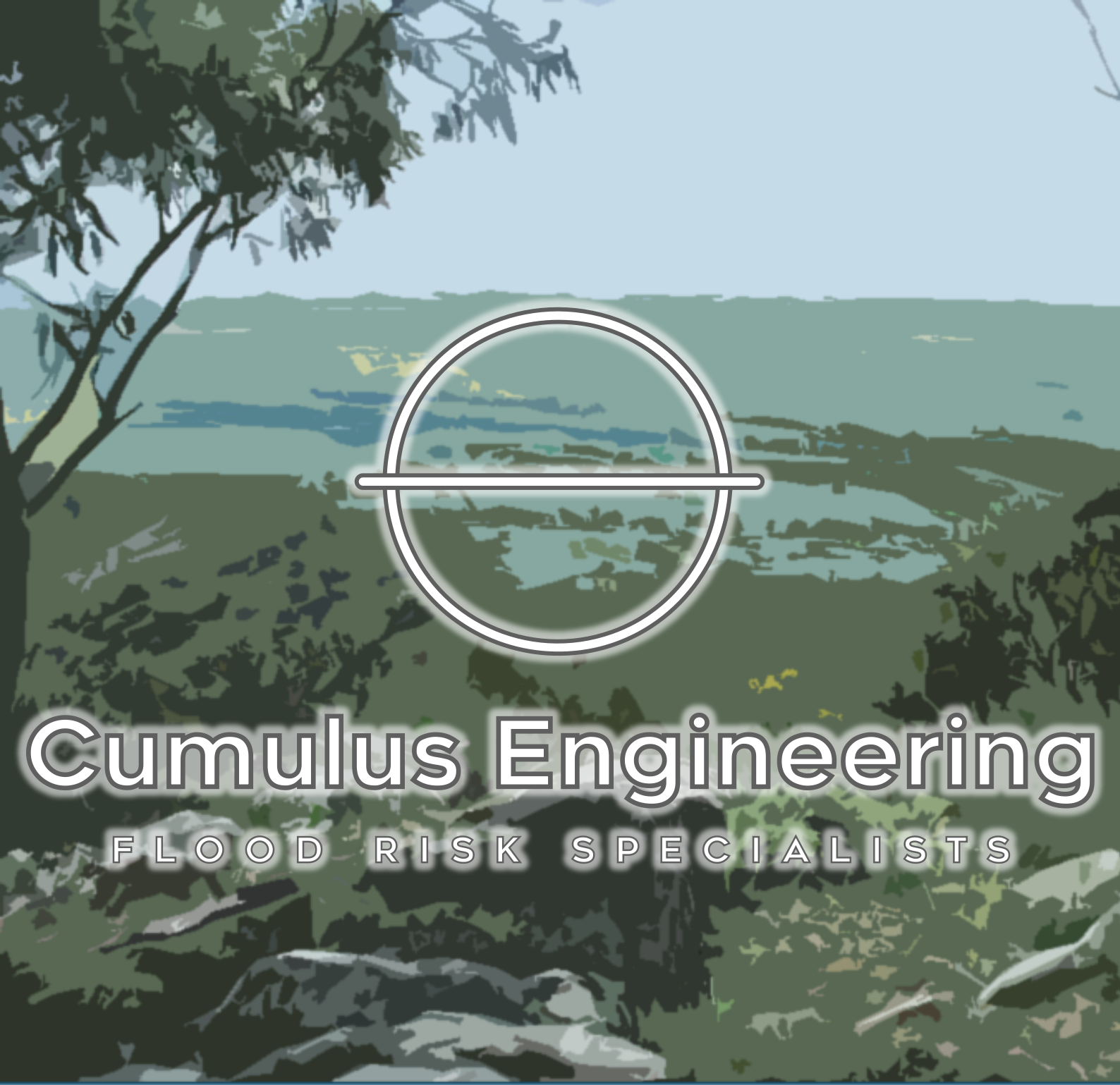




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FLOOD RISK SPECIALISTS

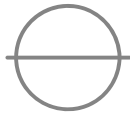
## MANGOPLAH BATTERY ENERGY STORAGE SYSTEM

### FLOOD IMPACT ASSESSMENT

PREPARED FOR

NGH CONSULTING & SAMSUNG C&T RENEWABLE ENERGY AUSTRALIA PTY LTD

**SEPTEMBER 2025**



**Project Name** Mangoplah Battery Energy Storage System - Flood Impact Assessment

**Client** NGH Consulting & Samsung C&T Renewable Energy Australia Pty Ltd (SREA)

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*In the spirit of reconciliation, Cumulus Engineering acknowledges the Traditional Custodians of country throughout Australia and their connections to land, sea, and community. We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today.*





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# 1 Introduction

Cumulus Engineering has undertaken a flood assessment for the proposed development of Lot 222 DP754557 (herein referred to as the 'Subject Lot'). The development consists of the construction, operation, and decommissioning of an up to 100 MW / 400 MWh (4hr) Battery Energy Storage System (BESS), generally comprising of battery storage units, transformers, access roads, underground and above ground cables, onsite substation, and associated operation facilities.

The flood assessment has been actioned to determine the existing flood regime in and around the Subject Lot, to identify any potential flood impacts due to the development on surrounding properties and waterways, identification of flood risk within the Subject Lot, and provide flooding information to inform the development design to minimise and mitigate flood risk.

As the development is classified as a State Significant Development (SSD), the NSW Department of Climate Change, Energy, the Environment and Water (DCCEEW) issues Secretary's Environmental Assessment Requirements (SEARs) specific to this type of project. This report outlines the modelling methodology, summarises key investigation findings, and addresses the flood assessment criteria detailed within the SEARs.

## 1.1 Background

The Subject Lot is located approximately 3 kilometres south-east of Mangoplah, NSW, and accessible via Holbrook Road from the south, the subject lot's northern boundary is defined by the significant Burkes Creek. Pastoral farmland surrounds the Subject Lot in all other directions. Further west, at 1.2 kilometres, lies the minor waterway of Paper Forest Creek. The Subject Lot is currently utilised for agricultural purposes, predominantly cropping.

As per the SEARs outlined by DCCEEW, the following requirements are to be addressed for the proposed development in relation to flooding:

- Assessment of the likely impacts of the development (including flooding) on surrounding watercourses (including their Strahler Stream Order)
- Assessing the impacts of the development, including any changes to flood risk and overland flows on-site or off-site, and detail design solutions and operational procedures to mitigate flood risk where required.

Advice provided by the BCS of the DCCEEW outlined the following items in relation to flooding to be addressed within the EIS for the development:

**Requirement 6:** Map the following features relevant to flooding including:

- a) Flood prone land.
- b) Flood planning area, the area below the flood planning level.
- c) Hydraulic categorisation (floodway and flood storage areas).
- d) Flood hazard.

**Requirement 7:** Conduct and describe flood assessment and modelling undertaken in determining the project's design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP, flood levels and the Probable Maximum Flood (PMF), or an equivalent extreme event.

**Requirement 8:** Model the effect of the project (including fill) on the current flood behaviour under the following scenarios:

- a) Current flood behaviour for a range of design events as identified in Requirement 7 above. This includes the 0.5% and 0.2% AEP year flood event as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.

**Requirement 9:** Modelling must consider and document:

- a) Existing council flood studies in the area and examine consistency to the flood behaviour documented in these studies.

- b) The impact on existing flood behaviour for a full range of flood events including up to the probable maximum flood.
- c) Impacts of the project on flood behaviour resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazard categories and hydraulic categories.
- d) Relevant provisions of the Flood Risk Management Manual: the policy manual for flood liable land (2023).

**Requirement 10:** Assess the impacts of the project on flood behaviour, including:

- a) Whether there will be detrimental increases in the potential flood affectation of other properties, assets, and infrastructure.
- b) Consistency with Council floodplain risk management plans
- c) Consistency with any Rural Floodplain Management Plans.
- d) Compatibility with the flood hazard of the land.
- e) Compatibility with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.
- f) Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.
- g) Any impacts the project may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council.
- h) Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the NSW SES and Council.
- i) Emergency management, evacuation and access, and contingency measures for the project considering the full range of flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the NSW SES.
- j) Any impacts the project may have on the social and economic costs to the community.

Table 1-1 outlines sections within the report that relate to each of the requirements outlined above.

**TABLE 1-1 SEARS REQUIREMENTS REFERENCE**

| Sears Requirement       | Report Location                                  |
|-------------------------|--------------------------------------------------|
| <b>Requirement 6</b>    | 4.1 1% AEP Results – Existing Conditions         |
| <b>Requirement 7</b>    | 2 Hydrological Analysis<br>3 Hydraulic Modelling |
| <b>Requirement 8</b>    | 4.2 1% AEP Results – Developed Conditions        |
| <b>Requirement 9a</b>   | 1.2 Agency Consultation                          |
| <b>Requirement 9b-d</b> | 4.2 1% AEP Results – Developed Conditions        |
| <b>Requirement 10</b>   | 4.3 Impacts on Flood Behaviour                   |

This flood assessment has been prepared in accordance with the Flood Impact and Risk Assessment – Flood Risk Management Guide LU01, encompassing assessment of the following:

- Assessing the full range of flood risk, by assessing flood behaviour across a range of events by modelling the 5%, 1%, 0.5%, 0.2% AEP and PMF events.
- Assessing the constraints flood places on the land (floodways, flood storage, & flood hazard) determined for the full range of events.
- Assessing the appropriateness of the development for the location.
- Assessing the adequacy of measures taken to ensure flood risks to the proposed developments are acceptable
- Actioning the assessment utilising best practice & actioning the assessment in compliance with the appropriate guidelines.

The location of the Subject Lot & BESS Footprint is shown below in Figure 1-1 with the current concept layout of the project shown in Figure 1-2.

## 1.2 Agency Consultation

Wagga Wagga City Council was contacted through the project to acquire information regarding flood studies that encompass the involved lands.

A flood study for The Rock located approximately 20 km to the northwest from the site that includes the Burkes Creek Catchment is currently underway. The study has been commissioned by the NSW Department of Climate Change, Energy, The Environment and Water (DCCEEW). As of the completion of this assessment, The Rock Flood Study is in draft stage, and as such, products of this study were unable to be utilised for this assessment.

## 1.3 Engagement and Consultation

### 1.3.1 Community Consultation

Community feedback for the project was solicited by NGH Consulting and Samsung C&T Renewable Energy Australia via an online feedback form, community open days, and direct one-on-one discussions with neighbouring residents.

It is noted that a landholder close to the subject lot raised concerns regarding how improvements will impact surrounding landholders. Impacts of the development are discussed further in detail in Sections 4.2 & 5.1 showing that the development will have minimal impact on flood behaviour.

For further detail regarding community consultation, please refer to chapter 5 of the project's Environmental Impact Statement which provides a comprehensive record of community consultation activities and outcomes.

### 1.3.2 Stakeholder Consultation

As per SEARs advice provided by the Biodiversity and Conservation Division (BCD) for the preparation of an Environmental Impact Statement (EIS) for the Mangoplah BESS, it is recommended that emergency management, evacuation and planning matters for the development be discussed with local SES and Council, as outlined within **Requirement 10**.

Meetings with local SES and Council have been conducted and are discussed below, with minutes from the meetings attached in Appendix C.

#### 1.3.2.1 Meeting with Wagga Wagga City Council (19/06/2025)

Council provided the following insights and recommendations:

- The emergency access route, especially along Paper Forest Road, has had issues regarding flooding in historic flood events.
- The township of Mangoplah itself becomes isolated in significant flood events.

#### 1.3.2.2 Meeting with NSW SES (24/07/2025)

SES provided the following insights and recommendations:

- Recommends a Flood Emergency Response Plan be included for the construction and operational plan of the project.
- Noted that even though the site will be mainly operated remotely with infrequent site visits, raised concerns over the relatively large construction crew who will be present on-site during construction.
- Suggests the Probable Maximum Flood event be considered when assessing flood risk on emergency evacuation routes.

Following the meeting, SES provided a response letter inclusive of their recommendations, also detailed in Appendix C.



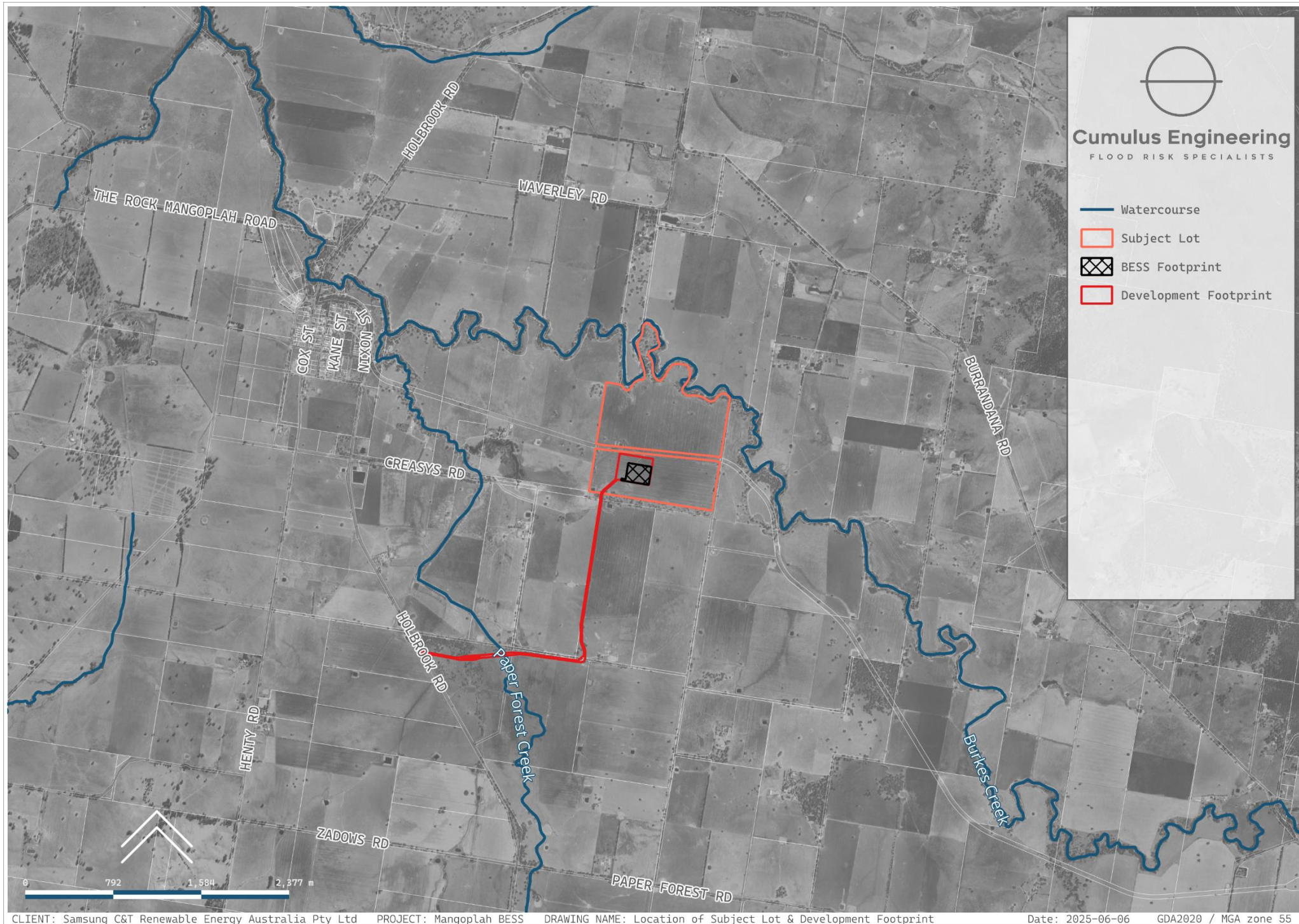


FIGURE 1-1 LOCATION OF SUBJECT LOT



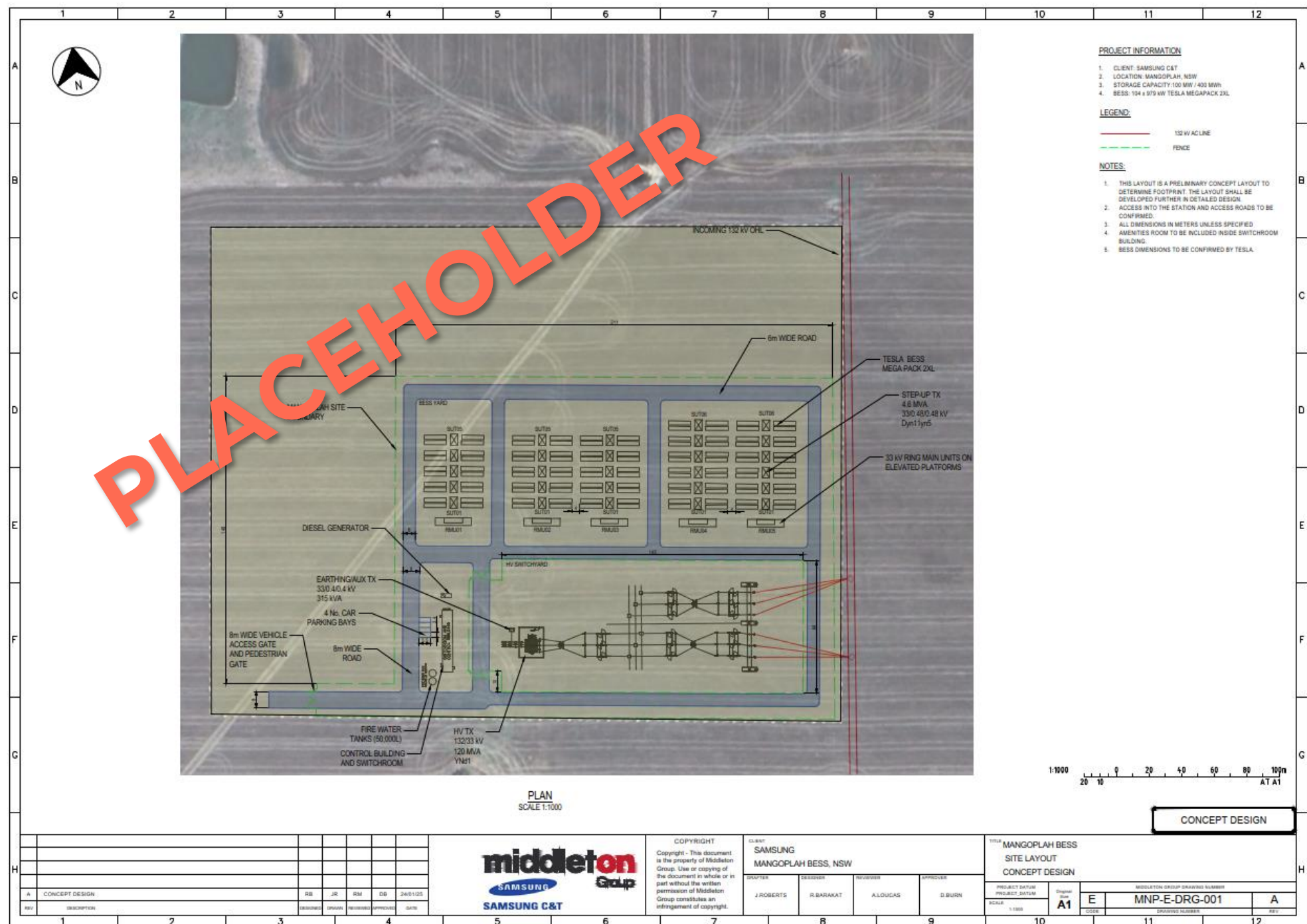


FIGURE 1-2 INDICATIVE LAYOUT - PROVIDED BY SAMSUNG C&T RENEWABLE ENERGY AUSTRALIA PTY LTD.

## 2 Hydrological Analysis

The RORB hydrological model Version 6.51 (Laurenson, Mein and Nathan, 2010) was used for the analysis of local catchment runoff. RORB is a rainfall-runoff model which calculates flood hydrographs from storm rainfall hyetographs and can be used for modelling natural, part urban and fully urban catchments. RORB is an industry standard modelling package that is used widely in hydrological studies in Australia.

### 2.1 Local Catchment Delineation

Analysis of the catchment impacting the Subject Lot presents a complex hydrological scenario. Situated on a local highpoint, the Subject Lot receives minimal direct upstream contributions, as the surrounding topography slopes predominantly southwest towards Paper Forest Creek. However, the Subject Lot's proximity to the deeply incised Burkes Creek, located to the north, northeast, and east, is a significant factor, given Burkes Creek's considerable upstream catchment area. To comprehensively assess potential impacts the delineated catchment area incorporates the upstream extents of both Paper Forest Creek and Burkes Creek. Furthermore, a substantial downstream area was included to account for any potential backflow effects.

The catchment boundaries were initially delineated automatically using the QMYDRO (HydroRepo, 2025) catchment analysis tool. This initial delineation was then manually refined by referencing contour data and spatial imagery. The 5-metre VicMap Digital Elevation Model (DEM) from 2014 formed the basis of the delineation.

The adopted catchment delineation is displayed in Figure 2-1.

### 2.2 Strahler Order

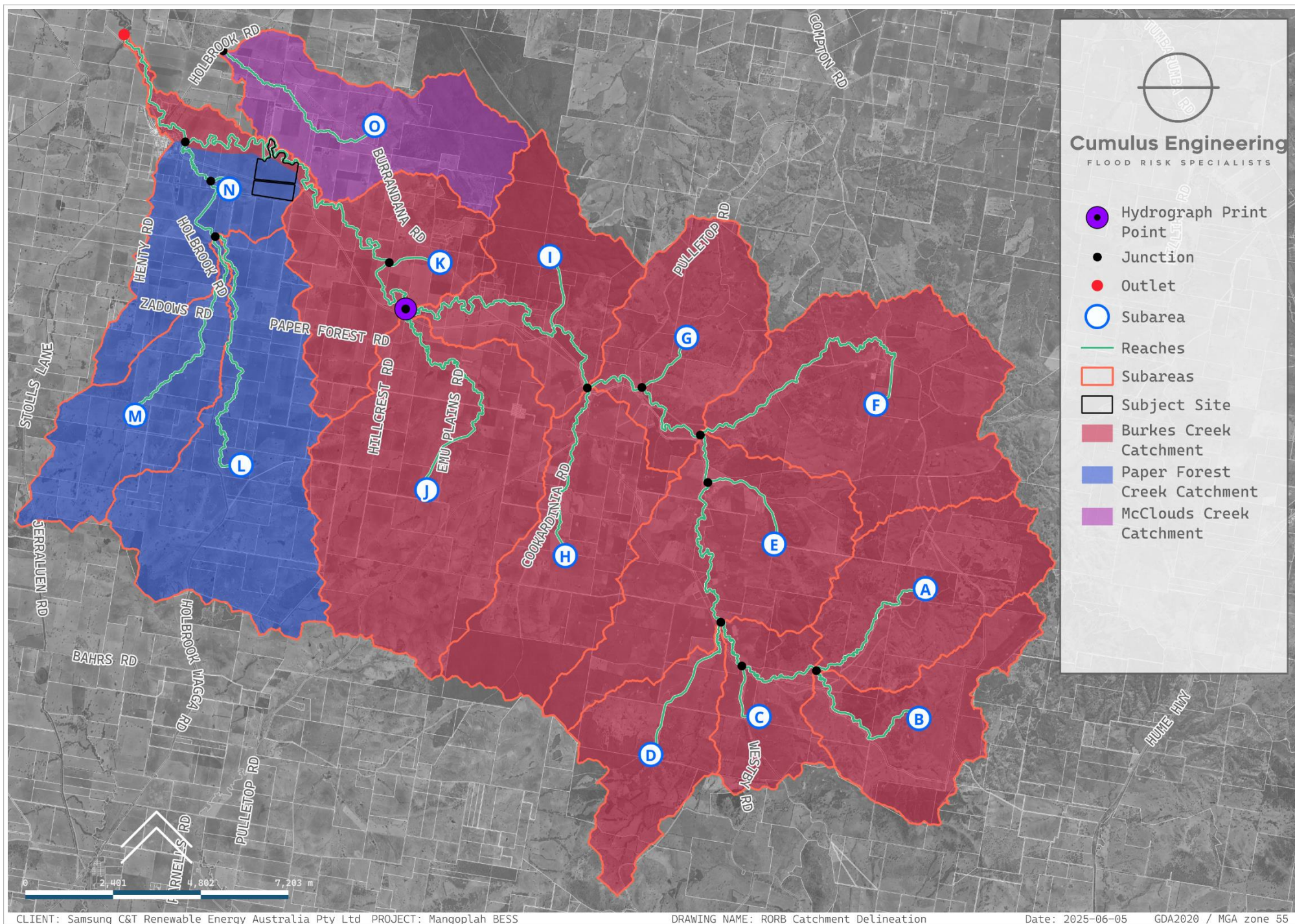
The Strahler stream order system is a method used to classify and quantify the hierarchy of natural watercourses within a catchment. First-order streams are defined as the smallest, unbranched headwater channels. When two first-order streams converge, they form a second-order stream. When two second-order streams converge, they form a third-order stream, and so on. This classification helps in understanding the relative size, flow accumulation, and ecological characteristics of different stream segments.

The BESS installation footprint is located on the periphery of two third-order streams. Due to its positioning and design, the BESS itself is not expected to alter the classification of these adjacent streams or the streams into which they flow. Consequently, the direct influence of the BESS component on the overall Strahler Order of the catchment is considered minimal.

The wider Development Footprint, which includes access routes, intersects several watercourses with Strahler orders ranging up to the ninth order, representing significant river systems. For any upgrades to access routes, it is crucial that modifications, particularly at waterway crossings, do not obstruct existing flow paths or alter natural stream confluences. Provided these conditions are met through appropriate engineering design, the Strahler order of these traversed streams will not be impacted by the access route works.

