

Our Ref: DJW: L.T2257.006.docx

24 April 2025
Catalyze Property Consulting Pty Ltd
PO Box 44
Islington NSW 2296
Attention: Craig McGaffin

Dear Craig

RE FLOOD IMPACT AND RISK ASSESSMENT FOR PLANNING PROPOSAL AT 16-21 CUSACK PLACE, YASS NSW

Background

Torrent Consulting was engaged to undertake a Flood Impact and Risk Assessment to assist in the approval process for the Planning Proposal at 16-21 Cusack Place, Yass NSW (the Site). It is understood that Yass Valley Council has requested a flood assessment, as the existing Flood Study does not cover the Site, but an overland flow path is identified as traversing the Site.

This Site is located at the southern end of Yass, as presented in Figure 1. It is situated at the head of three local catchments, as presented in Figure 2, each of which drain to the Yass River. Much of the Site has no upstream catchment reporting to it, but there is a catchment area of over 20 ha that enters the Site along the southern boundary. It should be noted that this small a catchment is better described and assessed as a stormwater management consideration, rather than flooding. Nevertheless, it is being conservatively assessed in the context of floodplain risk management in this report.

To expand on the level of detail provided in the previous assessment (refer L.T2257.004 dated 17 November 2023), Torrent Consulting was provided with a proposed lot layout for future subdivision. The layout incorporates a drainage easement for the overland flow path.

The Yass Floodplain Risk Management Study and Plan (Lyll & Associates, 2021) also identifies the continuation of the overland flood flow path as being a floodway. However, the flood modelling and mapping undertaken to support the study has its upstream limit located around 330 m downstream of the Site. Therefore, a TUFLOW model has been developed for this assessment to provide flood risk mapping along the overland flow path at the Site.

Model Development

For this assessment, a TUFLOW model was developed covering the catchment of the overland flood flow path draining through the Site (as presented in Figure 3), which totals around 0.4 km² at the outlet on the northern boundary. The model utilised the NSW Spatial Services LiDAR data to define the floodplain topography and was constructed using a 4 m horizontal grid cell resolution. The sub-grid sampling routine was employed in TUFLOW to represent ground surface elevations at a 2 m horizontal spacing. Land use within the catchment is effectively pastoral grassland and was assigned a Manning's 'n' roughness coefficient of 0.05.

There are a few hydraulic structures located within the modelled area and the dimensions of these have been assumed using the available aerial imagery and LiDAR data. The structure details do not have a significant impact on the model results at the Site but have been included for completeness.

The downstream boundary of the model was configured as an automatically generated stage-discharge curve with a slope of 1.2%, around 680 m downstream of the Site at Perry Street. Direct rainfall input was applied to the full modelled area to simulate catchment runoff. The five farm dams located within the modelled area were configured with initial water levels set at the initial point of overtopping of the dam walls.

The TUFLOW model was used to simulate the catchment rainfall-runoff process, utilising the ensemble storm method outlined in the ARR 2019 guidelines.

A more detailed TUFLOW model was developed to resolve local flood hydraulics, adopting a 2 m horizontal grid cell resolution, with a sub-grid sampling at a 1 m horizontal spacing. The flow hydrograph at the southern boundary of the Site from the TUFLOW hydrological model was applied to the dam immediately upstream of the Site, representing a contributing catchment area of around 20 ha. Inflow from an additional 16 ha of contributing catchment (which is largely proposed for rezoning) was applied to the drainage easement within the Site. Manning's 'n' values of 0.04, 0.02 and 0.1 were adopted for the drainage channel, road surfaces and residential lots, with 0.05 being retained for the broader catchment.

The design concept for the management of the overland flow path through the Site was developed together with DRB Consulting Engineers. This included the sizing of an open drainage channel, road levels and culvert structures for road crossings at the upstream and downstream end of the channel, and minor earthworks to provide a suitable level of flood immunity for the proposed lots adjacent to the drainage channel. A minor drainage channel easement was also required within the rear of four lots along the southern boundary of the Site, to accommodate overland flow spilling from the eastern side of the upstream dam structure. The details contained in "2024 10 04 - XO_DESIGN 3D.dwg" represent the final landform modelled for this assessment.

The culvert structures under the roadways are a configuration of six 600 mm concrete pipes. Structure blockages were applied to the pipes in TUFLOW in-line with the ARR 2019 guidelines, with a 50% blockage for the 0.2% AEP and PMF events and a 25% blockage for all other events.

Design Flood Hydrology

The TUFLOW hydrological model was simulated (using the HPC solver) for the 10% AEP, 5% AEP, 1% AEP, 0.5% AEP and 0.2% AEP design rainfall events for storm durations ranging from 10 minutes to two hours. The design rainfall depths were sourced from the BoM IFD (Intensity Frequency Duration) portal. Because of the small size of the catchment no areal reduction factor was applied. Design rainfall losses considered the recent NSW-specific guidance. This provided a continuing loss of 1.6 mm/h, with initial losses of around 11 to 12 mm.

The ensemble method involves the simulation of ten rainfall temporal patterns for each design event magnitude and duration, with the average condition of the ten being adopted for design purposes. The TUFLOW model simulations were analysed at the outlet from the Site to identify the critical storm duration, i.e. that which produces the peak flood flow for each design event magnitude. The 60-minute duration was identified as being critical for the 1% AEP event, with the 90-minute duration being critical for the 10% AEP and 5% AEP events.

