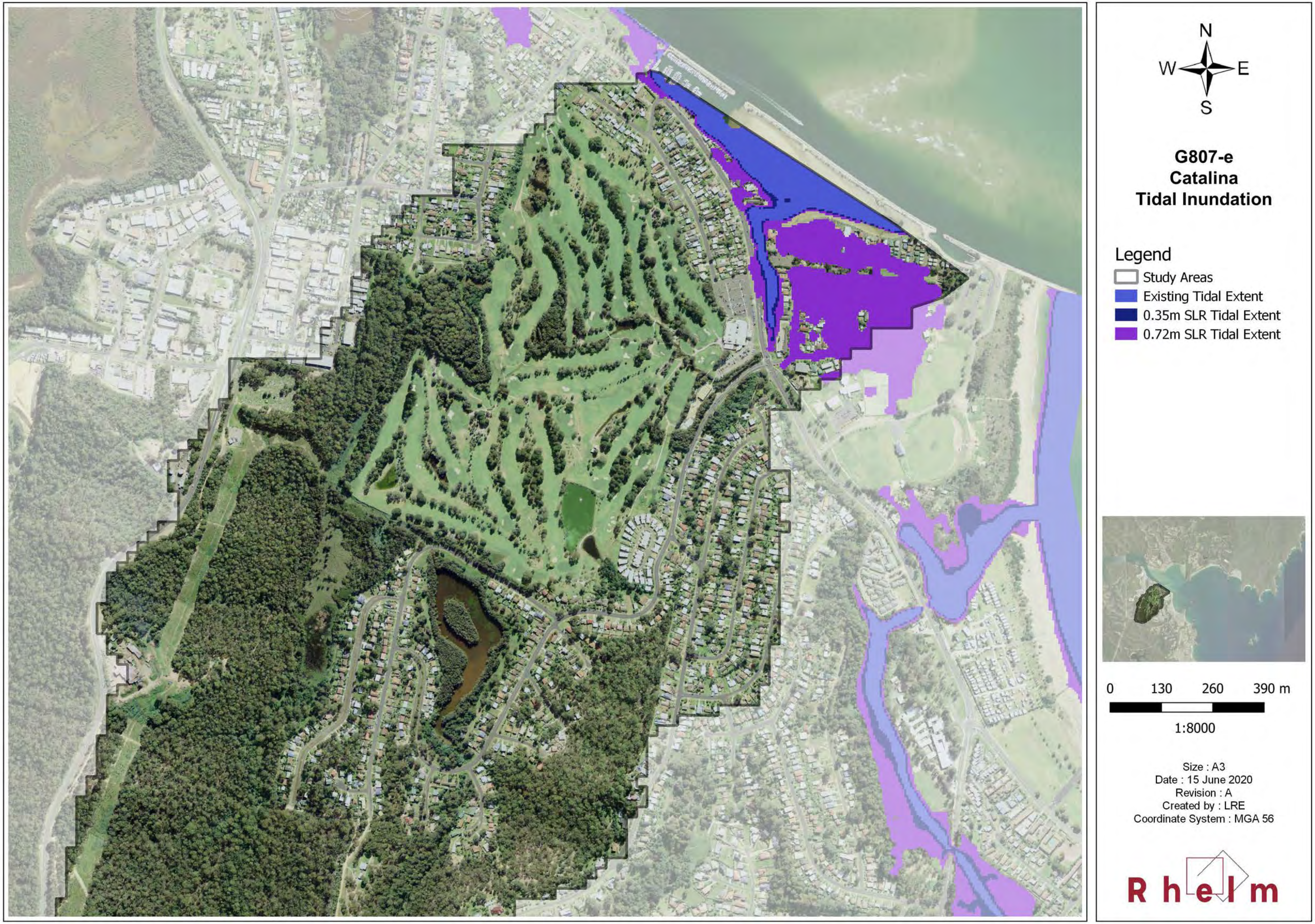
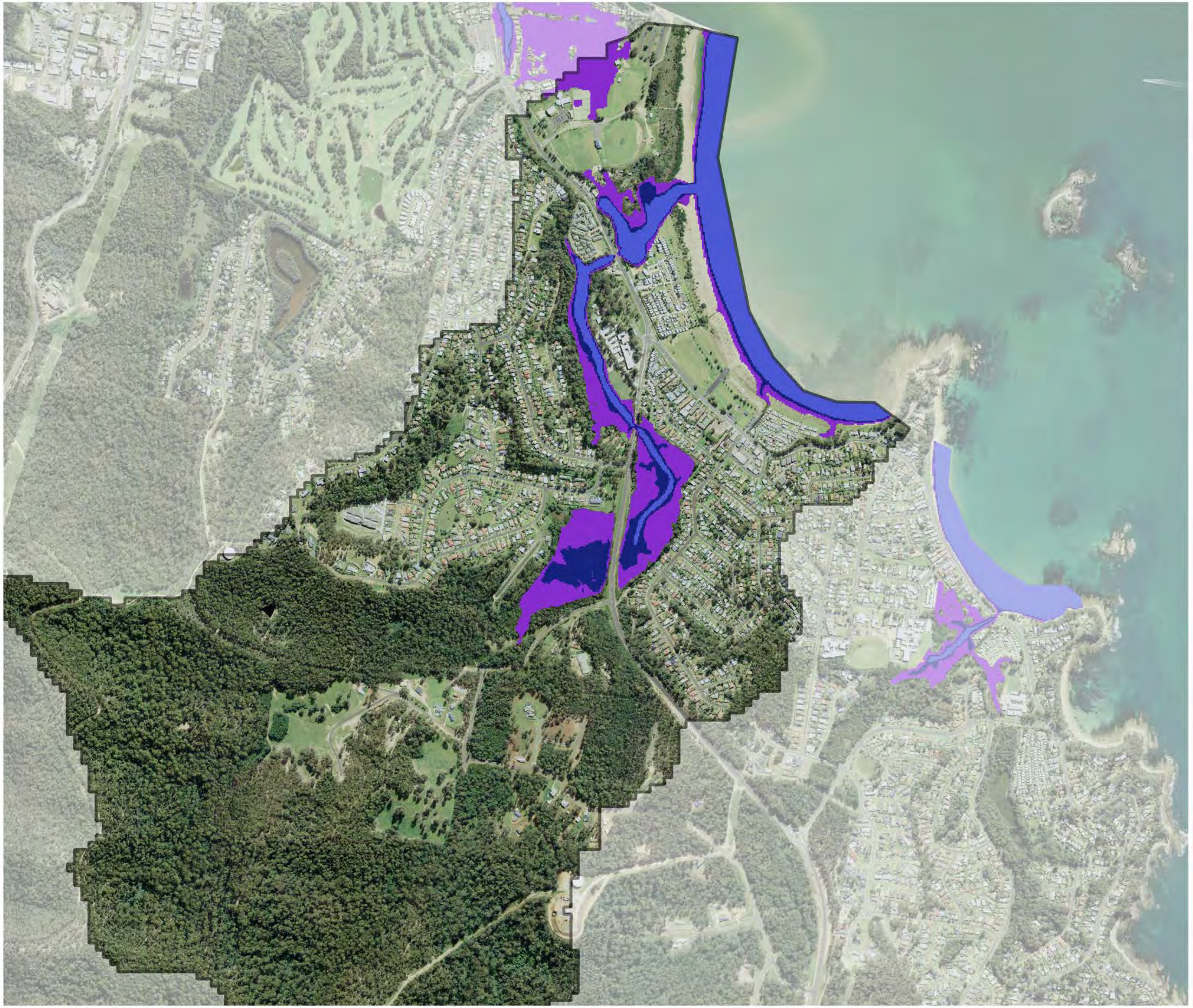

N
W
E
S
G807-e
Catalina
Tidal Inundation
Legend
Study Areas
Existing Tidal Extent
0.35m SLR Tidal Extent
0.72m SLR Tidal Extent
0
130
260
390 m
1:8000
Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm



G807-f
Batehaven
Tidal Inundation

Legend

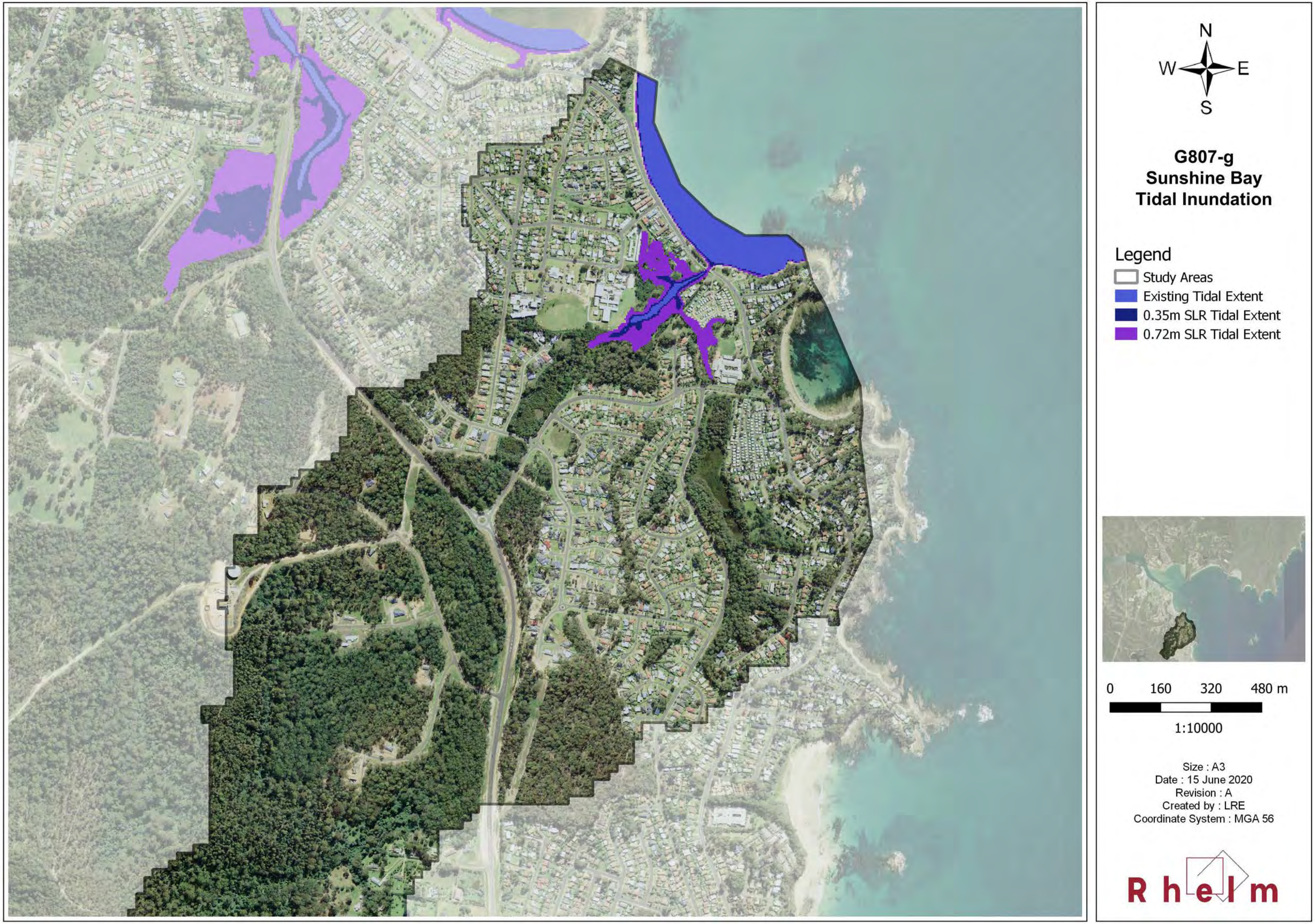
- Study Areas
- Existing Tidal Extent
- 0.35m SLR Tidal Extent
- 0.72m SLR Tidal Extent

0 200 400 600 m

1:12500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm


N
W
E
S
G807-g
Sunshine Bay
Tidal Inundation
Legend
Study Areas
Existing Tidal Extent
0.35m SLR Tidal Extent
0.72m SLR Tidal Extent
0 160 320 480 m
1:10000
Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm

G901-a
Maloneys Beach
Flood Planning Area

Legend

- Study Areas
- Existing 1% AEP +0.5m
- 0.35m SLR 1% AEP +0.5m
- 0.72m SLR 1% AEP +0.5m
- PMF Extent

0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

G901-b
Long Beach
Flood Planning Area

Legend

- Study Areas
- Existing 1% AEP +0.5m
- 0.35m SLR 1% AEP +0.5m
- 0.72m SLR 1% AEP +0.5m
- PMF Extent

0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

G901-c
Surfside
Flood Planning Area

Legend

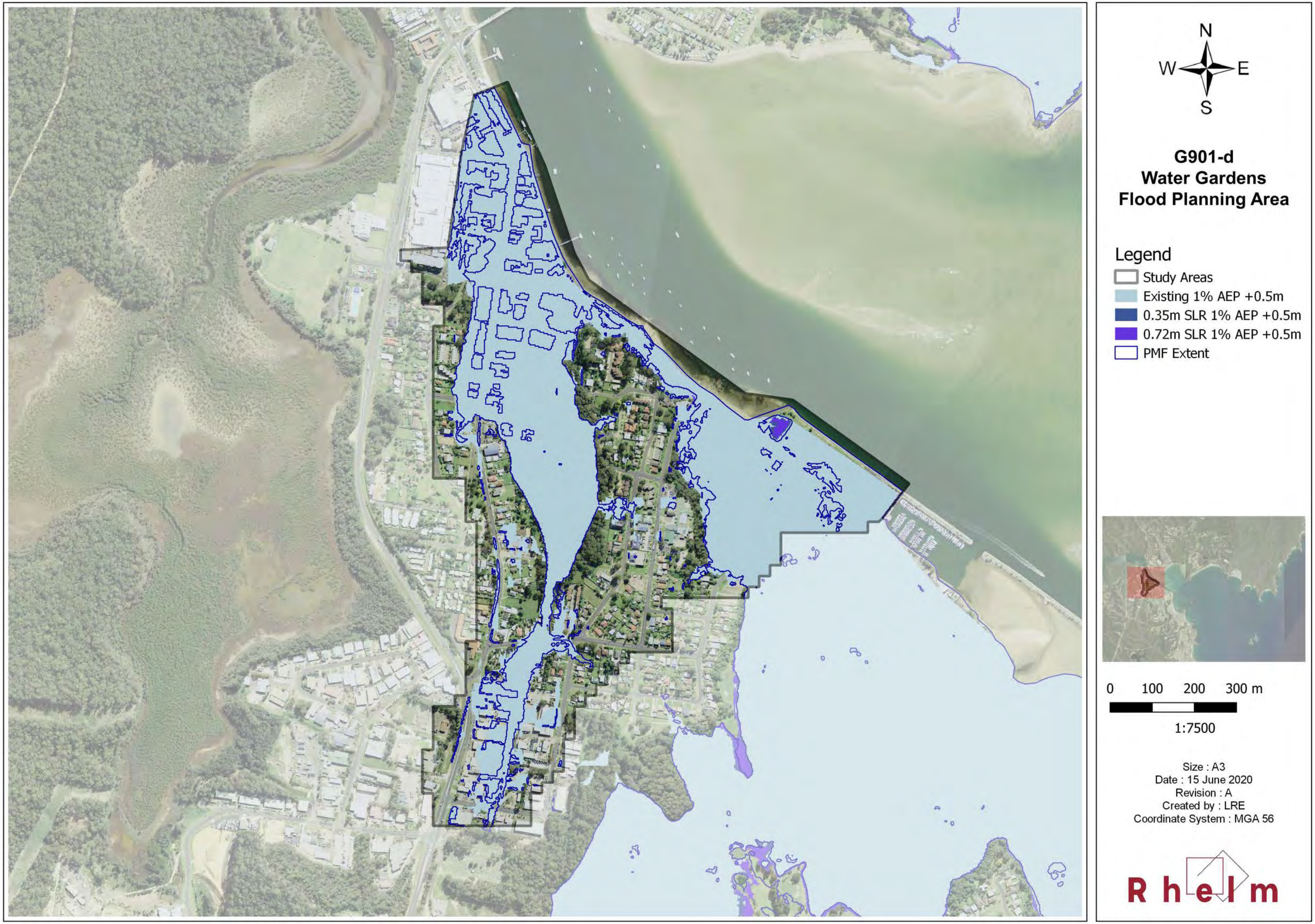
- Study Areas
- Existing 1% AEP +0.5m
- 0.35m SLR 1% AEP +0.5m
- 0.72m SLR 1% AEP +0.5m
- PMF Extent

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

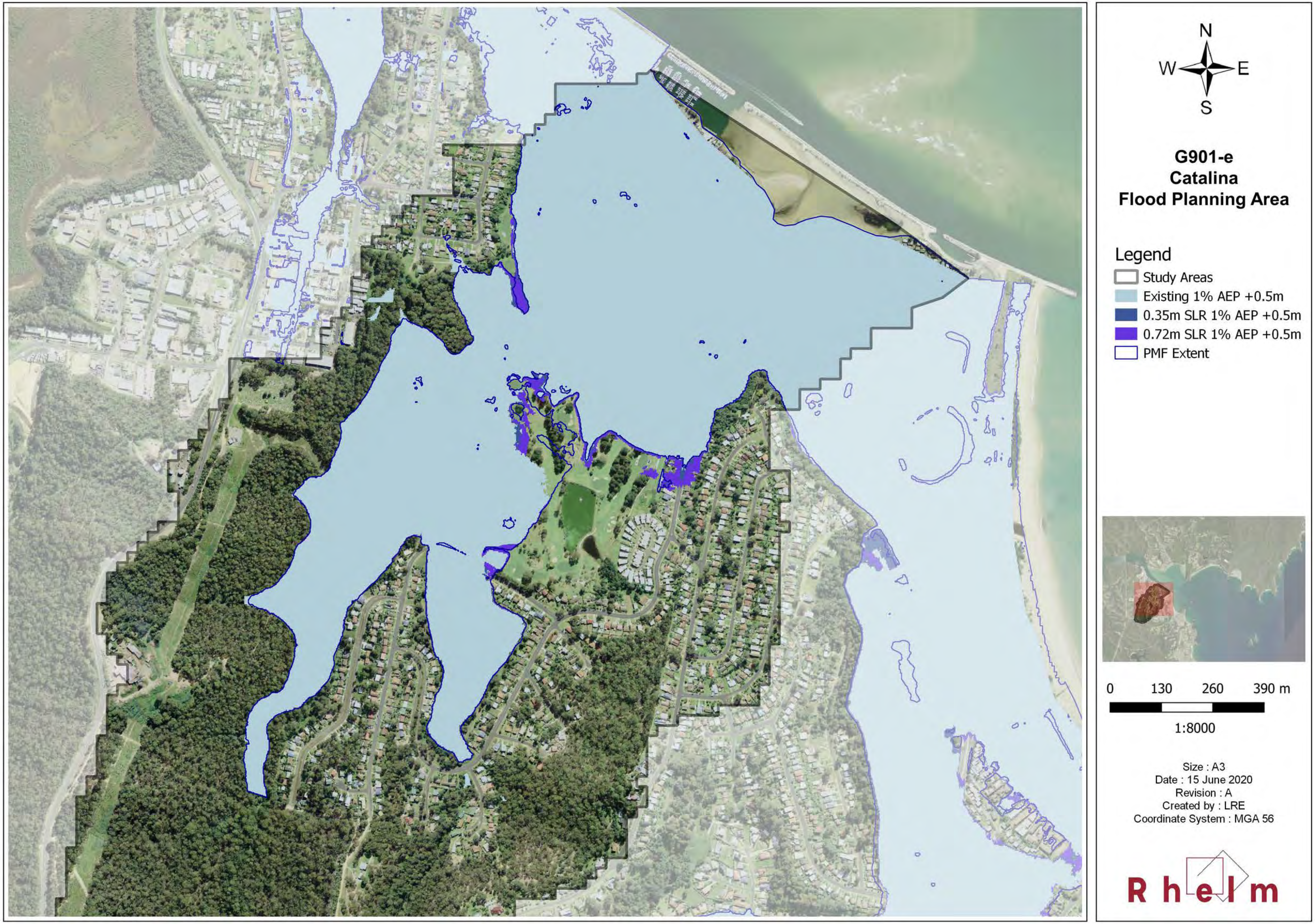


G901-d Water Gardens Flood Planning Area

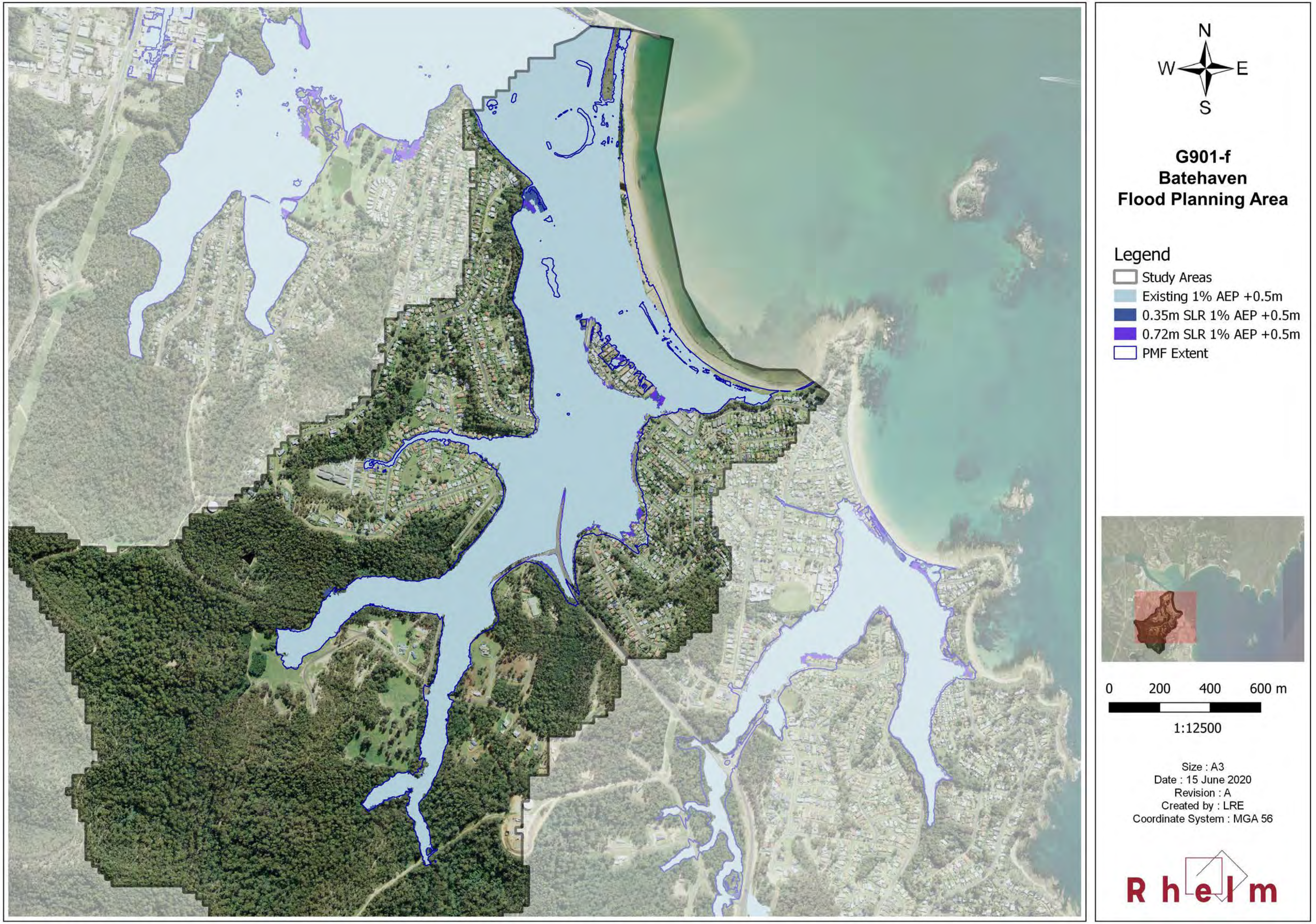
Legend
- Study Areas
- Existing 1% AEP +0.5m
- 0.35m SLR 1% AEP +0.5m
- 0.72m SLR 1% AEP +0.5m
- PMF Extent

