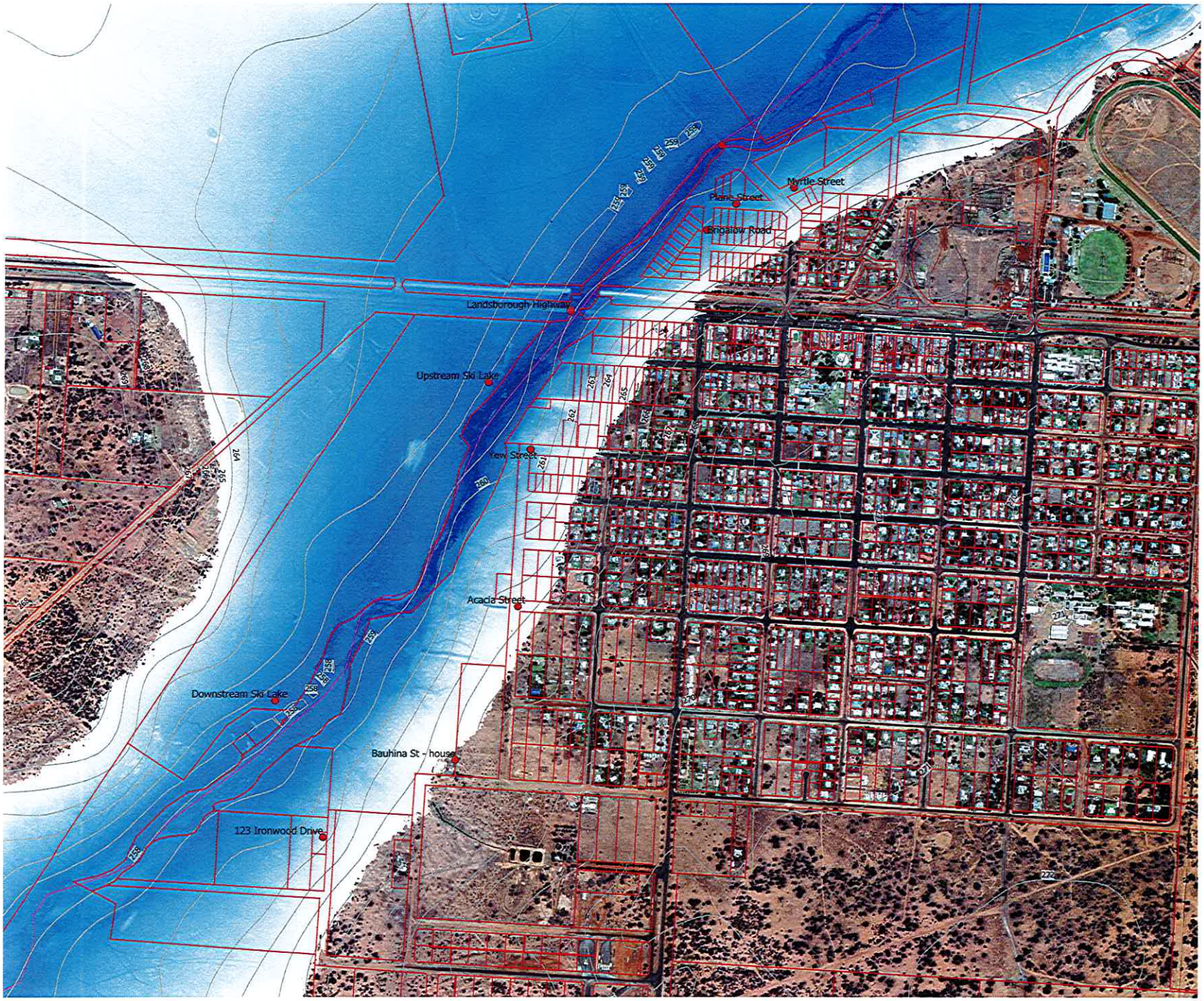

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Barcaldine Recreation Park Flood Impact Assessment

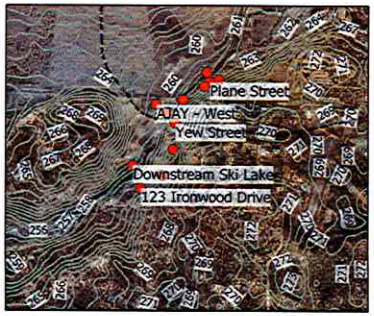
Figure 7 of 40.
Flood Innundation Mapping
Scenario 1 - Pmf

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
23/07/2020

N

0 100 200 300 400 m

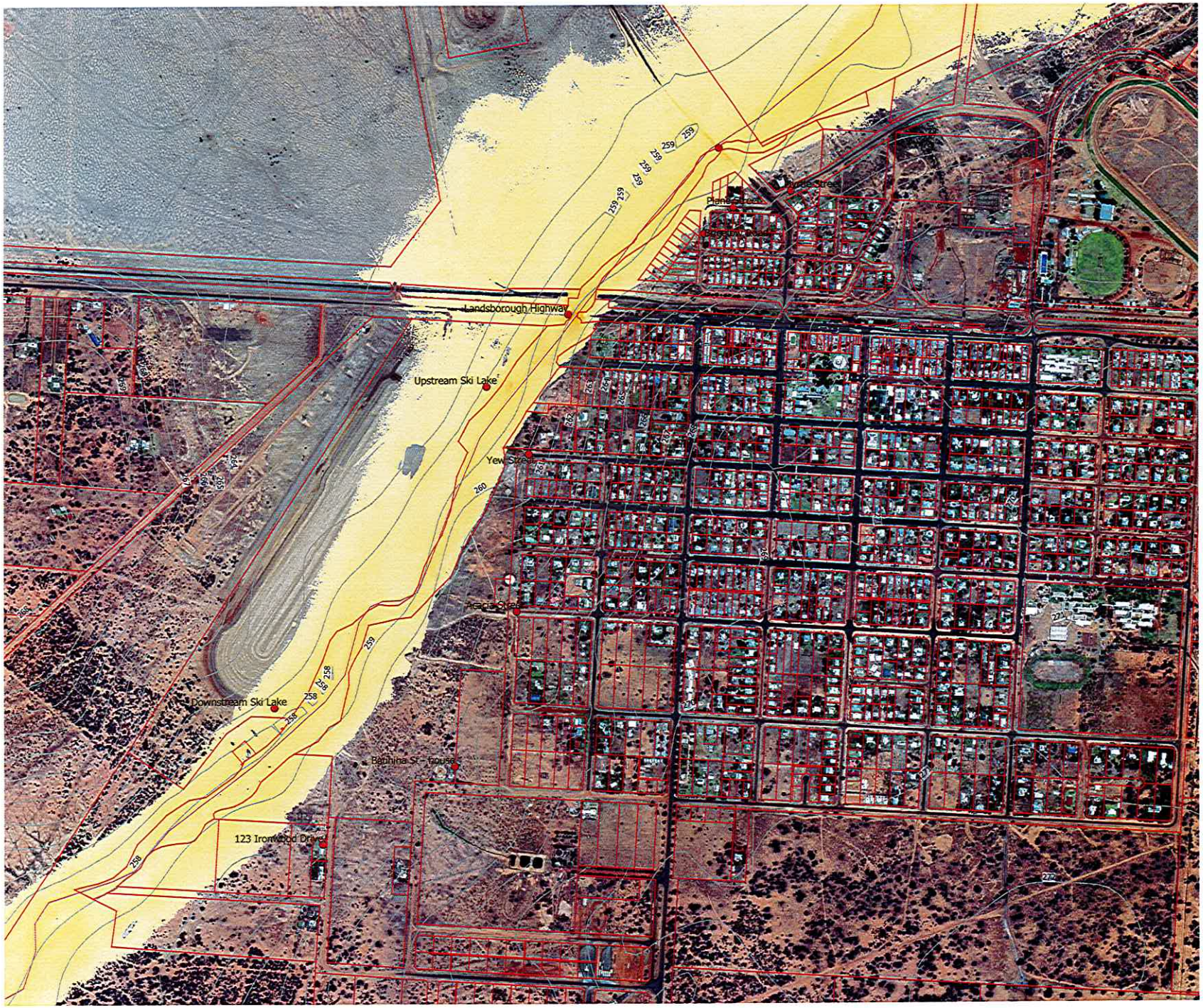


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Figure 8 of 40.
Flood Innundation Mapping
Scenario 1 - 50% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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N

0 100 200 300 400 m

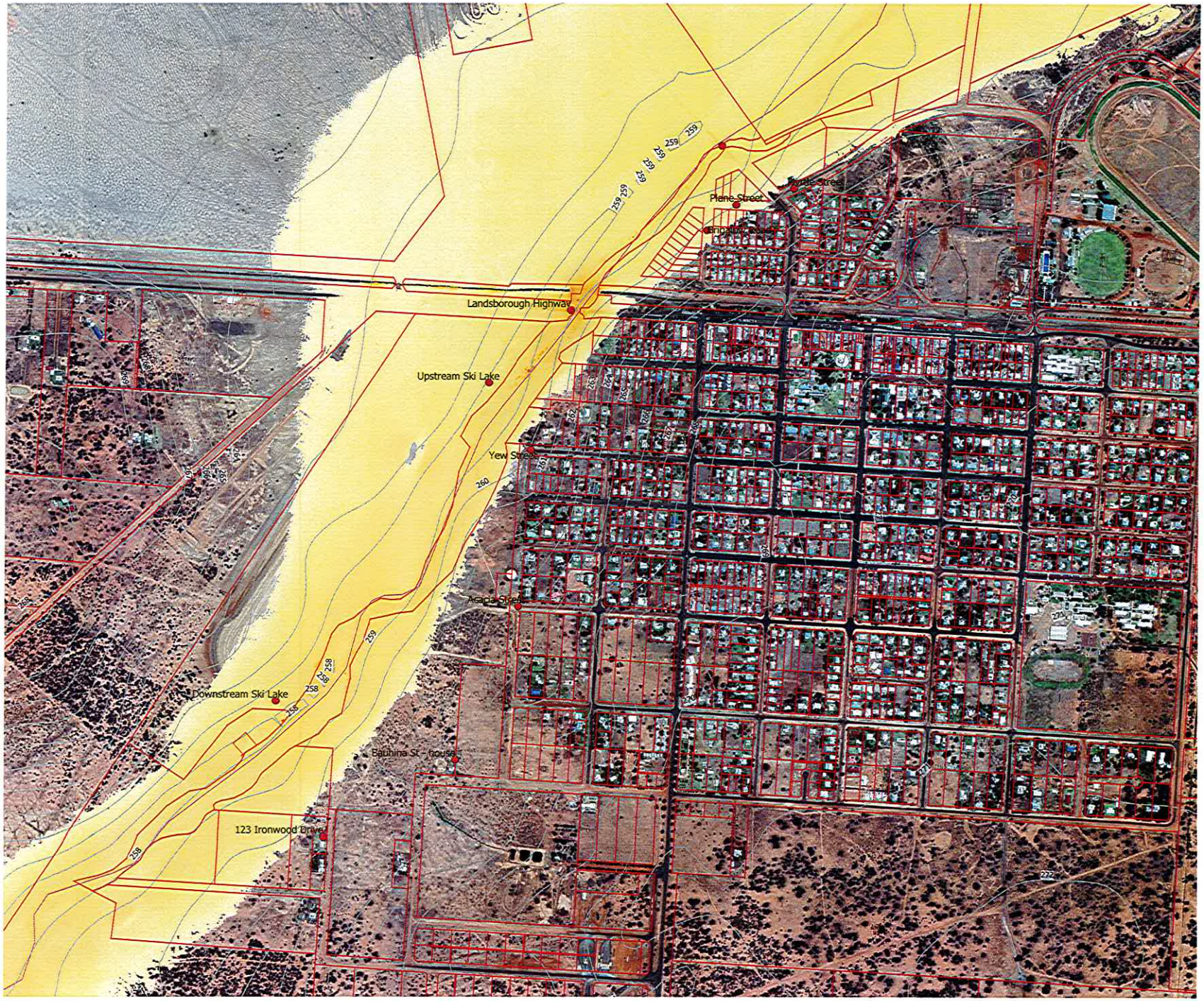

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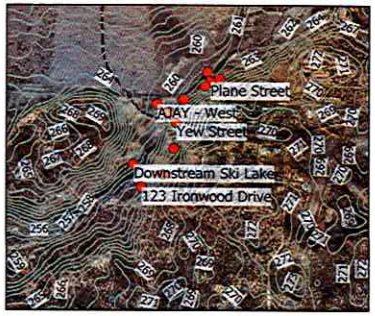
Figure 9 of 40.
Flood Innundation Mapping
Scenario 1 - 10% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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N

