MENINDEE FLOW RELEASE IMPACT ASSESSMENT

Report MHL2889
August 2022

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Foreword

NSW government's professional specialist advisor, Manly Hydraulics Laboratory (MHL) was commissioned by Water Group, Department of Planning and Environment (DPE Water) to undertake an impact assessment of control flow releases from the Lake Wetherell on Menindee township. The outcome of this study will assist DPE Water to regulate flows upstream of Weir 32 to ensure minimum inundation risk for Menindee township.

Executive summary

The Department of Planning and Environment (DPE) Water is interested in understanding the inundation risk for properties in Menindee township during releases of flows ranging between 18,000 and 25,000 ML/day at Lake Wetherell (as recorded at Weir 32). DPE Water engaged Manly Hydraulics Laboratory (MHL) to undertake a flow release impact assessment for the Menindee township.

For this purpose, a two-dimensional Menindee hydraulic model was produced based on the existing Lower Darling River hydraulic model previously developed by MHL. The Menindee hydraulic model covers the areas between Lake Wetherell and Weir 32 downstream of Menindee Lake. The Menindee hydraulic model was calibrated and validated against the latest flow release event that occurred between December 2021 and February 2022 as well as an historic event from December 2010.

The calibrated and validated Menindee hydraulic model was simulated for the release scenarios ranging between 18,000 ML/day and 25,000 ML/day at 500 ML/day increments assuming a steady-state flow at each increment. This report produced inundation maps for each release scenario and identified impacts on the properties and road situated in the vicinity of Menindee township.

Contents

TABLES

FIGURES

1 Introduction

1.1 Background

Menindee township is located downstream of Lake Wetherell on the bank of the Lower Darling River. Large flow releases from Lake Wetherell may lead to inundation in Menindee township. In particular, several properties around Menindee township may become flood affected during larger flow events in the Darling River. Therefore, the Department of Planning and Environment (DPE) Water is interested in understanding the inundation risk for such properties during flows released down the river ranging between 18,000 and 25,000 ML/day to minimise inundation risk of these properties. For this purpose, DPE Water commissioned Manly Hydraulics Laboratory (MHL) to undertake a flow release impact assessment for Menindee township.

1.2 Introduction

Fit-for-purpose, a two-dimensional (2D) hydraulic model is suitable for a detailed investigation of the inundation risks due to flow releases from Lake Wetherell. In 2021, MHL developed a TUFLOW hydraulic model for the Lower Darling River (LDR) covering the areas between Lake Wetherell and Wentworth (~540 km of the Darling River). The LDR hydraulic model is the most recent calibrated model covering the Menindee township. Therefore, the LDR hydraulic model was adopted as a base case model for this present study with further modifications as discussed in **Section 3**.

1.3 Scope of works

The scope of works for this purpose includes:

- Review of latest available data in the study area.
- Trim existing LDR hydraulic model to focus on the section between Lake Wetherell and Weir 32 and reduce cell size from 20 m to 5 m to improve local representation of inundation extent.
- Run the latest December 2021 - February 2022 flow event to validate the trimmed model against the field measurements.
- Undertake some sensitivity to understand the impact of the source of the flow release on the inundation extent.
- Run scenarios at increasing releases levels from 18,000 ML/day to 25,000 ML/day at 500 ML/Day increments assuming steady state flows at each increment.
- Provide results as maps of the extent for each increment and summarise outcomes in a brief letter report.

2 Review of existing data

2.1 Overview of Lower Darling River hydraulic model

The Lower Darling River (LDR) hydraulic model was developed as part of the Lower Darling Hydraulic Assessment - Hydraulic Modelling study (MHL, 2021). The purpose of the study was to develop an improved understanding of the flow behaviour along the Lower Darling River between Menindee Lakes and the Murray River. Below is a brief overview of the LDR hydraulic model:

- The LDR hydraulic model was a coupled 1D/2D TUFLOW model which covers ~540km reaches of the Darling River between Lake Wetherell and Wentworth. The model comprised 12,600 channels.
- The main channel of the Darling River was modelled as a one-dimensional (1D) channel. The cross-section profiles of the 1D channel were derived from a combination of 2019/2020 Bathymetric Survey data and 2019 LiDAR data.
- The floodplains were represented in 2D using a grid size of 20 m X 20 m. The elevation of the grid was derived mainly from the Menindee Lower Darling 2019 LiDAR dataset. Sub-Grid Sampling (SGS) was also utilised in this model to improve the representation of floodplain topography whilst retaining a coarse grid size. SGS resolutions were set to match the resolution of the LiDAR data.
- Hydraulic structures in the vicinity of the study area (bridges, culverts and weirs) were modelled as 1D features.
- River bend losses were accounted for as a factor of dynamic head, with typical factors ranging between 0.5 and 1.5 (Syme, 2001).
- The model was well calibrated with a focus on flows up to approximately 17,000 ML/day using historical data from 2010-2012 which were the most recent suitable events for calibration purposes at the time of the study.

2.2 Field investigation

MHL organised a survey brief to collect additional data for DPE Water in March 2022 and the survey brief is attached as **Appendix A**. Field survey work was conducted by Public Works Advisory at the end of March 2022. The survey consisted of measurement of floor levels, septic tank levels and driveway levels along Irrigation Road, Menindee as well as the crest of Irrigation Road and the crest and toe of a local levee. The survey also identified potential peak water level marks from the latest flow event that occurred between December 2021 and February 2022. A field investigation report will be provided as a separate report.

2.3 Other building database

A spreadsheet was received from DPE Water on March 10, 2022. The spreadsheet contains the building floor levels in the vicinity of the project site along with other details. The data was utilised to identify buildings that may be subject to above-floor flooding in the simulated flow release scenarios.

3 Menindee Hydraulic Model

Initial review of the LDR hydraulic model highlighted that further modifications were required for the purpose of the present study. Further calibration/validation was also undertaken on the reduced model. These modifications and additional calibration/validation are presented in the following sections.

3.1 Model development

The LDR hydraulic model was updated to produce a Menindee hydraulic model (**Figure 3-1**). Modelling approaches and assumptions can be found in the Lower Darling Hydraulic Assessment report (MHL, 2021) and the below list summarises the adjustments made to the existing model:

- As Weir 32 is the gauging station where flow releases are monitored, the LDR hydraulic model was trimmed at Weir 32 to simulate inundation risk for the various flow releases.
- The new roads and driveways around Irrigation Road were included in the Menindee hydraulic model as a zsh layer to ensure that the model represents the crests of the roads appropriately. Elevations data for those roads and driveways were collected during the field survey described in **Section 2.2**.
- In the LDR hydraulic model, the main channel of the Darling River was represented in 1D and floodplains were modelled in 2D using a 20 m X 20 m grid and 1D-2D were coupled dynamically. Similar approaches and configurations were adopted for the present study but the 1D channel was slightly modified to exclude 2D floodplain, where required due to the change in model cell size. The floodplain was represented using a 5 m X 5 m grid along with a 1 m Sub-Grid Sampling (SGS) to ensure that the terrain was represented with an improved grid resolution while maintaining reasonable run times.
- The Menindee hydraulic model was updated to improve the representation of the rail bridge as a 2D flow constriction layer (2d_lfcsh).
- Land use around the vicinity of the project site was further updated to represent the land use with a reasonable accuracy, which includes road, waterbody, vegetation and developed areas. The roughness values for the various land use were adopted based on Australian Rainfall and Runoff (ARR) 2019 guidelines.
- Adopted tailwater boundary level were based on rating table 265 for each flow release scenario. The rating table 265 was received from WaterNSW on 16 March 2022.
- A further modification to the 2D model domain was made to ensure that breakouts within the vicinity of the project site are appropriately represented in the model.
- Detail of the river channel and structures in the vicinity of the model was confirmed with the available field data which include bathymetric data, the survey of hydraulic structures and cross-sections. LDR model was found to appropriately represent the river channel and hydraulic structures.

Figure 3-1: Schematic Diagram of Menindee Hydraulic Model

Legend

- Railway
- Waterbody
- Modelled as 1D
- US Inflow Boundary
- DS Slope Boundary
- DS Water Level Boundary
- TUFLOW Model Extent

Report MHL2889

Menindee Flow Release Impact Assessment

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3.2 Model calibration and validation

Model calibration was undertaken by replicating an event in December 2021 – February 2022, which reached peak flows of approximately 18,500 ML/day at Weir 32. Water levels derived from the Menindee hydraulic model outputs were compared to field measured water levels. Several iterations were undertaken which included slight modifications 1D channel and 2D floodplain to match the simulated water levels to the field data. Comparison of calibrated model water levels and observed water levels are presented in **Table 3-1** and calibration points are shown in **Figure 3-2**. Comparison shows that the Menindee hydraulic model produced a good match with observed water levels.

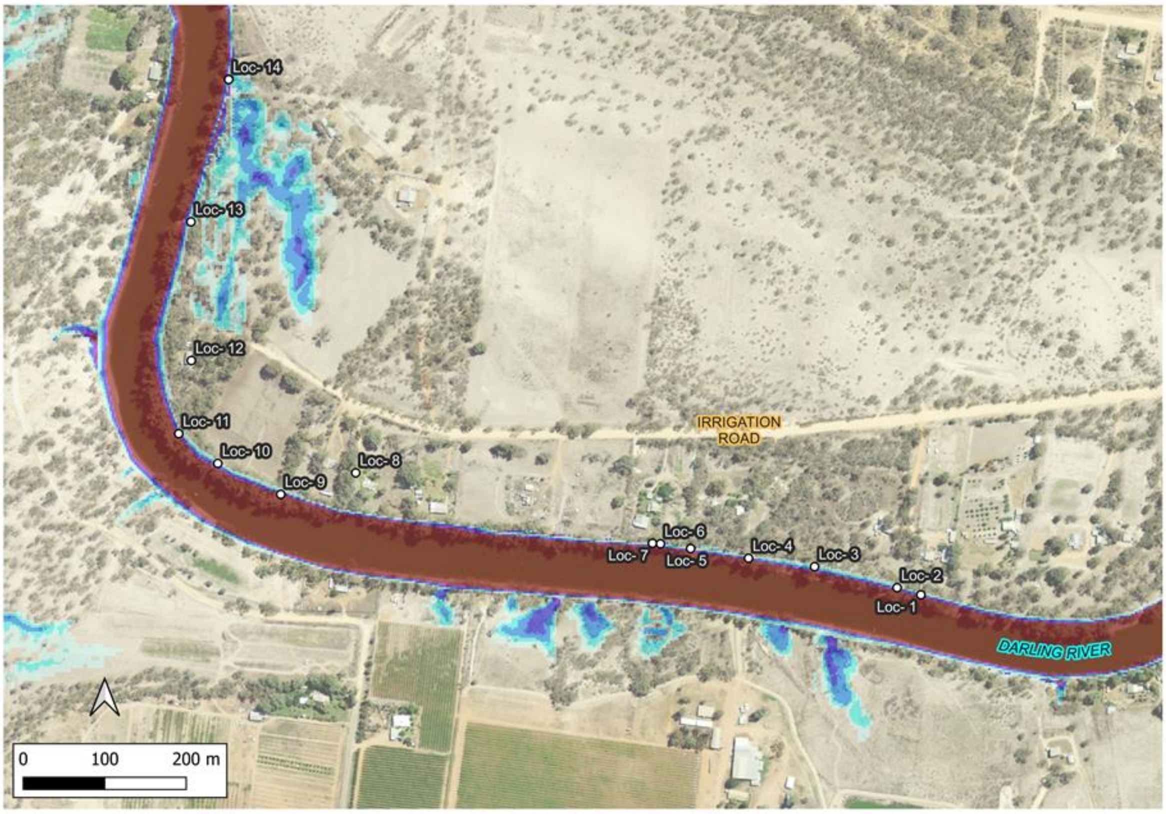


Figure 3-2 Calibration points for the event January – February 2022

Table 3-1 Comparison model water levels and field measured water levels

Location No.	Location type	Easting	Northing	Type of mark	Field measured water level (m AHD)	Model simulated water level (m AHD)	Comments
Loc- 1	River Bank	631755.09	6414097.91	Water Mark	58.39	58.39	Excellent match
Loc- 2	River Bank	631725.87	6414106.63	Water Mark	58.33	58.39	Measured water level appears lower than surrounding measured levels
Loc- 3	River Bank	631624.67	6414132.44	Water Mark	58.39	58.39	Excellent match
Loc- 4	River Bank	631543.64	6414142.76	Water Mark	58.41	58.39	Good match
Loc- 5	River Bank	631472.58	6414154.67	Water Mark	58.38	58.39	Good match
Loc- 6	River Bank	631435.57	6414160.5	Water Mark	58.36	58.38	Good match
Loc- 7	River Bank	631425.71	6414161.16	Water Mark	58.38	58.38	Excellent match

Location No.	Location type	Easting	Northing	Type of mark	Field measured water level (m AHD)	Model simulated water level (m AHD)	Comments
Loc- 8	Property	631061.68	6414247.6	Water Mark	59.70	NA	Measured level should represent other historic major flood event as inconsistent with other levels measured
Loc- 9	River Bank	630969.73	6414221.26	Water Mark	58.39	58.38	Good match
Loc- 10	River Bank	630892.53	6414259.2	Water Mark	58.37	58.37	Excellent match
Loc- 11	River Bank	630844.56	6414295.71	Water Mark	58.37	58.37	Excellent match
Loc- 12	Property	630859.97	6414385.49	Water Mark	59.38	NA	Measured level should represent other historic major flood event as inconsistent with other levels measured
Loc- 13	River Bank	630859.6	6414555.75	Water Mark	58.29	58.37	Measured level appears lower than surrounding measured levels
Loc- 14	River Bank	630905.86	6414730.46	Water Mark	58.34	58.36	Good match

Further investigations were undertaken to validate the model results against historic events. Inundation extents derived from the model output for the December 2021 – February 2022 event were compared to satellite imagery (source: OpenStreamMap) to assess the model's ability to represent inundation and extents are presented in **Figure 3-3**. The satellite image was captured on 9 February 2022. The flow rate on that date was ~18,100 ML/day and it is understood that a small local levee located along the bank of the river breached 1-2 days prior to this imagery being taken. The model inundation extent for the December 2021 – February 2022 event provides a fair match with the inundation extent identified on the satellite imagery.

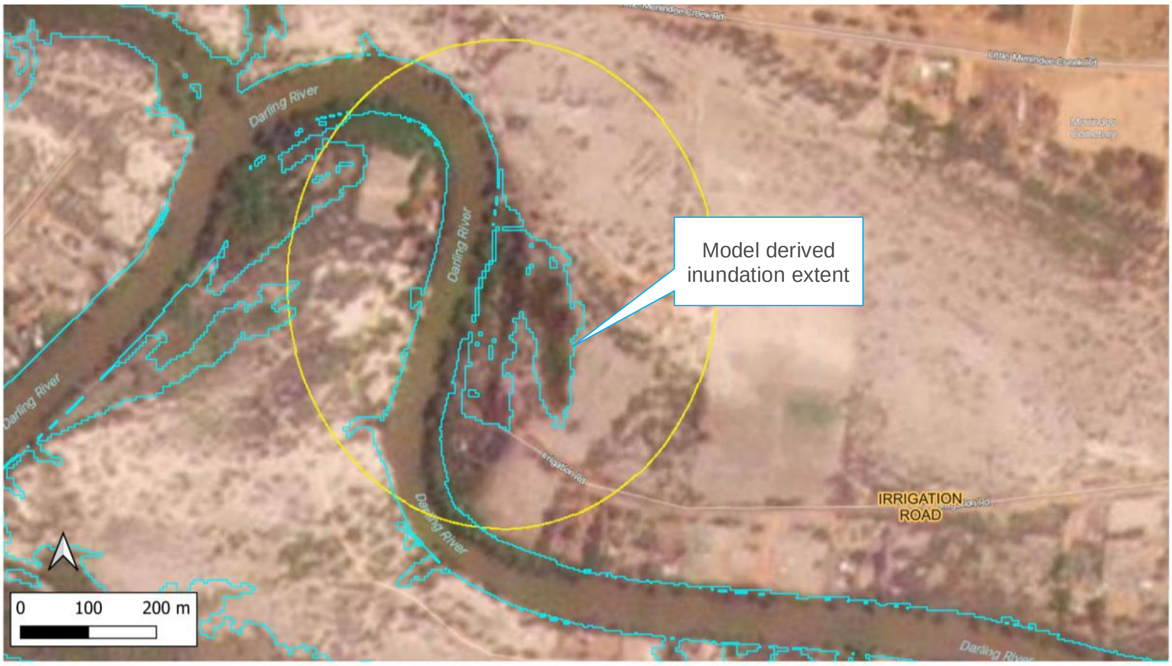


Figure 3-3 Comparison of inundation extent for the December 2021 – February 2022 event

Further to the December 2021 – February 2022 event, inundation extents derived by the model for the 22,000 ML/day flow rate scenario were compared to satellite imagery and presented in **Figure 3-4**. The satellite imagery was captured on 26 December 2010 (source:

EO Browser). The flow rate on that date was ~22,000 ML/day at Weir 32. The modelled inundation extent provides a fair match with the inundation extent identified on the satellite imagery.

