

APPENDIX

INLAND
RAIL 

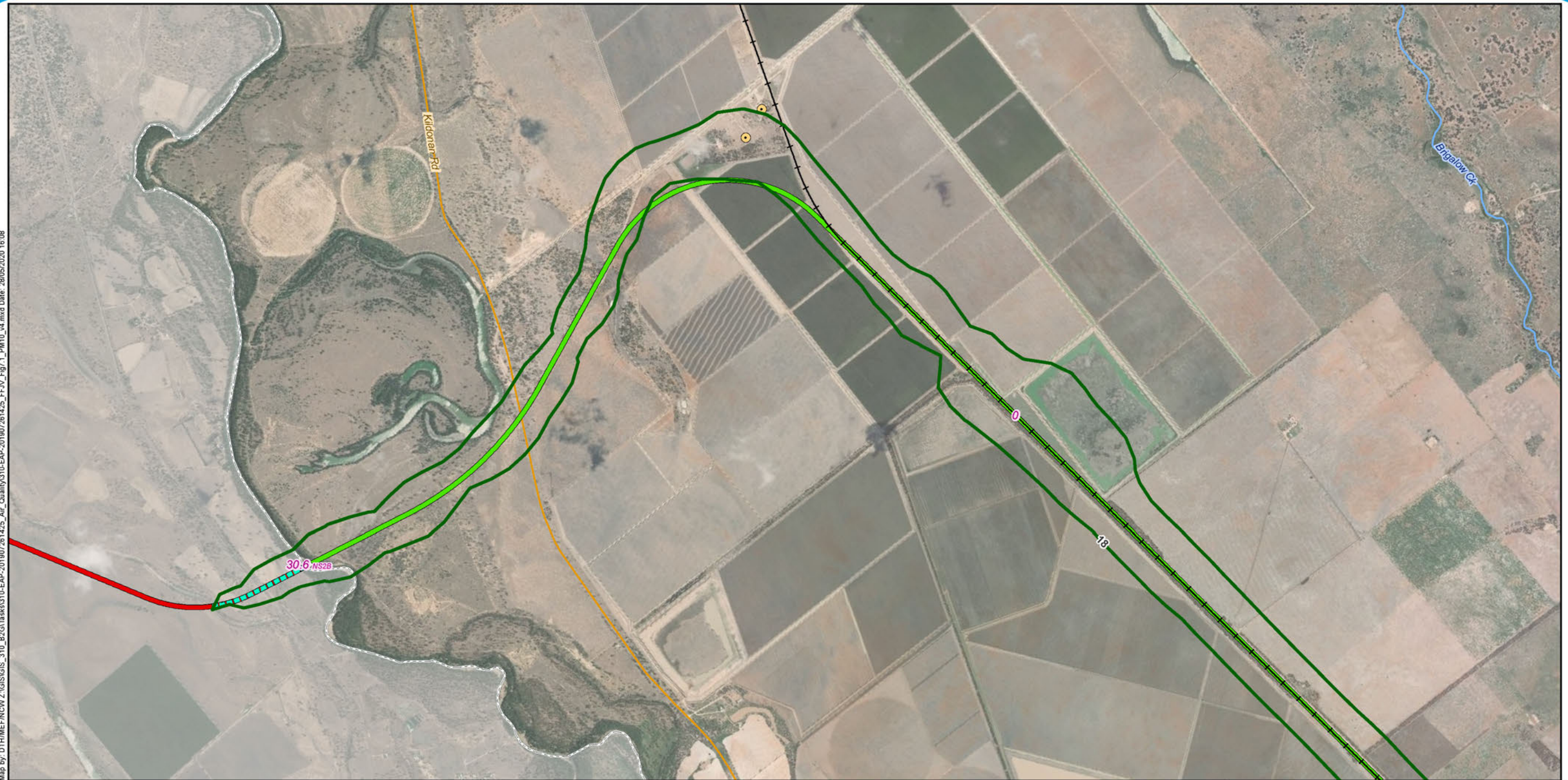
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Air Quality Technical Report

Part 2 of 3

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\V_Fig7.1_PMI0_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- 5 Chainage (km)
- ▬▬▬ Cumulative rail sources
- ▬ North Star to NSW/QLD border alignment
- ▬ Border to Gowrie alignment
- +—+—+ Existing rail (operational)
- ▬ Minor roads
- ▬ Watercourses
- - - NSW/QLD border

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- ▬ 18
- ▬ 20
- ▬ 25
- ▬ 30
- ▬ 40
- ▬ 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km



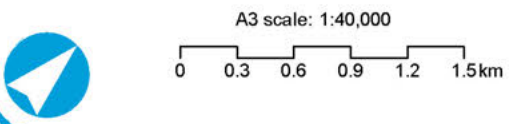
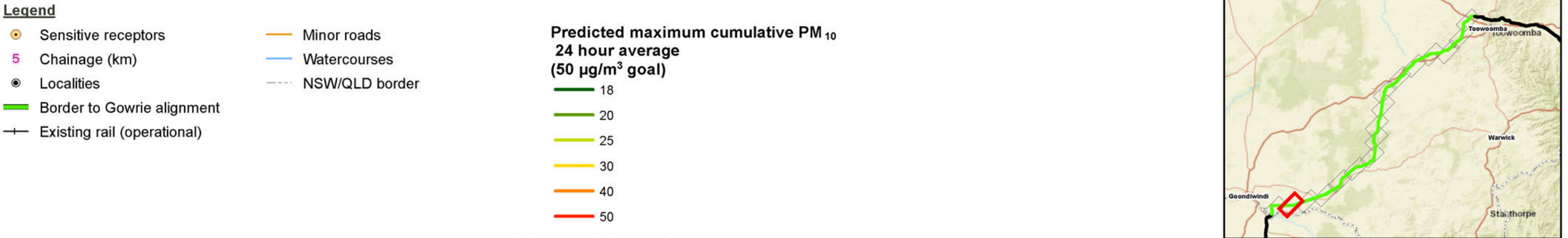
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 Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 7.1a:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot



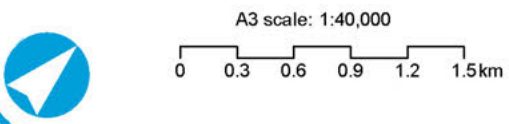


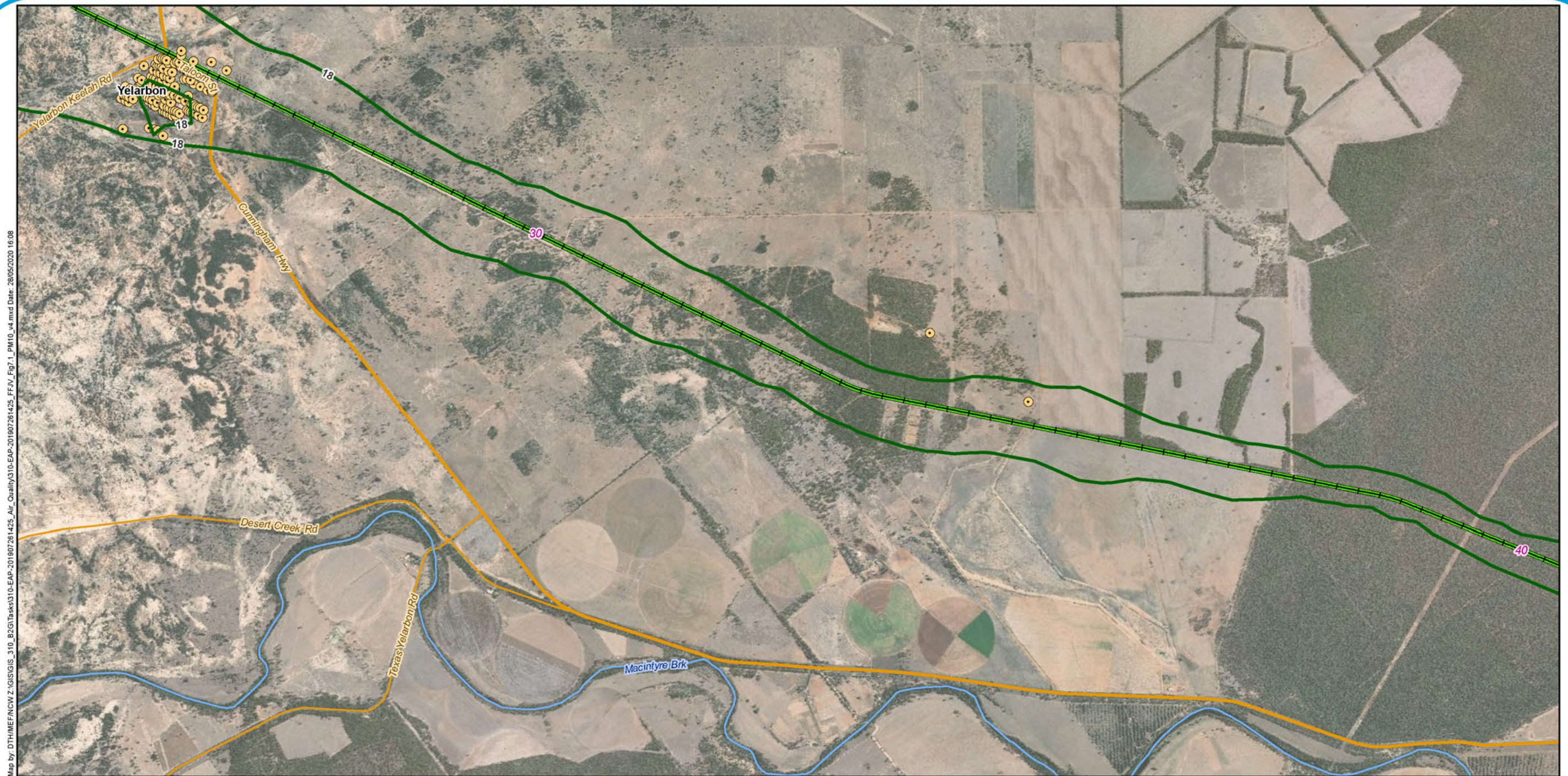
Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- NSW/QLD border

**Predicted maximum cumulative PM₁₀
 24 hour average
 (50 µg/m³ goal)**

- 18
- 20
- 25
- 30
- 40
- 50





Legend

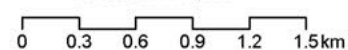
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000



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Border to Gowrie

Figure 7.1d:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\AV_Fig7.1_PMI10_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- 5 Chainage (km)
- Crossing loops
- Border to Gowrie alignment
- +— Existing rail (operational)
- Major roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.1e:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot

Map by: D:\HME\FN\CW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\FF_V_Fig7.1_PMI10_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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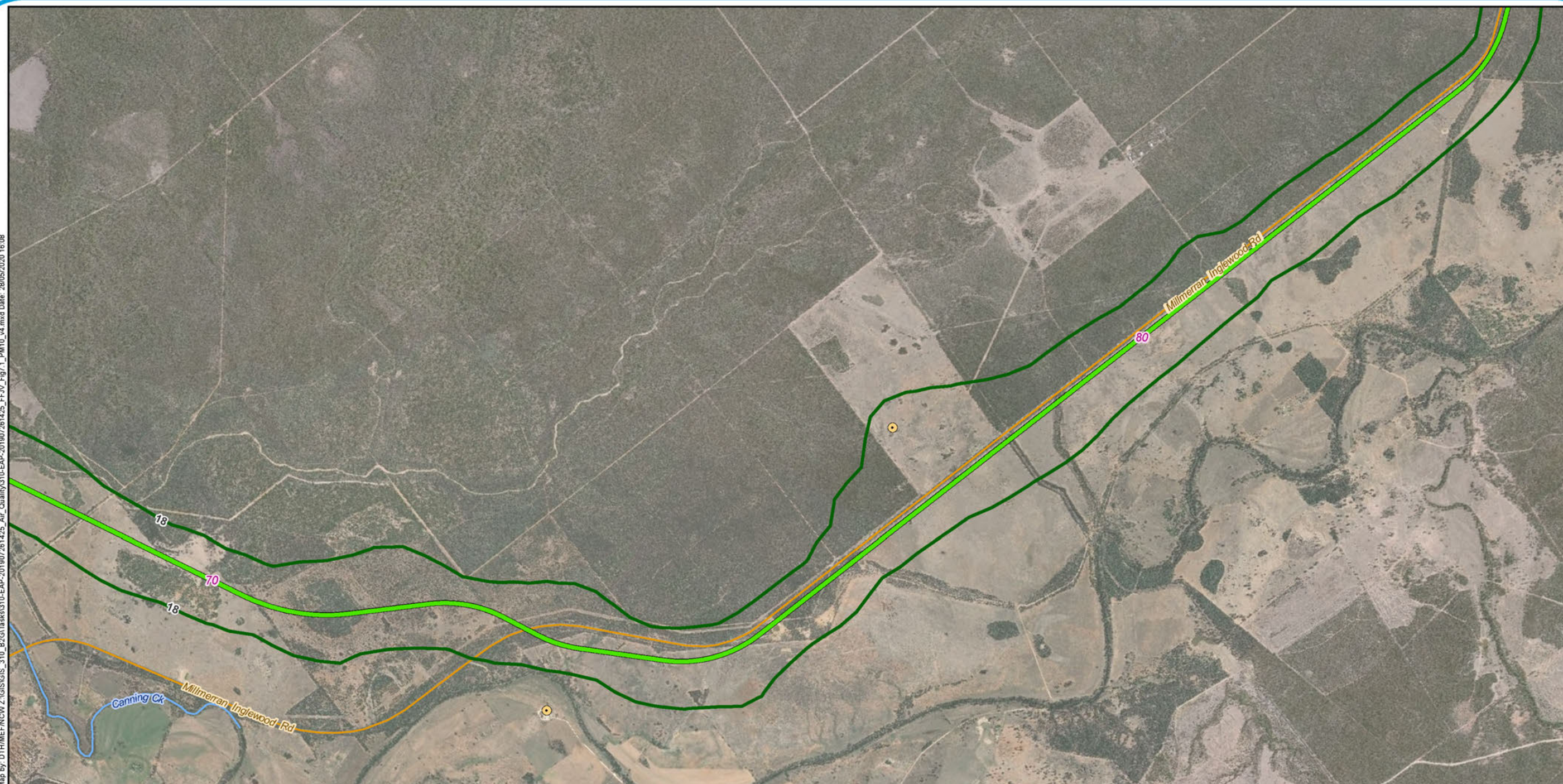
Issue date: 29/05/2020 Version: 1
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Border to Gowrie

Figure 7.1f:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot

Map by: D:\HME\FAC\WZ\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\FF_V_Fig7.1_PMI10_v4.mxd Date: 28/05/2020 16:08

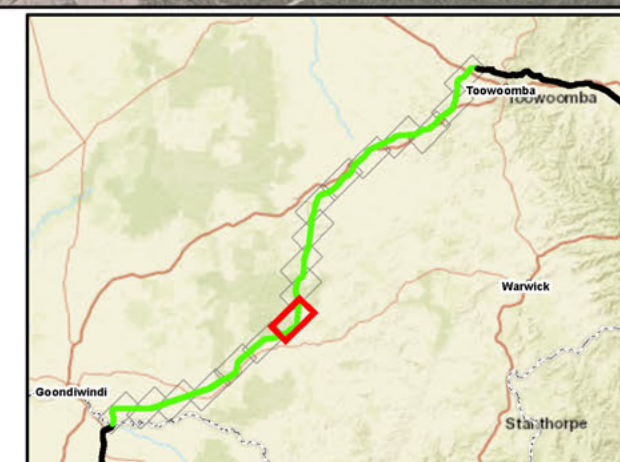


Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.1g:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\IV_Fig7.1_PMI0_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- Minor roads
- 5 Chainage (km)
- Crossing loops
- Border to Gowrie alignment

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.1h:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\IV_Fig7.1_PMI10_v4.mxd Date: 29/05/2020 16:08



Legend

- Sensitive receptors
- Minor roads
- 5 Chainage (km)
- Border to Gowrie alignment

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



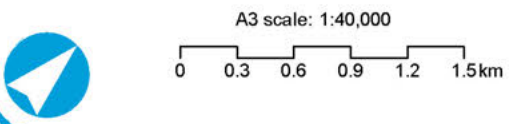
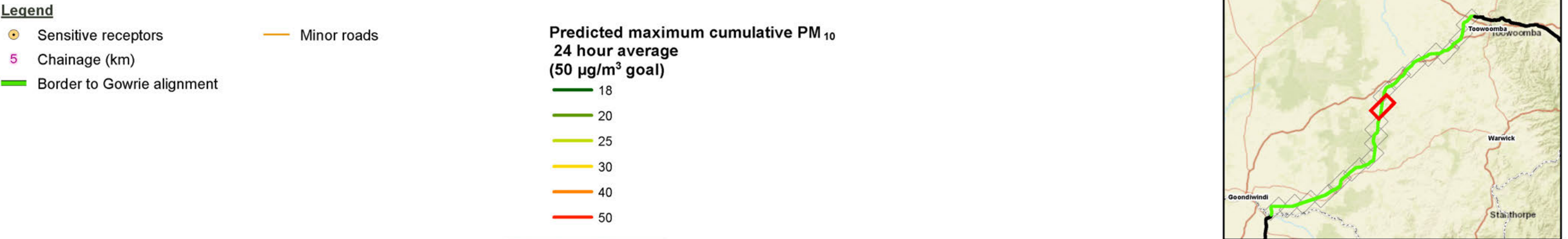
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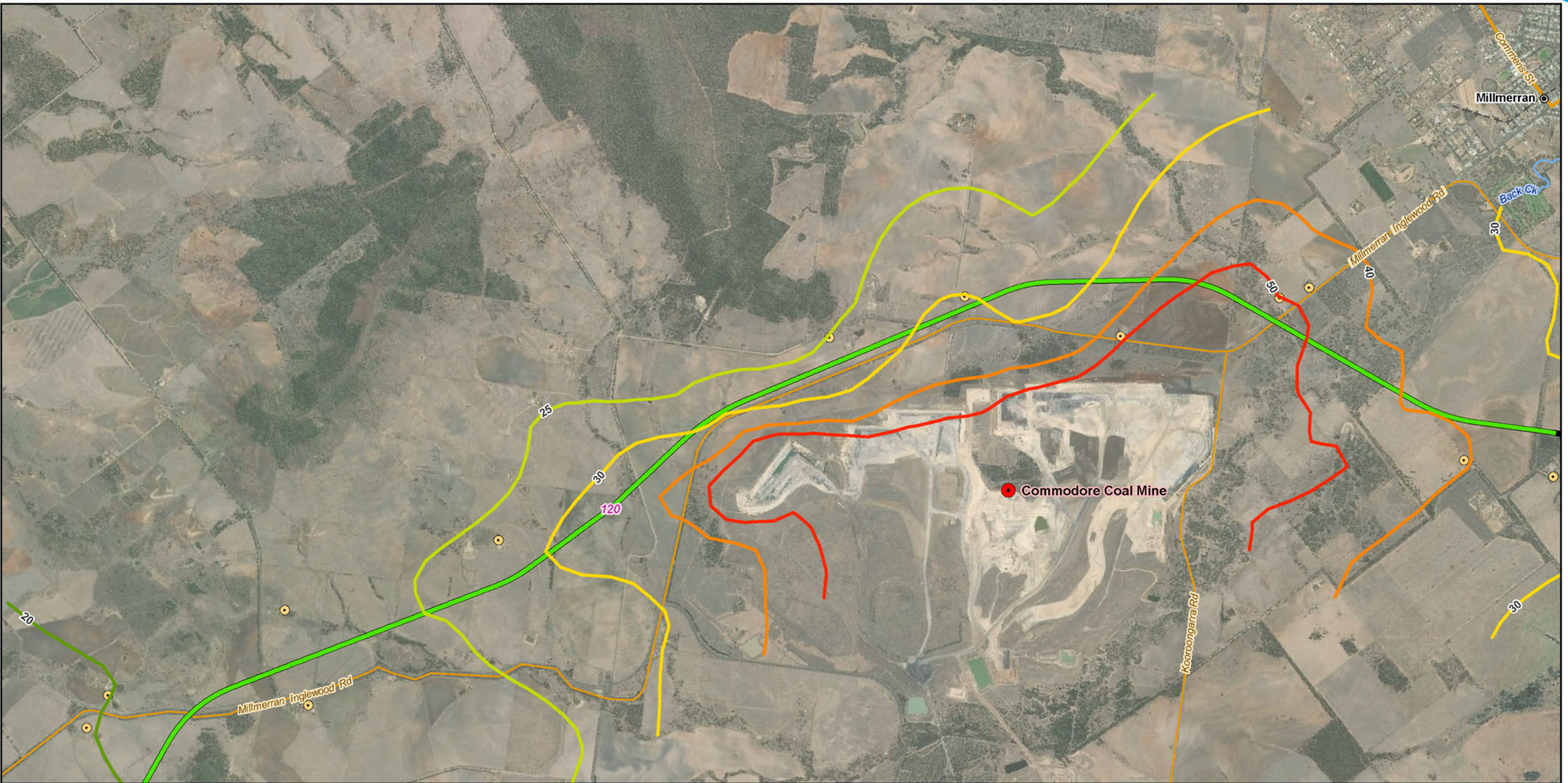
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Border to Gowrie

Figure 7.1i:

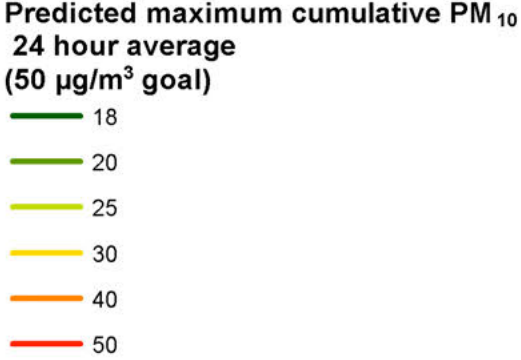
Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot



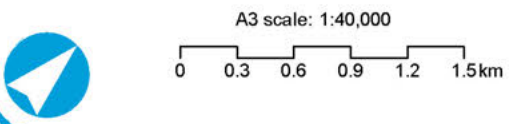
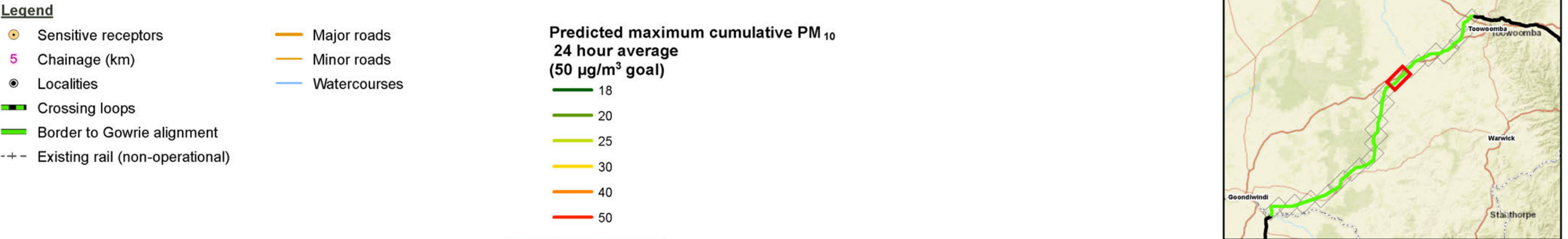


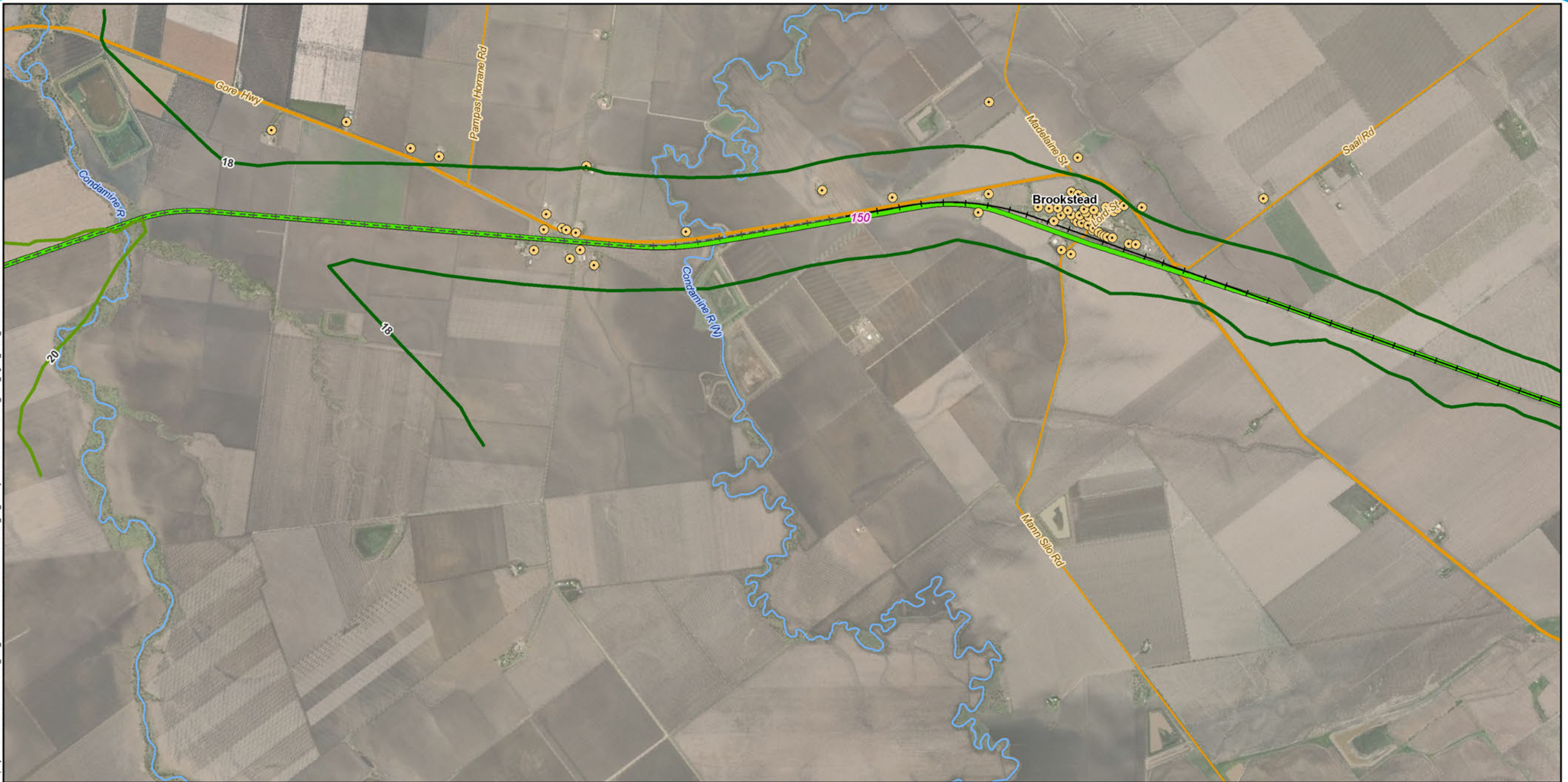
Legend

- Existing emission source
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses



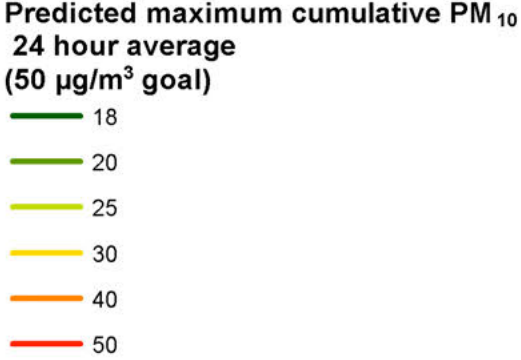
A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km





Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses





Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- +— Existing rail (operational)
- Major roads
- Minor roads

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.1n:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot



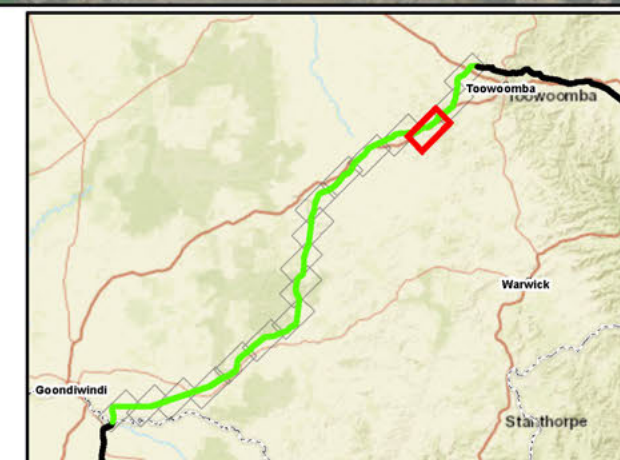
Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)

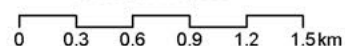
- Major roads
- Minor roads

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000



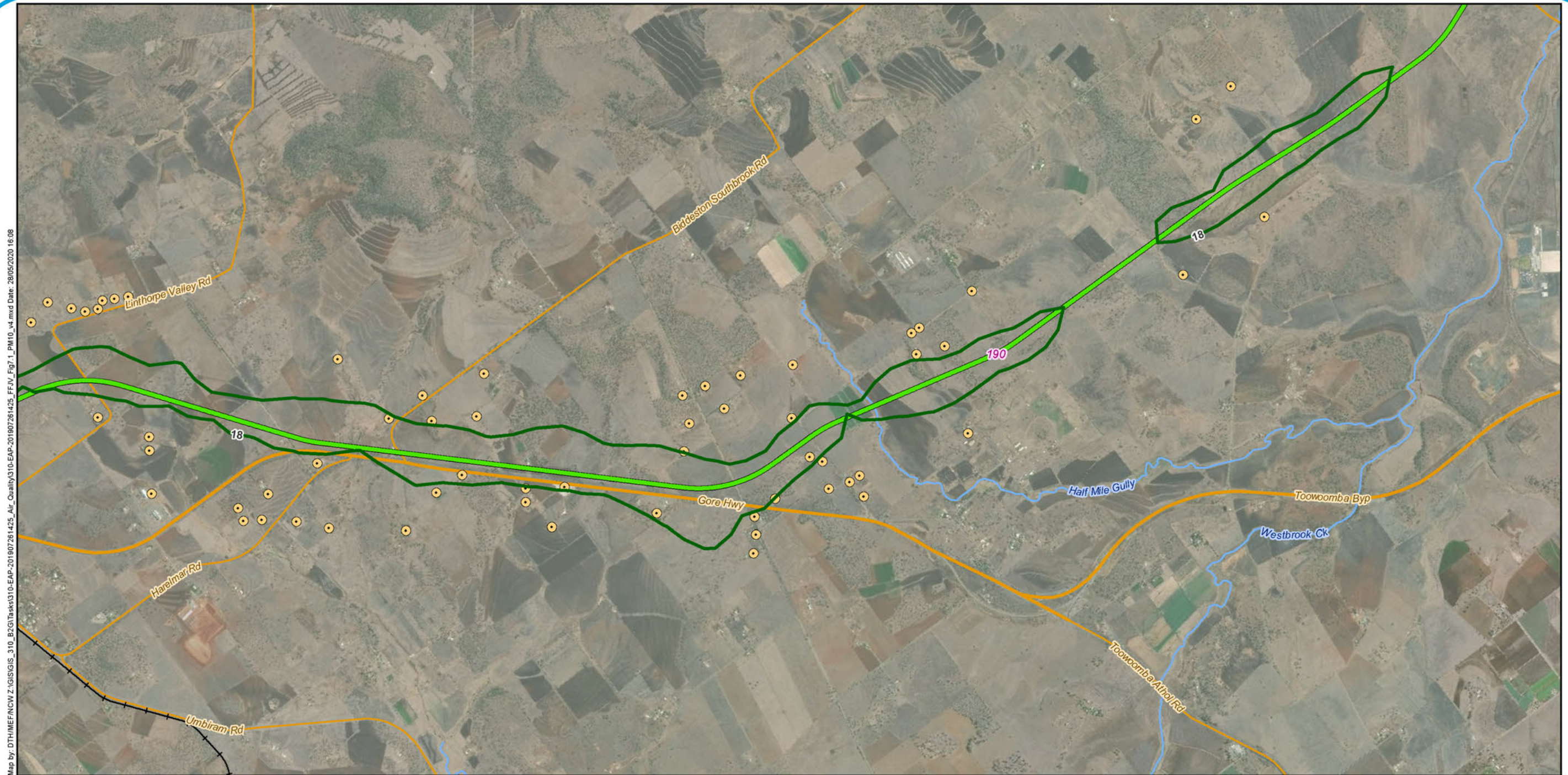
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Border to Gowrie

Figure 7.1o:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot



Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



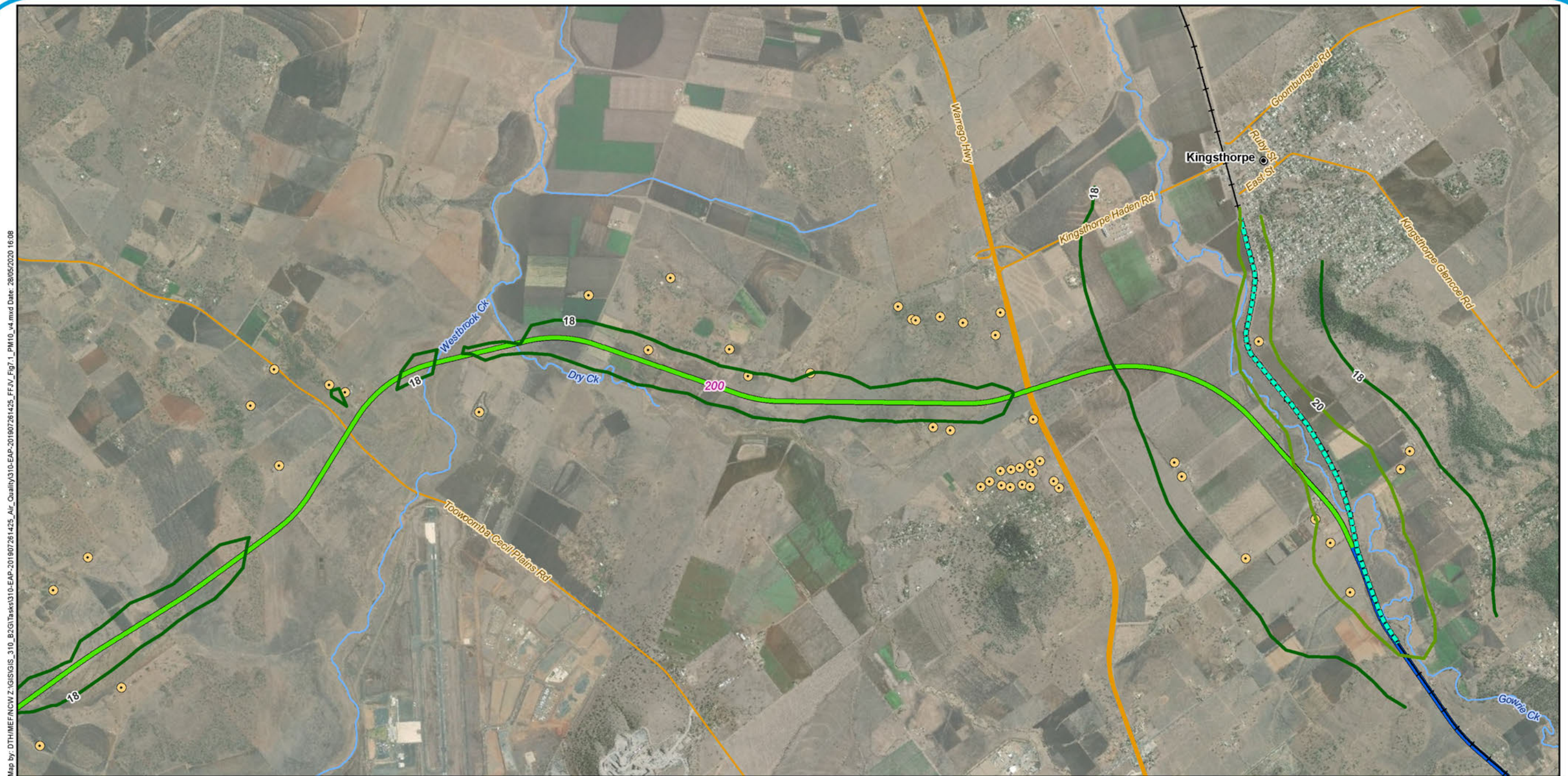
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Border to Gowrie