0 100 200 300 400 m

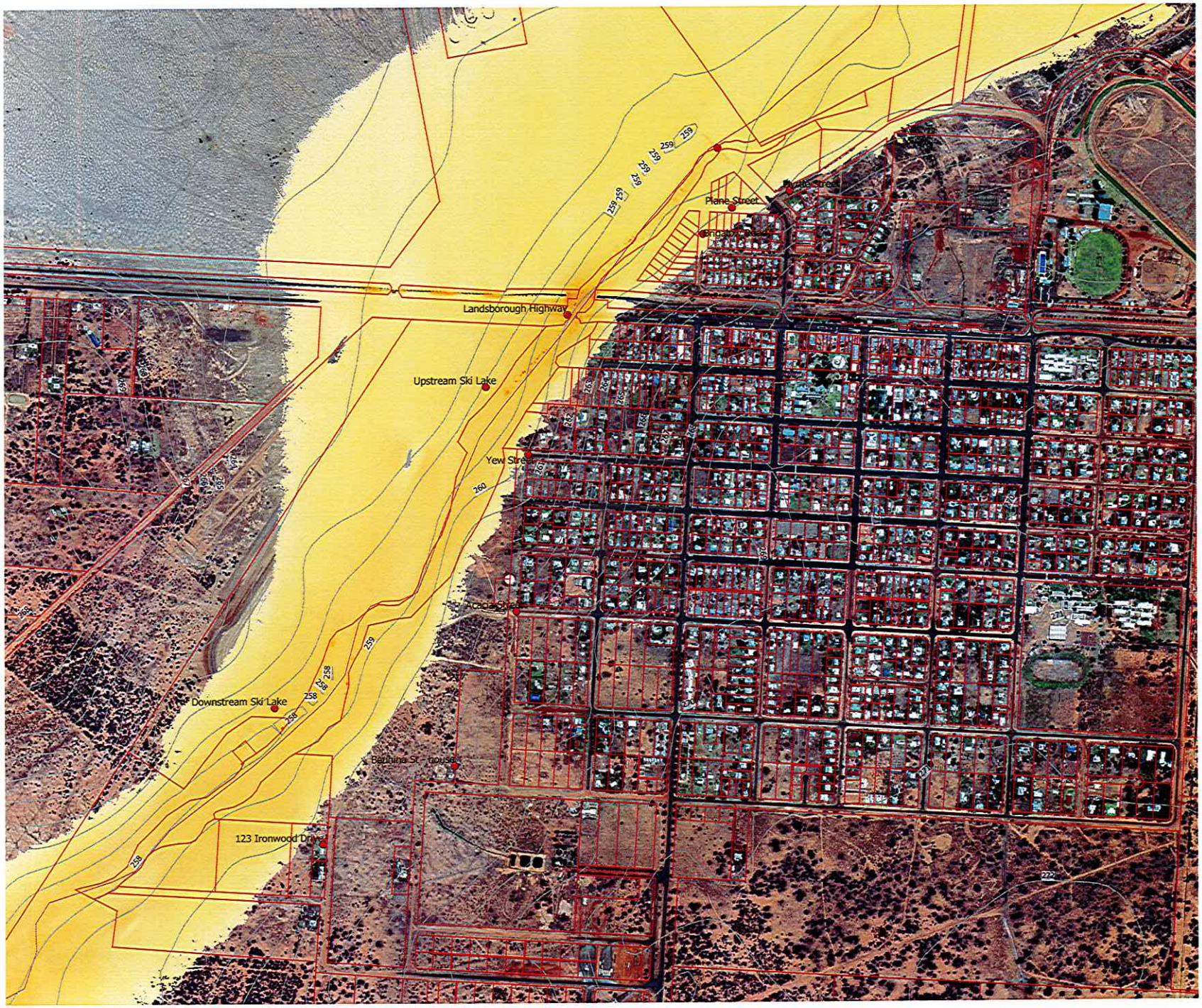

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Figure 10 of 40.
Flood Innundation Mapping
Scenario 1 - 5% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
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N

0 100 200 300 400 m

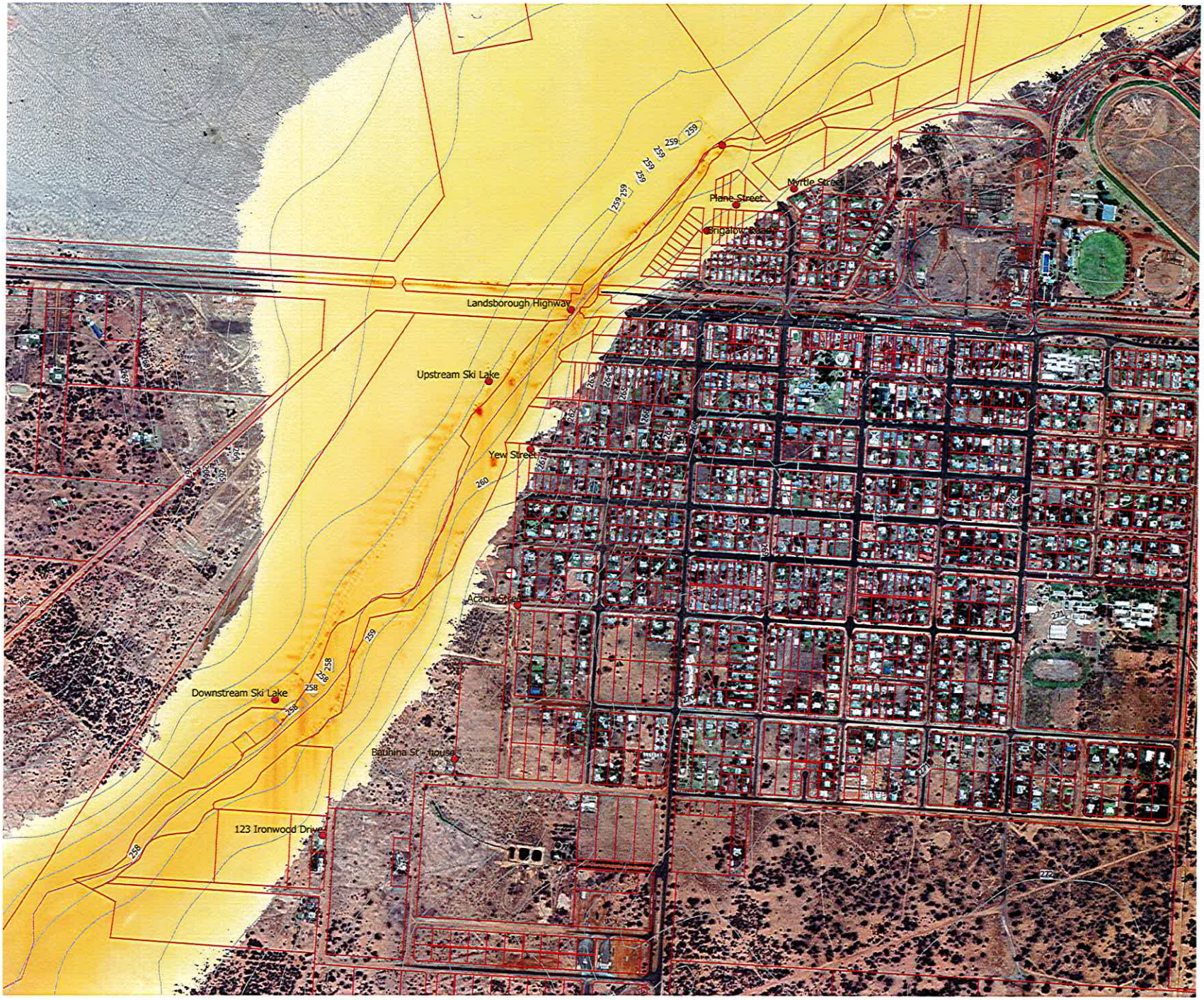

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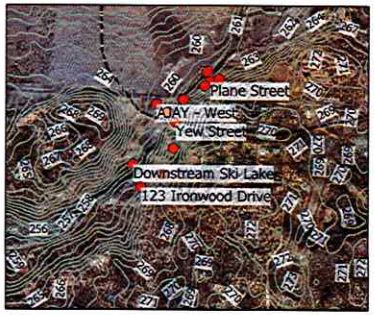
Figure 11 of 40.
Flood Innundation Mapping
Scenario 1 - 1% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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N

0 100 200 300 400 m

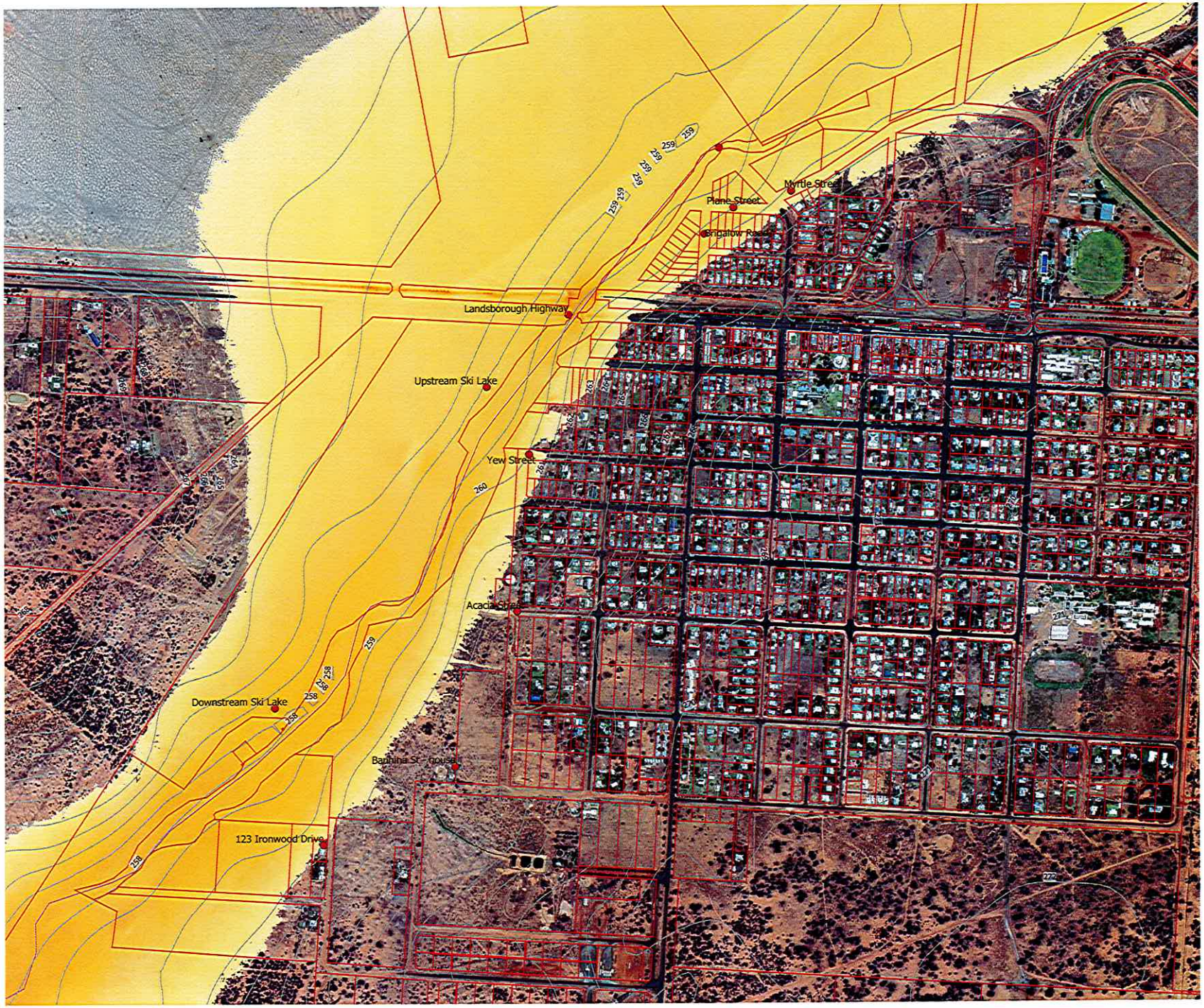

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Figure 12 of 40.
Flood Innundation Mapping
Scenario 1 - 0.2% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

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N

0 100 200 300 400 m

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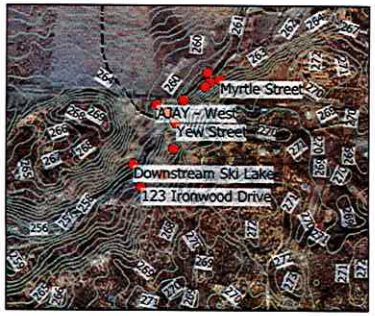
Figure 13 of 40.
Flood Innundation Mapping
Scenario 1 - Pmf Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
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N

0 100 200 300 400 m

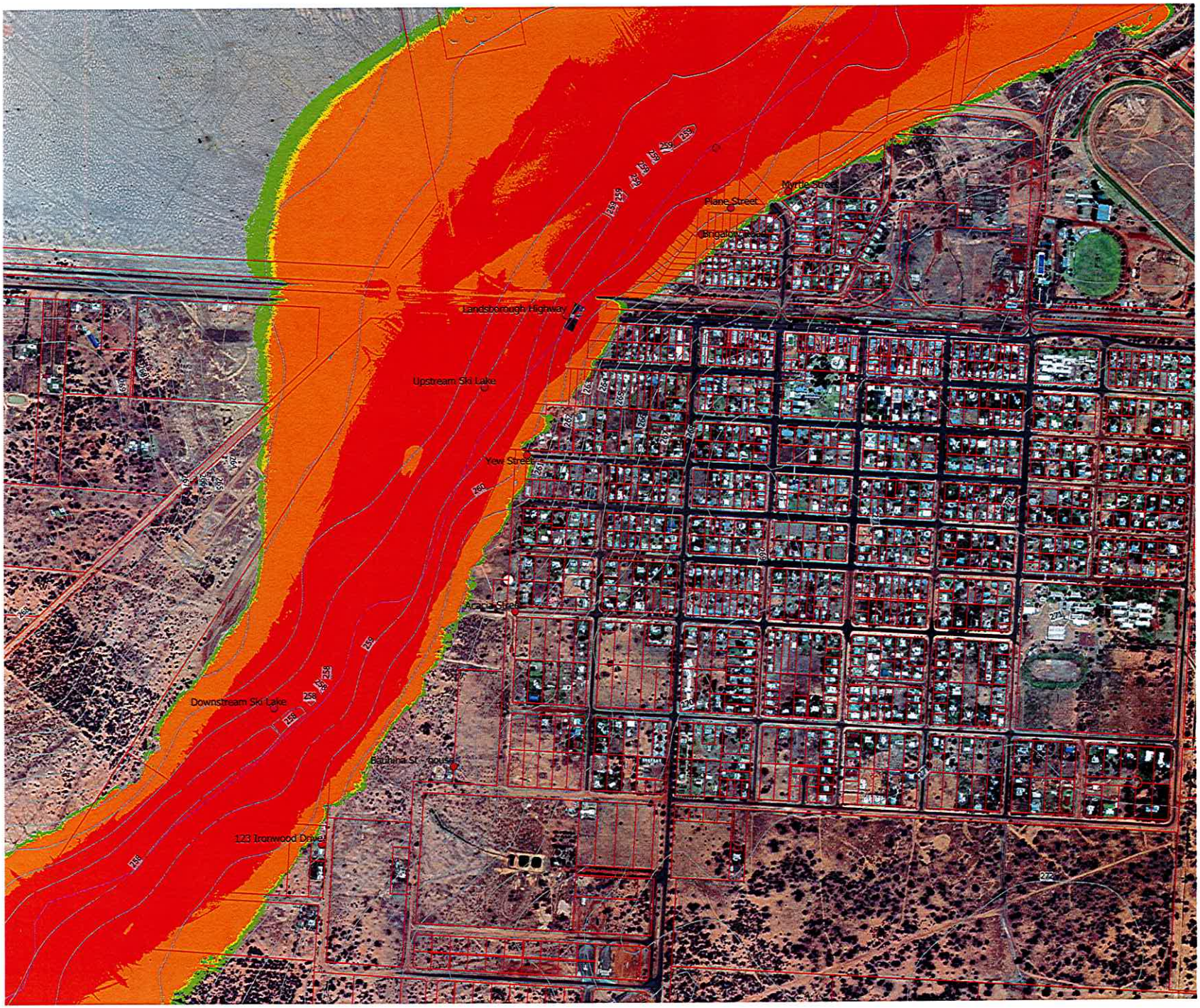

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Figure 14 of 40.
Flood Innundation Mapping
Scenario 1: 1% Aep D * V

