Matthew Creek Catchment Flood Impact Study for LW W1-W2

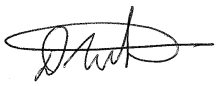
Tahmoor NSW

Tahmoor Coking Coal Operations

1072-05-B1, 3 May 2019

For and on behalf of WRM Water & Environment Pty Ltd
Level 9, 135 Wickham Tce, Spring Hill
PO Box 10703 Brisbane Adelaide St Qld 4000
Tel 07 3225 0200

WRM Water & Environment Pty Ltd



David Newton

Director

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1 Introduction

Tahmoor Coking Coal Operations (TCCO) operates an underground coal mine located near the townships of Tahmoor and Picton in the Wollondilly Local Government Area of New South Wales (NSW). WRM Water & Environment Pty Ltd (WRM) has previously completed a flood impact study of Matthews Creek catchment, for LW31-37 as documented in our previous report *Tahmoor Coal Flood Impact Study: LW31-37* (WRM, 2014).

TCCO has revised the configuration of longwall panels LW33-LW37 which are potentially impacted by Matthews Creek catchment. The Matthews Creek Catchment includes Mathews Creek which flows northeast before joining Cedar Creek and then Stonequarry Creek. The revised longwall panels are referred to as Longwall West 1 (LW W1) and Longwall West 2 (LW W2). The locations of LW W1 and LW W2 are shown in Figure 2.1.

WRM was commissioned by TCCO to undertake a flood impact assessment for LW W1 and LW W2 for the 1% annual exceedance probability (AEP) and the Probable Maximum Flood (PMF) events. The methodology and results of the assessment are presented in this report.

2 Method of analysis

The hydrological (XP-RAFTS) and hydraulic (TUFLOW) models developed in the previous study (WRM, 2014) were used to assess the impacts of the revised longwall panels on flood levels and velocities in the Matthews Creek catchment.

The TUFLOW model was updated with ground levels based on LiDAR flown in November 2018 and the updated design surface elevations for the proposed subsidence of LW W1 and LW W2 provided by Mine Subsidence Engineering Consultants (MSEC).

The 1% AEP design discharges from the previous study were adopted to reassess the existing conditions and post-subsidence conditions for LW W1 and LW W2.

It was assumed for this study that the PMF is equivalent to the Probable Maximum Precipitation (PMP) design flood event. Estimation of PMF discharges and flood levels was undertaken in the following three steps:

- Estimation of PMP using the Generalised Short Duration Method (GSDM) for the Matthews Creek catchment;
- Estimation of PMF flood discharges using the XP-RAFTS model; and
- Estimation of PMF design flood levels using the TUFLOW model.

Flood levels and velocities were assessed for two scenarios:

- Existing conditions; and
- Post-subsidence conditions following the subsidence of LW W1 and LW W2.