Figure 7.1p:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot



Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Cumulative rail sources
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30
- 40
- 50



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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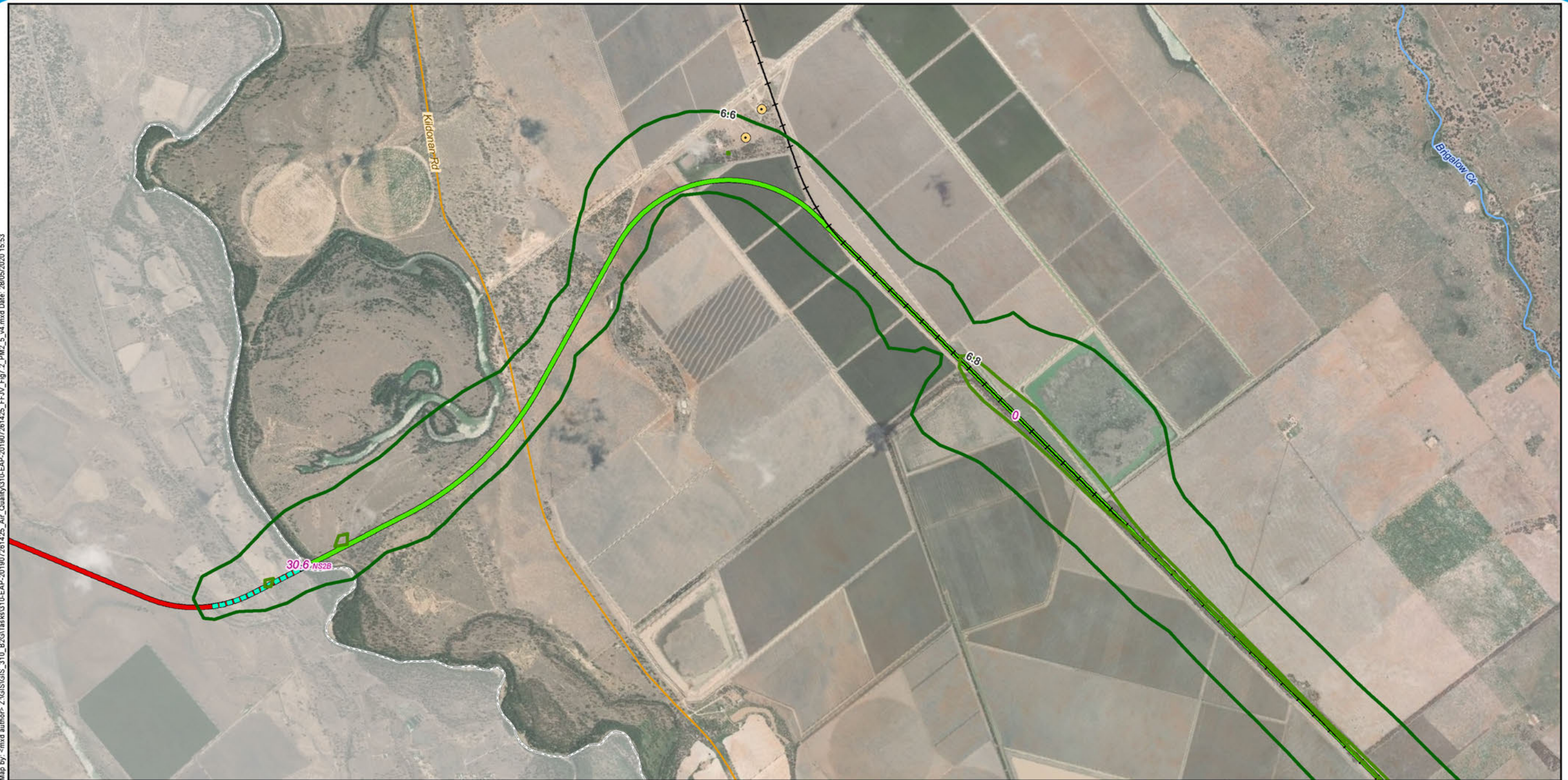
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Border to Gowrie

Figure 7.1q:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FFIV_Fig7_2_PM2.5_v4.mxd Date: 28/05/2020 15:53



Legend

- Sensitive receptors
- Chainage (km)
- - - Cumulative rail sources
- North Star to NSW/QLD border alignment
- Border to Gowrie alignment
- + + + Existing rail (operational)

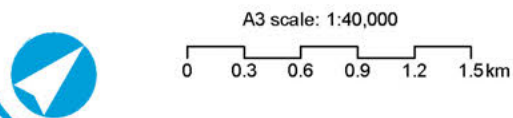
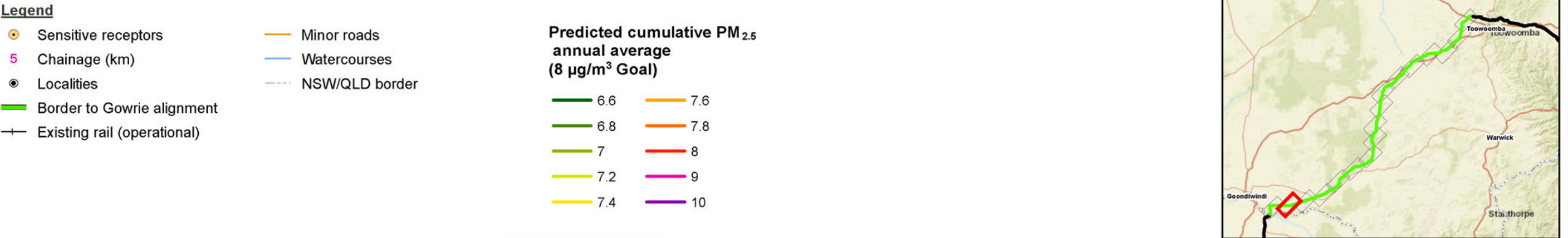
- Minor roads
- Watercourses
- - - NSW/QLD border

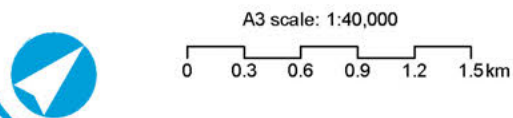
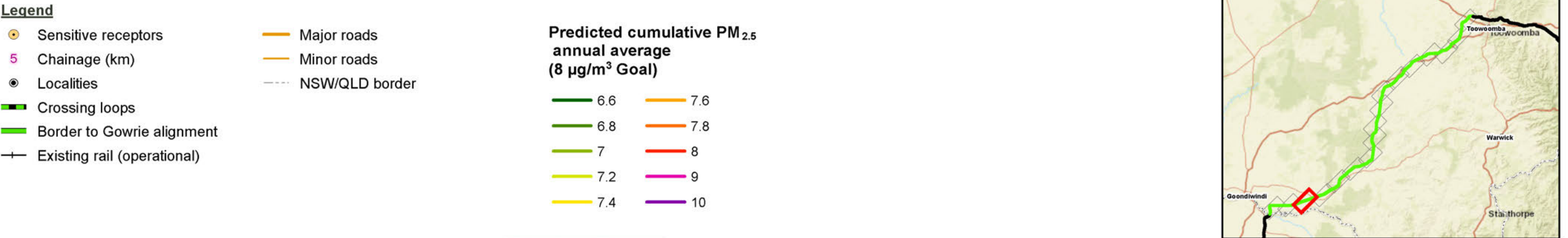
Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

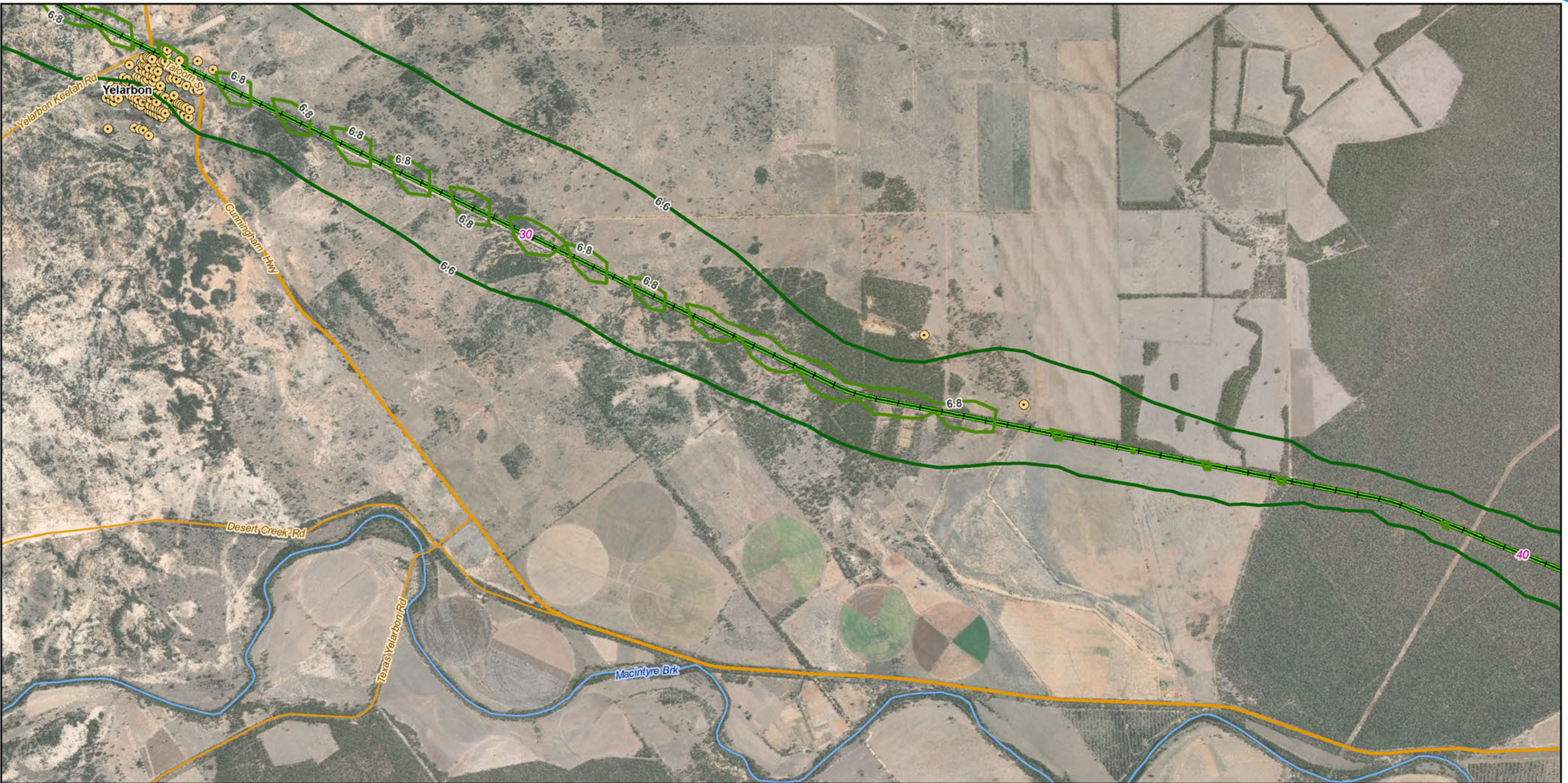
- | | |
|--|--|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7.0 | — 8.0 |
| — 7.2 | — 9.0 |
| — 7.4 | — 10.0 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km







Legend

- Sensitive receptors
- Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

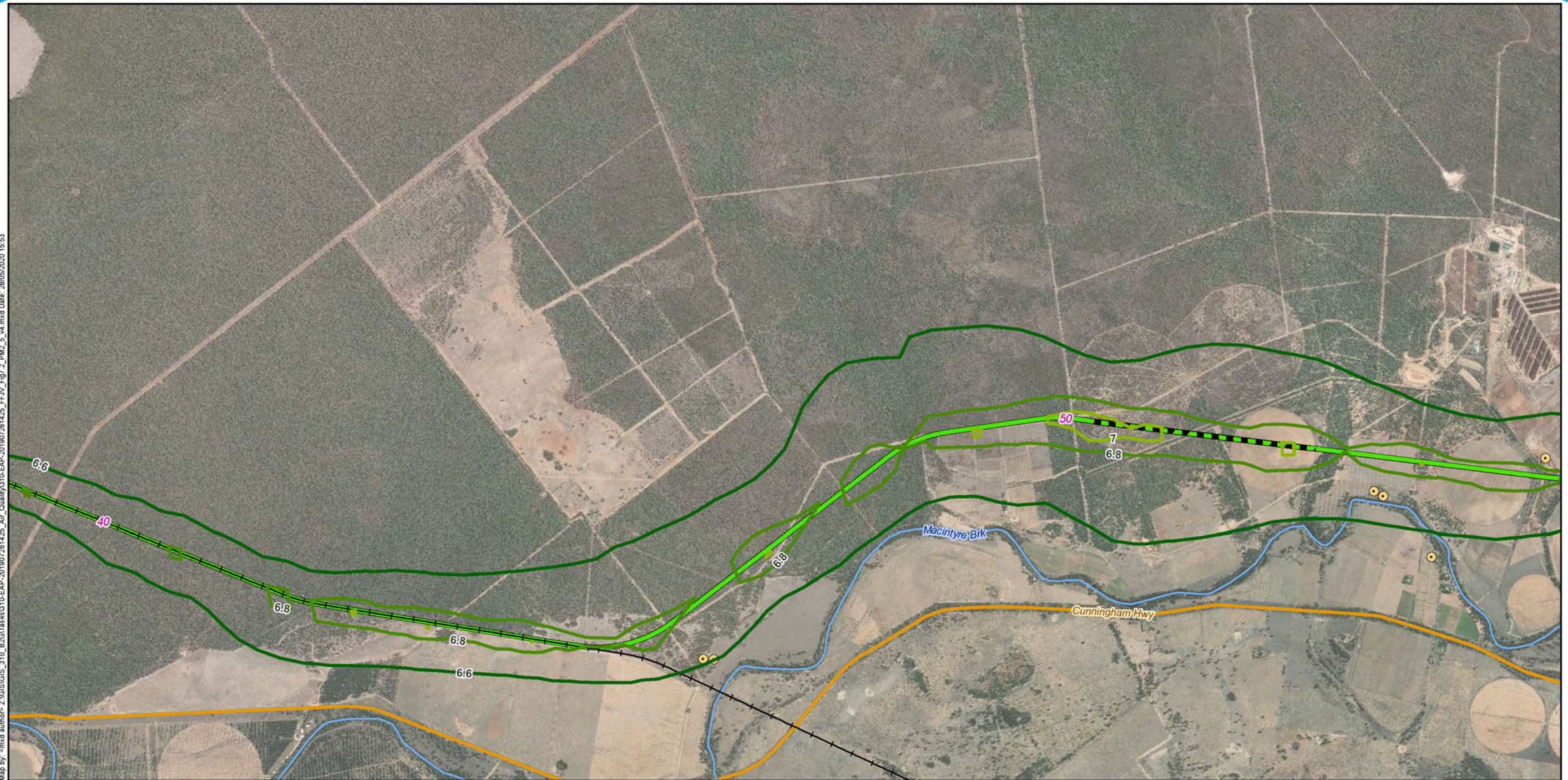
Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|---|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_2_PM2.5_v4.mxd Date: 28/05/2020 15:53



Legend

- Sensitive receptors
- 5 Chainage (km)
- Crossing loops
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|--|---|
| --- 6.6 | --- 7.6 |
| --- 6.8 | --- 7.8 |
| --- 7 | --- 8 |
| --- 7.2 | --- 9 |
| --- 7.4 | --- 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



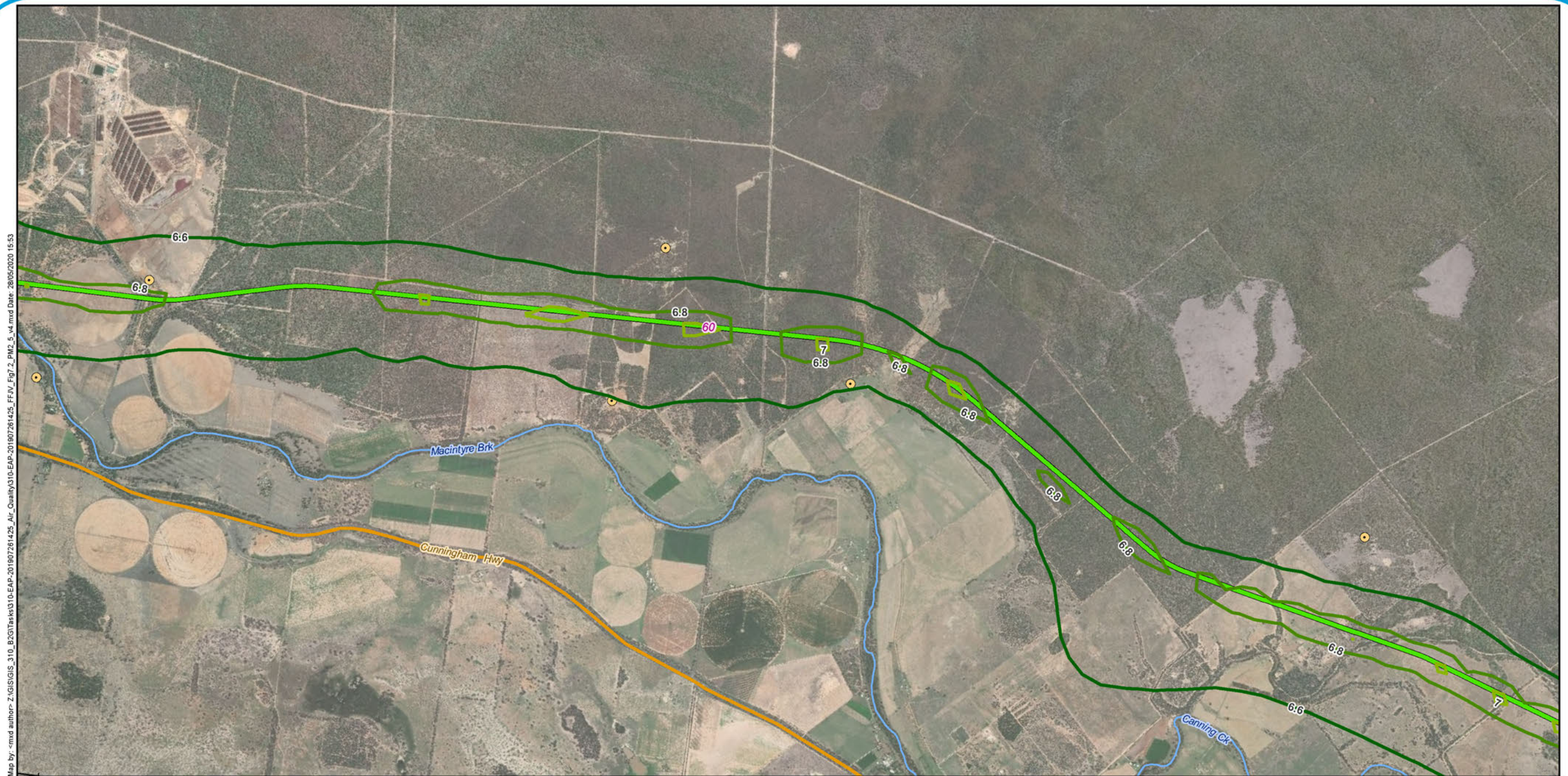
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Border to Gowrie

Figure 7.2e:

Predicted cumulative PM_{2.5} annual average ground level concentration plot



Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- Major roads
- Watercourses
- + Existing rail (operational)

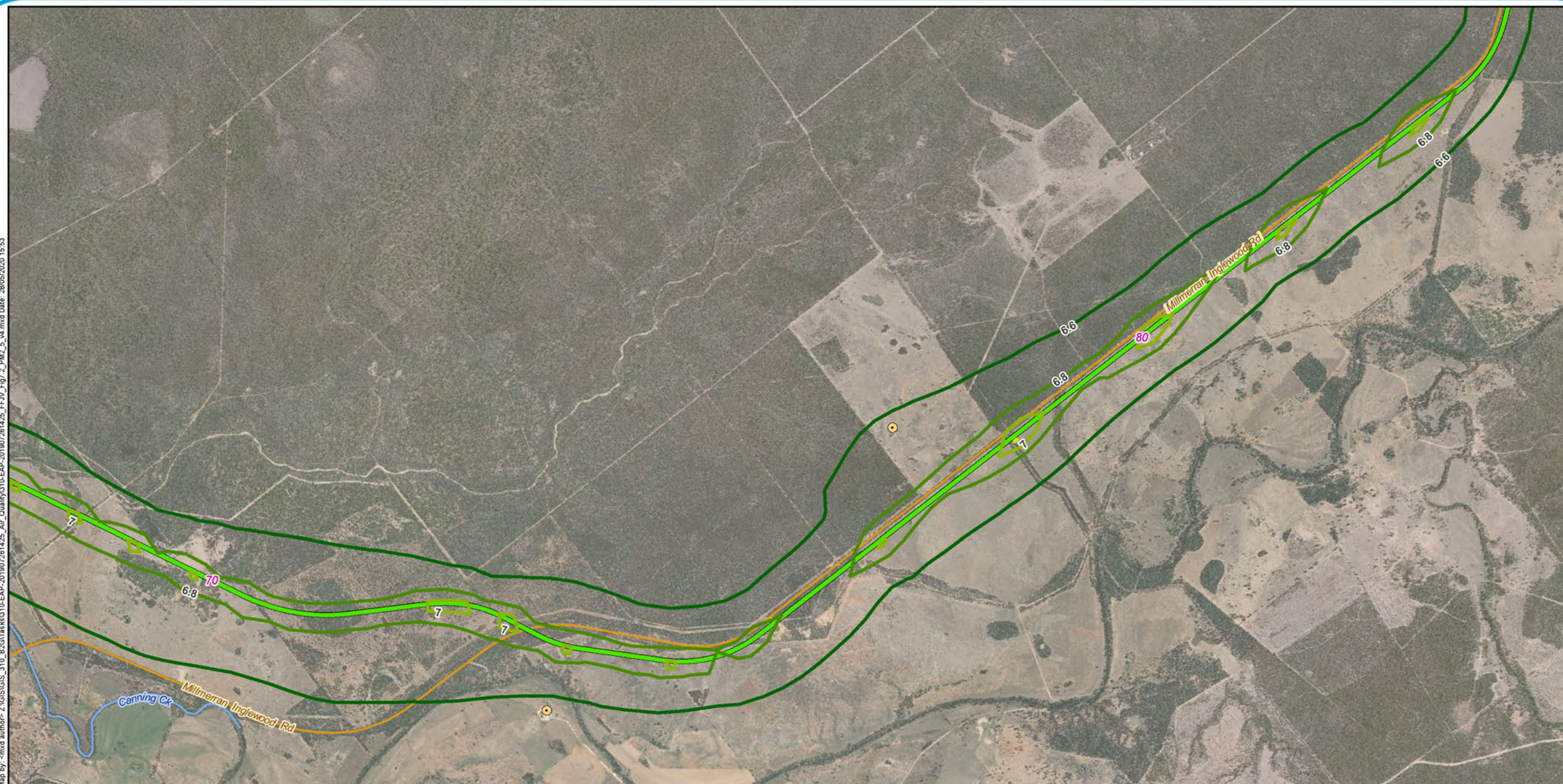
Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|--|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km

Map by: <md author: Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FFIV_Fig7_2_PM2_5_v4.mxd Date: 28/05/2020 15:53

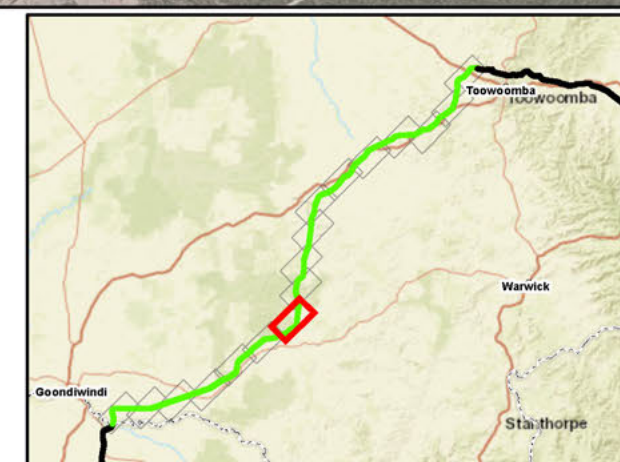


Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

6.6	7.6
6.8	7.8
7	8
7.2	9
7.4	10



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



Legend

- Sensitive receptors
- Minor roads
- 5 Chainage (km)
- Crossing loops
- Border to Gowrie alignment

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|--|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.2h:

Predicted cumulative PM_{2.5} annual average ground level concentration plot

Map by: <msd author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FFIV_Fig7_2_PM2.5_v4.mxd Date: 28/05/2020 15:53



Legend

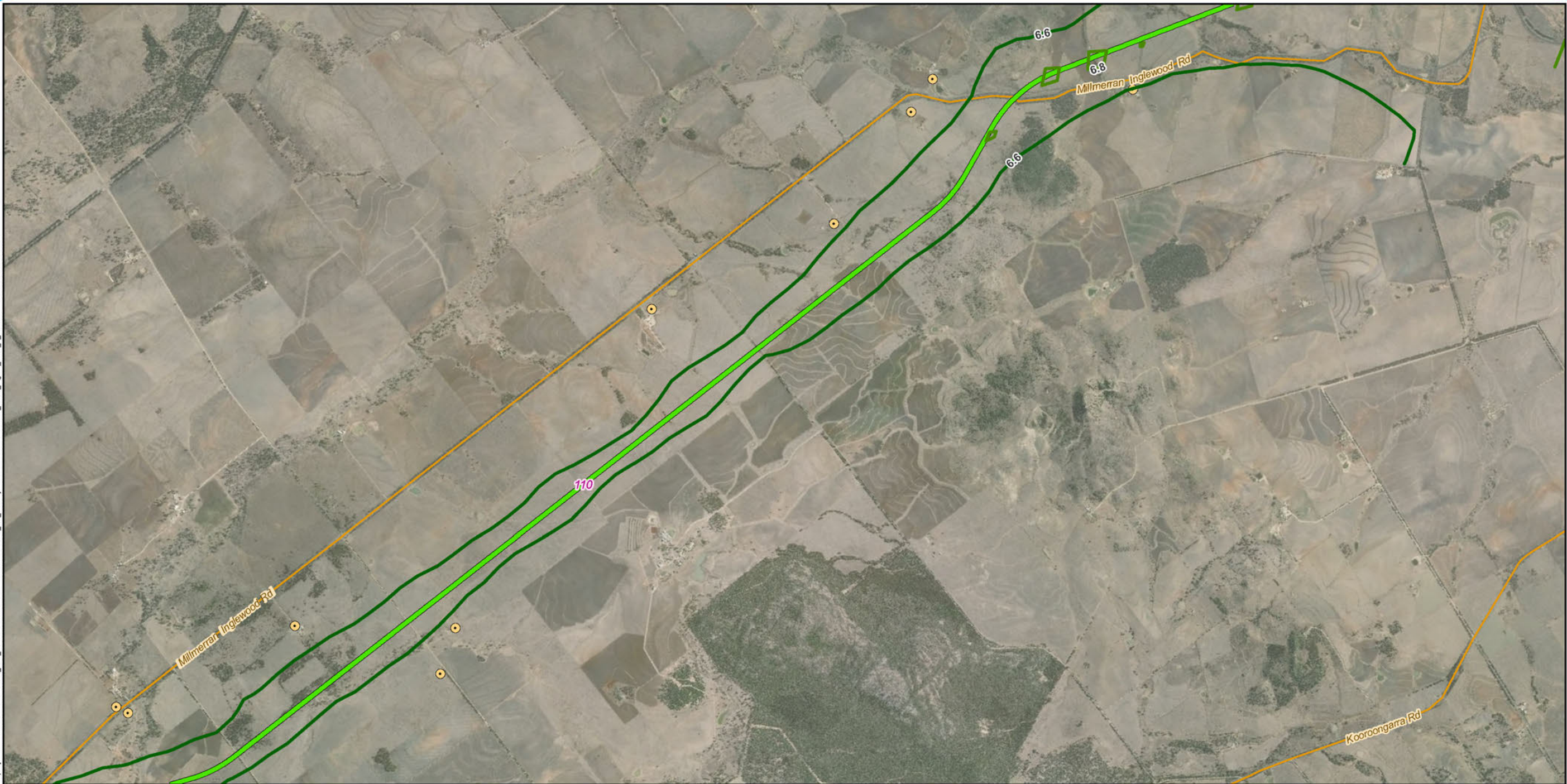
- Sensitive receptors
- Minor roads
- Border to Gowrie alignment
- Chainage (km)

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

6.6	7.6
6.8	7.8
7	8
7.2	9
7.4	10



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



Legend

- Sensitive receptors
- Minor roads
- 5 Chainage (km)
- Border to Gowrie alignment

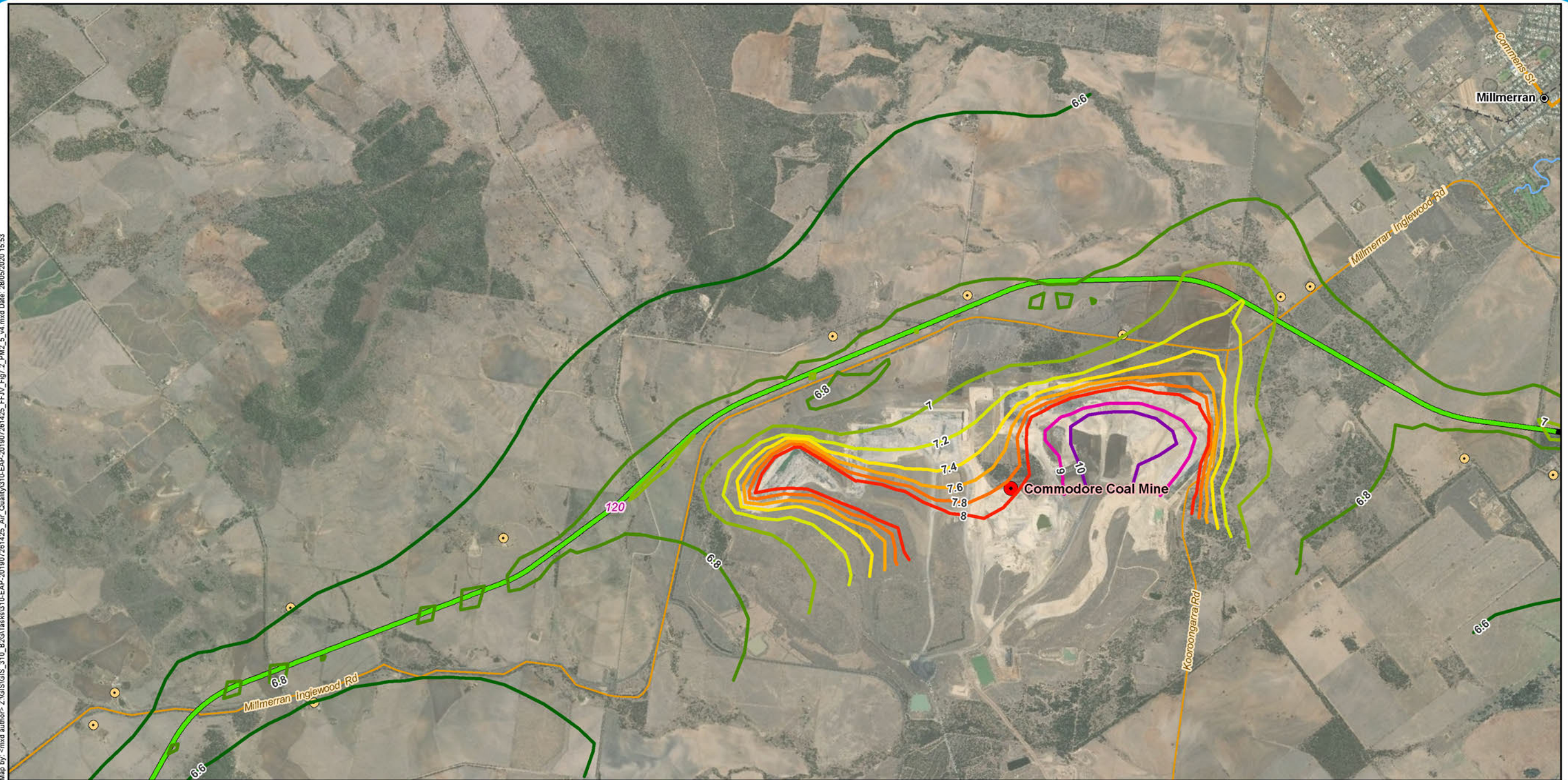
Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

— 6.6	— 7.6
— 6.8	— 7.8
— 7	— 8
— 7.2	— 9
— 7.4	— 10



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_2_PM2_5_v4.mxd Date: 28/05/2020 15:53



Legend

- Existing emission source
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|-----|-----|
| 6.6 | 7.6 |
| 6.8 | 7.8 |
| 7 | 8 |
| 7.2 | 9 |
| 7.4 | 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