Legend

- Cadastral_data_LOTBDY
- contour
- SMK Design cont contour LineString
- Flood innundation_Critical Points-
- Surface HydroLines National
- LOW (<0.6)
- SIGNIFICANT (0.6 to <0.8)
- HIGH (0.8 to <1.2)
- EXTREME (>1.2)

A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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N

0 100 200 300 400 m

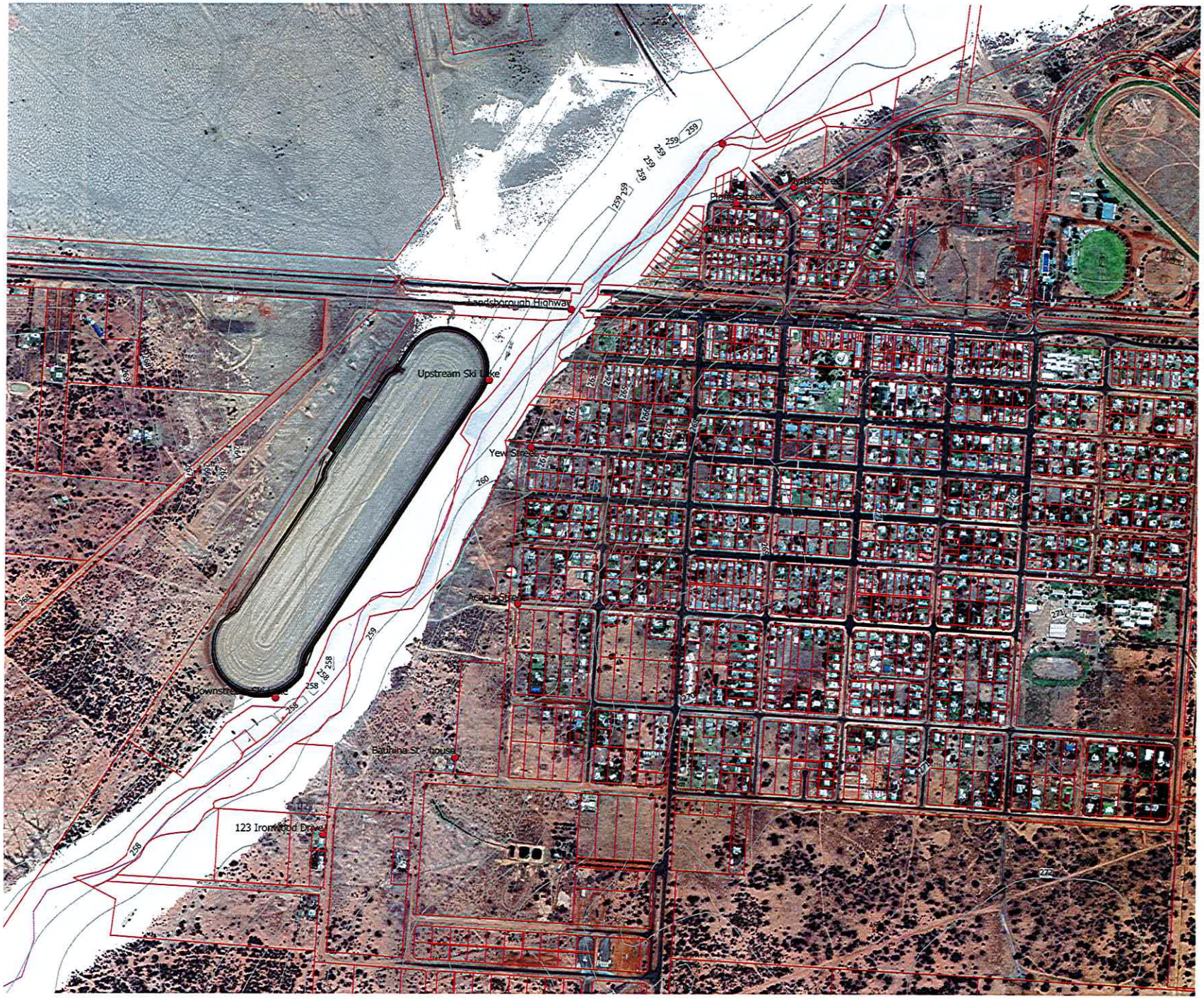

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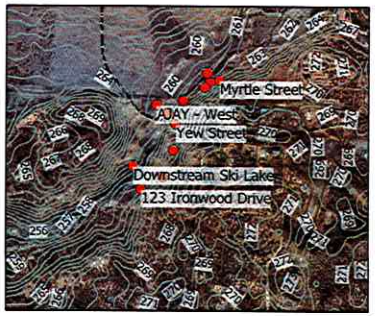
Figure 15 of 40.
Flood Innundation Mapping
Scenario 2 - 50% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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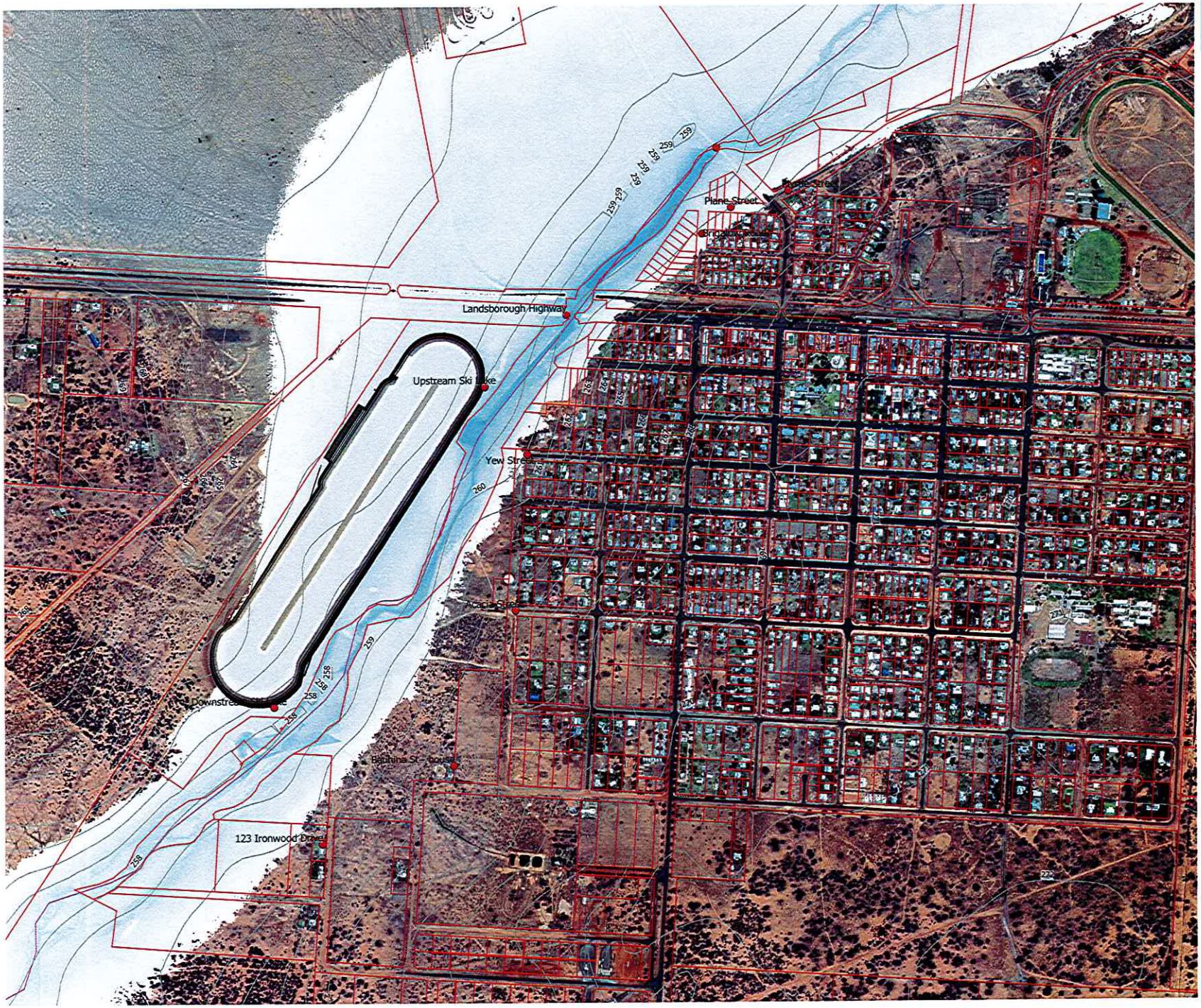
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

Figure 16 of 40.
Flood Innundation Mapping
Scenario 2 - 10% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

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N

0 100 200 300 400 m

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Figure 17 of 40.
Flood Innundation Mapping
Scenario 2 - 5% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
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N

0 100 200 300 400 m

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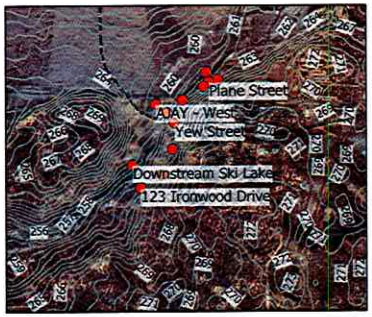
Figure 18 of 40.
Flood Innundation Mapping
Scenario 2 - 1% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



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N

0 100 200 300 400 m

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Figure 19 of 40.
Flood Innundation Mapping
Scenario 2 - 0.2% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
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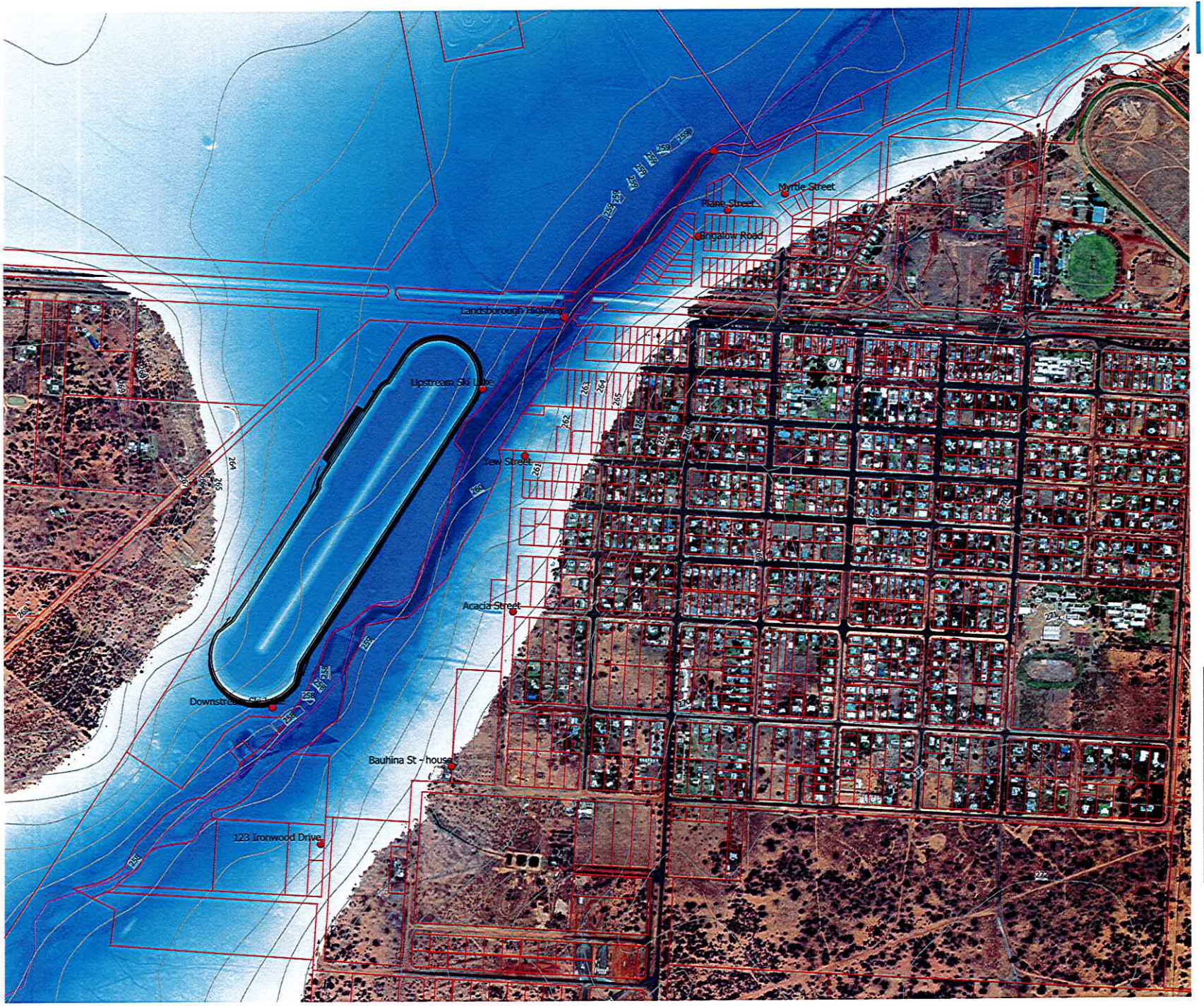
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

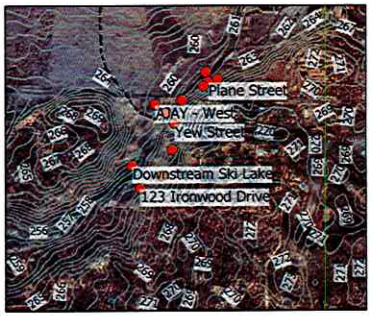
Figure 20 of 40.
Flood Innundation Mapping
Scenario 2 - Pmf