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W
E
S
G901-e
Catalina
Flood Planning Area
Legend
Study Areas
Existing 1% AEP +0.5m
0.35m SLR 1% AEP +0.5m
0.72m SLR 1% AEP +0.5m
PMF Extent
0
130
260
390 m
1:8000
Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm


N
W
E
S
G901-f
Batehaven
Flood Planning Area
Legend
Study Areas
Existing 1% AEP +0.5m
0.35m SLR 1% AEP +0.5m
0.72m SLR 1% AEP +0.5m
PMF Extent
0
200
400
600 m
1:12500
Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm

G901-g
Sunshine Bay
Flood Planning Area

Legend

- Study Areas
- Existing 1% AEP +0.5m
- 0.35m SLR 1% AEP +0.5m
- 0.72m SLR 1% AEP +0.5m
- PMF Extent

0 160 320 480 m

1:10000

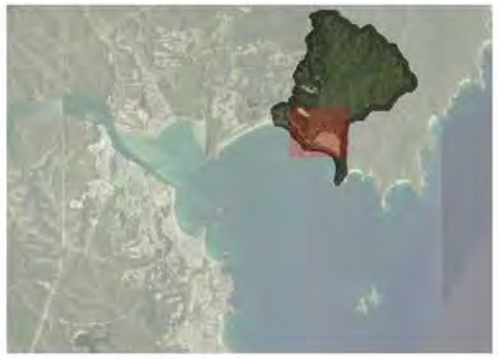
Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
W E
S

G902-a-1
Maloneys Beach
PMF Flood Emergency Response Classifications

Legend
Study Areas
Classifications
Flooded Rising Road
Flooded Overland Escape
Isolated, Elevated
Isolated, Submerged

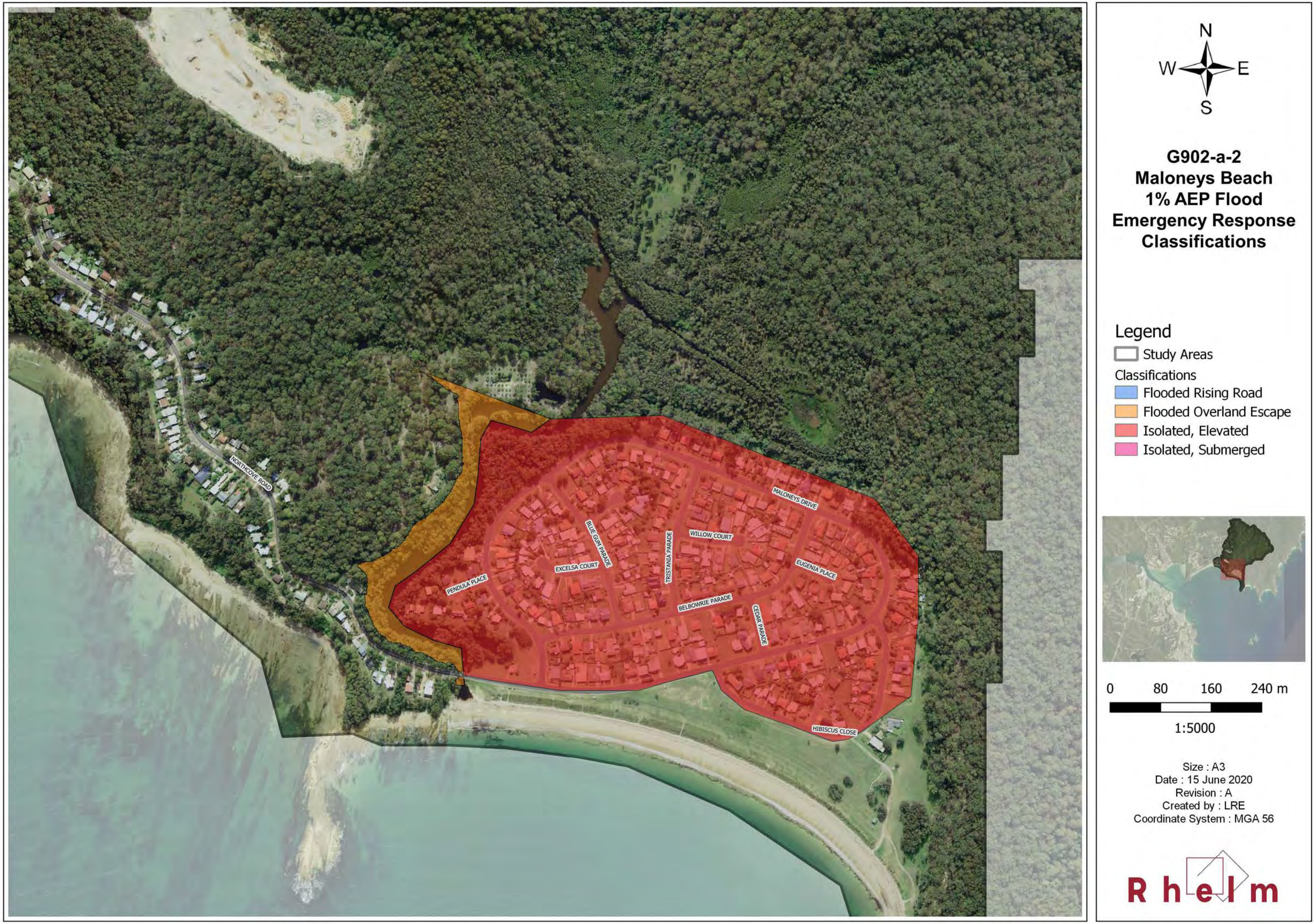


0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W
E
S
G902-a-2
Maloneys Beach
1% AEP Flood
Emergency Response
Classifications
Legend
Study Areas
Classifications
Flooded Rising Road
Flooded Overland Escape
Isolated, Elevated
Isolated, Submerged
0 80 160 240 m
1:5000
Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm
NORTHCOVE ROAD
MALONEYS DRIVE
BLUE GUM PARADE
WILLOW COURT
TRISTANIA PARADE
EXCELSA COURT
PENDULA PLACE
EUGENIA PLACE
BELBOWRIE PARADE
CEDAR PARADE
HIBISCUS CLOSE

N
W E
S

G902-b-1
Long Beach
PMF Flood Emergency Response Classifications

Legend

Study Areas

Classifications

- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
W E
S

G902-b-2
Long Beach
1% AEP Flood
Emergency Response
Classifications

Legend

Study Areas

Classifications

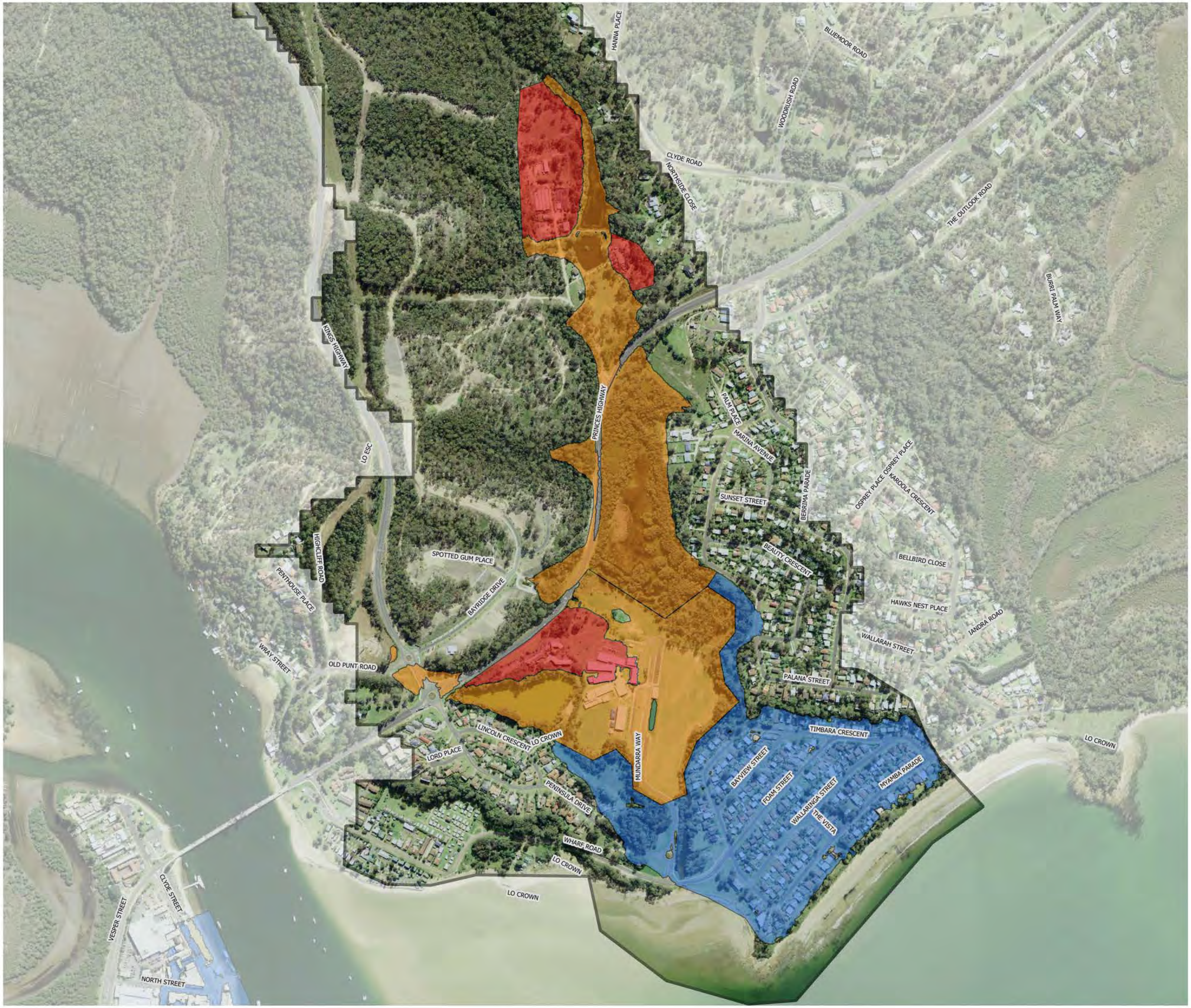
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-c-1
Surfside
PMF Flood Emergency Response Classifications

Legend

Study Areas

Classifications

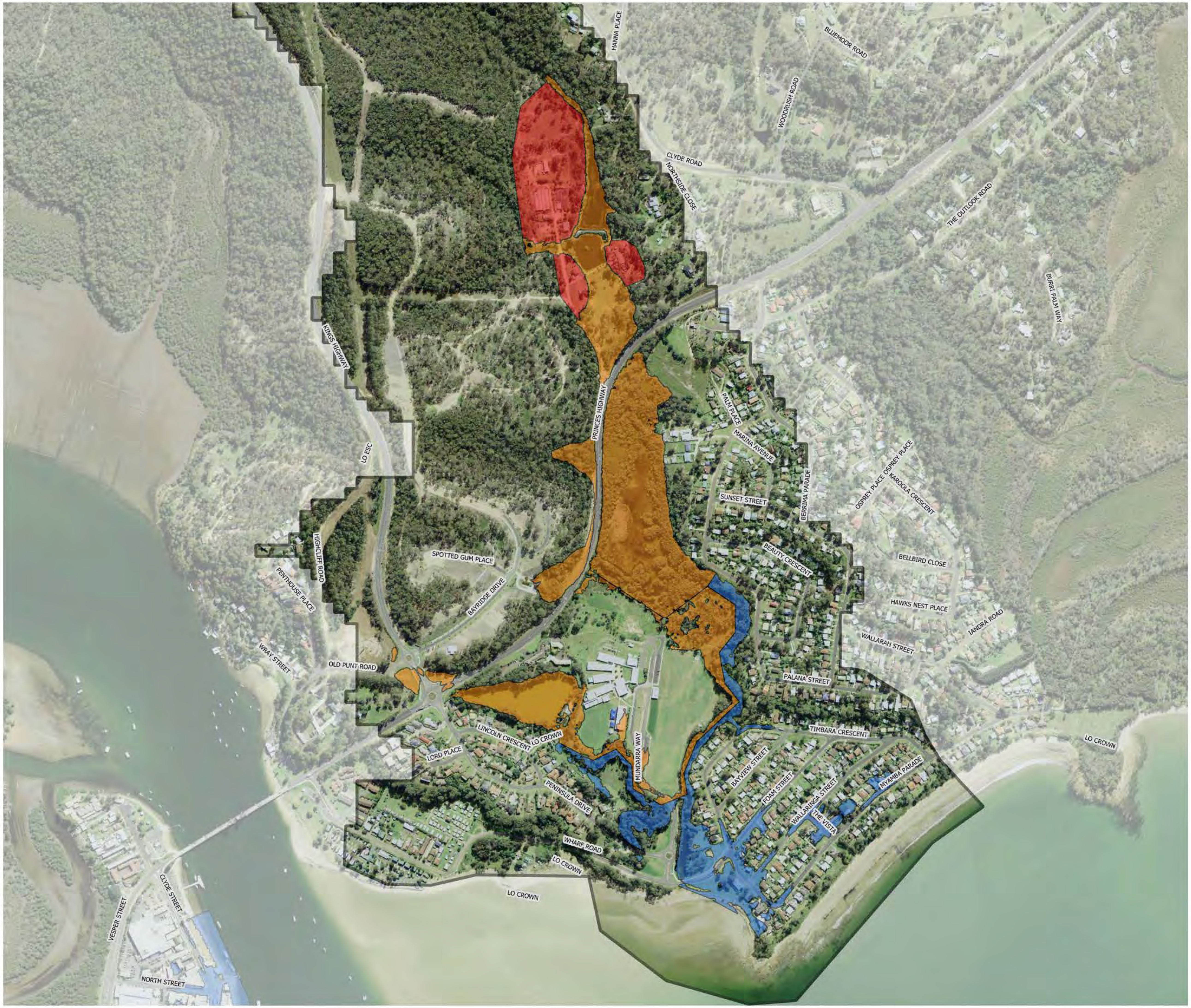
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-c-2
Surfside
1% AEP Flood
Emergency Response
Classifications

Legend

Study Areas

Classifications

Flooded Rising Road

Flooded Overland Escape

Isolated, Elevated

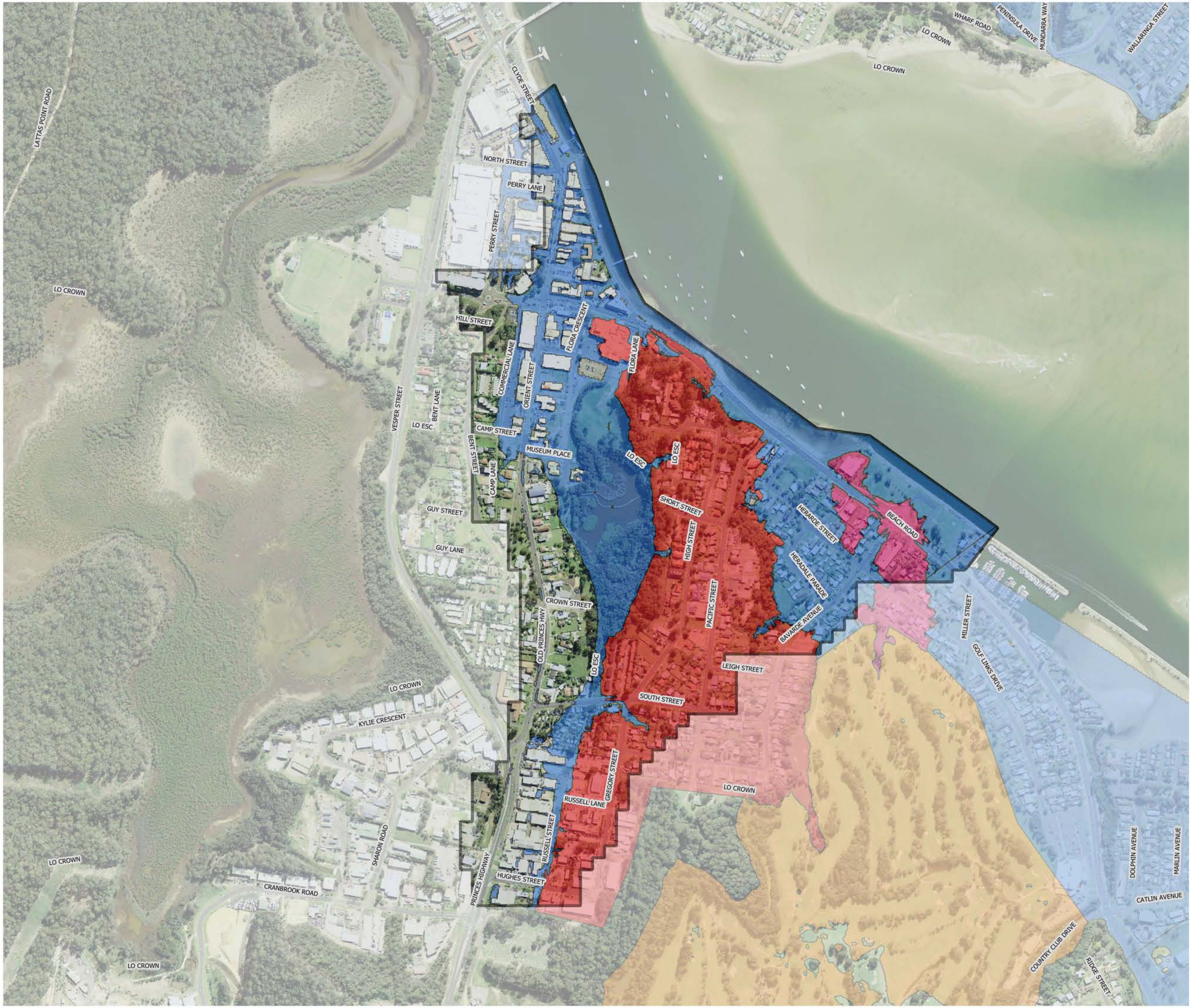
Isolated, Submerged

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-d-1
Water Gardens
PMF Flood Emergency Response Classifications

Legend

Study Areas

Classifications

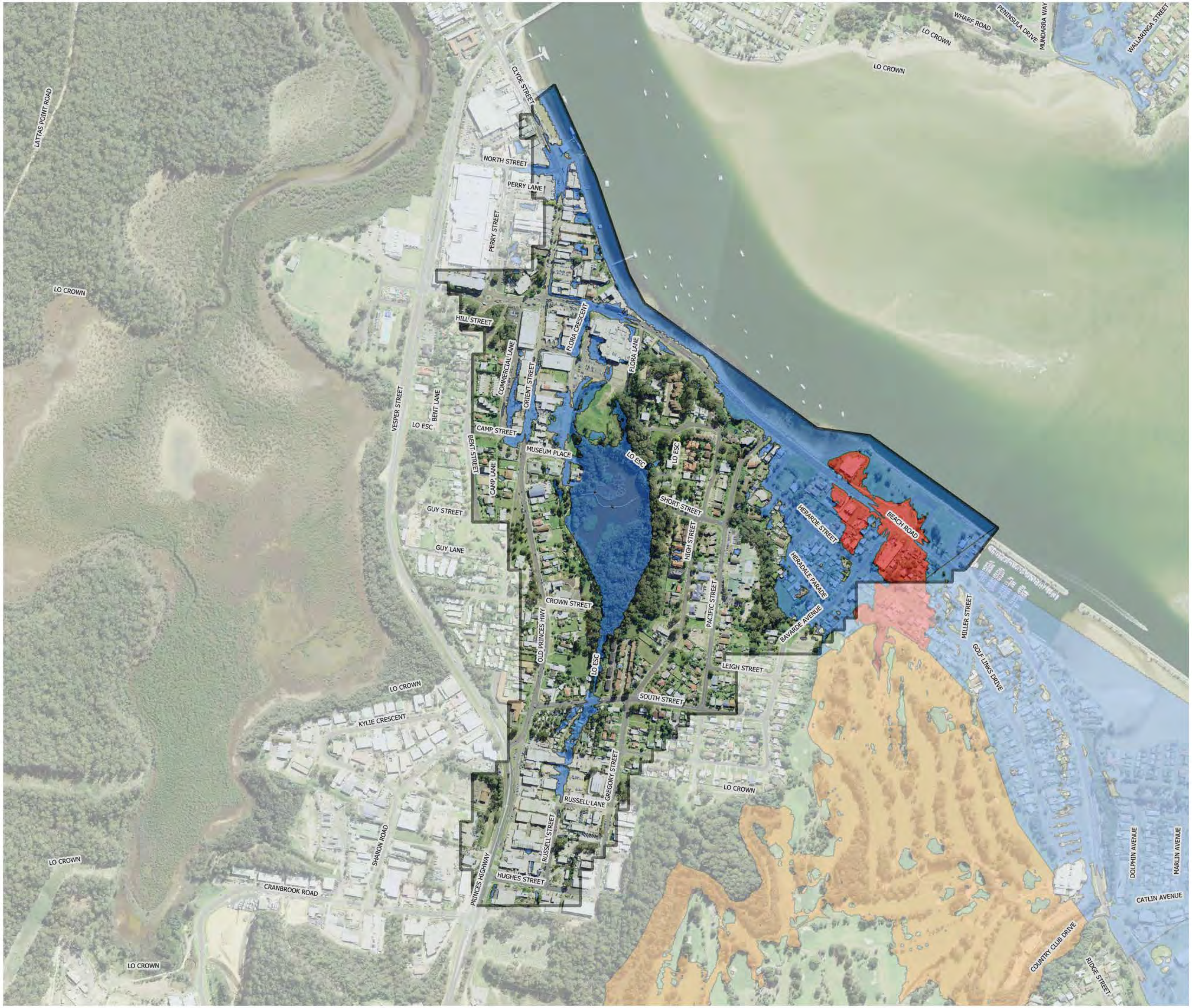
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 100 200 300 m

1:7500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-d-2
Water Gardens
1% AEP Flood
Emergency Response
Classifications