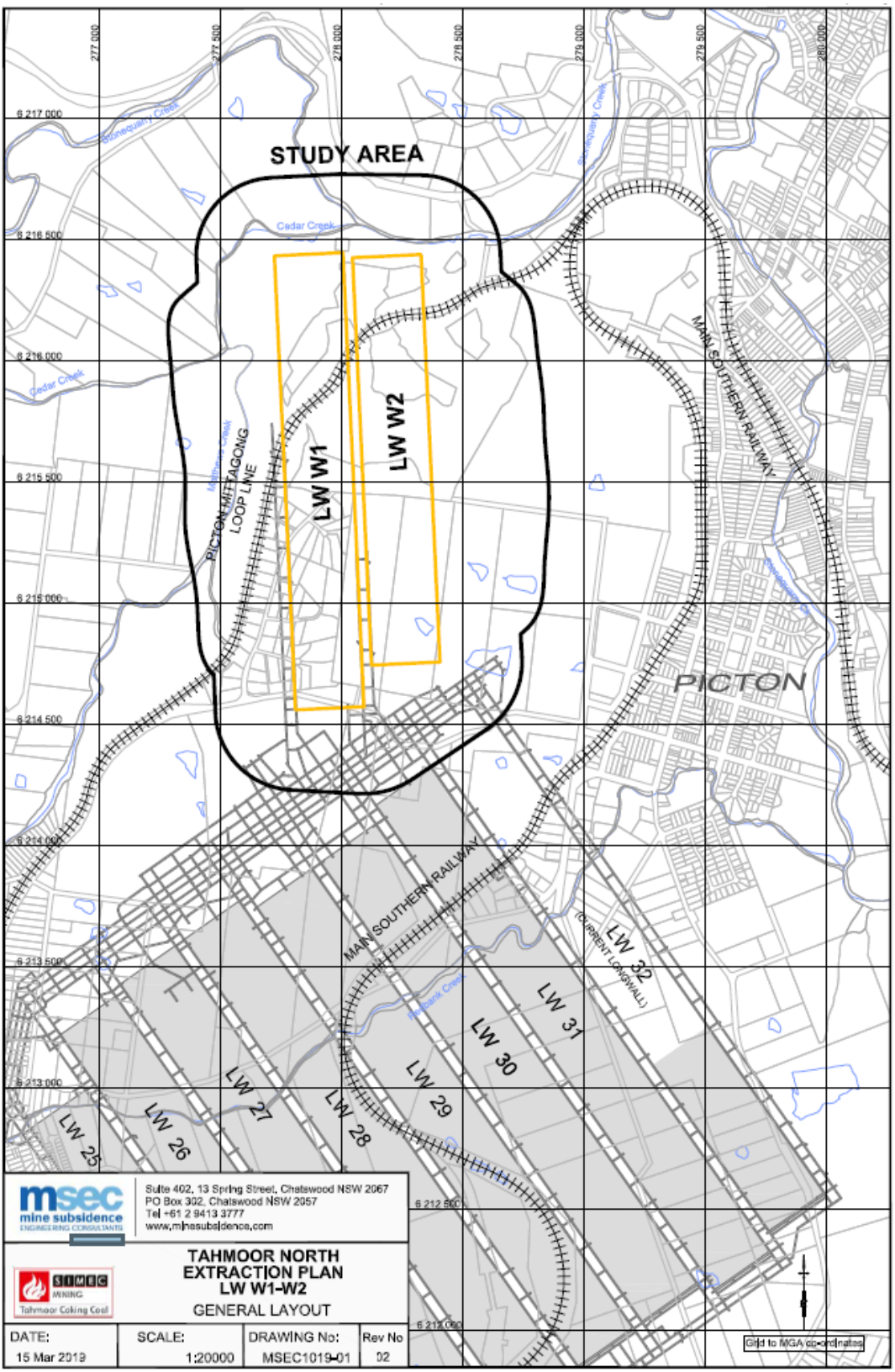

Figure 2.1 – Locations of LW W1 and LW W2

3 PMP rainfall depths

PMP rainfalls for the Matthews Creek catchment were estimated using the Generalised Short Duration Method (GSDM) (BOM, 2003a). The GSDM is suitable for application to small catchments (up to 1,000km^2) for short durations (up to 6 hours). The design spatial distribution of PMP was also applied, which resulted in four spatial zones (A, B, C and D). The rainfall distribution across the spatial zones decreased from zone A (centre of the catchment) through to spatial zone D. The spatial rainfall depths determined by the GSDM design spatial distribution were applied to the XP-RAFTS subcatchments. The subcatchments located in each spatial zone are shown in Figure 3.1.

Table 3.1 shows the estimated PMP rainfall depths for the Matthews Creek catchment spatial zones based on the GSDM method. The parameters used in the study include:

- Total catchment area of 42.6 km^2;
- Located in the coastal zone;
- The terrain was assumed rough (R = 1);
- Elevation Adjustment Factor (AEF = 1);
- Moistures Adjustment Factor (MAF = 0.69);
- The spatial zones include:
  - Zone A, full ellipse (2.6 km^2);
  - Zone B, full ellipse (13.4 km^2);
  - Zone C, partial ellipse (23 km^2); and
  - Zone D, partial ellipse (3.6 km^2).

Table 3.1 - PMP rainfall depth estimates for the Matthews Creek catchment spatial zones

Duration (hr)	Spatial Zone A	Spatial Zone B	Spatial Zone C	Spatial Zone D
	Rainfall depth (mm)			
0.25	160	137	54	90
0.50	232	203	78	131
0.75	293	259	97	166
1.00	340	304	124	200
1.50	439	389	157	255
2.00	513	454	181	297
2.50	566	501	205	331
3.00	622	547	220	359
4.00	711	625	246	407
5.00	783	687	272	449
6.00	828	732	287	476