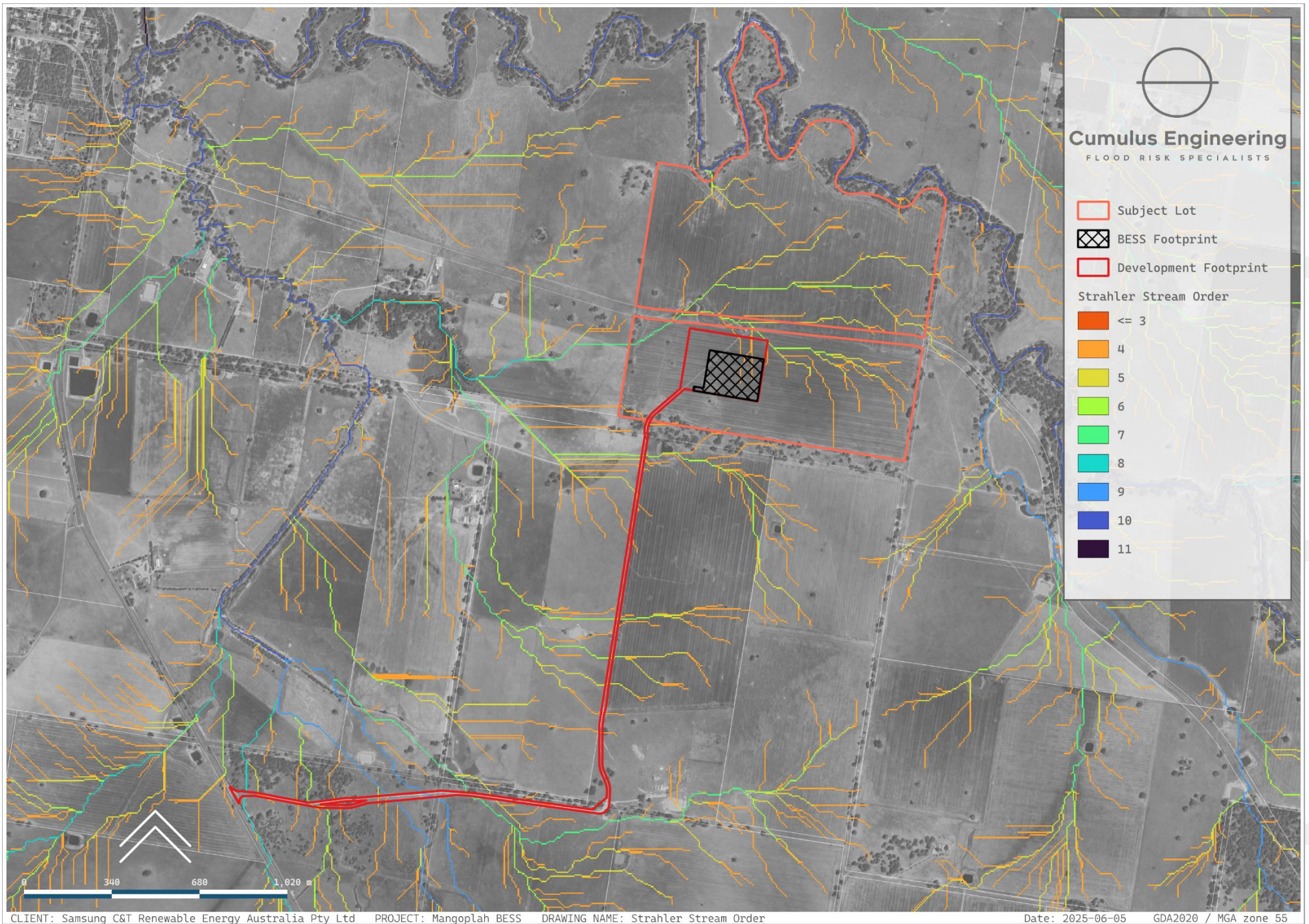
The Strahler stream order of the catchment surrounding the Project Site is displayed in Figure 2-2.





**FIGURE 2-1 CATCHMENT DELINEATION**





**FIGURE 2-2 STREAM STRAHLER ORDER**  
Mangoplah Battery Energy Storage System - Flood Impact Assessment | NGH Consulting & Samsung C&T Renewable Energy Australia Pty Ltd

## 2.3 RORB Modelling Parameters

### 2.3.1 Values of Fraction Imperviousness

Values of fraction imperviousness (FI) were determined through aerial imagery and planning zone codes using standard values obtained from ARR2019. Weighted values of FI are outlined in Table 2-1.

TABLE 2-1 RORB SUBAREAS - WEIGHTED FRACTION IMPERVIOUS VALUES

| Subarea | Area (km <sup>2</sup> ) | Weighted FI |
|---------|-------------------------|-------------|
| A       | 22.09                   | 0.054       |
| B       | 17.51                   | 0.051       |
| C       | 11.15                   | 0.063       |
| D       | 15.61                   | 0.051       |
| E       | 31.38                   | 0.054       |
| F       | 35.72                   | 0.054       |
| G       | 20.09                   | 0.057       |
| H       | 25.62                   | 0.059       |
| I       | 21.46                   | 0.06        |
| J       | 44.66                   | 0.056       |
| K       | 21.98                   | 0.063       |
| L       | 36.08                   | 0.057       |
| M       | 17.64                   | 0.058       |
| N       | 19.51                   | 0.08        |
| O       | 21.90                   | 0.056       |

### 2.3.2 Loss and Routing Parameters

Currently in NSW, rainfall losses are derived utilising a hierarchy of approaches depending on the available loss information for a particular catchment. The hierarchy for selecting losses is as follows:

- Use the average of calibration losses from the actual study on the catchment if available.
- Use the average calibration losses from other studies in the catchment, if available and appropriate for the study.
- Use the average calibration losses from other studies in the similar adjacent catchments, if available and appropriate for the study.
- Use the NSW FFA-reconciled losses available through the ARR Data Hub. These losses may be used within the catchment in which they were derived or similar adjacent catchments with appropriate scrutiny.
- Use default ARR data hub continuing losses with a multiplication factor of 0.4

The RORB routing parameter  $K_c$  was estimated using the AUS wide equation ( $K_c = 1.14 * D_{av}$ ) for each interstation within the model. The typical value for the m routing parameter of 0.8 was adopted across the catchment. Loss and routing parameters adopted for the model are outlined in Table 2-2.



**TABLE 2-2      ADOPTED LOSS AND ROUTING PARAMETERS**

| Input Parameter      | Adopted Value |
|----------------------|---------------|
| M                    | 0.80          |
| K <sub>c</sub>       | 47.38         |
| Initial Loss (IL)    | 29.4          |
| Continuing Loss (CL) | 1.96          |

### 2.3.3 Climate Conditions

In line with Australian Rainfall and Runoff 2019 (ARR 2019) guidance, the study's adopted climate condition incorporates a 1.3°C temperature increase. This adjustment accounts for warming observed since the establishment of the 2016 Intensity-Frequency-Duration (IFD) design rainfall data, thereby providing a more representative assessment of current hydrological conditions. This approach aligns with best practice for ensuring the accuracy of data used. The temperature increase is consistent with the Climate Change Scenario SSP3-7.0 for the year 2030. As such, losses & rainfall depths have been adjusted to align with this climate scenario.

### 2.3.4 Pre-burst Rainfall

Local initial loss values for the catchment were unavailable for use for the catchment, as there was inadequate data to calibrate losses & there were no studies within the area that could provide calibrated or adopted losses. As such, Probability Neutral Burst Losses were adopted for the study, in accordance with ARR2019.

### 2.3.5 Probable Maximum Flood (PMF)

The PMF hydrology was undertaken utilising both the Generalised Short Duration Method (GSDM) and the Generalised Southeast Australia Method (GSAM) as per the ARR2019 Guidelines. The GSDM is applicable for durations of up to six hours and areas of up to 1,000 km<sup>2</sup> (Bureau of Meteorology, 2003) whereas the GSAM is generally adopted for durations greater than 6 hours. Both methods were considered appropriate given the short durations anticipated for the local catchment as well as potential for flooding during longer events due to the low-grade terrain in the area. Zones of application for longer duration methods are outlined in Figure 2-3.



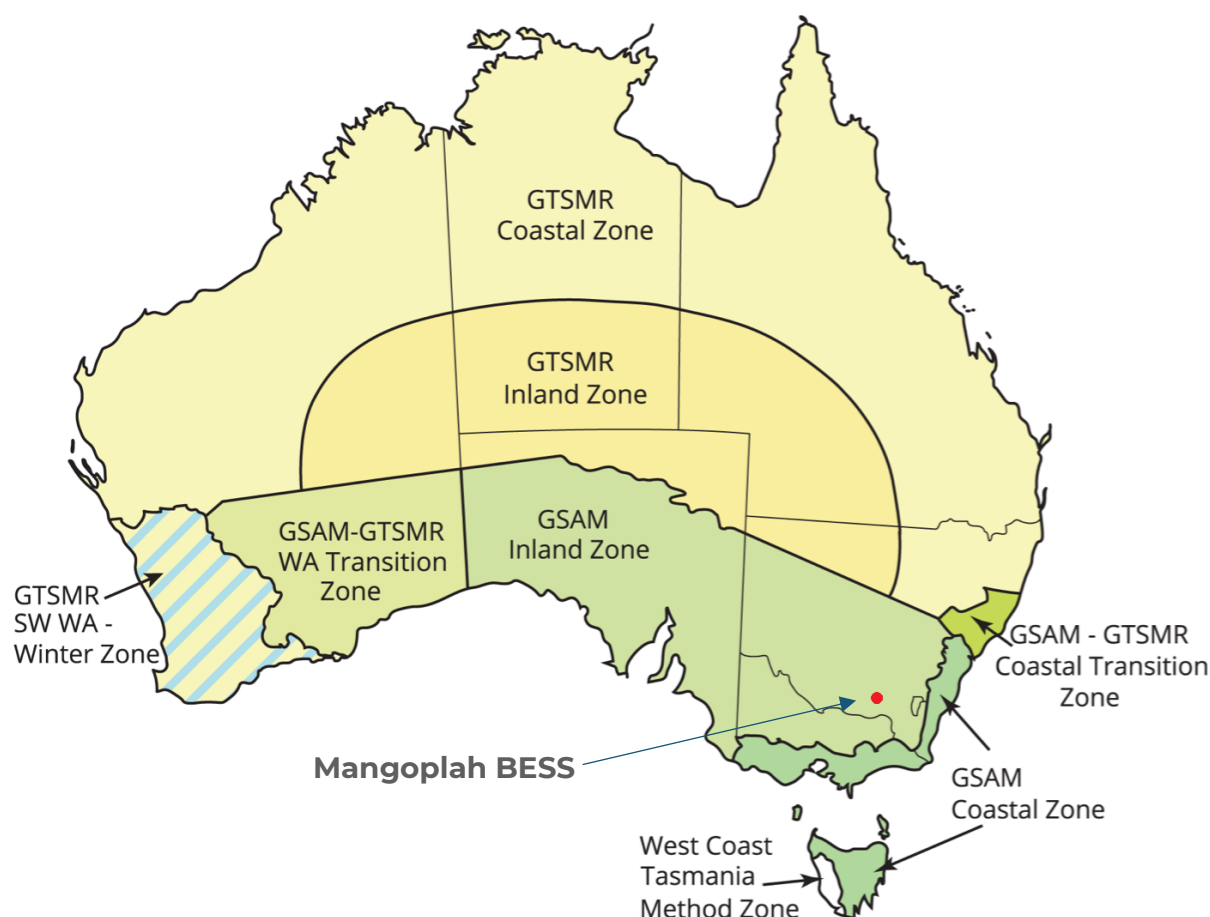


FIGURE 2-3 GENERALISED LONG-DURATION PROBABLE MAXIMUM PRECIPITATION METHOD ZONES (NATHAN, WEINMANN, 2019)

GSDM and GSAM temporal and spatial patterns were used in line with ARR2019 recommendations for each of the respective events. The same loss model that was adopted for all previous design events was adopted for PMF.

## 2.4 RORB Modelling Results

### 2.4.1 Model Validation

Table 2-3 outlines a comparison of the outputs from the RORB model to the Regional Flood Frequency Estimation model.

Discrepancies between flood estimates from the RORB runoff routing model and the Regional Flood Frequency Estimation (RFFE) tool are anticipated due to their fundamental methodological differences. RORB simulates event-based rainfall-runoff processes and is sensitive to specific input parameters (such as rainfall patterns and loss rates) and calibration data. In contrast, RFFE employs statistical analysis of regional gauged data, relying on assumptions of hydrological similarity and subject to its own limitations regarding applicability and underlying data quality. However, the RORB model for this study demonstrates good alignment with the RFFE: the modelled peak flow is of the same magnitude and falls within the RFFE's 95% confidence interval.

TABLE 2-3 PEAK FLOW VALIDATION

| Event  | Rational Flood Frequency Estimate (m <sup>3</sup> /s)  | RORB Peak Flow @ Model Outlet (m <sup>3</sup> /s) |
|--------|--------------------------------------------------------|---------------------------------------------------|
| 1% AEP | 208 with 95 Percent Confidence Interval of (76.2, 572) | 287                                               |

## 2.4.2 Model Results

The model was run for the 5%, 1%, 0.2%, 0.5% AEP and PMF flood events for the 12-, 18-, 24-, and 36-hour storms. Due to the size of the catchment (i.e. 362.4 km<sup>2</sup>), the area exceeds the point temporal pattern limit of 75 km<sup>2</sup>, therefore areal temporal patterns were adopted to consider a more realistic rainfall distribution and corresponding impact on catchment response.

Peak flow rates, taken at the model outlet, are displayed in Table 2-4.

TABLE 2-4 PEAK FLOW RATES

| Event    | Duration (hrs) | Flowrate @ Model Outlet (m <sup>3</sup> /s) |
|----------|----------------|---------------------------------------------|
| 5% AEP   | 12             | 167.6                                       |
| 1% AEP   | 12             | 287                                         |
| 0.5% AEP | 12             | 336.4                                       |
| 0.2% AEP | 24             | 419.8                                       |
| PMF      | 24             | 1611                                        |

## 2.5 RORB Model Outputs

The RORB model configured as described above, produced hyetographs of effective rainfall on the catchment. These hyetographs, which reflected rainfall losses, were then prepared for use in the TUFLOW hydraulic model. For each storm duration, three representative patterns; rear-loaded, middle-loaded, and front-loaded were selected. The median results from these three patterns calculated during post-processing, served as the representative storm duration output, with the maximum of these medians serving as the final model output grids. Adopted temporal pattern per duration is displayed in Table 2-5.

Additionally, hydrographs were extracted for each adopted storm located downstream of Subareas J as illustrated in Figure 2-1. This hydrograph served as a direct inflow boundary condition within the TUFLOW hydraulic model, operating in conjunction with the effective rainfall hyetographs applied over the remainder of the hydraulic model domain to capture cumulative flows upstream from each of these subareas.

TABLE 2-5 ADOPTED TEMPORAL PATTERNS PER DURATION

| Duration (hrs) | Areal Temporal Pattern |
|----------------|------------------------|
| 12             | 5, 6, 9                |
| 18             | 2, 3, 4                |
| 24             | 2, 4, 5                |
| 36             | 1, 4, 9                |

### 3 Hydraulic Modelling

Hydraulic modelling of the existing and design scenarios was undertaken by developing a combined 1-dimensional and 2-dimensional model in the industry standard software TUFLOW. TUFLOW is a numerical model widely used to simulate the hydrodynamic behaviour of rivers, floodplains, and urban drainage environments and is considered the industry standard in Australia.

#### 3.1 Modelling Methodology

Hyetographs for the design events (5%, 1%, 0.5%, 0.2% AEP, and Probable Maximum Flood (PMF)) with varying storm durations and temporal patterns were generated using RORB and applied to the TUFLOW model as excess rainfall hyetographs. These were assigned to subareas delineated within the hydrological model located within the hydraulic model extent. Hydrographs representing cumulative flows downstream of Subarea J were input as a direct point inflow within the TUFLOW model.

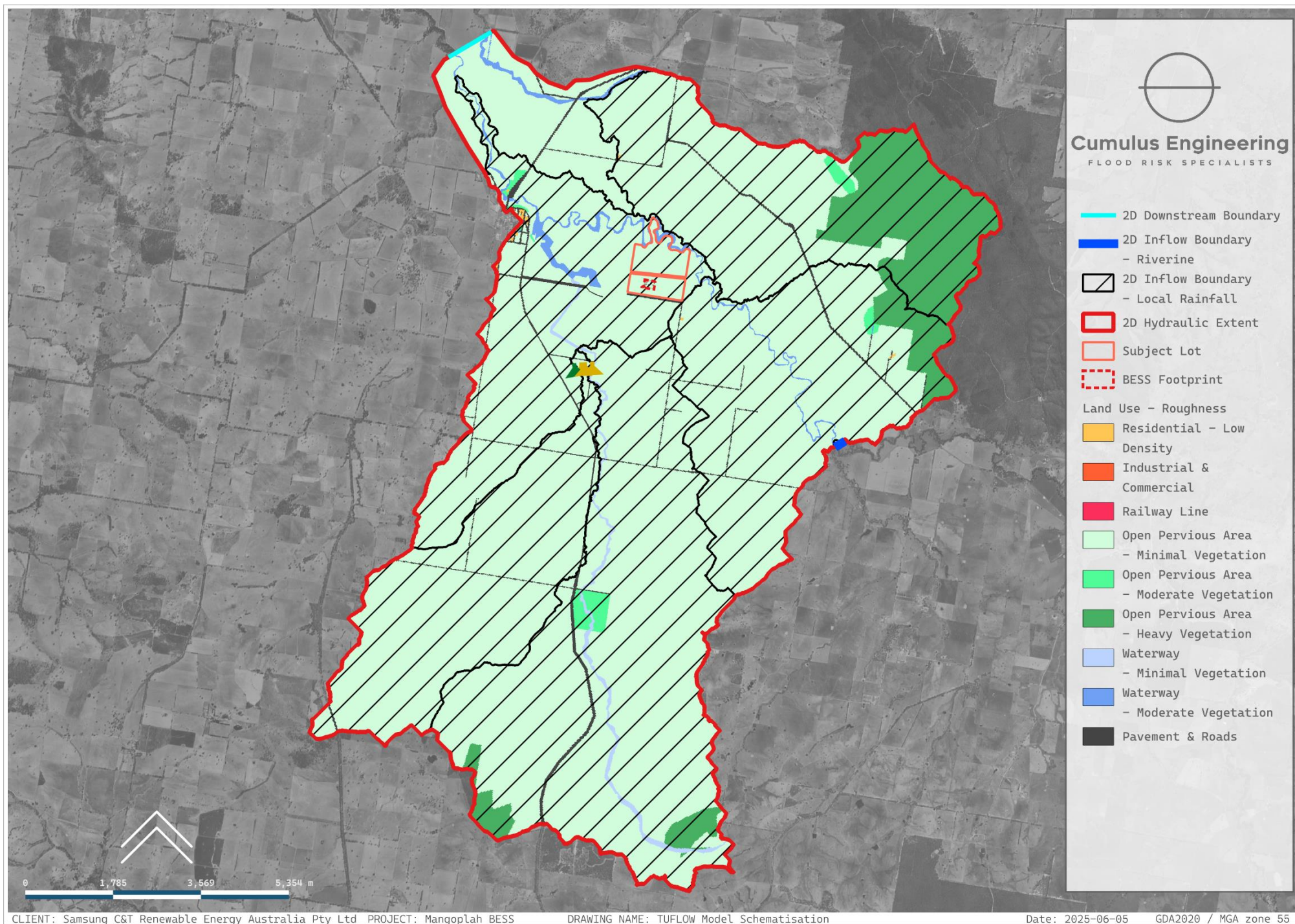
#### 3.2 Model Setup – Existing Conditions

The hydraulic model covers the project lot and surrounding areas to ensure any potential impacts due to the development are identified. The model schematics representing existing conditions are outlined in Table 3-1 and illustrated in Figure 3-1. The model parameters adopted for the hydraulic model are outlined in detail in Appendix A.

TABLE 3-1 HYDRAULIC MODEL – EXISTING SCENARIO

| Model Parameter               | Description                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model Extent                  | Determined by catchment delineation, incorporating Subareas K, L, M, N, R from the RORB hydrologic model                                                                                                                                                                                                                                                                                                   |
| Topography                    | <ul style="list-style-type: none"><li>5 metre LiDAR captured in 2015 owned by the NSW Government</li><li>0.1 metre Survey captured by Fyfe in 2025, provided by Samsung C&amp;T Renewable Energy Australia Pty Ltd.</li></ul>                                                                                                                                                                              |
| Terrain Modifiers             | 2D Z Shapes were utilised to reinforce road crests within the model                                                                                                                                                                                                                                                                                                                                        |
| Mannings Roughness            | <ul style="list-style-type: none"><li>Residential: Rural – Lower Density (When building footprints and remainder of parcel are modelled together)</li><li>Industrial/Commercial</li><li>Open Pervious Areas: Minimal Vegetation</li><li>Open Pervious Areas: Moderate Vegetation</li><li>Open Pervious Areas: Heavy Vegetation</li><li>Waterbodies/Lakes</li><li>Car Park/Pavement/Driveway/Road</li></ul> |
| Inflow Boundary Condition     | 2D Inflow <ul style="list-style-type: none"><li><i>Local Catchment</i> – Applied Rainfall Excess Hyetographs extracted from RORB Subareas K, L, M, N, &amp; O.</li><li><i>Riverine Inflow</i> – Applied point inflow using the inflow hydrographs provided by the RORB print point downstream of Subareas I &amp; J.</li></ul>                                                                             |
| Downstream Boundary Condition | HQ (water level-discharge boundary) adopting the respective terrain slope upstream of boundary location                                                                                                                                                                                                                                                                                                    |
| 2D Outputs                    | Water levels, Depths, Velocity, Hazard (ZAEM1)                                                                                                                                                                                                                                                                                                                                                             |





**FIGURE 3-1 TUFLOW MODEL SCHEMATISATION**

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### 3.3 Model Setup – Developed Conditions

To determine potential impacts due to the proposed development, the existing scenario was modified to include the following:

- Manning's roughness across the BESS Footprint, with the exception of decreased manning's roughness value to 0.03 (Road/Pavement) representing the proposed internal road network.
- Adopted terrain modifiers to increase elevation of areas of BESS infrastructure by 100mm.
- The building footprints were removed from the model domain representing a 'fully blocked' scenario.

Only the BESS Footprint was assessed for the developed scenario. The full Development Footprint, inclusive of the access road is unable to be assessed without detailed design of proposed upgrades to the proposed access route.

The alterations to the existing model schematics for the developed scenario are illustrated in Figure 3-2.

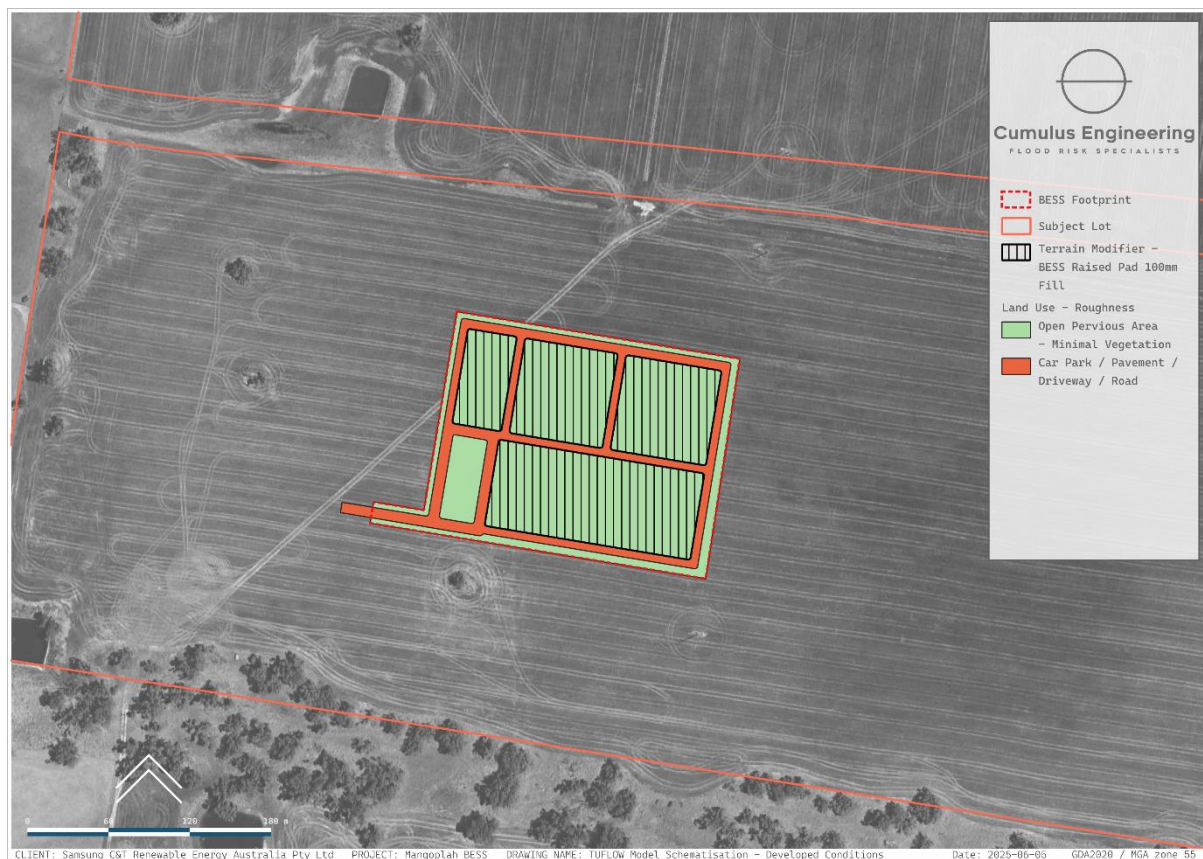


FIGURE 3-2 TUFLOW MODEL SCHEMATISATION – DEVELOPED CONDITIONS

## 4 Results

The model was run for the range of flood events including the 5%, 1%, 0.5%, 0.2% AEP and Probable Maximum Flood (PMF) events for both existing and developed conditions. Gridded results of flood depths, water levels, hazards, and velocities were post-processed from the TUFLOW raw outputs for all modelled scenarios. The full suite of maps for existing and design scenarios can be found in Appendix B.