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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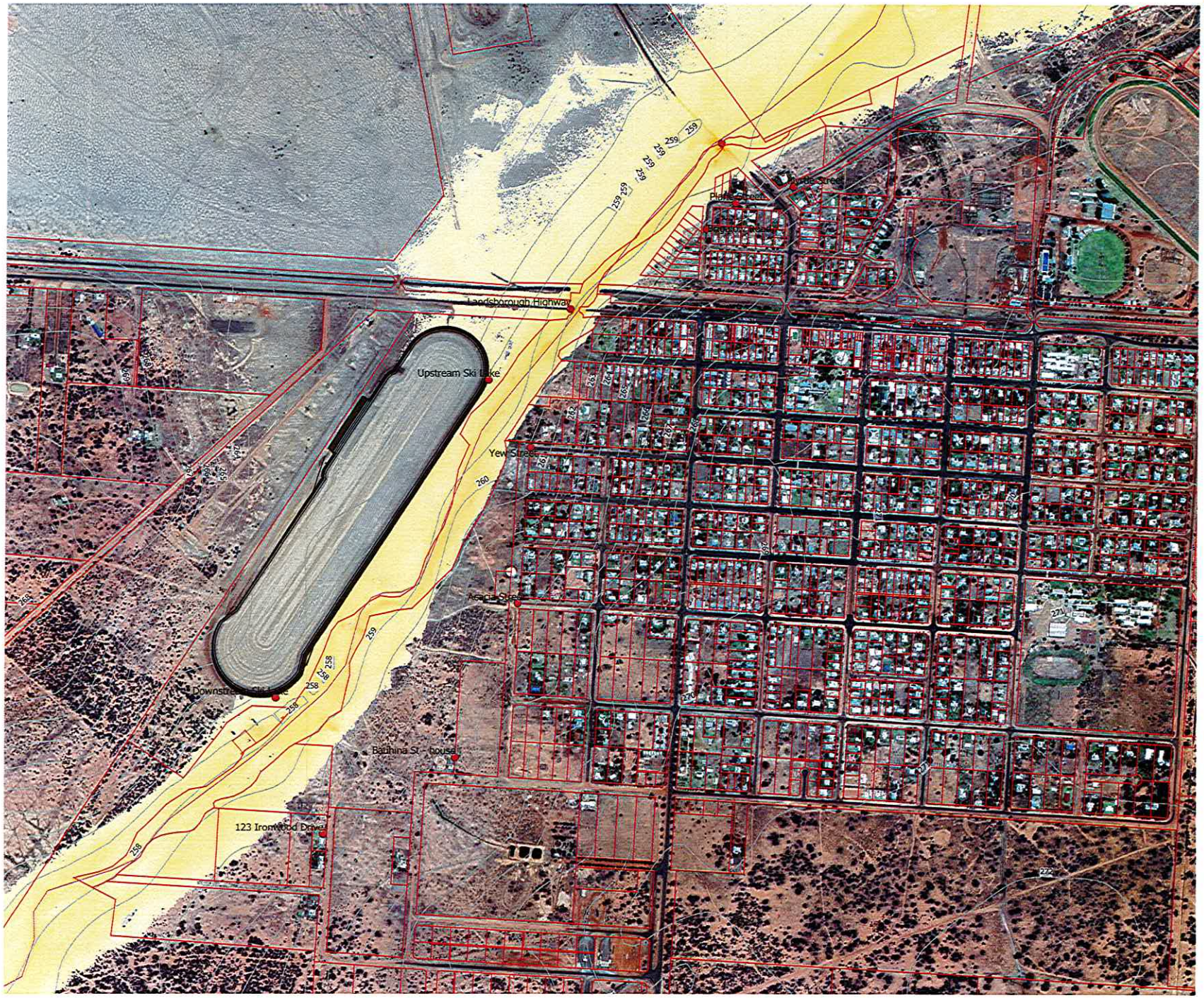
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

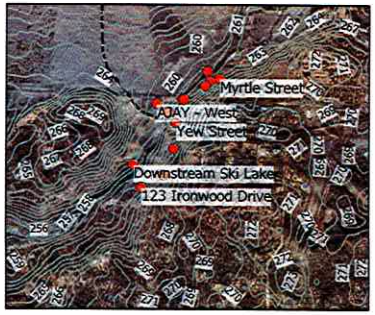
Figure 21 of 40.
Flood Innundation Mapping
Scenario 2 - 50% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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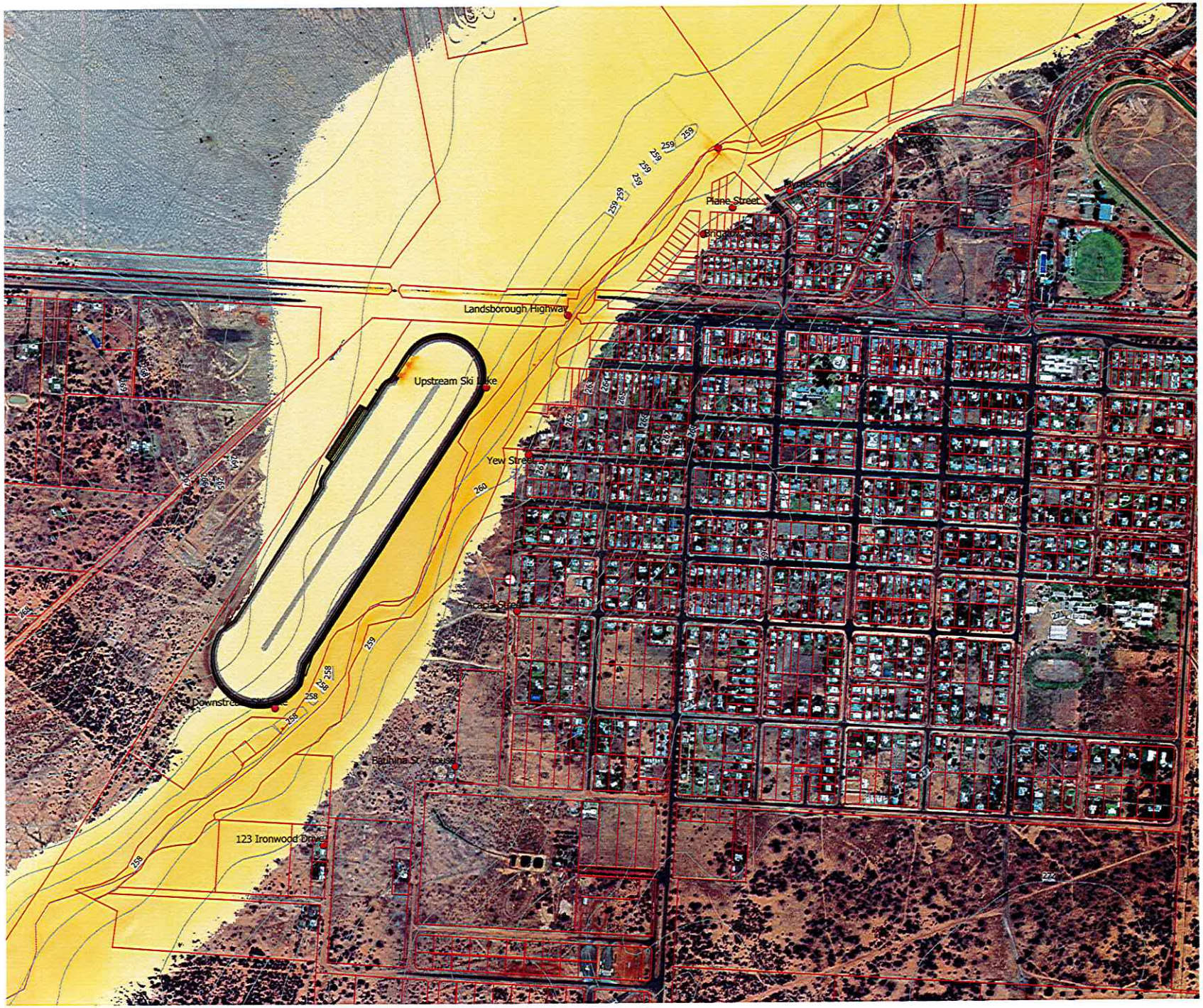
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

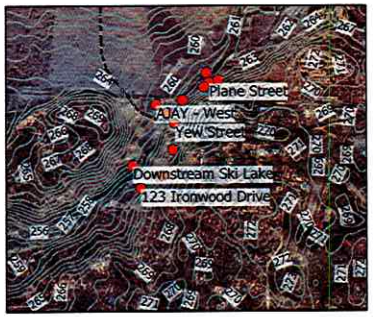
Figure 22 of 40.
Flood Innundation Mapping
Scenario 2 - 10% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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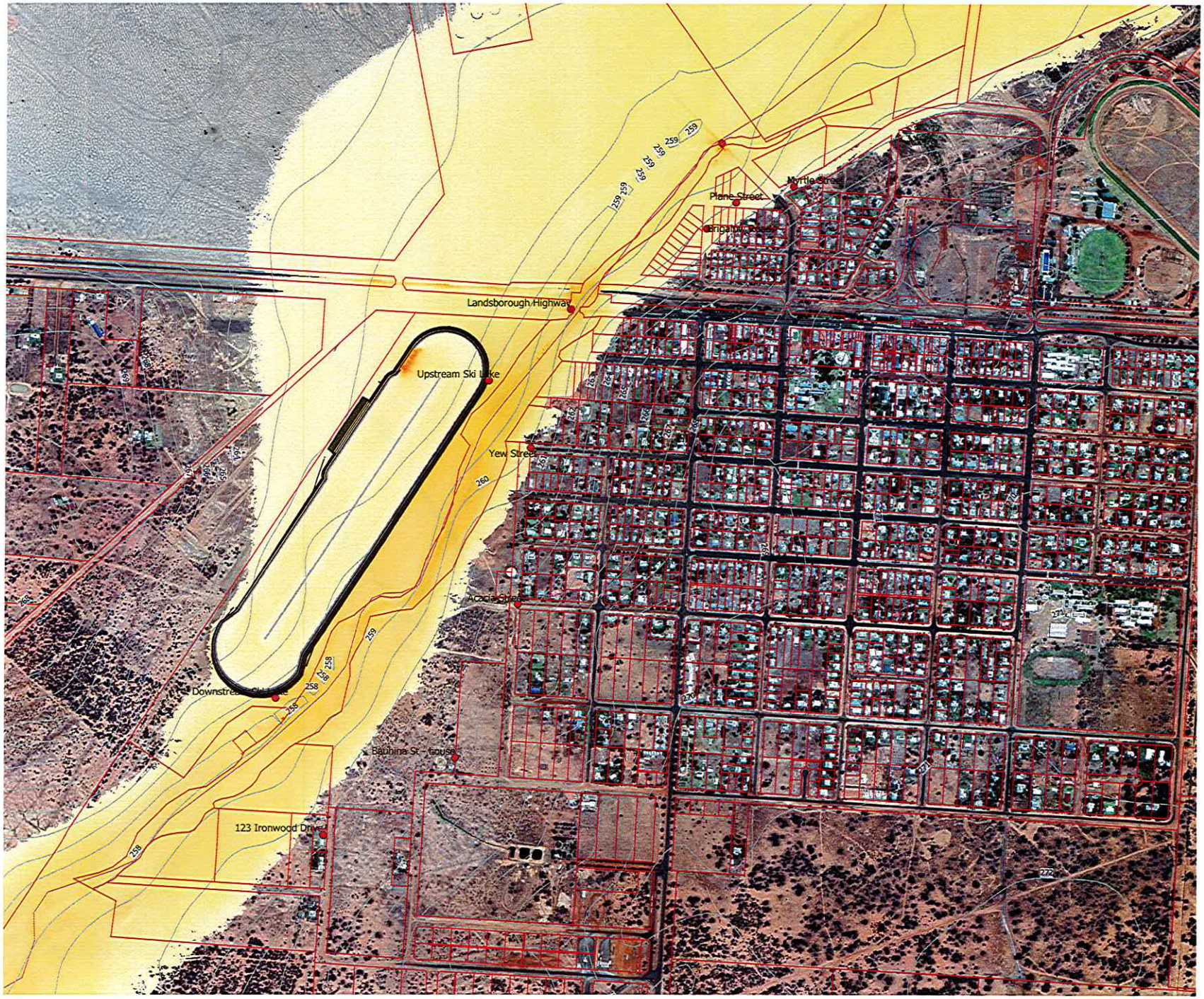
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

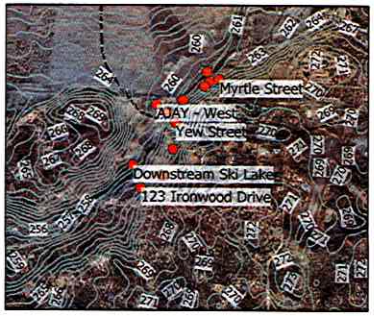
Figure 23 of 40.
Flood Innundation Mapping
Scenario 2 - 5% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
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N