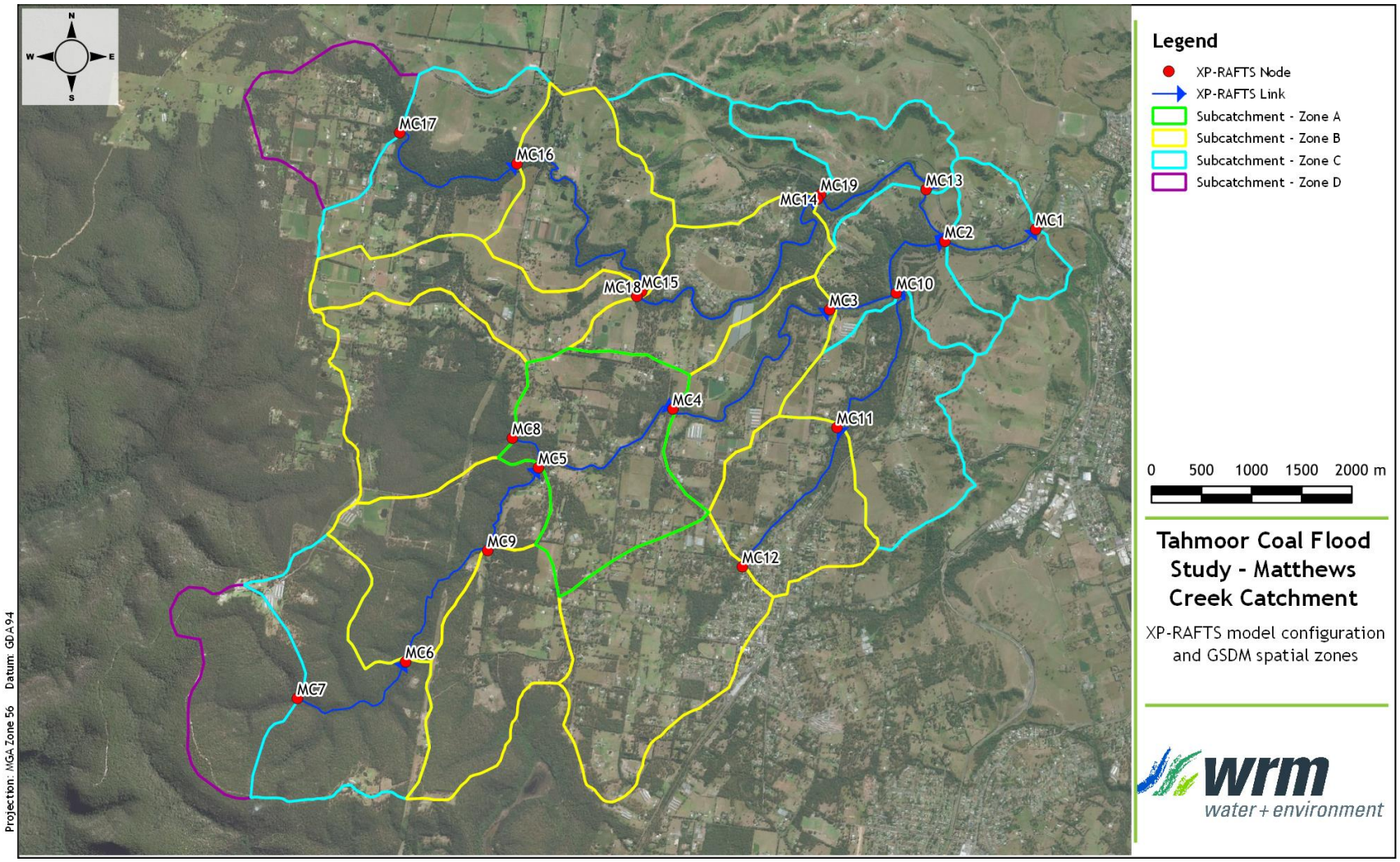

Figure 3.1 – XP-RAFTS subcatchments and spatial zones

4 Peak discharges

4.1 PEAK DISCHARGES FOR THE 1% AEP EVENT

The 1% AEP event discharges adopted from the previous study (WRM, 2014) calculated a critical storm duration of 6 hours and a peak discharge at the catchment outlet of 319 m^3/s.

4.2 PEAK DISCHARGES FOR THE PMF EVENT

The XP-RAFTS model was used to estimate discharges to determine the critical storm duration for the PMF event. Design rainfall depths and temporal and spatial rainfall distributions for the Matthews Creek catchment were derived using specified procedures for the GSDM (BOM, 2003a).

Figure 4.1 shows the PMF event discharges estimated by the XP-RAFTS model at the downstream boundary of the Matthews Creek catchment. The XP-RAFTS outputs were adopted as the hydraulic model inputs and modelled as inflows in the TUFLOW model. Storm durations of 1 hour to 6 hours were modelled. The critical storm duration was 2.5 hours and the peak discharge at the catchment outlet was calculated to be 1,836 m^3/s. Only the critical storm duration determined using the XP-RAFTS model was simulated in the TUFLOW model.

