APPENDICES

APPENDIX A AREA DEFINED AS THE NORTHBOURNE PRECINCT

Attachment B – Northbourne Precinct

APPENDIX B FLOOD MAPS OF EXISTING RIVERINE FLOODING ALONG DICKSON CHANNEL

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Legend

Existing Flood Depths (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16

Project

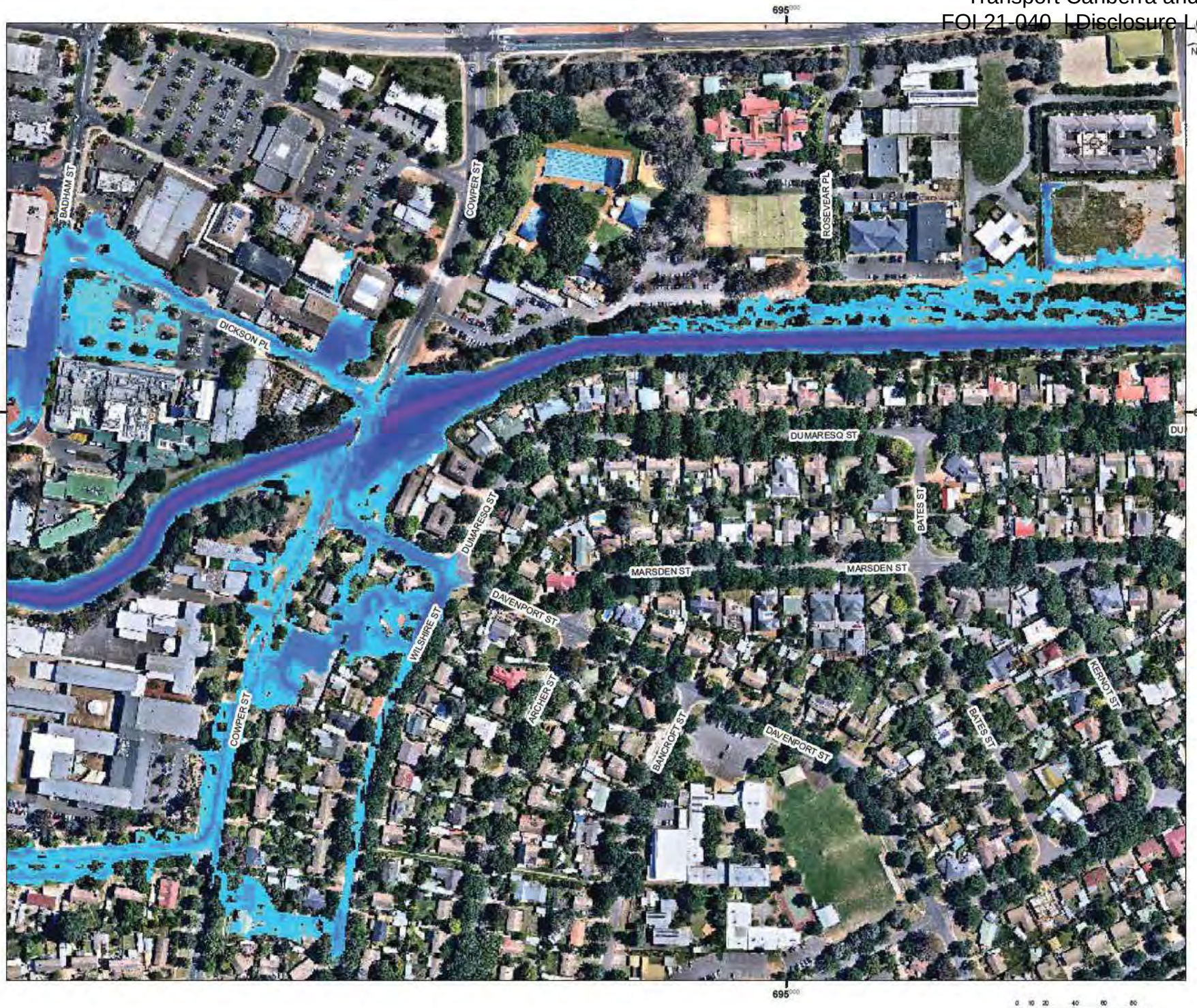
DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOOD EXTENTS

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F001.1_D (Sheet 1 of 3)

Issue 2



calibre CONSULTING

Legend

Existing Flood Depths (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOOD EXTENTS

Scale 1:2500 @ A3 - 1:1250 @ A1

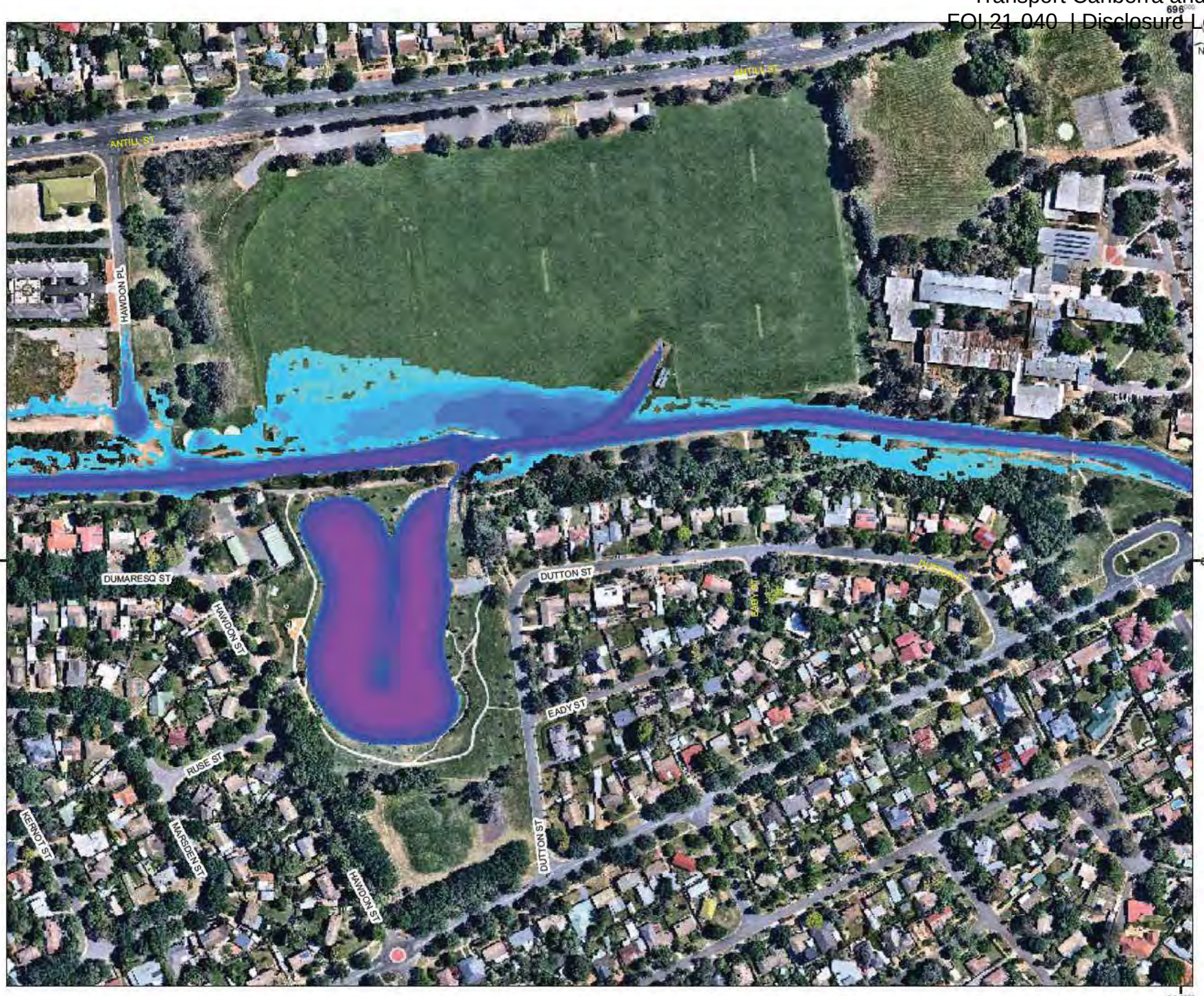
Drawn [redacted]

Checked

Job No. 15-003999

Figure F001.2_D (Sheet 2 of 3)

Issue 2



calibre CONSULTING

Legend

Existing Flood Depths (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

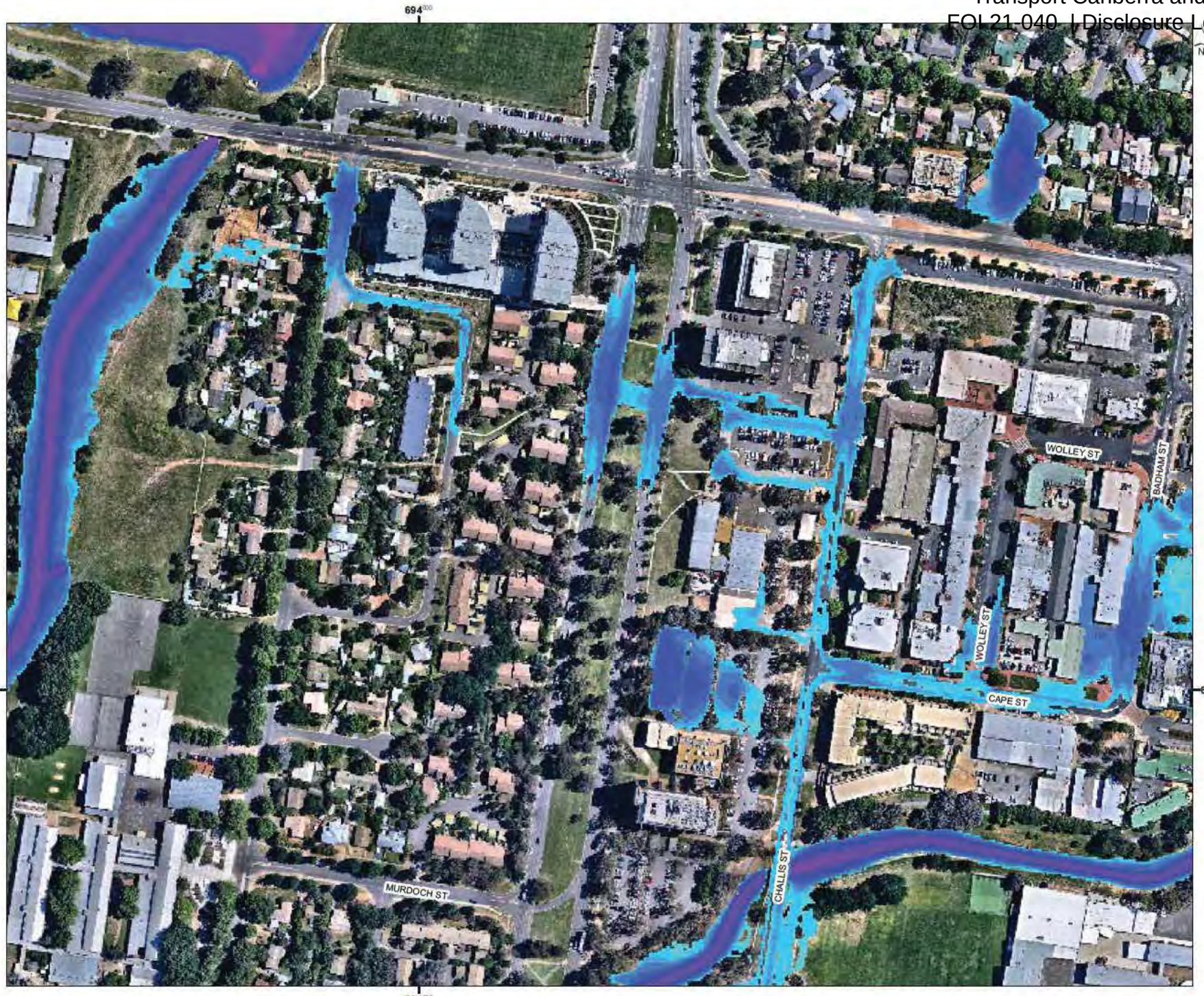
Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOOD EXTENTS