Legend

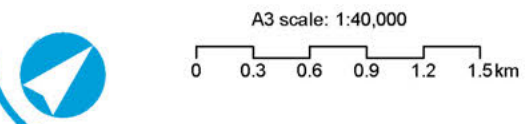
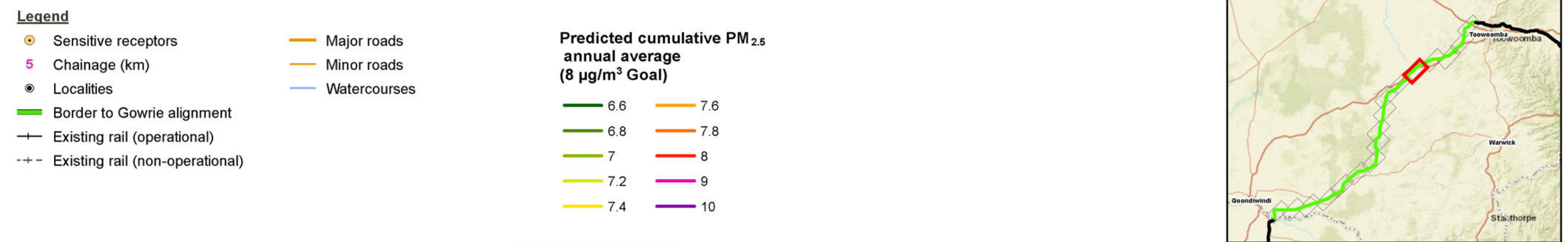
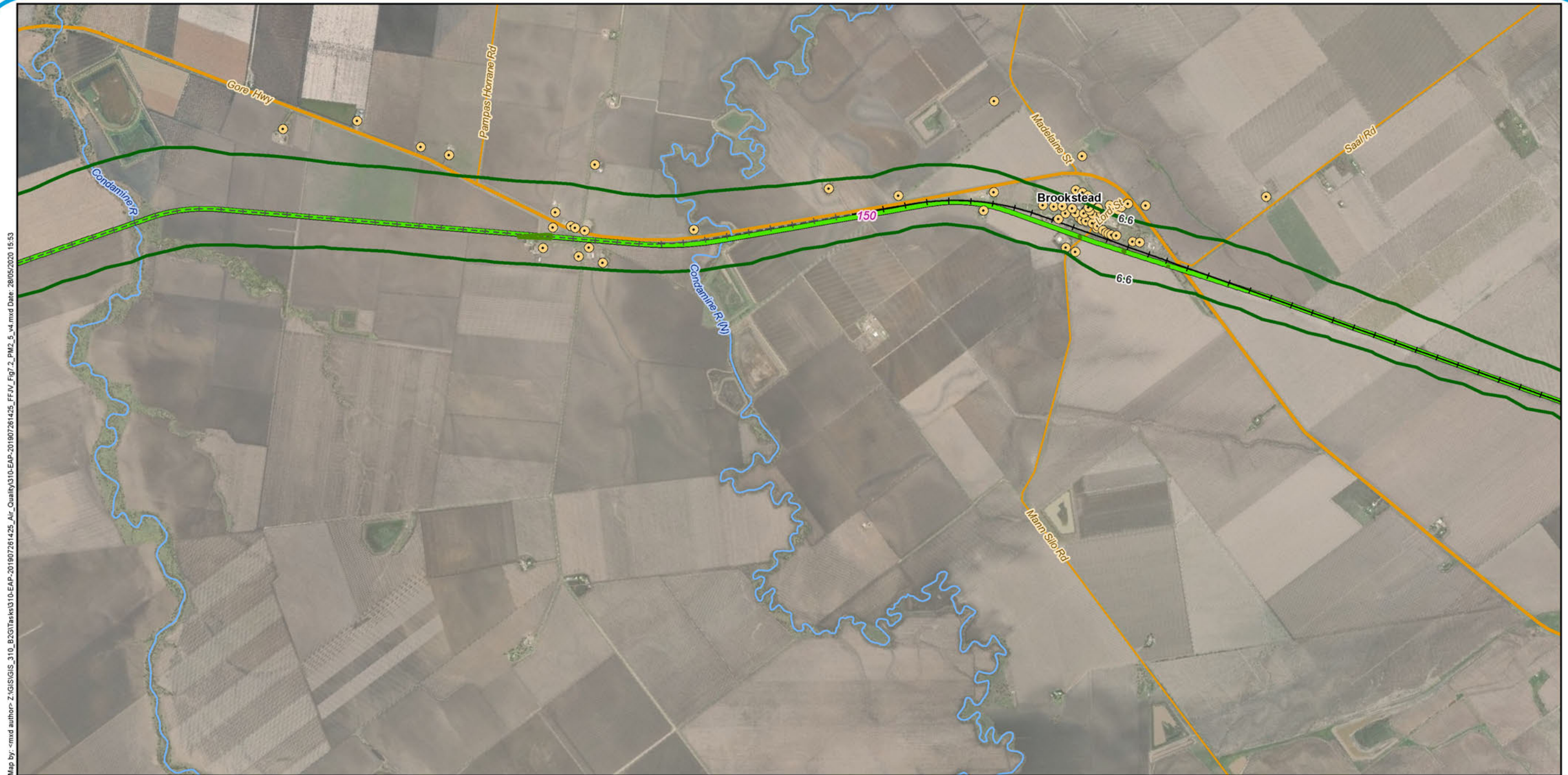
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|---|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km





Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- +— Existing rail (operational)
- Major roads
- Minor roads

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|---|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



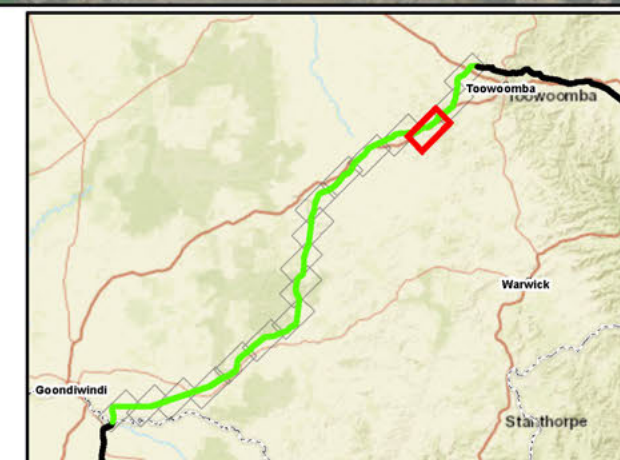
Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)

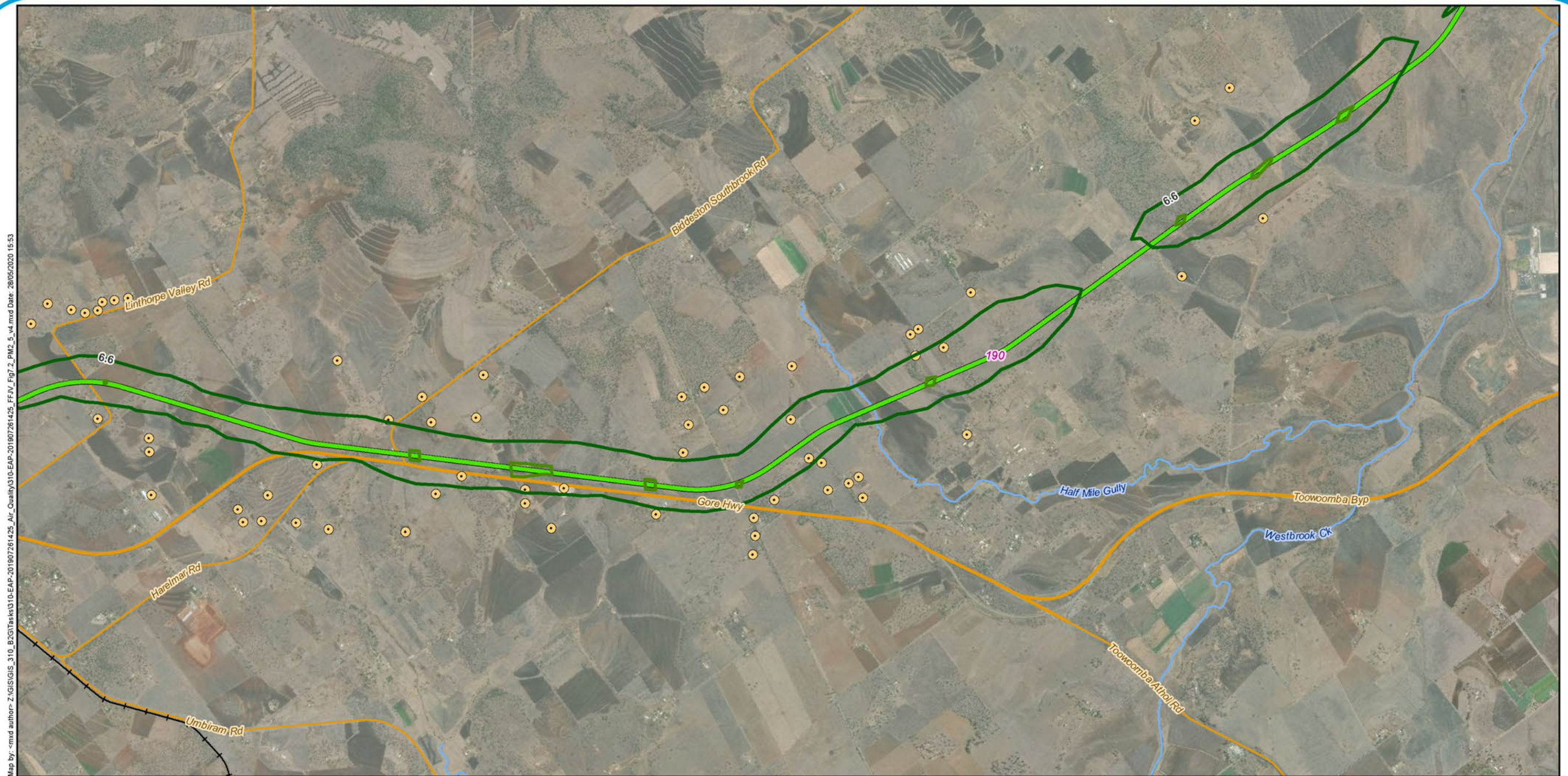
- Major roads
- Minor roads

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|---|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



Legend

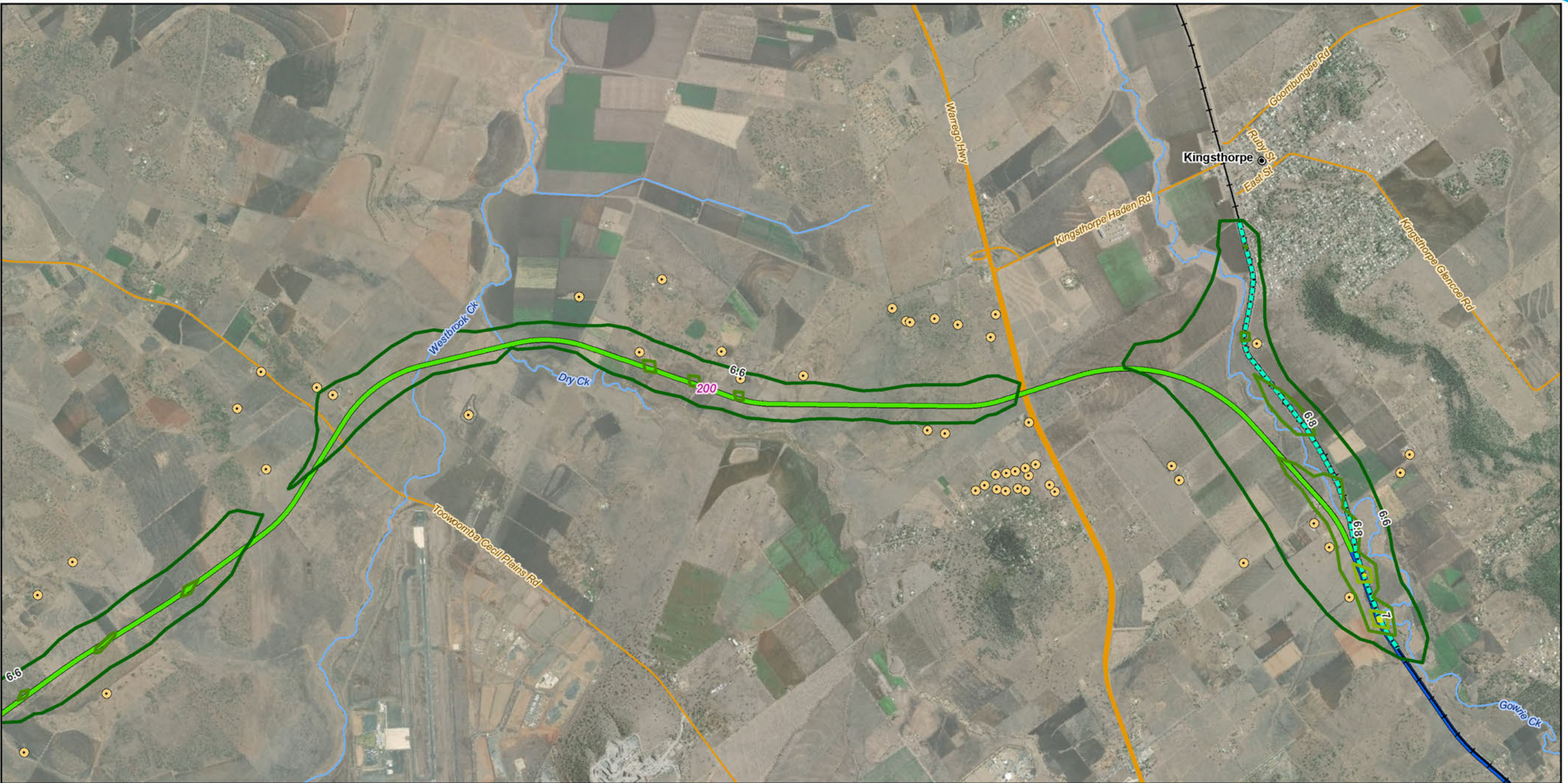
- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

- | | |
|--|---|
| — 6.6 | — 7.6 |
| — 6.8 | — 7.8 |
| — 7 | — 8 |
| — 7.2 | — 9 |
| — 7.4 | — 10 |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km

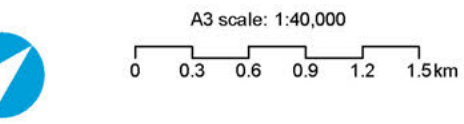


Legend

- Sensitive receptors
- Chainage (km)
- Localities
- Cumulative rail sources
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

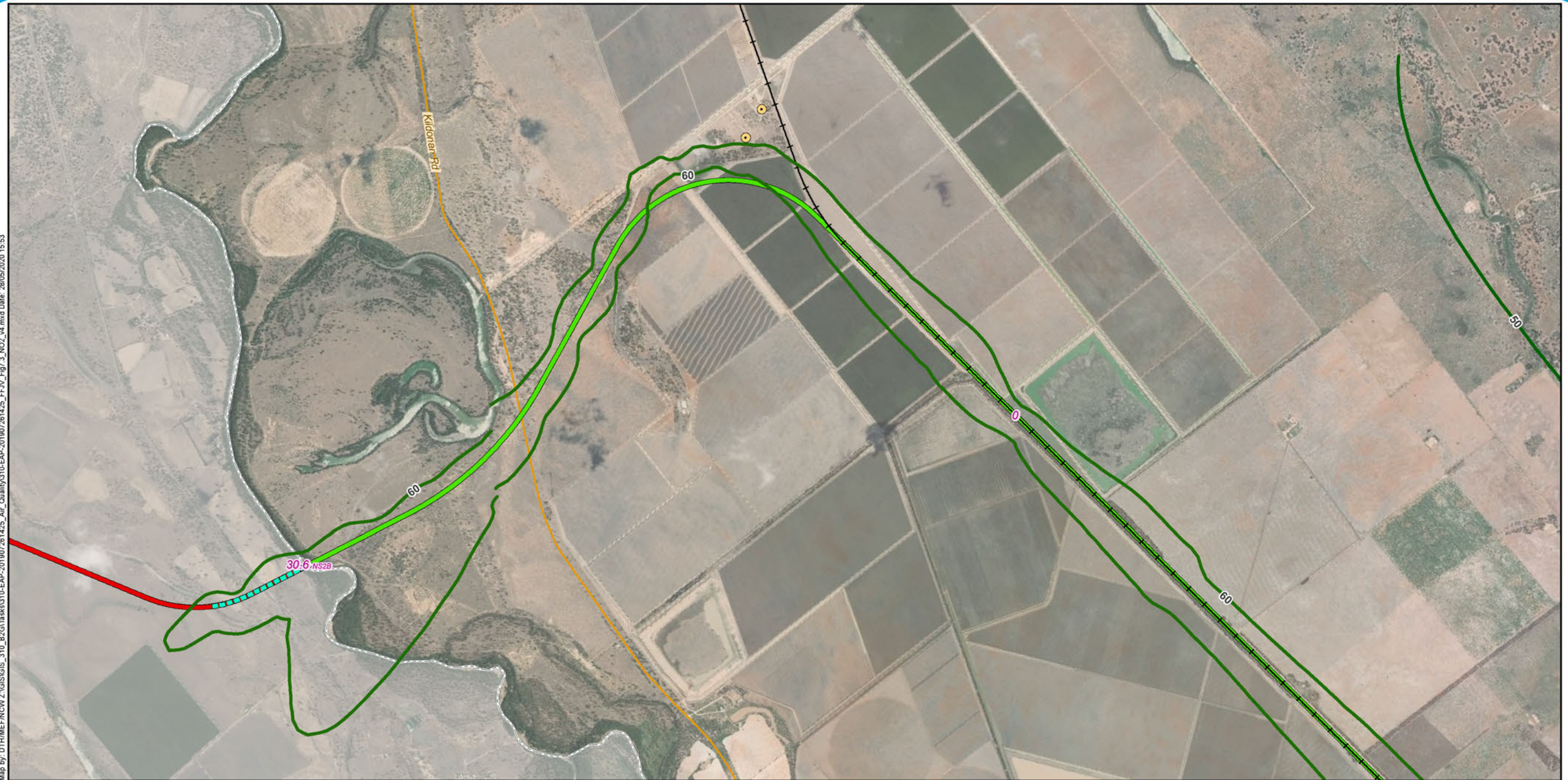
Predicted cumulative PM_{2.5} annual average (8 µg/m³ Goal)

6.6	7.6
6.8	7.8
7	8
7.2	9
7.4	10



Border to Gowrie
Figure 7.2q:
Predicted cumulative PM_{2.5} annual average ground level concentration plot

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\Fig7.3_NO2_v4.mxd Date: 28/05/2020 15:53



Legend

- 5 Chainage (km)
- Sensitive receptors
- ▬ Cumulative rail sources
- ▬ North Star to NSW/QLD border alignment
- ▬ Border to Gowrie alignment
- ▬ Existing rail (operational)
- ▬ Minor roads
- ▬ NSW/QLD border

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.3a:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

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Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Border to Gowrie alignment
- Existing rail (operational)
- Minor roads
- NSW/QLD border

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

— 50	— 130
— 60	— 140
— 70	— 150
— 80	— 160
— 90	— 170
— 100	— 180
— 110	— 190
— 120	



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



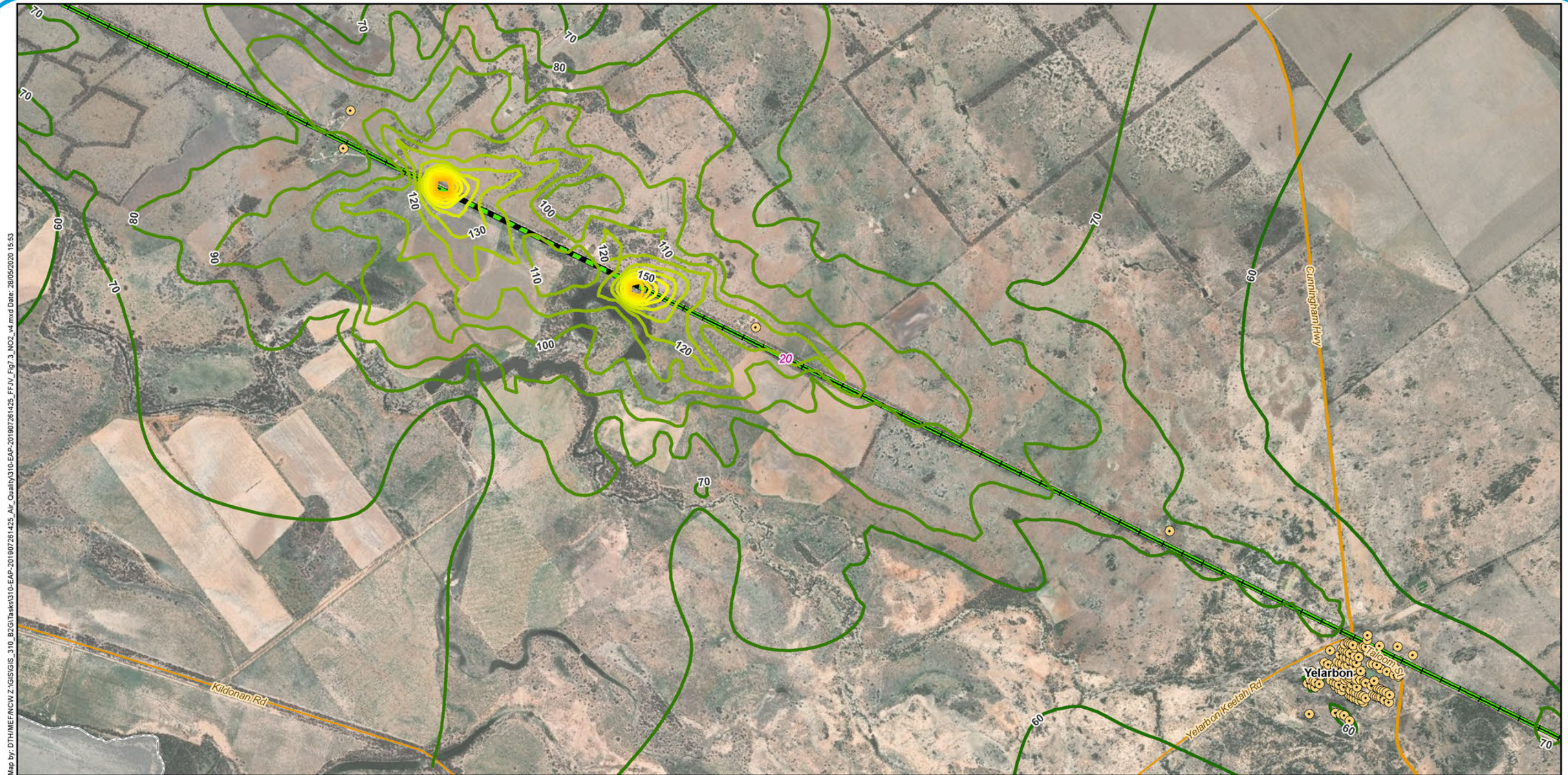
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Border to Gowrie

Figure 7.3b:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- NSW/Qld border

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

- 50
- 60
- 70
- 80
- 90
- 100
- 110
- 120
- 130
- 140
- 150
- 160
- 170
- 180
- 190



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



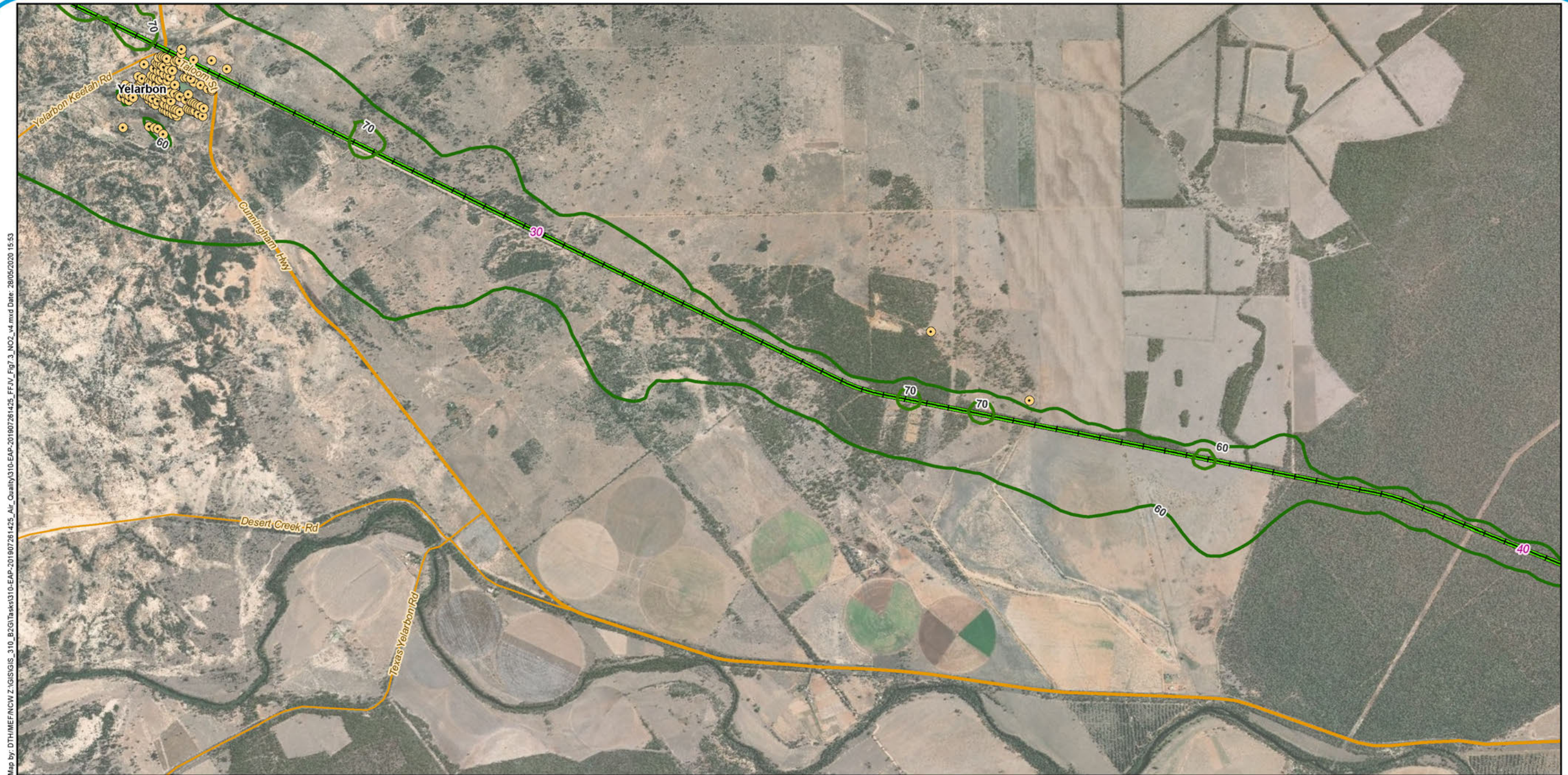
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Border to Gowrie

Figure 7.3c:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km



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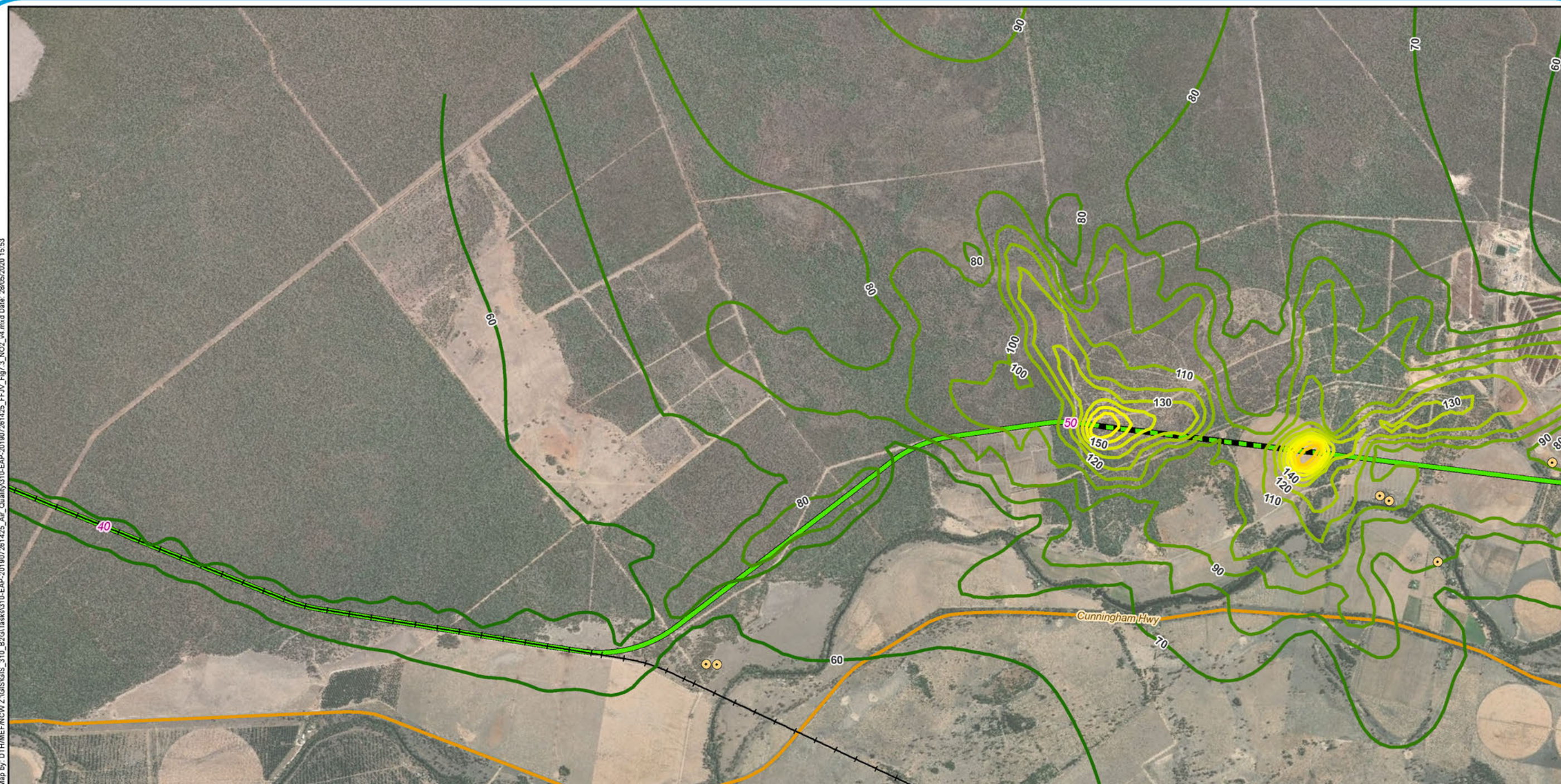
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 Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 7.3d:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

Map by: D:\THME\FACW\Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\AV_Fig7.3_NO2_v4.mxd Date: 28/05/2020 15:53

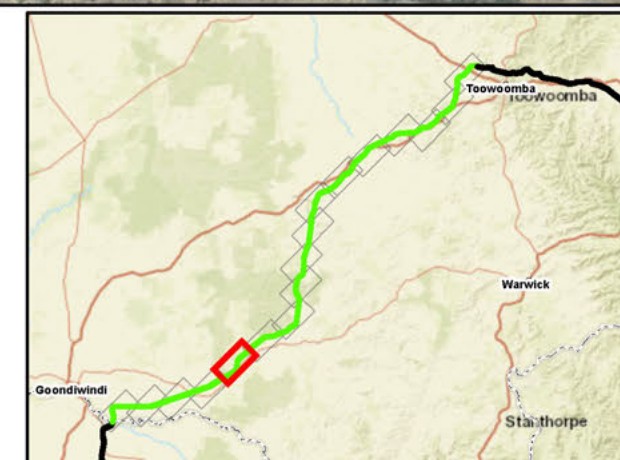


Legend

- 5 Chainage (km)
- Sensitive receptors
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

- | | |
|-----|-----|
| 50 | 130 |
| 60 | 140 |
| 70 | 150 |
| 80 | 160 |
| 90 | 170 |
| 100 | 180 |
| 110 | 190 |
| 120 | |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.3e:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



Legend

- 5 Chainage (km)
- Sensitive receptors
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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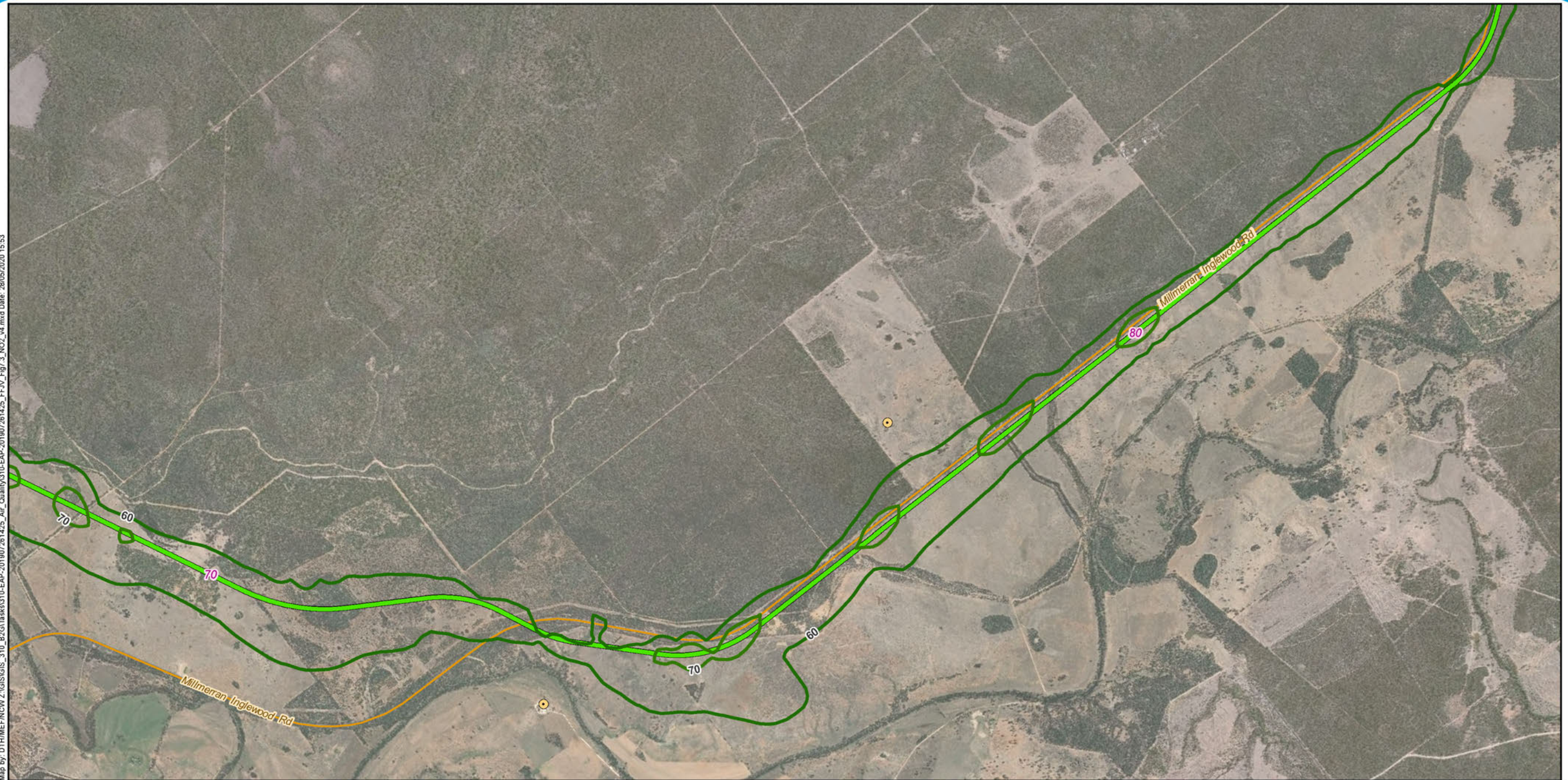
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Border to Gowrie

Figure 7.3f:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

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Legend

- 5 Chainage (km)
- Sensitive receptors
- Border to Gowrie alignment
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



