METAL RECYCLING FACILITY DEVELOPMENT

LOT 3 DP251779

88 MURRAYS FLAT

TOWRANG. NSW. 2580

LOCAL FLOOD & OVERLAND FLOW STUDY

Prepared by SOWDES
1 October 2025

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Local Flood and Overland Flow Study

Introduction

SOWDES has been commissioned by the proponents of a metal recycling facility development to be established on a parcel of land identified as 88 Murrays Flat Road, Towrang to undertake a *Local Flood and Overland Flow Study* and to assess the proposed development against the relevant risks associated with the results of the study which are focused on the 1% AEP rain events.

Preparation of the *Local Flood and Overland Flow Study* addresses the following specific information requirements:

- NSW Department of Planning and Environment – Planning Secretaries Environmental Assessment Requirements (SEARS: 1819); second item listed under the category of 'hazard and risk', and the third item under the category of 'soil and water'.
- Goulburn Mulwaree Council – Minutes of Pre-lodgement Meeting (Ref: FWA/0042/2122); Part 12 'Flood Planning' – items 12.1 to 12.4.

Chapter 3.8 'Flood Affected Lands' of the Goulburn Mulwaree Council Development Control Plan provides for specific development controls for development occurring within land that is identified as flood prone or potentially flood prone. The development property is identified as being partially burdened by probable maximum flood (PMF) associated with riverine flooding of the Wollondilly River, and localised flooding from the overland flow path associated with surface water runoff from the south of the site and therefore a flood risk assessment is required. It is noted that the site is not located within the adopted 'flood planning area' associated with the 1% AEP rain event for riverine flooding, however it is affected by overland flows in event magnitudes greater than the 10% AEP.

In 2022 the Goulburn Mulwaree Council adopted a new Floodplain Risk Management Study which introduced the extents of flood affectation in the probable maximum flood (PMF) and the use of Flood Planning Constraints Categories (FPCC) which relies on a risk matrix table to identify prohibited land uses, permissible land uses with controls, and unrestricted land uses in various categories of risk. Approximately 50% of the development site is located on the outer bounds of the probable maximum flood extents with the eastern half and a small portion in the southwest corner being outside of the mapped area. The extent of the probable maximum flood that burdens the property is wholly within the flood planning constraints category of FPCC4 which is at the lower end of the risk categories with very few development controls.

The aims and objectives of the local flood and overland flow study report are:

- To demonstrate the existing extent and depths of overland flow, the proposed extent and depths of overland flow in the post-development scenario and identify any adverse impact on downstream properties.
- Prepare a detailed assessment and description of the catchment area which generates overland flow that drains to and through the development property – in particular where the access to and from the development property may be impacted
- establishment of suitable hydrological and hydraulic models to provide a robust assessment of the potential for flooding within the development property
- provide a detailed description of the data sources that form part of the background information within the models including terrain information and post-development regrading of the site.
- Identification of areas within the property and surrounding catchment that may be impacted by the proposed development in the 'design' rain events by undertaking pre-development and post-development comparison modelling.
- Identification and classification of the hydraulic hazard and flood function areas associated with the developed site in the design flood events, and
- Prepare a summary of the findings and the implications (if any) on and by the proposed development.
- By undertaking the above specific objectives satisfy the information requirements of the relevant state agencies and local Council.

The proposed development will result in slight reductions in the peak flow rate to adjoining properties across the range of modelled design rainfall events whist still maintaining the existing overland flow pathways. It is considered that the proposed development for the establishment of a metal recycling facility is consistent with the intent of the NSW Flood Prone Land Policy, the NSW Flood Risk Management Manual (2023), and the development controls within Chapter 3.8 'Flood Affected Lands' of the Goulburn Mulwaree Council Development Control Plan.

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1 October 2025

1. DEVELOPMENT PROPOSAL		
#	***DESCRIPTION***	***DETAIL***
1.1	Property details	The development site is located on the northeastern outskirts of the city of Goulburn in an area that is not serviced by Council utilities or infrastructure and is identified as Lot 3 DP251779 – 88 Murrays Flat Road, Towrang. NSW. 2580
1.2	Land zoning	The development property is zoned 'E4 – General Industrial' (Goulburn Local Environmental Plan 2009 – Land Zone Maps LZN_001G) and comprises approximately 32.26 hectares.
1.3	Development	The proposed development is for the establishment of a metal recycling facility that will process up to 30,000 tonnes of ferrous and non-ferrous metals per year.
1.4		The overall recycling facility will occupy an area of 6.50 hectares along the western boundary of the property within grass paddocks and include an existing dwelling and curtilage.
1.5		The recycling facility component will be contained within a defined precinct that will occupy an area of approximately 4.733 hectares and include dedicated entrance and exit provisions with inter-connecting roadways; sorting bays to separate the different types of incoming metals; a de-pollution shed to manage dismantling of vehicles and similar end-of-life machinery; pre-shredding bays and storage areas; shredding, cutting, and hammermill processing facilities; post-shredding storage and sorting areas; and ancillary structures and facilities.
1.6		Materials being processed at the recycling facility will be sourced predominantly from the larger metropolitan areas of Syndey, Canberra, and the south coast, and regional areas such as the southern highlands and Goulburn.
1.7		Processed materials will be stored in separate stockpiles of 'like' metals for transport offsite to other facilities and businesses for further processing, recycling, and re-purposing.
1.8		Once operational the facility will employ 10 full-time persons with the potential for an additional 15 persons on a transient and intermittent basis associated with inward and outward truck movements, service contractors, and occasional visitors.
1.9		The business trading hours will be Monday to Friday 7:00am to 6:pm, Saturday 7:00am to 4:30pm, and after hours and Sundays will be used to undertake machinery and vehicle maintenance.
1.10		The existing dwelling will be converted into an administration building with combined staff amenities, and between the southern aspect of the building and the recycling precinct a staff and visitor parking area will be established.

1.11		Approximately half of the development site is burdened by the extents of the probable maximum flood associated with flooding of the Wollondilly River which lies approximately 800 metres to the north, the eastern half and a portion of land in the southwest corner of the holding are located outside of this mapped area.
1.12		The corresponding portion of the site within the mapped probable maximum flood is also captured in the Council's recently adopted *Flood Precinct Constraints Category* mapping with the entire area of affectation being within the 'FPCC4' constraints category, however it is noted that the site does not fall within the mapped flood planning area presently adopted by the Council which equals the 1% AEP level plus a freeboard of 800mm.
1.13		In addition to the impacts associated with riverine flooding the site and surrounding area is also affected by overland flows that are generated in the adjoining rural lands and a portion of the Hume Highway traffic corridor to the south of the holding.
1.14		The focus of the report will be on the overland flows that run through the property associated with the 10%, 5%, and 1% AEP rain events that burden the site as these are the most likely events to have an adverse impact on the proposed development, and assessing these impacts on downstream flows in the post-development scenario.

Figure 1. Recent aerial image showing the proposed metal recycling development precinct to be located along the western boundary of the property inside the area bounded by the light blue coloured line – an area of approximately 6.50 hectares.

2. EXISTING SITE CONDITIONS		
#	***DESCRIPTION***	***DETAIL***
2.1	Land area	The development property comprises approximately 32.26 hectares and is irregular in shape being somewhat rectangular except that from a point approximately midway along the southern boundary there is a kick in the boundary alignment to the southwest that makes the western boundary significantly longer than the eastern boundary.
2.2	Access	The development site is accessed from the Murrays Flat Road which lies adjacent to the western boundary with three separate entrances off the roadway into the site.
2.3		The first entrance is located in the southwestern corner and is clearly identified with an access gate however to date it is not used regularly.
2.4		The second entrance is located approximately 390 metres further north along Murrays Flat Road from the southwestern corner and it is the main entrance to the property with a gravel carriageway that leads up to an existing dwelling and curtilage.
2.5		The third entrance is located near to the northwest corner of the property, approximately 80 metres north of the main entrance, and it is just aligned with a 20-metre-wide Right of Carriageway within the property that runs parallel to the northern boundary and is assumed to benefit the adjoining land holding to the immediate east of the site.
2.6		The existing internal access carriageway is formed as a loop commencing from the main entrance and sweeping along the front aspect of the dwelling and then heading to the northwest around an existing row of trees to exit at the gateway associated with the Right of Carriageway.
2.7	Slope / topography	The development property is divided into two distinct topographical regimes with the majority of the site to east of the nominated development precinct having a general fall from the southeast to the northwest at an average grade of 3.3% (~2°) with subtle changes in surface micro-relief around several drainage depressions and farm dams.
2.8		The western quarter of the site where the proposed development will be located has a general fall from the southwest to the north-northeast at similar grades and variations
2.9		The two topographical regimes converge at a defined drainage depression that runs through the site in a south to north alignment.

2.10	Site stormwater drainage	The development site is burdened by several defined drainage depressions and farm dams, some of which have been purposely designed and constructed in what appears to be soil and water protection measures.
2.11		The most significant of the drainage systems is the main corridor that essentially runs parallel to the Murrays Flat Road traffic corridor in a south to north alignment through the site and is approximately 200 metres to the east of the western boundary.
2.12		This system is highlighted by a moderately sized dam in the northern third of its alignment through the property and receives most of the incoming flows from a catchment that begins on the southern side of the Hume Highway traffic corridor and includes the adjoining property to the immediate south.
2.13		A second drainage corridor traverses the eastern portion of the property in a southeast to northwest pattern and includes a series of small dams that cascade from one to the other over a short distance.
2.14		The outlet from the dam in the main drainage corridor and the last dam in the secondary drainage system both discharge into a small dam just to the south of the Right of Carriageway along the northern boundary with the combined outflows eventually draining into the Wollondilly River approximately 800 metres to the north of the property.
2.15		There are a few other smaller dams within the property, some of which in the eastern portion have diversion berms running parallel to the contours of the terrain to direct upslope flows into them, and others in and around the nominated development precinct which would have been used for stock drinking water in separated fenced paddocks are relatively small and have a limited contributing catchment area.
2.16		Rainwater runoff from the roof of an existing dwelling is collected in an 80,000-litre metal water tank that is located to the north of the dwelling.
2.17	Vegetation	The vegetation formations throughout the property are dominated by open paddocks that have historically had improved pastures and grasslands for livestock to graze.
2.18		Historically there may have also been silage production with pictorial evidence of regular slashing.

2.19		The dam within the main drainage corridor has a small stand of trees along the western banks whilst the dam near to the northern boundary has scattered trees and shrubs along the incoming and outgoing drainage channels, and around the top of the banks on most aspects.
2.20		Within the western portion of the site where the proposed metal recycling facility will be established the vegetation formations are essentially the same as the paddocks to the east - being dominated by open grasslands, however there is a short row of radiata pine trees just to the south of the main entrance to the holding which provides an element of screening from the prevailing winds and privacy for the existing dwelling from the road corridor.
2.21		On the northern aspect of the main entrance there is a continuation of the trees along the western boundary that extends for approximately 50 metres and then turns at 90° to run east – west which also provides shielding from the prevailing winds and screening of vehicle traffic for the existing dwelling.
2.22	Constraints / other matters	The drainage corridors that traverse the site are subject to overland flows and potential flood affects in large to rare rain events, and the site is mapped as being affected by the extents of the probable maximum flood associated with the flooding of the Wollondilly River which lies approximately 800 metres to the north.
2.23		The proposed metal recycling precinct will be located in the southwest corner of the holding which essentially represents the highest elevations of the site and an area that is largely unaffected by large rain events and overland flows apart from some minor surface water ponding within the post-development processing areas that is somewhat deliberate to help prevent the first flush of rainwater leaving the precinct without any form of detention or treatment.
2.24		The location and associated operations of the recycling facility does not involve crossing or access across any of the drainage corridors that traverse through the site.

3. OVERLAND FLOW AND CATCHMENT DETAILS		
#	***DESCRIPTION***	***DETAIL***
3.1	Flood liable lands	A study of riverine flooding within the Goulburn city area (2022) identified that in the probable maximum flood (PMF) the extent of flooding from the Wollondilly River located to the north of the site would over-top the banks and inundate approximately 50% of the property with excluded portions being in the eastern half and the southwest corners.
3.2		Details of the probable maximum flood affectation on the property and the impacts for the proposed metal recycling facility development are discussed in Section 5 of this assessment.
3.3		Whilst approximately half of the development property is located within the extents of the PMF it sits well outside and above the adopted flood planning level for riverine flooding which is equivalent to the 1% AEP level plus a freeboard of 800m – the nearest extent of the adopted flood planning area occurs 50 metres to the north of the site.
3.4		There are however sources of overland flow that are generated from the vacant rural lands and the Hume Highway traffic corridor to the south of the development property that flow in a south to north alignment through the western portion of the development site that need to be considered.
3.5		For overland flows not directly associated with riverine flooding the Council's Development Control Plan requires that all buildings (habitable or otherwise) have a finished floor level that is above the 1% AEP water levels plus a freeboard of 500mm – where practical and appropriate.
3.6	Catchment details	The catchment area which generates rainwater and surface water runoff that directly affects the southern boundaries of the development property originate from the southern aspect and comprises an area of approximately 80 hectares.
3.7		The catchment is made up of predominantly grassed rural lands with the exception of a small area of bitumen roadway associated with the Hume Highway traffic corridor, and the average slope across the length of the catchment measured from the northern side of the Hume Highway is 3.4% (14.25 metres of rise over a distance of 420 metres).
3.8		The catchment area is not benefited by any form of stormwater drainage infrastructure apart from a few piped culverts under the north and south bound lanes of Hume Highway to help manage upslope surface water across the corridor.

3.9		The rural lands between the highway corridor and the southern boundary of the development site are generally unimproved grasslands with a few existing natural drainage depression and scattered farm dams throughout.
3.10		There is one particular drainage depression that is continuous through the adjoining lands to the south that provides a direct flow path from the highway runoff to the main drainage depression that runs through the western portion of the development property.
3.11		The drainage corridor has a slightly meandering alignment with a moderate sized dam and several small but deeper pools that temporarily retain water, and there are many areas of eroded soils and scouring along the banks with numerous trees along the banks and within the main flow pathways .
3.12		To the east of the aforementioned drainage system there are several smaller drainage corridors and depressions that are associated with the scattered dams in the adjoining lands, and the overflow from these systems gradually make their way to the southern boundary of the development site and then forms part of the inflows that are associated with the second drainage depression that runs through the eastern portion of the site.
3.13		The homogonous nature of the rural lands that form the overall catchment create a reasonably consistent roughness condition that affects the flow of water over the surface, and as the catchment is predominantly set to open grassland vegetation with some drainage corridors that have exposed banks a uniform Mannings 'N' coefficient of 0.04 which is a median value for 'open pervious areas, minimal vegetation' land use type has been adopted in accordance with Table 6.2.2 of AR&R (2019)
3.14		The Mannings 'N' coefficient used in the pre-development flood models applies to the areas of the entire catchment as there is very little variation in other surface types and areas that influences the rate of water runoff and the general flow of water, however in the post-development flood models the areas proposed to be used as part of the metal recycling precinct have been attributed a different coefficient that reflects the change in surface type and potential rate of runoff.
3.15		To determine the bounds of the contributing catchment, the downstream receiving areas, and the network of overland flow paths a large catchment model of approximately 215.56 hectares has been identified and used in the various models to help clearly define the areas that do and do not drain toward and through the development site.

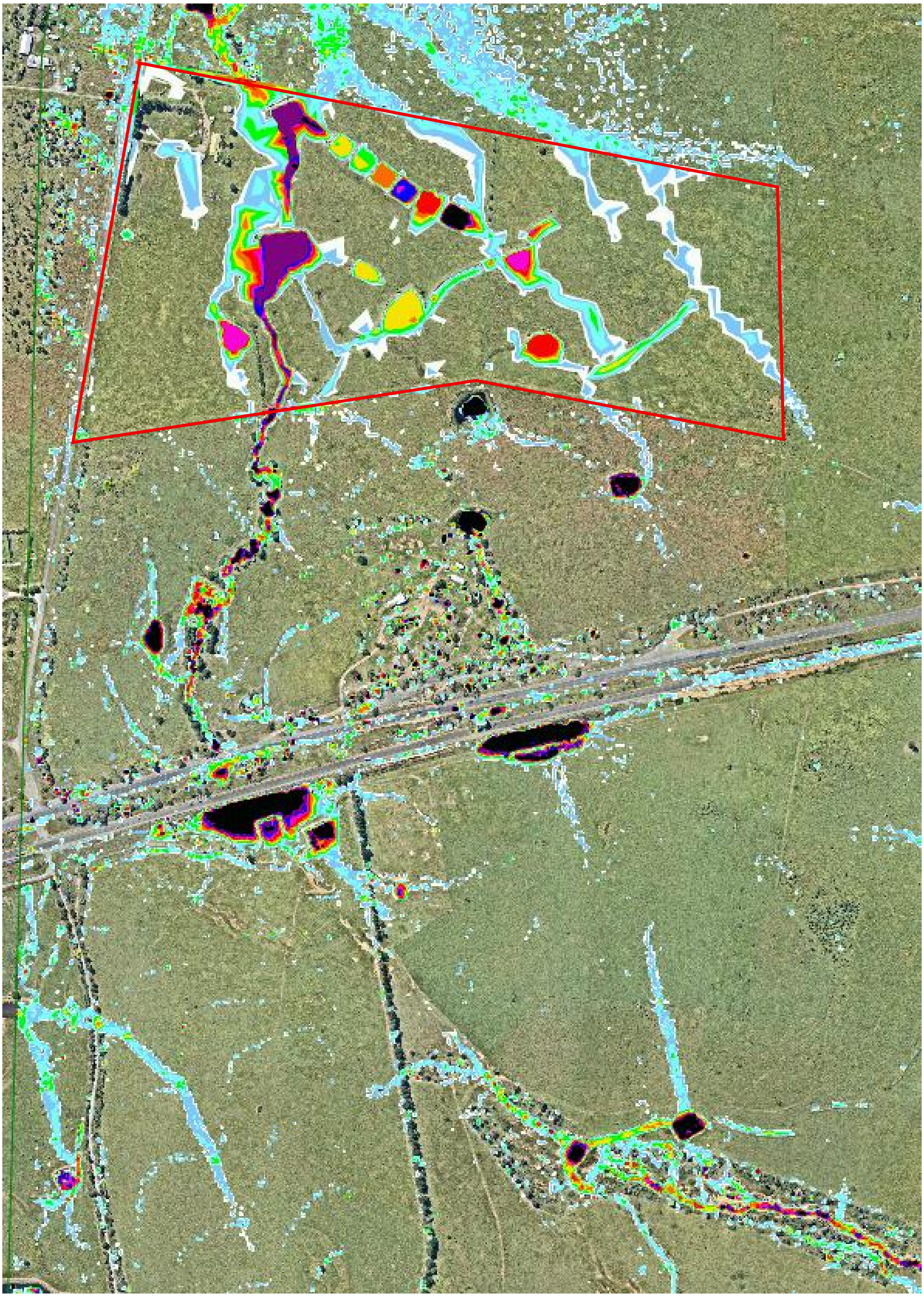


Figure 2. Aerial image of the development site (red) and the contributing catchment area to the south of approximately 80 hectares including portions of the Hume Highway traffic corridor which generates surface water runoff that burdens the site. The coloured shadings throughout the image represents different depths in the 1% AEP pre-development flood event – refer to Appendix A for further details. It is noted that the surface types within the upstream catchment are fairly uniform with predominantly grass covered rural lands.

4. OVERLAND FLOW MODELLING RESULTS		
#	***DESCRIPTION***	***DETAIL***
4.1	Details of the flood modelling and parameterisation	To assess the impacts of overland flows and surface water drainage on the proposed development both pre-development and post-development stormwater drainage and overland flow models have been undertaken of the existing site and surrounding catchment area using a combination of detailed contour survey of the entire development property and LiDAR mapping information for the greater catchment area beyond the property boundaries.
4.2		To create a terrain profile for the stormwater drainage and overland flow assessment outside of the detailed property survey LiDAR information was obtained for the development area from the Geoscience Australia '*Elevation and Depth Foundation Spatial Data'* website (ELVIS).
4.3		The defined catchment area and development property is captured within two datasets (Goulburn201906-LID1-AHD_7546152_55_0002_0002 and Goulburn201906-LID1-AHD_7566154_55_0002_0002) which has a grid area of 2km x 2km which was downloaded as 2 metre grid Digital Elevation Model metadata item.
4.4		The primary objective of the modelling is to determine the existing overland flow patterns, water depths, and velocities that affect the development property and to conservatively estimate for the 'design events' – being the 10%, 5% and 1% AEP rain events where the main impacts from external sources are experienced.
4.5		Results from the modelling exercise were also used to help define areas within the property that are not suitable for development and to determine the appropriate location for the placement of stormwater drainage infrastructure throughout the post-development site.
4.6		Software used to undertake the modelling is the '*InfoWorks ICM Ultimate*' which is licenced, distributed, and supported by Autodesk.
4.7		'*InfoWorks ICM Ultimate*' is a stormwater and flood modelling program incorporating 1D network and 2D scaled mesh operations to perform both above and below ground hydrology and hydraulic simulations.
4.8		The digital elevation model was imported into the software to create a terrain profile which was paired with a georeferenced aerial image of the catchment area for ease of identification, correlation, and result analysis purposes.