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F001.3_D (Sheet 3 of 3)

Issue 2

APPENDIX C FLOOD MAPS OF EXISTING FLOODING ON NORTHBOURNE AVENUE, JUST SOUTH OF ANTILL STREET



calibre CONSULTING

Legend

Existing Flood Depths (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00- 5.00
- 5.00 <

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUPE CENTRE AND PRECINCT FLOOD STUDY - SHORTLIST OPTIONS

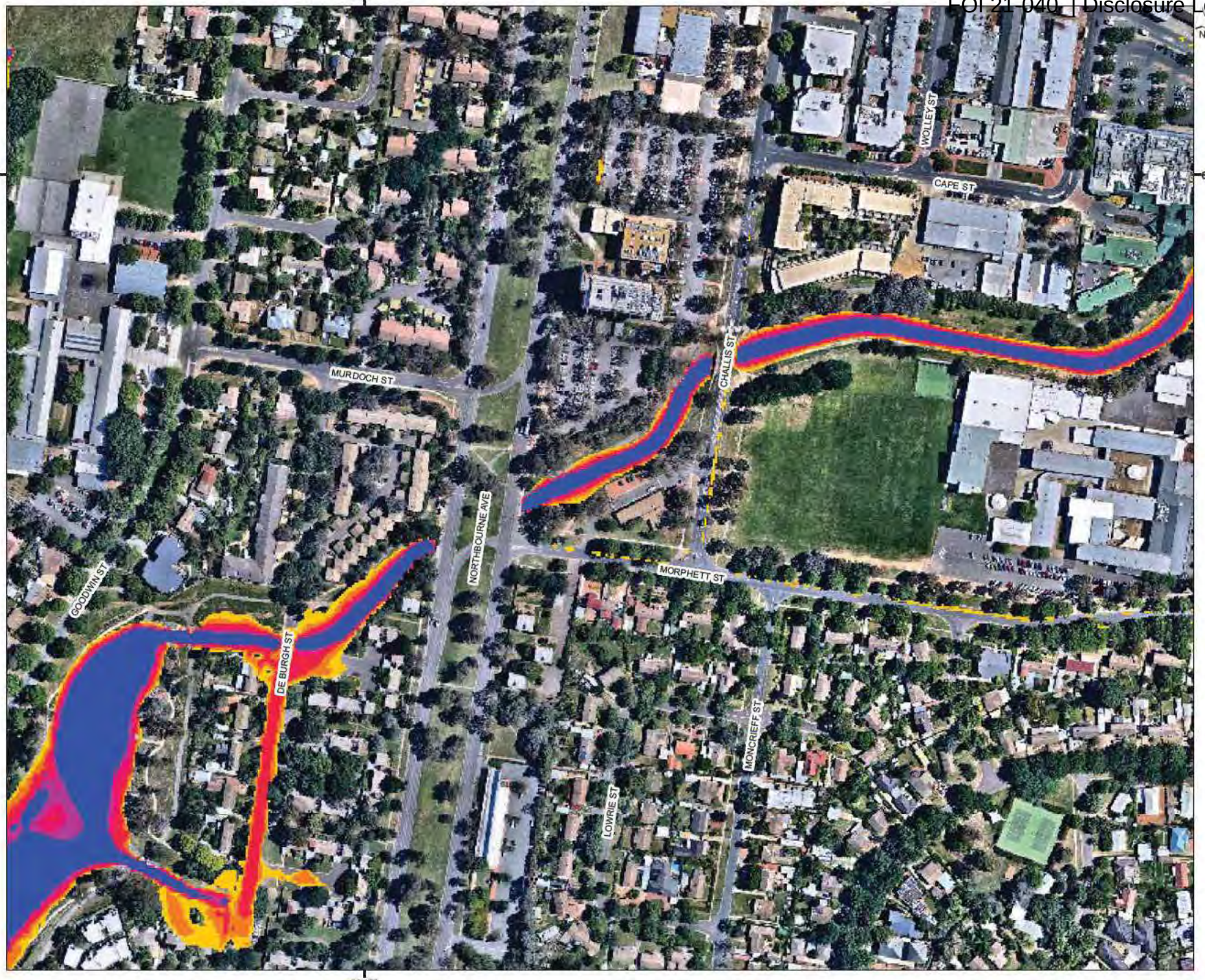
Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOODING ON NORTHBOURNE AVENUE

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F013.1

Issue 2

APPENDIX D VELOCITY DEPTH PRODUCT MAPS OF EXISTING SCENARIO ALONG THE DICKSON CHANNEL



calibre CONSULTING

Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.8 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16

Project

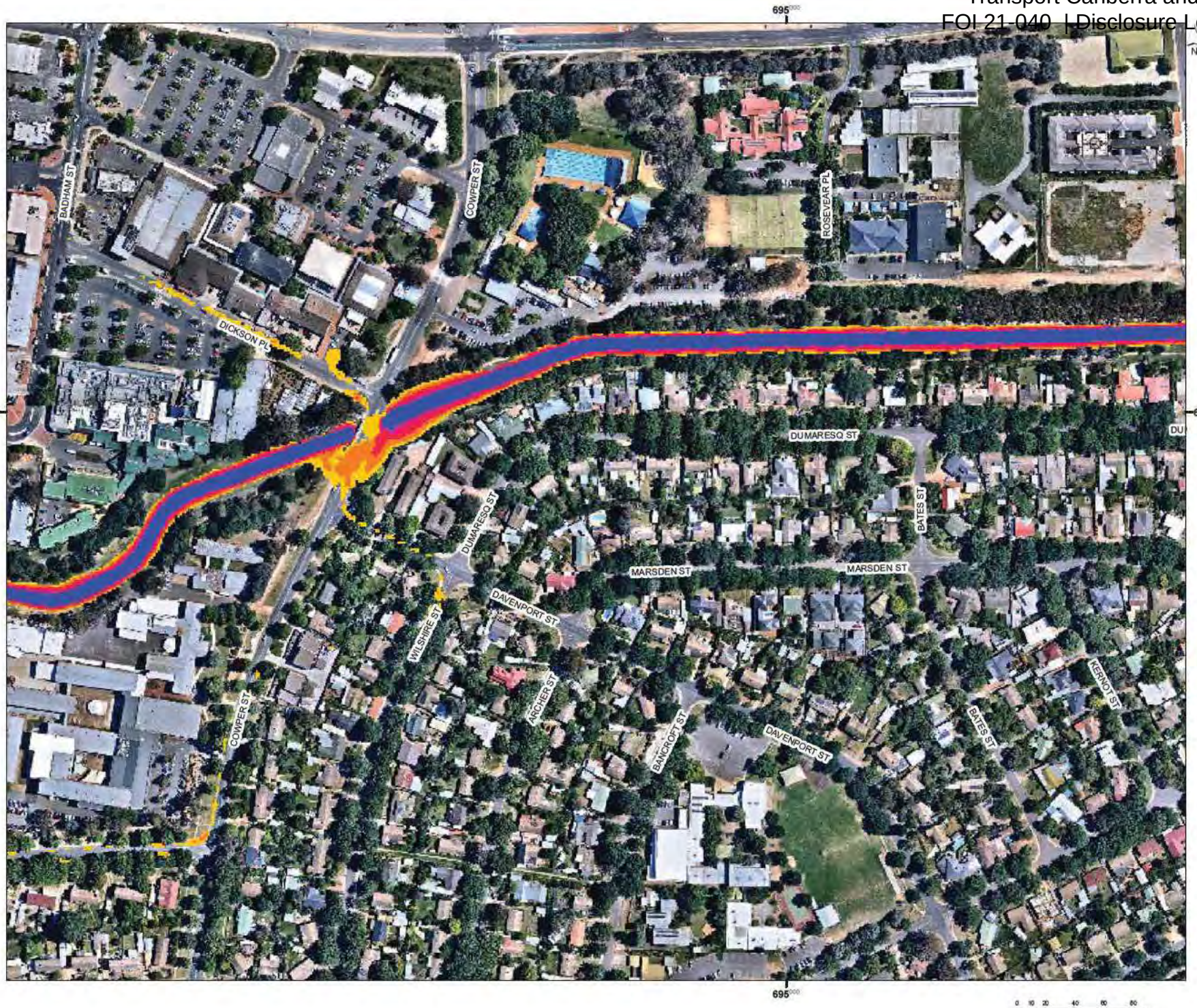
DICKSON GROUPE CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOOD VELOCITY DEPTH PRODUCT

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F003.1 (Sheet 1 of 3)

Issue 1



calibre CONSULTING

Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.8 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUPE CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOOD VELOCITY DEPTH PRODUCT

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F003.2 (Sheet 2 of 3)

Issue 1

calibre CONSULTING

Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.8 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUPE CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOOD VELOCITY DEPTH PRODUCT

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F003.3 (Sheet 3 of 3)

Issue 1

APPENDIX E VELOCITY DEPTH PRODUCT MAPS OF EXISTING SCENARIO ON NORTHBOURNE AVENUE AND CHALLIS STREET

calibre CONSULTING

Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.8 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUPE CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - EXISTING FLOODING VELOCITY DEPTH PRODUCT ON NORTHBOURNE AVENUE

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F013.3

Issue 1

APPENDIX F FLOOD MAPS OF PROPOSED FLOOD MITIGATION TREATMENTS ALONG DICKSON CHANNEL

calibre CONSULTING

Legend

Flood Depths Mitigated (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16
3	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - CONCRETE CHANNEL WITH MITIGATION TREATMENTS

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn [redacted]

Checked

Job No. 15-003999

Figure F004.1 (Sheet 1 of 3)

Issue 3

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Legend

Flood Depths Mitigated (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16
3	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - CONCRETE CHANNEL WITH MITIGATION TREATMENTS

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F004.2 (Sheet 2 of 3)

Issue 3

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Legend

Flood Depths Mitigated (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16
3	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