### 4.1 1% AEP Results – Existing Conditions

#### 4.1.1 Flooding Behaviour

The Subject Lot occupies a localised high point relative to the surrounding terrain and the broader catchment area. This elevated position means that inundation on the Subject Lot primarily originates from local rainfall. Rainfall on the Subject Lot tends to collect in minor depressions before flowing towards the south-west towards Paper Forest Creek, eventually merging with the main watercourse.

Burkes Creek defines the northern border of the Subject Lot, and significant depths and flows are within the creek banks. The creek itself is very incised, where the depths up to 8 metres are confined to the creek bank, having minimal impact on flood depths within the Subject Lot.

Water exits the Subject Lot with velocities reaching up to 0.7 m/s, flowing southwest towards Paper Forest Creek. While hazard levels on the Subject Lot are generally low (H1), a significant hazard (up to H5) is present within the minor dam on the west of the Subject Lot.

Unlike Burkes Creek, Paper Forest Creek is less defined with a relatively wide flow path where the creeks cross-sectional area is inadequate in sufficiently conveying flows, with embankments of the creek overtopping between Zadows Road to Creasys Road. The flow path does not impact the Subject Lot, however, does impact potential access routes, as discussed below in Section 5.1.

Flood depths for the 1% AEP storm are displayed in Figure 4-1.

#### 4.1.2 Flood Function

Given the rural nature of the catchment, and based on previous criteria applied to similar catchments in NSW the flood function for all events were determined using the following criteria for the 1% AEP event:

- **Floodway:** Hazard ( $V \times D$ ) greater than  $0.25 \text{ m}^2/\text{s}$  and velocity  $> 0.25 \text{ m/s}$  OR Velocity  $> 1 \text{ m/s}$
- **Flood Storage:** Area outside of the floodway which exceed 0.5 metres in depth.
- **Flood Fringe:** Remainder of the flood extent for depths exceeding 10mm and less than 0.5 metres. Removal of islands and some manual smoothing adopted.

Results of the flood function analysis for the 1% AEP event (as shown in Figure 4-2) show that the BESS footprint lies outside of the floodway, flood storage, and flood fringe.

#### 4.1.3 Flood Planning Area

Typically, the Flood Planning Area (FPA) is developed based on the Flood Planning Level (FPL) which for most locations is based on the 1% AEP flood extent plus a freeboard of 0.5 metres.

As displayed in Figure 4-3, both the Subject Lot & the BESS Footprint are within the FPA, as such, the development must ensure that the building floor elevations are above the FPL of 269.81 m AHD. It should be noted that the suggested FPA presented as part of this assessment is considered high level and indicative only. Development of FPA's should be considered as part of a wider flood study.



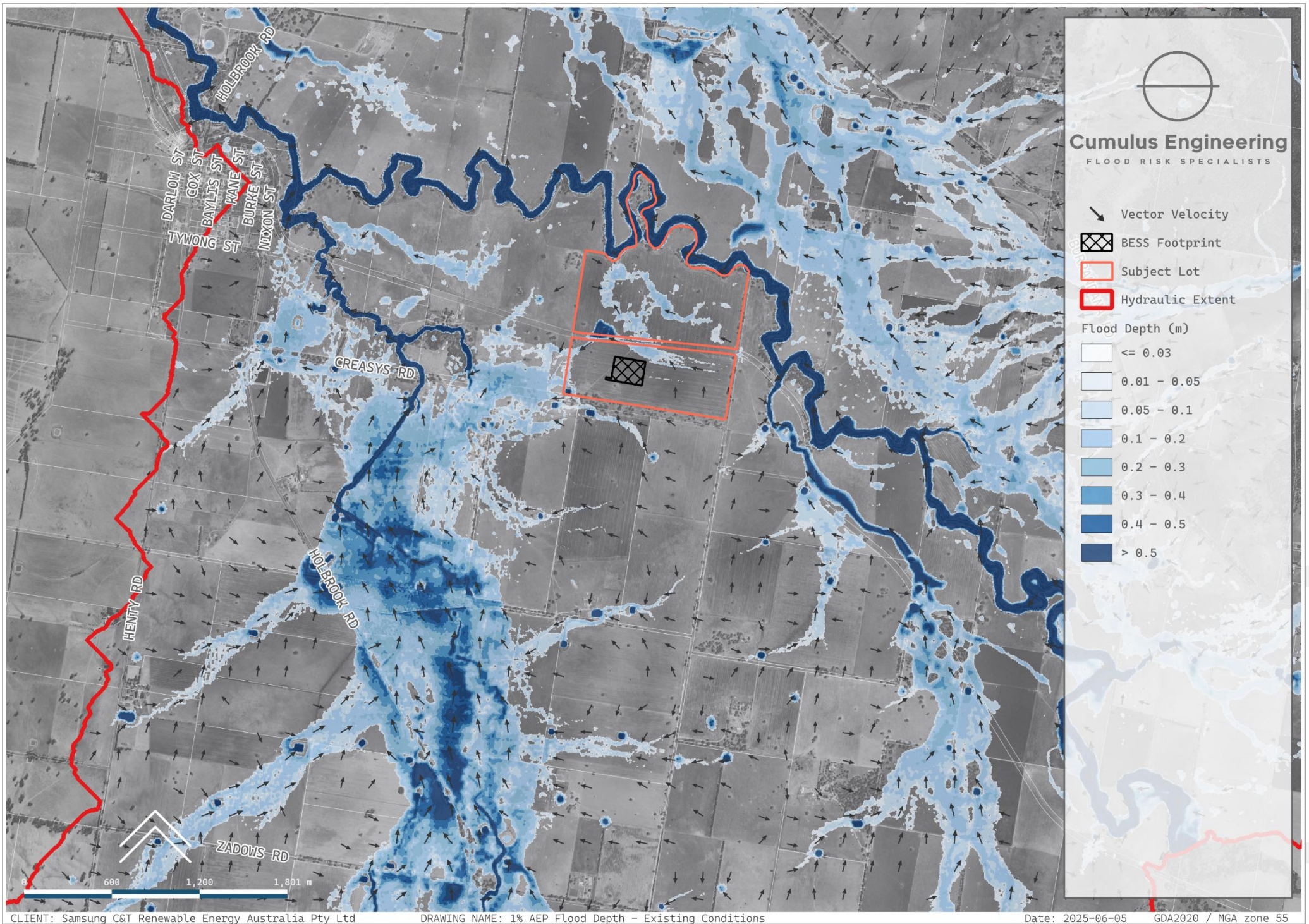


FIGURE 4-1 1% AEP FLOOD DEPTH - EXISTING CONDITION



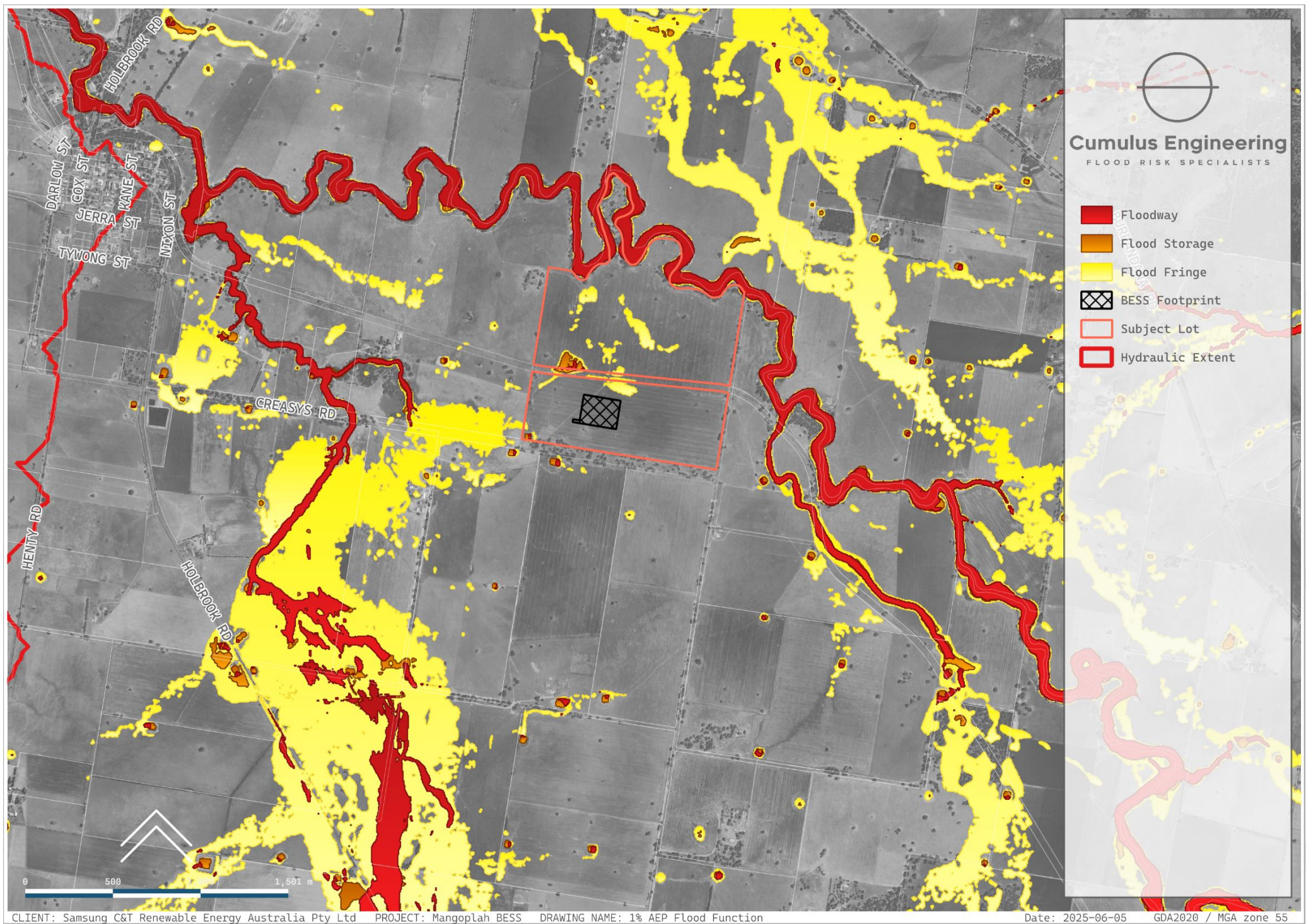
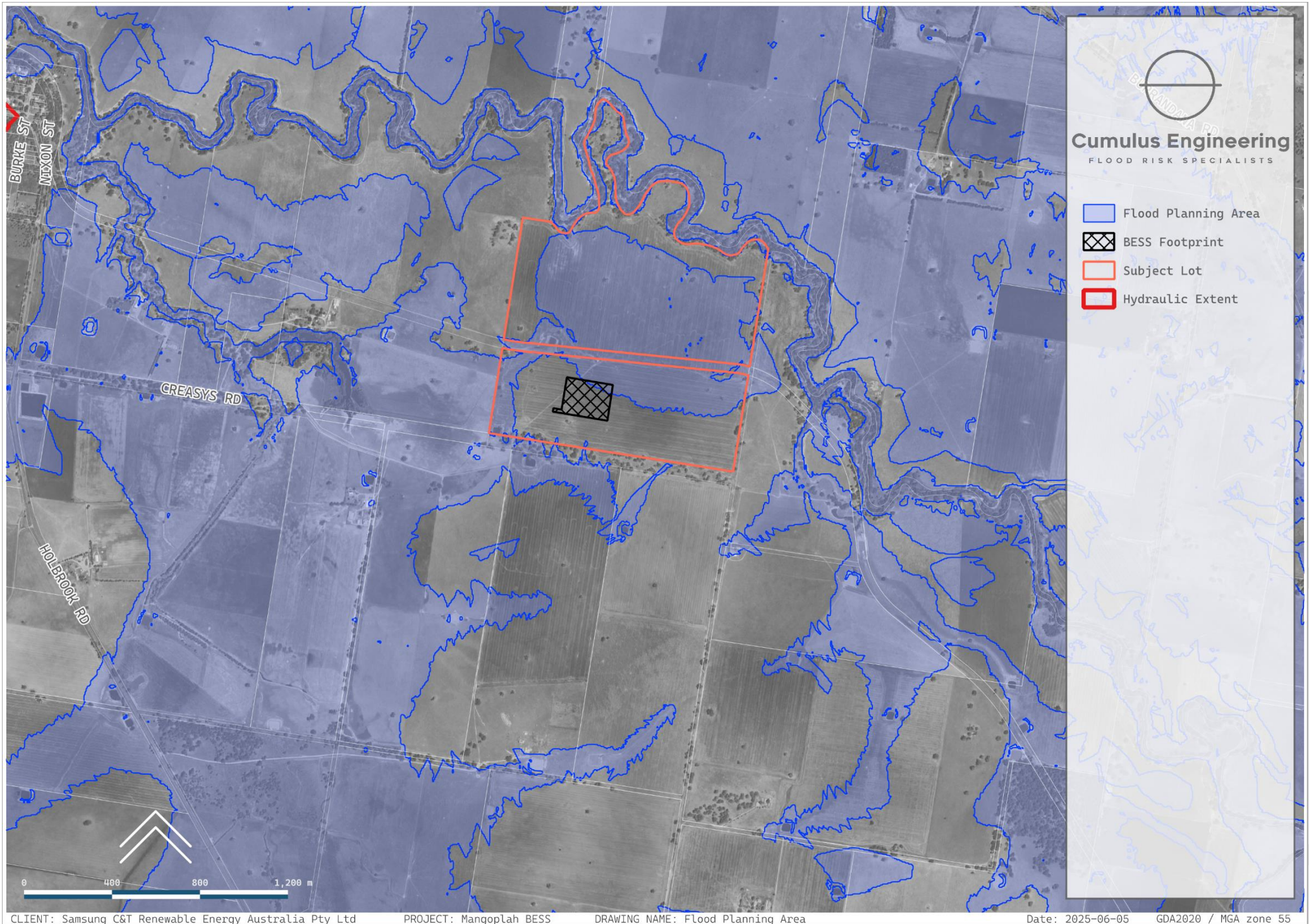


FIGURE 4-2 1% AEP FLOOD FUNCTION





**FIGURE 4-3 FLOOD PLANNING AREA**

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## 4.2 1% AEP Results – Developed Conditions

An analysis of 1% AEP flood behaviour under developed conditions indicates the proposed development will have a minimal impact on existing flood patterns and characteristics. Within the Subject Lot, maximum flood depths, hazard levels, and flow velocities are shown to remain consistent with those detailed for the existing, pre-development conditions (refer to Section 4.1.1 for existing conditions flood behaviour).

The modelling identifies that the appreciable changes in flood behaviour between the existing and developed scenarios are localised to the BESS Footprint. These changes are attributable to the increase in ground elevation for BESS infrastructure.

While floodwaters across the Subject Lot can reach depths of up to 1 metre, the BESS Footprint is shown to experience minimal inundation. This reduced flood risk is due to its position on a ridge, preventing localised rainfall from pooling. In addition, natural flow paths effectively channel water away from this area, alleviating potential for any meaningful ponding. Modelling for the BESS Footprint predicts negligible flood depths, not exceeding 12 mm, with correspondingly low hazard levels and velocities.

The overall flood behaviour of the Subject Lot remains largely unchanged. Hydraulic modelling shows no evidence of any new or adverse flood impacts outside of the BESS Footprint including no measurable increase in flood levels, depths, or detrimental changes to flow behaviour on adjacent properties or within the wider catchment downstream of the Subject Lot. Hazard levels on the BESS Footprint remain low (H1), and a minor pocket of depths up to 30 mm, indicating conditions on BESS Footprint are generally safe for people, vehicles, and infrastructure. As such, no detailed design solutions for the BESS footprint are needed.

Flood depths for the 1% AEP storm are displayed in Figure 4-4, a flood height comparison between existing and developed conditions for the 1% AEP storm is displayed in Figure 4-5.



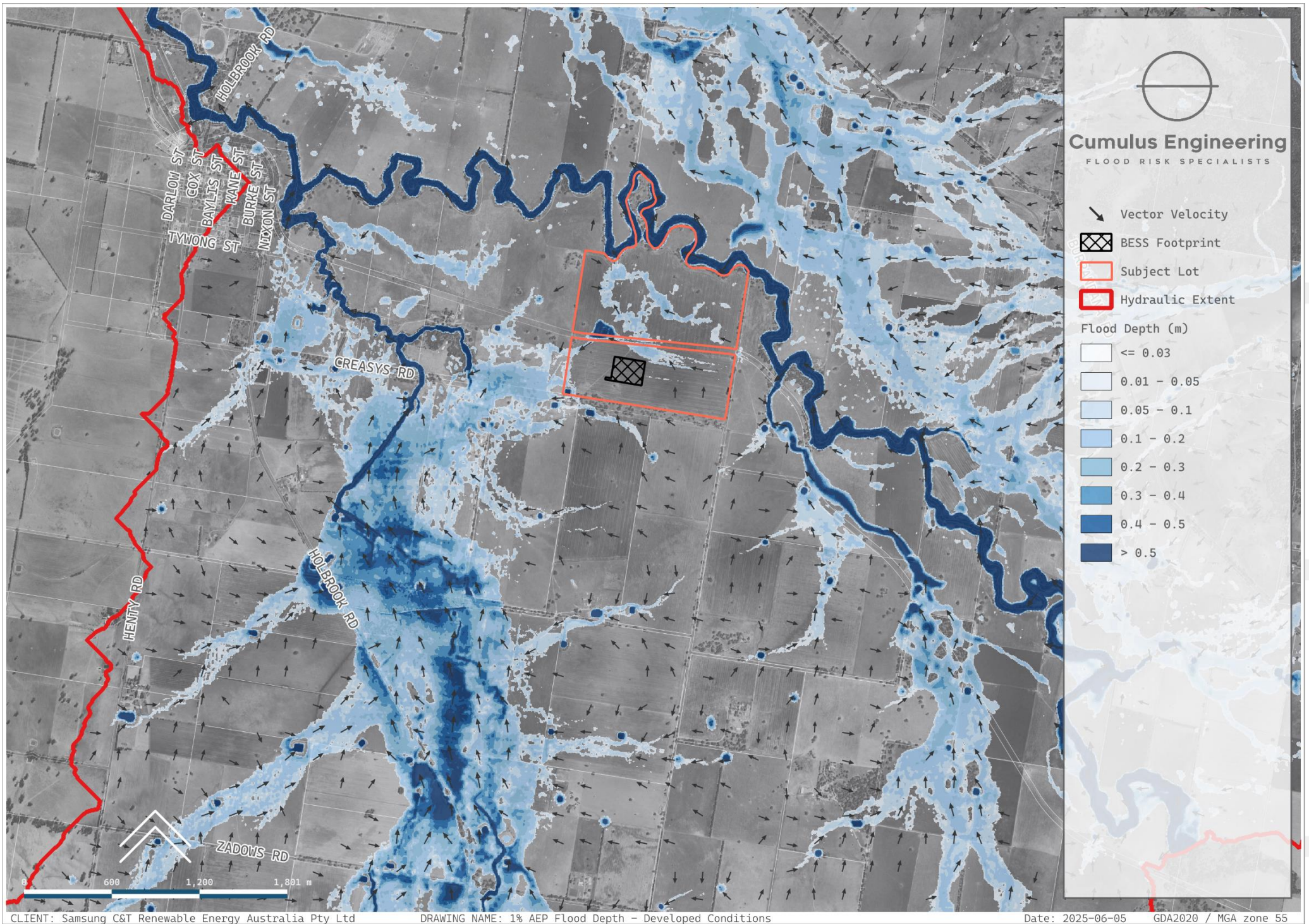


FIGURE 4-4 1% AEP FLOOD DEPTH - DEVELOPED CONDITIONS





**FIGURE 4-5 1% AEP AFFLUX**  
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### 4.3 Impacts on Flood Behaviour

As per Requirement 10 of advice received from BCS regarding the Environmental impacts Statement, the impacts of the proposed development on flood behaviour are outlined in Table 4-1.

TABLE 4-1 IMPACT OF THE DEVELOPMENT ON FLOOD BEHAVIOUR

| Requirement                                                                                                                                                                       | Response                                                                                                                                                                                                                                                                                                              | Requirement Met? |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Are there detrimental increases in the potential flood affectation of other properties, assets, and infrastructure?</b>                                                        | A comparison of modelled flood levels between existing and developed conditions indicates that any afflux is negligible and entirely confined within the BESS Footprint boundary for all simulated events. The modelling shows no adverse off-site flood impacts resulting from the development.                      | ✓                |
| <b>Is the development consistent with Council floodplain risk management plans</b>                                                                                                | Access Route B provides an adequate evacuation route, and the development meets the objectives by facilitating safe egress during a 1% AEP flood event. The development does not cause adverse flood impacts and does not result in unreasonable additional flood risk to the township and the wider floodplain.      | ✓                |
| <b>Is the development consistent with Rural Floodplain Management Plans.</b>                                                                                                      | No local floodplain management plan was found as the Subject Lot is not located within an active floodplain adjacent or adjacent to major waterways or tributaries.                                                                                                                                                   | ✓                |
| <b>Is the development compatible with flood hazard of the land?</b>                                                                                                               | AEMI Hazard Category of H4 are located within the Subject Lot boundary, however, Flood Hazard over the BESS Footprint is AEMI hazard category of H1 (no restrictions).                                                                                                                                                | ✓                |
| <b>Is the development compatible with the hydraulic functions of flow conveyance in floodways and storage in flood storage areas of the land.</b>                                 | The proposed BESS Footprint is located outside the floodway. The BESS Footprint is primarily impacted by local rainfall and will therefore has no effect on the function of the broader floodplain.                                                                                                                   | ✓                |
| <b>Will there be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site</b>                                             | Analysis of the results indicates that the development will have a negligible impact on key flood characteristics, such as the frequency, depth, and duration of inundation. Any such impacts are considered minor and are predicted to be confined within the BESS Footprint boundaries.                             | ✓                |
| <b>Will there be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses</b>          | The development has negligible impact on flood behaviour. While there are two watercourses in close proximity, the Subject Lot has no contribution to Burkes Creek, and the development has no impact on receiving flows to Paper Forest Creek.                                                                       | ✓                |
| <b>Will the development have any impacts on existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council</b> | The development will have minimal impacts on existing community emergency management arrangements for flooding due to the geographical location of the site outside of any existing emergency management arrangements as well as the minimal flood impacts due to the development.                                    | ✓                |
| <b>Does the project incorporate specific measures to manage risk to life from flood.</b>                                                                                          | The development is situated outside the floodway. The fill pad and internal access track will be raised sufficiently with adequate freeboard to ensure no local ponding or inundation of infrastructure. Additionally, with adequate design, Access Route B provides a safe access and egress route in a flood event. | ✓                |
| <b>Does the project have any impacts on the social and economic costs to the community as a consequence of flooding</b>                                                           | Flood risk for the development is low with no impacts observed in any modelled event for surrounding properties or infrastructure therefore it is not anticipated that the development will have impacts on social to economic costs in the event of a flood.                                                         | ✓                |

## 5 Flood Evacuation and Planning

### 5.1 Access Routes

To ensure safe evacuation during a flood event, two potential access routes are proposed as part of the development as illustrated in Figure 5-1. A safety analysis has been undertaken for both routes to assess their suitability for managing risk to life from flooding.

The analysis below assesses the routes under a 1% AEP event, noting that the site is isolated in events larger than the 1% AEP event, as emergency access routes are deemed unsafe in these events. It is therefore recommended that a Flood Emergency Response Plan be adopted for the site, in order to manage safe evacuation of personnel if they are located on site at the time of a significant event.

#### 5.1.1 Access Route A

Access Route A originates from the Subject Lot's southwestern corner, following an unnamed track south for approximately 1.5 km. It then turns westward, crossing Paper Forest Creek before connecting with Holbrook Road.

Hydraulic modelling of the 1% AEP event indicates that in this area, Paper Forest Creek overtops creating a wide flow path from south to north. The access track itself acts as a hydraulic control, causing water to pond upstream with flood depths reaching up to 700 mm over the track.

Furthermore, high hazard classifications (H3 – Unsafe for vehicles & the elderly) and high velocities (approximately 1 m/s) impact the access route.

#### 5.1.2 Access Route B

Access Route B commences from the Subject Lot's south-eastern corner and extends south for approximately 3.4 km along an unnamed track. It connects with Paper Forest Road, then continues west towards Zadows Road, also crossing Paper Forest Creek.

While floodwaters from Paper Forest Creek also inundate Access Route B, 1% AEP modelled depths across the track are not expected to exceed 300 mm. The route is predominantly subject to H1 hazard levels, with only minor areas experiencing H2 hazard conditions.

Although both routes cross Paper Forest Creek, Access Route B traverses a section where the creek channel is more defined, facilitating more concentrated flow within the creek itself, contrasting with the wider flow path observed at the crossing point of Access Route A. As hazard and depths are low, no further works are required to maintain this emergency Access Route B.