4.9		It is noted that in the pre-development and post-development models all water depths less than 50mm have been turned off to help clear the image and to remove multiple areas of isolated and small ponding.
4.10		In accordance with best practice engineering standards as prescribed by Engineers Australia the overland flow and flood assessment has adopted the *Australian Rainfall & Runoff 2019* (AR&R2019) modelling guidelines.
4.11		Within the model a direct-rainfall methodology was employed which is deemed suitable to determine overland flow paths, depths, and velocity information for small catchment areas.
4.12		Design parameterisation and rainfall data for the site was obtained directly through the Australian Rainfall & Runoff Data Hub and the Bureau of Meteorology portal and was focused on the 10%, 5%, and 1% AEP rain events as these are generally the critical rain events of interest for assessing local flood and overland flow impacts.
4.13		As the characteristics of the upstream catchment area is comprised of varied but relatively uniform land uses and surface types associated with 'open pervious areas, minimal vegetation (grass)' a roughness coefficient (Manning's 'n') of 0.04 has been adopted for all existing rural lands which is in accordance with Table 6.2.2 of the AR&R2019 guidelines.
4.14		Within the Bureau of Meteorology rainfall data an initial rainfall loss of 16mm is adopted however as a conservative approach the model does not include an assumption of a continuing loss.
4.15		Within each of the pre-development rain events which include an ensemble of 10 different temporal patterns the durations of 25, 30, 45, and 60 minutes were modelled for the 10%, 5%AEP's, and the durations of 25, 30, 45, 60, 90, and 120 minutes were modelled for the 10% AEP to determine the peak flow that crosses the section of the northern boundary of the property where the majority of outflows occur as this is the effective flow that could be affected by the proposed development with the potential for adverse impacts downstream.
4.16		The duration and temporal pattern (TP) for each rainfall event that generated the greatest peak flow across the boundary (not the mean flow value) was adopted as the design rainfall event for the post-development modelling: • 10% AEP – 30 minute, TP10 • 5% AEP – 45 minute, TP4 • 1% AEP – 90 minute, TP6

		Copies of the peak flow graphs for the pre-development models are included in Appendix B of this document.
4.17		The modelled catchment area that drains into, through, and beyond the development site covers 215.56 hectares and it is broken down into approximately 1,100,000 meshing triangles that have an average area of 1.93m², and each 'working' face allows normal flow conditions from one mesh triangle to the next.
4.18		The large modelling area validates the effective upstream catchment that directly burdens the development property (approximately 80 hectares) by identifying other drainage regimes that occur outside, around, and beyond the property, and which therefore can effectively be ignored.
4.19		Within each of the modelling scenarios 'break lines' were created along the edges of the roadways, drainage swales, and other features to force meshing triangles for the different surface types, and to reflect changes in possible elevations.
4.20	Pre-development model	The pre-development model comprised a total catchment area of approximately 215.56 hectares which included adjoining upslope lands to the south to gauge the impact of all external sources of surface water runoff that potentially burden the site.
4.21		From the modelling outcomes it is possible to determine that the 'effective' catchment area that directs overland flows into or adjacent to the site covers an area of approximately 80 hectares.
4.22		The results for each of the modelled rain events indicate that the central and eastern portions of the property are burdened by overland flows and mild flood affectation that are essentially contained within the banks of the existing drainage corridors and flow paths which are identified on the site by existing internal fence lines.
4.23		The natural shape of the terrain within the western portion of the site rises above the surface levels associated with the main overland flow pathways which retains the deeper and wider waters in the design rain events to the central and eastern portions of the site and thereby essentially creates a flood-free zone where the proposed metal recycling facility can be established.
4.24		There is a small amount of surface water runoff generated within the central western portion of the site in the design rain events that tends to pool on the southern side of the existing access carriageway into the site.
4.25		The ponding of water is created by the finished level of the carriageway being slightly higher than the surrounding terrain

		on the same side however the depths associated with this are less than 200mm in the 1% AEP event.
4.26		In the northwest corner of the property there is a separate pool of surface water runoff ponding to depths of less than 100mmm in all of the design rain events but this does not have direct influence or impact on the proposed metal recycling facility precinct or development, and if need be, can be managed by a slight regrading of the surface to promote runoff from the site.
4.27		Any surface water runoff that is generated or may enter the property from the western or southern aspects where the proposed metal recycling facility will be established is of little consequence as it generally less than 50mm in all design rain events noting that it does not appear in the model results.
4.28	Peak flow details associated with the different AEP event pre-development models - refer to Appendix B – Figures B-01 to B-14.	At the peak of the 10% AEP rain event the maximum flow of water across the northern boundary is 1.210m³/sec, the highest flow rate is 0.556m/s, and the maximum water depth is 332mm
4.29		At the peak of the 5% AEP rain event the maximum flow of water across the northern boundary is 1.956m³/sec, the highest flow rate is 0.553m/s, and the maximum water depth is 329mm
4.30		At the peak of the 1% AEP rain event the maximum flow of water across the northern boundary is 6.004m³/sec, the highest flow rate is 0.802m/s, and the maximum water depth is 473mm.
4.31	Site design considerations based on pre-development model findings	The pre-development models identified areas of the site that should not be developed in order to maintain the existing flow of water through the site, and also where development could be undertaken without any significant increase in flow patterns or direction in the post-development scenario.
4.32		The pre-development models also provided important data on water depth and flow characteristics such that informed design of the site could be undertaken.
4.33		From the 1% AEP model (being the larger of the rain events) the water depths and flow velocity were used to define the '*flood function'* characteristics of the catchment with the 'flood conveyance', 'flood storage' and 'flood fringe' areas identified.
4.34		Classification of the three separate flood function components is important in determining the likely impact of development in a design rain event with each of the separate flood function classifications responding differently to changes.
4.35		'Flood conveyance' is defined as those areas where a significant flow of water occurs and are normally associated with natural and man-made channels and are often the areas of deeper flows and/or where the higher velocities occur – changes in topography or development within these areas can cause a

		significant redistribution of flood flow or cause a significant rise in flood levels.
4.36		'Flood storage' are areas that temporarily store floodwater in a flood event and by doing so attenuate or slow-down the peak water flows and flood levels, and as the main flow of floodwater recede, they slowly release the stored water downstream – filling or removing flood storage areas reduces their ability to attenuate the flood flows and thereby flood flows and levels downstream may significantly increase.
4.37		'Flood fringe' is the remainder of the flood extent and is generally the areas where effects on flood function are not a constraint with development unlikely to significantly alter the flood behaviour.
4.38		Determination of the 'flood function' for overland flow within the 1% AEP model has been undertaken using the criteria prescribed by *Howells et al (2003*) with the flood conveyance (floodway) defined as: **velocity x depth >0.25m/s and velocity >0.25m/s, or velocity >1.0m/s and depth >0.15m** Flood storage is the area outside of the floodway with a depth greater than 500mm, whilst the flood fringe is the area outside the floodway with a depth less than 500mm.
4.39		Using the above the criteria the 1% AEP flood function has been determined for the catchment with a focused view of the development site and surrounding areas displayed in Figure 03 (it is noted that the flood function calculations have been undertaken using water depths that are greater than 50mm).
4.40		From the details in Figure 03 it is observed that the main drainage corridor through the western portion of the site is subject to 'floodway' conditions whilst the dams within the same corridor and the dams associated with the eastern drainage system form both 'flood storage' and 'flood fringe' functions.
4.41		Areas of flood affectation outside of and surrounding the two main drainage systems is classified as 'flood fringe' which would suggest that with certain controls 'development' within these portions of the site will not have a significant effect on flooding and overland flow behaviour.
4.42		It is particularly noted that the western portion of the site where the proposed metal recycling facility is to be established is located outside of the mapped flood function areas with the exception of the small pond of water on the southern aspect of the existing access carriageway which is classified as 'flood fringe'.

4.43		Any changes within this portion of the site in a post-development state is unlikely to have a significant impact on the existing flood and overland flow behaviour.
4.44		For each of the pre-development design rain event models a separate hydraulic hazard or 'flood hazard' has been determined in accordance with the AR&R (2019) guidelines which provides important information on particular characteristics of the flood event that are likely to have an effect or present a risk to people, vehicles, infrastructure, and buildings – refer to Appendix C.
4.45		This detail is used to assess the proposed development against the relevant flood effects, access provisions, evacuation considerations, and overall risk associated with flooding under different water depth and flow conditions.
4.46		The hazard classifications are divided into six separate categories based on a combination of flow velocities and water depth thresholds with slower and shallower water representing a lesser risk than the deeper and faster flowing water.
4.47		The hazard categories are defined as 'H1' to 'H6' with areas of 'H1' and 'H2' generally safe for all people, infrastructure, buildings, and vehicles with the exception of 'small vehicles' at category 'H2'.
4.48		Hazard categories 'H3' and 'H4' are generally deemed to be unsafe for all vehicles and people, whilst categories 'H5' and 'H6' are unsafe for essentially all development considerations.
4.49		For each of the pre-development design rain events where water depths are identified the site and surrounding areas associated with the proposed metal recycling facility are classified as 'H1' hazard categories meaning that the site is considered to be generally safe for all potential land users and development types – this is particularly important for a vehicle risk assessment with the possibility that egress from the site along the public road system may be required using different types of vehicles in a large rain event, although the site should not be used or accessed in such situations where avoidable.
4.50	Post-development model	To gauge the potential impact of the proposed development on existing overland flows a second 'post-development' model was prepared for each of the design rain events that combined the existing terrain data with the proposed regrading of the site to achieve the design surface levels, access carriageways, and stormwater conveyance and treatment measures associated with establishing the metal recycling facility.
4.51		The change of surface type and land use associated with the recycling precinct was modified in the model by applying a

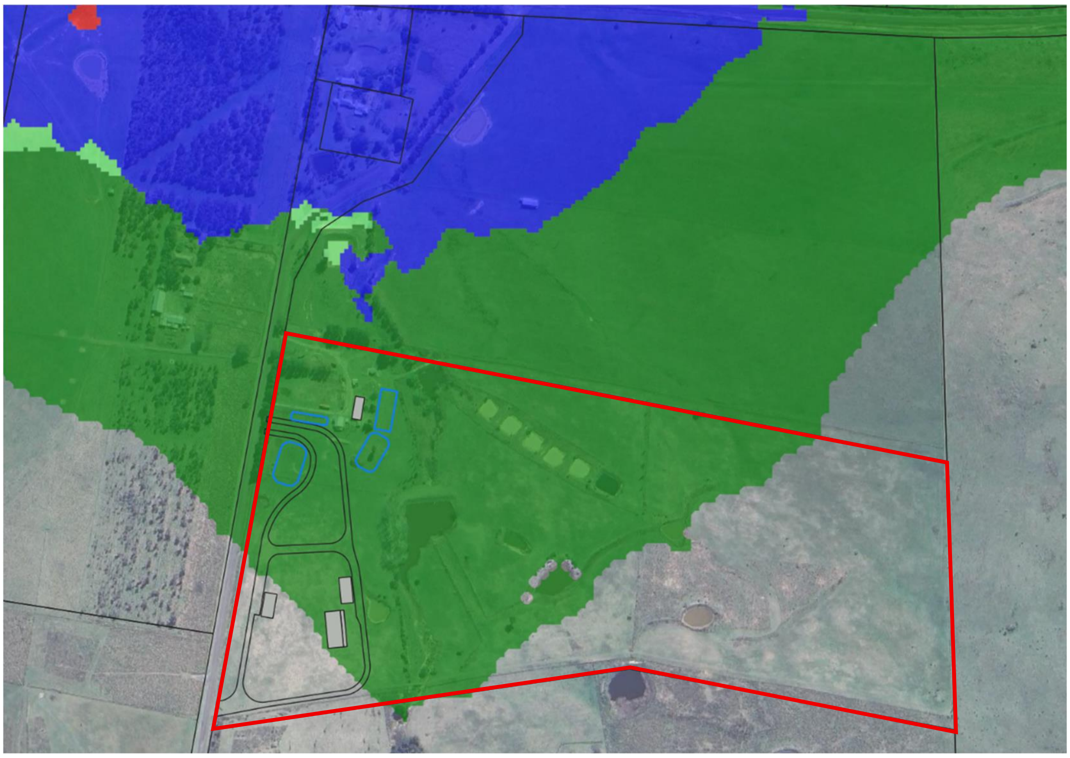
		Mannings 'N' coefficient of 0.30 for the two compacted gravel infill areas as a type of commercial land use zone, and 0.025 for the concrete roadways around the perimeter and within the recycling precinct.
4.52		Existing terrain data around the proposed administration precinct which is the area surrounding the existing dwelling that will be re-purposed was not altered as there are no design changes to this part of the site, however the existing dam to the east of the proposed workshop and recovery sheds just outside of the fenced recycling precinct has been removed and 'filled'.
4.53		The primary objective of the post-development models is to assess the impacts of the proposed site regrading and 'end of work' site conditions – including stormwater conveyance and treatment measures on the existing overland flow patterns and characteristics, and to look for any adverse changes on the downstream side of the property as a consequence of the proposed development.
4.54		The layout and design of the metal recycling precinct in the post-development conditions is focused on the retention, conveyance, and treatment of stormwater and surface water runoff to meet the NorBE criteria for developments in the Sydney drinking water catchment.
4.55		This aspect of the proposal has essentially been addressed by ensuring that as much water runoff is retained within the two infill areas inside the perimeter roadways that run around the recycling precinct so that the first flush of water in a rain event that typically contains most of the heavy pollutant loads is prevented from directly flowing into the adjoining waterways.
4.56		To achieve this objective the perimeter roadways have been designed with a slight crossfall from the outer edge to the inner edge which encourages surface water runoff into the internal areas, with the inner edge of the roadways being 100mm to 200mm higher than the adjoining internal areas which will be formed with a slight fall from the south to the northeast to also encourage surface water runoff for site management purposes.
4.57		The two infill areas within the recycling precinct have been designed with a 'pit and pipe' stormwater drainage system within their respective lower northern portions, and these systems convey ponded water to a separate sedimentation basin servicing each area that is to be constructed just outside of the perimeter roads.
4.58		The two sedimentation basins servicing the two infill areas each have a high-level outlet pipe that drains into a third

		sedimentation basin for additional settling prior to then draining into an 'end-of-line' biofiltration raingarden treatment system that 'polishes' the water before entering the existing overland flow drainage corridor that lies to the east.
4.59		It is noted that the details for the design of the stormwater drainage system within the two infill zones has been included in the post-development models for improved accuracy.
4.60	Post-development modelling results	The combination of measures to manage stormwater runoff from within the recycling precinct has the effect of slowing the flow of water from the site via various detention measures, and this invariably results in a reduction of the peak flows and water depths crossing the northern boundary of the property.
4.61		The loss of water storage associated with the decommissioning of the small dam to the east of the proposed workshop and recovery sheds in the recycling precinct is more than adequately compensated by the increased storage provisions associated with the three sedimentation basins in the post-development conditions.
4.62		The combined surface area of the three sedimentation basins is significantly greater than that of the existing dam, and for the two larger basins there is an extended detention zone of 800mm above the invert level of the outlet pipe, and for the remaining basin the extended detention zone is 500mm above the invert level of the outlet pipe.
4.63		Additional detention storage is created within lower northern end of the two infill areas within the recycling precinct by the raised roadways which helps to attenuate the release of water until after the peak of the event and thereby add to the overall reduction in peak flows.
4.64	Post-development peak flow and volume results – refer to Appendix B for chart details.	A result section analysis was undertaken along the same section of the northern boundary as the pre-development flow analysis to compare the peak flow and volume of water exiting the property under the post-development conditions once all proposed works and site grading to establish the metal recycling precinct is completed.
4.65		The result section analysis was undertaken along the northern boundary commencing from the northwest corner of the property and extending for 370 metres toward the east as this represented the flow of surface water most likely to be influenced by the proposed development.
4.66		The result analysis indicates that there is a reduction in the peak flow of water exiting the property across all modelled post-development design rainfall events compared to the pre-

		development flow rates with the 10% AEP having a flow rate of 1.016m³/sec (16% reduction), the 5% AEP having a flow rate of 1.902m³/sec (2.76% reduction), and the 1% AEP having a flow rate of 5.008m³/sec (16.58% reduction).
4.67		The post-development maximum water depths and speeds are slightly less than the equivalent pre-development rain events with the exception of the 5% post-development water depth which is slightly more than the pre-development measurement (342mm compared to 329mm). Refer to Appendix B – Figures B-15 to B-17 for details.
4.68		The duration and time to the peak of measurable parameters in the 10% AEP post-development design event model is very short, with the peak flow, depth, and velocity occurring approximately 30 minutes after the commencement of the event, and all subsiding to negligible conditions after 60 minutes.
4.69		Similarly for the 5% AEP, the duration and time to the peak of measurable parameters is very short, with the peak flow, depth, and velocity occurring approximately 25 minutes after the commencement of the event, with a slight rise again around the 45 minute mark, and all subsiding to negligible conditions after 60 minutes.
4.70		For the 1% AEP the measurable parameters begin to rise after 60 minutes with a peak around 90 minutes, and then there is a rapid decline with only shallow depths and low flows evident after 2 hours, and these continue to reduce progressively thereafter.
4.71		The significance of discussing the duration to the peak of the measurable parameters for each design event is that it highlights the short period of time that the site may be subjected to the peak conditions, and as the following water depth and water level result maps will show, the water depths around the proposed development precinct are relatively shallow with slow velocities.
4.72		Whilst the development property is not within the adopted flood planning area associated with flooding of the Wollondilly River, localised flood planning provisions are still applicable.
4.73		In relation to this matter is it noted that the design finished surface levels for the perimeter roads around the eastern aspect of the recycling precinct where the greatest risk of flood affectation is likely to be encountered are at least 500mm higher than the adjacent flood contour level, and in most instances the height differential is significantly greater.

4.74		The 'end-of-line' biofiltration raingarden treatment device will be constructed near to the edge of the modelled flood extents in the 5% and 1% design events which has a very minor impact on the flow of water in that area, however the aforementioned post-development flow and water level results are inclusive of this impact.
4.75		Further details describing the stormwater conveyance and management measures associated with the metal recycling precinct are contained in Sections 3 and 4 of the '*Water Cycle Management Study'* report and the *Stormwater Drainage and Water Quality Management Site Plan* – Ref: 0060222-S101-A that accompanies the development application.
4.76	Modelling summary and results	A suite of pre-development and post-development local flood results have been prepared for the development site and are presented in Appendix A.
4.77		Mapping results include the 'flood function', 'water depths and levels', and 'flood hazard' for the pre-development and post-development 10%, 5%, and 1% AEP's.
4.78		The pre-development and post-development modelling results are presented in Appendix A of this report with the result images starting with the 'flood function' followed by the 'water depths and levels' and 'flood hazard' which are collated in order of event magnitude starting from the more frequent rainfall event being the 10% AEP and finishing with the larger 1% AEP design rain event.
4.79		Additional modelling results include a comparison between the pe-development and post-development 'velocity' and 'velocity x depth product' for the 1% AEP.
4.80		For each of the flood model images the pre-development results are on the lefthand side and the post-development results are on the righthand side, and there is a legend to the right of the images to explain the different colour bands.

5. FLOOD PLANNING CONSTRAINTS CATEGORY		
#	***DESCRIPTION***	***DETAIL***
5.1	Flood Planning Constraints Category and development controls	Approximately half of the development site is burdened by the extents of the probable maximum flood associated with flooding of the Wollondilly River which lies 800 metres to the north with the extent of the inundation being entirely within the *Flood Planning Constraints Category* (FPCC) of '*FPCC4*'.
5.2		The eastern half and a portion of land in the southwest corner of the holding are located outside of this mapped probable maximum flood area, however a separate overland flow study undertaken for the Goulburn Mulwaree Council at the same time as the riverine flooding studies indicates that the overland flows that burden the site and have been discussed throughout the previous sections of this document may also create certain flood planning constraint category areas.
5.3		When the associated images from the two flood planning constraint maps are laid over each other to scale it is apparent that the mapped area associated with the riverine flooding is significantly greater than the area associated with the overland flow flooding, and therefore the constraints associated with the riverine flooding have been adopted for the purposes of the assessment.
5.4		In relation to the above discussion; it is firstly noted that the nominated area for the metal recycling facility is either outside of the mapped probable maximum flood extents or is within the lower risk FPCC4 mapped areas; and secondly, the overland flow study undertaken on behalf of the Council has not been formally adopted and therefore is only to be used as a guide.
5.5		Chapter 3.8.2.3 of the Goulburn Mulwaree Council Development Control Plan discusses the different flood planning constraint categories and references Appendix J of the Council's Development Control Plan for the prohibited, permissible, and unrestricted land use activities within each land-use type category.
5.6		Appendix J of the Council's Development Control Plan includes a risk matrix table that plots the various development land uses against the relevant development planning control considerations, and for this development as a type of 'commercial / industrial' land use it is noted that there are no development controls applicable.
5.7		With no development controls applicable it can be concluded that the effects of the probable maximum flood on the development site will not be limiting factor.



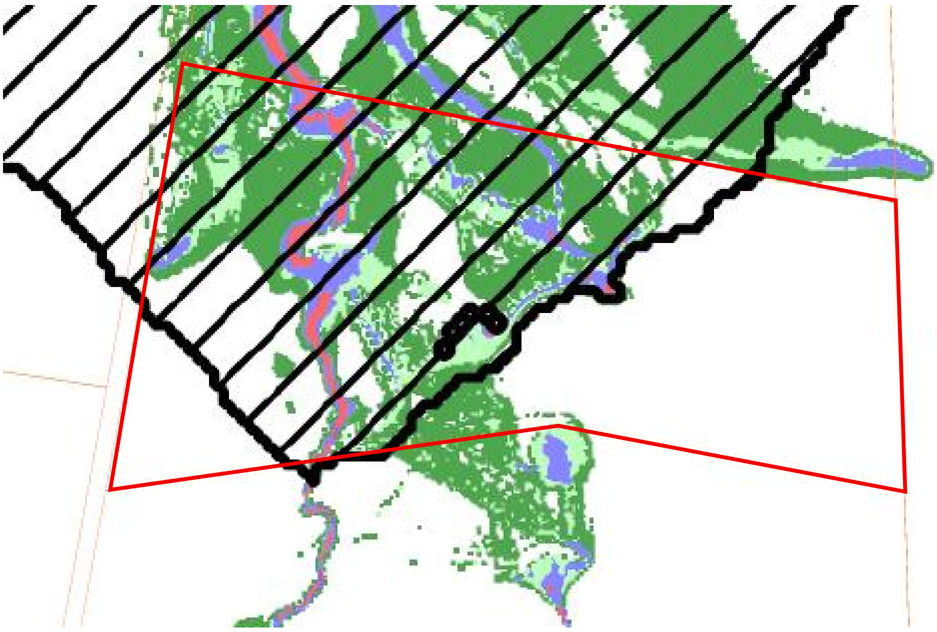


Figure 3: Screen shot from both the riverine flooding (top) and overland flow (bottom) maps showing the different classifications of the *Flood Planning Constraint Categories* based on the source of the mainstream flows. The location of the proposed metal recycling facility in the top image gives a general idea of the level of affection and Development constraint that would be applicable adopting either study. A legend for the different colours associated with the Flood Planning Constraint Category zones is explained by the Table on the following page with the infill colours across the top closely aligning with the colours in the images.