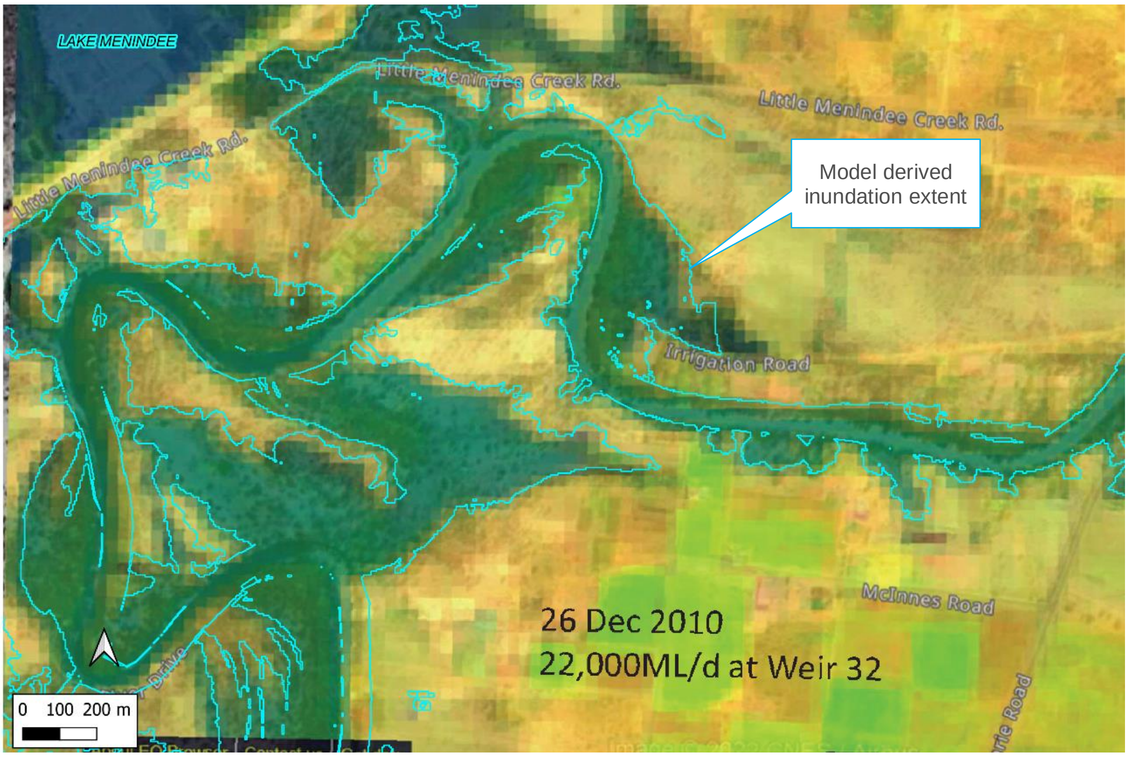


Figure 3-4 Comparison of extent for the 22,000 ML/day flow with the December 2010 event

3.3 Sensitivity analysis - flow release location

On the Lower Darling there are two main inflow locations from which water can be released:

- Lake Wetherell via Menindee Main Weir (upstream extent of model)
- Lake Menindee via regulator (approximately 9 km upstream of Weir 32)

Flow time boundary conditions are in place for both of these locations in the 1D/2D model allowing for water to be input at either / both locations. Comparing the effect of releasing water from Lake Menindee as opposed to Lake Wetherell was performed as part of the Lower Darling study (MHL, 2021) by running the same flow input at each of these locations. Between Menindee Main Weir and Lake Menindee there were significantly lower levels when water was released from Lake Menindee as opposed to Menindee Main Weir. A long section is presented in **Figure 3-5** and shows that this difference is most exaggerated at the upstream extent of the model, with a difference of around one metre, the difference reduces closer to Lake Menindee and is negligible from then on.

Therefore, it was assumed that the full flow was originating from Lake Wetherell for each scenario modelled in this study.

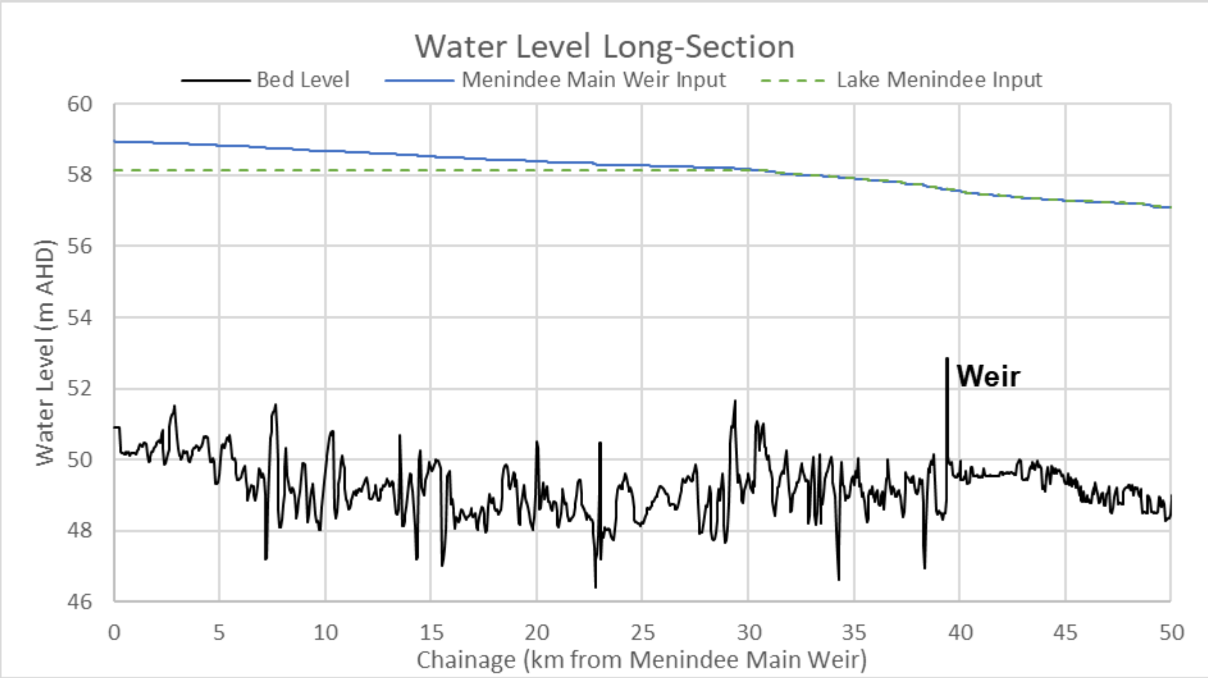


Figure 3-5 Sensitivity of flow release locations

4 Flow release impact assessment

The calibrated and validated Menindee hydraulic model was simulated for the 18,000 ML/day to 25,000 ML/day at 500 ML/day increments assuming steady state flows at each increment. Model results show that a portion of flow is lost along the Darling River due to a few breakouts occurring between Lake Wetherell and Weir 32. Therefore, upstream model inflows were adjusted accordingly to ensure that the model appropriately simulated the design release flow rate at Weir 32, i.e. model upstream inflow = target release (e.g. 18,000 ML/day) + losses due to breakouts (e.g. 460 ML/day for a 18,000 ML/day flow).

Model results show that the difference in peak water levels between Orchard Road and Weir 32 is about 0.9 m for the 18,000 ML/day flow release scenario and about 1.2 m for the 25,000 ML/day flow release scenario. For any flow release scenarios, water surface slopes are within 3 to 4% in the vicinity of the project site. The water surface slopes were calculated based on model simulated water levels and the distance between Orchard Road and Weir 32. The distance between these two locations is about 29 km measured along the Lower Darling River. Further investigation of model results indicates that the water surface levels in the vicinity of the project site are mainly driven by the tailwater boundary condition. A summary of the simulated peak water levels at selected investigation locations between Orchard Road and Weir 32 is presented in **Table 4-1** and **Figure 4-1**. Inundation extent maps are presented in **Appendix B**. Detailed investigations of the impacts on buildings, roads and other facilities are presented in the sections below.

Table 4-1 Peak water levels for various flow release scenarios

Flow Release Scenarios	**Peak water level at investigation locations (see Figure 4-1 for reference position) in m AHD**								
	1 (*Orchard Road*)	**2**	**3 (*Rail Bridge*)**	**4 (*Menindee Town Gauge*)***	**5 (*Road Bridge*)**	**6**	**7 (*West-Irrigation Rd*)**	**8**	**9 (*Weir 32*)**
18,000 ML/day	58.69	58.45	58.40	58.35 (8.39)*	58.33	58.32	58.29	58.27	57.78
18,500 ML/day	58.82	58.58	58.52	58.48 (8.52)*	58.46	58.44	58.41	58.39	57.90
19,000 ML/day	58.92	58.67	58.62	58.57 (8.61)*	58.55	58.53	58.50	58.48	57.99
19,500 ML/day	58.99	58.73	58.68	58.63 (8.67)*	58.61	58.59	58.56	58.54	58.04
20,000 ML/day	59.07	58.81	58..75	58.70 (8.74)*	58.68	58.66	58.63	58.61	58.09
20,500 ML/day	59.13	58.86	58.79	58.74 (8.78)*	58.72	58.7	58.67	58.65	58.12
21,000 ML/day	59.18	58.90	58.84	58.78 (8.82)*	58.76	58.74	58.71	58.69	58.15
21,500 ML/day	59.23	58.95	58.88	58.83 (8.87)*	58.80	58.78	58.75	58.73	58.18
22,000 ML/day	59.28	59.00	58.93	58.87 (8.91)*	58.85	58.83	58.80	58.77	58.21
22,500 ML/day	59.35	59.06	59.00	58.93 (8.97)*	58.91	58.89	58.85	58.82	58.24
23,000 ML/day	59.39	59.11	59.04	58.98 (9.02)*	58.95	58.93	58.89	58.86	58.27
23,500 ML/day	59.45	59.17	59.10	59.03 (9.07)*	59.01	59.98	58.94	58.91	58.31
24,000 ML/day	59.49	59.21	59.14	59.07 (9.11)*	59.04	59.02	58.97	58.95	58.33
24,500 ML/day	59.53	59.26	59.18	59.11 (9.15)*	59.08	59.06	59.01	58.98	58.36
25,000 ML/day	59.57	59.30	59.23	59.15 (9.19)*	59.12	59.10	59.05	59.02	58.39

** value in parenthesis is the value directly read on gauge 425001 – Darling River at Menindee Town. Australian Height Datum (AHD) values were calculated considering the gauge zero of 49.96 m AHD.*

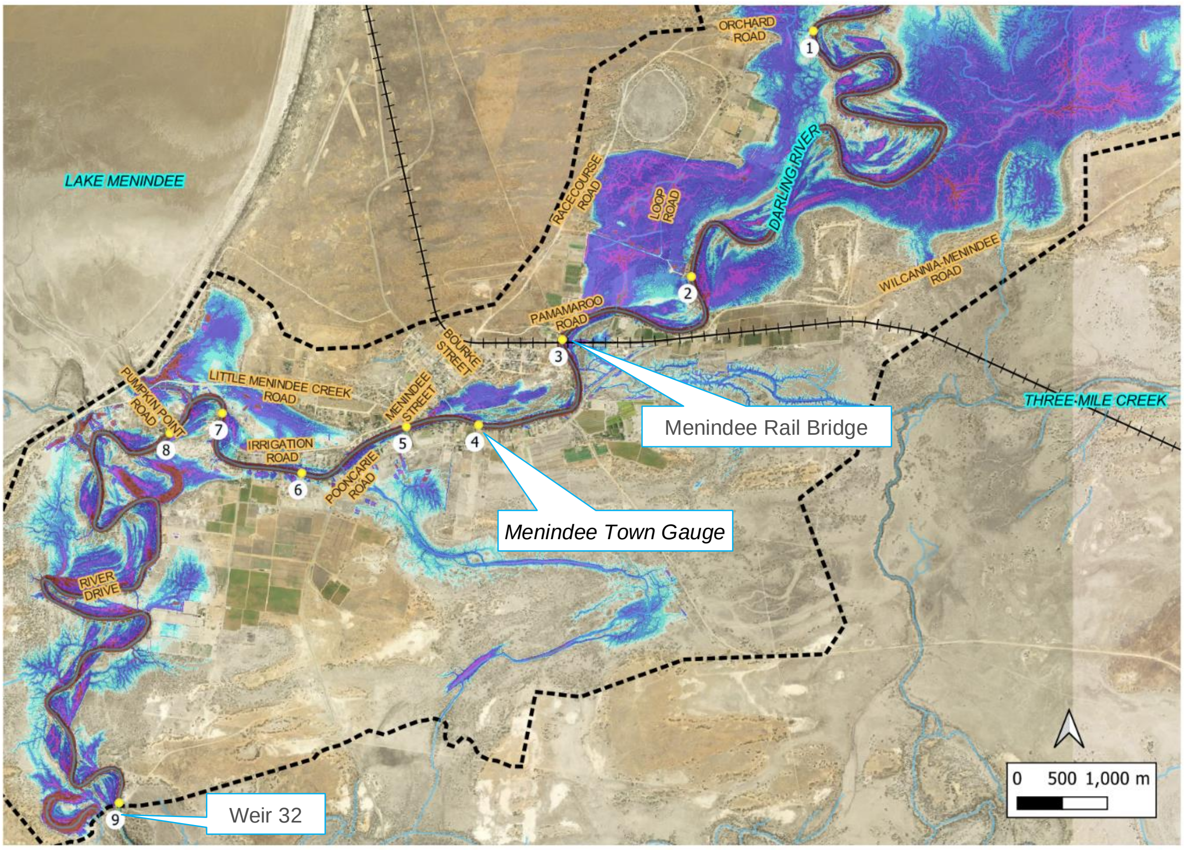


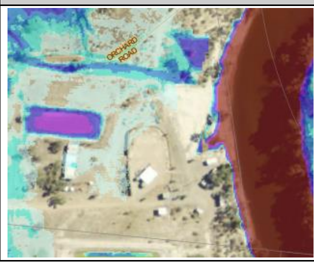
Figure 4-1 Investigation location for the summary Table 4-1

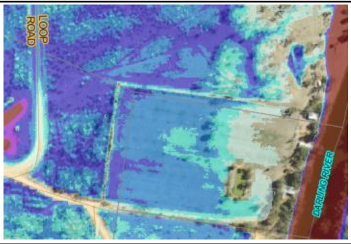
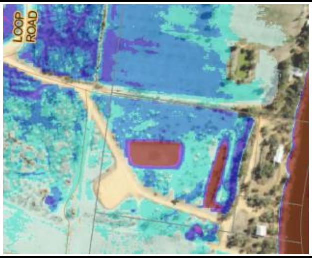
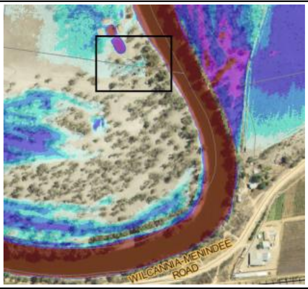
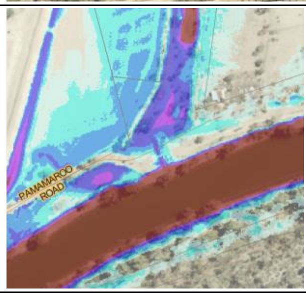
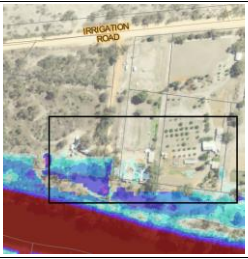
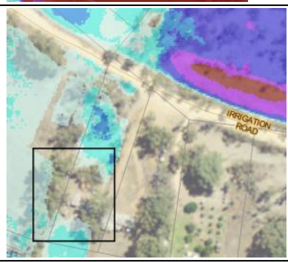
4.1 Impact on buildings

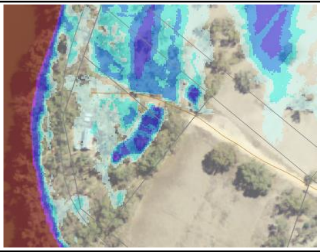
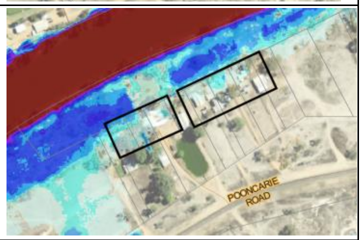
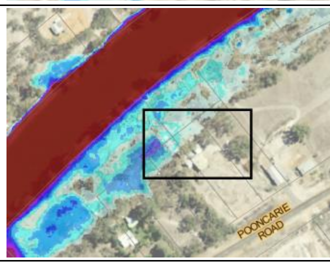
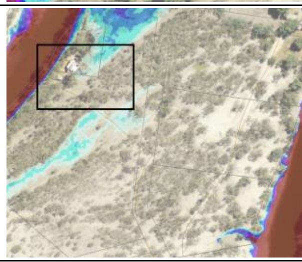
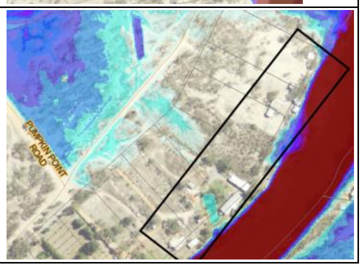
None of the buildings located in the vicinity of the project site appears to be impacted above floor level due to the flow release scenarios up to and including 24,000 ML/day. A building (ID104715862) located south of Irrigation Road appears to be inundated above floor by 10 mm in the 24,500 ML/day flow release scenario and by 50 mm in the 25,000 ML/day flow release scenario. It is important to note that simulated water levels are still water levels and any boat wake or wind generated wave may exacerbate these values. Floor levels of other buildings are at least 0.3 m above the 25,000 ML/day water surface except for one building (ID103901071, south of Irrigation Road) which is 0.1 m above 25,000 ML/day water surface. Floor levels for the available buildings are represented in **Figure 4-2A** to **Figure 4-2D**.