Additionally, Access Route B is proposed to only be utilised in the event of emergency, as directed by NSW SES. Outside of these conditions, there will not be any traffic to and from the Subject Lot along Access Route B due to the Project.

#### 5.1.3 Access Route Discussion

The initial assessment of each access route considered its current condition, as represented by the adopted topography. Access Route A is proposed as the primary access route for the site and upgrades are proposed as part of the development.

It is important to acknowledge that the operation of the BESS is proposed to be undertaken remotely, therefore there will be no physical presence of workers onsite during day-to-day operations. Consequently, during the operational phase, the risk to human life from flooding is inherently minimised as there will be no permanent on-site staff with only periodic visits by workers for essential maintenance and optimisation of the BESS. During the construction phase, a workforce of up to 60 people will be present on-site therefore temporary flood response measures should be considered.

A detailed assessment of this Route A's suitability during a flood event post-upgrade could not be completed at this stage, as specific design details for these upgrades, including finished road level elevations, road batters, and any modifications to waterway crossings, are necessary inputs for the flood model. Nevertheless, the adoption of Access Route A as the primary access to the site during day-to-day operations remains viable outside of when a flood event is occurring (i.e. for flood events



less than the 5% AEP event) with Access Route B providing an alternative emergency route during a flood event. Access Route B is only to be used in an emergency event as directed by NSW SES, providing site accessibility up to the 1% AEP event, when Access Route A is impacted by Flood Flows.

The above analysis of is considering flood events up to the 1% AEP event. Results of the 0.5%, 0.2% AEP and PMF events show that both access routes are impassable due to floodwaters for up to 39 hours. It is recommended that a flood emergency respond plan be developed for the Subject Lot and given that the BESS site is outside of the PMF Flood Extent, Shelter-In-Place measures may be an option to consider.

Peak flood depths, hazards, and velocities on each road/track for both Access Routes are displayed below in Table 5-1.

**TABLE 5-1 ACCESS ROUTE IMPACTS**

| Access Route | Road/Track        | 0.5% AEP  |                |               | 0.2% AEP  |                |               | PMF       |                |               |
|--------------|-------------------|-----------|----------------|---------------|-----------|----------------|---------------|-----------|----------------|---------------|
|              |                   | Depth (m) | Velocity (m/s) | Hazard (AEMI) | Depth (m) | Velocity (m/s) | Hazard (AEMI) | Depth (m) | Velocity (m/s) | Hazard (AEMI) |
| A            | Unnamed Track A   | 0.78      | 1.08           | 3             | 0.80      | 1.10           | 3             | 1.33      | 1.49           | 5             |
|              | Holbrook Road     | 0.40      | 0.73           | 2             | 0.41      | 0.75           | 2             | 0.58      | 0.95           | 3             |
| B            | Unnamed Track B   | 0.03      | 0.38           | 1             | 0.03      | 0.56           | 1             | 0.06      | 1.00           | 1             |
|              | Paper Forest Road | 0.32      | 0.80           | 2             | 0.35      | 0.83           | 2             | 0.82      | 1.37           | 4             |
|              | Zadows Road       | 0.55      | 0.90           | 3             | 0.58      | 0.96           | 3             | 1.04      | 1.49           | 5             |



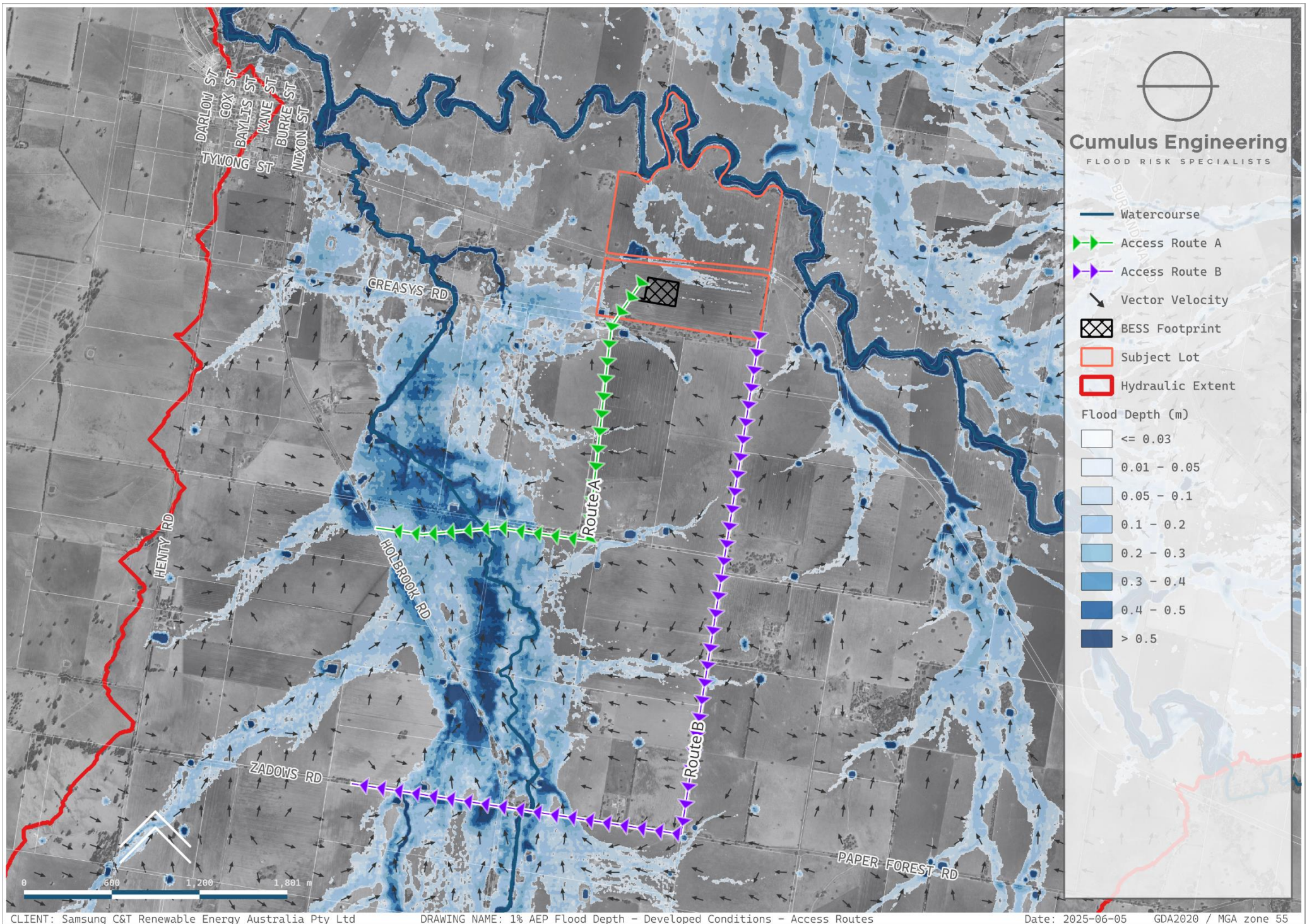


FIGURE 5-1 1% AEP FLOOD DEPTH - DEVELOPED CONDITIONS - ACCESS ROUTES



## 6 Conclusions and Recommendations

Cumulus Engineering has undertaken a Flood Impact Assessment for the proposed Mangoplah Battery Energy Storage System (BESS), located approximately 3 kilometres south-east of Mangoplah, NSW. The primary objectives of this assessment were to determine the existing flood regime in and around the Subject Lot, identify potential flood impacts resulting from the proposed development on surrounding properties and waterways, assess flood risk within the Subject Lot itself, and provide crucial flooding information to inform the development design, aiming to minimise and mitigate flood risk in line with the Secretary's Environmental Assessment Requirements (SEARS) and relevant guidelines. New hydrologic and hydraulic models were developed for this assessment to simulate the catchment for the 5%, 1%, 0.5%, 0.2% AEP and PMF events under the SSP3-7.0 climate change scenario for the year 2030.

The key findings from this investigation are summarised below

- Modelling indicates that the subject lot is outside of the floodway, and experiences low depths (< 30 mm) and hazard levels (H1). The BESS is predominantly flood free for all events including the PMF.
- Modelling shows that the proposed development does not have any meaningful impact on flood behaviour or Strahler Stream Order. There are no off-site impacts on the surrounding floodplain, downstream & neighbouring waterways. Any change in levels due to the development are contained to the subject lot.
- Access Route B (via an unnamed track to Paper Forest Road and then Zadows Road) provides safe access and egress during events up to the 1% AEP Event.
- The Subject Lot is isolated by significant flood depths and hazards for all modelled events exceeding the 1% AEP event including the 0.5%, 0.2% AEP and PMF events.
- It is recommended that a Flood Emergency Response plan be developed for construction and operation of the project.
- The development is compliant with the SEARs outlined by DCCEE, and the Environmental Impact Statement Flood Risk Management requirements have been met by the development

## 7 References

Australian Government & Engineering Australia. (2019). Australian Rainfall & Runoff. [https://www.arr-software.org/pdfs/ARR\\_190514.pdf](https://www.arr-software.org/pdfs/ARR_190514.pdf)

Department of Planning and Environment. (2023). Flood Risk Management Manual. NSW Environment and Heritage. <https://www.environment.nsw.gov.au/research-and-publications/publications-search/flood-risk-management-manual>

Department of Environment, Land, Water and Planning. (2019). Guidelines for development in flood affected areas. In Department of Environment, Land, Water and Planning [Report]. [https://www.water.vic.gov.au/\\_data/assets/pdf\\_file/0024/662325/guidelines-for-development-in-flood-affected-areas.pdf](https://www.water.vic.gov.au/_data/assets/pdf_file/0024/662325/guidelines-for-development-in-flood-affected-areas.pdf)



# Appendix A. Hydraulic Model Setup



## A1. Model Summary

A summary of the TUFLOW Model is presented in Table A 1.

**TABLE A 1**      **TUFLOW MODEL PARAMETERS**

| Model Parameter      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Model Engine         | TUFLOW HPC GPU                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Model Build          | 2025.0.2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 1D/2D time steps     | <p><i>2D Timestep</i></p> <ul style="list-style-type: none"> <li>Adaptive time step</li> </ul> <p><i>1D Timestep</i></p> <ul style="list-style-type: none"> <li>0.5 seconds</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Model Extent         | Based on delineated subareas as part of the hydrologic modelling. Subareas surrounding the Subject lot defined the model extent.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Topography           | <ul style="list-style-type: none"> <li>5 metre LiDAR captured in 2015 owned by the Commonwealth of Australia represented by Geoscience Australia*</li> <li>0.1 metre Survey captured by Fyfe in 2025, provided by Samsung C&amp;T Renewable Energy Australia Pty Ltd.</li> </ul> <p>The adopted digital elevation model is displayed in Figure A 3.</p> <p>*Note that the 5-metre LiDAR dataset was adjusted by applying a 400 mm terrain modifier to lower the overall elevations. A discrepancy between the 5 m LiDAR &amp; Survey elevations was identified. Consultation with the surveyor confirmed that the survey conducted in 2025 was developed using highly accurate survey markers, and therefore lower accurate dataset was translated to match. Levels described in this report are based upon the survey captured by Fyfe.</p> |
| Terrain Modifiers    | Terrain modifiers to represent the raised BESS platform in the developed scenario, and terrain modifiers were adopted to enforce key road crests within the model.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 2d Grid Size         | <p>Sub-Grid Sampling was adopted to better represent the underlying DEM.</p> <p>Due to the wide model extent, quadtree was also adopted, resulting in varied cell size across the model extent.</p> <ul style="list-style-type: none"> <li>5 metre cell size was adopted for the site and Paper Forest Creek, covering each of the access routes</li> <li>10 metre cell size was adopted for the area matching the 1% AEP flood extent, except for the areas of 5m cell size described above</li> <li>20 metre cell size was adopted for the remainder of the model extent.</li> </ul> <p>Varied cell size is displayed visually in Figure A 4.</p>                                                                                                                                                                                          |
| Mannings Roughness   | Standard ARR2019 values applied, detailed in Table A 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Inflow Condition     | <p><b>Boundary</b> 2D Inflow</p> <ul style="list-style-type: none"> <li><i>Local Catchment</i> – Applied Rainfall Excess Hyetographs extracted from RORB Subareas K, L, M, N, &amp; R.</li> <li><i>Riverine Inflow</i> – Applied point inflow using the inflow hydrographs provided by the RORB print point downstream of Subarea J.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Downstream Condition | <p><b>Boundary</b> HQ (water level-discharge boundary) adopting the respective terrain slope upstream of boundary location.</p> <p>Downstream boundary was positioned sufficiently downstream of the subject lot to ensure that inadequacies with the boundary condition will not have backwater impacts on the Subject Lot.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| 2d Outputs           | Depths, water levels, velocity, and hazard (AEMI)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |

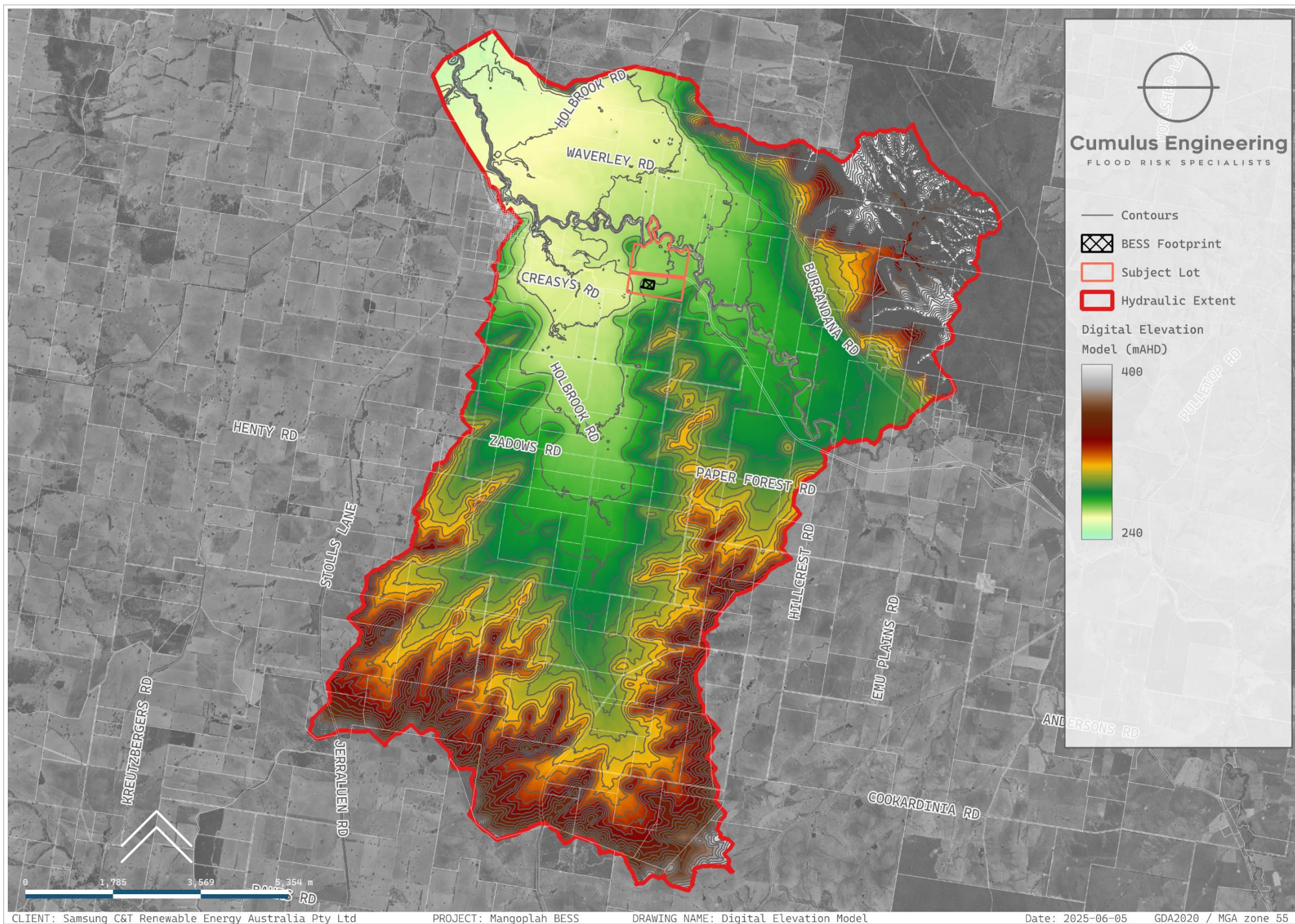


## A2. Mannings Roughness Values

Adopted manning's roughness values were based on typical values outlined in ARR2019 and detailed in Table A 2.

TABLE A 2 ADOPTED MANNING'S ROUGHNESS VALUES

| Land Use                                                                                                                             | Adopted Manning's n |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| Residential: Rural – Lower Density (When building footprints and remainder of parcel are modelled together with one roughness value) | 0.06                |
| Industrial/Commercial (Or large/significant buildings on site)                                                                       | 0.05                |
| Open Pervious Area – Minimal Vegetation                                                                                              | 0.04                |
| Open Pervious Area – Moderate Vegetation                                                                                             | 0.06                |
| Open Pervious Area – Heavy Vegetation                                                                                                | 0.10                |
| Waterway/Channel – Minimal Vegetation                                                                                                | 0.03                |
| Waterway/Channel – Moderate Vegetation                                                                                               | 0.06                |
| Waterbodies/Lakes                                                                                                                    | 0.02                |
| Driveway / Car Park / Roadway                                                                                                        | 0.03                |



**FIGURE A 3** DIGITAL ELEVATION MODEL



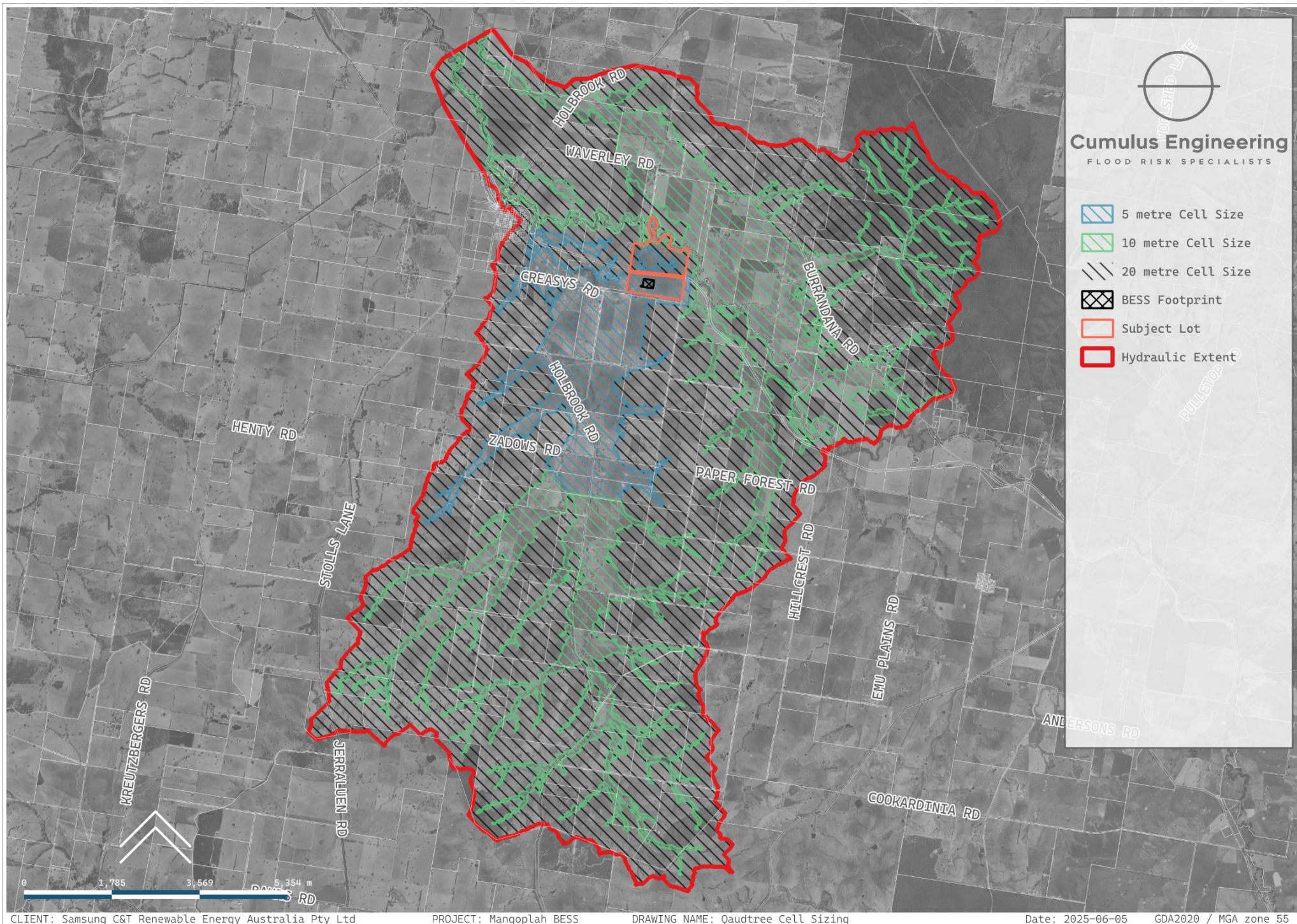


FIGURE A 4 QUADTREE CELL SIZING



# Appendix B. Flood Maps





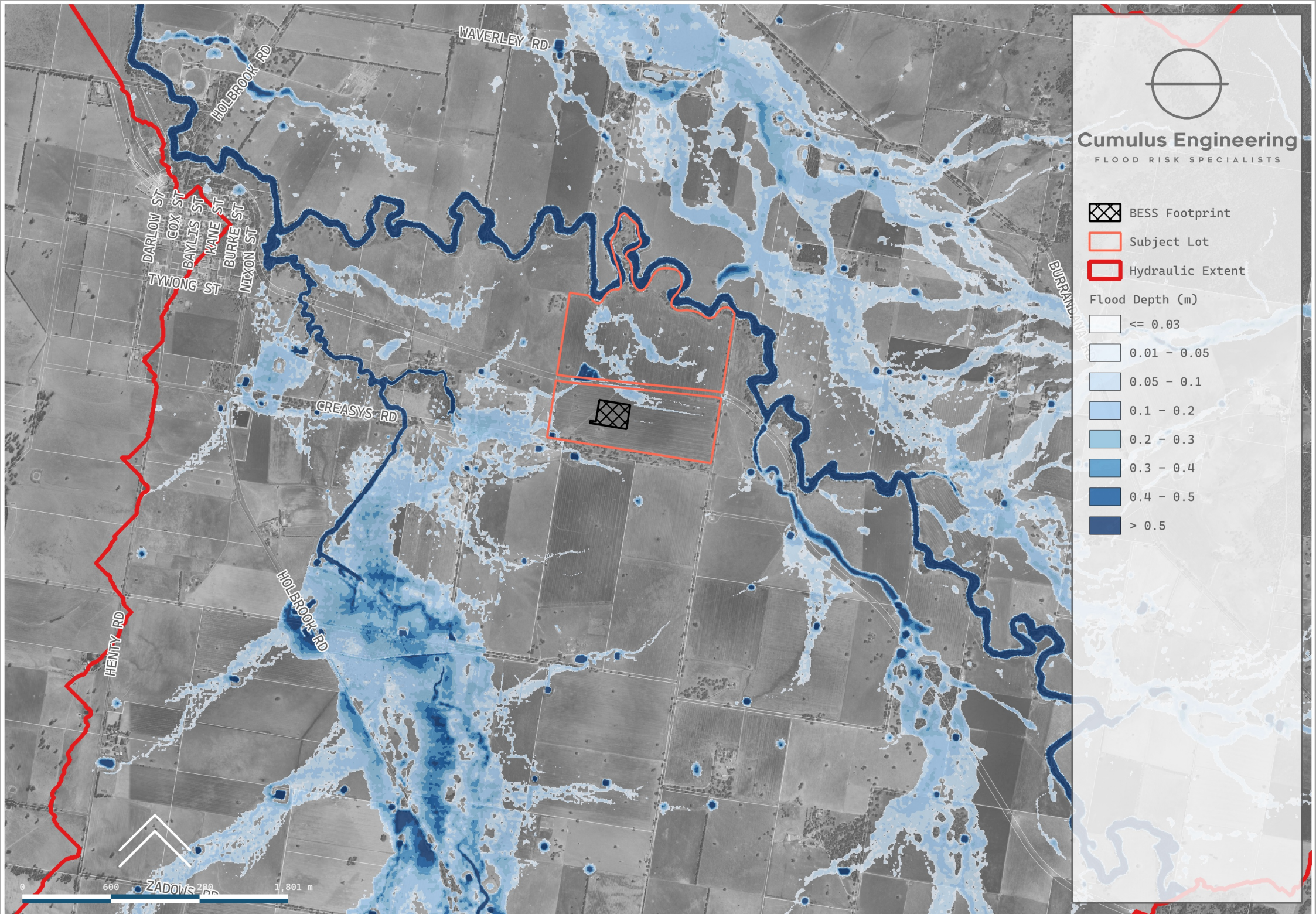


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

|                                                                                     |             |
|-------------------------------------------------------------------------------------|-------------|
|  | <= 0.03     |
|  | 0.01 - 0.05 |
|  | 0.05 - 0.1  |
|  | 0.1 - 0.2   |
|  | 0.2 - 0.3   |
|  | 0.3 - 0.4   |
|  | 0.4 - 0.5   |
|  | > 0.5       |