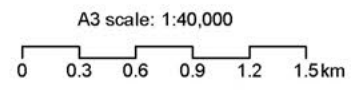
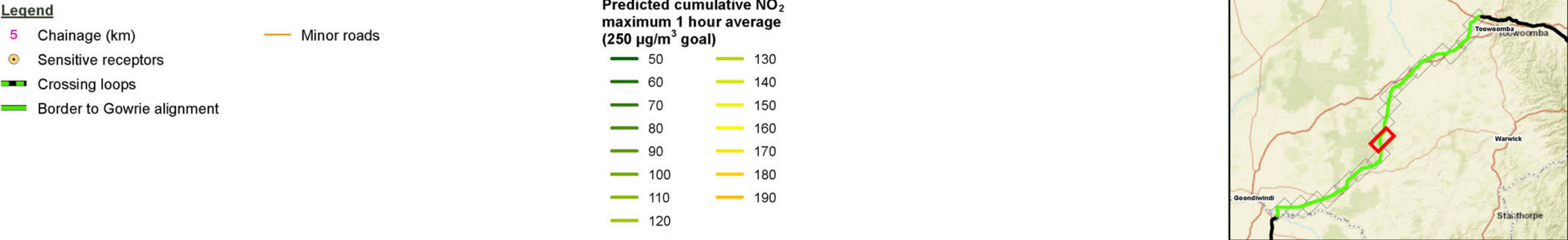
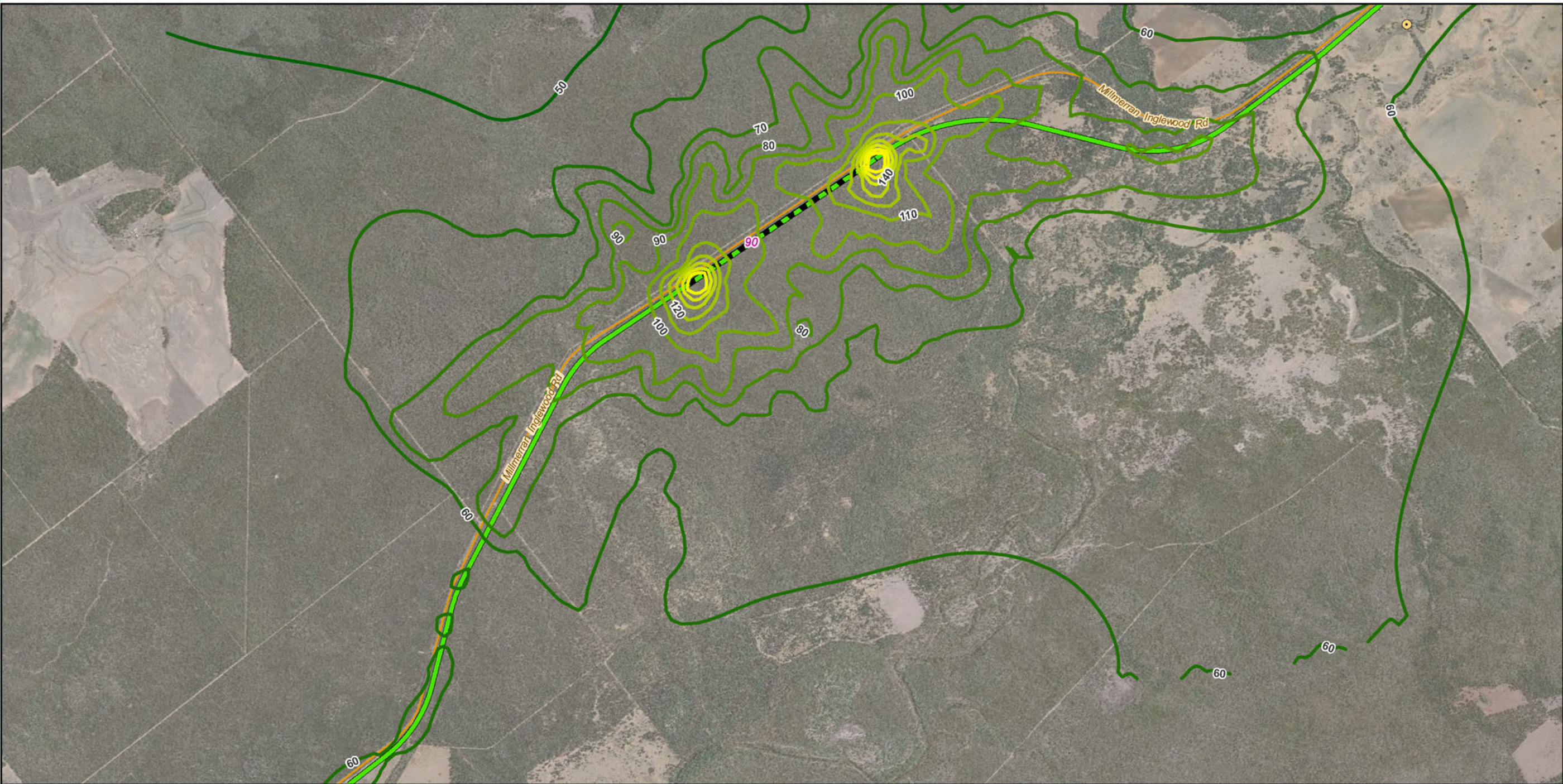
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Border to Gowrie

Figure 7.3g:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\Fig7.3_NO2_v4.mxd Date: 28/05/2020 15:53



Legend

- 5 Chainage (km)
- Sensitive receptors
- Border to Gowrie alignment
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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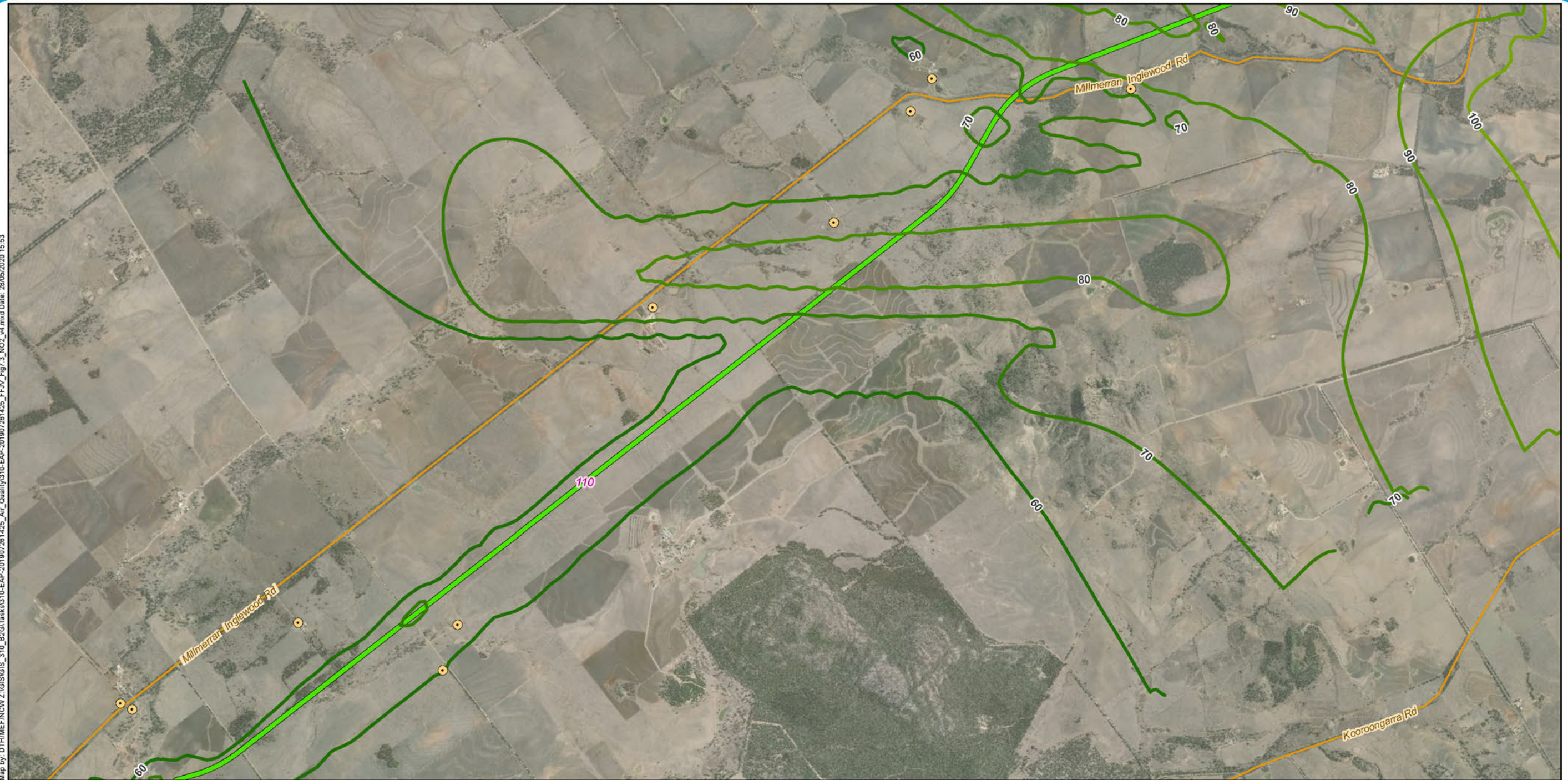
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Border to Gowrie

Figure 7.3i:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\AV_Fig7.3_NO2_v4.mxd Date: 28/05/2020 15:53



Legend

- 5 Chainage (km)
- Sensitive receptors
- Border to Gowrie alignment
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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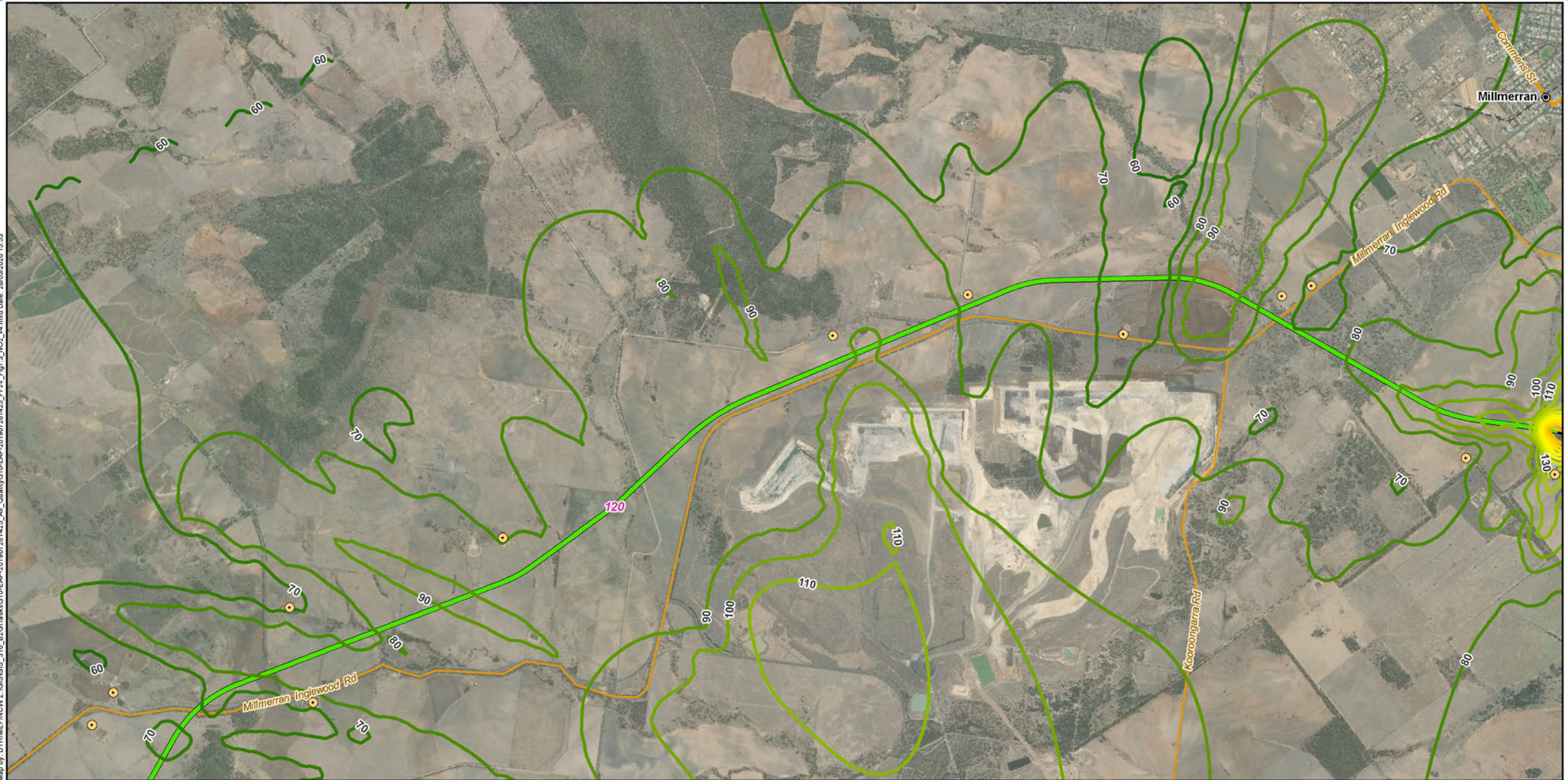
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Border to Gowrie

Figure 7.3j:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

Map by: D:\THME\FANCW\Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\AV_Fig7.3_NO2_v4.mxd Date: 28/05/2020 15:53



Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Crossing loops
- Border to Gowrie alignment
- Existing rail (non-operational)

- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

- | | |
|-----|-----|
| 50 | 130 |
| 60 | 140 |
| 70 | 150 |
| 80 | 160 |
| 90 | 170 |
| 100 | 180 |
| 110 | 190 |
| 120 | |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.3k:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)

- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

- | | |
|-----|-----|
| 50 | 130 |
| 60 | 140 |
| 70 | 150 |
| 80 | 160 |
| 90 | 170 |
| 100 | 180 |
| 110 | 190 |
| 120 | |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



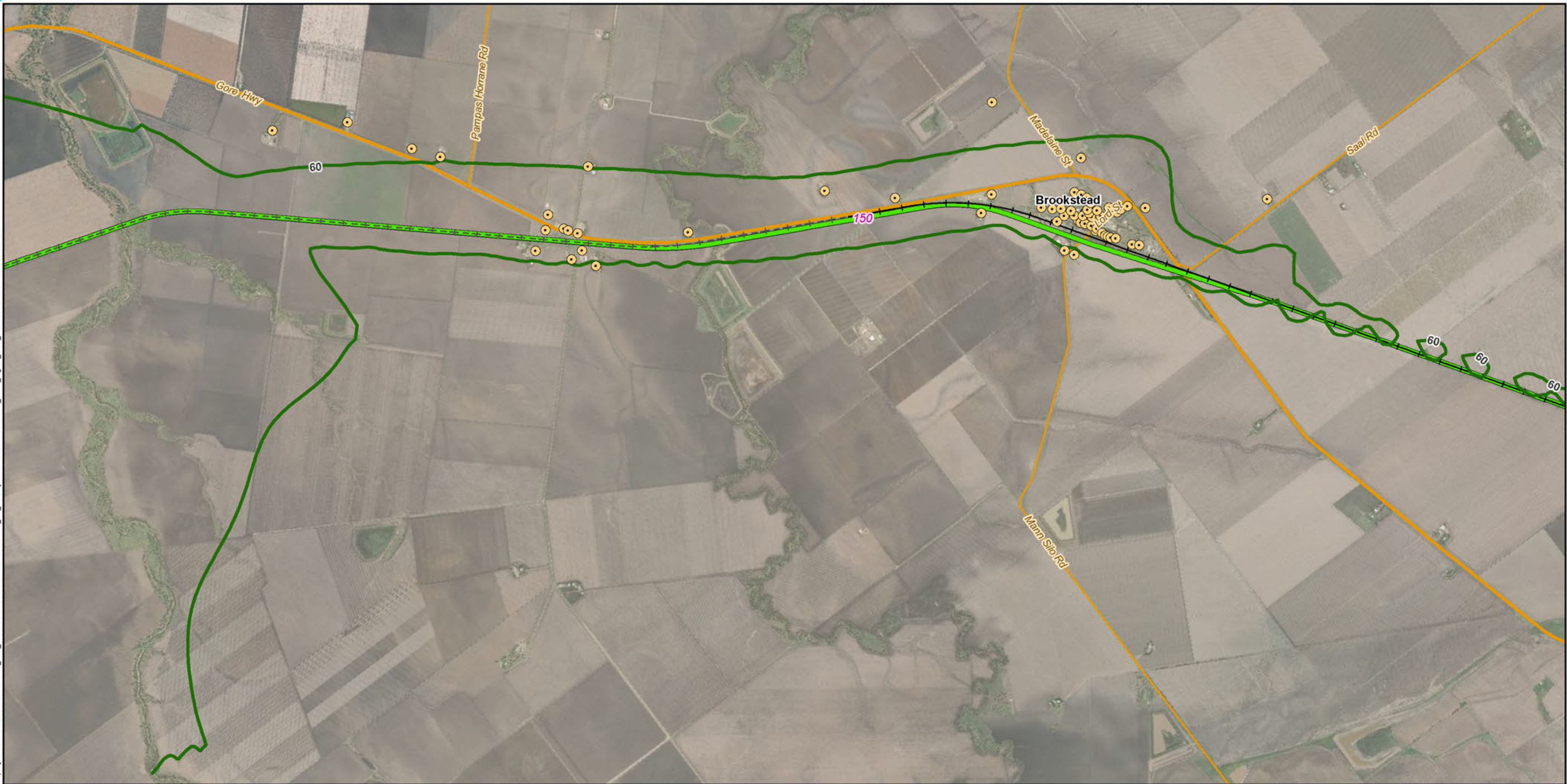
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Border to Gowrie

Figure 7.31:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Border to Gowrie alignment
- Existing rail (operational)
- - - Existing rail (non-operational)
- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km



Legend

- 5 Chainage (km)
- Sensitive receptors
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



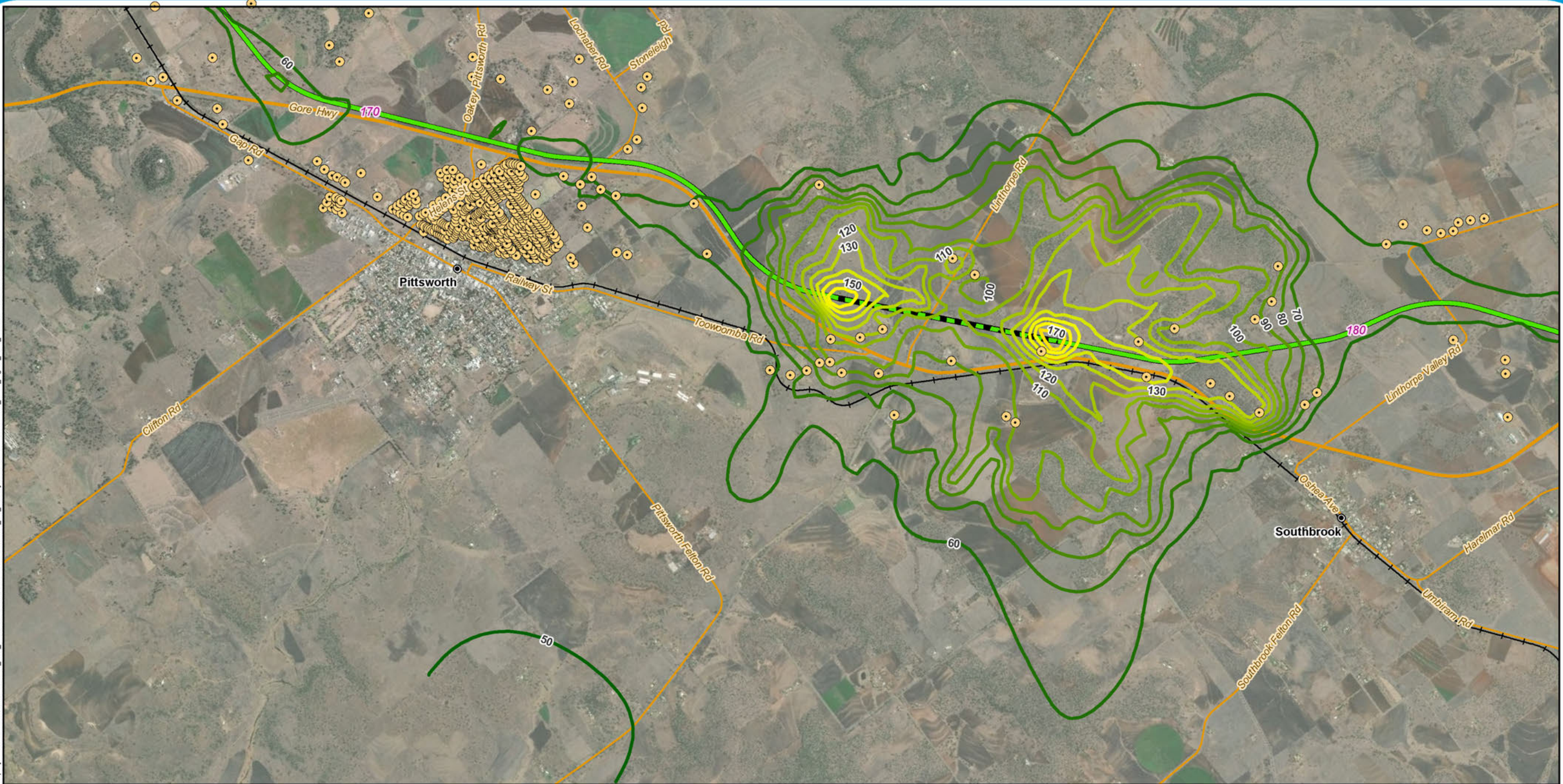
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Border to Gowrie

Figure 7.3n:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

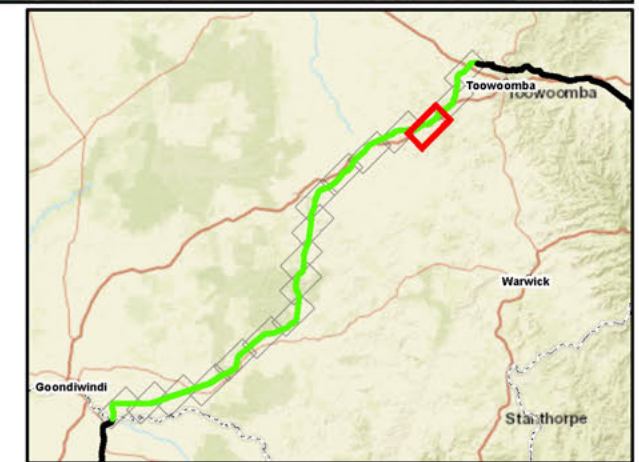


Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

- | | |
|-----|-----|
| 50 | 130 |
| 60 | 140 |
| 70 | 150 |
| 80 | 160 |
| 90 | 170 |
| 100 | 180 |
| 110 | 190 |
| 120 | |



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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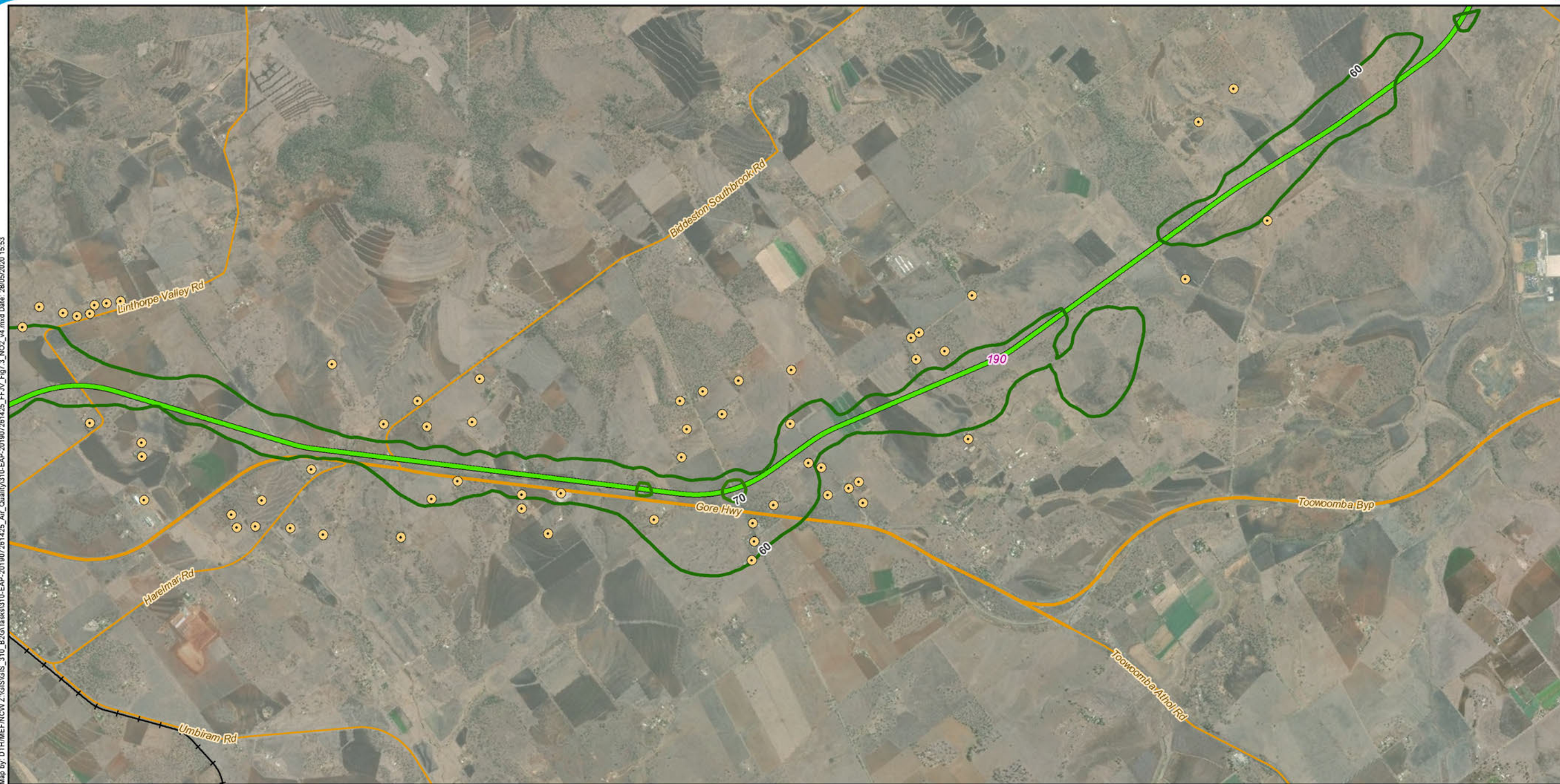
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Border to Gowrie

Figure 7.3o:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

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Legend

- 5 Chainage (km)
- Sensitive receptors
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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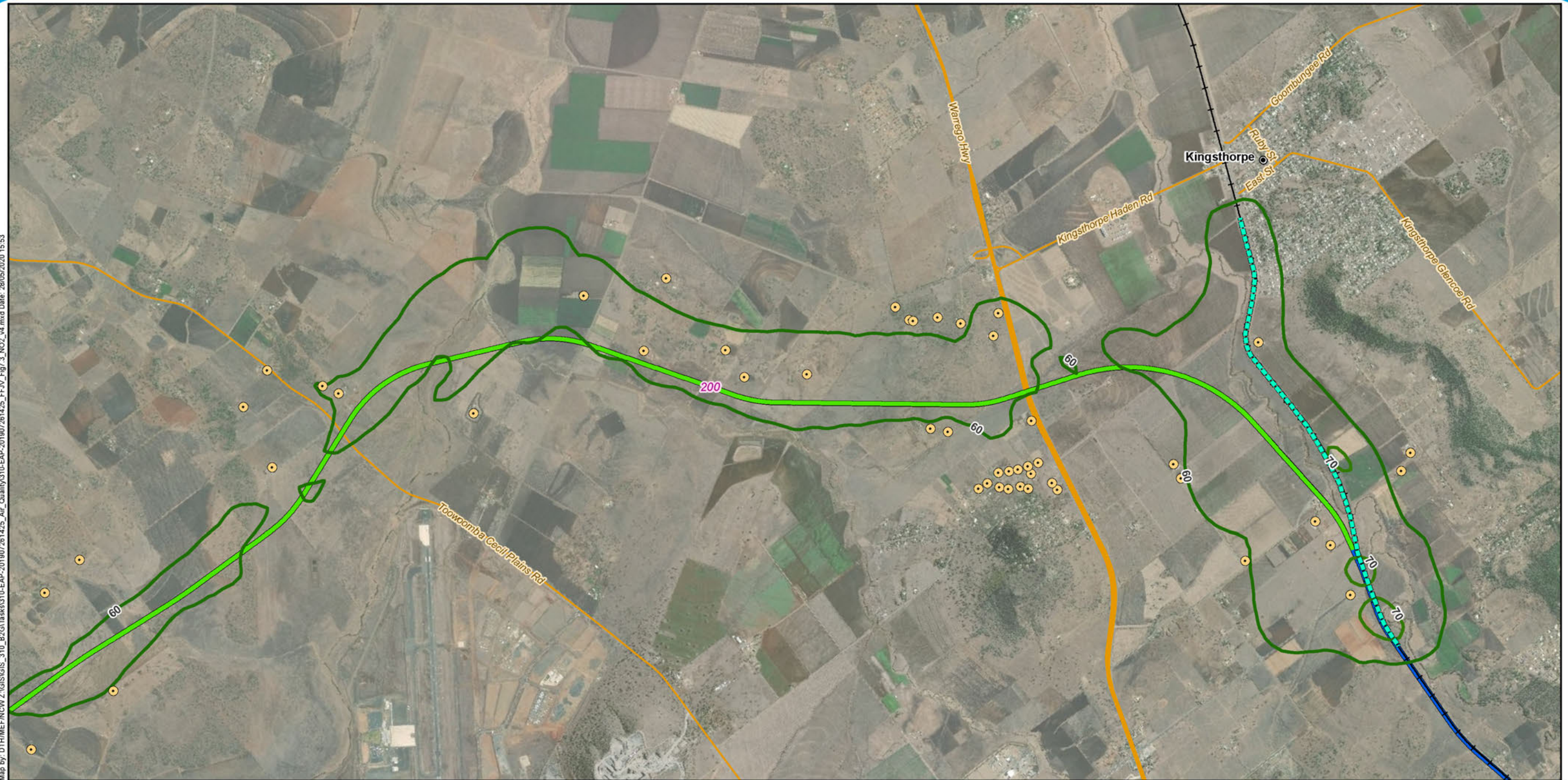
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Border to Gowrie

Figure 7.3p:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot

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Legend

- 5 Chainage (km)
- Localities
- Sensitive receptors
- Cumulative rail sources
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Existing rail (operational)
- Major roads
- Minor roads

Predicted cumulative NO₂ maximum 1 hour average (250 µg/m³ goal)

50	130
60	140
70	150
80	160
90	170
100	180
110	190
120	



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



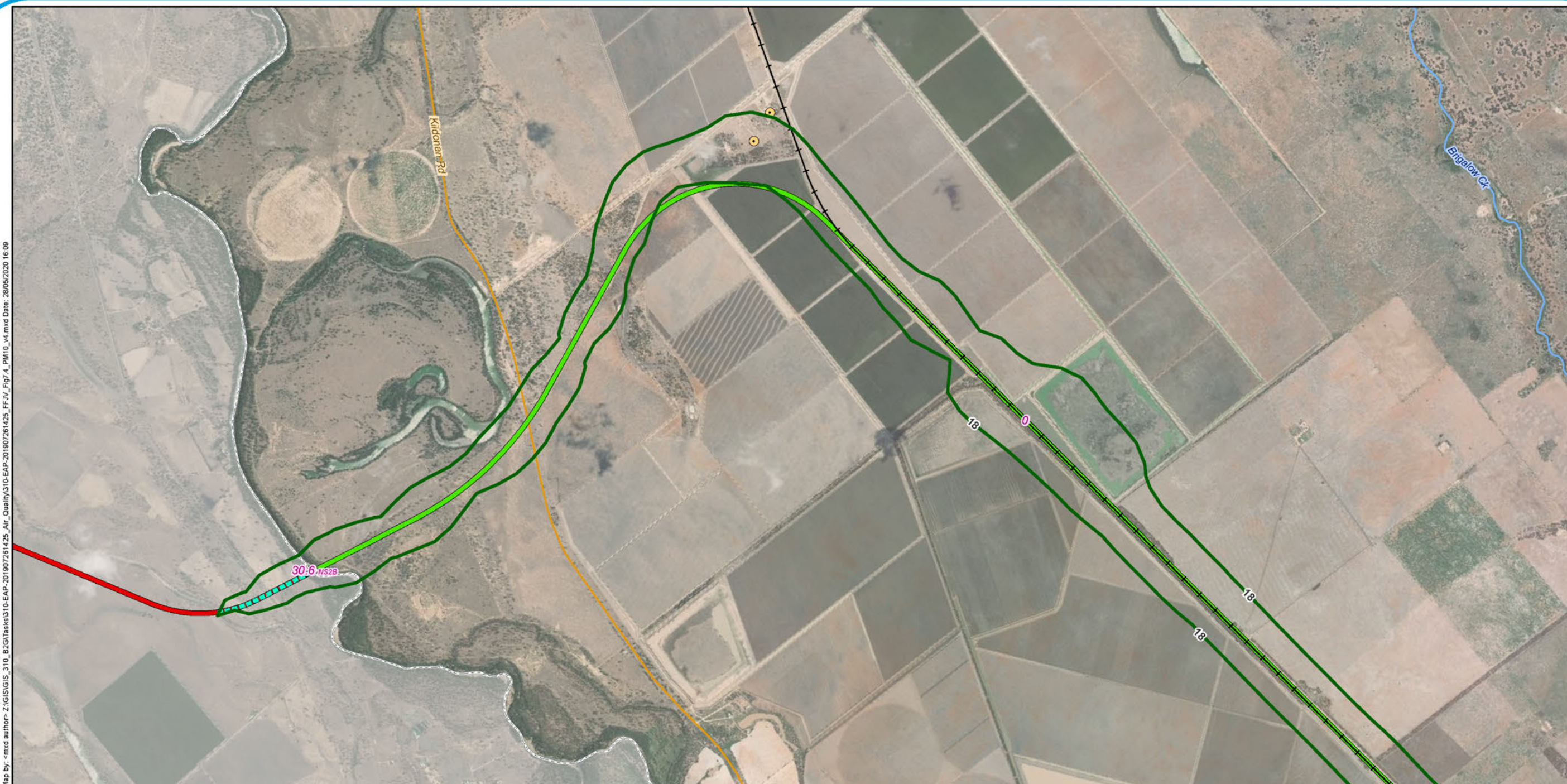
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Border to Gowrie

Figure 7.3q:

Predicted cumulative NO₂ maximum 1 hour average ground level concentration plot



- Sensitive receptors
- Chainage (km)
- Cumulative rail sources
- North Star to NSW/QLD border alignment
- Border to Gowrie alignment
- Existing rail (operational)

- Minor roads
- Watercourses
- NSW/QLD border

18
20
25
30



Figure 7.4a:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

A3 scale: 1:40,000



0 0.3 0.6 0.9 1.2 1.5km



Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Minor roads
- Watercourses
- NSW/QLD border

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.4b:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

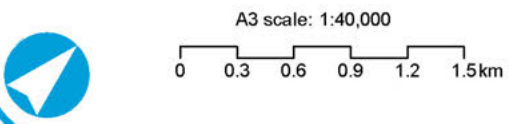
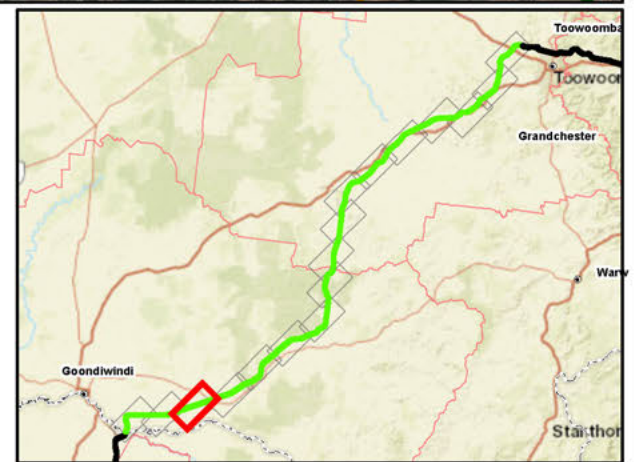