Several other properties were identified as they may become indirectly impacted by lot flooding and/or access road flooding. These properties are summarised in **Table 4-2**.

Table 4-2 Indirect impacts on other buildings

Cadastre ID	Building type#	Location	Description of impact	Snapshot
103513617	Residential building and shed	Eastern end of Orchard Road	➢ Access road (Orchard Road) impacted from 19,000 ML/day release scenario ➢ Surrounded by water from 22,500 ML/day release scenario	

Cadastre ID	Building type[#]	Location	Description of impact	Snapshot
103901312	Residential building and shed	At the riverbank, eastern side of Loop Road	➢ Access road (local unsealed) impacted by 0.1 m from 21,500 ML/day release scenario ➢ Lot flooding from 21,500 ML/day release scenario ➢ Surrounded by water from 22,000 ML/day release scenario	
103901311 and 103900654	Residential building and shed	At the riverbank, southern side of Loop Road	➢ Access road (Loop Road) impacted by 0.1 m from 21,500 ML/day release scenario	
168658519	Several buildings, (types are unknown)	At the riverbank, north of railway/ Wilcannia-Menindee Road	➢ Access road (local unsealed) impacted by 0.1 m from 21,500 ML/day release scenario ➢ Surrounded by water from 22,000 ML/day release scenario	
103900688	Several buildings, (types are unknown)	At end of Pamamaroo Road	➢ Access road (local unsealed) impacted by 0.2 m from 18,000 ML/day release scenario ➢ Surrounded by water from 18,500 ML/day release scenario	
104715862, 103901062, 104715861	Residential building and shed	At the riverbank, south of Irrigation Road	➢ Lot flooding from 23,000 ML/day release scenario	
103901071	Residential building and shed	At the riverbank, end of Irrigation Road	➢ Surrounded by water from 23,500 ML/day release scenario	

Cadastre ID	Building type#	Location	Description of impact	Snapshot
103901073	Residential building and shed	At the riverbank, end of Irrigation Road	➢ Surrounded by water from 19,000 ML/day release scenario	
168508982	Several buildings, (types are unknown)	At left bank, north-west of Pooncarie Road	➢ Lot flooding from 20,000 ML/day release scenario ➢ Surrounded by water from 20,500 ML/day release scenario	
103901354, 103901176, 103901177, 103901179, 103901181 and 168508983	Residential buildings and sheds	Between river and Pooncarie Road	➢ Lot flooding from 22,500 ML/day release scenario	
103901167	Shed	Between river and Pooncarie Road	➢ Lot flooding from 19,000 ML/day release scenario	
103901263	Residential building and sheds	At left bank, end of Budgie Street	➢ Access road (Budgie Street) impacted by 0.1 m from 18,000 ML/day release scenario ➢ Lot flooding from 18,000 ML/day release scenario ➢ Surrounded by water from 18,500 ML/day release scenario	
103901278, 103901285, 103901284, 103901283, 103901282, 103901281	Residential buildings and sheds	At right bank, end of Pumpkin Point Road	➢ Access road (local unsealed) impacted by 0.1 m from 24,500 ML/day release scenario ➢ Lot flooding from 18,000 ML/day release scenario for the property 103901285.	

#Building type was assumed from NSW Sixmap

4.2 Impact on roads

Several roads would be cut off in the simulated flow release scenarios. Road inundations would be expected on Orchard Road, Loop Road, Budgie Street, Pamamaroo Road and River Road in most of the flow release scenarios. For a small car, River Road becomes unsuitable in an 18,000 ML/day scenario, Budgie Street in an 19,000 ML/day scenario, Pamamaroo Road in an 18,500 ML/day scenario, Orchard Road in a 19,000 ML/day scenario and Loop Road in a 19,500 ML/day scenario. A summary of the findings of the impact on key roads is presented in **Table 4-3** and a representative impact map is shown in **Figure 4-3**.

Table 4-3 Summary of potential road cut-offs for the simulated release scenarios

Road Name	Impacted by	Inundation depth on road	Location of inundation	Extent of impact
Orchard Road	>=19,000 ML/day	~0.5 m in 19,000 ML/day and ~1.2 m in 25,000 ML/day	West of the investigation location - 1	~80 m of the road in the 19,000 ML/day ~800 m of the road in the 25,000 ML/day
Loop Road	>=18,500 ML/day	~0.25 m in 18,500 ML/day and ~1.2 m in 25,000 ML/day	North-west of the investigation location - 2	~100 m of the road in the 18,500 ML/day ~2000 m of the road in the 25,000 ML/day
Racecourse Road	Not impacted	NA	NA	NA
Pamamaroo Road	>=18,000 ML/day	~0.2 m in 18,000 ML/day and ~1.1 m in 25,000 ML/day	Entire road	~50 m of the road in 18,000 the ML/day ~250 m of the road in 25,000 the ML/day
Menindee Rail Bridge	Not impacted	NA	NA	NA
Wilcannia-Menindee road	Not impacted	NA	NA	NA
Menindee Road Bridge	Not impacted	NA	NA	NA
Menindee Street	Not impacted	NA	NA	NA
Irrigation Road	Not/minimum impacted	NA	NA	NA
Little Menindee Creek Road	>=25,000 ML/day	~0.1 m in 25,000 ML/day	Near Pumpkin Point Road	~160 m of the road in the 25,000 ML/day
Budgie Street	>=18,000 ML/day	~0.1 m in 18,000 ML/day and ~0.9 m in 25,000 ML/day	At north-western end of the road near the river	~30 m of the road in 18,000 the ML/day ~210 m of the road in 25,000 the ML/day
Pumpkin Point Road	Not impacted	NA	NA	NA
River Road	>=18,000 ML/day	1m or more	At several locations	Entire road

4.3 Impact on other facilities

Due to the unavailability of field data, detailed impacts on property's septic tanks were investigated around Irrigation Road only. Simulated water levels were also compared with the elevation of the septic tank. Septic tank-01 will be impacted by a flow rate equal to or larger than 21,000 ML/day and septic tank-04 will be impacted by a flow rate equal to or larger than 19,000 ML/day (**Figure 4-4)**. It is noted that a few sceptic tanks were not accessible at the time of the survey and levels are therefore unavailable.

4.4 Flow velocities

The average velocity in the main channel of the Darling River in the vicinity of the project site is between ~0.6 and ~0.9 m/s for the various simulated release scenarios.

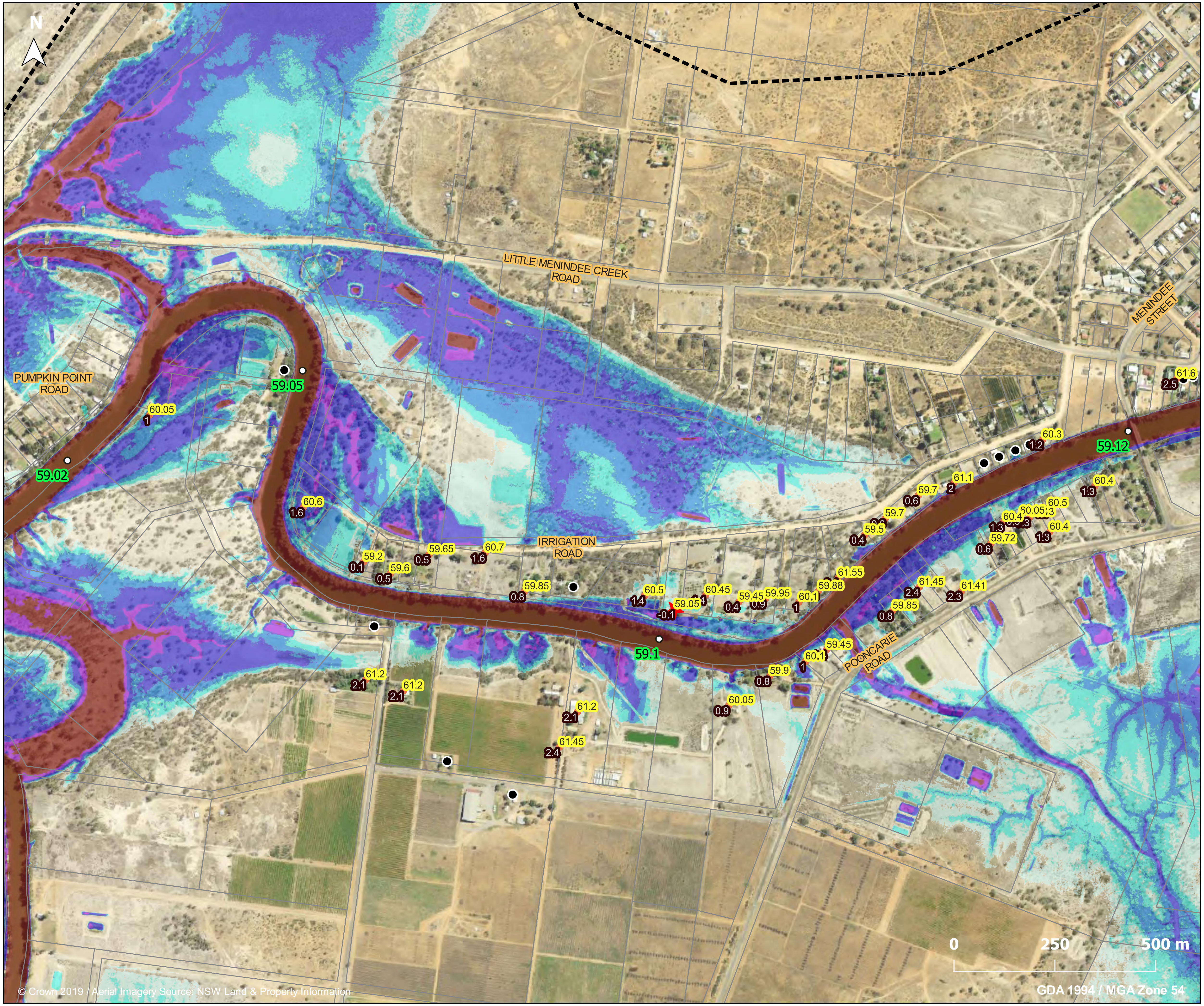


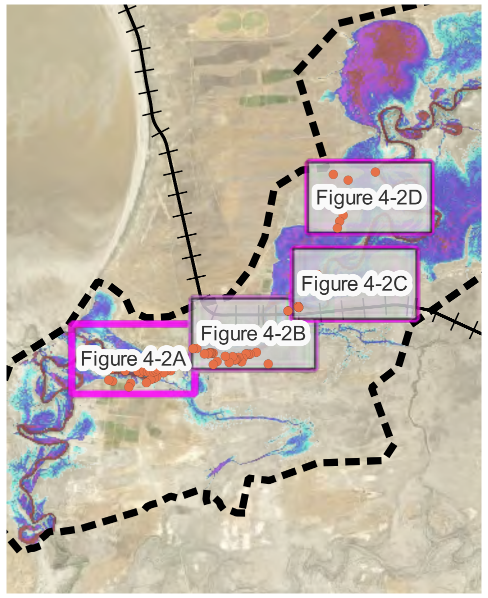
Figure 4-2A Comparison of Building floor levels with water levels in 25,000 ML/ day release scenario

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50
- 58.2 Peak Water Level (m AHD)
- 60.6 Builing Floor Level (mAHD)
- 0.4 Freeboard Above Peak Water Level
- Building Impacted (Above Floor)
- No data



Report MHL2889

Menindee Flow Release Impact Assessment

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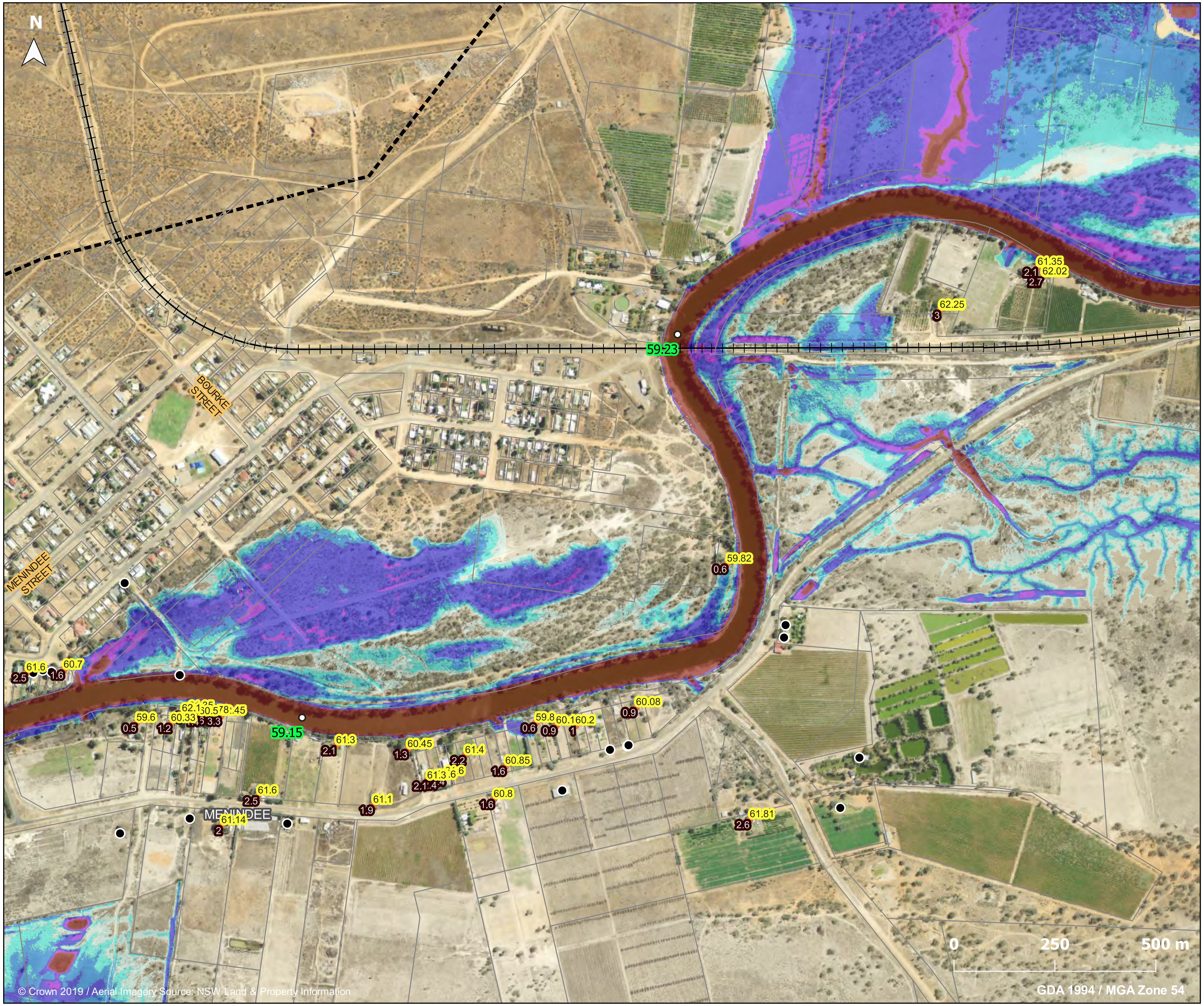


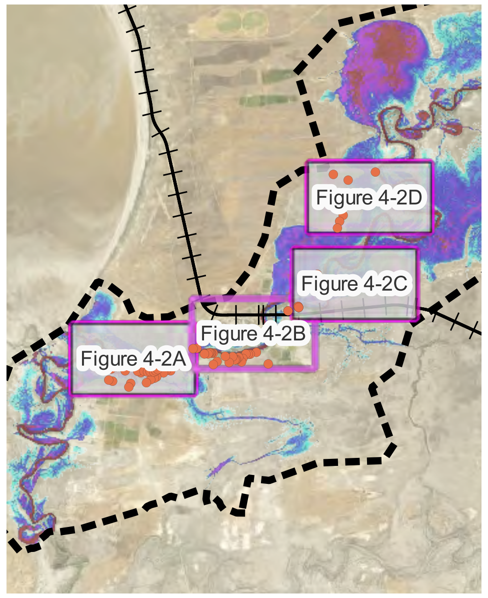
Figure 4-2B Comparison of Building floor levels with water levels in 25,000 ML/ day release scenario

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50
- 58.2 Peak Water Level (m AHD)
- 60.6 Builing Floor Level (mAHD)
- 0.4 Freeboard Above Peak Water Level
- Building Impacted (Above Floor)
- No data