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

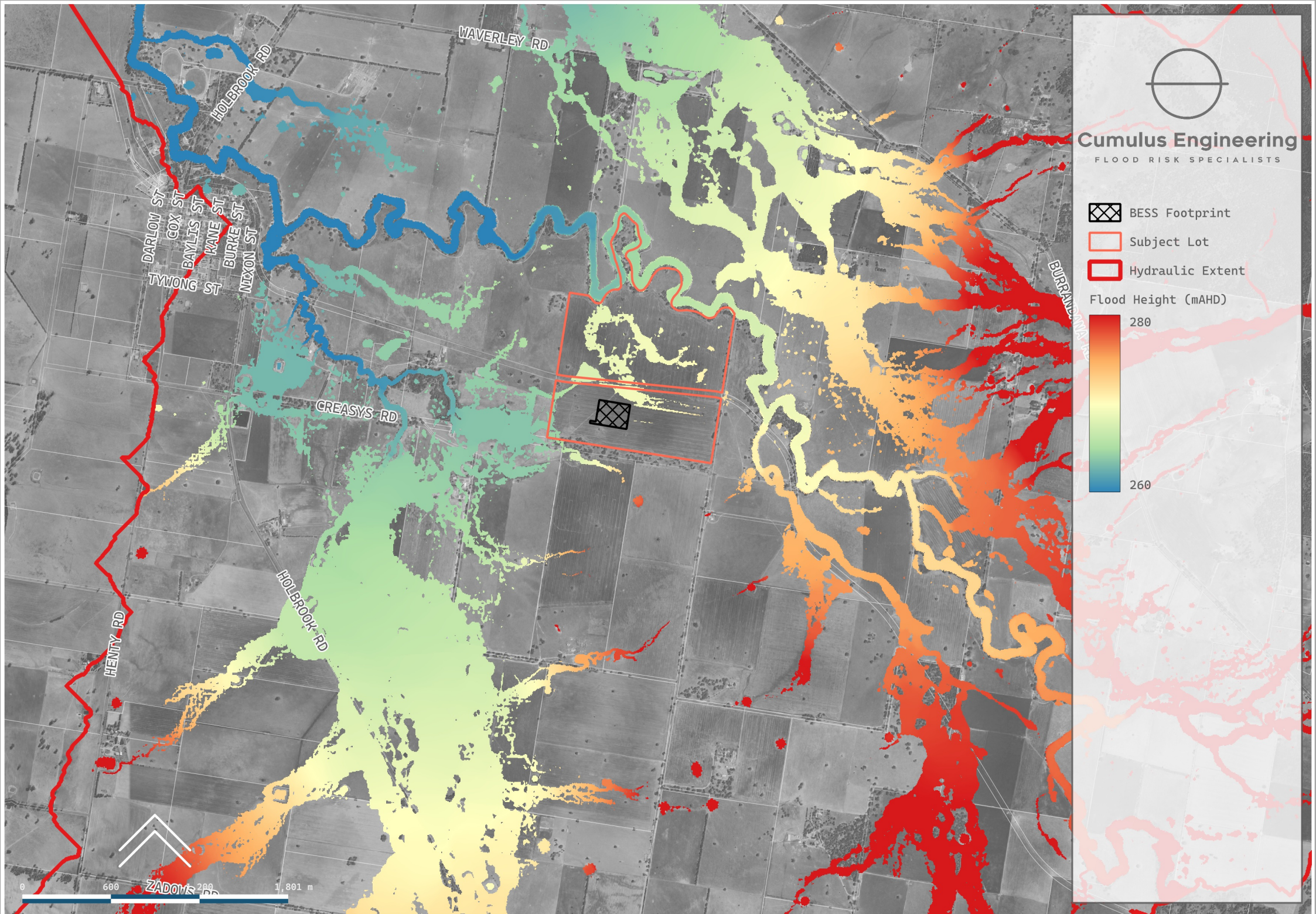


Subject Lot



Hydraulic Extent

Flood Height (mAHD)







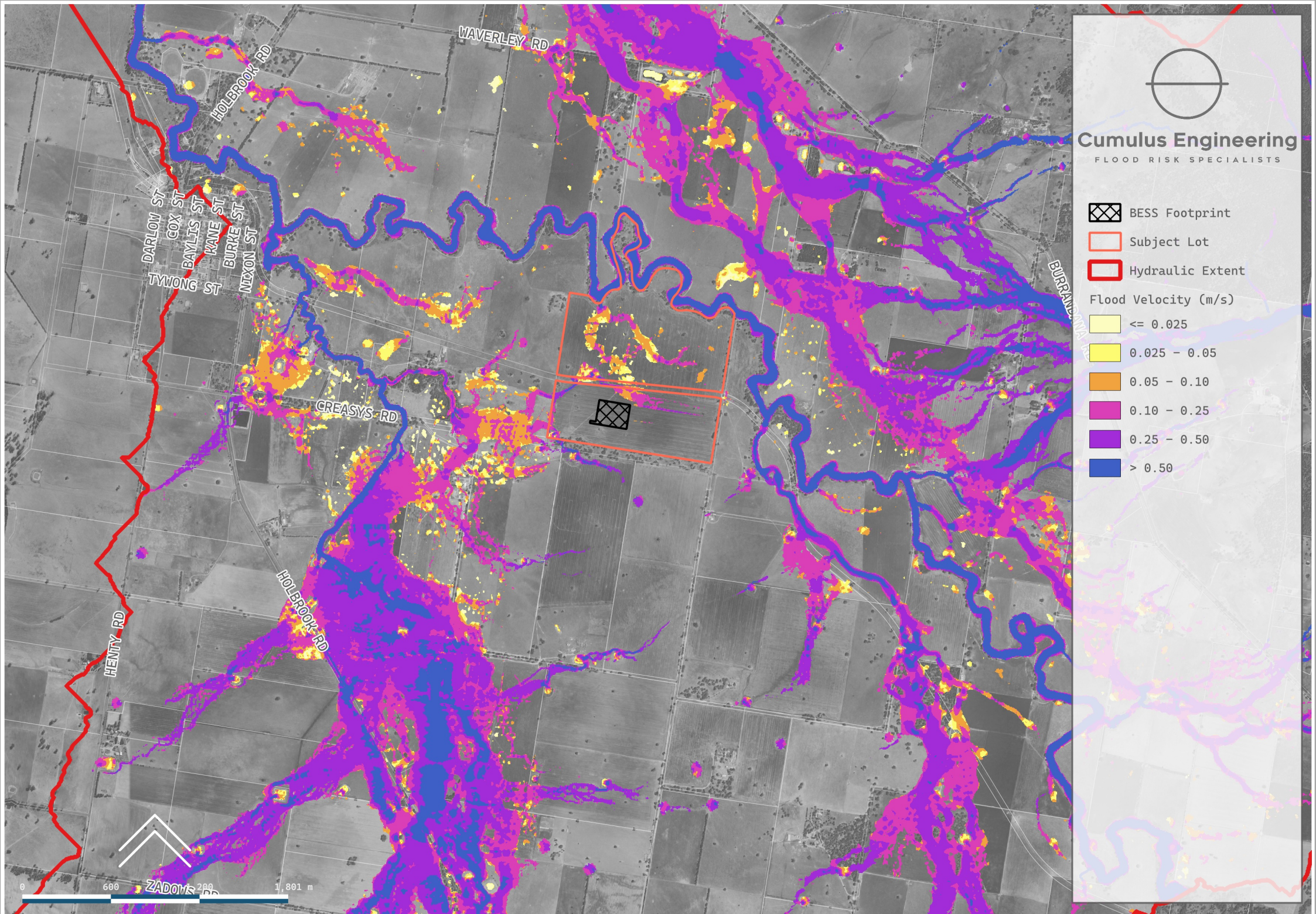
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

Flood Velocity (m/s)

- $\leq 0.025$
- $0.025 - 0.05$
- $0.05 - 0.10$
- $0.10 - 0.25$
- $0.25 - 0.50$
- $> 0.50$







**Cumulus Engineering**

FLOOD RISK SPECIALISTS

 BESS Footprint

 Subject Lot

 Hydraulic Extent

Flood Hazard Classification

 H1 - No restrictions

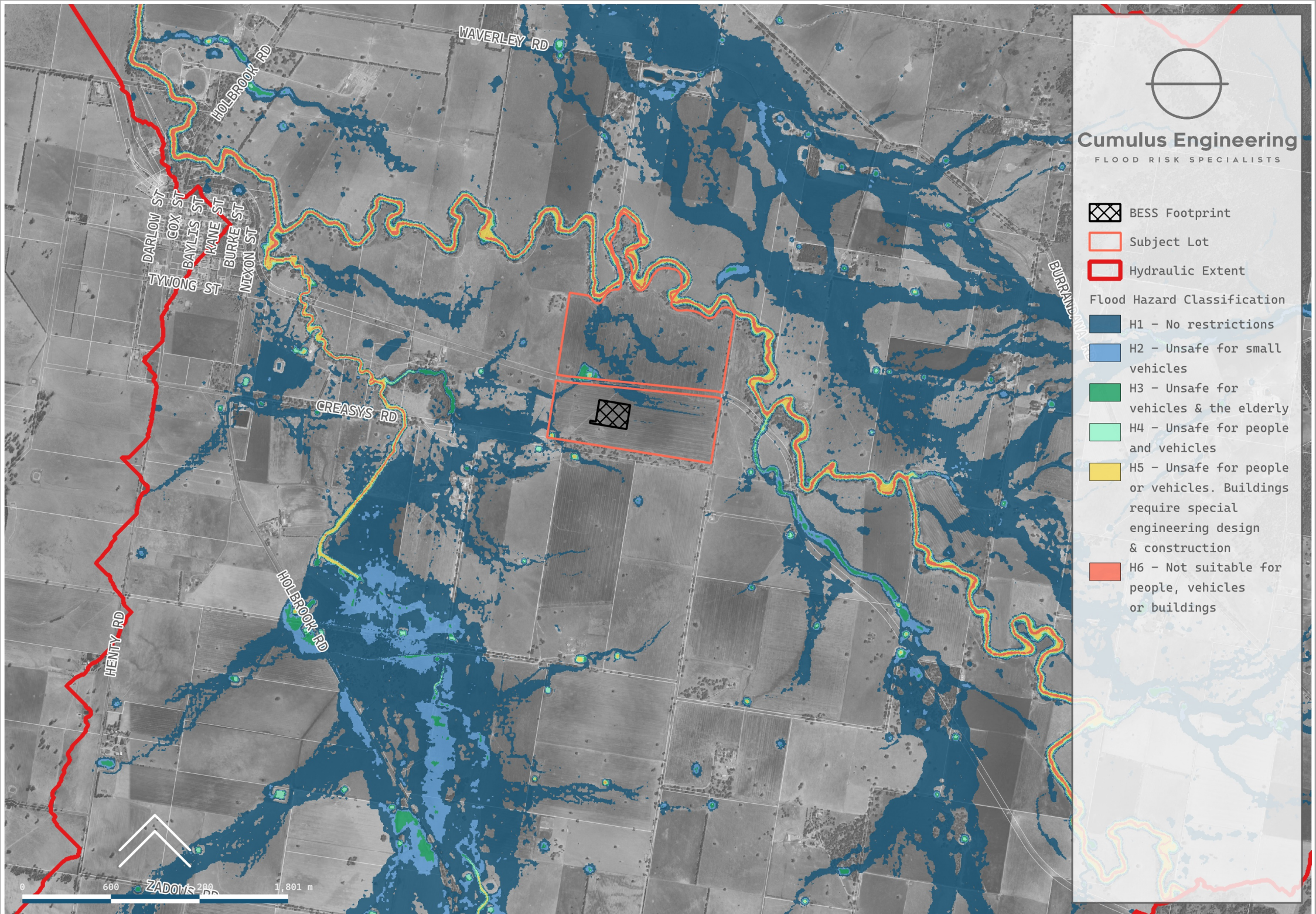
 H2 - Unsafe for small vehicles

 H3 - Unsafe for vehicles & the elderly

 H4 - Unsafe for people and vehicles

 H5 - Unsafe for people or vehicles. Buildings require special engineering design & construction

 H6 - Not suitable for people, vehicles or buildings







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FLOOD RISK SPECIALISTS



BESS Footprint



Subject Lot



Hydraulic Extent

Flood Depth (m)



$\leq 0.03$



0.01 - 0.05



0.05 - 0.1



0.1 - 0.2



0.2 - 0.3



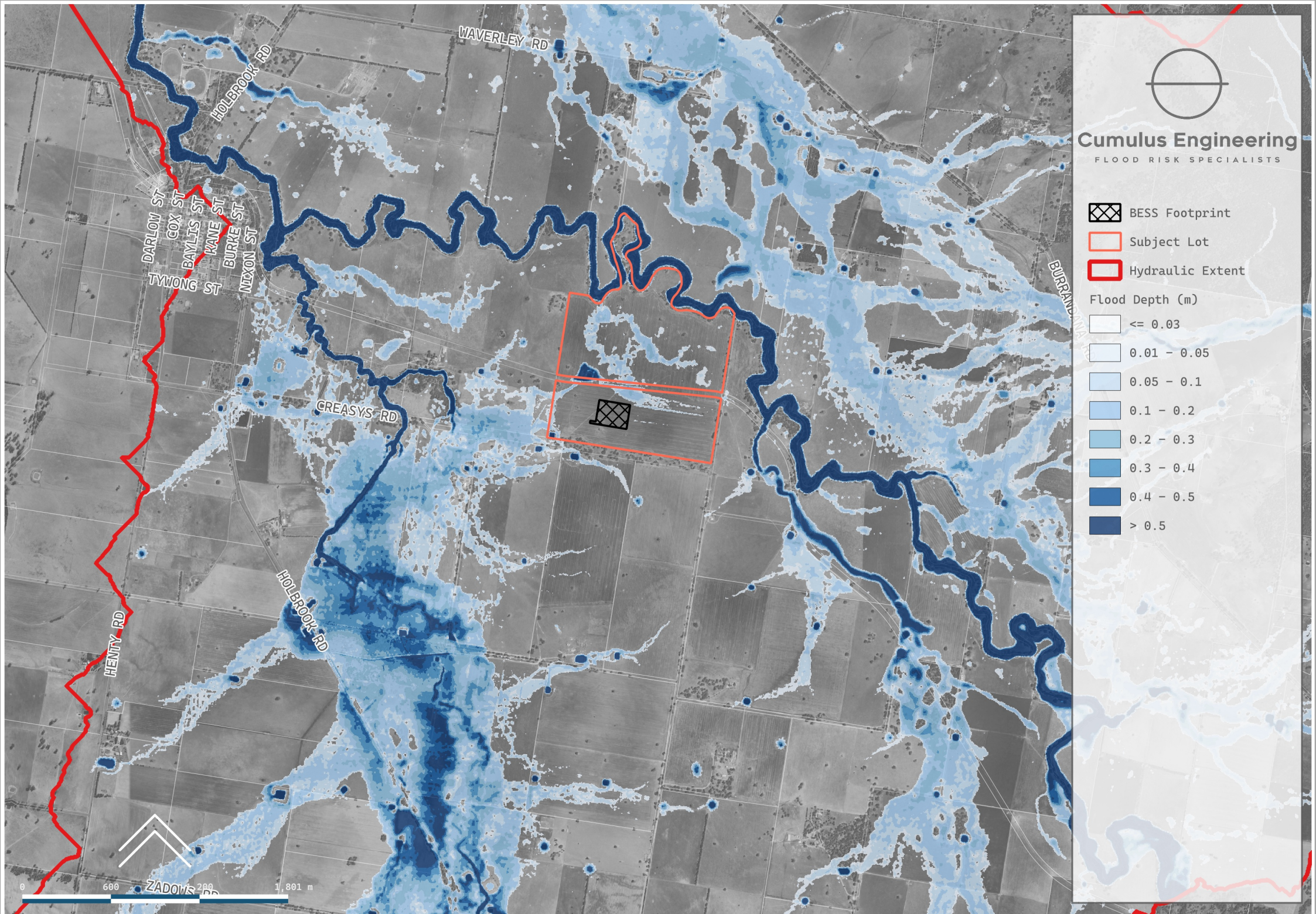
0.3 - 0.4



0.4 - 0.5



$> 0.5$







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

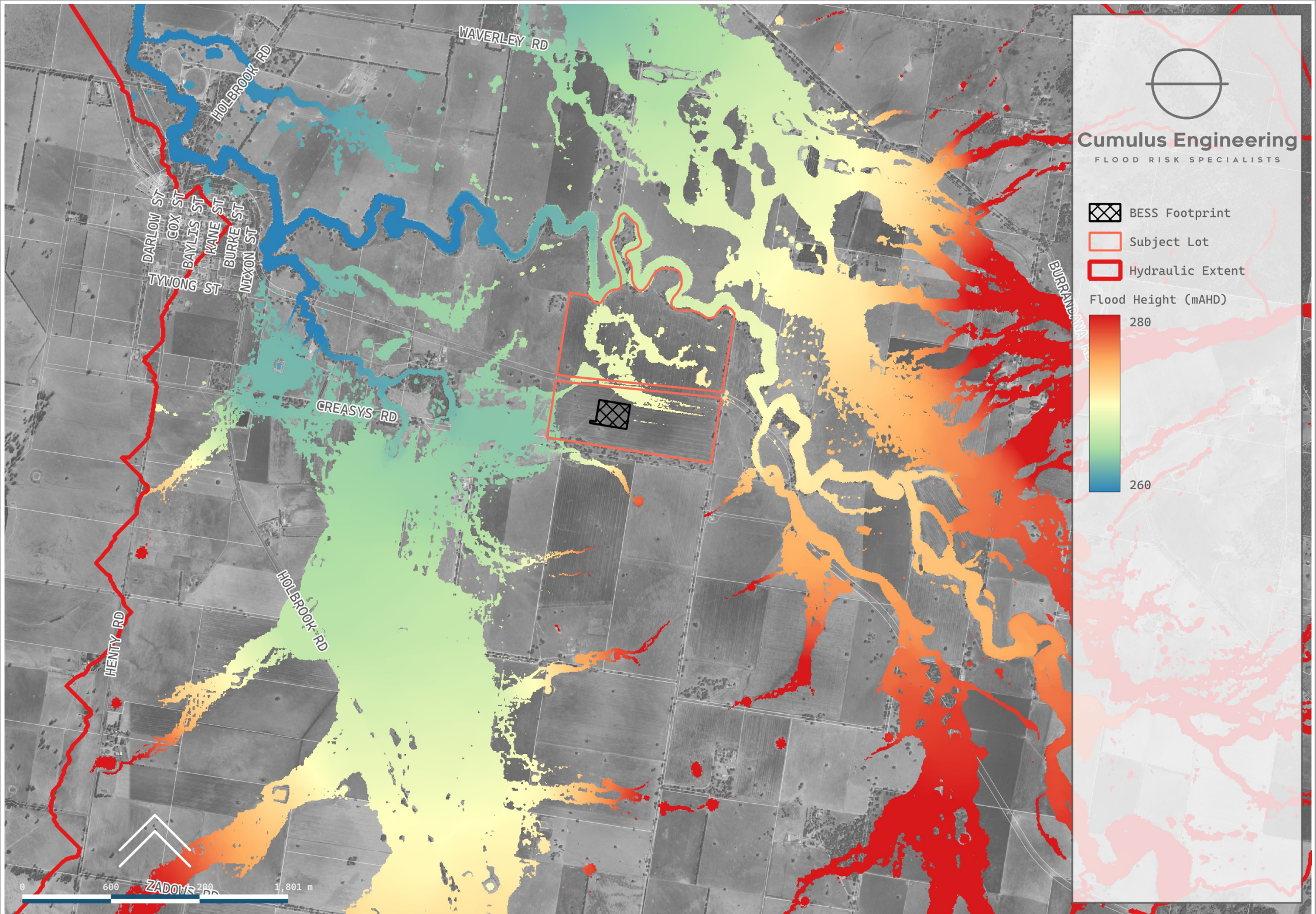
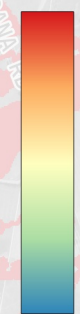


Subject Lot



Hydraulic Extent

Flood Height (mAHD)







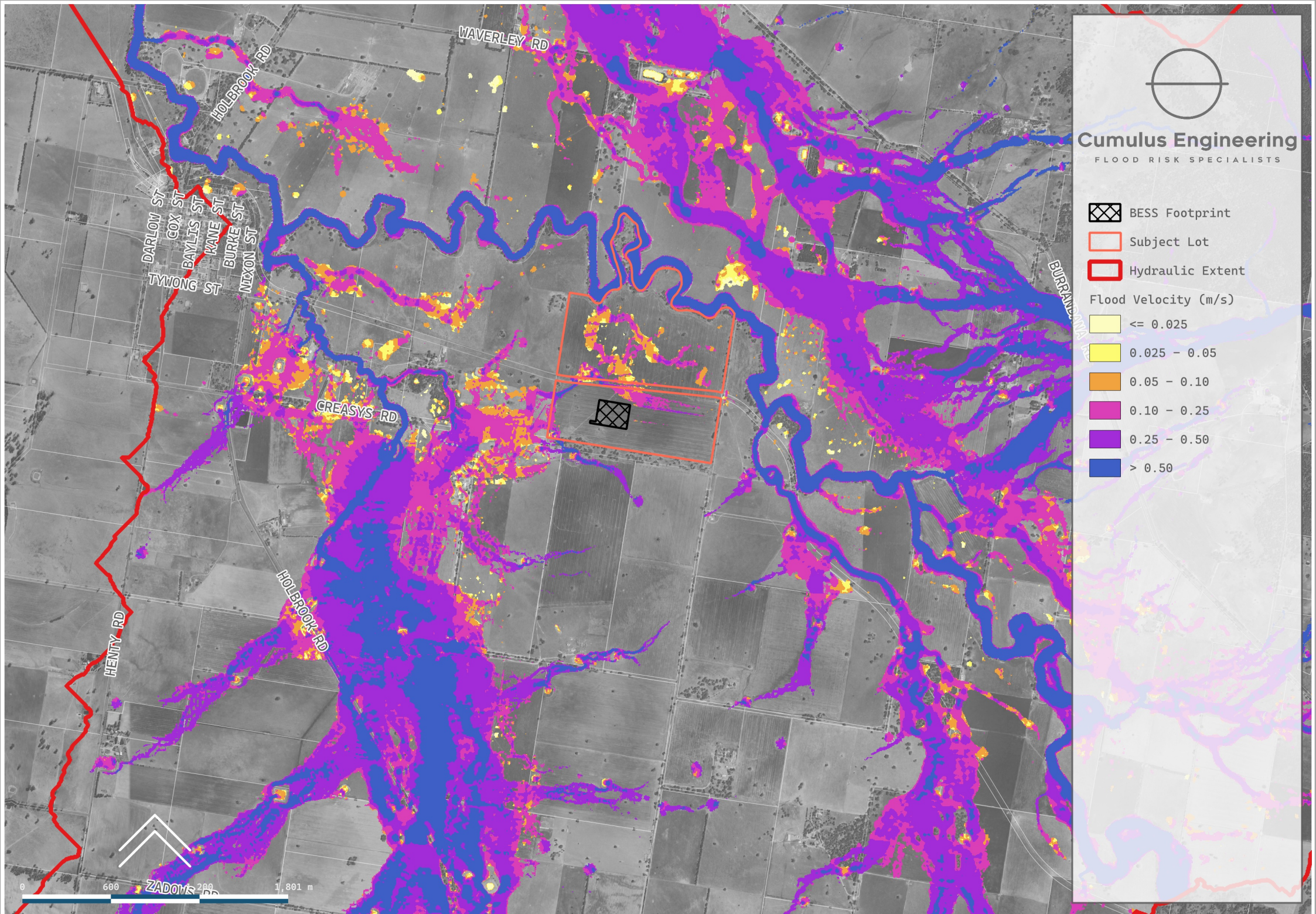
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$