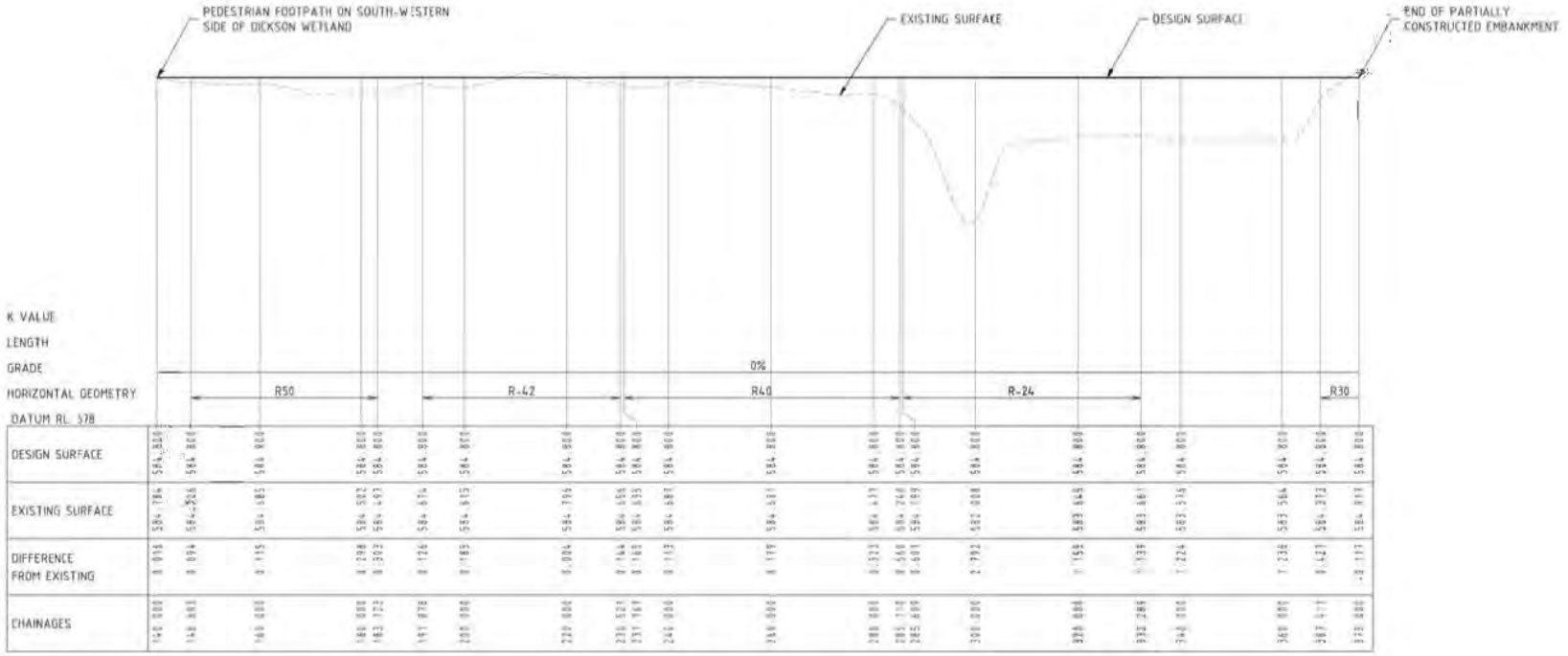
Drawing Title

1% AEP 60 MIN EVENT - CONCRETE CHANNEL WITH MITIGATION TREATMENTS

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F004.3 (Sheet 3 of 3)

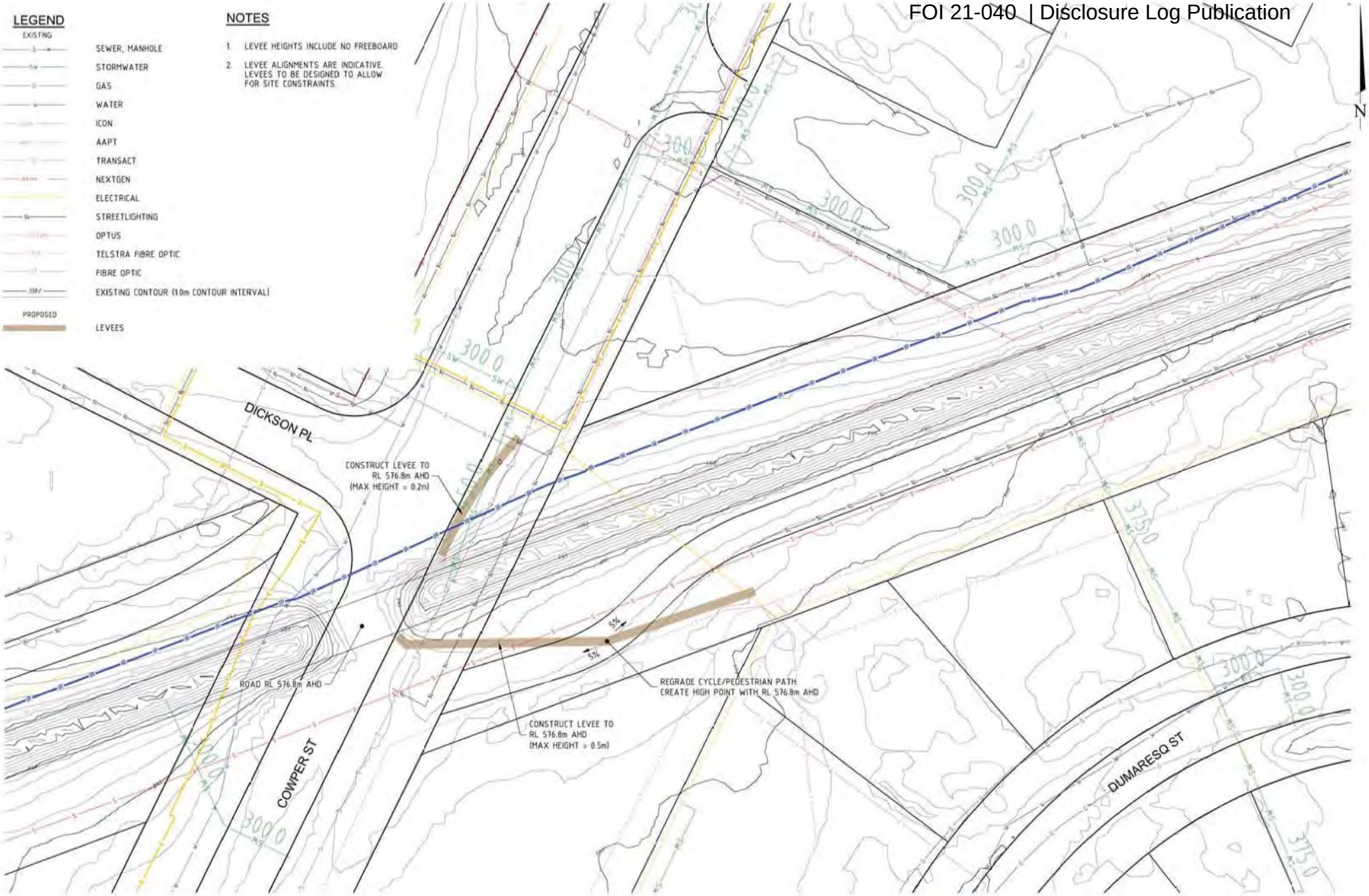
Issue 3

APPENDIX G RETARDATION INCLUDING LEVEES OPTION SKETCH PLANS



1:1000 1:500 HOR
1:100 1:50 VER
@A3 @A1

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY
RETARDATION BASIN EMBANKMENT LONG SECTION
For Discussion Purposes Only
15-003999#SK002+



1:2000 @A3 1:1000 @A1

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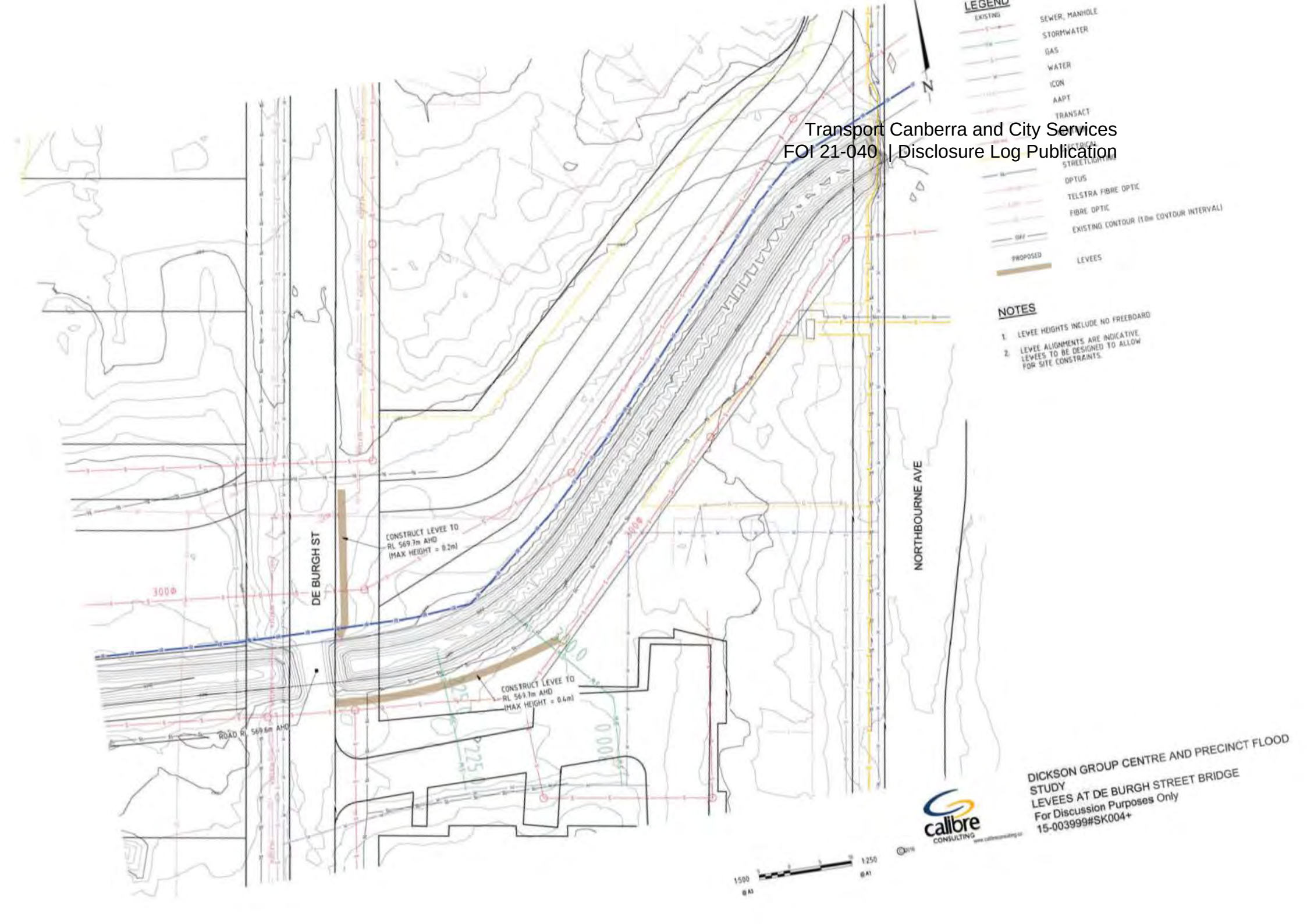
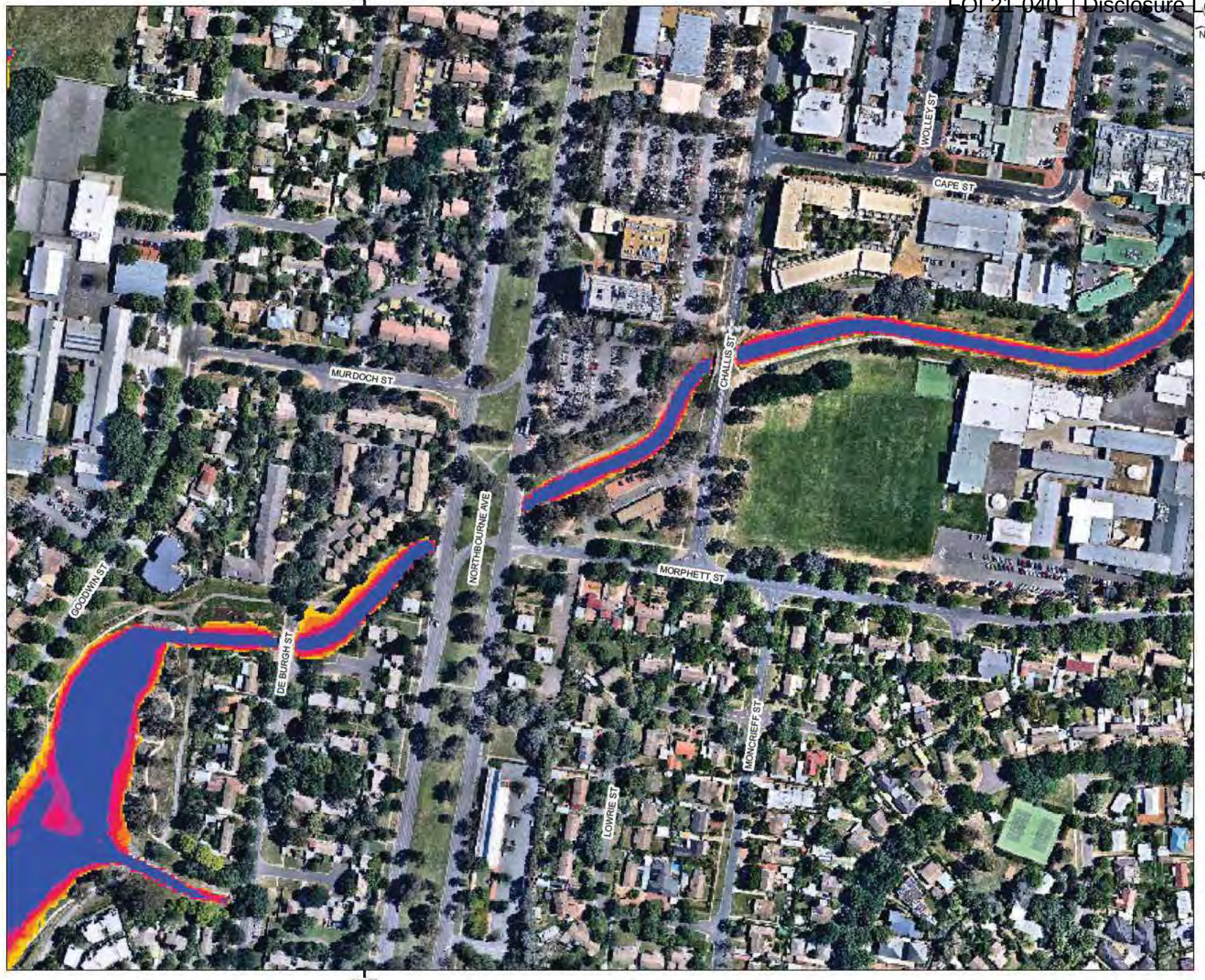
DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY
LEVEES AT COWPER STREET BRIDGE
For Discussion Purposes Only
15-003999#SK003+