0 100 200 300 400 m

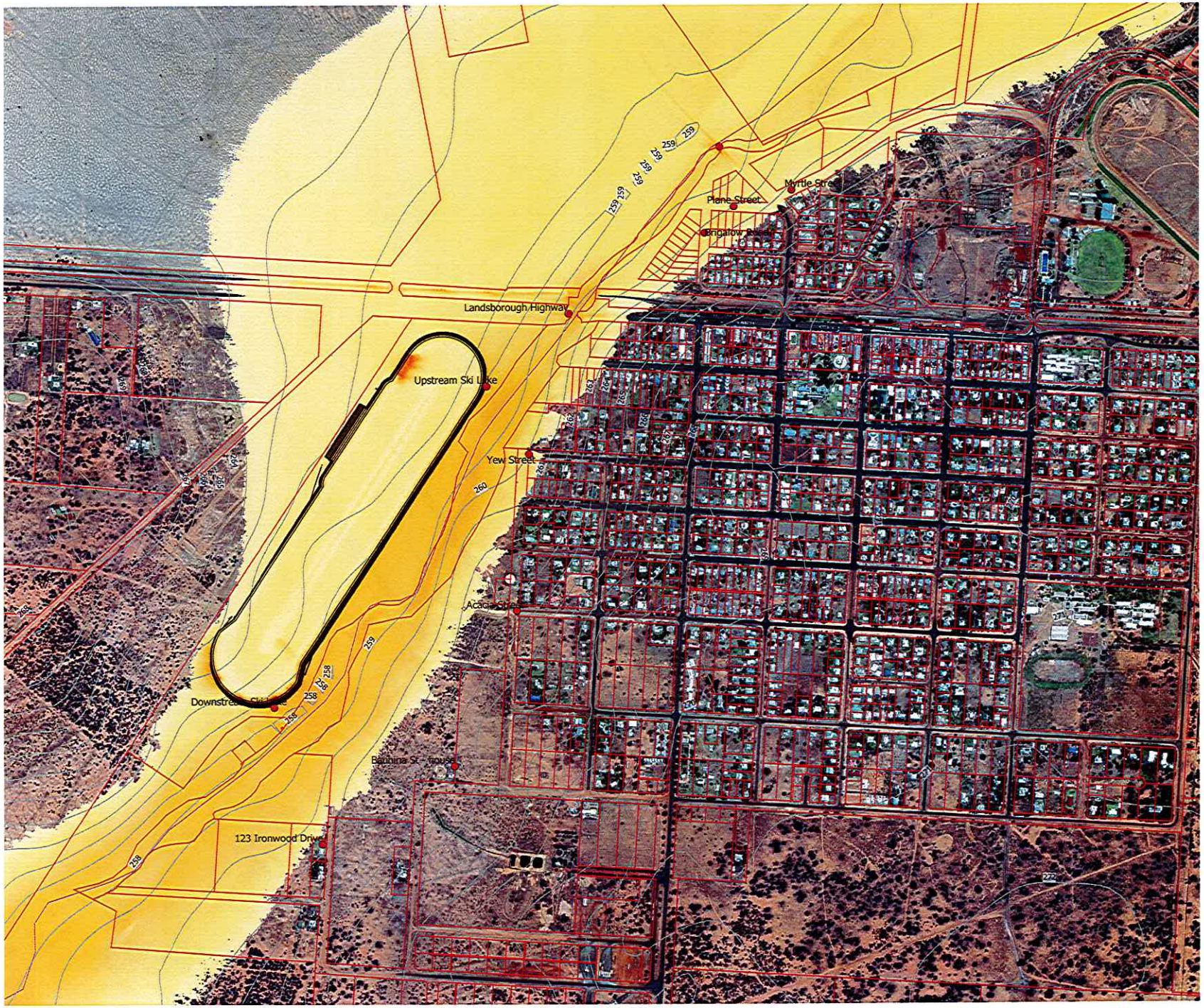

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Figure 24 of 40.
Flood Innundation Mapping
Scenario 2 - 1% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
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N

0 100 200 300 400 m

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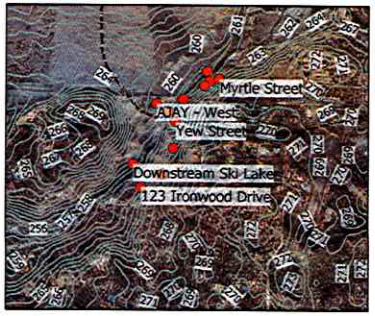
Figure 25 of 40.
Flood Innundation Mapping
Scenario 1 - 0.2% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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N

0 100 200 300 400 m

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Barcaldine Recreation Park Flood Impact Assessment

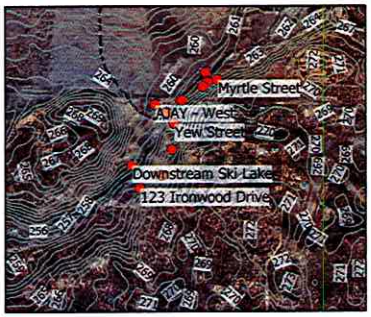
Figure 26 of 40.
Flood Innundation Mapping
Scenario 2 - Pmf Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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N

0 100 200 300 400 m

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Barcaldine Recreation Park Flood Impact Assessment

Figure 27 of 40.
Flood Innundation Mapping
Scenario 2: 1% Aep D * V

Legend

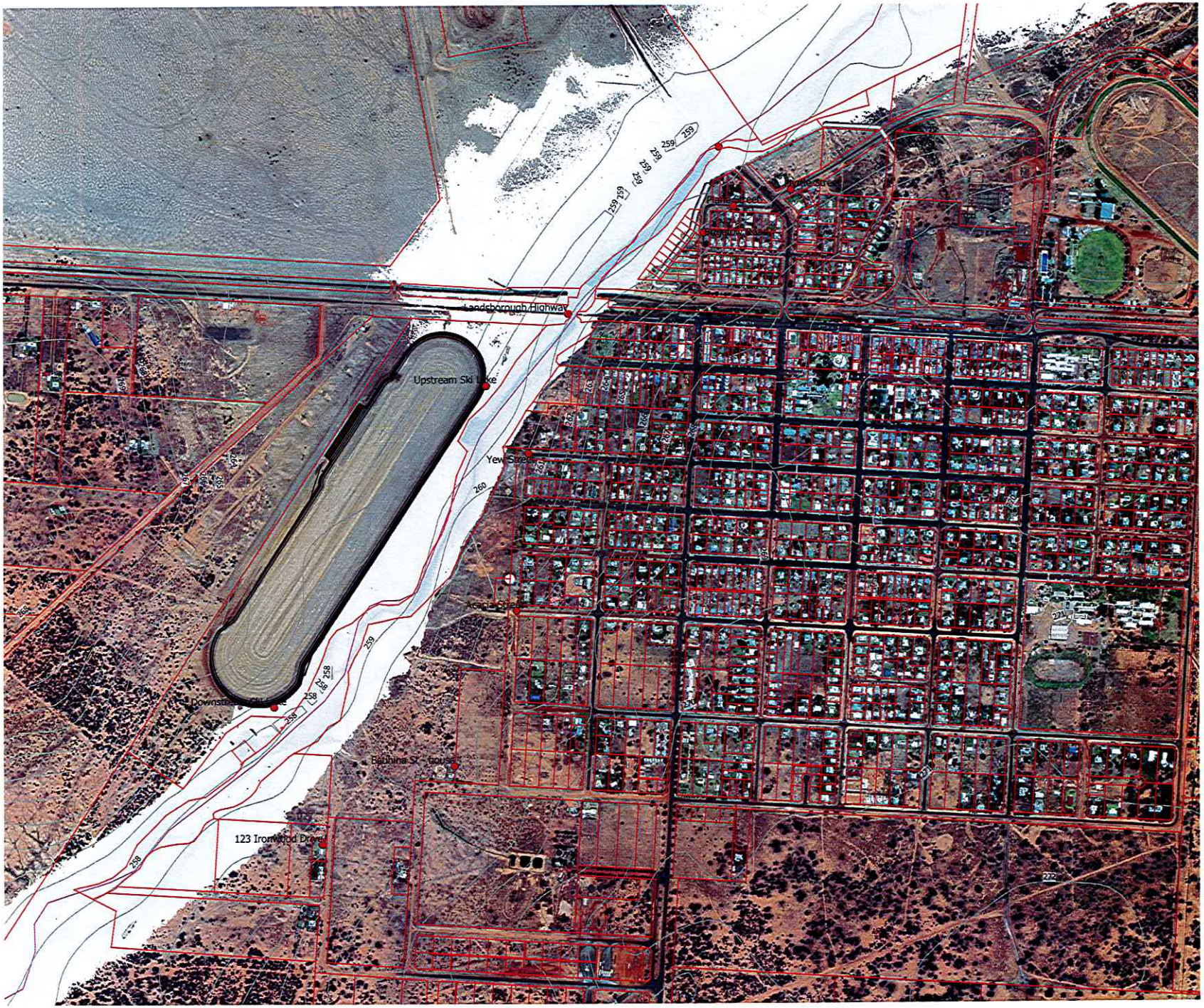
- Cadastral_data_LOTBDY
- contour
- SMK Design cont contour LineString
- Flood innundation_Critical Points-
- Surface HydroLines National
- LOW (<0.6)
- SIGNIFICANT (0.6 to <0.8)
- HIGH (0.8 to <1.2)
- EXTREME (>1.2)

A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
23/07/2020

N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

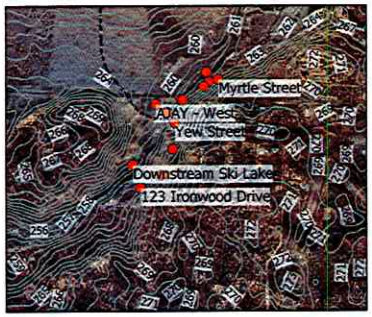
Figure 28 of 40.
Flood Innundation Mapping
Scenario 3 - 50% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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N

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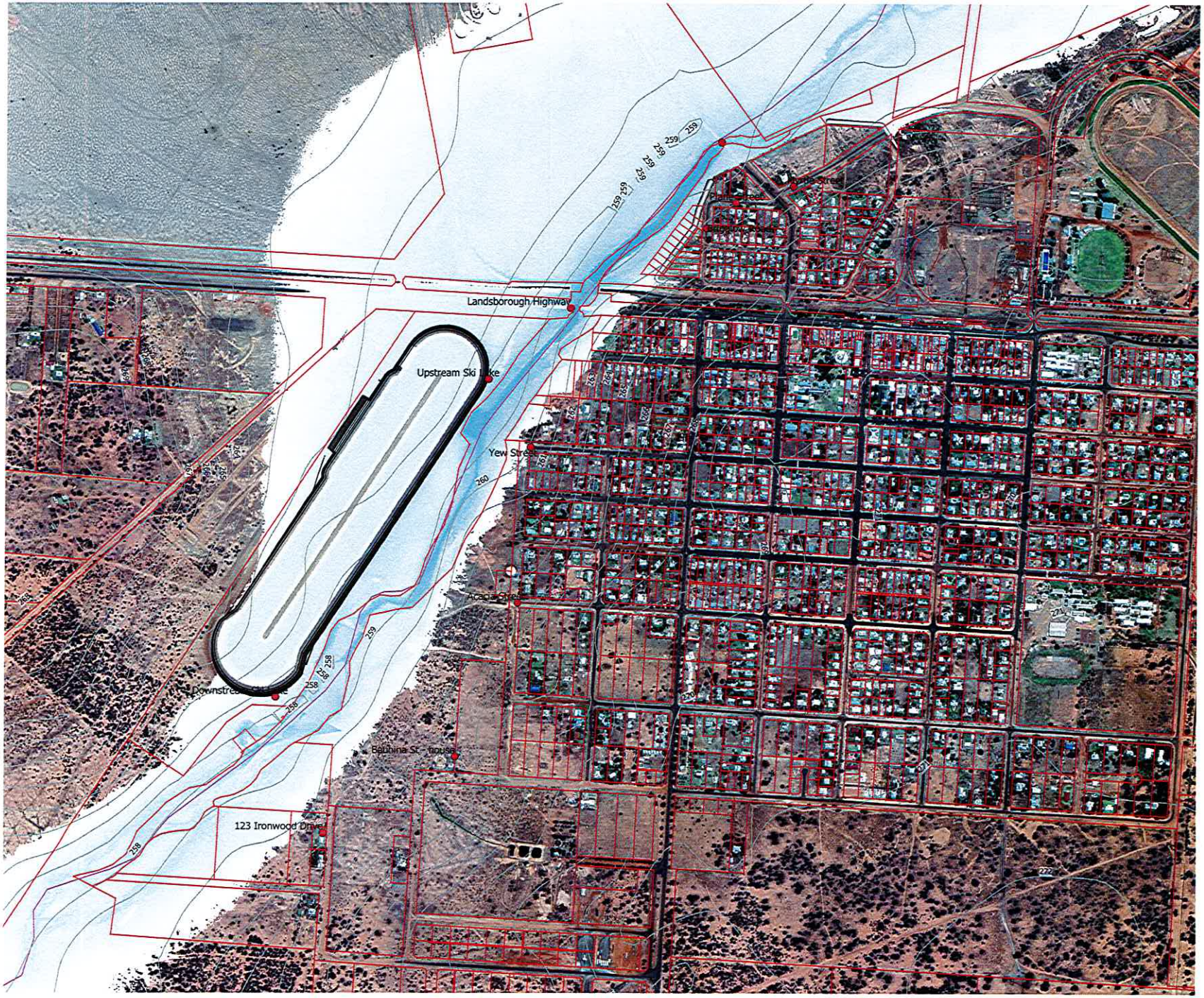

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Barcaldine Recreation Park Flood Impact Assessment

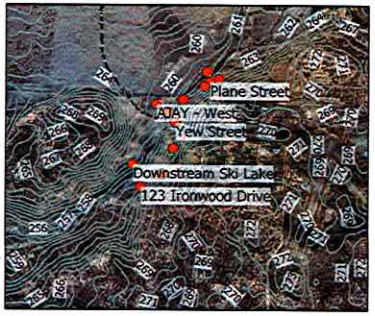
Figure 29 of 40.
Flood Innundation Mapping
Scenario 3 - 10% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
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N