0 600 1,200 1,801 m

ZADOM





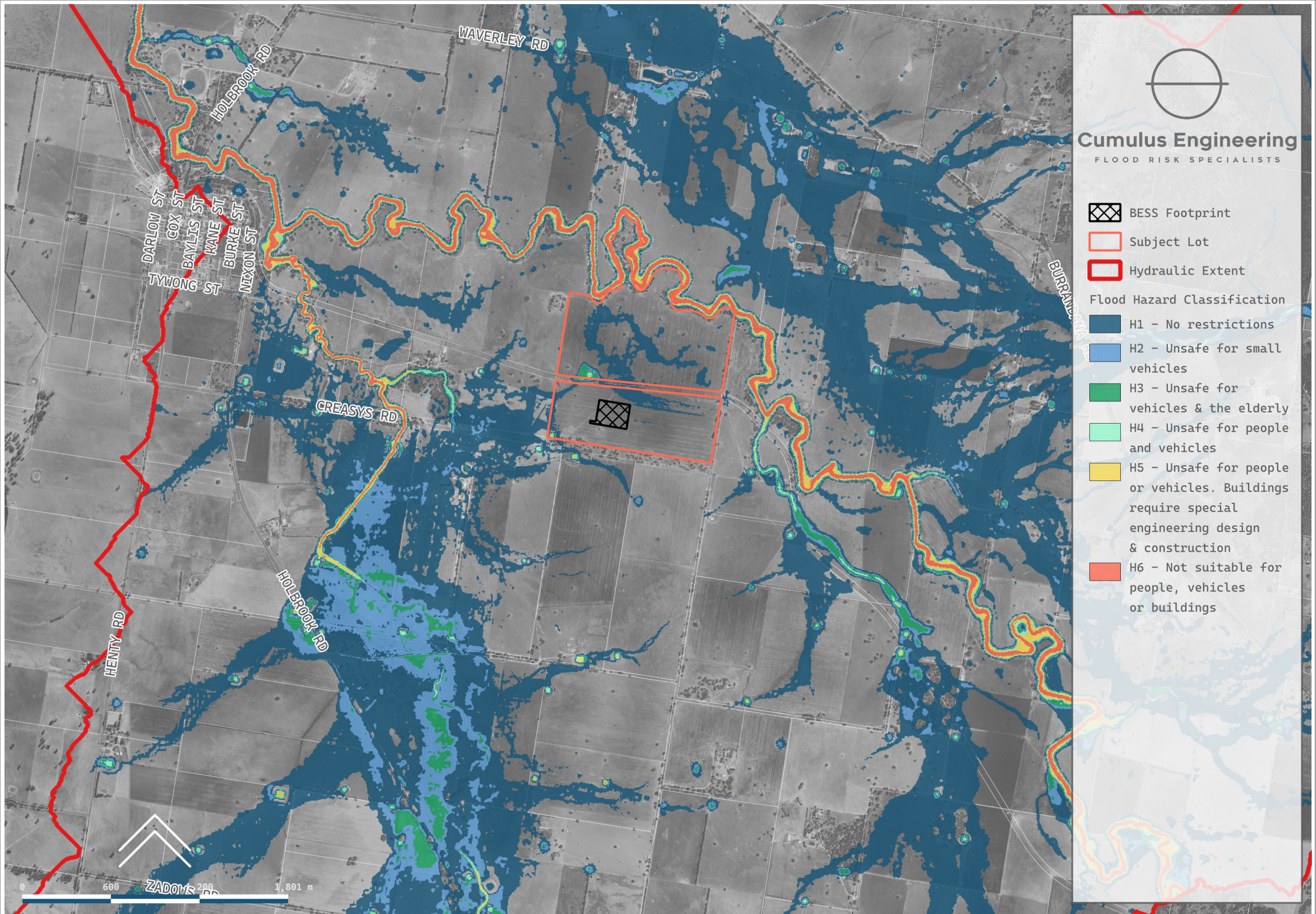
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

Flood Hazard Classification

- H1 - No restrictions
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles & the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people or vehicles. Buildings require special engineering design & construction
- H6 - Not suitable for people, vehicles or buildings



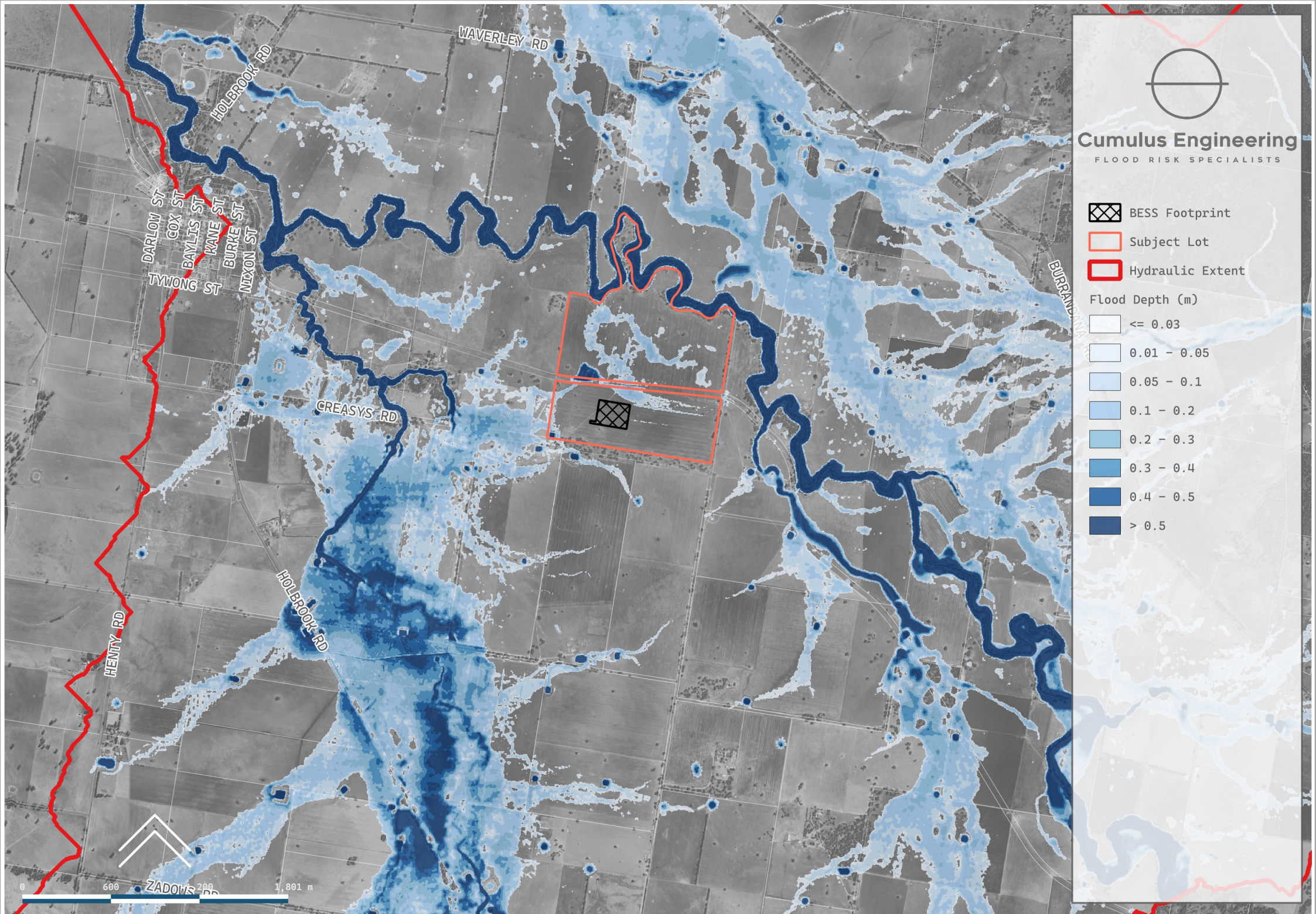




**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

- Flood Depth (m)
-   $\leq 0.03$
  -  0.01 - 0.05
  -  0.05 - 0.1
  -  0.1 - 0.2
  -  0.2 - 0.3
  -  0.3 - 0.4
  -  0.4 - 0.5
  -   $> 0.5$







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

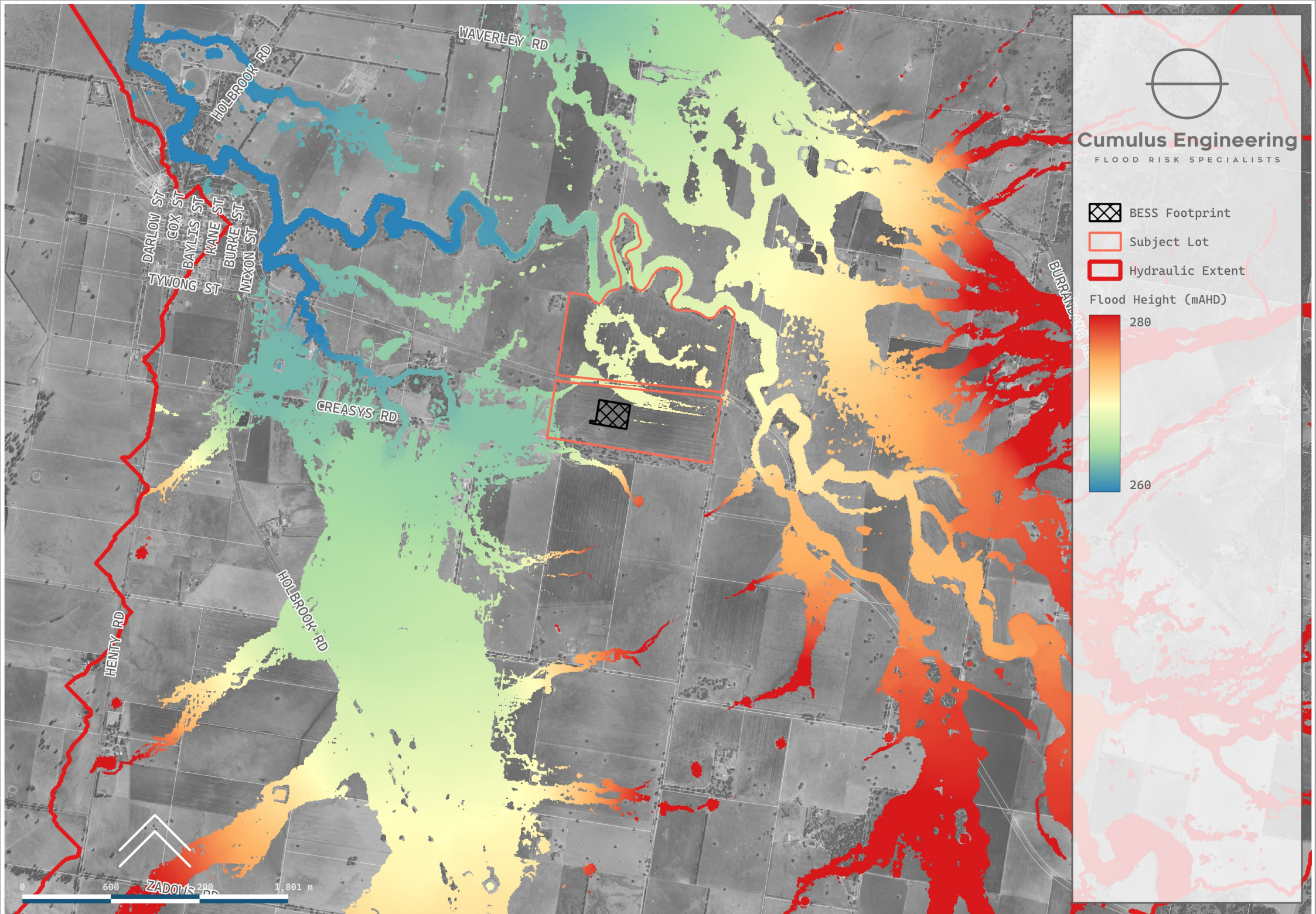


Subject Lot



Hydraulic Extent

Flood Height (mAHD)





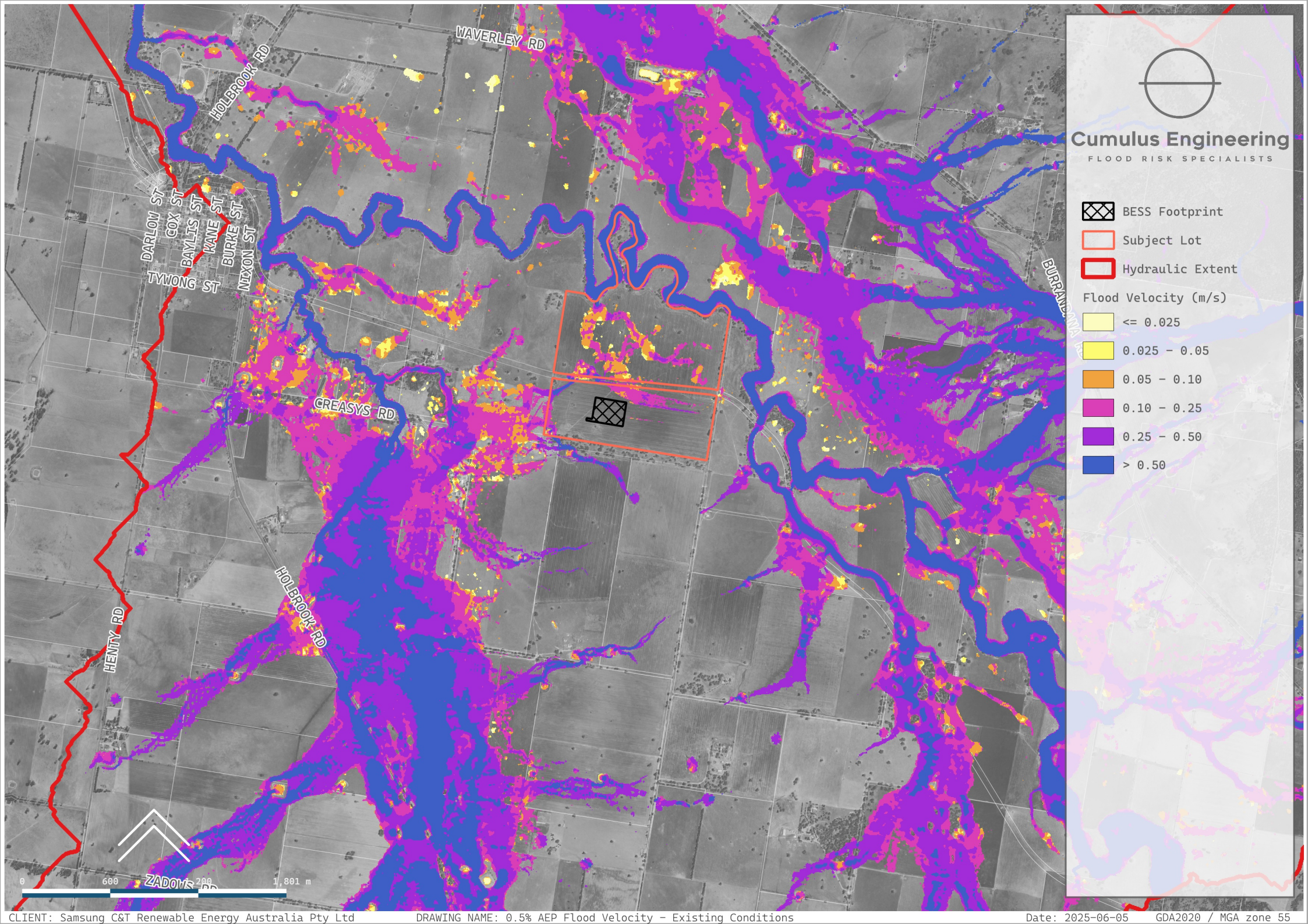


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$



0 600 1,201 m





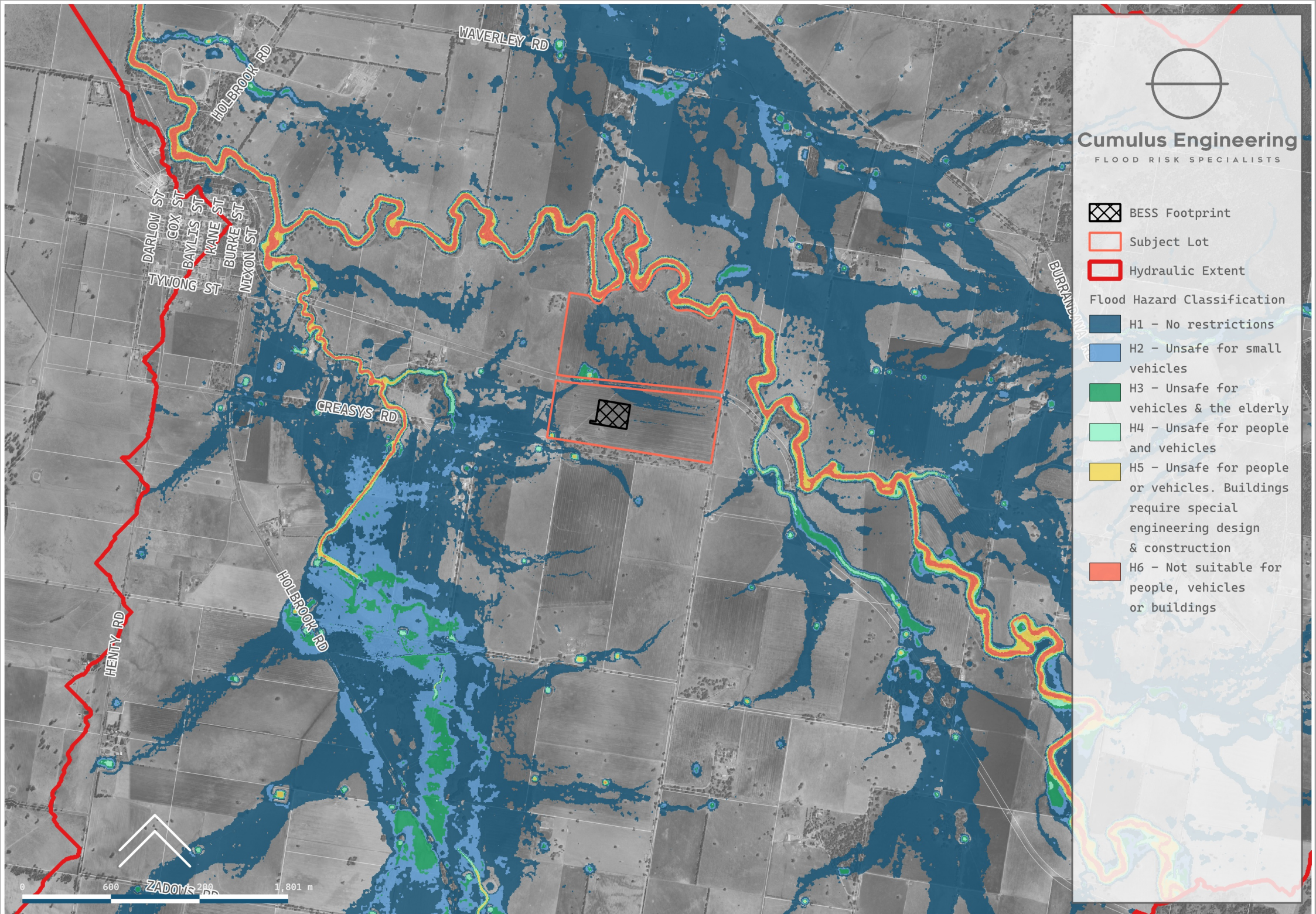
# Cumulus Engineering

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

## Flood Hazard Classification

- H1 - No restrictions
- H2 - Unsafe for small vehicles
- H3 - Unsafe for vehicles & the elderly
- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people or vehicles. Buildings require special engineering design & construction
- H6 - Not suitable for people, vehicles or buildings







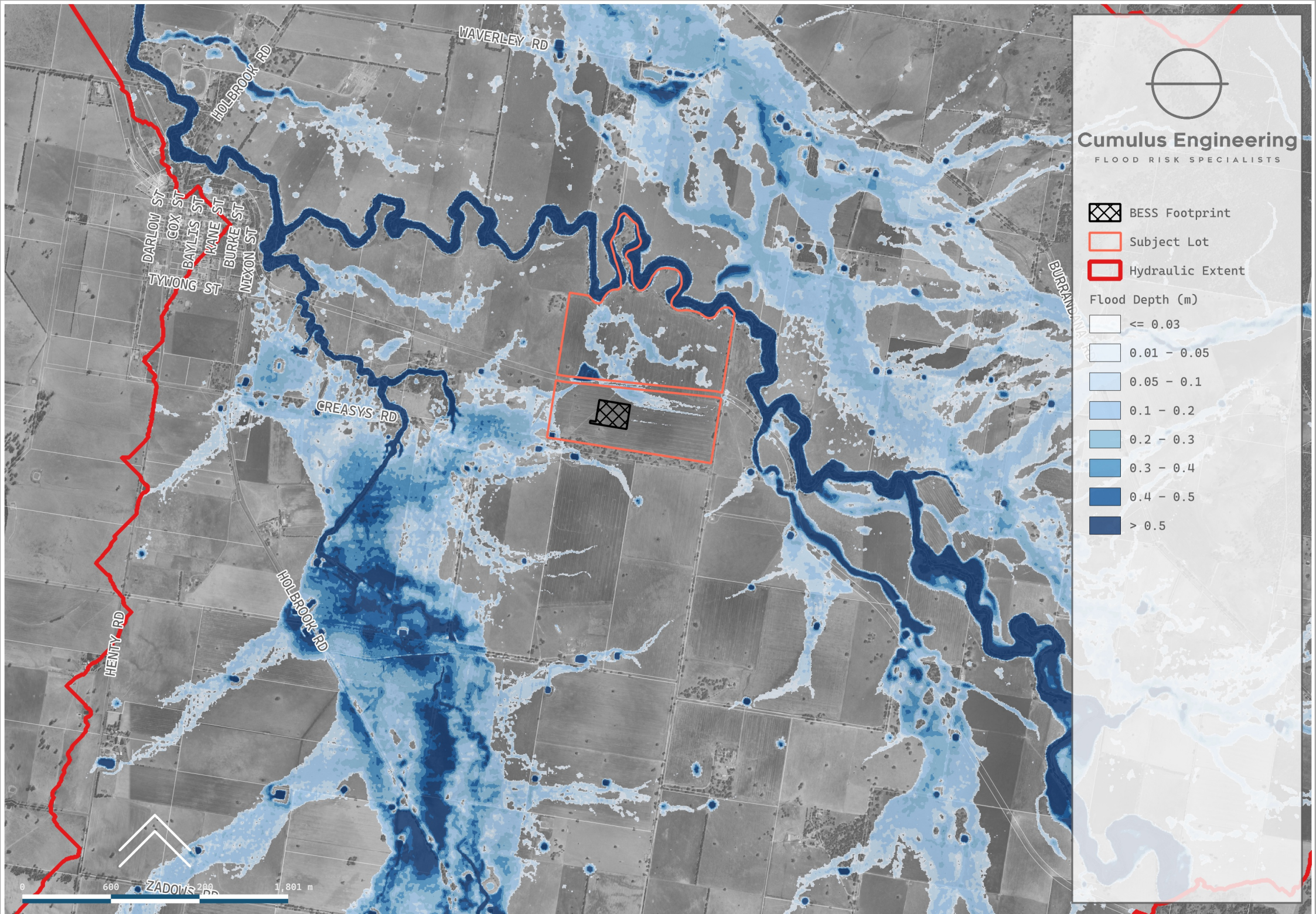
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

-   $\leq 0.03$
-  0.01 - 0.05
-  0.05 - 0.1
-  0.1 - 0.2
-  0.2 - 0.3
-  0.3 - 0.4
-  0.4 - 0.5
-   $> 0.5$







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

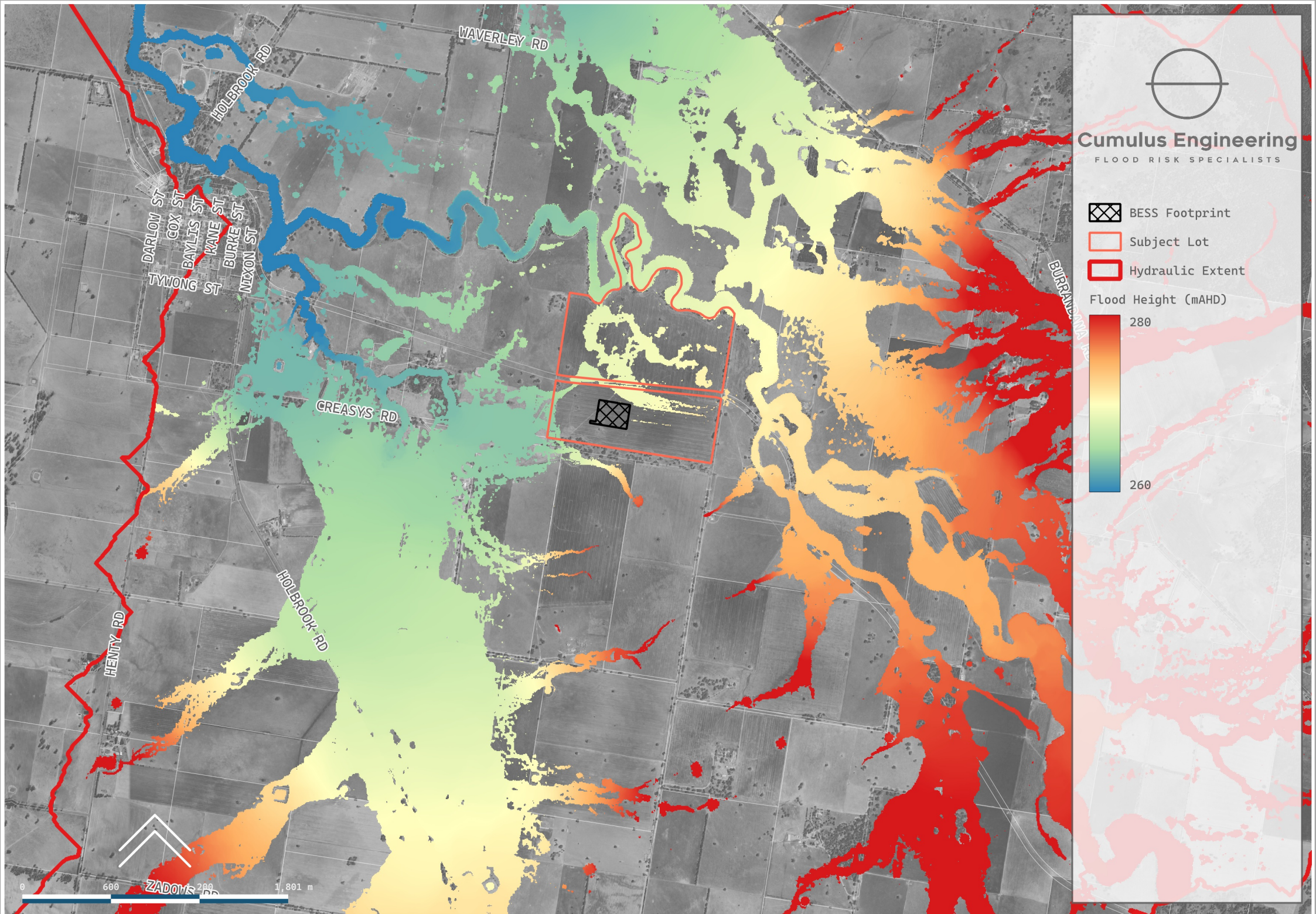


Subject Lot



Hydraulic Extent

Flood Height (mAHD)





