RESIDENTIAL SUBDIVISION DEVELOPMENT

LOT 12 SECTION 6 DP758493

50 BIALA STREET

GUNNING. NSW. 2581

LOCAL FLOOD & OVERLAND FLOW STUDY

Prepared by SOWDES
4 January 2025

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Local Flood & Overland Flow Assessment for the 1% AEP with Water Depths and Levels (>50mm) Site Plan - 0020624-F100-A (A1)	Separate
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Introduction

SOWDES has been commissioned by the owner of the property identified as Lot 12 Section 8 DP758493, 50 Biala Street at Gunning to prepare a 'flood impact assessment' for a proposed two-Lot subdivision development in which both Lots will be seeking new residential dwelling permissibility.

The southern portion of the development property has been identified as being affected by general overland flows during frequent to rare rain events (Gunning Village Flood Study – Lyall & Associates, 2017), therefore in accordance with Chapter 4.5.4 'Overland Flow Paths' of the Upper Lachlan Shire Council Development Control Plan a detailed analysis of flood affectation has been undertaken for the development site for the 63.2%, 20&, 10&, 5%, 2% and 1% Annual Exceedance Probabilities (AEP's). Additional flood impact analysis has been included within the site study to identify areas of low and high hydraulic hazard, and a comparison between the pre-development and post-development water depths for the 1% AEP event.

The development property which comprises 2,023m² of vacant residential zoned land and is aligned in northwest to southeast pattern is located within the established residential portion of the Gunning village, being approximately 140 metres due north of the Gunning Primary School. The site is accessed from the Biala Street road corridor which lies to the north however there is presently no formal entrance crossover between the road carriageway and the property boundary. There is a general fall from the front northern corner to the lower southern corner at variable grades that average 5% with the greater falls being in the northern half of the site and a flatter 'plateau' effect in the lower southern portion.

The development site is serviced by the Council's reticulated water supply and gravity sewer system, however there is no form of inter-allotment stormwater drainage system that benefits the property or surrounding holdings. It is proposed as part of the subdivision civil works that inter-allotment stormwater drainage will be installed within existing and proposed easements between the development property and the Council's stormwater drainage system within the Yass Street road reserve to the south.

The flood study undertaken by Lyall & Associates in 2017 identified parts of the village that were subject to mainstream and tributary flooding as well as areas that were associated with overland flows that inevitably drain into the main creeks and streams. The development site is burdened by both the extents of the probable maximum flood from mainstream flooding as well as 'low hazard floodways' from overland flows and is subsequently classified as being located within the '*Mainstream and Minor Tributary Flooding Outer Floodplain*'.

The relevant flood related controls for developments within the '*Mainstream and Minor Tributary Flooding Outer Floodplain*' are set out in Annexure 2.1 of 'Appendix D' of the Flood Study document, noting that for residential and residential subdivision developments the only matters for consideration are related to 'floor levels' which are required to be at least 500mm above the 1% AEP flood level.

A 'Localised Flood and Overland Flow Model' has been undertaken for the proposed subdivision development noting that the intent of the model is not to replicate or contradict the Council's adopted flood studies, but simply to provide a model using all the resources applicable to the site including any changes within the catchment to undertake a comparison between the pre-development and post-development scenarios and identify any effects and impacts.

Section 1 of this report provides a summary of the existing site conditions, and the existing and proposed stormwater drainage regimes; Section 2 discusses the flood modelling and parameters used in the development impact assessment – including the pre-development and post-development outcomes; and provides an assessment of the burdened Lots against the Council's Flood Risk Matrix and Development Control Plan provisions for developments in flood liable lands. The results from the pre-development and post-development models, and the data derived from the pre-development models to determine the design rainfall events for the post-development models are presented in Appendices A to C, whilst Appendices D and E provide some additional supporting and general information.

Comparison between the 1% AEP pre-development and post-development models which includes minor earthworks for an access driveway and inter-allotment stormwater drainage indicate there is a slight decrease in water levels for adjoining properties immediately downstream of the development site. Certain controls and restrictions are recommended to be placed over the proposed Lots created by the subdivision to ensure that any future development within those Lots does not result in an increase in rainwater and surface water runoff during all rain events up to and including the 1% AEP. It is also recommended that at the time of lodging a development application to Council for the construction of a dwelling within the proposed Lot 2 that the site layout and the design of the building demonstrate how the structure has addressed the requirements for construction techniques and materials for flood liable lands with publications such as: '*Reducing Vulnerability of Buildings to Flood Damage*' – Hawkesbury Nepean Floodplain Management Steering Committee (2006).

It is concluded that the proposed subdivision of land to create two allotments with residential dwellings permissibility will be able to satisfy the relevant controls for flood liable lands in accordance with Chapter 4.5 of the the Council's Development Control Plan.

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1. EXISTING SITE CONDITIONS, CATCHMENT & DEVELOPMENT DETAILS		
#	*DESCRIPTION*	*DETAIL*
1.1	General description	The development proposal is for the subdivision of the existing vacant parcel of land to create two allotments, both of which will be seeking residential dwelling entitlements by satisfying the minimum Lot size provisions for RU5 zoning.
1.2		The development property, which is rectangular in shape and comprises 2,023m² is aligned in a northwest to southeast pattern with the frontage of the property lying parallel to the Biala Street road corridor.
1.3		The terrain within the development site has a general fall from the north to the south at moderate grades that average less than 5% (~3°) with slightly steeper grades within the front northern portion and a flatter plateau in the lower southern portion.
1.4		The development site is surrounded by similar land types and uses with many residential Lots having established dwellings, structures, gardens and lawns, whilst several of the registered Lots are still undeveloped.
1.5		Most of the surrounding residential allotments where existing dwellings are located are rather spacious with large areas of open spaces that include gardens and lawns that on average would occupy more than 50% of the available land area.
1.6		The landscape to the north, northeast, and northwest of the site generally rises toward the crest of a ridge line where the Great Southern Rail Corridor is located, whilst the southeastern, southwestern, and south aspects fall at relatively consistent grades of less than 3°.
1.7		The site is connected to the Council's reticulated water supply with a water meter installed within the front northern corner, and there is two separate gravity sewer lines that traverse the property; one approximately midway along the length of the holding and the other along the southern boundary.
1.8		There is no Council maintained, or inter-allotment stormwater drainage system connected to or available within close proximity of the site with the nearest form of stormwater drainage being the kerb and gutter system within the Warrataw Street road reserve to the east which is both inaccessible and upslope of the development site.
1.9		The Biala Street road corridor along the frontage of the property does not comprise a kerb and gutter system thereby allowing surface water runoff from the roadway and the upper portion of the Warrataw Road carriageway which are both higher than the development site to cross the front boundary of the holding.

1.10		Presently rainwater from gutters and tank overflows along with surface water runoff from two neighbouring properties to the east (#20 & #22 Warrataw Street) is allowed to discharge onto the development site, however a future development of the subject site will need to discuss the current discharge of stormwater with the respective property owners to ensure that there is an agreement and legal mechanism for this drainage to occur in a controlled and managed manner – if it is to continue.
1.11		There is also a source of overland flow during the frequent to rare rain events where surface water runoff from the neighbouring property on the western aspect drains across the lower southern portion of the development site.
1.12		This flow of water originates in the lands to the north and northwest of the site and is clearly identified within the Council's adopted flood study for the village and the separate flood study that has been prepared for this submission.
1.13		The management of rainwater and surface water runoff through the site needs to be addressed at the subdivision design stage to ensure there are no adverse impacts on existing downstream properties - refer to the Site Stormwater Drainage section on the following page for details of the proposed stormwater drainage
1.14		The subdivision layout is such that the front northern Lot (Lot 1) will comprise approximately 1,006m² and include an easement for access and services – including a metered water supply to benefit the rear southern Lot (Lot 2)
1.15		The easement will be 6 metres wide along the western facing boundary with a 4.5 to 6.0 metre wide concrete driveway to be used by both Lots for access to the individual allotments.
1.16		An existing sewer junction that services the development site is understood to be constructed on the western edge of the sewer main that traverses through the centre of the holding – therefore potentially being under the alignment of the access driveway.
1.17		If this is confirmed to be the case then the landowner will need to lodge an application and pay the relevant fee for the Council (or approved contractor) to install a new sewer junction for Lot 1 that is both away from the access driveway, but still low enough within Lot 1 to service the future dwelling envelope.
1.18		A future residential dwelling development within the proposed Lot 2 will be lower in the terrain and therefore unable to drain into the sewer main that traverses through the centre of the holding hence a new sewer junction will need to be created from the gravity sewer line that runs parallel to the southern boundary – the landowner will need to lodge an application and pay the relevant fees to Council for a connection to this service line.

1.19		It is recommended that an existing eucalypt tree in the lower southern portion of the site that stands within the centre of the mapped floodway and has been recently dropping limbs and branches be removed for genuine safety concerns.
1.20		The tree (believed to be *Eucalyptus melliodora*) is in poor health compared to other similar trees in the general area with many dead and broken branches, and sparse foliage within the canopy and mid-strata growth areas which is likely due to the constant flux in wetting and drying of the root system by the changes in groundwater conditions.
1.21	Site stormwater drainage – to be read in conjunction with the accompanying Stormwater Drainage Site Plan and long section details	At the subdivision stage of the development, it is proposed that an inter-allotment stormwater drainage system will be installed from the subject site to Yass Street to the south.
1.22		The proposed stormwater drainage system will levy off an existing 3.66 metre wide easement for drainage located to the west of the site that benefits the Upper Lachlan Shire Council – identified as DP613453 which appears to have been created and registered in 1980.
1.23		The easement extends from the Yass Street road corridor to the south of the development site to the Biala Street road corridor and passes through the existing properties identified as #105 Yass Street (Lot 2 DP611991), #109 Yass Street (Lot 1 DP611991), and #52 Biala Street (Lot 13 Section 8 DP758493).
1.24		To date the easement has not been used for the purposes of piped stormwater drainage however a 65 metre section of the existing sewer drainage system is located within the western portion of the easement.
1.25		It is noted that the 2017 Flood Study of the village did identify the easement and also investigated the feasibility and overall benefit of installing a piped drainage system through the easement however it was concluded that any perceived benefit from a flood management / mitigation perspective did not justify the cost hence the installation of a pipeline was not endorsed as a recommendation.
1.26		Whilst the adopted Flood Study did not recommend the installation of a piped stormwater drainage system within the easement this does not preclude the use of the easement as part of a wider inter-allotment stormwater drainage system which is considered within the context of this submission to provide a beneficial outcome for both the subject site, and the neighbouring downstream properties.
1.27		The landowner of the subject site has discussed both an easement and access for the purposes of stormwater drainage with the neighbouring landowner to the west - #52 Biala Street.

1.28		The owner of #52 Biala Street has consented to the easement and access subject to its position not necessitating the relocation of existing sheds that are established along the southern boundary of the block – hence an easement is proposed to be created approximately 3 metres off and parallel to the southern boundary of the property.
1.29		A copy of the signed letter of agreement by the owner of #52 Biala Street accompanies this submission.
1.30		An easement through #52 Biala Street would provide a connection to the existing registered easement that benefits Council, and in doing so provide a continuous route for the installation of stormwater drainage between the two Lots within the subdivision of the development site and Yass Street to the south.
1.31		Further, and subject to discussion with the neighbouring landowners to the east (#20 & #22 Warrataw Street), the formation of easements through both #50 and #52 Biala Street will allow a managed conveyance of stormwater from the two landholdings to the east where they presently cannot drain stormwater to the kerb and gutter system within Warrataw Street.
1.32		The combined effect of managing stormwater drainage from the five Lots benefited and burdened by the new easements (Lots 1 and 2 created by the subdivision of #50 Biala Street, #52 Biala Street, and #20 & #22 Warrataw Street) is that there will be a reduction in the flows associated with the early rainfalls in the design events, and there will be a continued removal of ground water and seepage from the affected flood areas by way of sub-surface drainage pipes that can be connected to the new stormwater drainage system.
1.33		The net gain is the reduction in overland flow impacts on the downstream properties, and the management of existing rainwater and surface water drainage that presently occurs but without any form of legal entitlements.
1.34		For the newly created Lots within the subdivision of the development site there will be a requirement that the peak discharge of water from the combined land holding in the post-development conditions does not exceed that of the pre-development flow rates for all events up to the 1% AEP.
1.35		To help achieve this requirement each of the new Lots at residential development stage will be required to provide temporary on-site detention measures in the form of rainwater tanks that regulates the flow of water from the respective Lots to be equal to or less than the pre-development rates.

1.36		Appropriate calculations based on the changes in surface finishes will need to be provided with the development application to substantiate the proposed on-site detention provisions which will be in addition to any other requirements that are triggered by satisfying *BASIX* or any water quality objectives.
1.37		An indicative guide as to the on-site detention requirements for each of the proposed Lots created by the subdivision is as follows: In the un-developed state for one of the proposed Lots at 1,000m² of pervious area the peak flow rate for the 1% AEP rain event is 0.029m³/sec. For the post-development state where there is a roof area of 350m², driveway and hardstand areas of 350m², and pervious area of 300m² (total 1,000m²) the required temporary detention volume in the form of a rainwater tank with 50mm orifice regulated outlet is 5,000 litres, this would result in a peak flow from all sources in the 1% AEP event of 0.027m³/sec with no overflows from the rainwater tank. **The above figures are derived from the *DRAINS* hydrological model using rainfall data for the geographical area.**
1.38		The proposed stormwater drainage system will comprise a set of pits and pipes to convey the stormwater to the Yass Street road corridor where it will discharge to the existing fenced stormwater pit compound in front of #105 Yass Street.
1.39		With reference to the accompanying Stormwater Drainage Site Plan (Ref: 0020624-S100-A) stormwater pits SWP1.2 to SWP1.6 will be a surcharge gully pit with the finished surface level between pits SWP1.2 to SWP1.5 formed with a 2 metre wide and 300mm deep swale.
1.40		The swale between these pits will help compensate for the flat terrain and a possible depression within the landscape that does not otherwise allow for deeper pits to be installed which would provide additional water storage.
1.41		The new pipeline that exits the easement at SWP1.2 and enters the Yass Street road corridor will replace an existing small rectangular box culvert, and a kerb inlet pit (SWP1.1) that is designed to be installed along the edge of the roadway will allow a change in pipe direction whilst also collecting surface water runoff from within the roadside kerb.
1.42		The pipeline will continue from the new kerb inlet pit to the existing fenced stormwater pit compound and will terminate with a concrete headwall (or similar arrangement) that discharges to the concrete ramp that drains down into the pit.

1.43		A conceptual design for the stormwater drainage system between the development property and the discharge point in Yass Street has been undertaken with a long section detail showing pipe size and grades also accompanying this submission – refer to drawings 0020624-S200-A and 0020624-S201-A.
1.44		To offset the natural slope of the terrain within the development site which has a general fall from the north to the south the formed access driveway within the easement along the western boundary will have a slight fall from the outer edges to a depression along the centreline and it will have a 150mm high raised edge beam along the western aspect.
1.45		The edge beam will commence from the front boundary (chainage 11.70 metres in the accompanying site plans) to a point beyond the neighbouring dwelling to the west (chainage 55 metres in the accompanying site plans) to help retain all surface water runoff within the property and thereby avoid creating nuisance to the neighbouring landholding.
1.46		Where the edge beam ceases the formation of the driveway will begin the flatten-out so that when it reaches the entrance to the proposed Lot 2 it will be a constant grade across the width and therefore it can drain uniformly into a 300mm wide 'medium duty' grated channel that is connected to the stormwater pit SWP3.1.

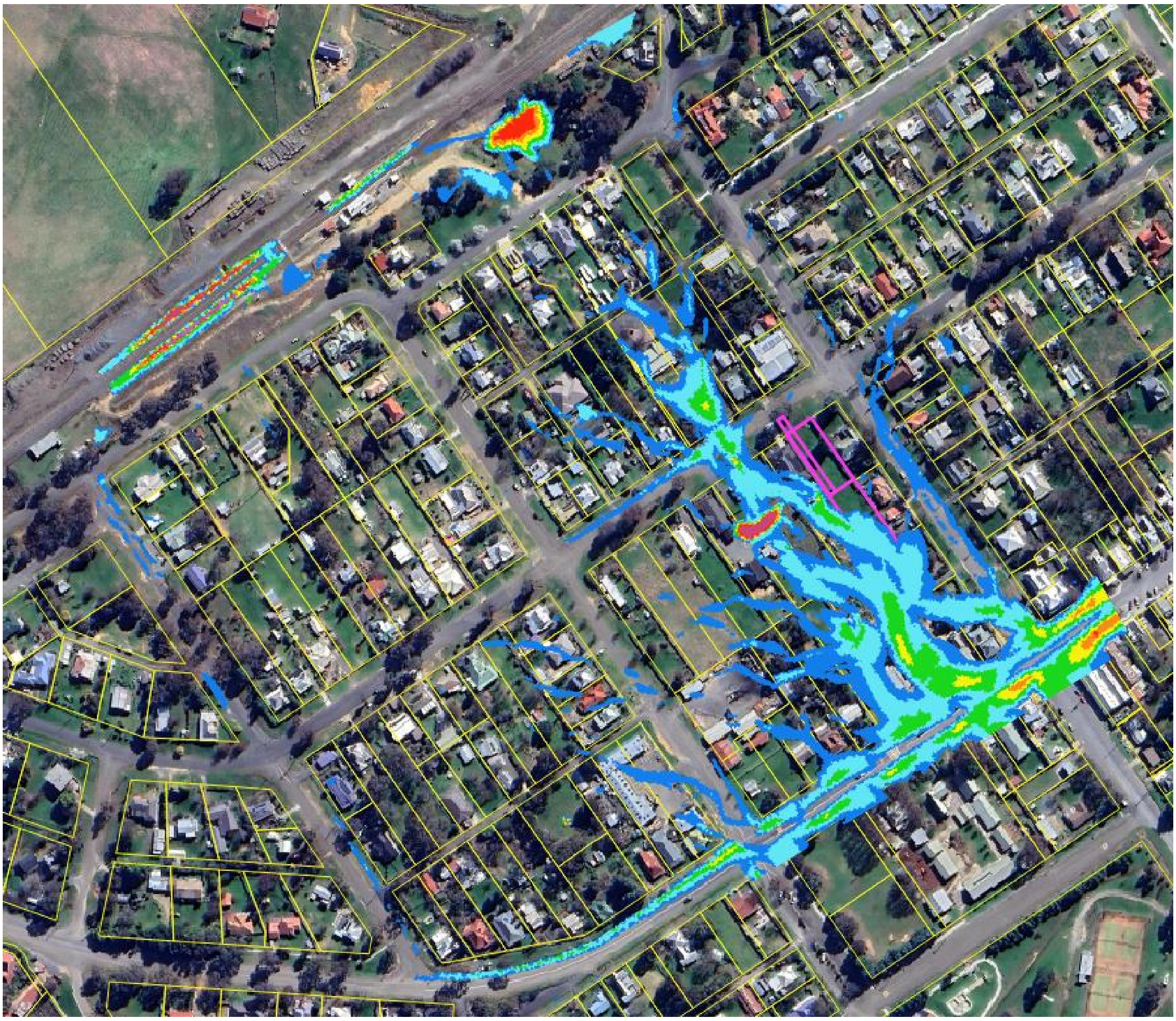


Figure 1. Aerial image showing a portion of the village of Gunning with the development property outlined in magenta. The image also shows the overland flow paths for the 1% AEP design rain event that commence to the northwest and burden the development site. It is noted that the surface types within the catchment are uniform with low density residential dwellings including large managed yard areas, and both public and private road corridors.

2. LOCAL FLOOD & OVERLAND FLOW MODELLING AND RESULTS

#	DESCRIPTION	DETAIL
2.1	Flood modelling background and development model	The Upper Lachlan Shire Council has adopted a flood study of the Gunning village that was undertaken by *Lyall & Associates* in 2017 with the emphasis being on the mainstream flooding associated with Meadow Creek and its tributaries, and the major overland flow paths that drain to the creek system.
2.2		The adopted flood study has identified the main catchment areas that drain to Meadow Creek – which includes the area surrounding the development property, and from the study produced a suite of maps such as water depths, flood planning area, hydraulic categorisation, and flood risk precincts for a range of design rain events.
2.3		The adopted flood study identifies that the development site is not directly burdened by mainstream flooding associated with frequent to rare rain events but may be affected by the extents of the probable maximum flood, and from general overland flows that drain the to the creek which is located to the southeast of the site.
2.4		The adopted flood study was undertaken in 2017 using available LiDAR data which according to Geoscience Australia was last updated in 2015 for the Gunning area, however since then both the preferred Australian height datum and coordinate projection systems have been upgraded (GDA2020).
2.5		Practical modelling complications arise from the changes to the national height and positioning systems when using or referencing earlier flood models in that real-world elevations and coordinates which are required for design and construction purposes for new developments and are captured by site-specific survey is often significantly different to the elevations and land features captured in the earlier data sets.
2.6		These variations can be in the order of hundreds of millimetres, and often the variances are not uniform between the different models with the height differences being both higher and lower within the one model compared to the other model – an example being random spot height checks where the earlier LiDAR data was 300mm higher in one location but 400mm lower in another location compared to the surveyed site data.
2.7		It is also noted that the 'Flood Study' prepared by *Lyall & Associates* in 2017 makes the following comment in relation to the digital elevation model that was used in the flood studies: *"The extents of inundation shown in this study are indicative reflecting the accuracy of the LiDAR survey (68% of the points lie within +/- 150mm of the true elevation)".*

2.8		In lieu of the previous comments a localised flood and overland flow model has been undertaken for the proposed subdivision development noting that the intent of the model is not to replicate or contradict the Council's adopted flood studies, but simply to provide a model using all the resources applicable to the site in a uniform progression through the catchment to enable comparison assessment between the pre-development and post-development scenarios.
2.9		Any differences between the Council's adopted flood study of the Gunning village and the model prepared for this development is essentially negated by the fact that the development proposal acknowledges the mapped flood risk precincts within the floodplain and will therefore design with this in mind.
2.10		The results from the development specific flood study is focusing on the proposed access driveway, and stormwater conveyance matters for the development and therefore highlighting any changes to the floodplain between the current and proposed scenarios.
2.11		It is surmised that any variations within the floodplain resulting from the proposed development irrespective of the model being used will generally result in consistent outcomes and findings.
2.12		The available building envelopes and floor levels for each of the proposed Lots derived from the development specific flood study can be applied to the site irrespective of the 'actual' site elevations as the water depths and levels can be extrapolated from the accompanying site plans which includes aerial imagery as an underlay and adjusted accordingly.
2.13	Details of the flood modelling and parameterisation	To create a terrain profile for the stormwater drainage and overland flow assessment outside of the development property survey LiDAR information was obtained for the development area from the Geoscience Australia '*Elevation and Depth Foundation Spatial Data'* website (ELVIS).
2.14		The defined catchment area and development property is captured within a single dataset (Gunning201503-PHO3-C0-AHD_7066148_55_0002_0002) which has a grid area of 2km x 2km which was downloaded as 2 metre grid Digital Elevation Model metadata item.
2.15		The external elevation data was coupled with a survey of the site that was undertaken in 2024 with adjustments made to the data sets to get a relatively consistent correlation and profile of the terrain that avoided large discrepancies in elevation levels between adjacent points.

2.16		The primary objective of the modelling is to determine the existing overland flow patterns, water depths and levels, and velocities that affect the development property and to conservatively estimate for the 'design events' – being the 63.2%, 20%, 10%, 5%, 2%, and 1% AEP rain events where any impacts will be experienced in the post-development conditions.
2.17		Results from the modelling exercise were also used to help define areas for the placement of stormwater drainage infrastructure throughout the development site.
2.18		Software used to undertake the modelling is the '*InfoWorks ICM Ultimate*' which is licenced, distributed, and supported by Autodesk.
2.19		'*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.
2.20		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.
2.21		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, which is consistent with the approach adopted for the Gunning village Flood Study.
2.22		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.
2.23		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.
2.24		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 63.2%, 20%, 10%, 5%, 2%, and 1% AEP rain events as these are generally the critical rain events of interest for assessing stormwater drainage systems and design floor levels and is consistent with the requirements of the Council's DCP.
2.25		As the characteristics of the upstream catchment area is comprised of varied but relatively uniform land uses and surface types akin to low-density residential a single roughness coefficient of 0.21 has been adopted in the model.

2.26		Within the Bureau of Meteorology rainfall data an initial rainfall loss of 24mm is adopted however the model does not include an assumption of a continuing loss.
2.27		Within each of the pre-development rain events which include an ensemble of 10 different temporal patterns durations of 20, 25, 30, 45, 60, 90, and 120 minutes were modelled for each of the AEP's to determine the peak flow that crosses the southern side of the Biala Street road corridor as this is the flow of water that either in-part or in-full flows through the development site.
2.28		The duration and temporal pattern (TP) for each rainfall event that generated either the median peak flow rate or the nearest value above the median value (not the mean flow value) that crosses the southern side of the road was adopted as the design rainfall event for the post-development modelling: • 63.2% AEP – 30minute, TP8 • 20% AEP – 30 minute, TP8 • 10% AEP – 25 minute, TP3 • 5% AEP – 20 minute, TP2 • 2% AEP – 25 minute, TP6 • 1% AEP – 20 minute, TP3 Copies of the peak flow graphs for the pre-development models are included in Appendix A of this document.
2.29		The modelled catchment area covers 30 hectares and it is broken down into approximately 230,200 meshing triangles that have an average area of 1.29m^2, and each 'working' face allows normal flow conditions from one mesh triangle to the next.
2.30		The large modelling area validates the effective upstream catchment that directly burdens the development property (approximately 4.5 hectares) by identifying other drainage regimes that occur outside, around, and beyond the property, and which therefore can effectively be ignored.
2.31		Within each of the modelling scenarios 'break lines' were created along the edges of the roadways and other features to force meshing triangles for the different surface types, and to reflect changes in possible elevations.
2.32	Pre-development model	The pre-development model comprised a total catchment area of approximately 30 hectares which included adjoining upslope properties to the northwest, north, and northeast to gauge the impact of all external sources of surface water runoff that potentially burden the site.
2.33		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 4.50 hectares.

2.34		The results for each of the pre-development rain events indicate that the northwestern half of the property is essentially unaffected by overland flow with depths of more than 50mm, whilst the southeastern half below the proposed new access driveway starts to become burdened by surface water runoff from the northwest and west that crosses the lower southern portion of the western boundary.
2.35		The flow of surface water that enters the property is relatively shallow and slow moving which is supported by separate 'velocity' and 'velocity x depth product' result maps that are presented in Appendix A, however the southern portion of the site is identified in the adopted Flood Study of the village as comprising a 'low hazard floodway' and 'low hazard flood fringe' for major overland flows.
2.36		The corridor of flow that represents the 'low hazard floodway' is essentially restricted to the central southern third of the site and therefore needs to be excluded from any potential future development area within the proposed Lot 2 of the subdivision.
2.37	Site design considerations based on pre-development model findings	The pre-development overland flow models identified that to a reasonable and practical extent there is a need to maintain the existing flow of water through the site such that there is no increase in flow patterns or direction to adjoining downstream properties in the post-development scenario.
2.38		It is noted that the adjoining property to the south – identified as #26 Warrataw Street has a residential dwelling that is directly in the path of the overland flows, so any increase in water velocities or levels associated with the subdivision development will not be an acceptable outcome.
2.39		The pre-development models also provided important data on water depth and flow characteristics such that informed design of the site could be undertaken, including the available footprint for the construction of a future dwelling in the proposed Lot 2.
2.40		From the 1% AEP model (being the larger of the rain events) the water depths and levels, flow velocity, and 'velocity x depth product' was used to undertake an assessment of the development against the relevant controls within the Council's Development Control Matrix for flood liable lands.
2.41		For each of the design rain AEP pre-development 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 E.

2.42		This detail is not intended to oppose any maps or information derived from the Council's adopted Flood Study of the village however it is a slightly different risk matrix that is used to help assess the proposed development against certain hazard criteria and the suitability of land for different types of development.
2.43		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.
2.44		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'.
2.45		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.
2.46		For each of the design rain events the pre-development site and surrounding areas are essentially classified as 'H1' hazard categories meaning that the site is considered 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 may be required in a large rain event.
2.47	Post-development model and results.	To gauge the potential impact of the proposed development on existing overland flows and downstream properties a 'post-development' model was prepared for each of the design rain events that incorporated the external terrain with the regrading and modifications to the site associated with the proposed access driveway to service both Lots and the inter-allotment stormwater drainage system.
2.48		The primary objective of the post-development model was to assess the impacts of the proposed subdivision development on the existing overland flow patterns and water levels, and to review the results to then further refine the site design and flow conveyance measures to achieve the smallest impacts.
2.49		It is noted that there is a slight variation in the extents of flood affection between the pre-development and post-development models which is mainly attributed to the changes in the 'meshing' process of the catchment terrain in the flood modelling program.
2.50		Changes in the terrain data in the post-development scenario which includes the site regarding for the access driveway and the inclusion of finer meshing around the pits for the inter-allotment stormwater drainage system will generate a change in the triangulation of the terrain data hence the differences.

2.51		The inclusion of the access driveway along the western boundary of the proposed Lot 1 does not show any changes to the flood waters as all runoff is retained within the construction of the carriageway and directed to the proposed stormwater drainage system.
2.52		The inter-allotment stormwater drainage system that extends from the development site to Yass Street road corridor has been modelled with grated lids at each pit such that a proportion of the surface water that passes over the lids will drain into the pit, and conversely, flows that exceed the capacity of the downstream pipe system can exit the pit.
2.53		Long section water levels derived directly from the flood model program for the main section of the proposed inter-allotment stormwater drainage (SWP2.1 to the outlet in Yass Street) in the 20%, 10%, 5%, and 1% AEP's show that the majority of rainwater within the pit and pipe system – particularly within the development site is contained and conveyed to the discharge point – refer to Appendix C for the result images.
2.54		An exception is experienced at pits SWP1.3, SWP1.4, and SWP1.5 where the model indicates that the pits surcharge and result in overland flows – which was discussed briefly in Items 1.39 and 1.40 within this report.
2.55		The recommendation to construct the finished surface level between pits SWP1.2 to SWP1.5 as a 2 metre wide and 300mm deep swale should capture the majority of the overflows and convey them to the downstream pit SWP1.2, noting that this recommendation has not been included in the post-development terrain data and modelling results.
2.56		It is also highlighted that the management of peak discharge from the two proposed Lots to not be greater than the pre-development flow rates is critical in ensuring that the inter-allotment stormwater drainage system can adequately handle the anticipated flows for the range of design events up to and including the 1% AEP.
2.57		Similar controls will need to be placed on the two Lots to the east of the development site (#20 & #22 Warrataw Street) if they choose to connect to the inter-allotment stormwater drainage system to ensure that peak flow of water does not exceed the capacity of the pit and pipe provided to them - which for each site will be in the order of 0.015m³/sec.
2.58		The duration and time to peak flow in the 1% AEP post-development design event model is very short, with the peak occurring approximately25 minutes after the commencement of the event, and subsiding to negligible depths after 60 minutes.

2.59		The longer modelled rainfall event for the 1% AEP (120 minutes) whilst not producing the greatest median peak flow had a peak in the rainfall event after 40 minutes from the commencement with only shallow depths evident after 2 hours.
2.60		The significance of the previous two items highlights that the modelled rain events that produce water inundation are generally for short durations, and as the water depth and level result maps will show, they also have relatively shallow depths and slow velocities.
2.61		'Difference' mapping between the pre-development and post-development shows that there is a slight decrease in water levels immediately downstream of the development site which is attributed to the reduction of surface water volume captured within the inter-allotment stormwater drainage system.
2.62		The water level reductions are generally less than 10mm with the most noticeable decreases being along the existing drainage easement within #105 Yass Street which does not include the proposed swales between the pits, and a branch flow of water that goes from the rear of the development property through #26 Warrataw Street and out to the Warrataw Road corridor.
2.63		The 'difference' mapping also suggests that there is a slight increase in water depths on the upstream aspects of the development site however this cannot be accurate as there are no changes in the terrain between the pre-development and post-development scenarios, hence the apparent difference is being generated by the same changes in the terrain meshing process discussed earlier.
2.64		It is noted that the processing of flood modelling results in the GIS program uses vector data to represent the water levels and various other inundation images which has discrete features constructed from vertices and lines, however elevation data such as water levels is prepared using raster data which is reliant upon pixels - each with singular specific values.
2.65		Vectors are usually bigger and often will take an average value from the different vertices that are associated with its shape whereas pixels are generally much smaller than vectors and therefore can have very distinct variations in values compared to adjoining elements.
2.66		With 'difference' mapping for the changes in water levels the image appears as a multitude of small square pieces that are laid beside each other over the affected area and sometimes with very abrupt changes in colour, however the image should be viewed for the overall effects over a broad area and not any abrupt changes in colour between adjoining elements.

2.67	Flood risk assessment for 'Mainstream and Minor Tributary Flooding' Development Control Matrix	The development site is located within the 'Mainstream and Minor Tributary Flooding Outer Floodplain' of the Gunning Village Flood Study (2017 – Figure D1.6) and therefore must address the relevant development controls for the proposed land use in accordance with Annexure 2.1 of Appendix D of the study (refer to Appendix D for a version of the Control Matrix).
2.68		A 'residential subdivision' in the 'Outer Floodplain' need only address the requirements for 'floor levels' which requires a finished floor level for any habitable component of a residential structure to at least 500mm above the 1% AEP water level.
2.69		With reference to Figure a-06 – '*1% AEP Pre-Development and Post-Development Overland Flow Water Depths and Levels'* in Appendix A of this report the finished floor level for the proposed Lot 1 of the subdivision development need only meet the requirements for local drainage provisions (floor level at least 150mm above the natural surface level) as it outside the mapped flood plain, whilst the proposed Lot 2 should have a finished floor level of at least 565.500 mAHD (565.000 + 500mm).
2.70		The design of a future dwelling within the proposed Lot 2 should refer to the current best practices for development in flood liable lands such as '*Reducing Vulnerability of Buildings to Flood Damage*' – Hawkesbury Nepean Floodplain Management Steering Committee (2006) for potential construction techniques and materials to be used.
2.71		Additional measures such ensuring the management of surface water from any upstream sources are adequately captured and diverted away for the development envelope within each of the proposed Lots will also be important to minimise any adverse or long-term impacts - the installation of the inter-allotment stormwater drainage system will assist with managing 'water' generally on the sites.
2.72		It is also a requirement that any work associated with the installation of the inter-allotment stormwater drainage system reinstate the finished surface levels to the existing site conditions to avoid creating changes to the overland flow paths that could adversely impact downstream properties.
2.73		Finally, to preserve the existing overland flow pathways and flood patterns it is recommended that there be a restriction on the title of the proposed Lot 2 that will prohibit the construction of any building or undertaking any modifications to the natural surface levels (post subdivision civil works) within the land area below the identified development envelope that sits within the extents of the 1% AEP rain event.

2.74	Modelling summary and results analysis	A suite of pre-development and post-development results have been prepared for the development site and are presented in Appendix A.
2.75		Mapping results include the water depths and levels for the 63.2%, 20%, 10%, 5%, and 1% AEP's, and velocity, and 'velocity x depth product' for the 1% AEP design events.
2.76		Additional post-development results from the 1% AEP design event includes 'difference mapping' that compares the post-development water levels less the pre-development water levels to demonstrate the minor increases and decreases in water depths across the site and adjoining downstream properties, and there is a separate map showing areas that were 'wet but now are dry', and areas that were 'dry but now are wet'.
2.77		In the difference mapping the changes in water levels has been broken into small segments either side of a 'no change' with increments of 5mm, 10mm, 25mm, 50mm, 100mm, and then additional increments to the extent of the variations.
2.78		The fine measurements between the increases and decreases in water level is clearly evident in the 'difference mapping' result image, and this is complemented by the comparative water level images for the 1% AEP pre-development and post-development conditions with the contour lines for the water elevations being almost identical.
2.79		Additional modelling results includes a comparison between the pe-development and post-development velocity and 'velocity x depth product' for the 1% AEP, and as with the pre-development models, a 'flood hazard' assessment of the post-development conditions has been undertaken for the 63.2%, 20%, 10%, 5%, and 1% AEP's which does not show any significant change in the post-development conditions – the hazard category for each rain event remains as 'H1'.
2.80		The pre-development and post-development modelling results are presented in Appendix A of this report with the models collated in order of event magnitude starting from the more frequent rainfall event being the 63.2% AEP and finishing with the rarer and larger 1% AEP design rain event.
2.81		For each event magnitude a comparison of the pre-development and post-development results for water depths and levels are presented on the same page with the pre-development on the lefthand side and the post-development on the righthand side.
2.82		Similarly for the 63.2%, 20%, 10%, 5%, and 1% AEP's hydraulic hazards, and the 1% velocity and 'velocity x depth product' the pre-development is on the lefthand side and post-development on the righthand side.

Figure 2. Image from Yass Street showing the location of the discharge point in front of the power pole from the existing easement that traverses between Yass Street and Biala Street, and the fenced stormwater pit compound in front of 105 Yass Street where the proposed inter-allotment stormwater drainage system will discharge.