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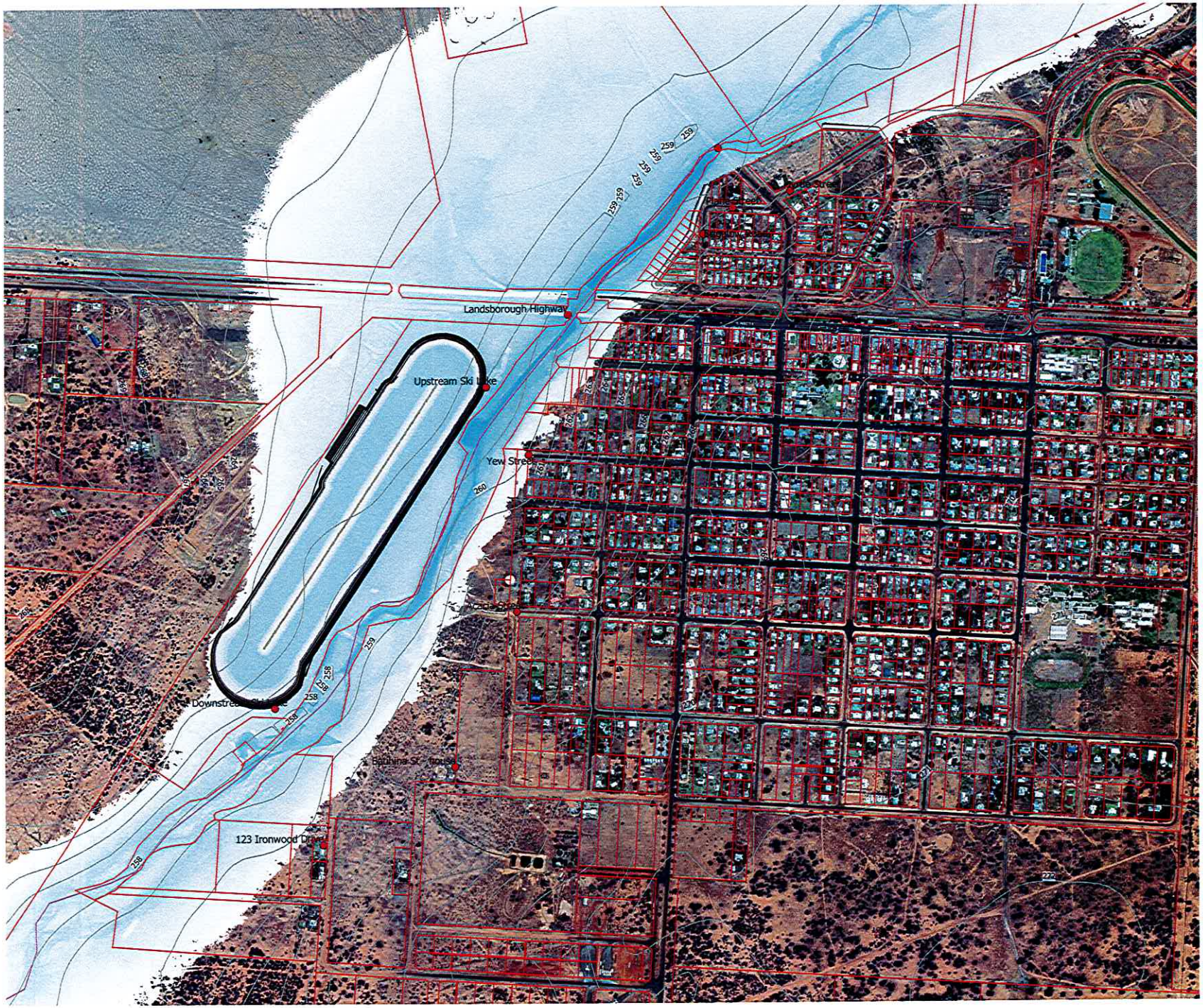

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Barcaldine Recreation Park Flood Impact Assessment

Figure 30 of 40.
Flood Innundation Mapping
Scenario 3 - 5% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

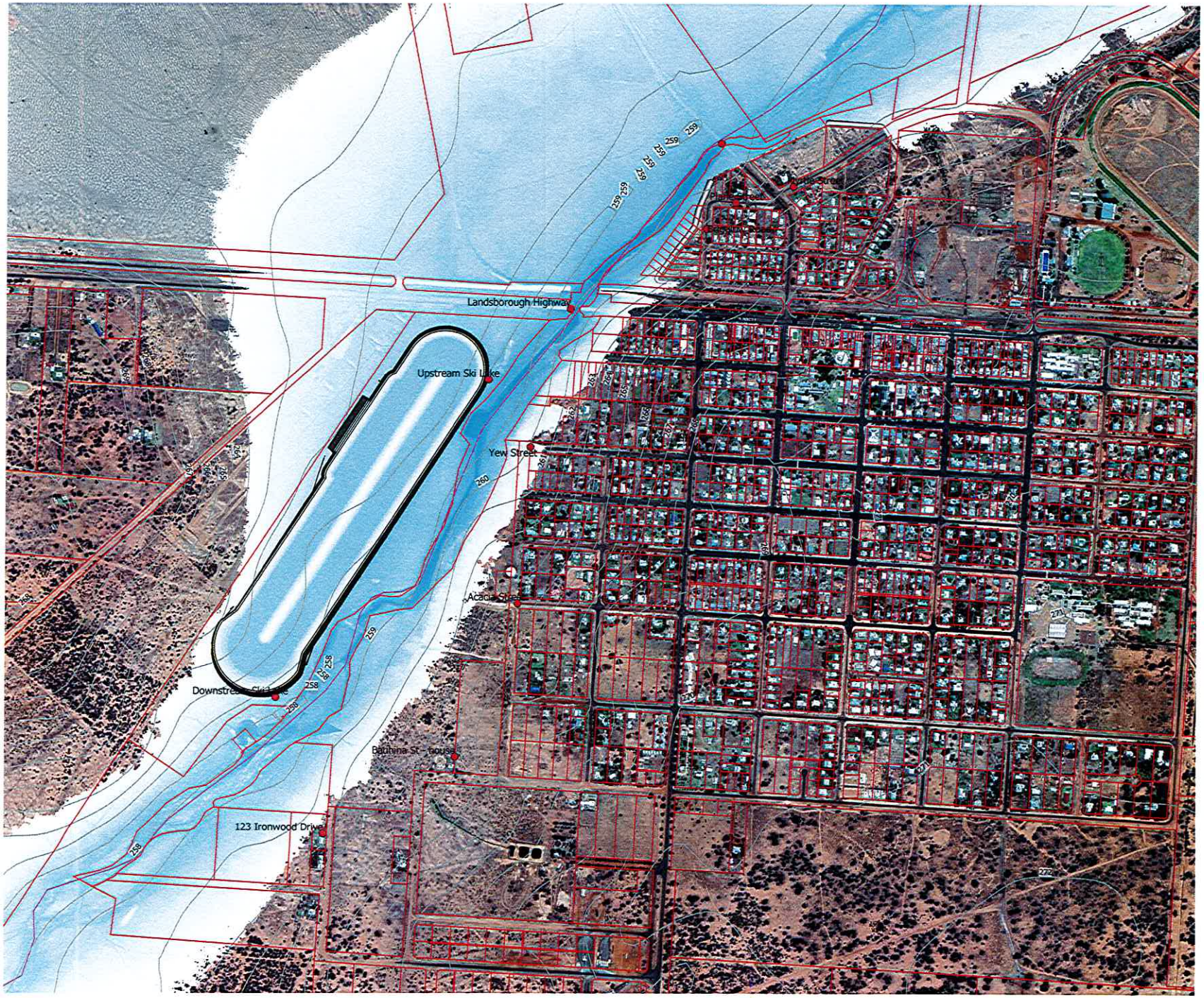
- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
23/07/2020

N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

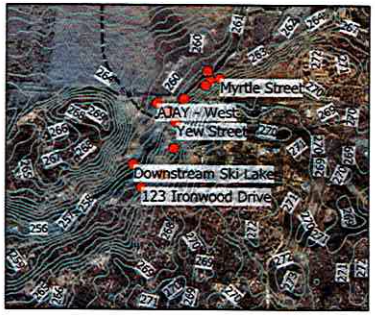
Figure 31 of 40.
Flood Innundation Mapping
Scenario 3 - 1% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



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N

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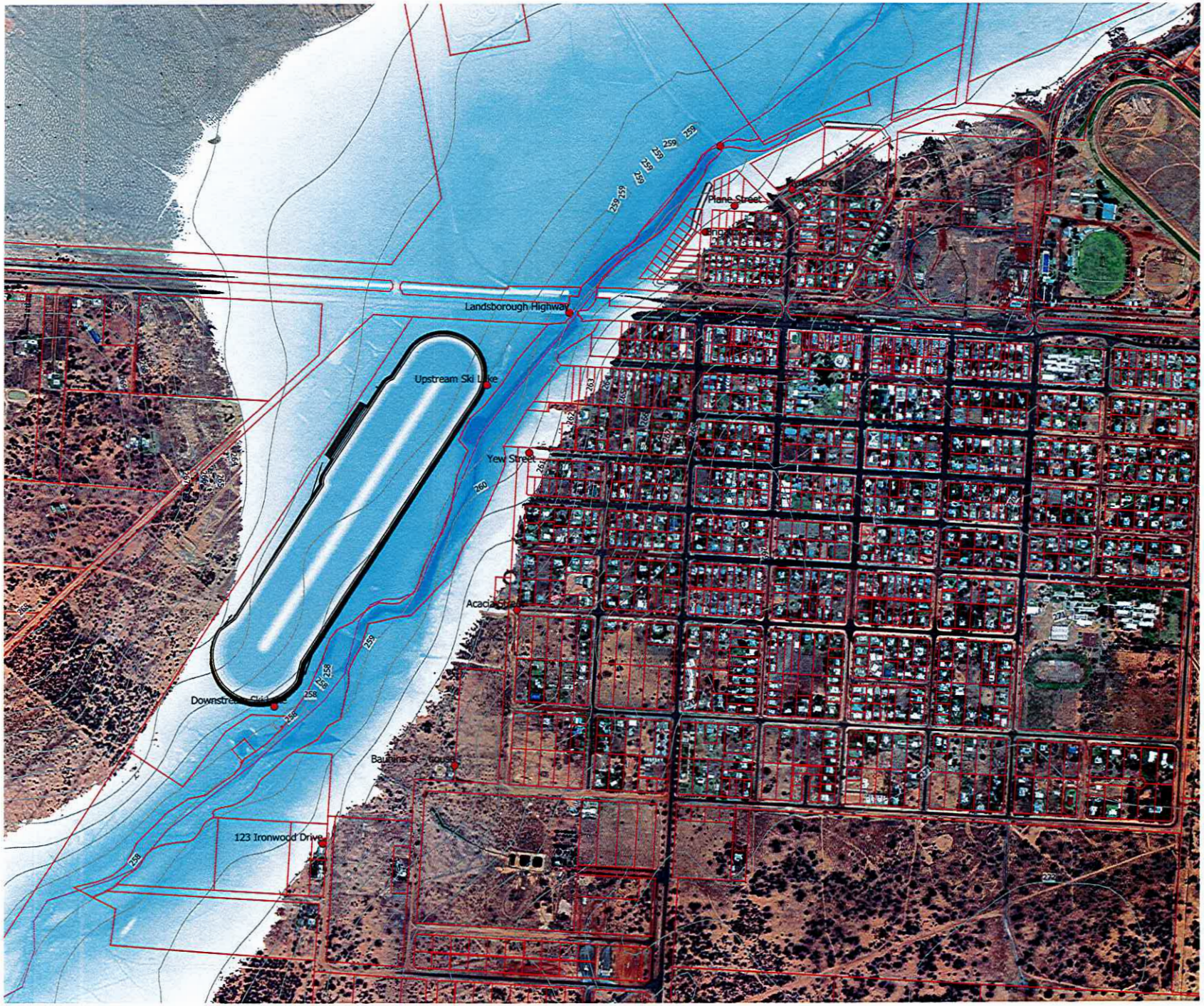

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Barcaldine Recreation Park Flood Impact Assessment

Figure 32 of 40.
Flood Innundation Mapping
Scenario 3 - 0.2% Aep

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6

A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

Job ID: 190005
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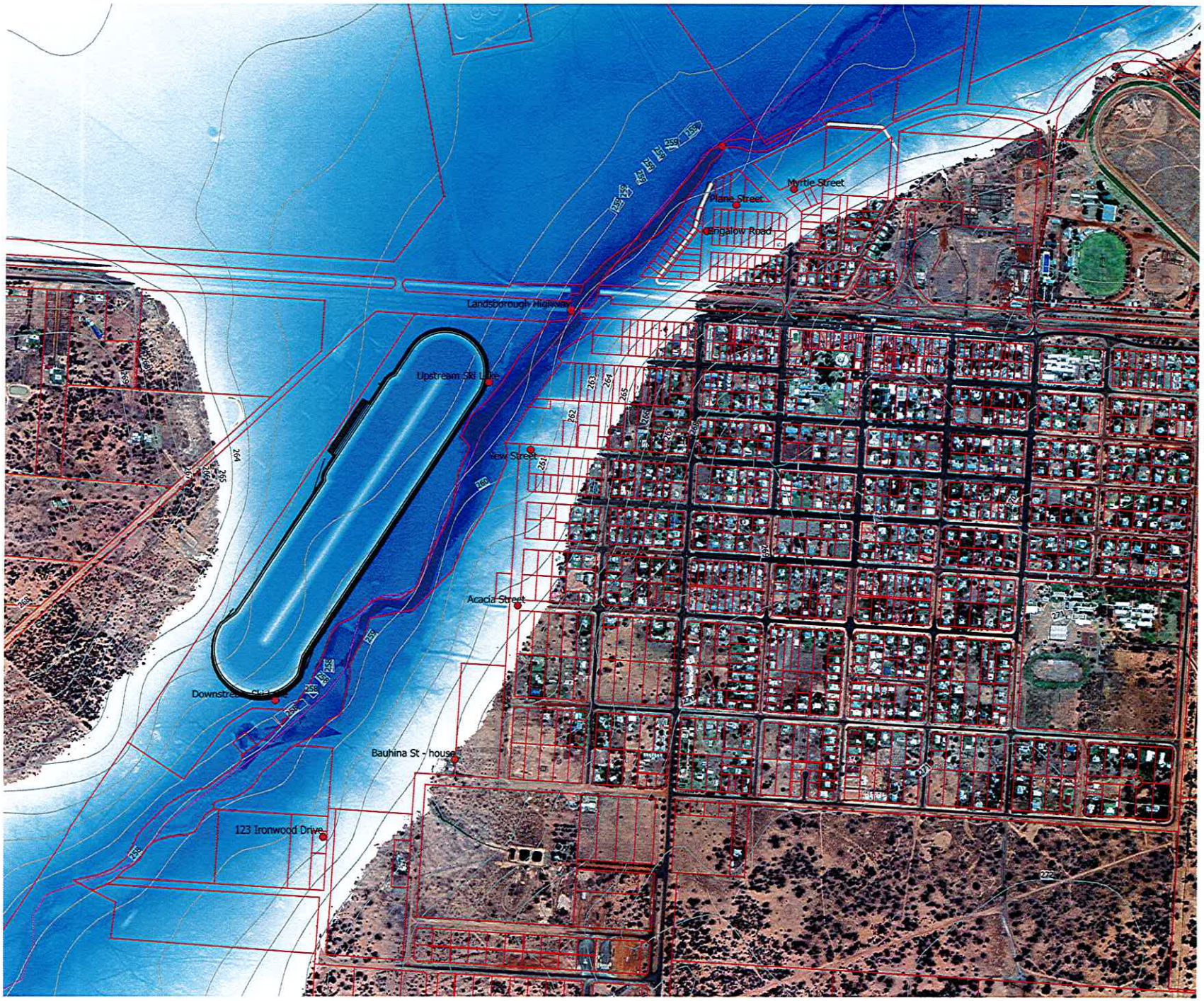
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

