

Job Number: 230038
Date: 17 September 2025

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Re: 717 Appin Road, Gilead– Flood Impact and Risk Assessment

1. INTRODUCTION

This report has been prepared by GRC Hydro Pty Ltd on behalf of Omayia to address flood-related policy requirements for the Planning Proposal for 717 Appin Road, Gilead.

The site is situated to the west of Appin Road in Gilead, between the Georges River and the Nepean River (see Image 01). A portion of the site is subject to mainstream flooding from Woodhouse Creek and the general area also experiences overland flooding originating from the site's own catchments. The site is not affected by Nepean River flooding.

The Planning Proposal's compliance with the following policies has been assessed:

- Ministerial Conditions (EP&A, 1979) Section 9.1, Clause 4.1 Flooding;
- Flood-prone land package (2021); and
- Council flood planning policies (DCP and LEP).

Image 01 – Site Location



1.1. Study Area

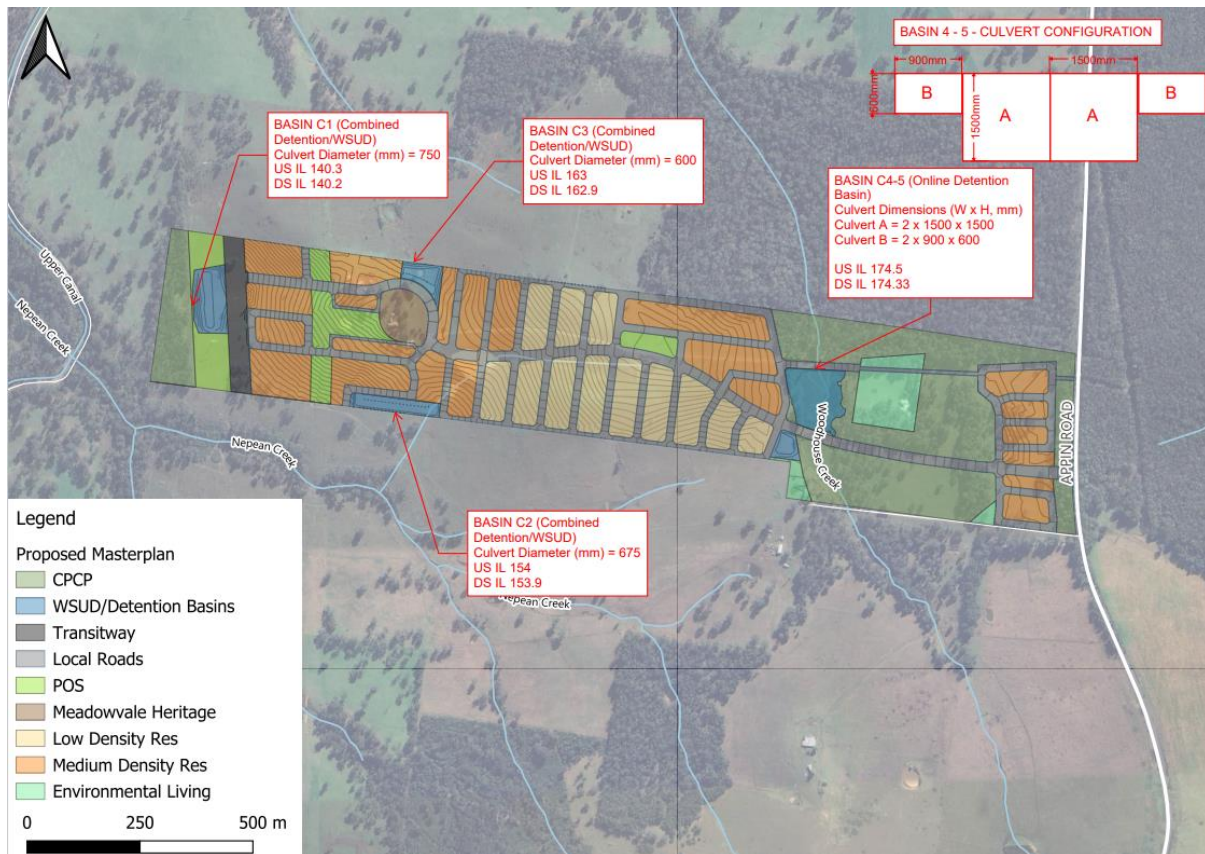
The subject site is located on the west side of Appin Road, Gilead approximately 9 km south of Campbelltown. The site is approximately 70 ha in size with ground elevations around 135 to 200 mAHD (see Appendix: *Figure 2 – Topography and Catchment*). Woodhouse Creek flows from the southeast to the north, crossing a portion of the site. Nepean Creek lies 100 m south of the site flowing from east to west. Shallow overland flow from the west of the site drains to Nepean Creek, but modelling indicates the site is not affected by flooding from the creek. The Nepean River is located around 1.2 km west of the site's western boundary.

The existing site consists of cleared land with a handful of houses and pockets of vegetation. A road accesses the existing houses and other buildings from Appin Road.

1.2. Planning Proposal

The planning proposal for 717 Appin Road converts the site to a mix of open space and low and medium density residential land. A draft master plan showing the proposed land-uses across the site is shown below in Image 2. The plan shows:

- A central east-west road through the development, from Appin Road to the west, an east-west road through the northern-east part of the site and smaller roads running mostly north-south
- Medium density residential land near Appin Road, adjacent to natural open space near Woodhouse Creek in what is currently an area of vegetation. The existing creek is retained in this section and the farm dams replaced with a channel, with two roads over the channel. Two roads are located upstream and downstream of the basin, each incorporating culverts to maintain conveyance of creek flows. The sizes of culverts are shown as follows:
 - 2*1.5 m*1.5 m and 2* 0.9 m *0.6 m culverts at the downstream side of the basin
 - 9*3 m*1.4 m culverts at the upstream side of the basin
- The main portion of residential land is in the centre of the site, consisting of low and medium density residential on either side of the central road
- Five areas for detention/WSUD basins, which are to capture runoff from the site itself



1.3. Objectives

This report addresses the Campbelltown Council and DPHI flood planning controls for a planning proposal on flood-prone land. The following analysis has been undertaken in support of the assessment:

- Establishment of hydrologic and hydraulic models to determine design flood behaviour at the site
- Modelling of the 5% AEP, 1% AEP, 0.2% AEP and PMF events for Existing and Post Development conditions;
- Modelling of potential future catchment conditions associated with climate change;
- Assessment of flood impacts due to the development;
- Provision of flood hazard, hydraulic categorisation, and flood planning area mapping; and
- Consideration of potential isolation, accessibility and risk to life.

2. FLOOD MODELLING

The site is affected by both mainstream and overland flow. Mainstream flooding refers to flooding from creeks and rivers when the channel capacity is exceeded. Flooding at the site occurs as a result of local creek flooding – Woodhouse Creek has a catchment of approximately 1.4 km² and experiences flooding following heavy localised rainfall events, typically lasting hours or less. On the west portion of the site, overland flow refers to relatively shallow flow before it has reached a creek channel. The site itself has little to no overland flow but shallow overland flowpaths occur in the vicinity of the site and this has been included in the flooding assessment. Nepean River flooding has been shown to not affect the site.

Design flood information at the site has been mapped based on a hydrologic and hydraulic model, established by GRC Hydro. The model setup is described below.

2.1. Model Setup

The model system is comprised of a hydrologic model (WBNM) and a hydraulic model (TUFLOW), to assess creek and overland flow flooding. The WBNM model takes design rainfall as an input and provides flow hydrographs. TUFLOW inputs the hydrographs and outputs flood depths, levels, velocities, and other outputs.

2.2. Hydrological Model (WBNM)

The hydrologic model consists of two catchments (total 890 ha), divided into 24 sub-catchments (see Appendix: *Figure 2 – Topography and Catchment*). The following parameters and loss values have been used in the model:

- Lag Parameters
 - C = 1.8
 - Imp Lag = 0.1
- Losses
 - IL = 18mm
 - CL = 2.4 mm/hr
 - Imp IL = 1.5mm
- ARR2019 rainfall

2.3. Hydraulic Model (TUFLOW)

The flows calculated by the WBNM model are used as input for a TUFLOW model. TUFLOW is a 2D numerical hydraulic modelling package. It is widely used and is considered best practice under the NSW Floodplain Risk Management Program. For this study, a TUFLOW model has been built with the following characteristics (see Appendix: *Figure 3 – Model Setup*):

- Cell size: 2m
- Topography: 2019 LiDAR accessed via NSW 'ELVIS' website (*Wollongong201906-LID1_1m*)
- Critical duration of 2 hours determined for the 50% AEP and 1% AEP, 90 minutes for the 0.2% AEP
- 3 downstream boundaries (HQ boundary)
- Breaklines added for roads and creeks
- Detailed materials layer
 - Default, n=0.035
 - Roads, n=0.02
 - Dense vegetation, n=0.065
 - Sparse vegetation, n=0.045
 - Creeks, n= 0.035
- Culverts represented as 1D elements. The culverts on the site's southern boundary on Woodhouse Creek were shown on survey as 4 x 0.6 m diameter. Creek culverts 100 m inside the northern boundary were not shown on survey and so were assumed to be 3 x 0.6 m diameter, based on the headwall width. Inverts for both were estimated from LiDAR.
- Farm dams were assumed to be full at the start of the flood event (i.e., they provide no flood mitigation role).

2.4. Model Validation

In the absence of calibration data for the site's catchment, the hydraulic model results were validated based on Regional Flood Frequency Estimation (RFFE) available as part of Australian Rainfall and Runoff 2019. RFFE provides estimates of design flow rates based on similar catchments with gauged data. RFFE estimates for a 140-ha catchment in Gilead (i.e. Woodhouse Creek at the site) are:

- 16.7 m³/s for expected value
- 4.2 to 58.5 m³/s for lower and upper confidence limits

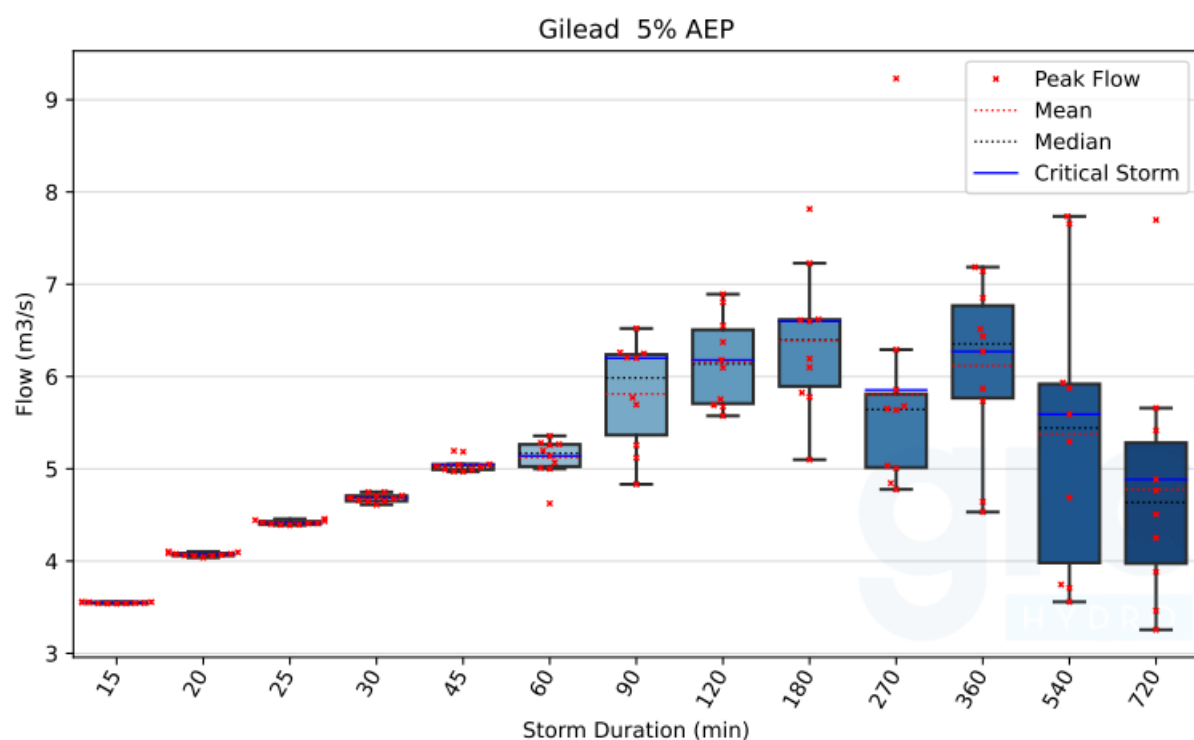
In comparison, the modelled flow rate was 7.86 m³/s. The flow rate is close to the RFFE estimate and well within the confidence limits. The catchment size is small compared to those nearby used by the RFFE, so results are generally an extrapolated value and this likely leads to the wide range of estimated value.

2.5. Hydrologic Results

ARR2019 ensemble results generated by the WBNM model are presented in Image 2 as Box and Whisker Plots. The ensemble results by the WBNM model were extracted at the subject site (catchment area = 1.4 km²)

Table 01 – Critical Duration at Subject Site

AEP %	Critical Duration (mins)	Critical Storm #
5	180	09
1	120	06
0.2	90	03
PMF	60	-