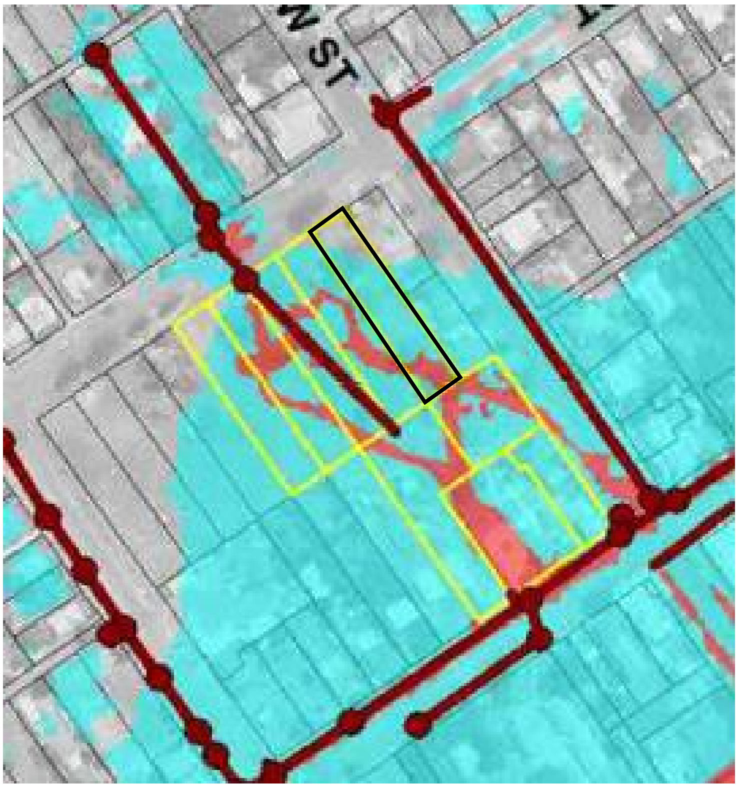
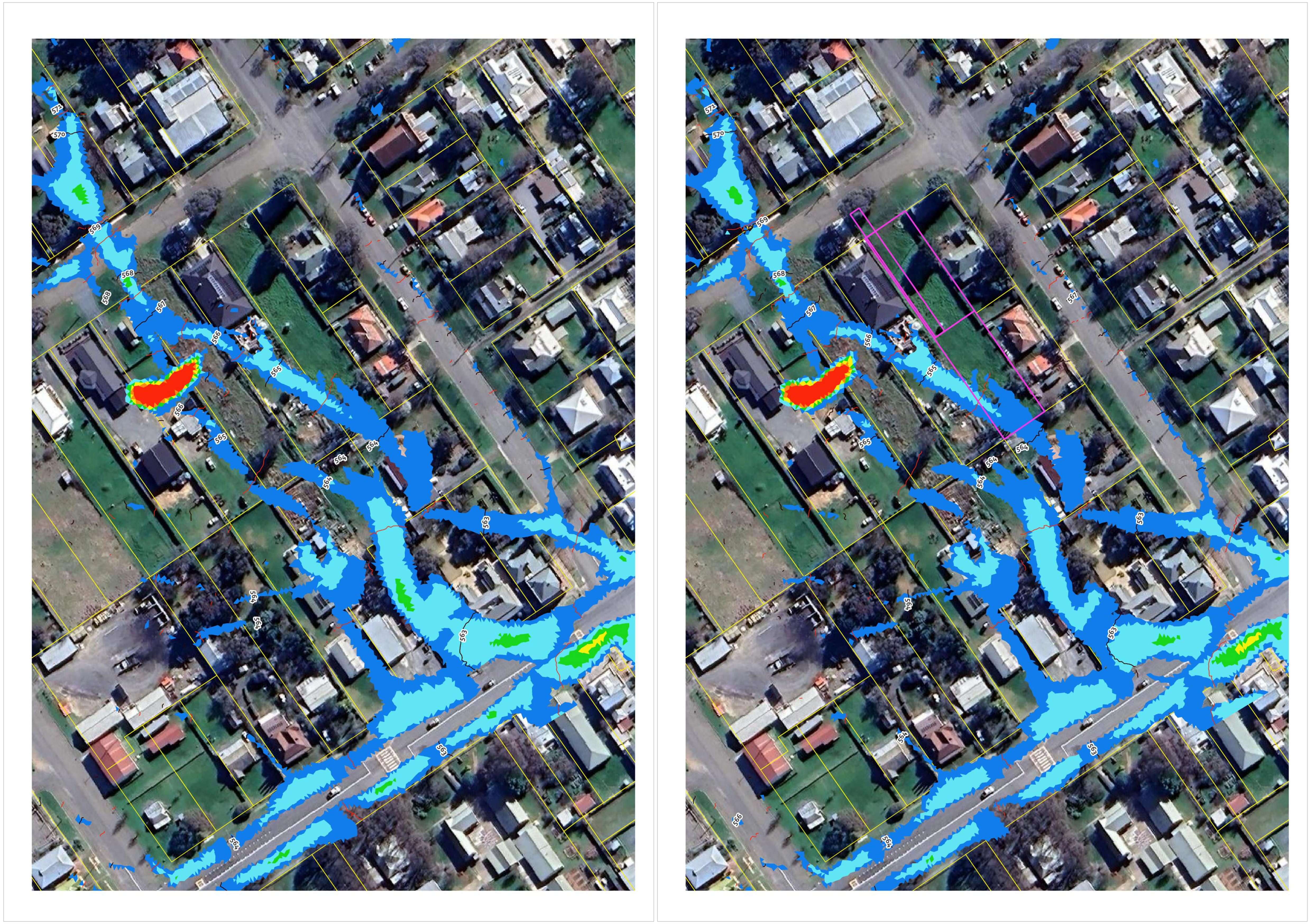


Figure 3. Partial image from the adopted Gunning Village Flood Study (2017) showing the mapped floodway (red), and the 'outer floodplain' (light blue) that burdens the development property which is outlined in black.

APPENDIX A

Figure	Details
A-01	63.2% AEP Pre-Development and Post-Development Water Depths and Levels
A-02	20% AEP Pre-Development and Post-Development Water Depths and Levels
A-03	10% AEP Pre-Development and Post-Development Water Depths and Levels
A-04	5% AEP Pre-Development and Post-Development Water Depths and Levels
A-05	2% AEP Pre-Development and Post-Development Water Depths and Levels
A-06	1% AEP Pre-Development and Post-Development Water Depths and Levels
A-07	63.2% AEP Pre-Development and Post-Development Hydraulic Categories
A-08	20% AEP Pre-Development and Post-Development Hydraulic Categories
A-09	10% AEP Pre-Development and Post-Development Hydraulic Categories
A-10	5% AEP Pre-Development and Post-Development Hydraulic Categories
A-11	2% AEP Pre-Development and Post-Development Hydraulic Categories
A-12	1% AEP Pre-Development and Post-Development Hydraulic Categories
A-13	1% AEP Pre-Development and Post-Development Water Velocity
A-14	1% AEP Pre-Development and Post-Development Velocity x Depth Product
A-15	1% AEP Post-Development v Pre-Development Difference Mapping
A-15	1% AEP Post-Development ‘Dry Now Wet’ & ‘Wet Now Dry’



RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

63.2% AEP
PRE-DEVELOPMENT &
POST DEVELOPMENT
OVERLAND FLOW WATER DEPTHS & LEVELS

FIGURE: A-01

Cadastral boundary
Subdivision Lots

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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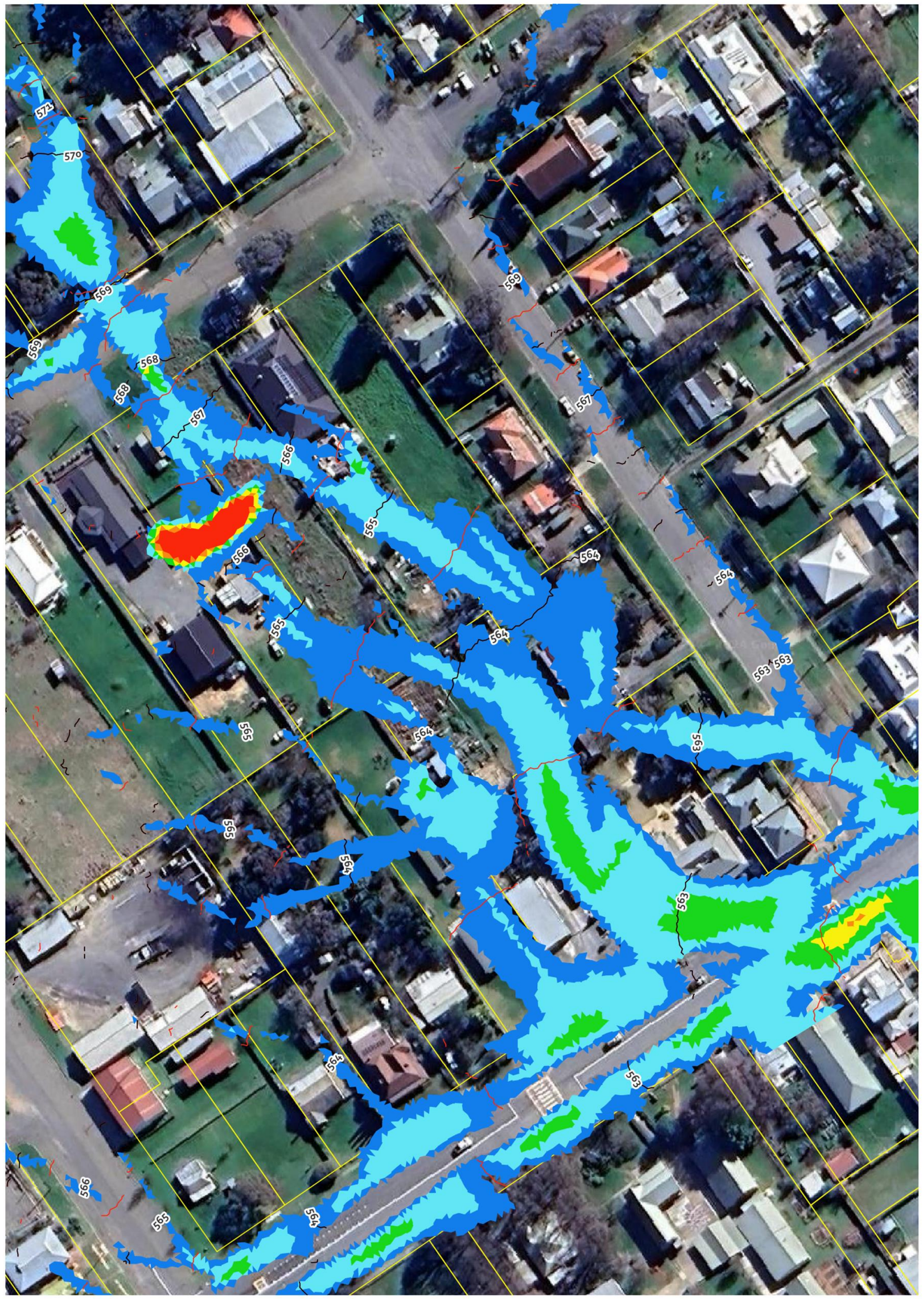

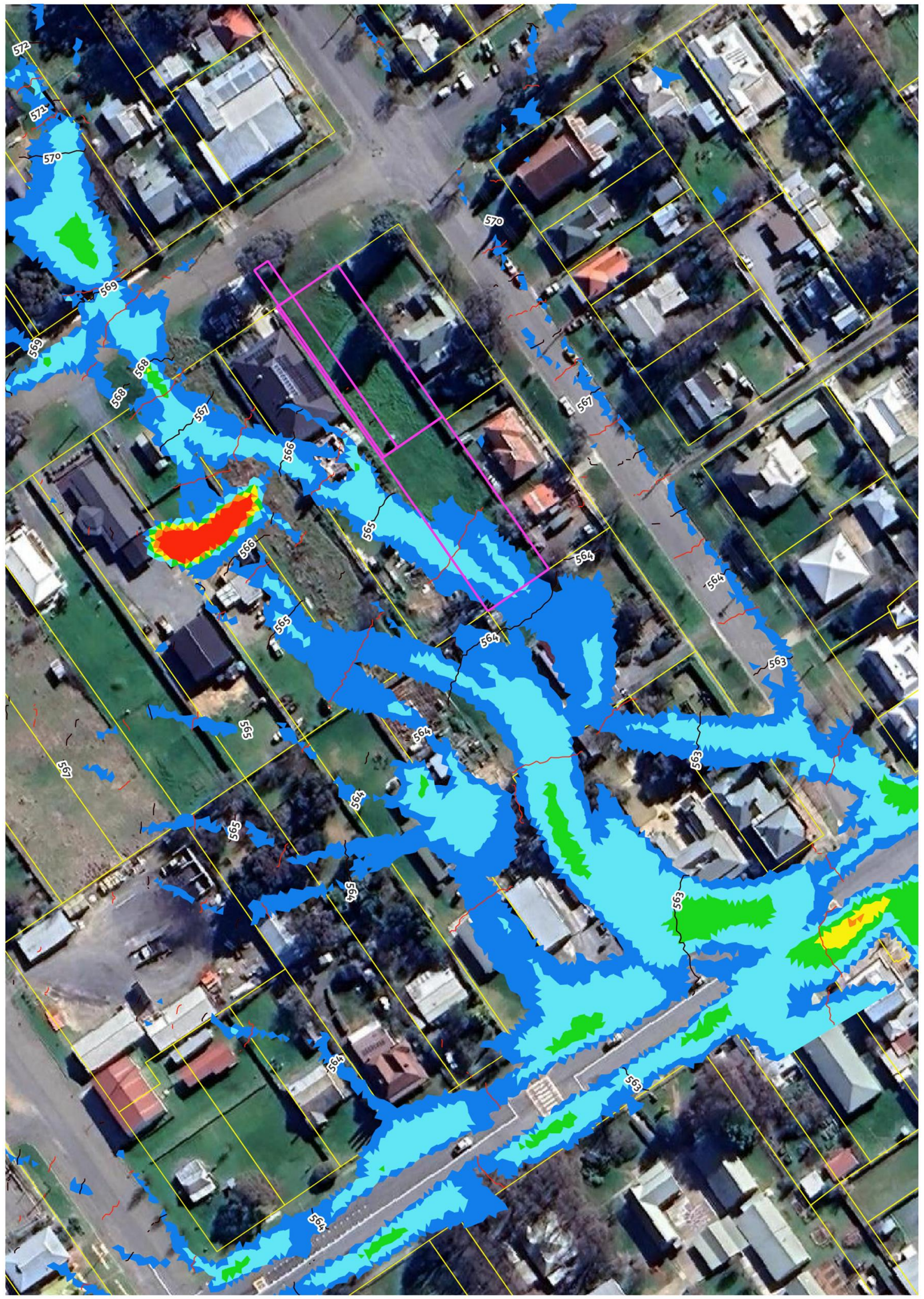

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

20% AEP
PRE-DEVELOPMENT &
POST DEVELOPMENT
OVERLAND FLOW WATER
DEPTHS & LEVELS

FIGURE: A-02

Cadastral boundary

Subdivision Lots

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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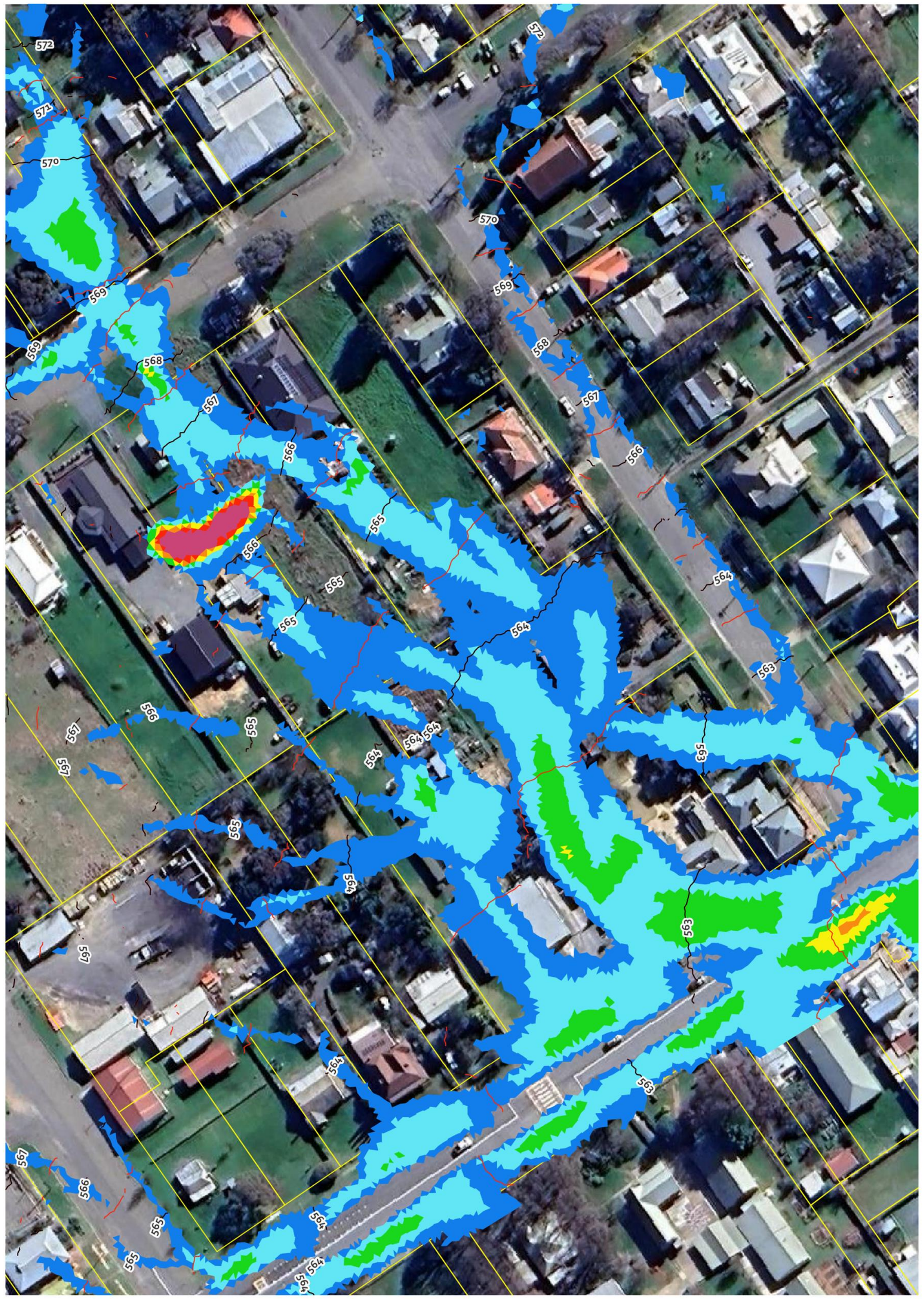

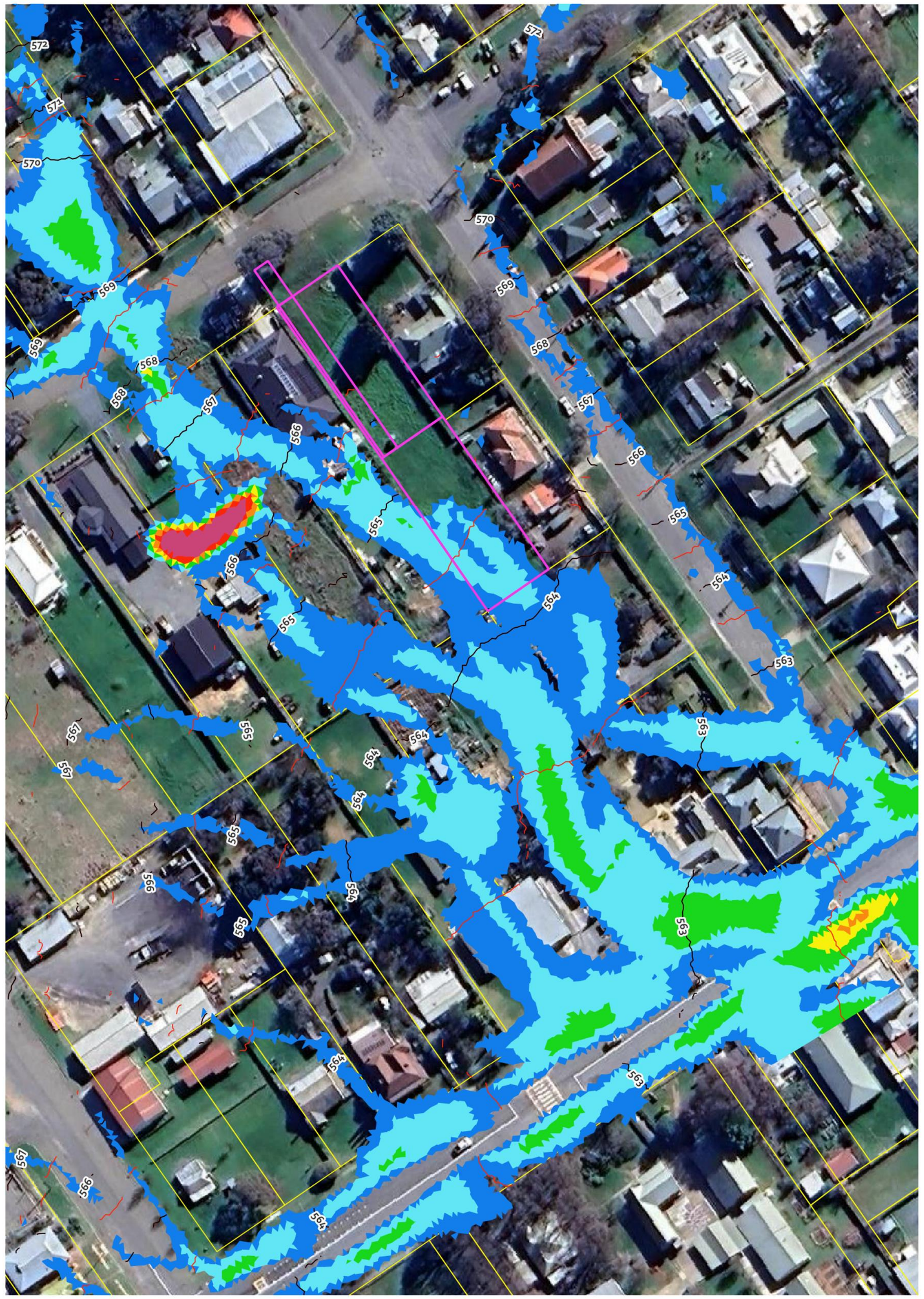

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-03

Cadastral boundary

Subdivision Lots

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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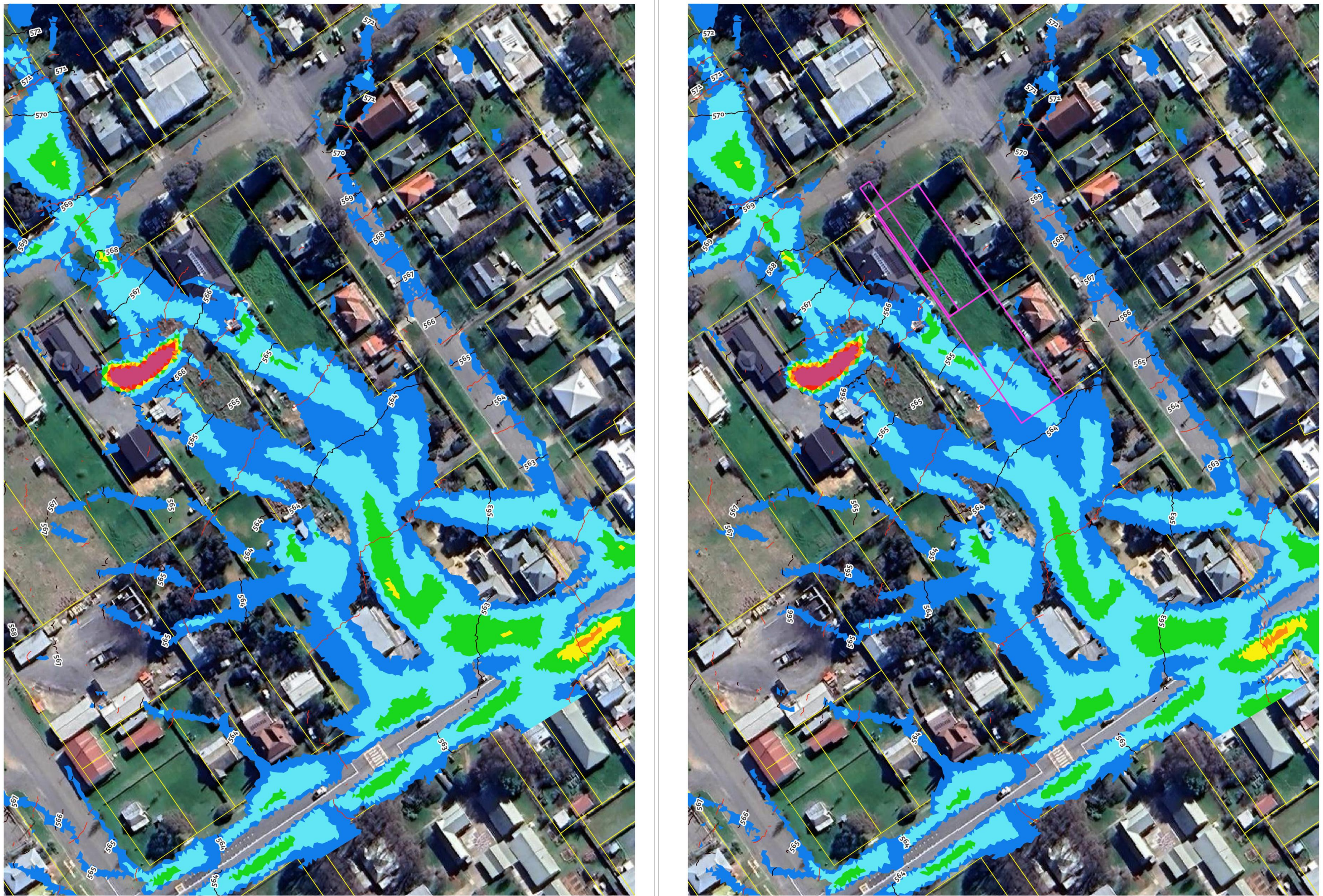

**RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581**

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

FIGURE: A-04

Cadastral boundary

Subdivision Lots

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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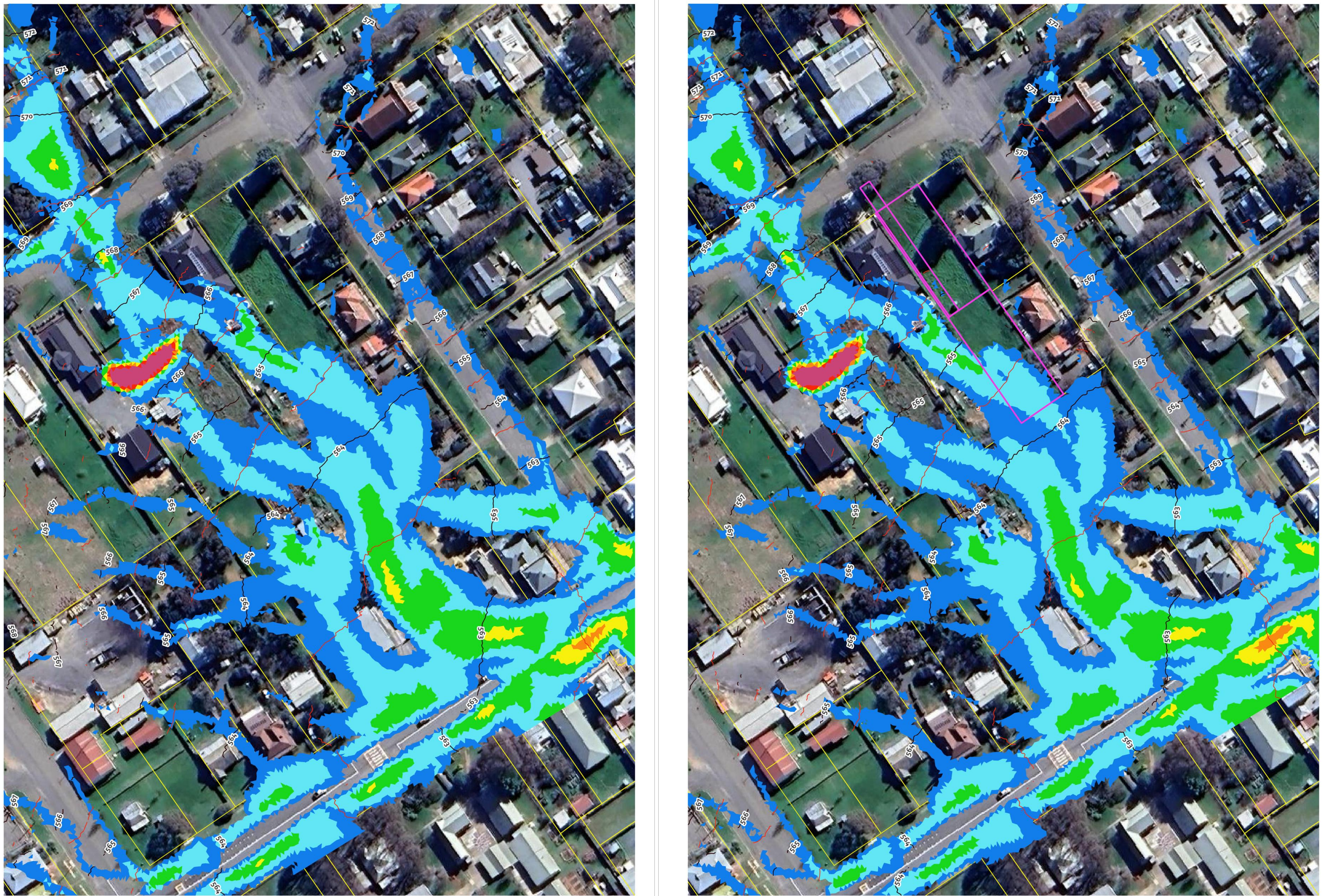

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

2% AEP
PRE-DEVELOPMENT &
POST DEVELOPMENT
OVERLAND FLOW WATER
DEPTHS & LEVELS

FIGURE: A-05

Cadastral boundary

Subdivision Lots

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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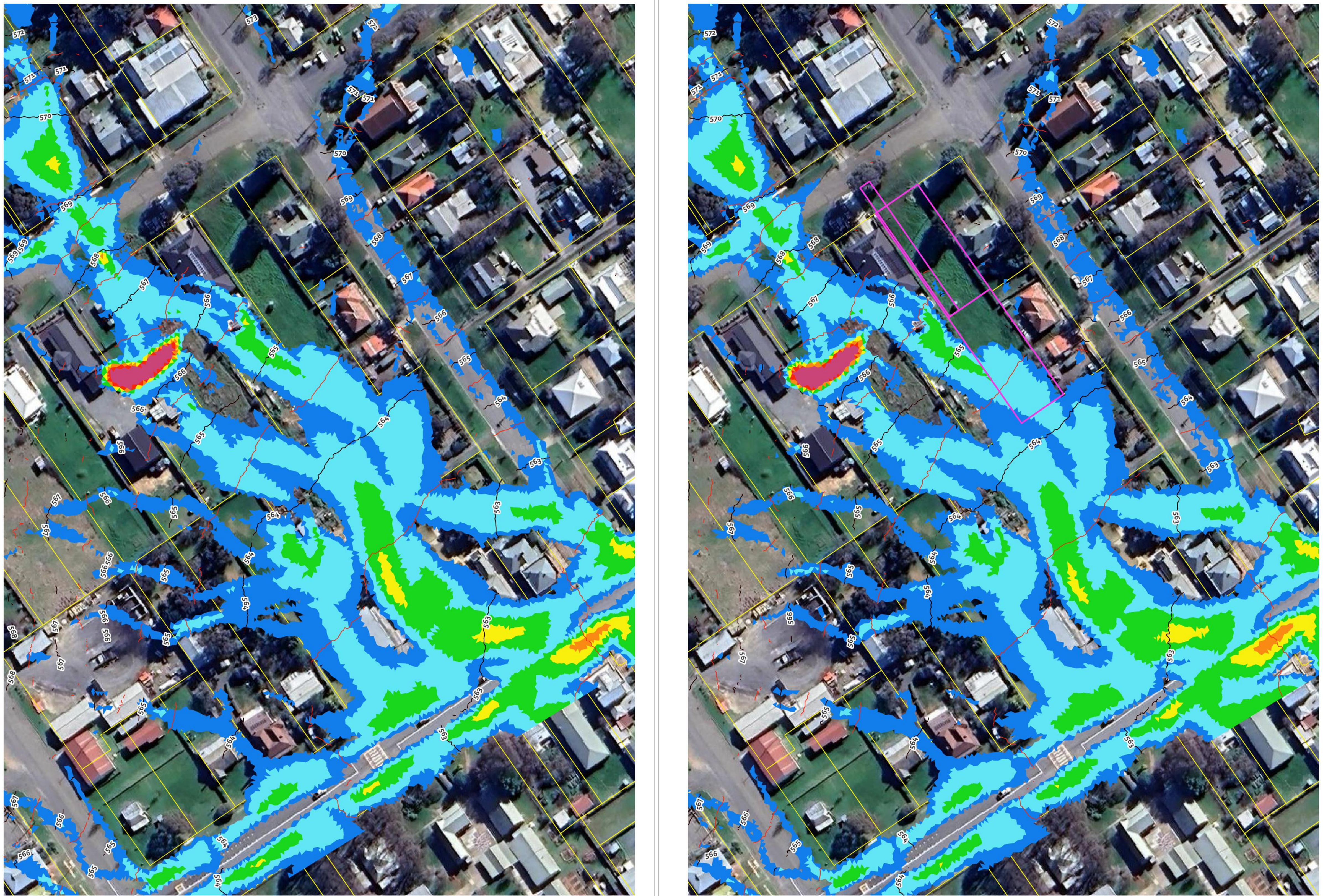

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-06

Cadastral boundary

Subdivision Lots

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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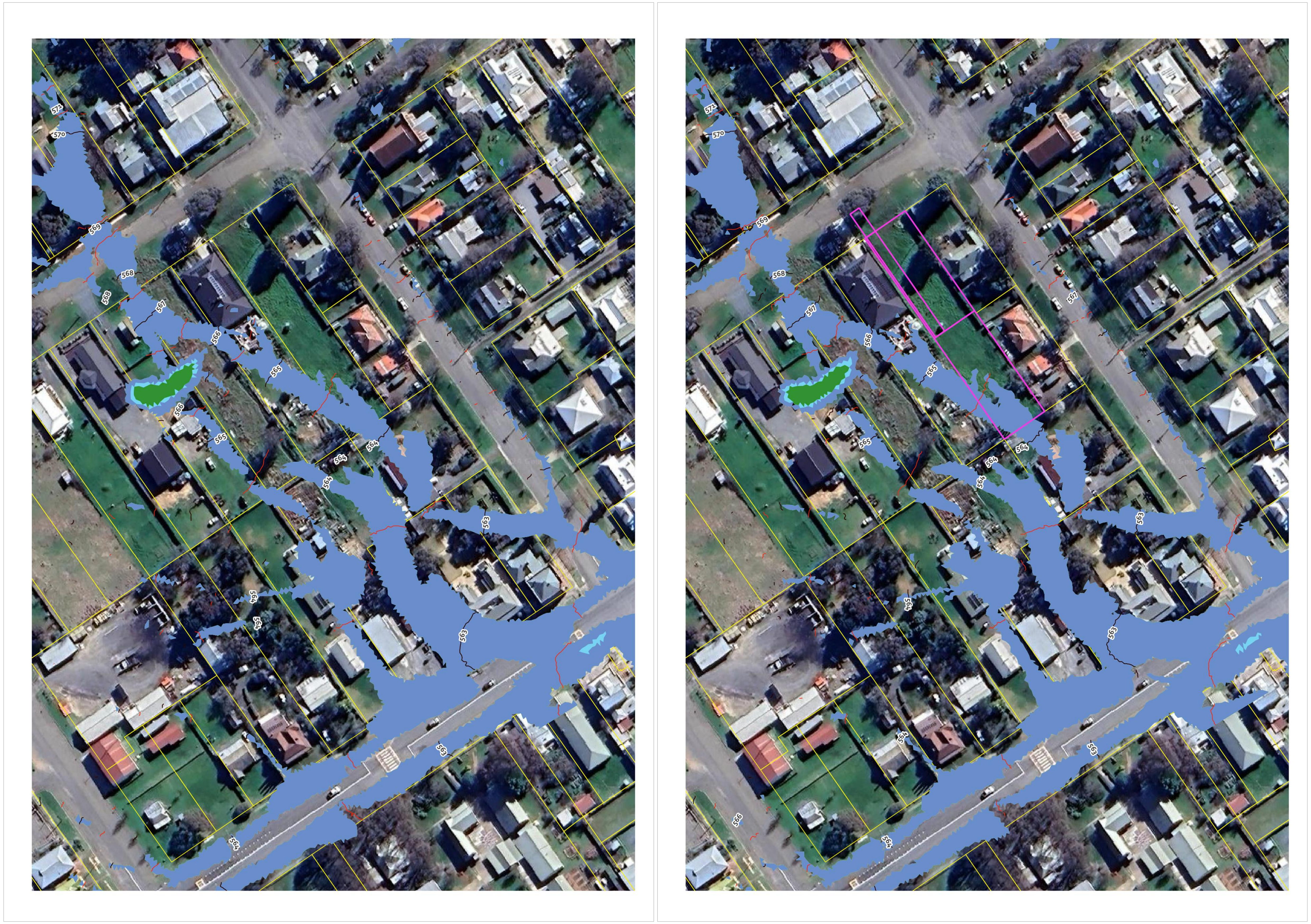

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

63.2% AEP
PRE-DEVELOPMENT &
POST DEVELOPMENT
FLOOD HAZARD
CATEGORY

FIGURE: A-07

Cadastral boundary

Subdivision Lots

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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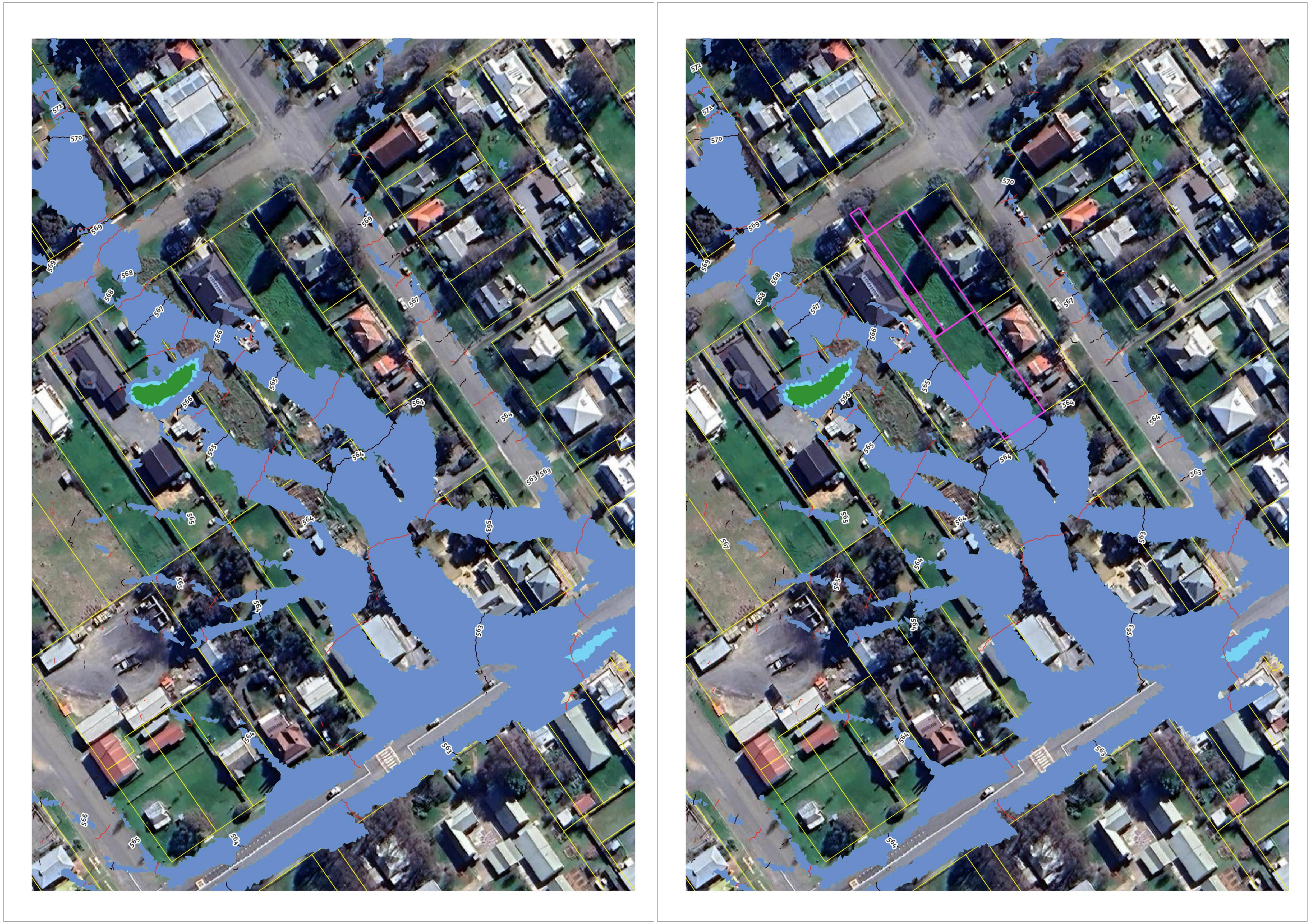

