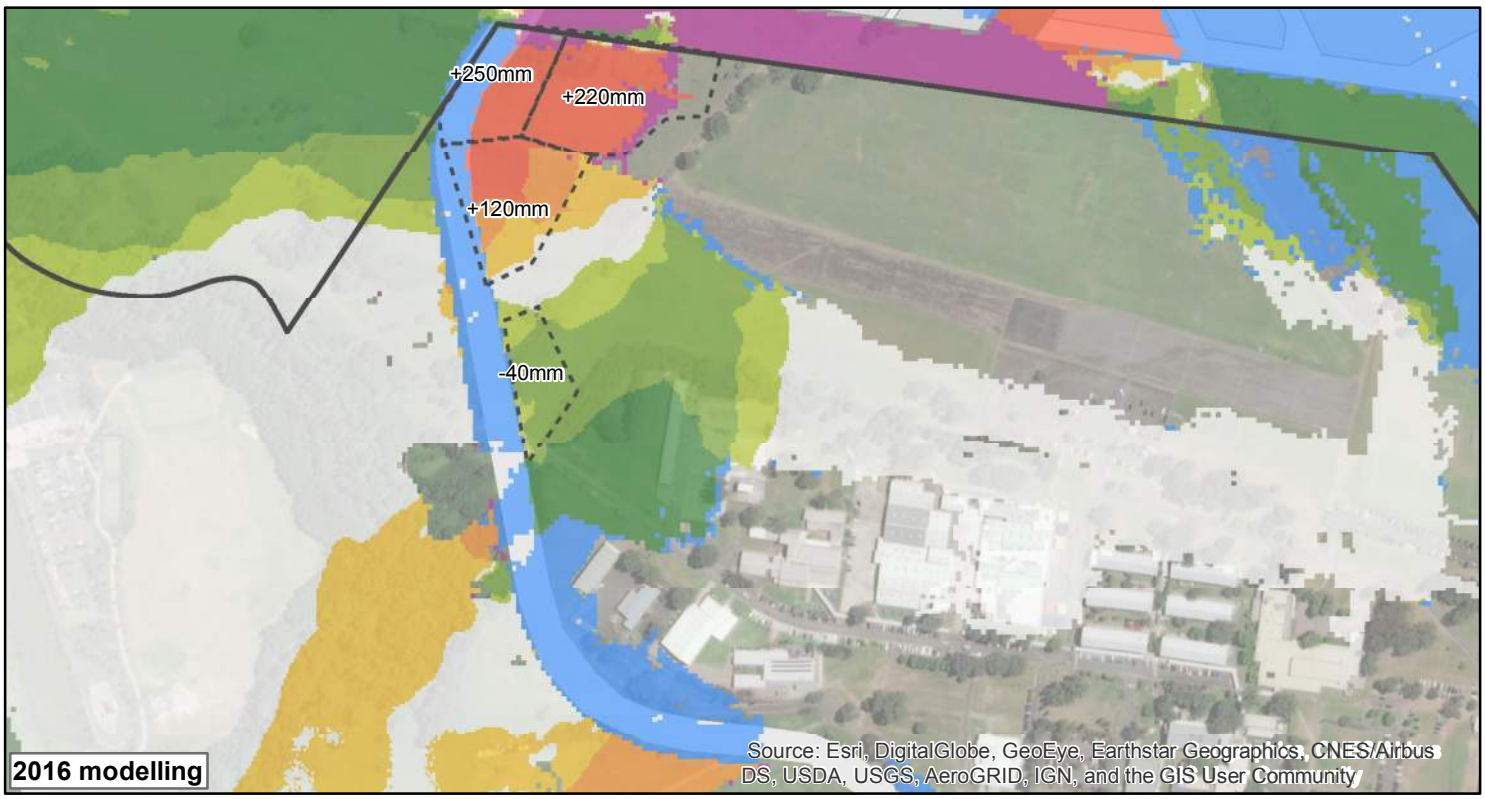
Figure 15 - 100 Year ARI Flood Level Difference Map (2018 VS 2016)





Legend

Difference [m]

- < -0.1
- -0.05 to -0.1
- -0.02 to -0.05
- -0.02 to 0.02
- 0.02 to 0.05
- 0.05 to 0.1
- > 0.1
- Was Wet Now Dry
- Was Dry Now Wet
- DHA Site Boundary
- Average change in water level within reference polygon

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	10/08/2018
APPROVED	BS		

N

1:6,000

0 0.05 0.1 0.2 Km

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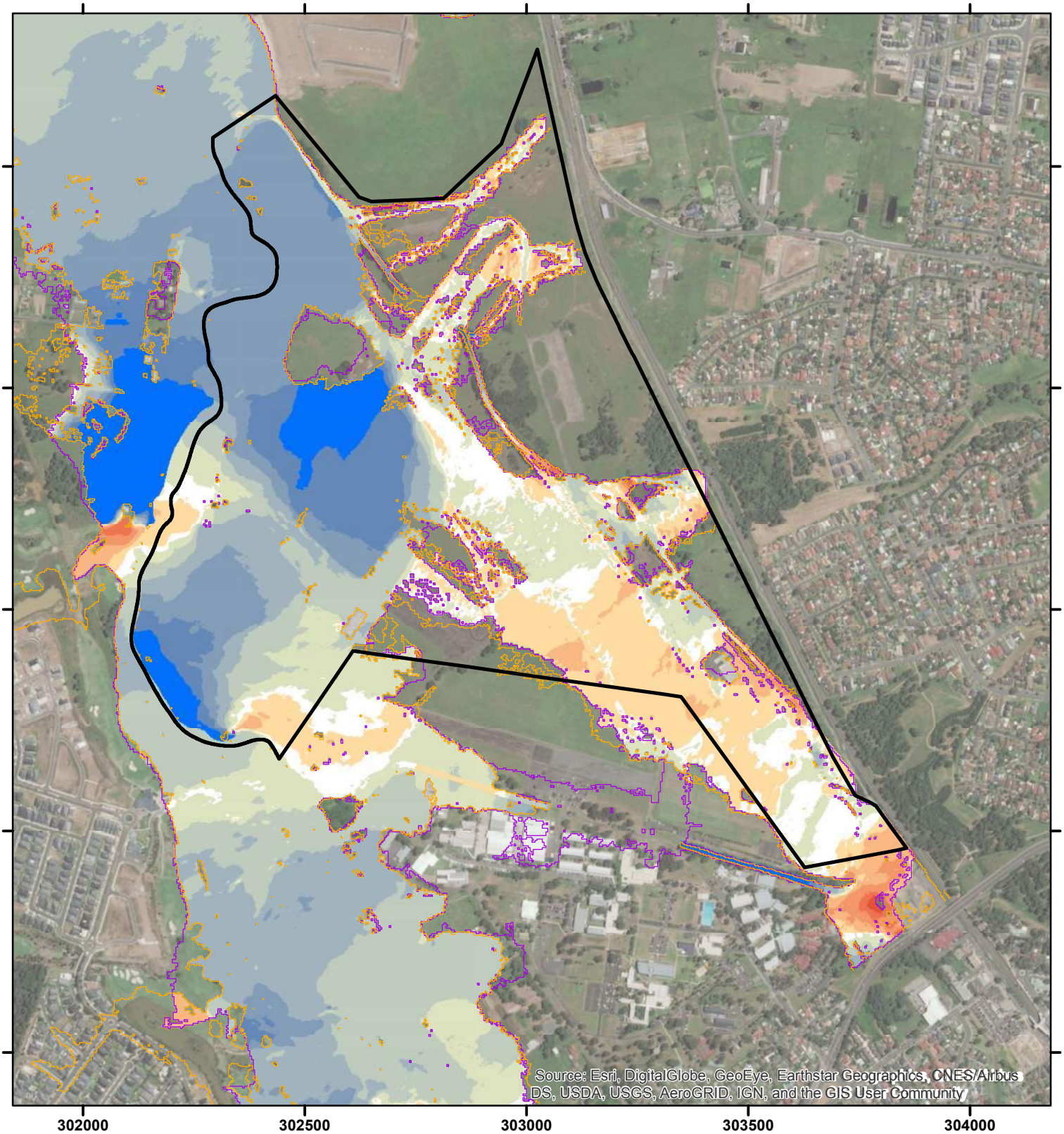
Figure 16 - 100 Year ARI Pre-Development Flood Extents Comparison



WL change [mm]

- >500
- 400-500
- 300-400
- 200-300
- 100-200
- 20-100
- -20-20
- -100- -20
- -200- -100
- -300- -200
- -400- -300
- -500- -400
- < -500

- Pre-development 100y extents (2016 model)
- Pre-development 100y extents (2012 model)
- Site Boundary

Positive value represents higher water levels in the DHA flood model compared to the 2016 Council flood model. Negative value represents lower water levels.