Legend

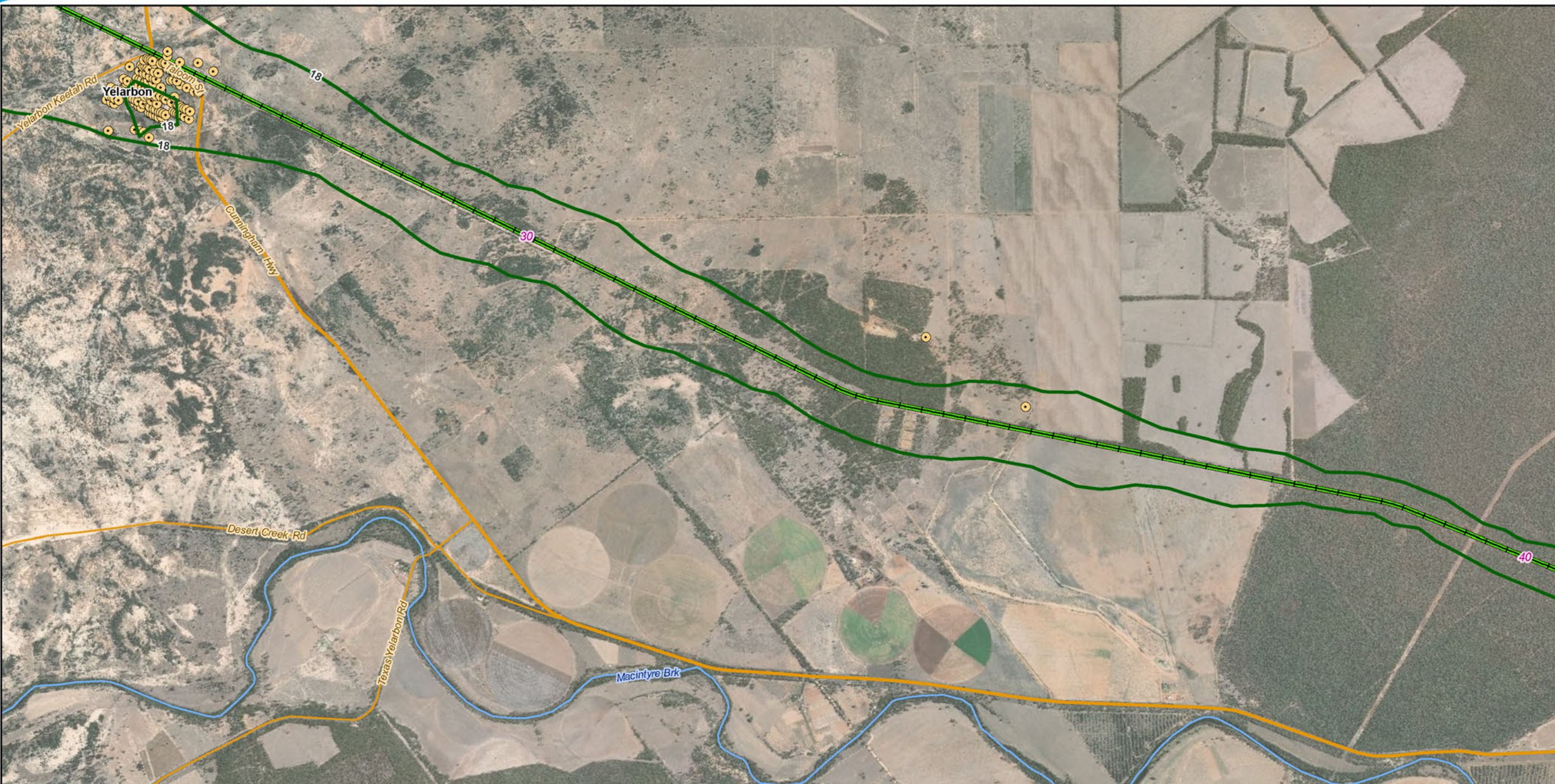
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- NSW/QLD border

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



Border to Gowrie
Figure 7.4c:
Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

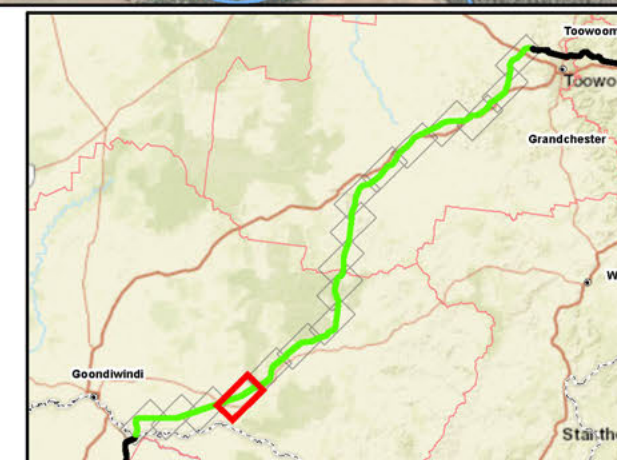


Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.4d:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <mx>author: Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09



Legend

- Sensitive receptors
- 5 Chainage (km)
- Crossing loops
- Border to Gowrie alignment
- + Existing rail (operational)

- Major roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5 km



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Border to Gowrie

Figure 7.4e:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09



Legend

- Sensitive receptors
- Chainage (km)
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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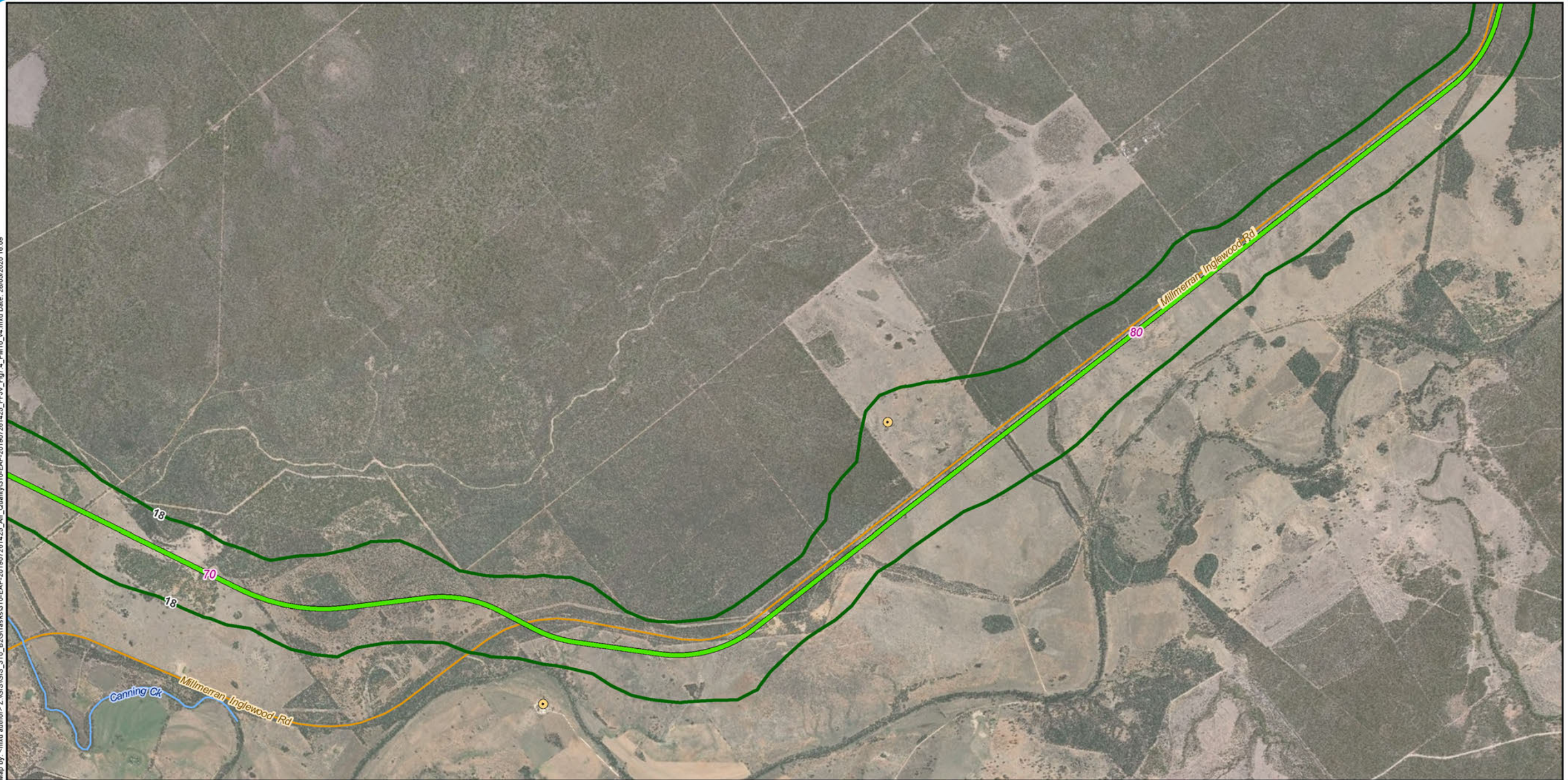
Issue date: 28/05/2020 Version: 1
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Border to Gowrie

Figure 7.4f:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <msd author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09



Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.4g:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)



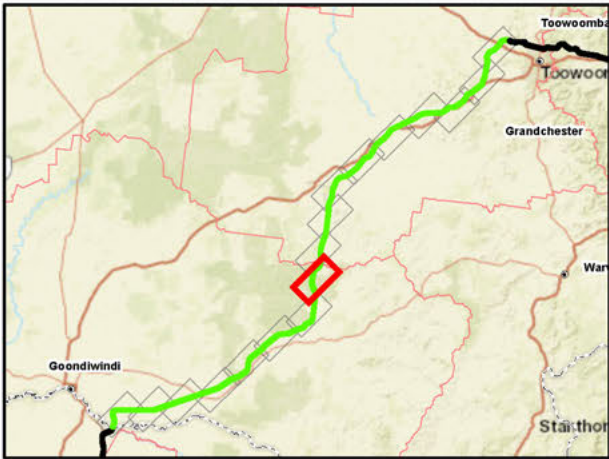
Legend

- Sensitive receptors
- 5 Chainage (km)
- Crossing loops
- Border to Gowrie alignment

— Minor roads

**Predicted maximum cumulative
 PM₁₀ 24 hour average
 (50 µg/m³ goal)**

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.4h:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <msd author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09



Legend

- Sensitive receptors
- Chainage (km)
- Border to Gowrie alignment
- Minor roads

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.4i:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09



Legend

- Sensitive receptors
- Minor roads
- 170 Chainage (km)
- Border to Gowrie alignment

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km



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Border to Gowrie

Figure 7.4j:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <msd author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09



Legend

- Existing emission source
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



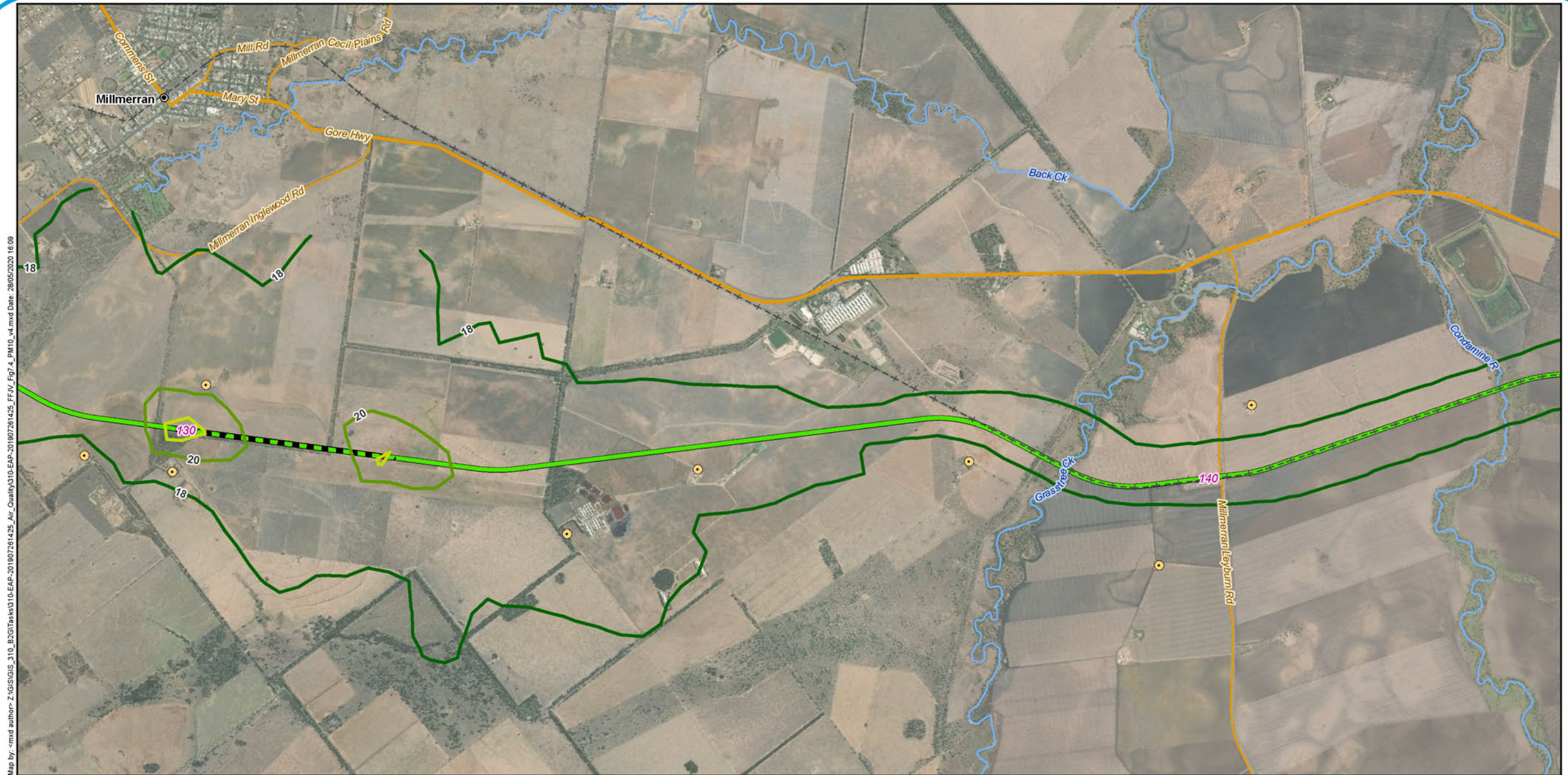
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Border to Gowrie

Figure 7.4k:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

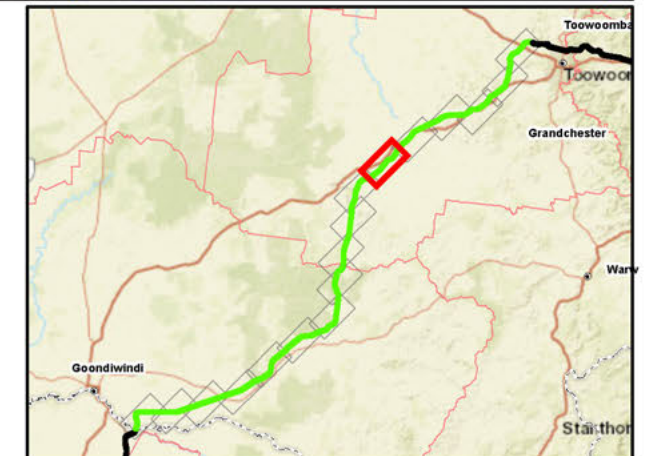


Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.41:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

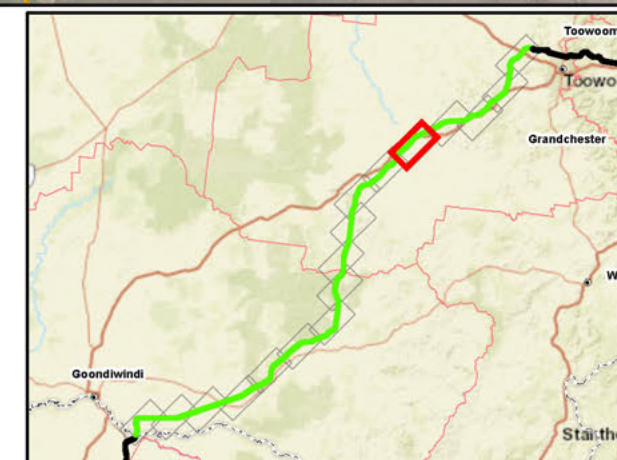


Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- Existing rail (operational)
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5 km



Issue date: 28/05/2020 Version: 1
Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 7.4m:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)



Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



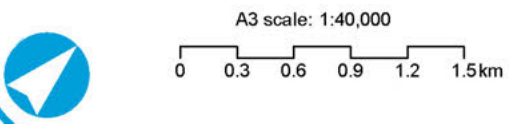
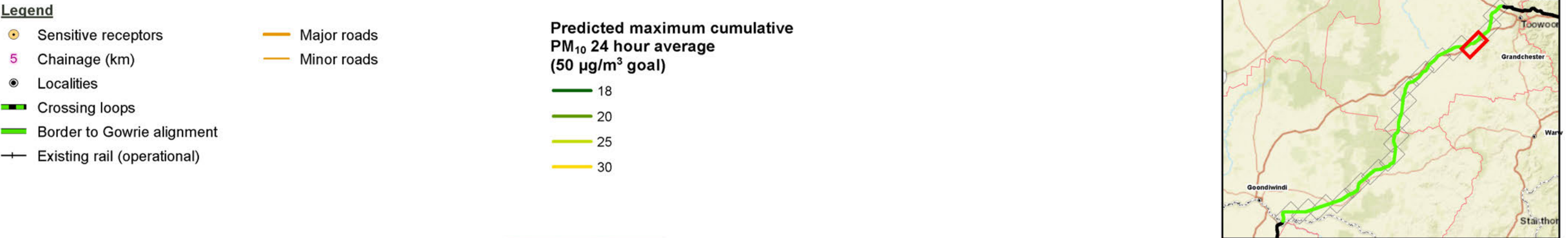
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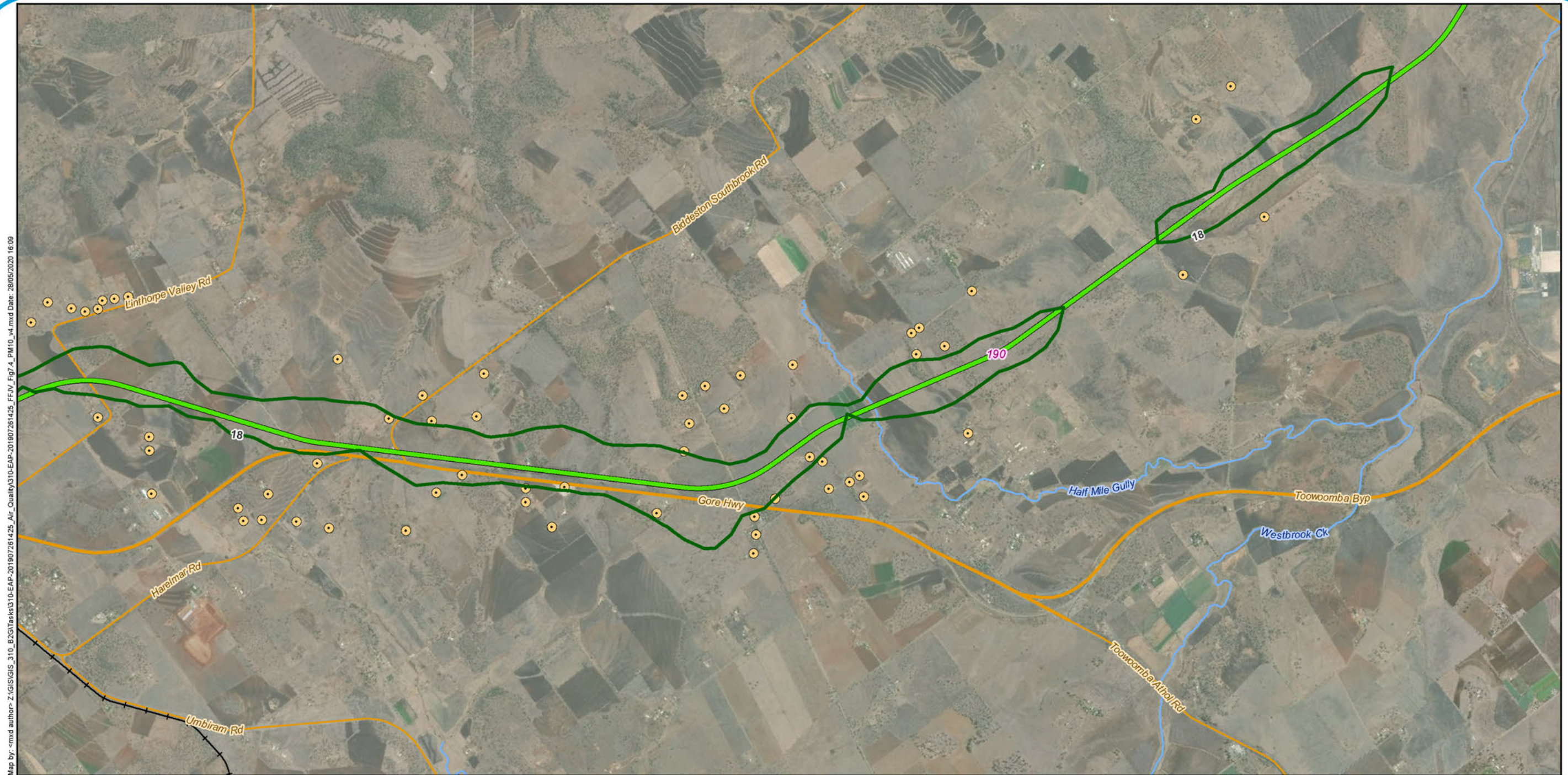
Issue date: 28/05/2020 Version: 1
 Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 7.4n:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)





Legend

- Sensitive receptors
- 5 Chainage (km)
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



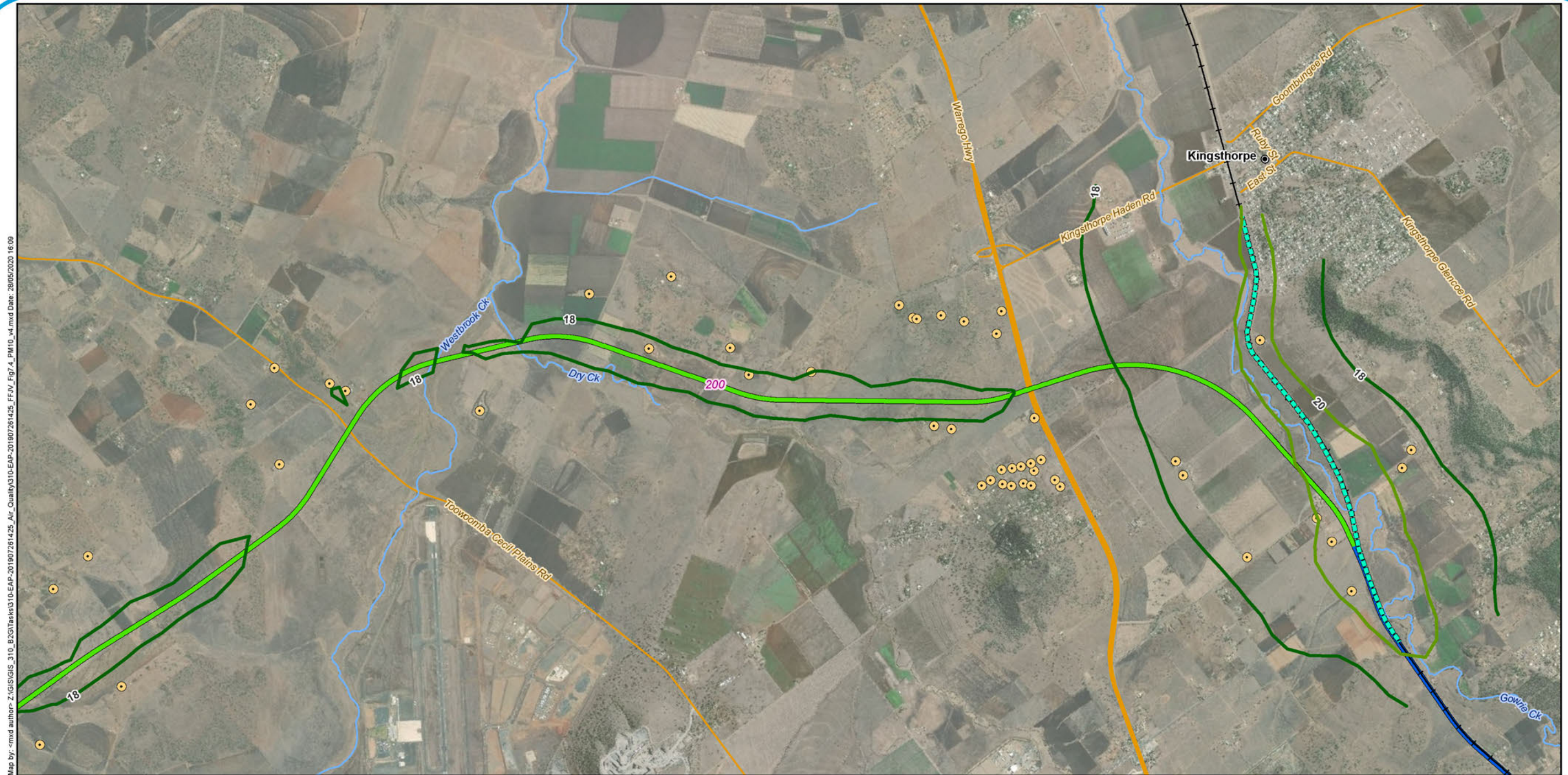
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Border to Gowrie

Figure 7.4p:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)



Map by: <mx> author: Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_4_PMI0_v4.mxd Date: 28/05/2020 16:09

Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Cumulative rail sources
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted maximum cumulative PM₁₀ 24 hour average (50 µg/m³ goal)

- 18
- 20
- 25
- 30



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Figure 7.4q:

Predicted maximum cumulative PM₁₀ 24 hour average ground level concentration plot (Project only)

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FFIV_Fig7_5a_PM2_5_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- 5 Chainage (km)
- Cumulative rail sources
- Crossing loops
- North Star to NSW/QLD border alignment
- Border to Gowrie alignment
- Existing rail (operational)

- Minor roads
- Watercourses
- NSW/QLD border

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



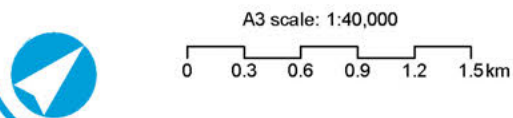
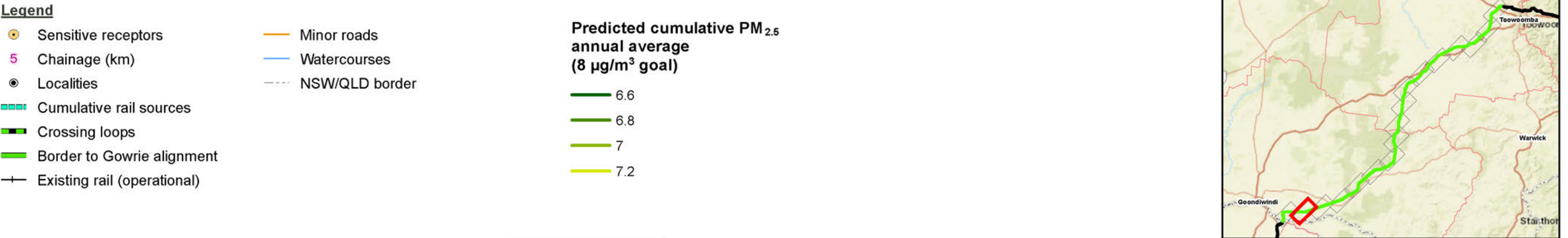
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Border to Gowrie

Figure 7.5a:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)





Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- Watercourses
- NSW/QLD border

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



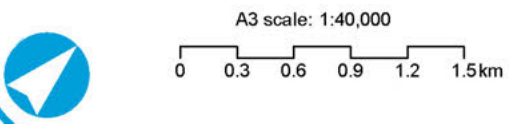
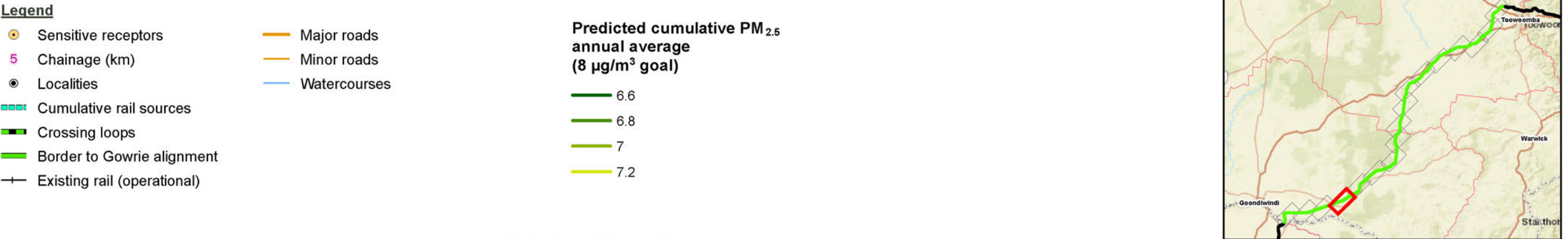
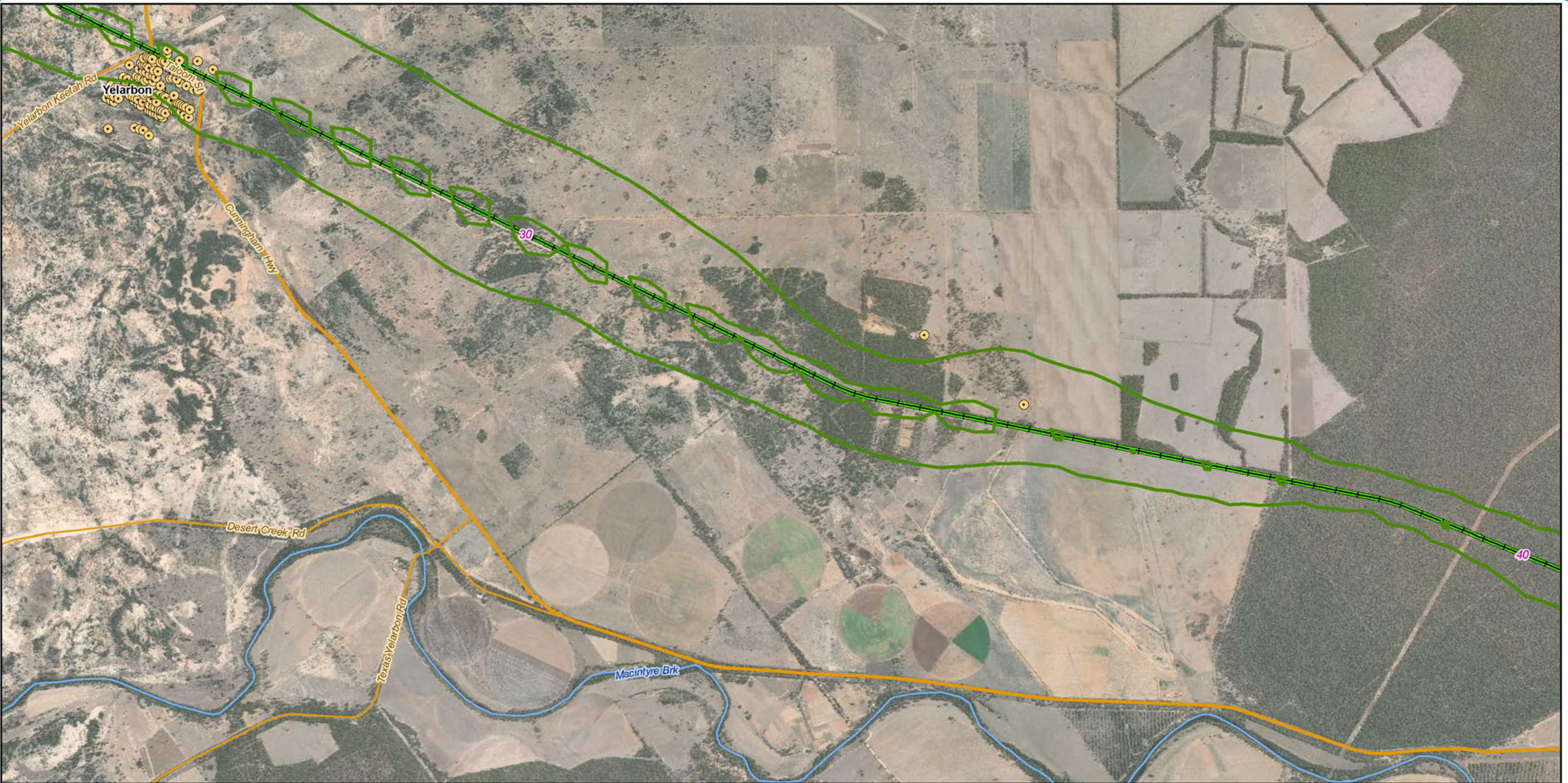
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Border to Gowrie

Figure 7.5c:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)



Border to Gowrie
Figure 7.5d:
Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_5_PM2_5_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Watercourses

**Predicted cumulative PM_{2.5}
annual average
(8 µg/m³ goal)**

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.5e:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_5f_P2_5_v4.mxd Date: 28/05/2020 16:08

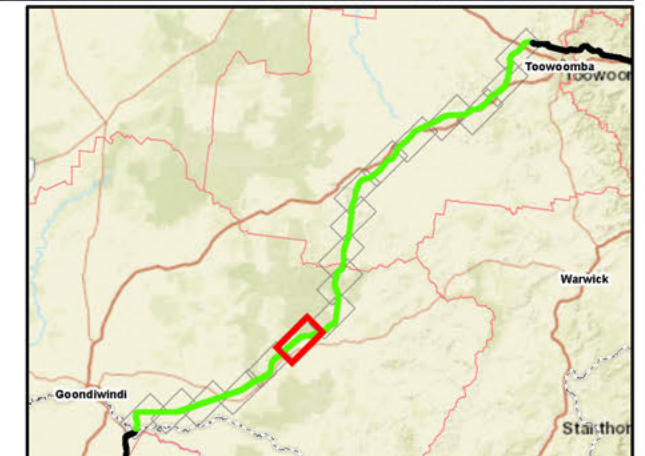


Legend

- Sensitive receptors
- 5 Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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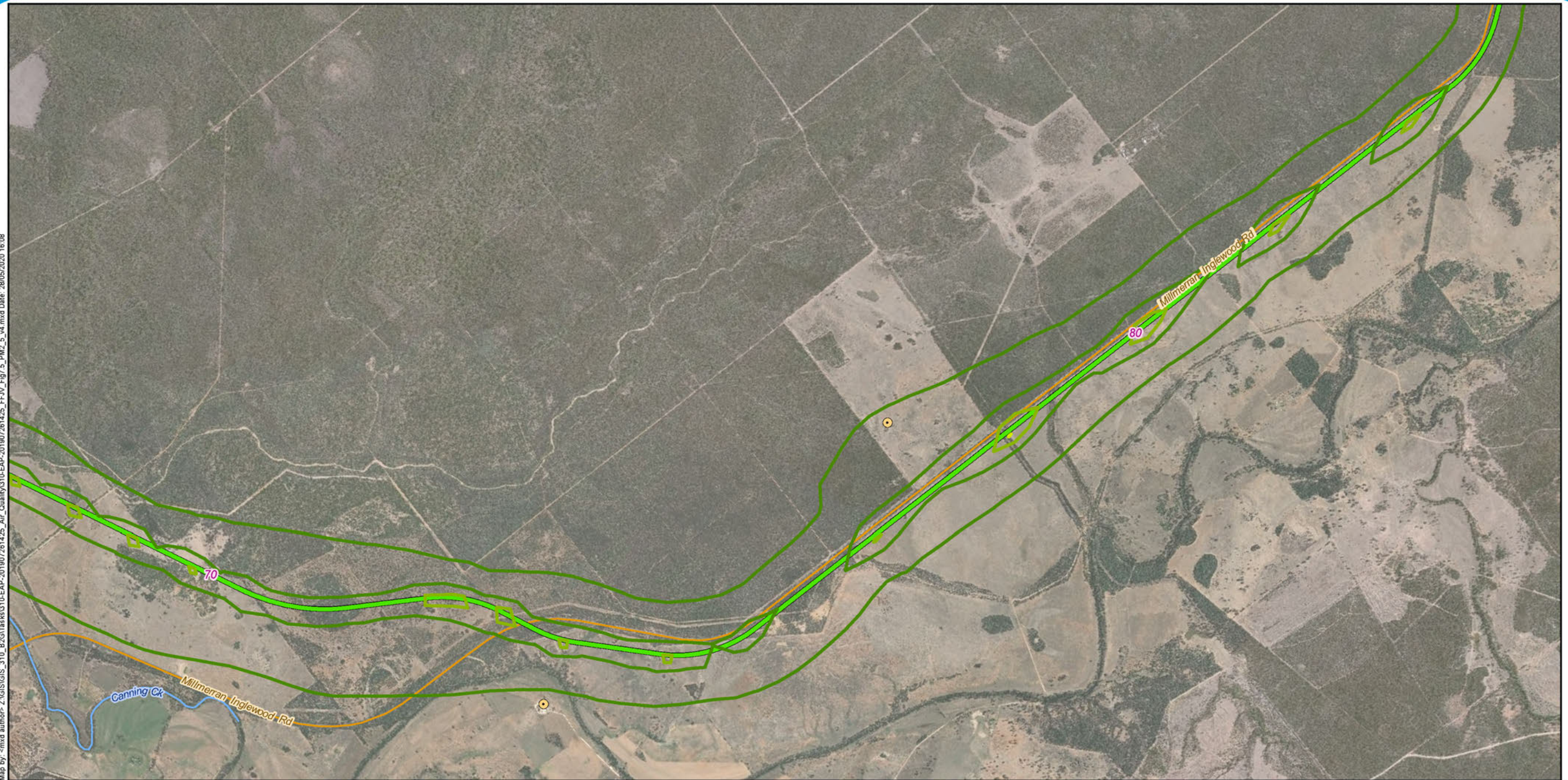
Issue date: 29/05/2020 Version: 1
 Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 7.5f:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