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

20% AEP
PRE-DEVELOPMENT &
POST DEVELOPMENT
FLOOD HAZARD
CATEGORY

FIGURE: A-08

Cadastral boundary

Subdivision Lots

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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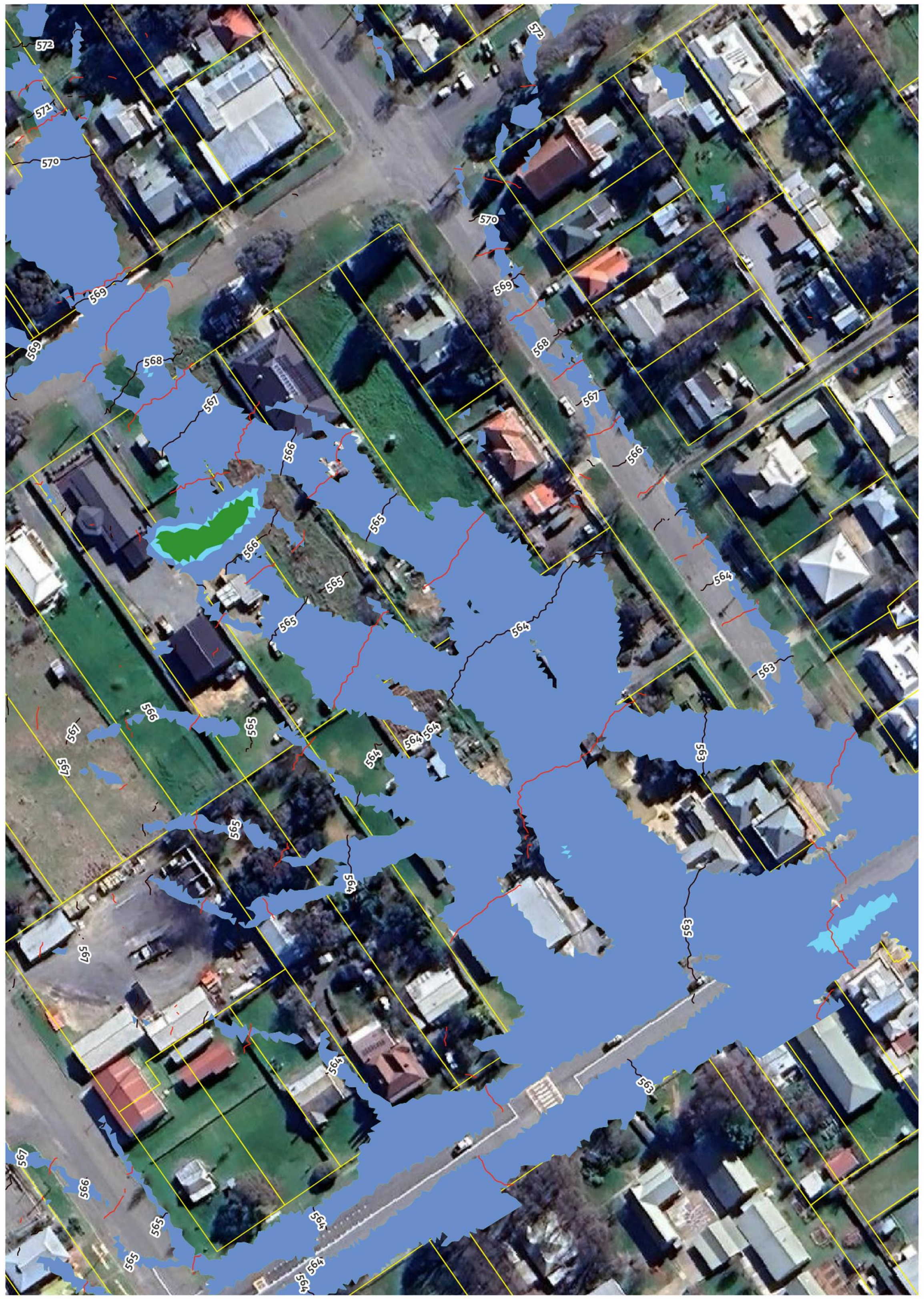

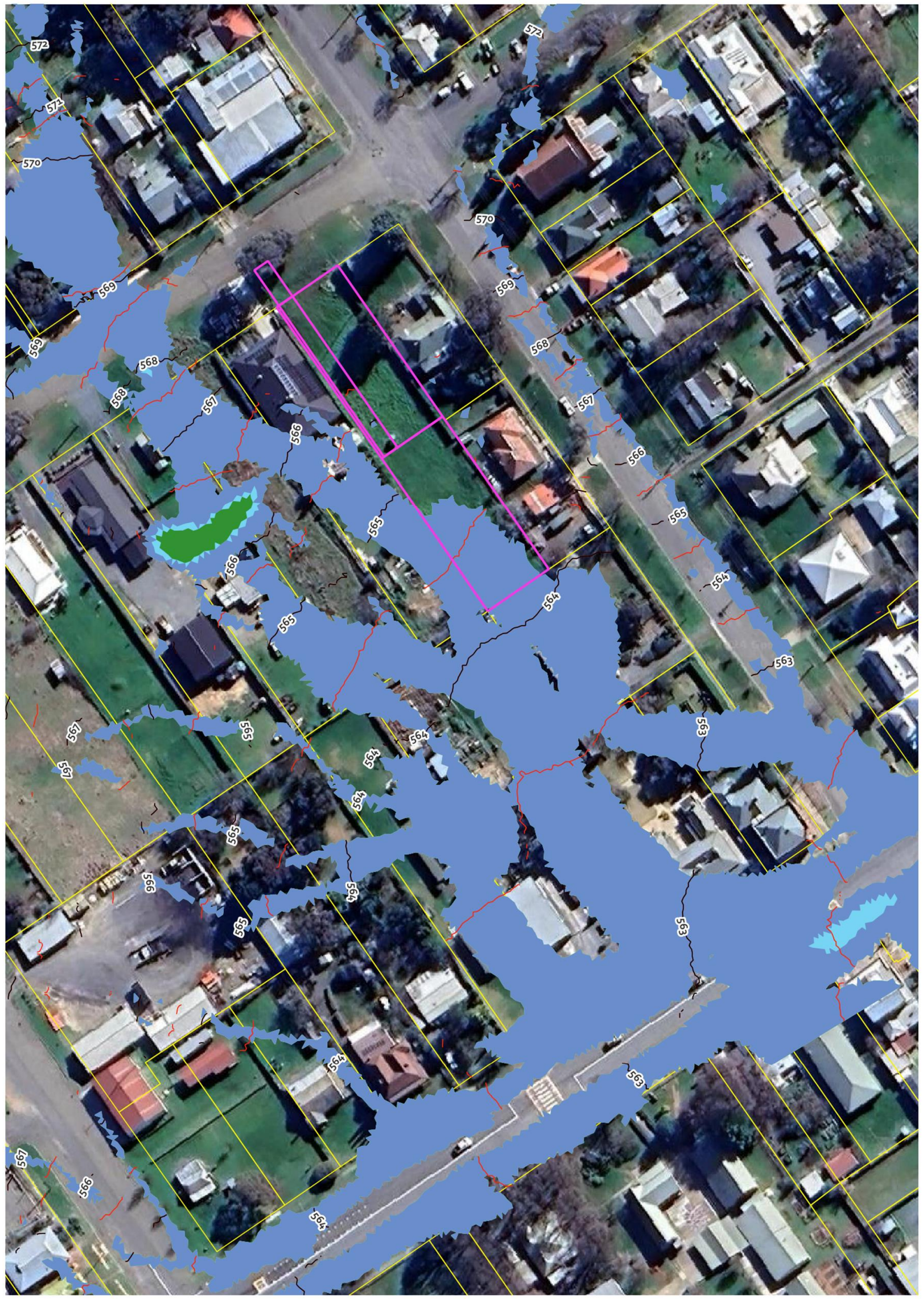

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-09

Cadastral boundary

Subdivision Lots

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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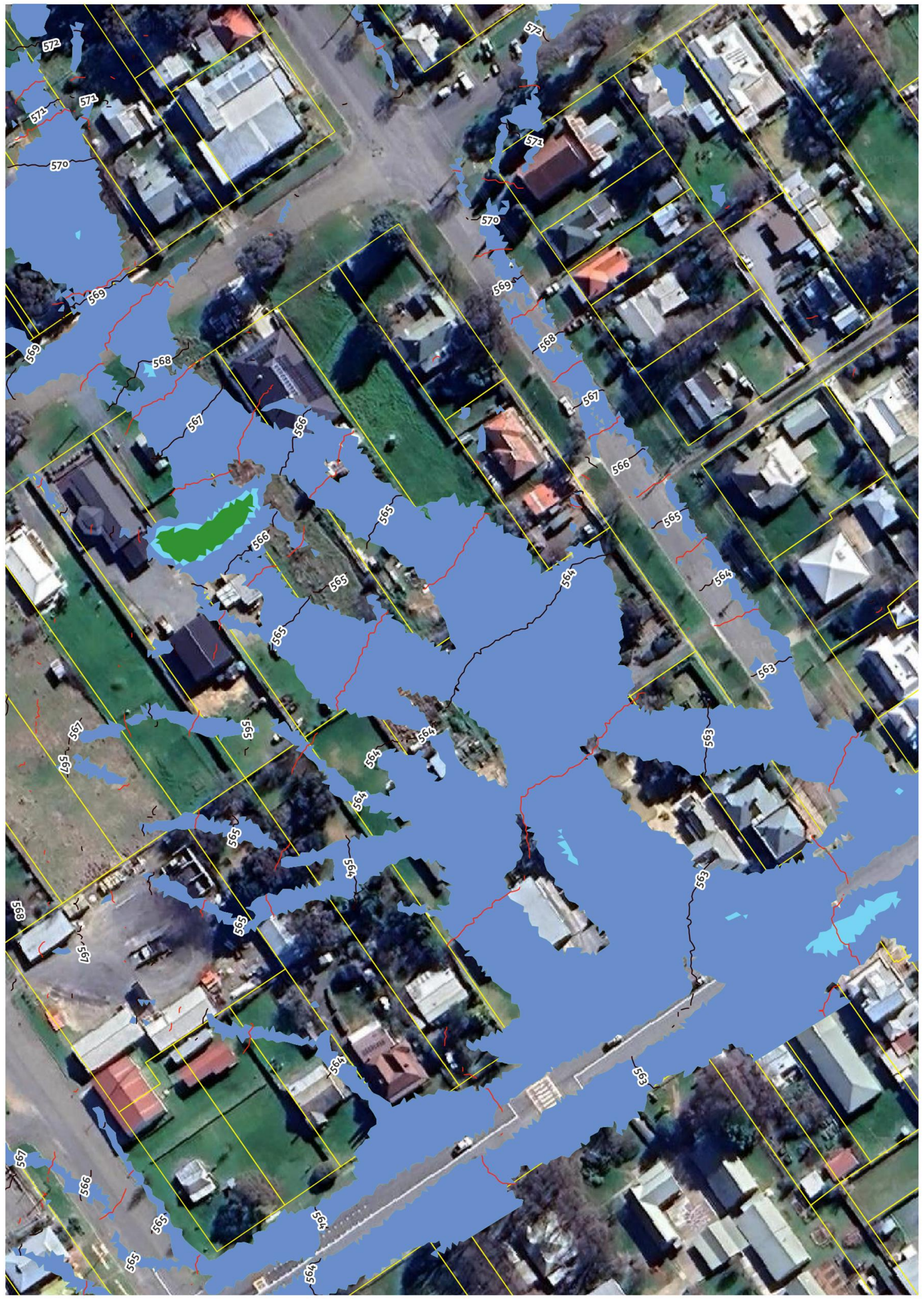

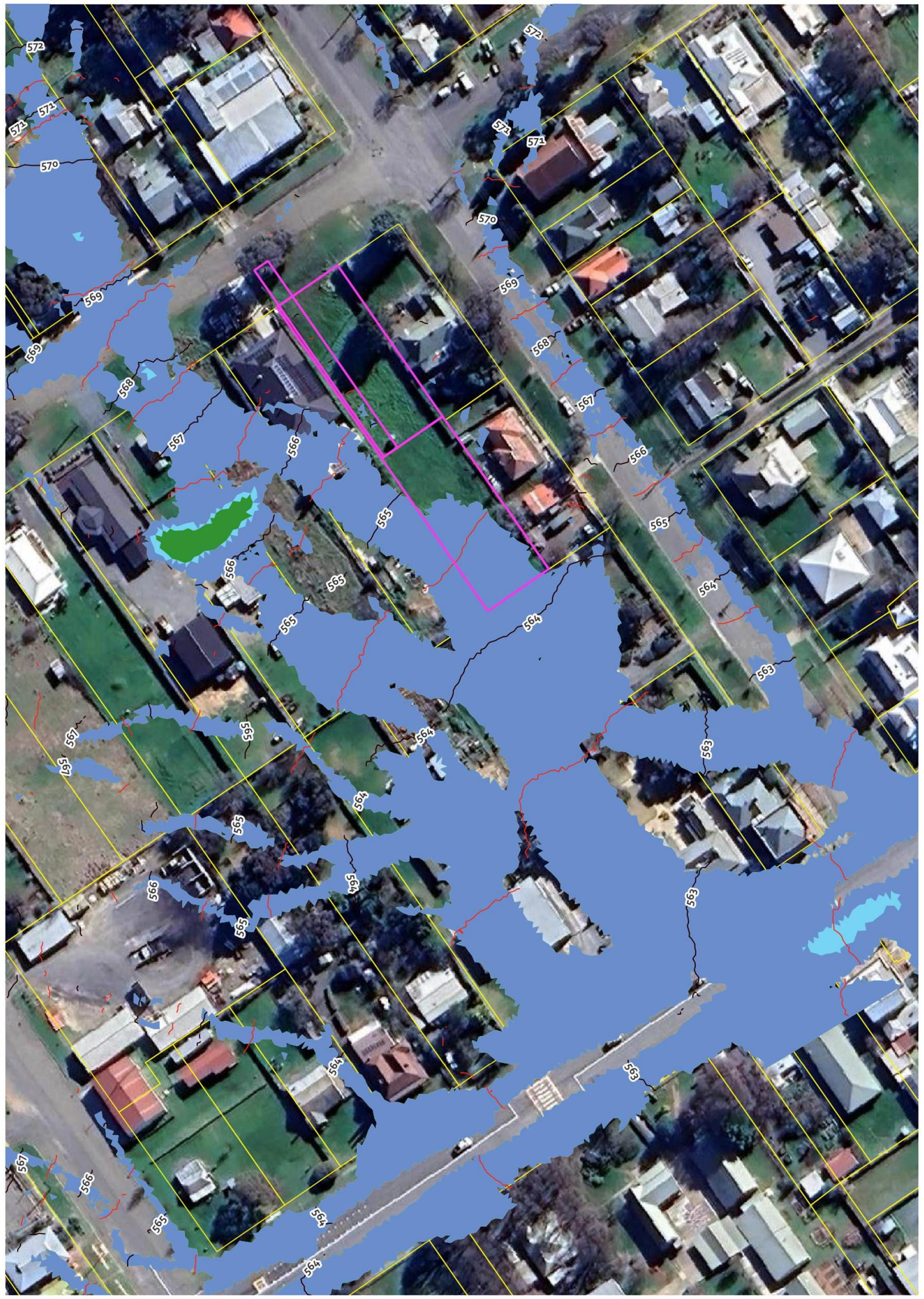

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-10

Cadastral boundary

Subdivision Lots

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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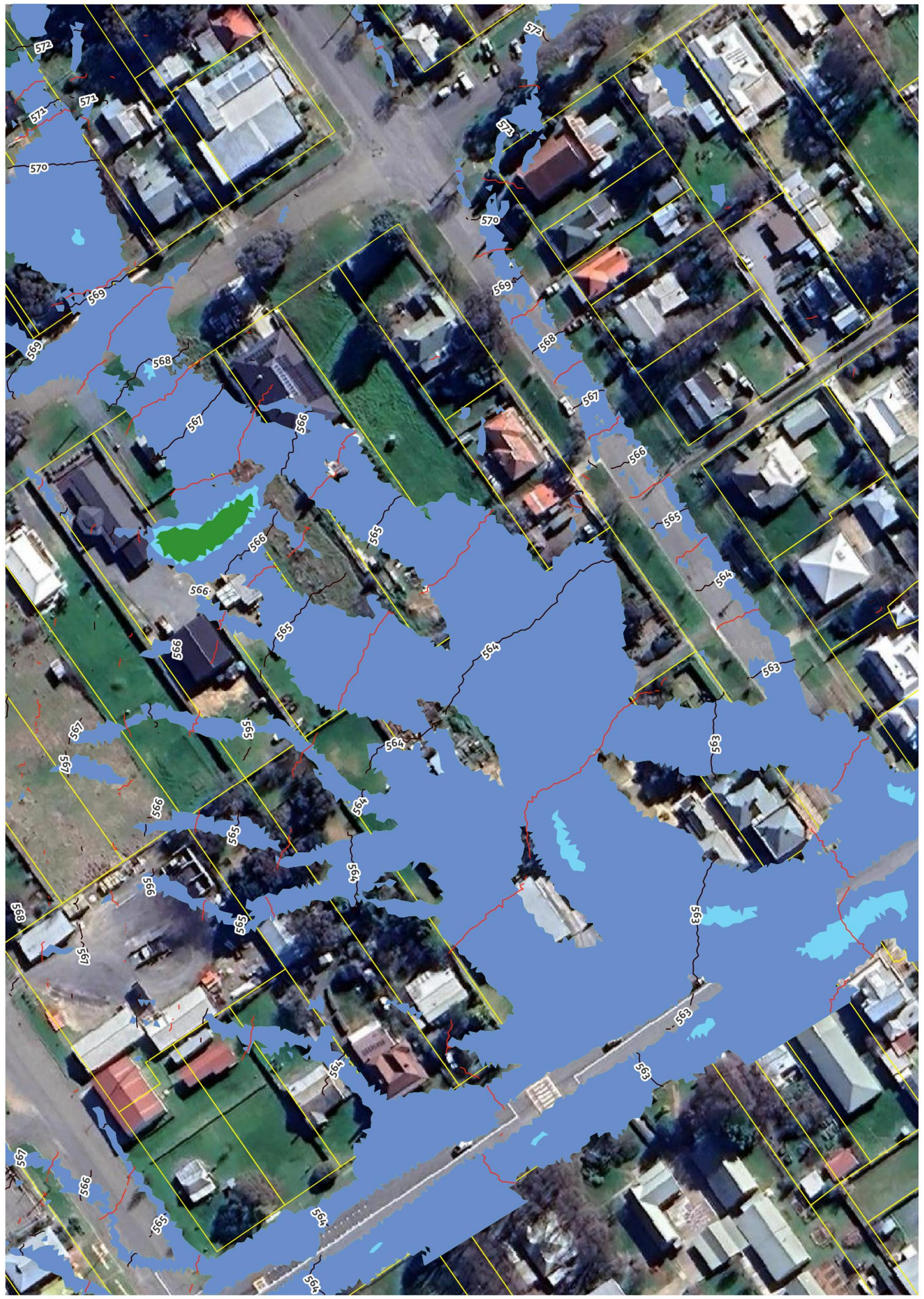

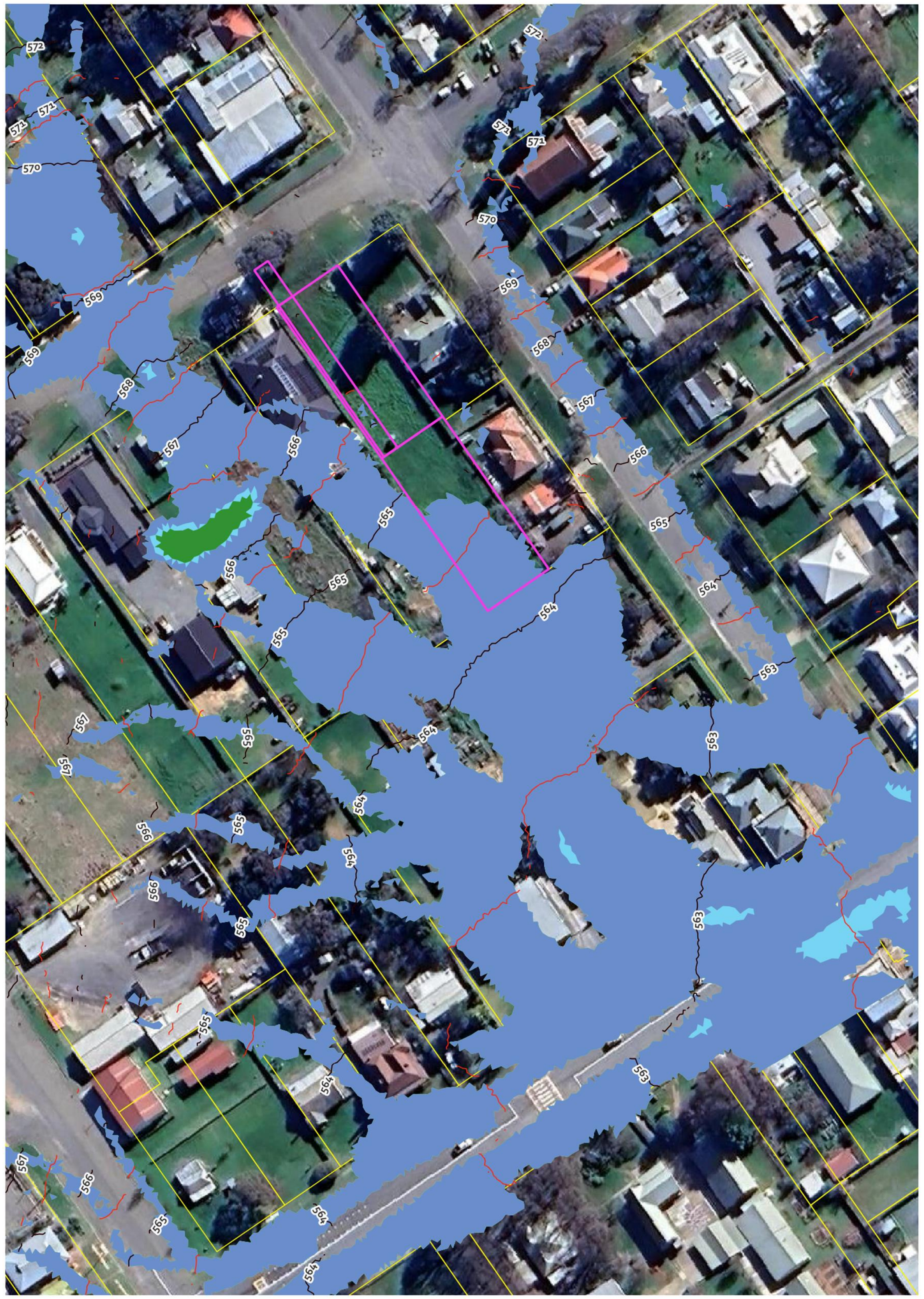

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

2% AEP
PRE-DEVELOPMENT &
POST DEVELOPMENT
FLOOD HAZARD
CATEGORY

FIGURE: A-11

Cadastral boundary

Subdivision Lots

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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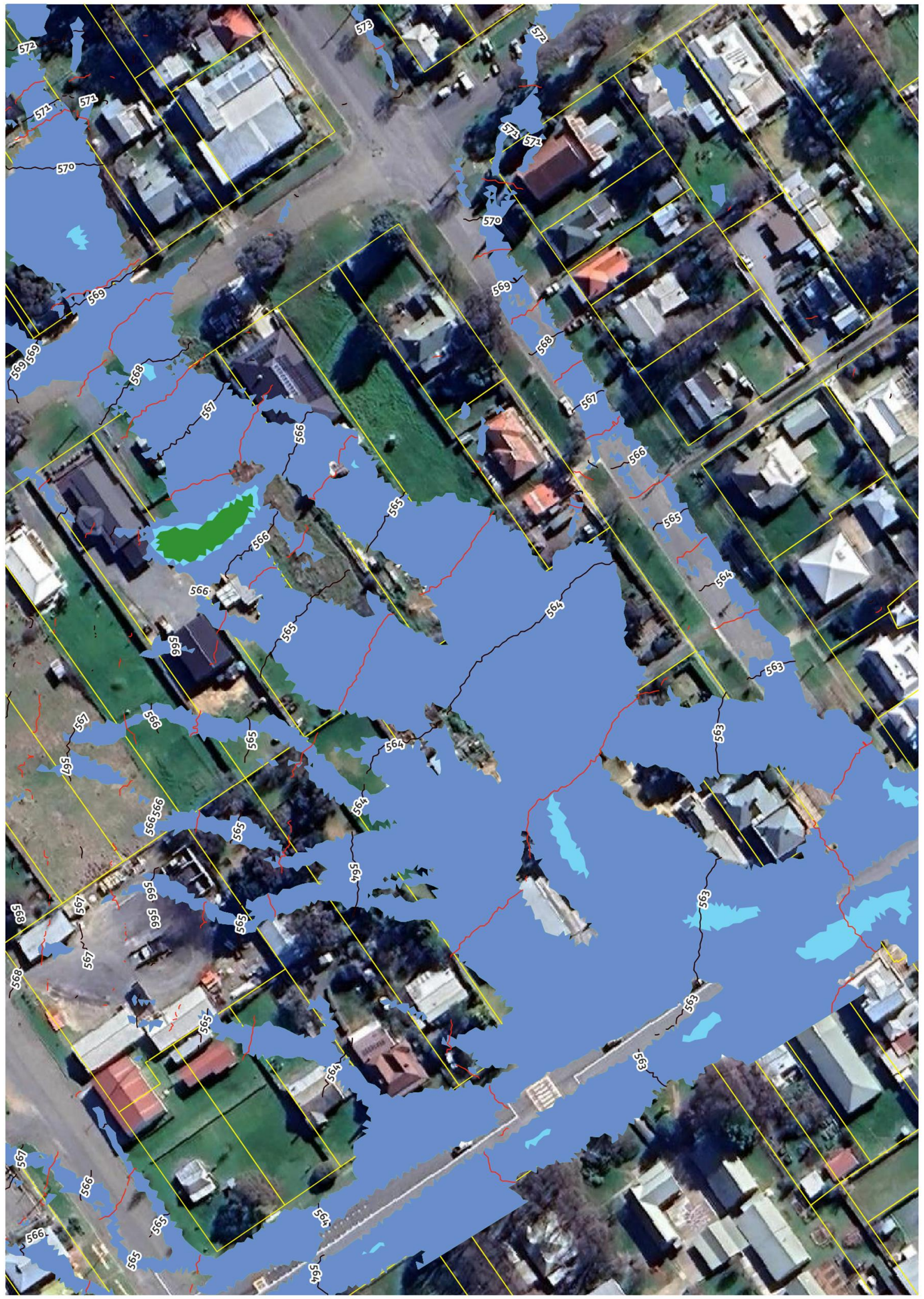

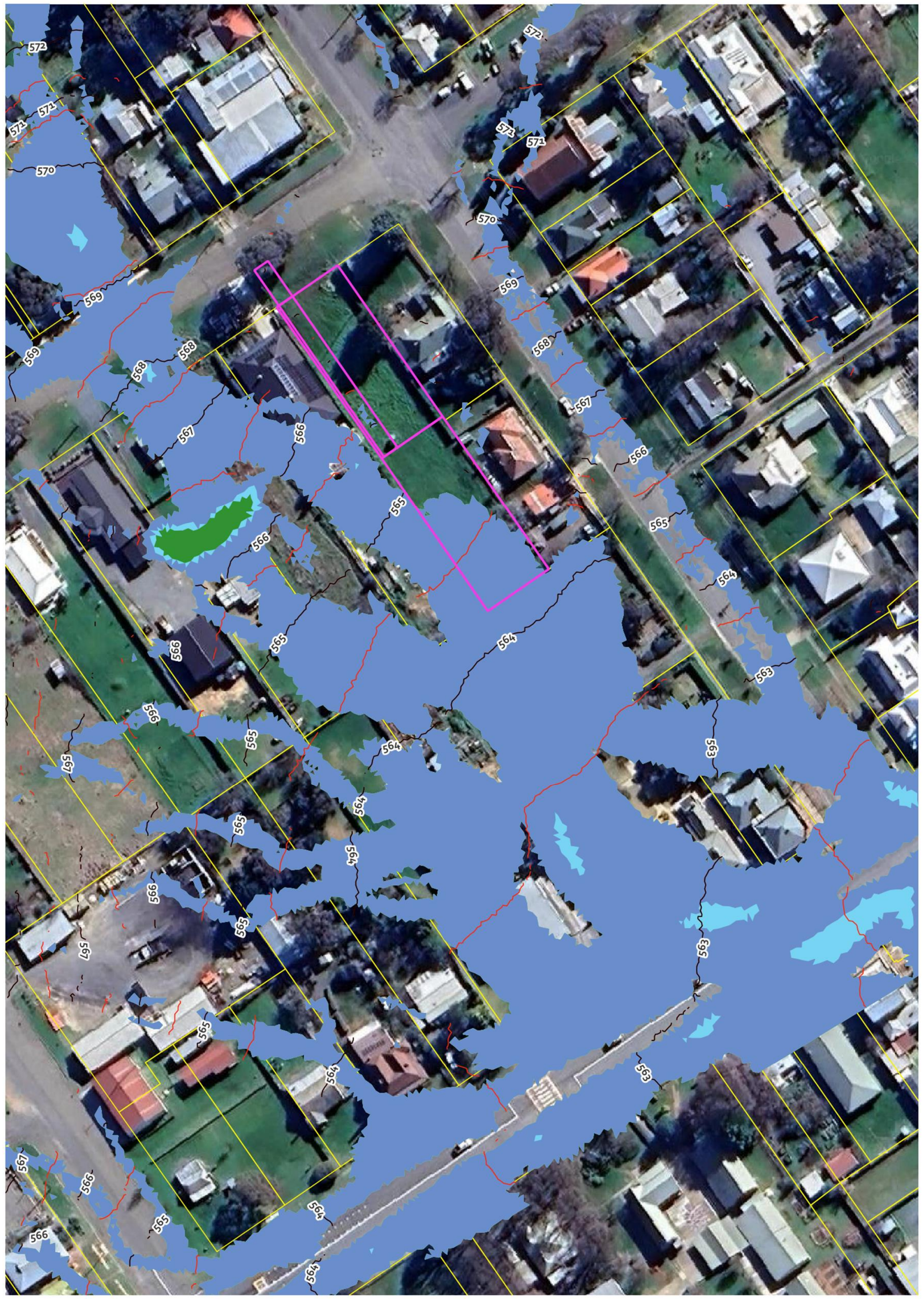

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-12

Cadastral boundary

Subdivision Lots

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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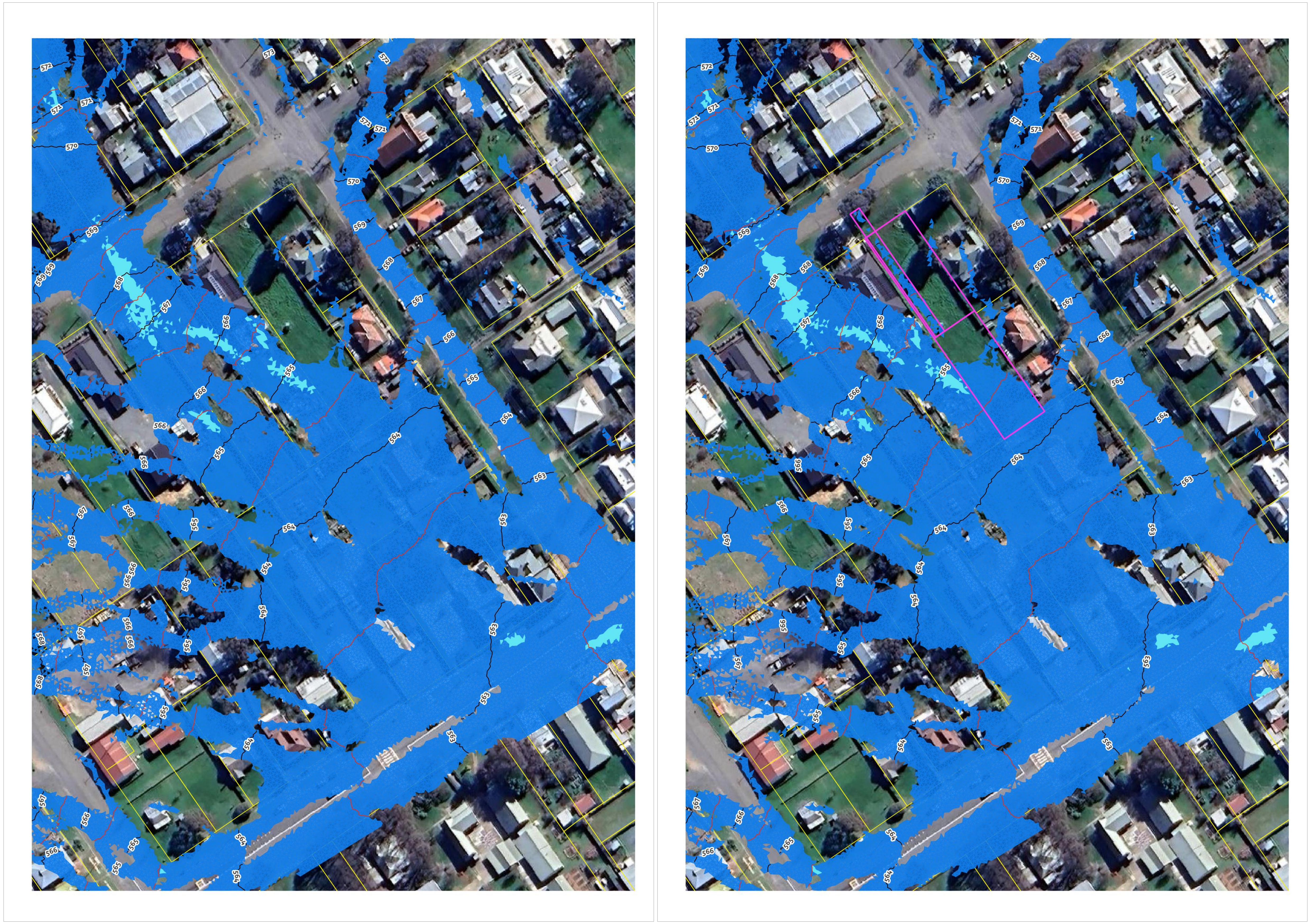


RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-13

Cadastral boundary

Subdivision Lots

Velocity Category

0.01 – 0.25

0.25 – 0.50

0.50 – 1.0

1.0 – 1.5

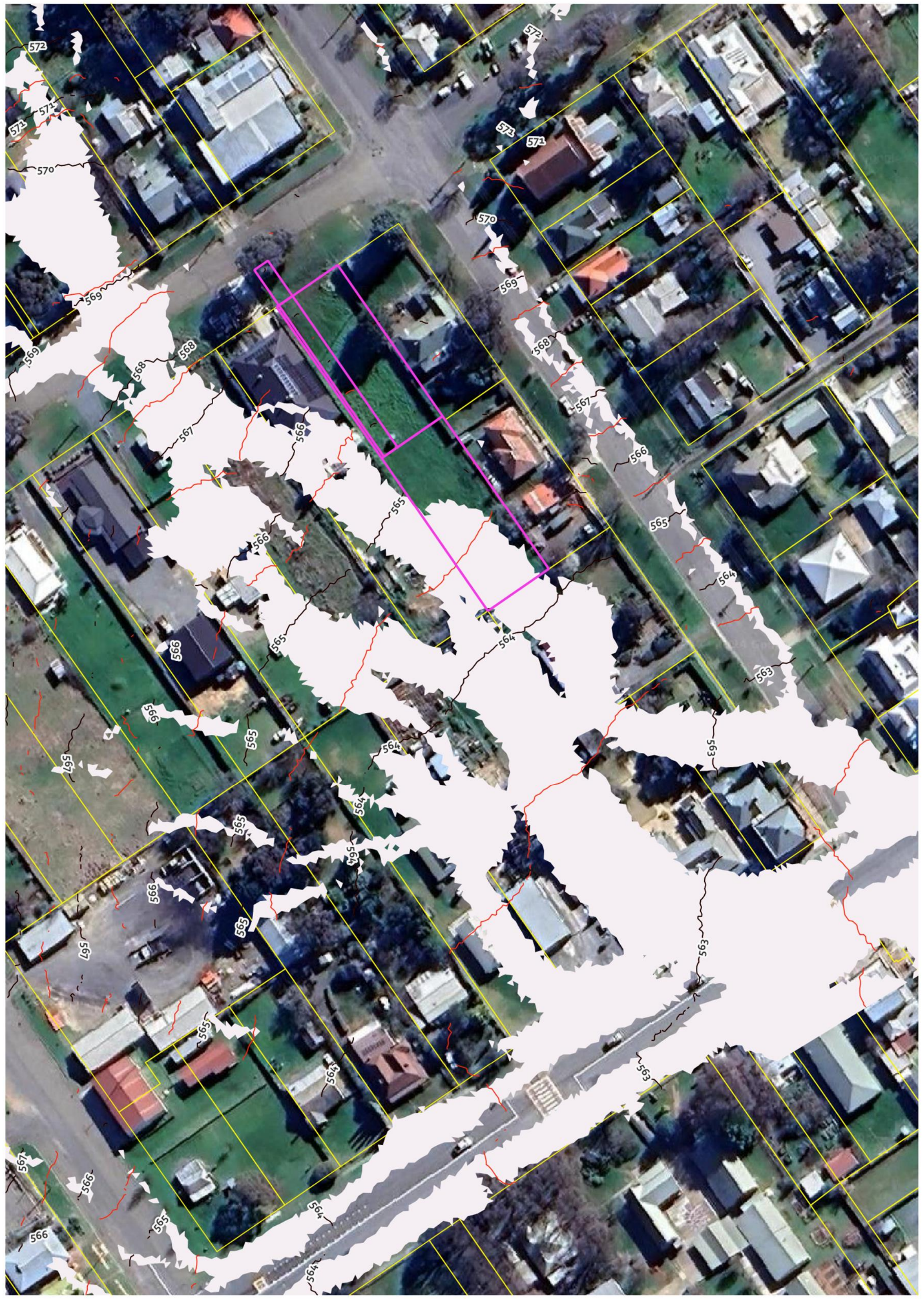
1.5 – 2.0

2.0 – 2.5

2.5 – 3.0

3.0 – 5.0

SOWDES
PO Box 619
Goulburn. 2580
sowdes@sowdes.com
0428 863 401



RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

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

FIGURE: A-14

Cadastral boundary

Subdivision Lots

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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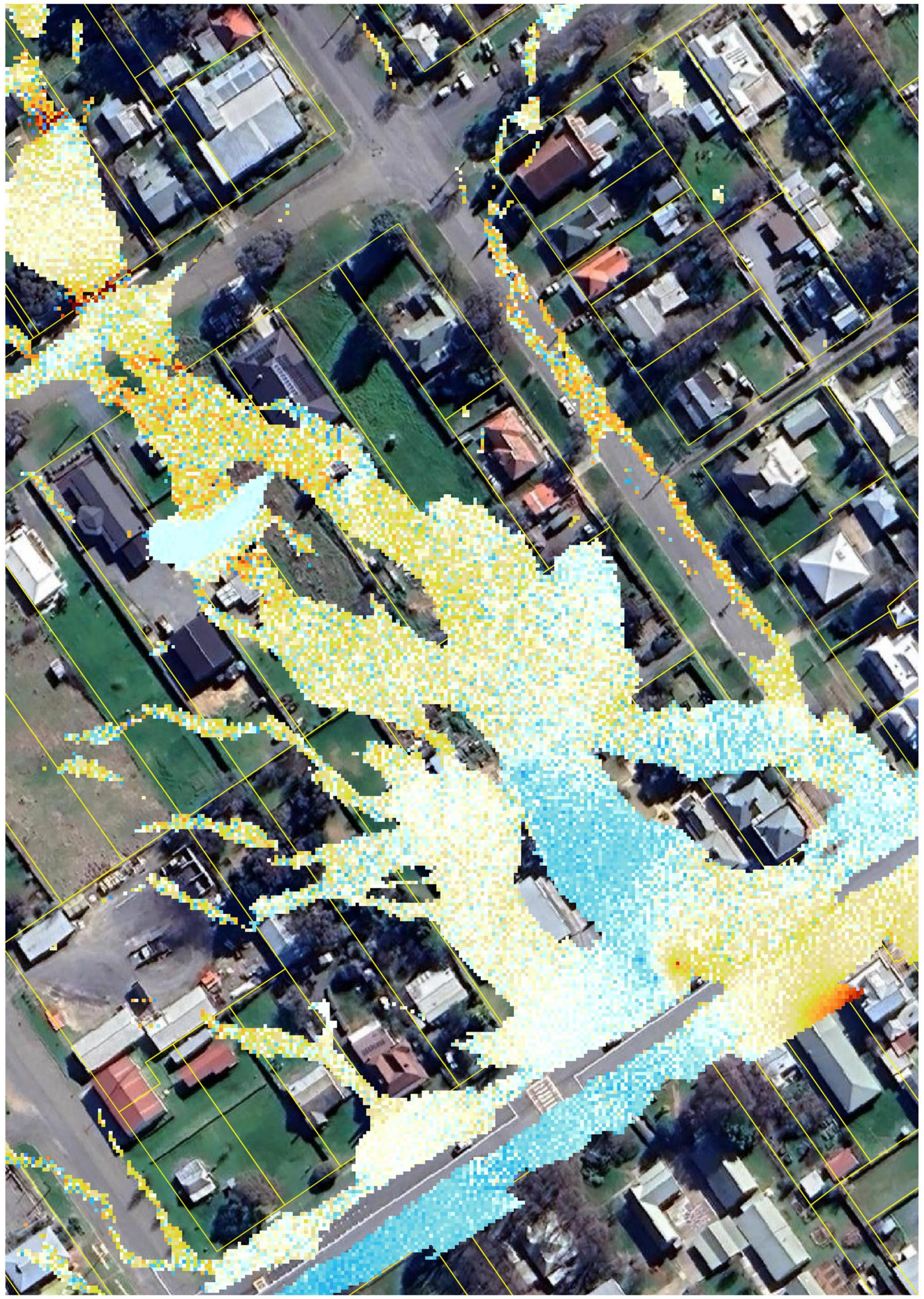