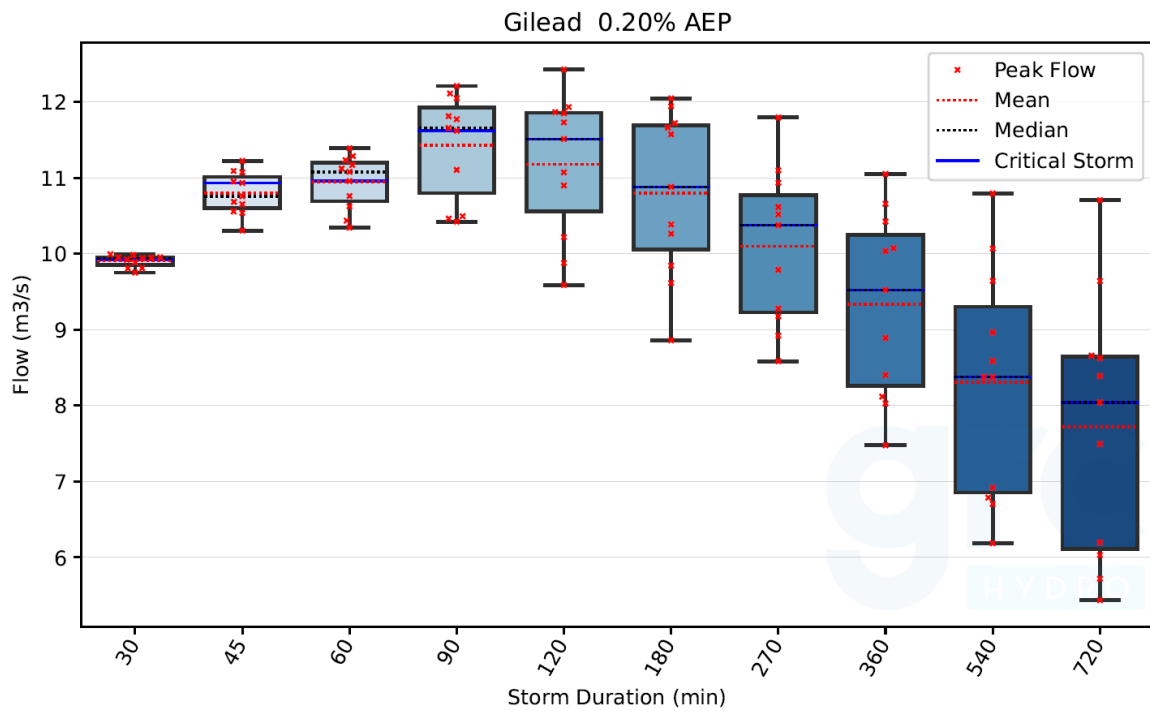
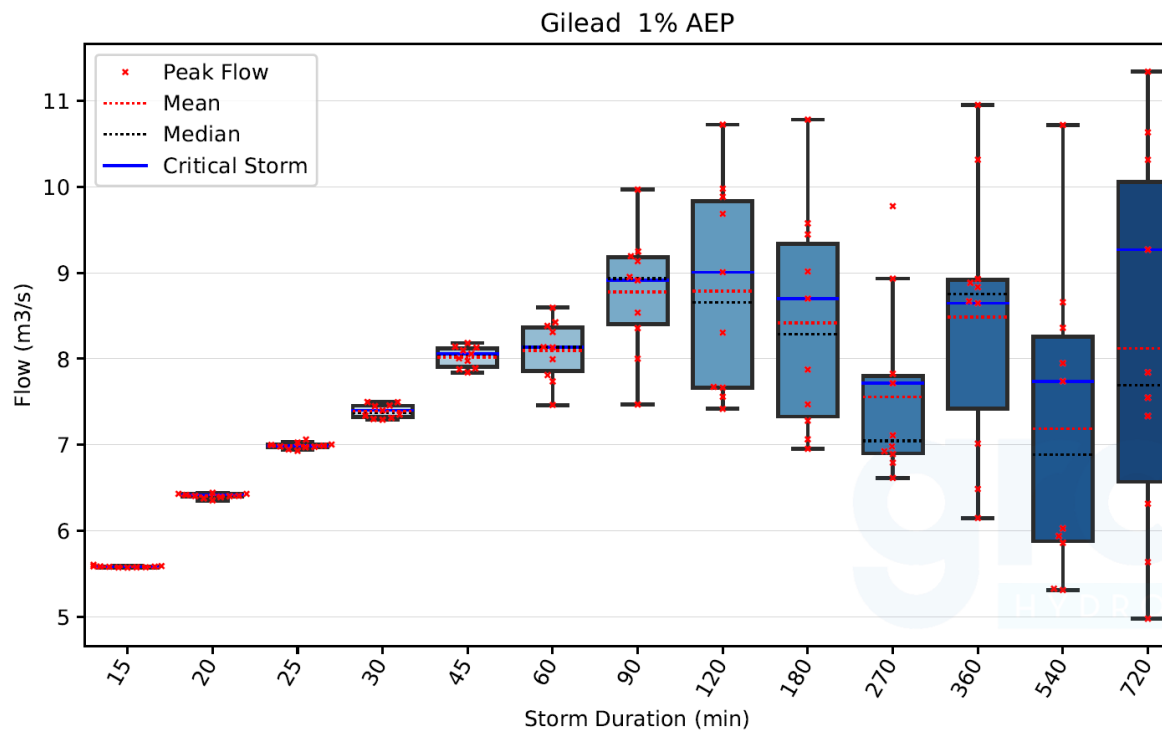


Image 1: ARR2019 Ensemble Results at the Subject Site

2.6. Climate Change

Climate change is expected to lead to increased intensity of flood-producing rainfall, and has been considered as part of the current assessment. Taking the modelled 1% AEP event, the design rainfall intensity was increased by 20% to account for potential increases in rainfall intensity associated with climate change. The procedures outlined in Book 1, Chapter 6 of ARR2019 were applied with the following parameters/assumptions; RCP8.5 and 2090 planning horizon. These represent the worst-case

emissions scenario over a long time frame, to the year 2090, with the rainfall increase value of 20% available from the ARR Datahub. The results are shown on Figure A7 and A8.

The figures show very minimal change in flood level in the 1% AEP climate change scenario, with an increase of around 0.03 to 0.05 m in flood level within the site.

2.7. Design Flood Results – Depth and Level

Design flood results were produced for the existing case for the 5% AEP, 1% AEP, 0.2% AEP and PMF events, as well as 1% AEP with climate change. Flood mapping showing the peak flood depth and level is shown on Figure A1, Figure A3, Figure A5, and Figure A11. Woodhouse Creek crosses the subject site from southeast to northeast and three flowpaths with shallow flow depth start from the site's own catchments. The figures show that the flowpath and creek are quite confined, and the large majority of the site is not affected by creek or overland flow flooding. Peak flood levels in the creek are:

- 5% AEP: 179.4 mAHD to 170.4 mAHD
- 1% AEP: 179.5 mAHD to 170.5 mAHD across the site
- 0.2% AEP: 179.6 mAHD to 170.6 mAHD
- PMF: to 179.8 mAHD to 171.3 mAHD

As shown above, the PMF is around 0.3-0.8 m higher than the 1% AEP, along the creek. The difference is 0.4 m, which make up the majority of the section of creek through the site, with smaller areas of 0.5-0.8 m difference.

With regards to overland flow from the site's own catchment, this occurs just outside the site boundary. Drainage within the site including kerb and gutter, and pit and pipe drainage, has been included in the civil design. This flooding assessment therefore does not model or assess the WSUD basins proposed for the site. This approach has been followed to give a clean separation between the civil design of the site's drainage and the flooding assessment of significant overland flow and the mainstream flooding along the creek.

With regard to velocity, velocities are around 1-2 m/s in the creek with some local spots reaching velocities higher than 2 m/s.

2.8. Flood Hazard

Flood hazard mapping has been developed through application of ARR2019 and Australian Emergency Management Institute (AEMI) flood hazard guidelines. The guidelines consider the threat to people, vehicles and buildings based on flood depth and velocity at a specific location. The AEMI flood hazard mapping can be used to assess the flood hazard for site occupants and proposed site usage, as well as for the community surrounding the site.

Chart 1 and Table 1 present the relationship between the velocity and depth of floodwaters and the corresponding classification.

Chart 1: Flood Hazard Curves (Australian Emergency Management Handbook 7)

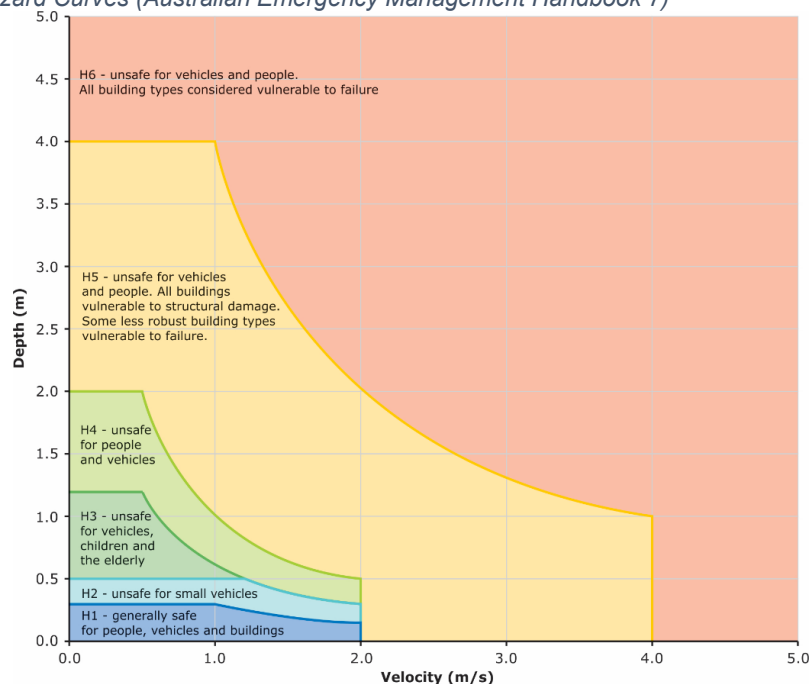


Table 1: Flood Hazard – Vulnerability Thresholds

Hazard 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.

The hazard is shown on Figures A2, A4, A6, and A12 for the 5% AEP, 1% AEP, 0.2% AEP and PMF. The figures show in the 1% AEP the farm dams have H4 to H5 hazard, due to the significant depths, while other areas are mostly H1-H3 with some H4 in the creek channel. Downstream of the site where no dams are presents, hazard is H4-H6 in the creek channel. In the proposed case is mostly H3-H4 in the channel and H1-H3 in areas of out-of-bank flow. Hazard increases in the PMF to H4-H5 across most of the flood extent.

2.9. Flood Planning Area

The Flood Planning Area is traditionally the area to which flood planning controls apply. Following recent NSW Ministerial Directions, flood planning controls more specifically now apply up to the PMF. The Flood Planning Area is still referred to in the policy and guidelines so has been included in this assessment.

There is no Flood Planning Area for the site as set by Campbelltown Council. The Flood Planning Area is typically based on a flood extent equivalent to a flood height 0.5 m above the 1% AEP flood level. The complication at the subject site is that the majority of the flood extent consists of two large farm dams, which in effect create two level pools in a flood event and artificially elevate the flood level above that of the natural creek flood levels. Adding 0.5 m freeboard to the elevated level and then calculating the

resulting extent based on LiDAR in GIS, exaggerates the area covered by the Flood Planning Area and covers areas not flooded in the PMF (existing or proposed case). Given the proposed case removes the two farm dams and returns the channel to a geometry more similar to that upstream and downstream of the site, the proposed case PMF flood extent is shown on the FPA figure (Figure A10) and has been taken as the outer limit of the FPA.

2.10. Nepean River Flooding

The Nepean River is located around 1.2 km west of the site in a steep valley feature running from south to north. The river is well below the site with an elevation of around 60 mAHD versus 134 mAHD on the western site boundary. The river channel is incised with steep valley sides rising to 110 mAHD within 150 m of either side of the river. Given the elevation range it is highly unlikely the river flooding has any bearing on flooding at the site, nevertheless, a check was made of the approximate PMF flood level.

The closest PMF flow estimate was available from the Upper Nepean River Flood Study Report Vol 1, (Sept. 1995) sourced from Camden Council. The report estimates a PMF flow at Maldon Weir (well upstream of the site) of ~6500 m³/s and a flow at Menangle Weir (downstream of the site) of 7800 m³/s, so the latter was taken as a conservative estimate of flow in the vicinity of the site.

The section of the Nepean River in the vicinity of the site was then setup in a basic TUFLOW hydraulic model based on LiDAR. Applying the PMF event hydrograph reported in the 1995 study, which has a duration of 70 hours peaking at 7800 m³/s, resulted in a peak flood level of 80.0 mAHD, west of the site. This means the flood extent is fully contained within the steep valley which rises to 110 mAHD, and some ~54 m below the site, in elevation. The modelling confirmed Nepean River flooding does not affect the site.

2.11. Flood Access

Consideration of isolation potential and access issues for emergency services during flood is discussed below. The proposed development site has one external access point, from the site's main east-west road on to Appin Road, which connects to Campbelltown to the north and Appin to the south. The road is located on a general ridge feature between the Georges River and the Nepean River, around 50-150m above both rivers, and is therefore considered not flood-affected. On this basis, the site has access during a flood, with no significant potential for isolation during a flood, and continual access to the site is available for emergency services.

Within the site, a road is proposed as part of the site development that would cross Woodhouse Creek. The southern road is above the creek and would provide access during creek flooding. The PMF level in the creek, at the location of the road, is 177.5 mAHD and the road level is 177.6 mAHD.

3. ASSESSMENT OF PROPOSED SITE ZONING

The master plan for the site presents residential zoning along a central east-west road through site, with vegetation and some open space areas retained. The layout is accompanied by a proposed ground surface including new roads, and cut and fill along Woodhouse Creek, as well as concept-level details of two new roads over Woodhouse Creek. WSUD basins have not been included in the ground surface (see further discussion below). In addition to the ground surface, the creek upstream of the access road was graded down to the road, to replace the existing farm dam. The ground surface has been modelled in the TUFLOW model as a proposed case, to determine the effect on flood behaviour in the existing

case, and to determine design flood levels and extents in the site, for the proposed case. The model results are shown on Figures A1-A6, A11, and A12 alongside the existing case. The master plan layout is also overlaid on the results, on the figures.

The figures show that the proposed case retains Woodhouse Creek and includes a new detention basin. The design incorporates two proposed road crossings of the creek with culverts at each, located upstream and downstream of the detention basin, to convey creek flows into the basin and allow water to continue downstream. The effect on flood behaviour is, with reference to the 1% AEP event:

- Flood depths and extents upstream/south of the site are largely unchanged
- Within the site, the detention basin reduces the flood extent in the southern half of the site
- The two proposed east-west access roads are not flooded. (The northern road, not essential for site access, is flooded in a PMF)
- Flood depths and extent downstream/north of the site are largely unchanged

The effect of the proposed surface on flood levels is shown on Figure A9 which shows the impact in the 1% AEP and PMF. In the 1% AEP there is no adverse impact both upstream and downstream of the site. These have no material effect on flood risk outside of the site but can be addressed in the subsequent civil design for the site. In the PMF, there is likewise no impacts on flood behaviour outside of the site.

With regards to the proposed development's flood liability, Figure A5 shows the residential areas, and the roads, are all located outside of the PMF flood extent. The portions of the site to be developed are located well above the creek, which itself is relatively minor. A portion of the figure is reproduced below in Image 2. As shown, residential areas and roads are outside the PMF.

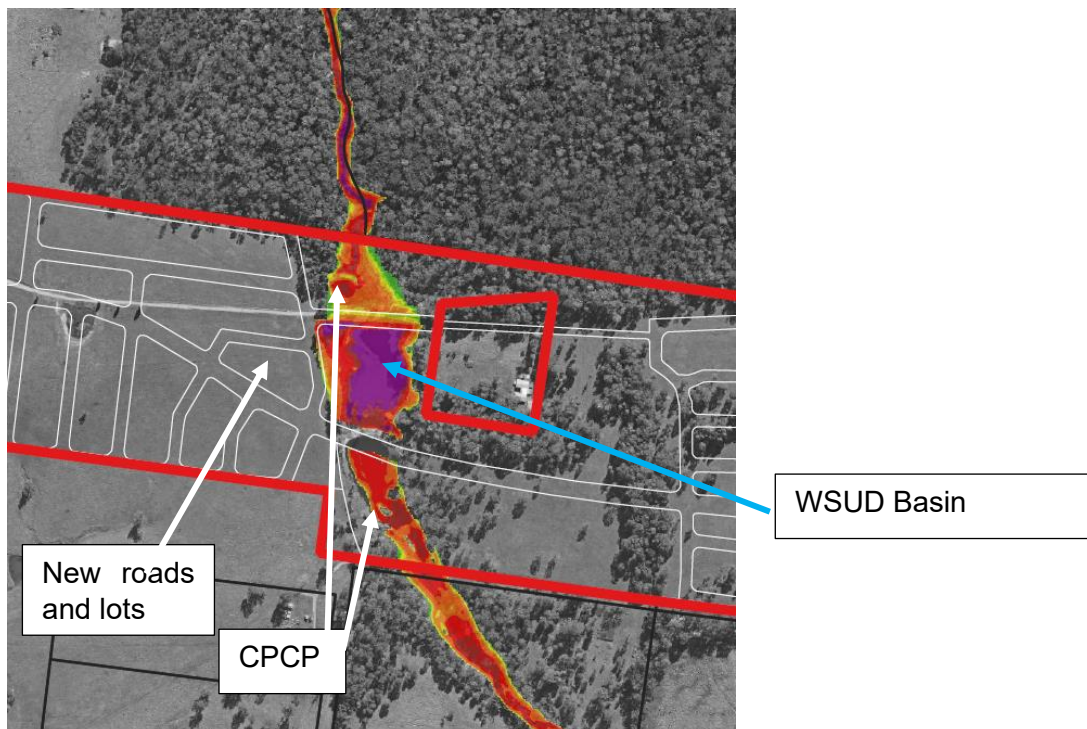


Image 2: PMF flood extent and proposed zoning

The remainder of the site lies on a general ridge feature and is not flood-affected.