For the simulation of the PMF (Probable Maximum Flood) condition the Generalised Short Duration Method (GSDM) published by the BoM was adopted. Events for the 15-minute to 1-hour durations were simulated to determine the critical conditions. This found the Probable Maximum Precipitation (PMP) for the 15-minute duration to be critical, with a rainfall depth of 160 mm (~640 mm/h intensity). The simulated peak design flood flows at the Site are summarised in Table 1.

Table 1 – Modelled Peak Design Flood Flows at the Site

Design Event	Peak Flow (m ³ /s)
10% AEP 90-min (3914)	1.8
5% AEP 90-min (3915)	2.3
1% AEP 60-min (3819)	3.5
PMF 15-min (GSDM)	77

Note: contents of parentheses denote the adopted design temporal pattern ID

Design Flood Conditions

The design flood conditions incorporating the proposed subdivision earth and drainage works were simulated for the range of design events using the detailed TUFLOW hydraulic model. Figure 4 presents the modelled peak flood extents at the Site for the 5% AEP, 1% AEP and PMF events, with the Site boundary shown for context. Figure 5, Figure 6 and Figure 7 are presented for additional context and show the modelled peak flood depths and peak flood level contours for the 5% AEP, 1% AEP and PMF events respectively.

Figure 8, Figure 9 and Figure 10 present the flood hazard classification at the Site for the 5% AEP, 1% AEP and PMF events respectively. The flood hazards have been determined in accordance with Guideline 7-3 of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017). This produces a six-tier hazard classification, based on modelled flood depths, velocities and velocity-depth product. The hazard classes relate directly to the potential risk posed to people, vehicles and buildings, as presented in Chart 1.

The flood hazard mapping is useful for providing context to the nature of the modelled flood risk and to identify potential constraints for development of the Site with regards to floodplain risk management. The principal consideration of good practice floodplain risk management is to ensure compatibility of the proposed development with the flood hazard of the land, including the risk to life and risk to property.

Floodplain Risk Management Considerations

Ministerial Direction 4.1 provides guidance on how to consider flooding implications when considering planning proposals on land identified within a flood planning area or below the probable maximum flood. Relevant provisions of the Ministerial Direction are that:

- A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Employment, Mixed Use, W4 Working Waterfront or Special Purpose Zones.
- A planning proposal must not contain provisions that apply to the flood planning area which permit a significant increase in the development and/or dwelling density of that land.

The planning proposal seeks to rezone land that is already zoned for large lot residential purposes and so the Ministerial Direction is not applicable. Nevertheless, given that the proposed rezoning will enable further intensification of residential land, the requirements of the Ministerial Direction have been considered in this assessment.