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	10/08/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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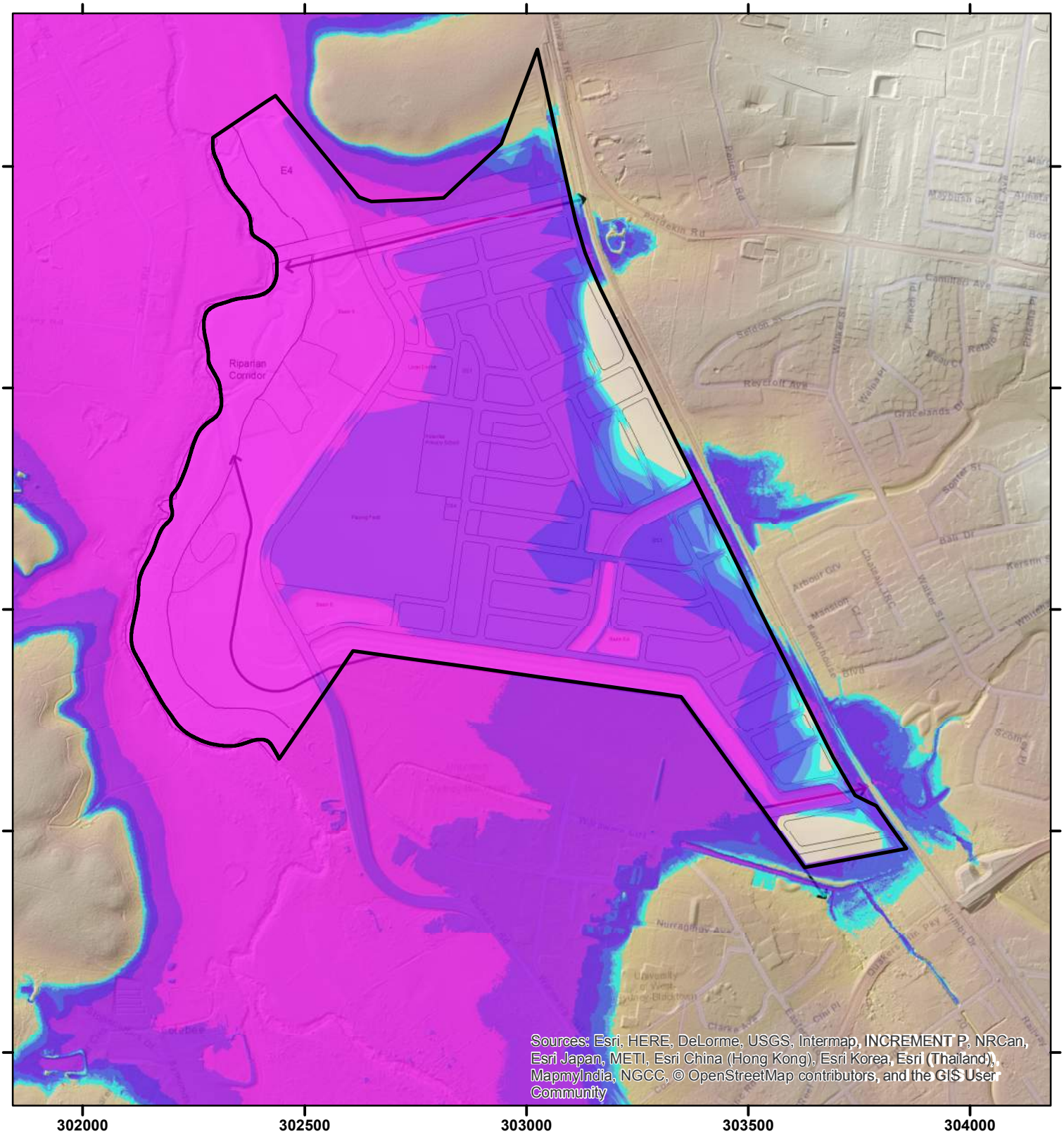
P:\BGE\SYD\S13026.01\300 GIS\Figures\DHA_PP\additional_figures_07 08 2018\S13026.01_A05_001.mxd

Figure 17 - Regional PMF Extents and Depth (26.4mAHD)



Max Depth [m]

- 0 - 0.3
- 0.3 - 0.5
- 0.5 - 1.0
- 1.0 - 2.0
- 2.0 - 5.0
- > 5.0
- Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	10/08/2018
APPROVED	BS		

N

1:12,000

0 0.1 0.2 0.4 Km

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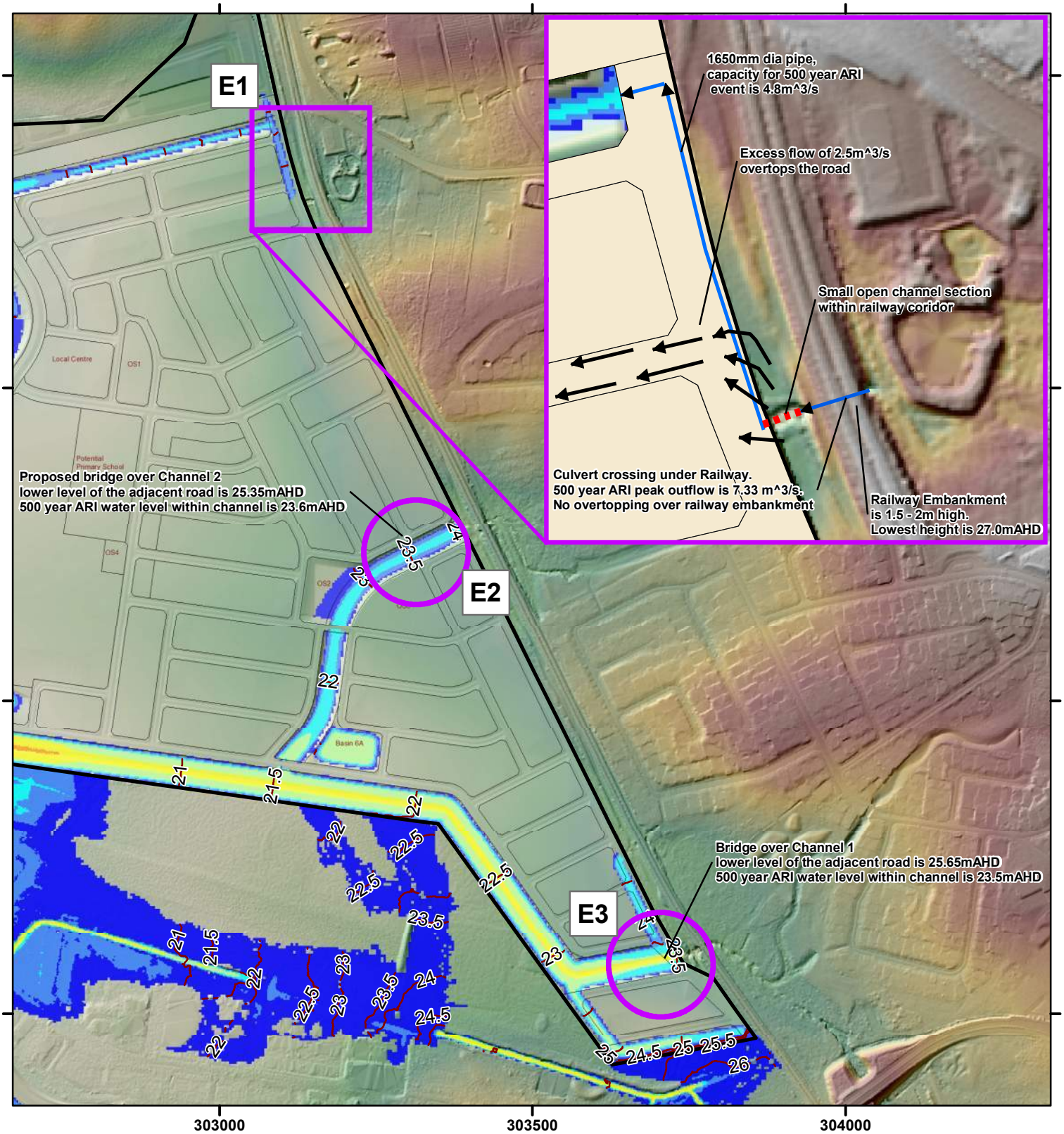
Figure 18 - Critical Evacuation Route Crossing for 500 Year ARI



Depth (m)

- 0 - 0.5
- 0.5 - 1.0
- 1.0 - 1.5
- 1.5 - 2.0
- 2.0 - 3.0
- 3.0 - 4.0
- Over 4

Flood Level (m AHD)

Site Boundary

DRAWN	AV	PROJECT	S13026
REVIEWED	BS	DATE	10/08/2018
APPROVED	BS		

N

1:8,500

0 0.075 0.15 0.3 Km

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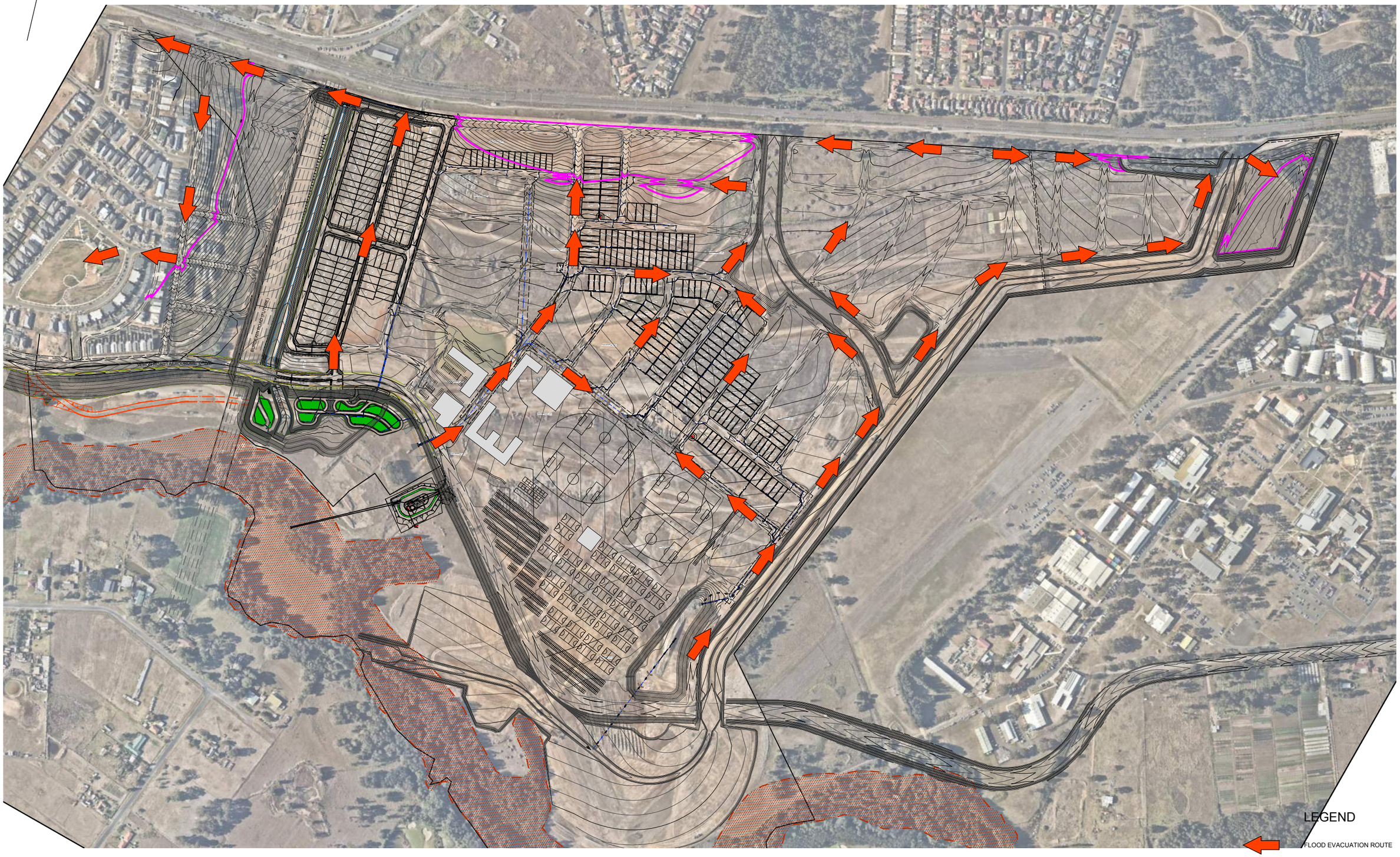
Appendix E – Flood Evacuation Routes