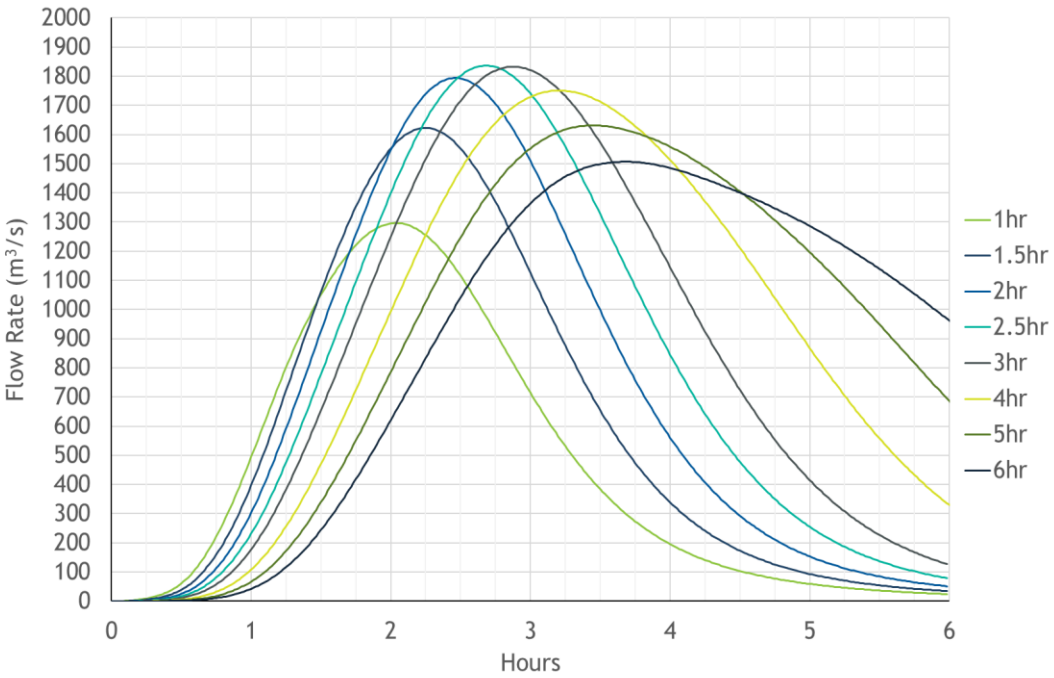

Figure 4.1 - PMP discharges at the XP-RAFTS downstream boundary of Matthews Creek catchment

5 Design flood levels

5.1 OVERVIEW

The TUFLOW model was run for the 1% AEP and PMF events for both the existing and post-subsidence conditions. The impacts of LW W1 and LW W2 were assessed by comparing the peak flood levels of the post-subsidence conditions with the peak flood levels of the existing conditions.

The post-subsidence contours of LW W1 and LW W2 shown in Figure 5.1 to Figure 5.4 indicate a change in ground surface elevations of up to 0.7 m in the vicinity of Matthews Creek, Cedar Creek and Stonequarry Creek. However, the proposed subsidence directly adjacent to the watercourses only changes ground elevations by up to 0.1 m.

5.2 PEAK FLOOD IMPACTS FOR THE 1% AEP EVENT

The impacts on peak water levels and peak velocities in Matthews Creek catchment for the 1% AEP event are shown in Figure 5.1 and Figure 5.2 respectively. The results for the peak water levels and peak velocities at reporting locations along Matthews Creek, Cedar Creek and Stonequarry Creek for the 1% AEP event are summarised in Table 5.1 and Table 5.2. The following is of note for the 1% AEP event:

- Within the TUFLOW model extent, Barkers Lodge Road has a 1% AEP flood immunity;
- The peak flood level is predicted to decrease by up to 0.07 m;
- The peak flood velocity is predicted to increase by up to 0.02 m/s; and
- These increases in peak flood levels and peak velocities are considered negligible.

The peak flood level maps for the 1% AEP event are provided in Appendix A. The existing conditions peak flood depths and peak velocities are shown in Figure A.1 and Figure A.2 respectively. The post-subsidence conditions peak flood depths and peak velocities are shown in Figure A.3 and Figure A.4 respectively.

Table 5.1 – Comparison of peak flood levels for the 1% AEP event, Matthews Creek catchment

Reporting Location	Existing Conditions (mAHD)	Post-Subsidence Conditions (mAHD)	Difference (m)
RP1	211.37	211.33	-0.04
RP2	196.48	196.41	-0.07
RP3	174.30	174.27	-0.03
RP4	174.10	174.03	-0.07
RP5	173.89	173.86	-0.03
RP6	174.15	174.12	-0.03
RP7	173.83	173.80	-0.03
RP8	172.89	172.87	-0.02
RP9	172.60	172.58	-0.02
RP10	171.68	171.67	-0.01

Table 5.2 – Comparison of peak velocities for the 1% AEP event, Matthews Creek catchment

Reporting Location	Existing Conditions (m/s)	Post-Subsidence Conditions (m/s)	Difference (m/s)
RP1	2.94	2.94	-
RP2	3.23	3.23	-
RP3	3.25	3.27	0.02
RP4	2.07	2.08	0.01
RP5	1.77	1.76	-0.01
RP6	2.01	2.02	0.01
RP7	1.84	1.84	-
RP8	2.98	2.95	-0.03
RP9	2.59	2.57	-0.02
RP10	3.75	3.74	-0.01