FLOOD PLANNING CONTROLS – DEVELOPMENT CONTROL MATRIX (APPENDIX J OF THE DEVELOPMENT CONTROL PLAN)

FLOOD PLANNING CONTROLS - DEVELOPMENT CONTROL MATRIX

	FPCC 1								FPCC 2 (Subcategory a,b,c,e)								FPCC 2 (Subcategory d)								FPCC 3								FPCC 4							
	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercuial & Industrial	Recreational & Non-Urban	Sheds & Outbuildings	Minor Additions	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercuial & Industrial	Recreational & Non-Urban	Sheds & Outbuildings	Minor Additions	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercuial & Industrial	Recreational & Non-Urban	Sheds & Outbuildings	Minor Additions	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercuial & Industrial	Recreational & Non-Urban	Sheds & Outbuildings	Minor Additions	Critical Uses & Facilities	Sensitive Uses & Facilities	Lot Subdivisions	Residential Development	Commercuial & Industrial	Recreational & Non-Urban	Sheds & Outbuildings	Minor Additions
Floor Level						A1	A1						A2 A6	A1	SA 2	A2				A4 A6	A2 A6	A1	A2	A3				A2 A6	A2 A6	A1	A2	A3	A5 A6	A5 A6						
Building Components													D1	D1	D1	D1				D1	D1	D1	D1	D1				D1	D1	D1	D1	D1	D2	D2						
Structural Soundness													E1	E1	E1	E1				E1	E1	E1	E1	E1				E1	E1	E1	E1	E1	E2	E2						
Parking & Driveway Access						F2 F5	F1 F3 F4						F1 F3 F4 F5	F2 F 5	F1 F3 F4	F5			F1 F3 F4 F5	F1 F3 F4 F5	F1 F3 F4 F5	F2 F5	F1 F3 F4				F1 F3 F4 F5	F1 F3 F4 F5	F1 F3 F4 F5	F2 F5	F1 F3 F4		F2 F3	F2 F3						
Evacuation & Refuge						G1 G3 G4	G1						G2 G3	G2 G3 G4	G1	G1 G3			G3 G4	G3	G3	G3					G2 G3 G4	G2 G3	G2 G3	G3 G4	G1		G2 G3 G4	G2 G3 G4	G2 G3 G4					
Management & Design						H2 H3 H4	H2 H3 H4						H2 H3 H4	H2 H3 H4	H2 H3 H4	H2 H3 H4			H1 H5		H2 H3 H4	H2 H3 H4	H2 H3 H4				H1 H5		H2 H3 H4	H2 H3 H4	H2 H3 H4				H1 H5					
Flood Impacts						J1	J1						J1	J1	J1	J1			J1	J1	J1	J1	J1	J1			J1	J1	J1	J1	J1	J1								

Unsuitable Land Use   Not Relevant   Potentially unsuitable. Significant management required to manage flood risk

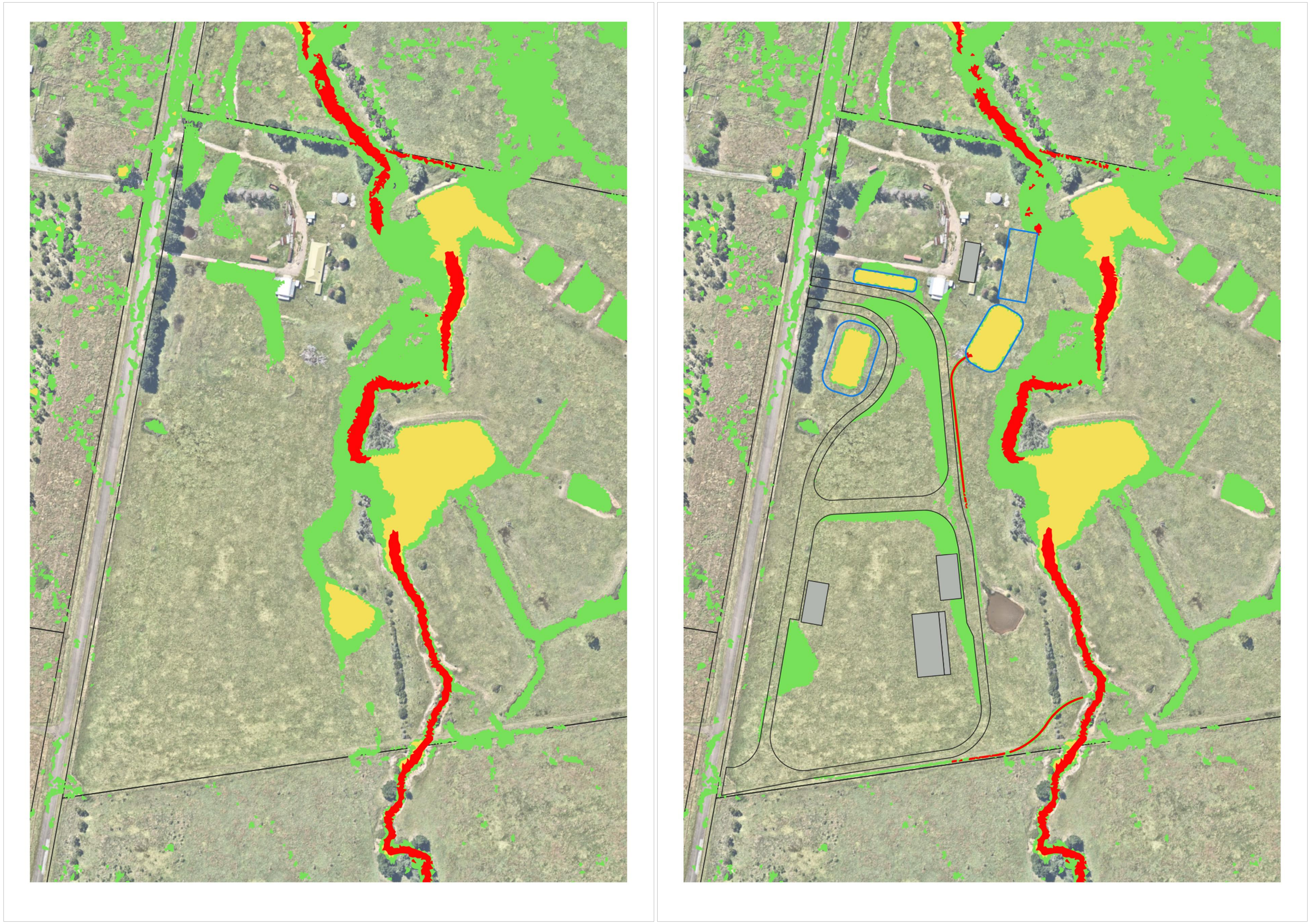
The highlighted cell in yellow represents the relevant Flood Planning Constraints Category and the land use type applicable to the proposed development

The proposed development is classified as a commercial / industrial land use with no controls applicable in 'FPCC4'

6. SUMMARY AND CONCLUSION		
#	***DESCRIPTION***	***DETAIL***
6.1	Summary	The combination of measures to manage stormwater runoff from within the recycling precinct has the effect of slowing the flow of water from the site via various detention and retention measures, and this invariably results in a reduction of the peak flows and water depths crossing the northern boundary of the property without any adverse on existing flow patterns which is supported by the post-development modelling results.
6.2		The result section analysis undertaken along the northern boundary of the property indicates that there is a reduction in the peak flow of water exiting the property across all modelled post-development design rainfall events compared to the pre-development flow rates with the 10% AEP having a 16% reduction in peak flow rate, the 5% AEP having a 2.76% reduction in peak flow rate, and the 1% AEP having a 16.58% reduction in the peak flow rate.
6.3		The duration and time to the peak of measurable parameters in the 10% and 5% AEP post-development design event models is generally very short, with the peak flow, depth, and velocity occurring approximately 25 to 30 minutes after the commencement of the event, and all subsiding to negligible conditions after 60 minutes.
6.4		The duration and time to the peak of measurable parameters in the 1% AEP post-development design event models is slightly longer but still relatively short with the peak flow, depth, and velocity occurring approximately 90 minutes after the commencement of the event, and subsiding to negligible conditions after 2 hours.
6.5	Conclusion	The reduction in flow rates suggest that the proposed metal recycling facility development will not have an adverse impact on existing flows patterns or adjoining downstream properties.
6.6		The design finished surface levels for the perimeter roads around the eastern aspect of the recycling precinct where the greatest risk of flood affectation is likely to be encountered are at least 500mm higher than the adjacent flood contour level which creates an acceptable freeboard above the flood extents for general occupation safety and any modelling uncertainty.
6.7		The metal recycling facility as a type of 'commercial / industrial' land use is located either outside of the mapped probable maximum flood extents or is within the lower risk 'FPCC4' mapped areas hence no development controls as per Appendix J of the Council's Development Control Plan are applicable.

APPENDIX A

Figure	Details
A-01	1% AEP Pre-Development and Post-Development Flood Function Categories
A-02	10% AEP Pre-Development and Post-Development Water Depths and Levels
A-03	10% AEP Pre-Development and Post-Development Flood Hazard Categories
A-04	1% AEP Pre-Development and Post-Development Water Depths and Levels
A-05	5% AEP Pre-Development and Post-Development Flood Hazard Categories
A-06	1% AEP Pre-Development and Post-Development Water Depths and Levels
A-07	1% AEP Pre-Development and Post-Development Flood Hazard Categories
A-08	1% AEP Pre-Development and Post-Development Velocity x Depth Product
A-09	1% AEP Pre-Development and Post-Development Water Velocity



**METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580**

**1% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT FLOOD FUNCTION CATEGORY**

FIGURE: A-01

Cadastral boundary

Function Category

Floodway
Areas where a significant flow of water occurs and are normally associated with natural and man-made channels and are often the areas of deeper flows and/or where the higher velocities occur

Flood Storage
areas that temporarily store floodwater in a flood event and by doing so attenuate or slow-down the peak water flows and flood levels, and as the main flow of floodwater recede, they slowly release the stored water downstream

Flood Fringe
The remainder of the flood extent and is generally the areas where effects on flood function are not a constraint with development unlikely to significantly alter the flood behaviour

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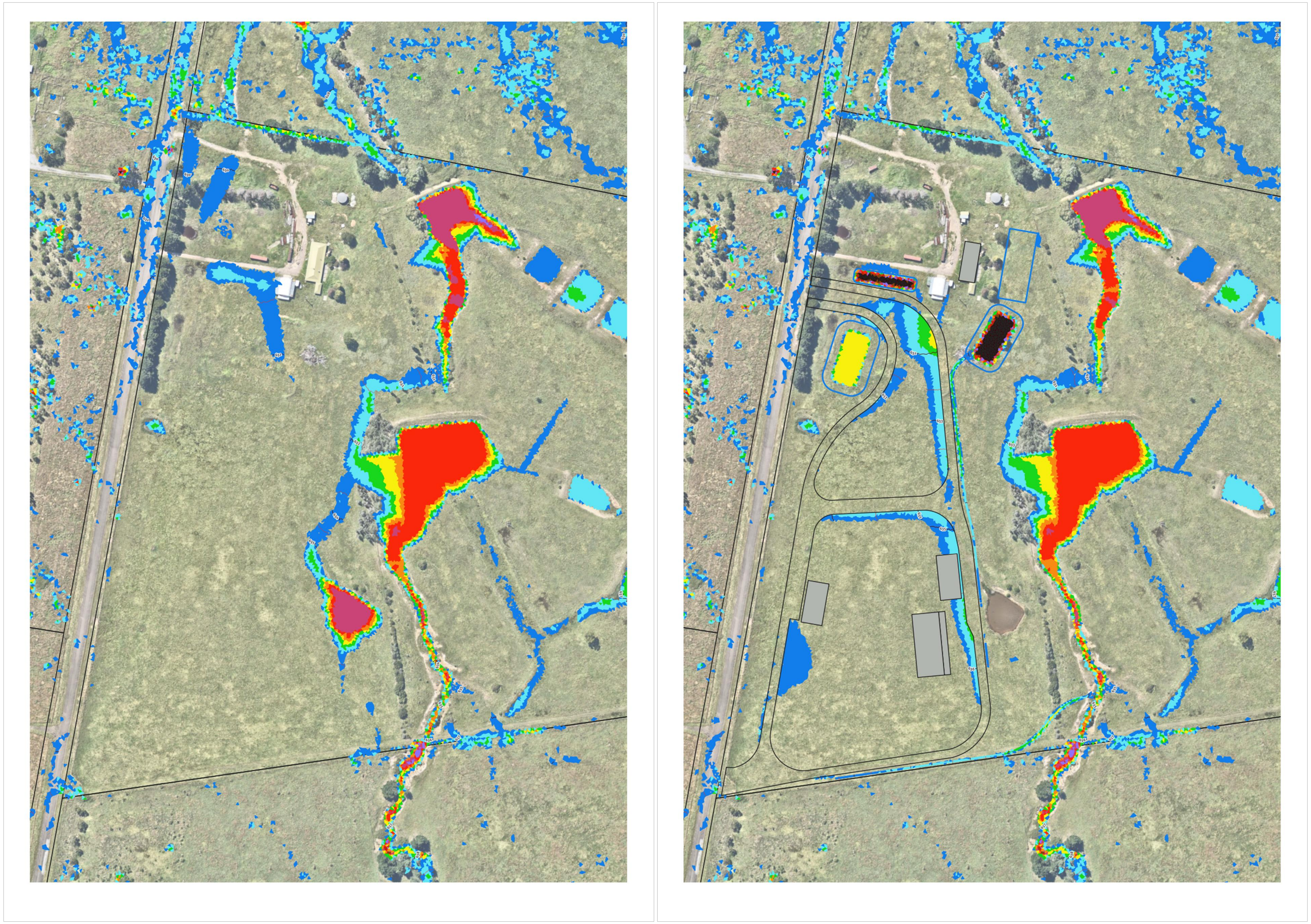

**METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580**

**10% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT OVERLAND FLOW WATER DEPTHS & LEVELS**

FIGURE: A-02

Cadastral boundary

Water Depths (m)

0.00 – 0.050
0.050 – 0.100
0.100 – 0.200
0.200 – 0.300
0.300 – 0.400
0.400 – 0.500
0.500 – 0.600
0.600 – 0.700
0.700 – 0.800
0.800 – 0.900
0.900 – 1.000
> 1.000

Major water level – 1.0m

Minor water level - 0.5m

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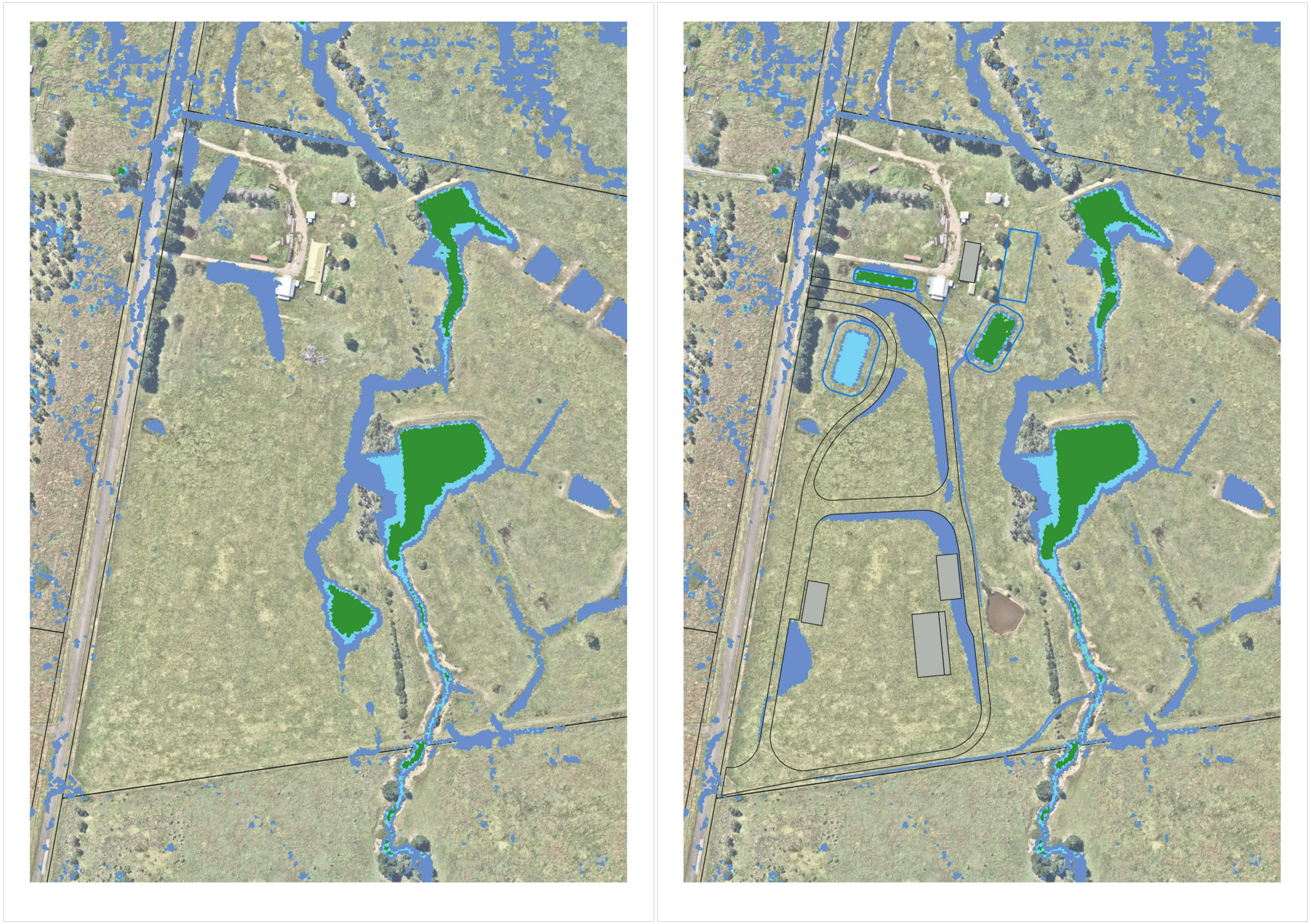

METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580

10% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT FLOOD HAZARD CATEGORY

FIGURE: A-03

Cadastral boundary

Hazard Category

- **H1** (Generally safe for vehicles, people & buildings)
- **H2** (Unsafe for small vehicles)
- **H3** (Unsafe for vehicles, children & the elderly)
- **H4** (Unsafe for vehicles & people)
- **H5** (Unsafe for vehicles & people. All buildings subject to structural damage)
- **H6** (Unsafe for vehicles & people. All building types considered vulnerable to failure)

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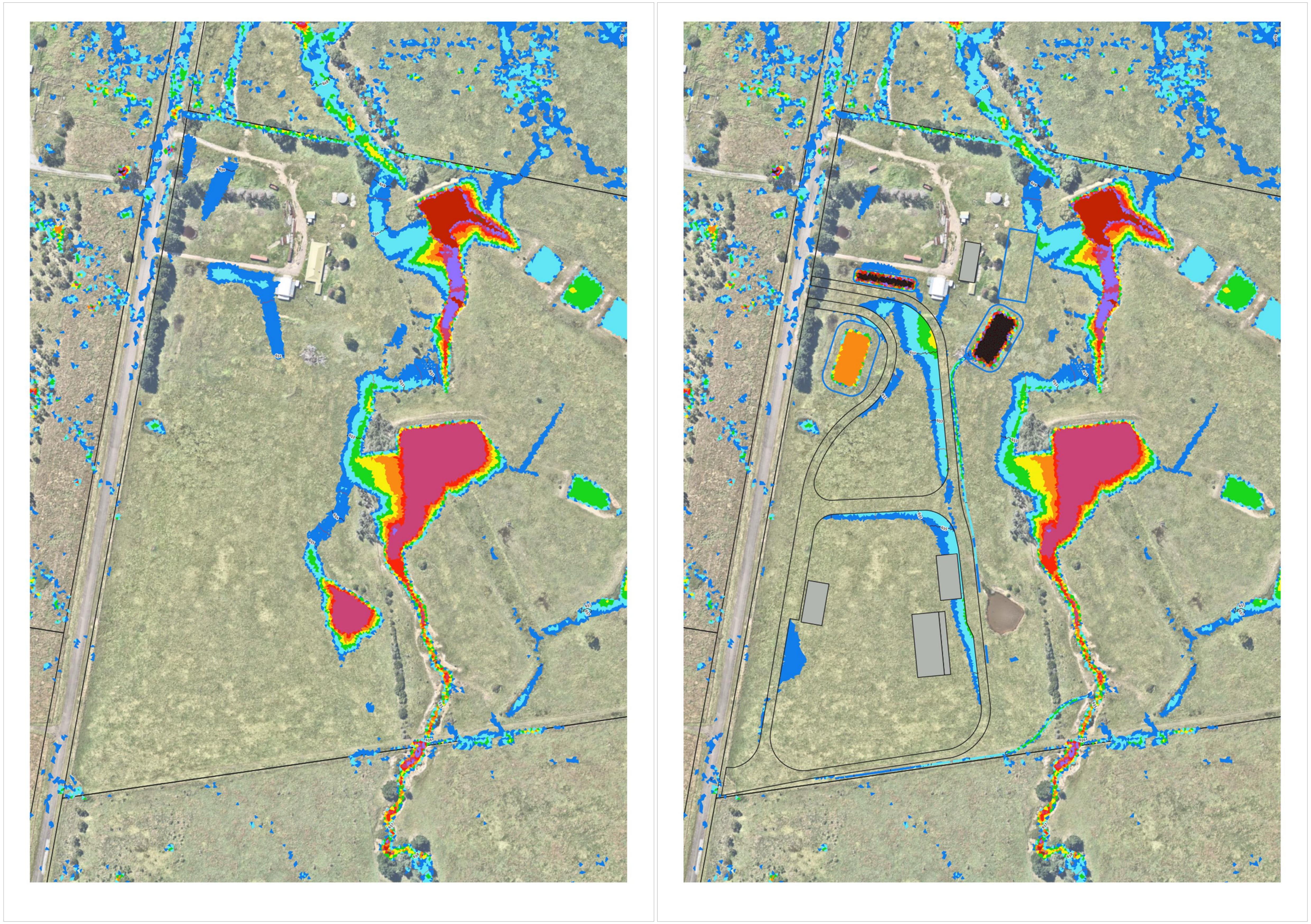

METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580

5% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT OVERLAND FLOW WATER DEPTHS & LEVELS

FIGURE: A-04

Cadastral boundary

Water Depths (m)

0.00 – 0.050
0.050 – 0.100
0.100 – 0.200
0.200 – 0.300
0.300 – 0.400
0.400 – 0.500
0.500 – 0.600
0.600 – 0.700
0.700 – 0.800
0.800 – 0.900
0.900 – 1.000
> 1.000

Major water level – 1.0m

Minor water level - 0.5m

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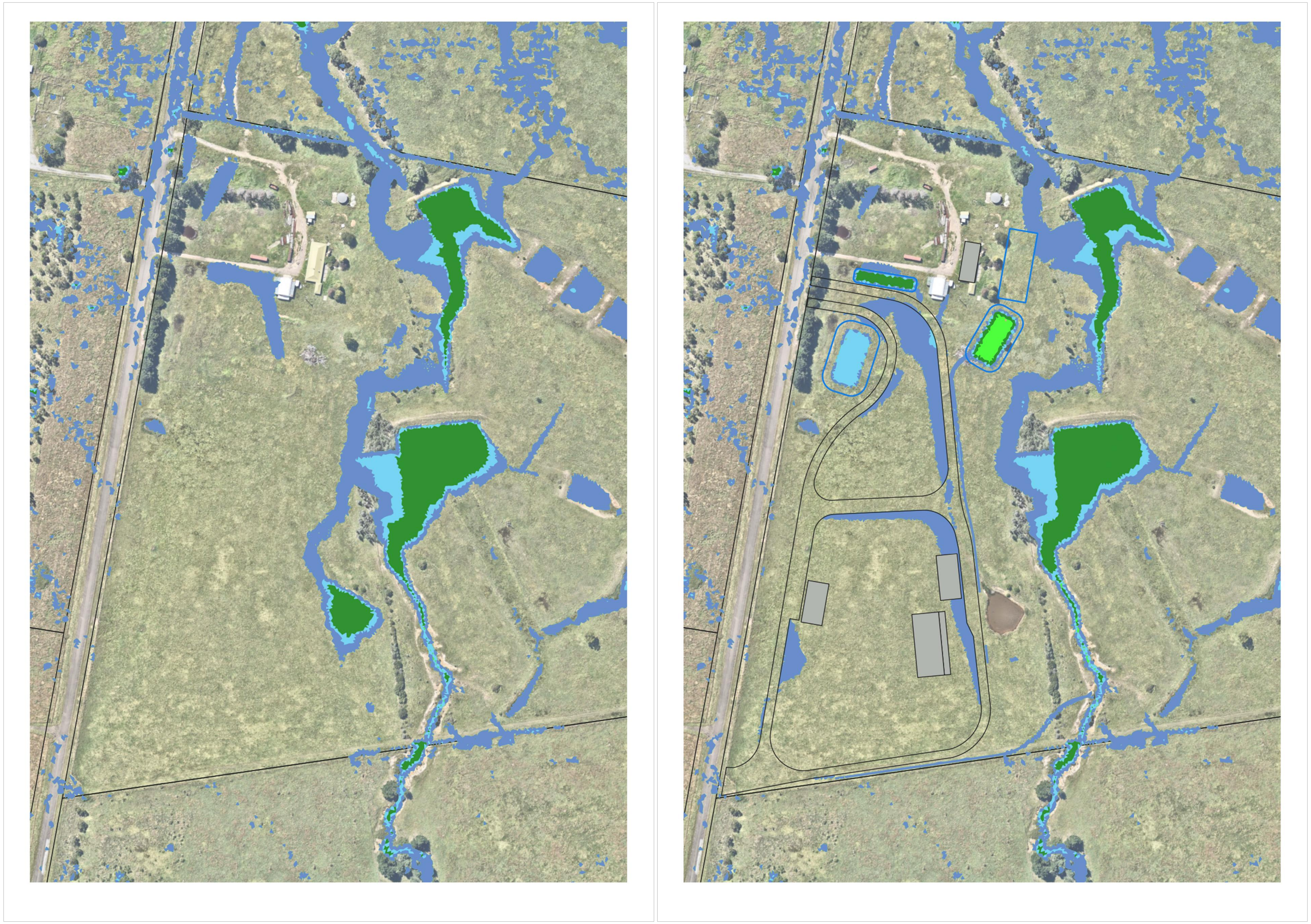

METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580

5% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT FLOOD HAZARD CATEGORY

FIGURE: A-05

Cadastral boundary

Hazard Category

H1 (Generally safe for vehicles, people & buildings)

H2 (Unsafe for small vehicles)

H3 (Unsafe for vehicles, children & the elderly)

H4 (Unsafe for vehicles & people)

H5 (Unsafe for vehicles & people. All buildings subject to structural damage)

H6 (Unsafe for vehicles & people. All building types considered vulnerable to failure)

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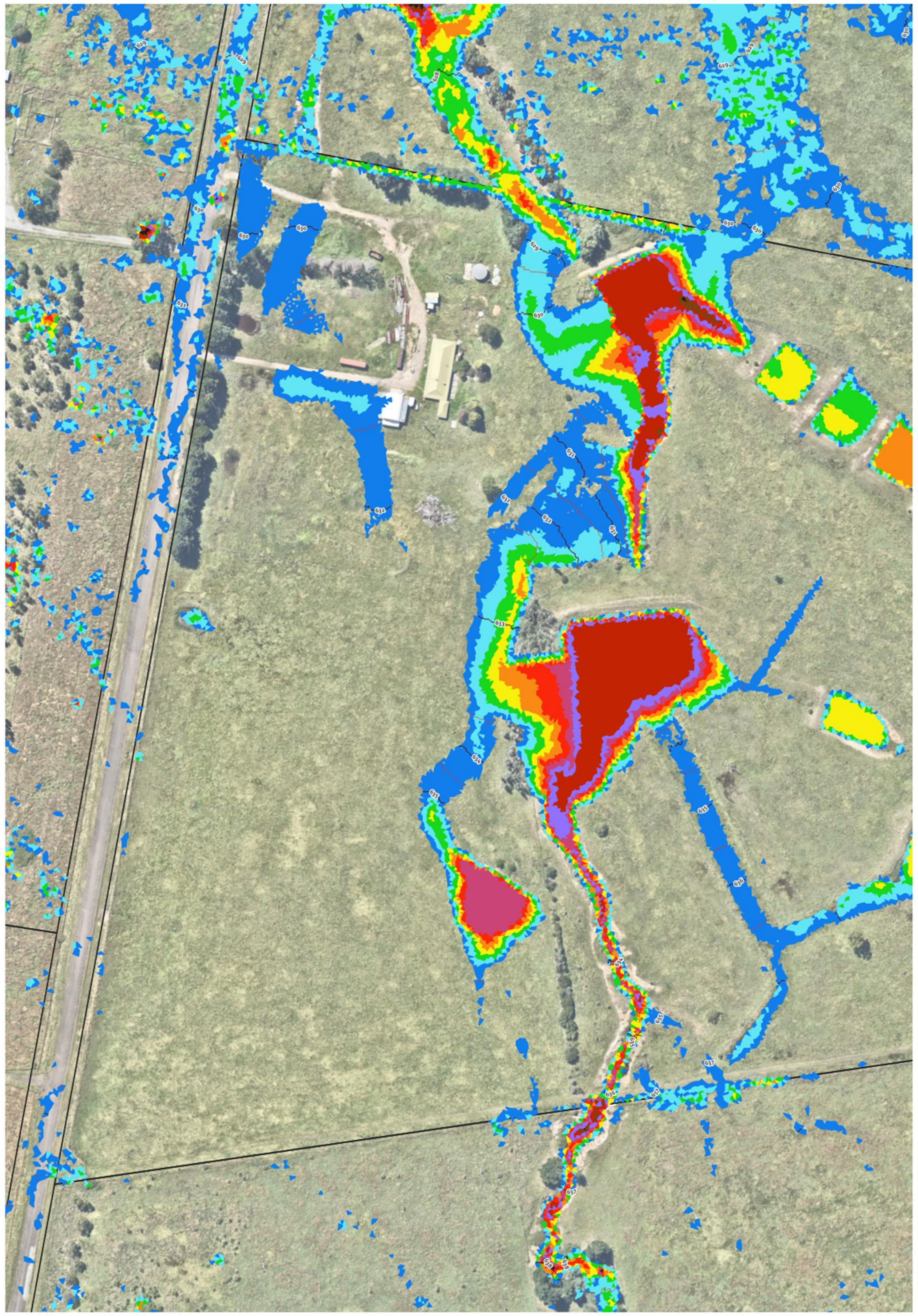

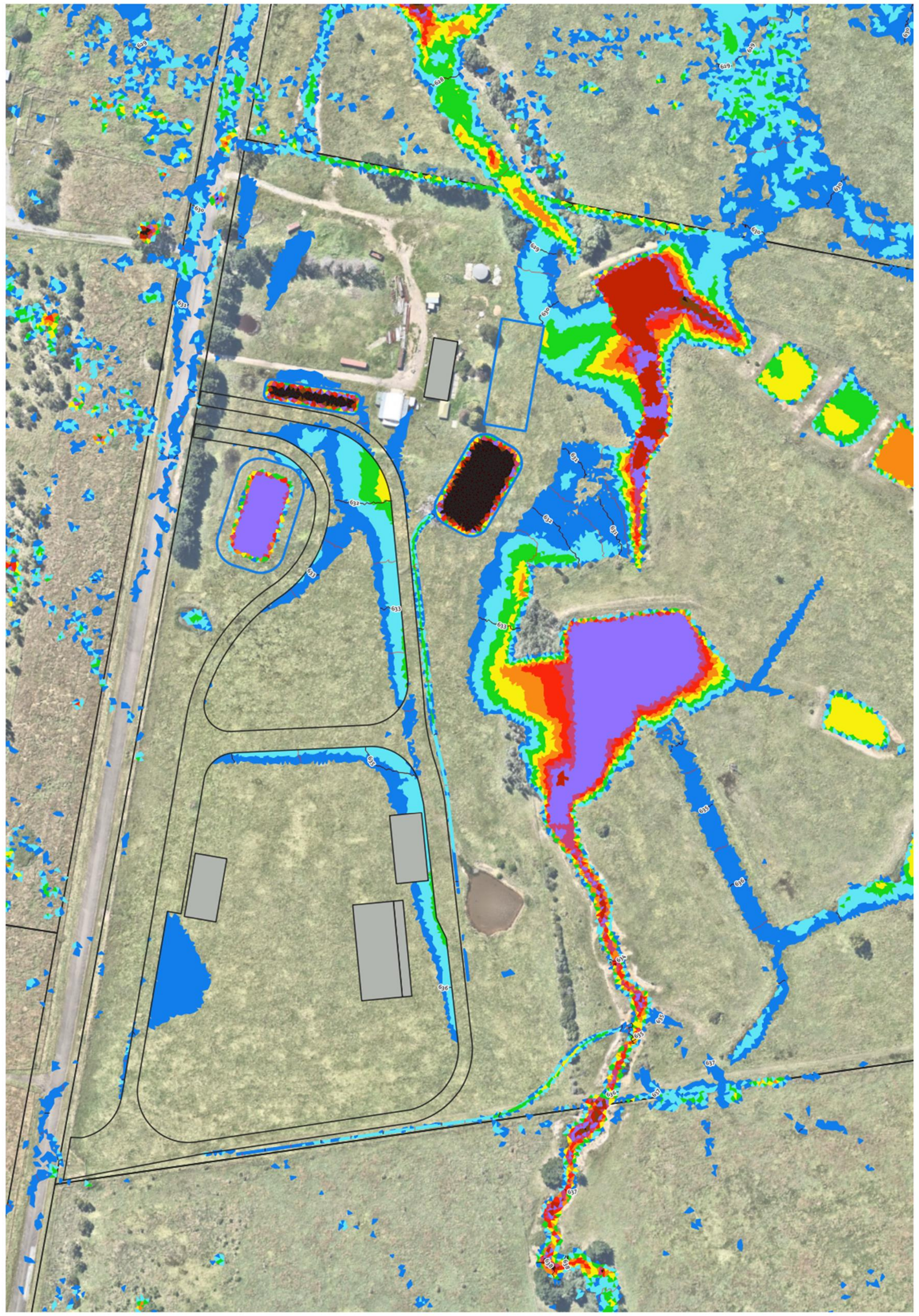

METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580

1% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT OVERLAND FLOW WATER DEPTHS & LEVELS

FIGURE: A-06

Cadastral boundary

Water Depths (m)

0.00 – 0.050
0.050 – 0.100
0.100 – 0.200
0.200 – 0.300
0.300 – 0.400
0.400 – 0.500
0.500 – 0.600
0.600 – 0.700
0.700 – 0.800
0.800 – 0.900
0.900 – 1.000
> 1.000

Major water level – 1.0m

Minor water level - 0.5m

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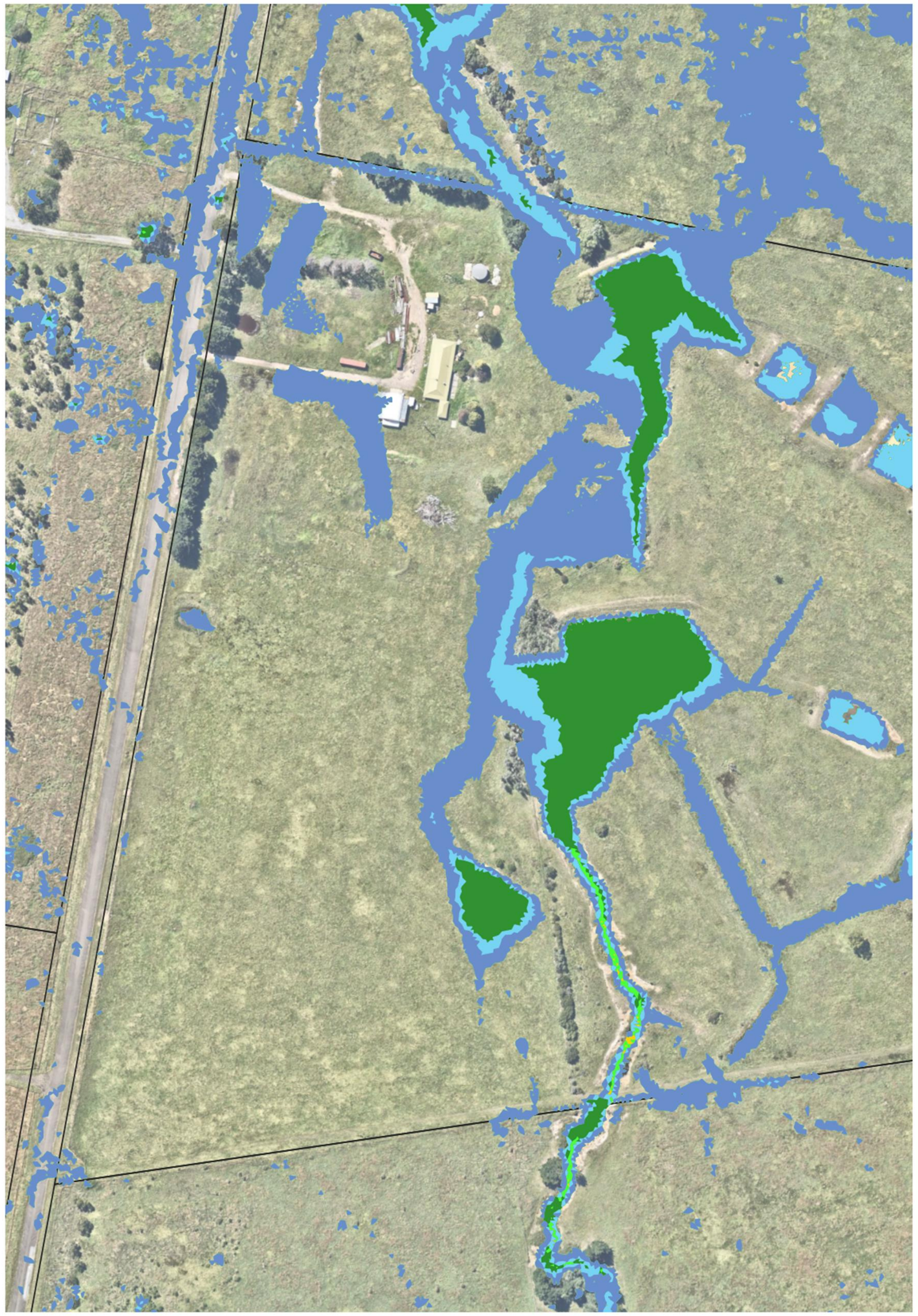

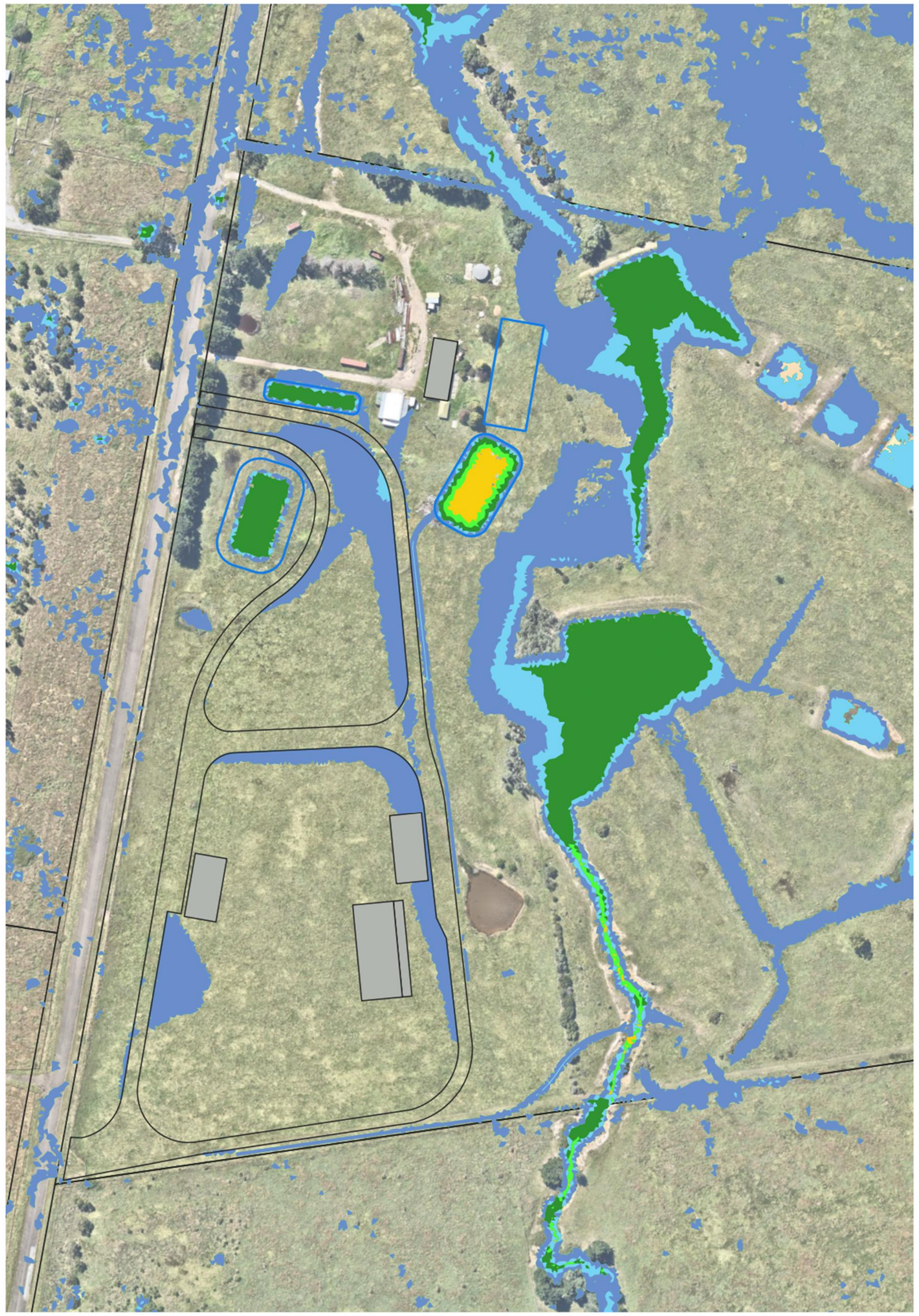

METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580

1% AEP
PRE-DEVELOPMENT & POST DEVELOPMENT FLOOD HAZARD CATEGORY

FIGURE: A-07

Cadastral boundary

Hazard Category

H1 (Generally safe for vehicles, people & buildings)

H2 (Unsafe for small vehicles)

H3 (Unsafe for vehicles, children & the elderly)

H4 (Unsafe for vehicles & people)

H5 (Unsafe for vehicles & people. All buildings subject to structural damage)

H6 (Unsafe for vehicles & people. All building types considered vulnerable to failure)