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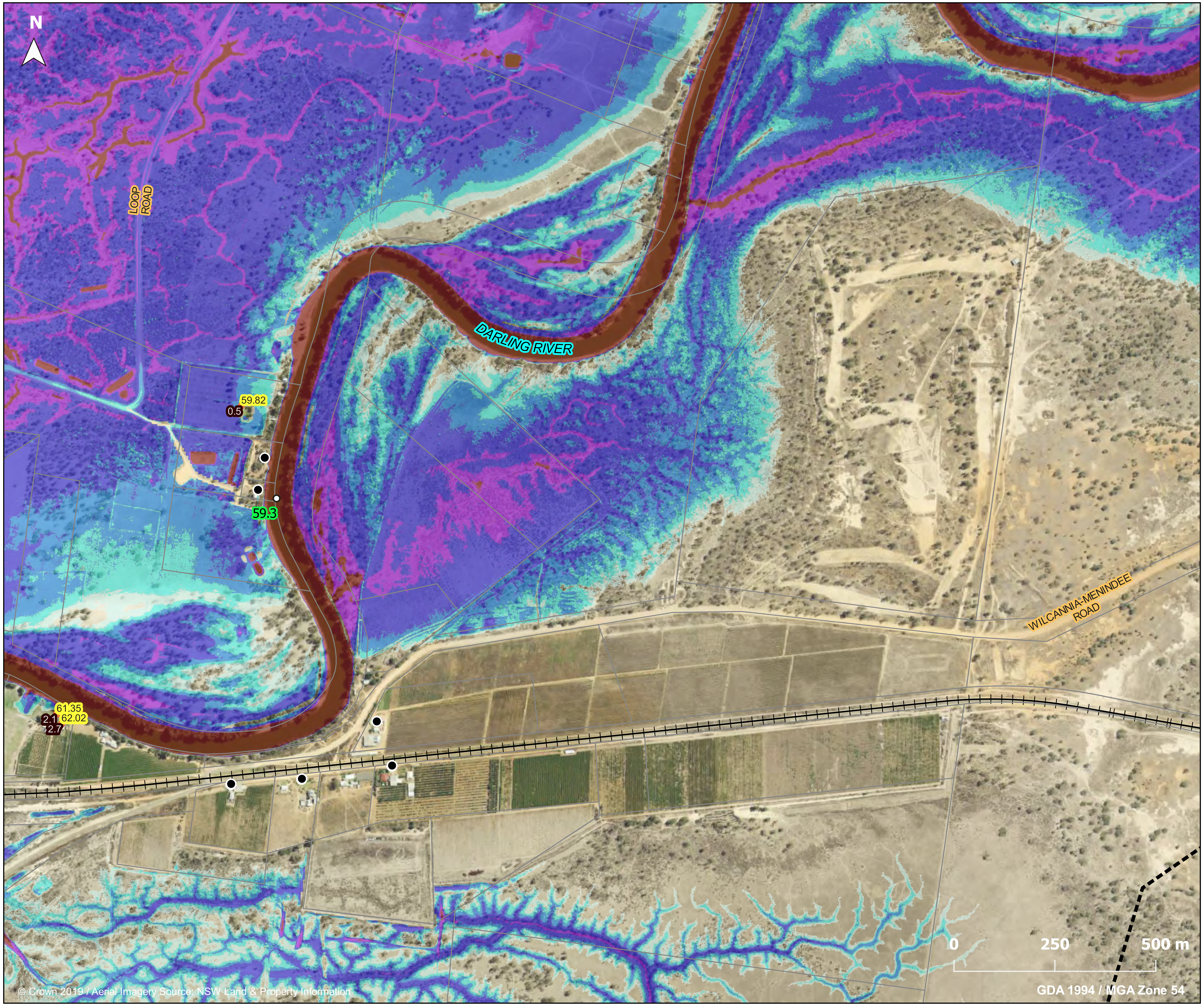

Figure 4-2C Comparison of Building floor levels with water levels in 25,000 ML/ day release scenario

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50
- 58.2 Peak Water Level (m AHD)
- 60.6 Builing Floor Level (mAHD)
- 0.4 Freeboard Above Peak Water Level
- Building Impacted (Above Floor)
- No data

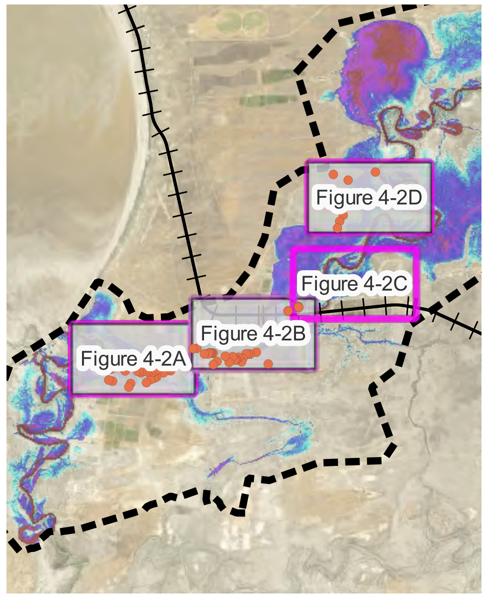

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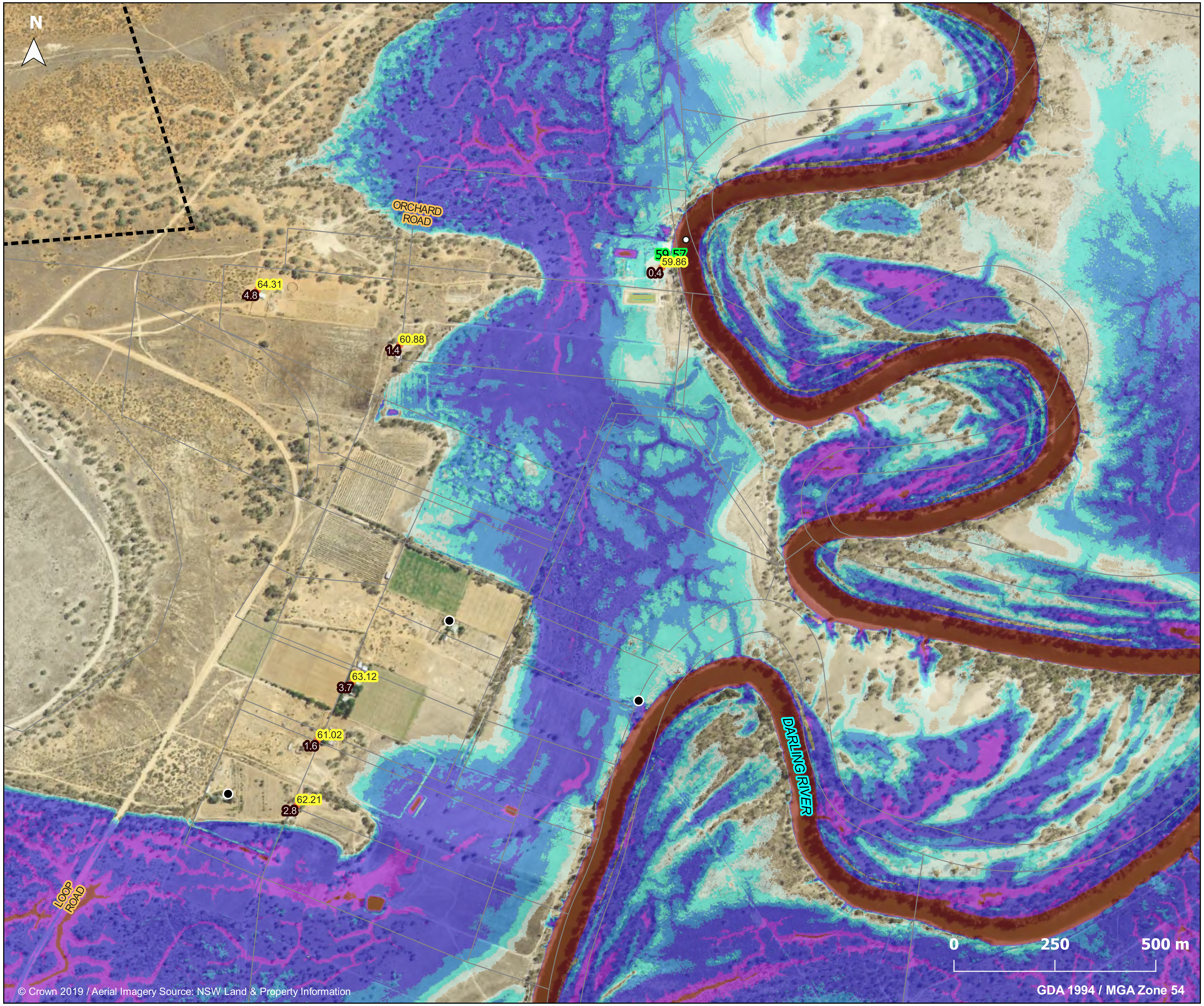
Figure 4-2D Comparison of Building floor levels with water levels in 25,000 ML/ day release scenario



Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50
- 58.2 Peak Water Level (m AHD)
- 60.6 Builing Floor Level (mAHD)
- 0.4 Freeboard Above Peak Water Level
- Building Impacted (Above Floor)
- No data

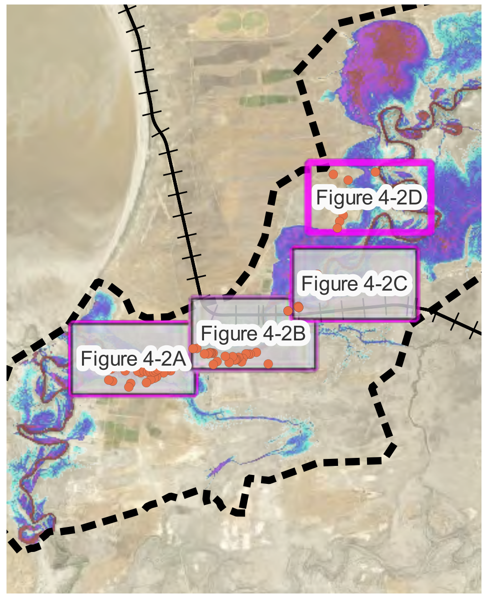


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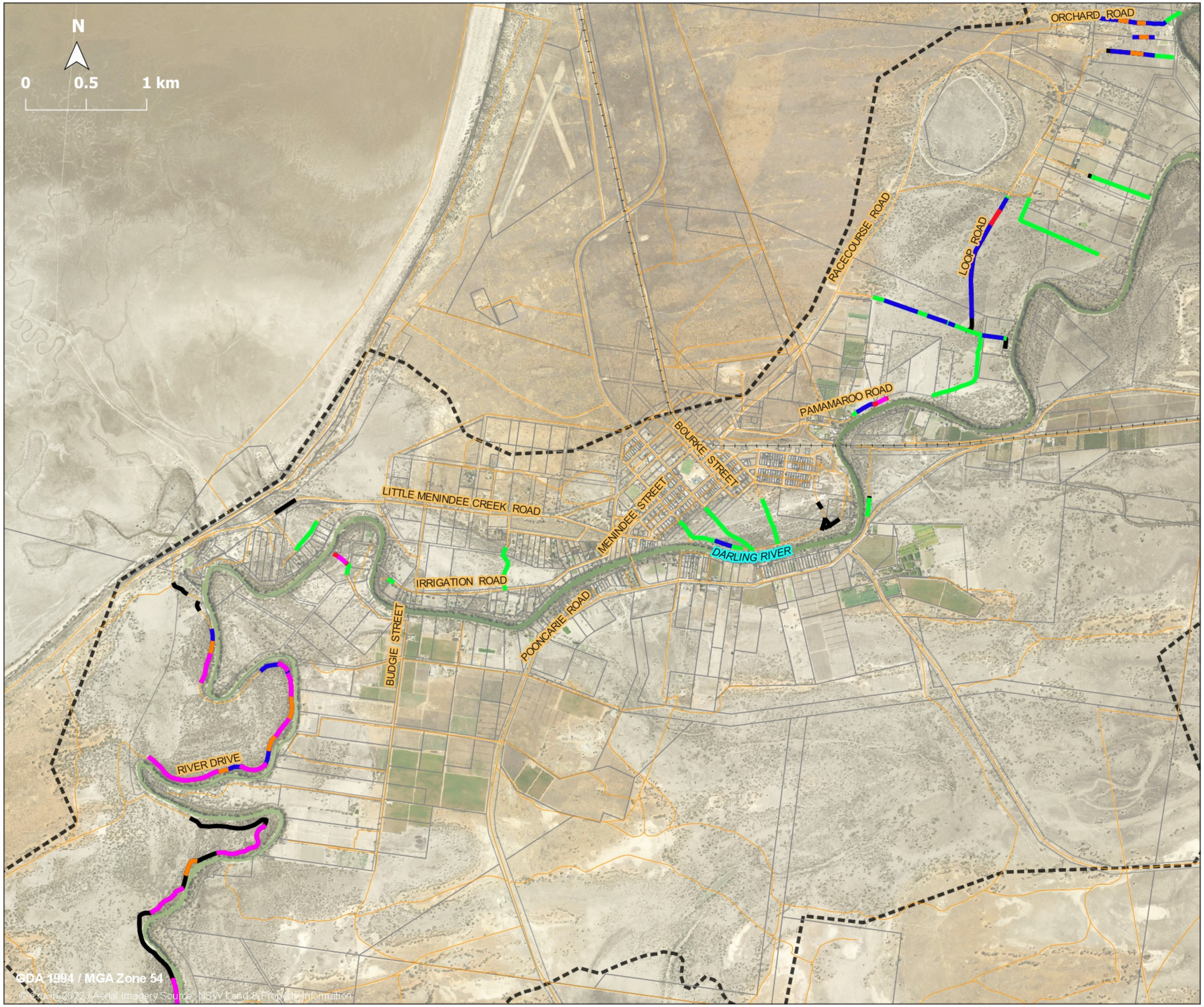
Figure 4-3 Roads Impact Map



Legend

- Roads
- Railway
- Cadastre
- TUFLOW Model Extent
- Impacted by =>18,000 ML/day flow
- Impacted by =>18,500 ML/day flow
- Impacted by =>19,000 ML/day flow
- Impacted by =>21,500 ML/day flow
- Impacted by =>24,500 ML/day flow
- Impacted by =>25,000 ML/day flow

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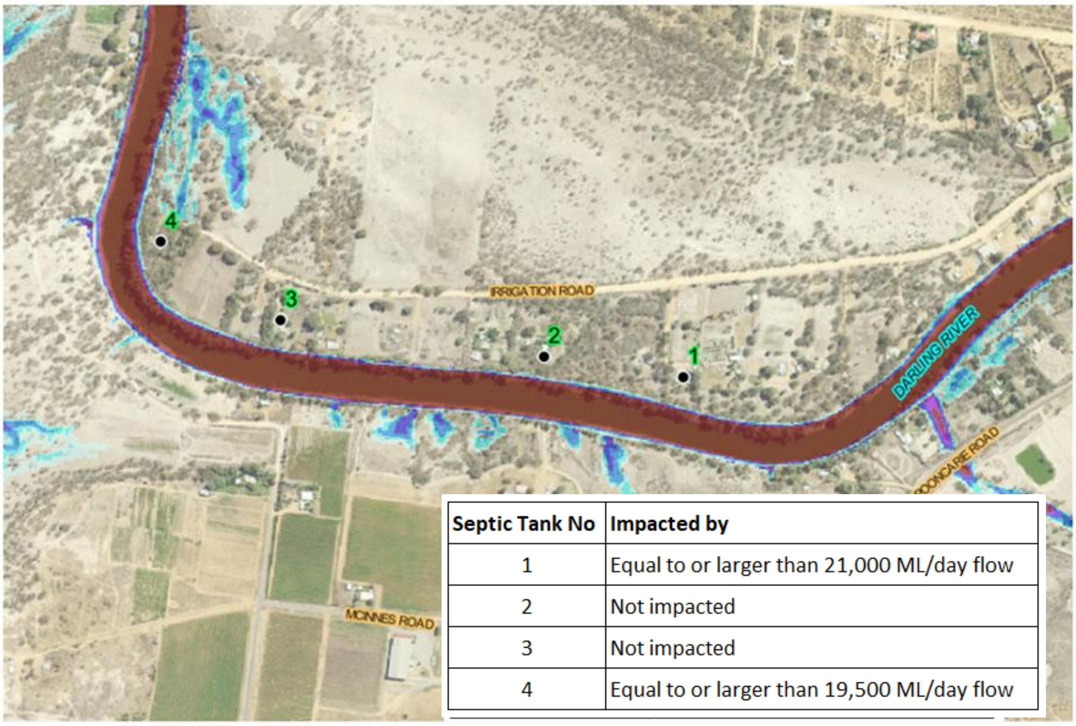


Septic Tank No	Impacted by
1	Equal to or larger than 21,000 ML/day flow
2	Not impacted
3	Not impacted
4	Equal to or larger than 19,500 ML/day flow

Figure 4-4 Inundation risk to the surveyed septic tanks for the flow release scenarios

Appendix A Survey Brief

Survey Brief

1. Purpose of the Survey

A survey of floor levels, septic tank levels and driveway levels along Irrigation Road, Menindee as well as crest of Irrigation Road and the crest and toe of a local levee and potential peak level marks from latest flow event from December 2021 to February 2022 to inform hydraulic modelling of the study area.

All digital and hard copy data supplied for this purpose are the property of the Department of Planning and Environment (DPE) and may only be used for the purposes specifically authorised. Any unauthorised use relating to this data could give rise to legal proceedings.