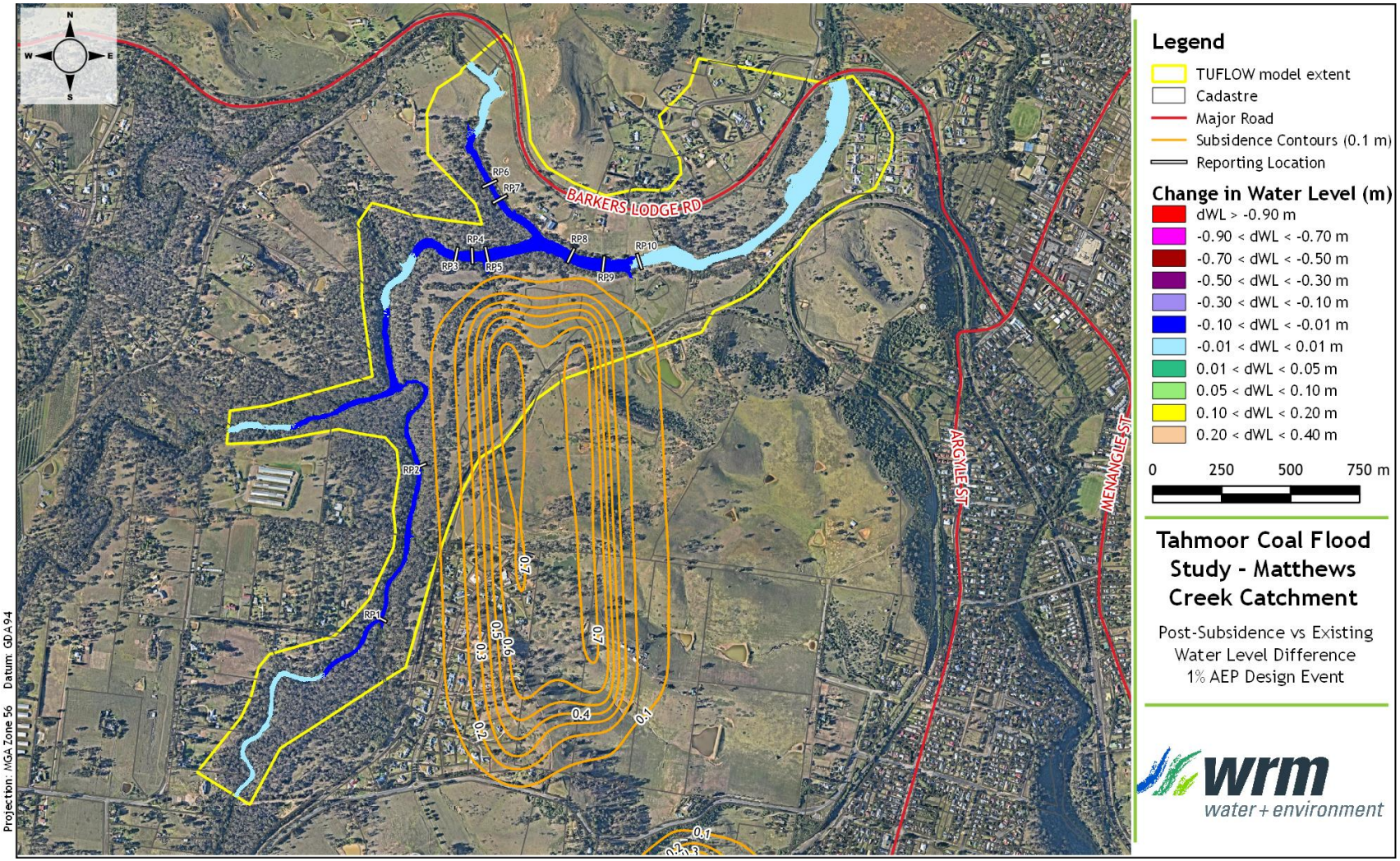

Figure 5.1 – Matthews Creek catchment 1% AEP event impact – change in water level