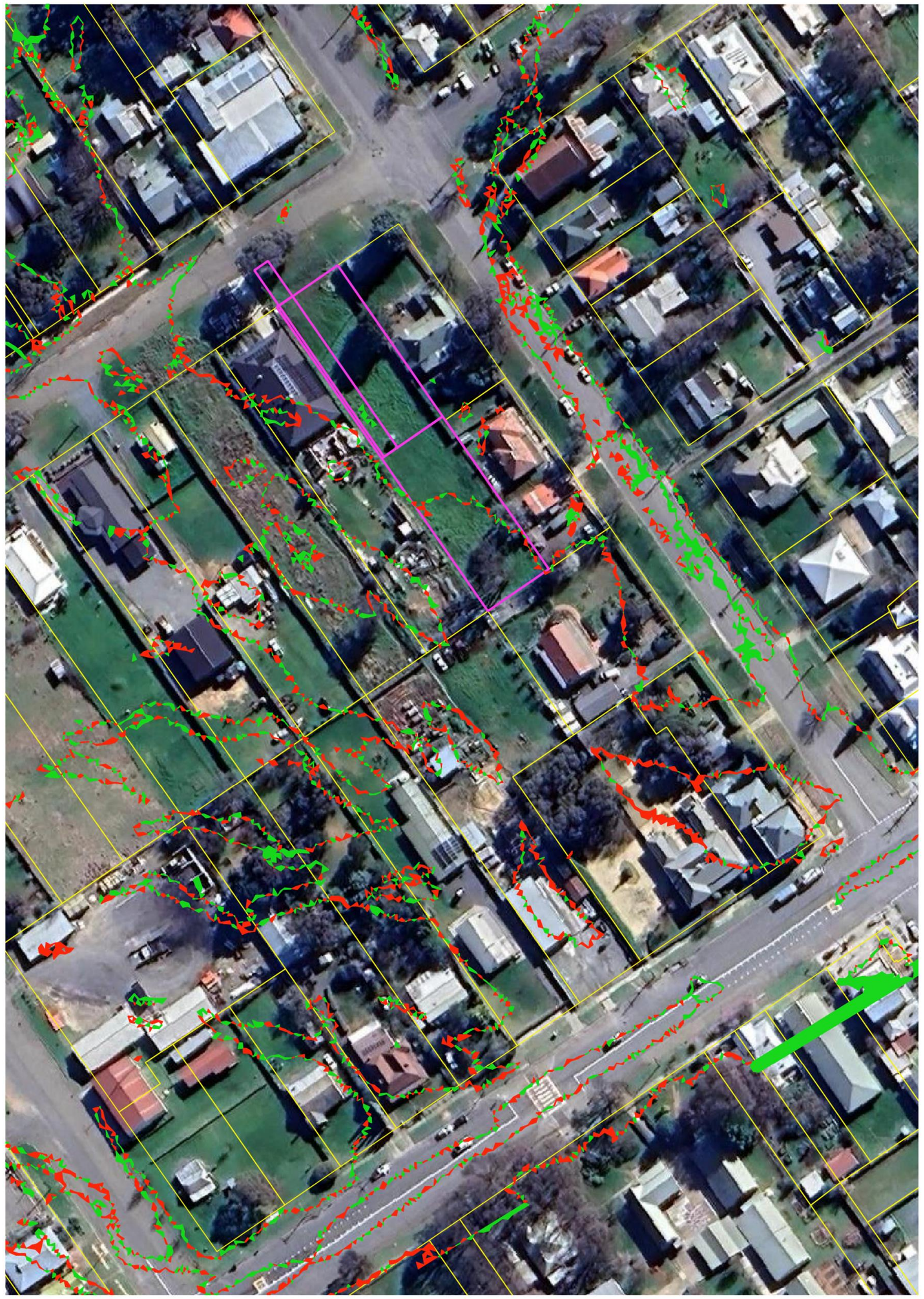

RESIDENTIAL SUBDIVISION
50 BIALA STREET
GUNNING. NSW. 2581

DIFFERENCE MAPPING
POST-DEVELOPMENT
LESS
PRE-DEVELOPMENT

FIGURE: A-15

Cadastral boundary

Subdivision Lots

WATER LEVEL DIFFERENCES (m) FOR DEPTHS >50mm

-0.170 <
-0.100 to -0.170
-0.050 to -0.100
-0.025 to -0.050
-0.010 to -0.025
-0.005 to -0.010
0.000
0.005 to 0.010
0.010 to 0.025
0.025 to 0.050
0.050 to 0.100
0.100 to 0.130
0.130 to 0.160
0.160 to 0.190
0.190>

Dry now wet

Wet now dry

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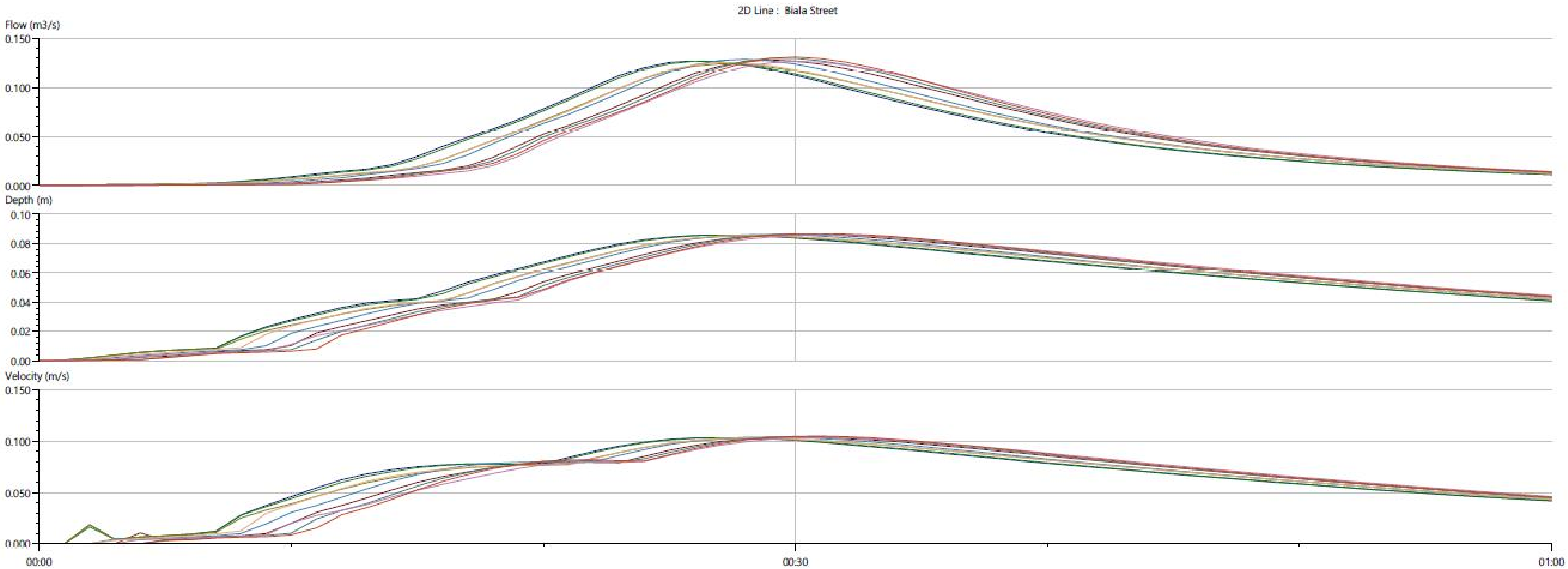
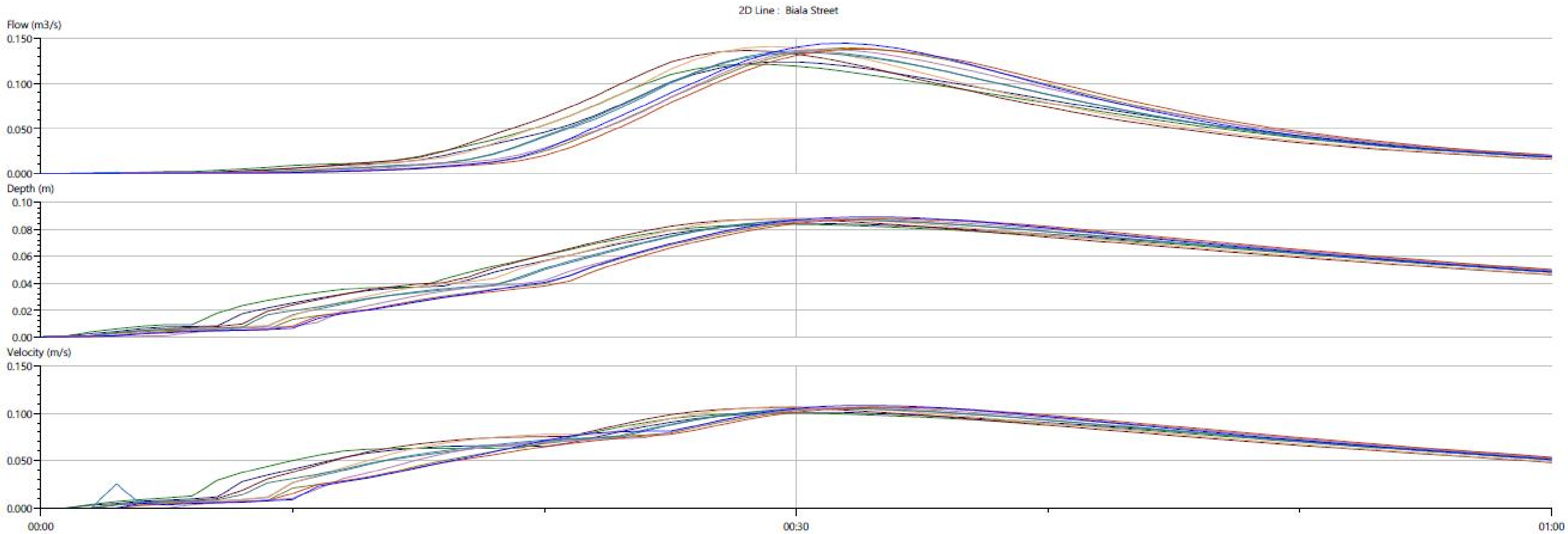
APPENDIX B – Results Graphs for Pre-Development Peak Flows

Figure	Details
B-01	63.2% - 20 minute
B-02	63.2% - 25 minute
B-03	63.2% - 30 minute – Temporal Pattern (TP) 8 used in the flood modelling analysis
B-04	63.2% - 45 minute
B-05	63.2% - 60 minute
B-06	63.2% - 90 minute
B-07	63.2% - 120 minute
B-08	20% - 20 minute
B-09	20% - 25 minute
B-10	20% - 30 minute – Temporal Pattern (TP) 8 used in the flood modelling analysis
B-11	20% - 45 minute
B-12	20% - 60 minute
B-13	20% - 90 minute
B-14	20% - 120 minute
B-15	10% - 20 minute
B-16	10% - 25 minute – Temporal Pattern (TP) 3 used in the flood modelling analysis
B-17	10% - 30 minute
B-18	10% - 45 minute
B-19	10% - 60 minute
B-20	10% - 90 minute
B-21	10% - 120 minute
B-22	5% - 20 minute – Temporal Pattern (TP) 2 used in the flood modelling analysis
B-23	5% - 25 minute
B-24	5% - 30 minute
B-25	5% - 45 minute
B-26	5% - 60 minute
B-27	5% - 90 minute
B-28	5% - 120 minute
B-29	2% - 20 minute
B-30	2% - 25 minute – Temporal Pattern (TP) 6 used in the flood modelling analysis
B-31	2% - 30 minute
B-32	2% - 45 minute
B-33	2% - 60 minute
B-34	2% - 90 minute
B-35	2% - 120 minute
B-36	1% - 20 minute – Temporal Pattern (TP) 3 used in the flood modelling analysis
B-37	1% - 25 minute
B-38	1% - 30 minute
B-39	1% - 45 minute
B-40	1% - 60 minute
B-41	1% - 90 minute
B-42	1% - 120 minute



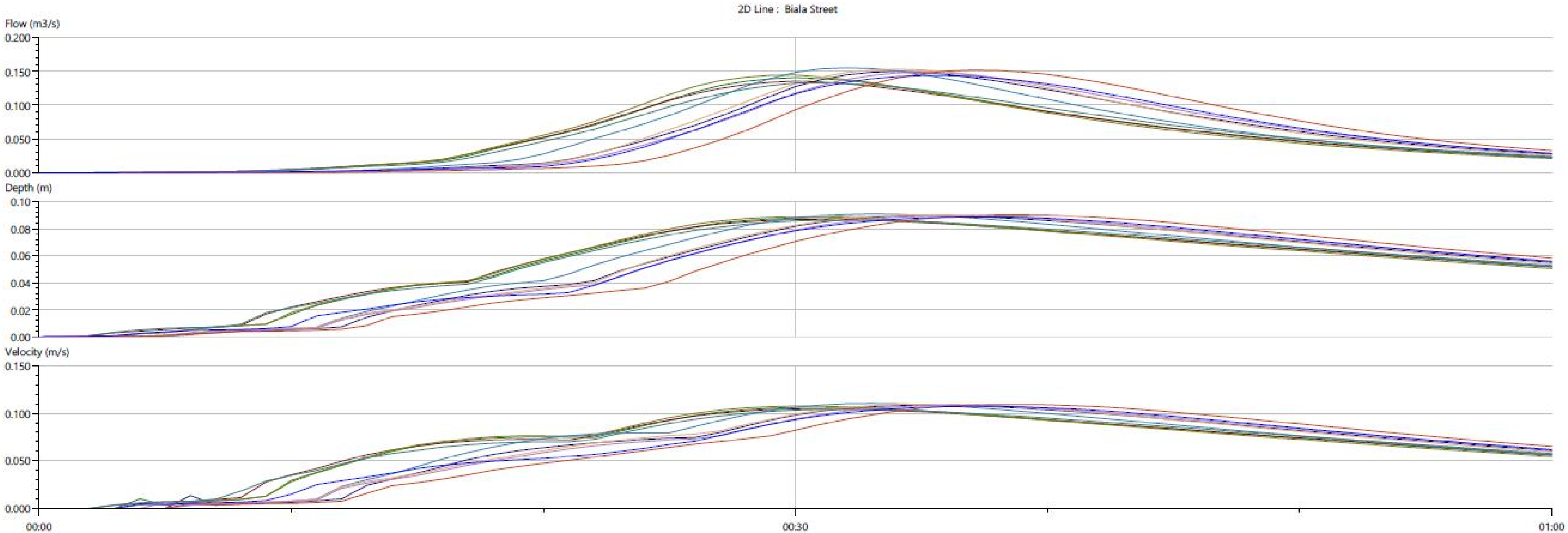
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_63pct_20min_2	0.000	0.127	171.356	0.000	0.086	0.000	0.103
...3.2 to 1% 20min to 45min>MB_63pct_20min_3	0.000	0.127	171.334	0.000	0.086	0.000	0.103
...3.2 to 1% 20min to 45min>MB_63pct_20min_4	0.000	0.128	170.359	0.000	0.086	0.000	0.104
...3.2 to 1% 20min to 45min>MB_63pct_20min_5	0.000	0.124	170.214	0.000	0.085	0.000	0.102
...3.2 to 1% 20min to 45min>MB_63pct_20min_6	0.000	0.129	171.209	0.000	0.086	0.000	0.104
...3.2 to 1% 20min to 45min>MB_63pct_20min_7	0.000	0.126	170.328	0.000	0.085	0.000	0.103
...3.2 to 1% 20min to 45min>MB_63pct_20min_8	0.000	0.130	170.668	0.000	0.086	0.000	0.104
...3.2 to 1% 20min to 45min>MB_63pct_20min_9	0.000	0.127	169.740	0.000	0.086	0.000	0.103
...2 to 1% 20min to 45min>MB_63pct_20min_10	0.000	0.131	170.752	0.000	0.087	0.000	0.105

Figure B-01: Peak flows for the 63.2% AEP – 20 minute duration



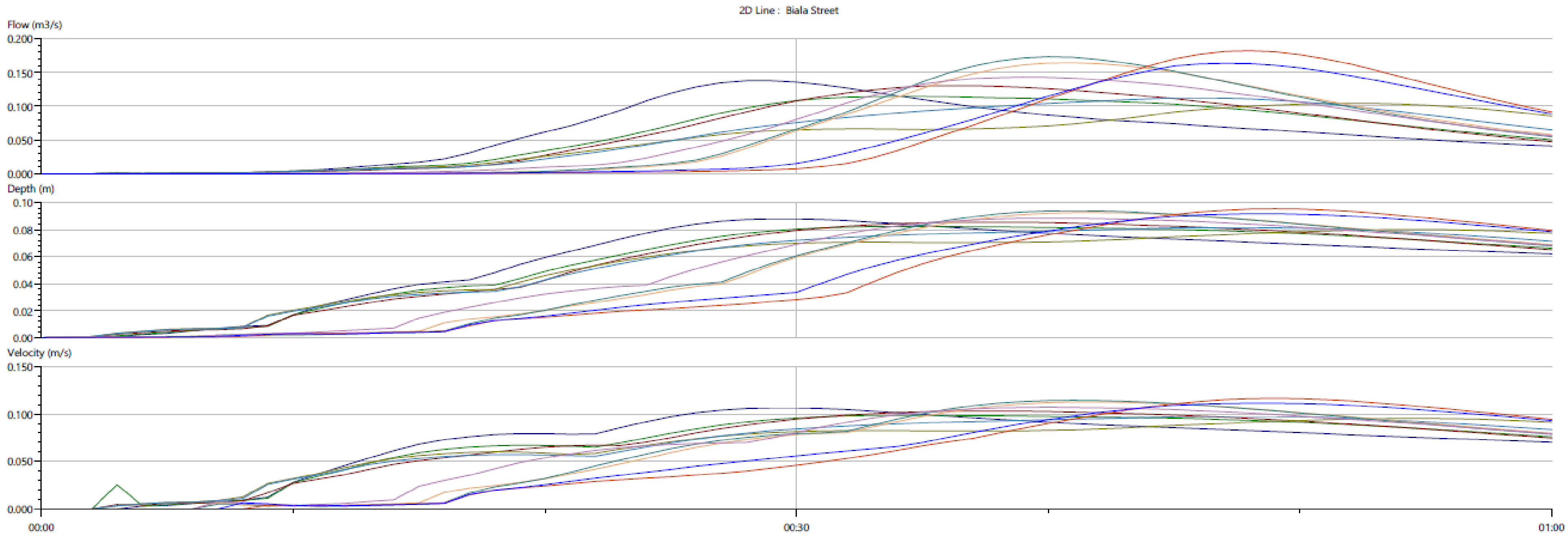
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_63pct_25min_1	0.000	0.124	186.271	0.000	0.084	0.000	0.101
...3.2 to 1% 20min to 45min>MB_63pct_25min_2	0.000	0.121	186.796	0.000	0.083	0.000	0.100
...3.2 to 1% 20min to 45min>MB_63pct_25min_3	0.000	0.137	191.021	0.000	0.087	0.000	0.106
...3.2 to 1% 20min to 45min>MB_63pct_25min_4	0.000	0.140	189.636	0.000	0.088	0.000	0.107
...3.2 to 1% 20min to 45min>MB_63pct_25min_5	0.000	0.136	189.729	0.000	0.087	0.000	0.105
...3.2 to 1% 20min to 45min>MB_63pct_25min_6	0.000	0.141	191.439	0.000	0.088	0.000	0.107
...3.2 to 1% 20min to 45min>MB_63pct_25min_7	0.000	0.134	189.588	0.000	0.087	0.000	0.105
...3.2 to 1% 20min to 45min>MB_63pct_25min_8	0.000	0.138	188.571	0.000	0.087	0.000	0.106
...3.2 to 1% 20min to 45min>MB_63pct_25min_9	0.000	0.138	189.018	0.000	0.088	0.000	0.106
...2 to 1% 20min to 45min>MB_63pct_25min_10	0.000	0.145	191.669	0.000	0.089	0.000	0.108

Figure B-02: Peak flows for the 63.2% AEP – 25 minute duration



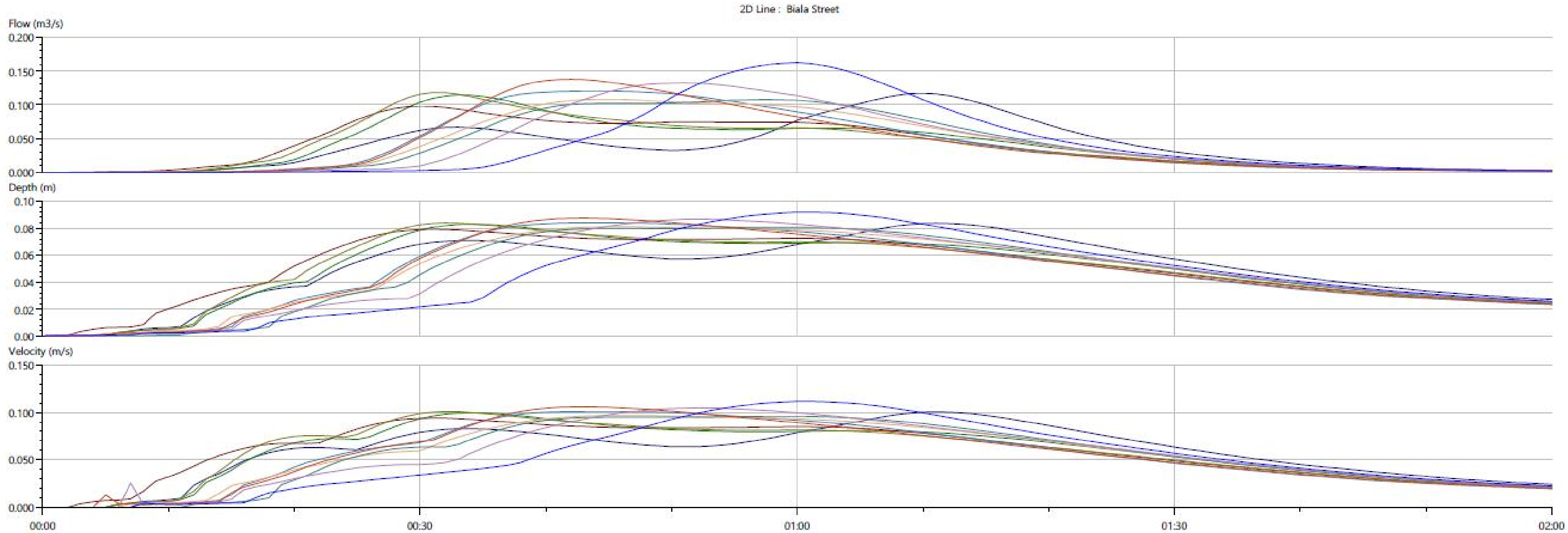
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_63pct_30min_1	0.000	0.150	204.651	0.000	0.090	0.000	0.109
...3.2 to 1% 20min to 45min>MB_63pct_30min_2	0.000	0.141	205.587	0.000	0.088	0.000	0.106
...3.2 to 1% 20min to 45min>MB_63pct_30min_3	0.000	0.135	204.453	0.000	0.087	0.000	0.105
...3.2 to 1% 20min to 45min>MB_63pct_30min_4	0.000	0.144	207.453	0.000	0.089	0.000	0.108
...3.2 to 1% 20min to 45min>MB_63pct_30min_5	0.000	0.155	208.337	0.000	0.091	0.000	0.110
...3.2 to 1% 20min to 45min>MB_63pct_30min_6	0.000	0.153	206.851	0.000	0.090	0.000	0.110
...3.2 to 1% 20min to 45min>MB_63pct_30min_7	0.000	0.133	203.327	0.000	0.086	0.000	0.104
...3.2 to 1% 20min to 45min>MB_63pct_30min_8	0.000	0.148	203.628	0.000	0.089	0.000	0.108
...3.2 to 1% 20min to 45min>MB_63pct_30min_9	0.000	0.152	202.435	0.000	0.090	0.000	0.110
...2 to 1% 20min to 45min>MB_63pct_30min_10	0.000	0.144	203.810	0.000	0.089	0.000	0.107

Figure B-03: Peak flows for the 63.2% AEP – 30 minute duration – Temporal Pattern (TP) 8 used in the flood modelling analysis



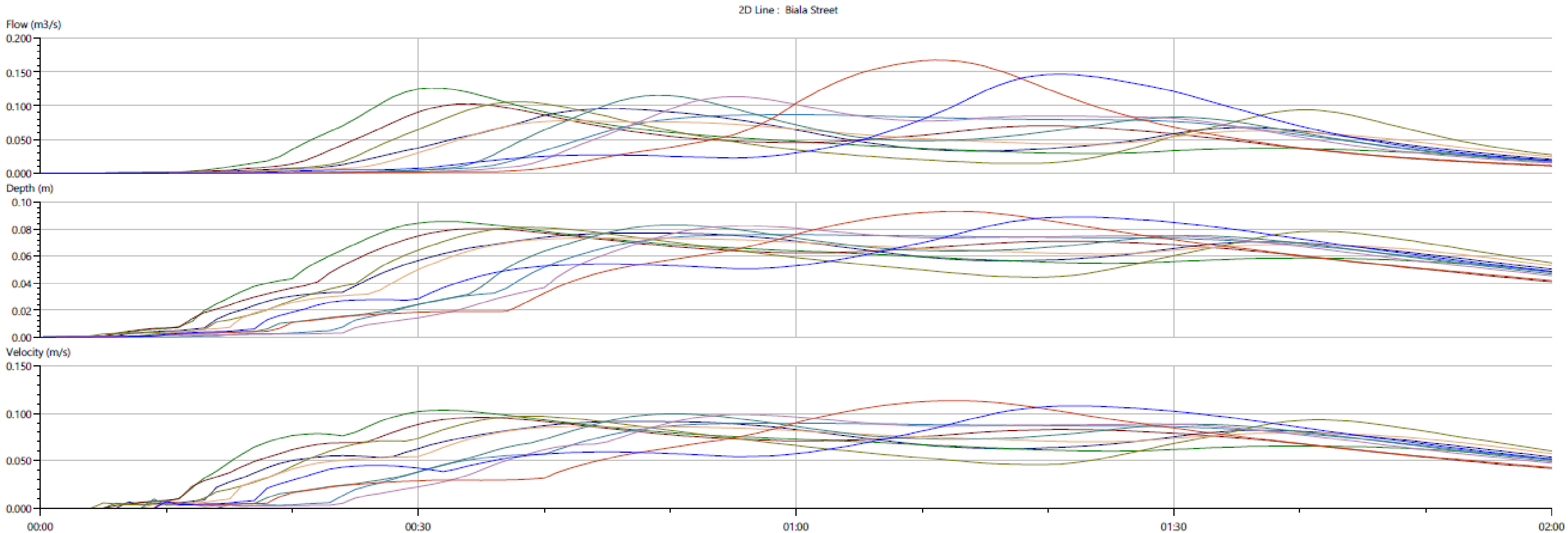
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_63pct_45min_1	0.000	0.137	222.224	0.000	0.088	0.000	0.106
...3.2 to 1% 20min to 45min>MB_63pct_45min_2	0.000	0.114	221.005	0.000	0.082	0.000	0.099
...3.2 to 1% 20min to 45min>MB_63pct_45min_3	0.000	0.130	226.852	0.000	0.085	0.000	0.103
...3.2 to 1% 20min to 45min>MB_63pct_45min_4	0.000	0.104	188.850	0.000	0.080	0.000	0.095
...3.2 to 1% 20min to 45min>MB_63pct_45min_5	0.000	0.112	208.136	0.000	0.082	0.000	0.098
...3.2 to 1% 20min to 45min>MB_63pct_45min_6	0.000	0.164	224.264	0.000	0.093	0.000	0.113
...3.2 to 1% 20min to 45min>MB_63pct_45min_7	0.000	0.173	229.963	0.000	0.094	0.000	0.115
...3.2 to 1% 20min to 45min>MB_63pct_45min_8	0.000	0.143	222.152	0.000	0.088	0.000	0.107
...3.2 to 1% 20min to 45min>MB_63pct_45min_9	0.000	0.182	209.080	0.000	0.095	0.000	0.117
...2 to 1% 20min to 45min>MB_63pct_45min_10	0.000	0.163	204.652	0.000	0.092	0.000	0.112

Figure B-04: Peak flows for the 63.2% AEP – 45 minute duration



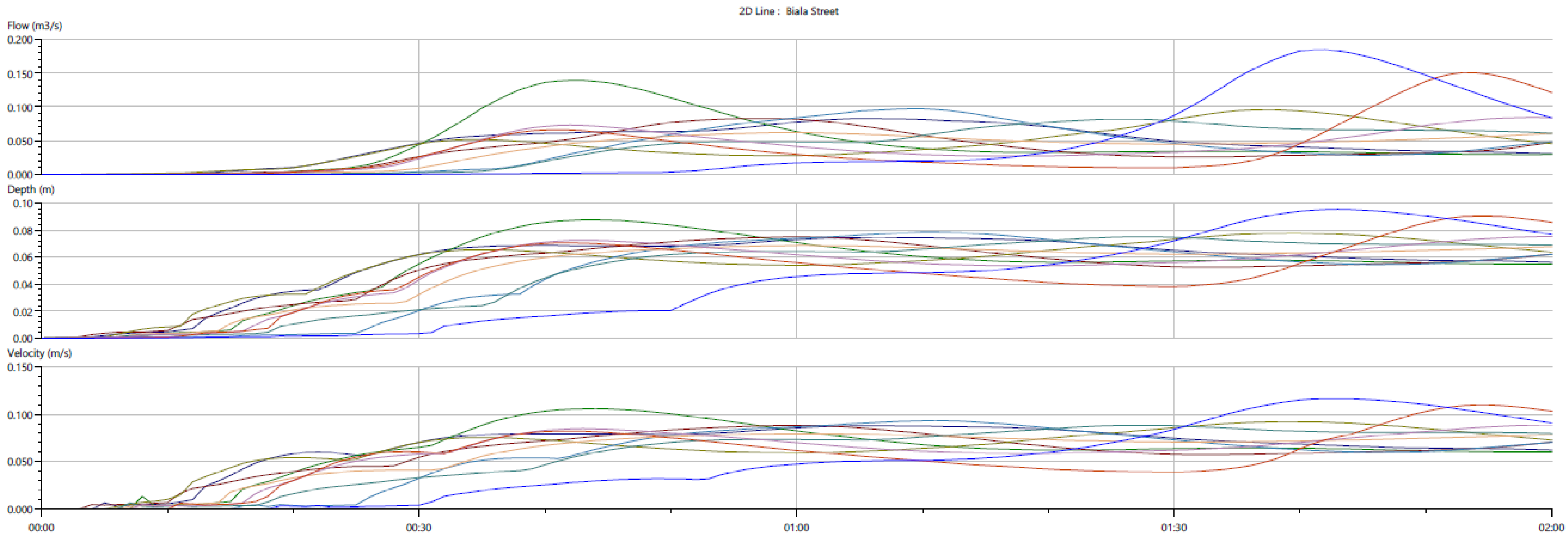
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_1	0.000	0.117	285.745	0.000	0.084	0.000	0.101
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_2	0.000	0.115	287.038	0.000	0.083	0.000	0.100
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_3	0.000	0.098	286.306	0.000	0.079	0.000	0.094
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_4	0.000	0.118	288.539	0.000	0.084	0.000	0.101
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_5	0.000	0.121	295.882	0.000	0.084	0.000	0.101
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_6	0.000	0.108	291.694	0.000	0.081	0.000	0.097
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_7	0.000	0.107	293.226	0.000	0.080	0.000	0.096
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_8	0.000	0.133	295.947	0.000	0.087	0.000	0.105
...>63.2 to 1% 60min to 90min>MB_63pct_1hr_9	0.000	0.138	296.746	0.000	0.087	0.000	0.106
...63.2 to 1% 60min to 90min>MB_63pct_1hr_10	0.000	0.163	301.703	0.000	0.092	0.000	0.112

Figure B-05: Peak flows for the 63.2% AEP – 60 minute duration



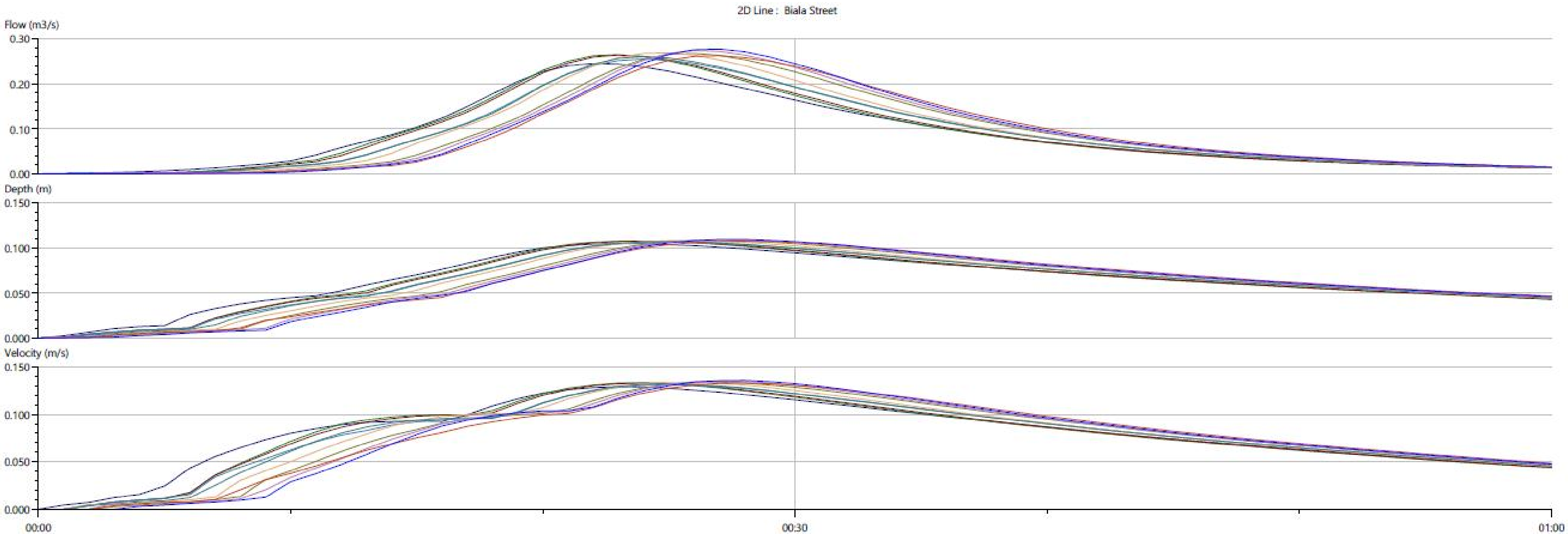
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_1	0.000	0.096	316.379	0.000	0.077	0.000	0.091
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_2	0.000	0.127	318.603	0.000	0.086	0.000	0.103
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_3	0.000	0.103	325.344	0.000	0.080	0.000	0.096
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_4	0.000	0.106	316.439	0.000	0.081	0.000	0.097
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_5	0.000	0.087	325.399	0.000	0.076	0.000	0.090
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_6	0.000	0.078	311.445	0.000	0.073	0.000	0.086
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_7	0.000	0.115	327.380	0.000	0.083	0.000	0.100
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_8	0.000	0.114	332.082	0.000	0.082	0.000	0.099
...3.2 to 1% 60min to 90min>MB_63pct_1_5hr_9	0.000	0.167	345.539	0.000	0.093	0.000	0.113
...2 to 1% 60min to 90min>MB_63pct_1_5hr_10	0.000	0.146	331.499	0.000	0.089	0.000	0.108

Figure B-06: Peak flows for the 63.2% AEP – 90 minute duration



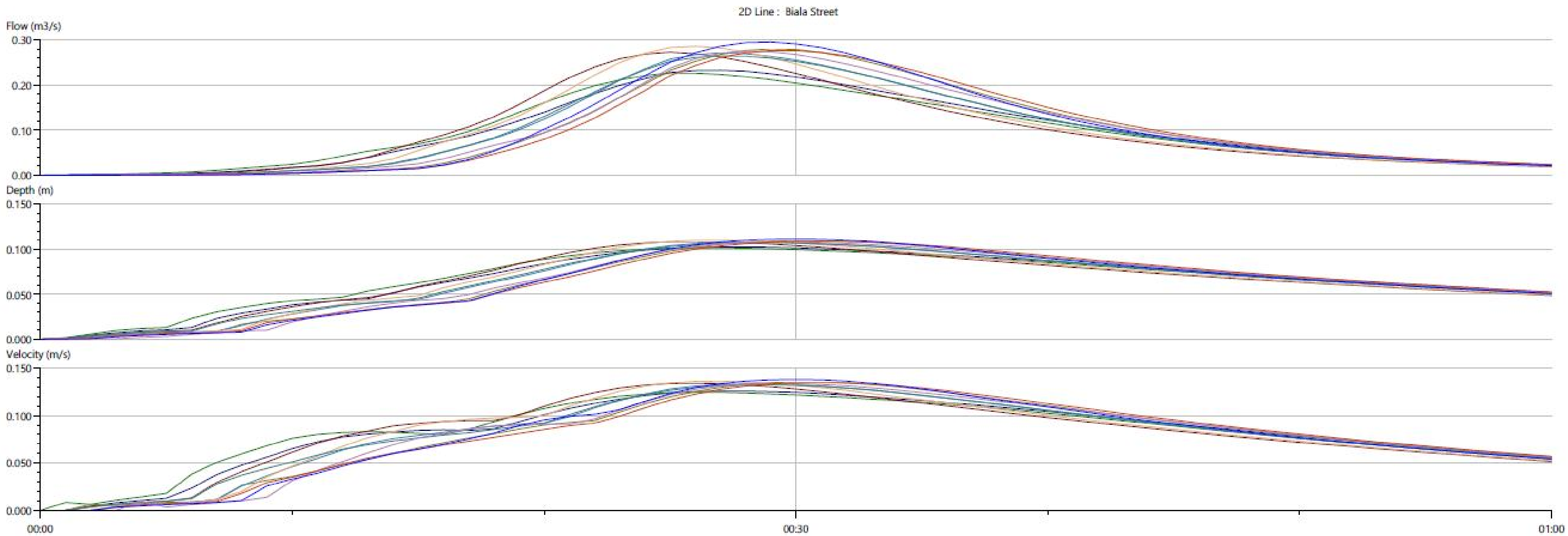
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...and flow>63.2 to 1% 120min>MB_63pct_2hr_1	0.000	0.083	330.565	0.000	0.075	0.000	0.088
...and flow>63.2 to 1% 120min>MB_63pct_2hr_2	0.000	0.139	325.764	0.000	0.088	0.000	0.106
...and flow>63.2 to 1% 120min>MB_63pct_2hr_3	0.000	0.083	260.906	0.000	0.075	0.000	0.088
...and flow>63.2 to 1% 120min>MB_63pct_2hr_4	0.000	0.096	314.083	0.000	0.078	0.000	0.092
...and flow>63.2 to 1% 120min>MB_63pct_2hr_5	0.000	0.097	279.138	0.000	0.078	0.000	0.093
...and flow>63.2 to 1% 120min>MB_63pct_2hr_6	0.000	0.062	269.632	0.000	0.069	0.000	0.079
...and flow>63.2 to 1% 120min>MB_63pct_2hr_7	0.000	0.082	294.905	0.000	0.075	0.000	0.088
...and flow>63.2 to 1% 120min>MB_63pct_2hr_8	0.000	0.084	269.077	0.000	0.075	0.000	0.089
...and flow>63.2 to 1% 120min>MB_63pct_2hr_9	0.000	0.150	276.517	0.000	0.090	0.000	0.110
...nd flow>63.2 to 1% 120min>MB_63pct_2hr_10	0.000	0.185	321.907	0.000	0.095	0.000	0.116