2. Location and Extent of the Survey

The properties for survey are located around Irrigation Road along the Darling River in the township of Menindee, within the Central Darling Shire Council. The extent and location of survey requirements are presented in Appendix A.

The survey will consist of:

- Floor levels, septic tank height and driveways level for properties along the western end of Irrigation Road.
- Crest and toe of unofficial levee at downstream (western) end of Irrigation Road.
- Crest of Irrigation Road to confirm accuracy of available road designs.
- Level of flow marks created during the previous event.

3. Delivery Schedule

- Proposed Start Date: ASAP
- Completion date for whole services: ASAP

4. Deliverables

The IP of the survey deliverables belongs to the Client (DPE) in terms of an unrestricted licence to use and copy the data.

The following deliverables are required on or before the Completion Date:

- Measured elevation data point and long-section of road/levee as drawings in AutoCAD and pdf format
- Measured elevation data point and long-section of road/levee in ASCII (x,y,z) format
- Brief report summarising data provided; and
- Site photographs.

Data in EACSD format is NOT required.

Hard copy drawing formats are NOT required.

4.1. Format of ASCII Data

4.1.1. Levee and Road Long Sections

Long Sections require data to be presented in ASCII (x,y,z) format, data should follow the below format conventions:

- Road Long-section and levee long-sections are to be contained in individual files named as “Menindee_Levee_Crest_01.asc”, “Menindee_Levee_Toe_01.asc” and “Menindee_Irrigation_Road_Crest_01.asc”.
- Each file should be formatted as follows:

Easting, Northing, Elevation
Easting, Northing, Elevation
…, … , …
Easting, Northing, Elevation

  - Note that the points in the ASCII should be ordered to define a long-section from the upstream extent of the section to the downstream extent
- All co-ordinates should be reported as MGA (2020) Zone 54

All levels should be reported based on Australian Height Datum (AHD)

4.1.2. Elevation data points

Floor levels, septic tanks levels and driveway levels data points require data to be presented in ASCII (x,y,z) format, data should follow the below format conventions:

- The file should be formatted as follows:

Easting, Northing, Elevation
Easting, Northing, Elevation
…, … , …
Easting, Northing, Elevation

- All co-ordinates should be reported as MGA (2020) Zone 54
- All levels should be reported based on Australian Height Datum (AHD)

4.1.3. Release flow marks

For the flow mark of the latest event (December 2021 to February 2022), survey data should be presented as follows:

Easting, Northing, Elevation
Type of mark: Water marks / Debris Mark
Location: River / Floodplain / Property

5. Potential Hazards

The survey work is to be carried out on the banks of a watercourse and along Irrigation Road. Therefore, the surveyor shall be required to take full consideration of the risks involved in the work. Appropriate Health and Safety measures and safe working practices to mitigate risk to themselves, their staff and the general public shall be taken.

The Surveyor should provide information on their approach, procedures and qualifications for the management of health and safety in their tender response.

Site specific risk assessments and evidence of compliance with relevant quality standards will be required on appointment.

6. Site Access and Public Relations

Good public relations are vital, and the Surveyor shall ensure this is maintained at all times.

Prior to attending the site, the Surveyor should contact Veronica Silberschneider, Principal Implementation Officer on 0477 760 682 or at veronica.silberschneider@dpie.nsw.gov.au to allow local community to be contacted by DPE prior to the completion of the survey work.

The surveyor is to follow all DPE/Council protocols for entering private property and the relevant Occupational Health and Safety requirements for working in traffic. Should landowners be encountered during the survey, their details should be taken and included in the Survey Report. Any incidents that occur while on site should be reported immediately to the DPE Project Manager.

7. Technical Requirements

7.1. Levee long-section

The identified levee at the downstream (western) end of Irrigation Road should be surveyed with the following detail:

- Long section along the levee crest sufficient to determine low and high points along the structure (~10 m interval).
- Long section along the levee toe on the landward side of the levee sufficient to determine ground level should the levee be removed (~10 m interval).
- Level in m AHD
- All co-ordinates should be reported as MGA 2020 Zone 54
- All levels should be reported based on Australian Height Datum (AHD)
- Vertical accuracy is to be ±25mm and horizontal accuracy is to be ±1m
- Photographs of the levee (in both directions) should be provided at regular interval sufficient to cover the entire levee.

Figure 1 – Photograph of unofficial levee

7.2. Irrigation Road long-section

The crest of Irrigation Road should be surveyed with the following detail:

- Long-section along the crest of Irrigation Road sufficient to determine low and high points along the road crest (~50 m interval).
- Level in m AHD
- All co-ordinates should be reported as MGA 2020 Zone 54
- All levels should be reported based on Australian Height Datum (AHD)
- Vertical accuracy is to be ±25mm and horizontal accuracy is to be ±1m
- Photographs of the road (in both directions) should be provided at ~100 m interval.

7.3. Floor levels

All floor levels should be surveyed with the following detail:

- Address
- Property type: slab-on-ground / high-set / low-set
- Number of storeys
- Wall type
- Floor level in m AHD
- All co-ordinates should be reported as MGA 2020 Zone 54
- All levels should be reported based on Australian Height Datum (AHD)
- Vertical accuracy is to be ±25mm and horizontal accuracy is to be ±1m
- Photographs should be provided for each building surveyed. These will be clearly named to match the building.

7.4. Septic tank and driveways level

All septic tank and driveways levels should be surveyed with the following detail:

- Address
- Level in m AHD
- Photographs should be provided for each structure surveyed. These will be clearly named to match the structure.
- All co-ordinates should be reported as MGA 2020 Zone 54
- All levels should be reported based on Australian Height Datum (AHD)
- Vertical accuracy is to be ±25mm and horizontal accuracy is to be ±1m

7.5. Flood marks

All flood marks levels should be surveyed with the following detail:

- Up to ten (10) flood marks locations.
- Address (if applicable) or general location (i.e. River bank)
- Level in m AHD
- Photographs should be provided for each flood mark surveyed. These will be clearly named to match the flood mark and indicate the direction of view. Photos should not be resized to resolutions lower than 1500 pixels along the longest edge.
- All co-ordinates should be reported as MGA 2020 Zone 54
- All levels should be reported based on Australian Height Datum (AHD)
- Vertical accuracy is to be ±25mm and horizontal accuracy is to be ±1m

Figure 2 – Example of flood mark from latest event across river from properties

Appendix A Survey Location Plan

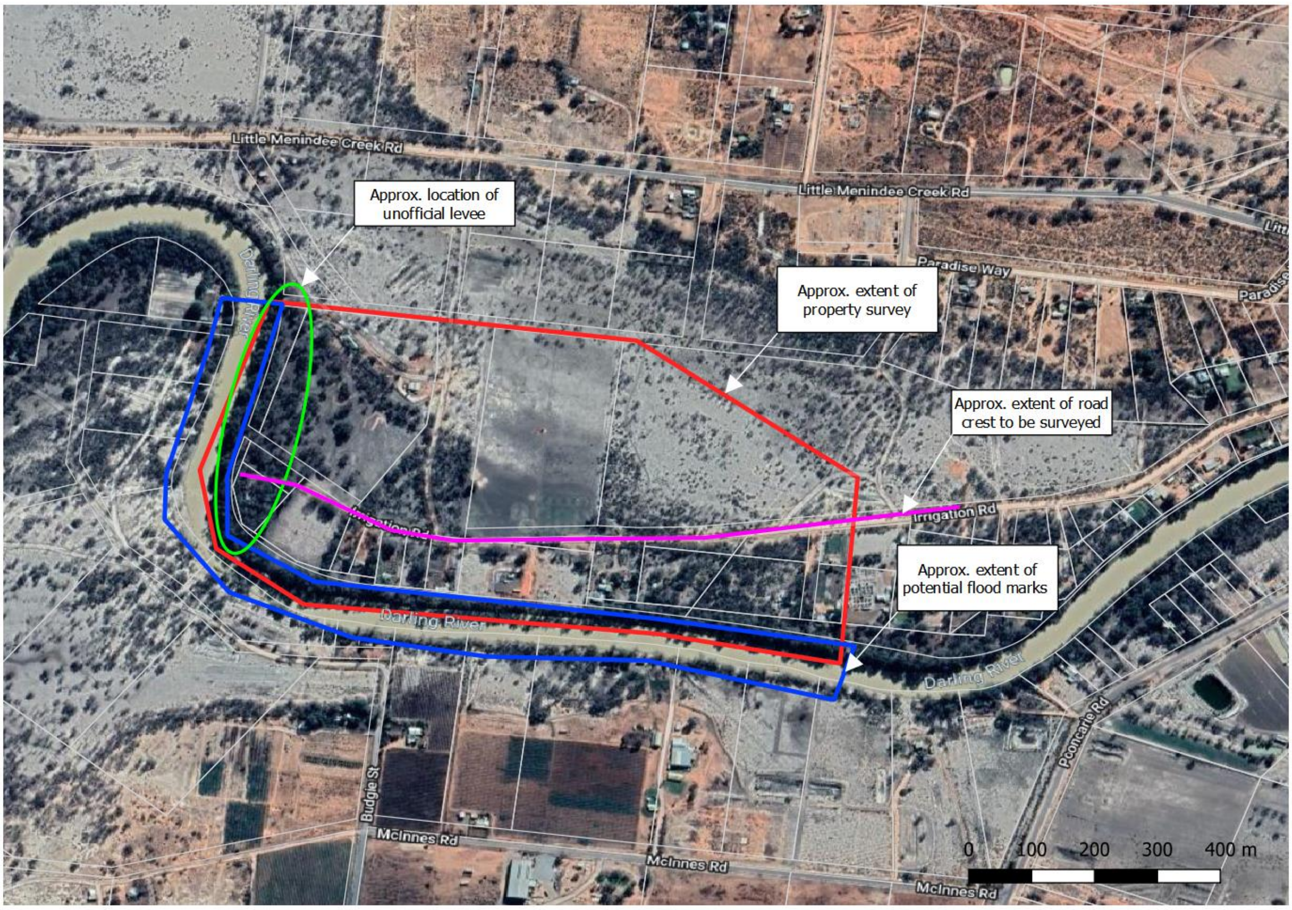
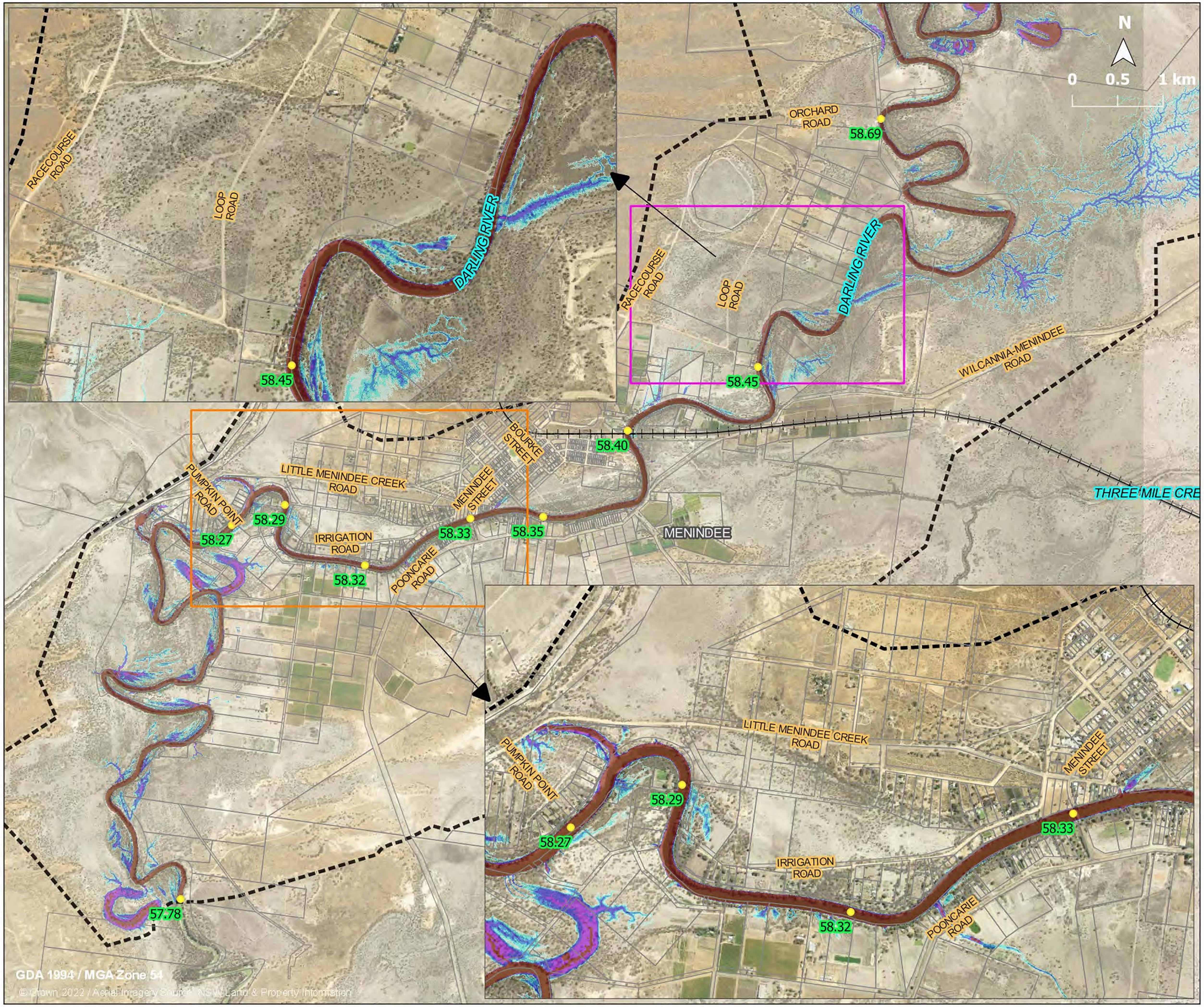


Figure 3 - Survey Location Plan

Appendix B Inundation maps

Figure B.01: Peak Inundation Map for the Release Scenario 18,000 ML/day



Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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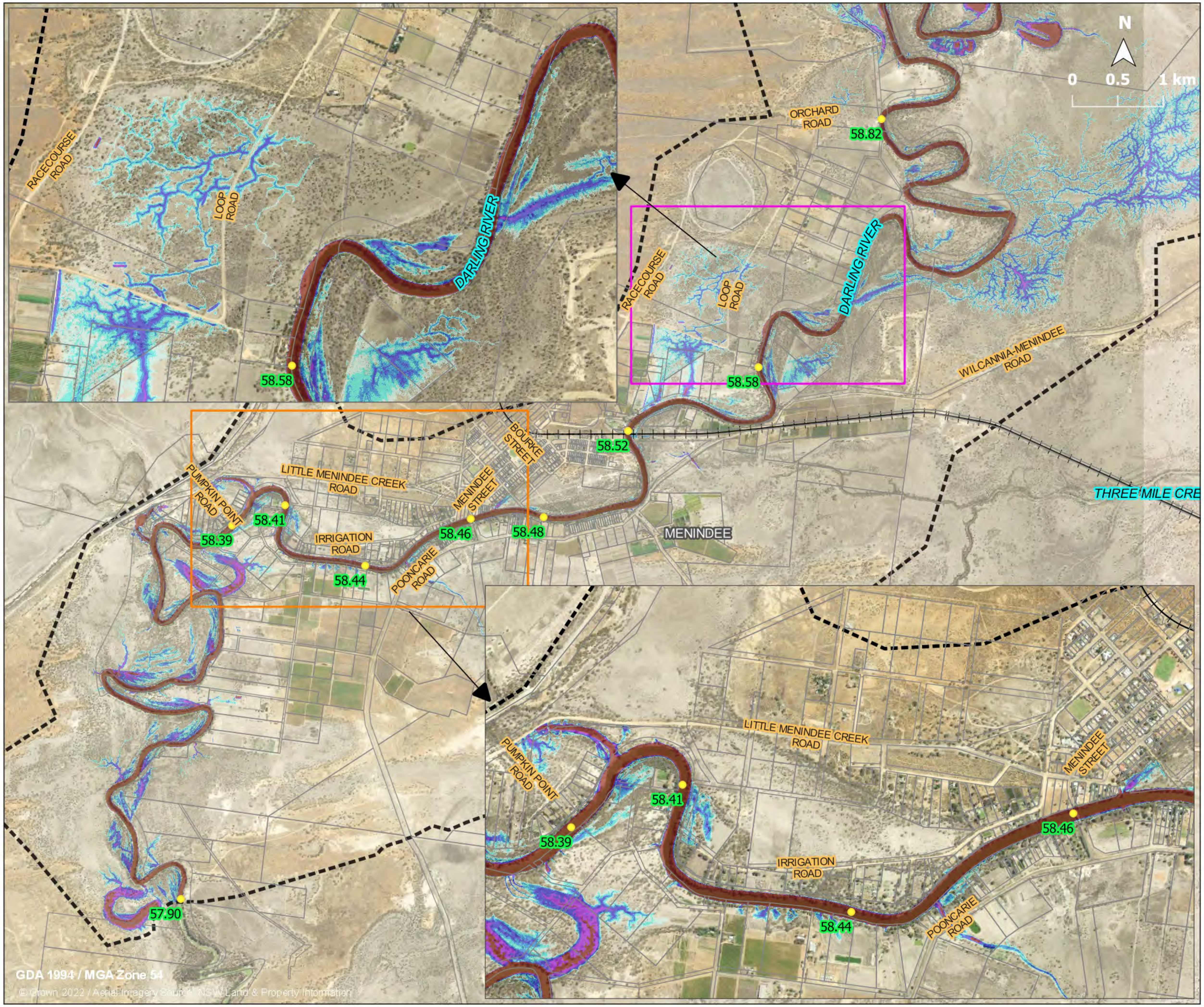