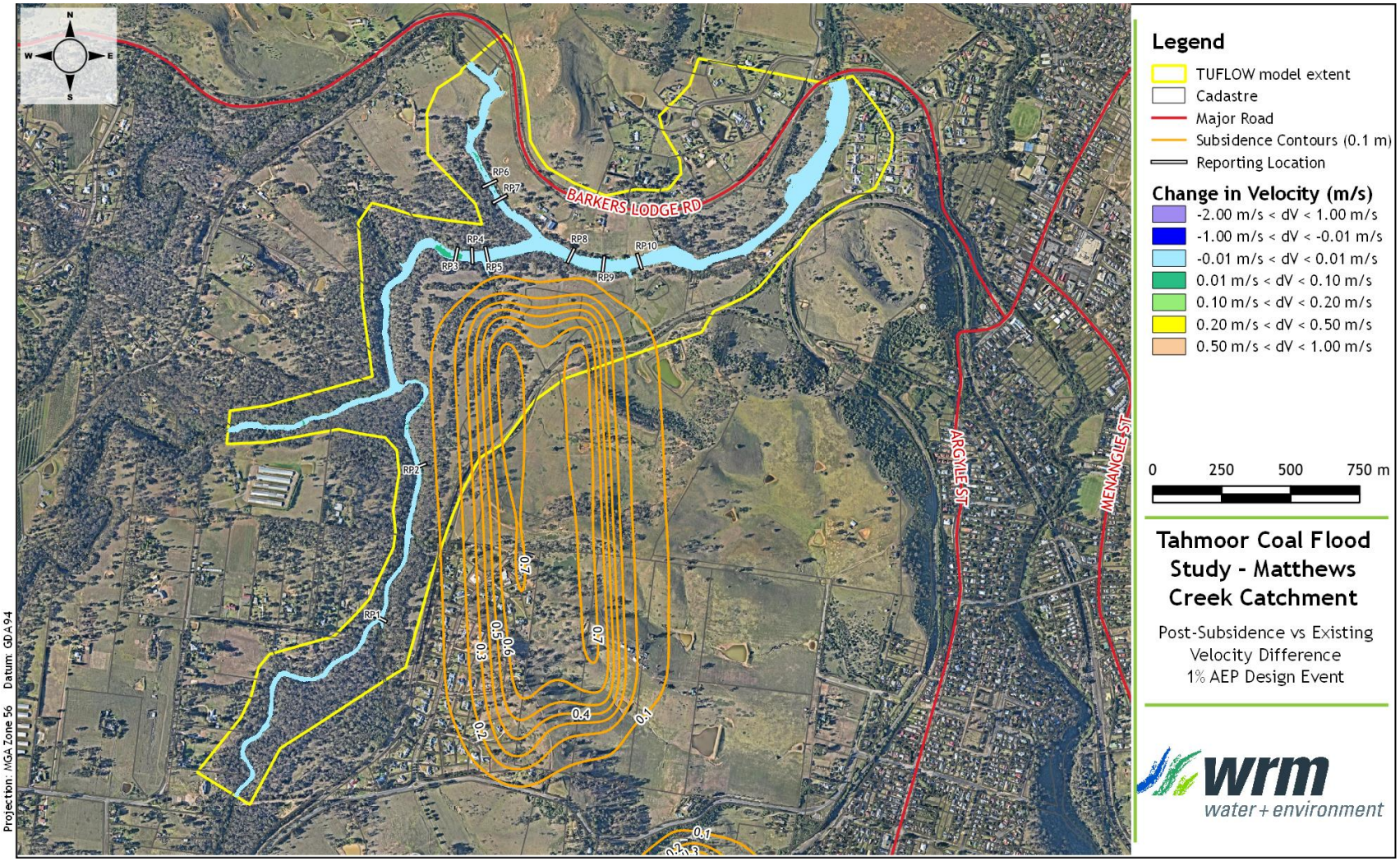

Figure 5.2 – Matthews Creek catchment 1% AEP event impact – change in velocity

5.3 PEAK FLOOD IMPACTS FOR THE PMF EVENT

The impacts on peak water levels and peak velocities in Matthews Creek catchment for the PMF event are shown in Figure 5.3 and Figure 5.4 respectively. The results for the peak water levels and peak velocities at reporting locations along Matthews Creek, Cedar Creek and Stonequarry Creek for the PMF event are summarised in Table 5.3 and Table 5.4. The following is of note for the PMF event:

- The crest of Barkers Lodge Road is overtopped during the PMF event under existing and post-subsidence conditions by up to 1.4 m;
- The peak flood level is predicted to decrease by up to 0.06 m;
- The peak flood velocity is predicted to increase by up to 0.02 m/s; and
- These increases in peak flood levels and peak velocities are considered negligible.

The peak flood level maps for the PMF event are provided in Appendix B. The existing conditions peak flood depths and peak velocities are shown in Figure B.1 and Figure B.2 respectively. The post-subsidence conditions peak flood depths and peak velocities are shown in Figure B.3 and Figure B.4 respectively.

Table 5.3 – Comparison of peak flood levels for the PMF event, Matthews Creek catchment

Reporting Location	Existing Conditions (mAHD)	Post-Subsidence Conditions (mAHD)	Difference (m)
RP1	214.52	214.49	-0.03
RP2	200.12	200.06	-0.06
RP3	180.16	180.11	-0.05
RP4	179.83	179.79	-0.04
RP5	179.82	179.77	-0.05
RP6	179.69	179.65	-0.04
RP7	179.60	179.55	-0.05
RP8	178.00	177.96	-0.04
RP9	176.81	176.79	-0.02
RP10	176.31	176.29	-0.02

Table 5.4 – Comparison of peak velocities for the PMF event, Matthews Creek catchment

Reporting Location	Existing Conditions (m/s)	Post-Subsidence Conditions (m/s)	Difference (m/s)
RP1	5.82	5.82	-
RP2	4.82	4.81	-0.01
RP3	5.18	5.20	0.02
RP4	4.13	4.14	0.01
RP5	3.45	3.45	-
RP6	2.57	2.58	0.01
RP7	2.47	2.48	0.01
RP8	5.51	5.50	-0.01
RP9	5.72	5.69	-0.03
RP10	6.10	6.08	-0.02