3.1. Local Planning Controls

The Campbelltown LEP requirements are set out in Table 2 below. The second column provides assessment of compliance with each requirement. Campbelltown LEP does not include the new 5.22 clause at the time of writing but there is not expected to be any non-compliance with that clause, if adopted.

Table 2: LEP Compliance

LEP Planning Control	Compliance Comment
(1) The objectives of this clause are as follows— (a) to minimise the flood risk to life and property associated with the use of land, (b) to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change, (c) to avoid adverse or cumulative impacts on flood behaviour and the environment, (d) to enable the safe occupation and efficient evacuation of people in the event of a flood.	The site experiences creek flooding. Development has been situated outside of the creek flood extent and the site is accessible during a flood. Development is therefore compatible with the flood risk. Impact assessment has been carried out and shows no increase in peak flow or significant change in flood level outside of the subject site. Flood access is available for the site up to and including the PMF event.
(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development— (a) is compatible with the flood function and behaviour on the land, and (b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and (c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and (d) incorporates appropriate measures to manage risk to life in the event of a flood, and (e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	a) See above. b) See above – the change of use will not affect flood behaviour c) see above. d) The design of the site has been carried out to ensure no flood risk is posed to future site occupants. e) Flow rates during a flood are matched or slightly reduced under the proposed case. The stability of the new channel (that replaces the farm dams) can be incorporated into the civil design, to avoid erosion and siltation.
(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters— (a) the impact of the development on projected changes to flood behaviour as a result of climate change, (b) the intended design and scale of buildings resulting from the development, (c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood, (d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.	a) See above – the change of use will not affect flood behaviour including as a result of climate change b) new development is located outside of the flood extent c) See above d) Building relocation would not be required at the location, with the site along a natural ridge feature.

3.2. State Planning Controls

The relevant state-wide policies and guidelines are:

- March 2022 Local Planning Directions
- Considering flooding in land use planning (guideline) dated July 2021
- Considering flooding in land use planning: guidance and statutory requirements (planning circular) dated July 2021
- NSW Flood Risk Management Manual (2023), which replaces the earlier Floodplain Development Manual

These policies and guidelines set out requirements for planning proposals for flood-affected areas. The March 2022 Local Planning Directions requirements are set out below with a response to each in blue.

The direction requires that:

- *A planning proposal must include provisions that give effect to and are consistent with the NSW Flood Prone Land Policy and the principles of the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas).*

Response:

Consideration of a range of flood events up to the PMF, including flood hazard and flood function classification, has been undertaken. Further, site access and the potential for isolation and emergency vehicle access issues are considered. The analysis and findings are consistent with the objectives of the Floodplain Development Manual 2005 and newer Flood Risk Management Manual.

- *A planning proposal must not rezone land within the flood planning areas from Special Use, Special Purpose, Recreation, Rural or Environmental Protection Zones to a Residential, Business, Industrial, Special Use or Special Purpose Zone.*

Response:

The Planning Proposal rezones land to these uses but all such rezoning is outside the Flood Planning Area, which is limited to a relatively small section of the site along Woodhouse Creek.

- *A planning proposal must not contain provisions that apply to the flood planning areas which:*
 - permit development in floodway areas,*
 - permit development that will result in significant flood impacts to other properties,*
 - permit a significant increase in the development of that land,*
 - are likely to result in a substantially increased requirement for government spending on flood mitigation measures, infrastructure or services, or*
 - permit development to be carried out without development consent except for the purposes of agriculture (not including dams, drainage canals, levees, buildings or structures in floodways or high hazard areas), roads or exempt development.*

Response:

All development is outside the PMF flood extent and therefore outside the floodway.

Impact assessment has been undertaken and show no offsite impacts. There is no increase in peak flow as a result of the development and no change to neighbouring properties' flood risk.

No increase in development in the Flood Planning Area is proposed.

Given the site has access during a PMF flood event and properties are not flooded, there would be no increase on government spending on flood mitigation measures, infrastructure or services.

No such development is proposed as developable areas are outside the Flood Planning Area.

- *A planning proposal must not impose flood related development controls above the residential flood planning level for residential development on land, unless a relevant planning authority provides adequate justification for those controls to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).*
- *For the purposes of a planning proposal, a relevant planning authority must not determine a flood planning level that is inconsistent with the Floodplain Development Manual 2005 (including the Guideline on Development Controls on Low Flood Risk Areas) unless a relevant planning authority provides adequate justification for the proposed departure from that Manual to the satisfaction of the Director-General (or an officer of the Department nominated by the Director-General).*

Response:

Flood related development controls for residential development above the FPL are not proposed.

4. INITIAL STAKEHOLDER FEEDBACK

Initial comments from DCCEEW/SES and GRC response are listed in the following table.

Table 3: Comments from Council, DCCEEW and SES

Comments	GRC Response
DCCEEW	
BCS considers that the proposal appears to have been developed generally in consideration of the flood constraints of the land but should be subject to further detailed assessment.	
BCS recommends that the proponent undertakes a Flood Impact Risk Assessment (FIRA) in accordance with the Flood Risk Management Manual and its supporting flood risk management guidelines, with particular attention to Flood Impact and Risk Assessment (LU01) and Support for Emergency Management Planning (EM01). This includes:	
presentation of comprehensive detail on the flood modelling, including validation or verification, given there is no Council flood study for the area	See section 2.1 - 2.4 for model build and model validation
description of flood behaviour	See section 2.7-2.8 for description of flood behaviour
analyses of key flood behaviour and constraints, including level, depth, velocity, conveyance, hazard and flood function for the full range of flooding up to the PMF. A lesser flood event such as the 10 or 5% AEP event should be included as well as the 1% AEP and PMF events	This information is set out in Section 2.7-2.8. A lesser flood event has now been modelled (the 5% AEP).
flood impacts of development for the full range of flooding up to the PMF. A scenario with no significant impact should be presented in the planning proposal. The impact of removing existing farm dams on flood storage should be considered. The proposed design needs to consider all landform changes needed to rehabilitate Woodhouse Creek following removal of the dam	Flood impacts are discussed in Section 3 of this report, up to the PMF. Modelling has not been carried out of the full rehabilitation Woodhouse Creek following removal of farm dams. Modelling of the current and previous proposed case (from 2023) does not indicate

	impacts downstream or upstream of the site are likely to be a significant constraint.
potential flood mitigation measures to achieve no significant impact, particularly where these need to be co-ordinated at the precinct level	Development of the site will not rely on any flood mitigation measures, beyond ensuring development is located outside of the flood extent (which it is), and ensuring suitable road access over the creek, during a flood.
information on flooding under climate change, either using site specific percentage increases in rainfall intensity or the 0.5% and 0.2% AEP flood events as proxies per the Incorporating 2016 Australian Rainfall and Runoff in studies (FB04) guideline	The 1% AEP design rainfall intensity was increased by 20% to account for potential increases in rainfall intensity associated with climate change. See section 2.6
consideration of climate change in decisions per sections 2.6 and 2.7 in the Understanding and Managing Flood Risk (FB01) guideline	As above
consideration of the compatibility of the proposed development with the flood function and behaviour of the land	The site design is compatible with the flood function and behaviour of the land. All development (i.e. new roads and lots) is outside the PMF flood extent and the access road is flood free in the PMF.
emergency management considerations, including evacuation potential and impacts on the emergency management arrangements of existing communities. The flood immunity of the proposed bridge over Woodhouse Creek should be considered to avoid isolation of the future community	Emergency management considerations are set out in Section 2.11. West of the creek, the site lies on a topographic ridge, and has road access during a PMF event.
consideration of the local planning direction 4.1 and development of a provisional flood planning area	Consideration of local and state planning controls is set out in Section 3.1 and 3.2. A provisional flood planning area has been developed.
recommendations for flood related development controls	Flood related development controls set out in Council LEP are assessed as being sufficient, given that the proposed development area is not flood-affected.
a geomorphological impact assessment, due to the large increases in flood levels and extents predicted along Woodhouse Creek."	This has not been carried out but can be considered as part of the future design of the creek channel.
The proposal should be referred to NSW State Emergency Service and the Natural Resources Access Regulator.	The SES has provided feedback.
SES	
Request clarification of the height of the proposed bridge crossing Woodhouse Creek and the approaching roadway, to understand if there is a risk of the community becoming isolated due to floodwater.	The southern access road is set at 177.6 mAHD in the current design and is flood free during PMF. There is not a risk of isolation.
Recommend pursuing site design and stormwater management that reduces the impact of flooding and minimises any risk to the community. Any improvements that can be made to reduce flood risk will benefit the community.	Fortunately this site is not flooded as the site design has located all new lots outside the flood extent.
Recommend seeking advice from the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) regarding the impact of the proposed development on flood behaviour and adjacent areas as well as the cumulative impact of other approved development.	This has been provided (see above)
Campbelltown City Council	
[Council quoted the SES questions/comments which are responded to above]	

Council also has concerns regarding the proposed residential zoning for this site given the mainstream flooding by Woodhouse Creek and overland flow paths in part of the site.	The site is assessed to be suitable for rezoning on the basis that: -Proposed lots have no significant overland flow to the extent that it would preclude rezoning -Mainstream flooding along the creek is outside of the new lots and risk is readily managed via proposed access roads which can be access road in a PMF event
The Department of Climate Change, Energy, the Environmental & Water - Biodiversity and Conservation provided comments and requests for information regarding flooding and is contained in Attachment G.	See above

5. CONCLUSIONS

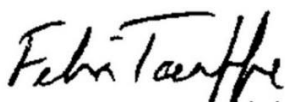
This report has been prepared by GRC Hydro Pty Ltd on behalf of Omayya as part of a planning proposal for 717 Appin Road Gilead.

Flood modelling has been undertaken which shows that the site is largely unaffected by flooding, as it lies along a general ridge feature, while a portion of the site is affected by Woodhouse Creek flooding, a relatively small watercourse passing through the site.

The design of the site has incorporated the flood behaviour and located all areas of future development outside of the PMF flood extent. The site has been given access during a PMF flood event via a new road over Woodhouse Creek. Impact assessment has also been undertaken. Local drainage of runoff from the site itself is not the subject of this flooding assessment.

The assessment found the planning proposal is consistent with the relevant state and local policy requirements.