Figure B.02: Peak Inundation Map for the Release Scenario 18,500 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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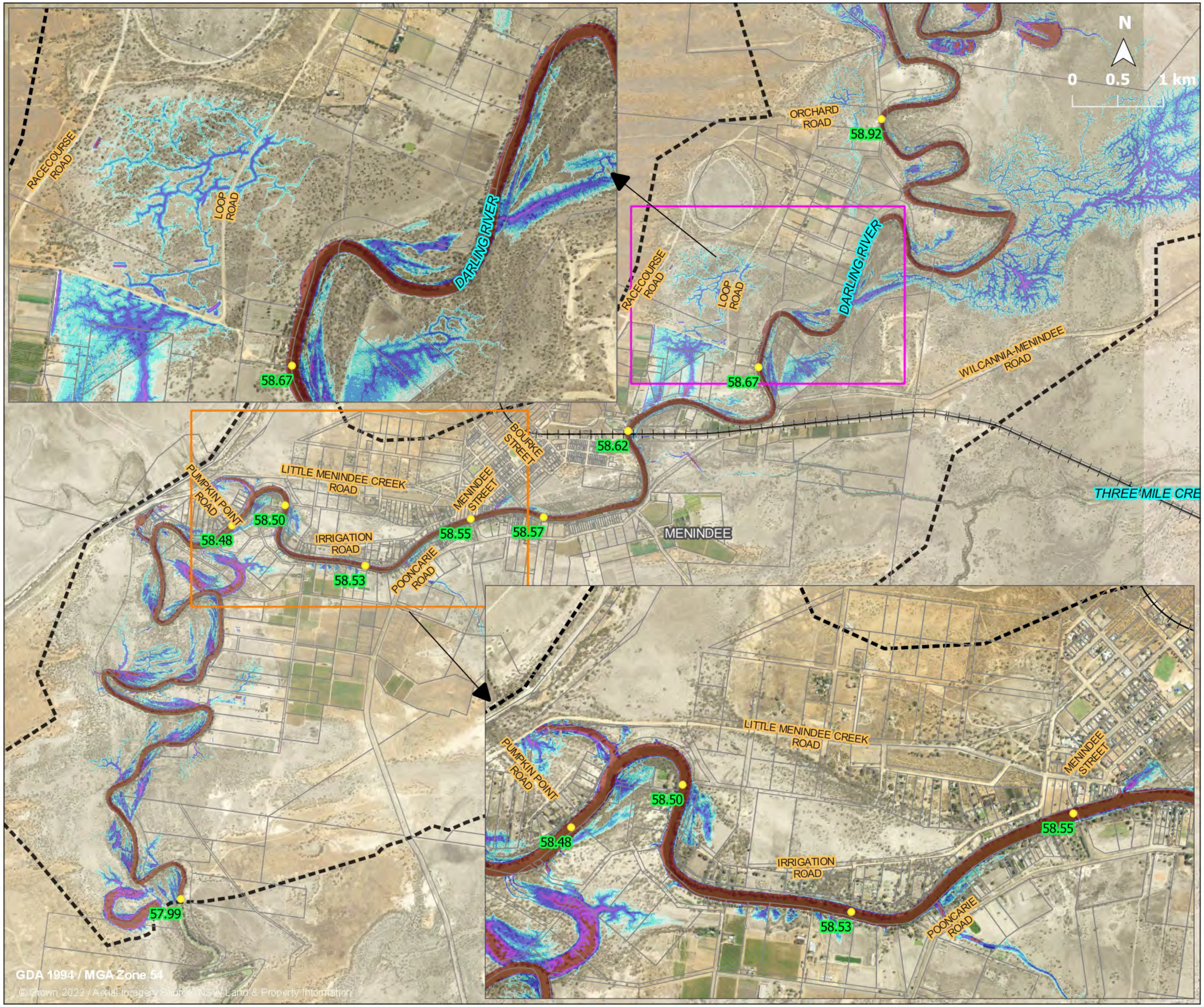
Figure B.03: Peak Inundation Map for the Release Scenario 19,000 ML/day



Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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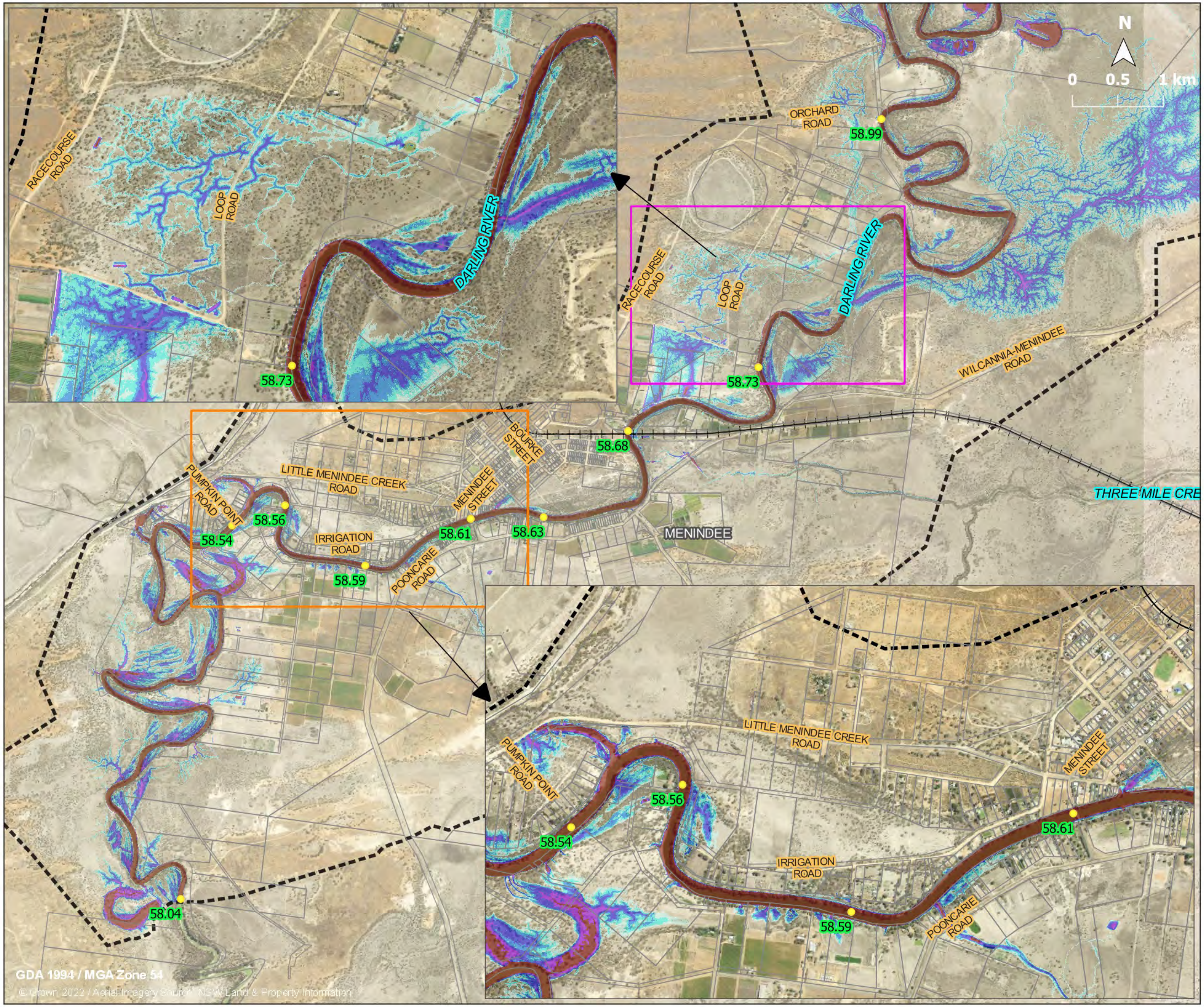

Figure B.04: Peak Inundation Map for the Release Scenario 19,500 ML/day

Legend

Railway
Cadastre
TUFLOW Model Extent

Inundation Depth (m)

0.05-0.15
0.15-0.30
0.30-0.50
0.50-1.00
1.00-1.50
> 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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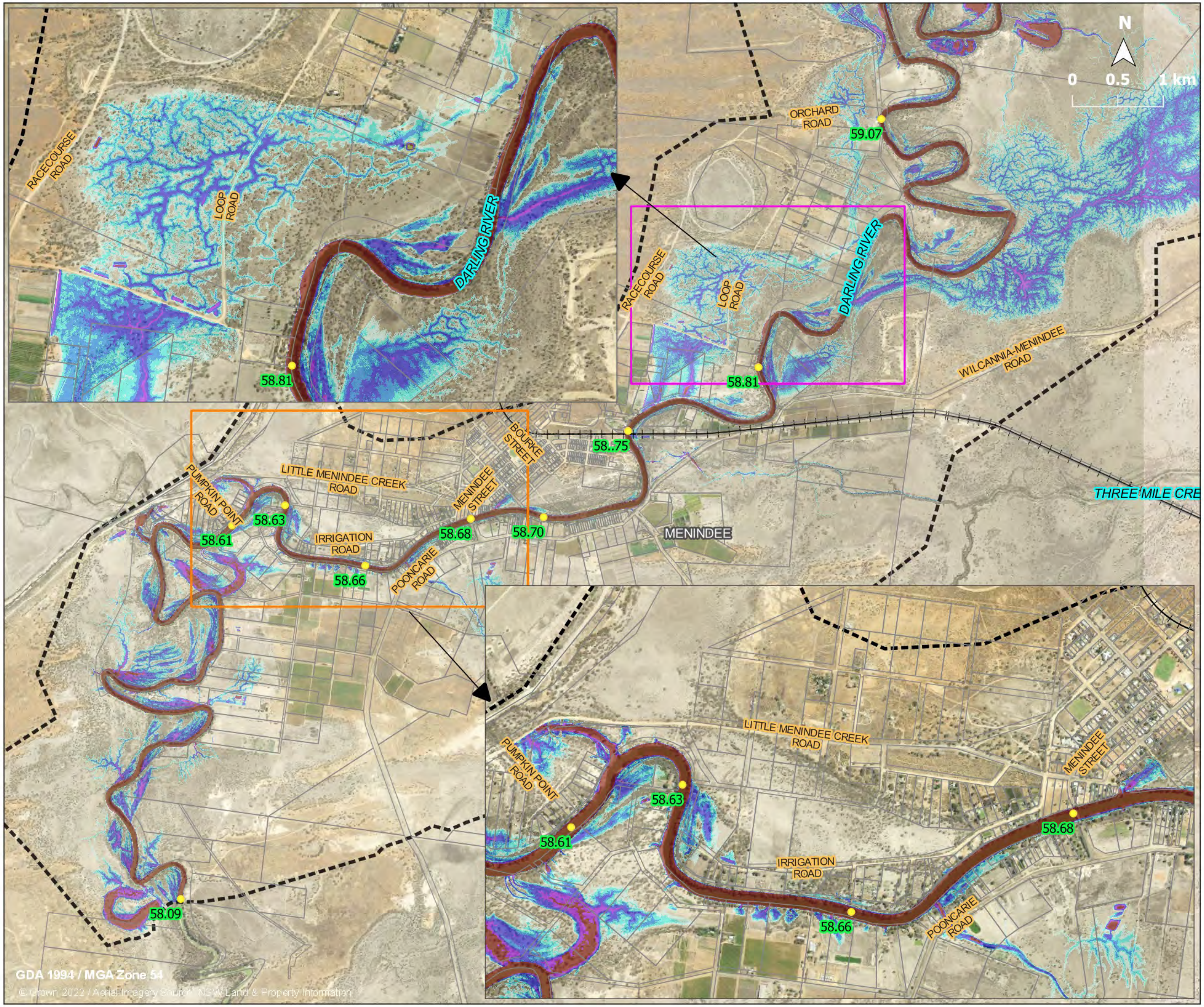

Figure B.05: Peak Inundation Map for the Release Scenario 20,000 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

- 58.2 Peak Water Surface Level (m AHD)
- Building Impacted (Above Floor)

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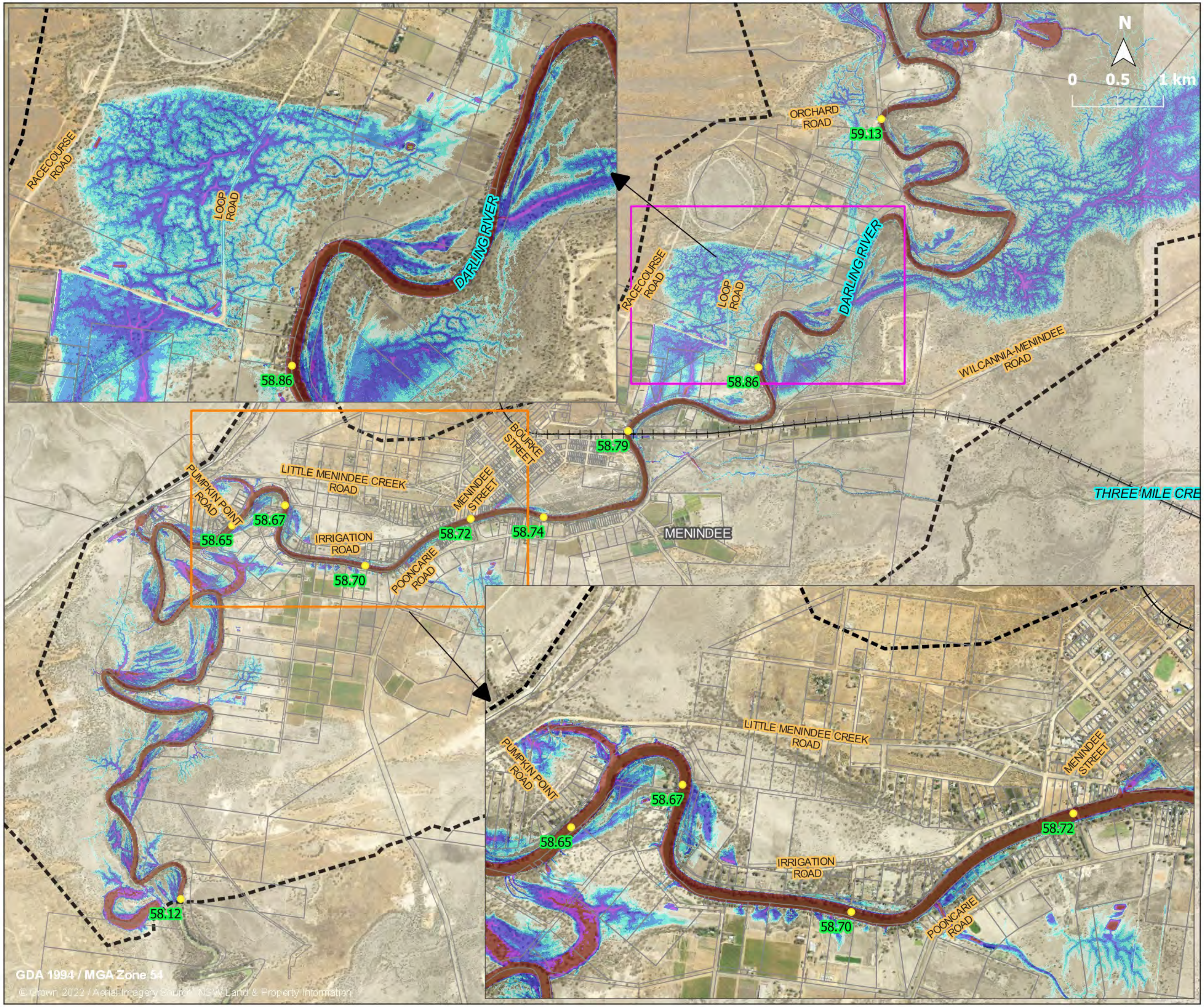

Figure B.06: Peak Inundation Map for the Release Scenario 20,500 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

- 58.2 Peak Water Surface Level (m AHD)
- Building Impacted (Above Floor)