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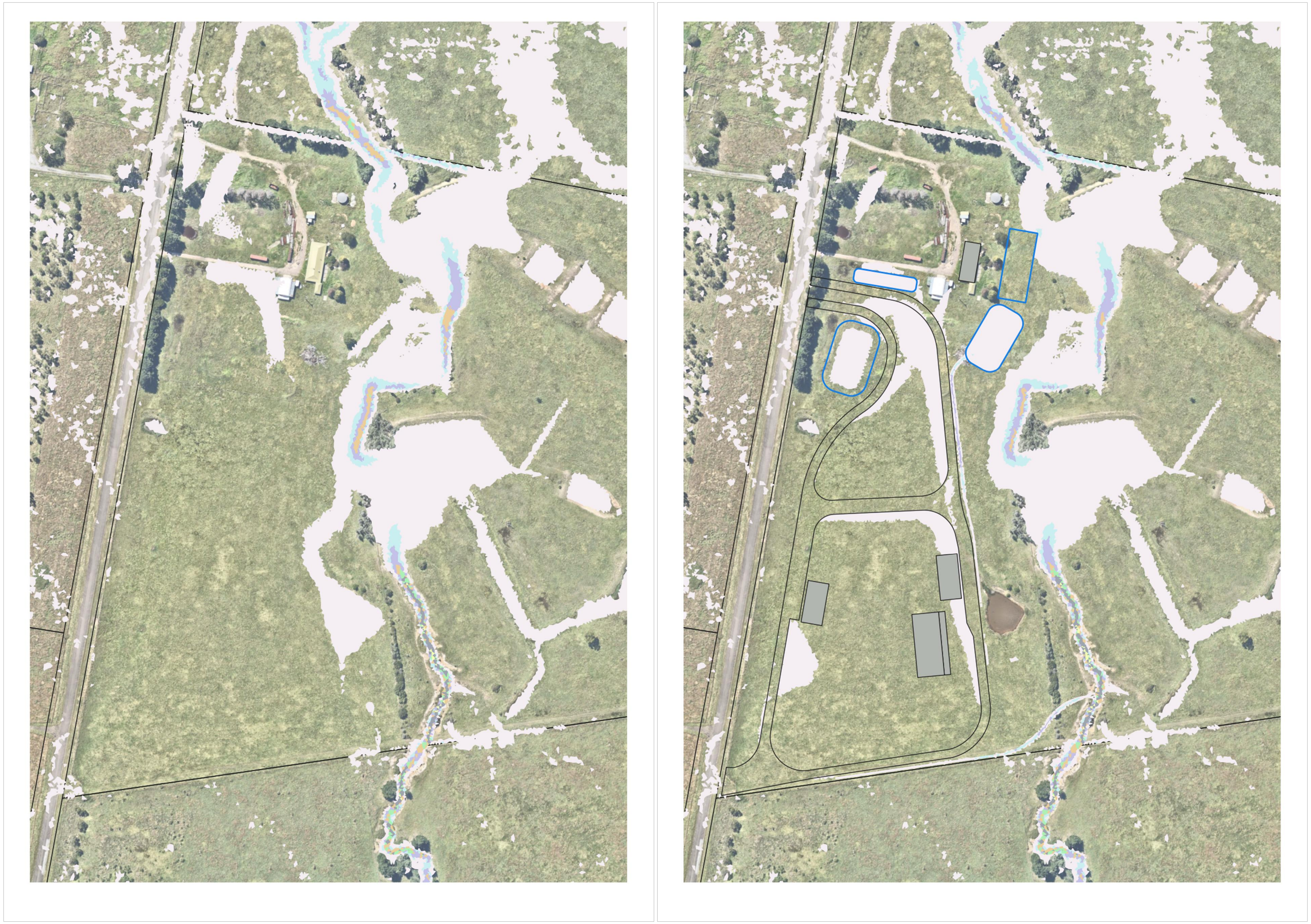

METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580

1% AEP
PRE-DEVELOPMENT &
POST-DEVELOPMENT
WATER VELOCITY x DEPTH

FIGURE: A-08

Cadastral boundary

Velocity x Depth Product

0.01 – 0.25
0.25 – 0.50
0.50 – 1.0
1.0 – 1.5
1.5 – 2.0
2.0 - 5.0

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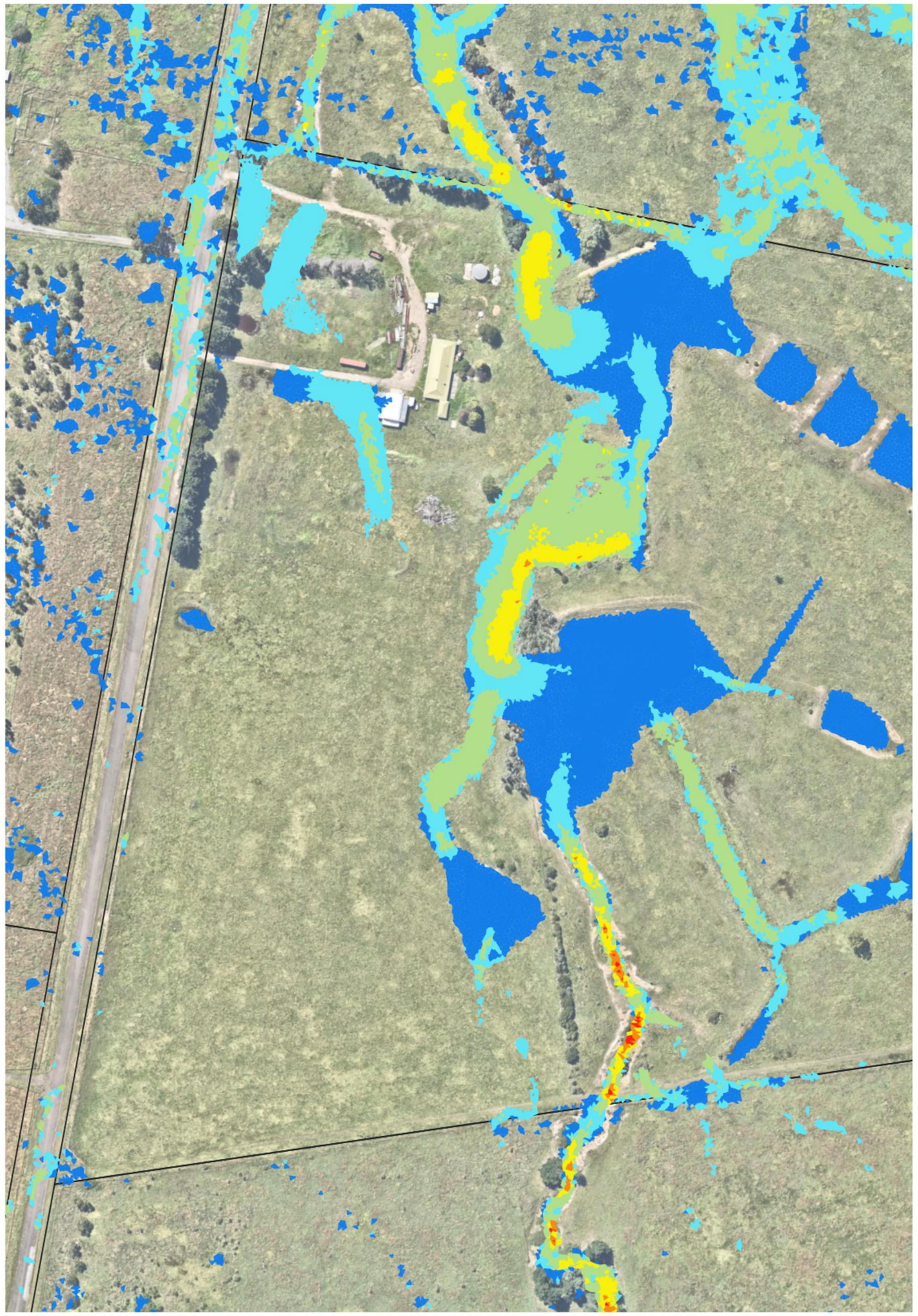

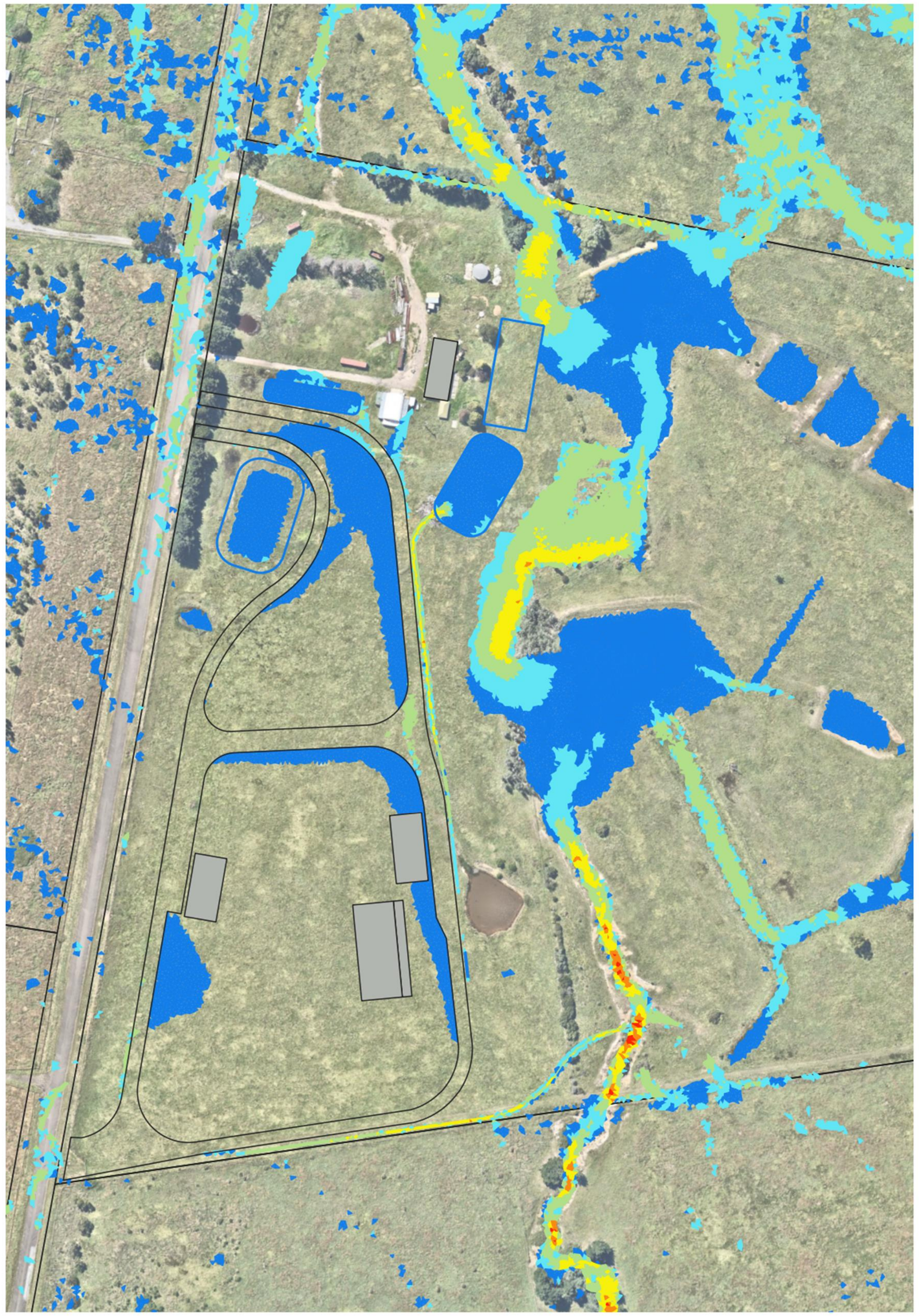

**METAL RECYCLING FACILITY
88 MURRAYS FLAT ROAD
TOWRANG. NSW. 2580**

**1% AEP
PRE-DEVELOPMENT & POST-DEVELOPMENT WATER VELOCITY (m/s)**

FIGURE: A-09

Cadastral boundary

Velocity Category

0.01 – 0.25

0.25 – 0.50

0.50 – 1.0

1.0 – 1.5

1.5 – 2.0

2.0 – 2.5

2.5 – 3.0

3.0 – 5.0

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APPENDIX B – Results Graphs for Pre and Post-Development Peak Flows

Figure	Details
B-01	10% - 25 minute
B-02	10% - 30 minute – Temporal Pattern (TP) 10- used in the flood modelling analysis
B-03	10% - 45 minute
B-04	10% - 60 minute
B-05	5% - 25 minute
B-06	5% - 30 minute
B-07	5% - 45 minute – Temporal Pattern (TP) 4 used in the flood modelling analysis
B-08	5% - 60 minute
B-09	1% - 25 minute
B-10	1% - 30 minute
B-11	1% - 45 minute
B-12	1% - 60 minute
B-13	1% - 90minute – Temporal Pattern (TP) 6 used in the flood modelling analysis
B-14	1% - 120 minute
B-15	10% AEP TP10 - Post-development model results - northern boundary
B-16	5% AEP TP10 - Post-development model results - northern boundary
B-17	1% AEP TP10 - Post-development model results - northern boundary

Simulation Plot Produced by User (5/08/2025 4:59:49 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_1 (5/08/2025 10:17:35 AM)
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Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_5 (5/08/2025 10:17:35 AM)
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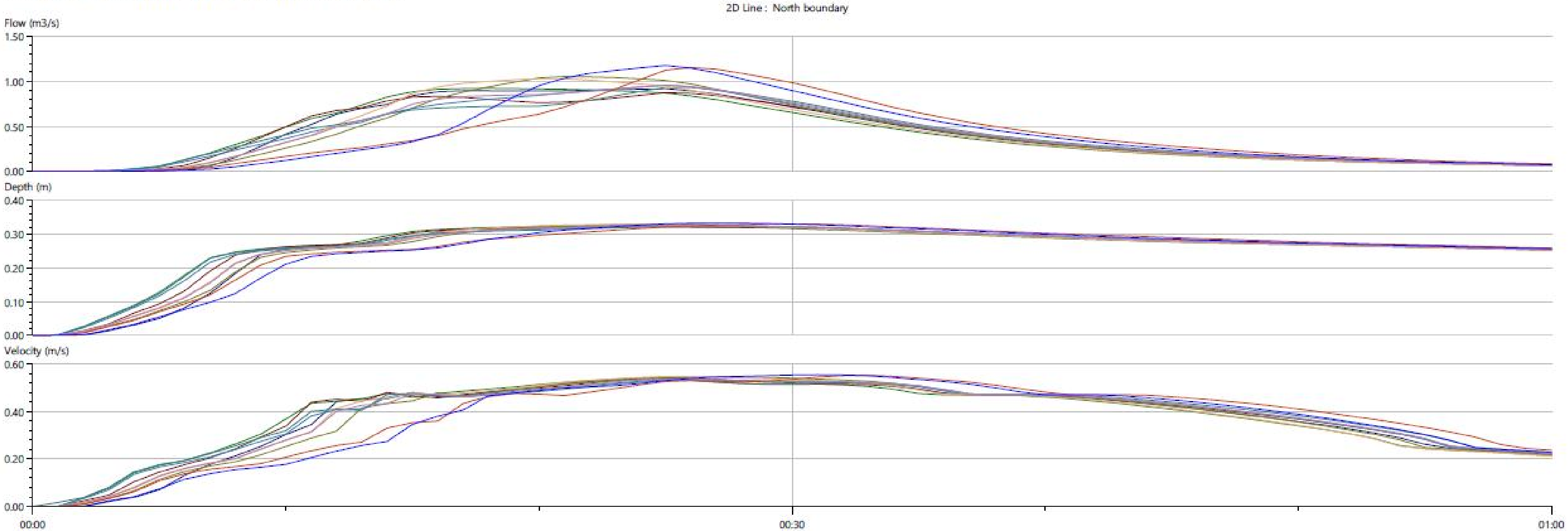
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_25min_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
... Study>60min 10% + 5%>ECS_10pct_25min_1	0.000	0.918	1498.104	0.000	0.325	0.000	0.542
... Study>60min 10% + 5%>ECS_10pct_25min_2	0.000	0.921	1499.144	0.000	0.324	0.000	0.541
... Study>60min 10% + 5%>ECS_10pct_25min_3	0.000	0.873	1491.265	0.000	0.321	0.000	0.537
... Study>60min 10% + 5%>ECS_10pct_25min_4	0.000	1.051	1501.189	0.000	0.330	0.000	0.548
... Study>60min 10% + 5%>ECS_10pct_25min_5	0.000	0.956	1491.586	0.000	0.324	0.000	0.535
... Study>60min 10% + 5%>ECS_10pct_25min_6	0.000	1.031	1503.232	0.000	0.328	0.000	0.548
... Study>60min 10% + 5%>ECS_10pct_25min_7	0.000	0.932	1486.585	0.000	0.321	0.000	0.531
... Study>60min 10% + 5%>ECS_10pct_25min_8	0.000	0.958	1492.787	0.000	0.325	0.000	0.539
... Study>60min 10% + 5%>ECS_10pct_25min_9	0.000	1.151	1484.009	0.000	0.330	0.000	0.552
...Study>60min 10% + 5%>ECS_10pct_25min_10	0.000	1.172	1494.917	0.000	0.332	0.000	0.555

Figure B-01

Simulation Plot Produced by User (5/08/2025 5:01:14 PM) Page 1 of 1
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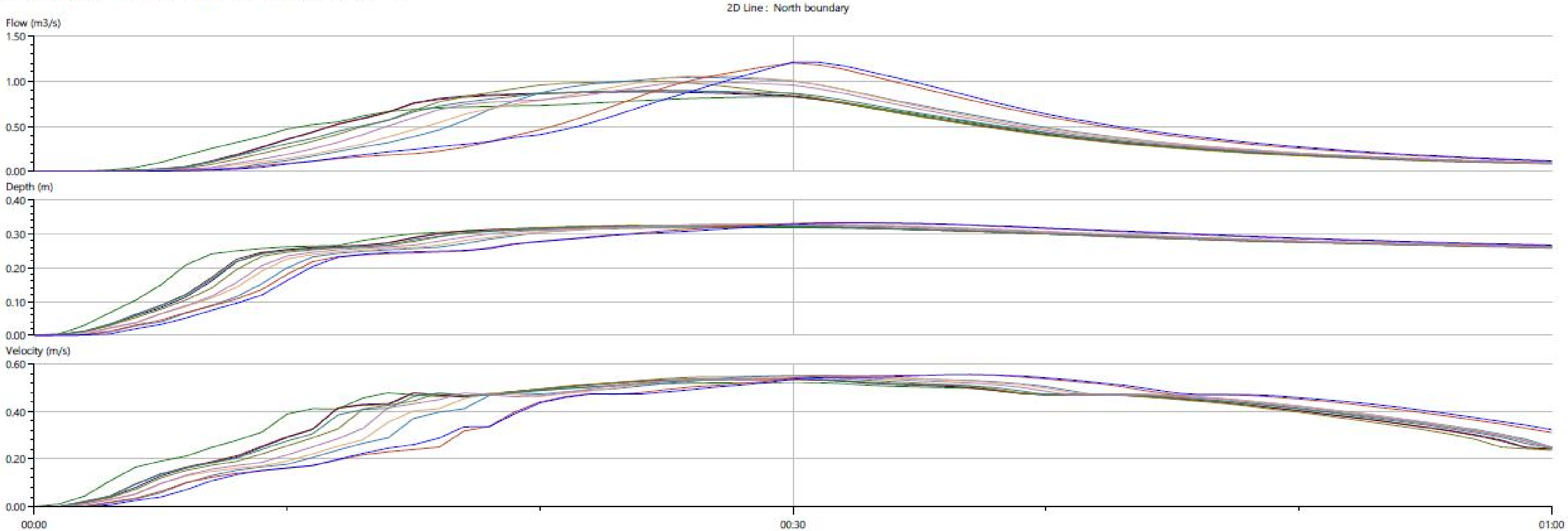
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_5 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_6 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_30min_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
... Study>60min 10% + 5%>ECS_10pct_30min_1	0.000	0.877	1591.837	0.000	0.323	0.000	0.536
... Study>60min 10% + 5%>ECS_10pct_30min_2	0.000	0.826	1583.547	0.000	0.319	0.000	0.523
... Study>60min 10% + 5%>ECS_10pct_30min_3	0.000	0.893	1592.638	0.000	0.323	0.000	0.535
... Study>60min 10% + 5%>ECS_10pct_30min_4	0.000	0.994	1598.945	0.000	0.328	0.000	0.545
... Study>60min 10% + 5%>ECS_10pct_30min_5	0.000	1.041	1590.327	0.000	0.330	0.000	0.553
... Study>60min 10% + 5%>ECS_10pct_30min_6	0.000	1.056	1591.715	0.000	0.330	0.000	0.549
... Study>60min 10% + 5%>ECS_10pct_30min_7	0.000	0.894	1588.182	0.000	0.323	0.000	0.539
... Study>60min 10% + 5%>ECS_10pct_30min_8	0.000	0.989	1591.762	0.000	0.327	0.000	0.542
... Study>60min 10% + 5%>ECS_10pct_30min_9	0.000	1.201	1577.733	0.000	0.333	0.000	0.555
...Study>60min 10% + 5%>ECS_10pct_30min_10	0.000	1.210	1573.614	0.000	0.332	0.000	0.556