APPENDIX H VELOCITY DEPTH PRODUCT MAPS OF PROPOSED FLOOD MITIGATION TREATMENTS ALONG DICKSON CHANNEL



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Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

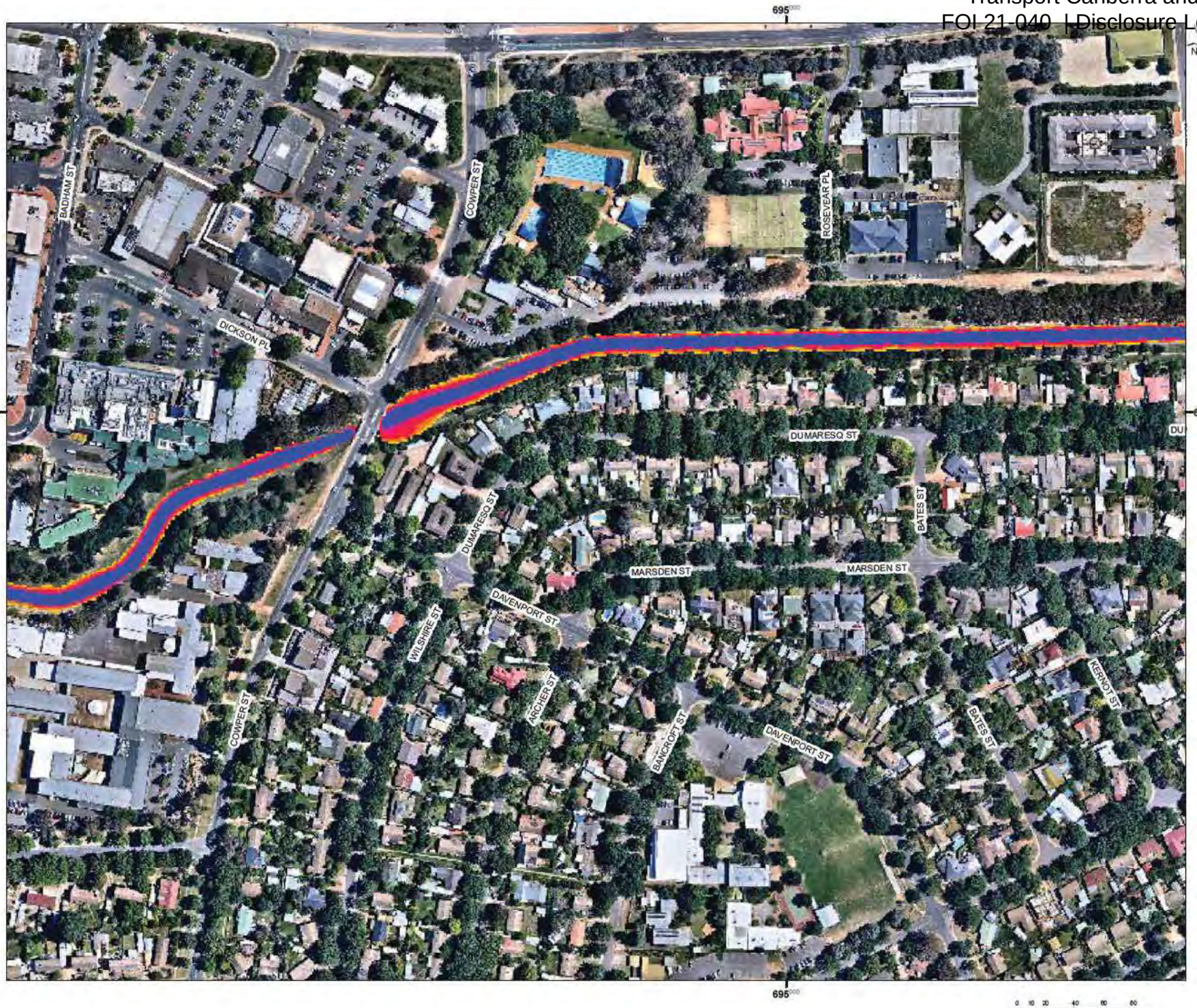
DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - CONCRETE CHANNEL WITH MITIGATION TREATMENTS FLOOD VELOCITY DEPTH PRODUCT

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F006.1 (Sheet 1 of 3)

Issue 2



calibre CONSULTING

Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - CONCRETE CHANNEL WITH MITIGATION TREATMENTS FLOOD VELOCITY DEPTH PRODUCT

Scale 1:2500 @ A3 - 1:1250 @ A1

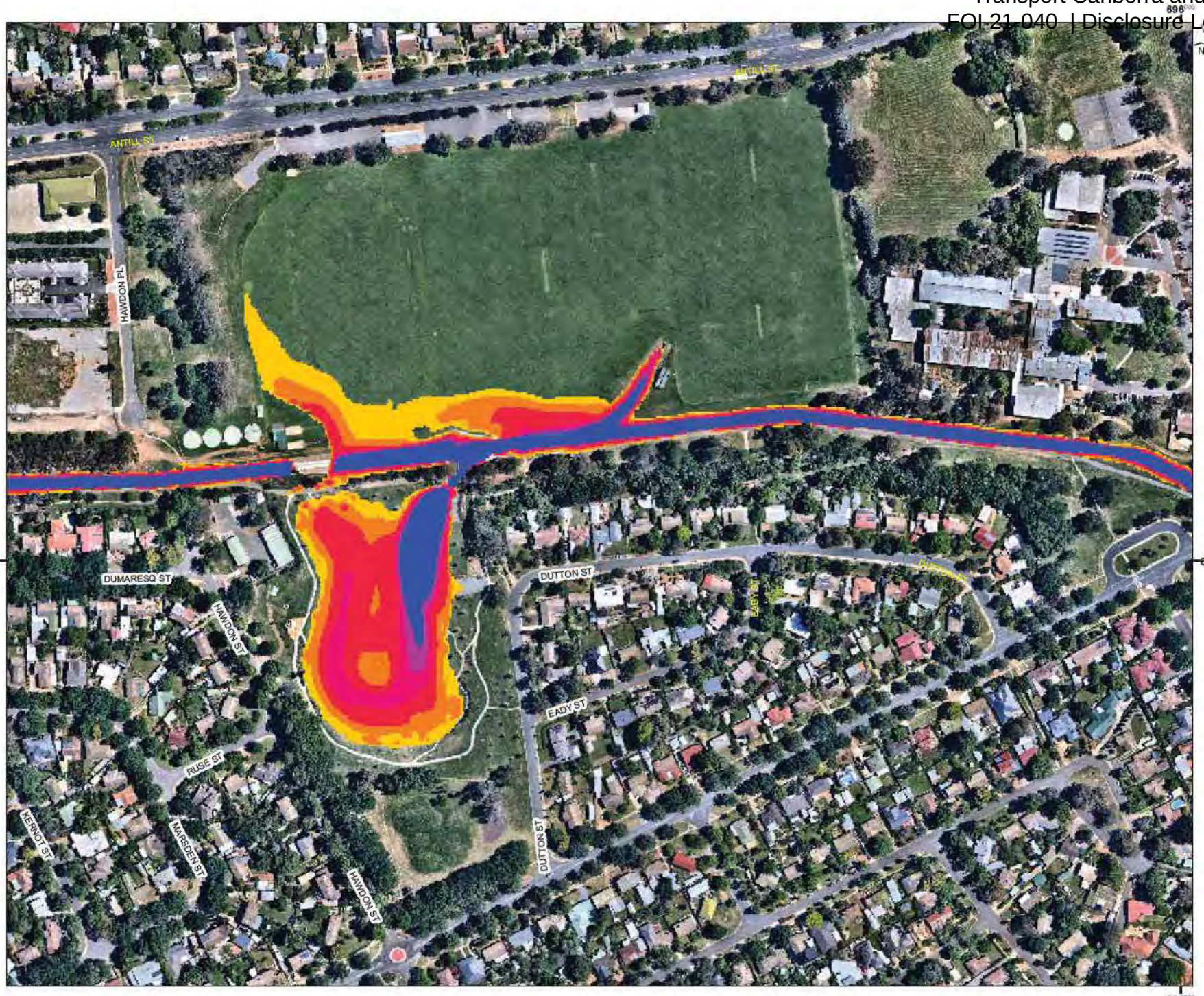
Drawn [redacted]

Checked

Job No. 15-003999

Figure F006.2 (Sheet 2 of 3)

Issue 2



calibre CONSULTING

Legend

Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - CONCRETE CHANNEL WITH MITIGATION TREATMENTS FLOOD VELOCITY DEPTH PRODUCT

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn [redacted]