Yours Sincerely



Felix Taaffe

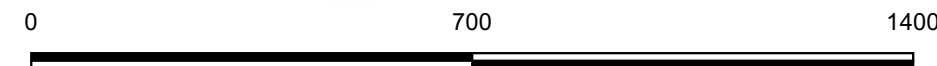
GRC Hydro

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Appendix A



 Subject Site



TITLE: **Study Area**

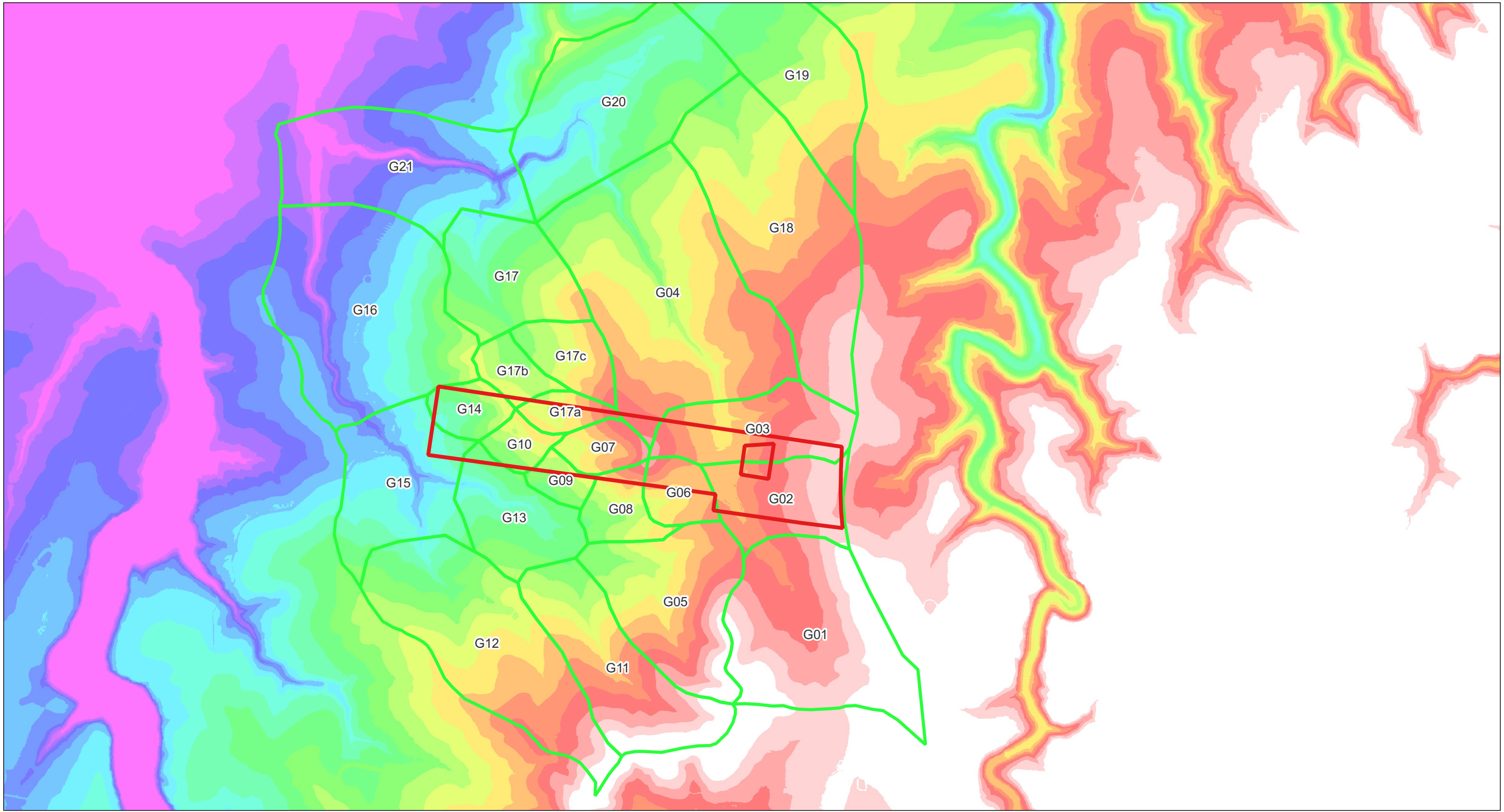
PROJECT: **717 Appin Road, Gilead**

PROJECT No. **230038**

DATE: **11-2023**

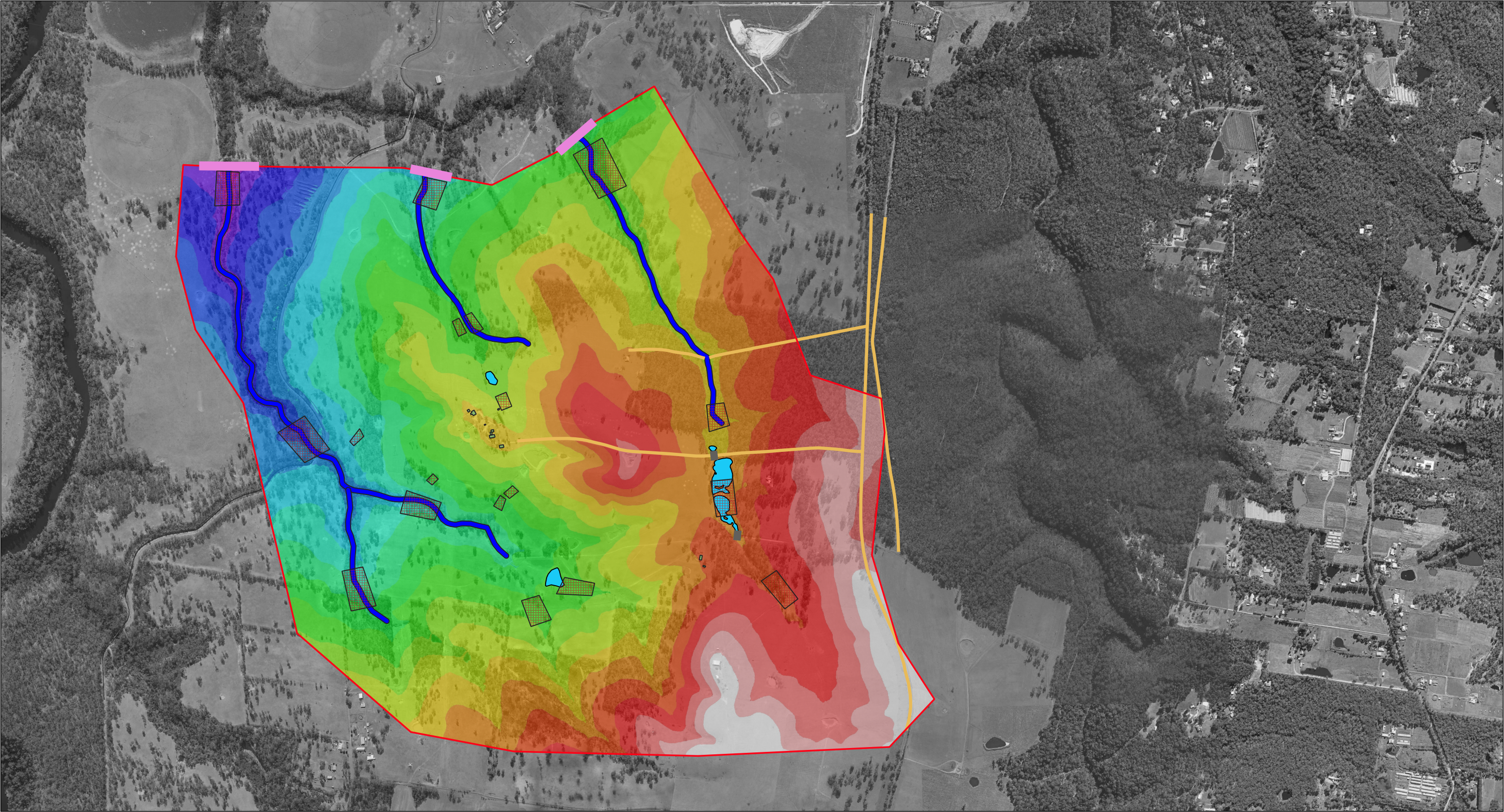
SCALE: **1:12000**

FIGURE No. **1**

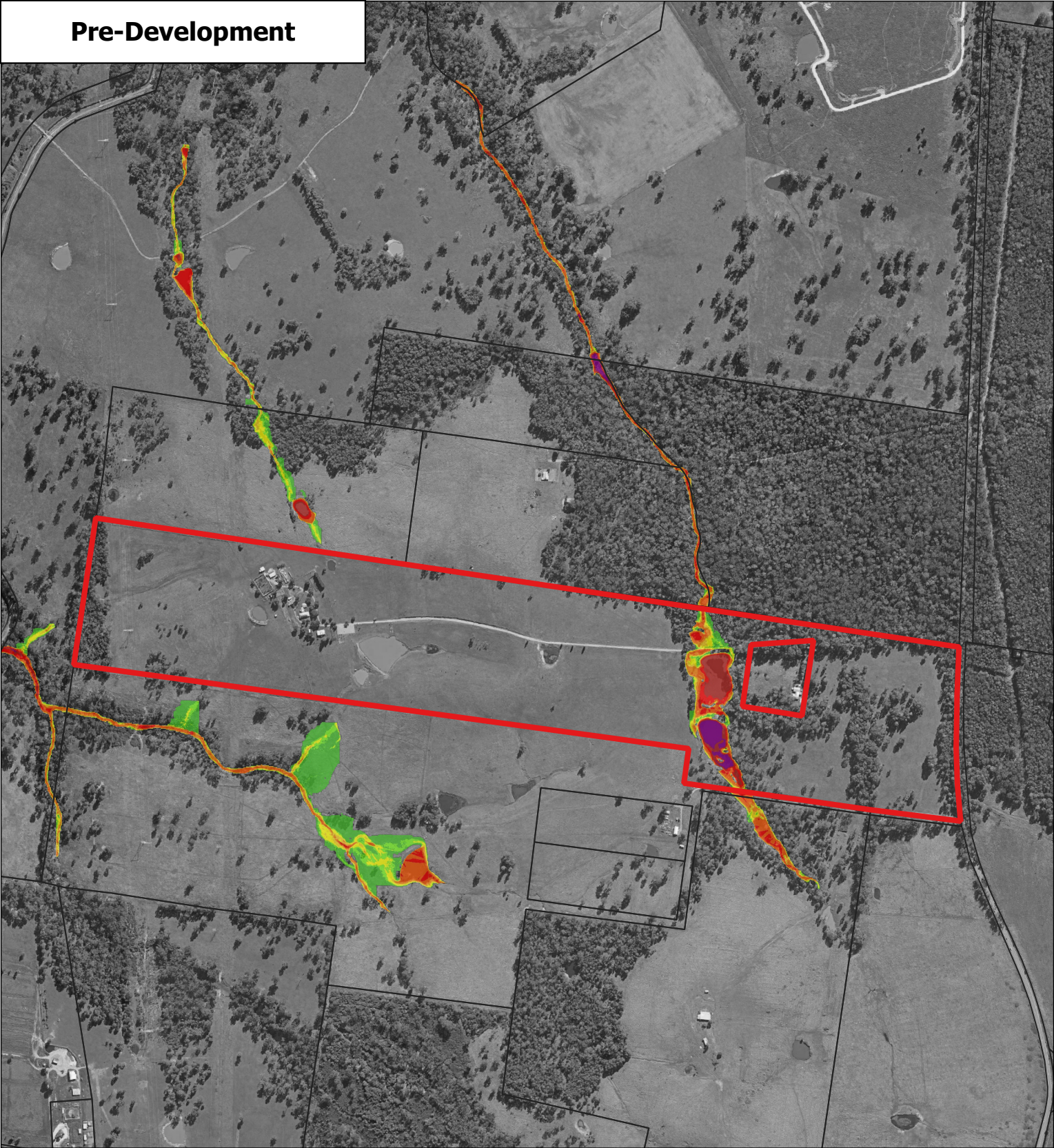


Subject Site Sub-catchments	Lidar (mAHD)	120.0 - 126.0	156.0 - 162.0	186.0 - 192.0
	<= 96.0	126.0 - 132.0	162.0 - 168.0	192.0 - 198.0
	96.0 - 102.0	132.0 - 138.0	168.0 - 174.0	198.0 - 204.0
	102.0 - 108.0	138.0 - 144.0	174.0 - 180.0	> 204.0
	108.0 - 114.0	144.0 - 150.0	180.0 - 186.0	
	114.0 - 120.0	150.0 - 156.0		

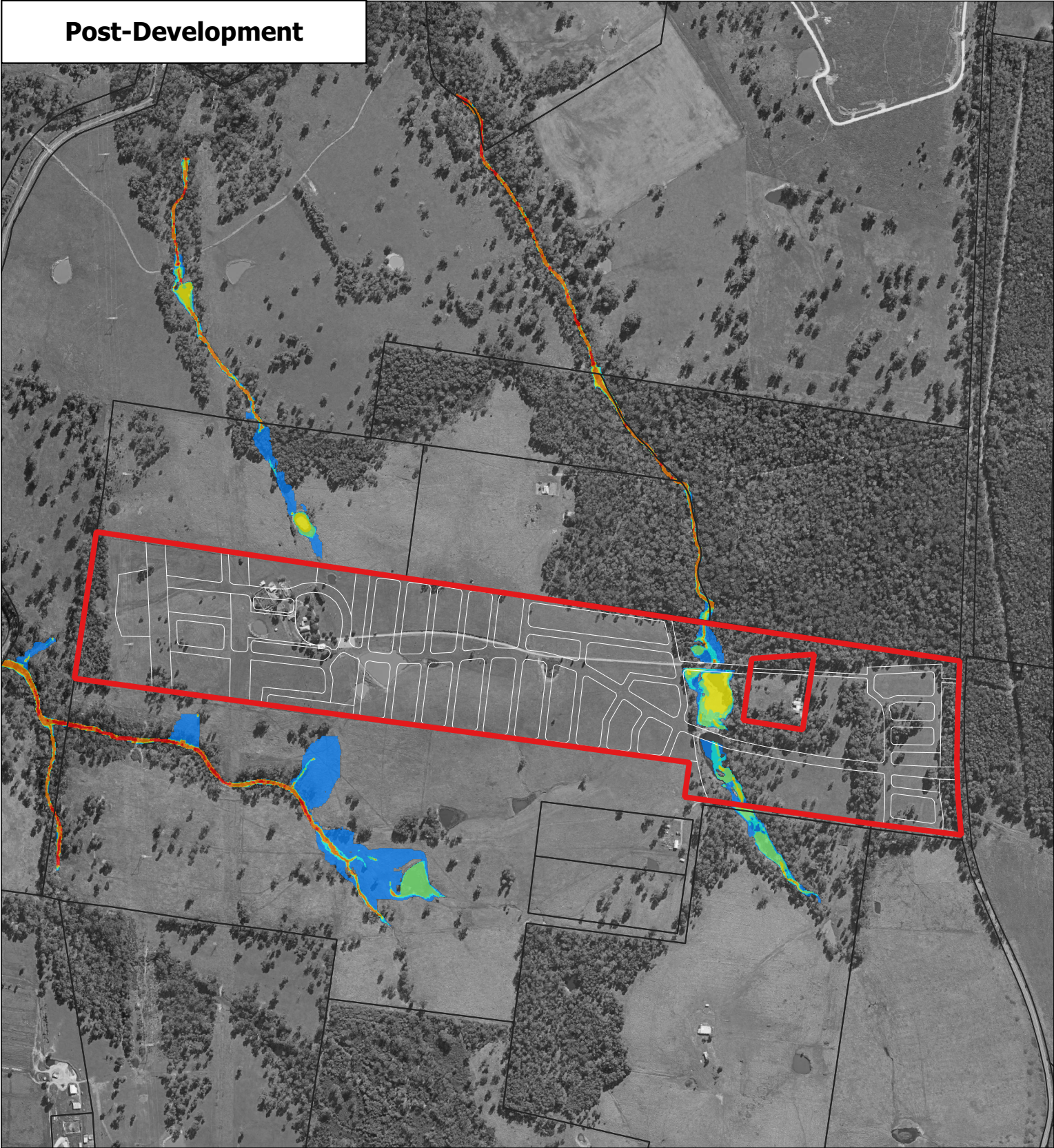
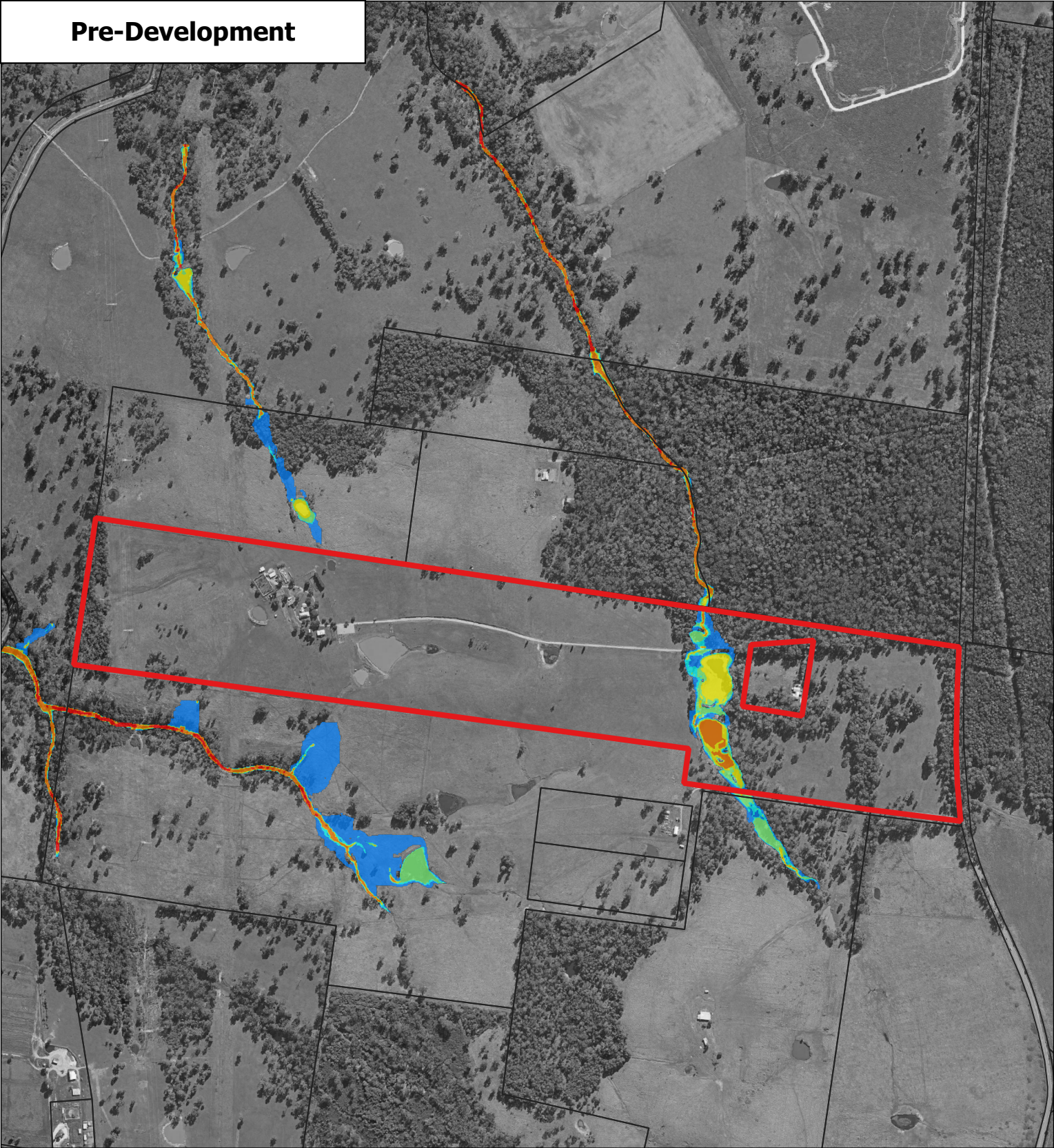
TITLE: Topography and Catchment	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 11-2023	SCALE: 1:18000	FIGURE No. 2
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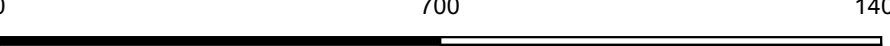
Model Extent Buildings Farm Dams (Assumed Full) Local Inflows	Outflows Culverts Roads Breaklines Channel Breaklines	Lidar (mAHD) <= 96.0 96.0 - 102.0 102.0 - 108.0 108.0 - 114.0 114.0 - 120.0 120.0 - 126.0 126.0 - 132.0 132.0 - 138.0 138.0 - 144.0 144.0 - 150.0 150.0 - 156.0 156.0 - 162.0 162.0 - 168.0 168.0 - 174.0 174.0 - 180.0 180.0 - 186.0 186.0 - 192.0 192.0 - 198.0 198.0 - 204.0 > 204.0	0 900 1800	N W E S	grc HYDRO	TITLE: Model Setup PROJECT: 717 Appin Road, Gilead PROJECT No. 230038 DATE: 11-2023 SCALE: 1:15000 FIGURE No. 3
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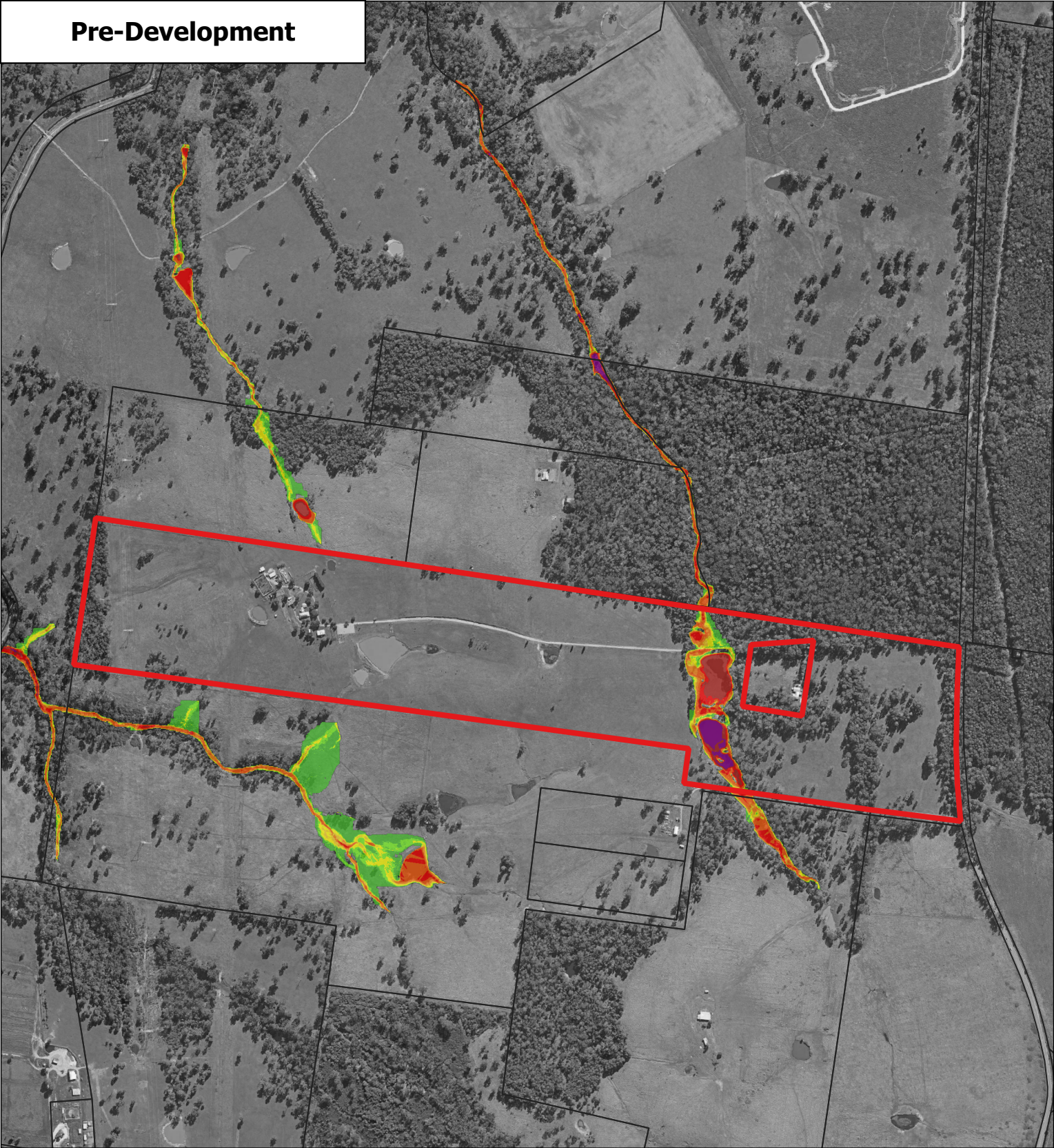
Subject Site Cadastre Boundaries Concept Lot Layout	Flood Depths (m) 0 - 0.05 0.05 - 0.1 0.1 - 0.2 0.2 - 0.3 0.3 - 0.5 1.0 - 1.5 1.5 - 2.0 > 2.0	0.5 - 1.0	 N W E S		 0 700 1400
Existing and Post Development TITLE: Conditions - 1% AEP Event Flood Depths	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A1