Legend

Study Areas

Classifications

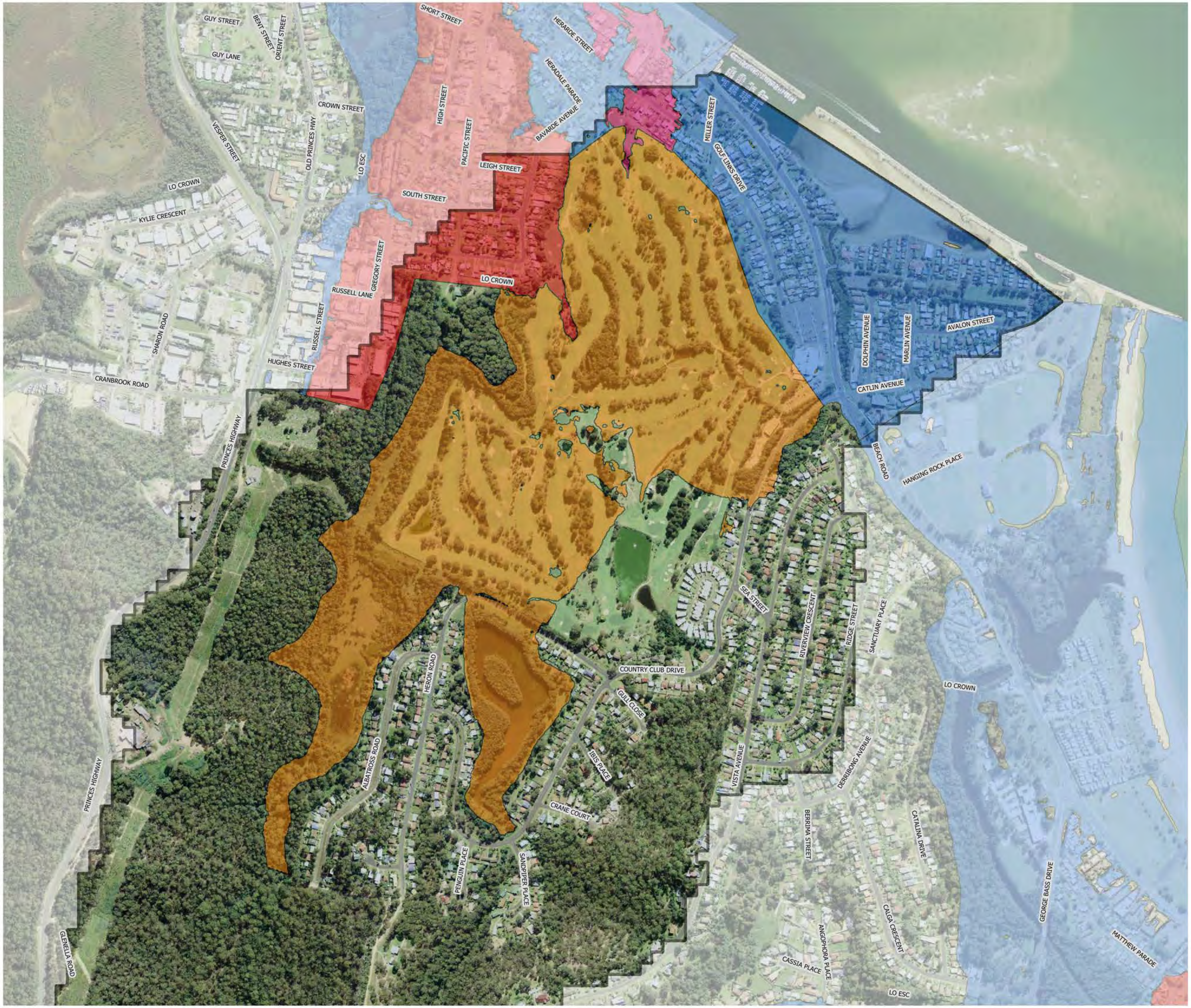
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 100 200 300 m

1:7500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-e-1
Catalina
PMF Flood Emergency Response Classifications

Legend

Study Areas

Classifications

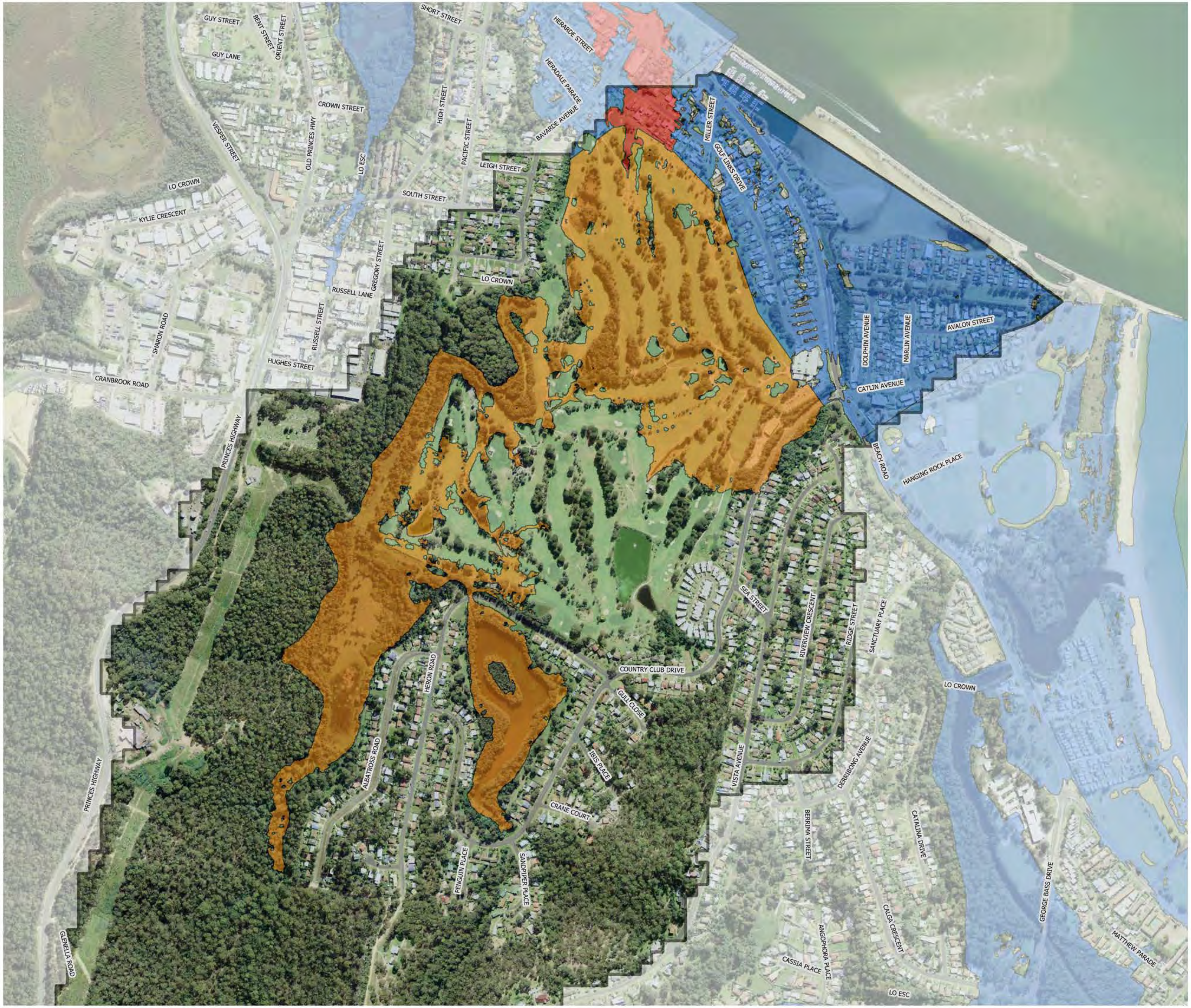
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-e-2
Catalina
1% AEP Flood
Emergency Response
Classifications

Legend

Study Areas

Classifications

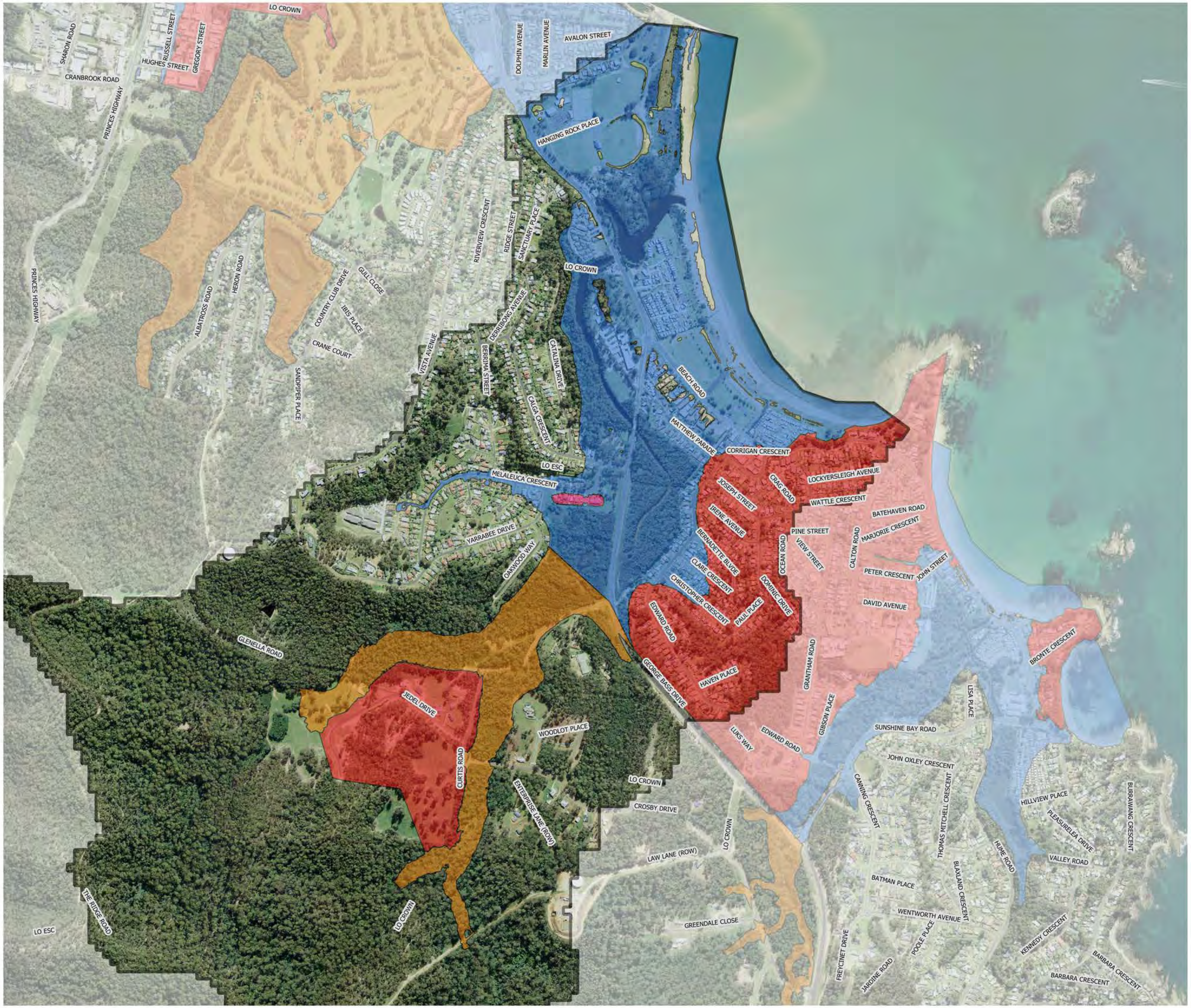
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-f-1
Batehaven
PMF Flood Emergency Response Classifications

Legend

Study Areas

Classifications

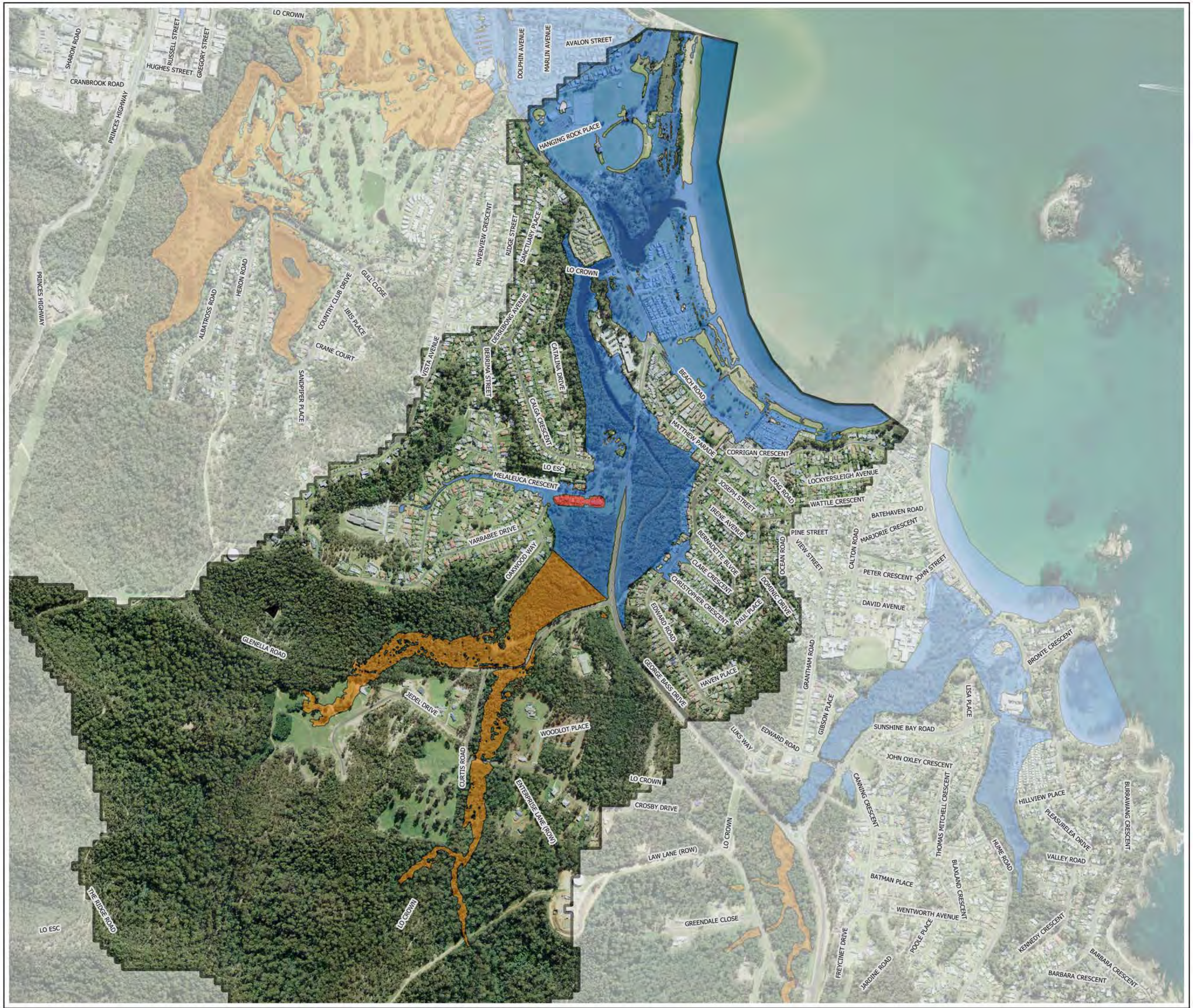
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 200 400 600 m

1:12500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-f-2
Batehaven
1% AEP Flood
Emergency Response
Classifications

Legend

Study Areas

Classifications

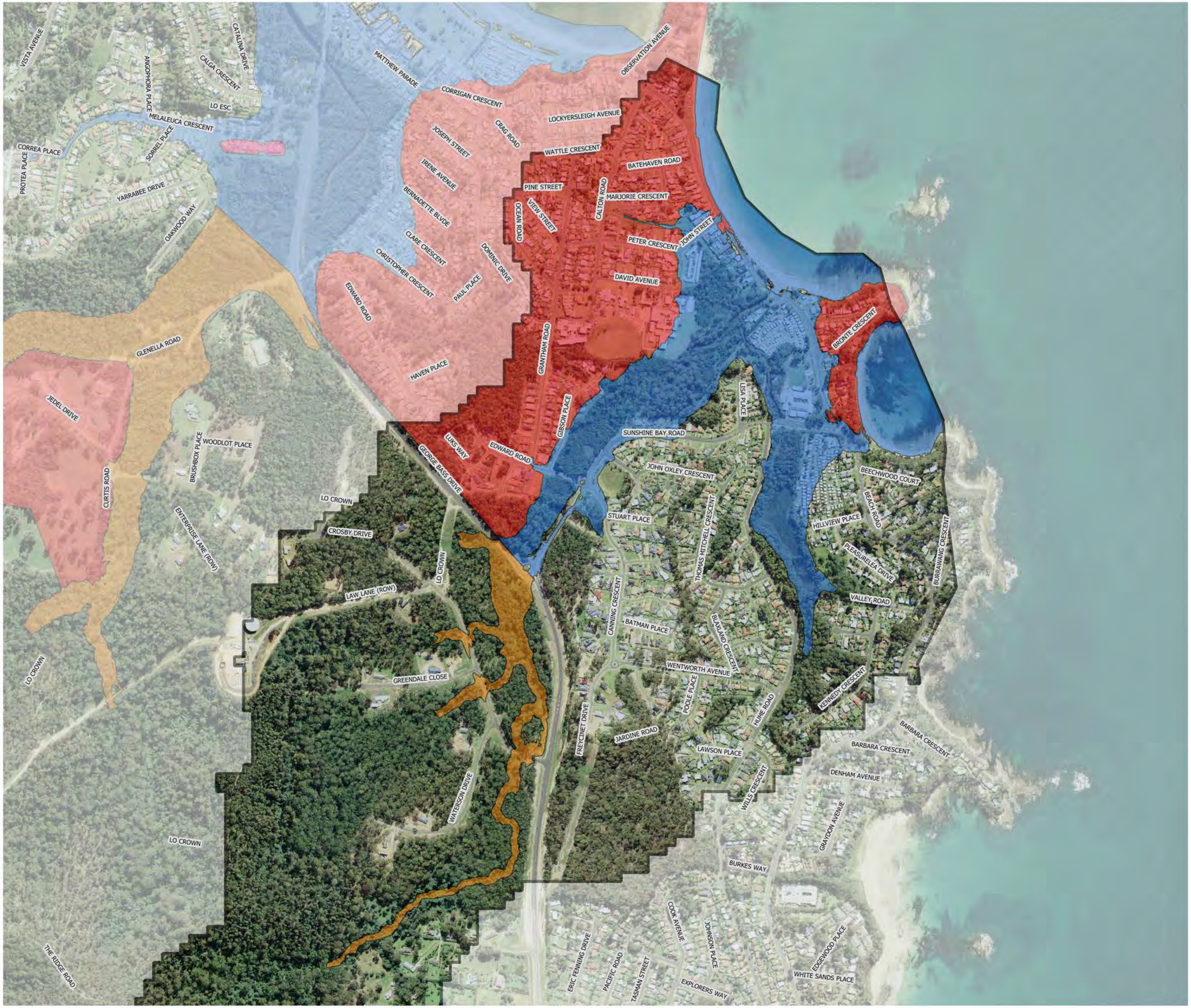
- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 200 400 600 m

1:12500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G902-g-1
Sunshine Bay
PMF Flood Emergency Response Classifications

Legend

Study Areas

Classifications

- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 160 320 480 m

1:10000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
W
E
S

G902-g-2
Sunshine Bay
1% AEP Flood
Emergency Response
Classifications

Legend

Study Areas

Classifications

- Flooded Rising Road
- Flooded Overland Escape
- Isolated, Elevated
- Isolated, Submerged

0 160 320 480 m

1:10000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
M-1	Northcove Road	0	0	0.57	2.46
M-2	Maloneys Drive	0	0	0	2.4
M-3	Belbowire Parade	0	0	0	1.21

N
W E
S

G903-a
Maloneys Beach
Road Overtopping

Legend

Study Areas

Overtopping Locations

1% AEP Depth (m)

0.15 - 0.3

0.3 - 0.5

0.5 - 1

1 - 2

2 - 3

3 - 4

>4

0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
LB-1	Sandy Place	0	0	0	1.42
LB-3	Longbeach Road	0	0	0	0.36
LB-2	Sandy Place	0	0	0	1.08

N
W E
S

G903-b
Long Beach
Road Overtopping

Legend

- Study Areas
- Overtopping Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 80 160 240 m

1:5000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
S-1	Wharf Road	0	0	0.56	1.29
S-2	Timbara Crescent	0	0	0.34	1.16
S-3	Mundarra Way	0	0	0.36	1.47
S-4	Palama Street	0	0	0	0.83
S-5	Princes Highway	0	0	0.17	0.41
S-6	Princes Highway	0.55	0.62	0.68	0.97
S-7	Princes Highway	0	0	0.23	0.78
S-8	Access Road	0.23	0.26	0.39	1.52

N
W E
S

G903-c
Surfside
Road Overtopping

Legend

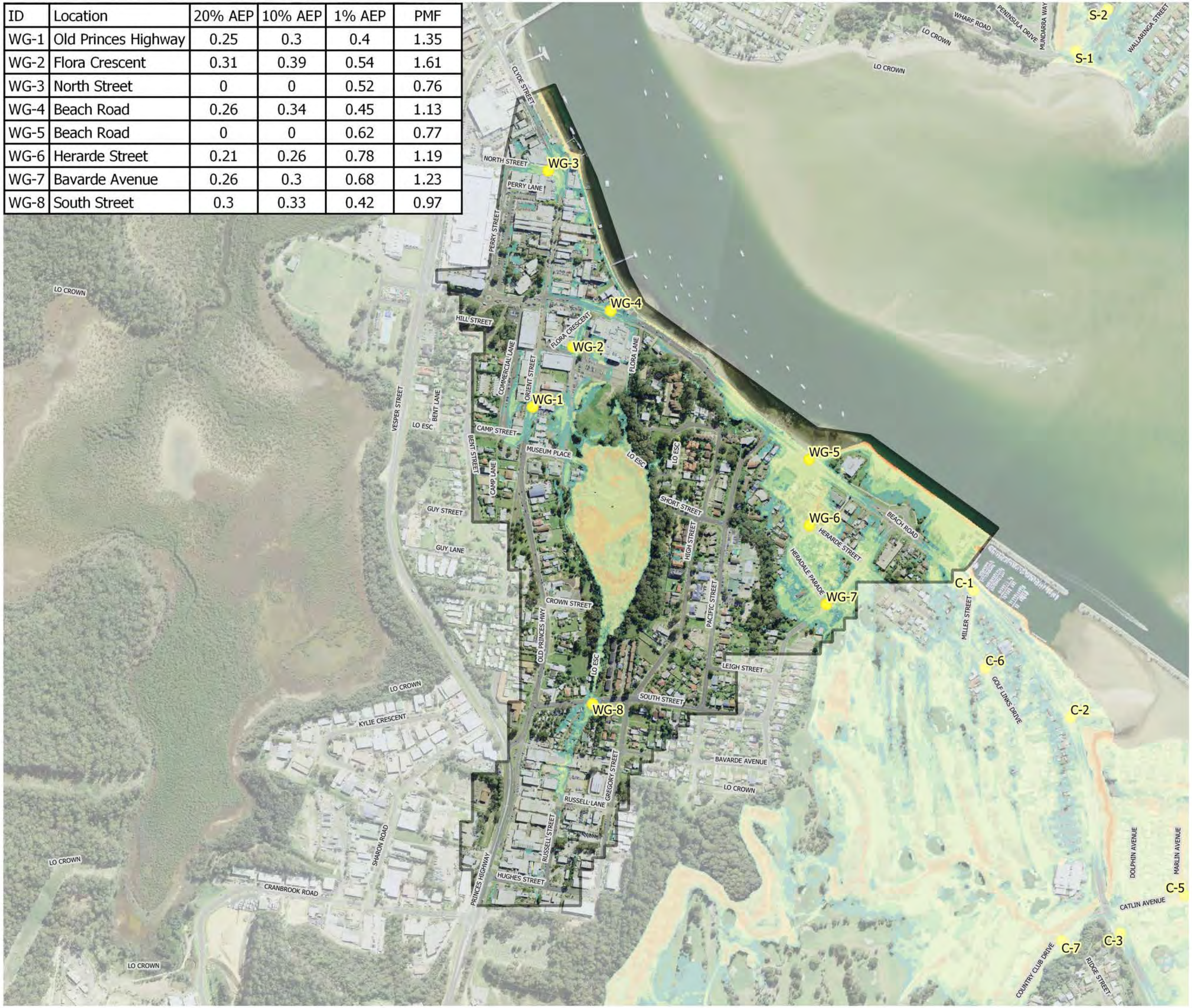
Study Areas
Overtopping Locations
1% AEP Depth (m)
0.15 - 0.3
0.3 - 0.5
0.5 - 1
1 - 2
2 - 3
3 - 4
>4

0 130 260 390 m
1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
WG-1	Old Princes Highway	0.25	0.3	0.4	1.35
WG-2	Flora Crescent	0.31	0.39	0.54	1.61
WG-3	North Street	0	0	0.52	0.76
WG-4	Beach Road	0.26	0.34	0.45	1.13
WG-5	Beach Road	0	0	0.62	0.77
WG-6	Herarde Street	0.21	0.26	0.78	1.19
WG-7	Bavarde Avenue	0.26	0.3	0.68	1.23
WG-8	South Street	0.3	0.33	0.42	0.97