Map by: <md author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201907261425_Air_Quality\310-EAP-201907261425_FFIV_Fig7_5_PM2_5_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- 5 Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.5g:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

Map by: <mxid author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FFIV_Fig7_5_PM2_5_v4.mxd Date: 28/05/2020 16:08

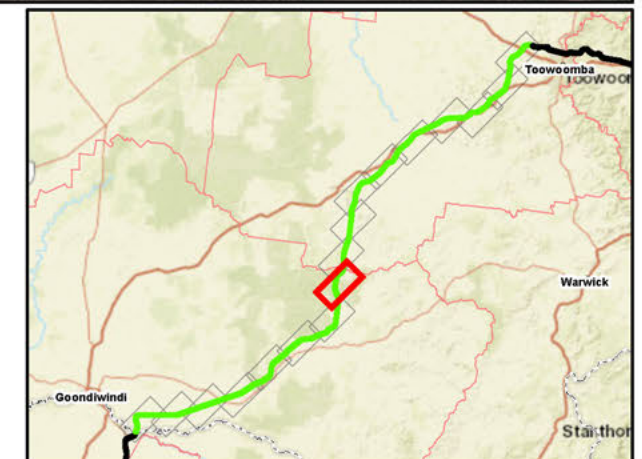


Legend

- Sensitive receptors
- Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.5h:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

Map by: <msd author> Z:\GIS\GIS_310_B2G\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FFIV_Fig7_5_PM2_5_v4.mxd Date: 28/05/2020 16:08



Legend

- Sensitive receptors
- Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



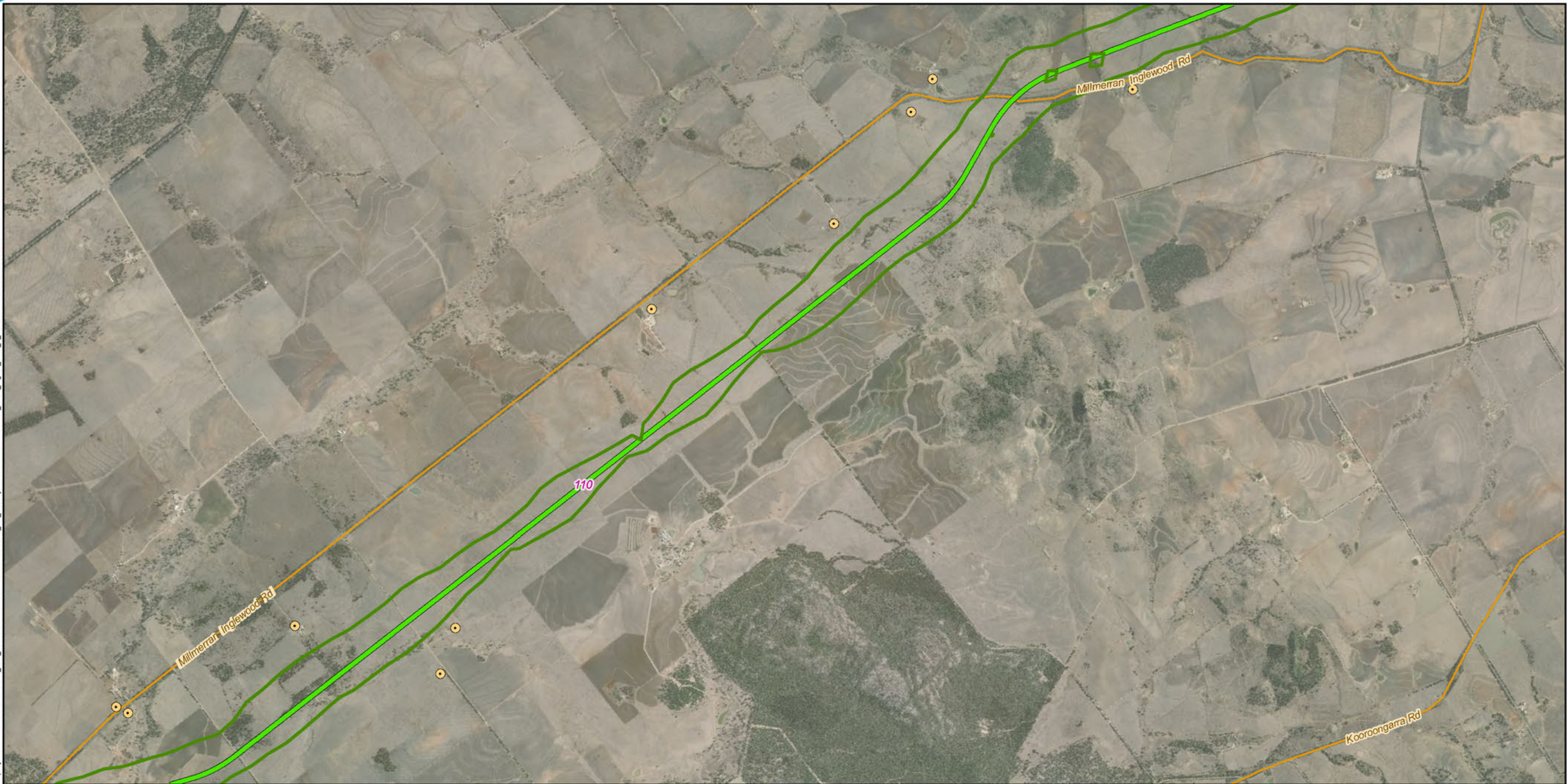
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Border to Gowrie

Figure 7.5i:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

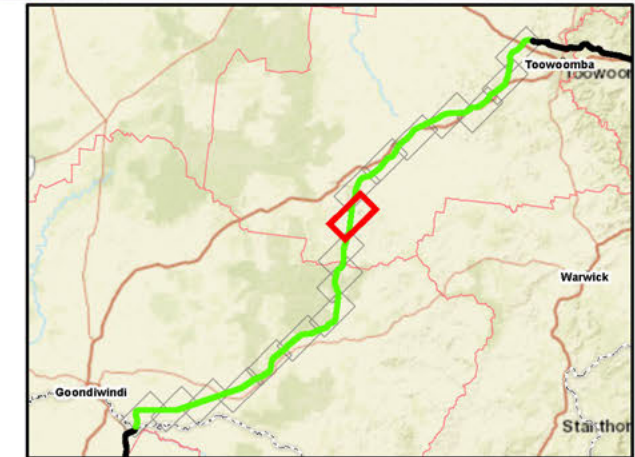


Legend

- Sensitive receptors
- 5 Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5 km



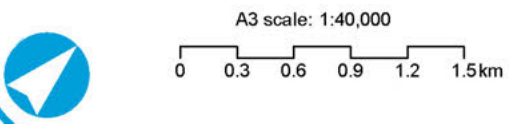
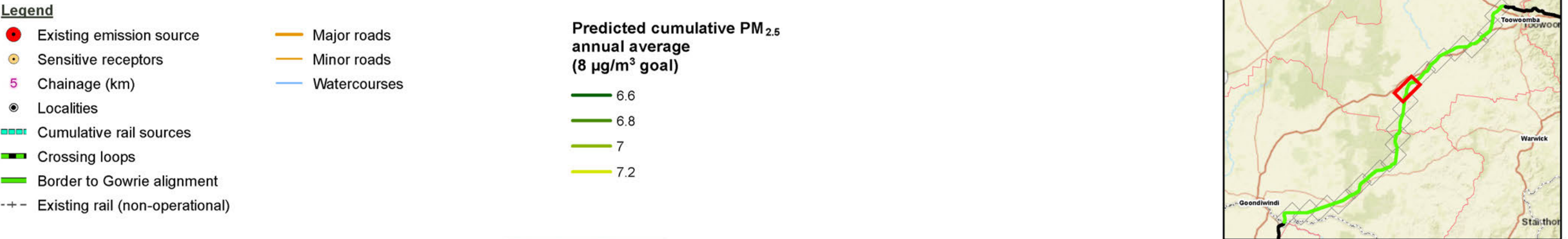
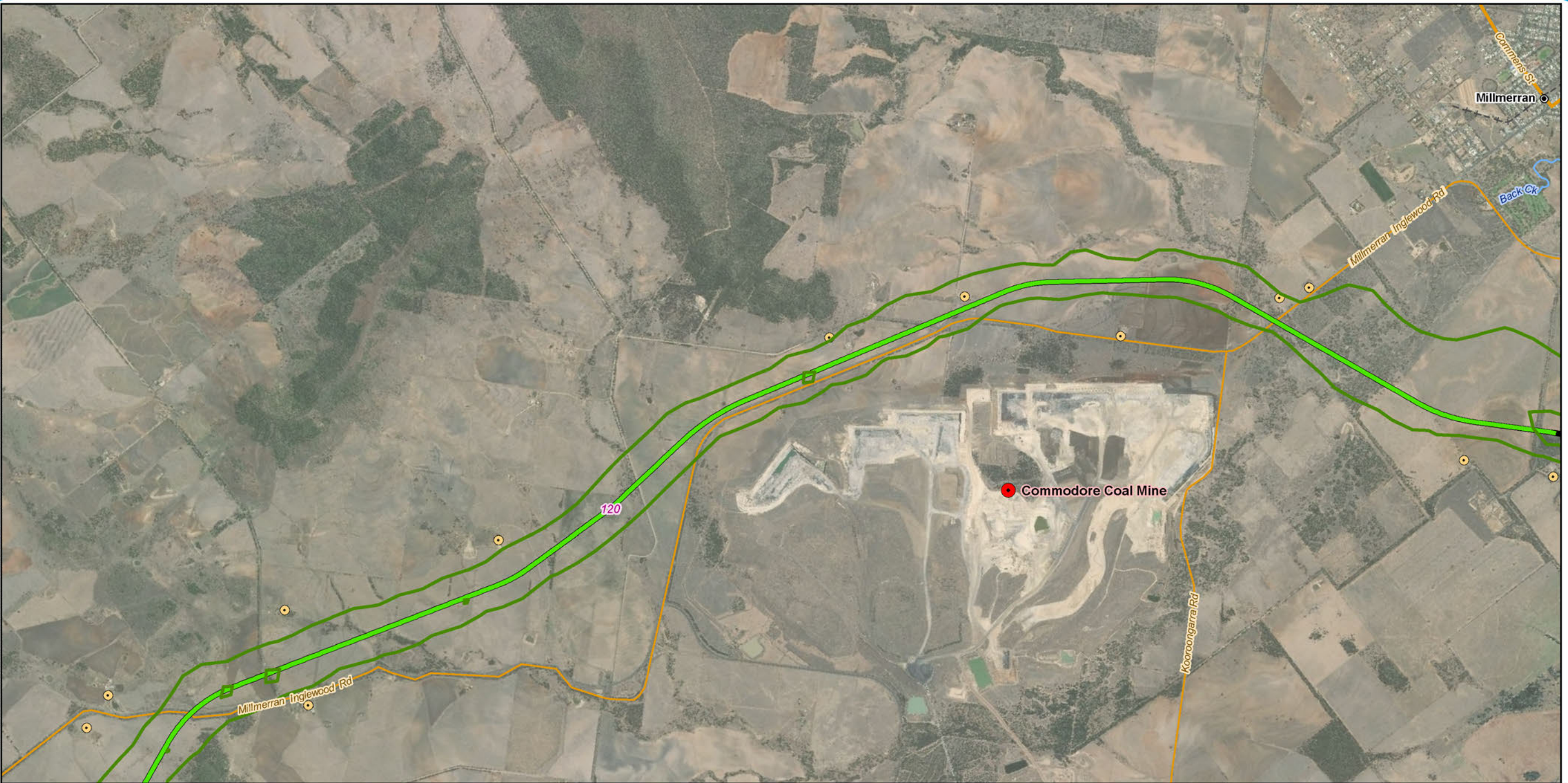
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Border to Gowrie

Figure 7.5j:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)





Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



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Border to Gowrie

Figure 7.51:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

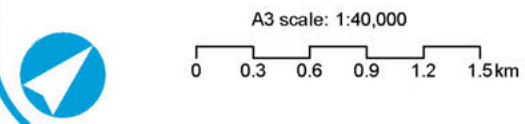
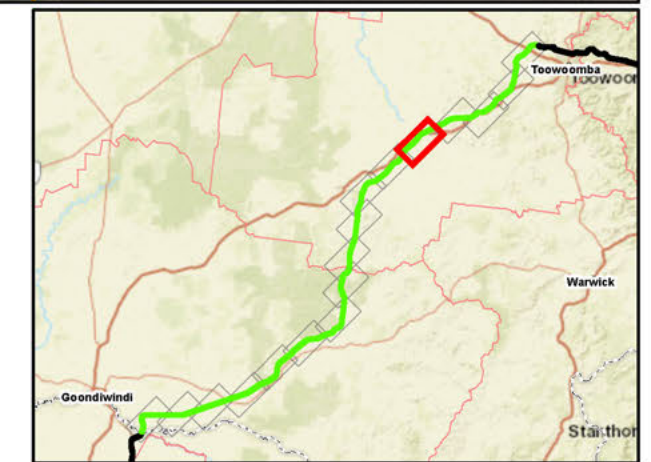


Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



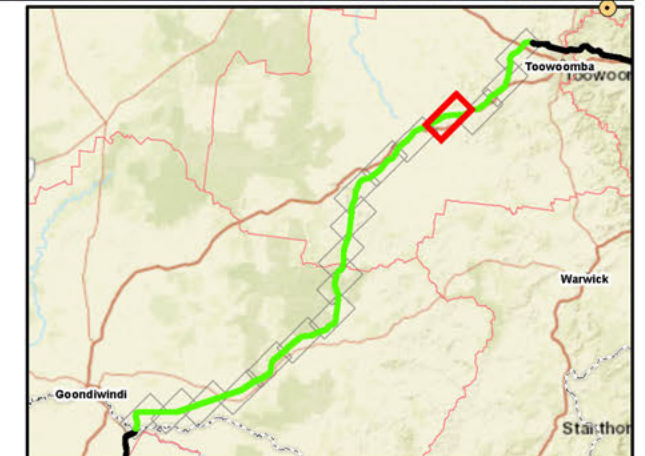


Legend

- Sensitive receptors
- 5 Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



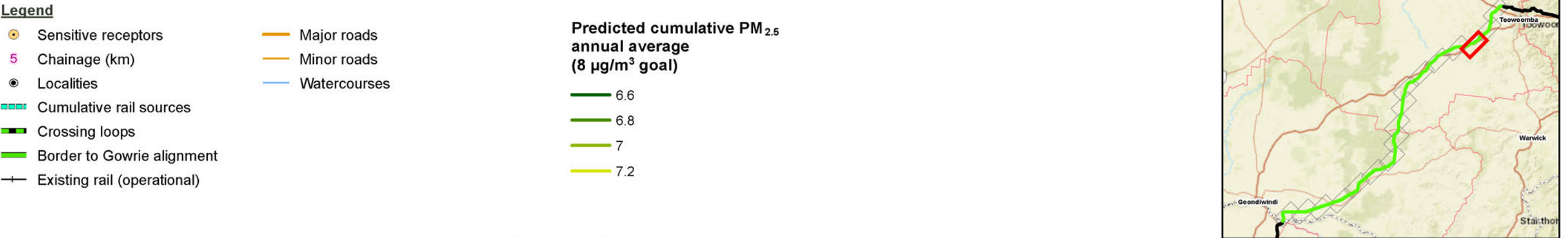
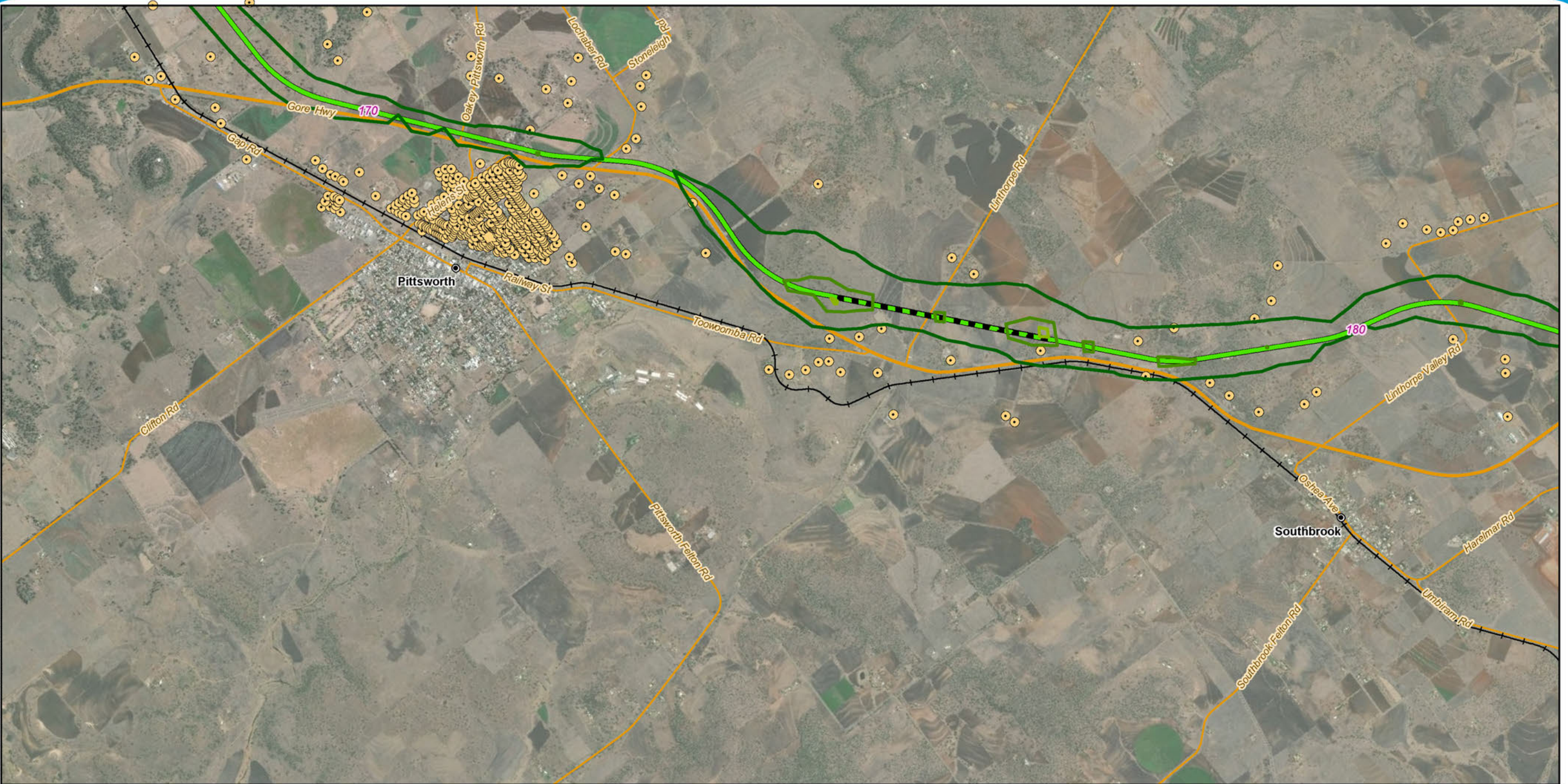
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Border to Gowrie

Figure 7.5n:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



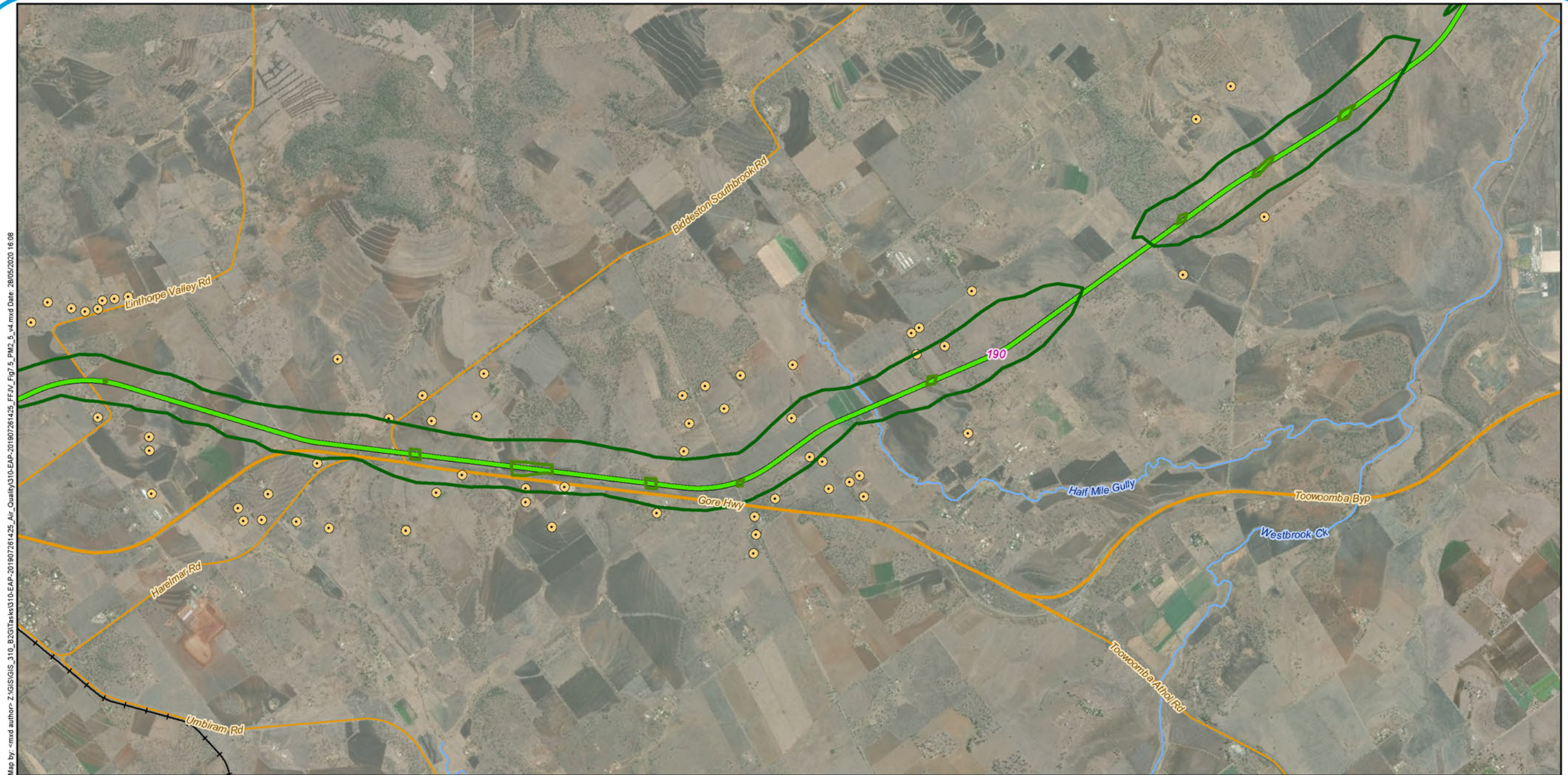
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Border to Gowrie

Figure 7.5o:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)



Legend

- Sensitive receptors
- 5 Chainage (km)
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- + Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
 0 0.3 0.6 0.9 1.2 1.5km



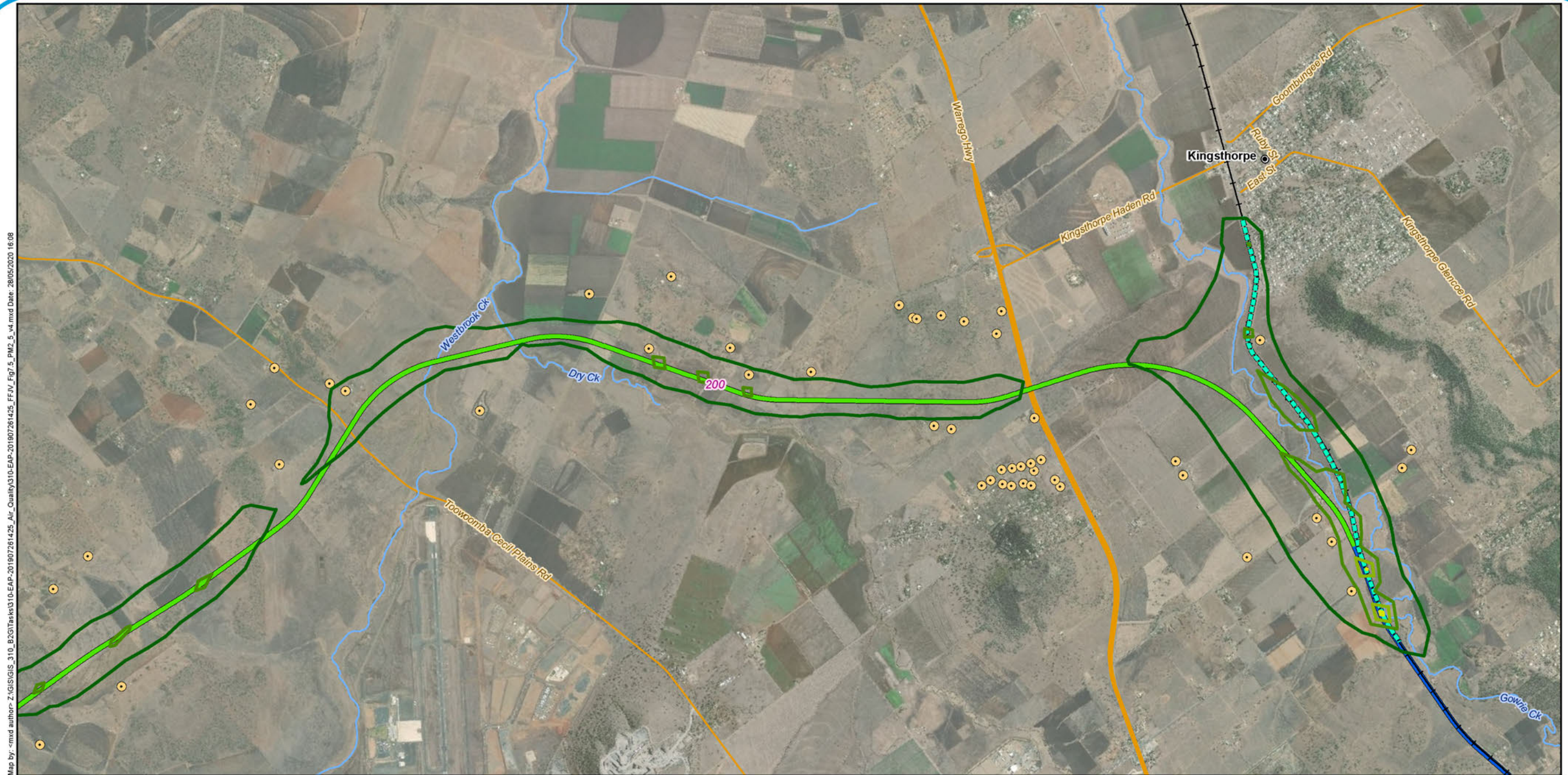
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Border to Gowrie

Figure 7.5p:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

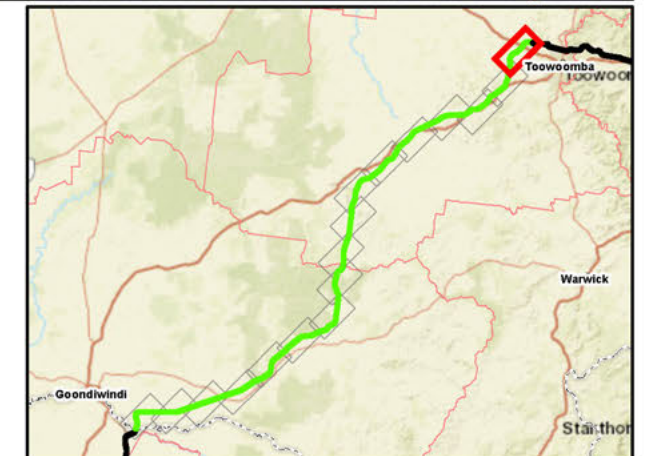


Legend

- Sensitive receptors
- 5 Chainage (km)
- Localities
- Cumulative rail sources
- Crossing loops
- Border to Gowrie alignment
- Gowrie to Helidon alignment
- Existing rail (operational)
- Major roads
- Minor roads
- Watercourses

Predicted cumulative PM_{2.5} annual average (8 µg/m³ goal)

- 6.6
- 6.8
- 7
- 7.2



A3 scale: 1:40,000
0 0.3 0.6 0.9 1.2 1.5km



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Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 7.5q:

Predicted cumulative PM_{2.5} annual average ground level concentration plot (Project only)

8 Mitigation measures and monitoring

This section outlines the air quality mitigation measures that have been identified and incorporated into the reference design for the Project (refer Section 8.1), in addition to those that will need to be implemented through future phases of the Project (refer Section 8.2). It also discusses the air quality monitoring which will be undertaken to support the Project.

No comprehensive guideline information is currently available for best practice environmental management measures for the emissions of air pollutants from construction related emissions in Queensland or Australia. Guidance on management measures are provided within the Guideline for the Assessment of dust from demolition and construction (UK IAQM, 2014). However, many of these measures are tailored to the UK and are not necessarily applicable for Australia. Where similar conditions do exist, the proposed mitigation measures do align with the suggested mitigation measures from the IAQM guideline document. Mitigation measures prescribed in the *NPI Emissions Estimation Manual for Mining* (Department of Sustainability, Environment, Water, Population and Communities, 2012) are also considered applicable for the construction phase, and selected mitigation measures from this document are proposed.

The mitigation measures that are identified are considered to represent best practice environmental management of air emissions.

8.1 Mitigation through the reference design phase

Development of the reference design for the Project has progressed in parallel with the impact assessment process. As a consequence, design solutions for avoiding, minimising or mitigating impacts have been incorporated into the reference design as appropriate and where possible.

Mitigation measures and controls that have been factored into the reference design, or otherwise implemented during the reference design phase of the Project are summarised in Table 8.1.

Table 8.1 Initial mitigation measures of relevance to air quality

Aspect	Initial mitigation measures
Emissions from refuelling activities during construction	■ The planning, siting and assessment of potential temporary fuel storage locations has taken into consideration the location of sensitive receptors to avoid potentially impacting sensitive receptors as far as practical.
Emissions from construction vehicles	■ The horizontal and vertical alignment has been established to optimise the earthworks required and achieve as close to a net-balance as is possible. By minimising the material deficit for construction of the Project, the volume of material required to be imported has been reduced. Less imported material equates to fewer construction truck movements and less vehicular emissions. ■ Construction haulage routes that provide the shortest journey time between origin and destination have been identified. These routes restrict fuel consumption and vehicular emissions. These routes have been assessed as part of the traffic impact assessment in the draft EIS (refer Chapter 18: Traffic, transport and access).
Fugitive dust emissions (windborne erosion) during construction and operation	■ The Project footprint has been established to provide the minimum clearing extents required to safely and efficiently construct and operate the Project, thus minimising the total extent of exposed area where possible. ■ Laydown areas and other construction-phase facilities have been located to avoid impacts to environmental and social receptors. ■ Embankment batters and other exposed surfaces have been designed to enable stabilisation to reduce fugitive dust emissions. ■ An air quality monitoring station has been installed at a residential dwelling on 524 Millmerran-Inglewood Road, Millmerran (sensitive receptor 188), which is located approximately 1.4 km to the north of Commodore Mine. Monitoring data (PM₁₀ and PM_{2.5}) from this location will improve understanding of ambient air quality and emissions from the mine, and will be used to guide the detail design and finalisation of the construction approach for the Project. Further discussion of the monitoring at this location is provided in Section 8.4.

Aspect	Initial mitigation measures
Emissions from operational locomotives	■ The Project has been co-located within existing transport corridors as much as possible, including being positioned within the existing South Western Line and Millmerran Branch Line rail corridors, to avoid introducing a new linear infrastructure corridor in proximity to receptors potentially sensitive to air emissions. ■ The Project has been aligned to avoid, where possible, steep terrain and topographical constraints to provide for more efficient operational track geometry and grade. This results in faster train transit time and less locomotive emissions.
Emissions from idling locomotives	■ Crossing loops at Yelarbon, Inglewood, Kooroongarra, Yandilla and Broxburn have been positioned to avoid, where possible, the exposure of sensitive receptors to diesel emissions from idling trains.

8.2 Operational considerations

During operation, ARTC will be responsible for management of access to the Inland Rail network by third party freight train operators and maintenance of the railway and other infrastructure components within the rail corridor.

Dust and air quality management measures will be incorporated into the environmental risk management frameworks that will apply to third party freight train operators as part of network access agreements. The access agreements established will require train operators to prepare suitably detailed environmental management plans for their operations to specify how the operator will manage all foreseeable risks. These plans will include clear performance requirements and traceable corrective measures and be subject to verification and auditing by ARTC.

There is presently no foreseeable market-driven demand for coal to be transported on the Inland Rail network, between the NSW/QLD border and Gowrie. However, the transportation of coal on this section of the network cannot be precluded in future operational years.

If coal is to be transported in future operational years, the potential for coal dust generation would require management via a Coal Dust Management Plan (CDMP). The measures included in the CDMP will aim to minimise surface lift-off of materials in transit and establish protocols to minimise spillage onto external areas of wagons. To achieve this, the following measures could be included:

- A requirement for veneering on loaded coal at coal loading facilities prior to its transportation along the rail network
- Coal washing and moisture management
- Load profiling and use of 'garden bed profile'
- Monitoring of performance.

If a CDMP was required to support future operational years, the plan would be prepared in consultation with the relevant regulatory agency at that time.

8.3 Proposed mitigation measures

In order to manage and mitigate the Project risks, several mitigation measures have been proposed for implementation in future phases of Project delivery. These proposed mitigation measures have been identified to address Project specific issues and opportunities.

Table 8.2 identifies the relevant Project phase, the aspect to be managed and the proposed mitigation measure. For this purpose, proposed mitigation measures of relevance to pre-construction and construction phase activities have been combined. For several of the mitigation measures proposed, the expected control efficiency (emission reduction percentage) has been nominated. The control efficiencies reported have been obtained from the *NPI Emissions Estimation Manual for Mining* (Department of Sustainability, Environment, Water, Population and Communities, 2012).

The mitigation measures presented in Table 8.2 have then been factored into the assessment of residual significance, as documented in Table 9.1.