A1



ISSUED FOR INFORMATION

REV	DATE	AMENDMENT DESCRIPTION
A	04.07.18	ISSUED FOR INFORMATION

DIAL 1100 BEFORE YOU DIG

DHA Defence Housing Australia

Project: SCHOFIELDS AERODROME DEVELOPMENT

Principal: DEFENCING HOUSING AUSTRALIA

Scale	Date	Council Ref.
1:3000	18.06.18	
	Datum AHD	L.G.A. BLACKTOWN CITY COUNCIL

Calc's	Drawn.	Proj.Man.	Client Ref:
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APPROVED COMPANY ISO 9001 Quality Management System QMS 9862

Drawing Title: REGIONAL PMF EVACUATION ROUTE

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0187	A

DATE: 27/06/2018 C:\CRAIG_RHODES\SCH_CAD\1784\SK-0187.DWG - LAYOUT1 ▸ ▸ ▸ DATE PRINTED 10/07/2018 4:01:34 PM

Appendix F – Bio-retention Basin Layout & Sections

A1

ACCESS TRACK CONSTRUCTED AS PART OF STAGE 1 TO BE REMOVED TO FACILITATE CONSTRUCTION OF STAGE 2 BIO-FILTRATION CELLS.

BIO-FILTRATION UPFLOW PIT. REFER TO DETAIL 2 ON DRAWING No.0751 FOR DETAILS (TYPICAL).

BIO-FILTRATION INFLOW PIT. REFER TO DETAIL 3 ON DRAWING No.0751 FOR DETAILS

CONSTRUCT ROCLA CDS 1518 G.P.T. (OR APPROVED EQUIVALENT). INSTALL IN ACCORDANCE WITH MANUFACTURERS SPECIFICATION.

CONSTRUCT SPLITTER PIT TO DIVERT 6 MONTH FLOWS TO GPT. PIT TO BE CONVERTED TO KERB INLET PIT DURING FUTURE STAGE WORKS.

TEMPORARY DRAINAGE CHANNEL No.1 TO CONVEY FLOWS TO BASIN No.5. REFER TO DRAWING No.0106 FOR DETAILS.

PROVIDE ROCK CHECK DAMS EVERY 25mIN ACCORDANCE WITH BCC STANDARD DETAILS A(BS)116S

CONSTRUCT SPLITTER PIT TO DIVERT 6 MONTH FLOWS TO GPT.

TEMPORARY CHANNEL No.1

2400 (RESIDUE LOT)

FUTURE MEDIAN

BIO-FILTRATION OUTFLOW PIT. REFER TO DETAIL 1 ON DRAWING No.0751 FOR DETAILS

CONSTRUCT 300mm DISTRIBUTION PIPE TO CONNECT SYAGE 1 BIO-RETENTION FLOWS TO NEW FILTRATION CELL.

BIO-FILTRATION OUTFLOW PIT. REFER TO DETAIL 1 ON DRAWING No.0751 FOR DETAILS

RESIDUE LOT 4

BASIN No.5A

CHANNEL No.3 (MY03)

150mm THICK COMPACTED SANDSTONE ACCESS TRACK. 3m WIDE WITH 500mm SHOULDERS. REFER TO BCC WSUD SPECIFICATIONS.

BIO-FILTRATION UPFLOW PIT. REFER TO DETAIL 2 ON DRAWING No.0751 FOR DETAILS (TYPICAL)

STAGE 1 BASIN AND BERM TO BE REMOVED TO EXTEND THE DETENTION AND TREATMENT AREA TO SUIT STAGE 2 AND FUTURE DRAINAGE.

CONNECT BIO-FILTRATION FROM PROPOSED STAGE 2 CELLS TO STAGE 1 HEADWALL

3 75 PIPES AND WEIR CONSTRUCTED AS PART OF STAGE 1 WORKS

LOW FLOW PIPE

SLOT IN FUTURE MEDIAN TO PROVIDE EMERGENCY OVERLAND FLOW PATH TO BASIN No.5. 100 YEAR FLOWS PIPED TO BASIN No.5. SUBJECT TO DETAILED DESIGN.

FUTURE LOW FLOW PIPE TO DIRECT 6 MONTH FLOW TO STAGE 2 G.P.T.

CONSTRUCT TEMPORARY HEADWALL TO DISCHARGE PIPE FLOWS INTO TEMPORARY CHANNEL. PROVIDE CULVERT ENTRY SEDIMENT TRAP IN ACCORDANCE WITH BCC STANDARD DETAILS A(BS(116S.

2400 (RESIDUE LOT)

FUTURE SPLITTER PIT TO DIVERT LOW FLOWS TO STAGE 2 GPT.

BASIN No.5 (EXTENSION)

LOW FLOW CHANNEL GRADING TO BASIN No.5 OUTLET STRUCTURE. REFER TO DETAIL No.3 ON DRAWING No.0762. (TYP)

PROVIDE DUMPED ROCK SCOUR PROTECTION TO DOWNSTREAM SIDE OF HEADWALL (D_{50} 400mm) (TYPICAL FOR ALL OUTLETS)

CONSTRUCT BERM WITH 1:6 BATTER

PLAN
1:500

0 5 10 15 20 30 40 50m
1:500

DEVELOPMENT APPLICATION

BASIN 5 CHARACTERISTICS

VOLUME (Estimated)	нпррУ¤
FILTER AREA (Stage 1)	илуп Уч
FILTER AREA (Additional) (Estimated)	ннмо Уч
DEPTH	2.33m
TOP OF BERM LEVEL	RL 19.593
TOP WATER LEVEL	RL 19.48
OUTLETS	
3 x 750 dia.	IL 17.265
Weir (25.0 m)	RL 19.20
CATCHMENTS	
DEVELOPED AREA (TO OSD BASIN)	57.7 ha
DEVELOPED AREA (BYPASS)	0 ha
EXTERNAL AREAS	50.49 ha
TOTAL AREA	108.19 ha

NOTE:
OSD VOLUME AND FILTER AREA ARE ESTIMATED AND SUBJECT TO FURTHER DETAILED DESIGN

BASIN 5

ARI (YEAR)	PRE DEVELOPED FLOW (m3/s)	POST DEVELOPED FLOW (m3/s)	BASIN 5 TOP WATER LEVEL (m)
2.000	4.540	3.990	18.77
5.000	6.700	4.450	19.03
10.000	7.920	4.700	19.17
20.000	9.980	6.530	19.31
50.000	12.100	8.970	19.41
100.000	14.000	11.000	19.48

REV	DATE	AMENDMENT DESCRIPTION
A	07.06.18	ISSUED FOR DEVELOPMENT APPLICATION

Project: SCHOFIELDS AERODROME DEVELOPMENT STAGE 2

Principal: DEFENCE HOUSING AUSTRALIA
Scale: AS SHOWN @ A1 | Date: 04.06.18 | Council Ref.
Datum: A.H.D. | L.G.A.: BLACKTOWN CITY COUNCIL
Calc's: S.W. | Drawn: F.K. | Proj.Man.: F.C. | Client Ref:

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ACN 050 209 991 Tel. 9869-1855 Fax. 9869-2341 reception@crhodes.com.au www.craigandrhodes.com.au
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Drawing Title: CONCEPT BASIN No.5 EXTENSION PLAN

C&R Ref. 1784 | Drawing Ref. 1784C-DA-S2-0751 | Revision A

APPROVED COMPANY AS/NZS 4801 OH&S Management System; APPROVED COMPANY ISO 14001 Environmental Management System; APPROVED COMPANY ISO 9001 Quality Management Systems; QMS Bureau Veritas; DIAL 1100 BEFORE YOU DIG

A1

NOTE:

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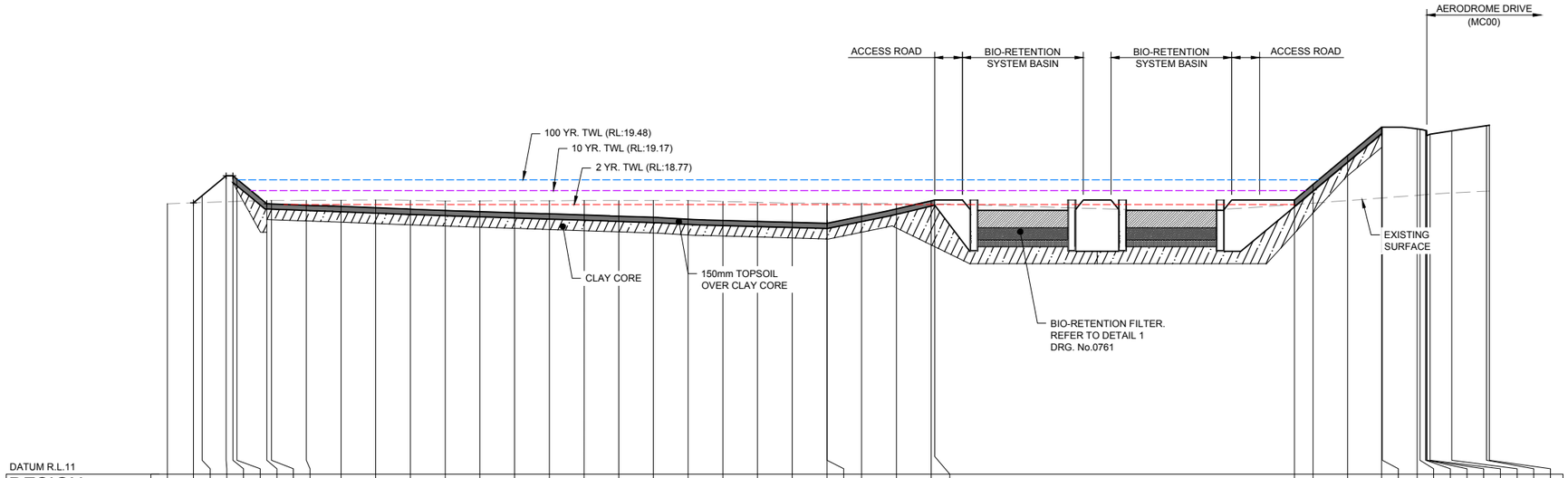
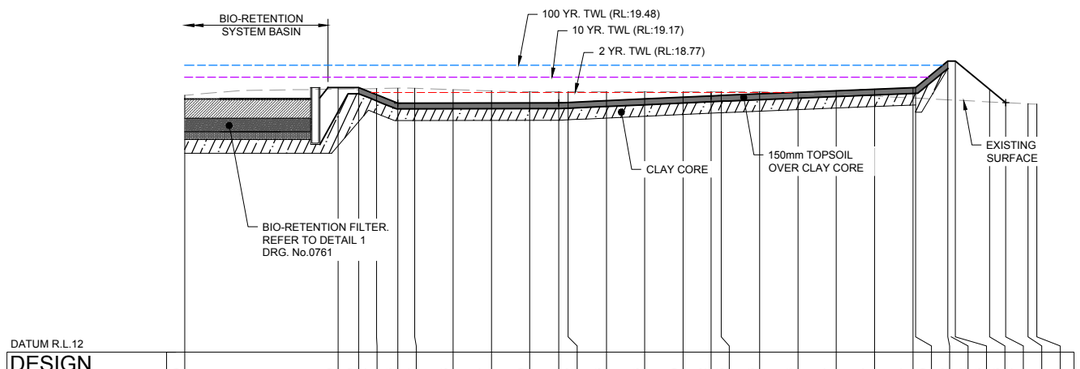


DATUM R.L.11

CHAINAGE	0	3.752	5	8.441	9.45	10	14.324	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	95.012	100	105	110	110.509	162.319	165	170	174.916	175	180	180.421	181.231	181.381	181.421	181.871	185	190	190.421
EXISTING LEVEL	18.791	18.817	18.826	18.850	18.857	18.861	18.881	18.882	18.888	18.893	18.899	18.890	18.870	18.874	18.877	18.879	18.881	18.883	18.885	18.883	18.856	18.830	18.808	18.802	18.802	18.797	18.791	18.786	18.785	18.770	18.808	18.880	18.955	18.956	19.034	19.040	19.053	19.055	19.056	19.063	19.101	19.153	19.157
DESIGN LEVEL		18.817	19.024	19.593	19.593	19.502	18.788	18.783	18.746	18.711	18.672	18.633	18.598	18.565	18.531	18.499	18.465	18.432	18.398	18.344	18.310	18.283	18.254	18.226	18.226	18.429	18.640	18.876	18.900	18.900	19.347	20.180	21.000	21.000	20.947	20.937	20.905	20.884	20.755	20.795	20.888	21.039	21.051

E 0751 SECTION

SCALE 1:400m (H) 1:80m (V)



DATUM R.L.12

CHAINAGE	0	20	22.676	25	27.777	30	35	40	45	48.789	50	55	60	65	68.648	70	75	80	85	90	95	95.339	99.533	100	100.541	105	107.115	110	111.164
EXISTING LEVEL	18.699	18.861	18.868	18.875	18.883	18.883	18.849	18.816	18.791	18.791	18.791	18.791	18.791	18.791	18.791	18.791	18.790	18.749	18.710	18.680	18.629	18.626	18.584	18.579	18.573	18.528	18.507	18.478	18.466
DESIGN LEVEL	18.900	18.900	18.900	18.717	18.493	18.494	18.495	18.497	18.499	18.501	18.512	18.558	18.603	18.649	18.682	18.695	18.736	18.776	18.817	18.857	18.897	18.900	19.593	19.593	19.593	18.856	18.507		

F 0751 SECTION

SCALE 1:400m (H) 1:80m (V)

0 0.8 1.6 2.4 3.2 4.8 6.4 8m
1:80

0 4 8 12 16 24 32 40m
1:400

DEVELOPMENT APPLICATION

APPROVED COMPANY AS/NZS 4801 OH&S Management System QMS
APPROVED COMPANY ISO 14001 Environmental Management System QMS
APPROVED COMPANY ISO 9001 Quality Management Systems QMS
DIAL 1100 BEFORE YOU DIG

REV	DATE	AMENDMENT DESCRIPTION
A	07.06.18	ISSUED FOR DEVELOPMENT APPLICATION

DHA Defence Housing Australia

Project: SCHOFIELDS AERODROME DEVELOPMENT STAGE 2

Principal: DEFENCE HOUSING AUSTRALIA

Scale	Date	Council Ref.
AS SHOWN @ A1	04.06.18	
	Datum A.H.D.	L.G.A. BLACKTOWN CITY COUNCIL

Calc's	Drawn.	Proj.Man.	Client Ref:
S.W.	F.K.	F.C.	

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Drawing Title: CONCEPT BASIN No.5 EXTENSION SECTIONS SHEET 1 OF 2

C&R Ref.	Drawing Ref.	Revision
1784	1784C-DA-S2-0753	A

DATE PRINTED: 7/06/2018 2:42:39 PM

A1

NOTE:

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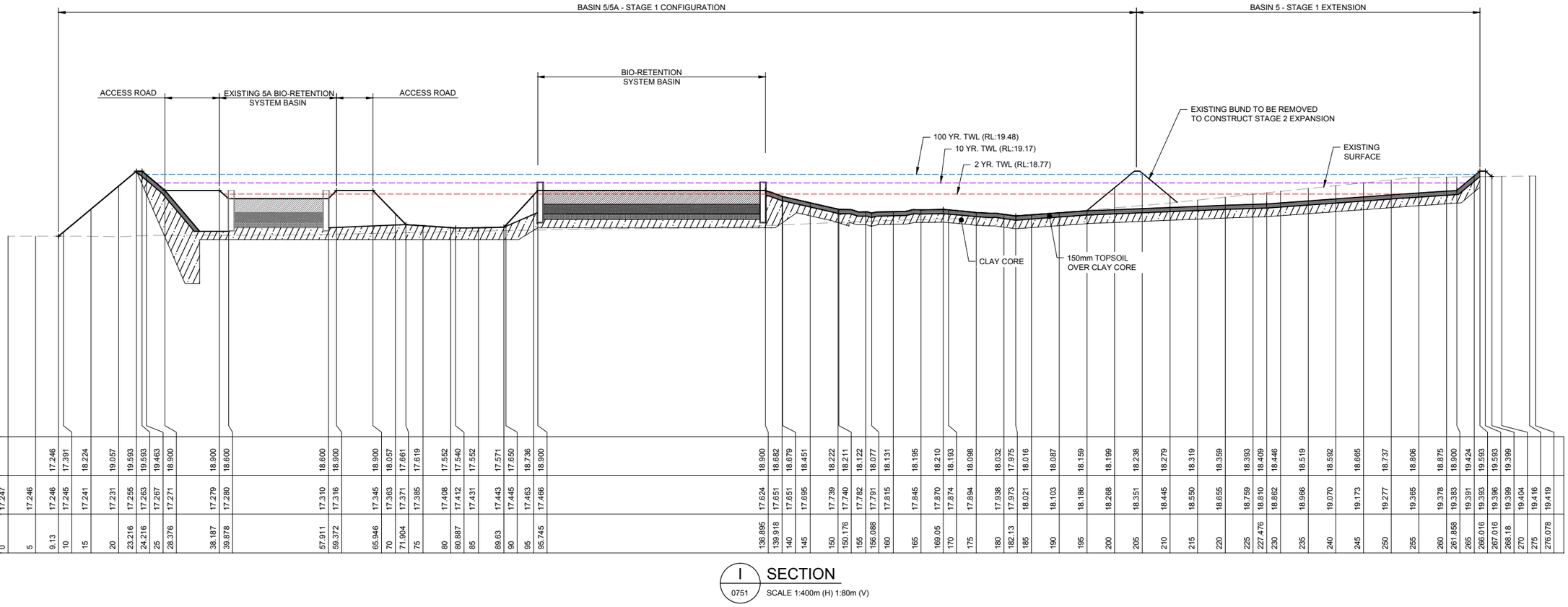

DATUM R.L.10

| | | |

A1

RESERVE 980

MC32

ROAD No.2 (MC02)

CHANNEL 1

MUSTANG DRIVE (MC00)

ACCESS TRACK IN ACCORDANCE WITH BCC WSUD SPECIFICATION.

1:5 BATTER SLOPE.

BIO-RETENTION SYSTEM BASIN IN ACCORDANCE WITH BCC WSUD SPECIFICATION

1:5 BATTER SLOPE.

BASIN OUTLET TO COMPENSATORY CUT

CATCHMENT DISCHARGE

LOW FLOW CHANNEL

ROAD VERGE TO BE IN ACCORDANCE WITH BCC STANDARD REQUIREMENTS

PLAN
1:500

BASIN 6	
FLOOR RL	18.45
TWL	19.89
VOLUME	12000m³
MINIMUM BIO-RETENTION FILTER AREA	3000m²

NOTE:
STORMWATER NETWORK IS INDICATIVE ONLY AND SUBJECT TO FUTURE DETAILED DESIGN.

0 5 10 15 20 30 40 50m
1:500

FOR INFORMATION ONLY

REV	DATE	AMENDMENT DESCRIPTION
B	17.08.18	ISSUED FOR INFORMATION
A	17.08.18	ISSUED FOR INFORMATION

DIAL 1100 BEFORE YOU DIG

DHA Defence Housing Australia

Project:
SCHOFIELDS AERODROME DEVELOPMENT
WATER CYCLE MANAGEMENT REPORT

Principal: DEFENCE HOUSING AUSTRALIA

Scale	1:500	Date	07.08.2018	Council Ref.	
		Datum	AHD	L.G.A.	BLACKTOWN CITY COUNCIL
Calc's	S.W.	Drawn	J.H.	Proj.Man.	F.C.