Figure B-07: Peak flows for the 63.2% AEP – 120 minute duration



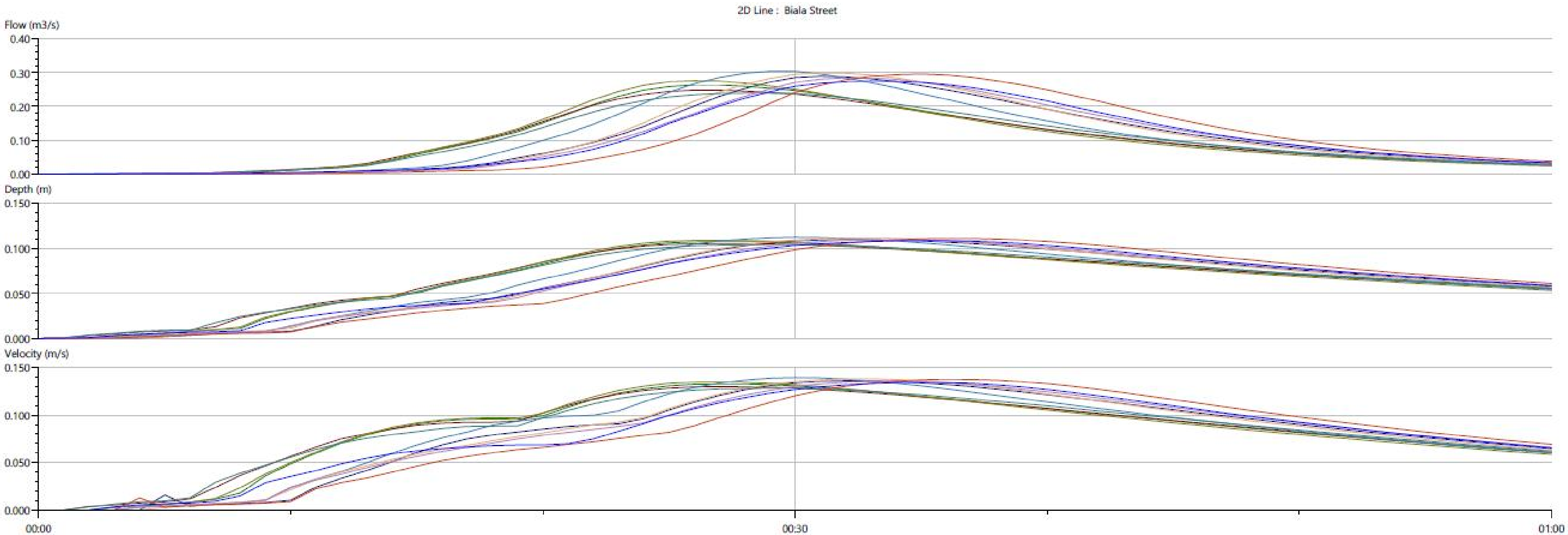
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_20pct_20min_1	0.000	0.245	311.983	0.000	0.105	0.000	0.129
...3.2 to 1% 20min to 45min>MB_20pct_20min_2	0.000	0.264	316.501	0.000	0.108	0.000	0.133
...3.2 to 1% 20min to 45min>MB_20pct_20min_3	0.000	0.263	316.475	0.000	0.107	0.000	0.133
...3.2 to 1% 20min to 45min>MB_20pct_20min_4	0.000	0.267	316.408	0.000	0.108	0.000	0.134
...3.2 to 1% 20min to 45min>MB_20pct_20min_5	0.000	0.255	314.236	0.000	0.106	0.000	0.131
...3.2 to 1% 20min to 45min>MB_20pct_20min_6	0.000	0.269	317.530	0.000	0.108	0.000	0.134
...3.2 to 1% 20min to 45min>MB_20pct_20min_7	0.000	0.260	314.803	0.000	0.107	0.000	0.132
...3.2 to 1% 20min to 45min>MB_20pct_20min_8	0.000	0.273	317.792	0.000	0.109	0.000	0.135
...3.2 to 1% 20min to 45min>MB_20pct_20min_9	0.000	0.262	315.555	0.000	0.107	0.000	0.133
...2 to 1% 20min to 45min>MB_20pct_20min_10	0.000	0.276	318.381	0.000	0.109	0.000	0.136

Figure B-08: Peak flows for the 20% AEP – 20 minute duration



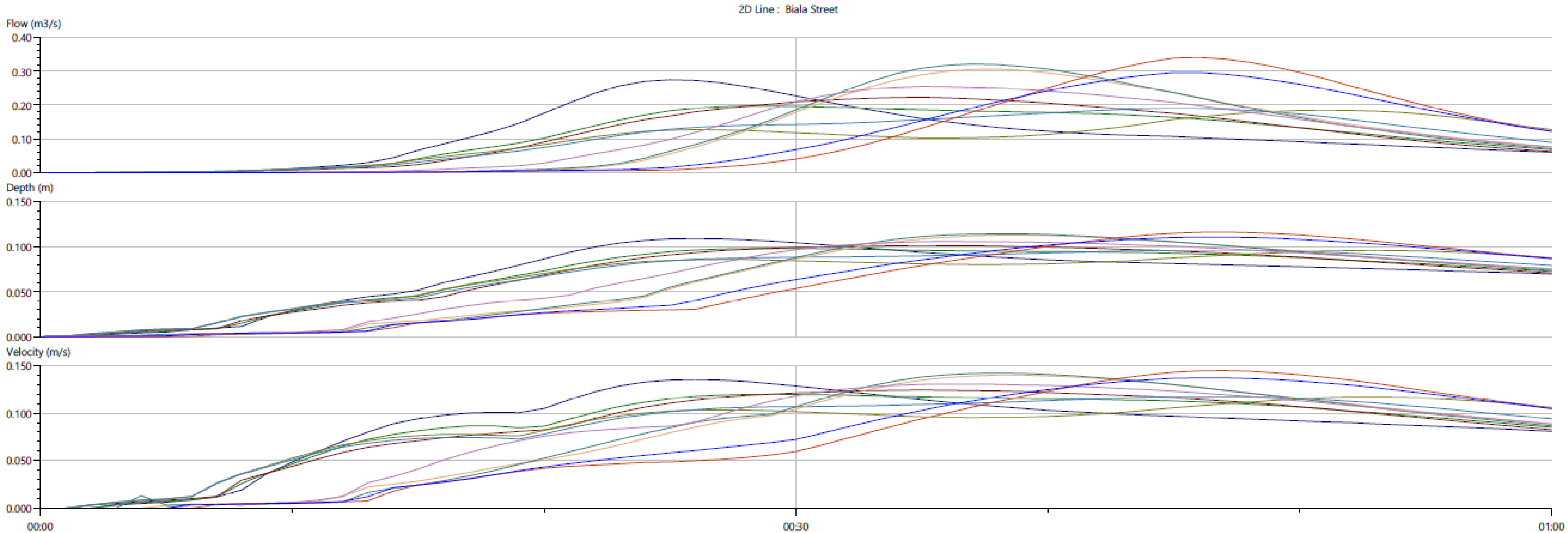
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_20pct_25min_1	0.000	0.233	340.728	0.000	0.102	0.000	0.126
...3.2 to 1% 20min to 45min>MB_20pct_25min_2	0.000	0.227	340.708	0.000	0.101	0.000	0.124
...3.2 to 1% 20min to 45min>MB_20pct_25min_3	0.000	0.273	351.518	0.000	0.108	0.000	0.134
...3.2 to 1% 20min to 45min>MB_20pct_25min_4	0.000	0.280	351.847	0.000	0.109	0.000	0.135
...3.2 to 1% 20min to 45min>MB_20pct_25min_5	0.000	0.271	350.160	0.000	0.108	0.000	0.133
...3.2 to 1% 20min to 45min>MB_20pct_25min_6	0.000	0.286	353.786	0.000	0.110	0.000	0.136
...3.2 to 1% 20min to 45min>MB_20pct_25min_7	0.000	0.264	349.550	0.000	0.107	0.000	0.132
...3.2 to 1% 20min to 45min>MB_20pct_25min_8	0.000	0.275	349.271	0.000	0.108	0.000	0.134
...3.2 to 1% 20min to 45min>MB_20pct_25min_9	0.000	0.276	350.973	0.000	0.109	0.000	0.135
...2 to 1% 20min to 45min>MB_20pct_25min_10	0.000	0.295	356.937	0.000	0.111	0.000	0.138

Figure B-09: Peak flows for the 20% AEP – 25 minute duration



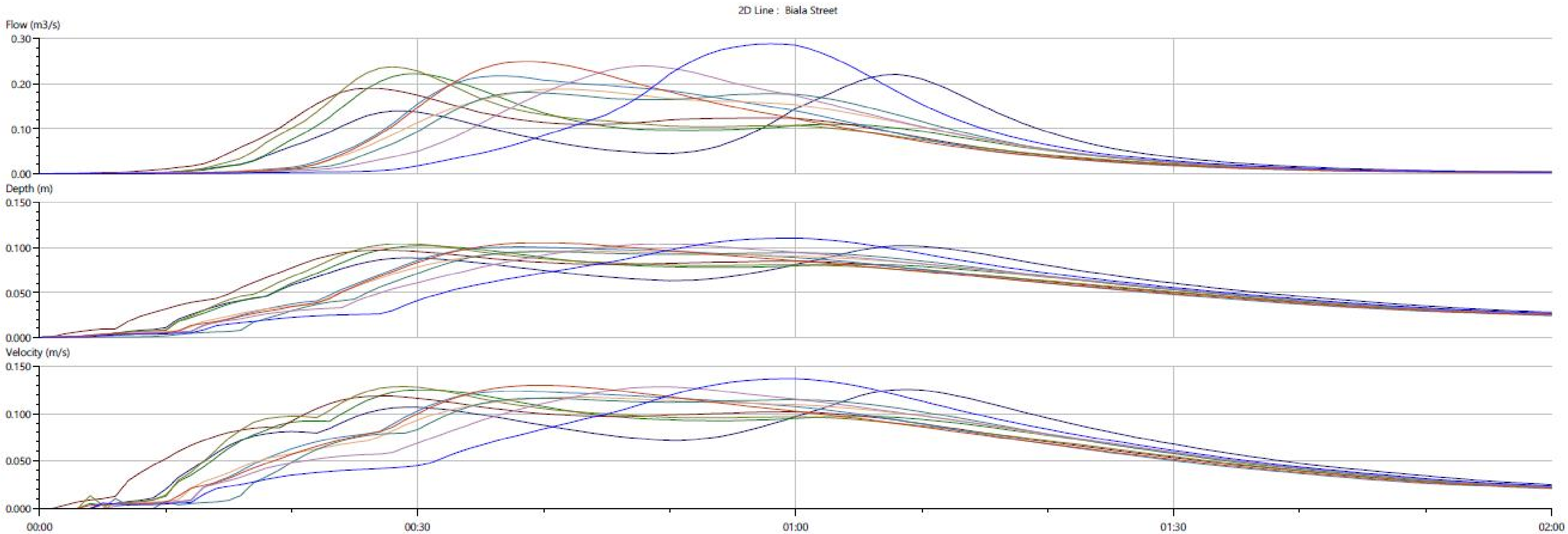
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_20pct_30min_1	0.000	0.289	376.155	0.000	0.110	0.000	0.136
...3.2 to 1% 20min to 45min>MB_20pct_30min_2	0.000	0.263	373.849	0.000	0.107	0.000	0.133
...3.2 to 1% 20min to 45min>MB_20pct_30min_3	0.000	0.248	370.734	0.000	0.105	0.000	0.130
...3.2 to 1% 20min to 45min>MB_20pct_30min_4	0.000	0.276	377.437	0.000	0.109	0.000	0.135
...3.2 to 1% 20min to 45min>MB_20pct_30min_5	0.000	0.303	382.404	0.000	0.112	0.000	0.139
...3.2 to 1% 20min to 45min>MB_20pct_30min_6	0.000	0.298	380.718	0.000	0.111	0.000	0.138
...3.2 to 1% 20min to 45min>MB_20pct_30min_7	0.000	0.240	368.527	0.000	0.104	0.000	0.128
...3.2 to 1% 20min to 45min>MB_20pct_30min_8	0.000	0.284	374.519	0.000	0.109	0.000	0.136
...3.2 to 1% 20min to 45min>MB_20pct_30min_9	0.000	0.296	375.557	0.000	0.111	0.000	0.138
...2 to 1% 20min to 45min>MB_20pct_30min_10	0.000	0.274	374.285	0.000	0.108	0.000	0.134

Figure B-10: Peak flows for the 20% AEP – 30 minute duration – Temporal Pattern (TP) 8 used in the flood modelling analysis



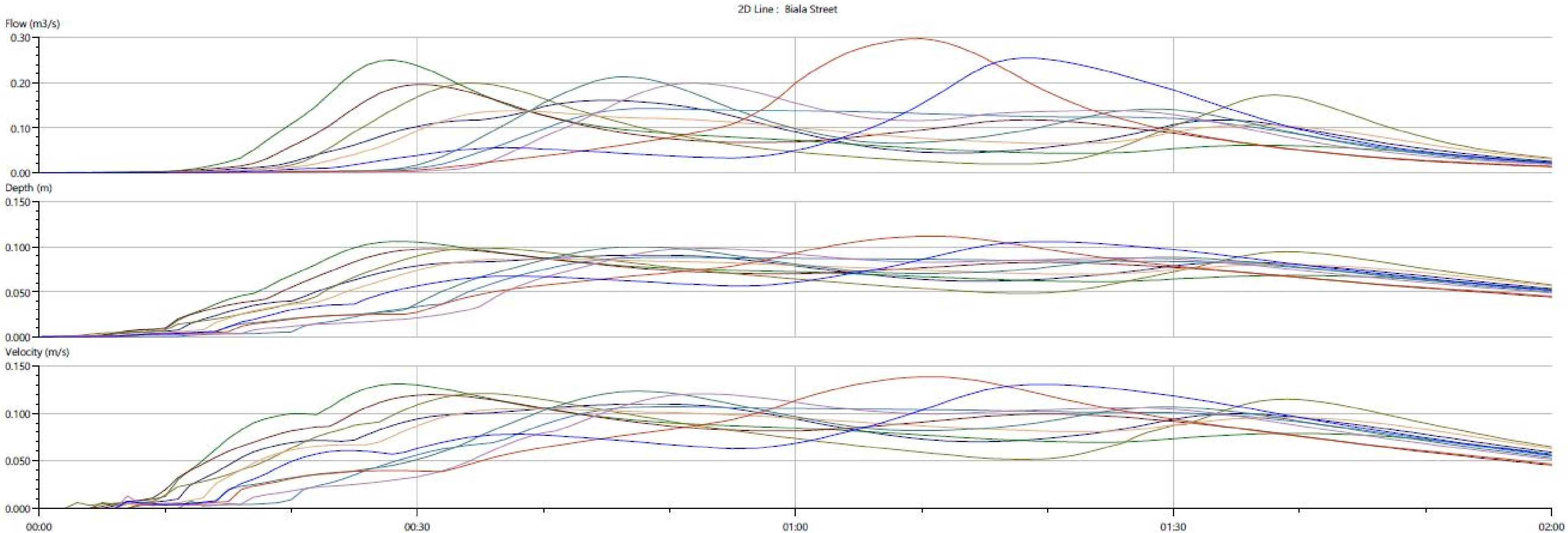
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_20pct_45min_1	0.000	0.275	402.329	0.000	0.109	0.000	0.135
...3.2 to 1% 20min to 45min>MB_20pct_45min_2	0.000	0.197	398.105	0.000	0.098	0.000	0.120
...3.2 to 1% 20min to 45min>MB_20pct_45min_3	0.000	0.223	408.788	0.000	0.101	0.000	0.124
...3.2 to 1% 20min to 45min>MB_20pct_45min_4	0.000	0.185	351.602	0.000	0.096	0.000	0.117
...3.2 to 1% 20min to 45min>MB_20pct_45min_5	0.000	0.191	378.723	0.000	0.096	0.000	0.118
...3.2 to 1% 20min to 45min>MB_20pct_45min_6	0.000	0.306	415.064	0.000	0.113	0.000	0.140
...3.2 to 1% 20min to 45min>MB_20pct_45min_7	0.000	0.321	424.962	0.000	0.114	0.000	0.142
...3.2 to 1% 20min to 45min>MB_20pct_45min_8	0.000	0.254	406.901	0.000	0.106	0.000	0.130
...3.2 to 1% 20min to 45min>MB_20pct_45min_9	0.000	0.340	399.823	0.000	0.116	0.000	0.145
...2 to 1% 20min to 45min>MB_20pct_45min_10	0.000	0.296	388.446	0.000	0.111	0.000	0.137

Figure B-11: Peak flows for the 20% AEP – 45 minute duration



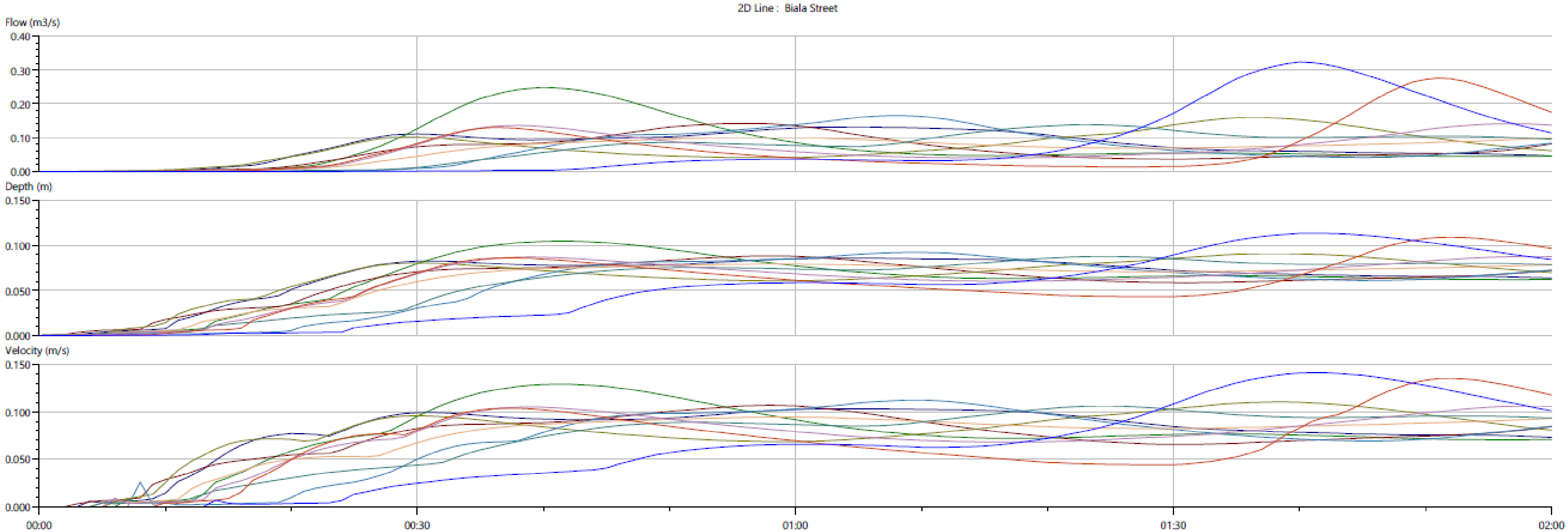
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_1	0.000	0.220	490.034	0.000	0.102	0.000	0.125
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_2	0.000	0.222	491.801	0.000	0.102	0.000	0.125
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_3	0.000	0.190	487.967	0.000	0.097	0.000	0.118
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_4	0.000	0.237	495.261	0.000	0.104	0.000	0.129
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_5	0.000	0.217	506.646	0.000	0.101	0.000	0.124
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_6	0.000	0.187	496.697	0.000	0.096	0.000	0.117
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_7	0.000	0.180	500.501	0.000	0.095	0.000	0.116
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_8	0.000	0.239	506.503	0.000	0.104	0.000	0.128
...>63.2 to 1% 60min to 90min>MB_20pct_1hr_9	0.000	0.249	510.200	0.000	0.105	0.000	0.130
...63.2 to 1% 60min to 90min>MB_20pct_1hr_10	0.000	0.288	520.398	0.000	0.110	0.000	0.137

Figure B-12: Peak flows for the 20% AEP – 60 minute duration



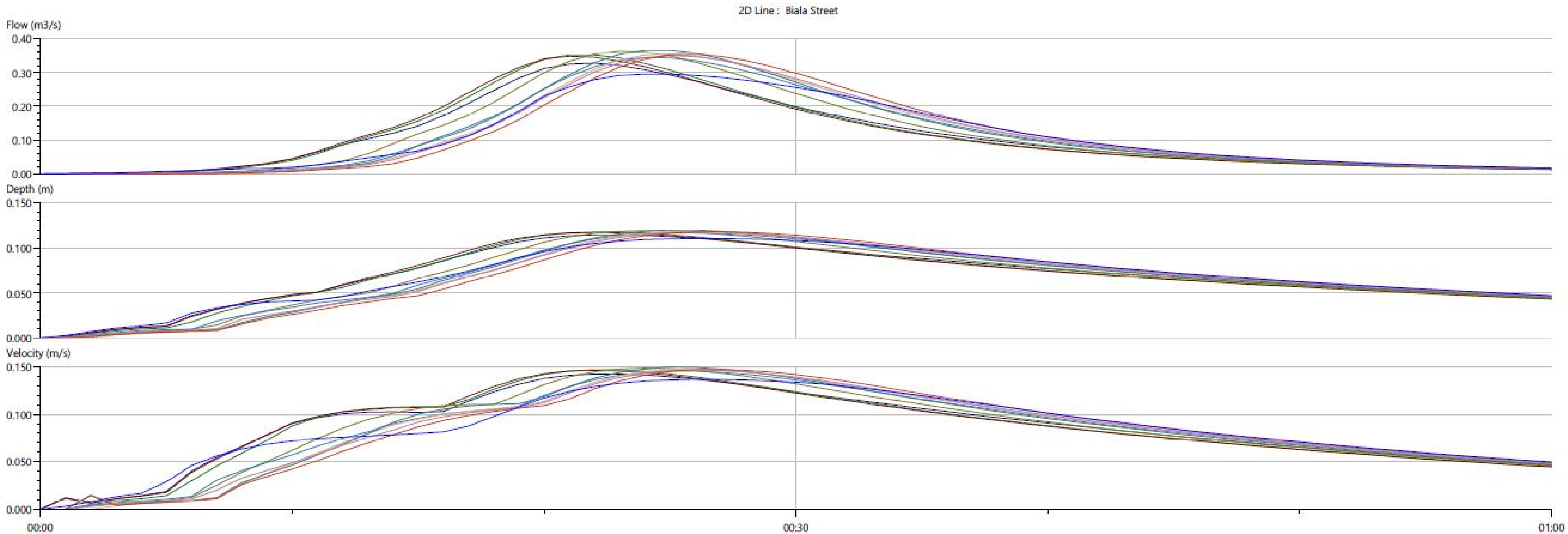
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_1	0.000	0.161	531.245	0.000	0.091	0.000	0.110
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_2	0.000	0.249	540.202	0.000	0.106	0.000	0.131
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_3	0.000	0.196	545.295	0.000	0.098	0.000	0.120
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_4	0.000	0.198	539.180	0.000	0.099	0.000	0.121
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_5	0.000	0.143	544.320	0.000	0.088	0.000	0.107
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_6	0.000	0.137	524.210	0.000	0.087	0.000	0.105
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_7	0.000	0.212	551.244	0.000	0.100	0.000	0.123
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_8	0.000	0.199	556.896	0.000	0.098	0.000	0.120
...3.2 to 1% 60min to 90min>MB_20pct_1_5hr_9	0.000	0.297	583.021	0.000	0.112	0.000	0.138
...2 to 1% 60min to 90min>MB_20pct_1_5hr_10	0.000	0.254	558.411	0.000	0.106	0.000	0.130

Figure B-13: Peak flows for the 20% AEP – 90 minute duration



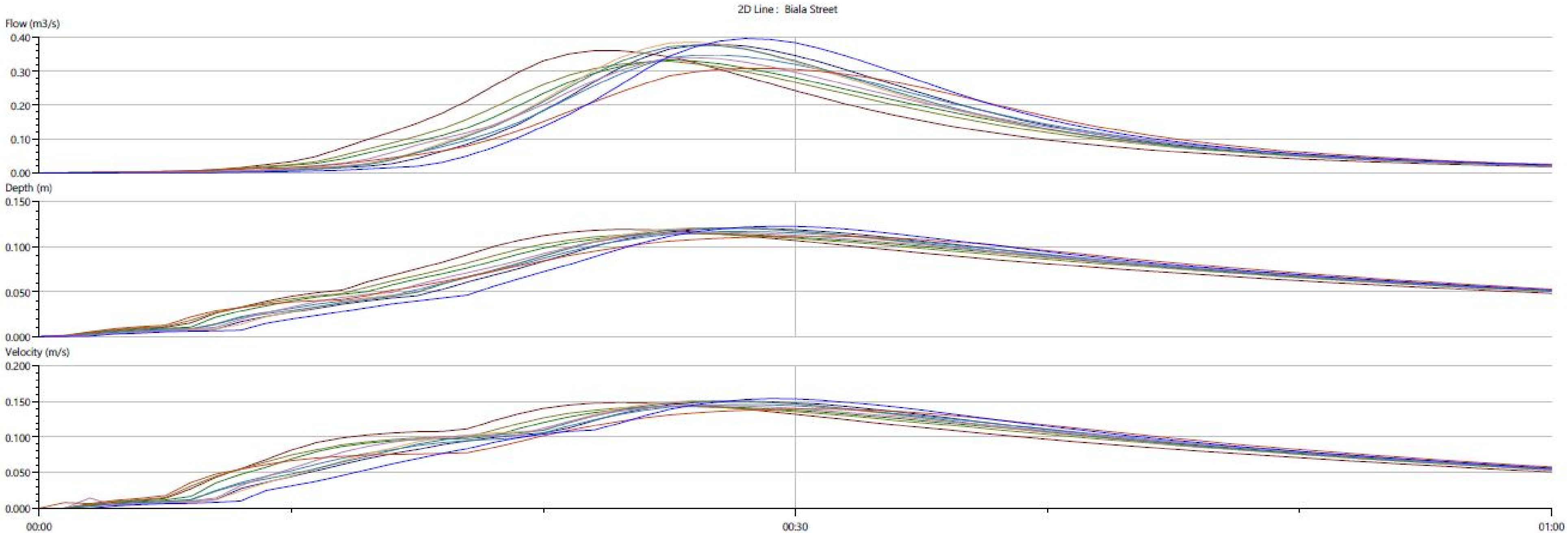
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...and flow>63.2 to 1% 120min>MB_20pct_2hr_1	0.000	0.132	553.192	0.000	0.086	0.000	0.103
...and flow>63.2 to 1% 120min>MB_20pct_2hr_2	0.000	0.249	551.574	0.000	0.105	0.000	0.129
...and flow>63.2 to 1% 120min>MB_20pct_2hr_3	0.000	0.142	441.328	0.000	0.088	0.000	0.107
...and flow>63.2 to 1% 120min>MB_20pct_2hr_4	0.000	0.160	530.872	0.000	0.091	0.000	0.110
...and flow>63.2 to 1% 120min>MB_20pct_2hr_5	0.000	0.165	472.440	0.000	0.092	0.000	0.112
...and flow>63.2 to 1% 120min>MB_20pct_2hr_6	0.000	0.101	459.199	0.000	0.079	0.000	0.094
...and flow>63.2 to 1% 120min>MB_20pct_2hr_7	0.000	0.138	501.480	0.000	0.088	0.000	0.106
...and flow>63.2 to 1% 120min>MB_20pct_2hr_8	0.000	0.141	466.186	0.000	0.088	0.000	0.106
...and flow>63.2 to 1% 120min>MB_20pct_2hr_9	0.000	0.275	498.333	0.000	0.109	0.000	0.135
...nd flow>63.2 to 1% 120min>MB_20pct_2hr_10	0.000	0.323	563.285	0.000	0.114	0.000	0.141

Figure B-14: Peak flows for the 20% AEP – 120 minute duration



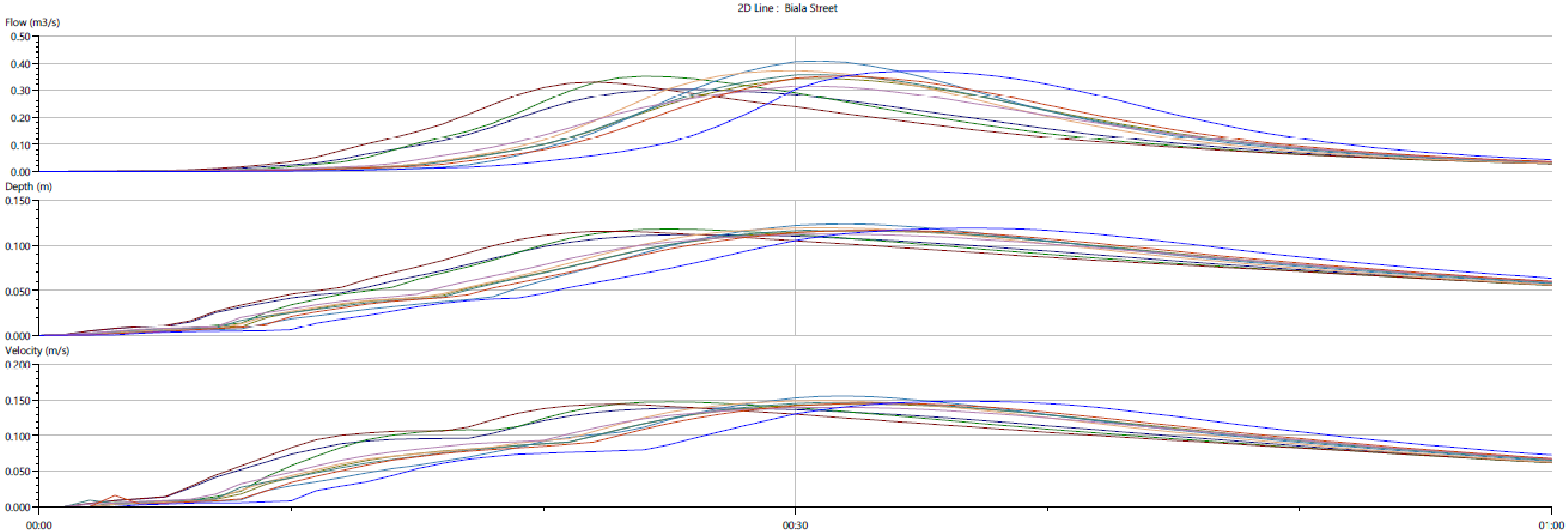
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_10pct_20min_1	0.000	0.327	395.441	0.000	0.115	0.000	0.143
...3.2 to 1% 20min to 45min>MB_10pct_20min_2	0.000	0.352	401.823	0.000	0.118	0.000	0.147
...3.2 to 1% 20min to 45min>MB_10pct_20min_3	0.000	0.347	401.013	0.000	0.117	0.000	0.146
...3.2 to 1% 20min to 45min>MB_10pct_20min_4	0.000	0.362	404.868	0.000	0.119	0.000	0.149
...3.2 to 1% 20min to 45min>MB_10pct_20min_5	0.000	0.343	400.667	0.000	0.117	0.000	0.146
...3.2 to 1% 20min to 45min>MB_10pct_20min_6	0.000	0.354	402.150	0.000	0.118	0.000	0.147
...3.2 to 1% 20min to 45min>MB_10pct_20min_7	0.000	0.366	405.683	0.000	0.120	0.000	0.150
...3.2 to 1% 20min to 45min>MB_10pct_20min_8	0.000	0.349	401.662	0.000	0.118	0.000	0.147
...3.2 to 1% 20min to 45min>MB_10pct_20min_9	0.000	0.353	402.461	0.000	0.118	0.000	0.147
...2 to 1% 20min to 45min>MB_10pct_20min_10	0.000	0.295	390.942	0.000	0.110	0.000	0.137

Figure B-15: Peak flows for the 10% AEP – 20 minute duration



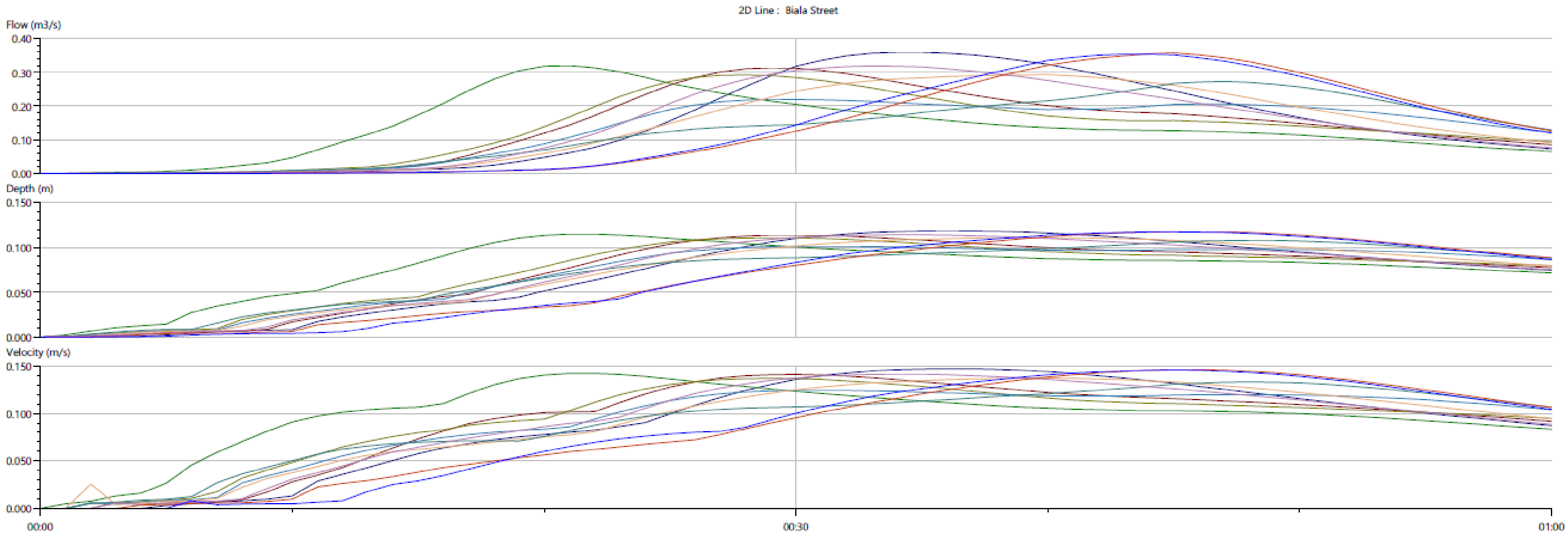
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_10pct_25min_1	0.000	0.379	449.295	0.000	0.121	0.000	0.151
...3.2 to 1% 20min to 45min>MB_10pct_25min_2	0.000	0.333	437.681	0.000	0.115	0.000	0.143
...3.2 to 1% 20min to 45min>MB_10pct_25min_3	0.000	0.361	446.047	0.000	0.119	0.000	0.148
...3.2 to 1% 20min to 45min>MB_10pct_25min_4	0.000	0.329	437.821	0.000	0.115	0.000	0.143
...3.2 to 1% 20min to 45min>MB_10pct_25min_5	0.000	0.349	441.125	0.000	0.117	0.000	0.145
...3.2 to 1% 20min to 45min>MB_10pct_25min_6	0.000	0.386	450.012	0.000	0.121	0.000	0.152
...3.2 to 1% 20min to 45min>MB_10pct_25min_7	0.000	0.377	448.723	0.000	0.120	0.000	0.150
...3.2 to 1% 20min to 45min>MB_10pct_25min_8	0.000	0.341	438.273	0.000	0.116	0.000	0.144
...3.2 to 1% 20min to 45min>MB_10pct_25min_9	0.000	0.308	432.915	0.000	0.112	0.000	0.139
...2 to 1% 20min to 45min>MB_10pct_25min_10	0.000	0.396	452.174	0.000	0.123	0.000	0.154

Figure B-16: Peak flows for the 10% AEP – 25 minute duration – Temporal Pattern (TP) 3 used in the flood modelling analysis



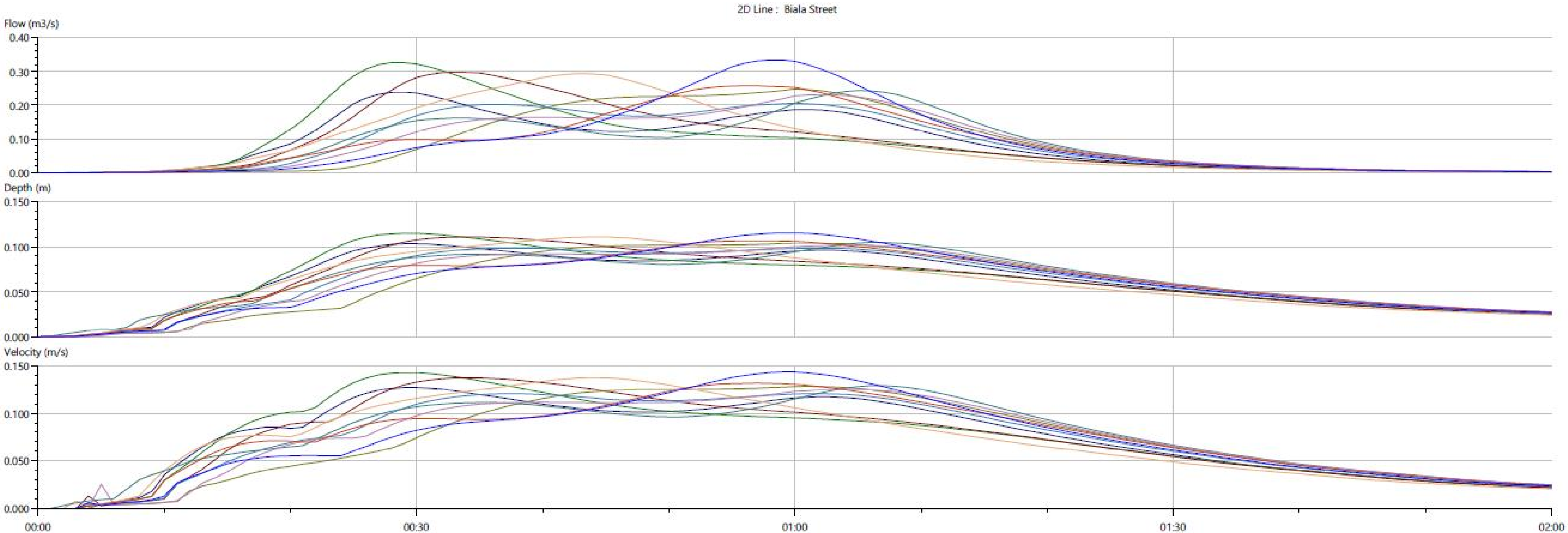
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_10pct_30min_1	0.000	0.304	465.145	0.000	0.112	0.000	0.139
...3.2 to 1% 20min to 45min>MB_10pct_30min_2	0.000	0.352	472.982	0.000	0.118	0.000	0.147
...3.2 to 1% 20min to 45min>MB_10pct_30min_3	0.000	0.330	465.176	0.000	0.116	0.000	0.144
...3.2 to 1% 20min to 45min>MB_10pct_30min_4	0.000	0.344	470.023	0.000	0.116	0.000	0.144
...3.2 to 1% 20min to 45min>MB_10pct_30min_5	0.000	0.408	485.431	0.000	0.124	0.000	0.155
...3.2 to 1% 20min to 45min>MB_10pct_30min_6	0.000	0.374	480.616	0.000	0.120	0.000	0.149
...3.2 to 1% 20min to 45min>MB_10pct_30min_7	0.000	0.357	473.346	0.000	0.117	0.000	0.147
...3.2 to 1% 20min to 45min>MB_10pct_30min_8	0.000	0.315	462.894	0.000	0.112	0.000	0.140
...3.2 to 1% 20min to 45min>MB_10pct_30min_9	0.000	0.352	470.773	0.000	0.117	0.000	0.145
...2 to 1% 20min to 45min>MB_10pct_30min_10	0.000	0.370	472.489	0.000	0.119	0.000	0.148