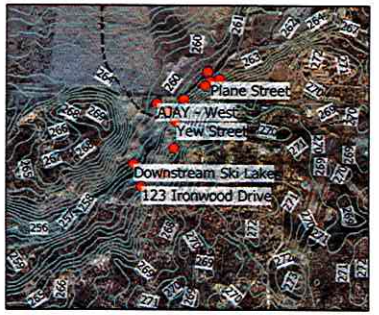
Figure 33 of 40.
Flood Innundation Mapping
Scenario 3 - Pmf

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Depth (Max) m

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



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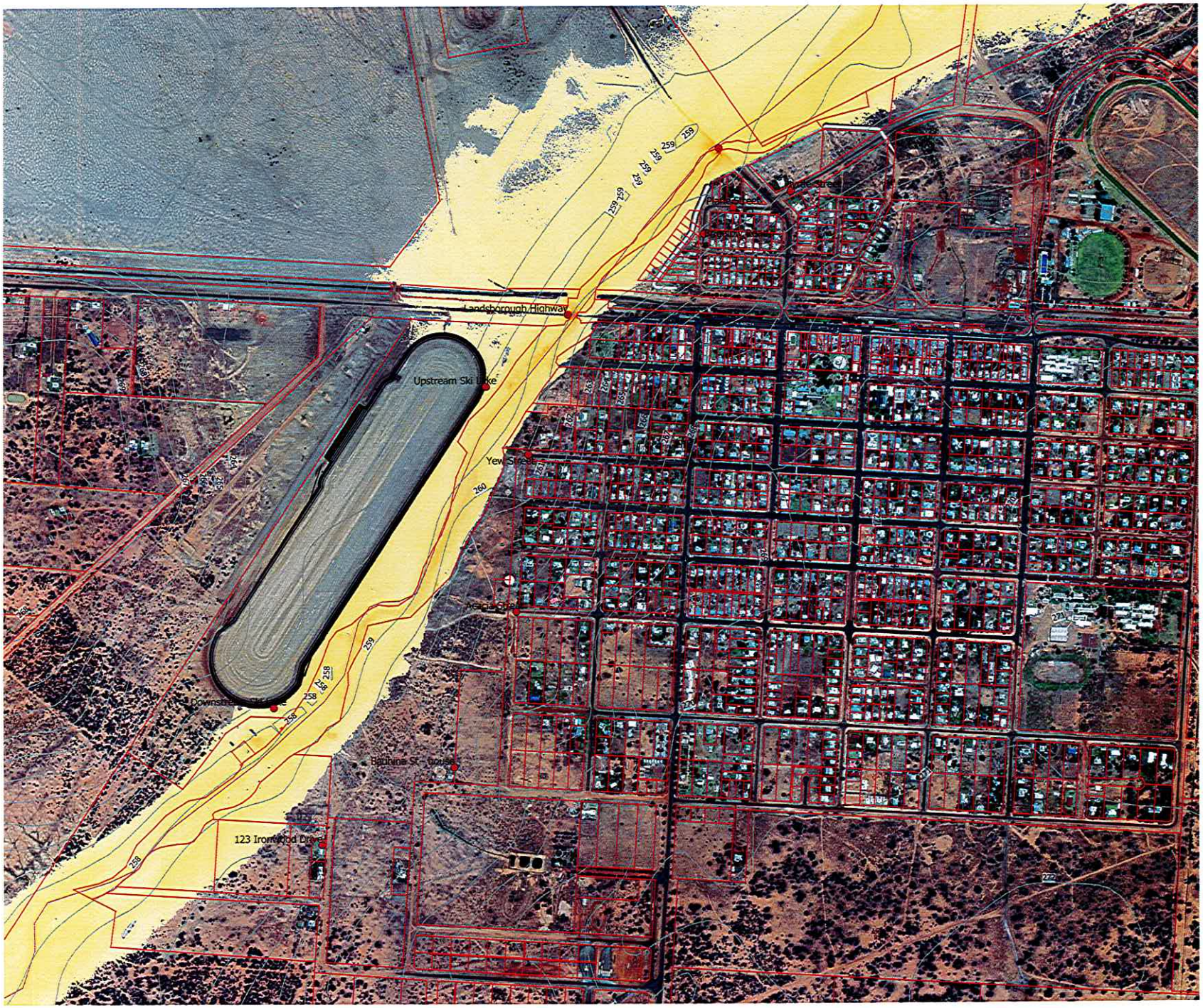

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Barcaldine Recreation Park Flood Impact Assessment

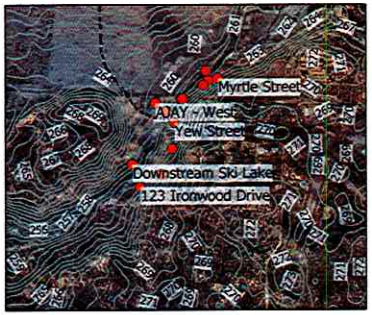
Figure 34 of 40.
Flood Innundation Mapping
Scenario 3 - 50% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



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Job ID: 190005
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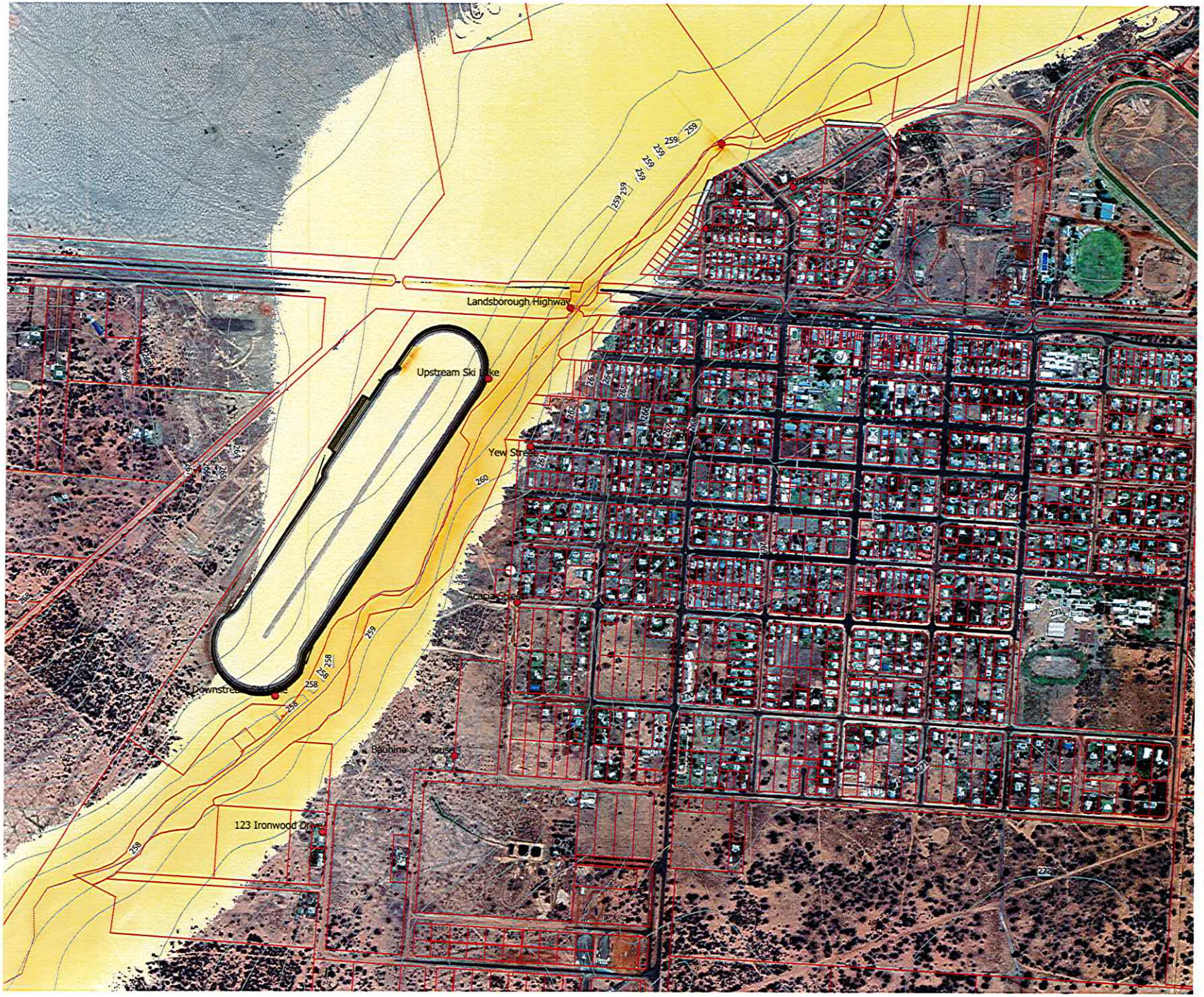
N

0 100 200 300 400 m



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Barcaldine Recreation Park Flood Impact Assessment

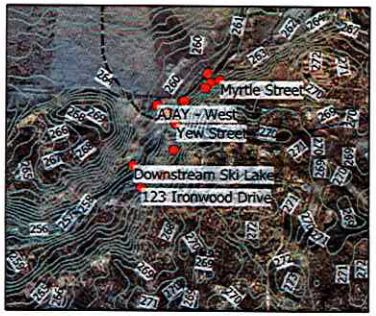
Figure 35 of 40.
Flood Innundation Mapping
Scenario 3 - 10% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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N

0 100 200 300 400 m

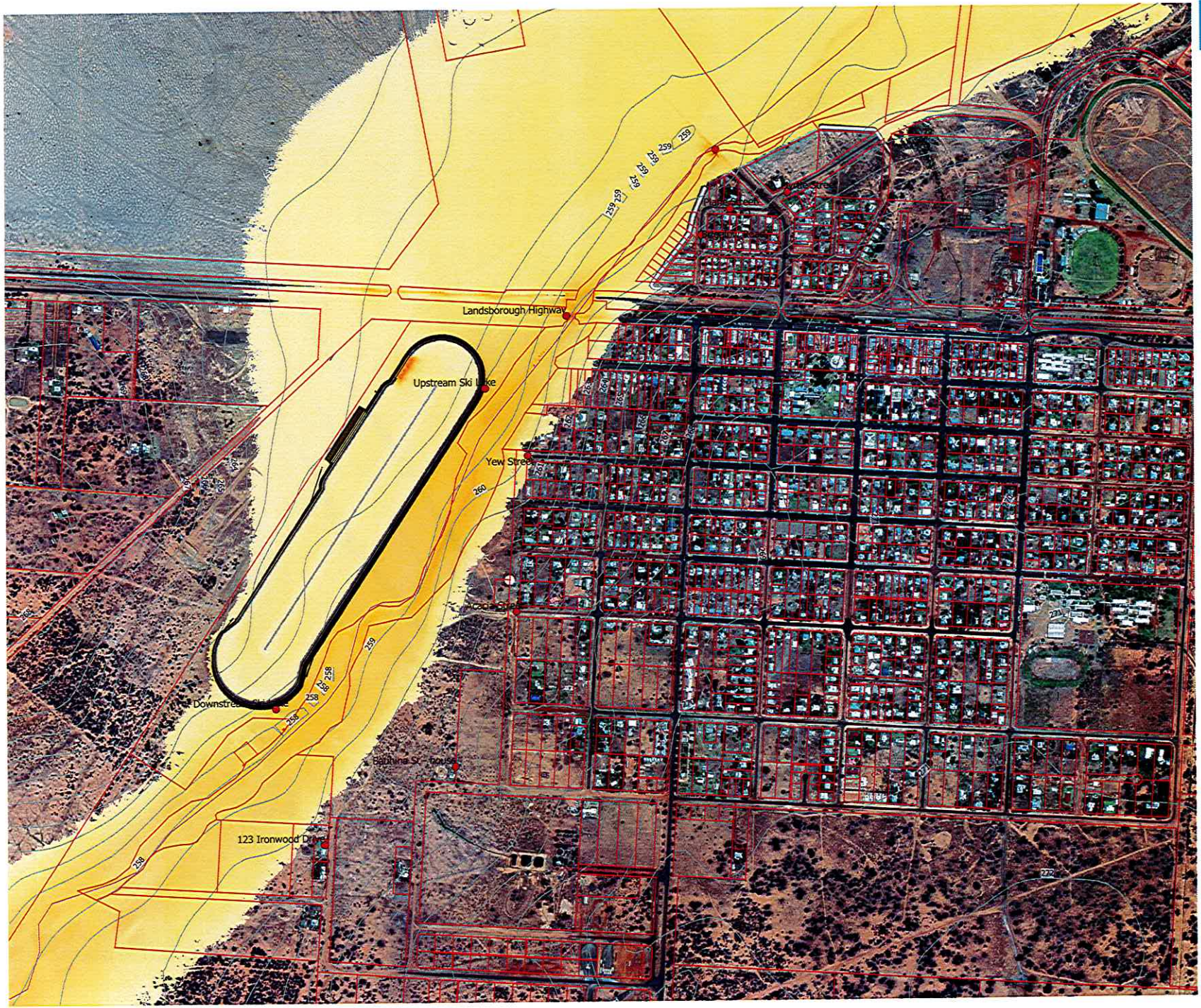

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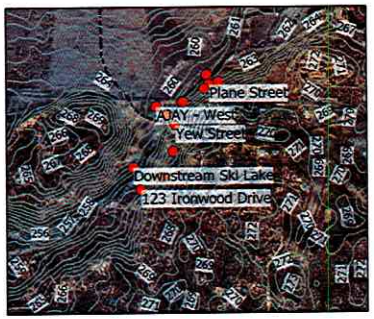
Figure 36 of 40.
Flood Innundation Mapping
Scenario 3 - 5% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



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N

0 100 200 300 400 m

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Barcaldine Recreation Park Flood Impact Assessment

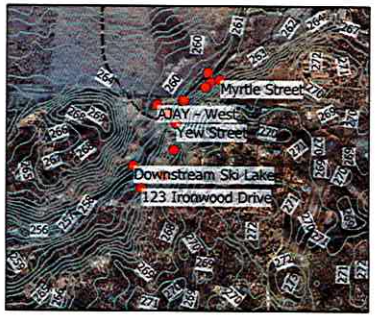
Figure 37 of 40.
Flood Innundation Mapping
Scenario 3 - 1% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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N

0 100 200 300 400 m

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Barcaldine Recreation Park Flood Impact Assessment