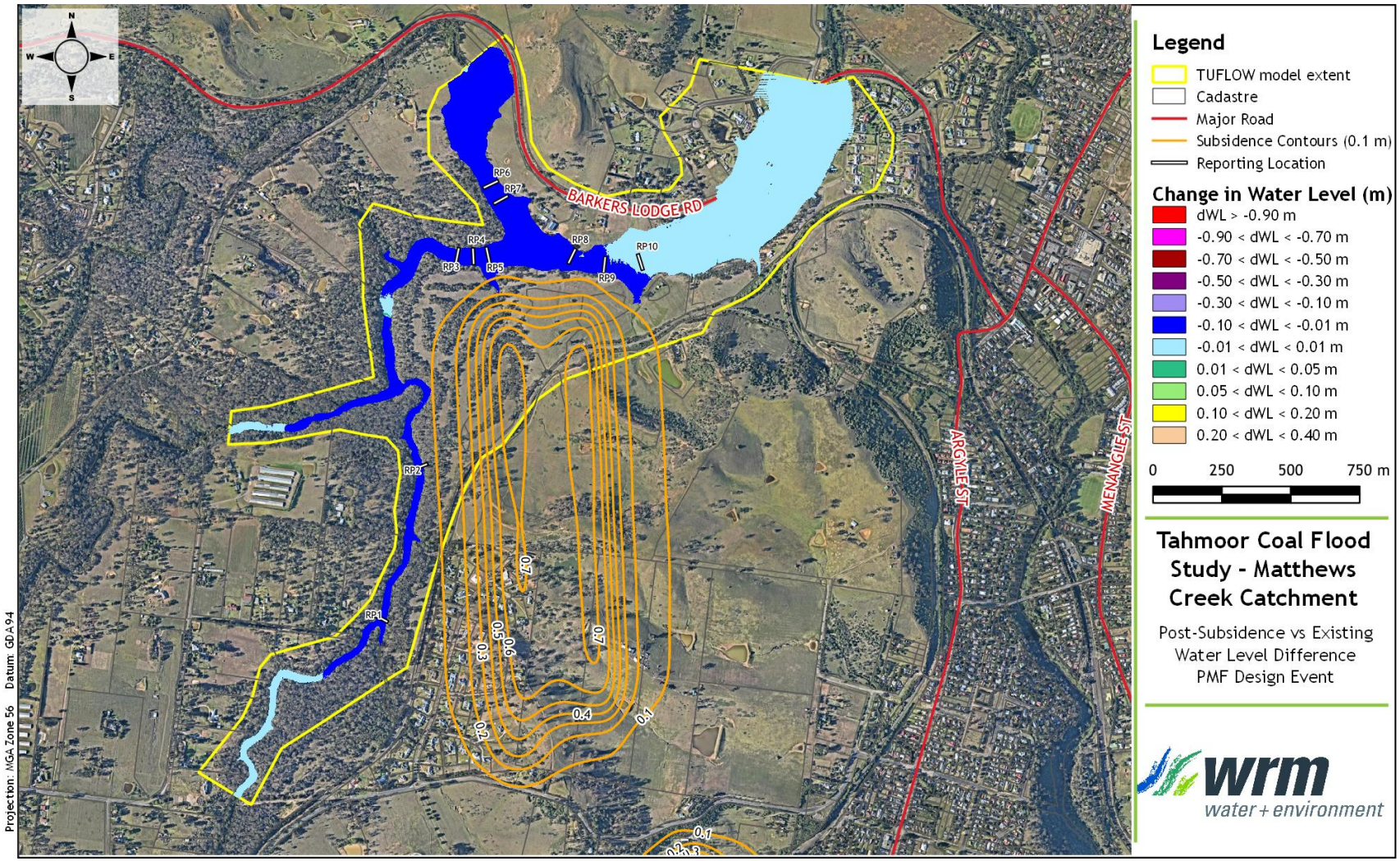

Figure 5.3 – Matthews Creek catchment PMF event impact – change in water level

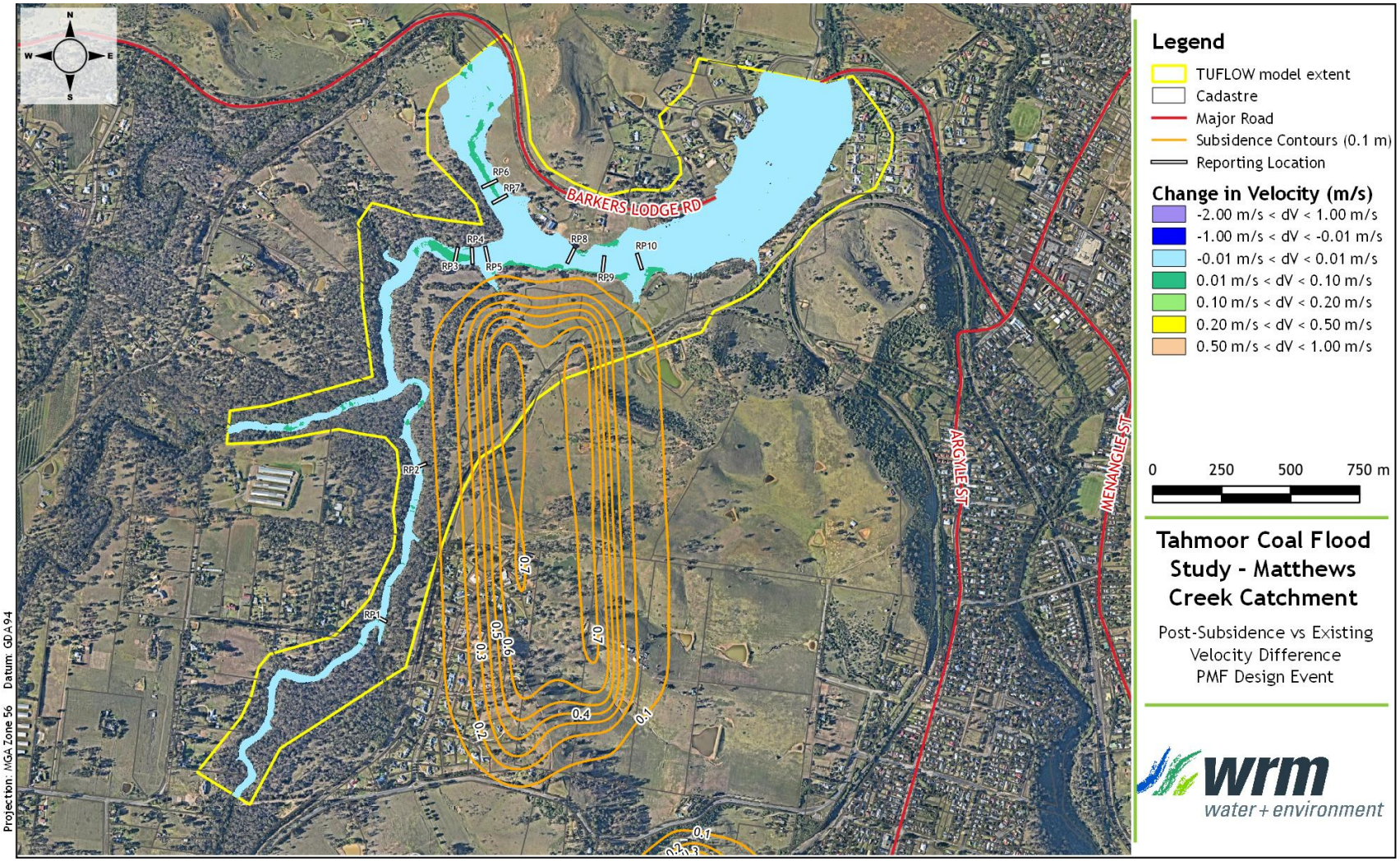

Figure 5.4 – Matthews Creek catchment PMF event impact – change in velocity

6 Summary

Hydrologic (XP-RAFTS) and hydraulic (TUFLOW) models were used to assess the impacts of the revised longwall panels LW W1 and LW W2 on peak flood levels in Matthews Creek, Cedar Creek and Stonequarry Creek for the 1% AEP and PMF events. The impact assessment found that the proposed subsidence from LW W1 and LW W2 will have negligible impacts on peak water levels and velocities.

For the 1% AEP event:

- Within the TUFLOW model extent, Barkers Lodge Road has a 1% AEP flood immunity;
- The peak flood level is predicted to decrease by up to 0.07 m;
- The peak flood velocity is predicted to increase by up to 0.02 m/s;
- Results indicate a similar flood extent in the existing and post-subsidence conditions; and
- Impacts due to the proposed subsidence are negligible.

For the PMF event:

- The crest of Barkers Lodge Road is overtopped during the PMF event under existing and post-subsidence conditions by up to 1.4 m;
- The peak flood level is predicted to decrease by up to 0.06 m;
- The peak flood velocity is predicted to increase by up to 0.02 m/s;
- Results indicate a similar flood extent in the existing and post-subsidence conditions; and
- Impacts due to the proposed subsidence are negligible.

7 References