Figure B-17: Peak flows for the 10% AEP – 30 minute duration



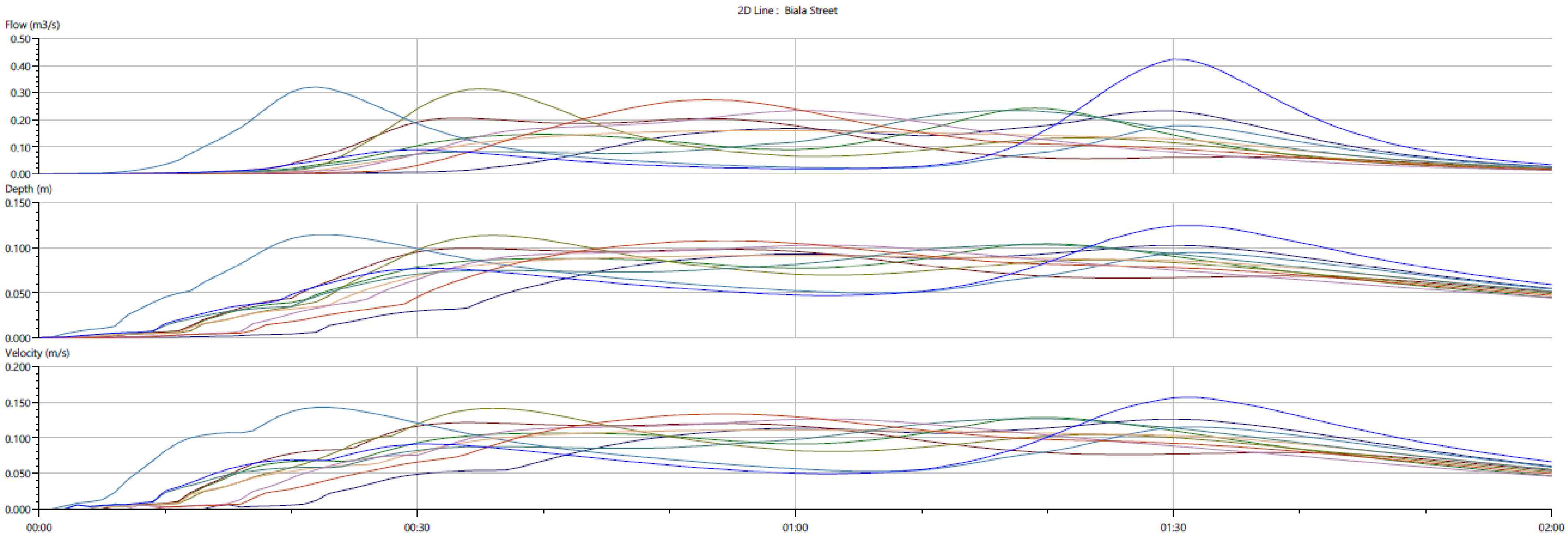
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 20min to 45min>MB_10pct_45min_1	0.000	0.359	531.195	0.000	0.118	0.000	0.147
...3.2 to 1% 20min to 45min>MB_10pct_45min_2	0.000	0.320	505.217	0.000	0.114	0.000	0.142
...3.2 to 1% 20min to 45min>MB_10pct_45min_3	0.000	0.313	499.296	0.000	0.113	0.000	0.141
...3.2 to 1% 20min to 45min>MB_10pct_45min_4	0.000	0.292	481.906	0.000	0.111	0.000	0.137
...3.2 to 1% 20min to 45min>MB_10pct_45min_5	0.000	0.220	466.119	0.000	0.101	0.000	0.125
...3.2 to 1% 20min to 45min>MB_10pct_45min_6	0.000	0.293	506.293	0.000	0.111	0.000	0.137
...3.2 to 1% 20min to 45min>MB_10pct_45min_7	0.000	0.272	466.825	0.000	0.108	0.000	0.133
...3.2 to 1% 20min to 45min>MB_10pct_45min_8	0.000	0.318	519.272	0.000	0.114	0.000	0.141
...3.2 to 1% 20min to 45min>MB_10pct_45min_9	0.000	0.357	500.033	0.000	0.117	0.000	0.146
...2 to 1% 20min to 45min>MB_10pct_45min_10	0.000	0.353	508.210	0.000	0.117	0.000	0.146

Figure B-18: Peak flows for the 10% AEP – 45 minute duration



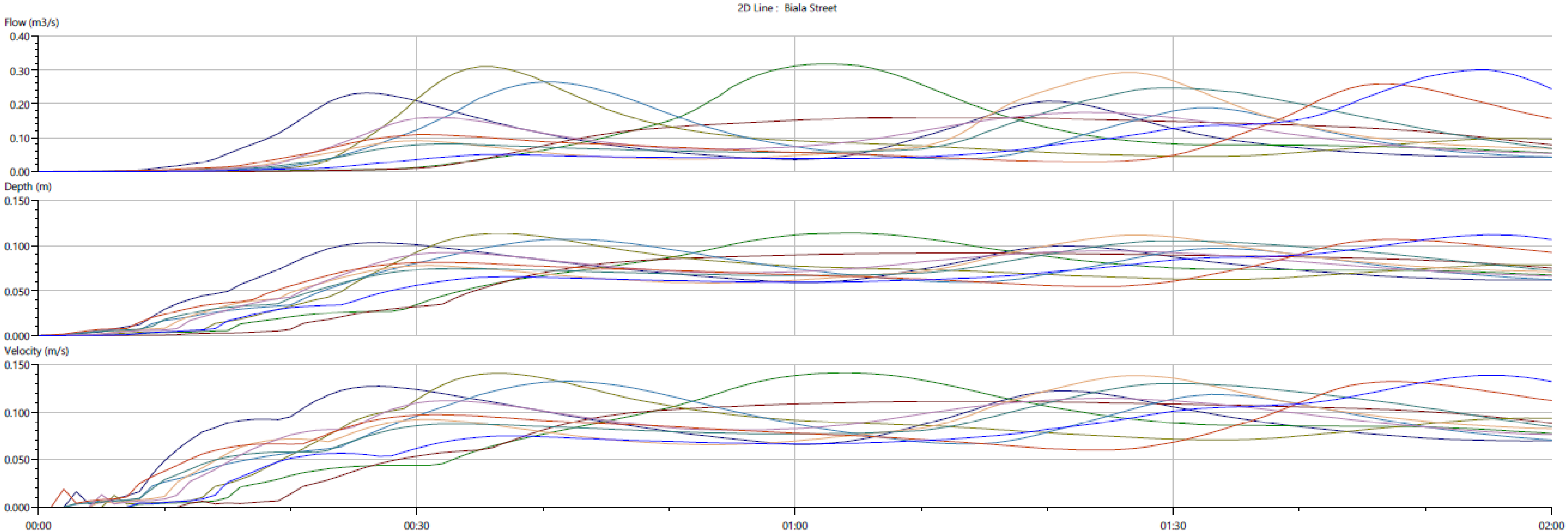
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_1	0.000	0.238	605.804	0.000	0.103	0.000	0.127
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_2	0.000	0.326	621.812	0.000	0.115	0.000	0.143
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_3	0.000	0.298	622.298	0.000	0.111	0.000	0.137
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_4	0.000	0.247	620.406	0.000	0.104	0.000	0.128
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_5	0.000	0.206	609.189	0.000	0.098	0.000	0.121
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_6	0.000	0.293	626.001	0.000	0.111	0.000	0.138
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_7	0.000	0.243	601.292	0.000	0.105	0.000	0.129
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_8	0.000	0.231	606.654	0.000	0.102	0.000	0.125
...>63.2 to 1% 60min to 90min>MB_10pct_1hr_9	0.000	0.257	609.589	0.000	0.107	0.000	0.132
...63.2 to 1% 60min to 90min>MB_10pct_1hr_10	0.000	0.333	628.658	0.000	0.115	0.000	0.143

Figure B-19: Peak flows for the 10% AEP – 60 minute duration



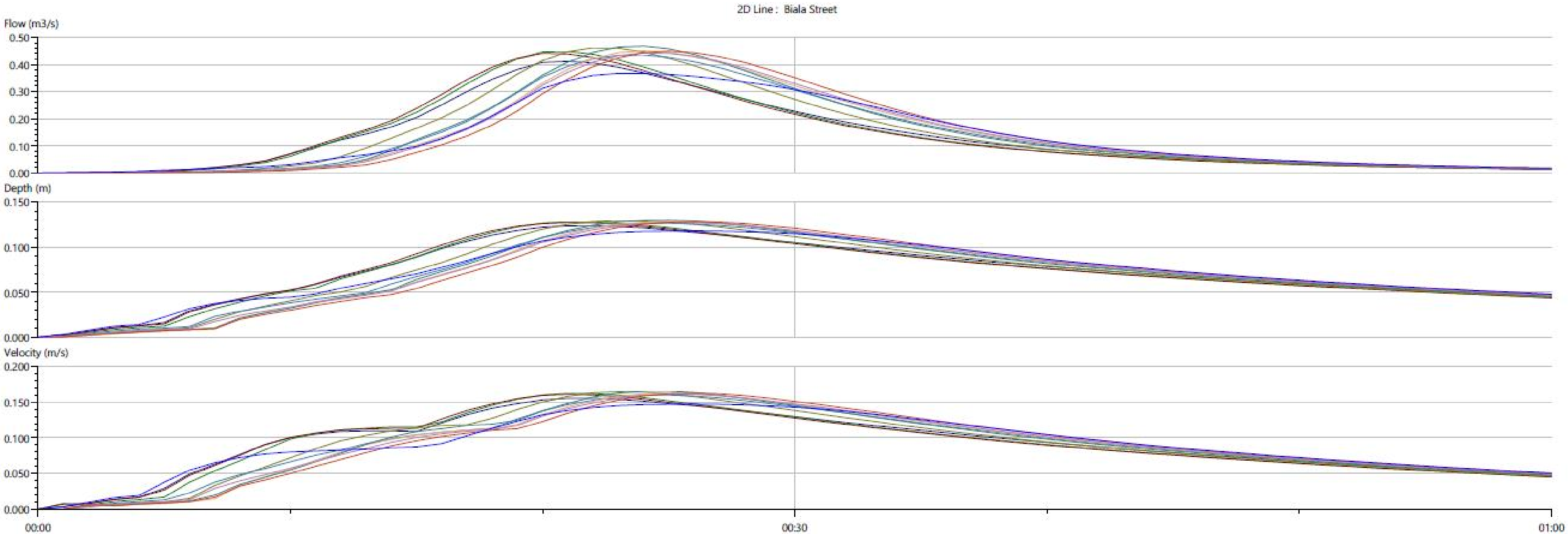
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_1	0.000	0.232	677.467	0.000	0.103	0.000	0.126
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_2	0.000	0.242	677.199	0.000	0.104	0.000	0.129
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_3	0.000	0.206	671.228	0.000	0.099	0.000	0.122
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_4	0.000	0.314	683.021	0.000	0.114	0.000	0.142
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_5	0.000	0.320	674.727	0.000	0.115	0.000	0.143
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_6	0.000	0.159	659.555	0.000	0.091	0.000	0.111
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_7	0.000	0.234	668.767	0.000	0.103	0.000	0.127
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_8	0.000	0.233	689.813	0.000	0.103	0.000	0.127
...3.2 to 1% 60min to 90min>MB_10pct_1_5hr_9	0.000	0.274	694.584	0.000	0.108	0.000	0.134
....2 to 1% 60min to 90min>MB_10pct_1_5hr_10	0.000	0.424	702.760	0.000	0.125	0.000	0.157

Figure B-20: Peak flows for the 10% AEP – 90 minute duration



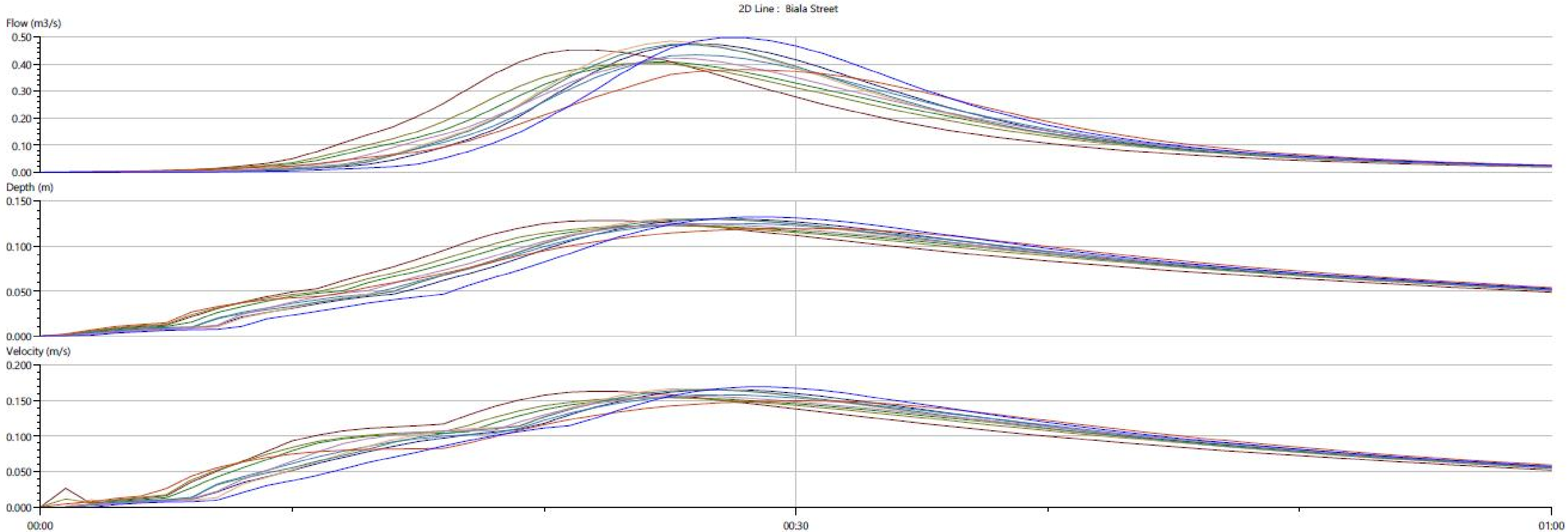
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...and flow>63.2 to 1% 120min>MB_10pct_2hr_1	0.000	0.232	683.337	0.000	0.103	0.000	0.127
...and flow>63.2 to 1% 120min>MB_10pct_2hr_2	0.000	0.318	714.705	0.000	0.114	0.000	0.141
...and flow>63.2 to 1% 120min>MB_10pct_2hr_3	0.000	0.161	678.436	0.000	0.092	0.000	0.111
...and flow>63.2 to 1% 120min>MB_10pct_2hr_4	0.000	0.310	650.847	0.000	0.113	0.000	0.141
...and flow>63.2 to 1% 120min>MB_10pct_2hr_5	0.000	0.265	705.006	0.000	0.107	0.000	0.132
...and flow>63.2 to 1% 120min>MB_10pct_2hr_6	0.000	0.293	666.229	0.000	0.112	0.000	0.139
...and flow>63.2 to 1% 120min>MB_10pct_2hr_7	0.000	0.247	687.473	0.000	0.105	0.000	0.130
...and flow>63.2 to 1% 120min>MB_10pct_2hr_8	0.000	0.175	658.818	0.000	0.094	0.000	0.114
...and flow>63.2 to 1% 120min>MB_10pct_2hr_9	0.000	0.259	606.837	0.000	0.107	0.000	0.132
...nd flow>63.2 to 1% 120min>MB_10pct_2hr_10	0.000	0.301	591.330	0.000	0.112	0.000	0.139

Figure B-21: Peak flows for the 10% AEP – 120 minute duration



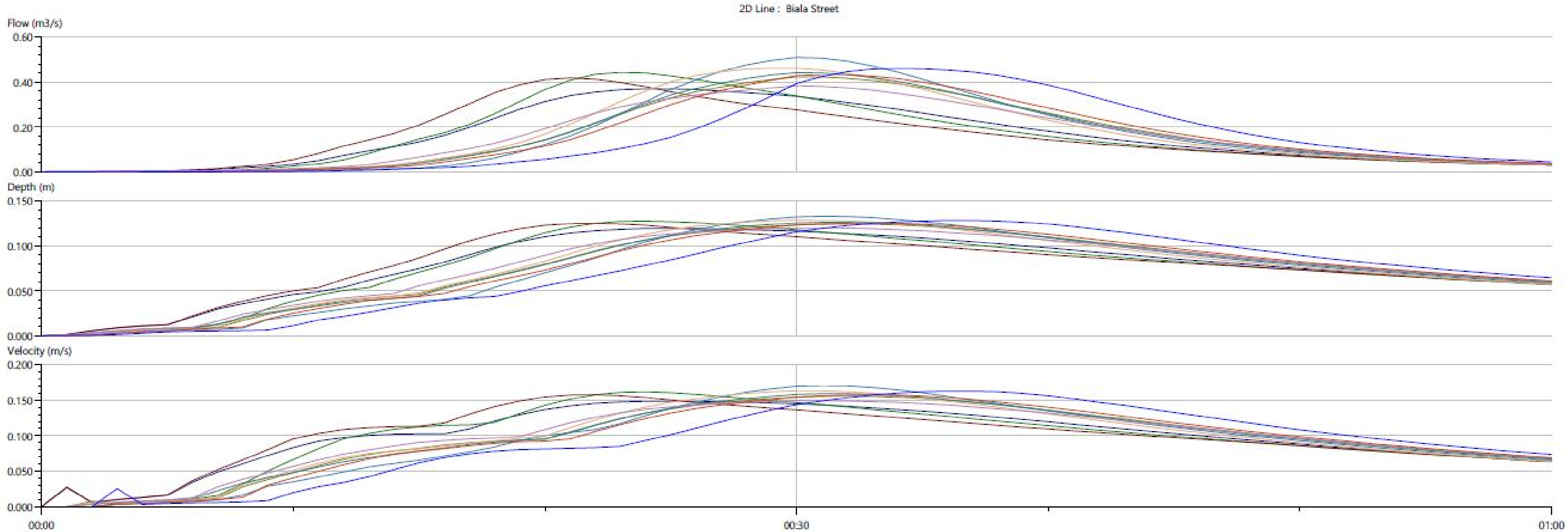
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_5pct_20min_1	0.000	0.412	483.887	0.000	0.124	0.000	0.155
...63.2 to 1% 20min to 45min>MB_5pct_20min_2	0.000	0.448	492.647	0.000	0.128	0.000	0.162
...63.2 to 1% 20min to 45min>MB_5pct_20min_3	0.000	0.441	491.411	0.000	0.127	0.000	0.161
...63.2 to 1% 20min to 45min>MB_5pct_20min_4	0.000	0.462	496.916	0.000	0.129	0.000	0.165
...63.2 to 1% 20min to 45min>MB_5pct_20min_5	0.000	0.435	491.290	0.000	0.126	0.000	0.160
...63.2 to 1% 20min to 45min>MB_5pct_20min_6	0.000	0.451	493.605	0.000	0.128	0.000	0.162
...63.2 to 1% 20min to 45min>MB_5pct_20min_7	0.000	0.468	498.174	0.000	0.130	0.000	0.166
...63.2 to 1% 20min to 45min>MB_5pct_20min_8	0.000	0.443	492.897	0.000	0.127	0.000	0.161
...63.2 to 1% 20min to 45min>MB_5pct_20min_9	0.000	0.450	494.053	0.000	0.128	0.000	0.163
...3.2 to 1% 20min to 45min>MB_5pct_20min_10	0.000	0.367	477.641	0.000	0.118	0.000	0.147

Figure B-22: Peak flows for the 5% AEP – 20 minute duration – Temporal Pattern (TP) 2 used in the flood modelling analysis



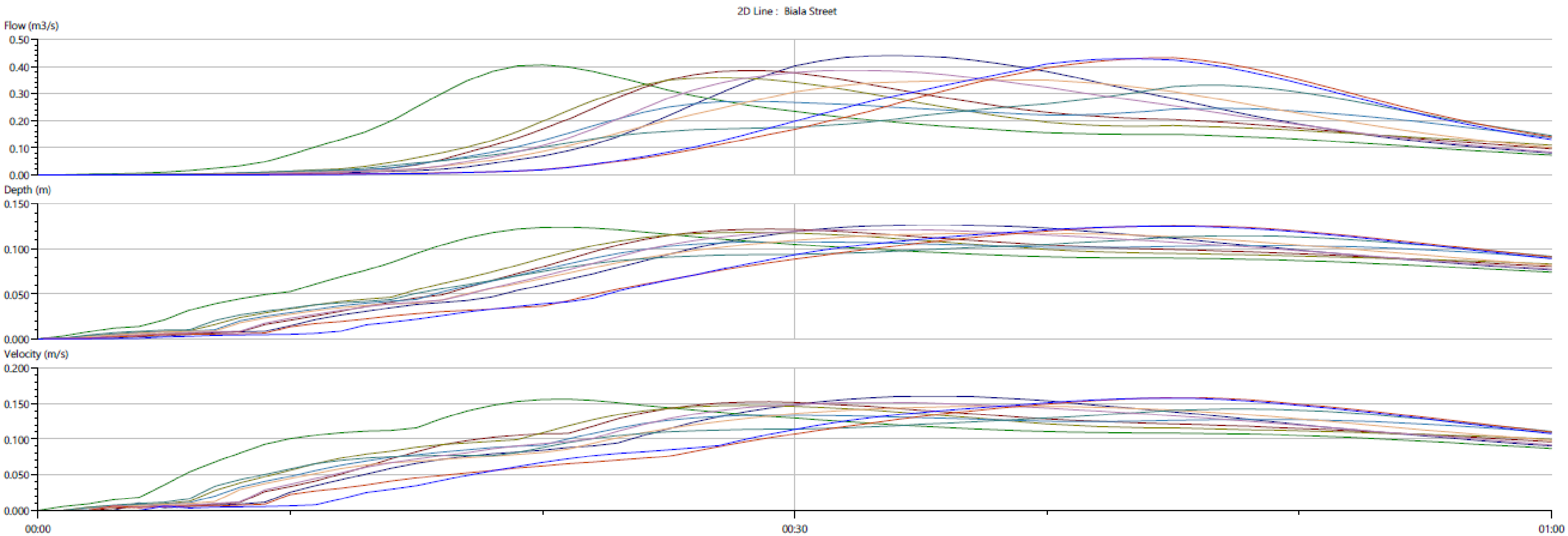
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_5pct_25min_1	0.000	0.475	548.901	0.000	0.130	0.000	0.165
...63.2 to 1% 20min to 45min>MB_5pct_25min_2	0.000	0.408	533.278	0.000	0.123	0.000	0.154
...63.2 to 1% 20min to 45min>MB_5pct_25min_3	0.000	0.452	544.446	0.000	0.128	0.000	0.163
...63.2 to 1% 20min to 45min>MB_5pct_25min_4	0.000	0.402	533.408	0.000	0.123	0.000	0.154
...63.2 to 1% 20min to 45min>MB_5pct_25min_5	0.000	0.433	538.099	0.000	0.125	0.000	0.158
...63.2 to 1% 20min to 45min>MB_5pct_25min_6	0.000	0.484	549.772	0.000	0.131	0.000	0.167
...63.2 to 1% 20min to 45min>MB_5pct_25min_7	0.000	0.472	548.010	0.000	0.130	0.000	0.165
...63.2 to 1% 20min to 45min>MB_5pct_25min_8	0.000	0.423	534.474	0.000	0.124	0.000	0.156
...63.2 to 1% 20min to 45min>MB_5pct_25min_9	0.000	0.379	526.681	0.000	0.120	0.000	0.149
...3.2 to 1% 20min to 45min>MB_5pct_25min_10	0.000	0.496	552.832	0.000	0.132	0.000	0.169

Figure B-23: Peak flows for the 5% AEP – 25 minute duration



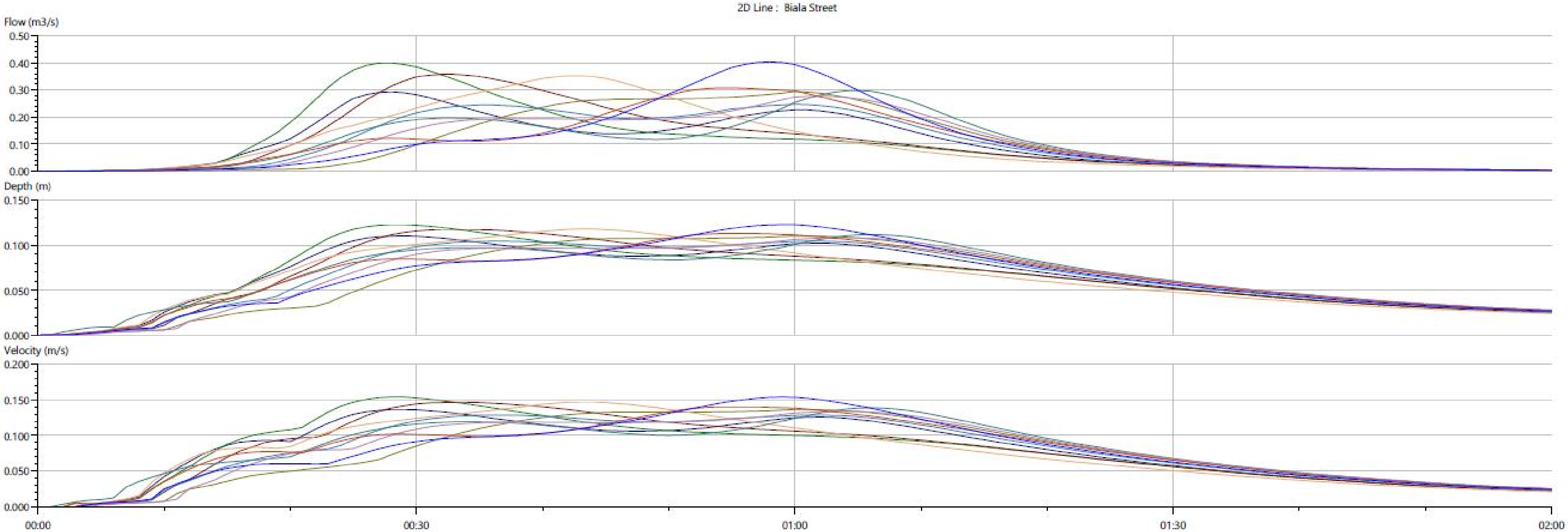
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_5pct_30min_1	0.000	0.370	566.180	0.000	0.119	0.000	0.148
...63.2 to 1% 20min to 45min>MB_5pct_30min_2	0.000	0.442	577.321	0.000	0.127	0.000	0.162
...63.2 to 1% 20min to 45min>MB_5pct_30min_3	0.000	0.417	567.376	0.000	0.125	0.000	0.158
...63.2 to 1% 20min to 45min>MB_5pct_30min_4	0.000	0.422	573.385	0.000	0.124	0.000	0.156
...63.2 to 1% 20min to 45min>MB_5pct_30min_5	0.000	0.508	593.159	0.000	0.133	0.000	0.170
...63.2 to 1% 20min to 45min>MB_5pct_30min_6	0.000	0.461	586.524	0.000	0.128	0.000	0.163
...63.2 to 1% 20min to 45min>MB_5pct_30min_7	0.000	0.441	577.569	0.000	0.126	0.000	0.159
...63.2 to 1% 20min to 45min>MB_5pct_30min_8	0.000	0.383	563.904	0.000	0.120	0.000	0.149
...63.2 to 1% 20min to 45min>MB_5pct_30min_9	0.000	0.432	574.663	0.000	0.125	0.000	0.158
...3.2 to 1% 20min to 45min>MB_5pct_30min_10	0.000	0.459	578.053	0.000	0.128	0.000	0.163

Figure B-24: Peak flows for the 5% AEP – 30 minute duration



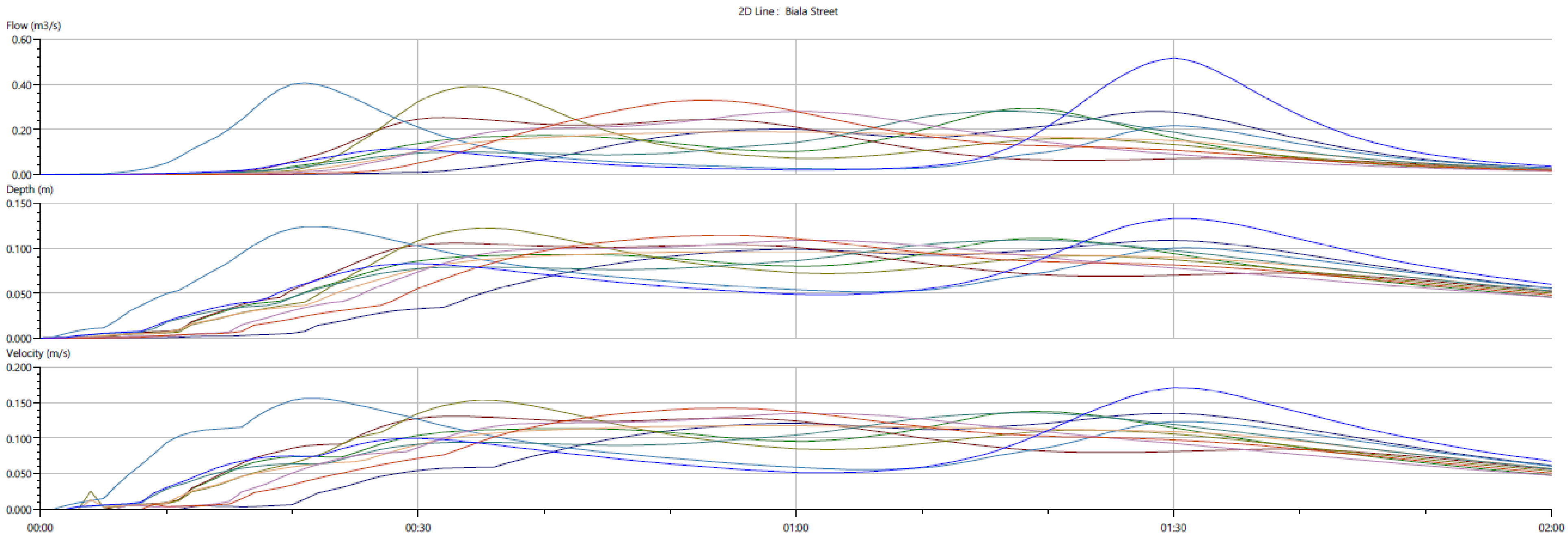
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_5pct_45min_1	0.000	0.441	647.003	0.000	0.127	0.000	0.160
...63.2 to 1% 20min to 45min>MB_5pct_45min_2	0.000	0.406	614.127	0.000	0.124	0.000	0.156
...63.2 to 1% 20min to 45min>MB_5pct_45min_3	0.000	0.385	608.380	0.000	0.122	0.000	0.152
...63.2 to 1% 20min to 45min>MB_5pct_45min_4	0.000	0.359	586.986	0.000	0.118	0.000	0.147
...63.2 to 1% 20min to 45min>MB_5pct_45min_5	0.000	0.271	569.809	0.000	0.108	0.000	0.134
...63.2 to 1% 20min to 45min>MB_5pct_45min_6	0.000	0.349	616.419	0.000	0.117	0.000	0.146
...63.2 to 1% 20min to 45min>MB_5pct_45min_7	0.000	0.330	570.604	0.000	0.114	0.000	0.142
...63.2 to 1% 20min to 45min>MB_5pct_45min_8	0.000	0.386	631.867	0.000	0.121	0.000	0.152
...63.2 to 1% 20min to 45min>MB_5pct_45min_9	0.000	0.432	612.607	0.000	0.126	0.000	0.158
...3.2 to 1% 20min to 45min>MB_5pct_45min_10	0.000	0.428	622.614	0.000	0.125	0.000	0.157

Figure B-25: Peak flows for the 5% AEP – 45 minute duration



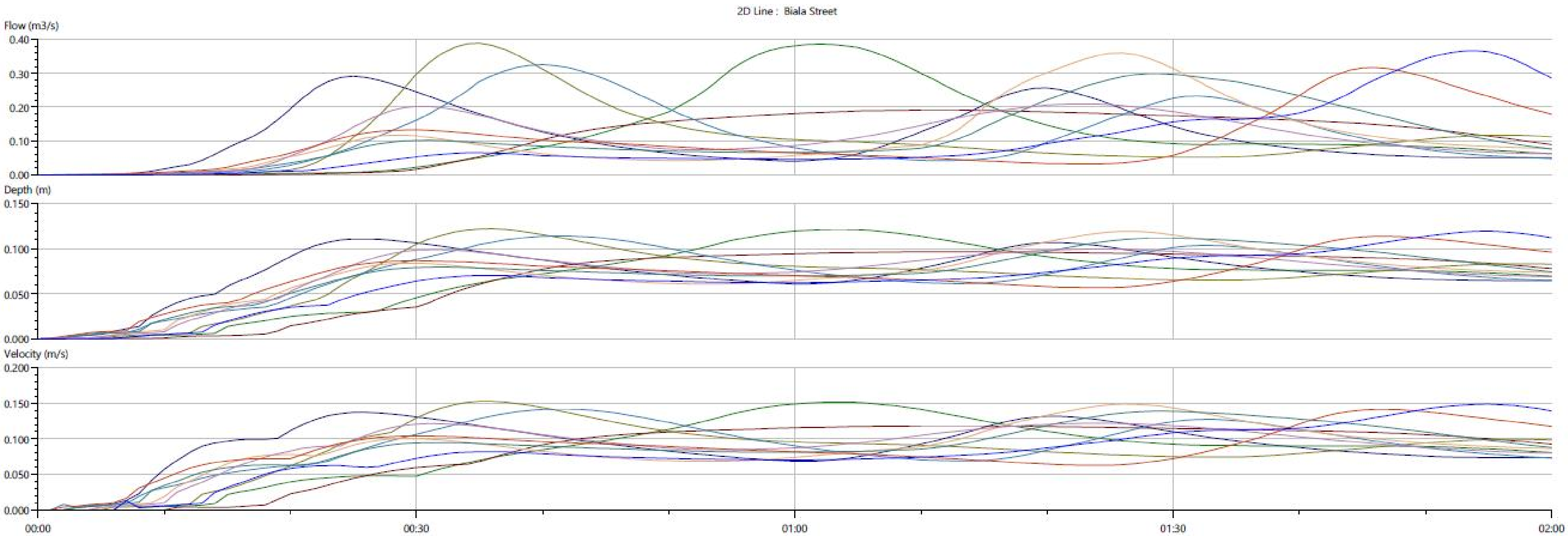
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_1	0.000	0.293	721.233	0.000	0.110	0.000	0.136
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_2	0.000	0.399	741.496	0.000	0.123	0.000	0.154
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_3	0.000	0.358	741.174	0.000	0.117	0.000	0.146
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_4	0.000	0.294	738.567	0.000	0.110	0.000	0.136
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_5	0.000	0.247	724.467	0.000	0.104	0.000	0.129
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_6	0.000	0.352	745.015	0.000	0.118	0.000	0.147
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_7	0.000	0.298	715.126	0.000	0.112	0.000	0.139
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_8	0.000	0.278	721.712	0.000	0.108	0.000	0.134
...w>63.2 to 1% 60min to 90min>MB_5pct_1hr_9	0.000	0.307	724.545	0.000	0.113	0.000	0.140
...>63.2 to 1% 60min to 90min>MB_5pct_1hr_10	0.000	0.403	748.166	0.000	0.123	0.000	0.154

Figure B-26: Peak flows for the 5% AEP – 60 minute duration



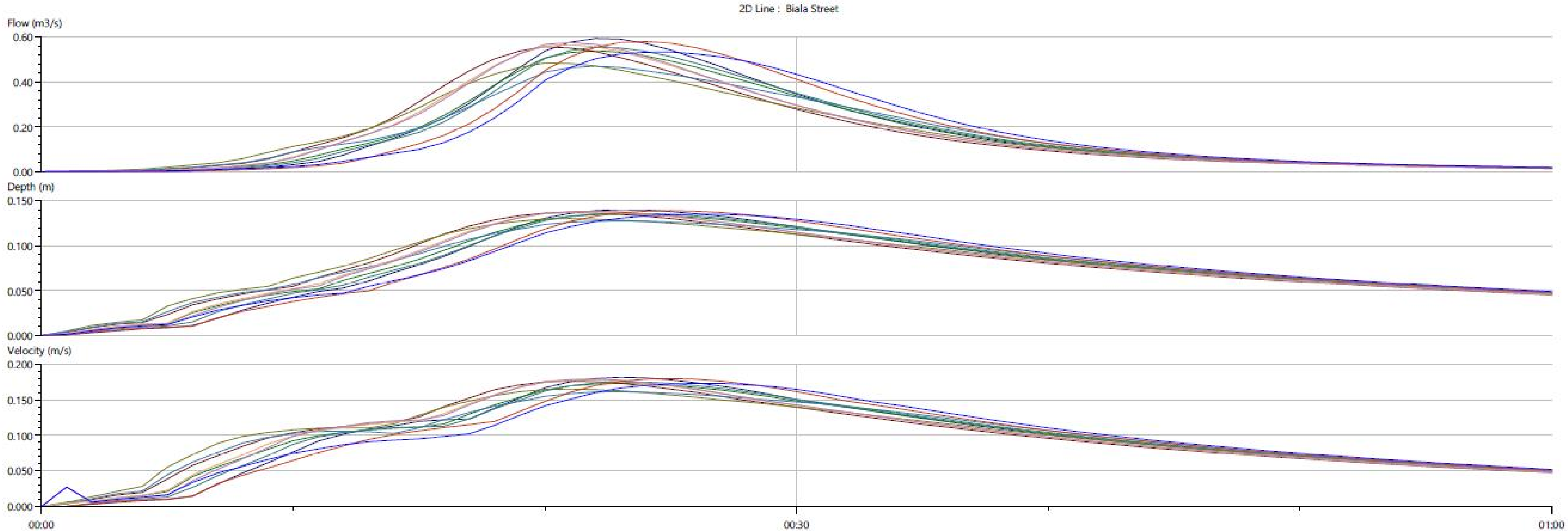
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_1	0.000	0.280	809.806	0.000	0.109	0.000	0.135
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_2	0.000	0.293	807.266	0.000	0.111	0.000	0.138
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_3	0.000	0.252	801.983	0.000	0.106	0.000	0.131
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_4	0.000	0.391	817.364	0.000	0.122	0.000	0.153
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_5	0.000	0.406	810.424	0.000	0.124	0.000	0.156
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_6	0.000	0.189	785.905	0.000	0.096	0.000	0.118
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_7	0.000	0.281	797.295	0.000	0.109	0.000	0.135
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_8	0.000	0.280	822.970	0.000	0.109	0.000	0.135
...63.2 to 1% 60min to 90min>MB_5pct_1_5hr_9	0.000	0.329	829.623	0.000	0.114	0.000	0.142
...3.2 to 1% 60min to 90min>MB_5pct_1_5hr_10	0.000	0.517	843.821	0.000	0.133	0.000	0.171