Client Ref:

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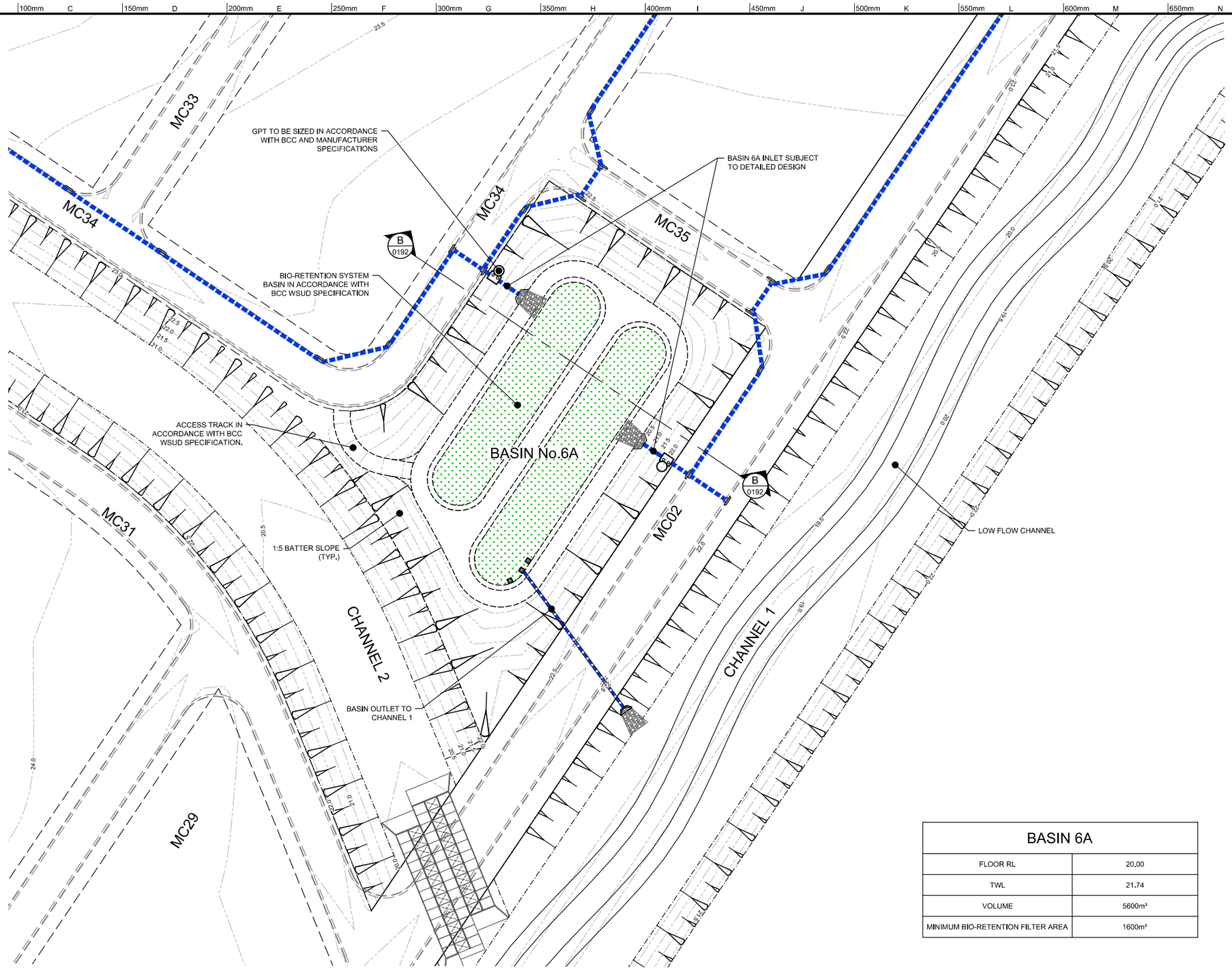
APPROVED COMPANY ISO 9001 Quality Management QMS REG

Drawing Title
BASIN 6
CONCEPT LAYOUT PLAN

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0188	B

CAD REF: J:\1784\DA_ENGINEERING\CAD\1784C-SK-0188.DWG - LAYOUT1 - 7/08/2018 4:48:16 PM

A1



PLAN
1:500

BASIN 6A	
FLOOR RL	20.00
TWL	21.74
VOLUME	5600m³
MINIMUM BIO-RETENTION FILTER AREA	1600m²

NOTE:
STORMWATER NETWORK IS INDICATIVE ONLY AND SUBJECT TO FUTURE DETAILED DESIGN.

0 5 10 15 20 30 40 50m
1:500

FOR INFORMATION ONLY

REV	DATE	AMENDMENT DESCRIPTION
B	21.08.18	ISSUED FOR INFORMATION
A	17.08.18	ISSUED FOR INFORMATION

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DHA Defence Housing Australia

Project:
SCHOFIELDS AERODROME DEVELOPMENT
WATER CYCLE MANAGEMENT REPORT

Principal: DEFENCE HOUSING AUSTRALIA
Scale: 1:500 | Date: 07.08.2018 | Council Ref.:
Datum: AHD | L.G.A.: BLACKTOWN CITY COUNCIL
Calc's: S.W. | Drawn: J.H. | Proj.Man.: F.C. | Client Ref.:

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APPROVED COMPANY ISO 9001 Quality QMS

Drawing Title:
BASIN 6A
CONCEPT LAYOUT PLAN

C&R Ref.: 1784 | Drawing Ref.: 1784C-SK-0189 | Revision: B

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A1

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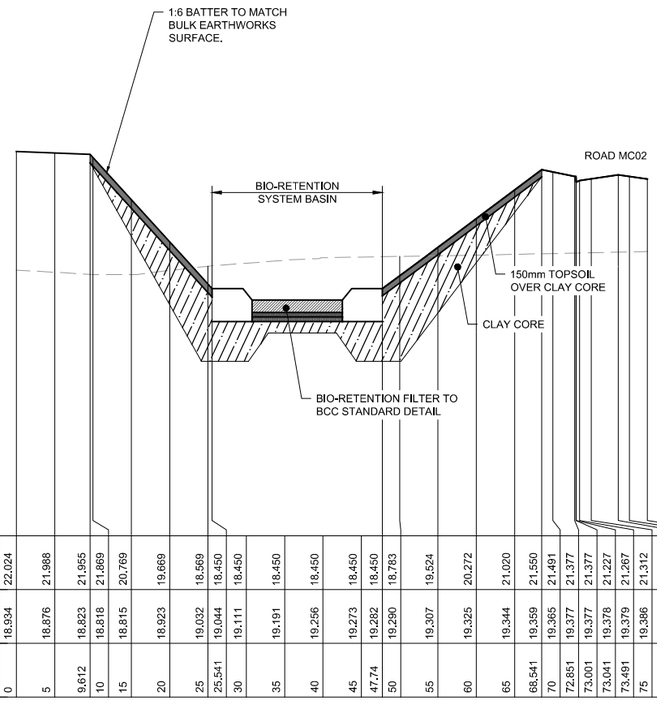

DATUM R.L.12

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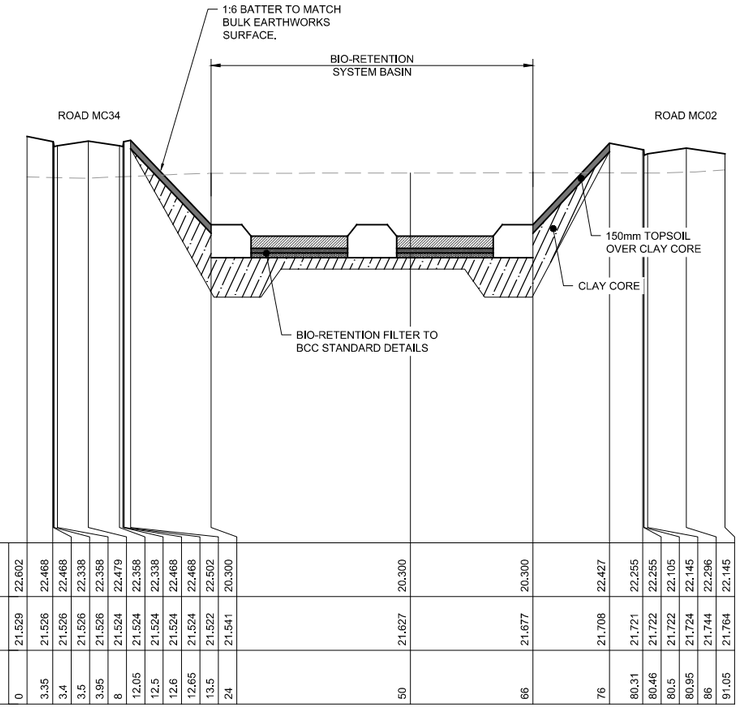
DESIGN LEVEL	22.024	21.988	21.955	21.869	20.769	19.669	18.569	18.450	18.450	18.450	18.450	18.450	18.450	18.783	19.524	20.272	21.020	21.550	21.491	21.377	21.377	21.227	21.267	21.312	21.419	21.375	21.305
EXISTING LEVEL	18.934	18.876	18.823	18.818	18.815	18.923	19.032	19.044	19.111	19.191	19.256	19.273	19.282	19.290	19.307	19.325	19.344	19.359	19.365	19.377	19.377	19.378	19.379	19.386	19.401	19.407	19.417

A 0188 SECTION

SCALE 1:400m (H) 1:80m (V)



DATUM R.L.12

CHAINAGE	0	3.35	3.4	3.5	3.95	8	12.05	12.5	12.6	12.65	13.5	24	50	66	76	80.31	80.46	80.5	80.95	86	91.05
DESIGN LEVEL	22.602	22.468	22.468	22.338	22.358	22.479	22.358	22.338	22.468	22.468	22.502	20.300	20.300	20.300	22.427	22.255	22.255	22.105	22.145	22.296	22.145
EXISTING LEVEL	21.529	21.526	21.526	21.526	21.526	21.524	21.524	21.524	21.524	21.524	21.522	21.541	21.627	21.677	21.708	21.721	21.722	21.722	21.724	21.744	21.764

B 0189 SECTION

SCALE 1:400m (H) 1:80m (V)