BOM (2003a)	The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method. Prepared by the Hydrometeorological Advisory Service Australian Government Bureau of Meteorology June 2003. Accessed from http://www.bom.gov.au/hydro/has/pmp.shtml on 11 October 2007
BOM (2003b)	Guide to the Estimation of Probable Maximum Precipitation: Generalised Tropical Storm Method. Report and accompanying CD prepared by the Hydrometeorological Advisory Service Australian Government Bureau of Meteorology November 2003
BMT WBM (2017)	*'TUFLOW User Manual Build 2017-09'*, BMT WBM Pty Ltd, 2017.
IEAUST (1999)	Australian Rainfall and Runoff. A Guide to Flood Estimation. Institution of Engineers Australia (1999)
WRM (2014)	Tahmoor Coal Flood Impact Study: LW31-37, WRM Water and Environment, 3 December 2014, reference 1072-02-B
XP Software (2013)	*'XP-RAFTS User Manual'*, XP Software, Australia, 2013.

Appendix A - 1% AEP event model results

Figure A.1 – Matthews Creek catchment existing conditions – 1% AEP event flood depth

Figure A.2 – Matthews Creek catchment existing conditions – 1% AEP event velocity

Figure A.3 – Matthews Creek catchment post-subsidence conditions – 1% AEP event flood depth

Figure A.4 - Matthews Creek catchment post-subsidence conditions - 1% AEP event velocity

Appendix B - **PMF event model results**

Figure B.1 – Matthews Creek catchment existing conditions – PMF event flood depth

Figure B.2 – Matthews Creek catchment existing conditions – PMF event velocity

Figure B.3 – Matthews Creek catchment post-subsidence conditions – PMF event flood depth

Figure B.4 – Matthews Creek catchment post-subsidence conditions – PMF event velocity