N
W E
S

G903-d
Water Gardens
Road Overtopping

Legend

- Study Areas
- Overtopping Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

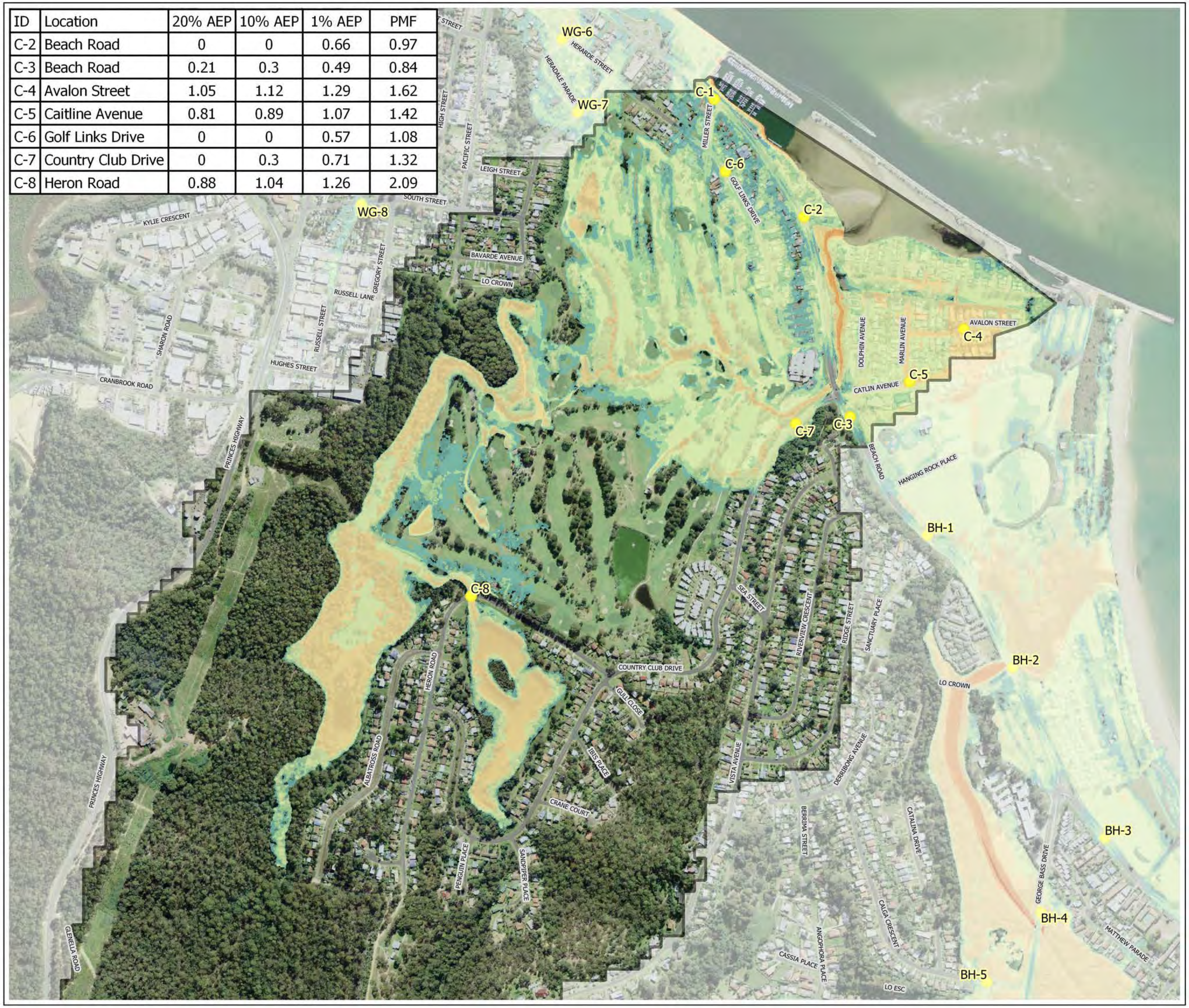
0 100 200 300 m

1:7500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
C-2	Beach Road	0	0	0.66	0.97
C-3	Beach Road	0.21	0.3	0.49	0.84
C-4	Avalon Street	1.05	1.12	1.29	1.62
C-5	Caitline Avenue	0.81	0.89	1.07	1.42
C-6	Golf Links Drive	0	0	0.57	1.08
C-7	Country Club Drive	0	0.3	0.71	1.32
C-8	Heron Road	0.88	1.04	1.26	2.09



N
W
E
S

G903-e
Catalina
Road Overtopping

Legend

- Study Areas
- Overtopping Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

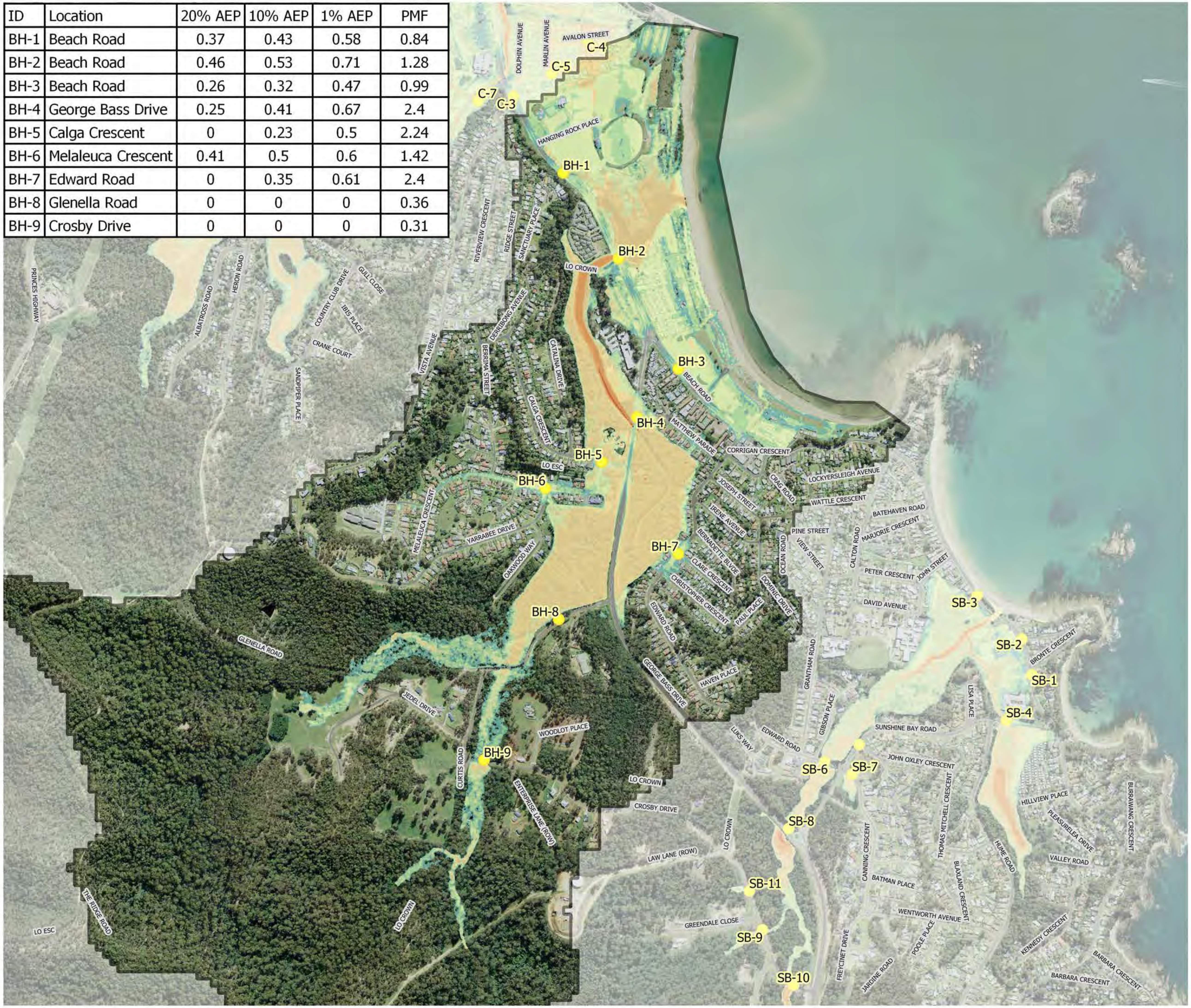
0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
BH-1	Beach Road	0.37	0.43	0.58	0.84
BH-2	Beach Road	0.46	0.53	0.71	1.28
BH-3	Beach Road	0.26	0.32	0.47	0.99
BH-4	George Bass Drive	0.25	0.41	0.67	2.4
BH-5	Calga Crescent	0	0.23	0.5	2.24
BH-6	Melaleuca Crescent	0.41	0.5	0.6	1.42
BH-7	Edward Road	0	0.35	0.61	2.4
BH-8	Glenella Road	0	0	0	0.36
BH-9	Crosby Drive	0	0	0	0.31



G903-f Batehaven Road Overtopping

Legend

- Study Areas
- Overtopping Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

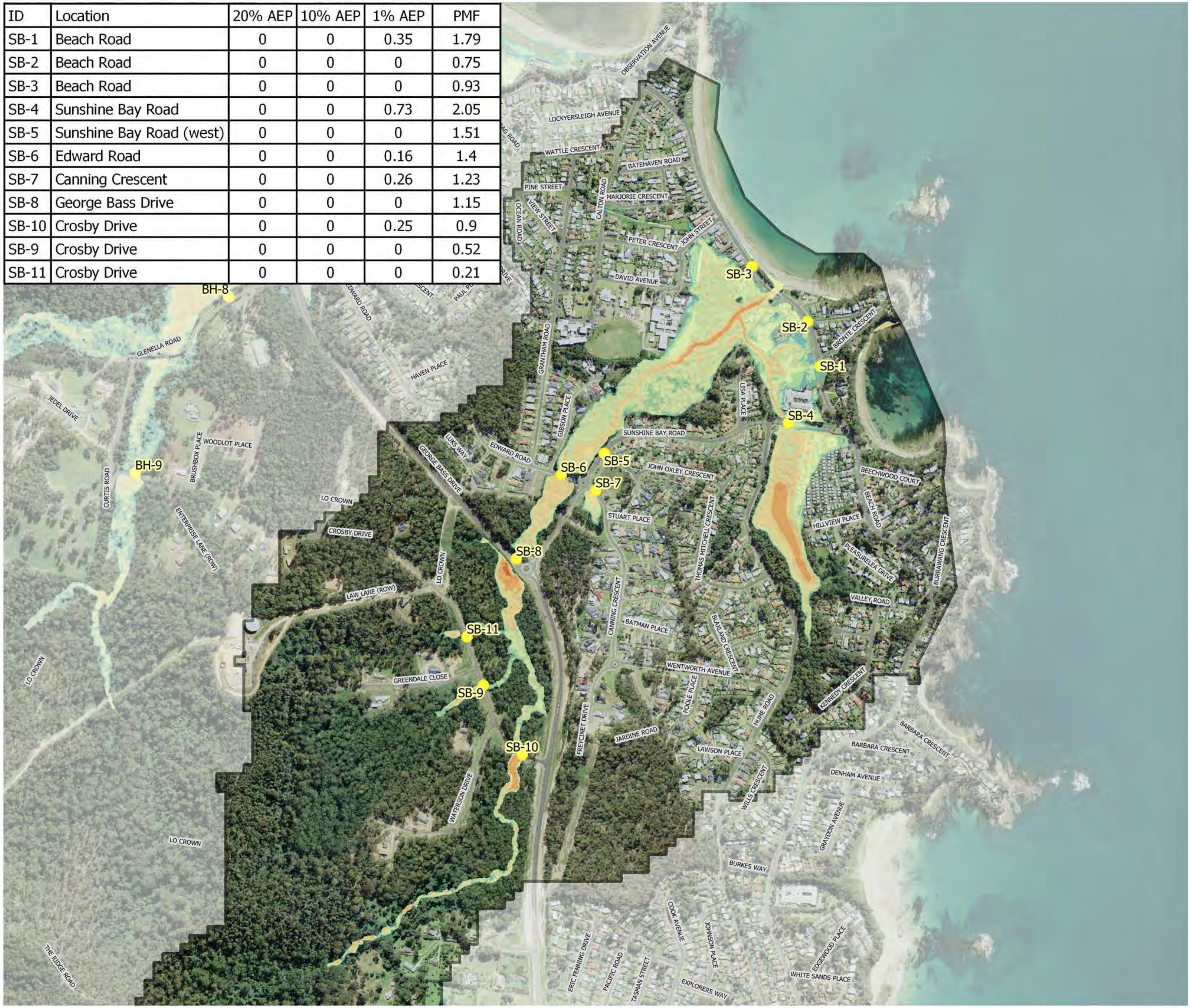
0 200 400 600 m

1:12500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

ID	Location	20% AEP	10% AEP	1% AEP	PMF
SB-1	Beach Road	0	0	0.35	1.79
SB-2	Beach Road	0	0	0	0.75
SB-3	Beach Road	0	0	0	0.93
SB-4	Sunshine Bay Road	0	0	0.73	2.05
SB-5	Sunshine Bay Road (west)	0	0	0	1.51
SB-6	Edward Road	0	0	0.16	1.4
SB-7	Canning Crescent	0	0	0.26	1.23
SB-8	George Bass Drive	0	0	0	1.15
SB-10	Crosby Drive	0	0	0.25	0.9
SB-9	Crosby Drive	0	0	0	0.52
SB-11	Crosby Drive	0	0	0	0.21



N
W
E
S

G903-g Sunshine Bay Road Overtopping

Legend

- Study Areas
- Overtopping Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 160 320 480 m

1:10000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
W E
S

G904-c Surfside Infrastructure Affectation

Legend

- Study Areas
- Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
W E
S

G904-d Water Gardens Infrastructure Affectation

Legend

Study Areas
Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 100 200 300 m

1:7500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
W E
S

G904-e Catalina Infrastructure Affectation

Legend

- Study Areas
- Locations

1% AEP Depth (m)

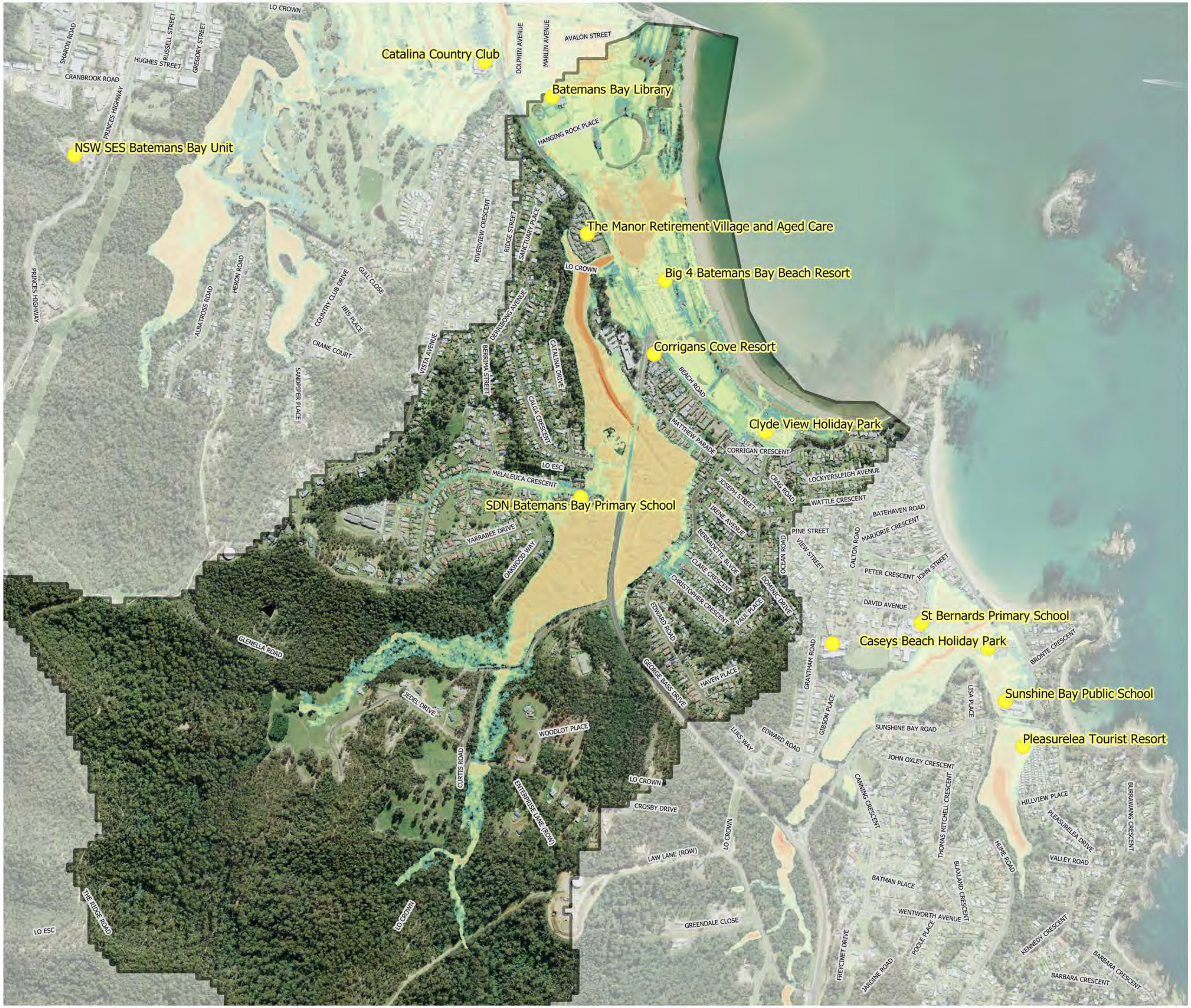
- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 130 260 390 m

1:8000

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
S

G904-f Batehaven Infrastructure Affectation

Legend

- Study Areas
- Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 200 400 600 m

1:12500

Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

N
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G904-g Sunshine Bay Infrastructure Affectation

Legend

- Study Areas
- Locations

1% AEP Depth (m)

- 0.15 - 0.3
- 0.3 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- >4

0 160 320 480 m

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Size : A3
Date : 15 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm

G905-a
Maloneys Beach Draft Flood Prone Land Control Areas

Legend

- Study Areas
- FPA - Flood Planning Area
- SFC - Special Flood Considerations

Land Use Zones

B1	E2	RE1	SP1
B2	E4	RE2	SP2
B4	IN1	RU1	SP3
B5	R2	RU3	W1
DM	R3	RU4	W2
E1	R5	RU5	

0 80 160 240 m

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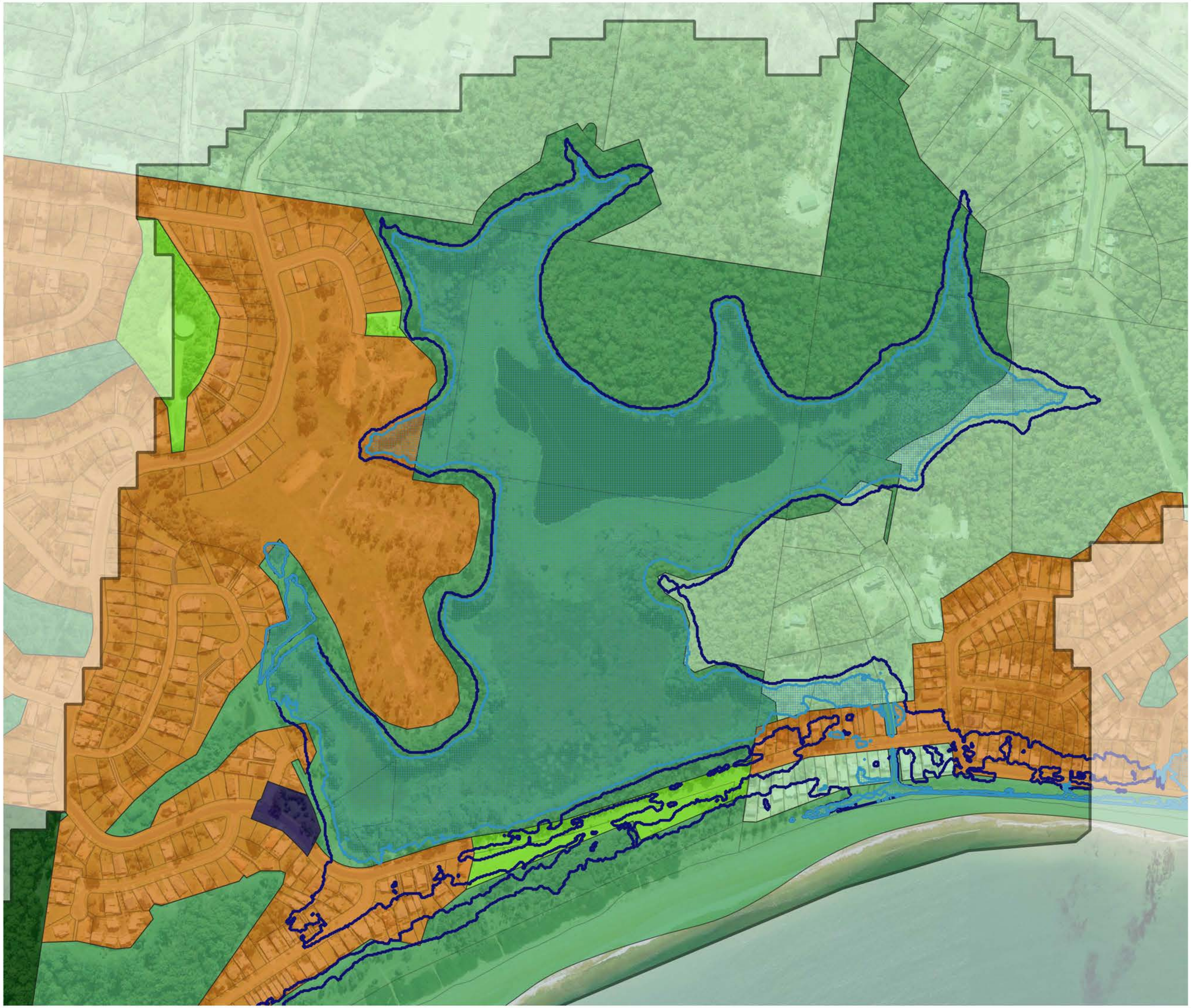
Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
W E
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G905-b
Long Beach
Draft Flood Prone Land Control Areas