0 0.8 1.6 2.4 3.2 4.8 6.4 8m
1:80

0 4 8 12 16 24 32 40m
1:400

FOR INFORMATION ONLY

APPROVED COMPANY AS/NZS 4801 OH&S Management System QMS
APPROVED COMPANY ISO 14001 Environmental Management System QMS
APPROVED COMPANY ISO 9001 Quality Management Systems QMS
DIAL 1100 BEFORE YOU DIG

REV	DATE	AMENDMENT DESCRIPTION
B	22.08.18	ISSUED FOR INFORMATION
A	17.08.18	ISSUED FOR INFORMATION

DHA Defence Housing Australia

Project: SCHOFIELDS AERODROME DEVELOPMENT
WATER CYCLE MANAGEMENT REPORT

Principal: DEFENCE HOUSING AUSTRALIA

Scale	AS SHOWN @ A1	Date	04.06.18	Council Ref.	
		Datum	A.H.D.	L.G.A.	BLACKTOWN CITY COUNCIL
Calc's	S.W.	Drawn.	F.K.	Proj.Man.	F.C.	Client Ref:

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Drawing Title: BASIN No.6 & No.6A CONCEPT BASIN SECTIONS

C&R Ref.	Drawing Ref.	Revision
1784	1784C-SK-0192	B

DATA REF: J:\1784\DA_DWGS\1784C-SK-0192.DWG -3-4-3-4- DATE PRINTED: 22/08/2018 11:17:12 AM

Appendix G – Concept Sewer Master Plan

A1

WATER SERVICING STRATEGY

EXISTING DN800 PE WATER MAIN

BURDEKIN RD

RAILWAY TCE

QUAKERS HILL

NIRIMBA DRIVE

EXISTING DN150 CICL WATER MAIN

PW MAIN TO BE DELIVERED BY STOCKLANDS. TIMING FOR THE DELIVERY OF THIS ASSET TO BE CONFIRMED.

FUTURE BURDEKIN ROAD

DRAINAGE CHANNEL 3

1A

2A

3(TBC)

5

6

7

2B

2C

2D

3

4

DRAINAGE CHANNEL 2

EXISTING DN150 PVC WATER MAIN

1B

OPTION (B) TEMP. SWC MAIN WITH 2.5m(W) EASMENT

OPTION (A) PREFERED ULTIMATE SOLUTION – SWC MAIN WITH 2.5m(W) EASMENT

DRAINAGE CHANNEL 1

NIRIMBA DRAINAGE LAND

UNIVERSITY WESTERN SYDNEY NIRIMBA CAMPUS

DELIVERY (BY/WHEN) FOR THE ACCESS ROAD TO BE CONFIRMED

POTABLE WATERMAIN IS REQUIRED TO SERVICE SPS 1202. PLEASE CONFIRM TIMING AND RESPONSIBLE PARTY (C&R OR AAJV) FOR THE DELIVERY OF THIS ASSET.

FUTURE AERODROME DRIVE

KERRY ROAD

EXISTING DN100 CICL WATER MAIN

QUAKERS ROAD

LEGEND

- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5
- STAGE 6
- STAGE 7
- STAGE 3 (TBC)
- FUTURE DN100 WATER MAIN
- FUTURE DN150 WATER MAIN
- EXISTING WATER MAIN

SCOPE OF:

STAGE 1

- FUTURE DN100 WATER MAIN
- FUTURE DN150 WATER MAIN

STAGE 2

- FUTURE DN100 WATER MAIN
- FUTURE DN150 WATER MAIN

DISCLAIMER

PRELIMINARY PLAN SUBJECT TO CHANGE

0 30 60 90 120 150 300 METRES

REF. 1784

PLAN DRAWN DATE:

VERSION:

SHEET OF SHEETS

PLAN TO BE READ IN CONJUNCTION WITH CURRENT SYDNEY WATER STANDARDS
SYDNEY WATER CORPORATION

PRIOR TO COMMENCEMENT OF EXCAVATION FOR PROPOSED AND EXISTING SERVICES CONTACT :-

DIAL BEFORE YOU DIG	Ph. 1100
ELECTRICITY	Ph.
GAS	Ph.
TELECOMMUNICATIONS	Ph.
	Ph.

GIVING AT LEAST 48 HOURS NOTICE.

UTILITIES

TYPE	DATE	REF.	TYPE	DATE	REF.

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER _____

WATER SERVICE CO-ORDINATOR _____

CONSTRUCTOR _____

COMPLETED _____ W.A.C. PREPARED _____

DESIGNER _____

I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS.

PIPE SCHEDULE

SIZE DN	TYPE	CLASS	LENGTH	PIPE JOINING METHOD / NOTES

DESIGN HEAD ____ m

BOUNDARY TRAPS REQUIRED.

AUSTRALIAN HEIGHT DATUM

SCALES

PLAN _____ SECTION { HOR. _____ VERT. _____

CROSS SECTIONS _____ NATURAL

LENGTHS: DEPTHS & LEVELS ARE IN METRES.

NO AMENDMENTS ARE TO BE MADE TO THIS PLAN WITHOUT REFERENCE TO SYDNEY WATER. THIS PLAN IS NOT NECESSARILY UP TO DATE OR CORRECT AND SYDNEY WATER ACCEPTS NO RESPONSIBILITY.

U.B. DIRECTORY _____

SHEET ____ OF ____ File No. _____

Sydney WATER

SYDNEY WATER CORPORATION

A1

SEWER SERVICING STRATEGY

BURDEKIN RD

RAILWAY TCE

QUAKERS HILL

NIRIMBA DRIVE

INDICATIVE LOCATION OF ELEC. SUBSTATION

FUTURE BURDEKIN ROAD

DRAINAGE CHANNEL 3

1A

2A

3(TBC)

2B

2C

2D

1B

3

4

5

6

7

DRAINAGE CHANNEL 2

DRAINAGE CHANNEL 1

NIRIMBA DRAINAGE LAND

3-WW-SCH2 DN300 SEWER LEAD-IN

EXISTING SCHOFIELDS SEWER CARRIER SECTION 1 DN300 PP SN10

DN450 GRAVITY SEWER MAIN

DN355 PRESSURE SEWER MAIN

DN355 PRESSURE SEWER MAIN

CH 222.02

CH 93.44

CH 0.00

FUTURE SCHOOL

INDICATIVE LOCATION OF ELEC. SUBSTATION TO BE MOVED (CURRENTLY DISCUSSED)

STORMWATER AND SEWER DESIGN COORDINATION REQUIRED.

FUTURE SPS1202 (BY OTHERS)

DATA BY AAJV-T.B.C.
RL:17.10
IL:12.04
DEPTH: 5.06m
DEFLECTION OF INLET T.B.C.

FUTURE SEWER GRAVITY LEAD-IN

FUTURE AERODROME DRIVE

CH 515.33

CH 773.52

CH 1005.30

ROAD DETAIL DESIGN REQUIRED FOR M.H. LEVELS. CONSTRUCTION PROGRAM REQUIRED FOR COORDINATION.

STORMWATER BATTER AND OUTLET TO BE RENEWED.

BOX CULVERT. LEVELS REQUIRED TO FINALISE SEWER LEAD-IN CROSSING.

ELECTRICAL SUB-STATION

UNIVERSITY WESTERN SYDNEY
NIRIMBA CAMPUS

EXISTING PRIVATE PRESSURE SEWER TO BE DISUSED

NIRIMBA PRIVATE PUMP STATION

ADE (ADVICE DESIGN ENTRY) ATTAINED. SURVEY REQUESTED, PLEASE CONTACT MATT COOPER FOR DETAILS.

BY AAJV-DATA T.B.C.
RL:20.00
IL:16.80
DEPTH: 3.20m

QUAKERS ROAD

KERRY ROAD

- STAGE 1 TO DRAIN TO EXISTING 3-WW-SCH2 SEWER LEAD-IN
- ALL OTHER STAGES TO DRAIN TO PUMPSTATION SPS1202

SCOPE OF:

STAGE 1
FUTURE DN150 SEWER MAIN

STAGE 2
FUTURE DN150 SEWER MAIN

LEAD-N
DN450 SEWER
DN300 SEWER

DISCLAIMER

PRELIMINARY PLAN SUBJECT TO CHANGE.

LEGEND

- STAGE 1
- STAGE 2
- STAGE 3
- STAGE 4
- STAGE 5
- STAGE 6
- STAGE 7
- STAGE 3 (TBC)
- FUTURE SEWER MAIN
- FUTURE SEWER MAINTENANCE HOLE
- EXISTING GRAVITY SEWER
- FUTURE PRESSURE SEWER
- EXISTING PRESSURE SEWER

0 30 60 90 120 150 300 METRES

REF. 1784

PLAN DRAWN DATE:

VERSION:

SHEET OF SHEETS

PLAN TO BE READ IN CONJUNCTION WITH CURRENT SYDNEY WATER STANDARDS
SYDNEY WATER CORPORATION

PRIOR TO COMMENCEMENT OF EXCAVATION FOR PROPOSED AND EXISTING SERVICES CONTACT :-

DIAL BEFORE YOU DIG Ph. 1100
ELECTRICITY Ph.
GAS Ph.
TELECOMMUNICATIONS Ph.
Ph.

GIVING AT LEAST 48 HOURS NOTICE.

UTILITIES

TYPE	DATE	REF.	TYPE	DATE	REF.

WORK AS CONSTRUCTED CERTIFICATION

DEVELOPER
WATER SERVICE CO-ORDINATOR
CONSTRUCTOR
COMPLETED W.A.C. PREPARED

DESIGNER

I CERTIFY THAT THE WORKS HAVE BEEN CONSTRUCTED IN ACCORDANCE WITH THE WORK AS CONSTRUCTED DRAWINGS.

PIPE SCHEDULE

SIZE DN	TYPE	CLASS	LENGTH	PIPE JOINING METHOD / NOTES

DESIGN HEAD ____m

BOUNDARY TRAPS REQUIRED.

AUSTRALIAN HEIGHT DATUM

SCALES

PLAN ____ SECTION HOR. ____ VERT. ____

CROSS SECTIONS ____ NATURAL

LENGTHS: DEPTHS & LEVELS ARE IN METRES.