Report MHL2889

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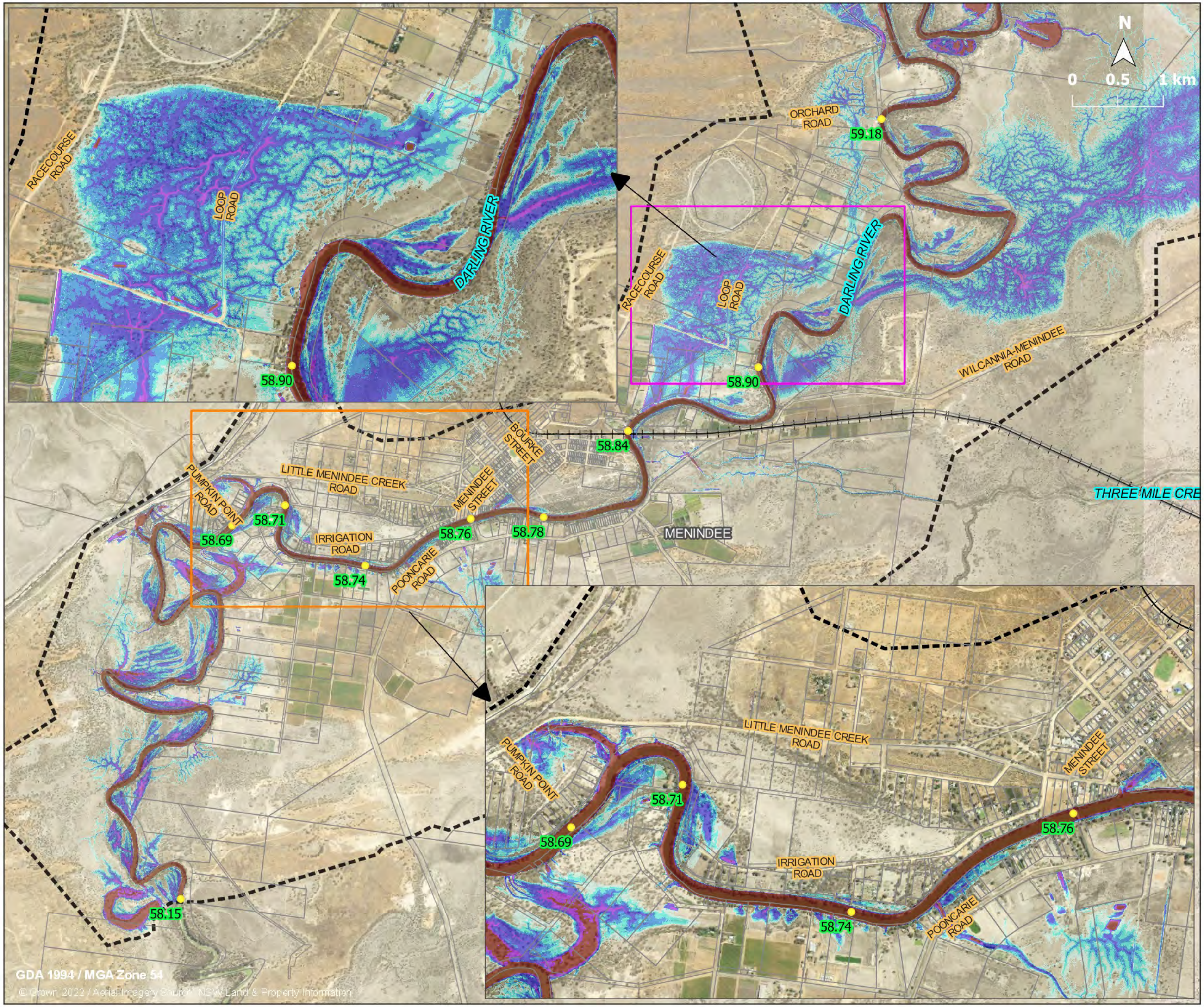

Figure B.07: Peak Inundation Map for the Release Scenario 21,000 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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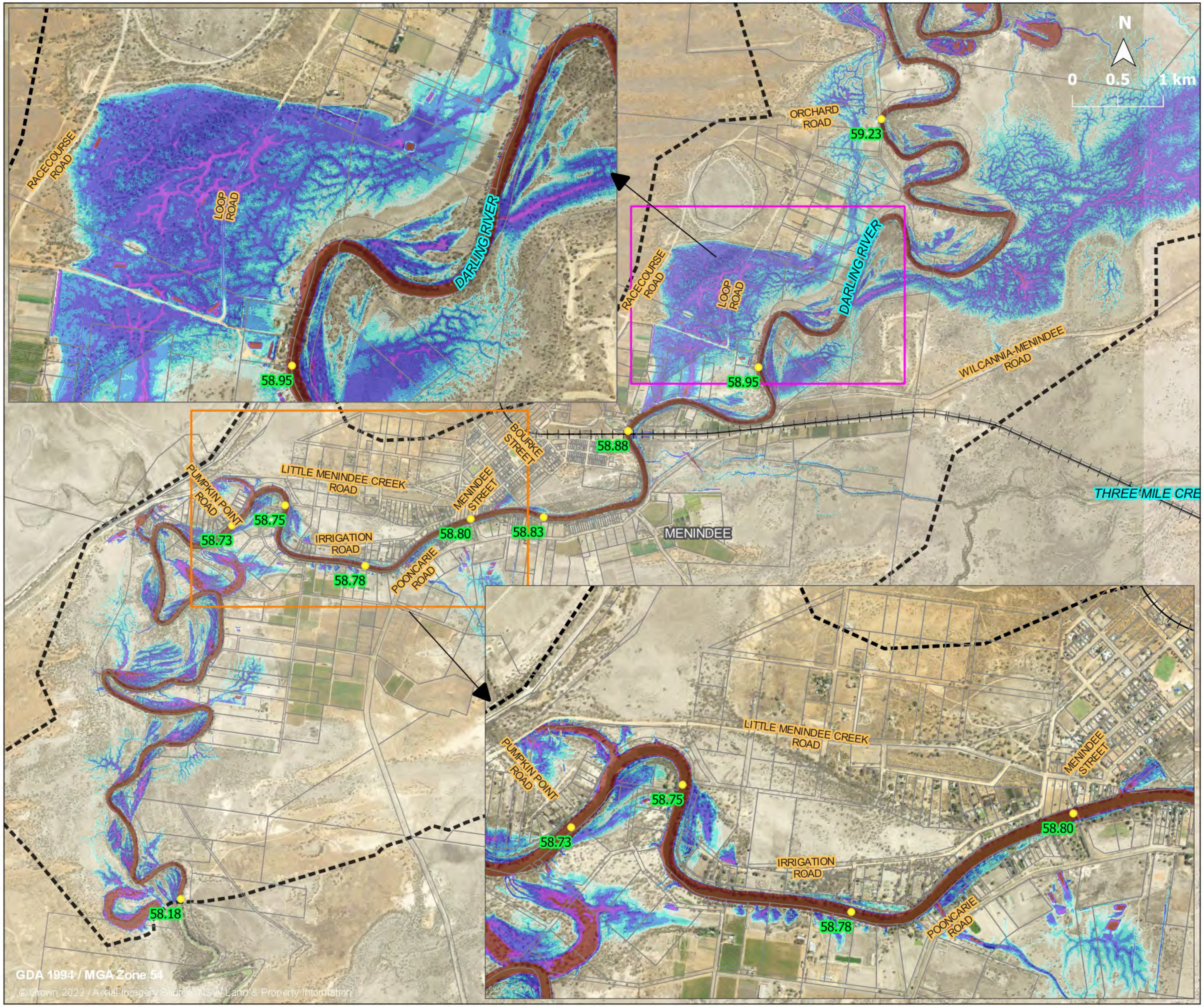

Figure B.08: Peak Inundation Map for the Release Scenario 21,500 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50
- 58.2 Peak Water Surface Level (m AHD)
- Building Impacted (Above Floor)

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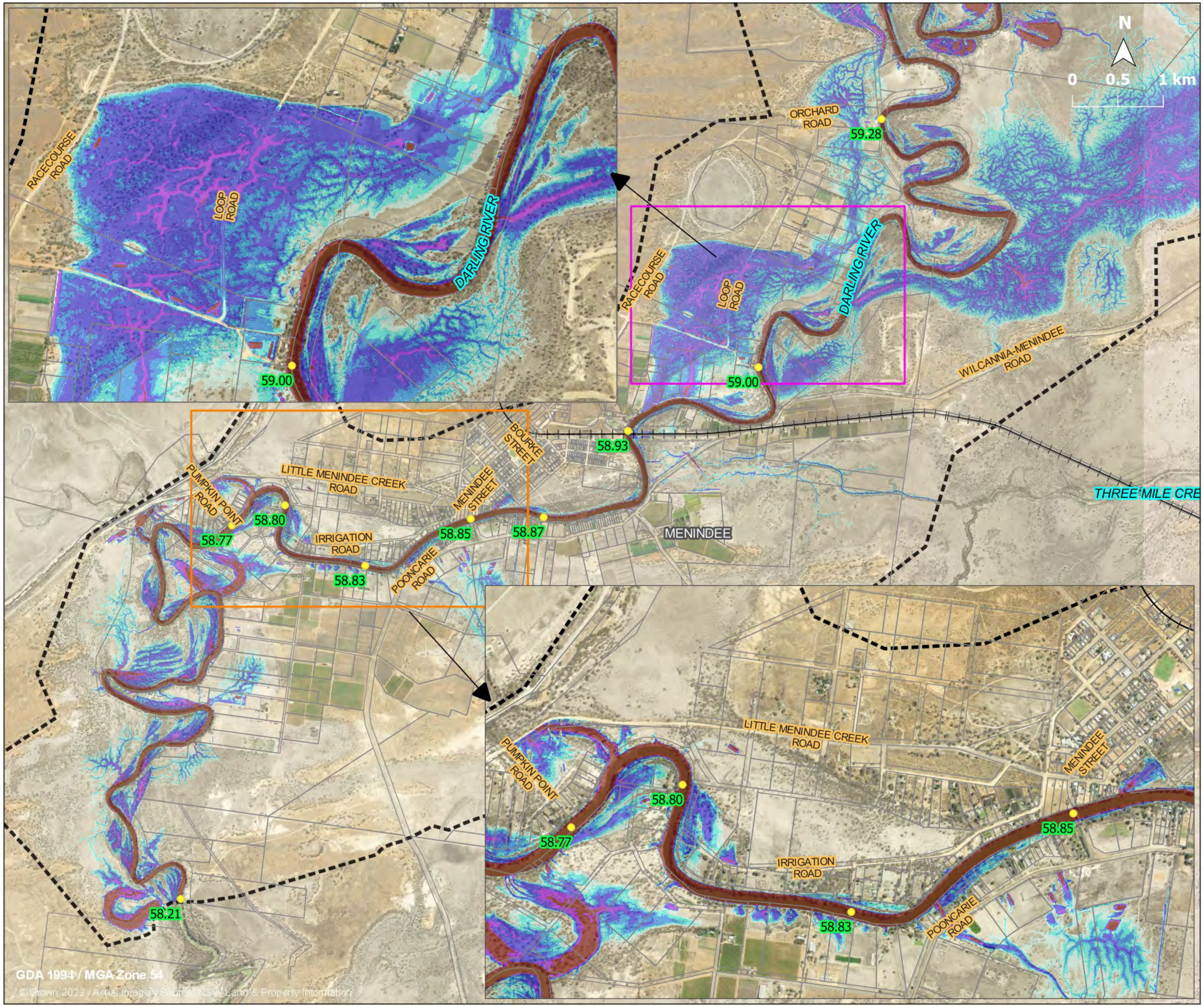

Figure B.09: Peak Inundation Map for the Release Scenario 22,000 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

- 58.2 Peak Water Surface Level (m AHD)
- Building Impacted (Above Floor)

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Menindee Flow Release Impact Assessment

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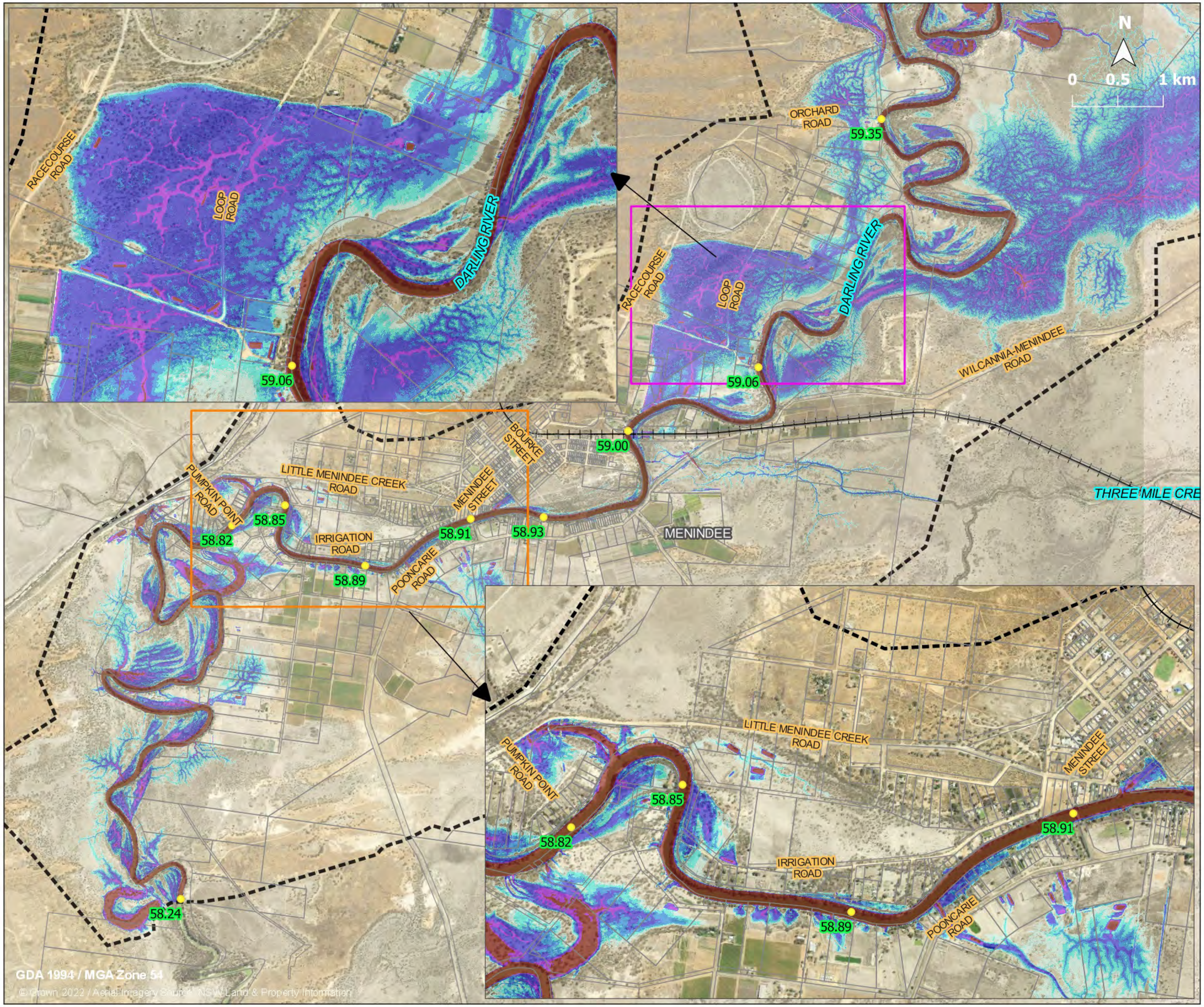

Figure B.10: Peak Inundation Map for the Release Scenario 22,500 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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Menindee Flow Release Impact Assessment

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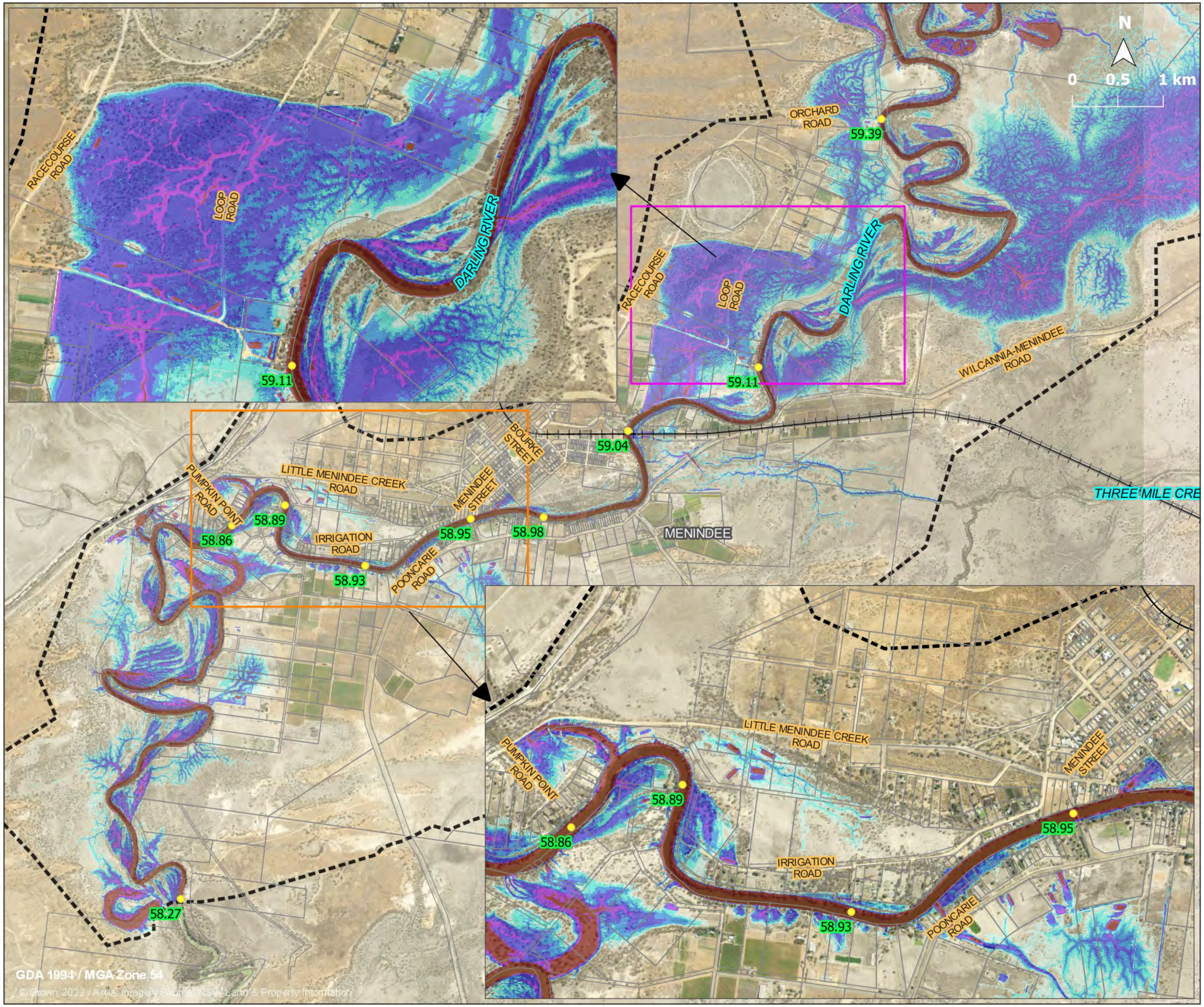