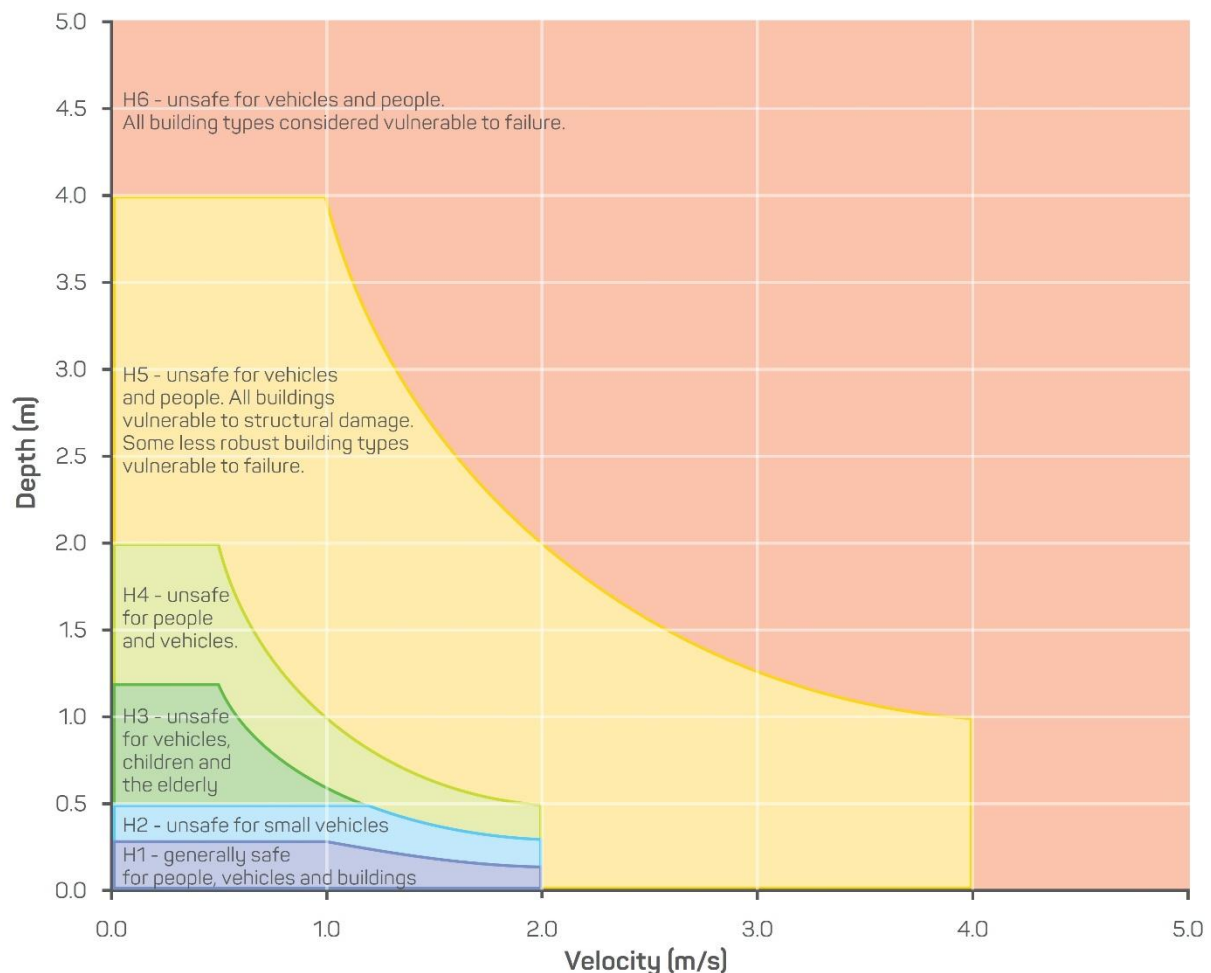


Chart 1 – General Flood Hazard Vulnerability Curves (AIDR, 2017)

To provide for future development that is compatible with the flood hazard of the land, consistent with Ministerial Direction 4.1 and readily facilitates compliance with the LEP and DCP requirements, this planning proposal has developed a subdivision in which the earth and drainage works have been designed to provide a final landform (outside of the drainage easement) that is at or above both the 0.2% AEP event and the 0.5% AEP event plus 0.5 m freeboard. The 0.5% AEP event has been used as a proxy for the 1% AEP event plus a future climate change allowance for increased rainfall intensity. The 0.2% AEP event provides a much more conservative structure blockage allowance.

The performance of the subdivision design is confirmed by the mapping shown in Figure 11 and Figure 12 for the 0.2% AEP event and Flood Planning Area (FPA), respectively. This confirms that the proposed subdivided lots are effectively all outside of the FPA. However, there is some minor encroachment within Lot 54, where the eastern limit of fill is around 0.4 m above the 0.5% AEP flood level rather than 0.5 m. This can readily be addressed through the provision of an additional 0.1 m fill depth at the subdivision stage, if required.

Given the small catchment size at the Site, the overland flow from catchment runoff can be readily managed through the implementation of appropriate stormwater measures. The hydraulic gradient is relatively steep, and the modelled flood surface of the 0.2% AEP event is typically less than 0.1 m higher than that of the 1% AEP event.

The use of the 0.2% AEP event for setting final landform and the 0.5% AEP for setting the FPL provides an appropriate level of risk management to accommodate potential future climate change impacts for future subdivision. The FPA extent shown in Figure 12 indicates that there are no significant constraints for dwellings to be constructed within the future subdivision and satisfy FPL controls for finished floor levels. The risk to property from flooding can therefore be managed to an appropriate standard.

For the management of risk to life from flooding, events rarer than the flood planning event need to be considered. With the road network and residential lots being elevated above the 0.2% AEP flood level, there is a very low flood risk exposure. The PMF event is an extremely rare condition, representing around a 1-in-10,000,000 AEP. Even under such extreme conditions the residential lots of the potential future subdivision are only exposed to a low-to-medium flood hazard. This does not present a risk to the structural damage of future buildings (refer Chart 1) and means that residents will be able to safely shelter in place, which is the appropriate flood emergency response in small catchments where insufficient warning time is available to safely evacuate.

A relative flood impact assessment has been undertaken to compare the modelled pre- and post-development flood conditions resulting from the concept design of the subdivision earth and drainage works. The modelled impacts to the baseline peak flood depth conditions are presented in Figure 13 and Figure 14 for the 1% AEP and 0.2% AEP events, respectively, with peak flood velocity impacts shown in Figure 15 and Figure 16.

The flood impact mapping confirms that changes to the existing flood conditions are largely contained within the Site and do not present any adverse impact to neighbouring property or infrastructure. There is a localised redistribution in flood flow (and hence peak depth and velocity conditions) immediately downstream of the Site due to the concentration of flows through the proposed culvert structure. However, this dissipates around 40 m downstream of the roadway, beyond which the modelled pre-development flood conditions are maintained (or improved due to attenuation by the road embankment and culverts with the structure blockage applied at the 0.2% AEP event).

The formalisation of the overland flow path through the Site and the adjacent filling effectively manages the risk to life and risk to property from flooding. Because of the short duration, high intensity rainfall required to generate flood conditions at the Site, flooding is coincident with the rainfall. It is therefore much safer to remain indoors and evacuation from the Site is not required (or advisable). The short duration of flooding also means that significant periods of isolation are not a concern, with the overland flow receding within half an hour following the cessation of the flood-producing rainfall.

The design flood modelling undertaken for this assessment has conservatively assumed that the upstream dam storage is full prior to the rainfall occurring, ensuring that the resultant flood conditions are not dependent on any flood storage that the dam might afford. Further, the dam storage is only minor, and a dam failure is not expected to produce flood conditions that exceed those considered by this assessment.

The proposed stormwater drainage alignment will function as a floodway, conveying the catchment runoff of the 0.5% AEP flood event, as shown in Figure 17.