Figure B-02 – Temporal Pattern (TP) 10 used in the flood modelling analysis

Simulation Plot Produced by User (5/08/2025 5:02:19 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_1 (5/08/2025 10:17:35 AM)
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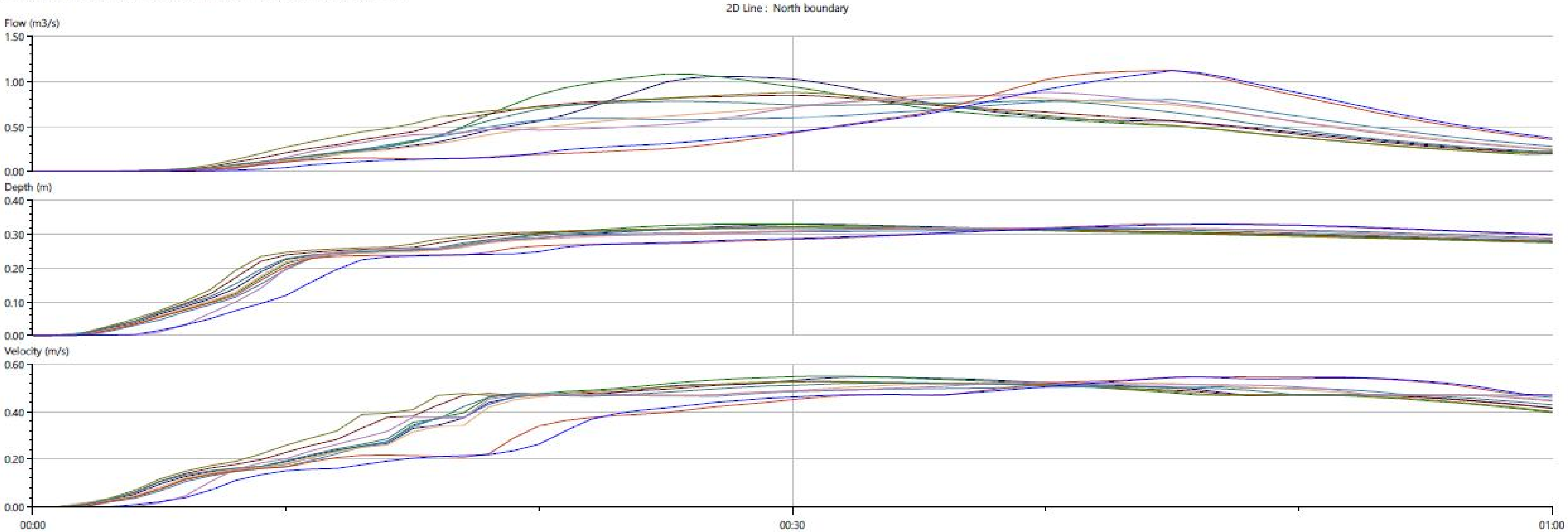
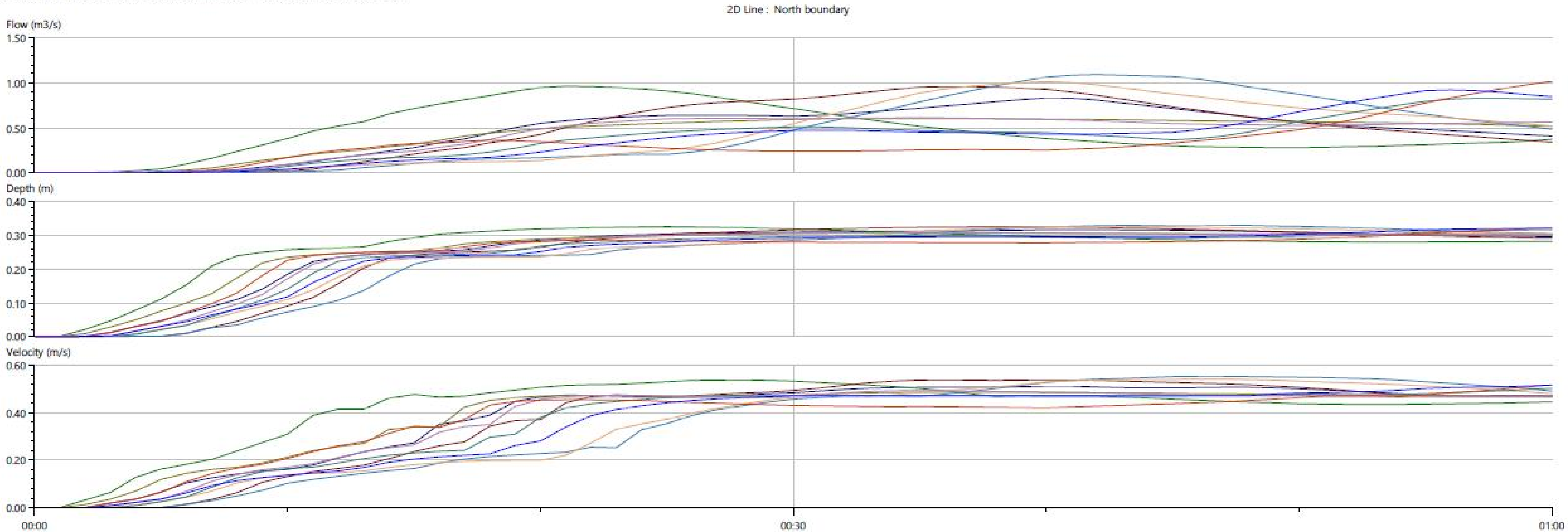
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_5 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_6 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_45min_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
... Study>60min 10% + 5%>ECS_10pct_45min_1	0.000	1.054	1733.490	0.000	0.329	0.000	0.546
... Study>60min 10% + 5%>ECS_10pct_45min_2	0.000	1.084	1755.384	0.000	0.330	0.000	0.551
... Study>60min 10% + 5%>ECS_10pct_45min_3	0.000	0.846	1743.144	0.000	0.320	0.000	0.527
... Study>60min 10% + 5%>ECS_10pct_45min_4	0.000	0.879	1758.716	0.000	0.321	0.000	0.529
... Study>60min 10% + 5%>ECS_10pct_45min_5	0.000	0.795	1679.931	0.000	0.316	0.000	0.508
... Study>60min 10% + 5%>ECS_10pct_45min_6	0.000	0.849	1700.717	0.000	0.319	0.000	0.521
... Study>60min 10% + 5%>ECS_10pct_45min_7	0.000	0.788	1733.195	0.000	0.317	0.000	0.522
... Study>60min 10% + 5%>ECS_10pct_45min_8	0.000	0.878	1715.250	0.000	0.319	0.000	0.525
... Study>60min 10% + 5%>ECS_10pct_45min_9	0.000	1.123	1641.329	0.000	0.331	0.000	0.550
...Study>60min 10% + 5%>ECS_10pct_45min_10	0.000	1.119	1627.767	0.000	0.329	0.000	0.546

Figure B-03

Simulation Plot Produced by User (5/08/2025 5:03:31 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_1 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_2 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_5 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_6 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_10pct_1hr_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...od Study>60min 10% + 5%>ECS_10pct_1hr_1	0.000	0.833	1709.933	0.000	0.316	0.000	0.512
...od Study>60min 10% + 5%>ECS_10pct_1hr_2	0.000	0.962	1701.212	0.000	0.325	0.000	0.538
...od Study>60min 10% + 5%>ECS_10pct_1hr_3	0.000	0.958	1796.490	0.000	0.325	0.000	0.539
...od Study>60min 10% + 5%>ECS_10pct_1hr_4	0.000	0.604	1590.319	0.000	0.306	0.000	0.487
...od Study>60min 10% + 5%>ECS_10pct_1hr_5	0.000	1.089	1693.904	0.000	0.331	0.000	0.554
...od Study>60min 10% + 5%>ECS_10pct_1hr_6	0.000	1.013	1640.599	0.000	0.327	0.000	0.541
...od Study>60min 10% + 5%>ECS_10pct_1hr_7	0.000	0.827	1371.324	0.000	0.317	0.000	0.503
...od Study>60min 10% + 5%>ECS_10pct_1hr_8	0.000	0.612	1538.036	0.000	0.308	0.000	0.493
...od Study>60min 10% + 5%>ECS_10pct_1hr_9	0.000	1.015	1179.561	0.000	0.322	0.000	0.518
...d Study>60min 10% + 5%>ECS_10pct_1hr_10	0.000	0.920	1387.242	0.000	0.321	0.000	0.517

Figure B-04

Simulation Plot Produced by User (5/08/2025 5:04:36 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_1 (5/08/2025 10:17:35 AM)
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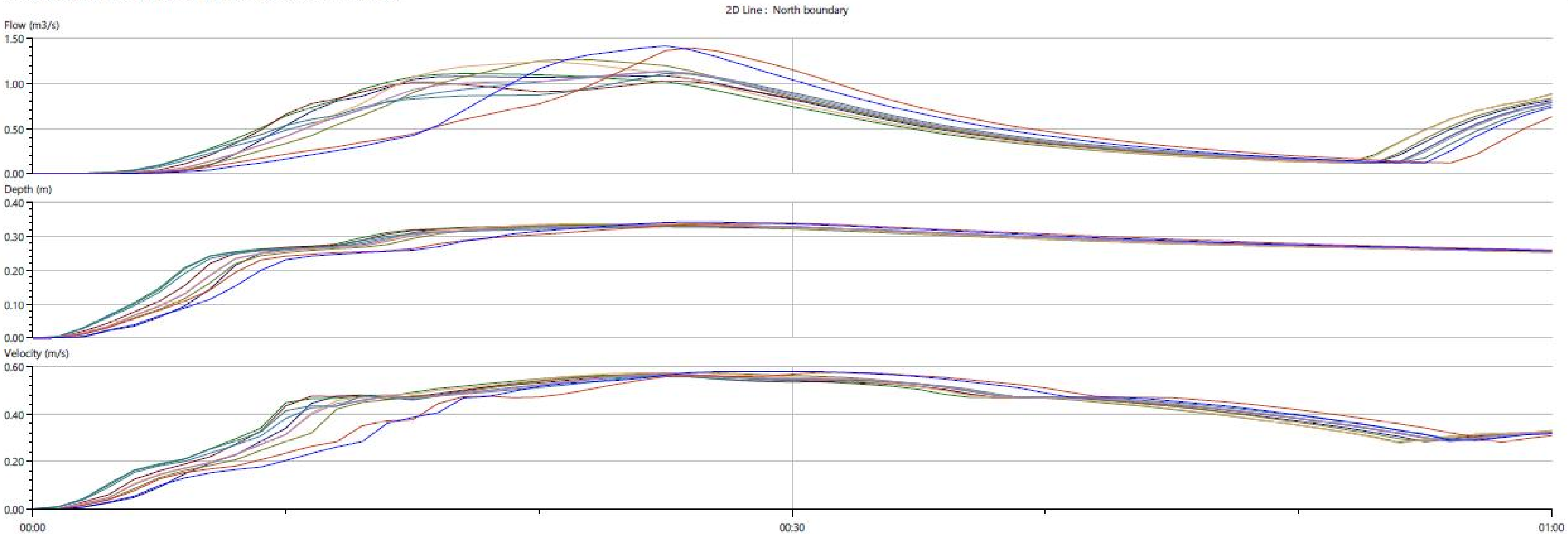
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_5 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_6 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_25min_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...d Study>60min 10% + 5%>ECS_5pct_25min_1	0.000	1.084	1938.263	0.000	0.333	0.000	0.569
...d Study>60min 10% + 5%>ECS_5pct_25min_2	0.000	1.109	1984.266	0.000	0.333	0.000	0.566
...d Study>60min 10% + 5%>ECS_5pct_25min_3	0.000	1.031	1906.114	0.000	0.329	0.000	0.562
...d Study>60min 10% + 5%>ECS_5pct_25min_4	0.000	1.265	1952.839	0.000	0.338	0.000	0.577
...d Study>60min 10% + 5%>ECS_5pct_25min_5	0.000	1.133	1906.744	0.000	0.333	0.000	0.563
...d Study>60min 10% + 5%>ECS_5pct_25min_6	0.000	1.240	1987.467	0.000	0.337	0.000	0.576
...d Study>60min 10% + 5%>ECS_5pct_25min_7	0.000	1.108	1875.351	0.000	0.329	0.000	0.558
...d Study>60min 10% + 5%>ECS_5pct_25min_8	0.000	1.135	1900.286	0.000	0.333	0.000	0.568
...d Study>60min 10% + 5%>ECS_5pct_25min_9	0.000	1.393	1811.219	0.000	0.339	0.000	0.577
... Study>60min 10% + 5%>ECS_5pct_25min_10	0.000	1.414	1868.041	0.000	0.342	0.000	0.580

Figure B-05

Simulation Plot Produced by User (5/08/2025 5:05:36 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_1 (5/08/2025 10:17:35 AM)
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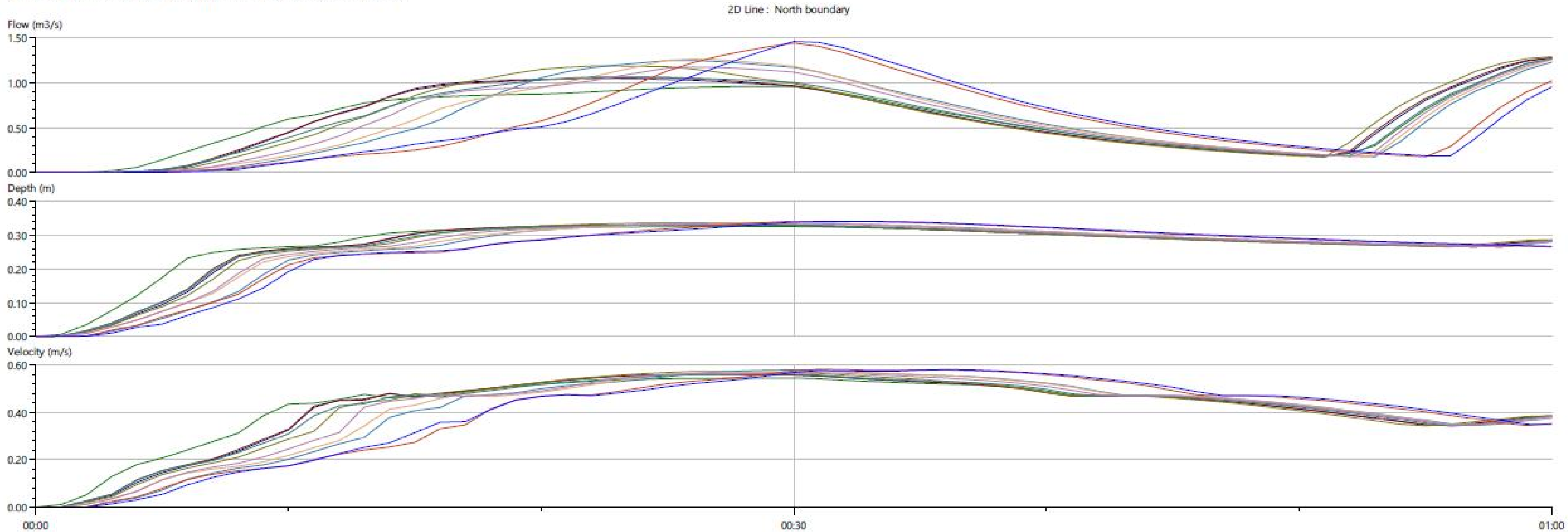
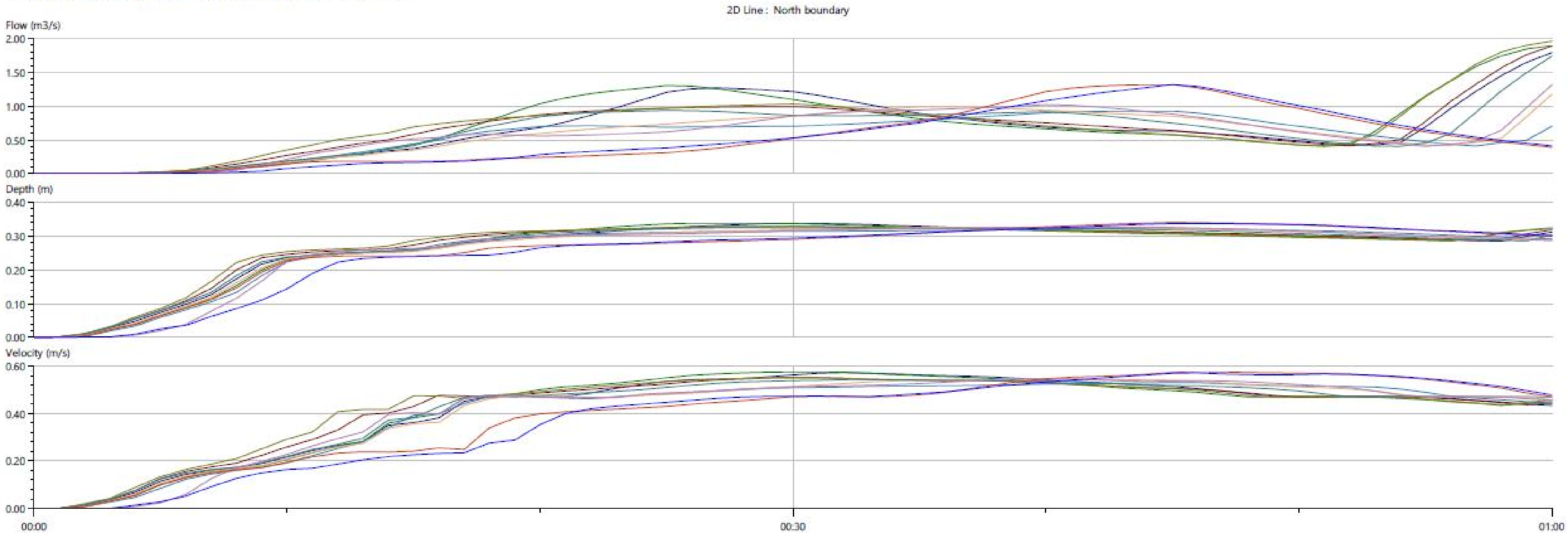
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_5 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_6 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_30min_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...d Study>60min 10% + 5%>ECS_5pct_30min_1	0.000	1.273	2229.892	0.000	0.331	0.000	0.560
...d Study>60min 10% + 5%>ECS_5pct_30min_2	0.000	1.261	2182.121	0.000	0.326	0.000	0.546
...d Study>60min 10% + 5%>ECS_5pct_30min_3	0.000	1.278	2241.354	0.000	0.331	0.000	0.561
...d Study>60min 10% + 5%>ECS_5pct_30min_4	0.000	1.288	2283.471	0.000	0.336	0.000	0.572
...d Study>60min 10% + 5%>ECS_5pct_30min_5	0.000	1.245	2140.612	0.000	0.338	0.000	0.580
...d Study>60min 10% + 5%>ECS_5pct_30min_6	0.000	1.264	2160.501	0.000	0.338	0.000	0.576
...d Study>60min 10% + 5%>ECS_5pct_30min_7	0.000	1.264	2193.392	0.000	0.332	0.000	0.562
...d Study>60min 10% + 5%>ECS_5pct_30min_8	0.000	1.264	2176.049	0.000	0.335	0.000	0.568
...d Study>60min 10% + 5%>ECS_5pct_30min_9	0.000	1.440	1995.020	0.000	0.342	0.000	0.582
... Study>60min 10% + 5%>ECS_5pct_30min_10	0.000	1.457	1960.248	0.000	0.341	0.000	0.580

Figure B-06

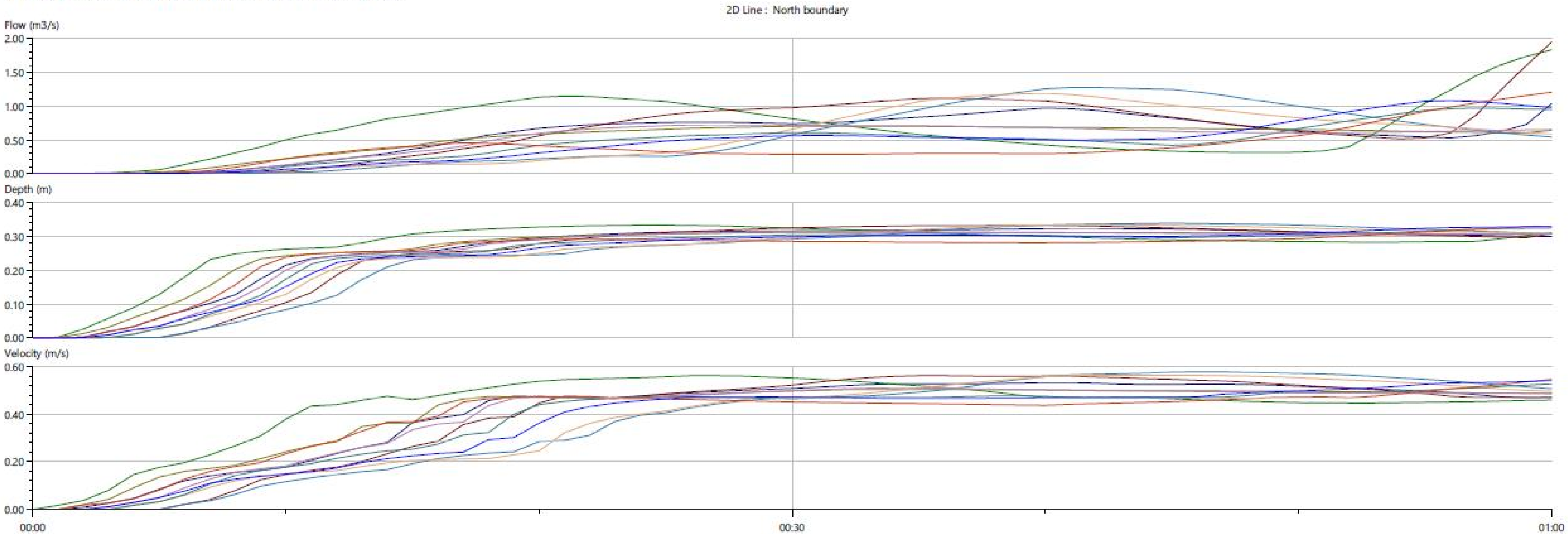
Simulation Plot Produced by User (5/08/2025 5:06:34 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_1 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_2 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_5 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_6 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_7 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_8 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_9 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_45min_10 (5/08/2025 10:17:35 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...d Study>60min 10% + 5%>ECS_5pct_45min_1	0.000	1.791	2360.929	0.000	0.338	0.000	0.572
...d Study>60min 10% + 5%>ECS_5pct_45min_2	0.000	1.894	2548.792	0.000	0.338	0.000	0.576
...d Study>60min 10% + 5%>ECS_5pct_45min_3	0.000	1.886	2416.503	0.000	0.328	0.000	0.551
...d Study>60min 10% + 5%>ECS_5pct_45min_4	0.000	1.956	2558.793	0.000	0.329	0.000	0.553
...d Study>60min 10% + 5%>ECS_5pct_45min_5	0.000	0.925	2004.678	0.000	0.323	0.000	0.531
...d Study>60min 10% + 5%>ECS_5pct_45min_6	0.000	1.172	2078.365	0.000	0.325	0.000	0.543
...d Study>60min 10% + 5%>ECS_5pct_45min_7	0.000	1.736	2271.607	0.000	0.324	0.000	0.544
...d Study>60min 10% + 5%>ECS_5pct_45min_8	0.000	1.312	2122.668	0.000	0.326	0.000	0.547
...d Study>60min 10% + 5%>ECS_5pct_45min_9	0.000	1.318	1938.645	0.000	0.339	0.000	0.576
... Study>60min 10% + 5%>ECS_5pct_45min_10	0.000	1.314	1923.129	0.000	0.337	0.000	0.572