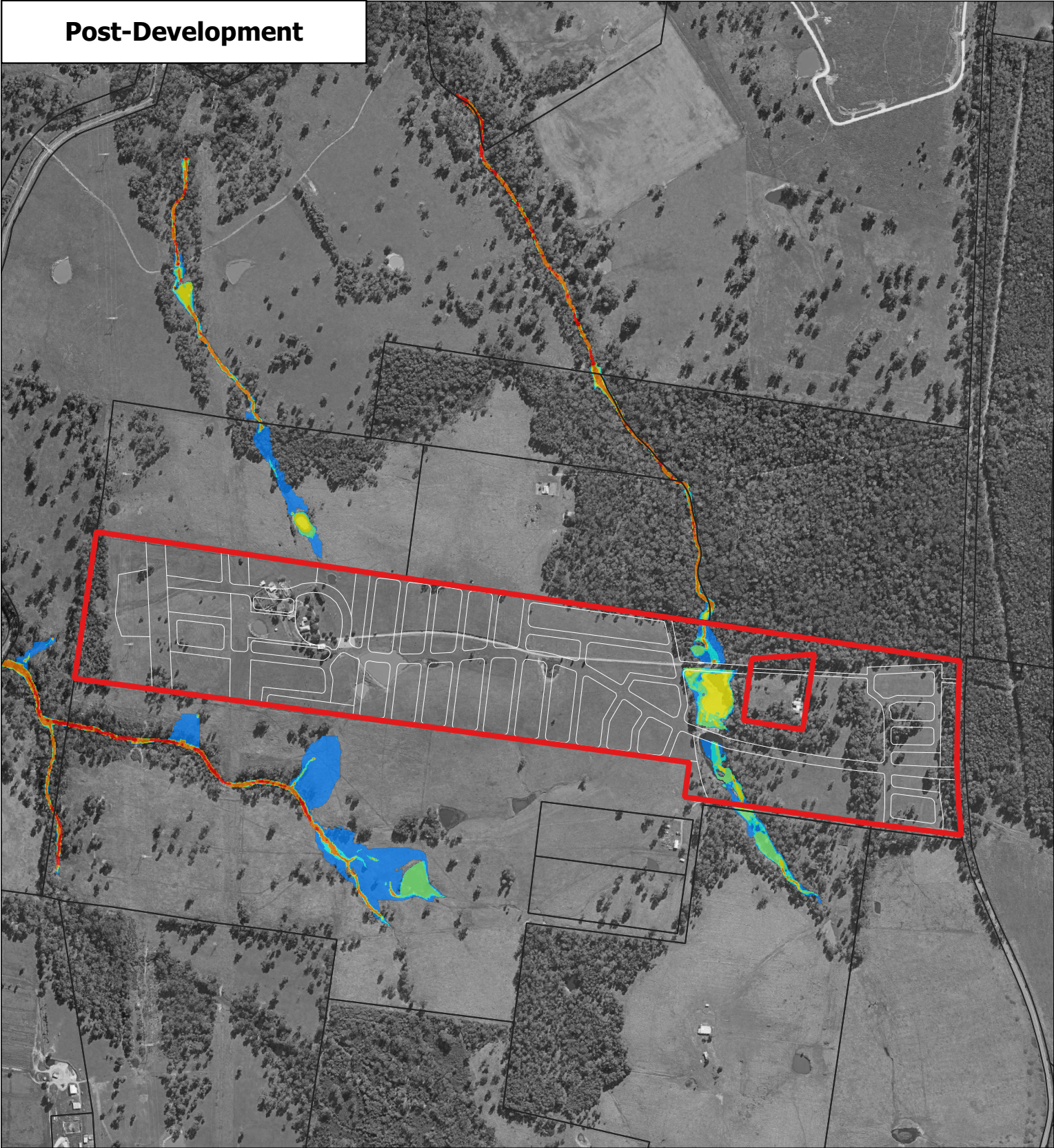
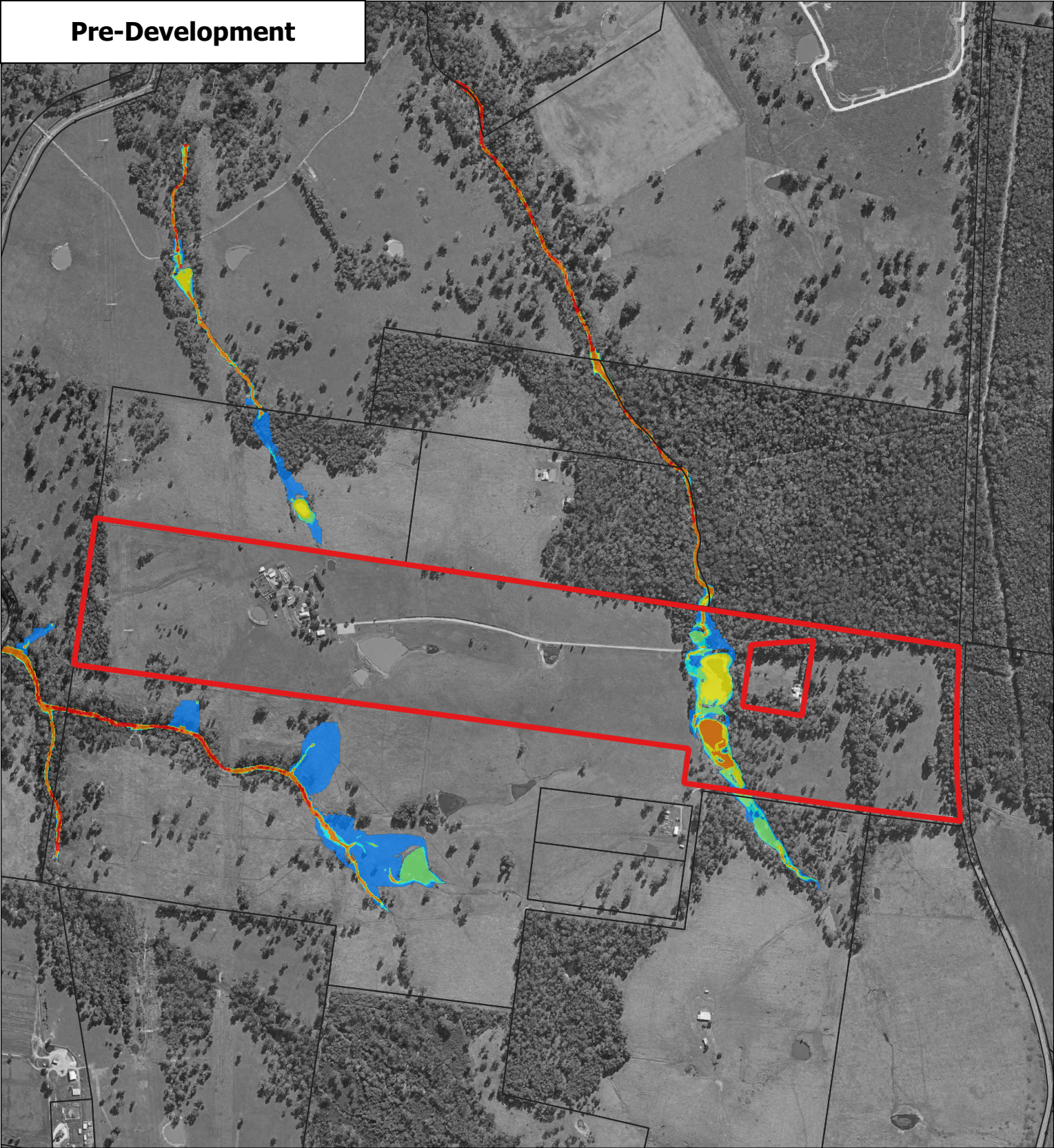
 Subject Site	Flood Hazard	 H4
 Cadastre Boundaries	 H1	 H5
Concept Lot Layout	 H2	 H6
	 H3	