Legend

- Study Areas
- FPA - Flood Planning Area
- SFC - Special Flood Considerations

Land Use Zones

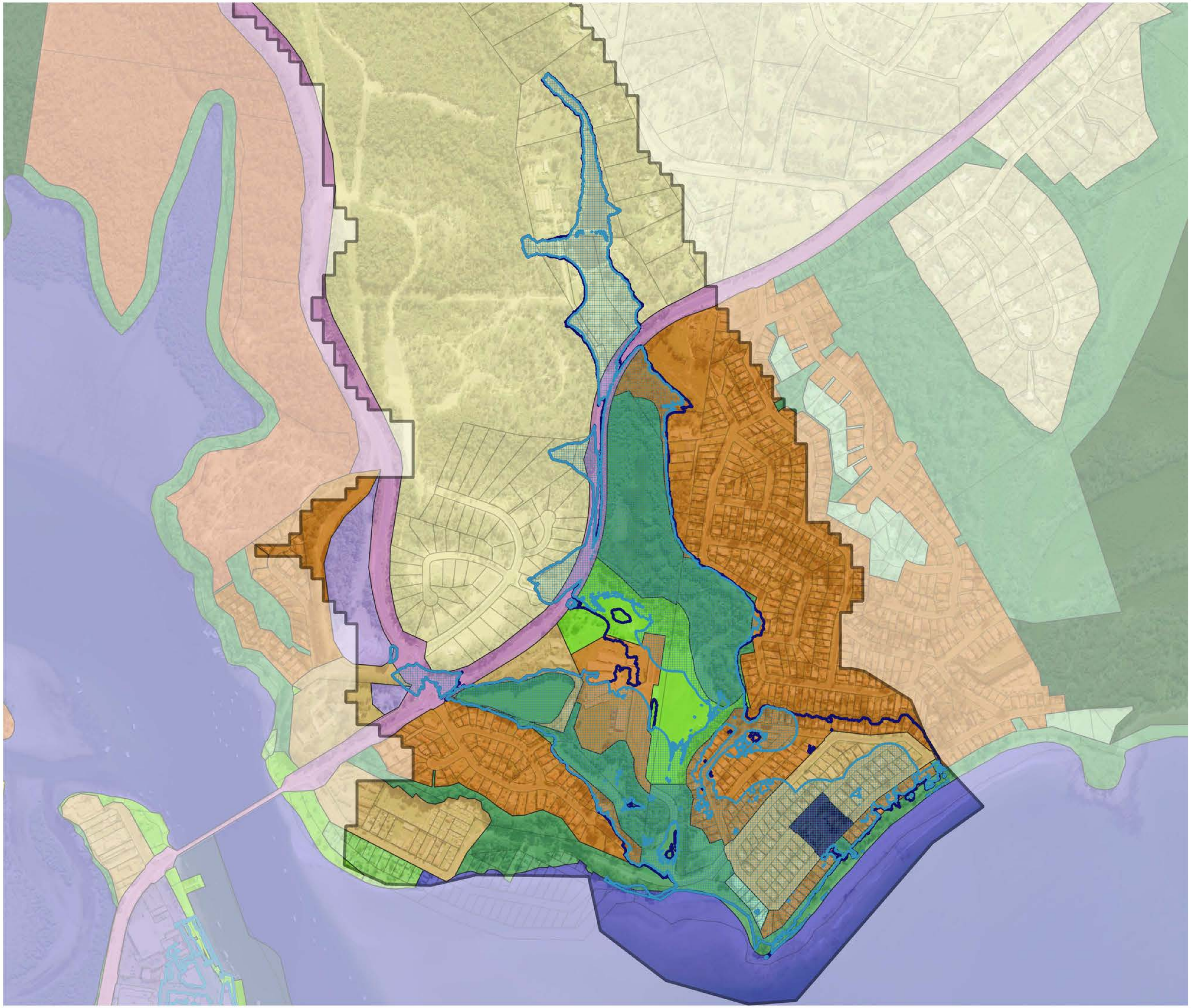
B1	E2	RE1	SP1
B2	E4	RE2	SP2
B4	IN1	RU1	SP3
B5	R2	RU3	W1
DM	R3	RU4	W2
E1	R5	RU5	

0 80 160 240 m

1:5000

Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
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G905-c
Surfside
Draft Flood Prone Land Control Areas

Legend

- Study Areas
- FPA - Flood Planning Area
- SFC - Special Flood Considerations

Land Use Zones

B1	E2	RE1	SP1
B2	E4	RE2	SP2
B4	IN1	RU1	SP3
B5	R2	RU3	W1
DM	R3	RU4	W2
E1	R5	RU5	

0 130 260 390 m

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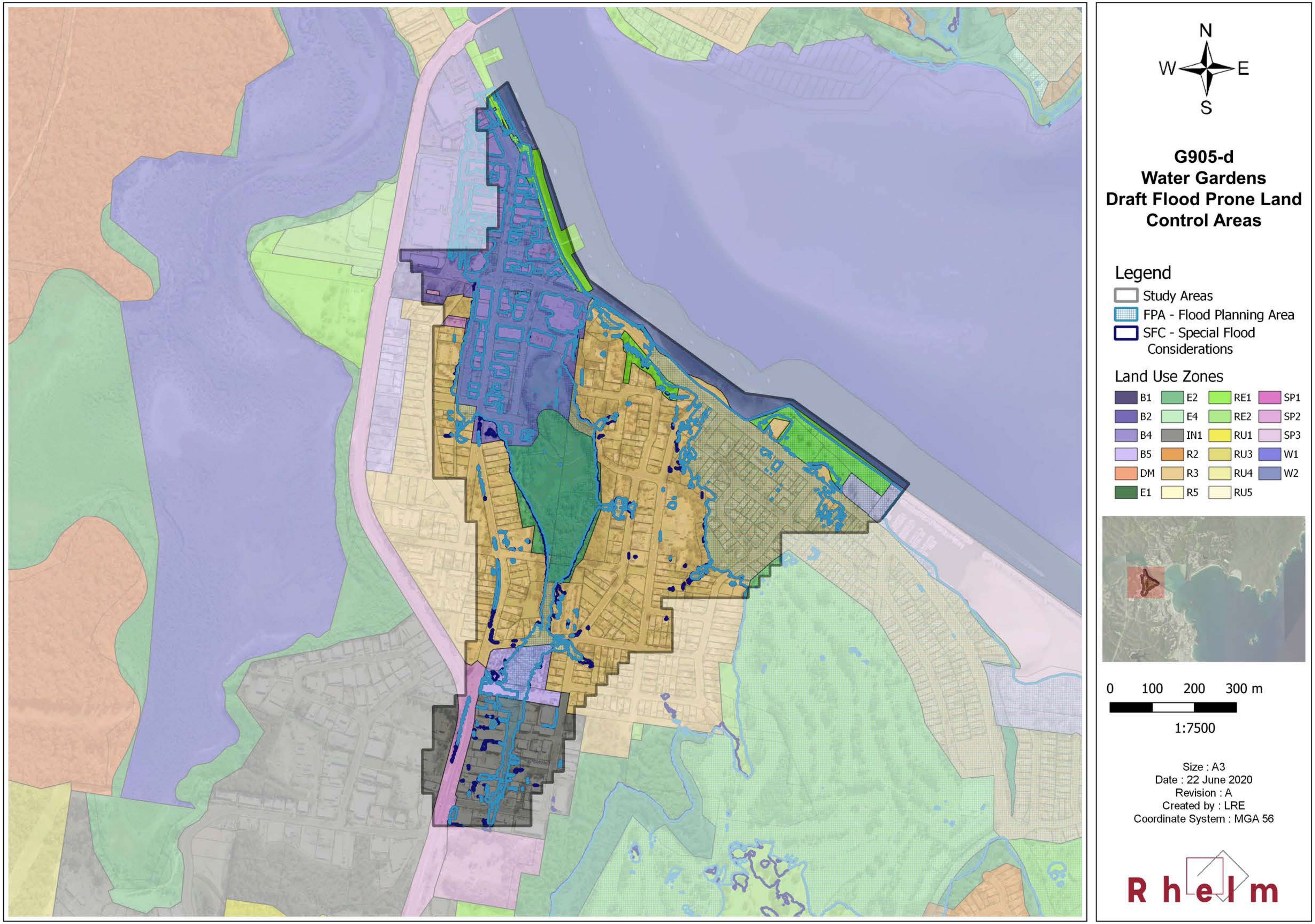
Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56

Rhelm



N
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G905-d
Water Gardens
Draft Flood Prone Land
Control Areas
Legend
Study Areas
FPA - Flood Planning Area
SFC - Special Flood Considerations
Land Use Zones
B1
B2
B4
B5
DM
E1
E2
E4
IN1
R2
R3
R5
RE1
RE2
RU1
RU3
RU4
RU5
SP1
SP2
SP3
W1
W2
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100
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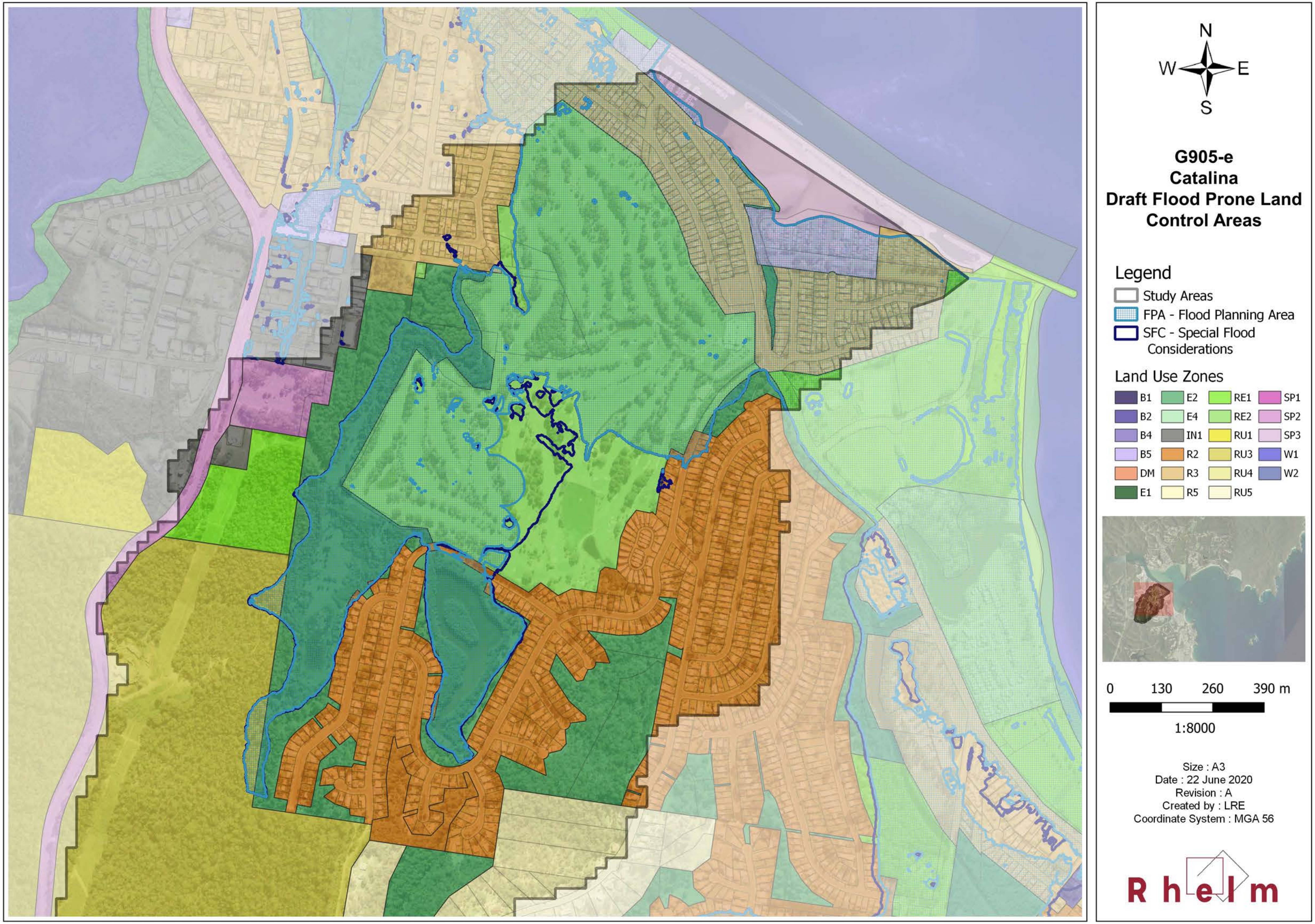
300 m
1:7500
Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm


N
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G905-e
Catalina
Draft Flood Prone Land
Control Areas
Legend
Study Areas
FPA - Flood Planning Area
SFC - Special Flood Considerations
Land Use Zones
B1
B2
B4
B5
DM
E1
E2
E4
IN1
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R3
R5
RE1
RE2
RU1
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SP1
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SP3
W1
W2
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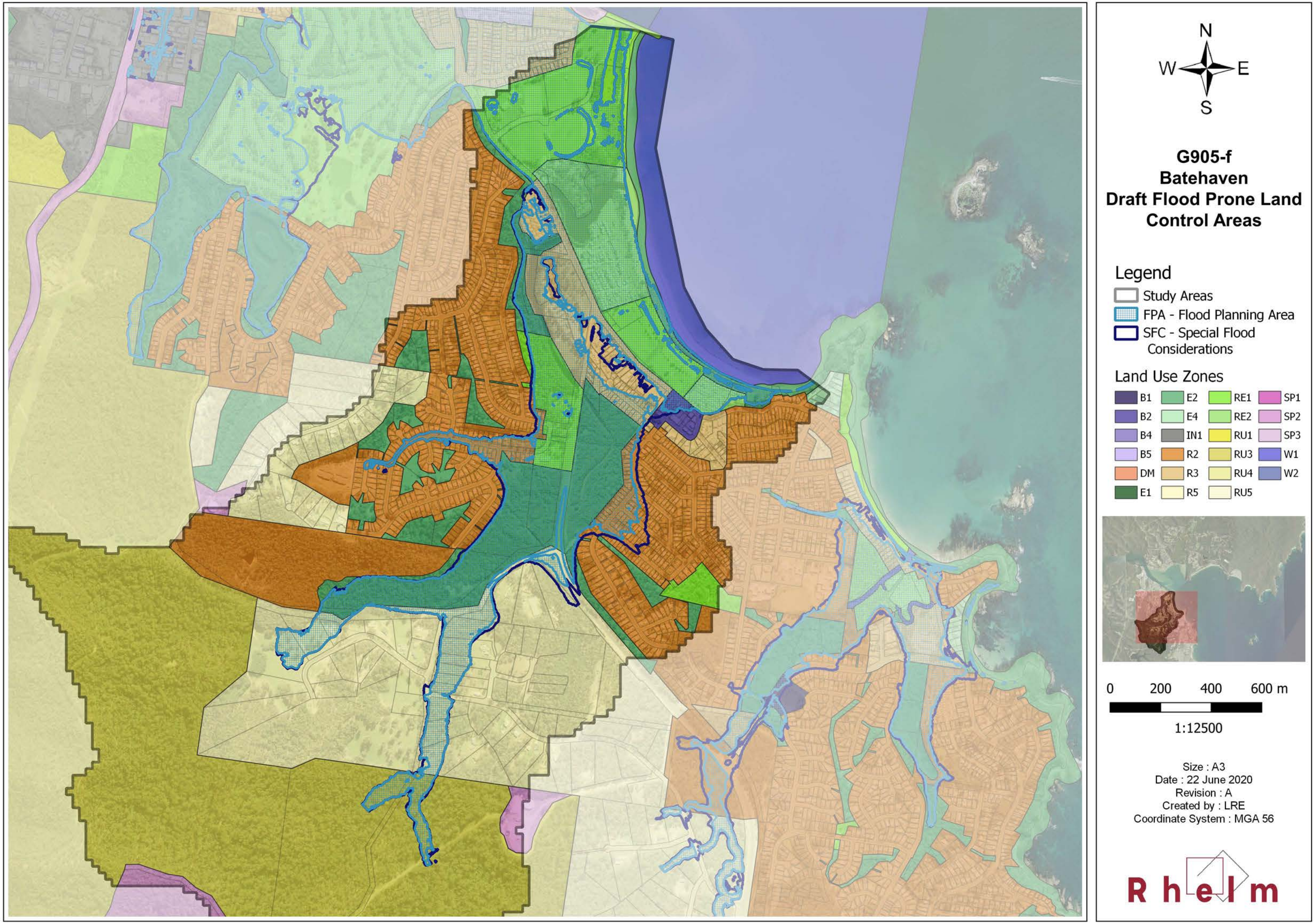
Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm



N
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G905-f
Batehaven
Draft Flood Prone Land Control Areas
Legend
Study Areas
FPA - Flood Planning Area
SFC - Special Flood Considerations
Land Use Zones
B1
E2
RE1
SP1
B2
E4
RE2
SP2
B4
IN1
RU1
SP3
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R2
RU3
W1
DM
R3
RU4
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E1
R5
RU5
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600 m
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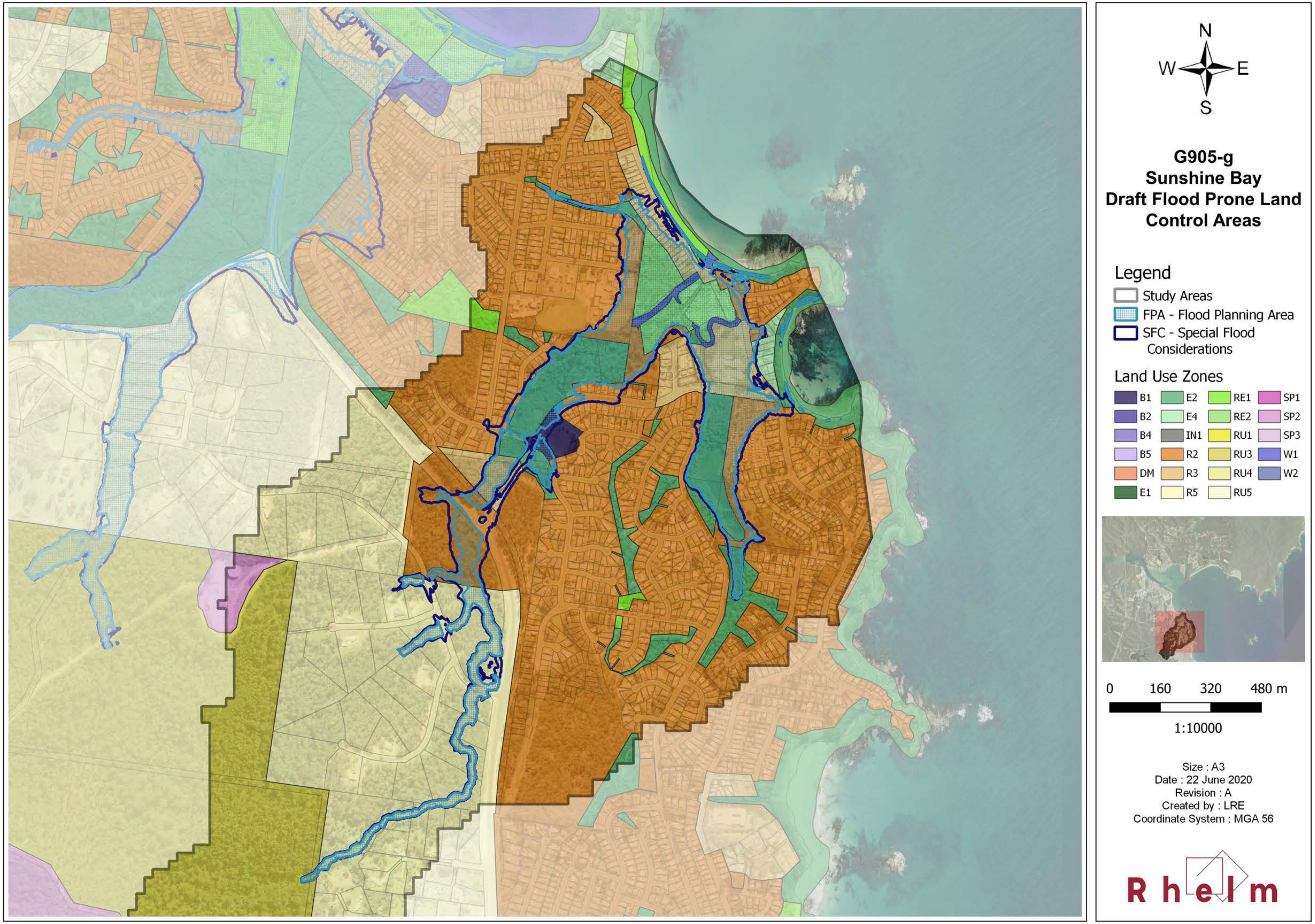
Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm


N
W
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G905-g
Sunshine Bay
Draft Flood Prone Land
Control Areas
Legend
Study Areas
FPA - Flood Planning Area
SFC - Special Flood Considerations
Land Use Zones
B1
B2
B4
B5
DM
E1
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E4
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R2
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RE1
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RU1
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SP2
SP3
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0 160 320 480 m
1:10000
Size : A3
Date : 22 June 2020
Revision : A
Created by : LRE
Coordinate System : MGA 56
Rhelm

APPENDIX A

Community Engagement

Batemans Bay Urban Creek Flood Study

Council is undertaking a Flood Study to understand the flooding from the creeks in the suburbs of Batemans Bay, Catalina, Batehaven, Sunshine Bay, Surf Side, Long Beach and Maloney's Beach. Council is inviting the community to share their experiences with flooding is these areas.

Previous studies have focused on ocean inundation rather than the effects of rainfall on local creeks and lagoons.

Very little is known of past flooding events. This information is important for verifying flood modelling.

Past rainfall events have flooded houses, shops, roads and public spaces.

Council is asking the community to share their experiences with flooding and any concerns about flood risk.

At Eurobodalla Shire Council we know some parts of the Local Government Area (LGA) are more prone to flooding than others and we're committed to finding solutions to reduce the social and economic damages of flooding.

With the assistance of the State and Commonwealth Government we are currently preparing a flood study for the creeks draining the urban areas in and around Batemans Bay. The areas in green on the map will be the focus of the study.

The flood study will involve developing flood models to represent the flooding from catchment rainfall and ocean storms. The computer based models will be built using survey data to represent the landform of the catchments and creeks. Rainfall and ocean conditions from past flood events will be used to recreate these events and calibrate the results against flooding observed by the community.

Do you have any local knowledge of flooding in and around Batemans Bay?

Council would like to hear from you by email, phone or by filling in a brief survey (via Council's website or the reverse side of this page). Your responses will help us understand the local flooding problems in more detail. Local knowledge and personal experiences of flooding are an invaluable source of data.

You can also share you knowledge and thoughts with the project team at the community drop in sessions (see below).

Community drop in sessions will be held on Tuesday 20th November at Batemans Bay Community Centre, 3 Museum Place between:

- 10am - 2pm
- 3pm - 6pm

You are invited to come along to find out more about the study and to share with the project team your experiences and concerns about flooding in the local area.

Online: www.esc.nsw.gov.au (got to ' Have Your Say' link on main page

For more information phone: (02) 4474 1374

Email: council@esc.nsw.gov.au
Mail: PO Box 99, Moruya 2537

Submissions should be provided by 30th November 2018

Batemans Bay Urban Creeks Flood Study

eurobodalla shire council

Community Feedback Form

Contact Details (these details will be confidential):

Name ____

Address ____

Email ____

Contact Phone Number ____

How have you lived, worked or visited in and around Batemans Bay?

_______ Years

Are you aware of flooding in and around Batemans Bay? (please select one)

Aware

Some knowledge

Not aware

Have you seen in and around Batemans Bay?

Date and time (as best as can be remembered) _________________________________

Location ____

Description of flooding (e.g. flooded the road outside my house or work, went into the house, went up to the front step, went part way up the yard, went into the garage) ______________________

____

____

____

____

Do you have any photos of flooding in the catchment?

Yes, I have attached a copy to the survey

Yes, please contact me to obtain a copy

Yes, I will email a digital copy to council@esc.nsw.gov.au

No

Can Council or our consultant contact you for further information relating to your responses to this survey?

Yes / No

Please feel free to attach additional pages. This survey can also be completed online at Council's website.

Please provide your responses to the survey via email, mail, phone or online through Council's website

Online: www.esc.nsw.gov.au (got to ' Have Your Say' link on main page

For more information phone: (02) 4474 1374

Email: council@esc.nsw.gov.au
Mail: PO Box 99, Moruya 2537

Submissions should be provided by 30th November 2018

APPENDIX B

Technical Note on Downstream Boundaries

Baird Australia Pty Ltd as Trustee for the Baird Australia Unit Trust
ACN 161 683 889 | ABN 92 798 128 010

Office | Suite 8, Level 22, 227 Elizabeth Street, Sydney, NSW 2000, Australia
Phone | +61 2 8278 7266 Email | sydney@baird.com

Emma Maratea
Director | Rhelm
50 Yeo Street
Neutral Bay, NSW 2089

Status: Final
11 March 2020

Dear Emma,

Reference # 13142.201.L1.Rev0

RE: BATEMANS BAY COASTAL TAILWATER CONDITIONS FOR DESIGN FLOOD EVENT MODELLING

As part of the Batemans Bay Urban Creeks Flood Study, Baird has completed an assessment of coastal water levels during storm tide conditions at seven locations within Batemans Bay (Figure 1). These water levels are provided for use as downstream boundary conditions (tailwater levels) for flood simulations to be undertaken by Rhelm.