Conclusion

Torrent Consulting was engaged to undertake a Flood Impact and Risk Assessment to assist in the approval process for the Planning Proposal at 16-21 Cusack Place, Yass NSW. This assessment has included development of a TUFLOW model for the local catchment and has simulated design flood conditions in accordance with the ARR 2019 guidelines, specifically the ensemble method for design flood hydrology.

To provide for future development that is compatible with the flood hazard of the land, consistent with Ministerial Direction 4.1 and readily facilitates compliance with the LEP and DCP requirements, this planning proposal has developed a subdivision in which the earth and drainage works have been designed to provide a final landform that is at or above both the 0.2% AEP event and the Flood Planning Level. The consideration of the 0.5% AEP and 0.2% AEP events is used to provide a suitable proxy for the expected 1% AEP flood conditions including allowances for future climate change.

The FPA extent indicates that there are no significant constraints for dwellings to be constructed within the future subdivision and satisfy FPL controls for finished floor levels. Under the extremely rare PMF conditions the residential lots of the potential future subdivision are only exposed to a low-to-medium flood hazard. Therefore, the formalisation of the overland flow path through the Site and the adjacent filling effectively manages the risk to life and risk to property from flooding.

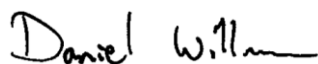
A relative flood impact assessment has also been undertaken and confirms that the required Site regrading will have a negligible impact on existing off-site flood conditions. The short duration of flooding also means that significant periods of isolation are not a concern, with the overland flow receding within half an hour following the cessation of the flood-producing rainfall.

The current state of subdivision design is compatible with the flood hazard of the land and can be rezoned with confidence that the flood risk at the Site is effectively managed. Any minor adjustments can be implemented and assessed as the earth and drainage works design progresses through the subdivision DA stage.

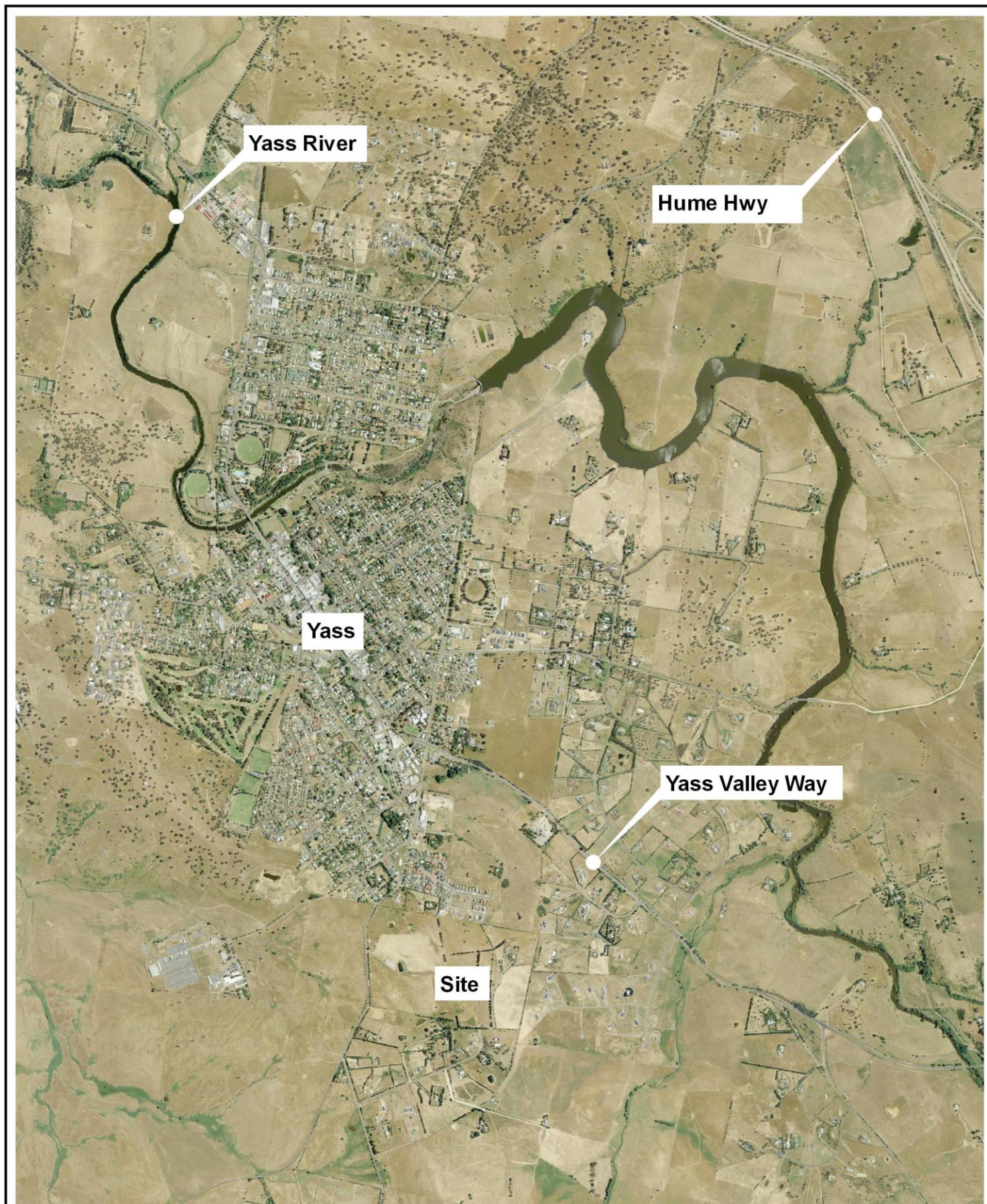
We trust that this report meets your requirements. For further information or clarification please contact the undersigned.