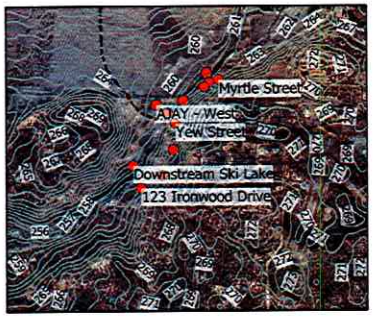
Figure 38 of 40.
Flood Innundation Mapping
Scenario 3 - 0.2% Aep Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
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N

0 100 200 300 400 m

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Barcaldine Recreation Park Flood Impact Assessment

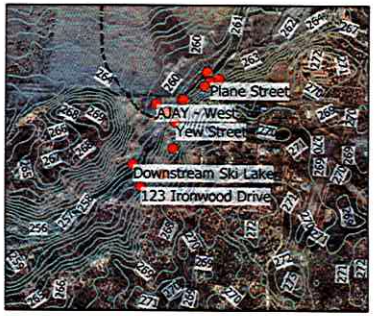
Figure 39 of 40.
Flood Innundation Mapping
Scenario 3 - Pmf Velocity

Legend

- SMK Design cont contour LineString
- Cadastral_data_LOTBDY
- Flood innundation_Critical Points-
- contour
- Surface HydroLines National

Velocity (Max) m/s

- 0
- 0.5
- 1
- 1.5
- 2
- 2.5
- 3
- 3.5
- 4
- 4.5
- 5
- 5.5
- 6



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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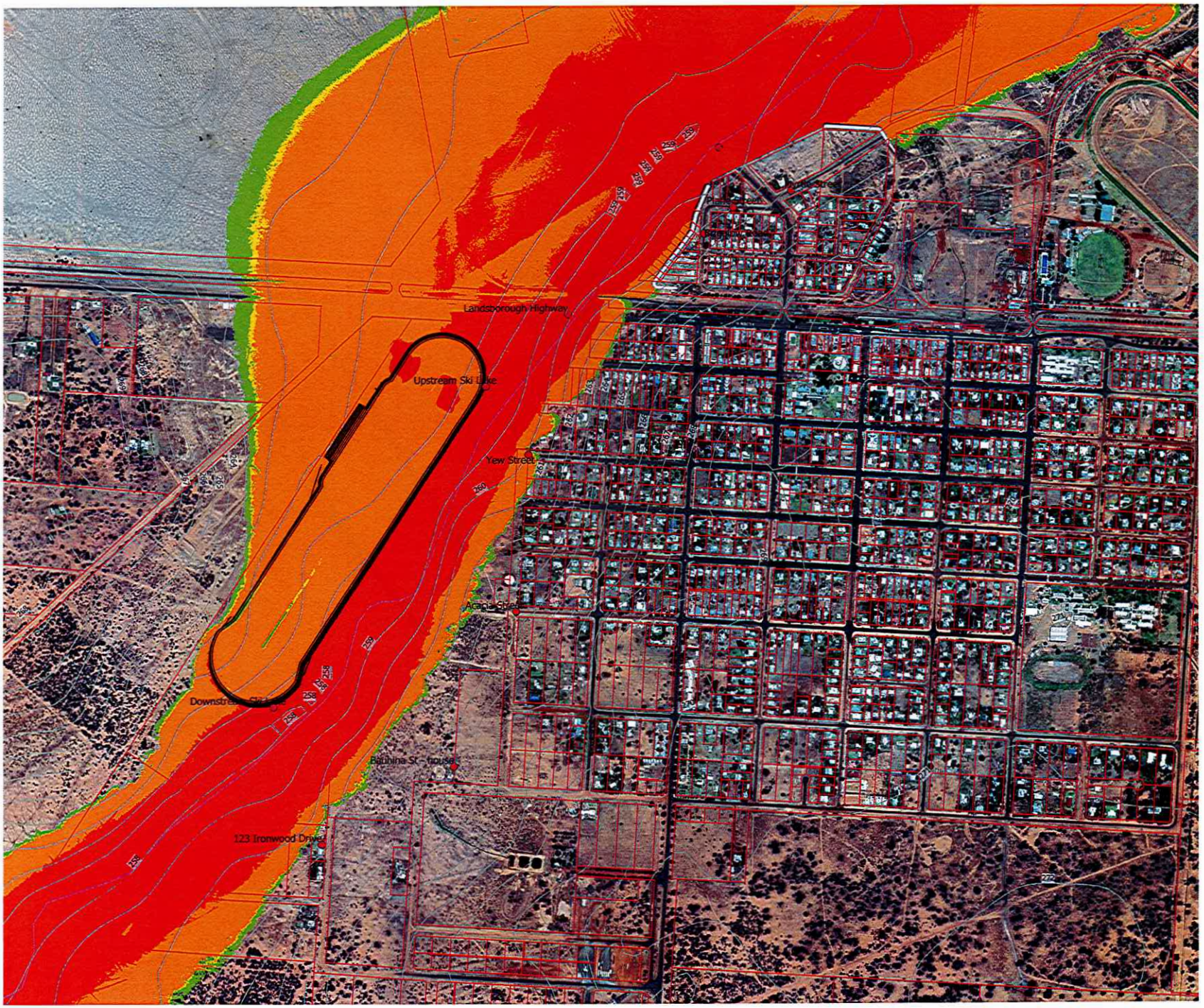
N

0 100 200 300 400 m



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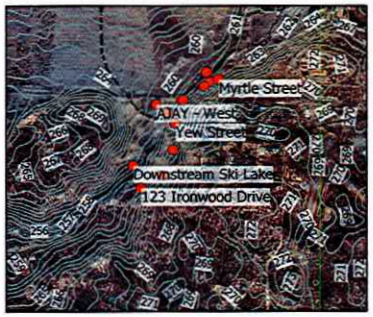
Barcaldine Recreation Park Flood Impact Assessment

Figure 40 of 40.
Flood Innundation Mapping
Scenario 3: 1% Aep D * V

Legend

- Cadastral_data_LOTBDY
- contour
- SMK Design cont contour LineString
- Flood innundation_Critical Points-
- Surface HydroLines National
- LOW (<0.6)
- SIGNIFICANT (0.6 to <0.8)
- HIGH (0.8 to <1.2)
- EXTREME (>1.2)



A3 Scale: 1:10000
GDA 1994 / MGA Zone 55

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N

0 100 200 300 400 m

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Levee Operations and Maintenance Manual

Project Name: Barcaldine Flood Mitigation

Prepared for: Barcaldine Regional Council

ACS Engineers

18 August 2020

ACS Project 190005

ACS Engineers
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Document Control:-

Rev No.	Author	Reviewed	Approved		Description	Date
	Name	Name	Name	Signature		
1	Darcy Stevenson	Susan Shay	Susan Shay		Draft	27/07/2020
2	Darcy Stevenson	Susan Shay	Susan Shay		Final	18/08/2020

Notes:

Revision 1 Draft for client review
Revision 2 Final issue

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1. Introduction

Barcaldine Regional Council have obtained approval for a recreational ski park. The proposed recreation park is to be located immediately to the east of the township of Barcaldine and situated within the Lagoon Creek flood impact zone. Lagoon Creek (proper) is within 50 m of the proposed ski lake extents and approximately 15 km upstream of the confluence with the Alice River. Both the Alice River and Lagoon Creek are ephemeral however sub-surface flow continues through much of the year.

Figure 1: Ski Park Location

2. Flood Modelling

ACS Engineers were engaged to undertake flood modelling to ascertain the impact on flood levels caused by the introduction of the recreation park. Refer to report *Barcaldine Flood Hazard Assessment Study* (ACS Engineers, 2020).

The study found that there is an increase in flood extent due to the introduction of the ski park and that mitigation measures were required to mitigate the flood hazard risk to nearby properties.

3. Flood Protection

To mitigate the increase in flood levels a flood levee has been proposed to be installed between the floodplain and nearby properties. Flood modelling suggests that the levee has been designed to a 1% Average Exceedance Probablity (AEP) event (this is a 1% chance each year that this flood event will occur). Under the 1% AEP event, the flood modelling shows the levee has a minimum freeboard of approximately 500 mm.

Minor flooding may occur under the 0.2% AEP event (this is a 0.2% chance each year that this flood event will occur) and under the Probable Maximum Flood (PMF) event the levee is submerged and houses in Barcaldine will flood.

Multiple alignments have been designed for the flood levee, and the final solution is to be determined by Barcaldine Regional Council. For illustrative purposes, Option B levee alignment is provided in Figure 2 below.

This alignment shows earthen walls on either side of Barcaldine-Aramac Road (460 m length on the southern side and 460 m on the northern side). The removable levee across Barcaldine-Aramac Road is proposed to be stockpiled fill pushed into place in the event of a potential flood.

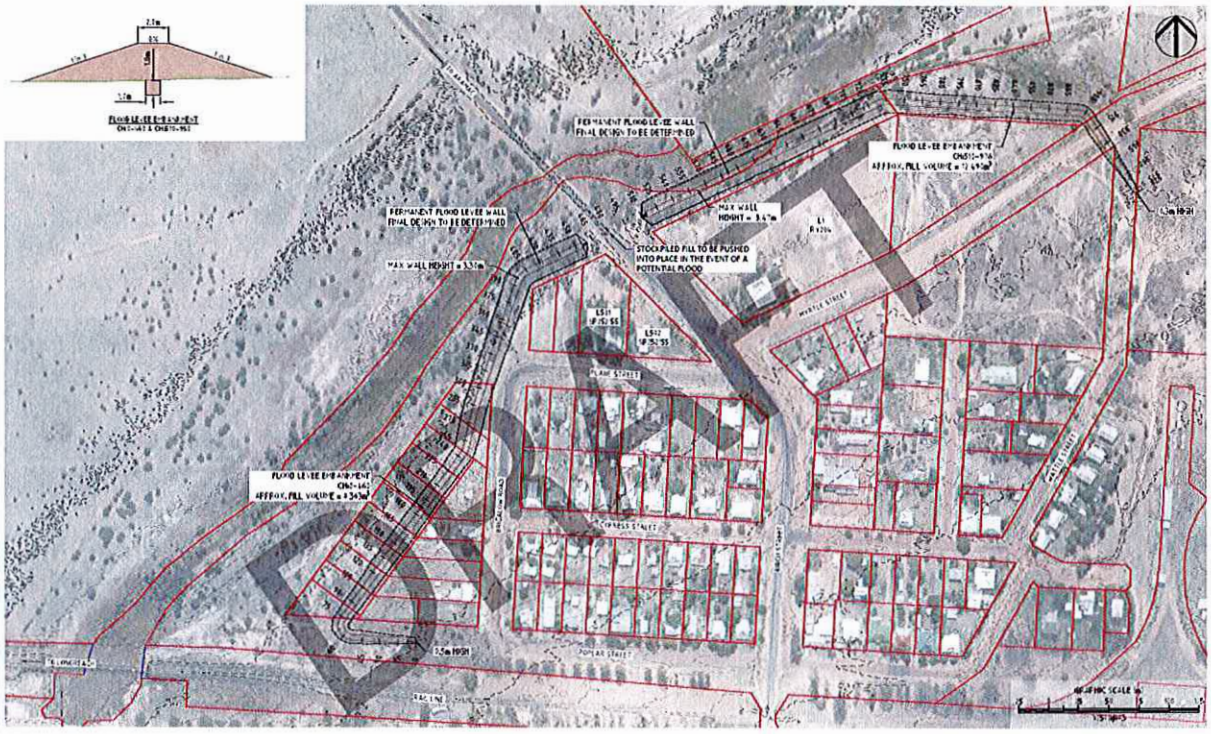

Figure 2: Option B Flood Levee Alignment

4. Levee Structure

4.1. Permanent Earth Embankment

The levee will be a predominantly earthen embankment with the following general dimensions:

- Height – 0.5 m to 3.5 m
- Crest width – 2 m
- Side slopes: 1 in 3

The levee will also have a 1 m x 1 m key into natural ground to act as a footing. See Figure 3 for general shape.

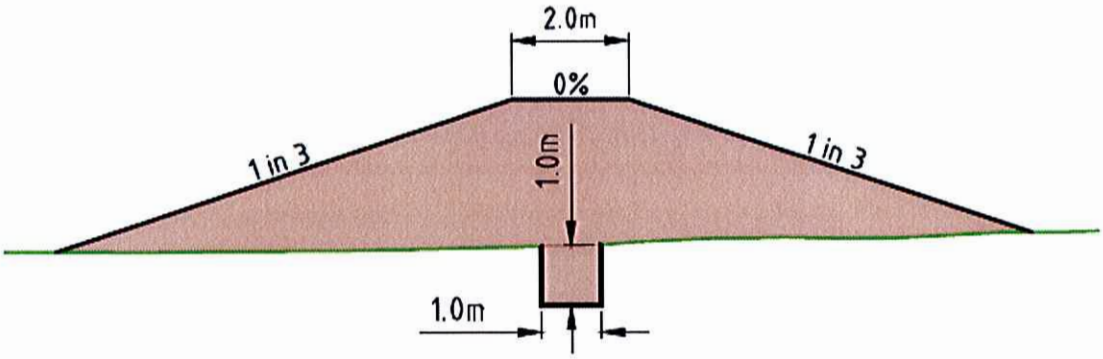

Figure 3: General Shape of Earthen Embankment

4.2. Removable levee

The section of levee across Barcaldine-Aramac road is proposed to be built up from stockpiled fill from the local area prior to the occurrence of a flood event. The fill is then removed after the flood event to reopen the road. It is presumed the fill will be placed in the same dimensions as the permanent earthen levee.

4.3. Internal Drainage

The flood model shows no flood waters can enter the protected area of town in a 1% AEP event, either by surrounding the levee or by overtopping it. However the proposed levee will restrict stormwater that falls over the protected area of the township from draining to the usual outlet of Lagoon Creek. Any water collected on the dry side of the levee will discharge via an outlet pipe installed through the levee. The outlet pipe will include a one-way flood valve to ensure backflow of flood waters through the pipe will not occur.

5. Operational Procedures

The removable section of the flood levee is to be open:

- At all times other than flood events
- After the flood has subsided and there is no risk of a reoccurrence

The removable section of the flood levee is to be closed:

- When there is a flood event imminent and the external water level is expected to reach the base of the earthen levee.

Fill to be used for the removable section of the levee is to be stockpiled above the 1% AEP flood extent and Council must ensure there is adequate access to the stockpile in a flood event.