Figure B-07 – Temporal Pattern (TP) 4 used in the flood modelling analysis

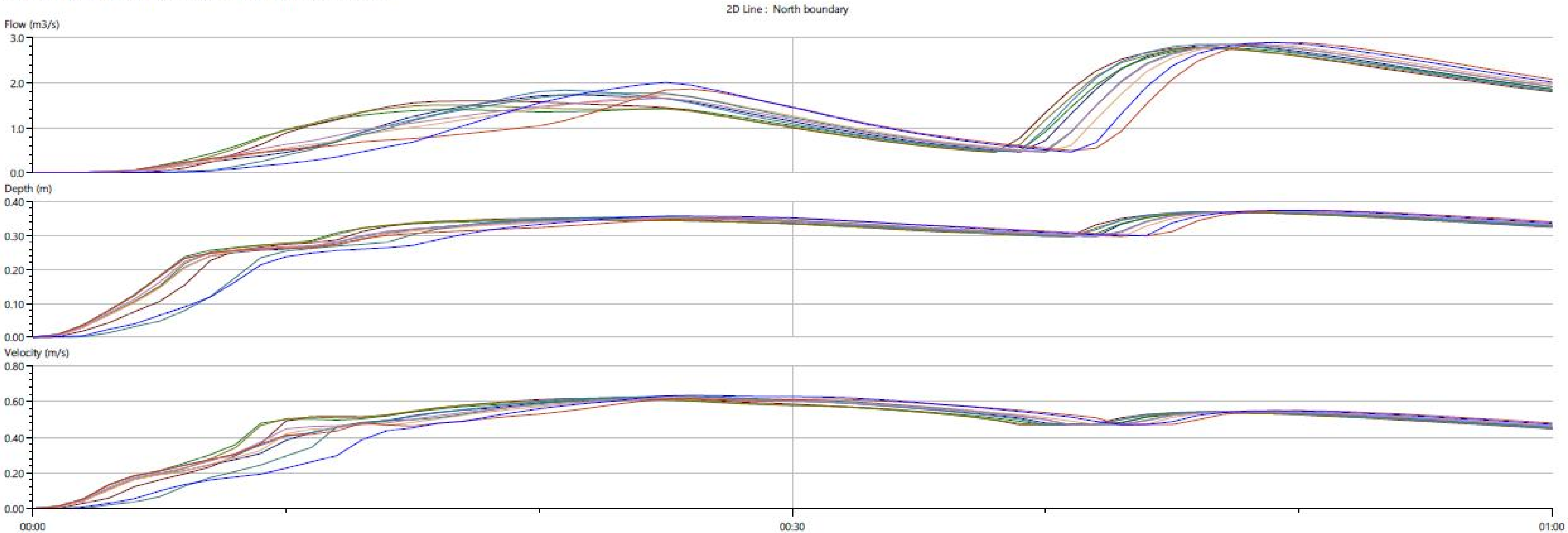
Simulation Plot Produced by User (5/08/2025 5:07:39 PM) Page 1 of 1
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_1 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_2 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_3 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_4 (5/08/2025 10:17:35 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_5 (5/08/2025 10:17:36 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_6 (5/08/2025 10:17:36 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_7 (5/08/2025 10:17:36 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_8 (5/08/2025 10:17:36 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_9 (5/08/2025 10:17:36 AM)
Sim: >Flood Study>60min 10% + 5%>ECS_5pct_1hr_10 (5/08/2025 10:17:36 AM)
Results analysis: >Flood Study>60min 10% + 5% (5/08/2025 4:59:09 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...lood Study>60min 10% + 5%>ECS_5pct_1hr_1	0.000	1.036	2045.173	0.000	0.323	0.000	0.534
...lood Study>60min 10% + 5%>ECS_5pct_1hr_2	0.000	1.826	2383.786	0.000	0.333	0.000	0.562
...lood Study>60min 10% + 5%>ECS_5pct_1hr_3	0.000	1.942	2301.499	0.000	0.332	0.000	0.562
...lood Study>60min 10% + 5%>ECS_5pct_1hr_4	0.000	0.700	1867.183	0.000	0.312	0.000	0.504
...lood Study>60min 10% + 5%>ECS_5pct_1hr_5	0.000	1.273	1988.581	0.000	0.339	0.000	0.578
...lood Study>60min 10% + 5%>ECS_5pct_1hr_6	0.000	1.187	1924.979	0.000	0.334	0.000	0.564
...lood Study>60min 10% + 5%>ECS_5pct_1hr_7	0.000	0.965	1621.951	0.000	0.324	0.000	0.527
...lood Study>60min 10% + 5%>ECS_5pct_1hr_8	0.000	0.721	1805.022	0.000	0.314	0.000	0.512
...lood Study>60min 10% + 5%>ECS_5pct_1hr_9	0.000	1.200	1404.615	0.000	0.331	0.000	0.547
...od Study>60min 10% + 5%>ECS_5pct_1hr_10	0.000	1.077	1643.022	0.000	0.328	0.000	0.541

Figure B-08

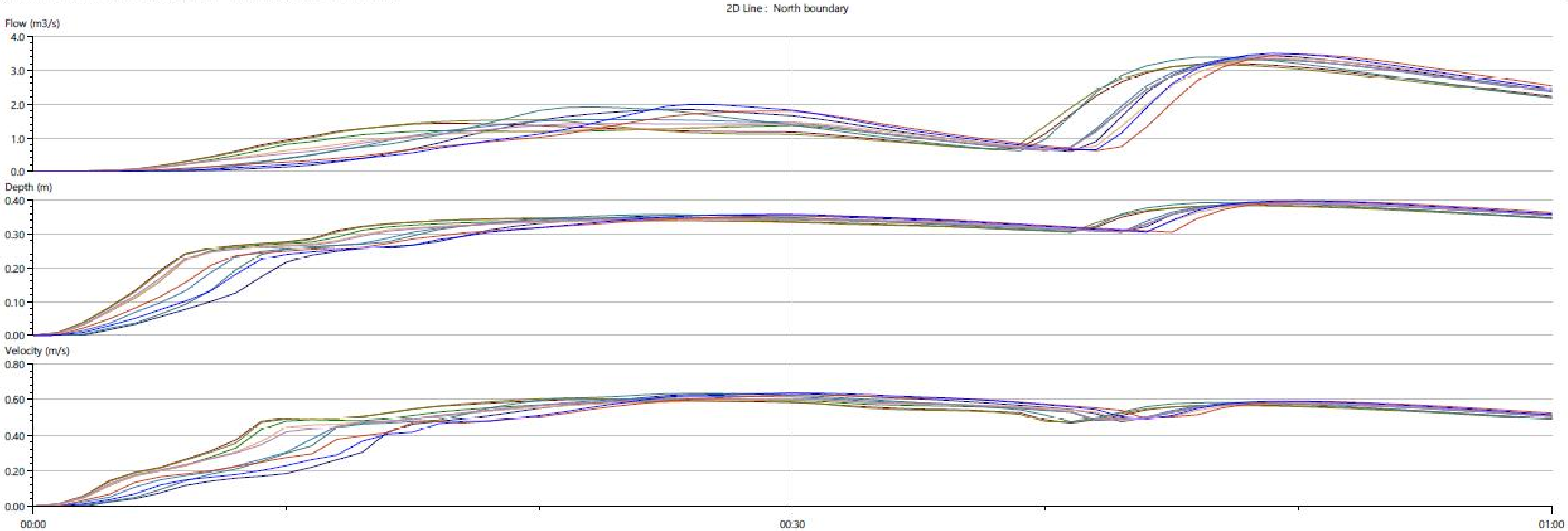
Simulation Plot Produced by User (31/07/2025 8:36:54 PM) Page 1 of 1
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_1 (31/07/2025 6:08:33 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_2 (31/07/2025 6:08:33 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_3 (31/07/2025 6:08:33 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_4 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_5 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_6 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_7 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_8 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_9 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_25min_10 (31/07/2025 6:08:34 PM)
Results analysis: >Flood Study>1% 25 - 45 min (31/07/2025 8:35:53 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
... Study>1% AEP 25-45min>ECS_1pct_25min_1	0.000	2.839	4942.725	0.000	0.372	0.000	0.627
... Study>1% AEP 25-45min>ECS_1pct_25min_2	0.000	2.774	4933.804	0.000	0.369	0.000	0.609
... Study>1% AEP 25-45min>ECS_1pct_25min_3	0.000	2.781	5022.904	0.000	0.369	0.000	0.619
... Study>1% AEP 25-45min>ECS_1pct_25min_4	0.000	2.766	4980.146	0.000	0.368	0.000	0.613
... Study>1% AEP 25-45min>ECS_1pct_25min_5	0.000	2.852	5002.423	0.000	0.373	0.000	0.628
... Study>1% AEP 25-45min>ECS_1pct_25min_6	0.000	2.860	4816.635	0.000	0.373	0.000	0.621
... Study>1% AEP 25-45min>ECS_1pct_25min_7	0.000	2.847	4880.127	0.000	0.373	0.000	0.630
... Study>1% AEP 25-45min>ECS_1pct_25min_8	0.000	2.837	4868.498	0.000	0.372	0.000	0.619
... Study>1% AEP 25-45min>ECS_1pct_25min_9	0.000	2.902	4672.405	0.000	0.375	0.000	0.617
...Study>1% AEP 25-45min>ECS_1pct_25min_10	0.000	2.895	4750.672	0.000	0.375	0.000	0.635

Figure B-09

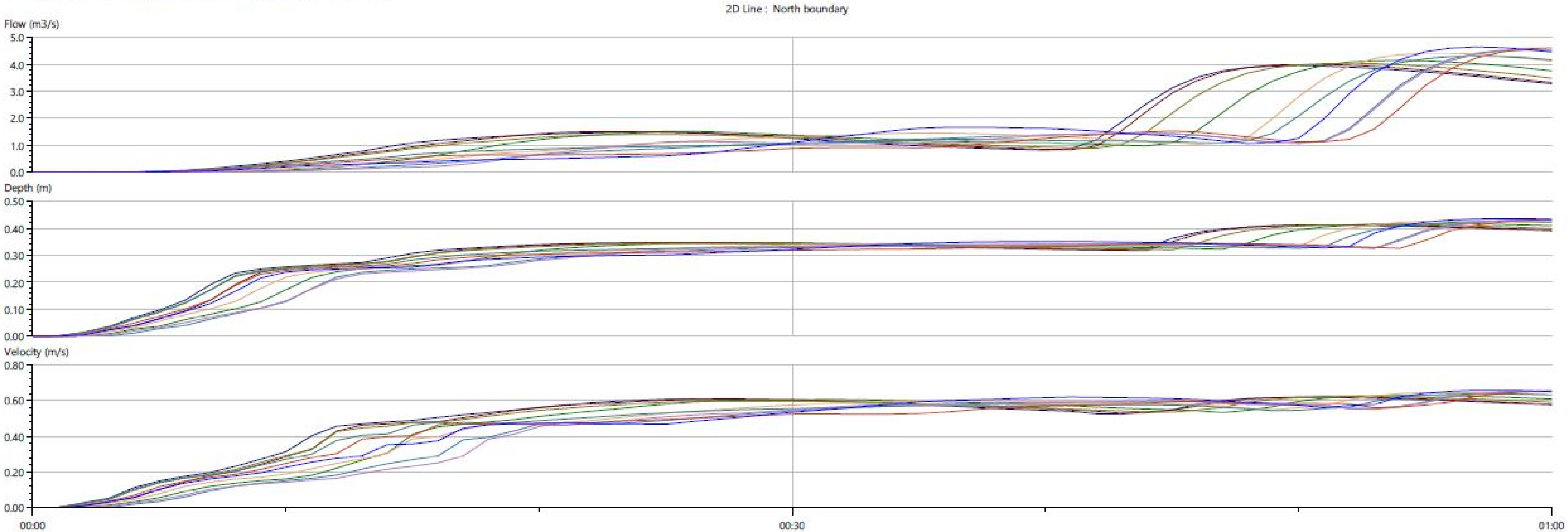
Simulation Plot Produced by User (31/07/2025 8:39:01 PM) Page 1 of 1
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_1 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_2 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_3 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_4 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_5 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_6 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_7 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_8 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_9 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_30min_10 (31/07/2025 6:08:34 PM)
Results analysis: >Flood Study>1% 25 - 45 min (31/07/2025 8:35:53 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
... Study>1% AEP 25-45min>ECS_1pct_30min_1	0.000	3.427	5335.691	0.000	0.395	0.000	0.634
... Study>1% AEP 25-45min>ECS_1pct_30min_2	0.000	3.308	5308.337	0.000	0.390	0.000	0.594
... Study>1% AEP 25-45min>ECS_1pct_30min_3	0.000	3.204	5478.472	0.000	0.385	0.000	0.599
... Study>1% AEP 25-45min>ECS_1pct_30min_4	0.000	3.162	5496.614	0.000	0.384	0.000	0.607
... Study>1% AEP 25-45min>ECS_1pct_30min_5	0.000	3.348	5350.079	0.000	0.392	0.000	0.617
... Study>1% AEP 25-45min>ECS_1pct_30min_6	0.000	3.348	5218.883	0.000	0.392	0.000	0.601
... Study>1% AEP 25-45min>ECS_1pct_30min_7	0.000	3.392	5588.632	0.000	0.394	0.000	0.635
... Study>1% AEP 25-45min>ECS_1pct_30min_8	0.000	3.330	5317.270	0.000	0.391	0.000	0.606
... Study>1% AEP 25-45min>ECS_1pct_30min_9	0.000	3.478	5153.493	0.000	0.397	0.000	0.627
...Study>1% AEP 25-45min>ECS_1pct_30min_10	0.000	3.500	5284.269	0.000	0.398	0.000	0.637

Figure B-10

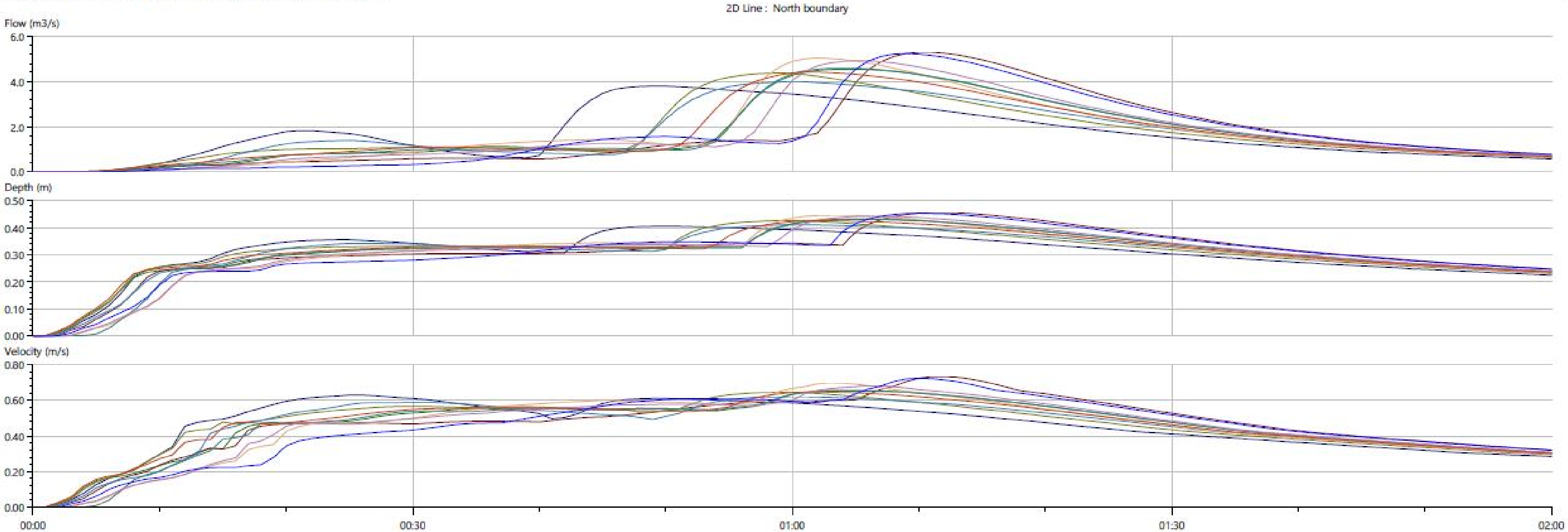
Simulation Plot Produced by User (31/07/2025 8:40:15 PM) Page 1 of 1
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_1 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_2 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_3 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_4 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_5 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_6 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_7 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_8 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_9 (31/07/2025 6:08:34 PM)
Sim: >Flood Study>1% AEP 25-45min>ECS_1pct_45min_10 (31/07/2025 6:08:34 PM)
Results analysis: >Flood Study>1% 25 - 45 min (31/07/2025 8:35:53 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
... Study>1% AEP 25-45min>ECS_1pct_45min_1	0.000	3.944	5946.314	0.000	0.411	0.000	0.618
... Study>1% AEP 25-45min>ECS_1pct_45min_2	0.000	4.144	5382.779	0.000	0.418	0.000	0.630
... Study>1% AEP 25-45min>ECS_1pct_45min_3	0.000	3.996	5903.171	0.000	0.412	0.000	0.621
... Study>1% AEP 25-45min>ECS_1pct_45min_4	0.000	4.034	5711.788	0.000	0.414	0.000	0.624
... Study>1% AEP 25-45min>ECS_1pct_45min_5	0.000	4.536	4211.409	0.000	0.432	0.000	0.652
... Study>1% AEP 25-45min>ECS_1pct_45min_6	0.000	4.413	5042.646	0.000	0.428	0.000	0.646
... Study>1% AEP 25-45min>ECS_1pct_45min_7	0.000	4.303	4727.152	0.000	0.424	0.000	0.639
... Study>1% AEP 25-45min>ECS_1pct_45min_8	0.000	4.524	4180.449	0.000	0.432	0.000	0.652
... Study>1% AEP 25-45min>ECS_1pct_45min_9	0.000	4.601	3954.028	0.000	0.433	0.000	0.656
...Study>1% AEP 25-45min>ECS_1pct_45min_10	0.000	4.637	4673.773	0.000	0.436	0.000	0.658

Figure B-11

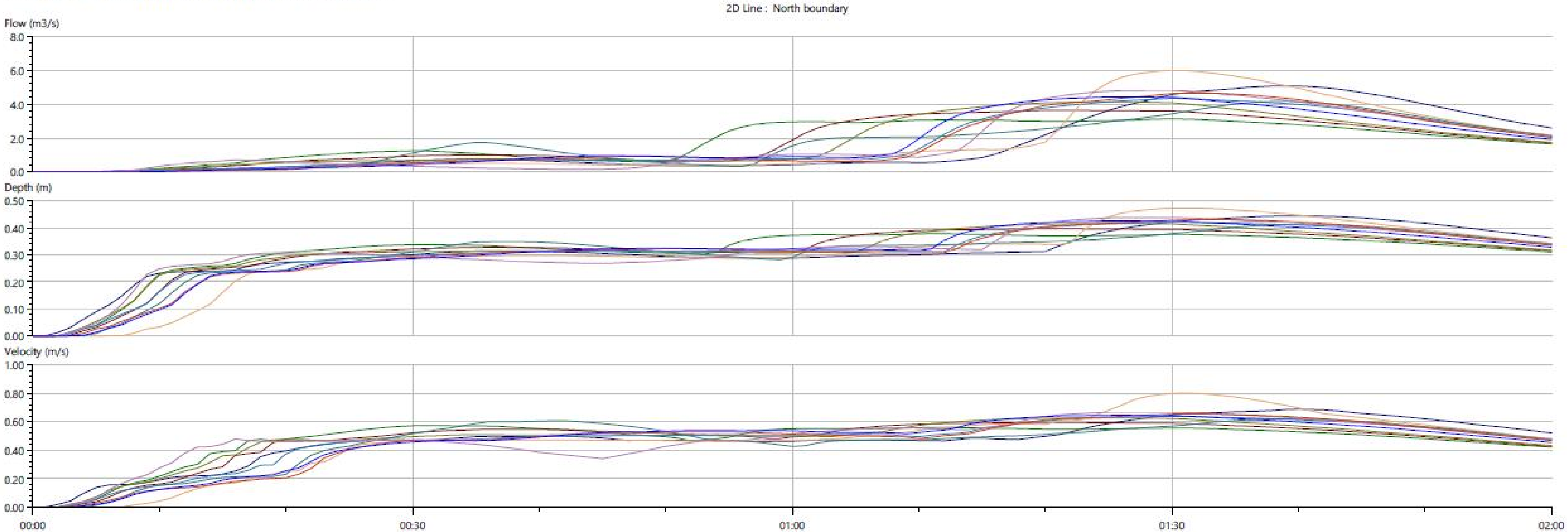
Simulation Plot Produced by User (1/08/2025 12:27:25 PM) Page 1 of 1
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_1 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_2 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_3 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_4 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_5 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_6 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_7 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_8 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_9 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1hr_10 (1/08/2025 8:56:21 AM)
Results analysis: >Flood Study>1% 60-90min (1/08/2025 12:26:31 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_1	0.000	3.810	12317.616	0.000	0.406	0.000	0.629
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_2	0.000	4.548	12092.026	0.000	0.430	0.000	0.653
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_3	0.000	5.301	11927.990	0.000	0.455	0.000	0.733
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_4	0.000	4.371	12205.758	0.000	0.426	0.000	0.645
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_5	0.000	3.999	12163.428	0.000	0.411	0.000	0.621
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_6	0.000	5.047	12130.939	0.000	0.447	0.000	0.698
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_7	0.000	4.599	12101.419	0.000	0.432	0.000	0.657
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_8	0.000	4.926	12057.378	0.000	0.443	0.000	0.681
...ood Study>1% AEP 60-90min>ECS_1pct_1hr_9	0.000	4.418	12134.990	0.000	0.426	0.000	0.647
...od Study>1% AEP 60-90min>ECS_1pct_1hr_10	0.000	5.237	11906.715	0.000	0.453	0.000	0.724