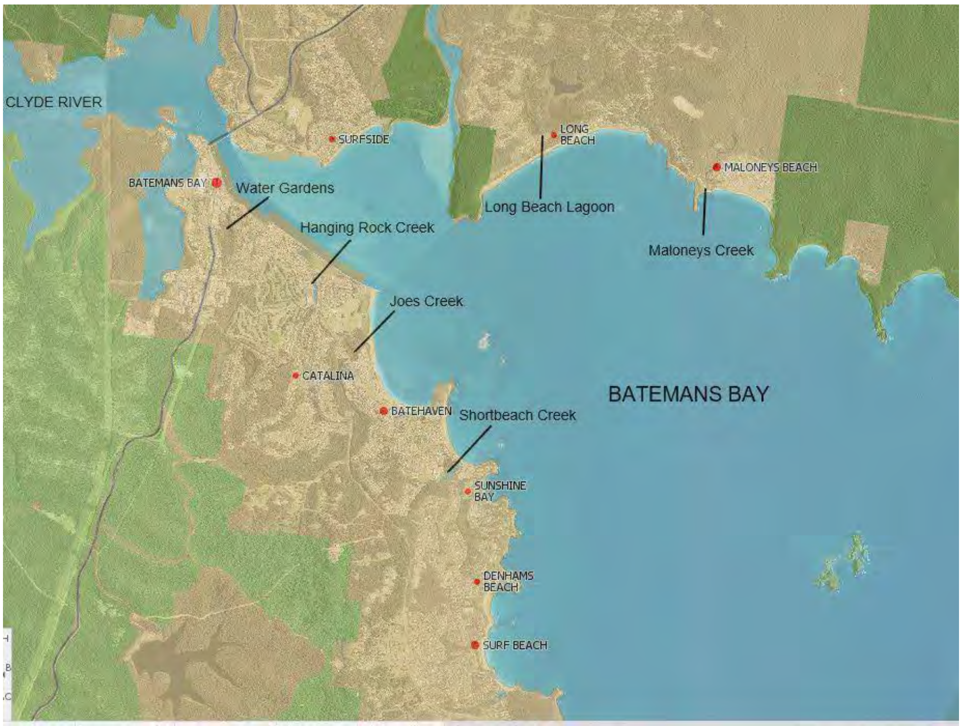

Figure 1: Creek Entrances within the Flood Study Area (from ESC, 2018)

Tailwater Levels for Flood Event Modelling

On the NSW South coast, major flooding typically occurs coincident with coastal storms and it is not unusual for flooding to occur on the spring tides during the East Coast Low season (ESC, 2018). Flood levels in the lower reaches of a catchment or waterway can therefore be exacerbated by the ocean conditions resulting in coincident ocean/catchment flooding. In 2017, Council completed the Eurobodalla Coastal Hazard Assessment (WRL, 2017), that quantified coastal hazards included extreme water levels at coastal locations.

For the determination of design flood levels, the *Floodplain Risk Management Guide - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways* (OEH, 2015) provides guidance as to the combination of catchment flood scenarios and ocean water level boundary conditions.

For dynamic numerical modelling, a timeseries of the downstream ocean water level boundary condition must be developed. Such a timeseries can be synthetised as follows:

- Select a representative predicted spring tide based on the measured water levels at the Princess Jetty tide gauge
- A design peak storm surge is then selected for the desired ARI
- The selected peak storm surge is then added to the predicted tide, scaling up and down over a 48-hour period.

The joint occurrence of catchment flooding and peak coastal water levels is also specified in OEH (2015) as follows:

- For catchment flood scenarios >2% AEP a downstream ocean water level of High High Water Springs (Solstice Spring) or HHWS(SS) should be used
- For catchment flood scenarios 1-2%AEP a downstream ocean water level of 5% AEP should be used
- For catchment flood scenarios <0.5%AEP a downstream ocean water level of 1% AEP should be used

Water Level Datasets

1. Measured Water Levels at Batemans Bay

Measured water levels from the tide gauge at the Princess Jetty (Batemans Bay) serviced by MHL (Manly Hydraulics Laboratory) were sourced for this study.

To develop the design ocean water level timeseries, a tide record spanning two days over a representative spring tide were extracted from the Princes Jetty measured data (25/09/2000 19:00 - 27/09/2000 19:00). The peak of this timeseries at 0.71mAHD, is above the Mean High Water Spring (MHWS) tidal plane level of, as defined in MHL (2012).

The HHWS(SS) level at Princess Jetty is defined as 0.92m (MHL, 2012), based on 19 years of measured data. A two day spring tide period representative of the HHWS(SS) level at its peak was extracted from the Princes Jetty dataset for use as a downstream boundary condition for catchment flood scenarios >2% AEP. This timeseries can be used for all catchments being assessed in this study.

2. Eurobodalla Coastal Hazard Assessment

The Eurobodalla Coastal Hazard Assessment (WRL, 2017) provides a comprehensive analysis and quantification of coastal hazards at key locations around Batemans Bay, including extreme water levels, nearshore waves, wave runup and beach erosion. For consistency between floodplain and coastal management, the coastal water levels from the Coastal Hazard Assessment were adopted. The Average

Return Interval (ARI) still water levels were calculated in this assessment for 20 year and 100 year ARI, for each of the seven locations.

Within Batemans Bay, coastal water levels have the potential to be higher than offshore due to wind setup over the shallow bathymetry and inland flood events from the Clyde River. Fresh water floods are not expected to cause significant increase in ocean inundation levels in most of the study area. However, in inner Batemans Bay, flooding from the Clyde River may increase peak coastal inundation levels by up to 0.16 m. Therefore, water level defined in the Coastal Hazard Assessment made an allowance for an increase in inundation levels due to flooding from the Clyde River. The flood contribution levels adopted for this study are provided in Table 1.

Table 1: Summary of Design Total Still Water Levels at the Creek Entrances extracted from the Eurobodalla Coastal Hazard Assessment (WRL, 2017)

Location (Coastal Hazard Assessment ID)	ARI (yrs)	Offshore WL (mAHD)	Wind Setup (m)	Storm Tide (mAHD, ex Wave setup and Flood)	Flood Contrib. (m)	Wave Setup (m)	Total SWL (mAHD)
Maloneys Creek (CHA: Western End)	20	1.37	0.11	1.48	0.00	0.55	2.03
	100	1.43	0.13	1.56	0.00	0.57	2.13
Long Beach (CHA: Central)	20	1.37	0.18	1.55	0.00	0.63	2.18
	100	1.43	0.22	1.65	0.00	0.66	2.31
Surfside Creek (CHA: Surfside W)	20	1.37	0.10	1.47	0.04	0.45	1.96
	100	1.43	0.13	1.56	0.07	0.43	2.06
Watergardens (CHA: CBS E)	20	1.37	0.12	1.49	0.03	0.54	2.08
	100	1.43	0.15	1.58	0.05	0.56	2.22
Hanging Rock Creek (CHA: Boat Harbour)	20	1.37	0.08	1.45	0.03	0.61	2.09
	100	1.43	0.10	1.53	0.06	0.61	2.21
Joes Creek (CHA: Corrigans S)	20	1.37	0.08	1.45	0.00	0.27	1.72
	100	1.43	0.10	1.53	0.00	0.28	1.82
Short Beach Creek (CHA: Caseys S)	20	1.37	0.07	1.44	0.00	0.30	1.74
	100	1.43	0.10	1.53	0.00	0.30	1.83

Boundary Condition Timeseries

As per the methodology for synthesising a downstream ocean water level boundary condition described above, water level timeseries representing the 20- and 100- year ARI levels were developed for each catchment. The design storm surge component was calculated as the difference between the Total Still Water Level (from the Coastal Hazard Assessment) and the peak of the two day representative spring tide signal. This storm surge value was then scaled up and down from zero over a total 48 hour period and added to the tidal signal (aligning the peak storm surge value at the peak of the tide signal) to derive a boundary condition timeseries that peaks at the design Total Still Water level, as shown in Figures 2 and 3.

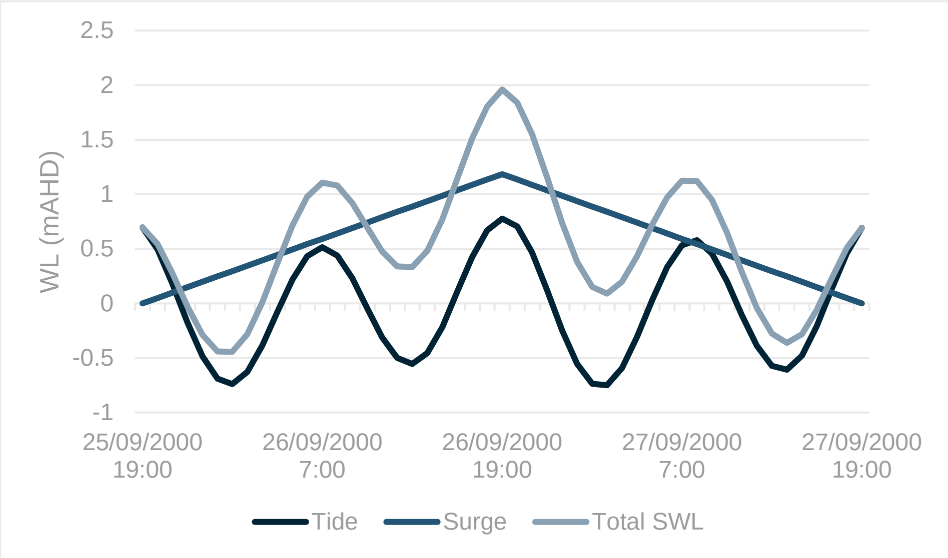

Figure 2: Surfside 20-year ARI. Peak Total SWL of 1.96mAHD

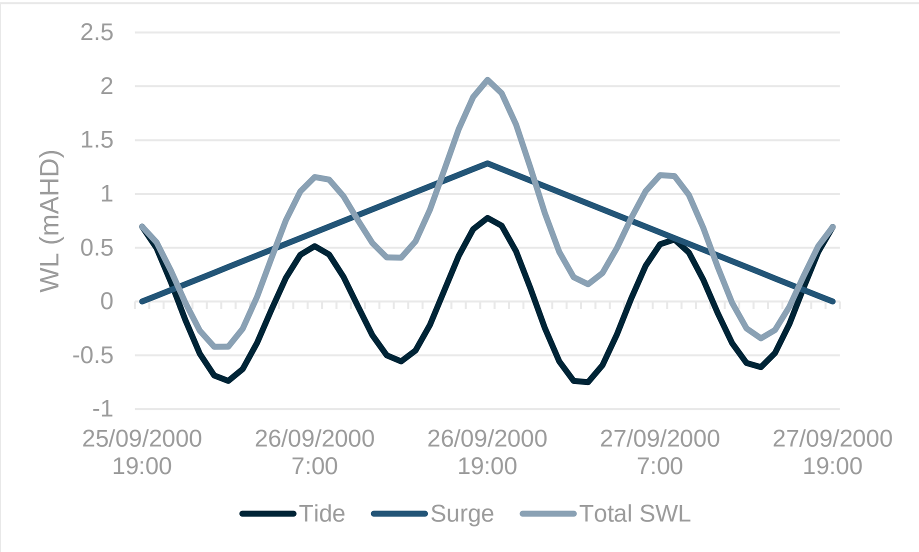

Figure 3: Surfside 100-year ARI. Peak Total SWL of 2.06mAHD

Data Transmittal

The boundary timeseries are being transmitted as CSV files for each location and ARI, with the following specification:

- Column 1: hour (from a nominal zero hour). The peak Total Still Water Level occurs at hour 24 of the timeseries.
- Column 2: Total Still Water Level referenced to mAHD.

File naming follows the following convention:

*CATCHMENT_ARIYEAR*yr_ARI.csv

I trust that these files provide you with the required boundary conditions to commence design flood simulations. Should you have any questions regarding the data files, please let me know.

With thanks,

Sean Garber | Associate Principal
Baird Australia
E: sgarber@baird.com
M: 0404 203 74

References

ESC (2018). Technical project brief for Batemans Bay Urban Creeks Flood Study. Commissioned by Eurobodalla Shire Council.

MHL (2012). OEH NSW Tidal Plane Analysis - 1990-2010 Harmonic Analysis. MHL Report 2053. Report Prepared for NSW Office of Environment and Heritage. October 2012.

OEH (2015). Floodplain Risk Management Guide - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways. OEH 2015/0769. Office of Environment and Heritage. November 2015.

WRL (2017). Eurobodalla Coastal Hazard Assessment. WRL Technical Report 2017/09, October 2017.

Attachments

13142.201_BatemansFloodStudy_CoastalWLs.zip

Document Approval and Revision History

Revision	Status	Comments	Prepared	Reviewed	Approved
0	Final	Transmittal of Data	CLS	SJG	SJG

Baird.

Baird Australia Pty Ltd as Trustee for the Baird Australia Unit Trust
ACN 161 683 889 | ABN 92 798 128 010

Office | Suite 8, Level 22, 227 Elizabeth Street, Sydney, NSW 2000, Australia
Phone | +61 2 8278 7266 Email | sydney@baird.com

Emma Maratea
Director | Rhelm
50 Yeo Street
Neutral Bay, NSW 2089

Status: Final
28 April 2020

Dear Emma,

Reference # 13142.201.L2.Rev0

RE: Downstream Boundary Conditions for the Batemans Bay Urban Creeks Flood Study

The Eurobodalla Shire Council (Council) recently commissioned Rhelm Pty Ltd (Rhelm) to complete the Batemans Bay Urban Creeks Flood Study. Baird Australia Pty Ltd (Baird) are assisting Rhelm to establish accurate downstream boundary conditions to be applied for design flood scenario modelling based on an understanding of the coastal hazards within Batemans Bay. Downstream coastal water levels have previously been delivered to Rhelm for seven urban creeks (Baird, 2020a). This memorandum outlines the further analysis performed by Baird for Joes Creek, an Intermittently Closed and Open Lake or Lagoon (ICOLL). Baird has created a hydrodynamic model for Joes Creek using Delft 3D-Flow, with sediment transport and morphology, to determine the downstream water levels in the Joes Creek lagoon for a range of flooding scenarios as provided by Rhelm.

Model Setup

Rhelm provided Baird with numerical catchment inflows at the Beach Road bridge which acts as a culvert, channelling discharge into the ICOLL at a single location. Maximum discharge was aligned to the time of high coastal water level, the joint occurrence of which was determined using the guidelines provided by the Office of Environment and Heritage (OEH, 2015). For 5, 10 and 20 % Average Exceedance Probability (AEP) catchment flood events, the High High Water Springs (Solstice Spring) tide for Batemans Bay was applied. For 1 and 2 % AEP floods, a storm tide of 5% AEP was used, whilst for flood events 0.2% AEP, 0.5% AEP and PMF (nominally defined as 0.0001% AEP), a storm tide of 1% AEP was applied.

The Delft 3D-Flow model used 2018 LIDAR bathymetry of Joes Creek, and a berm height of 2.3 m AHD, as previously reported in Baird (2020b). An observation point to obtain the downstream boundary conditions provided in this report was placed in the lagoon landward of the entrance beach berm. The model was run for two days, ensuring maximum flooding levels were captured. Timesteps were set at 0.125 s to accurately capture breakout over the berm and model maximum flooding, with results captured every 5 minutes.

Model Results

In total 264 models were run, for AEPs ranging from PMF to 20 % AEP, each with up to 4 storm durations and 10 temporal patterns.

An indicative water level timeseries from the 1%AEP event is presented in Figure 1. This shows that lagoon water level responds very quickly to the catchment inflow with little lag.

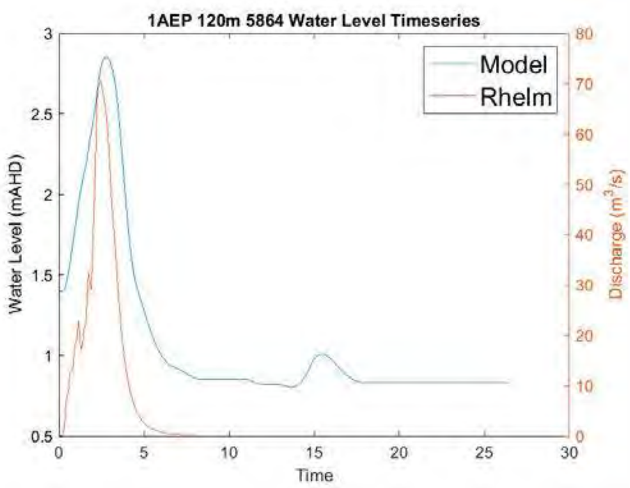

Figure 1 Timeseries of 1%AEP, 120min duration event (ID 5864) discharge rate provided by Rhelm and resultant flooding in the Delft 3D model. Time in hours.

A summary of the maximum water level results from all flood scenarios run in the Delft3D model is presented in Figure 2. This demonstrates that longer duration events govern the peak flood levels at each AEP.

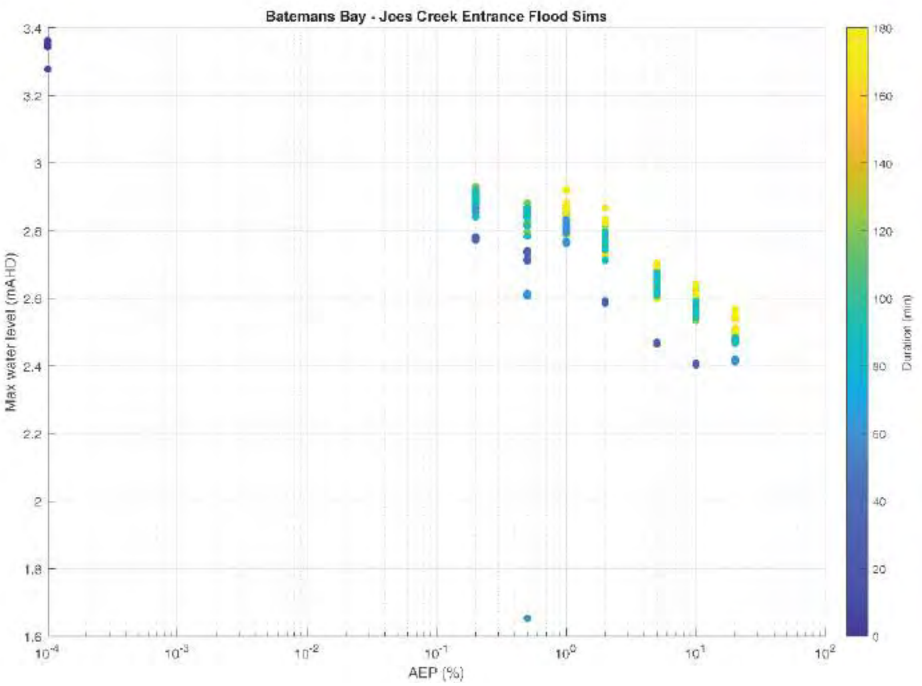

Figure 2 Comparison of maximum Water Level results all Joes Creek Lagoon Entrance Flood Simulations

Data Transmittal

Water level timeseries to be used for further modelling by Rhelm as the downstream boundary condition to the overland flow models are being transmitted as CSV files for each of the 264 flood events, with the following specification:

- Column 1: hour (from a nominal zero hour that aligns with the catchment inflow data files provided by Rhelm).
- Column 2: Lagoon Flood level referenced to mAHD.

File naming follows the following convention:

- *catchmentAEP*_duration_eventID.csv

The eventID is defined based on the catchment flow data provided by Rhelm.

I trust that these files provide you with the required downstream boundary conditions to commence design flood simulations for Joes Creek. Should you have any questions regarding the data files, please let me know.

With thanks,

Sean Garber | Associate Principal
Baird Australia
E: sgarber@baird.com
M: 0404 203 74

References

Baird (2020a). Batemans Bay Coastal Tailwater Conditions for Design Flood Event Modelling. 13142.201.L1.Rev0, March 2020.

Baird (2020b). Summary of Proposed Downstream Boundary Conditions to be Adopted for the Batemans Bay Urban Creeks Flood Study 13142.201.M1.Rev0. February 2020.

OEH (2015). Floodplain Risk Management Guide - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways. OEH 2015/0769. Office of Environment and Heritage. November 2015.

Attachments

13142.201_JoesCk_Timeseries_csv.zip
13142.201_JoesCk_Timeseries_Figures.zip

Document Approval and Revision History

Revision	Status	Comments	Prepared	Reviewed	Approved
0	Final	Transmittal of Data	CLS	SJG	SJG

Baird Australia Pty Ltd as Trustee for the Baird Australia Unit Trust
ACN 161 683 889 | ABN 92 798 128 010

Office | Suite 8, Level 22, 227 Elizabeth Street, Sydney, NSW 2000, Australia
Phone | +61 2 8278 7266 Email | sydney@baird.com

Memorandum

Reference # 13142.201.M1.RevA

Status: Draft

28 January 2020

Attention:	**Cameron Whiting (Eurobodalla Shire Council)**
CC:	Raymond Laine (NSW Department of Planning, Industry and Environment) Emma Maratea (Rhelm Pty Ltd)
From:	Sean Garber (Baird)

RE: Summary of Proposed Downstream Boundary Conditions to be Adopted for the Batemans Bay Urban Creeks Flood Study

The Eurobodalla Shire Council (Council) recently commissioned Rhelm Pty Ltd (Rhelm) to complete the Batemans Bay Urban Creeks Flood Study. Baird Australia Pty Ltd (Baird) are assisting Rhelm to establish accurate downstream boundary conditions to be applied for design flood scenario modelling based on an understanding of the coastal hazards within Batemans Bay.

This memo provides a summary of the available datasets, a review of each coastal entrance and the proposed downstream boundary conditions to be adopted for the flood study.

Study Area

The Batemans Bay Urban Creeks Flood Study will assess the flood behaviour and impacts at seven (7) catchments that connect to Batemans Bay, including:

- Maloneys Creek
- Long Beach Lagoon
- Surfside Creek
- Watergardens
- Hanging Rock Creek
- Joes Creek
- Short Beach Creek

The locality of each coastal entrance within Batemans Bay is presented in Figure 1.