Table 8.2 Air quality mitigation and management measures for future phases of Project delivery

Delivery phase	Aspect	Mitigation and management measures
Detail design	Emissions from construction vehicles	- Haulage routes and access roads will be confirmed for construction of the Project based on the shortest and safest trafficable route for each vehicle type, in consultation with relevant road managers, to minimise vehicular emissions. - Planning of haulage routes will seek to maximise the use of sealed trafficable surfaces, where appropriate to do so. - Additional geotechnical data will be used to refine the earthworks balance for the Project by providing further confirmation on the expected quantities of reusable, unusable and excess material. The objective of refinement will be to further minimise the material deficit for construction of the Project, thereby reducing the number of vehicular movements as part of the mass haul task. - Opportunities to treat and re-use otherwise unusable materials will be identified and assessed for applicability with the objective of minimising vehicular movements, and emissions, for offsite disposal. - Opportunities for the use of ethanol blend fuels during construction will be investigated. These opportunities will be adopted if found through investigation to be beneficial and if it is practical to do so.
	Fugitive dust emissions (windborne erosion) during construction and operation	- The extent of sensitive receptor impacts will be re-assessed through the detail design process once the Project footprint and construction methodology has been confirmed. The location and classification of sensitive receptors in proximity to the finalised Project footprint will be confirmed as part of the re-assessment process. - Baseline particulate data (PM₁₀ and PM_{2.5}) will continue to be collected from the air quality monitoring station on Millmerran-Inglewood Road, Millmerran. Data collected from this station will be used to guide the detail design and finalisation of the construction approach for the Project to ensure that air quality impacts to sensitive receptors are avoided or minimised as much as possible. Data will also enable comparison with PM₁₀ and PM_{2.5} data collected during construction of the Project (refer Section 8.4 for details). - Establish baseline dust deposition data (TSP) prior to construction in proximity to Commodore Mine (e.g. from Ch 120.0 km to Ch 28.0 km). This baseline data will enable comparison with TSP data during construction of the Project. Dust deposition monitoring will be completed at a small number of locations (< 5) adjacent to the Commodore Mine and nearby sensitive receptor locations. Monitoring will occur for a period of three months, and will aim to collect data representative of dust generating activities that occur at the mine, such as blasting, to provide baseline data on the existing air environment. This data will provide indication of the impact on the local air quality from the nearby Commodore Mine and Millmerran Power Station. Dust deposition monitoring will be conducted in accordance with AS/NZ 3580.10.1:2003 - Determination of Particulate Matter - Deposited matter - Gravimetric method. - Development of a Dust Management Sub-plan prior to construction commencing. The Sub-plan will include the following measures, tailored to be specific to the construction methodology, once confirmed: - Minimise major dust generating activities, e.g. blasting or material loading/unloading, during high wind speeds where practicable and unwatered - Routing roads away from sensitive areas wherever practically possible, e.g.: - Residential dwellings and caravan parks - Motels/hotels - Schools and kindergartens - Medical centres - Public parks and recreation areas

Delivery phase	Aspect	Mitigation and management measures
		– Restricting vehicle speeds on unsealed haul roads to reduce dust generation, e.g. to sign-posted speeds on public roads or to construction site speed limits on construction tracks (nominally 40 km/hr - be determined through consultation with the relevant local government and documented in the Traffic Management Sub-plan within the CEMP) – Further speed restrictions on construction tracks (e.g. from 40 km/hr to 20 km/hr) where the trafficable surface is within 200 m of a sensitive receptor – Long-term stockpiled material will be covered or seeded to prevent wind erosion from the prevailing wind – Regular cleaning of machinery and vehicle tyres to prevent track-out of dust onto public roads – Installation of rumble grids or similar at locations where construction traffic departs from the construction site and joins the public road network – Internal construction roads will be appropriately surfaced as soon as possible after the commencement of site activities – Revegetating disturbed areas as soon as practicable, in accordance with the Rehabilitation and Landscaping Management Sub-plan – Vehicles and equipment will be appropriately maintained to maximise fuel efficiency – Visual monitoring of the effectiveness of dust controls will occur on a daily basis. ■ Define and design temporary access tracks to minimise dust generation, e.g. appropriate surface treatments for the predicted construction traffic movements, installation of rumble grids, concrete pads or other physical measures to reduce track-out. ■ Establish designated stockpile locations within the Project corridor.
	Emissions from operational locomotives	■ The vertical alignment of the rail will be subject to refinement and confirmation through the detail design. Opportunities to further optimise the track geometry will be assessed to reduce operational fuel consumption.
	Emissions from idling locomotives	■ Detail design of the railway corridor will be developed to minimise impacts to sensitive receptors from emissions from idling locomotives, through consideration of topography, gradients, landscaping treatments and other surface treatments where practical. ■ The confirmation of the location of the five crossing loops for the Project will seek to minimise the number of receptors in proximity to each loop.
Pre-construction and construction ¹	Impacts to sensitive receptors	■ If on-site wastewater treatment systems are required for non-resident workforce accommodation, these systems will be planned and positioned in accordance with separation distances consistent with the EPA Victoria guideline <i>Recommended separation distances for industrial residual air emissions</i> (EPA Victoria 2013) and operated and maintained in accordance with conditions of approval (sought separately to approval sought through the EIS). Based on the anticipated requirement for a treatment system with a capacity of 300 EP, and assuming that a mechanical or biological wastewater treatment system will be used, a minimum separation distance of 67 m to sensitive receptors will be provided. ■ Laydown areas and other construction facilities (e.g. concrete batching plant, flash-butt welding facility) will be planned to ensure that sources of emissions, such as temporary fuel tanks and generator sets, are positioned as far as possible from neighbouring sensitive receptors, within the confines of the construction footprint.

Delivery phase	Aspect	Mitigation and management measures
	Dust generation from earthworks, clearing and grubbing, construction activities and exposed areas within the construction footprint	■ Limit clearing to the extent required to construct the works, in accordance with the Project footprint defined during detail design. ■ Stage clearing and grubbing activities to limit the size and duration of exposed areas. ■ Implement controls to prevent or minimise dust generation during activities involving excavation or disturbance of soils or vegetation, or handling ballast e.g.: – Use of water sprays or water carts for dust suppression as required (anticipated emission reduction of 50 per cent for water sprays when loading to or from material stockpiles, anticipated emission reduction of 70 per cent when water sprays applied to trucks unloading material) – Installation of hoardings or barriers on worksite perimeters, where appropriate – Polymer sealing of access roads, or similar, where practicable within the construction worksites and ensuring sealed access roads into worksites are kept relatively dust free by regular sweeping and washing, wherever needed (emission reduction of up to 100 per cent is possible for polymer sealing subject to the sealing method adopted) – Conducting demolition activities using appropriate dust controls, such as water sprays – Installing truck wheel wash stations in designated laydown areas, to control the spread of unsuitable materials from worksites. ■ Determination of which dust controls to apply in a given instance will be guided by the objective to minimise the use of water during construction to that absolutely necessary. ■ Water used in dust suppression will be consistent with the quality requirements specified for irrigation and general water use in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC & ARMICANZ, 2018). Investigate suitable additives to the water to improve dust suppression effectiveness and minimise water usage. Adopt the use of additives where appropriate and compliant with relevant approvals and legislation (i.e. the addition of soil binders to water for dust suppression on roads or hard stand areas). ■ Stabilise disturbed areas and exposed surfaces as soon as practical following the completion of works in each area, in accordance with the Rehabilitation and Landscaping Management Sub-plan (refer Chapter 8: Land resources of the Border to Gowrie Project EIS). The following mitigation methods may be used subject to final purpose of the exposed area: – Initial establishment of vegetation (anticipated emission reduction of 30 per cent) – Maintained revegetation (anticipated emission reduction of 90 per cent) – Establishment of self-sustaining rehabilitation vegetation (anticipated emission reduction of 100 per cent) – Sealing of exposed surface (i.e. concrete, asphalt, etc) (anticipated emission reduction of 100 per cent). ■ Long-term stockpiles will be avoided wherever possible. However, where necessary (e.g. topsoil), long-term stockpiles will be established in designated locations. Stockpiles will be positioned to minimise erosion by the prevailing wind. ■ Stabilise and protect long-term stockpiles from erosive processes whilst not in use, such as through impermeable cover or seeding. ■ To reduce wind erosion from stockpiles, the following mitigation methods may be used subject to water availability and stockpile activity: – Water sprays (anticipated emission reduction of 50 per cent) – Wind breaks or earthworks profiling (anticipated emission reduction of 30 per cent) – Application of rock armour/covering (anticipation emission reduction of 30 per cent)

Delivery phase	Aspect	Mitigation and management measures
		– Covering of the stockpile with an impermeable covering (i.e. tarpaulin) or binding agent (anticipated emission reduction of 100 per cent). If water sprays are implemented for stockpiles, the application rate of water will be increased for stockpiles which will receive new material regularly. ■ Direct exposure of construction workers to respirable silica and other airborne contaminants will be controlled through the use of appropriate Personal Protective Equipment in line with ARTC's Work Instruction for Personal Protective Equipment (WHS-WI-315) (available on the ARTC extranet). ■ Construction speed limits will apply to all unsealed routes used by construction vehicles. Applicable speed limits for local government roads will be determined through consultation with the relevant local government and documented in the Traffic Management Sub-plan within the CEMP (refer Chapter 22: Outline environmental management plan of the Border to Gowrie Project EIS). ■ Minimising the requirement for vehicle movement outside worked areas, where practically possible. ■ Landowners will be notified in advance of the commencement of construction activities in an area proximal to them. This notification will be in accordance with community notification procedures established for the Project and will provide information on the types of activities that will occur, indicative scheduling and the potential impacts that may be experienced (e.g. generation of dust). ■ A complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including the generation of excessive dust or other air emissions during construction. ■ In the event of a dust complaint, ARTC will: – In the first instance, investigate cause of the complaint – Determine appropriate remedial action – Liaise with administering authority and/or complainant over remedial action – Implement appropriate remedial action. ■ Maintain a complaints register relating to air quality, including record of remedial actions.
	Dust generation and deposition as a result of adverse weather conditions	■ Avoid ground-disturbing activities during windy conditions (i.e. winds > 36 km/hr). When this is not practical, implement additional management measures, such as enhanced watering of access roads (anticipated emission reduction of 50 to 75 per cent) and works areas to minimise the potential increase in dust generation. ■ Monitor meteorological conditions at worksites and designated stockpile locations, particularly wind speed and direction. Implement additional dust suppression controls prior to the onset of adverse weather, including covering of stockpiles (anticipated emission reduction of 100 per cent for impermeable cover) and additional watering of access roads (anticipated emission reduction of 50 to 75 per cent). ■ Maintain and improve (if necessary) weather monitoring protocols to enable dust suppression activities to occur prior to the onset of adverse weather.
	Cumulative effects of dust emissions from construction and external land uses or activities.	■ Undertake dust deposition (TSP) monitoring during the active period of construction in proximity to Commodore Mine, at locations where baseline data was collected (refer above), to determine if construction results in significant dust impacts. Dust deposition monitoring to be in accordance with AS/NZ 3580.10.1:2003 - Determination of Particulate Matter - Deposited matter - Gravimetric method. The results of construction dust deposition monitoring will be included in construction environmental reporting. ■ Advise the operators of the Commodore Mine of proposed construction activities scheduled to occur in proximity to the mine to enable coordinated consultation with potentially impacted stakeholders.

Delivery phase	Aspect	Mitigation and management measures
	Emissions from combustion engines (construction vehicles and generators)	■ Avoid queuing of the construction traffic vehicle fleet on public roads, which in turn would minimise the amount of exhaust emissions generated during construction works. ■ Marshalling and queuing of trucks and worksite vehicles to occur away from residential areas and other sensitive receptors, where possible. ■ Direct exhaust emissions from mobile and stationary plant away from the ground and sensitive receptors, where possible. ■ When locating temporary fuel storage, provide a minimum separation distance of 50 m from sensitive receptors and compliance with Australian Standard AS 1940:2017 <i>The storage and handling of flammable and combustible liquids</i>. This is of particular relevance where laydown facilities are in proximity to sensitive receptors, e.g. B2G-LDN006.3 on Yelarbon-Kurumbul Road. ■ Minimise the use and intensity of use of diesel engines, as much as practicable. ■ For stationary plant and equipment, ensure all diesel motors are fitted with emission control measures and are regularly maintained to manufacturer's specifications. ■ Turn off idling plant, equipment and vehicles when not in use. ■ Minimise haul distances between construction sites to spoil sites. ■ Implement a regular maintenance program to ensure equipment and construction fleet are maintained to manufacturer's specifications. ■ Use appropriately sized equipment for construction activities. ■ Procure energy efficient construction equipment, when appropriate. ■ Minimise waste from construction by procuring pre-fabricated products, where possible. ■ Where possible, use low energy intensity materials instead of high energy intensity building materials. ■ Minimise haul distances between construction sites to spoil sites. ■ Implement a regular maintenance program to ensure equipment and construction fleet are maintained to manufacturer's specifications. ■ Use appropriately sized equipment for construction activities.
	Fugitive dust emissions from vehicles transporting materials to and from site	■ Vehicles transporting material to and from the maintenance works site on public roads will cover loads to prevent wind-blown dust emissions and spillages. ■ Visually inspect vehicles entering/exiting the site and implement additional controls if corrective actions are required. ■ Install rumble grids, or similar, at the entry and exit points of laydown areas. ■ Site based construction traffic is limited to identified haul routes as per the Traffic Management Sub-plan developed as a component of the CEMP.
	Potential GHG gas emissions (other than combustion engine emissions)	■ Procure energy efficient construction equipment, when appropriate. ■ Minimise waste from construction by procuring pre-fabricated products, where possible. ■ Where possible, use low energy intensity materials instead of high energy intensity building materials.

Delivery phase	Aspect	Mitigation and management measures
Operation	Particulate matter and other emissions from freight on operation locomotives	- Before a train travels on the Inland Rail network, operators will make sure that the classes of dangerous goods, and the identification numbers of vehicles carrying dangerous goods, are recorded in the train consist documentation. Dangerous goods will be loaded, labelled, and marshalled in accordance with the Australian Dangerous Goods Code. - If coal is to be transported in future operation years, the potential for coal dust generation will require management via a CDMP. The measures included in the CDMP will aim to minimise surface lift-off of materials in transit and establish protocols to minimise spillage onto external areas of wagons. The plan will be prepared in consultation with the relevant regulatory agency at the time.
	Emissions from combustion engines (construction vehicles and generators)	- Maintenance plant, vehicles and machinery will be maintained and operated in accordance with manufacturer's recommendations to maximise fuel efficiency. - Minimise unnecessary travel between maintenance locations. - Turn off idling plant, equipment and vehicles when not in use.
	Stakeholder communication	- Landowners will be notified in advance of the commencement of maintenance activities in an area proximal to them. This notification will be in accordance with community notification procedures established for the Project and will provide information on the types of activities that will occur, indicative scheduling and the potential impacts that may be experienced (e.g. generation of dust). - A complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including the generation of excessive dust during operation and maintenance. - In the event of a dust complaint, ARTC will: - In the first instance, investigate cause of the complaint - Determine appropriate remedial action - Liaise with administering authority and/or complainant over remedial action - Implement appropriate remedial action. - Maintain a complaints register relating to air quality, including remedial actions. - Monitor, record and audit complaints about dust and emissions in accordance with the relevant complaints management handling procedures.
	Fugitive dust emissions from vehicles transporting materials to and from site (e.g. for maintenance)	- All operational personnel are aware of the sensitivities with regard to elevated dust levels within and adjacent to the Project footprint. - Vehicles transporting material to and from the maintenance works site on public roads will cover loads to prevent wind-blown dust emissions and spillages. - Visually inspect vehicles entering/exiting the site and implement additional controls if corrective actions are required. - During adverse wind conditions visual inspection of stockpiles will be conducted and mitigation procedures implemented if required.

Table note:

1 Combined, as there is no distinction between mitigation measures applicable for pre-construction and construction phases of the Project

8.4 Monitoring

8.4.1 Particulate matter

Based on assumed background concentrations and estimates of pollutant emissions from the Commodore Mine and Millmerran Power Station, an exceedance of the PM₁₀ 24 hour air quality goal of 50 µg/m³ is predicted at sensitive receptor 186, located approximately 1.1 km to the north of Commodore Mine (refer Section 7.1). Due to uncertainties with respect to emissions from the mine and an absence monitoring data in the area local to the mine and power station, there is uncertainty with respect to the accuracy of predicted cumulative concentrations at sensitive receptors in the area near the mine and power station, including at sensitive receptor 186.

To improve the understanding of background air quality in this area, an air quality monitoring station has been installed at a location representative of receptors near the mine and power station.

The monitoring station is located at 524 Millmerran Inglewood Road, Millmerran, and is referred to as the Millmerran AQMS. The location of the Millmerran AQMS is shown in Figure 8.1. The monitoring location is approximately 1.4 km north of the Commodore Mine, and approximately 300 m north of receptor 186.

Consistent with the pollutants of concern for the assessment, the Millmerran AQMS monitors concentrations of PM₁₀ and PM_{2.5} and measures meteorological conditions. Consistent with the methodology for the Inland Rail AQMS, monitoring is undertaken using Beta Attenuation Monitoring in accordance with AS/NZS 3580.9.11:2016 (PM₁₀) and AS/NZS 3580.9.12:2013 (PM_{2.5}). The monitoring station has been positioned in accordance with requirements listed in Australian Standard AS/NZS 3580.1.1:2016.

Monitoring at the Millmerran AQMS has started, however, at the time of reporting, insufficient measurement data was available.

Monitoring data from this location will be used guide the detailed design and finalisation of the construction approach for the Project to ensure that air quality impacts to sensitive receptors are avoided or minimised as much as possible.

8.4.2 Dust deposition

8.4.2.1 Baseline data

Baseline dust deposition (TSP) monitoring will be conducted prior to the commencement of construction in proximity to Commodore Mine. This baseline data will enable comparison with TSP data obtained during construction of the Project. Dust deposition monitoring will be completed at a small number of locations (< 5) adjacent to the Commodore Mine and nearby sensitive receptor locations.

Monitoring will occur for a period of three months, and will aim to collect data representative of dust generating activities that occur at the mine, such as blasting, to provide baseline data on the existing air environment. This data will provide indication of the impact on the local air quality from the nearby Commodore Mine and Millmerran Power Station. Dust deposition monitoring will be conducted in accordance with AS/NZ 3580.10.1:2003 - Determination of Particulate Matter - Deposited matter - Gravimetric method.

8.4.2.2 Construction phase monitoring

Dust deposition (TSP) monitoring will be conducted during the active period of construction in proximity to Commodore Mine, at locations where baseline data was collected (refer above), to determine if construction results in significant dust impacts. Dust deposition monitoring will be in accordance with AS/NZ 3580.10.1:2003 - Determination of Particulate Matter - Deposited matter - Gravimetric method. The results of construction-phase dust deposition monitoring will be included in construction environmental reporting, as specified in Chapter 22: Outline environmental management plan of the Border to Gowrie EIS.

Map by: DTH/MEF/NCW Z:\GIS\GIS_310_B2\GIS\Tasks\310-EAP-201807261425_Air_Quality\310-EAP-201807261425_FF\IV_Fig8_1_Millmerran_Monitoring_Location.mxd Date: 28/05/2020 14:30



Legend

- Millmerran AQMS
- Existing emission source
- Sensitive receptors
- 5 Chainage (km)
- Localities
- Border to Gowrie alignment
- - - Existing rail (non-operational)
- Major roads
- Minor roads
- Watercourses



A3 scale: 1:51,000
0 0.35 0.7 1.05 1.4 1.75 km



Future Freight
Integrating Community, Environment and Engineering

Issue date: 29/05/2020 Version: 1
Coordinate System: GDA 1994 MGA Zone 56

Border to Gowrie

Figure 8.1:
Millmerran monitoring location

9 Impact assessment summary

Potential construction phase impacts to air quality and sensitive receptors have been assessed qualitatively as presented in Section 6. Assessment of the residual impact of the construction phase of the Project following the implementation of the recommended mitigation measures (refer Section 8) is presented in this section, with the outcomes presented in Table 9.1.

This section provides a summary of the potential significance of construction phase impacts to air quality and sensitive receptors, before and after the application of mitigation measures through future phases of Project delivery. A quantitative (compliance) assessment has been undertaken for potential operation impacts, as predicted concentrations at sensitive receptors have been assessed against legislative and other nominated air quality objectives (refer Section 3.6). Therefore, operation phase impacts are omitted from discussion in this section. The results of the quantitative assessment of potential operation impacts are detailed in Section 7 and mitigation measures for the operational phase of the Project are included in Section 8.3.

The initial significance assessment in Table 9.1 is undertaken on the assumption that the design considerations (or initial mitigation measures) factored into the reference design phase have been implemented.

Additional mitigation and management measures (refer Table 8.2) were then applied to future phases of the Project to further reduce the level of potential impact and derive a residual significance of impact.

The initial and residual significance of potential impacts are presented in Table 9.1 to demonstrate the effectiveness of mitigation measures. This table has been structured to maintain consistency with the IAQM methodology which is activity based and as such earthworks and track-out are assessed across both the pre-construction and construction phase.

The IAQM construction dust assessment guidance states:

For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be “not significant”.

Consistent with the IAQM statement, it is expected that with effective implementation of the proposed mitigation measures the impacts to air quality with respect to dust deposition and human health will not be significant. Therefore, with effective implementation of the proposed mitigation measures the construction of the Project is not anticipated to significantly adversely impact the environmental values of human health and the aesthetic environment.

Table 9.1 Impact assessment for potential air quality impacts associated with construction

Activity	Aspect ¹	Potential impact	Receptor sensitivity	Initial significance ²		Residual significance ³	
				Emission magnitude	Significance	Emission magnitude	Significance
Demolition	All dust generating sources associated with demolition	Dust soiling	Medium	Small	Low	Small	Low
		Human health	Low	Small	Negligible	Small	Negligible
Earthworks associated with pre-construction and construction phase	All dust generating sources associated with pre-construction and construction phase earthworks	Dust soiling	Medium	Large	Medium	Small	Low
		Human health	Low	Large	Low	Small	Negligible
Construction	All dust generating sources associated with construction phase for the Project	Dust soiling	Medium	Large	Medium	Small	Low
		Human health	Low	Large	Low	Small	Negligible
Track-out associated with pre-construction and construction phase.	All dust generating sources associated with pre-construction and construction phase traffic associated with the Project	Dust soiling	Medium	Large	Medium	Medium	Low
		Human health	Low	Large	Low	Medium	Low

Table notes:

- 1 Refer to Table 8.2 for reference to the proposed additional mitigation measures relevant to each aspect.
- 2 Includes implementation of initial mitigation measures specified in Table 8.1
- 3 Assessment of residual risk once the mitigation measures identified in Table 8.1 and Table 8.2 have been applied.

10 Cumulative impact assessment

It is a requirement of the ToR for this Project that the potential for cumulative impacts be considered. This section provides a discussion on the potential for cumulative impacts in relation to air quality during the construction phase of the Project. As stated in Section 5.6, the assessment of operational phase air quality impacts has incorporated the emission contributions of existing or planned developments that are, or will be a significant source of pollutants of interest that are also relevant to the Project (refer Section 5.3.1.2). The potential cumulative impacts to air quality during operation of the Project are presented in Table 7.2. Therefore, the cumulative impact discussion in this section is confined to construction phase impacts.

10.1 Assessment matrix

The significance of construction phase cumulative impacts has been determined by using professional judgement to select the most appropriate relevance factor for each aspect in Table 10.1. The sum of the relevance factors determines the impact significance and consequence which are summarised in Table 10.2. For example if an environmental value (such as air quality) is considered to have a probability of impact of 2, duration of impact of 3, magnitude/intensity of impact of 1 and a sensitivity of receiving environment of 1 the significance of impact would be Medium ($2+3+1+1 = 7$).

Table 10.1 Assessment matrix

Aspect	Relevance factor		
	Low	Medium	High
Probability of impact	1	2	3
Duration of impact	1	2	3
Magnitude/Intensity of impact	1	2	3
Sensitivity of receiving environment	1	2	3

Table 10.2 Impact significance

Impact significance	Sum of relevant factors	Consequence
Low	1-6	Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
Medium	7-9	Mitigation measures likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
High	10-12	Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

10.2 Cumulative impacts

It is a requirement of the ToR for this Project that the potential for cumulative impacts to be considered. This section provides a discussion on the potential for cumulative impacts in relation to air quality during the construction phase of the Project. As stated in Section 5.6, the assessment of operation phase air quality impacts has incorporated the emission contributions of existing or planned developments that are or will be a significant source of pollutants of interest that are also relevant to the Project. The potential cumulative impacts to air quality during the operation of the Project are presented in Table 7.2. Therefore, the cumulative impact discussion in this section is confined to construction phase impacts.

A total of 23 projects were initially identified as having potential to contribute to cumulative impacts in combination with the Border to Gowrie Project. These projects are either currently operational, expected to undergo future expansion or are currently going through an approval process.

Dust is predicted to be the primary emission from the Project during construction. The IAQM guidance document specifies that receptors located 350 m or more from a dust generation source are expected to have a sensitivity to human health impacts that is 'Low' (refer Section 6.1.4). Therefore, for the purposes of construction air quality, projects that directly interface the Border to Gowrie project and will have temporal overlap in construction or expansion activities are considered to have potential to result in cumulative impacts. Only five of the initial 23 projects identified meet these criteria. These projects are listed in Table 10.3.

Table 10.3 Projects considered for the cumulative impact assessment

Projects	Location	Description	Construction dates
InterLinkSQ	13 km west of Toowoomba The northern limit of the Project is situated adjacent to the InterLinkSQ site	A 200 ha transport, logistics and business hub. Located on the narrow gauge regional rail network and interstate network. Located at the junction of the Gore, Warrego and New England Highways.	2018 to unknown Assumed to continue development until Inland Rail is operational
Commodore Mine and Millmerran Power Station	Domville, QLD The Project is aligned adjacent to potential future coal reserves for the mine	The Commodore Mine is an open cut coal mine which provides coal for the 850 MW Millmerran Power Station. The Millmerran Power Station is a coal-fired power station that supplies enough electricity to power approximately 1.1 million homes.	Operational Subject to annual maintenance shutdown and continual pit expansion. Also potential for coal reserves to be accessed beyond the current footprint
North Star to NSW/QLD Border (Inland Rail)	Rail alignment from North Star, NSW to the NSW/QLD border Adjoins the Project at its southern limit	New 37 km rail corridor to connect North Star (NSW) to the Queensland Rail South West Rail Line just over the NSW/QLD border.	2021 to 2024
Gowrie to Helidon (Inland Rail)	Rail alignment from Gowrie to Helidon, QLD Adjoins the Project at its northern limit	New 26 km dual gauge track between Gowrie (north-west of Toowoomba) and Helidon (east of Toowoomba), extending through the Local Government Areas of Toowoomba and Lockyer Valley. The Project includes a 6.38 km tunnel to create an efficient route through the steep terrain of the Toowoomba Range.	2021 to 2025
Asterion Medicinal Cannabis Facility	Wellcamp, QLD Located adjacent the eastern construction footprint boundary of the Project. The facility will be located between the Project and the Toowoomba Wellcamp Airport	A high-tech medicinal cannabis cultivation, research and manufacturing facility. The project involves construction of a 40 ha glasshouse to produce 20,000 plants per day at full capacity. Medicinal grade cannabis grown at the facility will be manufactured into a range of medicinal products, including single patient packs, cannabis oils, gels, salts and related products, destined solely for the medicinal market. The facility will be powered by renewable energy.	2020 to 2021

An assessment of cumulative impacts that may arise from the projects listed in Table 10.3 in combination with the construction of the Project is presented in Table 10.4, with a summary of how potential cumulative impacts would be managed.

This assessment has concluded that the construction phase cumulative air quality impacts of the Project are expected to be of **Low Significance**. The following factors contributed to this determination:

- Impact assessment for the Project has concluded that unmitigated air emissions from the construction of the Project pose a 'Low' risk of human health impacts but a 'Medium' risk of dust soiling (refer Section 6.1.5). However, mitigation measures for the emission of dust and other construction air pollutants will be implemented, and these risks are expected to be further reduced.
- The emissions sources of air pollutants during construction of the Project are expected to be activities that are reasonably short in duration and mobile. Therefore, no single sensitive receptor is expected to be subject to be medium or long term impacts.

To improve the understanding of background air quality in the area around Commodore Mine, an air quality monitoring station has been installed at a residential dwelling on Millmerran-Inglewood Road, Millmerran. Monitoring data from this location will improve understanding of ambient air quality and emissions from the mine and will be used to guide the detail design and finalisation of the construction approach for the Project. The data will also be used to establish a local baseline against which performance of the Project can be assessed during construction, thereby enabling cumulative impacts to be identified.

Table 10.4 Cumulative impact assessment for air quality

Project	Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Comments and management measures
InterLinkSQ	Emissions of air pollutants, specifically dust (construction)	Probability of the impact	Medium (2)	6	Low	The potential for cumulative impacts during construction to air quality is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the development and implementation of a Dust Management Sub-plan, as a component of the CEMP for the Project. ARTC will consult with InterLinkSQ regarding scheduling of construction activities to avoid the simultaneous undertaking of dust generating activities, where possible.
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Low (1)			
Commodore Mine and Millmerran Power Station	Emissions of air pollutants, specifically dust (construction)	Probability of the impact	Medium (2)	6	Low	The potential for cumulative impacts during construction to air quality is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through: - Development and implementation of a Dust Management Sub-plan, as a component of the CEMP for the Project - Establish a local baseline for particulate matter, using data collected from the Millmerran AQMS - Undertake dust deposition (total suspended particulate [TSP]) monitoring, at locations where baseline data is collected, whilst construction activities occur in proximity to Commodore Mine (e.g. where dust generating activities occur between Ch 120.0 km to Ch 128.0 km) - Consultation with Intergeren regarding scheduling of construction activities to avoid the simultaneous undertaking of dust generating activities, where possible
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Low (1)			
North Star to NSW/QLD Border (Inland Rail)	Emissions of air pollutants, specifically dust (construction)	Probability of the impact	Low (1)	6	Low	The potential for cumulative impacts during construction to air quality is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the development and implementation of a Dust Management Sub-plan, as a component of the CEMP for the Project.
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Medium (2)			
		Sensitivity of the receiving environment	Low (1)			

Project	Potential cumulative impact	Impact characteristic	Relevance factor	Sum of relevance factors	Impact significance	Comments and management measures
						A complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including the generation of excessive dust or other air emissions during construction, either from a single project or a combination of adjoining Inland Rail projects.
Gowrie to Helidon (Inland Rail)	Emissions of air pollutants, specifically dust (construction)	Probability of the impact	Low (1)	6	Low	The potential for cumulative impacts during construction to air quality is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the development and implementation of a Dust Management Sub-plan, as a component of the CEMP for the Project. A complaint hotline for the Project will be established and advertised to enable members of the public to notify ARTC of issues, including the generation of excessive dust or other air emissions during construction, either from a single project or a combination of adjoining Inland Rail projects.
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Medium (2)			
		Sensitivity of the receiving environment	Low (1)			
Asterion Medicinal Cannabis Facility	Emissions of air pollutants, specifically dust (construction)	Probability of the impact	Low (1)	5	Low	The potential for cumulative impacts during construction to air quality is considered to be low, therefore specific mitigation measures to address cumulative impacts are not warranted. The potential for the Project to contribute to such impacts is considered to be appropriately managed through the development and implementation of a Dust Management Sub-plan, as a component of the CEMP for the Project. ARTC will consult with Asterion regarding scheduling of construction activities to avoid the simultaneous undertaking of dust generating activities, where possible.
		Duration of the impact	Medium (2)			
		Magnitude/intensity of the impact	Low (1)			
		Sensitivity of the receiving environment	Low (1)			

Table notes:

Relevance factors between 1 and 3 were determined using professional judgement to select most appropriate relevance factor for each aspect and summing the relevance factors.

Sum of relevant factors definition:

- Low (1-6): Negative impacts need to be managed by standard environmental management practices. Monitoring to be part of general project monitoring program.
- Medium (7-9): Mitigation measure likely to be necessary and specific management practices to be applied. Targeted monitoring program required, where appropriate.
- High (10-12): Alternative actions should be considered and/or mitigation measures applied to demonstrate improvement. Targeted monitoring program necessary, where appropriate.

11 Conclusion

This air quality impact assessment has been undertaken to inform the EIS for the Project. The AQIA was undertaken to satisfy the ToR for the Project, which are listed in Section 1.2. In doing so, the objective of this AQIA has been to outline how the Project will be designed, constructed, operated and maintained in a manner to ensure protection of the environment, in particular air quality and environmental values which may be adversely impacted by air quality.

The AQIA consisted of the following tasks:

- Identification of typical and peak operation train movements for the year 2040
- An analysis of the expected construction and operation activities from an air quality perspective
- Identification of the relevant ambient air quality objectives that protect or enhance the environmental values of the air environment
- Discussion of existing air quality and local meteorology
- Identification of potential sources of air emissions associated with the Project
- Identification of nearby sensitive receptors
- Identification of potential air quality impacts, through:
 - A qualitative risk assessment of particulate emissions from construction works
 - A quantitative dispersion modelling assessment of operational emissions associated with freight rail movements for peak train operations, including prediction of pollutant water concentrations in rainwater water tanks
- Identification of mitigation and management measures to minimise potential air quality impacts, and assessment of the residual impact with the implementation of these measures.

For the assessment of construction phase impacts, a qualitative construction dust risk assessment was undertaken in reference to the *Guidance on the assessment of dust from demolition and construction* (UK IAQM, 2014). The risk of dust soiling and human health impacts due to particulate matter on surrounding areas were determined based on the scale of activities and proximity to sensitive receptors. The outcome of the assessment showed that the residual risk with the proposed mitigation measures is low or negligible. Consistent with the IAQM guidance, it is expected that with effective implementation of the proposed mitigation measures the impacts to air quality with respect to dust deposition and human health will not be significant. Therefore, with effective implementation of the proposed mitigation measures the construction of the Project is not anticipated to significantly adversely impact environmental values.

A Dust Management Sub-plan, as a component of the CEMP, will be required for the construction of the Project to manage potential impacts from dust emissions. It is expected that implementation of mitigation measures and monitoring of the effectiveness of these mitigation measures will prevent exceedance of air quality objectives and the residual impact with respect to dust soiling and human health will not be significant.

For the assessment of operation phase impacts, a quantitative dispersion modelling assessment was undertaken using the dispersion model CALPUFF. Diesel exhaust emissions from locomotives were estimated for projected peak train movements for the Project in 2040. Twelve months of representative meteorological input was developed for use in CALPUFF. Ground level concentrations of particulate matter, NO₂, VOCs, and heavy metals were predicted using CALPUFF at nearby sensitive receptors. The assessment predicted that cumulative pollutant concentrations and deposition levels would be below the relevant air quality objectives at all identified sensitive receptors for all pollutants of concern with the exception of 24-hour average PM₁₀. The air quality goal for 24-hour PM₁₀ is predicted to be exceeded by 0.1 µg/m³ at a single sensitive receptor located approximately 1.1 km to the north of the existing Commodore Mine. The dominant source of PM₁₀ at the exceeding receptor is Commodore Mine.

There is doubt regarding the quantum of emissions from the Commodore Mine due to the uncertainty in the emission estimation method used, and the absence of ambient monitoring data for the area local to the mine. To improve the understanding of background air quality at receptors near the mine, an air quality monitoring station has been installed at a residential dwelling on Millmerran-Inglewood Road, Millmerran, approximately 1.4 km to the north of Commodore Mine. Monitoring data from this location will be used to guide the detail design and finalisation of the construction approach for the Project to ensure that air quality impacts to sensitive receptors are avoided or minimised as much as possible.

Based on the intention of the EPP (Air), the operation of the Project is not expected to significantly adversely impact environmental values, including human health.

An investigation into the deposition of pollutants at sensitive receptor water tank locations showed that predicted pollutant water concentrations would be significantly lower than Australian Drinking Water Guidelines (NHMRC & NRMCC, 2018).

The impact of odour from agricultural trains using the Project alignment has been assessed qualitatively using FIDOL factors. Odour emissions from agriculture freight are considered unlikely to result in significant impact to neighbouring sensitive receptors due to the frequency and duration of the odour generating event (train pass-by) and the predominantly rural nature of the AQIA area.