Figure B-12

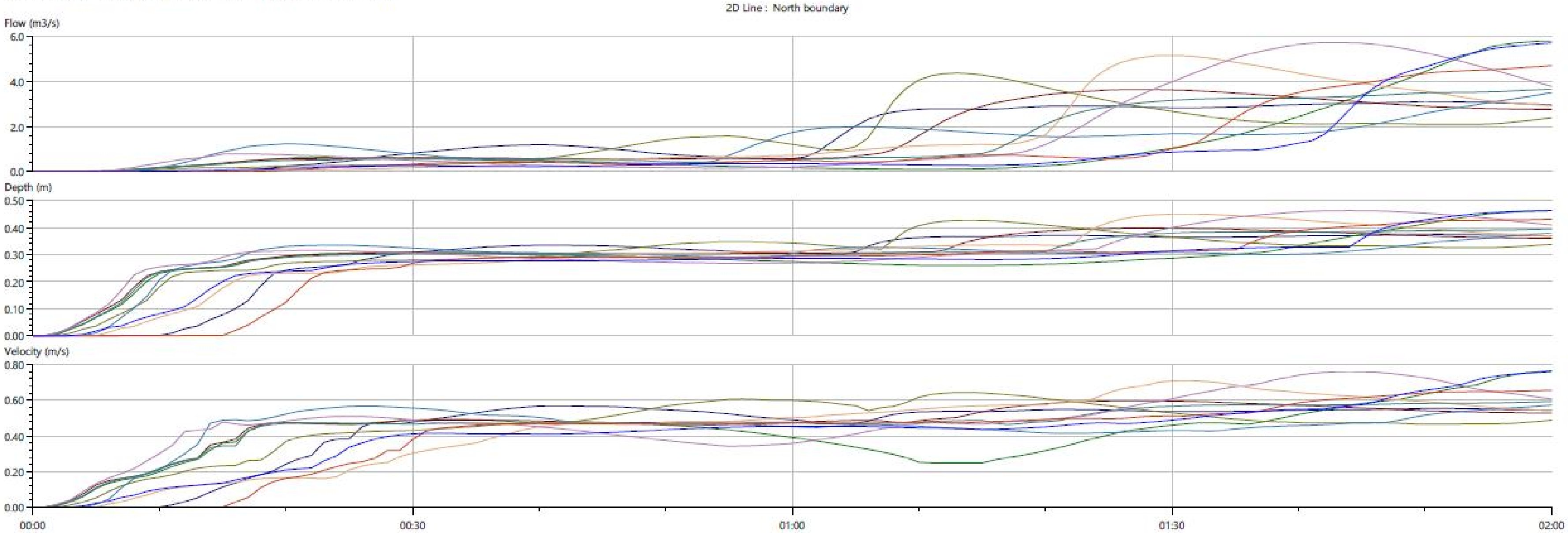
Simulation Plot Produced by User (1/08/2025 12:28:42 PM) Page 1 of 1
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_1 (1/08/2025 8:56:21 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_2 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_3 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_4 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_5 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_6 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_7 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_8 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_9 (1/08/2025 8:56:22 AM)
Sim: >Flood Study>1% AEP 60-90min>ECS_1pct_1_5hr_10 (1/08/2025 8:56:22 AM)
Results analysis: >Flood Study>1% 60-90min (1/08/2025 12:26:31 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_1	0.000	5.075	12117.648	0.000	0.444	0.000	0.688
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_2	0.000	3.138	13149.030	0.000	0.378	0.000	0.576
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_3	0.000	3.632	13123.618	0.000	0.397	0.000	0.596
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_4	0.000	4.143	13056.969	0.000	0.416	0.000	0.628
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_5	0.000	4.339	12576.615	0.000	0.420	0.000	0.639
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_6	0.000	6.004	12602.996	0.000	0.473	0.000	0.802
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_7	0.000	4.166	12653.294	0.000	0.413	0.000	0.620
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_8	0.000	4.823	12680.267	0.000	0.438	0.000	0.669
...d Study>1% AEP 60-90min>ECS_1pct_1_5hr_9	0.000	4.658	12743.885	0.000	0.430	0.000	0.656
... Study>1% AEP 60-90min>ECS_1pct_1_5hr_10	0.000	4.430	12829.039	0.000	0.426	0.000	0.647

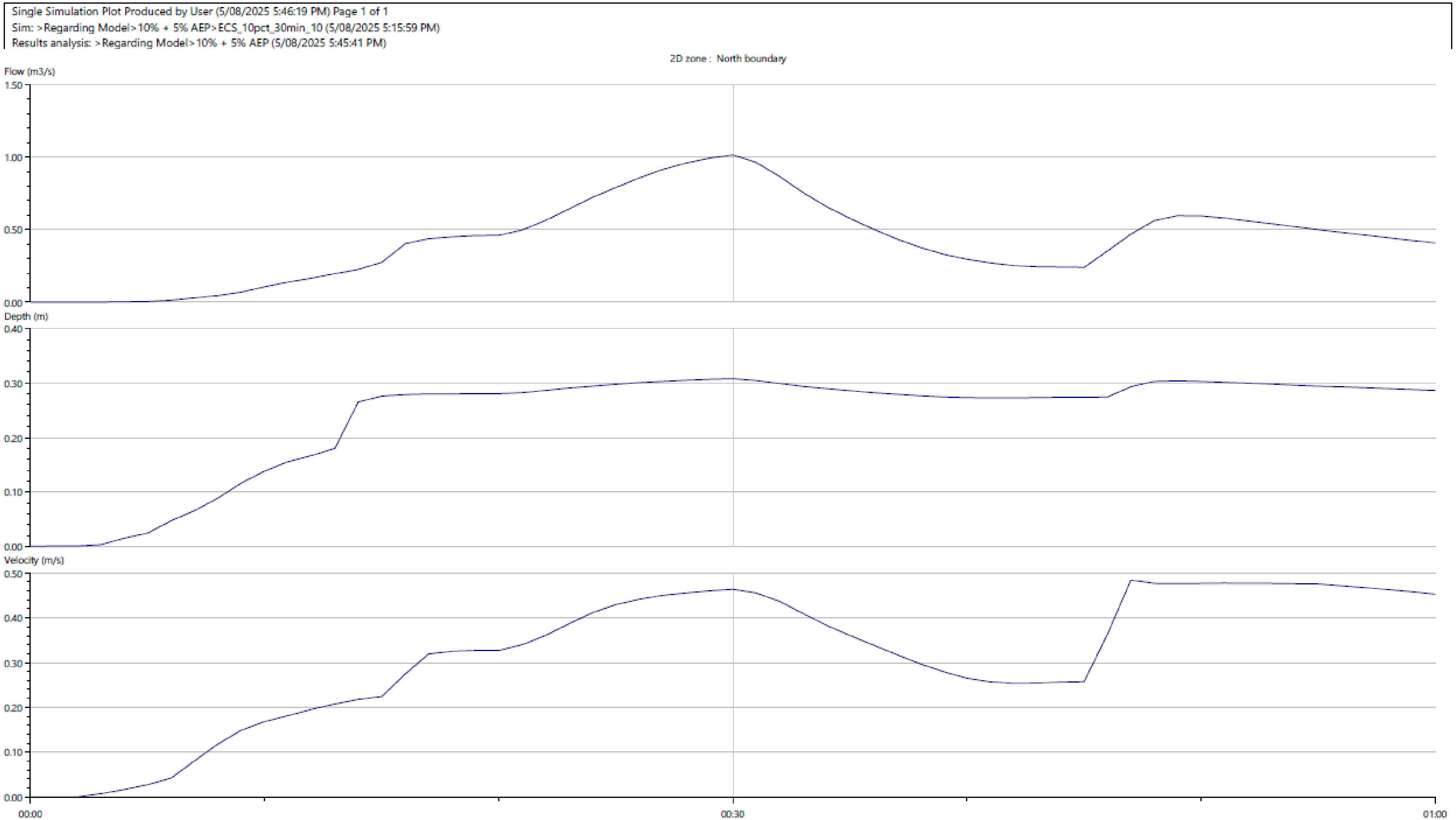
Figure B-13 – Temporal Pattern (TP) 6 used in the flood modelling analysis

Simulation Plot Produced by User (1/08/2025 2:29:55 PM) Page 1 of 1
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_1 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_2 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_3 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_4 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_5 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_6 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_7 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_8 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_9 (1/08/2025 12:31:12 PM)
Sim: >Flood Study>1% AEP 120min!>ECS_1pct_2hr_10 (1/08/2025 12:31:12 PM)
Results analysis: >Flood Study>1% AEP 120min (1/08/2025 2:29:27 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...lood Study>1% AEP 120min!>ECS_1pct_2hr_1	0.000	3.108	11847.944	0.000	0.374	0.000	0.569
...lood Study>1% AEP 120min!>ECS_1pct_2hr_2	0.000	5.792	8111.350	0.000	0.463	0.000	0.765
...lood Study>1% AEP 120min!>ECS_1pct_2hr_3	0.000	3.635	11540.988	0.000	0.398	0.000	0.598
...lood Study>1% AEP 120min!>ECS_1pct_2hr_4	0.000	4.359	11426.029	0.000	0.427	0.000	0.644
...lood Study>1% AEP 120min!>ECS_1pct_2hr_5	0.000	3.498	9502.385	0.000	0.381	0.000	0.573
...lood Study>1% AEP 120min!>ECS_1pct_2hr_6	0.000	5.145	11897.799	0.000	0.450	0.000	0.711
...lood Study>1% AEP 120min!>ECS_1pct_2hr_7	0.000	3.655	10117.892	0.000	0.394	0.000	0.592
...lood Study>1% AEP 120min!>ECS_1pct_2hr_8	0.000	5.731	12601.366	0.000	0.462	0.000	0.761
...lood Study>1% AEP 120min!>ECS_1pct_2hr_9	0.000	4.688	8354.179	0.000	0.430	0.000	0.657
...ood Study>1% AEP 120min!>ECS_1pct_2hr_10	0.000	5.713	7049.251	0.000	0.463	0.000	0.761

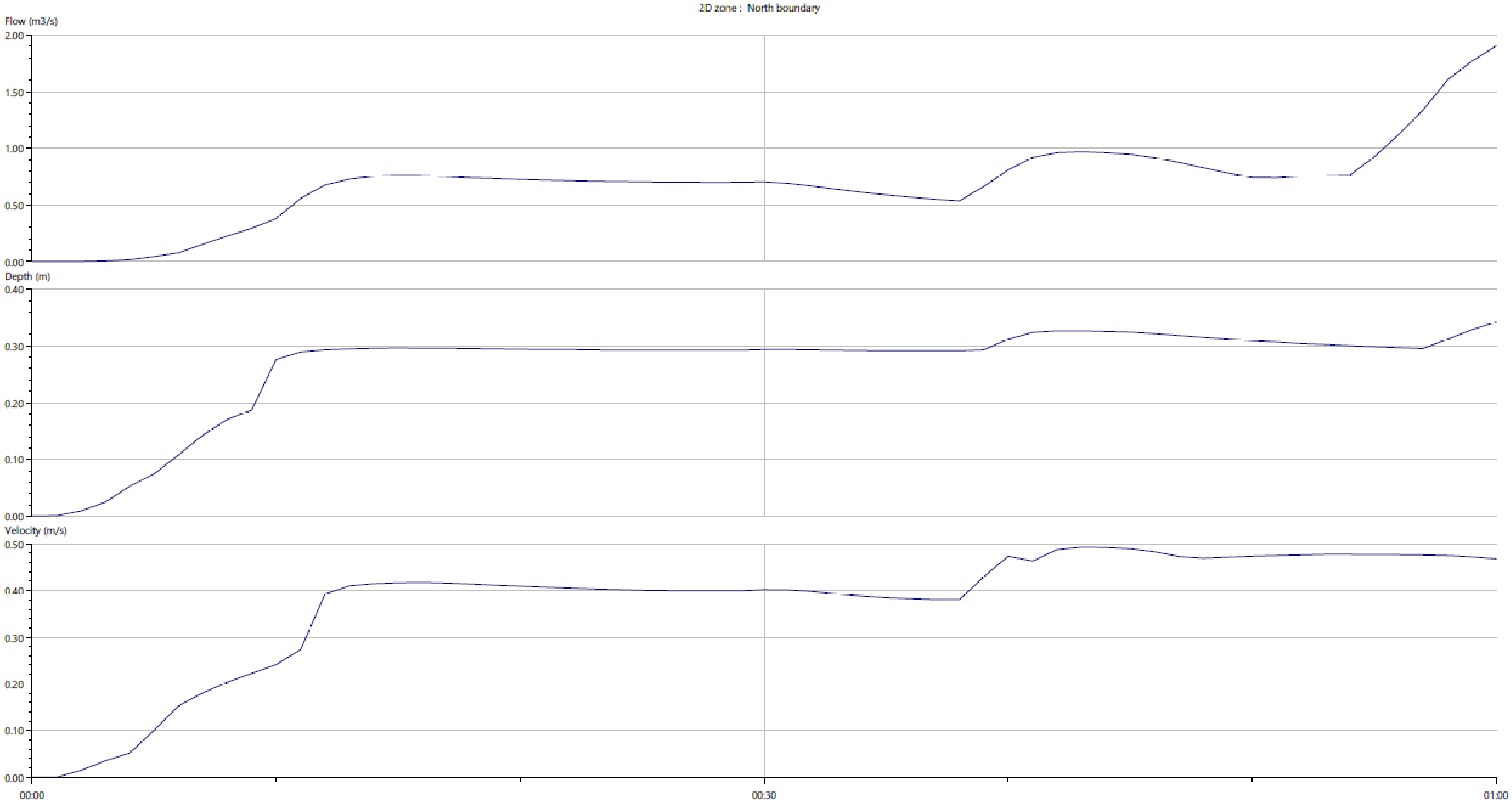
Figure B-14



		Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
		Min	Max	Volume (m3)	Min	Max	Min	Max
2D zone	———	0.000	1.016	1543.037	0.000	0.308	0.000	0.484

Figure B-15

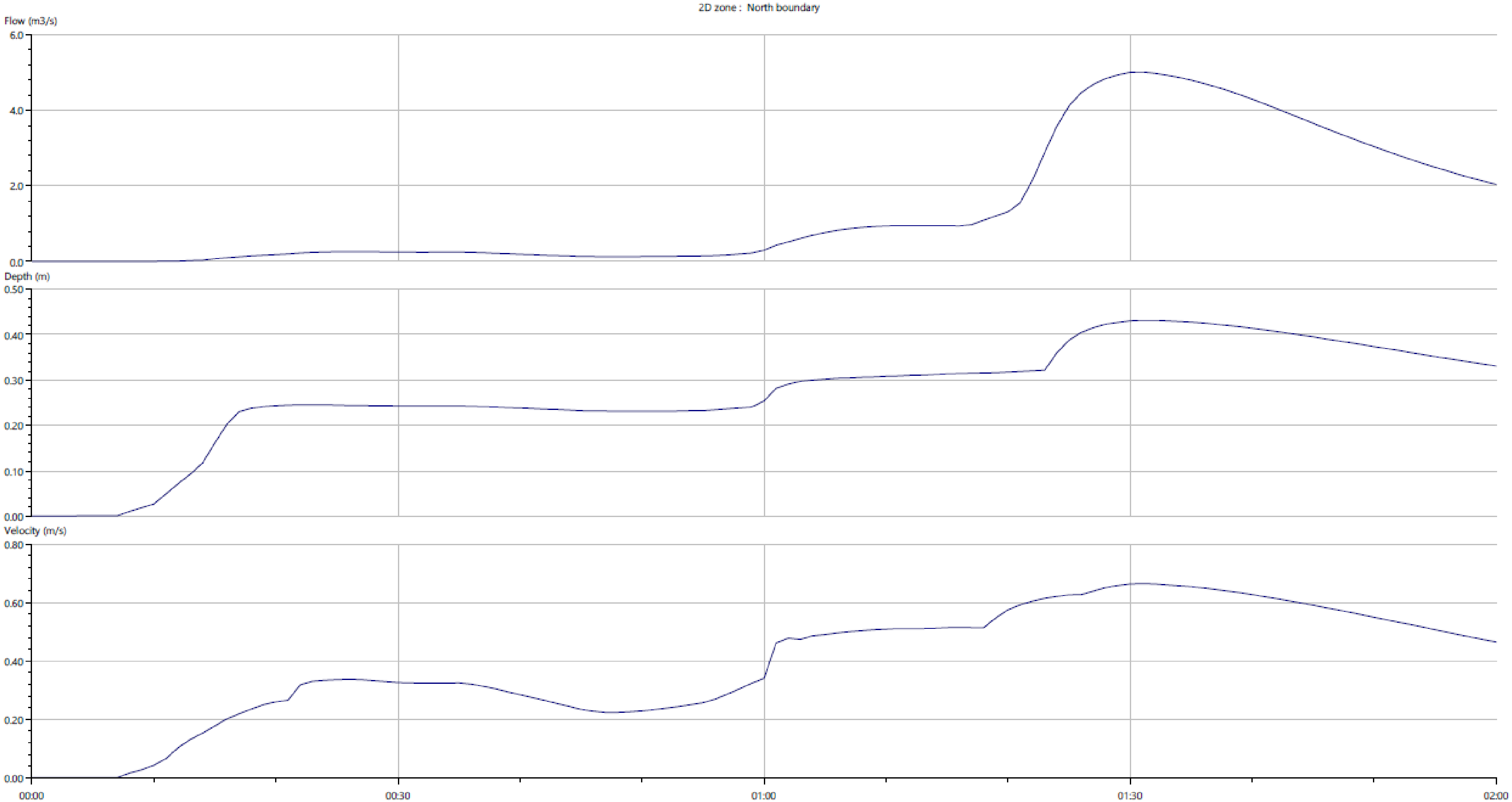
Single Simulation Plot Produced by User (5/08/2025 5:47:22 PM) Page 1 of 1
Sim: >Regarding Model>10% + 5% AEP>ECS_5pct_45min_4 (5/08/2025 5:16:00 PM)
Results analysis: >Regarding Model>10% + 5% AEP (5/08/2025 5:45:41 PM)



		Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
		Min	Max	Volume (m3)	Min	Max	Min	Max
2D zone		0.000	1.902	2483.518	0.000	0.342	0.000	0.493

Figure B-16

Single Simulation Plot Produced by User (1/08/2025 7:04:42 PM) Page 1 of 1
Sim: >Regarding Model>1% AEP Post 90min TP6>ECS_1pct_1_5hr_6 (1/08/2025 6:24:36 PM)
Results analysis: >Regarding Model>1% AEP Post 90min TP6 (1/08/2025 7:04:19 PM)



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
2D zone	0.000	5.008	10282.491	0.000	0.432	0.000	0.664

Figure B-17

APPENDIX C
Hazard risk curves and classification tables from Chapter 7, Book 6 of AR&R2019.

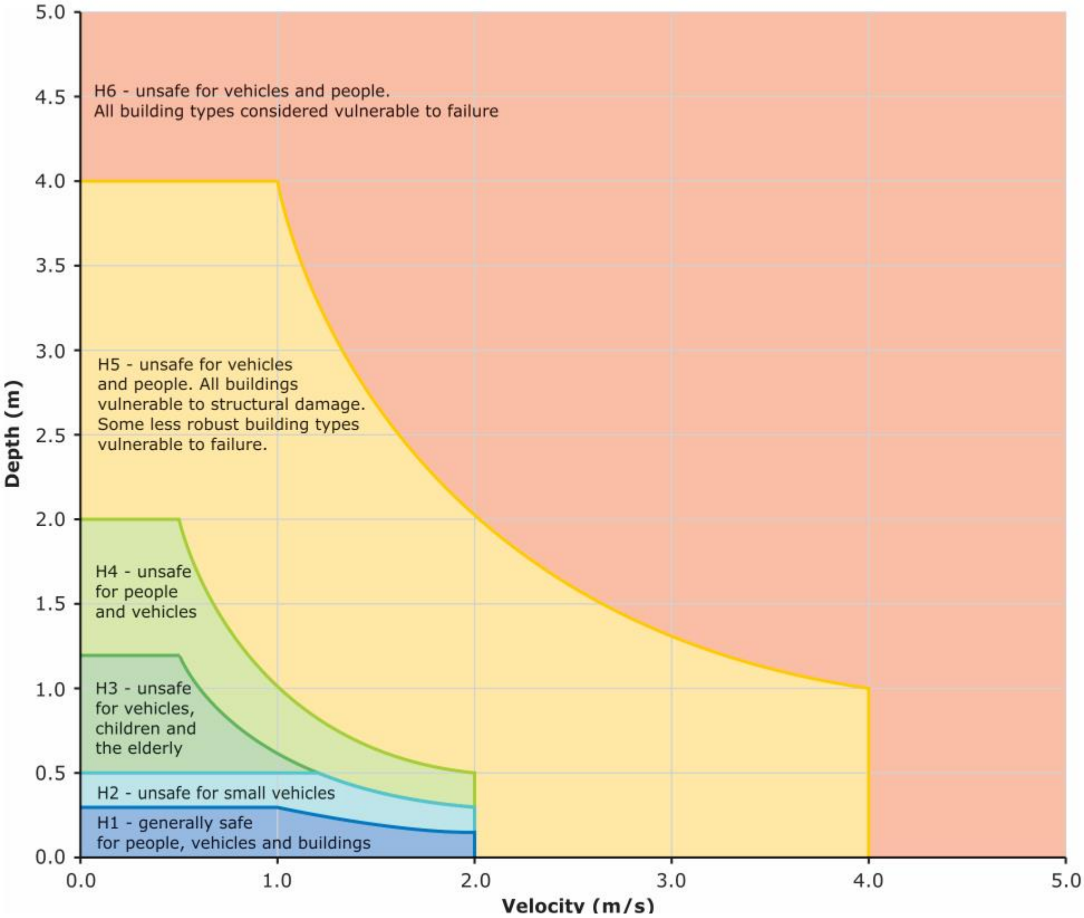


Table 6.7.3. Combined Hazard Curves - Vulnerability Thresholds (Smith et al., 2014)

Hazard Vulnerability Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles.
H3	Unsafe for vehicles, children and the elderly.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

Table 6.7.4. Combined Hazard Curves - Vulnerability Thresholds Classification Limits (Smith et al., 2014)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)
H1	D*V ≤ 0.3	0.3	2.0
H2	D*V ≤ 0.6	0.5	2.0
H3	D*V ≤ 0.6	1.2	2.0
H4	D*V ≤ 1.0	2.0	2.0
H5	D*V ≤ 4.0	4.0	4.0
H6	D*V > 4.0	-	-

References.

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Australian Rainfall and Runoff: A Guide to Flood Estimation, Commonwealth of Australia (Geoscience Australia), 2019; Ball J, Babister M, et al.

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Goulburn Mulwaree Council – Development Control Plan – Chapter 3.80 'Flood Affected Lands' (as amended July 2025)