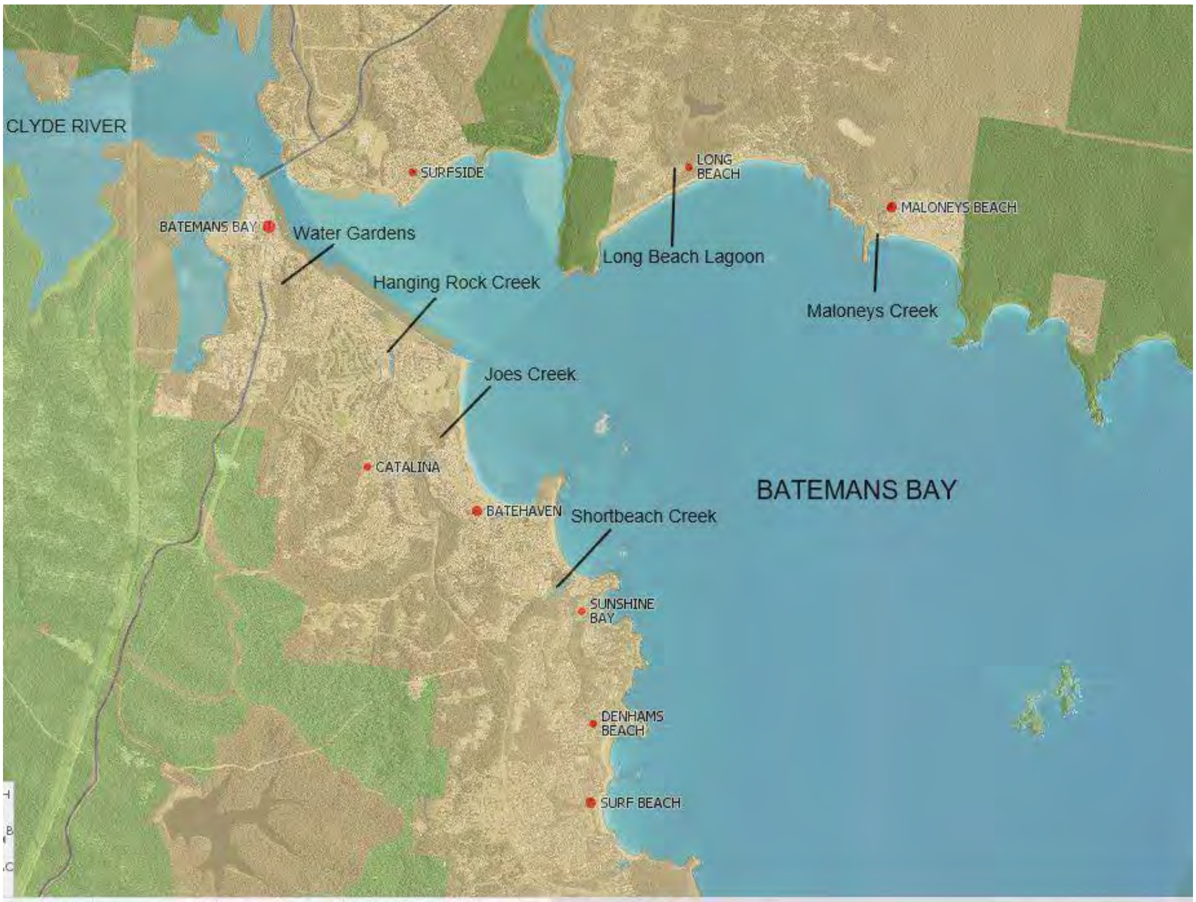

Figure 1: Creek Entrances within the Flood Study Area (from ESC, 2018)

The following sections provide a brief summary of each entrance, including the available topographic description. Topographic and bathymetric data for this study has been obtained from three sources, being:

- Ground Survey collected for the Flood Study in 2019. Data supplied as spot levels in dwg format (23762 SITE survey.dwg)
- NSW Marine LiDAR Topo-Bathy 2018 Dataset (DPIE, 2019)
- 1m Resolution Digital Elevation Model (DFSI, 2011)

The available data sets were in general agreement, where co-located data existed at the creek entrances. While some differences were identified between the 2018 and 2011 LiDAR datasets, berm levels extracted from the 2018 dataset were marginally higher. As a result, the 2018 NSW Marine LiDAR Topo-Bathy Dataset (DPIE, 2018) has been used to inform the adopted entrance conditions for this flood study.

Maloneys Creek

The entrance to Maloneys Creek is situated at the western end of Maloneys Beach, adjacent to a rock headland outcrop. Prior to reaching the entrance, creek waters flow through a culvert under Northcove Road that runs about 30m behind the back beach at this location. The entrance is generally closed but opens (breaks out) when water levels in the creek overtop the berm level, as such it is classed as an Intermittently Closed and Open Lake or Lagoon (ICOLL). The adjacent beach is a narrow (~10 m), moderately steep (1V:10H) and backed by a low foredune (WRL, 2017) typical of a stable barrier system. Recent photogrammetry indicating no net recession, but a possible counter-clockwise rotation of the shoreline (WRL, 2017).

Available topographic data indicates a berm crest level of between +2.05 and +2.45 mAHD (see Figure 2) when the entrance is closed, which is consistent with the berm levels further along the beach to the east. Council do not operate an entrance management policy at Maloneys Creek and the entrance is left to breakout naturally.

It is therefore feasible that prior to the onset of a design flood event that a berm level of +2.1 mAHD would have established. Further, from review of historical aerial imagery and cross checking with the available survey data a water level in creek of +1.8 mAHD may be present.

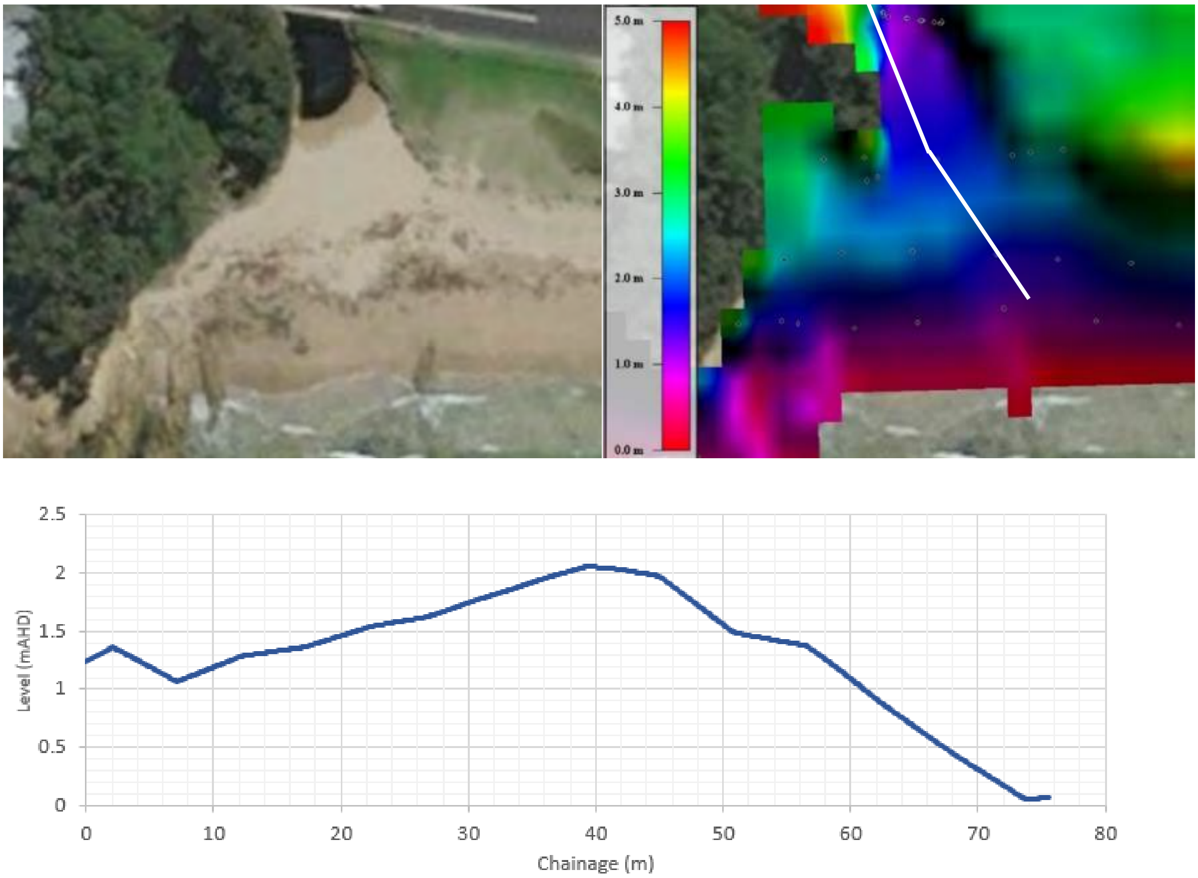

Figure 2: Maloneys Creek Entrance at the western end of Maloneys Beach. Top Left: An aerial view of the entrance. Top Right: Available topographic data of the entrance. Bottom: Transect Profile through the entrance indicating a berm level of +2.05mAHD.

Long Beach Lagoon

Long Beach Lagoon, located in the lee of the Long Beach barrier dune system, is a wetlands reserve that drains to the ocean via a small overland channel centrally located along the beach compartment. The entrance channel is approximately 300m in length between the lagoon and beach face and appears to typically remain dry outside of rainfall events. In this location the beach is relatively narrow (~20m) with a moderate beach slope (1V:9H-1V:18H) and experiences very little longshore transport (WRL, 2017). At the channel entrance, no trends in beach width are identifiable, although the beach compartment undergoes slight rotation in response to changes in wave direction (WRL, 2017).

Available topographic data indicates a lack of a classic entrance berm feature with the channel centreline profile starting at an elevation of +3.5 mAHD at the Lagoon and steadily dropping to +1.95m AHD through the beach dune (see Figure 3). Channel levels at the back beach are lower than the natural dune level of ~+3.0 mAHD to the east and west, indicating the potential for the channel entrance to further infill with sand during long periods of reduced rainfall. Council do not operate an entrance management policy at Long Beach Lagoon and the entrance is left to breakout naturally.

Given the elevation and length of the entrance channel, it is not expected to break-out and open like an ICOLL entrance, with no tidal exchange expected following the release of flood waters through the channel. As such, entrance channel levels from the 2018 LiDAR dataset (DPIE, 2018) will be adopted to describe the entrance condition in the flood models.

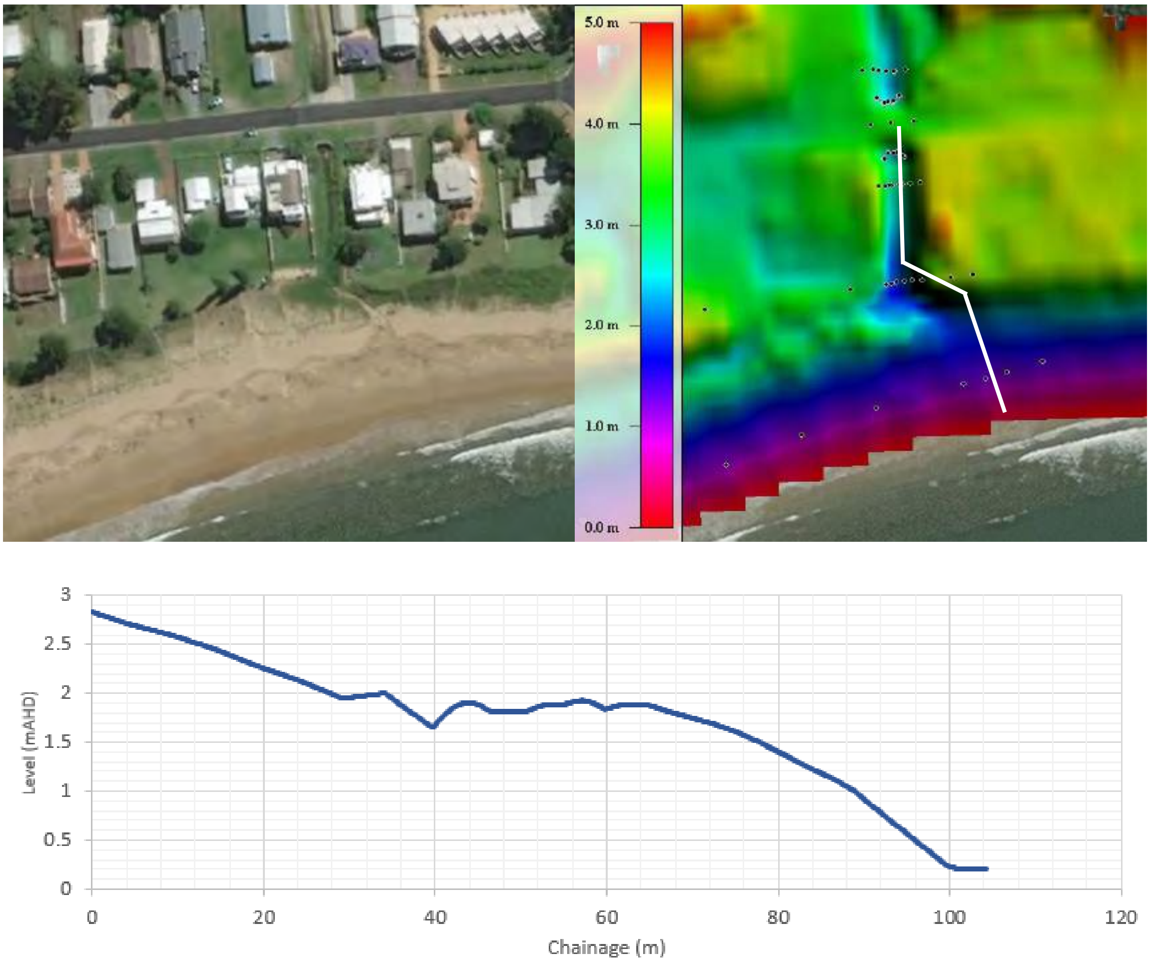

Figure 3: Long Beach Lagoon Entrance in the middle of Long Beach. Top Left: An aerial view of the entrance. Top Right: Available topographic data of the entrance. Bottom: Transect Profile through the entrance channel indicating a steady grade from lagoon to beach.

Surfside Creek

The entrance to Surfside creek is located at the western end of a small perched beach (Surfside Beach West) that marks the western side of a low regressive beach ridge plain (WRL, 2017). The entrance is an ICOLL, with sand closing over the entrance and infilling back to the culvert under McLeod Street during periods of limited rainfall. Council operate an entrance management policy at Surfside Creek entrance, whereby the entrance is mechanically opened if the water levels in the creek reach the trigger level of +1.5mAHD or when sand reaches the top of road culvert (ESC, 2019).

The shoreline along Surfside Beach (west) demonstrates a higher degree of oscillation owing to the impact of the migratory sand waves (WRL, 2017) and combined with the breakout process at the Surfside Creek entrance would likely lead to variable berms levels at the creek entrance. Available topographic data indicates a berm crest level of between +1.3 and +1.4mAHD (see Figure 4) when the entrance is closed, which is consistent with the entrance management policy (i.e. lower than the trigger level). It is therefore considered feasible that the berm level of +1.5 mAHD with a water level in the creek of +1.45 mAHD could occur prior to the onset of a design flood event.

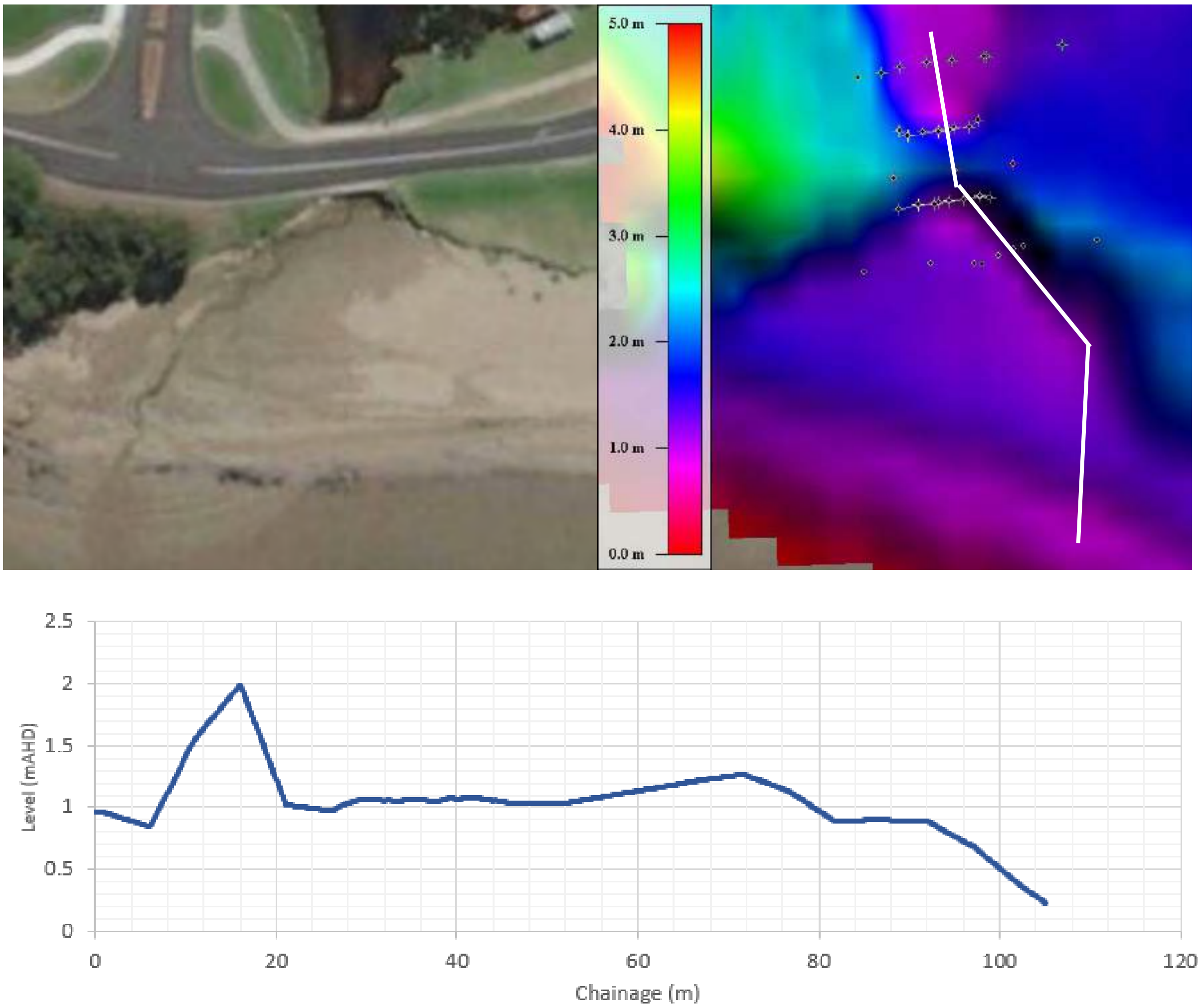

Figure 4: Surfside Creek Entrance at the Western end of Surfside Beach West. Top Left: An aerial view of the entrance. Top Right: Available topographic data of the entrance. Bottom: Transect Profile through the entrance indicating a berm level of +1.3mAHD.

Watergardens

The Water Gardens is a six-hectare wetland park close to the Batemans Bay town centre that is a natural drainage area that was once used for stock grazing (ESC, 2018). The wetlands drain to Batemans Bay via culverts under Beach Road to an engineered outlet. No data was available to ascertain the levels of the outlet however from site reconnaissance the outlet appears at or near mean sea level and would remain clear of sediment build up along the shoreline (see Figure 5). It could therefore be considered permanently open.

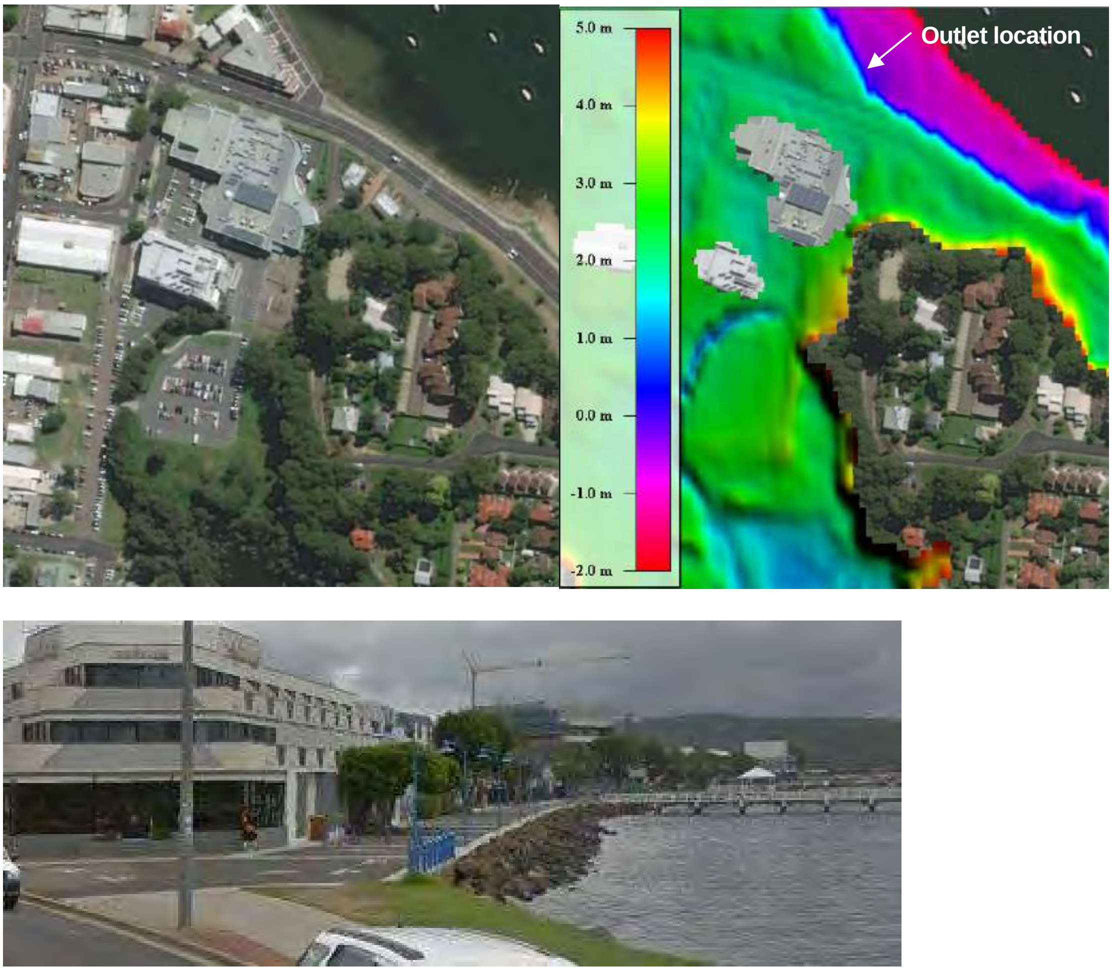

Figure 5: Watergardens Outlet. Top Left: An aerial view of the area. Top Right: Available topographic data of the area. Bottom: Google Street view image of the shoreline where the outlet is located.

Hanging Rock Creek

Hanging Rock Creek flows into the Batemans Bay marina precinct which is an 8-hectare water body that is enclosed by an 850m long breakwater structure (see Figure 6). Access from the basin to Batemans Bay is made via a 40m opening in the breakwater through which seabed levels are relatively deep (<-4.5mAHD). A large fluvial fan feature is present where the creek meets the enclosed water body with seabed levels of between -0.3 and +0.3 mAHD. Despite this shallow fluvial feature, the creek entrance remains permanently open.

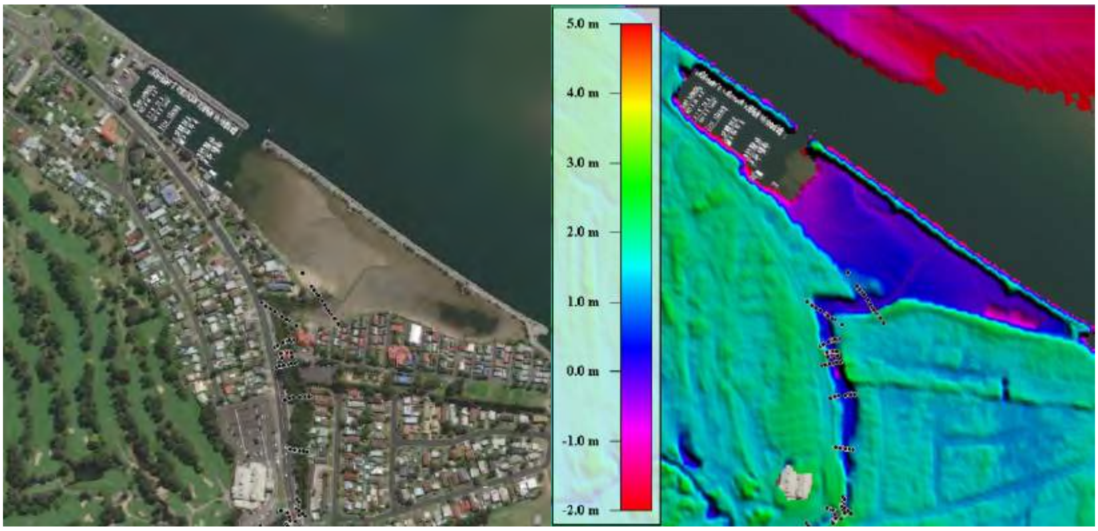

Figure 6: Hanging Rock Creek Entrance. Top Left: An aerial view of the entrance. Top Right: Available topographic data of the entrance indicating levels of 0mAHD (+/-0.3m) across the fluvial fan feature.