Yours faithfully

Torrent Consulting

A handwritten signature in black ink that reads "Daniel Williams". The signature is written in a cursive, flowing style.

Dan Williams
Director



Title:
Study Locality

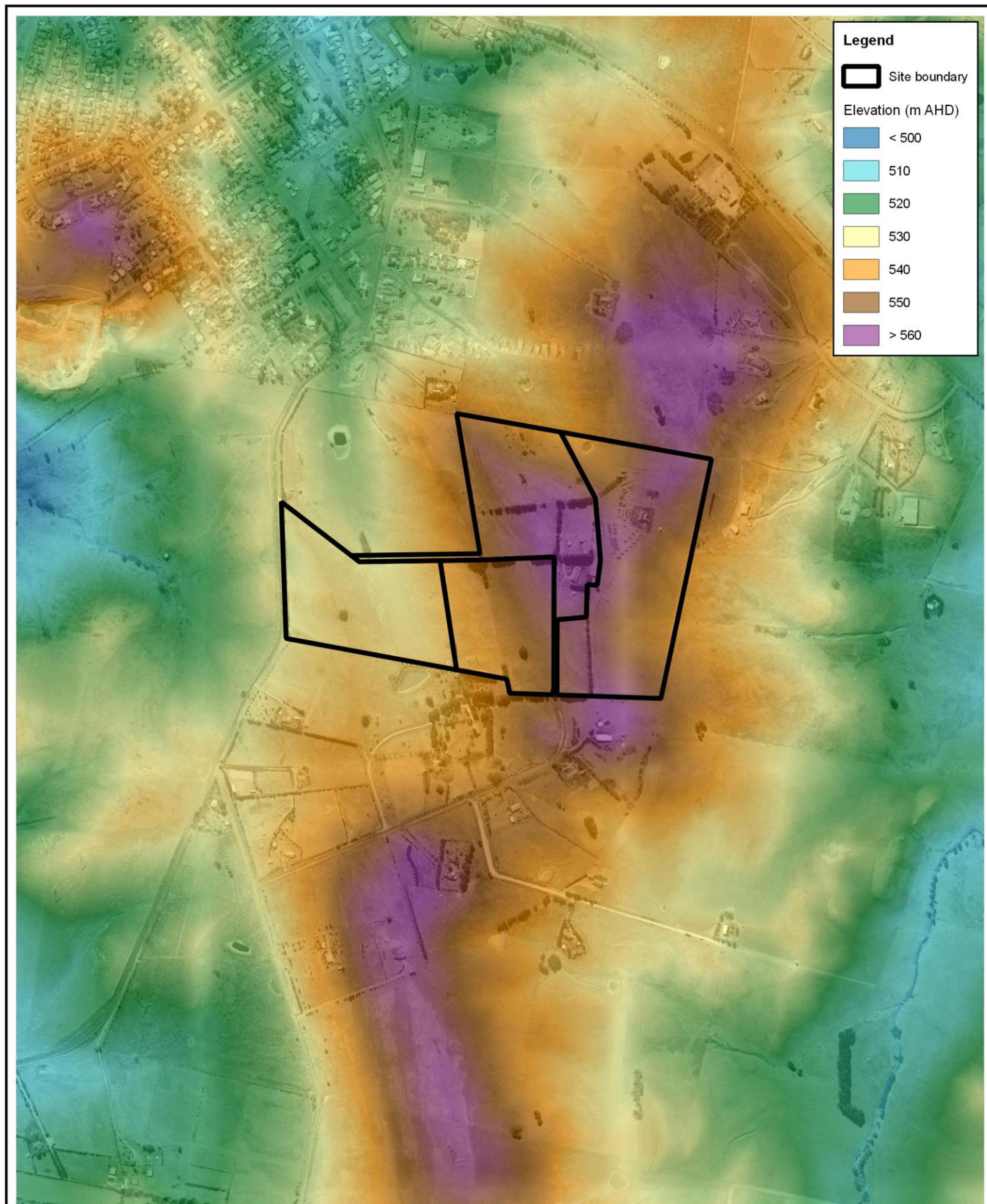
0 0.8 1.6 km
approx. scale

Figure: **1** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Title:

Local Catchment Topography

0 300 600 m



approx. scale

Figure:

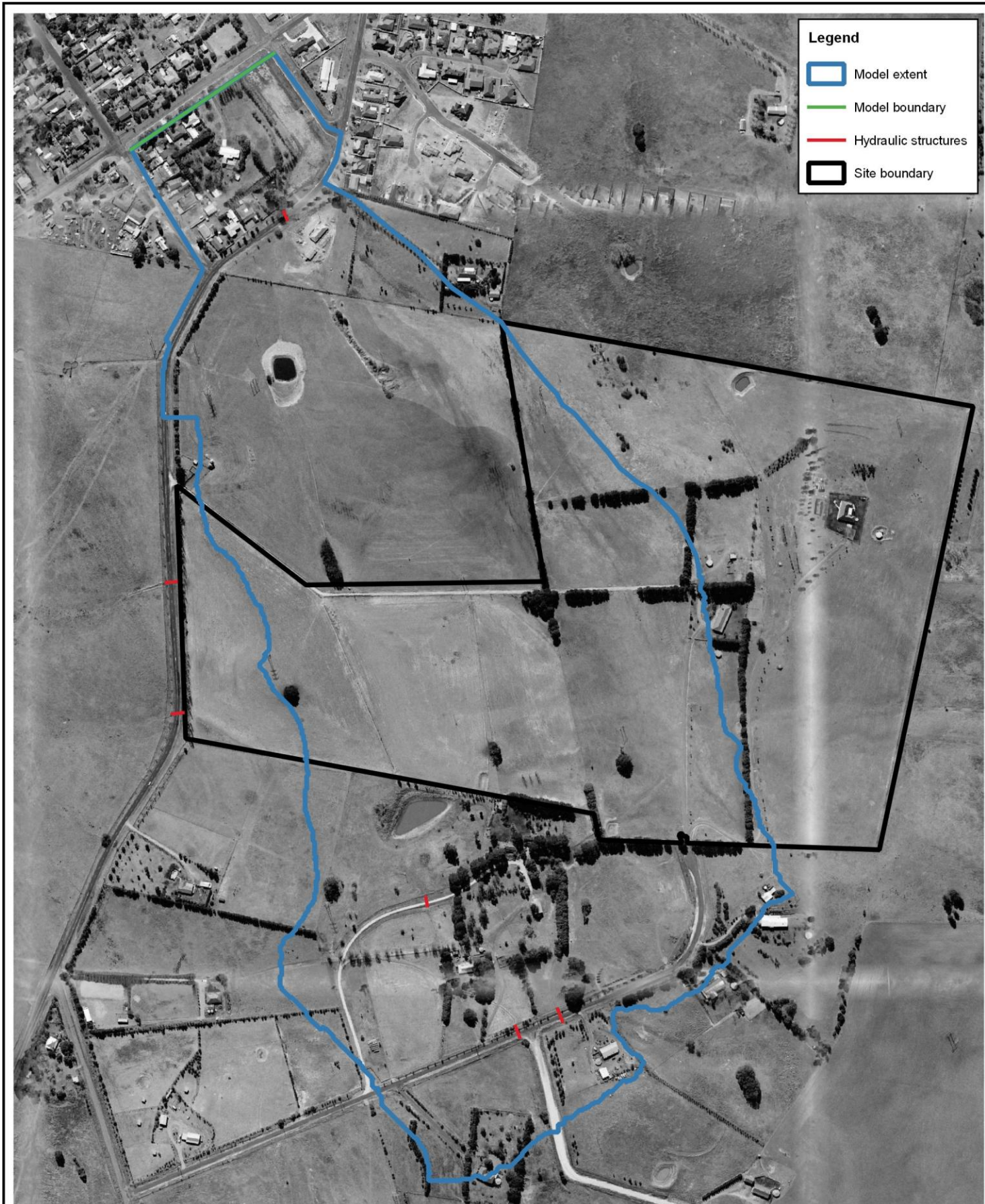
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Title:
TUFLOW Model Components

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Title:

Modelled Design Flood Extents

0 90 180 m



approx. scale

Figure:

4

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Revision:

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Title:

Modelled 5% AEP Flood Depths and Levels

0 90 180 m



approx. scale

Figure:

5

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Title:

Modelled 1% AEP Flood Depths and Levels

0 90 180 m

approx. scale

Figure: **6** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Title:

Modelled PMF Flood Depths and Levels

0 90 180 m

approx. scale

Figure:

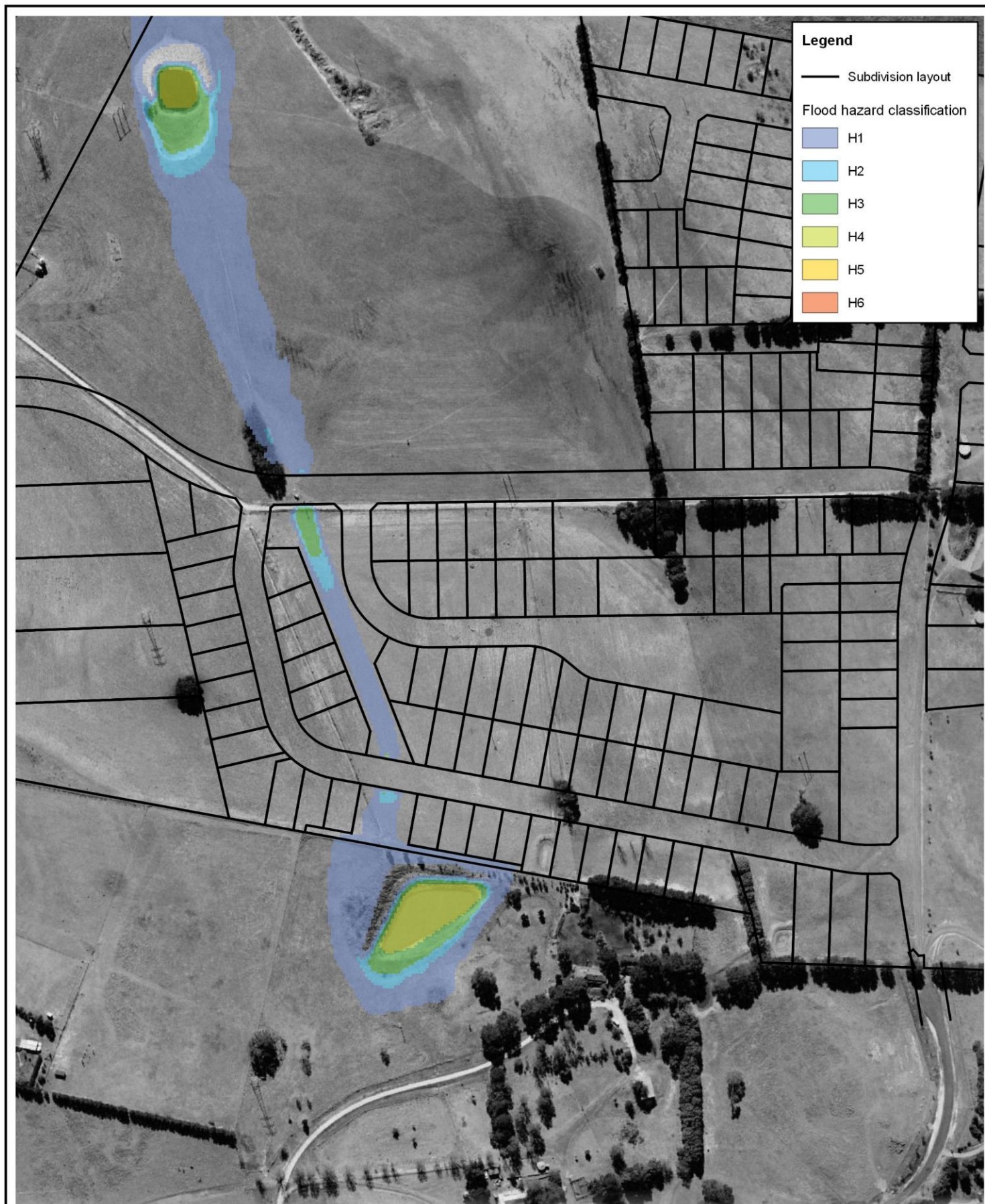
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Title:
5% AEP Flood Hazard Classification