Figure B-27: Peak flows for the 5% AEP – 90 minute duration



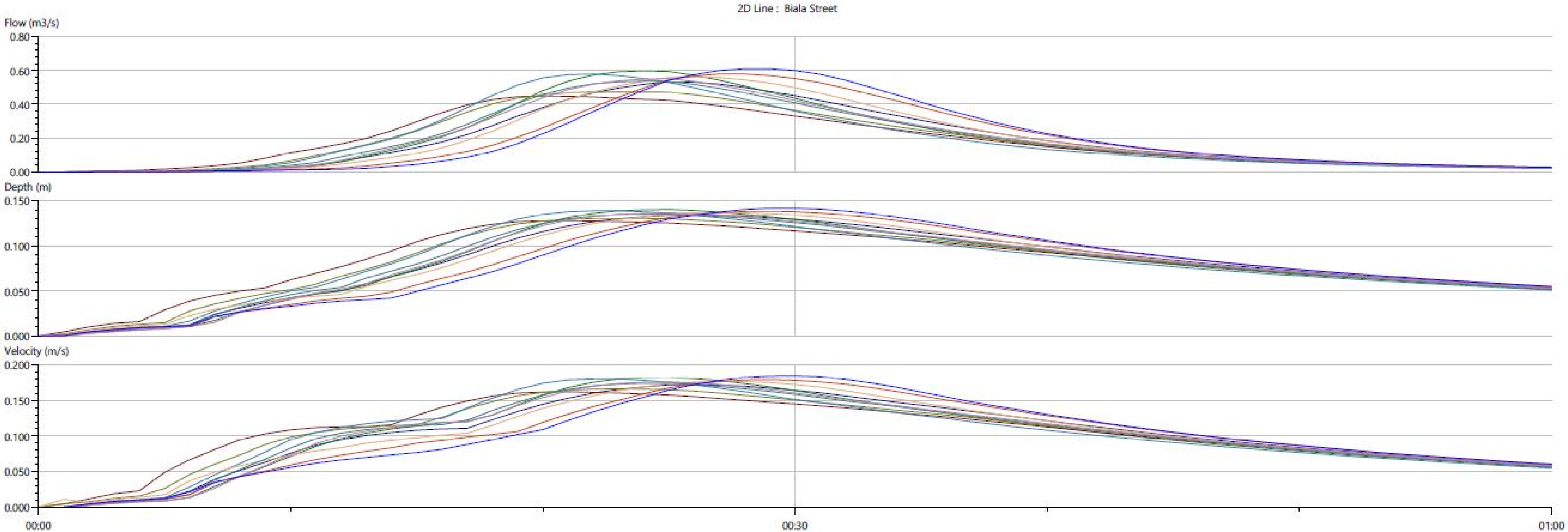
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_1	0.000	0.291	821.085	0.000	0.111	0.000	0.137
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_2	0.000	0.386	857.455	0.000	0.121	0.000	0.152
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_3	0.000	0.191	813.946	0.000	0.097	0.000	0.118
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_4	0.000	0.388	785.280	0.000	0.122	0.000	0.153
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_5	0.000	0.326	846.737	0.000	0.114	0.000	0.142
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_6	0.000	0.360	800.240	0.000	0.119	0.000	0.149
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_7	0.000	0.299	825.554	0.000	0.112	0.000	0.139
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_8	0.000	0.209	788.876	0.000	0.099	0.000	0.122
...rland flow>63.2 to 1% 120min>MB_5pct_2hr_9	0.000	0.317	734.214	0.000	0.114	0.000	0.141
...and flow>63.2 to 1% 120min>MB_5pct_2hr_10	0.000	0.366	720.231	0.000	0.119	0.000	0.149

Figure B-28: Peak flows for the 5% AEP – 120 minute duration



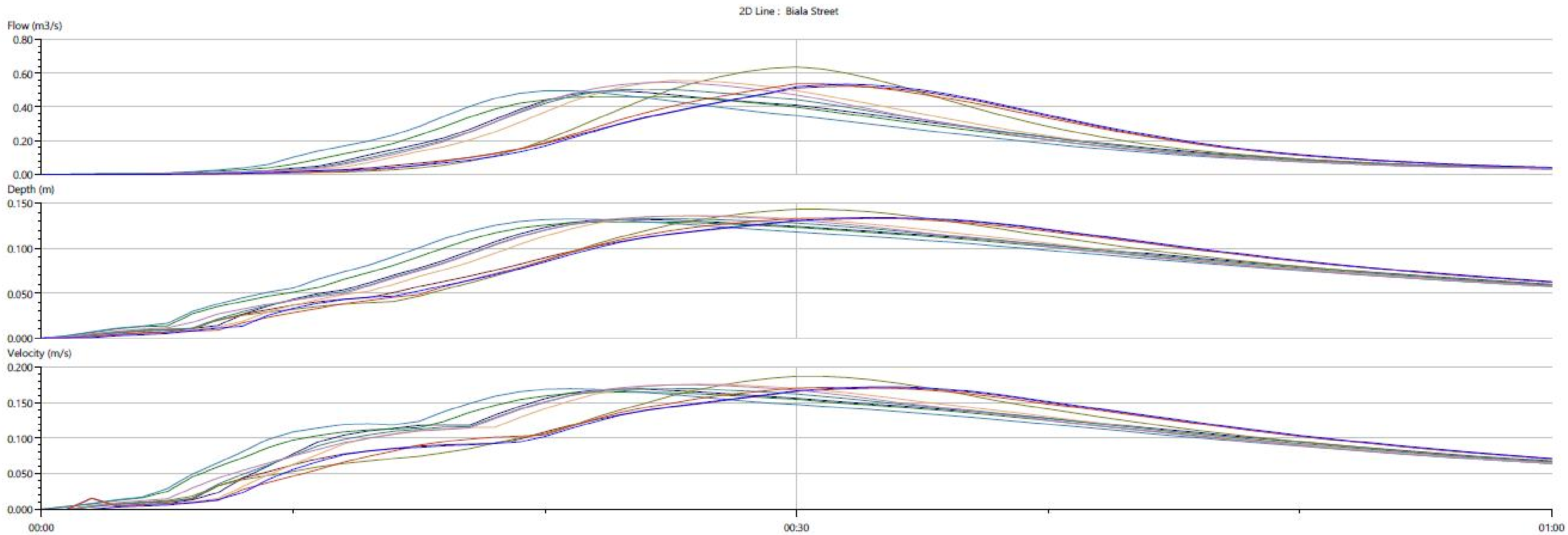
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_2pct_20min_1	0.000	0.593	624.571	0.000	0.140	0.000	0.182
...63.2 to 1% 20min to 45min>MB_2pct_20min_2	0.000	0.538	613.380	0.000	0.135	0.000	0.173
...63.2 to 1% 20min to 45min>MB_2pct_20min_3	0.000	0.555	617.566	0.000	0.137	0.000	0.176
...63.2 to 1% 20min to 45min>MB_2pct_20min_4	0.000	0.484	601.749	0.000	0.130	0.000	0.165
...63.2 to 1% 20min to 45min>MB_2pct_20min_5	0.000	0.469	598.402	0.000	0.127	0.000	0.161
...63.2 to 1% 20min to 45min>MB_2pct_20min_6	0.000	0.565	618.889	0.000	0.137	0.000	0.178
...63.2 to 1% 20min to 45min>MB_2pct_20min_7	0.000	0.553	615.810	0.000	0.136	0.000	0.175
...63.2 to 1% 20min to 45min>MB_2pct_20min_8	0.000	0.575	620.099	0.000	0.138	0.000	0.179
...63.2 to 1% 20min to 45min>MB_2pct_20min_9	0.000	0.578	623.449	0.000	0.139	0.000	0.180
...3.2 to 1% 20min to 45min>MB_2pct_20min_10	0.000	0.532	615.985	0.000	0.135	0.000	0.173

Figure B-29: Peak flows for the 2% AEP – 20 minute duration



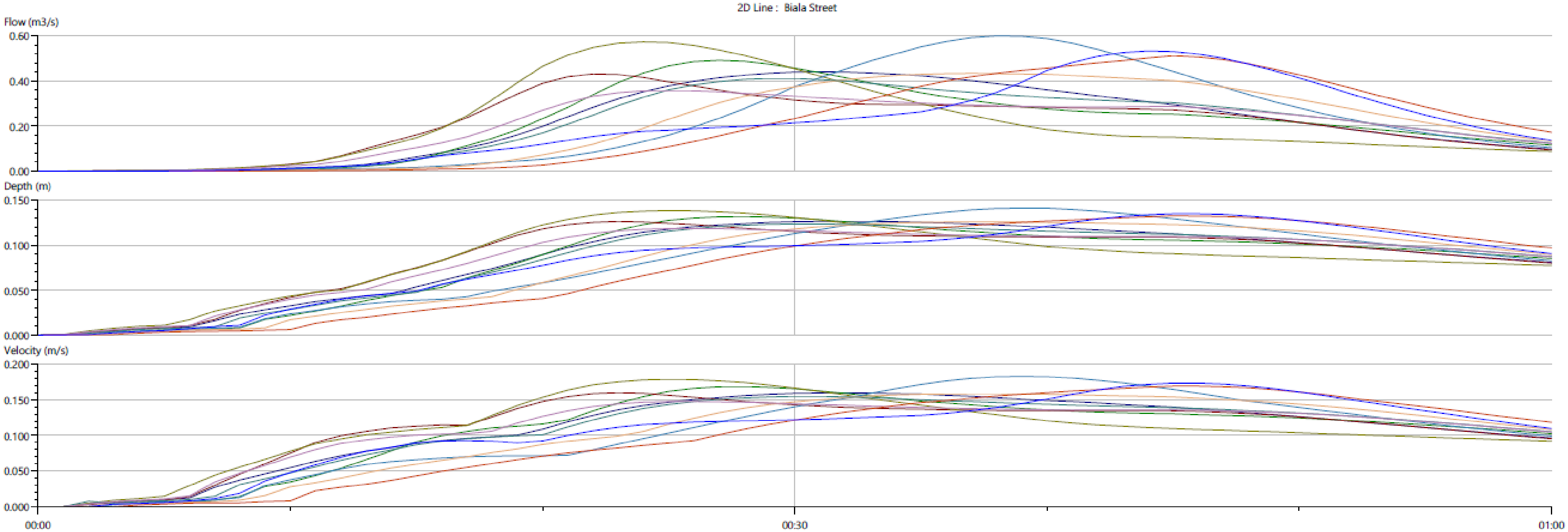
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_2pct_25min_1	0.000	0.534	673.527	0.000	0.134	0.000	0.172
...63.2 to 1% 20min to 45min>MB_2pct_25min_2	0.000	0.598	688.864	0.000	0.140	0.000	0.182
...63.2 to 1% 20min to 45min>MB_2pct_25min_3	0.000	0.447	659.680	0.000	0.128	0.000	0.162
...63.2 to 1% 20min to 45min>MB_2pct_25min_4	0.000	0.474	665.528	0.000	0.130	0.000	0.166
...63.2 to 1% 20min to 45min>MB_2pct_25min_5	0.000	0.578	684.513	0.000	0.139	0.000	0.180
...63.2 to 1% 20min to 45min>MB_2pct_25min_6	0.000	0.561	681.393	0.000	0.137	0.000	0.177
...63.2 to 1% 20min to 45min>MB_2pct_25min_7	0.000	0.537	676.255	0.000	0.135	0.000	0.174
...63.2 to 1% 20min to 45min>MB_2pct_25min_8	0.000	0.551	677.907	0.000	0.137	0.000	0.176
...63.2 to 1% 20min to 45min>MB_2pct_25min_9	0.000	0.578	683.082	0.000	0.138	0.000	0.179
...3.2 to 1% 20min to 45min>MB_2pct_25min_10	0.000	0.611	690.219	0.000	0.142	0.000	0.185

Figure B-30: Peak flows for the 2% AEP – 25 minute duration – Temporal Pattern (TP) 6 used in the flood modelling analysis



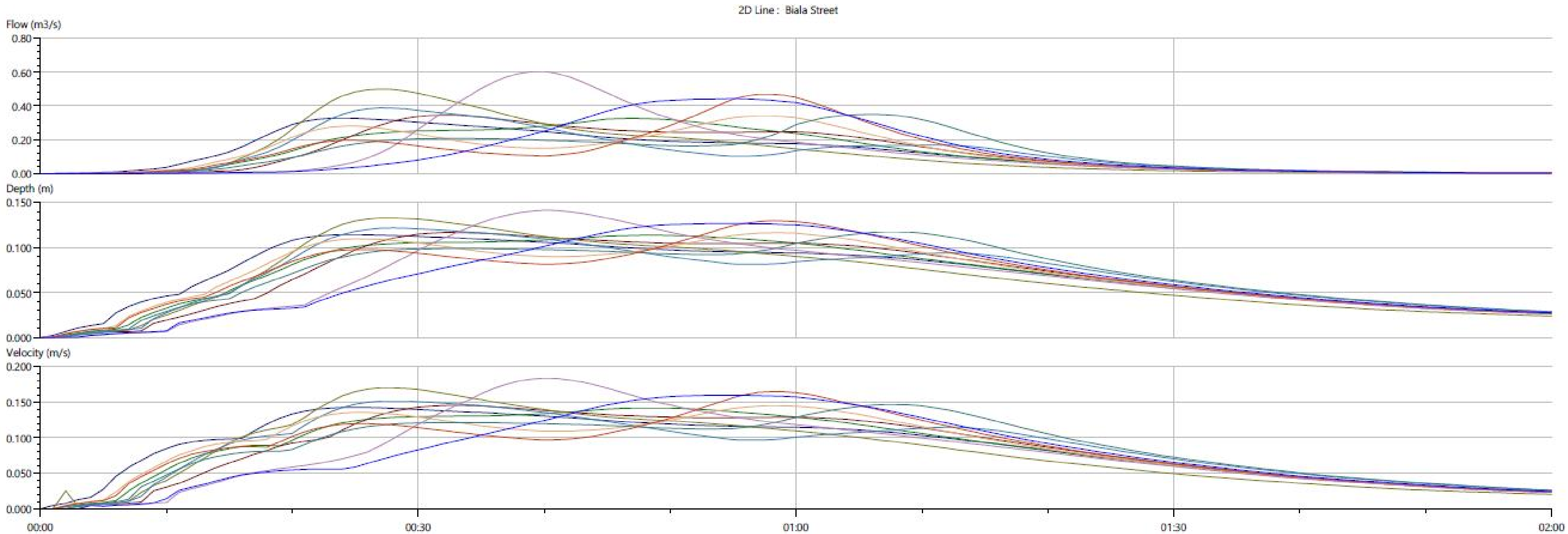
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_2pct_30min_1	0.000	0.493	711.449	0.000	0.132	0.000	0.169
...63.2 to 1% 20min to 45min>MB_2pct_30min_2	0.000	0.462	712.290	0.000	0.129	0.000	0.164
...63.2 to 1% 20min to 45min>MB_2pct_30min_3	0.000	0.522	713.563	0.000	0.133	0.000	0.171
...63.2 to 1% 20min to 45min>MB_2pct_30min_4	0.000	0.635	741.375	0.000	0.143	0.000	0.187
...63.2 to 1% 20min to 45min>MB_2pct_30min_5	0.000	0.495	711.094	0.000	0.132	0.000	0.169
...63.2 to 1% 20min to 45min>MB_2pct_30min_6	0.000	0.557	729.865	0.000	0.136	0.000	0.176
...63.2 to 1% 20min to 45min>MB_2pct_30min_7	0.000	0.506	717.553	0.000	0.133	0.000	0.170
...63.2 to 1% 20min to 45min>MB_2pct_30min_8	0.000	0.545	726.718	0.000	0.136	0.000	0.175
...63.2 to 1% 20min to 45min>MB_2pct_30min_9	0.000	0.535	718.510	0.000	0.134	0.000	0.172
...3.2 to 1% 20min to 45min>MB_2pct_30min_10	0.000	0.533	716.481	0.000	0.134	0.000	0.172

Figure B-31: Peak flows for the 2% AEP – 30 minute duration



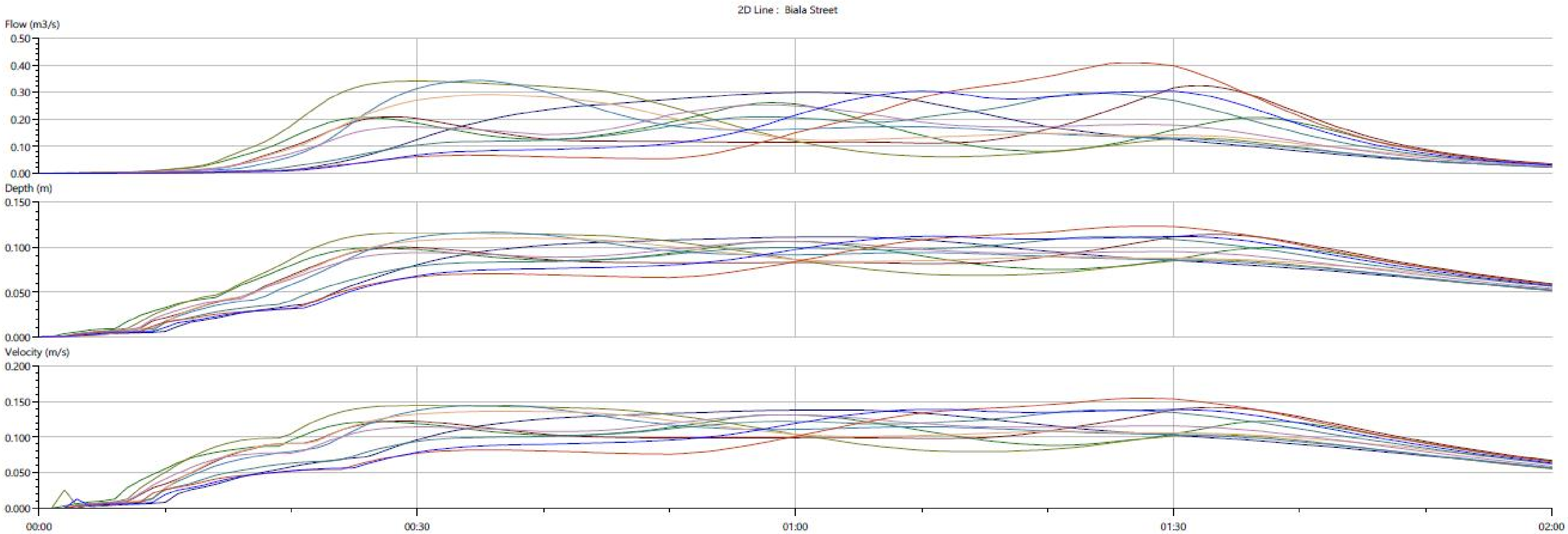
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_2pct_45min_1	0.000	0.440	773.336	0.000	0.126	0.000	0.160
...63.2 to 1% 20min to 45min>MB_2pct_45min_2	0.000	0.490	758.542	0.000	0.132	0.000	0.169
...63.2 to 1% 20min to 45min>MB_2pct_45min_3	0.000	0.430	762.699	0.000	0.126	0.000	0.160
...63.2 to 1% 20min to 45min>MB_2pct_45min_4	0.000	0.572	773.671	0.000	0.138	0.000	0.179
...63.2 to 1% 20min to 45min>MB_2pct_45min_5	0.000	0.599	806.375	0.000	0.141	0.000	0.183
...63.2 to 1% 20min to 45min>MB_2pct_45min_6	0.000	0.433	764.335	0.000	0.126	0.000	0.159
...63.2 to 1% 20min to 45min>MB_2pct_45min_7	0.000	0.410	747.519	0.000	0.123	0.000	0.155
...63.2 to 1% 20min to 45min>MB_2pct_45min_8	0.000	0.357	734.429	0.000	0.118	0.000	0.147
...63.2 to 1% 20min to 45min>MB_2pct_45min_9	0.000	0.511	755.667	0.000	0.132	0.000	0.169
...3.2 to 1% 20min to 45min>MB_2pct_45min_10	0.000	0.532	764.869	0.000	0.135	0.000	0.173

Figure B-32: Peak flows for the 2% AEP – 45 minute duration



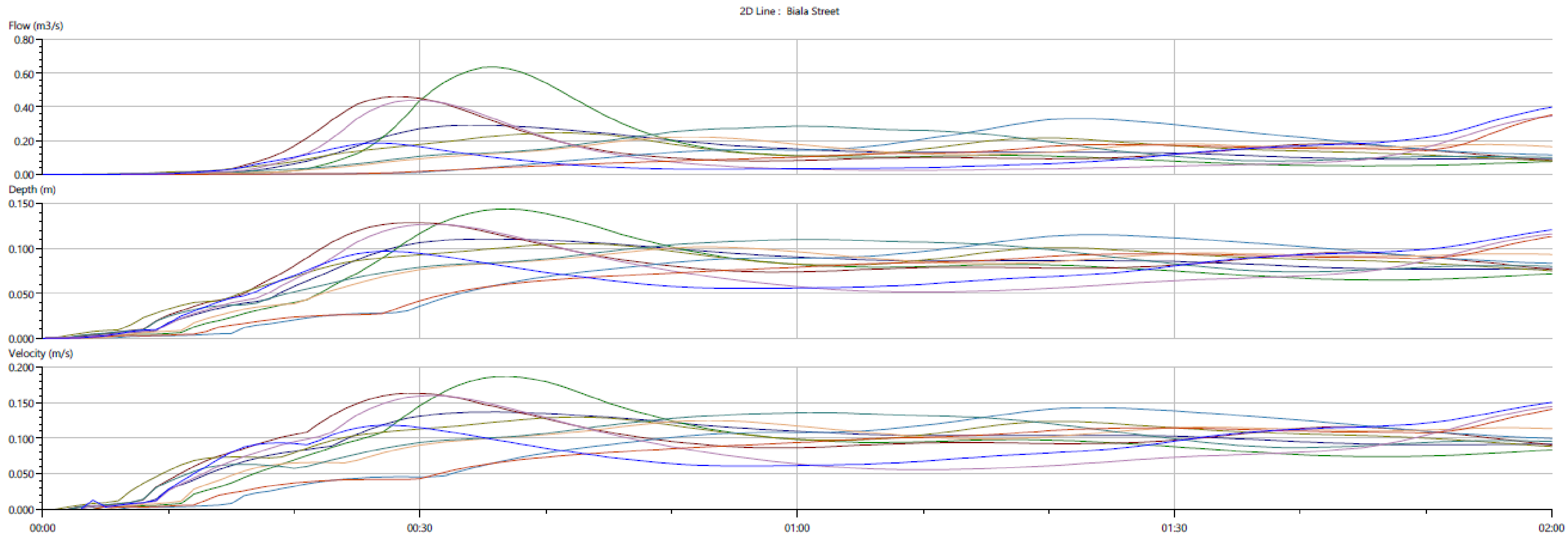
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_1	0.000	0.326	875.183	0.000	0.114	0.000	0.142
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_2	0.000	0.325	884.964	0.000	0.114	0.000	0.141
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_3	0.000	0.345	891.540	0.000	0.117	0.000	0.145
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_4	0.000	0.500	929.194	0.000	0.133	0.000	0.170
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_5	0.000	0.388	882.415	0.000	0.122	0.000	0.152
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_6	0.000	0.341	880.156	0.000	0.116	0.000	0.145
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_7	0.000	0.350	871.678	0.000	0.117	0.000	0.147
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_8	0.000	0.605	951.709	0.000	0.141	0.000	0.184
...w>63.2 to 1% 60min to 90min>MB_2pct_1hr_9	0.000	0.469	896.199	0.000	0.129	0.000	0.165
...>63.2 to 1% 60min to 90min>MB_2pct_1hr_10	0.000	0.442	931.282	0.000	0.126	0.000	0.160

Figure B-33: Peak flows for the 2% AEP – 60 minute duration



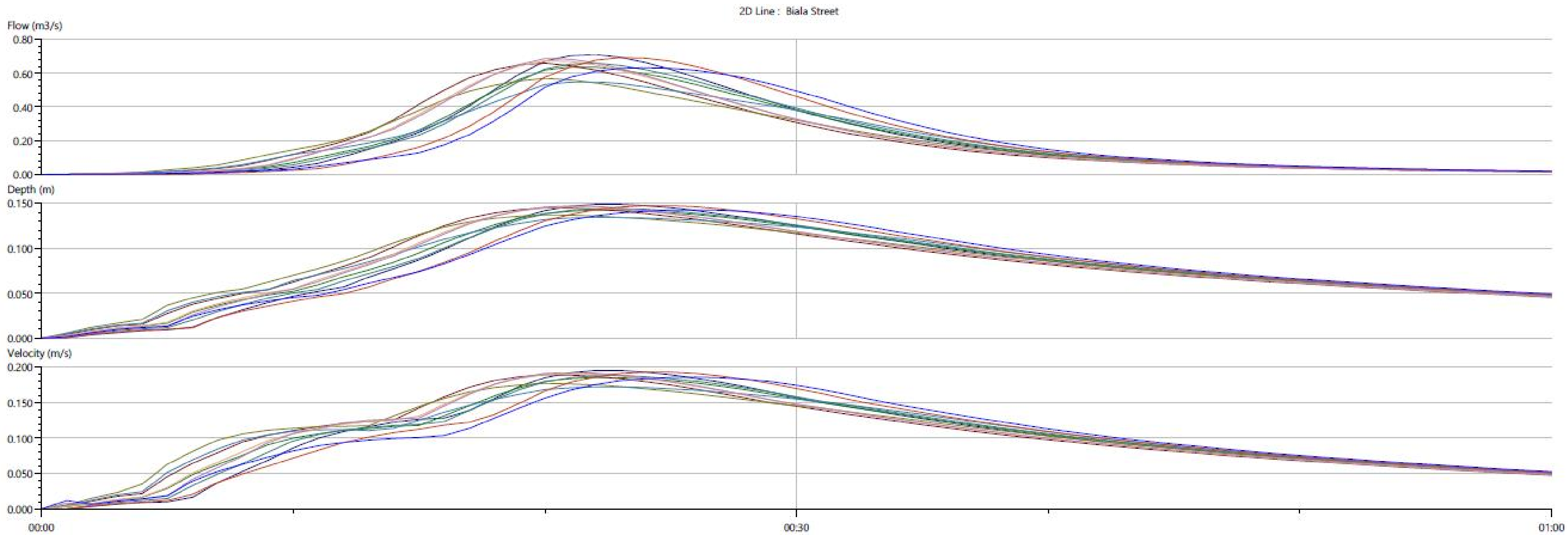
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_1	0.000	0.299	987.877	0.000	0.111	0.000	0.138
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_2	0.000	0.260	940.357	0.000	0.107	0.000	0.132
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_3	0.000	0.324	948.392	0.000	0.114	0.000	0.142
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_4	0.000	0.341	988.647	0.000	0.116	0.000	0.144
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_5	0.000	0.343	972.087	0.000	0.116	0.000	0.145
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_6	0.000	0.291	954.394	0.000	0.110	0.000	0.136
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_7	0.000	0.298	964.782	0.000	0.111	0.000	0.138
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_8	0.000	0.254	952.430	0.000	0.106	0.000	0.131
...63.2 to 1% 60min to 90min>MB_2pct_1_5hr_9	0.000	0.408	1006.801	0.000	0.123	0.000	0.154
...3.2 to 1% 60min to 90min>MB_2pct_1_5hr_10	0.000	0.304	985.169	0.000	0.112	0.000	0.139

Figure B-34: Peak flows for the 2% AEP – 90 minute duration



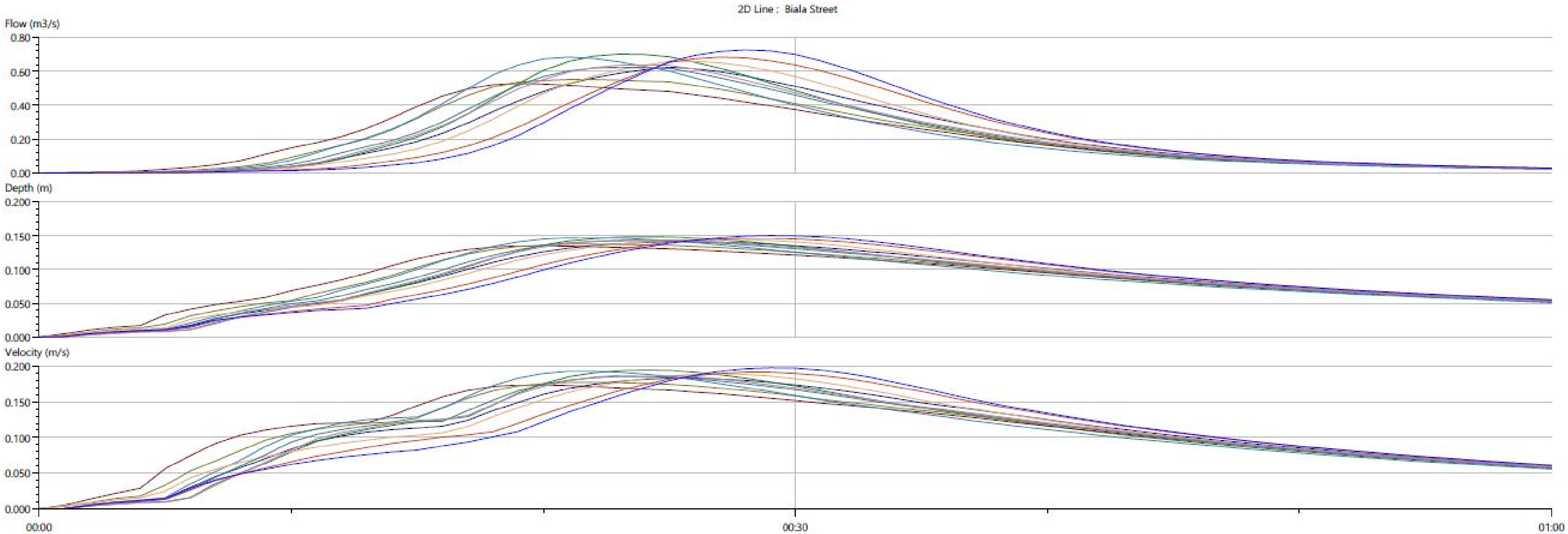
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_1	0.000	0.292	952.591	0.000	0.111	0.000	0.137
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_2	0.000	0.636	1039.918	0.000	0.143	0.000	0.187
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_3	0.000	0.462	1030.571	0.000	0.129	0.000	0.163
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_4	0.000	0.248	982.594	0.000	0.105	0.000	0.130
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_5	0.000	0.332	967.039	0.000	0.115	0.000	0.143
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_6	0.000	0.222	906.148	0.000	0.102	0.000	0.125
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_7	0.000	0.286	974.586	0.000	0.110	0.000	0.136
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_8	0.000	0.440	826.502	0.000	0.127	0.000	0.160
...rland flow>63.2 to 1% 120min>MB_2pct_2hr_9	0.000	0.354	710.871	0.000	0.113	0.000	0.141
...and flow>63.2 to 1% 120min>MB_2pct_2hr_10	0.000	0.399	727.499	0.000	0.121	0.000	0.150

Figure B-35: Peak flows for the 2% AEP – 120 minute duration



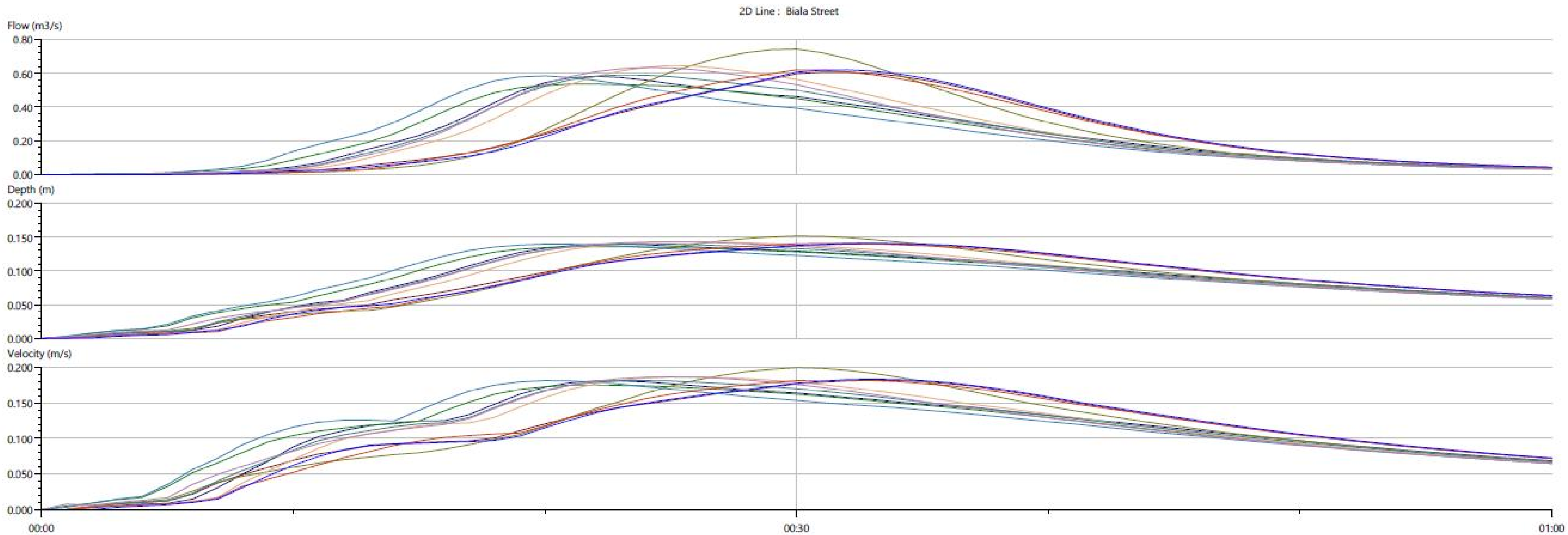
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_1pct_20min_1	0.000	0.710	729.641	0.000	0.149	0.000	0.195
...63.2 to 1% 20min to 45min>MB_1pct_20min_2	0.000	0.636	715.932	0.000	0.142	0.000	0.185
...63.2 to 1% 20min to 45min>MB_1pct_20min_3	0.000	0.659	720.936	0.000	0.145	0.000	0.189
...63.2 to 1% 20min to 45min>MB_1pct_20min_4	0.000	0.569	702.107	0.000	0.137	0.000	0.177
...63.2 to 1% 20min to 45min>MB_1pct_20min_5	0.000	0.548	698.056	0.000	0.134	0.000	0.172
...63.2 to 1% 20min to 45min>MB_1pct_20min_6	0.000	0.672	722.563	0.000	0.146	0.000	0.191
...63.2 to 1% 20min to 45min>MB_1pct_20min_7	0.000	0.658	718.989	0.000	0.144	0.000	0.188
...63.2 to 1% 20min to 45min>MB_1pct_20min_8	0.000	0.684	724.004	0.000	0.147	0.000	0.192
...63.2 to 1% 20min to 45min>MB_1pct_20min_9	0.000	0.690	728.173	0.000	0.147	0.000	0.193
...3.2 to 1% 20min to 45min>MB_1pct_20min_10	0.000	0.631	718.831	0.000	0.143	0.000	0.186

Figure B-36: Peak flows for the 1% AEP – 20 minute duration – Temporal Pattern (TP) 3 used in the flood modelling analysis



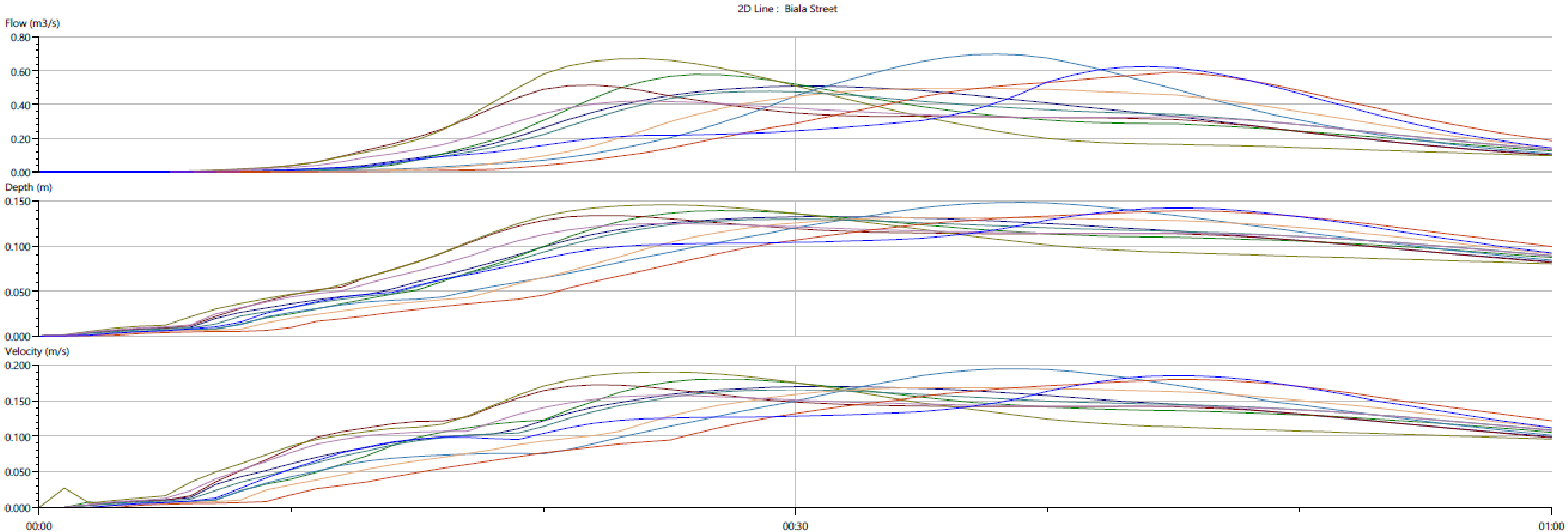
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_1pct_25min_1	0.000	0.623	783.723	0.000	0.141	0.000	0.183
...63.2 to 1% 20min to 45min>MB_1pct_25min_2	0.000	0.701	801.728	0.000	0.148	0.000	0.194
...63.2 to 1% 20min to 45min>MB_1pct_25min_3	0.000	0.529	767.715	0.000	0.135	0.000	0.174
...63.2 to 1% 20min to 45min>MB_1pct_25min_4	0.000	0.552	774.569	0.000	0.137	0.000	0.177
...63.2 to 1% 20min to 45min>MB_1pct_25min_5	0.000	0.683	796.754	0.000	0.147	0.000	0.193
...63.2 to 1% 20min to 45min>MB_1pct_25min_6	0.000	0.660	792.548	0.000	0.145	0.000	0.189
...63.2 to 1% 20min to 45min>MB_1pct_25min_7	0.000	0.624	787.061	0.000	0.142	0.000	0.185
...63.2 to 1% 20min to 45min>MB_1pct_25min_8	0.000	0.639	789.098	0.000	0.144	0.000	0.187
...63.2 to 1% 20min to 45min>MB_1pct_25min_9	0.000	0.683	794.774	0.000	0.146	0.000	0.191
...3.2 to 1% 20min to 45min>MB_1pct_25min_10	0.000	0.726	803.194	0.000	0.150	0.000	0.198