NO AMENDMENTS ARE TO BE MADE TO THIS PLAN WITHOUT REFERENCE TO SYDNEY WATER. THIS PLAN IS NOT NECESSARILY UP TO DATE OR CORRECT AND SYDNEY WATER ACCEPTS NO RESPONSIBILITY.

U.B. DIRECTORY ____

SHEET ____ OF ____ File No. ____

Sydney WATER

SYDNEY WATER CORPORATION

APPENDIX 10 – SCHOFIELDS DRAINAGE OFFSET STRATEGY

General Manager
Blacktown City Council
62 Flushcombe Road,
Blacktown NSW 2148

ECO LOGICAL AUSTRALIA PTY LTD
ABN 87 096 512 088
www.ecoaus.com.au

Attention Georg Eberl

11 February 2015

Dear Sir

Biodiversity Offset Strategy for Drainage Infrastructure, Lot 400 DP 1171596, Schofields.

This letter relates to matters discussed with Georg Eberl (Blacktown City Council) at a meeting with Defence Housing Australia and the NSW Department of Planning and Environment on the 21 January 2015.

Eco Logical Australia (ELA) was engaged by Defence Housing Australia (DHA) to develop an offset strategy for impacts to Existing Native Vegetation that would be caused by stormwater infrastructure at lot 400 DP 1171596. This document proposes a biodiversity offset solution to the impact and proposes that Council seek endorsement of this solution from the NSW Department of Planning and Environment as required by the SEPP (Growth Centres).

Background

DHA prepared technical documentation to support a development application to Blacktown City Council for bulk earthworks in the Schofields precinct. During preparation of the DA, Blacktown City Council advised that stormwater management is to be in accordance with a s94 Contribution Plan (currently with Department of Planning & Environment for approval) drafted by Blacktown City Council. The plan provides for a stormwater drainage alignment that would impact on an area mapped as Existing Native Vegetation under the Schofields Precinct Plan. As explained below, due to the effect of the planning instruments and the Biodiversity Certification Order, it is understood that Council cannot consent to such an impact. In order for the drainage alignment to be implemented, it is necessary to split the assessment process so that the majority of works are assessed as part of a DA to be submitted by DHA, whilst a small section of works in the riparian zone (where the Existing native vegetation is to be impacted) are assessed by Council under part 5 of the EP&A Act as development that is permissible without consent. In order to satisfy the Department of Planning that the outcome will be consistent with the Biodiversity Certification Order, a strategy to offset impacts to Existing Native Vegetation is required.

Figure 1 shows the proposed infrastructure in relation to the Existing Native Vegetation. Figure 2 shows the proposed offset area and vegetation communities in the vicinity of the works.

Planning Context

The Schofields Precinct Plan 2012 (Growth Centres SEPP 2006) establishes the zoning and development controls for the subject site. The majority of stormwater infrastructure is located on land zoned SP2 (Drainage),

an E2 (Environmental Conservation) zone separates the SP2 (Drainage) zoned land from Eastern Creek where stormwater will ultimately be discharged.

To access the discharge point on Eastern creek, the stormwater must pass through land zoned E2 which also contains native vegetation mapped as Existing Native Vegetation (ENV) on the SEPP maps. However, clause 6.5 of the Schofields Precinct Plan states:

> *(4) The consent authority must not grant development consent for development on land to which this clause applies unless it is satisfied that the proposed development will not result in the clearing of any existing native vegetation (within the meaning of the relevant biodiversity measures under Part 7 of Schedule 7 to the Threatened Species Conservation Act 1995).*

It is therefore not possible for Council to grant consent to a development application that includes the drainage alignment shown in the Draft s94 Plan.

However, Section 5.12 of the Schofields Precinct Plan allows for impacts to Existing native Vegetation in certain circumstances:

> *(1) This Precinct Plan does not restrict or prohibit, or enable the restriction or prohibition of, the carrying out of any development, by or on behalf of a public authority, that is permitted to be carried out with or without development consent, or that is exempt development, under State Environmental Planning Policy (Infrastructure) 2007.*

In order to proceed with this alignment, the part of the drainage line that passes through the ENV must therefore be assessed by Council under Part 5 of the EP&A Act 1979.

When such works are proposed, consultation with the Department of Planning and Environment is required by s18A of the Growth Centres SEPP 2006. The Department has a responsibility to ensure proposed impacts are consistent with the Biodiversity Certification Order (2007). The Order allows for impacts to ENV in certain circumstances during the development phase of the Growth Centres, as per Condition 11 of the Certification Order:

> *11. Where there are essential infrastructure proposals, including but not limited to proposals under Part 3A of the Environmental Planning and Assessment Act 1979, that involve clearing of existing native vegetation in the non-certified areas and that do not require development consent under the SEPP, such clearing must be offset by applying the same requirements specified in condition 8 above.*
>
> *In this case the offsets may be located outside of the Growth Centres (but within the Cumberland Plain of Western Sydney, as defined in condition 32) if the GCC is satisfied that there are no practicable offset options within the Growth Centres and all other requirements of condition 8 will be met. However, any offsets outside the Growth Centres cannot be counted towards meeting the requirements of condition 6.*

In order for the development to proceed with the drainage alignment shown in the Draft s94 Contribution Plan, the drainage infrastructure will need to be assessed under two processes:

- The bulk earthworks and majority of the drainage channel is to be assessed by Blacktown City Council under Part 4 of the EP&A Act 1979. Supporting technical documents will provided by the proponent (DHA).
- The discharge point of the drainage channel will be assessed under Part 5 of the EP&A Act 1979 by Blacktown City Council. Consultation with the Department of Planning and Environment would be required for the impacts and offsets for the Existing Native Vegetation.

Biodiversity Values

The Existing Native Vegetation impacted by the proposal has been mapped as Alluvial Woodland in moderate condition (**Figure 1**). The proposed alignment flows into Eastern Creek in the west of the study area. The vegetation is subject to ongoing edge effects, compaction of soils, slight slumping of creek banks and infestation of exotic vegetation. The canopy is native and represented by one species *Casuarina glauca* (Swamp Oak). The ground cover is mixed with native and exotic herbs. Woody weeds and exotic vines are also present.

The proposed offset area is located immediately south of the proposed drainage alignment (**Figure 1**). The proposed offset is mapped as Alluvial Woodland interspersed with Disturbed Grassland. The vegetation condition varies. Alluvial Woodland is in good to moderate condition. It is dominated by a canopy of *Casuarina glauca* and a dense cover of native grasses, *Microlaena stipoides* (Weeping Grass). Native shrubs are sparse. A few *Acacia parramattensis* (Parramatta Wattle) and *Ozothamnus diosmifolius* (Rice Flower) were present. Disturbed Grassland has low native species diversity. The vegetation consists of exotic pastoral grasses including: *Eragrostis curvula* (African Lovegrass) and *Setaria parviflora*. Few native herbs are scattered within the grassland and the occasional native grass. A large patch of *Rubus fruticosus* agg. (Blackberry) has been mapped within the Disturbed Grassland. Grazing by feral animals was noted within this patch. This area is suitable for revegetation through careful weed management and occasional planting of native species.

A small population of *Grevillea juniperina* subsp. *juniperina* is located between the potential offset area and the proposed drainage alignment. *Grevillea juniperina* subsp. *juniperina* is listed as vulnerable under the TSC Act. No direct impact to the patch will occur to the population and mitigation measures will be implemented to prevent indirect impacts during the construction process.

Proposed alignment and offset requirements

The proposed drainage alignment is shown in Figures 1 and 2. The impact to Existing Native Vegetation is 0.22 ha.

The Growth Centres Biodiversity certification Order allows for two offsetting scenarios under Condition 8:

(a) the protection of an equal or greater area of existing native vegetation elsewhere in the Growth Centres; and/or

(b) the revegetation and/or restoration of an area of land elsewhere in the Growth Centres, subject to satisfying the following,

i. that the clearance of existing native vegetation in the non-certified areas will not affect the capacity to achieve overall improvement or maintenance of biodiversity values for threatened species, populations and ecological communities and their habitats,

ii. ii. the revegetated and/or restored areas will be protected,

iii. iii. the extent of revegetation and/or restoration compared to clearing of existing native vegetation must be undertaken at a ratio of at least 3:1 (to reflect the greater ecological risks relative to retaining existing native vegetation),

iv. iv. areas subject to revegetation and/or restoration must be of a suitable boundary configuration and design to support long-term management,

v. v. revegetation and/or restoration of the proposed areas would not be undertaken under another scheme or regulatory requirement already in operation at the time that the clearing is approved (this includes but is not limited to any approvals, and associated conditions of such approvals, that may be required under the Rivers and Foreshores Improvement Act 1948 and Water Management Act 2000),

vi. vi. revegetation and/or restoration will be undertaken by suitably qualified and experienced persons using indigenous plant stock, and

vii. vii. sufficient resources will be made available to undertake the revegetation and/or restoration and any necessary follow-up maintenance and monitoring for a minimum period of 5 years following the commencement of the revegetation and/or restoration.

The offset would therefore need to be either:

- 0.22 ha of Existing Native Vegetation; or
- 0.66 ha of rehabilitation.

No areas of Existing Native Vegetation are available for protection elsewhere in the DHA site without impacting on other development landuses. Given the small area of impact involved (0.22ha) it is therefore proposed that an offset involving at least 0.66 ha of rehabilitation is reasonable.

Proposed offset approach

ELA understands that to date, most offsets have been targeted on areas of Existing Native Vegetation elsewhere in the Growth Centres that have not already been identified for protection. However as many of the precinct plans have been prepared, finding such areas has become more difficult. No areas of existing native vegetation within the Schofields Precinct area available for offset without jeopardising other land uses within the precinct. Offsetting impacts of the drainage discharge point will therefore need to focus on the alternative approach allowed for by Condition 8b(iii) of the Biodiversity Certification Order.

An area of 0.67 ha as shown on Figure 2 is proposed as the offset site. It is proposed that the area shown on Figure 2 be rehabilitated as part of the Vegetation Management Plan that is required to be prepared for the E2 zoned land. The following table shows how the offset is consistent with Condition 8 of the Certification Order.