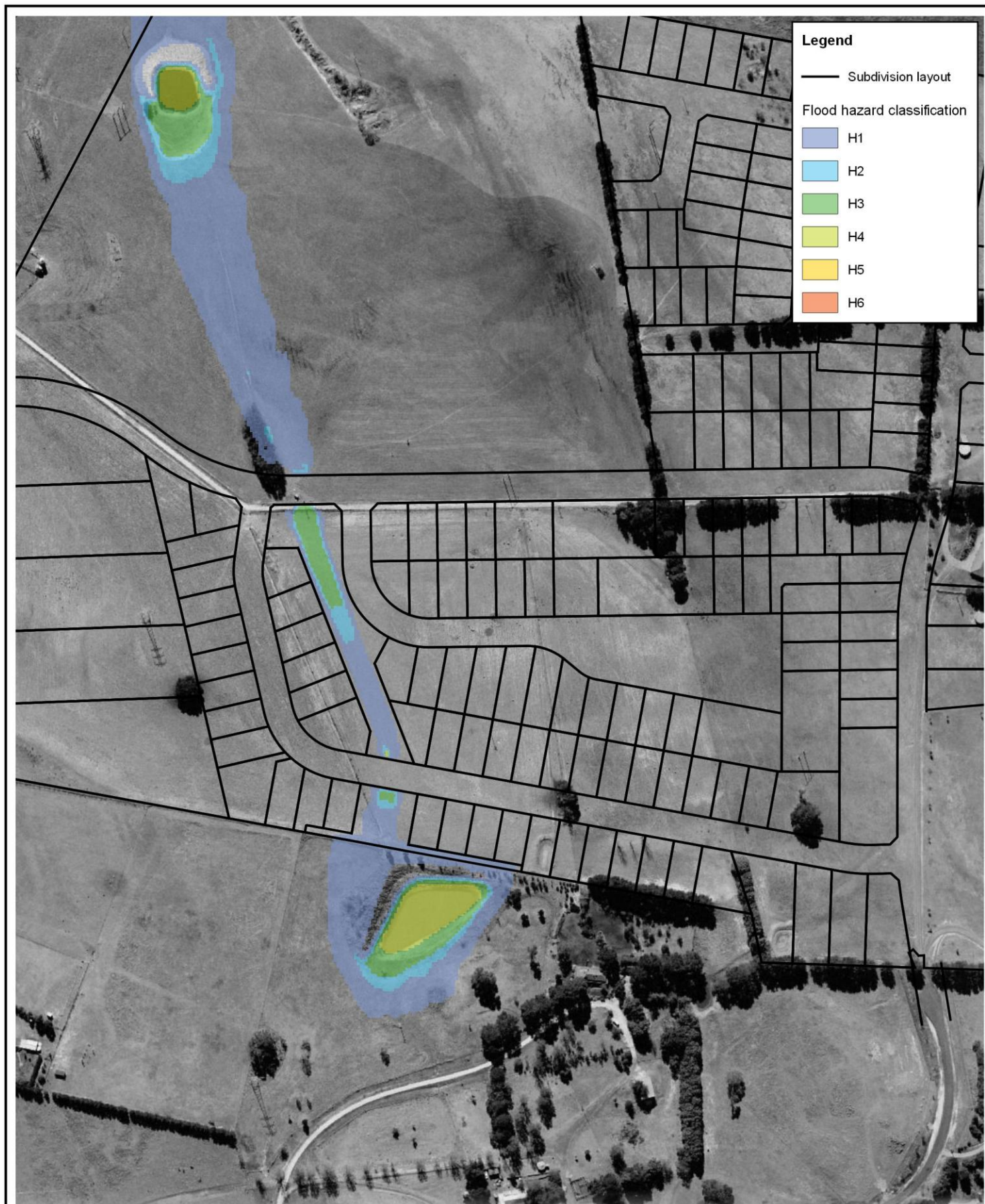
0 90 180 m
approx. scale

Figure: **8** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Title:
1% AEP Flood Hazard Classification

0 90 180 m
approx. scale

Figure: **9** Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarantees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.