Figure B-37: Peak flows for the 1% AEP – 25 minute duration



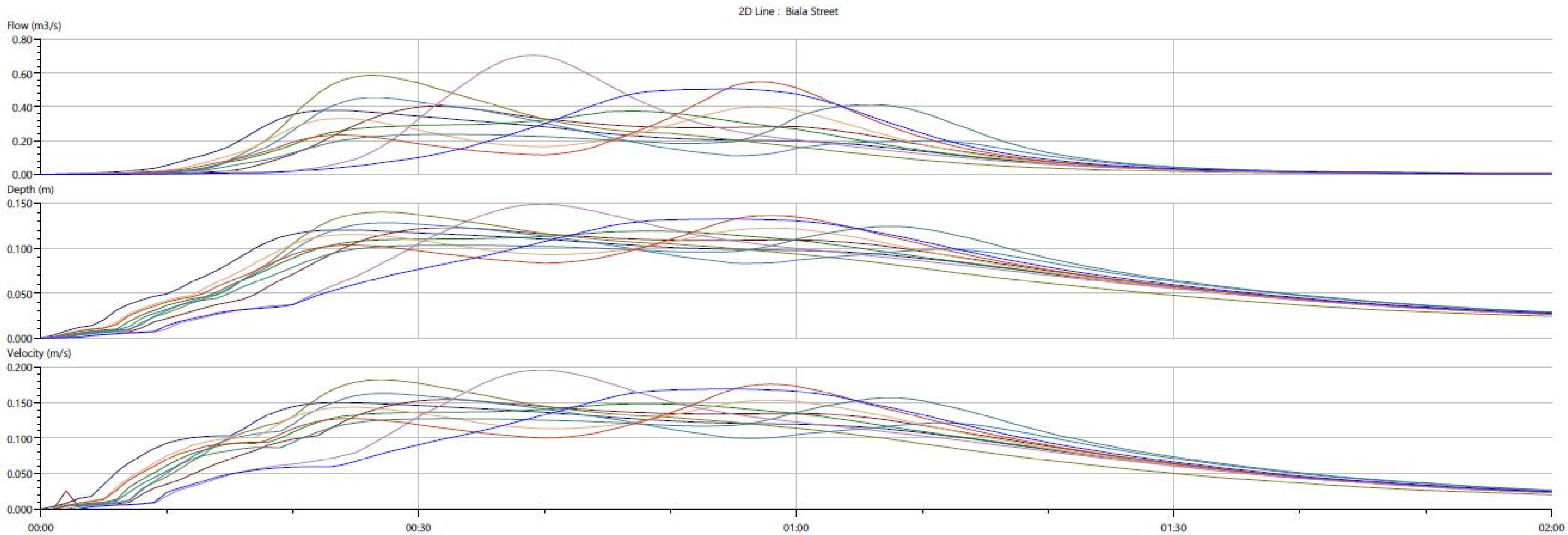
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_1pct_30min_1	0.000	0.581	824.494	0.000	0.139	0.000	0.181
...63.2 to 1% 20min to 45min>MB_1pct_30min_2	0.000	0.536	824.998	0.000	0.136	0.000	0.175
...63.2 to 1% 20min to 45min>MB_1pct_30min_3	0.000	0.607	826.200	0.000	0.140	0.000	0.182
...63.2 to 1% 20min to 45min>MB_1pct_30min_4	0.000	0.742	858.298	0.000	0.151	0.000	0.199
...63.2 to 1% 20min to 45min>MB_1pct_30min_5	0.000	0.584	823.762	0.000	0.140	0.000	0.181
...63.2 to 1% 20min to 45min>MB_1pct_30min_6	0.000	0.647	845.290	0.000	0.143	0.000	0.187
...63.2 to 1% 20min to 45min>MB_1pct_30min_7	0.000	0.590	831.136	0.000	0.140	0.000	0.182
...63.2 to 1% 20min to 45min>MB_1pct_30min_8	0.000	0.633	841.412	0.000	0.143	0.000	0.187
...63.2 to 1% 20min to 45min>MB_1pct_30min_9	0.000	0.621	832.347	0.000	0.141	0.000	0.182
...3.2 to 1% 20min to 45min>MB_1pct_30min_10	0.000	0.621	829.816	0.000	0.141	0.000	0.183

Figure B-38: Peak flows for the 1% AEP – 30 minute duration



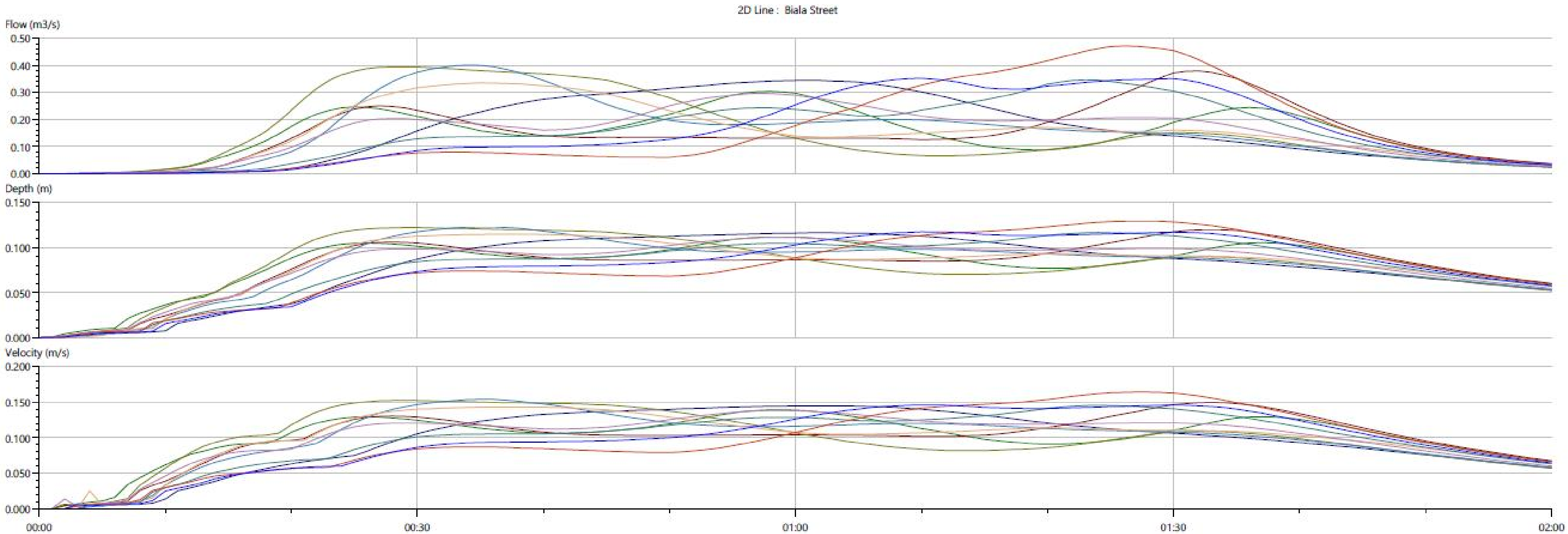
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 20min to 45min>MB_1pct_45min_1	0.000	0.510	899.548	0.000	0.133	0.000	0.170
...63.2 to 1% 20min to 45min>MB_1pct_45min_2	0.000	0.578	884.237	0.000	0.139	0.000	0.181
...63.2 to 1% 20min to 45min>MB_1pct_45min_3	0.000	0.515	888.555	0.000	0.134	0.000	0.172
...63.2 to 1% 20min to 45min>MB_1pct_45min_4	0.000	0.671	899.283	0.000	0.146	0.000	0.190
...63.2 to 1% 20min to 45min>MB_1pct_45min_5	0.000	0.699	937.402	0.000	0.148	0.000	0.195
...63.2 to 1% 20min to 45min>MB_1pct_45min_6	0.000	0.497	891.472	0.000	0.132	0.000	0.168
...63.2 to 1% 20min to 45min>MB_1pct_45min_7	0.000	0.478	871.383	0.000	0.130	0.000	0.165
...63.2 to 1% 20min to 45min>MB_1pct_45min_8	0.000	0.421	856.383	0.000	0.125	0.000	0.157
...63.2 to 1% 20min to 45min>MB_1pct_45min_9	0.000	0.592	882.618	0.000	0.139	0.000	0.180
...3.2 to 1% 20min to 45min>MB_1pct_45min_10	0.000	0.624	892.071	0.000	0.142	0.000	0.185

Figure B-39: Peak flows for the 1% AEP – 45 minute duration



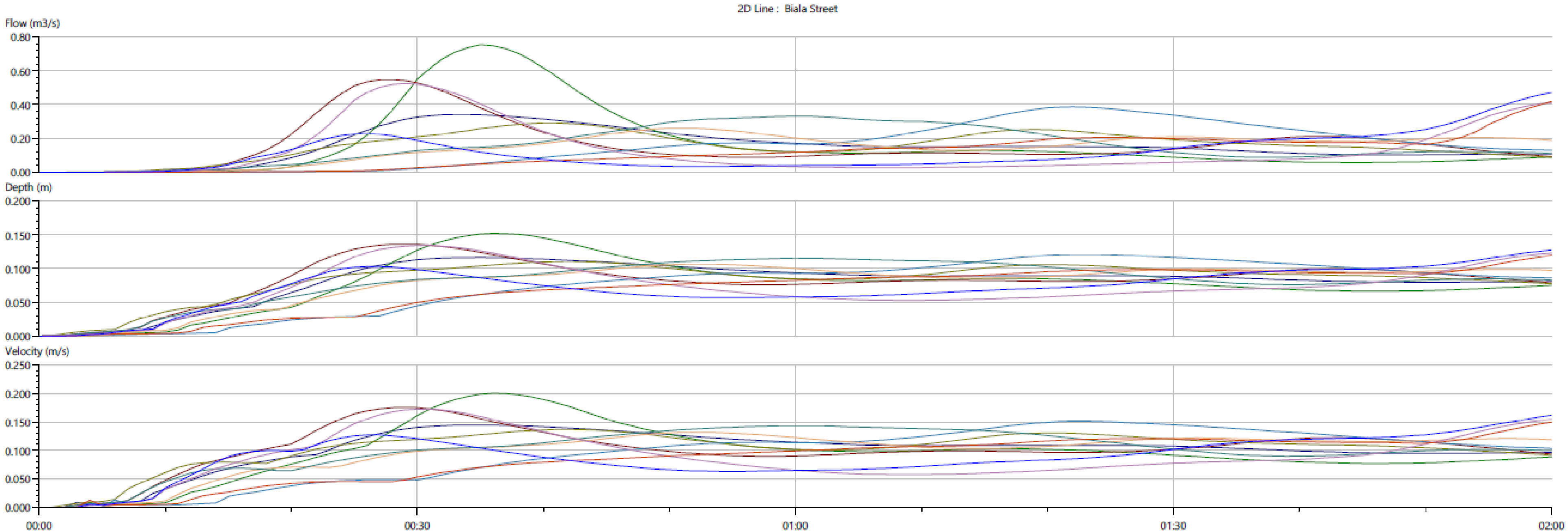
	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_1	0.000	0.380	1006.432	0.000	0.120	0.000	0.150
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_2	0.000	0.375	1017.878	0.000	0.119	0.000	0.148
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_3	0.000	0.403	1026.443	0.000	0.123	0.000	0.154
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_4	0.000	0.587	1070.786	0.000	0.140	0.000	0.182
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_5	0.000	0.455	1016.591	0.000	0.128	0.000	0.163
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_6	0.000	0.398	1013.723	0.000	0.122	0.000	0.153
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_7	0.000	0.413	1002.849	0.000	0.124	0.000	0.157
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_8	0.000	0.707	1095.384	0.000	0.149	0.000	0.196
...w>63.2 to 1% 60min to 90min>MB_1pct_1hr_9	0.000	0.549	1031.388	0.000	0.136	0.000	0.176
...>63.2 to 1% 60min to 90min>MB_1pct_1hr_10	0.000	0.507	1071.310	0.000	0.132	0.000	0.169

Figure B-40: Peak flows for the 1% AEP – 60 minute duration



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_1	0.000	0.343	1137.323	0.000	0.116	0.000	0.145
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_2	0.000	0.304	1084.220	0.000	0.112	0.000	0.139
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_3	0.000	0.379	1092.400	0.000	0.120	0.000	0.150
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_4	0.000	0.394	1139.434	0.000	0.122	0.000	0.152
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_5	0.000	0.401	1119.770	0.000	0.123	0.000	0.154
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_6	0.000	0.335	1098.882	0.000	0.115	0.000	0.143
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_7	0.000	0.346	1110.242	0.000	0.117	0.000	0.145
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_8	0.000	0.296	1095.875	0.000	0.111	0.000	0.138
...63.2 to 1% 60min to 90min>MB_1pct_1_5hr_9	0.000	0.471	1160.825	0.000	0.129	0.000	0.164
...3.2 to 1% 60min to 90min>MB_1pct_1_5hr_10	0.000	0.352	1134.244	0.000	0.117	0.000	0.146

Figure B-41: Peak flows for the 1% AEP – 90 minute duration



	Flow (m3/s)			Highest depth (m)		Highest speed (m/s)	
	Min	Max	Volume (m3)	Min	Max	Min	Max
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_1	0.000	0.341	1101.487	0.000	0.116	0.000	0.145
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_2	0.000	0.754	1204.699	0.000	0.152	0.000	0.200
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_3	0.000	0.548	1195.018	0.000	0.136	0.000	0.175
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_4	0.000	0.291	1136.256	0.000	0.110	0.000	0.137
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_5	0.000	0.386	1120.388	0.000	0.121	0.000	0.151
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_6	0.000	0.261	1050.342	0.000	0.107	0.000	0.132
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_7	0.000	0.331	1127.825	0.000	0.115	0.000	0.143
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_8	0.000	0.524	970.248	0.000	0.134	0.000	0.172
...rland flow>63.2 to 1% 120min>MB_1pct_2hr_9	0.000	0.419	828.261	0.000	0.120	0.000	0.149
...and flow>63.2 to 1% 120min>MB_1pct_2hr_10	0.000	0.471	852.740	0.000	0.128	0.000	0.162

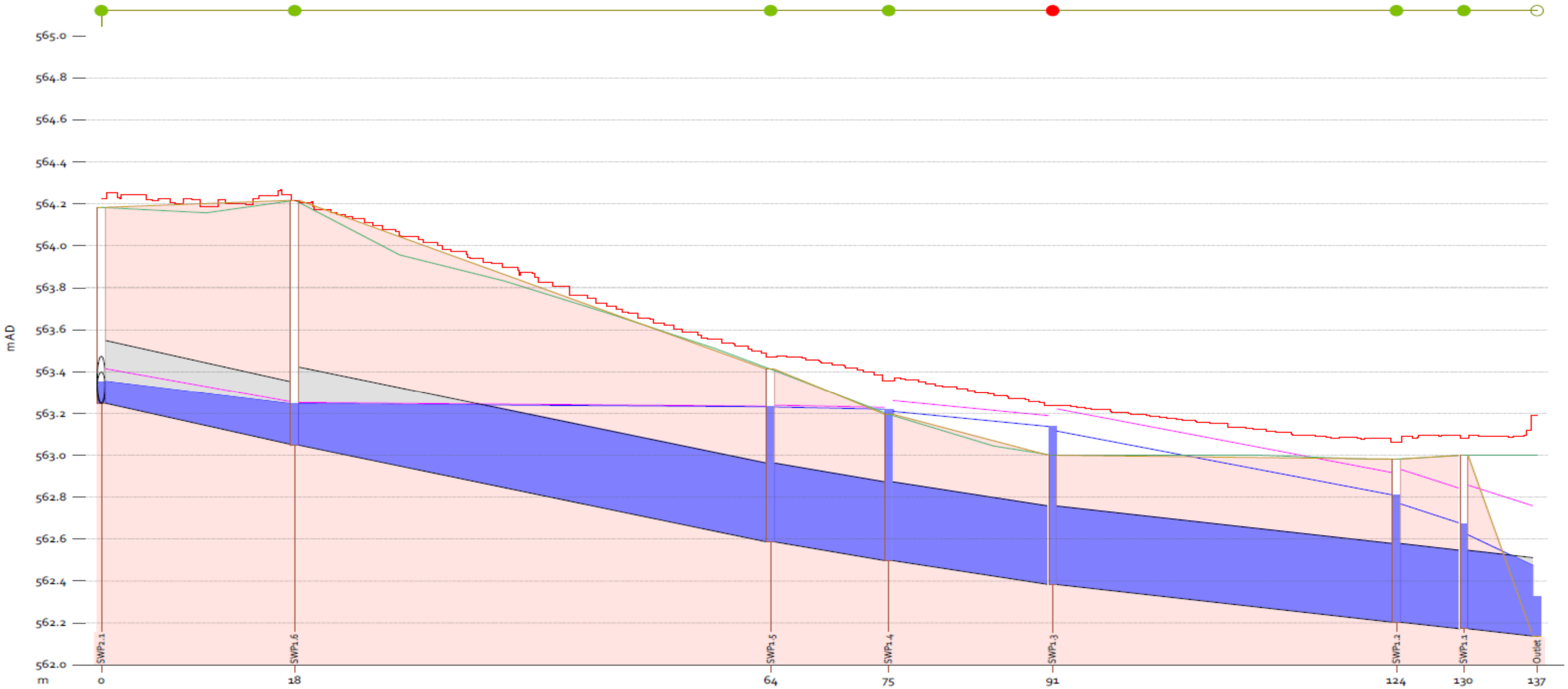
Figure B-42: Peak flows for the 1% AEP – 120 minute duration

APPENDIX C – Post-Development Water Levels for Proposed Stormwater Drainage System

Figure	Details
C-01	20% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street
C-02	10% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street
C-03	5% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street
C-04	1% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street

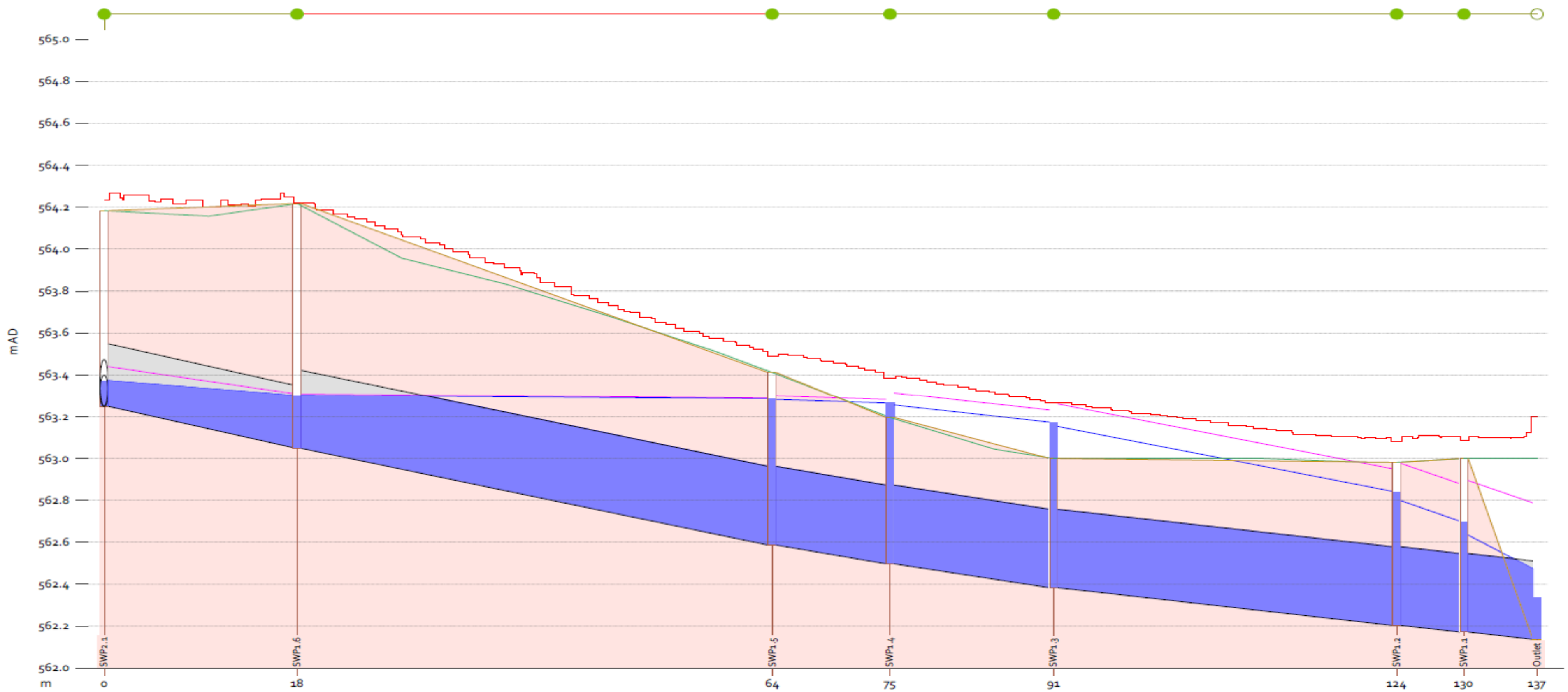
Images derived from the flood modelling program – *Innovyze ICM Ultimate* for the respective design rainfall events

APPENDIX C – POST-DEVELOPMENT WATER LEVELS FOR THE PROPOSED STORMWATER DRAINAGE SYSTEM – PIT SWP2.1 to OUTLET



Link	SWP2.1.1	SWP1.6.1	SWP1.5.1	SWP1.4.1	SWP1.3.1	SWP1.2.1	SWP1.1.1	
width (mm)	300	375	375	375	375	375	375	
numbarrels	1	1	1	1	1	1	1	
grad (%)	1.062	1.013	0.791	0.735	0.545	0.499	0.501	
DS flow (m3/s)	0.02397	0.02199	0.05068	0.11960	0.16900	0.20791	0.24726	
Node	SWP2.1	SWP1.6	SWP1.5	SWP1.4	SWP1.3	SWP1.2	SWP1.1	-

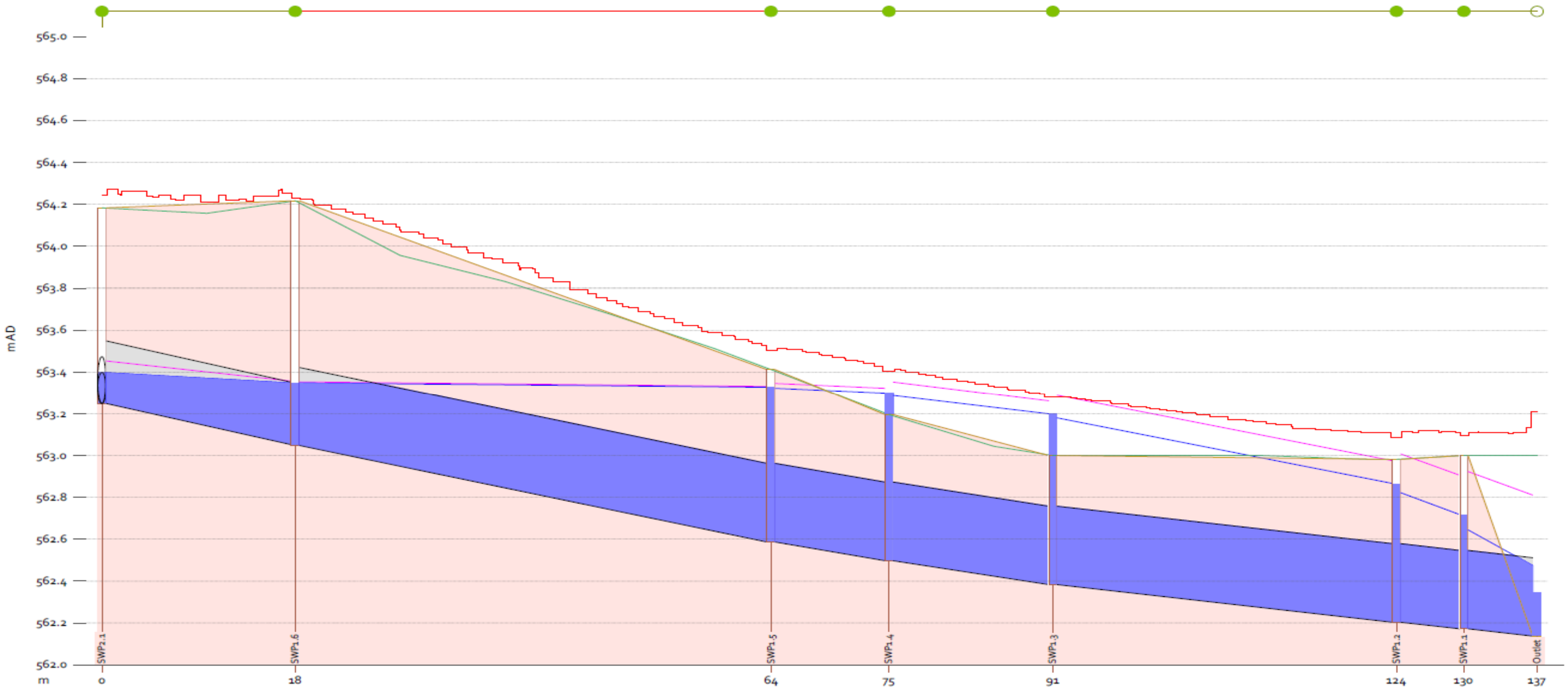
Figure C-01: 20% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street



Link	SWP2.1.1	SWP1.6.1	SWP1.5.1	SWP1.4.1	SWP1.3.1	SWP1.2.1	SWP1.1.1
width (mm)	300	375	375	375	375	375	375
numbarrels	1	1	1	1	1	1	1
grad (%)	1.062	1.013	0.791	0.735	0.545	0.499	0.501
DS flow (m3/s)	0.03045	0.02909	0.06725	0.12810	0.17184	0.21626	0.25993

Node	SWP2.1	SWP1.6	SWP1.5	SWP1.4	SWP1.3	SWP1.2	SWP1.1	-

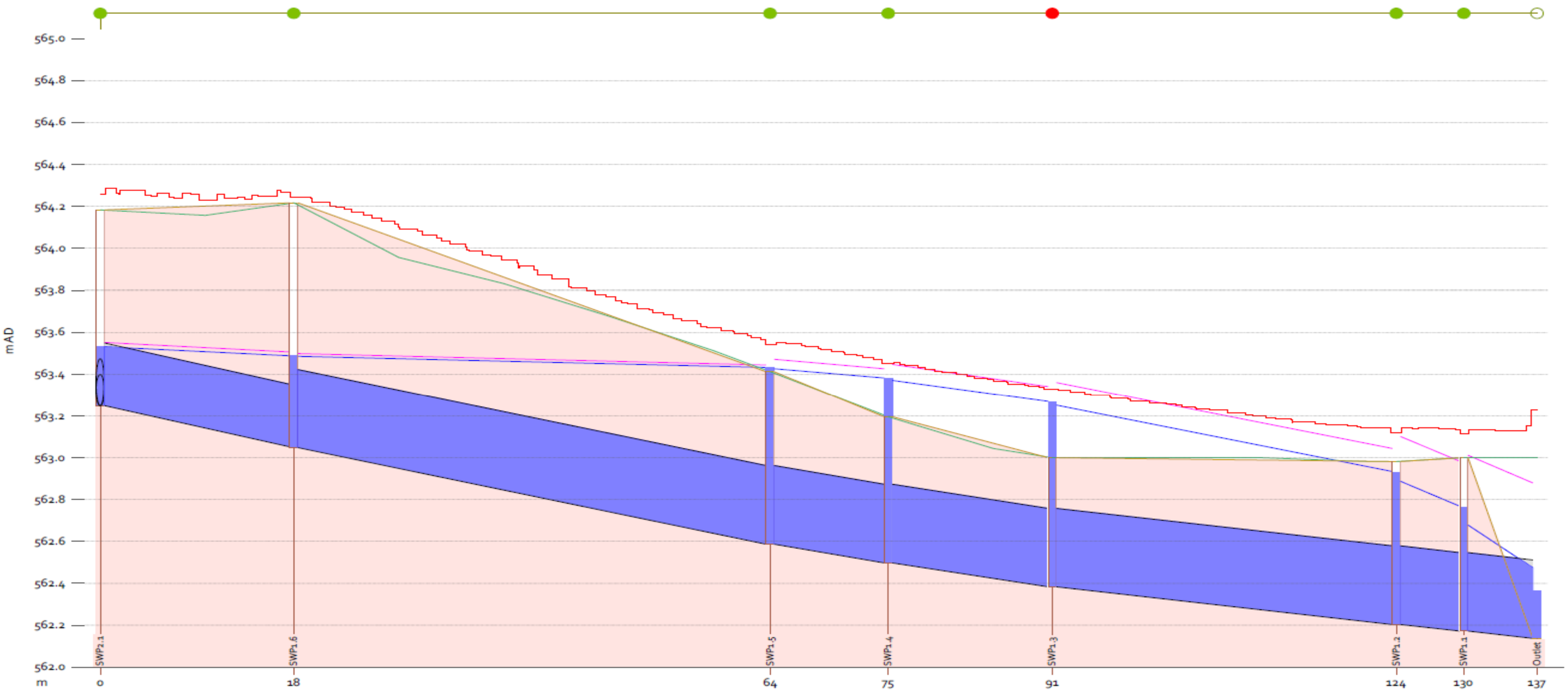
Figure C-02: 10% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street



Link	SWP2.1.1	SWP1.6.1	SWP1.5.1	SWP1.4.1	SWP1.3.1	SWP1.2.1	SWP1.1.1
width (mm)	300	375	375	375	375	375	375
numbarrels	1	1	1	1	1	1	1
grad (%)	1.062	1.013	0.791	0.735	0.545	0.499	0.501
DS flow (m3/s)	0.03418	0.03622	0.08054	0.13431	0.17352	0.22197	0.26864

Node								
Node	SWP2.1	SWP1.6	SWP1.5	SWP1.4	SWP1.3	SWP1.2	SWP1.1	-

Figure C-03: 5% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street



Link	SWP2.1.1	SWP1.6.1	SWP1.5.1	SWP1.4.1	SWP1.3.1	SWP1.2.1	SWP1.1.1	
width (mm)	300	375	375	375	375	375	375	
numbarrels	1	1	1	1	1	1	1	
grad (%)	1.062	1.013	0.791	0.735	0.545	0.499	0.501	
DS flow (m3/s)	0.04502	0.05868	0.11393	0.14896	0.17637	0.23822	0.29484	
Node	SWP2.1	SWP1.6	SWP1.5	SWP1.4	SWP1.3	SWP1.2	SWP1.1	-

Figure C-04: 1% AEP water profile for stormwater drainage long section between pits SWP2.1 to the outlet in Yass Street

APPENDIX D

Development Control Matrix – Mainstream & Minor Tributary Flooding

(green)	Not Relevant
(purple)	Unsuitable Land Use
(peach)	Hazard Zone & Land Use Category for this Development

HAZARD ZONES	LAND USE CATEGORIES	Floor Level	Building Components	Structural Soundness	Flood Affectation	Evacuation / Access	Management & Design
Outer Floodplain	Essential Community Facilities	1	2	2		1	2,3
Outer Floodplain	Critical Utilities & Uses	1	2	2		1	2,3
Outer Floodplain	Flood Vulnerable Residential	1				1	5
Outer Floodplain	Residential	1					
Outer Floodplain	Business, Commercial & Industrial	1					
Outer Floodplain	Non-Urban & Outbuildings						
Outer Floodplain	Residential Subdivision	1					
Outer Floodplain	Minor Additions (Residential)	1					
Intermediate Floodplain	Essential Community Facilities	1	2	2		1	2,3
Intermediate Floodplain	Critical Utilities & Uses	1	2	2		1	2,3
Intermediate Floodplain	Flood Vulnerable Residential	1	1	1		1	5
Intermediate Floodplain	Residential	1	1	1			
Intermediate Floodplain	Business, Commercial & Industrial	1	1	1			4
Intermediate Floodplain	Non-Urban & Outbuildings						
Intermediate Floodplain	Residential Subdivision	1	1	1			1
Intermediate Floodplain	Minor Additions (Residential)	1	1	1			6
Inner Floodplain (Hazard Cat. 2)	Essential Community Facilities						
Inner Floodplain (Hazard Cat. 2)	Critical Utilities & Uses						
Inner Floodplain (Hazard Cat. 2)	Flood Vulnerable Residential						
Inner Floodplain (Hazard Cat. 2)	Residential	1	1	1	1	1	7
Inner Floodplain (Hazard Cat. 2)	Business, Commercial & Industrial	1	1	1	1	1	4,7
Inner Floodplain (Hazard Cat. 2)	Non-Urban & Outbuildings				1	1	3,7
Inner Floodplain (Hazard Cat. 2)	Residential Subdivision	1	1	1	1	1	1,7
Inner Floodplain (Hazard Cat. 2)	Minor Additions (Residential)	1	1	1	1	1	6
Inner Floodplain (Hazard Cat. 2)	Essential Community Facilities						
Inner Floodplain (Hazard Cat. 2)	Critical Utilities & Uses						
Inner Floodplain (Hazard Cat. 2)	Flood Vulnerable Residential						
Inner Floodplain (Hazard Cat. 2)	Residential						
Inner Floodplain (Hazard Cat. 2)	Business, Commercial & Industrial						
Inner Floodplain (Hazard Cat. 2)	Non-Urban & Outbuildings				1		3,7
Inner Floodplain (Hazard Cat. 2)	Residential Subdivision						
Inner Floodplain (Hazard Cat. 2)	Minor Additions (Residential)						

Adopted from the Upper Lachlan Shire Council Development Control Plan

Development Control Matrix – Mainstream & Minor Tributary Flooding

Floor Level

1. Floor levels to be equal to or greater than the Mainstream and Minor Tributary Flooding Minimum Floor Level (MSMTF MFL) (100 year ARI flood level plus 500 mm freeboard).

Building Components

1. All structures to have flood compatible building components below the MSMTF MFL.
2. All structures to have flood compatible building components below PMF flood level (where PMF level is higher than the MSMTF MFL).

Structural Soundness

1. Structure to be designed to withstand the forces of floodwater, debris and buoyancy up to the MSMTF MFL.
2. Structure to be designed to withstand forces of floodwater, debris and buoyancy up to PMF flood (where PMF level is higher than the MSMTF MFL).

Flood Affection in Adjacent Areas

1. A Flood Risk Report may be required to demonstrate that the development will not increase flood hazard (see Item 7 Management and Design below).
   Note: When assessing Flood Affectation the following must be considered:
   i. Loss of conveyance capacity in the floodway or areas where there is significant flow velocity.
   ii. Changes in flood levels and flow velocities caused by the alteration of conveyance of floodwaters.

Evacuation/ Access

1. Reliable access for pedestrians or vehicles required in the event of 100 year ARI flood.

Management and Design

1. Applicant to demonstrate that potential developments as a consequence of a subdivision proposal can be undertaken in accordance with this Policy and the Plan.
2. Applicant to demonstrate that facility is able to continue to function in event of PMF.
3. No external storage of materials which may cause pollution or be potentially hazardous during PMF.
4. Where it is not practicable to provide floor levels to the MSMTF MFL, applicant is to provide an area to store goods at that level.
5. Applicant is to provide an area to store valuable equipment above the MSMTF MFL (level to be advised by Council) – see Section D2.8.
6. Where it is not practicable to provide floor levels to the MSMTF MFL, Council may allow a reduction for minor additions to habitable areas – see Section D2.11.
7. Flood Risk Report may be required prior to development of this nature in this area – see Sections D2.16.2 and D2.16.3.

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

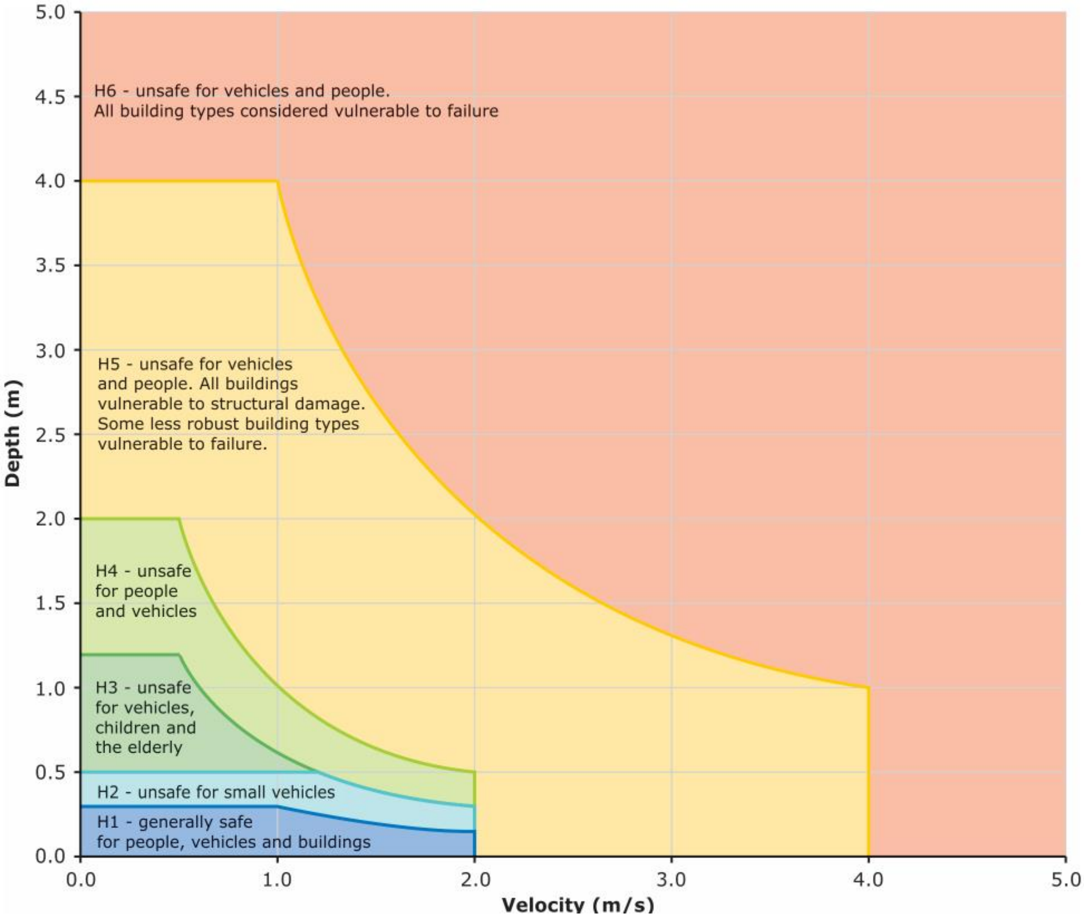


Table 6.7.3. Combined Hazard Curves - Vulnerability Thresholds (Smith et al., 2014)

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.

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

NSW Government Department of Planning and Environment – 'Flood Risk Management Manual – The management of flood liable land' (February 2022)

NSW Government Department of Planning, Industry and Environment – 'Considering Flooding in Land Use Planning Guideline' (May 2021)

NSW Government Office of Environment and Heritage – 'Floodplain Risk Management Guide – Incorporating 2016 Australian Rainfall and Runoff in Studies' (January 2019)

NSW Government Department of Planning and Environment – 'Flood Risk Management Manual – The Policy and Manual for the Management of Flood Liable Land' (June 2023)

Upper Lachlan Shire Council Development Control Plan.

Upper Lachlan Shire Council – "*The Villages of Crookwell, Gunning, Collector and Taralga Floodplain Risk Management Study and Draft Plan*", Lyall & Associates (June 2017)