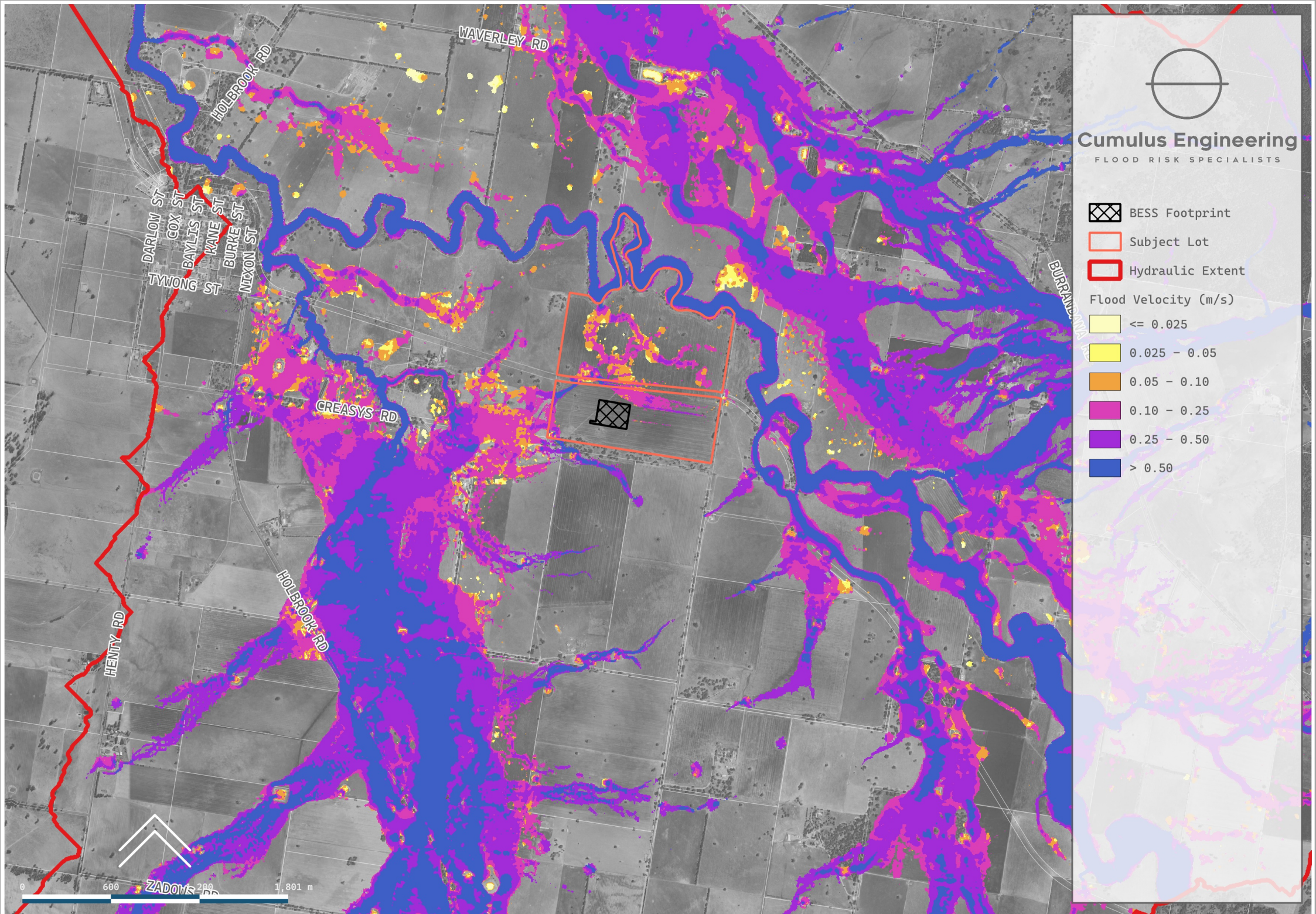


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$







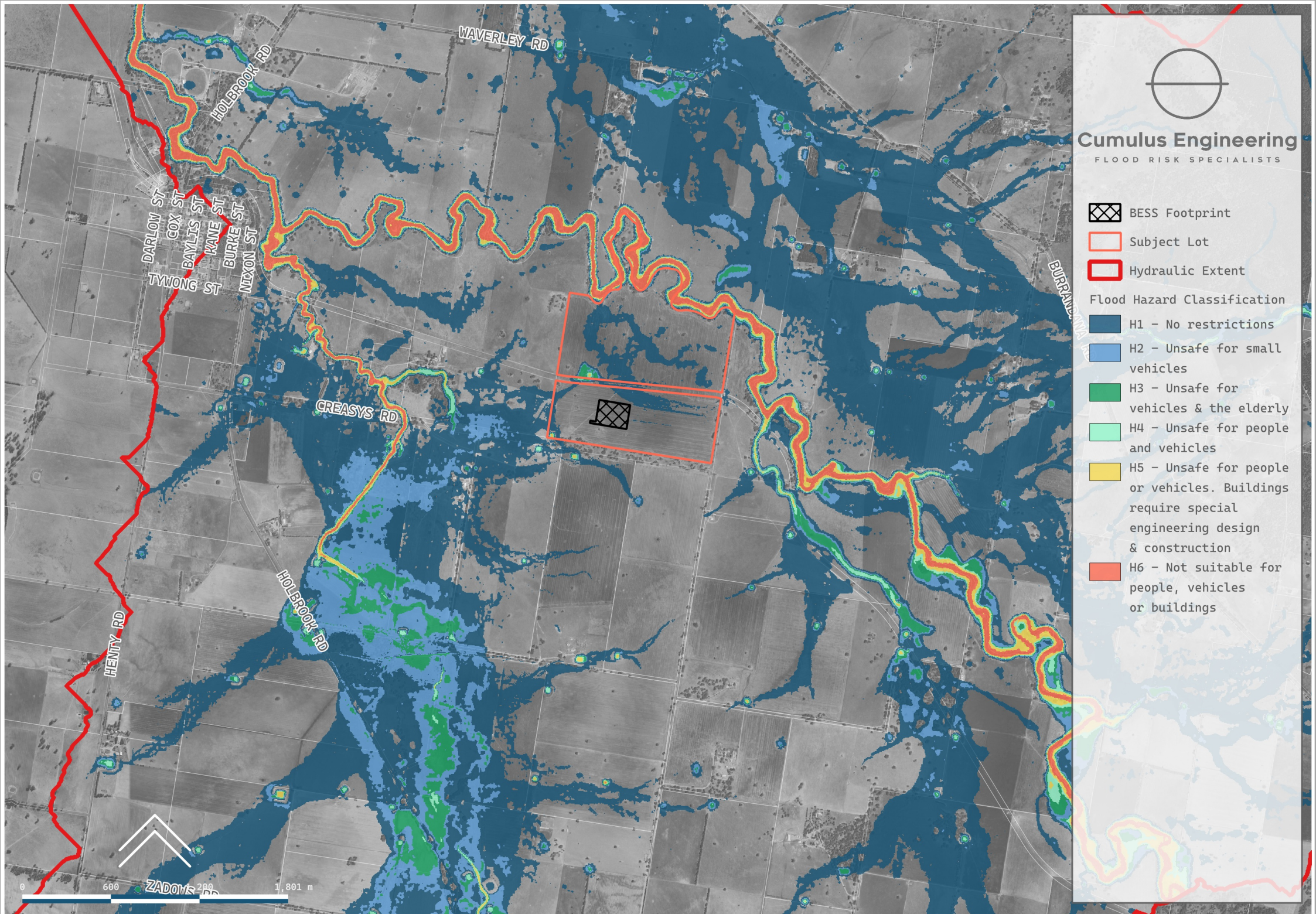
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

Flood Hazard Classification

- H1 - No restrictions
- H2 - Unsafe for small vehicles
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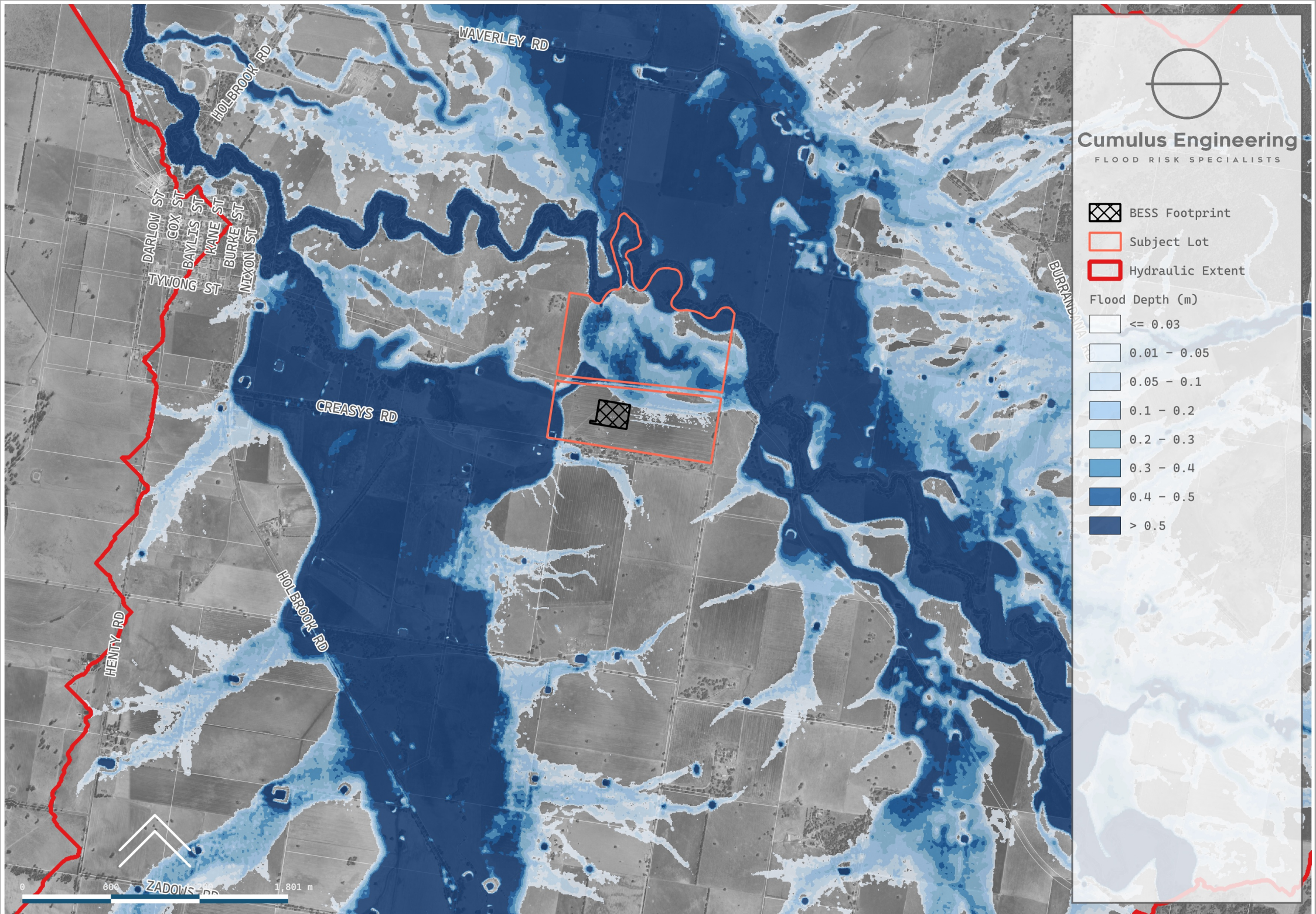


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

-   $\leq 0.03$
-  0.01 - 0.05
-  0.05 - 0.1
-  0.1 - 0.2
-  0.2 - 0.3
-  0.3 - 0.4
-  0.4 - 0.5
-   $> 0.5$





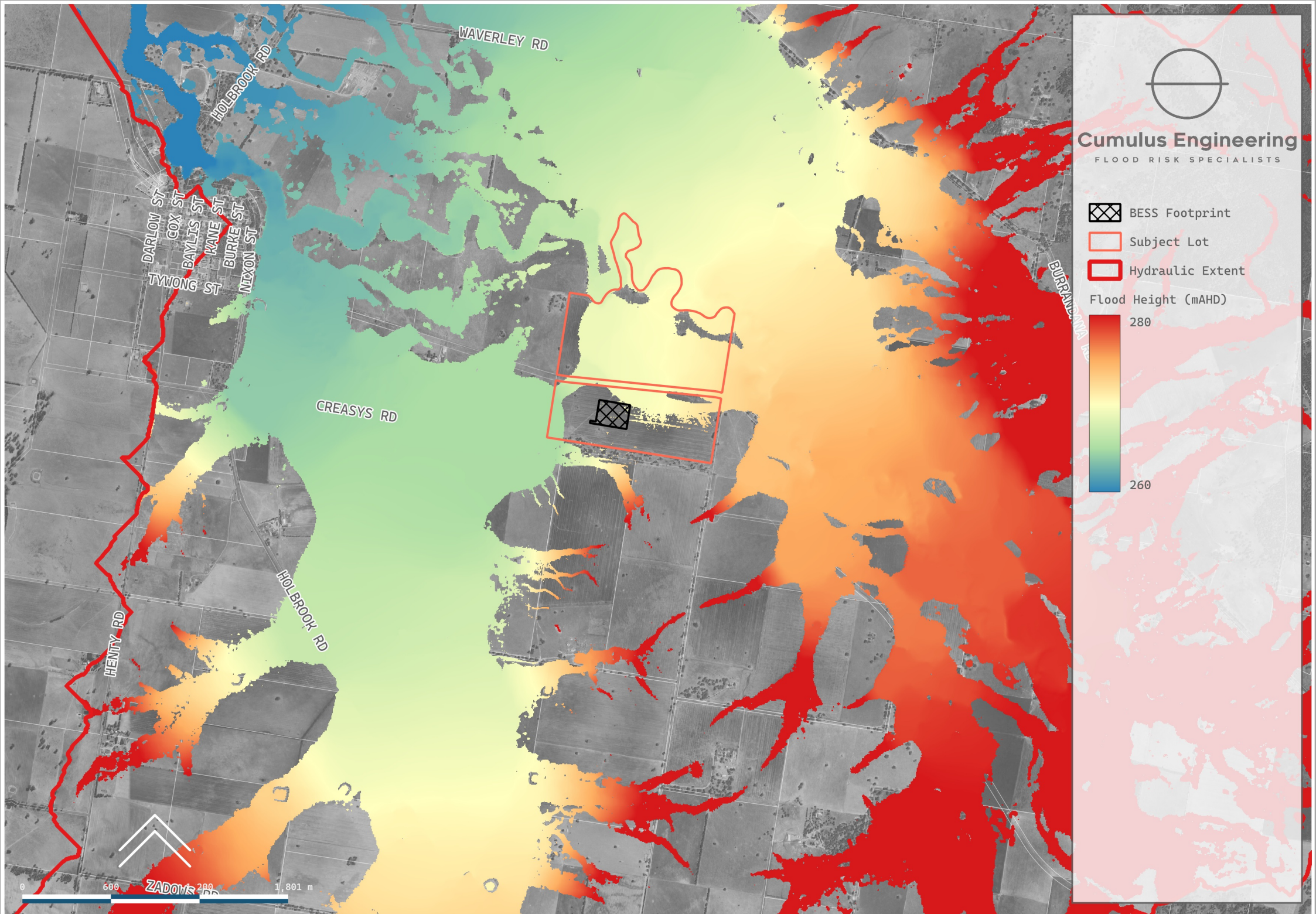
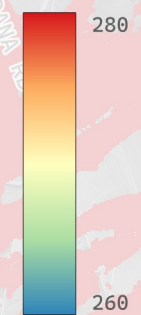


**Cumulus Engineering**

FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Height (mAHD)







**Cumulus Engineering**

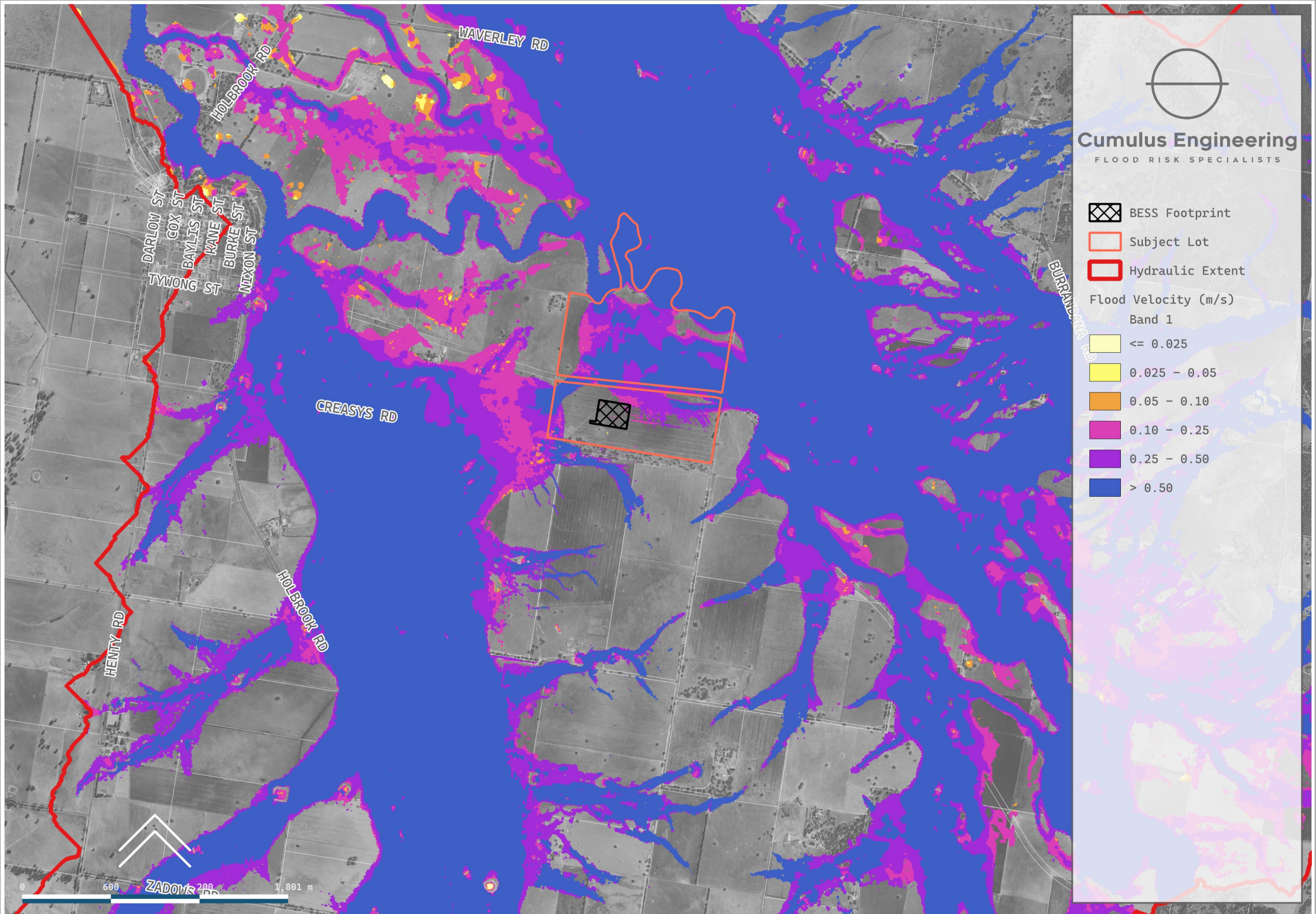
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

Band 1

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$







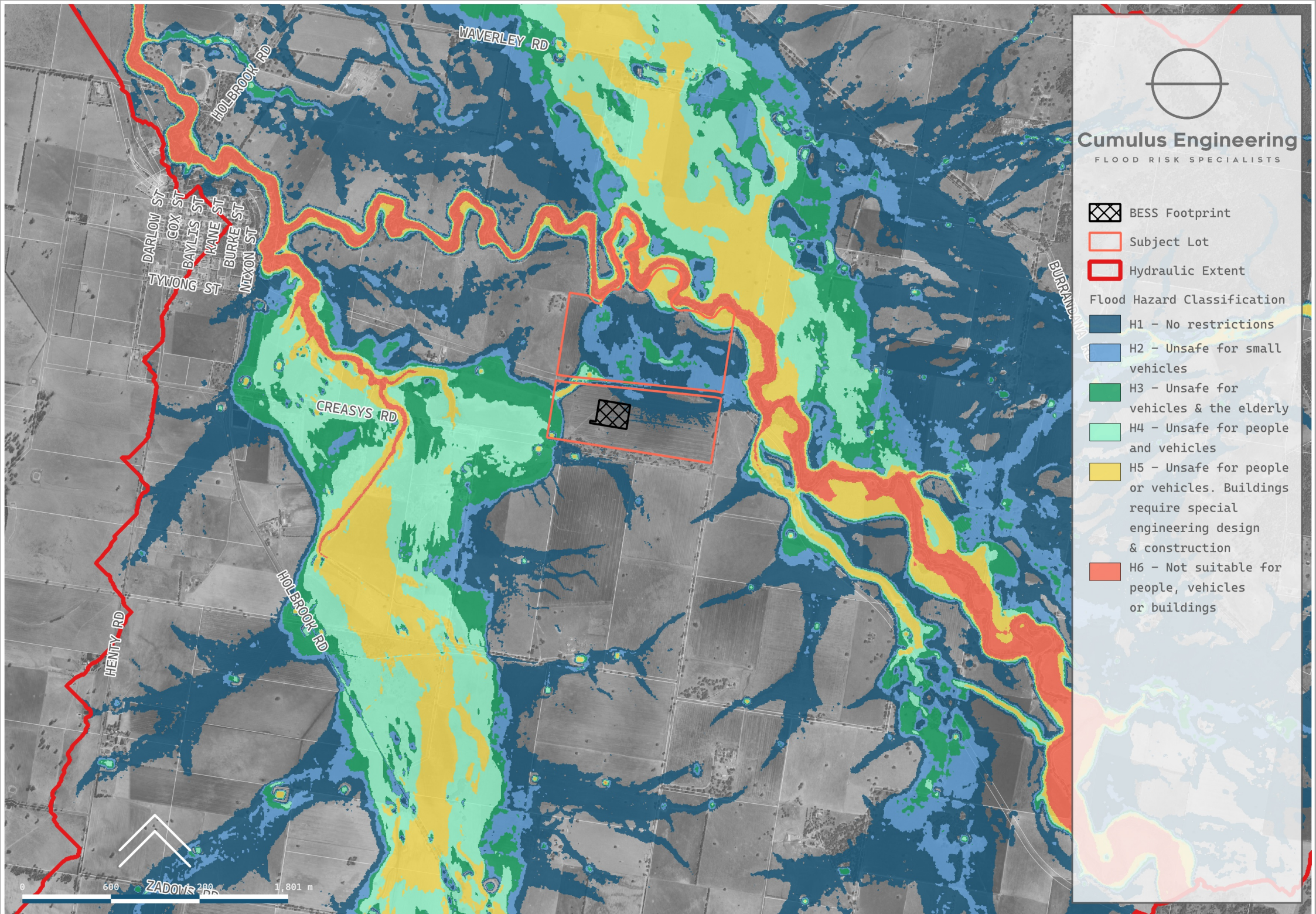
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

**Flood Hazard Classification**

-  H1 - No restrictions
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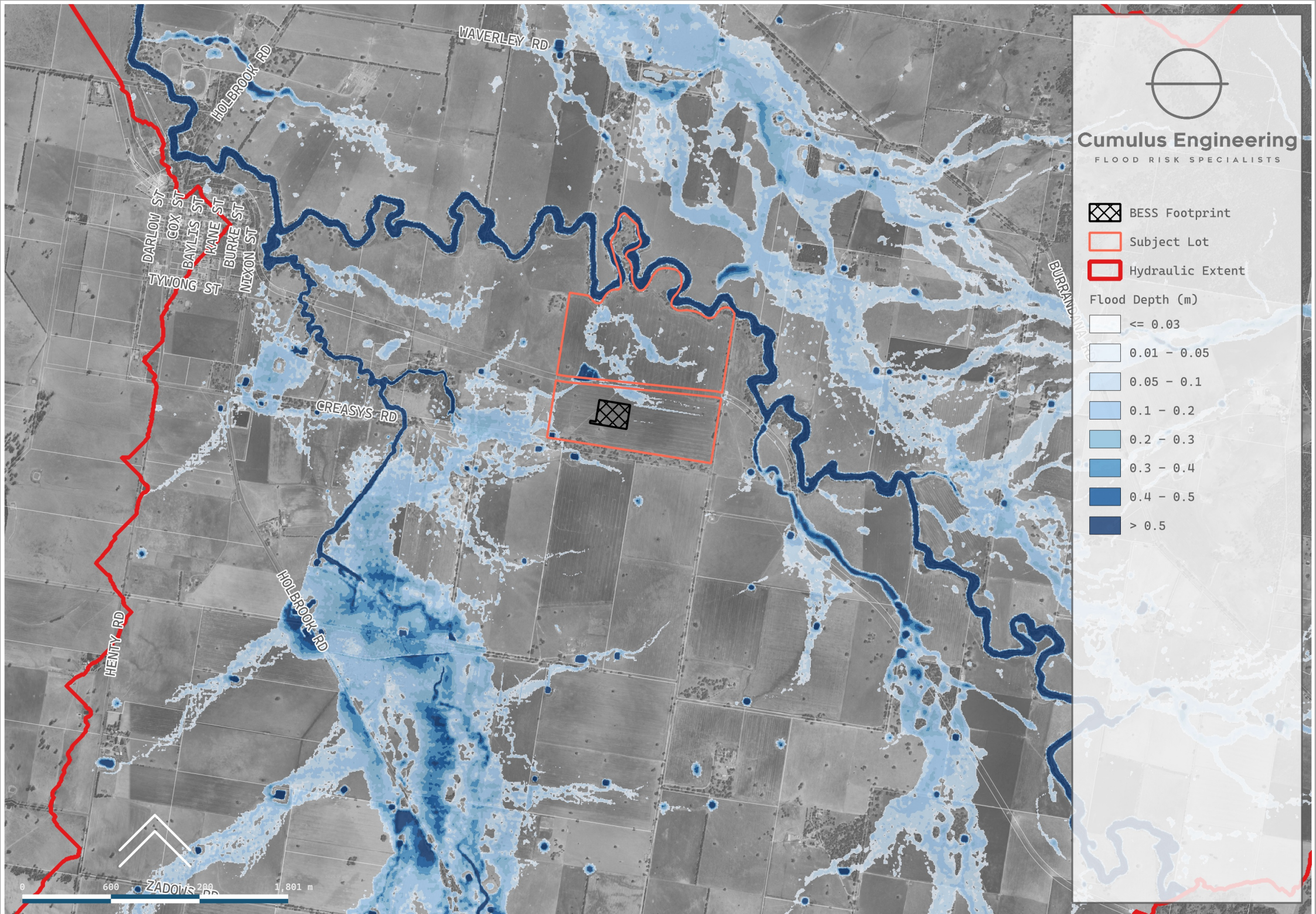