Joes Creek

The entrance to Joes Creek is centrally located along Corrigans Beach. The entrance is an ICOLL, with the beach berm closing over the entrance during periods of low rainfall following breakout events. Corrigans Beach has had recent nourishments from sediment dredged from the Clyde River entrance sand bar, in 2014 and 2016 (WRL, 2017), and has a beach width of 30 to 40m.

Available topographic data indicates a berm crest level of +1.81 mAHD (see Figure 7) when the entrance is closed, which is consistent with the beach berm levels both north and south of the entrance (between +1.75 and +1.90 mAHD). Council operate an entrance management policy at Joes Creek entrance, whereby the entrance is mechanically opened if the water levels at the cycle path bridge reach the trigger level of +1.4mAHD or +1.2mAHD if heavy rain is predicted (ESC, 2019).

It is therefore feasible that a berm level of up to +1.9 mAHD and a lake level of +1.4 mAHD could exist prior to the onset of a large design flood event.

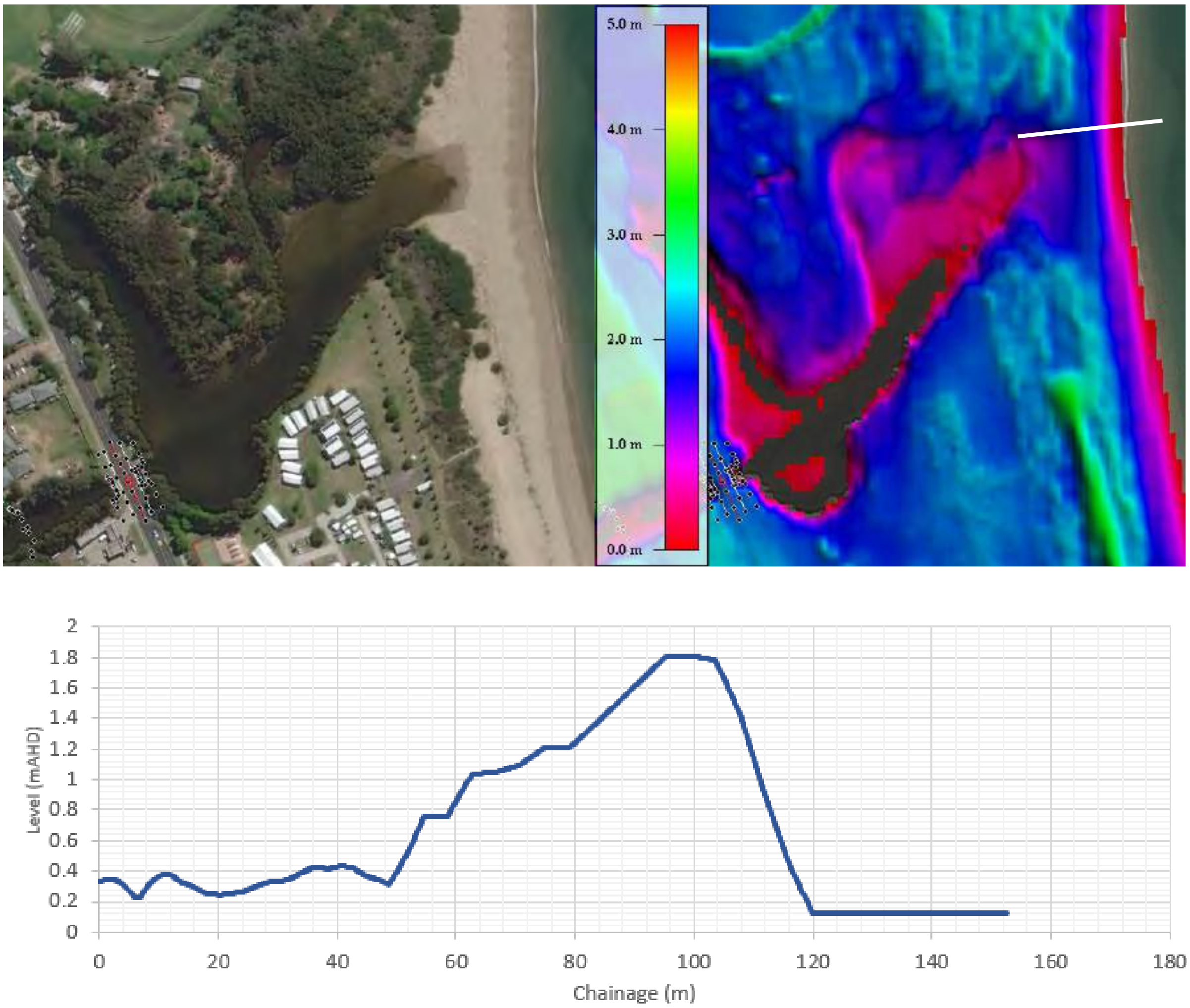

Figure 7: Joes Creek Entrance at Corrigans Beach. Top Left: An aerial view of the entrance. Top Right: Available topographic data of the entrance. Bottom: Transect Profile through the entrance indicating a berm level of +1.81mAHD.

Short Beach Creek

The entrance to Short Beach Creek is located towards the south end of Caseys Beach. The entrance is intermittently open and closed, where the beach berm builds up across the entrance between rainfall driven breakout events, and is intersected by the bridge along Beach Road. Caseys Beach is a relatively thin beach (~10-15m wide) in the vicinity of Short Beach Creek entrance, with the overall beach compartment displaying a recessional trend evidenced by the seawall constructed a long Beach Road.

Council operate an entrance management policy at Short Beach Creek entrance, whereby the entrance is mechanically opened if the water levels in the creek reach the trigger level of +1.3mAHD, however the entrance generally breaks out naturally (ESC, 2019). Available topographic data indicates a berm crest level of between +1.0 and +1.1 mAHD (see Figure 8) when the entrance is closed, which is consistent with the berm levels along the beach (+0.9 to +1.3 mAHD) and the entrance management trigger level.

Based on the available data and entrance management policy it is feasible that an entrance berm level of +1.3mAHD and creek water level of +1.1 mAHD could be present prior to the onset of design flood event.

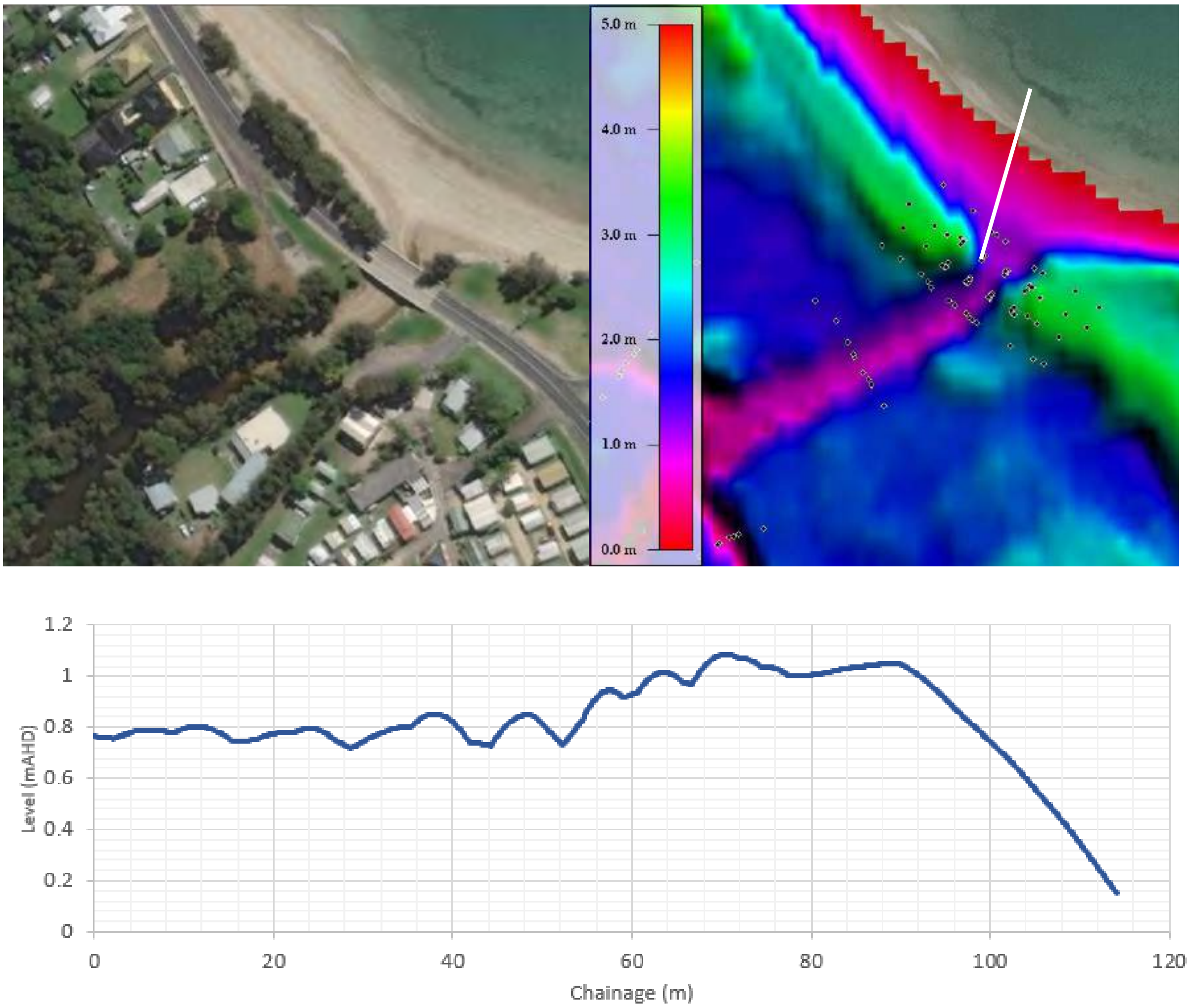

Figure 8: Short Beach Creek Entrance at Casseys Beach. Top Left: An aerial view of the entrance. Top Right: Available topographic data of the entrance. Bottom: Transect Profile through the entrance indicating a berm level of +1.10mAHD.

Tailwater Levels

On the NSW South coast, major flooding typically occurs coincident with costal storms and it is not unusual for flooding to occur on the spring tides during the East Coast Low season (ESC, 2018). Flood levels in the lower reaches of a catchment or waterway can therefore be exacerbated by the ocean conditions resulting in coincident ocean/catchment flooding. In 2017, Council completed the Eurobodalla Coastal Hazard Assessment (WRL, 2017), that quantified coastal hazards included extreme water levels at coastal locations.

For the determination of design flood levels, the *Floodplain Risk Management Guide - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways* (OEH, 2015) provides guidance as to the combination of catchment flood scenarios and ocean water level boundary conditions. In summary Table 8.1 of OEH (2015) specifies the following:

- For catchment flood scenarios <2% AEP a downstream ocean water level of High High Water Springs (Solstice Spring) or HHWS(SS)should be used
- For catchment flood scenarios 1-2%AEP a downstream ocean water level of 5% AEP should be used
- For catchment flood scenarios <0.5%AEP a downstream ocean water level of 1% AEP should be used

For dynamic numerical modelling, a timeseries of the downstream ocean water level boundary condition must be developed. Such a timeseries can be synthetised as follows:

- Select a representative predicted spring tide based on the measured water levels at the Princess Jetty tide gauge
- A design peak storm surge is then selected for the desired ARI (see sections below)
- The selected peak storm surge is then added to the predicted tide, scaling up and down over a 96-hour period. This is consistent with the guidance in OEH (2015) that applied a similar method using a scaled May 1974 event.

An example of a synthesised ocean water level timeseries in presented in Figure 9. The relative timing of catchment flooding and ocean water levels is then adjusted such that the peak of the storm tide timeseries is aligned with the peak in the flood discharge event.

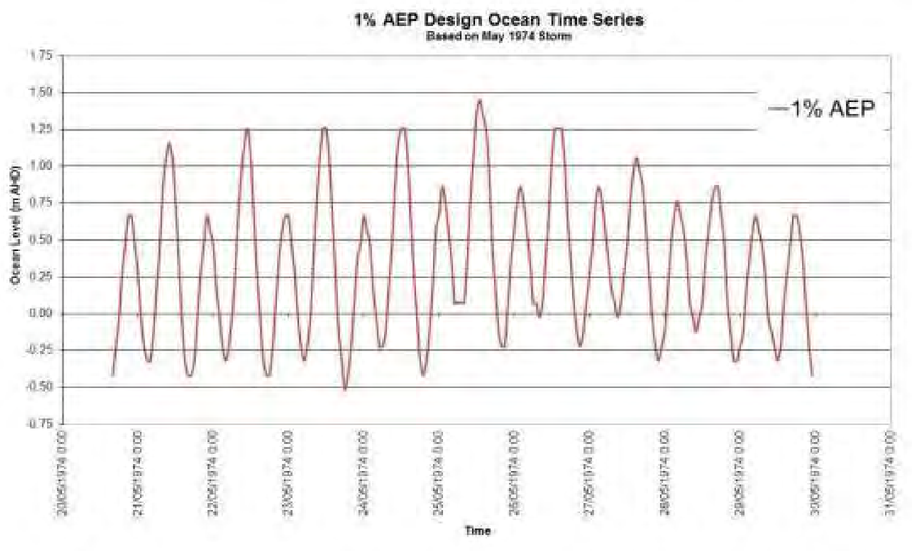

Figure 9: Example Timeseries of a downstream ocean water level peaking at +1.45mAHD (from OEH, 2015)

Eurobodalla Coastal Hazard Assessment

The Eurobodalla Coastal Hazard Assessment (WRL, 2017) provides a comprehensive analysis and quantification of coastal hazards at key locations around Batemans Bay, including extreme water levels, nearshore waves, wave runup and beach erosion. For consistency between floodplain and coastal management, it is proposed that the coastal water levels from the Coastal Hazard Assessment be adopted.

Within Batemans Bay, coastal water levels have the potential to be higher than offshore due to wind setup over the shallow bathymetry and inland flood events from the Clyde River. Fresh water floods are not expected to cause significant increase in ocean inundation levels in most of the study area. However, in inner Batemans Bay, flooding from the Clyde River may increase peak coastal inundation levels by up to 0.16 m. Therefore, water level defined in the Coastal Hazard Assessment made an allowance for an increase in inundation levels due to flooding from the Clyde River. The flood contribution levels adopted for this study are provided in Table 1.

Table 1: Summary of Design Total Still Water Levels at the Creek Entrances extracted from the Eurobodalla Coastal Hazard Assessment (WRL, 2017)

Location (Coastal Hazard Assessment ID)	ARI (Years)	Offshore WL (mAHD)	Wind Setup (m)	Storm Tide (mAHD, excl Wave setup and Flood)	Flood Contribution (m)	Wave Setup (m)	Total SWL (mAHD)
Maloneys Creek (CHA: Western End)	20	1.37	0.11	1.48	0.00	0.55	2.03
	100	1.43	0.13	1.56	0.00	0.57	2.13
Long Beach (CHA: Central)	20	1.37	0.18	1.55	0.00	0.63	2.18
	100	1.43	0.22	1.65	0.00	0.66	2.31
Surfside Creek (CHA: Surfside W)	20	1.37	0.10	1.47	0.04	0.45	1.96
	100	1.43	0.13	1.56	0.07	0.43	2.06
Watergardens (CHA: CBS E)	20	1.37	0.12	1.49	0.03	0.54	2.08
	100	1.43	0.15	1.58	0.05	0.56	2.22
Hanging Rock Creek (CHA: Boat Harbour)	20	1.37	0.08	1.45	0.03	0.61	2.09
	100	1.43	0.10	1.53	0.06	0.61	2.21
Joes Creek (CHA: Corrigans S)	20	1.37	0.08	1.45	0.00	0.27	1.72
	100	1.43	0.10	1.53	0.00	0.28	1.82
Short Beach Creek (CHA: Caseys S)	20	1.37	0.07	1.44	0.00	0.30	1.74
	100	1.43	0.10	1.53	0.00	0.30	1.83

Baird's Monte Carlo dataset

Baird have an established 1,000-year Monte Carlo synthetic East Coast Low (ECL) event set that includes maximum event impact footprints for coastal inundation as well as wind and rainfall, as presented in Taylor et. al. (2017). The dataset has been developed from a detailed library of hindcast data for 1,119 ECL events between 1970 and 2016 (46-years) and a novel synthetic track and intensity ECL model. The sequence applied to develop the data set is presented in Figure 10. The coastal inundation data set defines elevations for total peak steady water level (tide + residual + wave-setup) and maximum wave run-

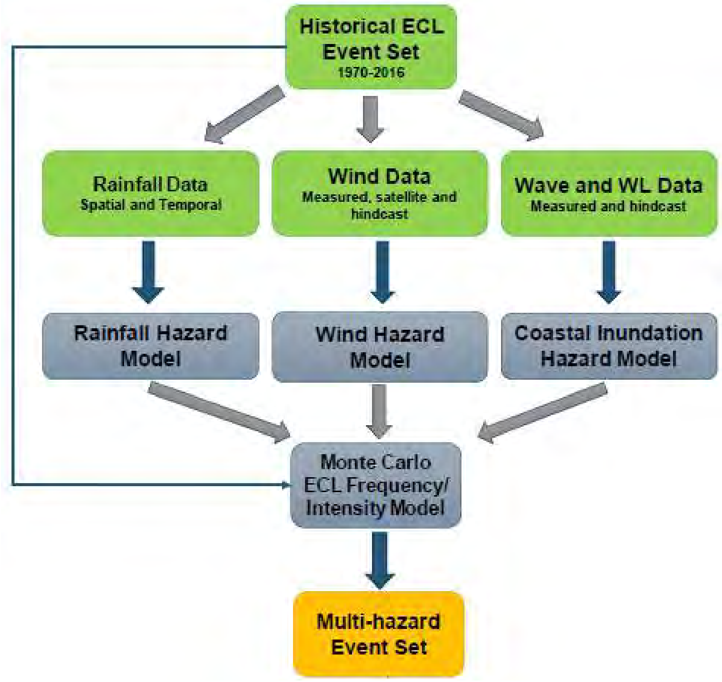

Figure 10: Method flow chart for Baird Australia's multihazard ECL Event Set

For the total peak steady water levels, a number of factors contribute to the observed water at the shoreline during ECL events. The factors contributing to total water level include:

1. Astronomical tide;
2. Surge from wind and pressure forcing along the coast;
3. Residual water levels from other oceanographic and meteorological forcing, including coastal trapped waves; and
4. Wave setup inshore of the surf zone.

The water levels included in the data set account for the above four components in the assessment of coastal water levels and wave run-up levels. Astronomical tide was based on a 19-year hindcast of astronomical tide along the NSW coast and covers an entire solar and lunar astronomical tide cycle which is applied in a continuous cycle over the 1,000 year data set period.

A comparison of the extreme Total Still Water Levels, excluding wave setup and flood contribution, at the Princess Street Jetty from Baird's Monte Carlo dataset and the Eurobodalla Coastal Hazard Assessment (WRL, 2017) is presented in Table 2. The comparison indicates Baird's ECL dataset is around 0.1m lower than that Eurobodalla Coastal Hazard Assessment. This is expected as the Coastal Hazard Assessment adopts a somewhat conservative method of combining extreme offshore water level and wind setup from the most severe direction at the same ARI, whereas Baird's ECL dataset makes consideration of the true joint occurrence of offshore water levels and local wind setup. Give the comparison, and for consistency with the Coastal Hazard Assessment it is recommended that Flood Study adopt Storm Tide levels from the Eurobodalla Coastal Hazard Assessment

Table 2: Comparison of Extreme Still Water Levels excluding wave setup and flood contribution at the Princes Street Jetty from the Eurobodalla Coastal Hazard Assessment (WRL, 2017) and Baird's Monte Carlo ECL dataset.

Location	ARI (Years)	Eurobodalla Coastal Hazard Assessment	Baird's ECL Dataset (mAHD)
Princes Street Jetty	20	1.48	1.39
	100	1.56	1.45

Entrance Condition

In addition to the consideration of ocean water levels for downstream boundary conditions, the condition of the creek entrance needs to be specified. Four of the seven creeks being investigated for this flood study are small coastal lagoons with intermittently open and closed entrances (ICOLLs). Consistent with requirements of *Floodplain Risk Management Guide - Modelling the Interaction of Catchment Flooding and Oceanic Inundation in Coastal Waterways* (OEH, 2015) for Group 4 Waterway Entrance Type (ICOLLs) consideration of dynamic morphology of the ICOLL entrances is important in establishing accurate flood levels in downstream areas of the catchment.

This requires an assumption as the entrance condition prior to the onset of the flood scenario and is a site-specific consideration of the following (OEH, 2015):

- Peak shoaled entrance condition from previous estuary/coastal study or historical analysis
- Current entrance geometry (confirmed by survey)
- Whether there is a trigger level for mechanical intervention under entrance management policy
- Dynamic morphology of entrance

A summary of each entrance to be considered in this flood study, included in previous sections, provides the extent of information available for this study. For the ICOLLs, a closed entrance condition will be adopted, noting that there is a high likelihood of the entrance being closed prior to a large flood event and it being a conservative position for flooding of the downstream areas of the catchment. The assumed closed entrance condition for each ICOLL has been based on the entrance berm level obtained from the available survey (ensuring consistency with the adjacent beach berm levels) or the entrance management trigger level, where available, as discussed in the previous sections.

Table 3 provides a summary of the berm levels to be adopted for the ICOLL entrances.

Table 3: Summary of Adopted Berm Level and Water Level for modelling of ICOLL entrances

ICOLL	Adopted Berm Level (mAHD)	Adopted Creek WL (mAHD)	Source
Maloneys Creek	+2.1	+1.8	Nearshore LiDAR Survey Data (OEH, 2018)
Surfside Creek	+1.50	+1.45	Entrance Management Trigger Level (ESC, 2019)
Joes Creek	+1.90	+1.4	Nearshore LiDAR Survey Data (OEH, 2018)
Short Beach Creek	+1.30	+1.10	Entrance Management Trigger Level (ESC, 2019)

Summary Adopted Downstream Boundary Conditions

Based on the information and data provided above, Table 4 provides a summary of the downstream boundary conditions to be adopted for the Batemans Bay Urban Creeks Flood Study.

Table 4: Summary of the Downstream Boundary Conditions for the Batemans Bay Urban Creeks Flood Study

Location	Entrance Type	Entrance Condition	Adopted Berm Level (mAHD)	Creek / Lagoon WL (mAHD)	20 yr Peak Total SWL (mAHD)	100 yr Peak Total SWL (mAHD)
Maloneys Creek	ICOLL	Closed	+2.10	+1.80	2.03	2.13
Long Beach Lagoon	Overland Channel	Closed	+3.5 - 2	TBA	2.18	2.31
Surfside Creek	ICOLL	Closed	+1.50	+1.50	1.96	2.06
Watergardens	Engineered Outlet	Open	N/A	N/A	2.08	2.22
Hanging Rock Creek	Navigable Entrance	Open	N/A	N/A	2.09	2.21
Joes Creek	ICOLL	Closed	+1.85	+1.40	1.72	1.82
Short Beach Creek	ICOLL	Closed	+1.30	+1.30	1.74	1.83

Concluding Remarks

This memo provides a summary of the rationale and assumptions that have informed the proposed downstream boundary conditions to be adopted for the Batemans Bay Urban Creeks Flood Study. The memo is submitted for review and feedback from Council and DPIE prior to the commencement of design flood simulations.

Should you have any queries or require clarification as the information presented herein, please do not hesitate to contact Rhelm (Emma Maratea) or Baird (Sean Garber) to discuss.

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Rhelm Pty Ltd

ABN 55 616 964 517

ACN 616 964 517

Head Office

Level 1, 50 Yeo Street

Neutral Bay NSW 2089

contact@rhelm.com.au

+61 2 9098 6998

www.rhelm.com.au