Mitigation measures have been recommended for the construction and operation phases of the Project. For the construction of the Project, emission sources will be transient and variable in nature and with differing proximity to sensitive receptors. Appropriate mitigation strategies are needed to address this variability. Key mitigation measures will be incorporated into the detail design, construction planning and operation phases of the Project.

The AQIA undertaken for the Project showed that with appropriate mitigation in place, the construction and operation of the Project can be managed in a way that air quality impacts to environmental values and sensitive receptors are maintained at an acceptable level.

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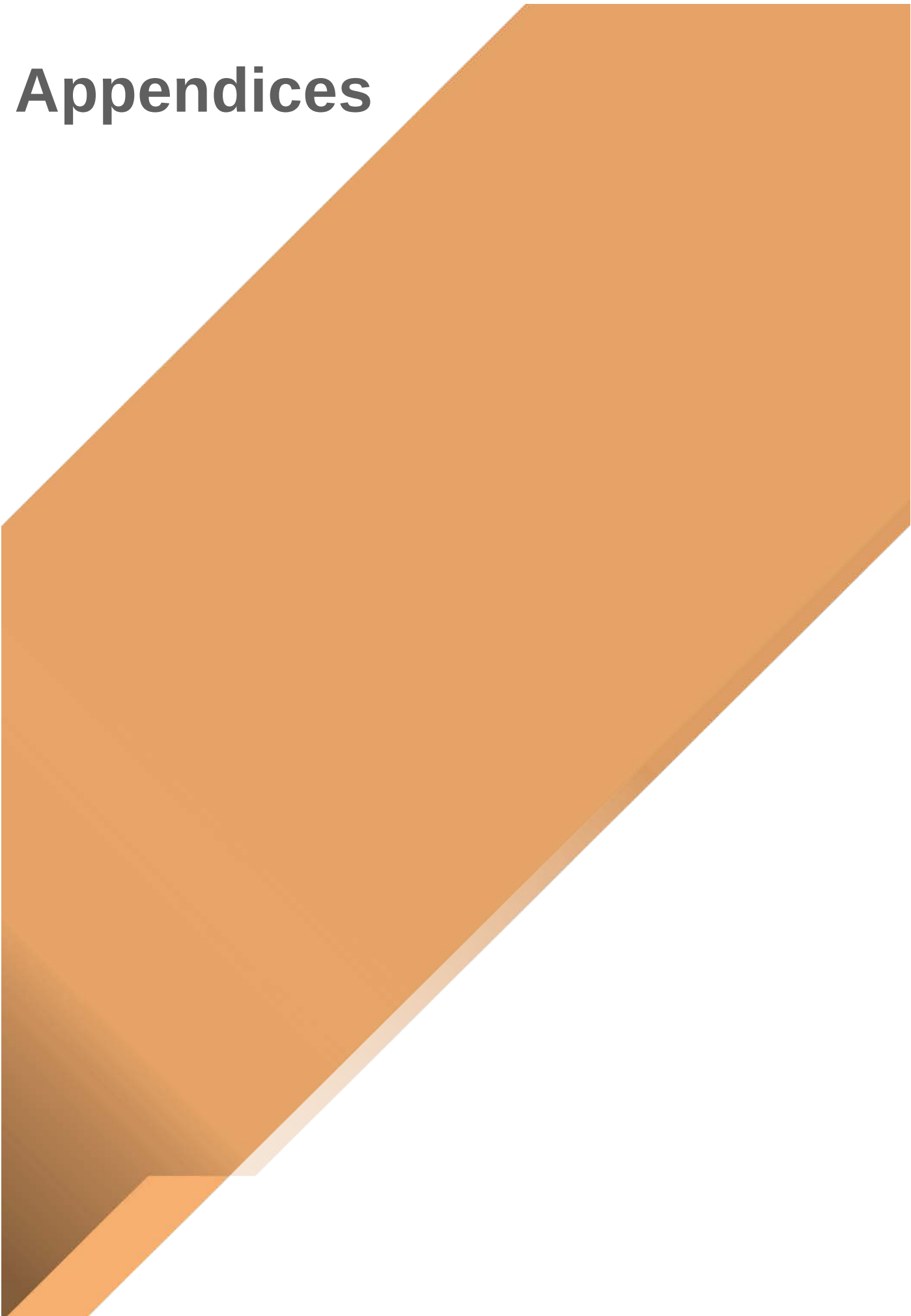
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Appendices



APPENDIX

0

Air Quality Technical Report

Appendix A Meteorological Data

INLAND RAIL—BORDER TO GOWRIE ENVIRONMENTAL IMPACT STATEMENT

Appendix A

Meteorological Data

El Niño-Southern Oscillation

For Australia, the El Niño-Southern Oscillation (ENSO) has the strongest effect on year to year climate variability in Australia, mostly affecting rainfall and temperature. El Niño incidences represent periods of unusually warm Pacific Ocean conditions along the western coast of South America, which frequently presents as high rainfall events in South America and drought conditions for Australia. Conversely, La Niña periods represent cooler ocean surface temperatures along the western coast of South America and increase the likelihood of drought conditions locally and high rainfall periods in Australia.

The Southern Oscillation Index (SOI), Oceanic Niño Index (ONI), and Multivariate ENSO Index (MEI) are measures that indicate episodes of El Niño and La Niña. Due to differences in methodology each of these aforementioned indices can have slightly differing results. In order to provide a robust investigation of ENSO periods, monthly results from each of these measures have been analysed.

The SOI is defined as the standardized differences in barometric readings from Darwin, Australia and Tahiti. Sustained negative SOI values of below -7 often present as El Niño episodes, and positive SOI values above 7 are associated with La Niña. Figure A1 presents the monthly SOI values for the period of 2008 to 2017. Several episodes of El Niño and La Niña have been documented by BoM for this period. These include the following:

- El Nino periods in 2015 – 2016 and 2009 – 2010
- La Nina periods in 2010 – 2012 and 2008 – 2009.

From review of the monthly SOI, three years have been identified as being relatively neutral. These include 2013, 2014, and 2017, which were measured to have 7, 5, and 8 months of the year to be neutral in terms of the SOI, respectively.

The ONI is the primary indicator utilised by the National Oceanic and Atmospheric Administration (NOAA) in the USA to monitor the strength of ENSO. ONI is based upon the averages in sea surface temperature anomalies in an area of the east-central equatorial Pacific Ocean, which is called the Niño-3.4 region. The index consists of a monthly 3-monthly running mean in order to better isolate variability closely related to the ENSO phenomenon. Threshold values of +/- 0.5 °C indicate periods of higher likelihood for El Niño and La Niña.

For the period of 2008 to 2017 the following El Niño and La Niña periods have been identified by NCEP utilising the ONI index.

- 2007 – 2008 Strong La Niña
- 2008 – 2009 Weak La Niña
- 2009 – 2010 Moderate El Niño
- 2010 – 2011 Strong La Niña
- 2011 – 2012 Moderate La Niña
- 2014 – 2015 Weak El Niño
- 2015 – 2016 Very Strong El Niño
- 2016 – 2017 Weak La Niña
- 2017 – 2018 Weak La Niña.

The period of 2012 – 2013 and 2013 – 2014 represent the only years that have been neutral in terms of ENSO utilising the ONI measure for the years 2008 to 2017.

The Multivariate ENSO Index (MEI) utilises six main observed variables of the tropical Pacific. These six variables are: sea-level pressure, zonal and meridional components of surface wind, sea surface temperature, and total cloudiness fraction of the sky. Negative values of the MEI represent the cold ENSO phase, La Niña, while positive MEI values represent the warm ENSO phase (El Niño). From review of the MEI monthly values, significant periods of La Niña are observed for 2008, 2010-2011, and El Niño for 2009 and 2014 to 2016. Weaker periods of El Niño in 2012 and the first half of 2017 were recorded. Neutral conditions were observed for 2013 utilising the MEI measure.

Utilising the SEI, ONI, and MEI measures for ENSO, agreement can be seen on which years represent periods of El Niño or La Niña. The three indices show that the year 2013 was relatively neutral in terms of ENSO. Therefore, the year 2013 represents an ideal candidate for selection of meteorological period that is relatively unaffected by variances in weather due to ENSO.

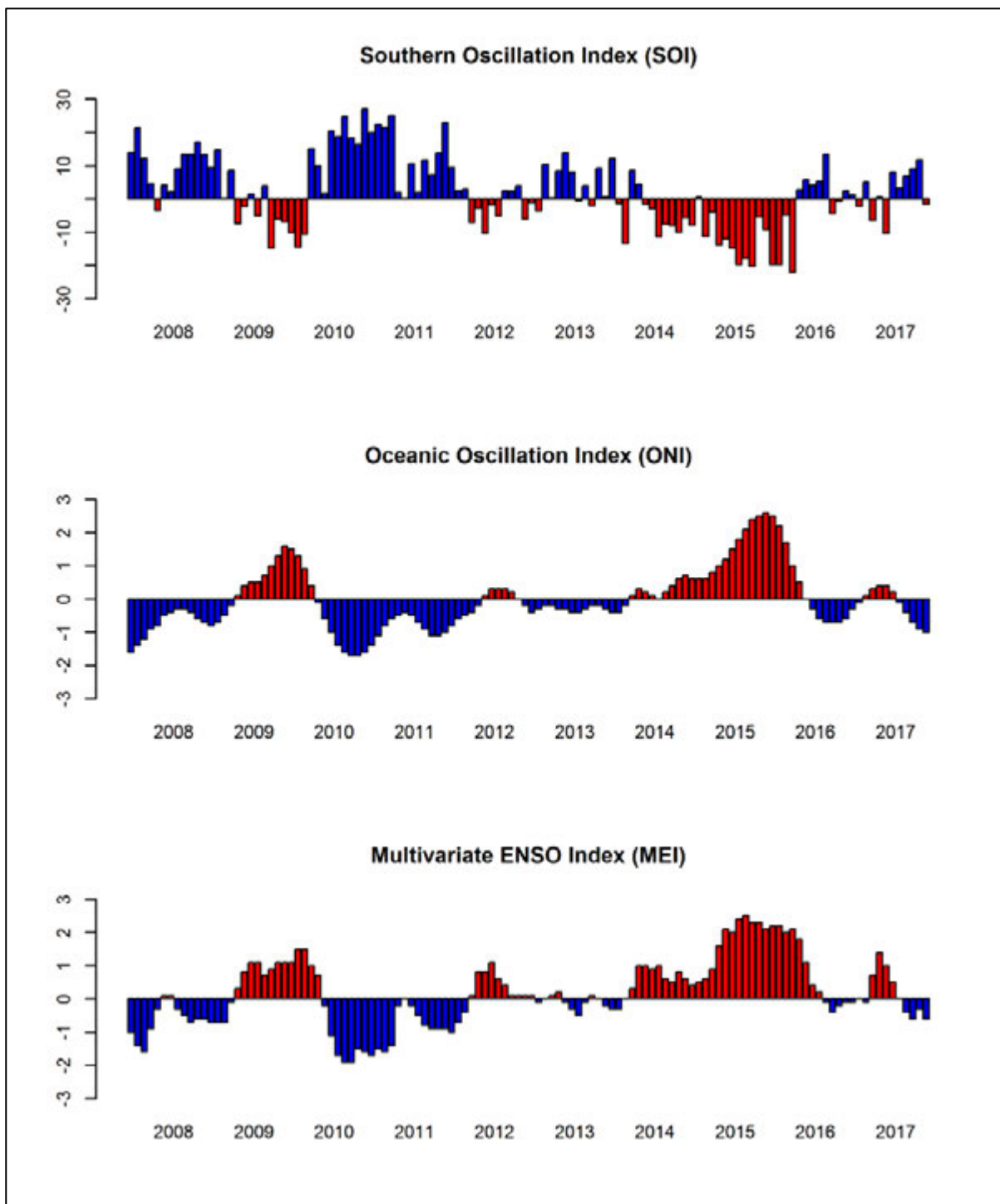


Figure A1 Comparison of Monthly SOI, ONI, and MEI for 2008 to 2017 (red indicating higher likelihood of El Niño conditions, and blue indication higher likelihood of La Niña conditions)

Analysis of CALMET Datasets

CALMET was run over three separate domains to cover the full alignment. The three domains modelled are as follows:

- Dimensions for all three domain grids: 87.5 km x 87.5 km at 0.5 km grid spacing (175 x 175)
- Northern domain: south-west corner coordinates 242,668 m E 6,795,249 m S
- Central domain: south-west corner coordinates 278,653 m E 6,842,956 m S
- Southern domain: south-west corner coordinates 310,859 m E 6,887,7160 m S.

Meteorological data was extracted for a single location (approximately in the centre of each domain along the rail alignment) for each of the domains. Analysis further to that provided in Section 4.1 for wind speed and direction and temperature is presented in this appendix.

Wind Speed and Direction

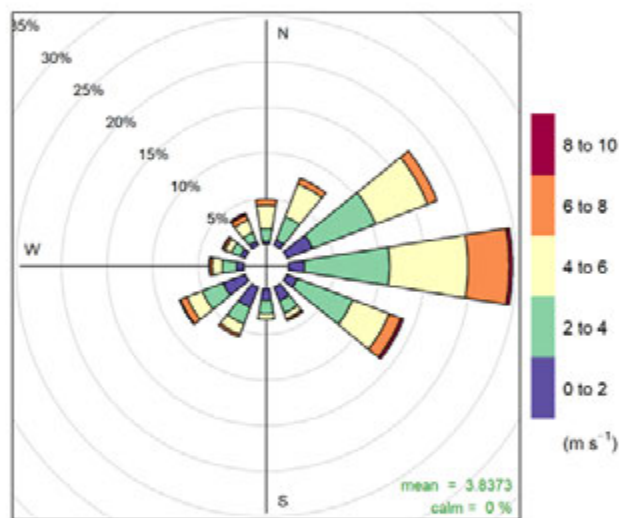
Wind speed statistics for the three CALMET domains are presented in the following table.

Table A1 CALMET wind speed statistics

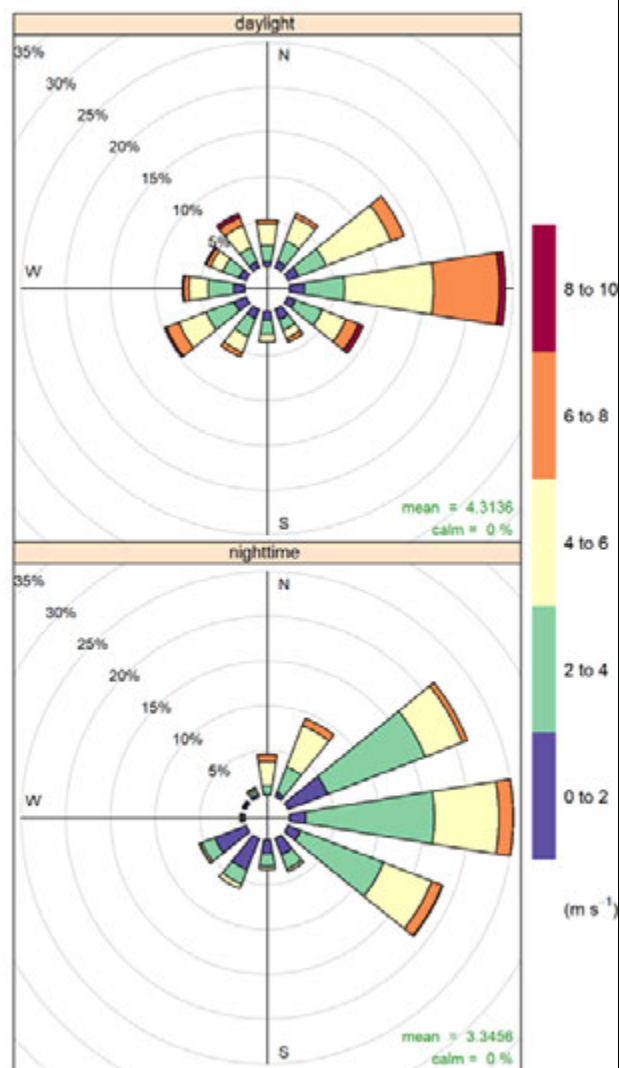
Parameter	Domain		
	Northern	Central	Southern
Minimum (m/s)	0.1	0.0	0.0
Average (m/s)	3.83	3.39	2.71
Maximum (m/s)	9.7	9.1	8.3
Calms (per cent)	1.2	2.4	2.1

Wind speed and direction for the three CALMET domains are presented in the following wind rose figures and are summarised as follows:

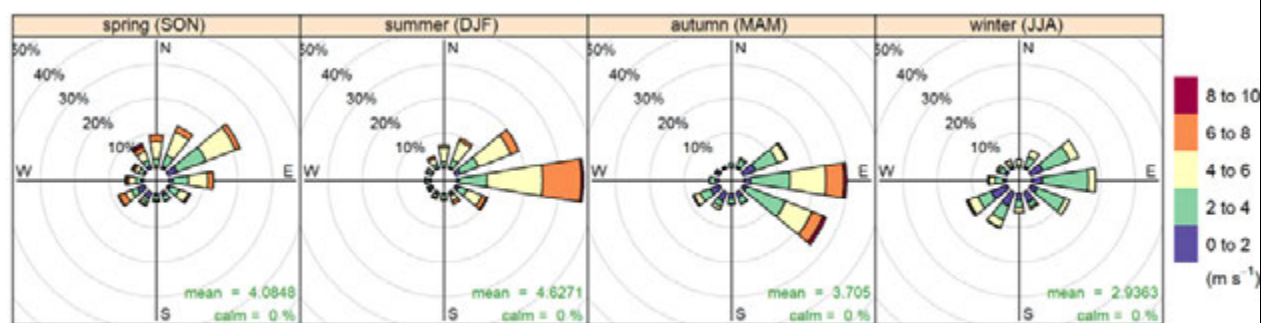
- As expected, overall daylight hours have higher wind speeds than night-time hours across all three domains
- All sites show a characteristic north-east and easterly wind dominance though summer and autumn. Winds are also typically strongest during summer and autumn.
- Winter sees a higher frequency of west or south-westerly winds across all three domains. On average winds are lightest during winter.
- Spring conditions show similarities to both summer and winter conditions, with west and south-west winds persisting, although at lower frequencies than during winter months. Northerly winds are most frequent during spring.



Frequency of counts by wind direction (%)

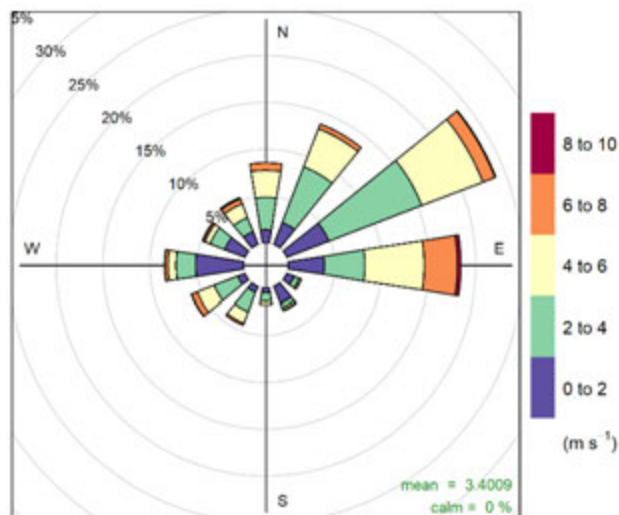


Frequency of counts by wind direction (%)

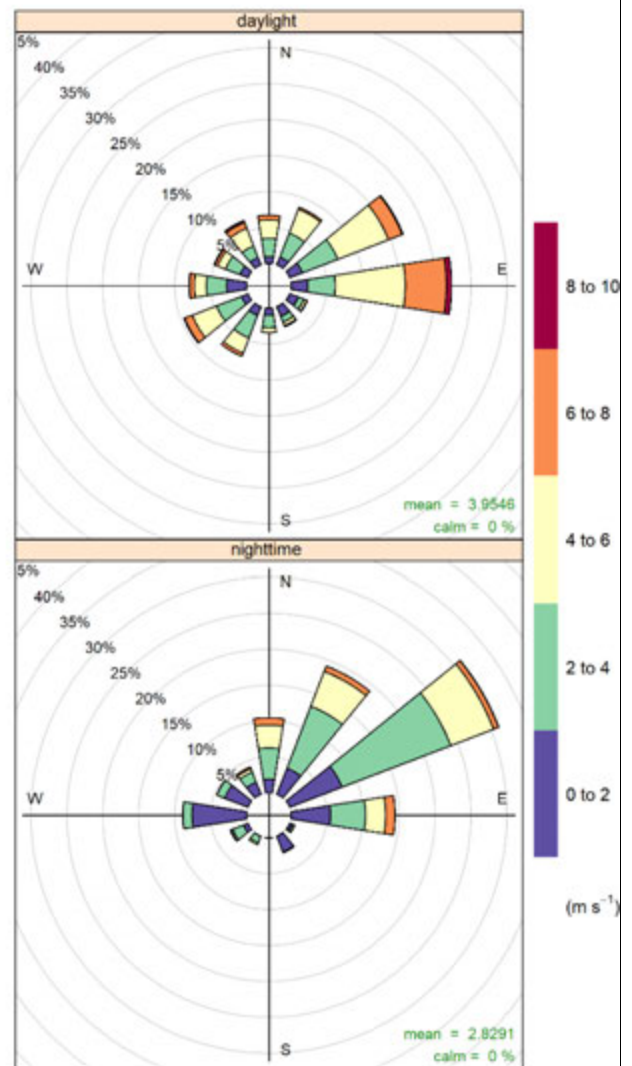


Frequency of counts by wind direction (%)

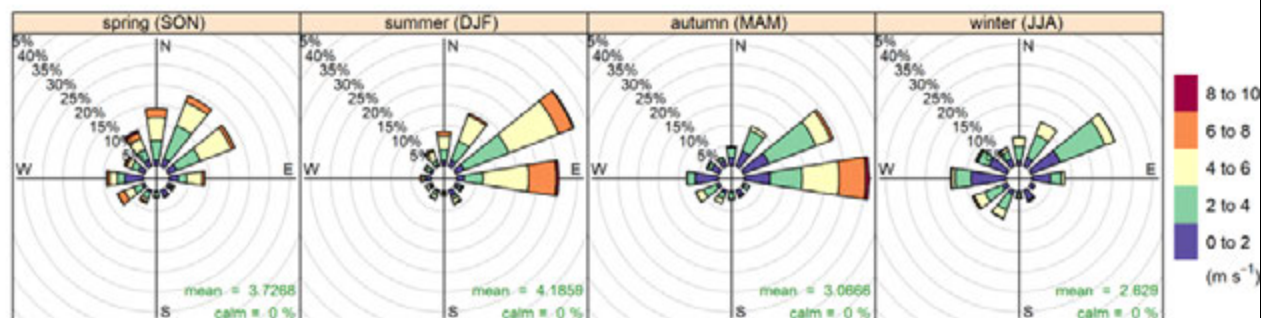
Figure A2 CALMET Northern domain wind roses for 2013: all hours (top left); daylight hours (top right); and seasons (bottom) – extracted at 355,903 m E, 6,933,040 m S – approximately centre of domain along rail alignment



Frequency of counts by wind direction (%)

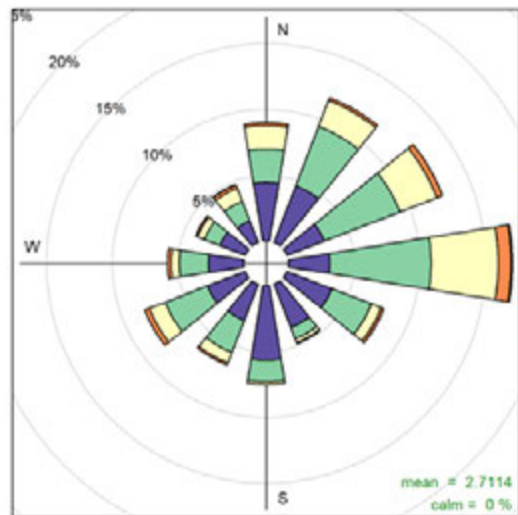


Frequency of counts by wind direction (%)

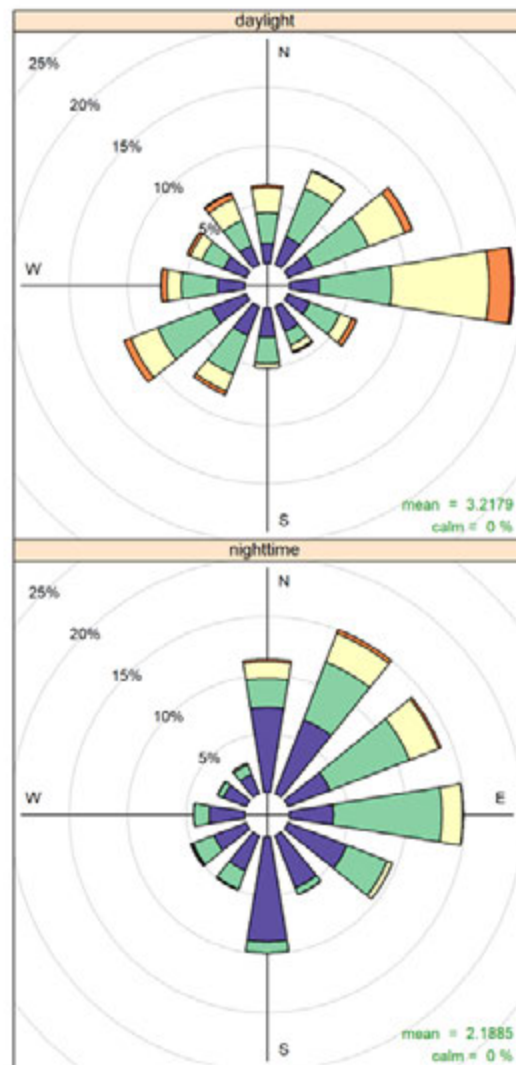


Frequency of counts by wind direction (%)

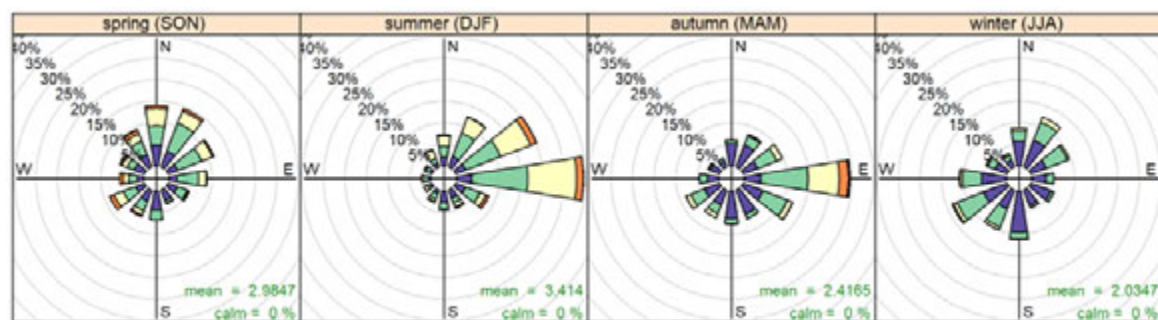
Figure A3 CALMET central domain wind roses for 2013: all hours (top left); daylight hours (top right); and seasons (bottom) – extracted at 320,449 m E, 6,867,211 m S – approximately centre of domain along rail alignment



Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)



Frequency of counts by wind direction (%)

Figure A4 CALMET southern domain wind roses for 2013: all hours (top left); daylight hours (top right); and seasons (bottom) – extracted at 288,110 m E, 6,840,367 m S – approximately centre of domain along rail alignment

Temperature

Temperature statistics for each CALMET domain are presented in the following figures. Each domain shows a similar pattern that is expected for the Darling Downs, with temperatures ranging from just above zero (on winter mornings) to the high 30s (summer afternoons).

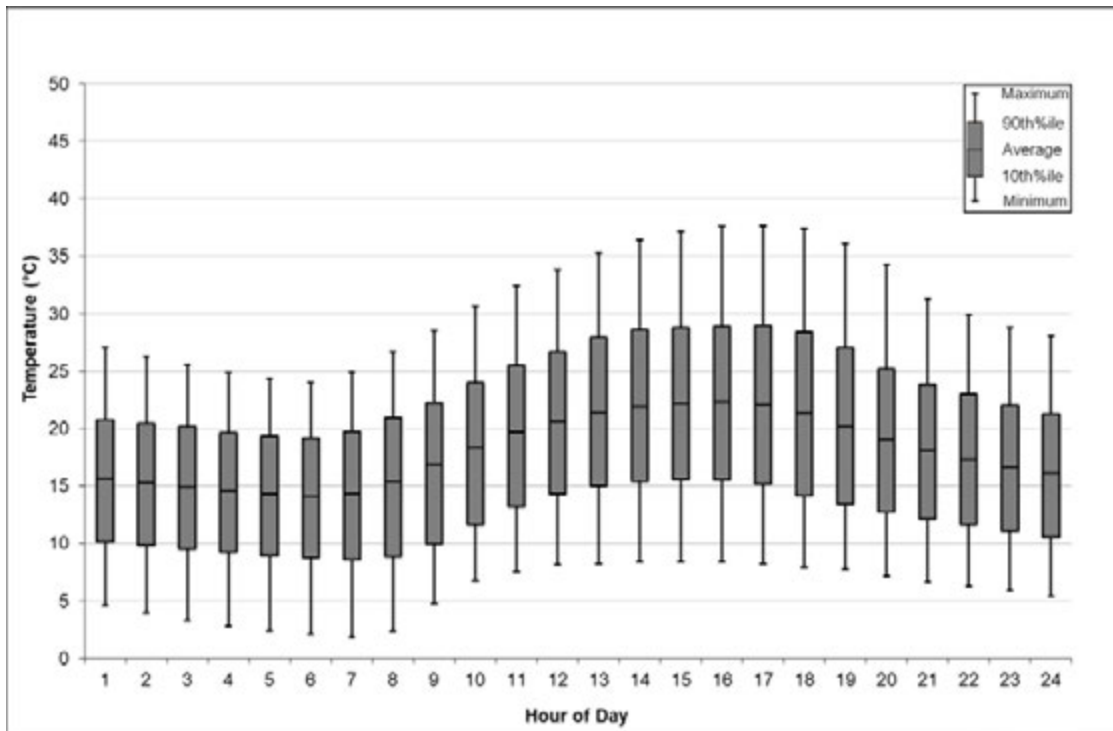


Figure A14 CALMET temperature statistics by hour of day for northern domain

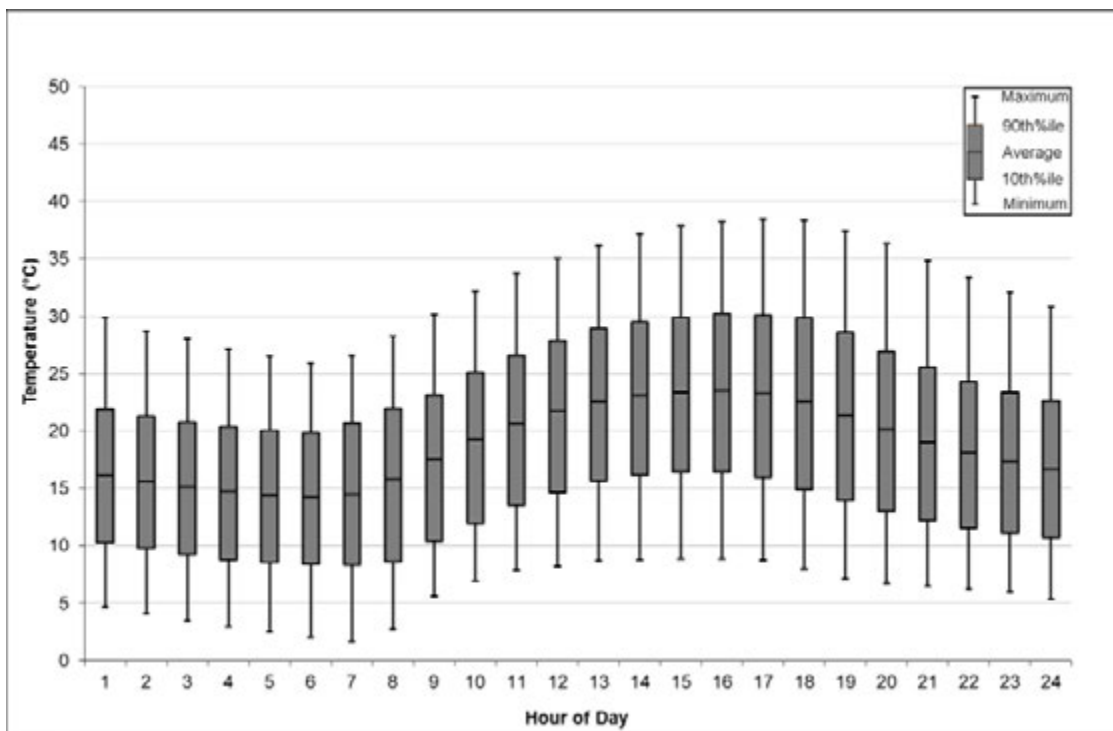


Figure A15 CALMET temperature statistics by hour of day for central domain

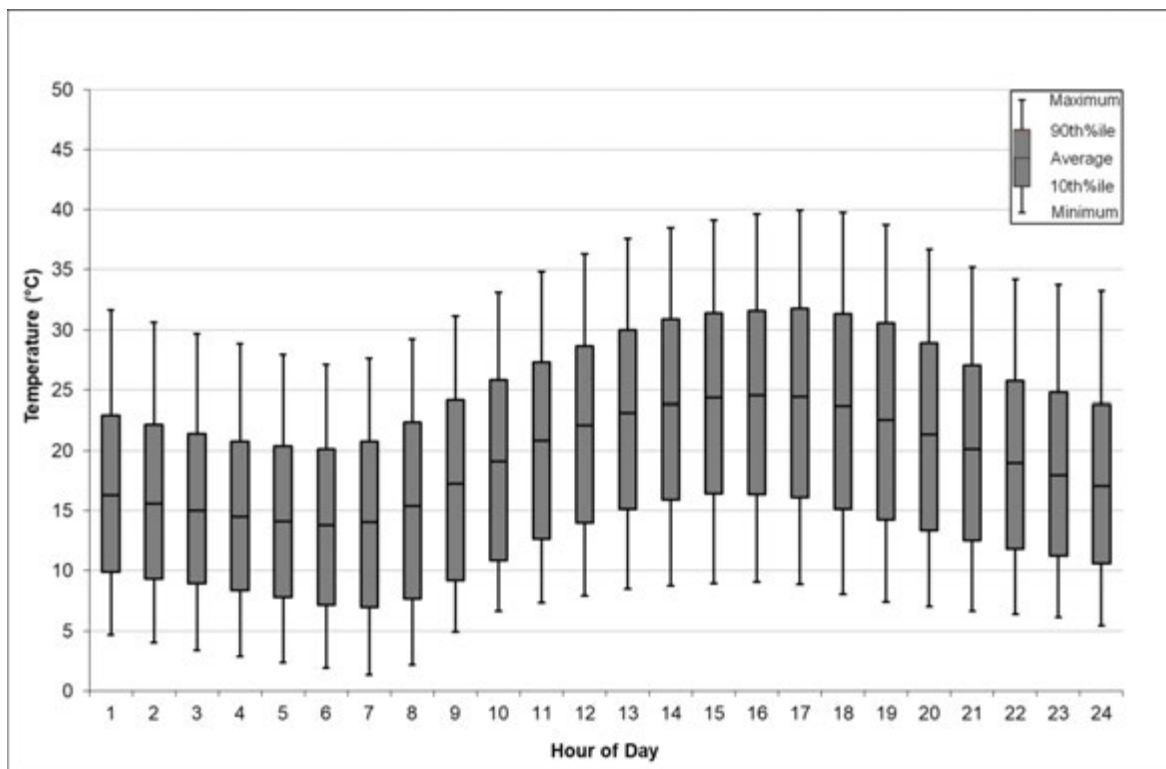


Figure A16 CALMET temperature statistics by hour of day for southern domain