Existing and Post Development TITLE: Conditions - 1% AEP Event Flood Hazard	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A2
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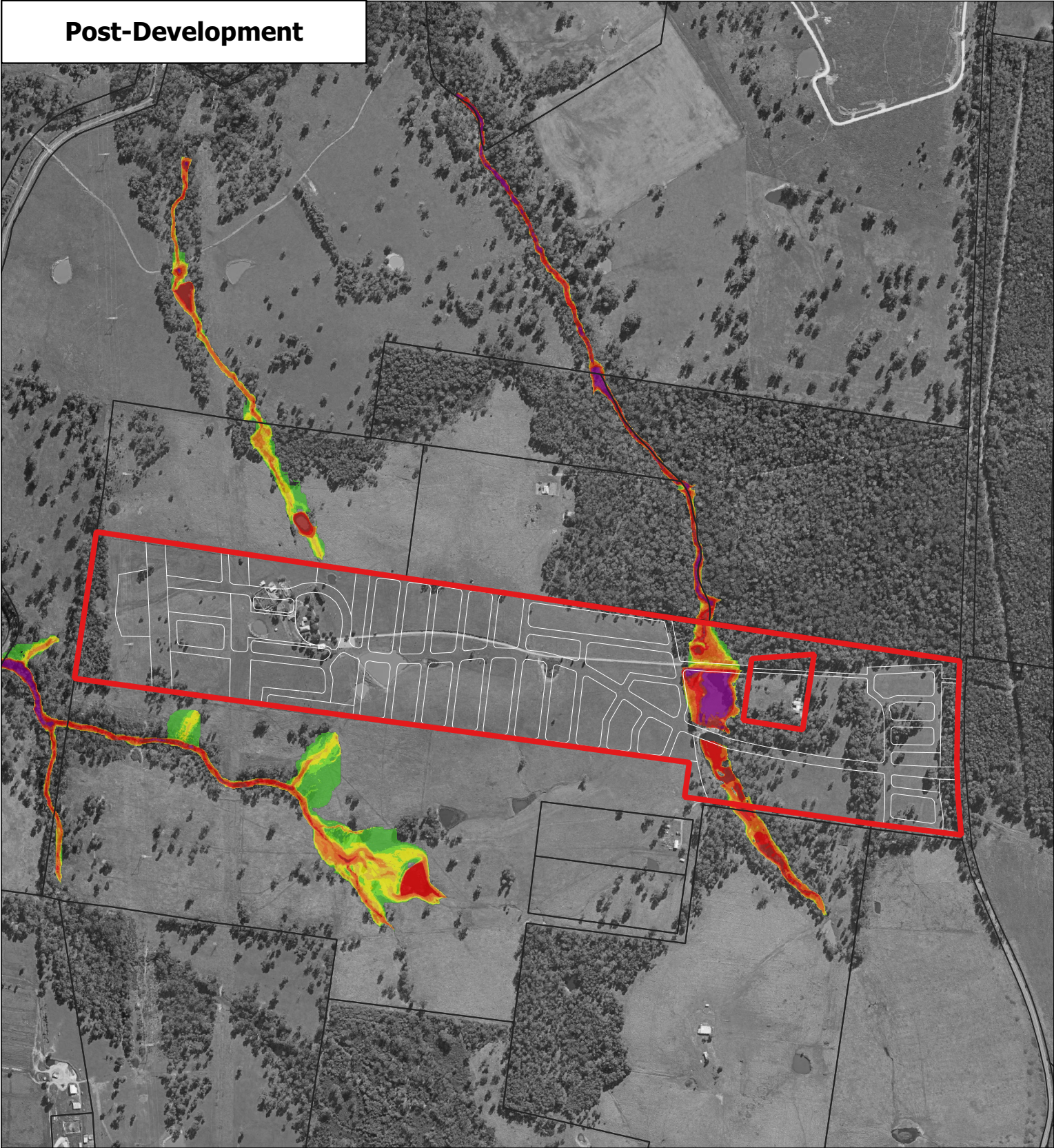
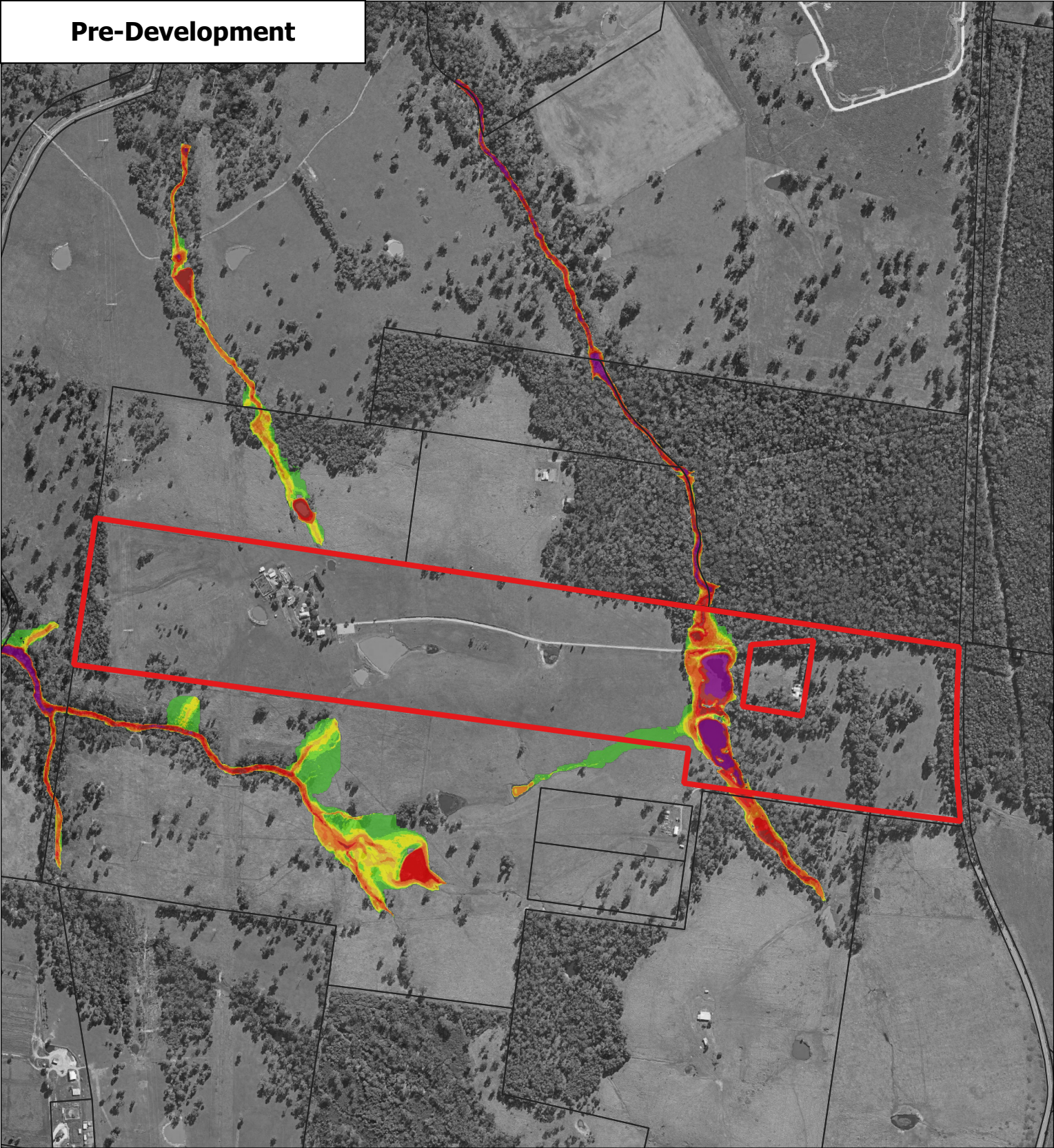


Subject Site Cadastre Boundaries Concept Lot Layout	Flood Depths (m)	0.5 - 1.0			
	0 - 0.05 0.05 - 0.1 0.1 - 0.2 0.2 - 0.3 0.3 - 0.5	1.0 - 1.5 1.5 - 2.0 > 2.0			
Existing and Post Development TITLE: Conditions - 0.2% AEP Event Flood Depths	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A3

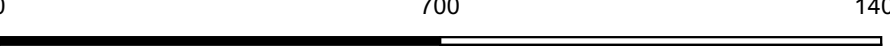


Subject Site	H1	H4
Cadastre Boundaries	H2	H5
Concept Lot Layout	H3	H6

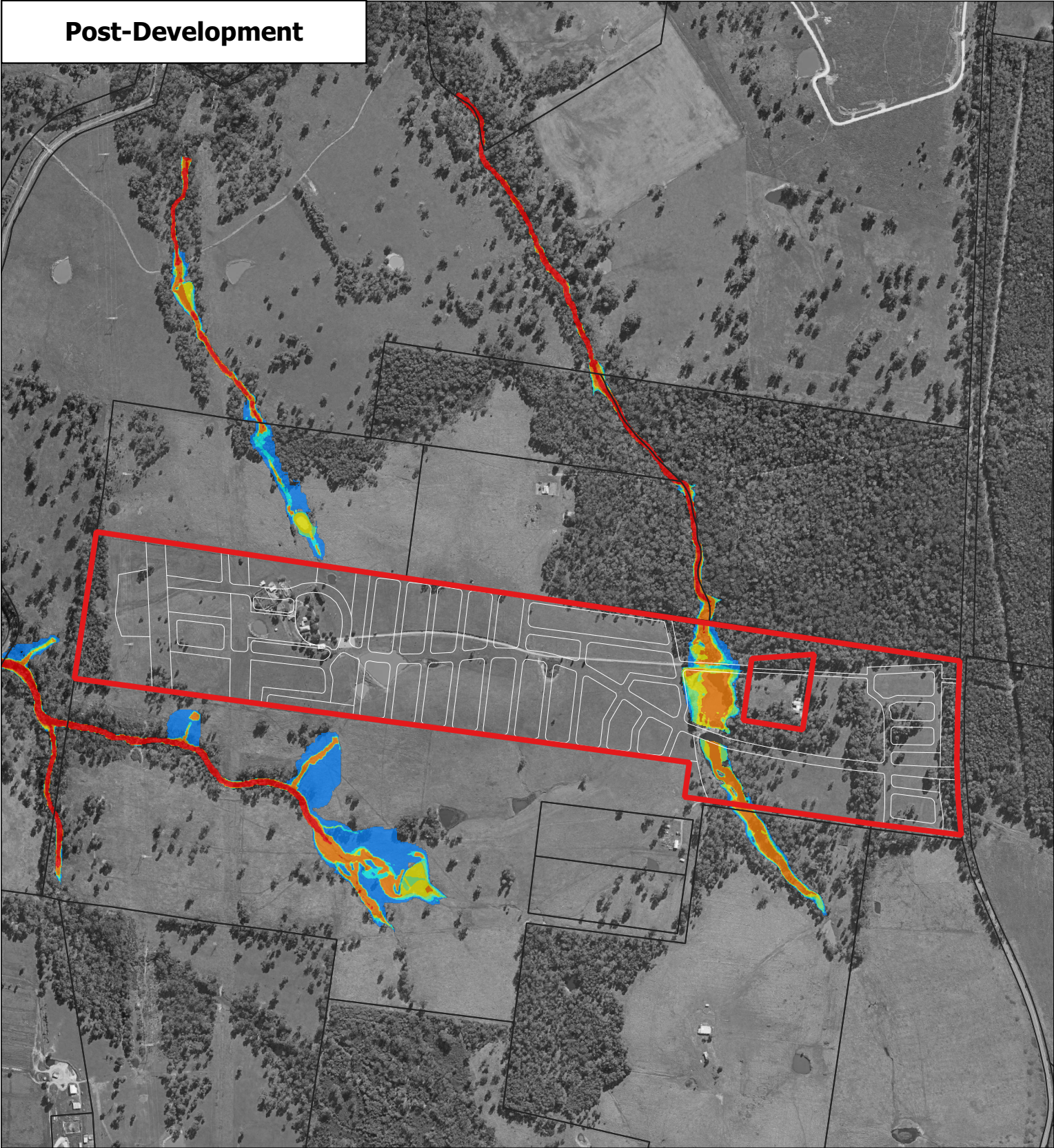
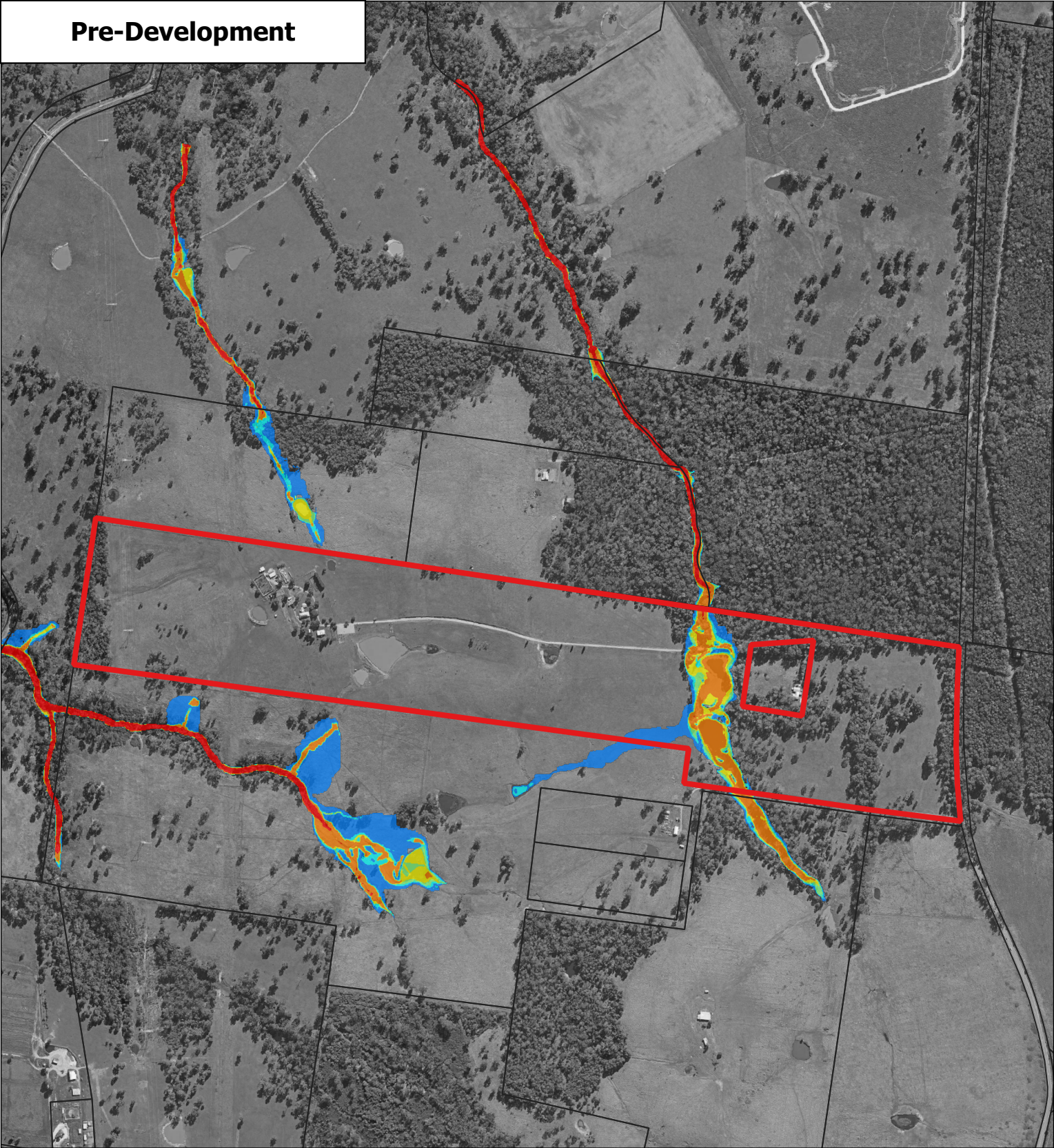
Existing and Post Development TITLE: Conditions - 0.2% AEP Event Flood Hazard	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A4
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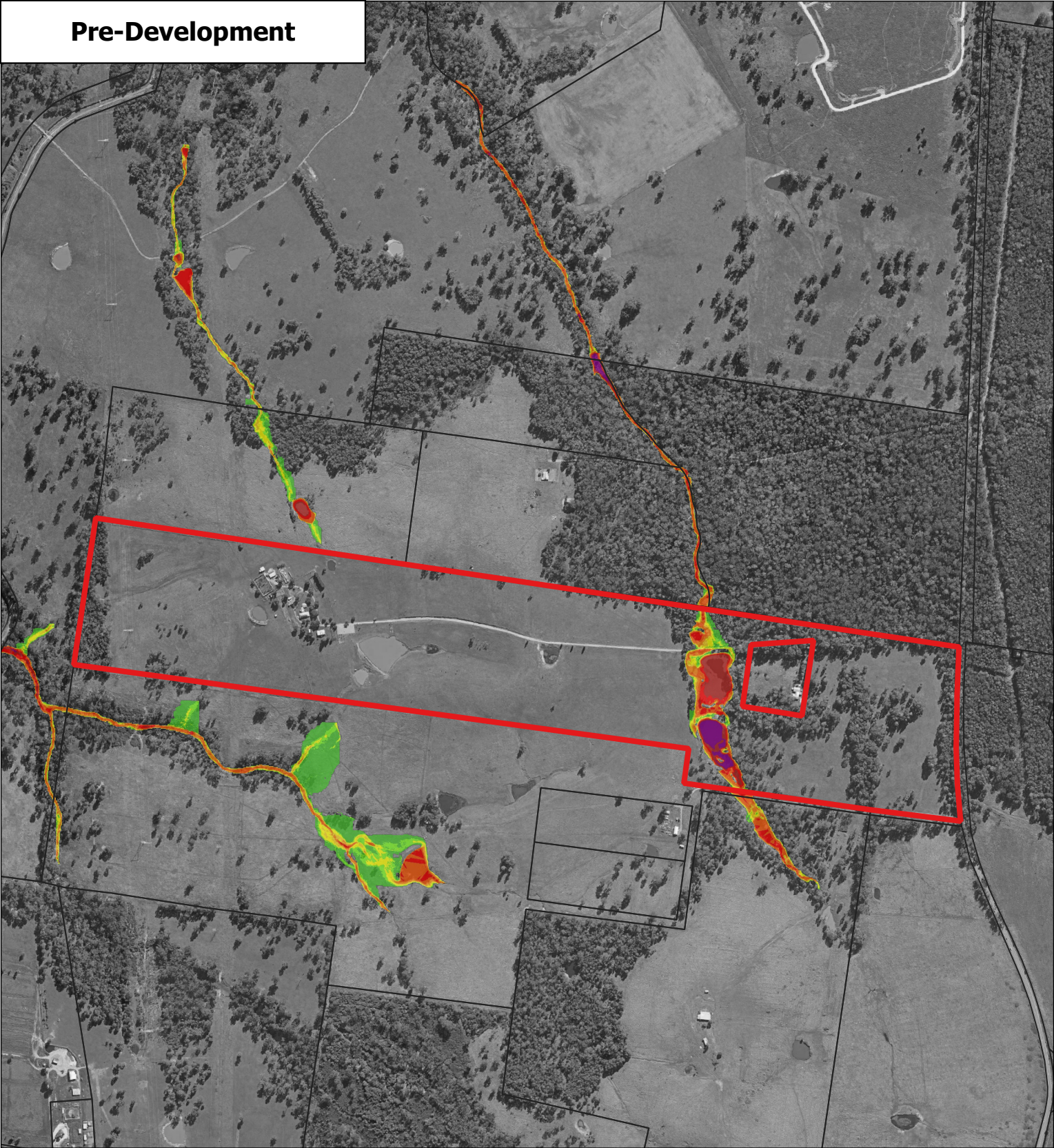
 Subject Site  Cadastre Boundaries Concept Lot Layout	Flood Depths (m)	 0.5 - 1.0
	 0 - 0.05	 1.0 - 1.5
	 0.05 - 0.1	 1.5 - 2.0
	 0.1 - 0.2	 > 2.0
	 0.2 - 0.3	
 0.3 - 0.5		