Condition	Consistency of offset
b. the revegetation and/or restoration of an area of land elsewhere in the Growth Centres, subject to satisfying the following,	
i. that the clearance of existing native vegetation in the non-certified areas will not affect the capacity to achieve overall improvement or maintenance of biodiversity values for threatened species, populations and ecological communities and their habitats,	The proposed revegetation will enhance the biodiversity values by rehabilitating vegetation that is adjoining the ENV and E2 lands.
ii. the revegetated and/or restored areas will be protected,	The revegetation areas are zoned SP2 and are not required for infrastructure purposes. The zoning would remain the same and therefore prevent the area from being developed at a later date.
iii. the extent of revegetation and/or restoration compared to clearing of existing native vegetation must be undertaken at a ratio of at least 3:1 (to reflect	The revegetation would be undertaken within an area of 0.67 ha which is at least 3 times the impact area,

the greater ecological risks relative to retaining existing native vegetation),	therefore satisfying this condition.
iv. areas subject to revegetation and/or restoration must be of a suitable boundary configuration and design to support long-term management,	The restoration area will adjoin the ENV and E2 lands that were to be subject to a Vegetation Management Plan and will therefore consolidate the vegetation in this area.
v. revegetation and/or restoration of the proposed areas would not be undertaken under another scheme or regulatory requirement already in operation at the time that the clearing is approved (this includes but is not limited to any approvals, and associated conditions of such approvals, that may be required under the Rivers and Foreshores Improvement Act 1948 and Water Management Act 2000),	The proposed offset area is not on waterfront land as defined by the Water Management Act and also outside the area zoned E2 and is therefore on land that does not have an obligation for restoration under other legislation.
vi. revegetation and/or restoration will be undertaken by suitably qualified and experienced persons using indigenous plant stock, and	A Vegetation Management Plan will be prepared and implemented by a suitable qualified person using indigenous plant stock.
vii. sufficient resources will be made available to undertake the revegetation and/or restoration and any necessary follow-up maintenance and monitoring for a minimum period of 5 years following the commencement of the revegetation and/or restoration.	The Vegetation Management Plan will include implementation and monitoring as required by this condition. The works will be funded by DHA. If the site is sold or the works contracted to a third party DHA will ensure arrangements are in place to meet these obligations.

Conclusion

The proposed offset site is consistent with the Certification Order and is a practical solution given the land is under the control of the developer. It enhances the conservation outcome by expanding the area managed under a VMP whilst allowing major trunk infrastructure that will serve the Schofields precinct and beyond.

ELA – on behalf of DHA – requests that Blacktown City Council consult with the Department of Planning and Environment to confirm that the proposed solution is acceptable.

Please do not hesitate to contact me if clarification is required on any of the above points.

Yours sincerely

David Bonjer

Senior planner

Eco Logical Australia

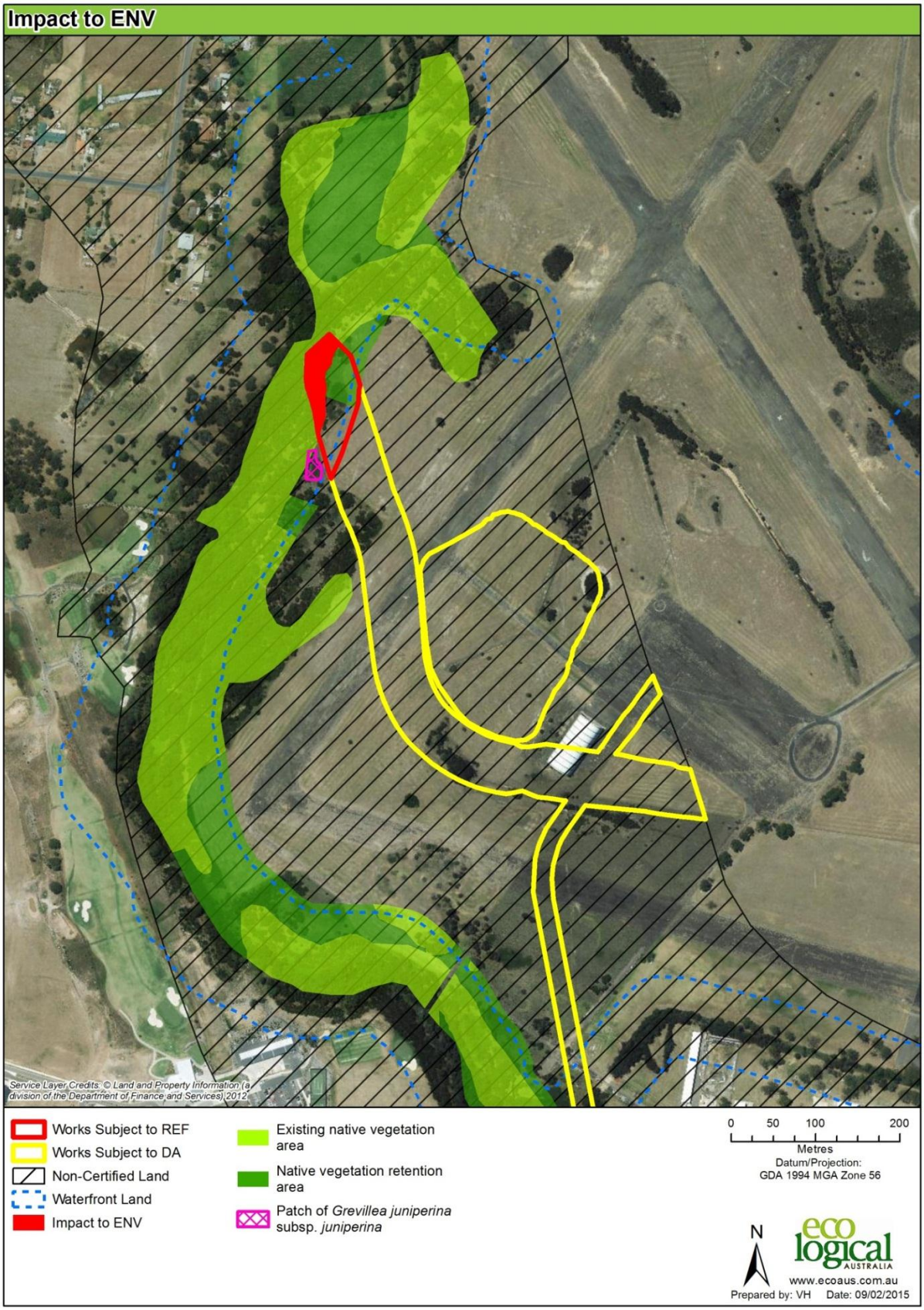

Figure 1 Impacts to Existing Native Vegetation

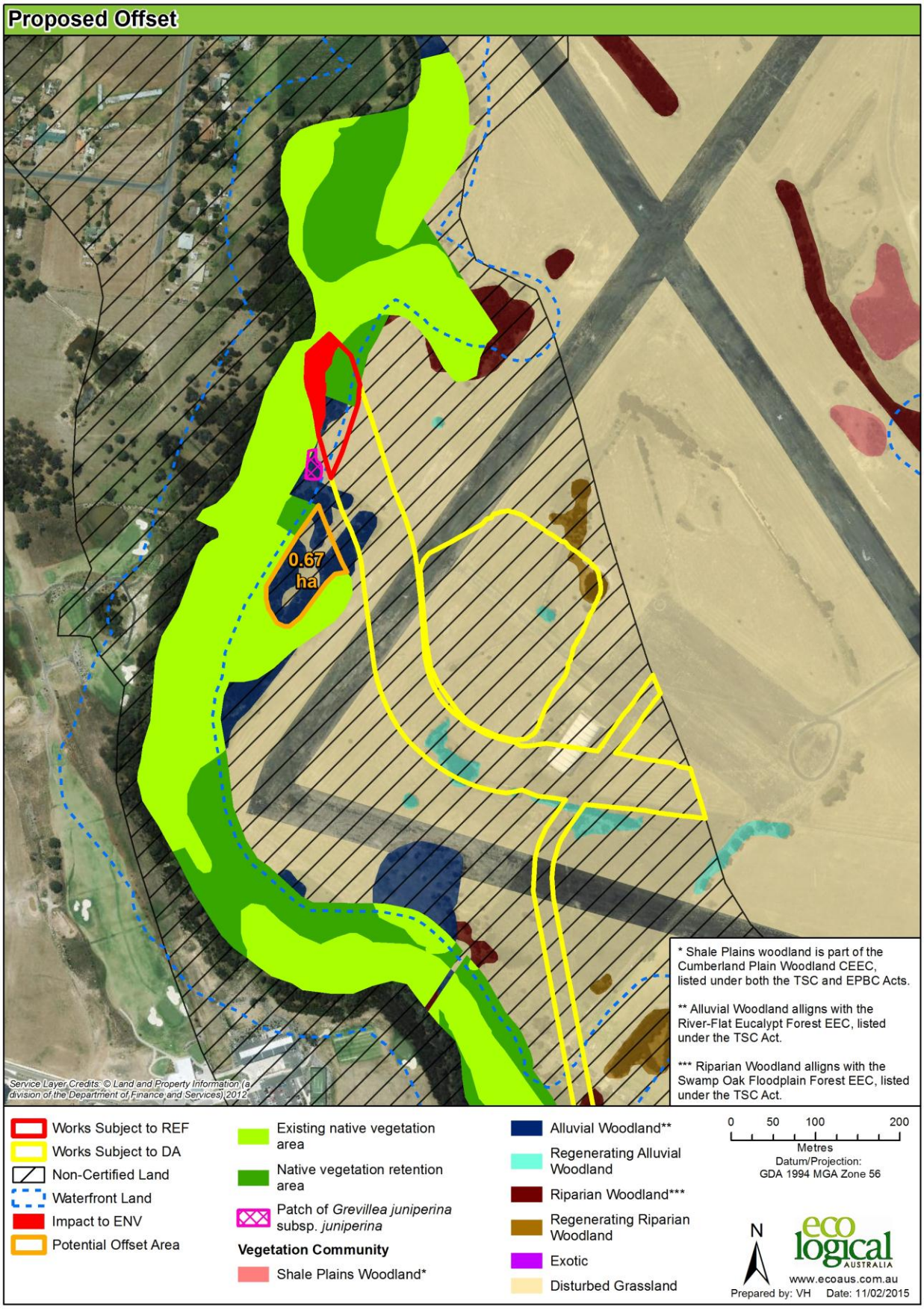

Figure 2 Proposed Offset Area