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Title:
PMF Flood Hazard Classification

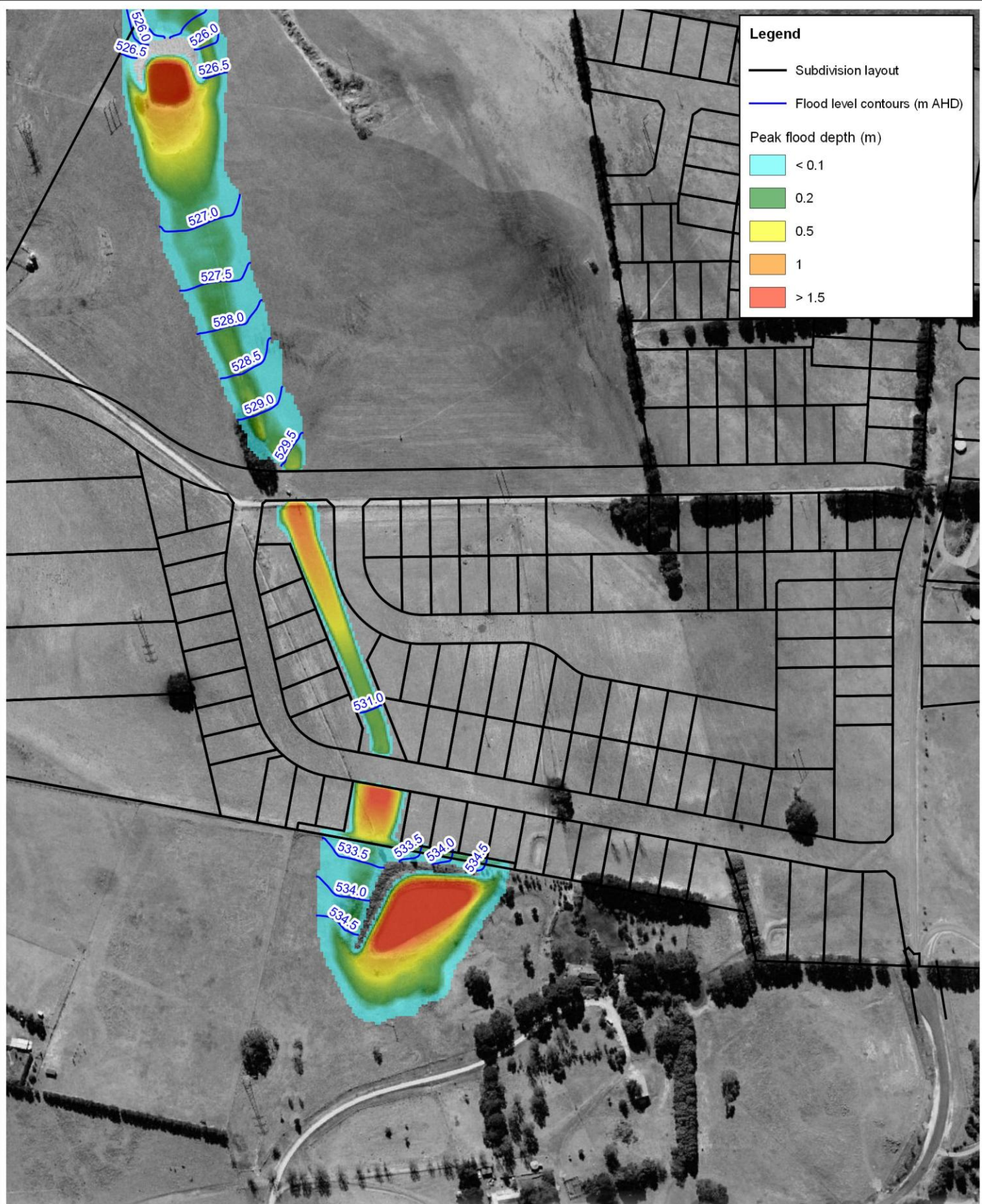
0 90 180 m
approx. scale

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Title:

Modelled 0.2% AEP Flood Depths and Levels

0 90 180 m



approx. scale

Figure:

11

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Legend

— Subdivision layout

■ FPA

Title:

Flood Planning Area

0 90 180 m



approx. scale

Figure:

12

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Title:

Modelled 1% AEP Peak Flood Depth Impact

0 90 180 m

approx. scale

Figure:

13

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Title:

Modelled 0.2% AEP Peak Flood Depth Impact

0 90 180 m



approx. scale

Figure:

14

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Title:

Modelled 1% AEP Peak Flood Velocity Impact

0 90 180 m



approx. scale

Figure:

15

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Title:

Modelled 0.2% AEP Peak Flood Velocity Impact

0 90 180 m



approx. scale

Figure:

16

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Title:

Flood Function Mapping

0 90 180 m



approx. scale

Figure:

17

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