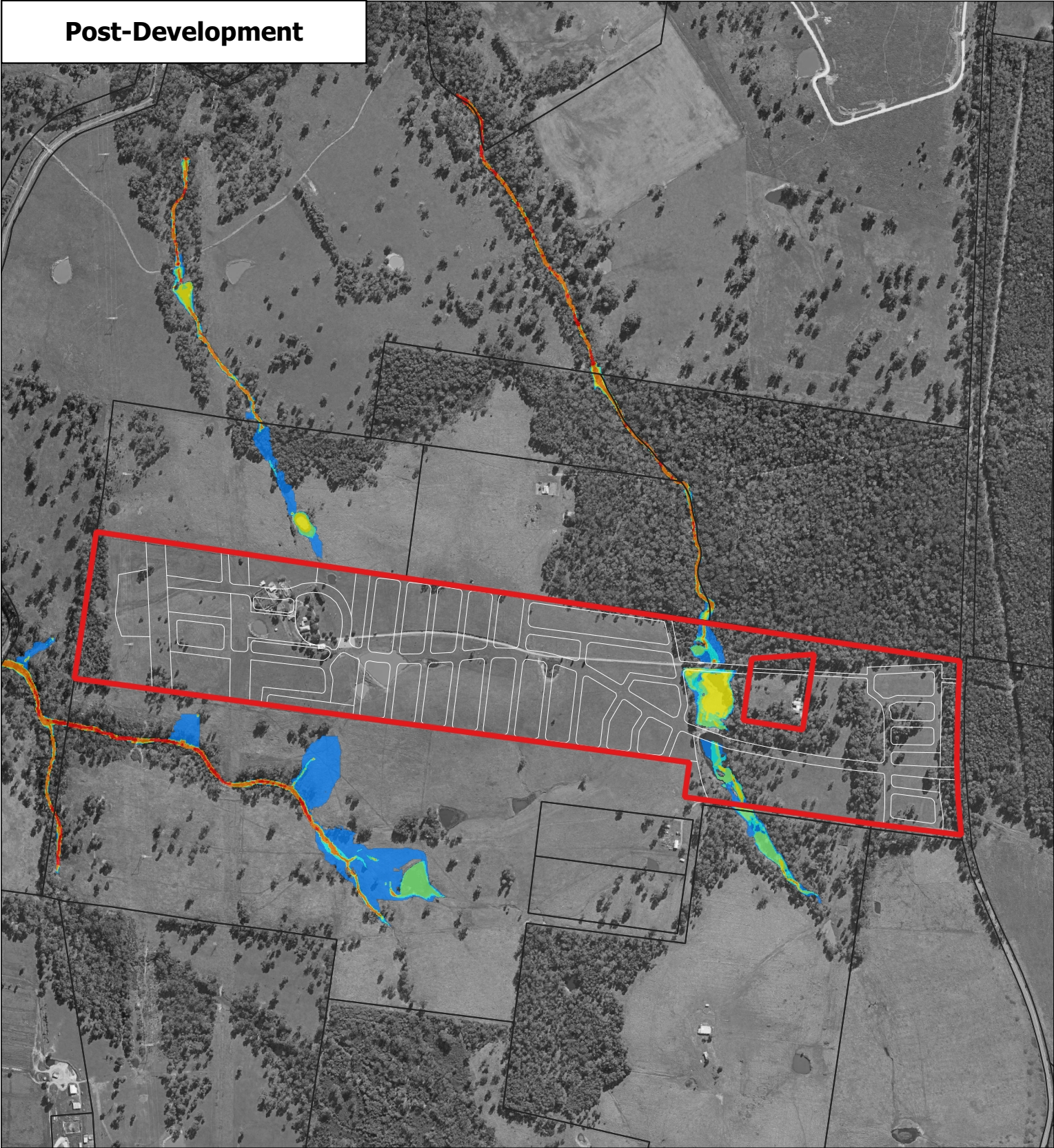
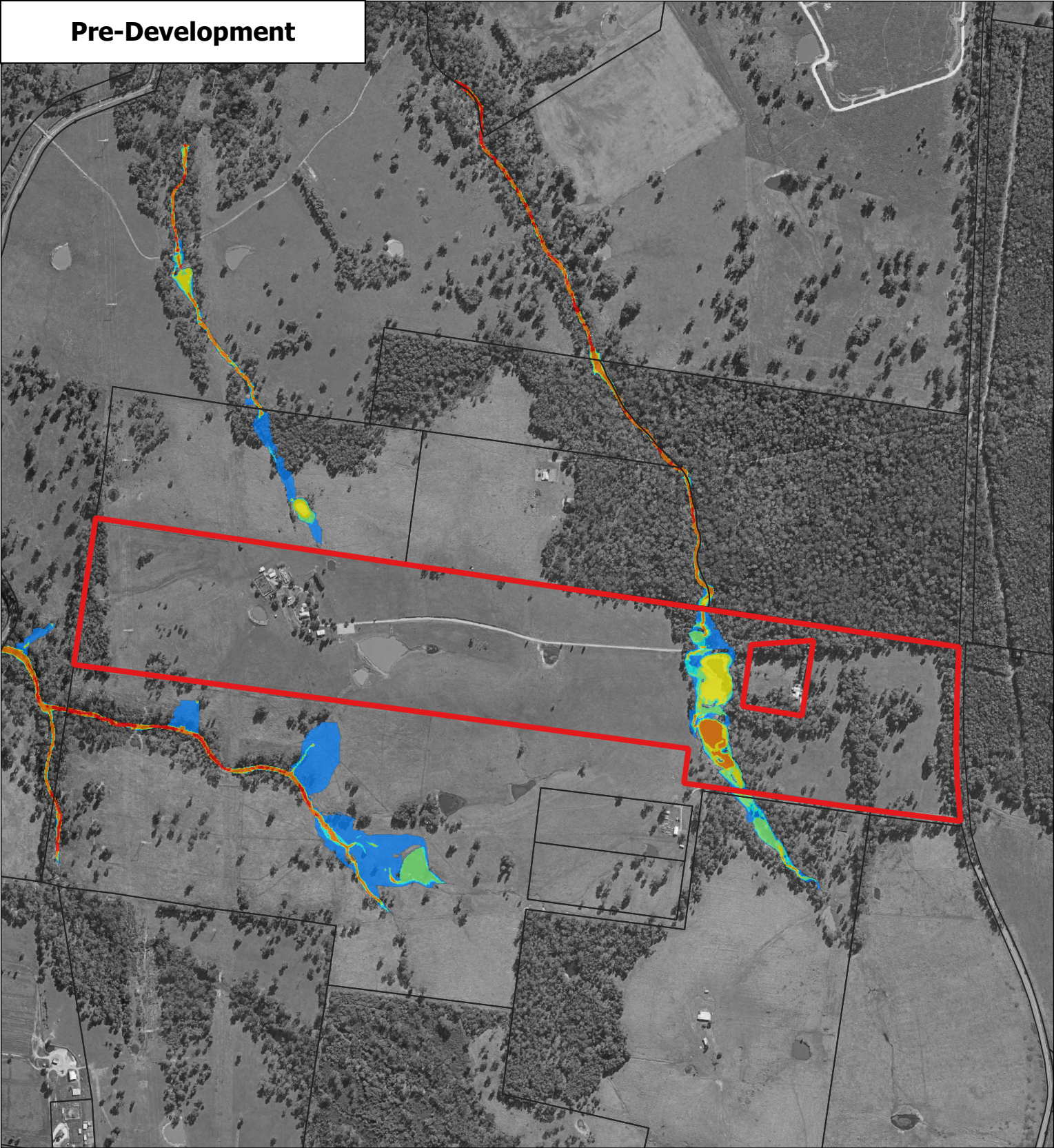
TITLE: Existing and Post Development Conditions - PMF Event Flood Depths	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A5
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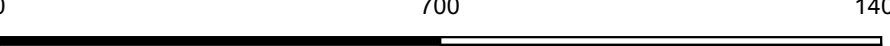
Subject Site Cadastre Boundaries Concept Lot Layout		Flood Hazard H1 H2 H3 H4 H5 H6		0 700 1400							
TITLE: Existing and Post Development Conditions - PMF Event Flood Hazard		PROJECT: 717 Appin Road, Gilead		PROJECT No. 230038		DATE: 09-2025		SCALE: 1:12000		FIGURE No. A6	



Subject Site Cadastre Boundaries Concept Lot Layout	Flood Depths (m)	0.5 - 1.0			
	0 - 0.05 0.05 - 0.1 0.1 - 0.2 0.2 - 0.3 0.3 - 0.5	1.0 - 1.5 1.5 - 2.0 > 2.0			
Existing and Post Development TITLE: Conditions - 1%AEP Climate Change Event Flood Depths	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A7



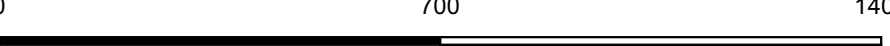
 Subject Site	Flood Hazard	 H4
 Cadastre Boundaries	 H1	 H5
Concept Lot Layout	 H2	 H6
	 H3	



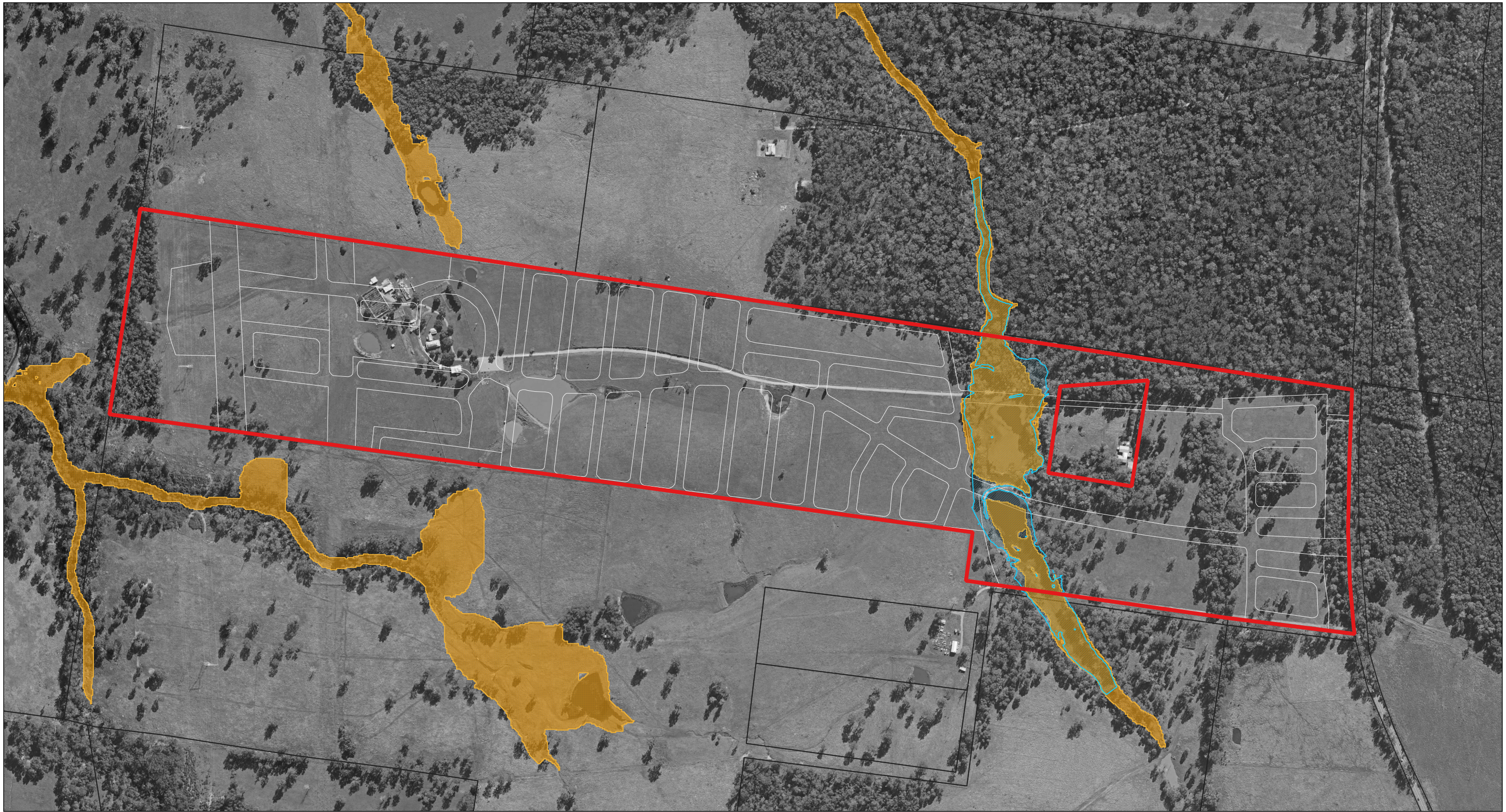
Existing and Post Development TITLE: Conditions - 1%AEP Climate Change Event Flood Hazard	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A8
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 Subject Site  Cadastre Boundaries Concept Lot Layout	Flood Impact(m)	 -0.1 to -0.01	 0.2 to 0.3
	 < -0.3	 No Impact	 > 0.3
	 -0.3 to -0.2	 0.01 to 0.1	 No Longer Flooded
	 -0.2 to -0.1	 0.1 to 0.2	 Newly Flooded



TITLE: Flood Level Impact Maps - 1% AEP and PMF Events	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A9
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Subject Site