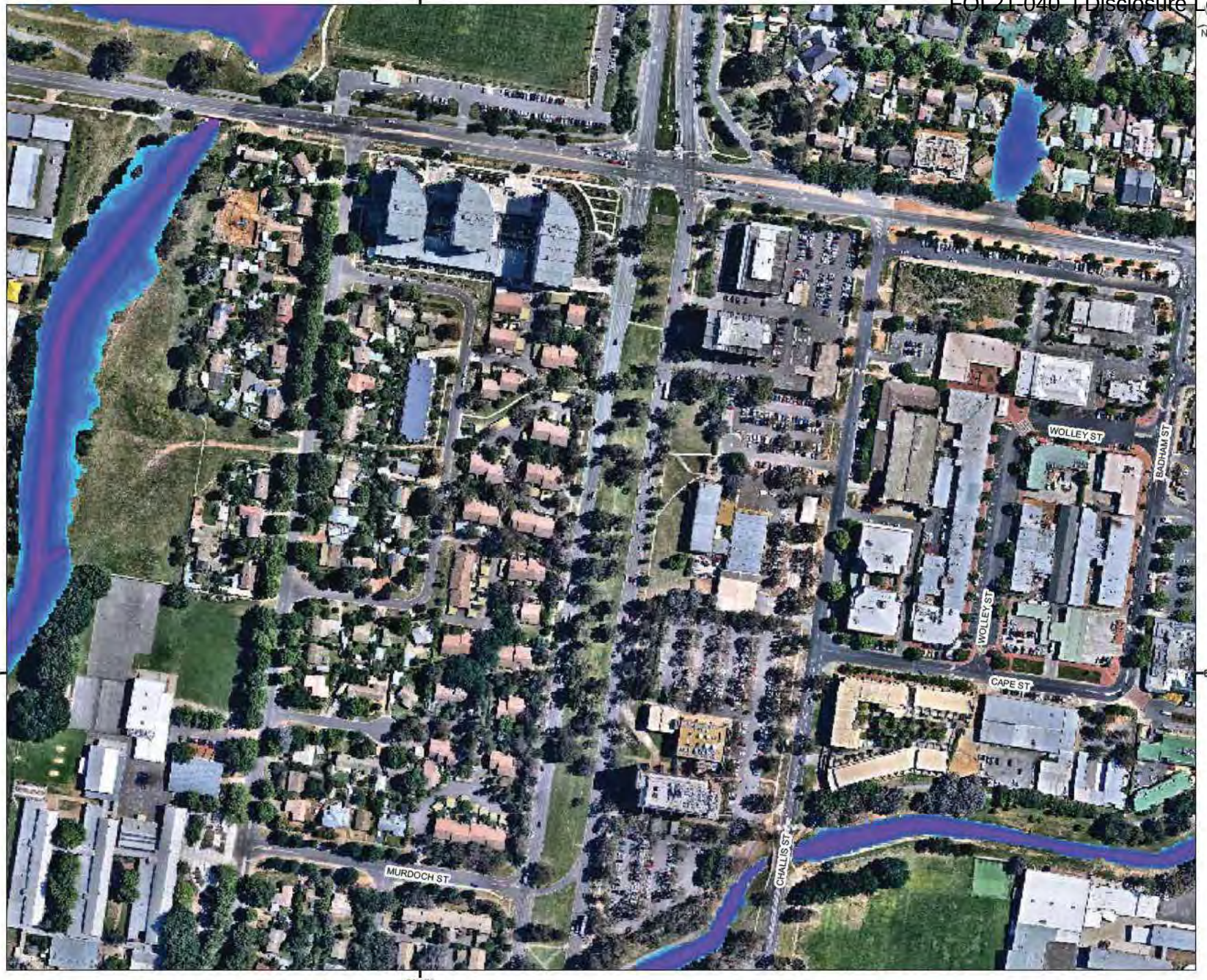
Checked

Job No. 15-003999

Figure F006.3 (Sheet 3 of 3)

Issue 2

APPENDIX I FLOOD MAPS OF PROPOSED FLOOD MITIGATION TREATMENT ON NORTHBOURNE AVENUE, JUST SOUTH OF ANTILL



calibre CONSULTING

Legend

Northbourne Option 1x1650 Depth (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 15
2	SHORT LIST OPTIONS	15 FEB 16

Project

DICKSON GROUPE CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NORTHBOURNE AVENUE OPTION 1 REPLACE 1350MM WITH 1650MM PIPE BETWEEN NORTHBOURNE AVE & GOODWIN ST, DUPLICATE 1350MM DOWNSTREAM OF GOODWIN ST

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn [redacted]

Checked

Job No. 15-003999

Figure F014.1

Issue 2

APPENDIX J FLOOD MAPS OF PROPOSED NATURALISED CHANNEL AND ASSOCIATED FLOOD MITIGATION TREATMENTS

calibre CONSULTING

Legend

Natural Channel Depth (m)

- 0.00- 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 <

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16
3	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL 1 IN 4 SIDE SLOPES TO 1.8M DEPTH MANNING'S 'N' OF 0.035

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F007.1 (Sheet 1 of 3)

Issue 3

calibre CONSULTING

Legend

Natural Channel Depth (m)

- 0.00- 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16
3	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL 1 IN 4 SIDE SLOPES TO 1.8M DEPTH MANNING'S 'N' OF 0.035

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn

Checked

Job No. 15-003999

Figure F007.2 (Sheet 2 of 3)

Issue 3

calibre CONSULTING

Legend

Natural Channel Depth (m)

- 0.00- 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	LONG LIST OPTIONS	28 JAN 16
2	SHORT LIST OPTIONS	15 FEB 16
3	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL 1 IN 4 SIDE SLOPES TO 1.8M DEPTH MANNING'S 'N' OF 0.035

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn [redacted]

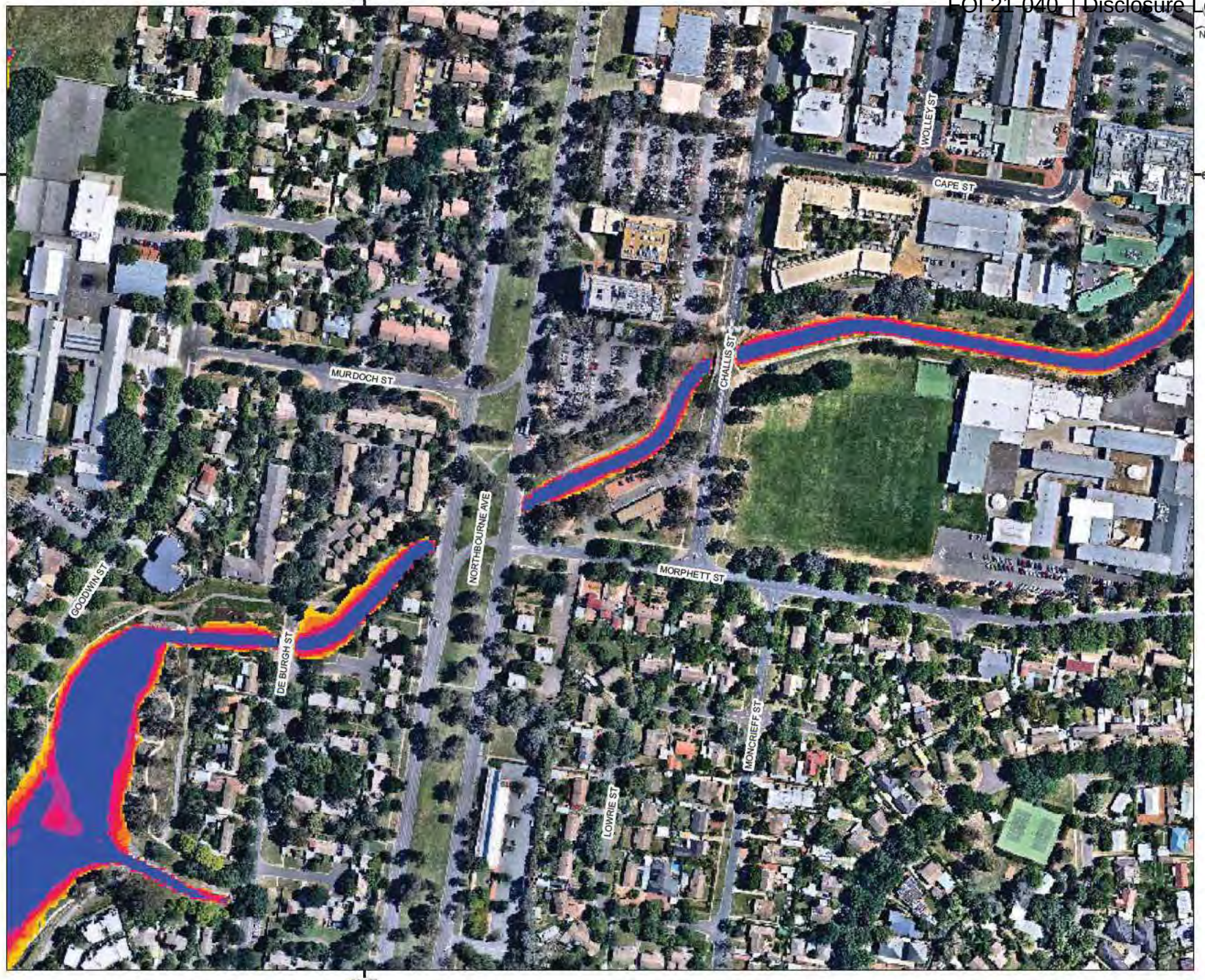
Checked

Job No. 15-003999

Figure F007.3 (Sheet 3 of 3)

Issue 3

APPENDIX K VELOCITY DEPTH PRODUCT MAPS OF PROPOSED NATURALISED CHANNEL AND ASSOCIATED FLOOD MITIGATION TREATMENTS



calibre CONSULTING

Legend

Natural Channel Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL FLOOD VELOCITY DEPTH PRODUCT
1 IN 4 SIDE SLOPES TO 1.8M DEPTH
MANNING'S 'N' OF 0.035

Scale 1:2500 @ A3 - 1:1250 @ A1

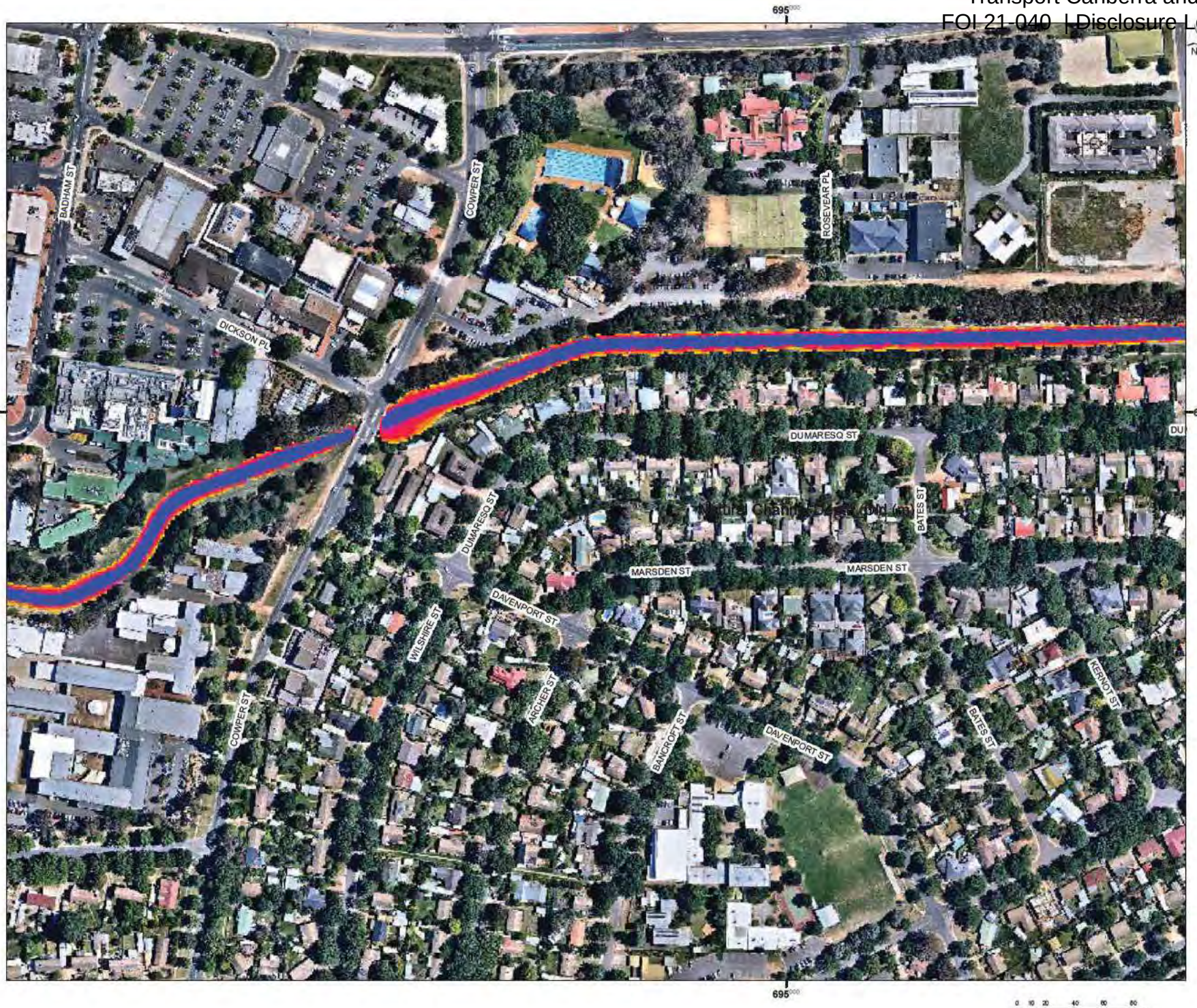
Drawn [redacted]