Figure B.11: Peak Inundation Map for the Release Scenario 23,000 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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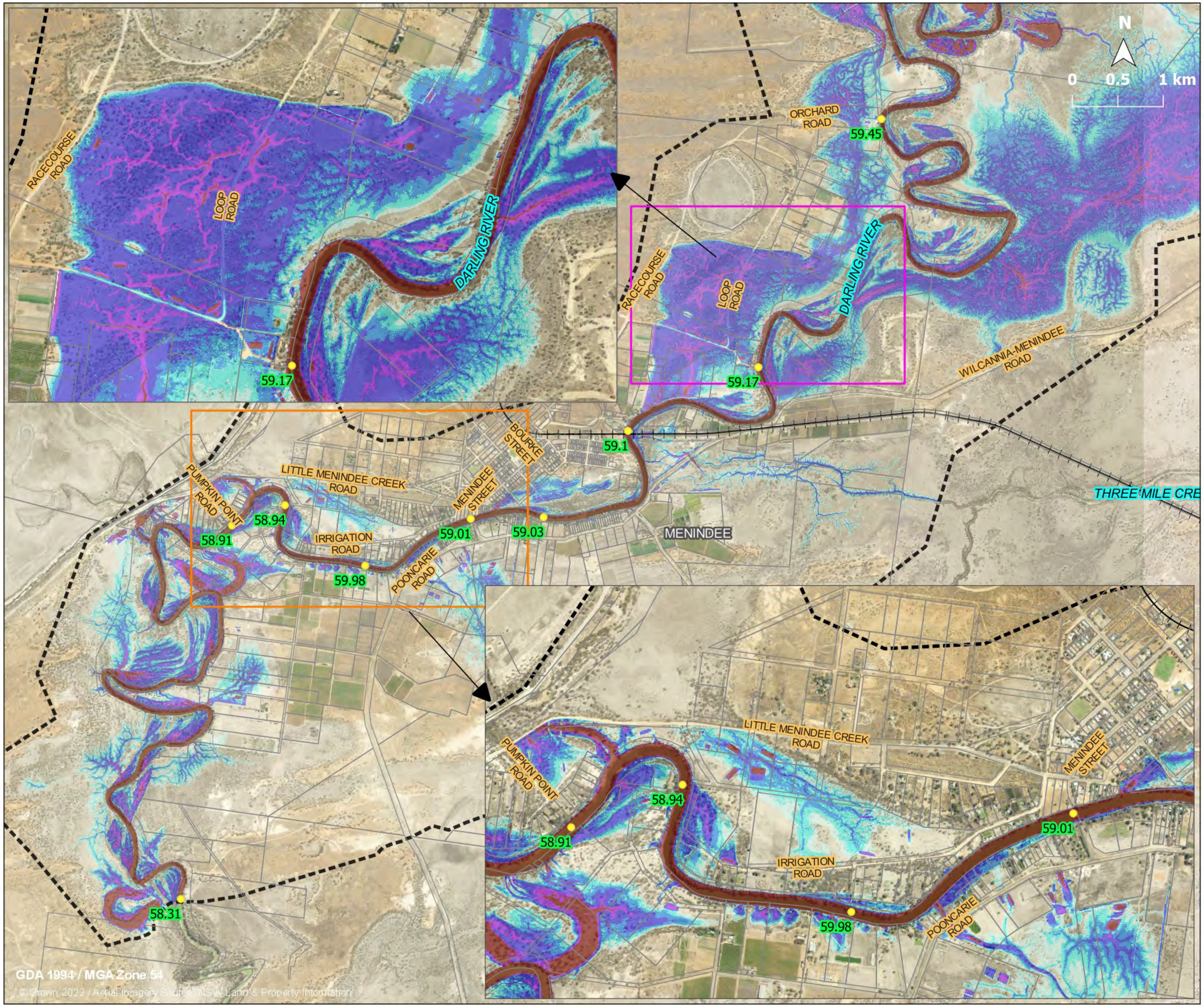

Figure B.12: Peak Inundation Map for the Release Scenario 23,500 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

- 58.2 Peak Water Surface Level (m AHD)
- Building Impacted (Above Floor)

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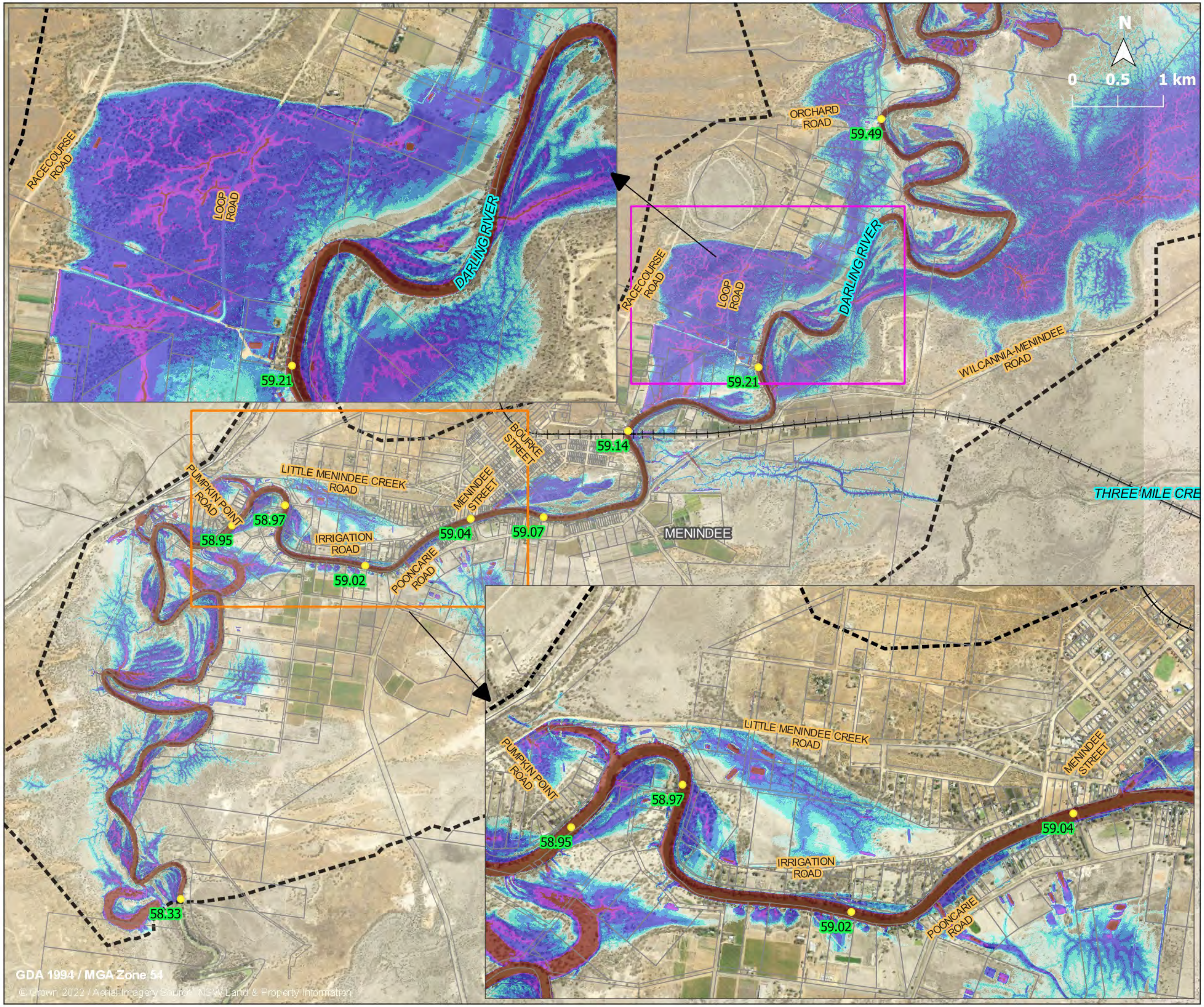

Figure B.13: Peak Inundation Map for the Release Scenario 24,000 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

58.2 Peak Water Surface Level (m AHD)

Building Impacted (Above Floor)

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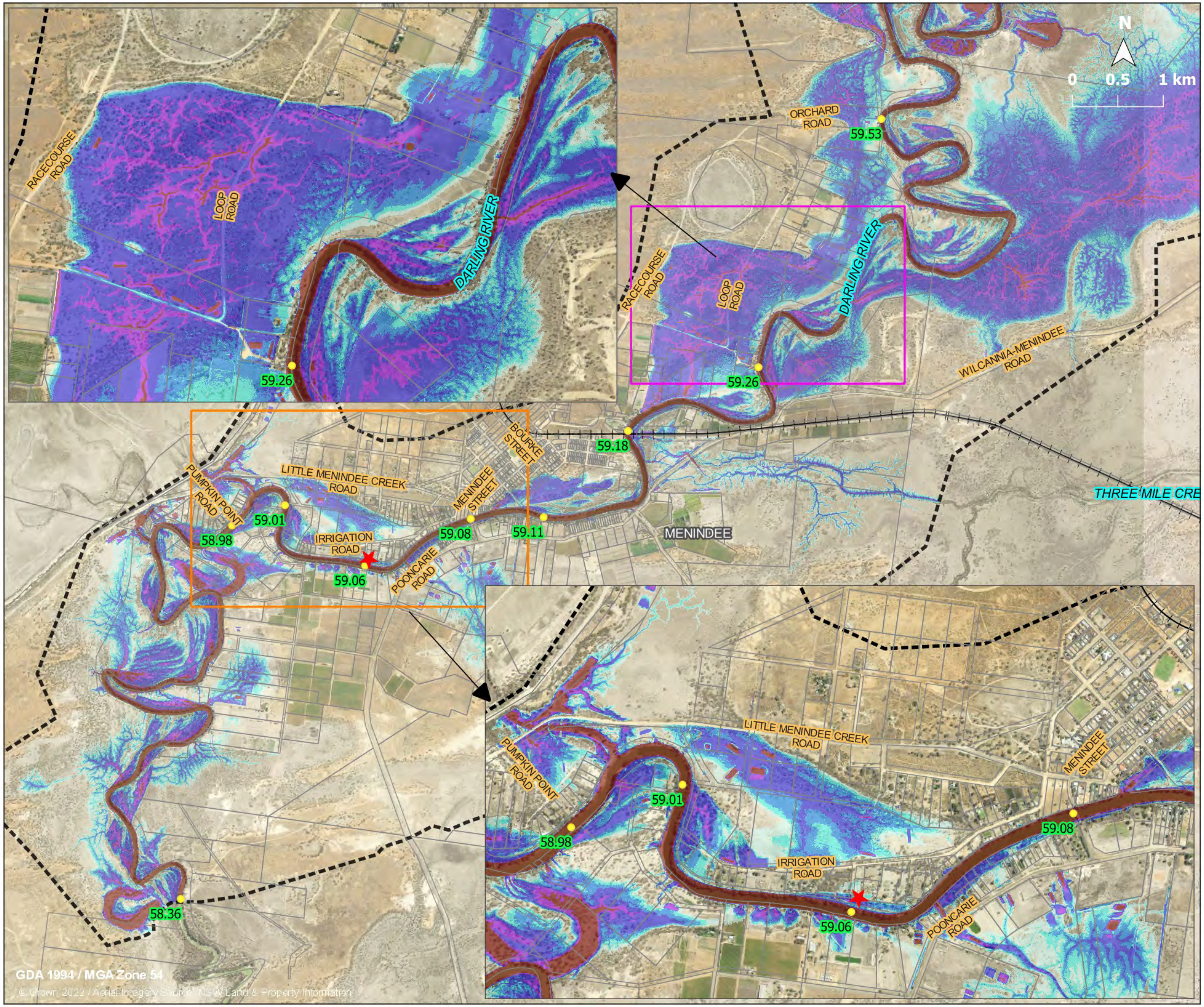

Figure B.14: Peak Inundation Map for the Release Scenario 24,500 ML/day

Legend

- Railway
- Cadastre
- TUFLOW Model Extent

Inundation Depth (m)

- 0.05-0.15
- 0.15-0.30
- 0.30-0.50
- 0.50-1.00
- 1.00-1.50
- > 1.50

- 58.2 Peak Water Surface Level (m AHD)
- Building Impacted (Above Floor)

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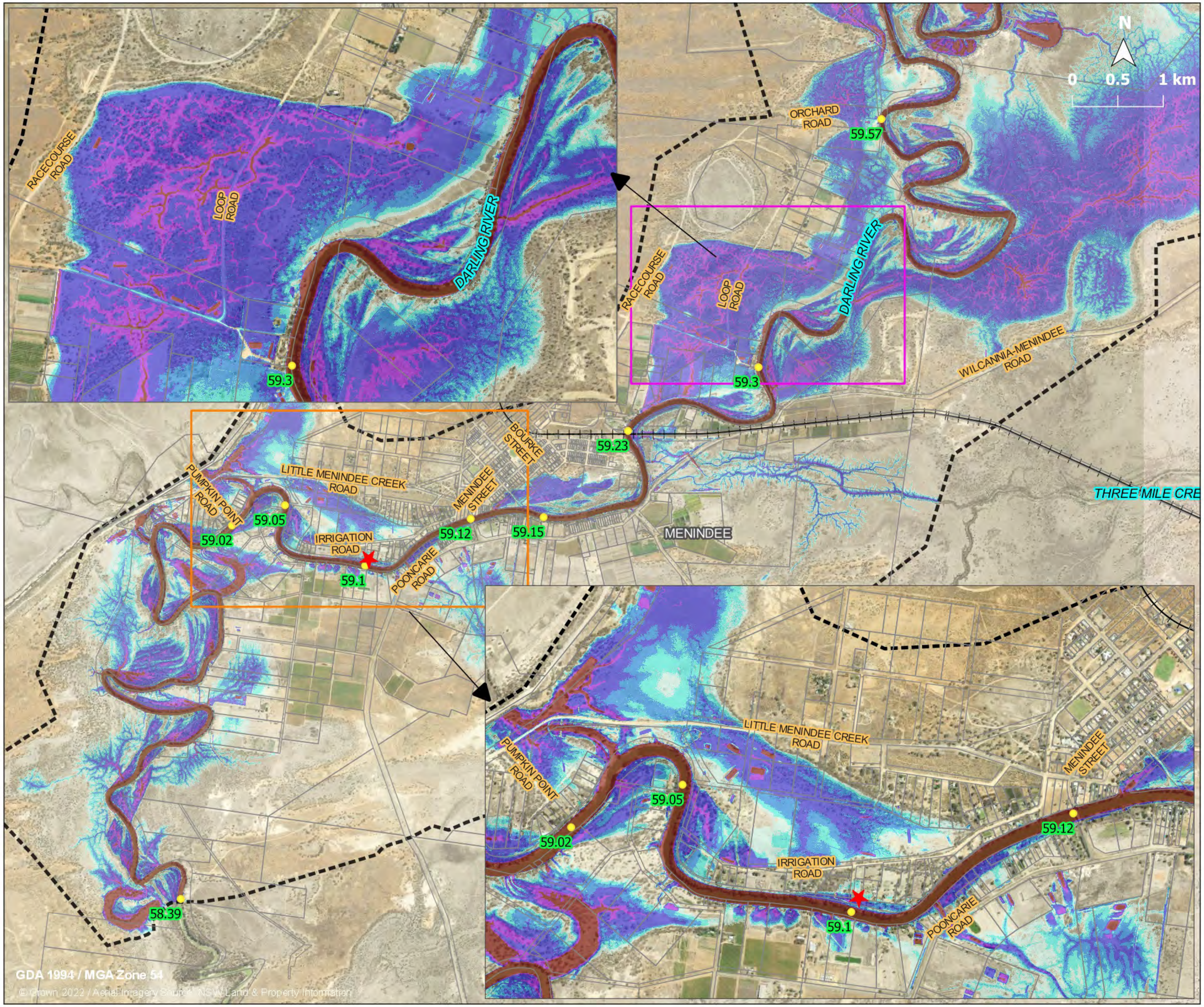

Figure B.15: Peak Inundation Map for the Release Scenario 25,000 ML/day

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