Cadastral Boundaries

Concept Lot Layout

Mainstream Flood Planning Area

Proposed PMF Flood Extent

N

W

E

S

0

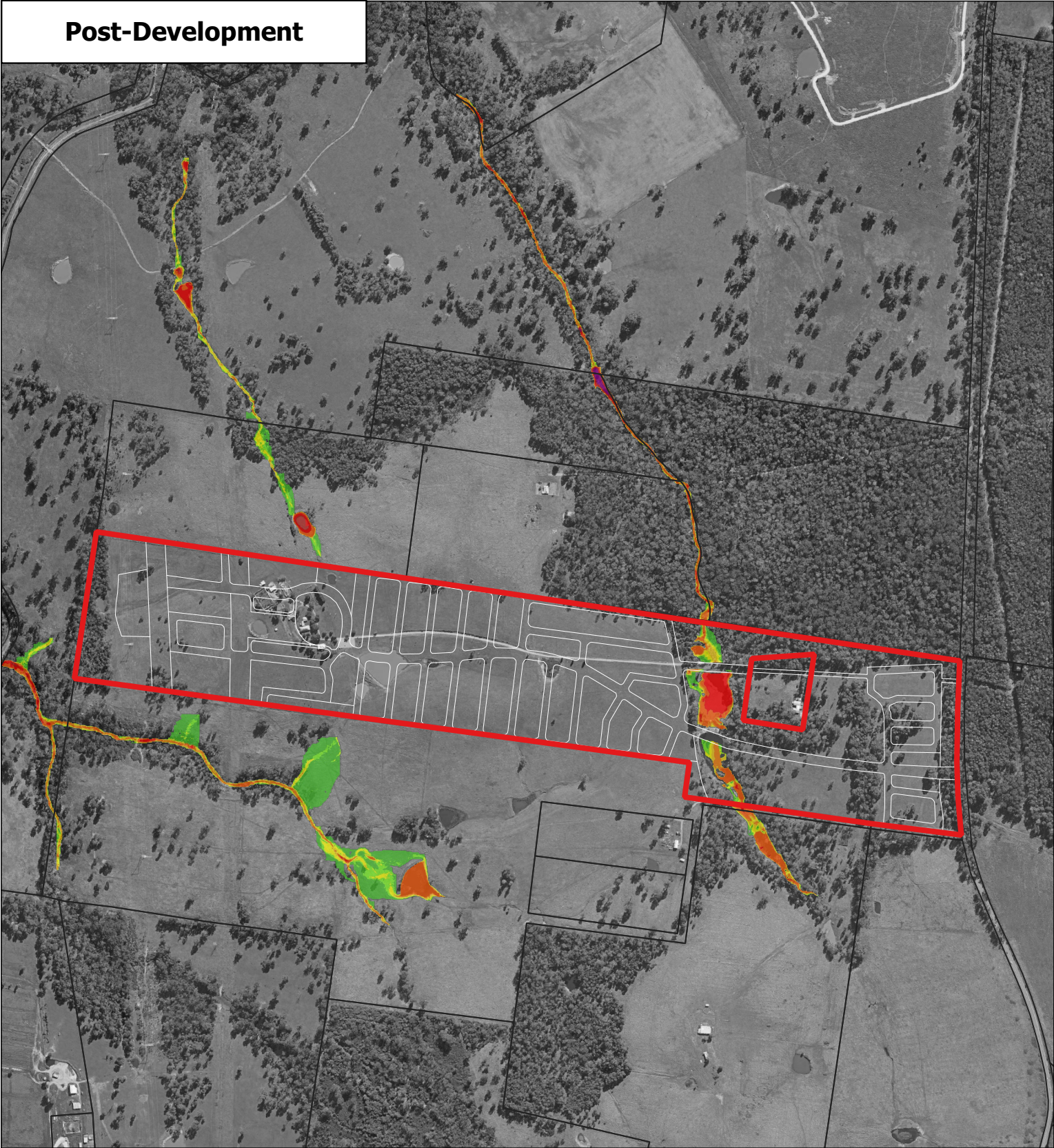
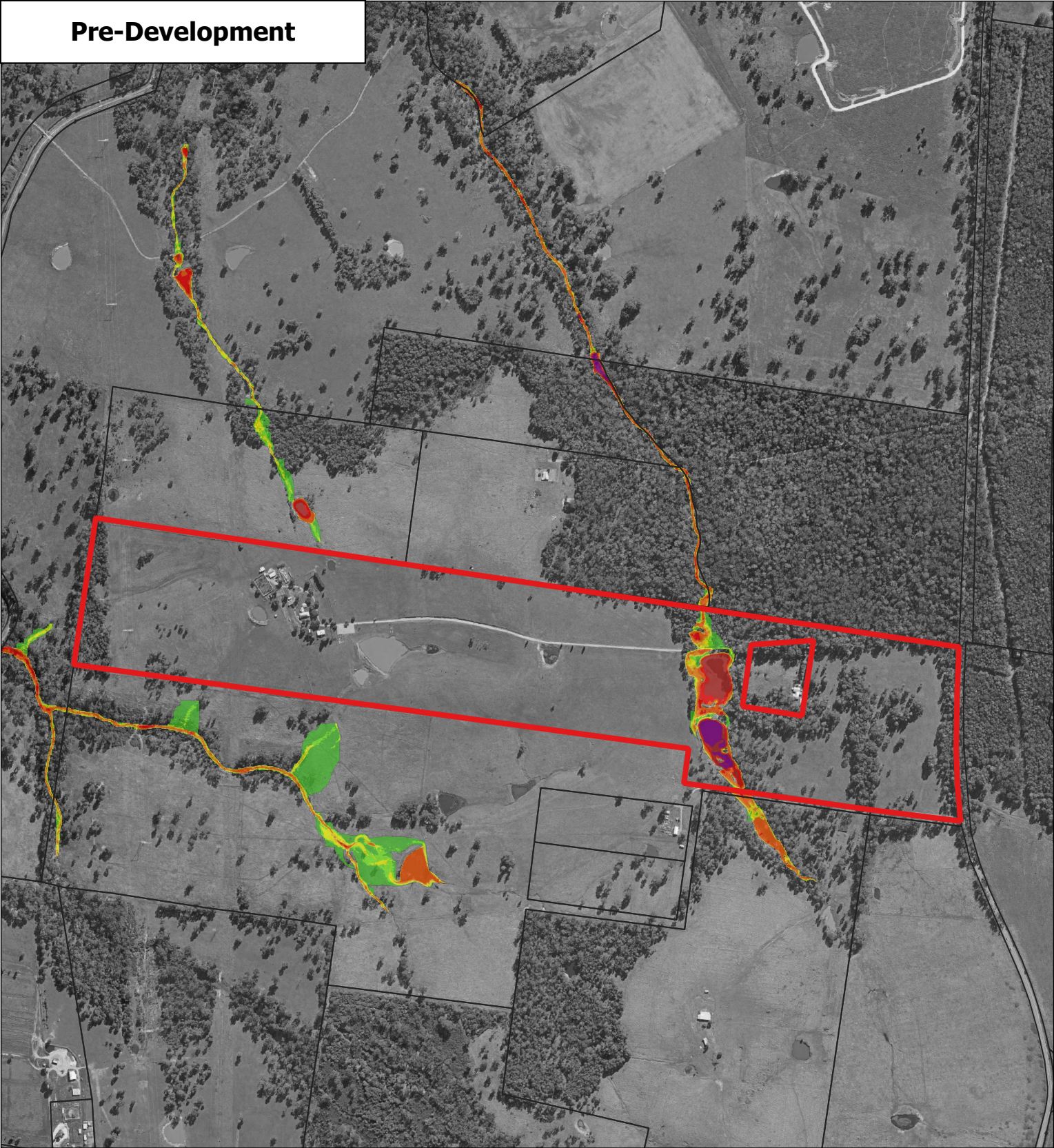
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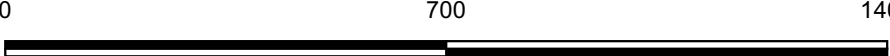
600

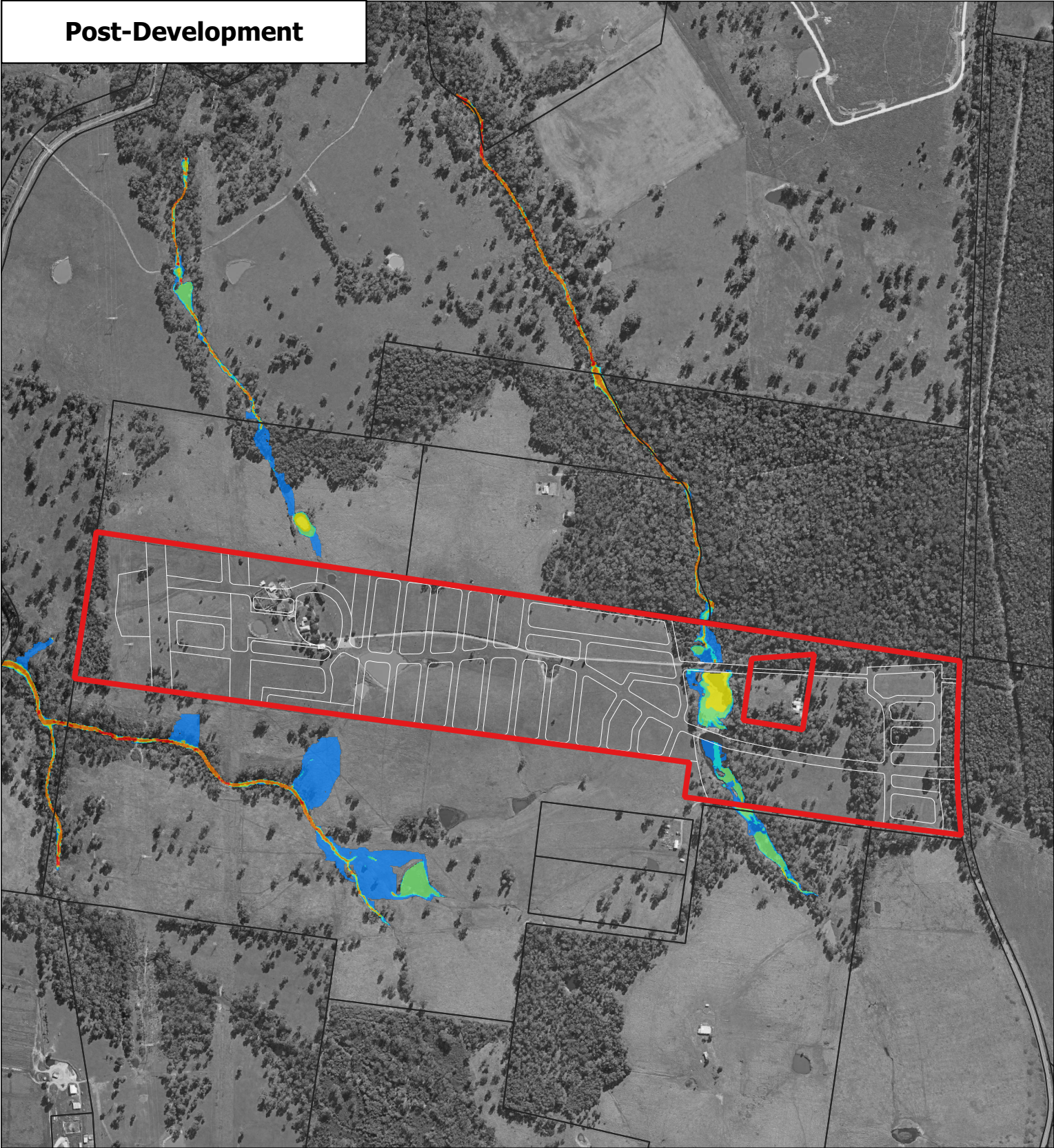
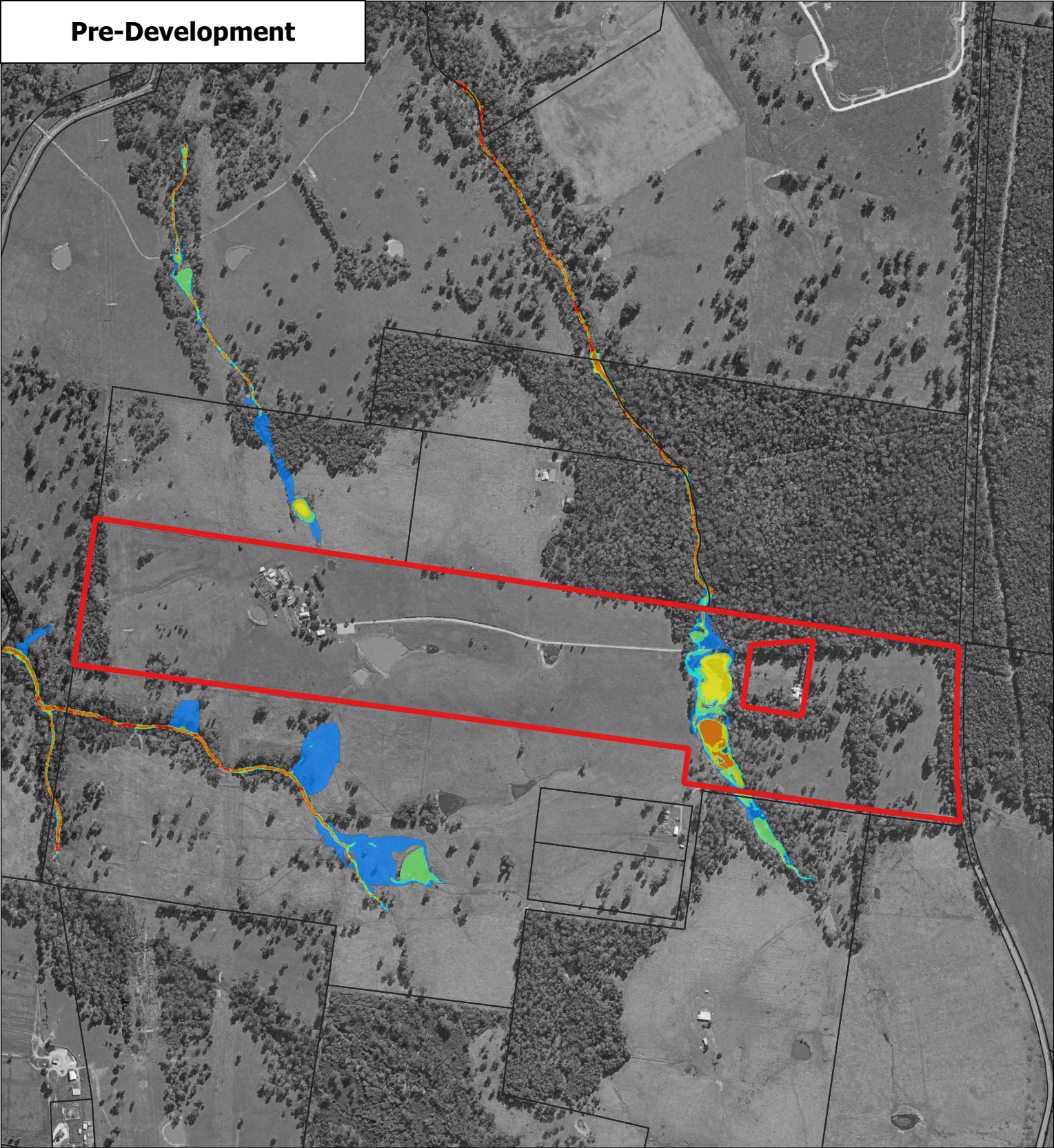
grc

HYDRO

TITLE: : Mainstream Flood Planning Area	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:6000	FIGURE No. A10
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Subject Site Cadastre Boundaries Concept Lot Layout	Flood Depths (m)	0.5 - 1.0			
	0 - 0.05 0.05 - 0.1 0.1 - 0.2 0.2 - 0.3 0.3 - 0.5	1.0 - 1.5 1.5 - 2.0 > 2.0			
					
Existing and Post Development TITLE: Conditions - 5% AEP Event Flood Depths	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A11



Subject Site	H1	H4
Cadastre Boundaries	H2	H5
Concept Lot Layout	H3	H6

Existing and Post Development TITLE: Conditions - 5% AEP Event Flood Hazard	PROJECT: 717 Appin Road, Gilead	PROJECT No. 230038	DATE: 09-2025	SCALE: 1:12000	FIGURE No. A12
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