Checked

Job No. 15-003999

Figure F009.1 (Sheet 1 of 3)

Issue 2



calibre CONSULTING

Legend

Natural Channel Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL FLOOD VELOCITY DEPTH PRODUCT
1 IN 4 SIDE SLOPES TO 1.8M DEPTH
MANNING'S 'N' OF 0.035

Scale 1:2500 @ A3 - 1:1250 @ A1

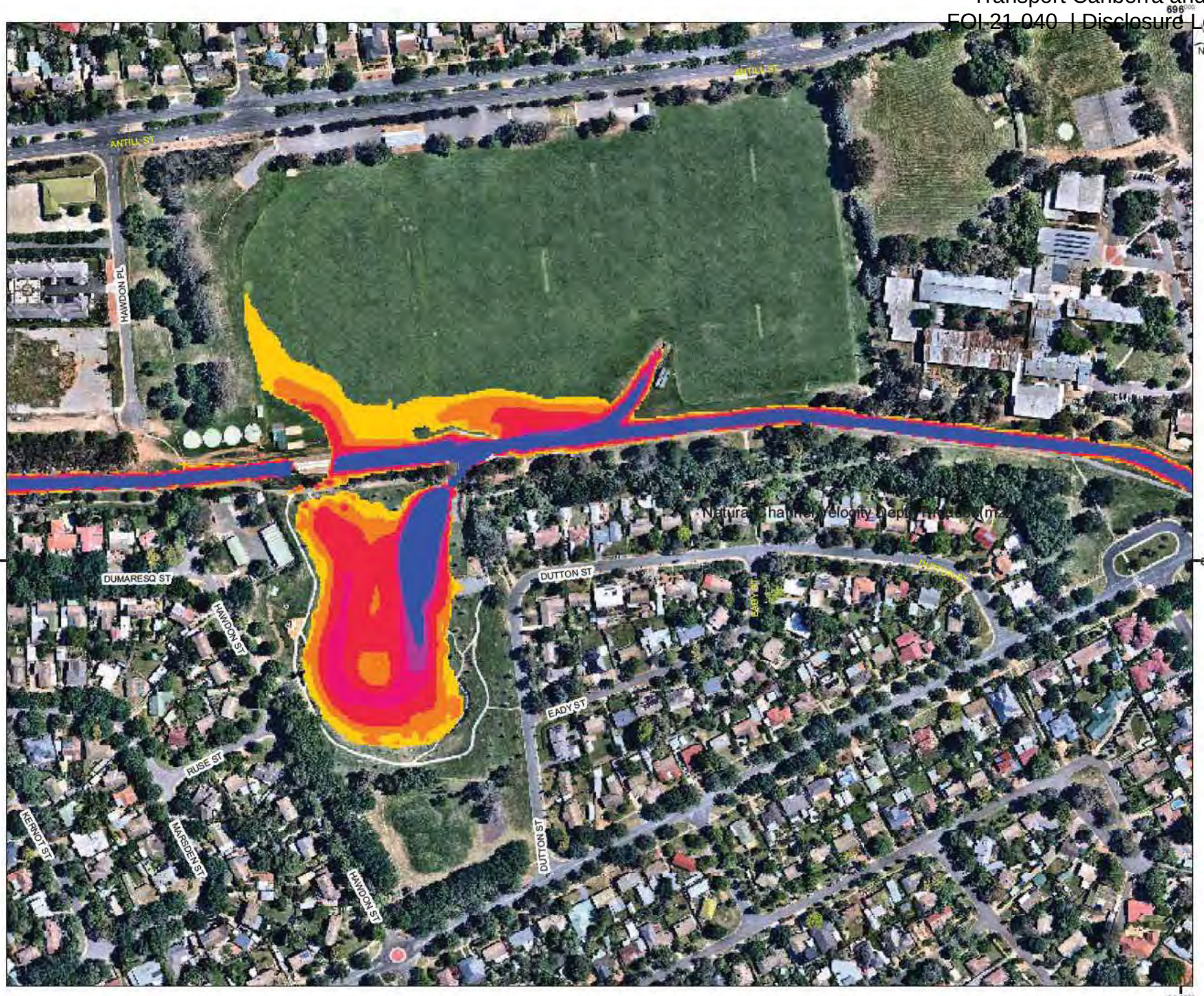
Drawn [redacted]

Checked

Job No. 15-003999

Figure F009.2 (Sheet 2 of 3)

Issue 2



calibre CONSULTING

Legend

Natural Channel Velocity Depth Product (m2/s)

- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.40
- 0.40 - 0.60
- 0.60 - 0.80
- 0.80 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL FLOOD VELOCITY DEPTH PRODUCT
1 IN 4 SIDE SLOPES TO 1.8M DEPTH
MANNING'S 'N' OF 0.035

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn [redacted]

Checked

Job No. 15-003999

Figure F009.3 (Sheet 3 of 3)

Issue 2

APPENDIX L FLOOD MAPS OF PROPOSED NATURALISED CHANNEL AND ASSOCIATED FLOOD MITIGATION TREATMENTS – SENSITIVITY ANALYSIS (N=0.045)

calibre CONSULTING

Legend

Natural Channel (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00
- 4.00 - 5.00
- 5.00 <

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL 1 IN 4 SIDE SLOPES TO 1.8M DEPTH MANNING'S 'N' OF 0.045

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F010.1 (Sheet 1 of 3)

Issue 2

calibre CONSULTING

Legend

Natural Channel (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL 1 IN 4 SIDE SLOPES TO 1.8M DEPTH MANNING'S 'N' OF 0.045

Scale 1:2500 @ A3 - 1:1250 @ A1

Drawn [redacted]

Checked

Job No. 15-003999

Figure F010.2 (Sheet 2 of 3)

Issue 2

calibre CONSULTING

Legend

Natural Channel (m)

- 0.00 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.30
- 0.30 - 0.50
- 0.50 - 0.75
- 0.75 - 1.00
- 1.00 - 2.00
- 2.00 - 3.00
- 3.00 - 4.00

Details

Issue	Amendment	Date
1	SHORT LIST OPTIONS	15 FEB 16
2	DE BURGH ST UPDATED	15 MAR 16

Project

DICKSON GROUP CENTRE AND PRECINCT FLOOD STUDY - SHORT LIST OPTIONS

Drawing Title

1% AEP 60 MIN EVENT - NATURALISED CHANNEL 1 IN 4 SIDE SLOPES TO 1.8M DEPTH MANNING'S 'N' OF 0.045

Scale	1:2500 @ A3 - 1:1250 @ A1
Drawn	[redacted]
Checked	
Job No.	15-003999
Figure	F010.3 (Sheet 3 of 3)

Issue 2

APPENDIX M LANDSCAPE REPORT

Dickson Group Centre and Precinct
Flood Study

Landscape Report

prepared by

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Revision C
23 March 2016

1.0 INTRODUCTION

Redbox Design Group were commissioned by Calibre Consulting to develop landscape and urban design options and recommendations for the future landscape and urban design character of the Dickson channel in response to Calibre's flood amelioration study, with urban design opportunities being identified and opportunities for improved access and amenity.

This report summarises the landscape contribution to the study, which included:

- Landscape context analysis: identifying key landscape and urban character units (combining known future development outcomes and existing conditions);
- Tree / vegetation appraisal: 'Rapid' assessment of major tree groupings and identification of relative value of groups
- Source and review prior and parallel studies and initiatives which may influence landscape outcomes of the project;
- Review and input on feasibility of naturalisation of the channel
- Restorative landscape strategy: Sketch concept plans for restorative soft landscape works to return lands to their pre-existing character;
- Urban Design Opportunities: Concept landscape & urban design showing potential innovations, value-adds, land development initiatives, etc. which may benefit the study area (but are ancillary to flood mitigation)

1.0 Landscape context analysis

Vegetation
Significant groups of planted trees line the channel corridor, and are a major contributor to the user amenity (character, microclimate) of the corridor. Main groupings by species are described on Drawing LA_AN_01, and are predominantly distinct mass plantings of:

- Native evergreen: *Eucalypt*
- Deciduous shade: *Fraxinus, Platanus, Sophora, Quercus, Ulmus*
- Deciduous ornamental: *Celtis, Crataegus, Liquidambar, Poplar, Prunus, Pyrus*
- Conifer: *Casuarina, Picea, Pinus/ Callitris*

Some groupings comprise a mix of Eucalypt and Deciduous, and Eucalypt and Conifer species.

The planted vegetation character is broadly typical of landscape planning of inner north suburban development under the NCDC, typified by massed and semi-formal groupings of introduced and exotic species chosen from genus known to perform reliably in local conditions – Eucalypts, Oaks, Ash, Pines, Elms and Planes.

A number of species present are currently considered weed / pest plants or are no longer considered high value trees for the urban context and therefore would not ordinarily be planted on a large scale other than on heritage grounds. These include *Celtis, Crataegus, Pinus, Populus*.

A detailed assessment of trees is outside the scope of the study, but Drawing LA_AN_01 indicates a broad relative higher / lower value to major groupings, based on a preliminary opinion of condition, contribution to landscape amenity, suitability for the urban environment and weed / pest status.

The large majority of tree groups are in late maturity, with many senescent and in declining health. Succession replacement of similar open spaces through Sullivan's Creek corridor has been underway in recent years, and suggests that many groupings are due for replacement. There is opportunity to coordinate any flood mitigation works with a targeted process of tree removal and replanting.

Circulation
Drawing LA_AN_02 marks major pedestrian routes and connections.

A shared cycle route follows the channel corridor, running along the northern side of the channel between Lyneham pond to Cowper Street, then along the southern side between Cowper Street and Majura Avenue.

Lateral connections coincide with crossing street intersections and laneways.

Desire lines are evident on the southern side of the channel adjacent residential properties, perhaps indicative of a preference for walking in

tree shade and unauthorised vehicle access to rear yards.

Landscape Character Units
Drawing LA-AN-03 defines the broad landscape character units surrounding the study site, being:
- Commercial
- Residential
- Open Space (including sports fields)
- Education

These character units are assigned based on a broad-scale visual character, and contain some minor intrusion of secondary character but that which does not diminish the overall visual typology (for example the ambulance station site within residential).

The study site can be described as a variable (but mostly narrow – 40m wide) band of open space following the floodway, flanked to the north by a major commercial centre of the Dickson Group Centre, and to the south by low-density residential suburb.

Landscape Character Elements
Within these character units, numerous built and natural elements contribute to the visual and spatial experience of the corridor. These are summarised on Drawing LA-AN-04 and include:

- The floodway channel
- Ponds and playing fields (which act visually as extensions of the open space floodway corridor)
- Multi-unit residential developments (both older and newer)
- Commercial (predominantly low-quality rear-elevation of premises fronting Cape Street & Dickson Place, detracting from the visual amenity)
- Tree belts (significant contributors to visual amenity)
- Municipal infrastructure (such as ambulance station, parks depot, rainwater tanks – mostly detractors from visual amenity)
- Schools (typically multi-storey secondary / college campuses)
- Single residential suburban properties (predominantly rear-fenced yards, with significant private plantings screening dwellings)
- Surface car parking (most with buffer and internal tree plantings, broadly detractors from visual amenity)
- Northbourne Avenue corridor (multi-lane roadway with landscape median and verges)
- Intersections (mostly low-volume street crossings characterised by bridge structures and utility infrastructure, detractors from visual amenity)

2.0 Prior and parallel studies and initiatives

Light Rail
Capital Metro intentions at the Northbourne Avenue corridor include the formalisation of pedestrian crossing points mid-block between Murdoch and Morphett Streets, the retention of the Eucalypt / Crataegus verge tree pattern and replacement of median Eucalypts.

These intentions are reflected in the landscape strategy drawings.

City and Gateway Urban Renewal Strategy
The Strategy identifies the potential for a 'destination park' adjacent the existing ambulance station, to enhance the amenity of adjacent land release development sites.

The Consultant team have reviewed in particular the indicative WSUD / wetland component to this park and note that any permanent water body would be:

- On-line to the channel: meaning any 'cascade' elements would be restricted in height to the total longitudinal fall of the channel – approximately 400mm: therefore of limited urban design potential;

- Requiring any soft treatment edge slopes of 1:15 to allow safety egress: thereby limiting capacity to achieve DS16 minimum water depth of 2.4m;

- At an operating water level matching the channel invert, so set approximately 1.5m + below the surrounding land (therefore, providing limited visual amenity except when viewed in very close proximity);

- Reliant on continuous conveyance of storm flows in a channel of at least the cross-sectional area as the naturalised channel

generally: therefore increasing the total width of the channel profile by at least the dimension of the pond itself;

- Given the above factors, small in area by standards of recent urban pond and wetland installations as evident in the following comparison: therefore of limited value as a key contributor to an urban 'destination' park;

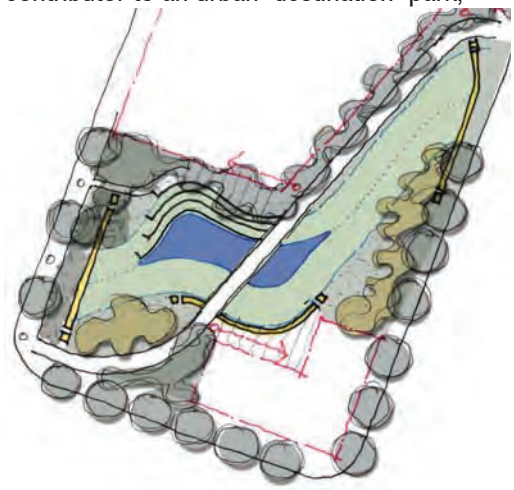


Figure – Indicative sizing and configuration of pond within 'destination park'

Figure – Pond sizes at comparable urban infill sites

- Of no detention / retardation function: Therefore offering no amelioration of stormwater flows downstream;

- Limited removal of sediment, pollutants and nutrients due to short retention times: Therefore negligible urban water quality benefit;

- Requiring considerable commitment of land area: Thereby restricting development potential of adjacent sites.

Further detailed comparative analysis is outside the scope of this report, but some primary benefits and risks of a terrestrial park on culverts would be as follows:

Benefits
- Increased area of usable public open space at amenable gradients
- More flexibility in planning interfaces between active frontage and public space
- Increased potential size of redevelopment sites
- Greater visibility of public realm at prevailing ground level (measured against a pond at channel invert level)
- Less reliance on bridge and grade change structures for circulation routes
- Maintains 'status quo' on underground water table / hydrology
- Reduced maintenance costs (measured against ornamental pondage)

Risks
- Longer travel distance within culvert if accidental or unauthorised human entry occurs (possibly managed by body racks, grilles, etc.)
- Capital cost of culverts (possibly offset by increased land values)

Based on the above, the Consultant team have shown an alternative terrestrial park over culverts as part of the Urban Design Opportunities drawing.

Dickson Group Centre Master Plan (2013)
The Master Plan indicates a number of major initiatives which have informed – and are consistent with - the urban design opportunities identified by the Consultant team, including:

- Introduction of an 'interface park' at the extended Cape Street, and direct pedestrian connection to Cowper Street across a new bridge;
- Creation of an 'entry plaza' at the corner of Cowper Street and Dickson Place;
- Increasing pedestrian permeability into the Group Centre off the channel corridor via open spaces between development sites;
- Creation of a linear 'avenue' between the channel and Dickson Place, passing in

front of the swimming pool site, and a new bridge crossing;

Northbourne Precinct Draft Master Plan (2014)
The Master Plan identifies opportunities arising from the development of existing public housing assets, which abut the study site as Block 41, Section 6 Dickson and Block 8, Section 51 Lyneham.

The Master Plan is understood to have no statutory status, and buyers / proponents will be required to develop their own masterplan. The heritage protection to selected buildings - subsequent to this Masterplan - impacts on the viability of footprints shown therein (see below).

Northbourne Housing Precinct Representative Sample Registration Boundary
Information received on the Extent of heritage registration indicates that the northern-most bachelor (bedsitter) buildings will be preserved. Paths and vegetation within building curtilages will require retention. This is not expected to have any implication on the design objectives of any naturalisation of the channel, and proposals within the urban design strategy are consistent with this condition.

Renewing Dickson Section 72
Redevelopment of the Salvation Army and former Downer Club / Observatory sites - and of Section 72 generally as a mixed use precinct -would increase the resident population of the northern side of the channel and benefit from enhanced pedestrian connection along the northern side of the channel corridor toward Dickson Group Centre.

Northbourne Corridor Utilities Masterplan - Sullivan's Creek 382 and 384 lines
Preliminary design plans indicate a sewer upgrade following the channel alignment between Northbourne Avenue and Cowper Street.

New tree plantings to maintain and enhance the corridor character are likely to be at intermittent locations and not impact the proposed sewer. Planting type and setout should be the subject of detailed design, coordination and agreement with the asset owner, with regard to maintenance access, easement, etc.

3.0 Feasibility of channel naturalisation

The concept by Calibre Consulting is for conversion of the concrete invert to a mown grass channel with a trapezoidal shape with a 1m wide base with 1v:4h sides and same depth as the existing concrete channel.

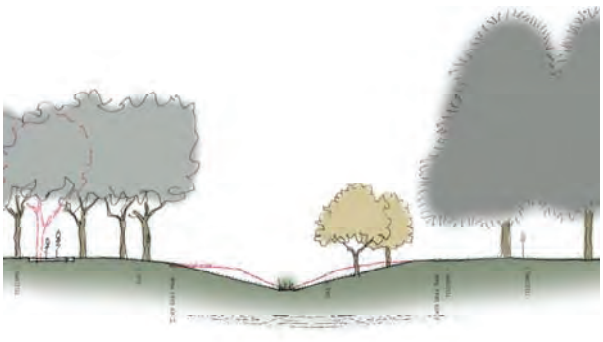
The floor of the channel would be un-mown grass / macrophytes.

The channel is proposed to follow the current channel alignment - that is, slight meander and continuous longitudinal gradient.

A limited number of scattered clean-trunked trees may be planted within the channel profile.

An indication of the channel character is shown in the photograph below:

An indicative section of the existing and proposed channel profile is shown below:



The resultant landscape character would appear as an extension of the mown grass and treed corridor landscape, and would - in the opinion of the Landscape Architect – offer a positive transformation of the amenity of the corridor.

Removal of existing trees and relocation of affected sections of pedestrian path would be required, but considered manageable.

Considerations which would require attention at the detail design stage include:

- Management of erosion control and plant establishment during construction in a 'live' watercourse;
- Conveyance and control of trickle-flow within the invert floor;
- Transitions between gradients, to enhance naturalistic character and avoid mower damage;
- Inclusion of floodway warning signage;
- Provision of egress points (in lieu of ladders)
- Aesthetically sensitive incorporation of body racks / trash racks / etc
- Protection of high value existing trees wherever possible, and a strategic approach to replacement of entire groupings where impacted by the works;
- Treatment of channel reinforcement upstream and downstream of bridge structures (notionally 8.0m in both directions)

4.0 Restorative landscape strategy

Redbox Design Group were asked to prepare a plan indicating broad objectives for landscape works associated with flood mitigation works, aimed at the restoration of a similar character and level of amenity as presently exists.

Drawing LA_SK_02 defines the key landscape works to achieve this. Major elements are indexed below:

1. Avoid duplication of pavements at proposed GPT site, by designing a unified route catering for pedestrians and cyclists, with capacity for vehicular access to GPT without preventing safe pedestrian thoroughfare.

2. Levee / bund devices at bridges to be well-detailed urban elements appropriate in material and form to Dickson Arm & Sullivan's Creek, for example quality stone pitched walls integrated into limited in-situ concrete structure. Avoid expansive grassed earthwork-style levees where abutting urban development sites, roads and other urban infrastructure.

3. Channel reinforcement upstream & downstream of bridges to be the smallest possible scale, whilst sympathetic to the overall Dickson Arm & Sullivan's Creek corridor landscape character;

4. Major levee at playing field / Dickson pond to be sensitively integrated into existing adjacent landforms. Consider providing path connection (or at least foot-traffic capability) to provide additional connection across channel;

5. Construct new shared cycle / pedestrian path, on a similar alignment to existing, where existing route is subsumed by the naturalised corridor, levees, etc. Align new paths to benefit from tree canopy summer shade and winter sun wherever practicable.

6. Form levee berms suitable for max 1:20 gradient path connections wherever possible, without built grade change structures and safety devices;

7. Selectively remove trees necessary for the works (major groupings for removal indicatively shown red dashed). Target earthworks, path routes and services infrastructure to impact trees of lowest value and expected longevity. Provide replacement tree plantings in similar species to existing, with preference for complimentary species with demonstrated performance (Oaks, Eucalypts, Casuarinas, Planes). Design mass planting arrangements which are complimentary to existing such as grids, edge rows, dense groupings and some scattered individuals.

8. Establish naturalised channel as 1:4 mown grass sides, with un-mown macrophyte and grassy species in invert. Extend invert plantings to stormwater inlet endwalls and the like, and design outlet stabilisation to be of an appropriate scale, material and design form to the context, to minimise visual dominance of hard surface treatments.

9. Provide supplementary landscape screen planting between existing play space and new GPT.

10. Provide alternative location for temporary sports storage containers.

5.0 Urban Design Opportunities

The study included consideration of potential innovations, value-adds, land development initiatives, etc. which may benefit the study area and support other initiatives such as land release, active travel, light rail, etc.

It should be noted that the opportunities identified are the result of preliminary 'high level' conceptualisation, are not costed as part of this study, and are ancillary to flood mitigation needs.

Drawing LA_SK_01 shows graphically the primary opportunities. Major elements are indexed below:

1. Levee / bund / GPT devices planned and designed as a suite of urban design elements unique to the Dickson Arm & Sullivan's Creek corridor, exhibiting a coordinated language of materials and design form which reflect contemporary urban design aesthetic principles. Structures designed to allow transfer of stormwater without reinforcement of naturalised channel upstream and downstream;

2. Levee structure built as stone-pitched wall at or near residential property boundary, minimising land-take and tree removal associated with earthwork berm;

3. Construct new widened bridge structure at Challis Street to allow of generous verge pedestrian realm as continuation to adjacent blocks;

4. Construct new widened bridge at Dickson Place and Cowper Street to allow creation of Group Centre entry plaza as identified in Group Centre Master Plan, and facilitate additional traffic land to match Cowper Street road width north of bridge

5. Design channel as culvert for majority of block length, to facilitate creation of a 'destination park' as identified in City and Gateway Urban Renewal Strategy, accessible from redevelopment sites to north (TransACT House carpark) and south (Ambulance Station). Park should be characterised by generous open public recreation space, direct active travel access from Northbourne Avenue through the site and to both redevelopment sites, visibility from Northbourne Avenue but a sense of being a distinct place in its own right, and a design language which mediates between the Light Rail corridor and Dickson Arm channel.

6. Create new 'interface park' at the extension of Cape Street as proposed in the Group Centre Master Plan, allowing a major connection point for walkers and cyclists into the commercial operating zone, as distinct from road entries;

7. Construct new pedestrian bridge, linking the Group Centre interface park directly with Davenport Street, Cowper Street southbound, and Daramalan College;

8. New bridge providing connection from residential zone footpath into Dickson Place, via swimming pool frontage;

9. New crossing point over channel accompanying flood levee, to provide enhanced connection to new pedestrian movement corridor on northern side of channel adjacent Section 72;

10. Replacement shared cycle route re-aligned at distance from existing multi-unit residential frontage, providing enhanced landscape character to path and greater privacy and sound attenuation to residential units;

11. Allow for connections into widened laneway corridors identified by Group Centre Master Plan;

12. Renewal and reconfiguration of existing surface carpark to allow new entry avenue into Dickson Square as identified in Group Centre Master Plan, with potential compact triangular redevelopment site on existing surface parking area;

13. Major shared cycle route constructed on northern side of channel, catering for urban renewal and increased population of Section 72, and characterised by a generous path dimension passing through existing tree groupings;

14. New minor footpath route on south side of floodway, replacing cycle route impacted by

naturalisation works. Path route through existing tree groupings to provide summer shade;

15. Continue naturalisation around new GPT wherever possible to soften GPT structure and reinforce renewed landscape character, with increasingly 'winding' alignment upstream of Dickson Ponds to provide subtle change in character towards meandering upstream zone;

16. Replacement shared cycle path upstream of Dickson Ponds assumes informal meandering alignment through tree groupings, recognising distance from urban Group Centre;

17. Shrub and groundcover species introduced to channel landscape design at ponds, highlighting a transition to pond and wetland environment and marking those precincts on the channel journey experience;

18. Introduce supplementary tree plantings within naturalised corridor, which are clean trunked (to reduce impact on stormwater conveyance), compact and ornamental in type (to provide visual interest but not encourage pedestrian thoroughfare in the channel), and in small randomly arranged groupings at locations which provide the greatest benefit to the landscape character of the corridor;

19. Introduce tree plantings at sports fields, for screening of low-quality built infrastructure and definition of playing field precincts by 'special' trees, for example columnar deciduous character trees;

20. Install culverts at outflow in Dickson District Playing Fields, to reduce risk of injury, increase usability of oval space and as extension of naturalised channel landscape character;

21. Provide supplementary landscape screen planting between existing play space and new GPT.

APPENDICES

DRAWINGS

Landscape Vegetation Appraisal	LA_AN_01
Pedestrian Circulation Analysis	LA_AN_02
Landscape Character Units	LA_AN_03
Landscape Character Elements	LA_AN_04
Urban Design Opportunities	LA_SK_01
Landscape Restorative Works	LA_SK_02
Floodway Section	LA_SK_03


Casuarina species


Celtis species


Crataegus species


Eucalyptus species


Fraxinus species


Liquidambar species


Picea species


Pinus/Callitris species


Platanus species


Populus species


Prunus species


Pyrus species


Sophora species


Quercus species


Ulmus species

LEGEND

TREE CHARACTER

- NATIVE EVERGREEN
- DECIDUOUS SHADE
- DECIDUOUS ORNAMENTAL
- CONIFER
- COMBINATION EUCALYPT/ DECIDUOUS ORNAMENTAL
- COMBINATION EUCALYPT/ CONIFER

TREE SPECIES

Ca	Casuarina	Pl	Platanus
Ce	Celtis	Po	Populus
Cr	Crataegus	Pr	Prunus
Eu	Eucalyptus	Py	Pyrus
Fr	Fraxinus	So	Sophora
Lq	Liquidambar	Qu	Quercus
Pc	Picea	Un	Unidentified
Pl	Pinus/callitris	Ul	Ulmus

TREE VALUE

(H) Higher quality/amenity/value
(L) Lower quality/amenity/value

KEY PLAN
SCALE 1:3000 @A1

dickson group centre+ precinct flood study

LANDSCAPE VEGETATION APPRAISAL

LA_AN_01 1234 19JFEBRUARY2016


POND


PLAYGROUND


MULIT-UNIT DEVELOPMENT


FLOODWAY


COMMERCIAL


SCHOOL


SINGLE RESIDENTIAL


ROAD BRIDGE/ INTERSECTION

KEY PLAN
SCALE 1:3000 @A1

dickson group centre+ precinct flood study

LANDSCAPE CHARACTER ELEMENTS

LA_AN_04 1234 19FEBRUARY2016

CYCLE PATH

DESIRE LINE (MAJOR/ VEHICLE TRACK)

STREET CROSSING

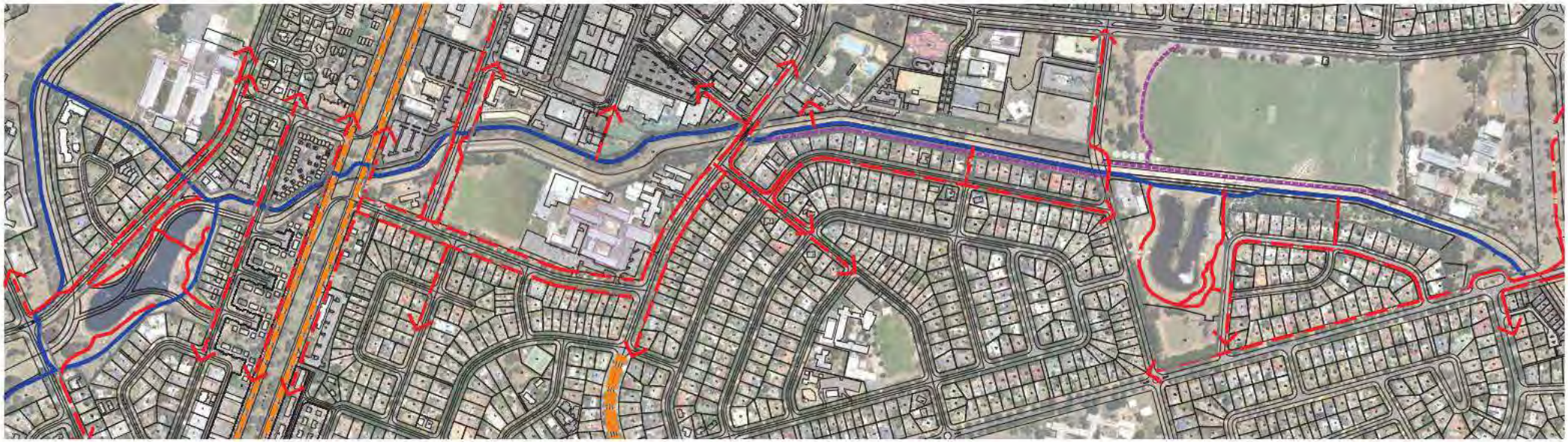
FOOTPATH

DESIRE LINE (MINOR)

PEDESTRIAN BRIDGE

LEGEND

- OFF ROAD CYCLING (Bitumen)
- ON ROAD CYCLING
- COMMUNITY PATH (Concrete)
- DESIRE LINE



KEY PLAN
SCALE 1:3000 @A1

dickson group centre+ precinct flood study

PEDESTRIAN CIRCULATION ANALYSIS

LA_AN_02 1234 19FEBRUARY2016

SUBURBAN RESIDENTIAL

COMMERCIAL

OPEN SPACE

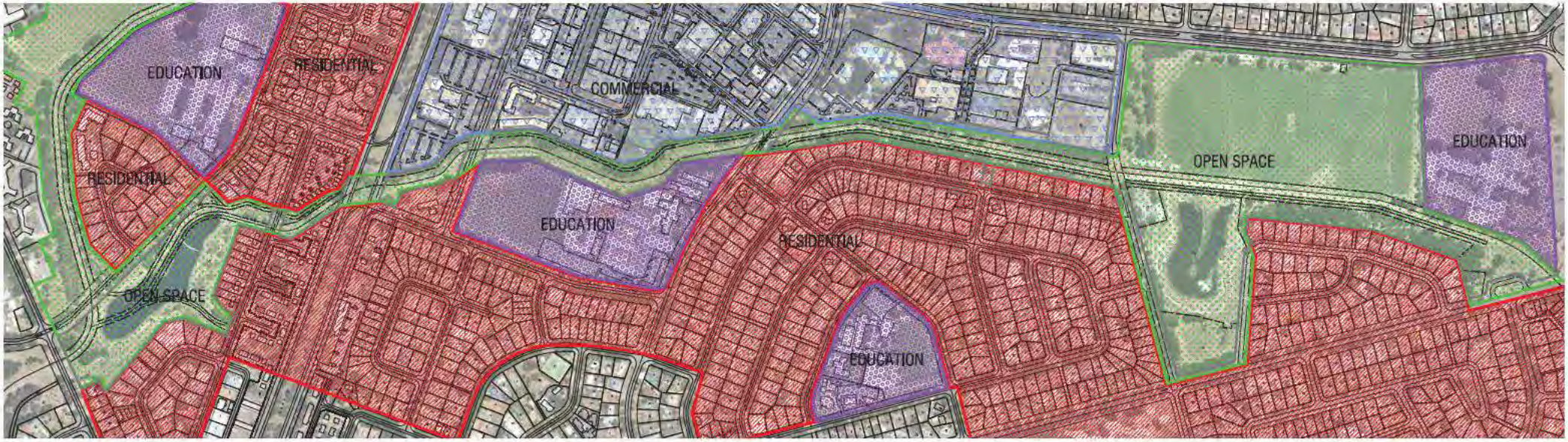
SUBURBAN RESIDENTIAL

COMMUNITY FACILITY

OPEN SPACE

LEGEND

- COMMERCIAL
- RESIDENTIAL
- OPEN SPACE
- EDUCATION



KEY PLAN
SCALE 1:3000 @A1

dickson group centre+ precinct flood study

LANDSCAPE CHARACTER UNITS

LA_AN_03 1234 19FEBRUARY2016