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

|                                                                                     |             |
|-------------------------------------------------------------------------------------|-------------|
|  | <= 0.03     |
|  | 0.01 - 0.05 |
|  | 0.05 - 0.1  |
|  | 0.1 - 0.2   |
|  | 0.2 - 0.3   |
|  | 0.3 - 0.4   |
|  | 0.4 - 0.5   |
|  | > 0.5       |







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

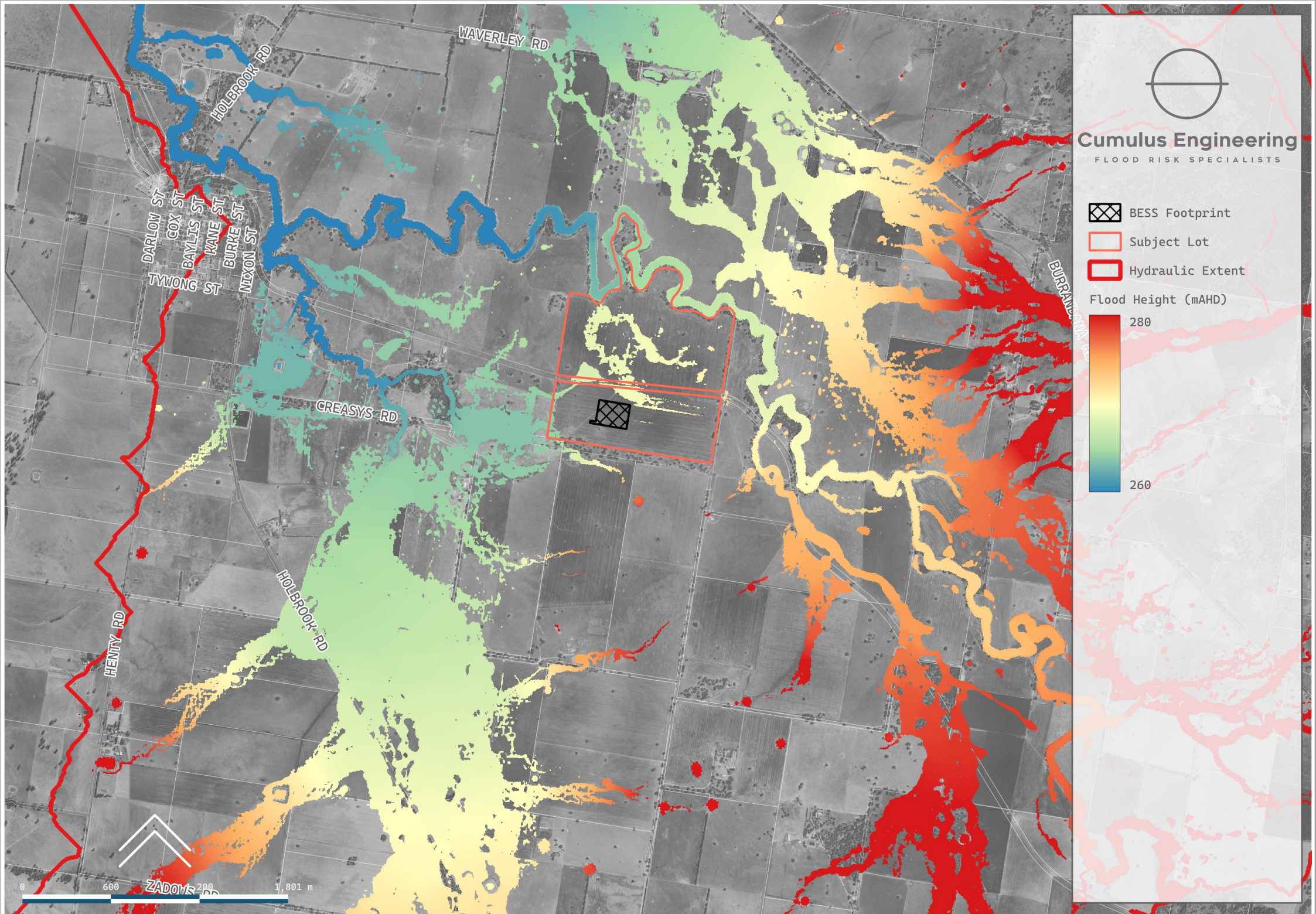


Subject Lot



Hydraulic Extent

Flood Height (mAHD)







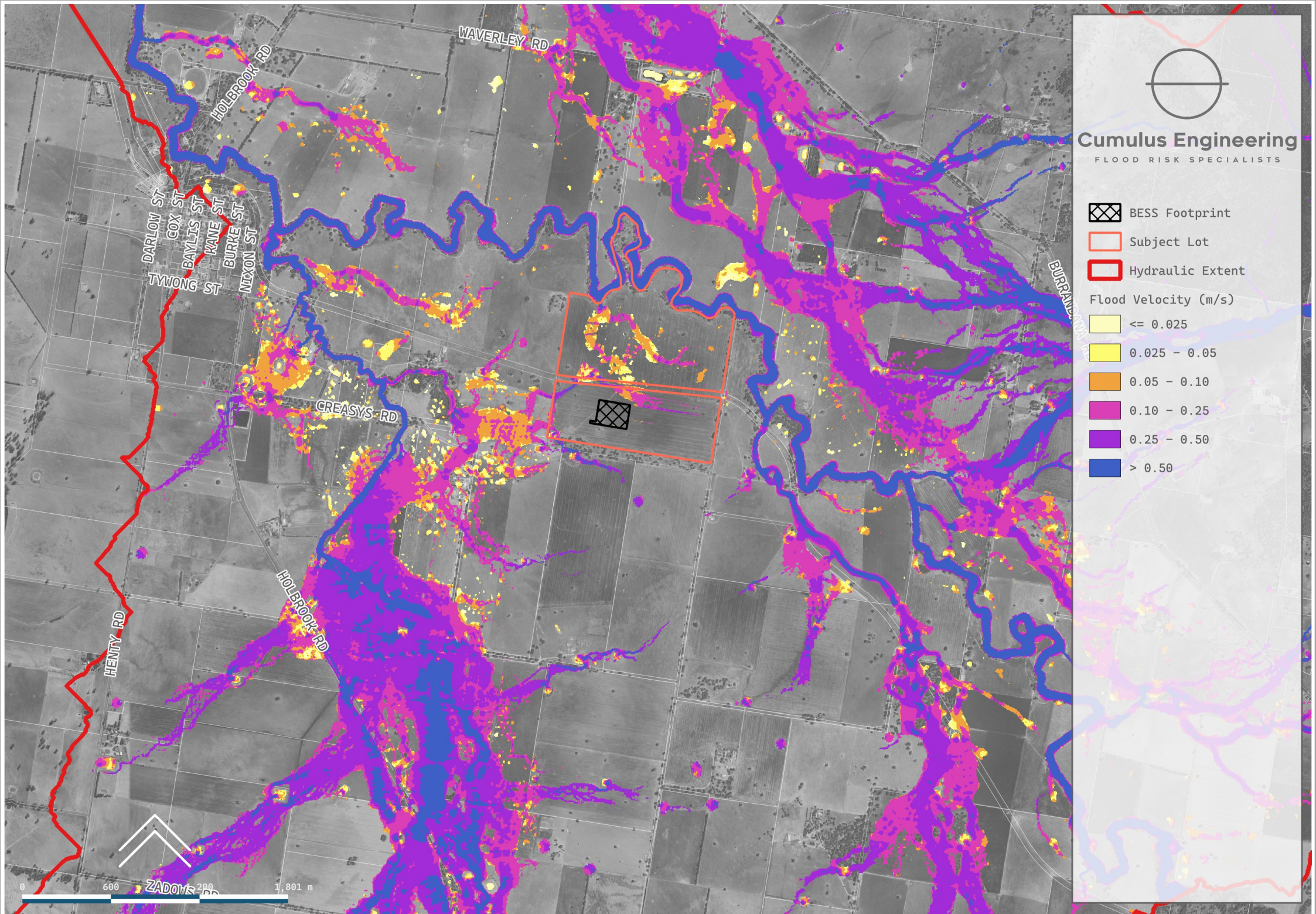
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

Flood Velocity (m/s)

- $\leq 0.025$
- $0.025 - 0.05$
- $0.05 - 0.10$
- $0.10 - 0.25$
- $0.25 - 0.50$
- $> 0.50$







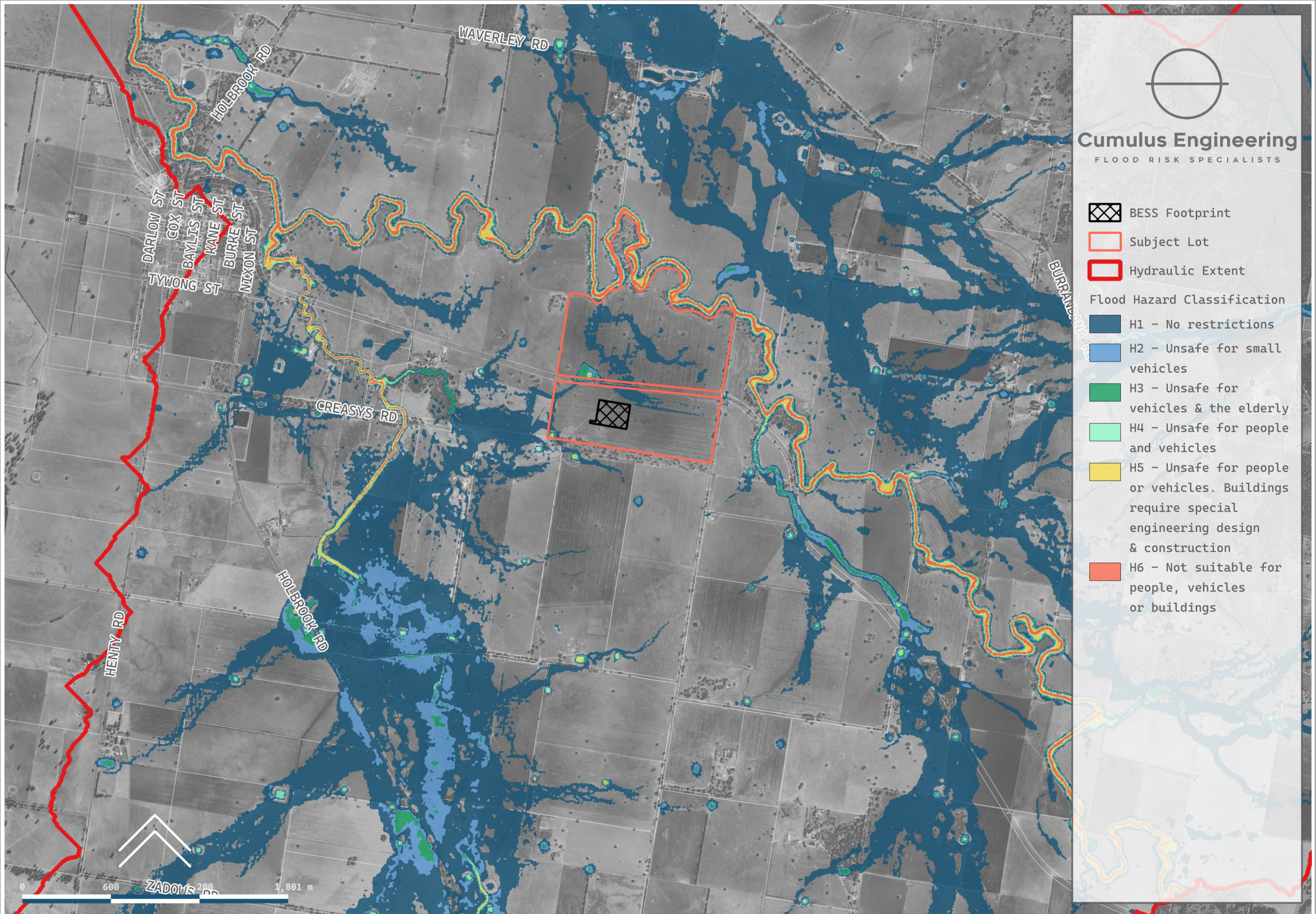
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Hazard Classification

-  H1 - No restrictions
-  H2 - Unsafe for small vehicles
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-  H4 - Unsafe for people and vehicles
-  H5 - Unsafe for people or vehicles. Buildings require special engineering design & construction
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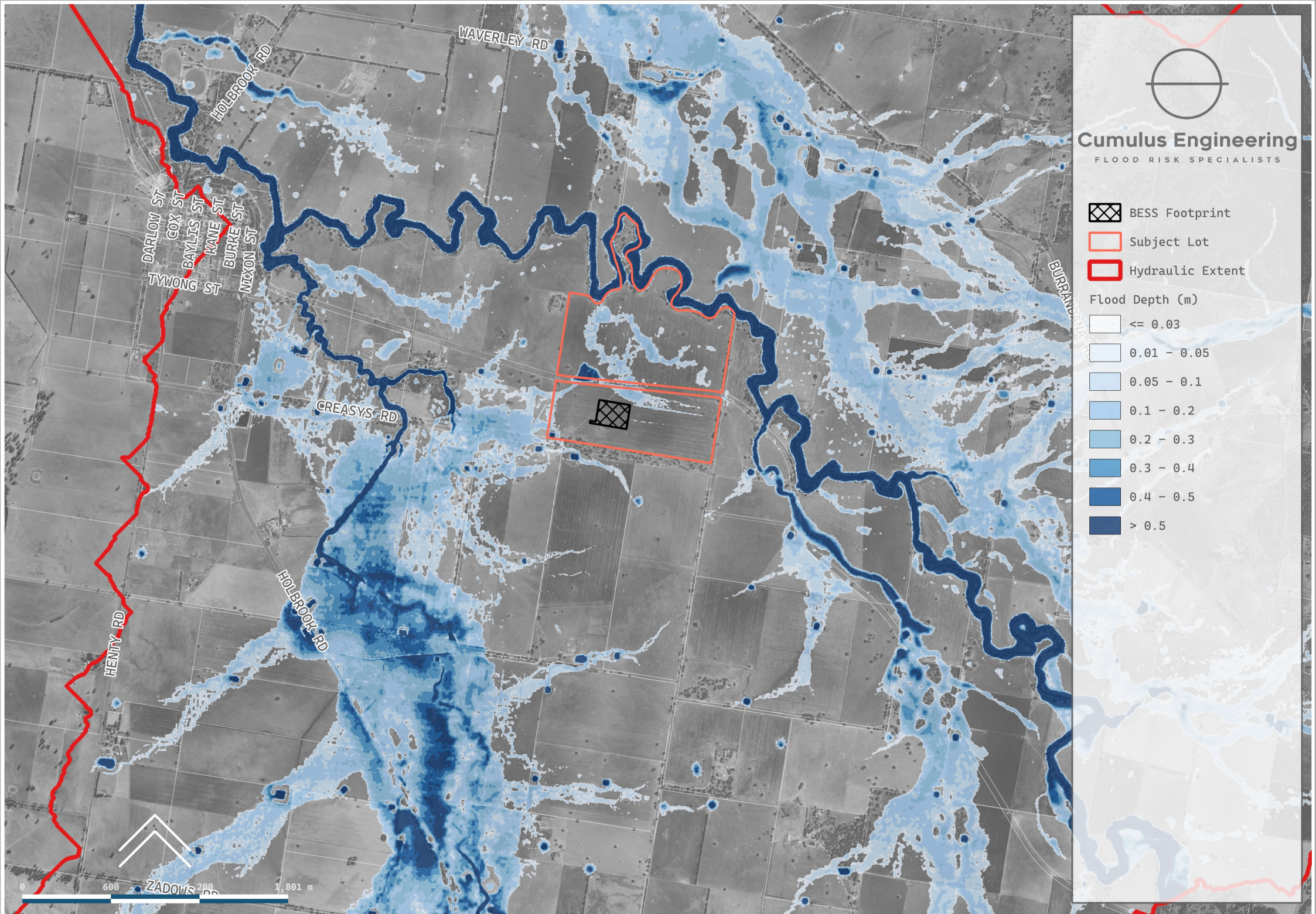


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

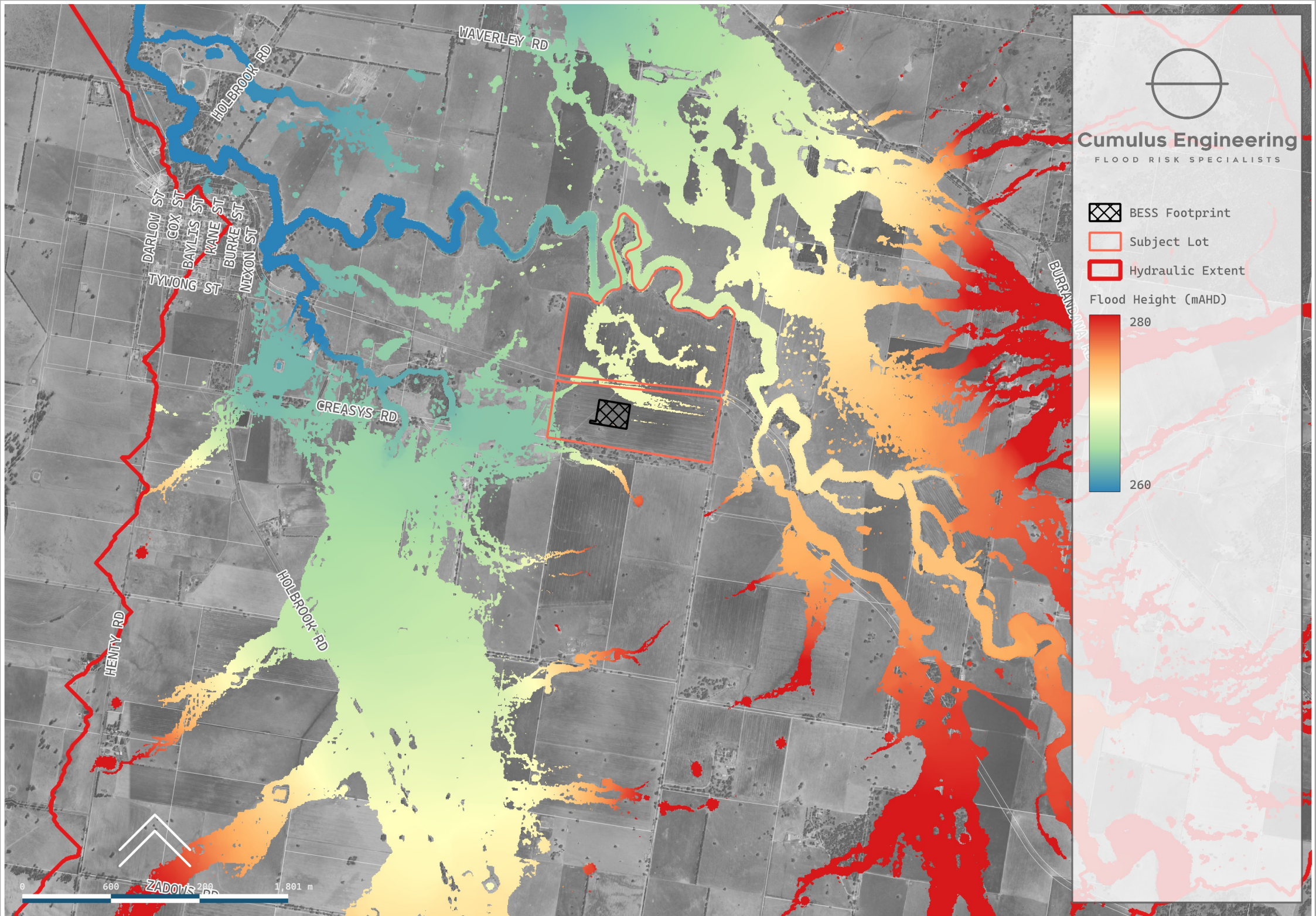
-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

-   $\leq 0.03$
-  0.01 - 0.05
-  0.05 - 0.1
-  0.1 - 0.2
-  0.2 - 0.3
-  0.3 - 0.4
-  0.4 - 0.5
-   $> 0.5$

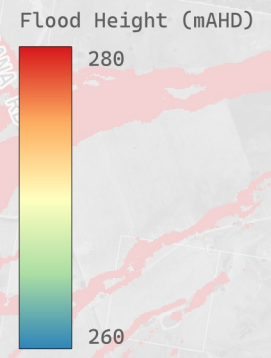






**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent







**Cumulus Engineering**

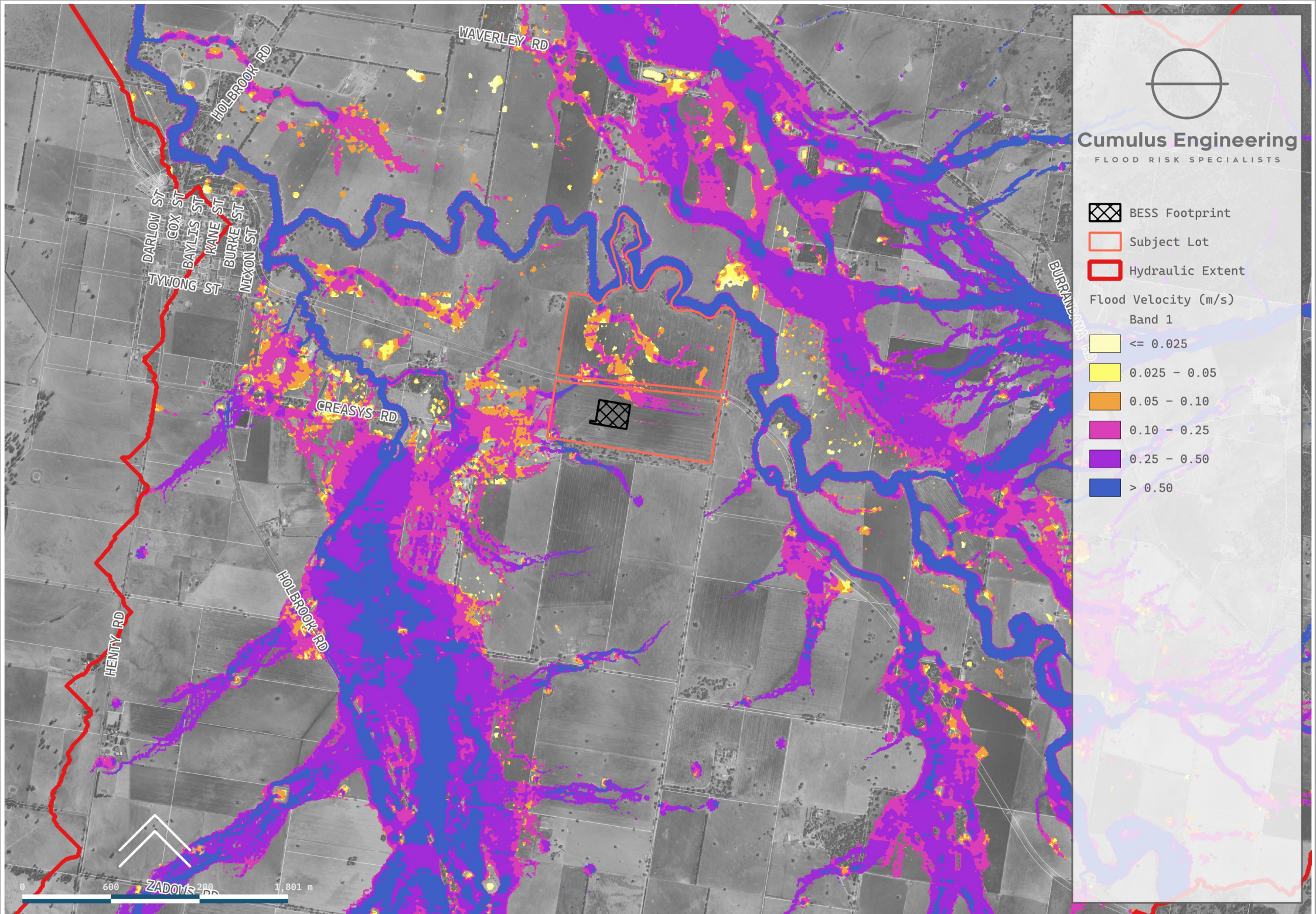
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

Band 1

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$







**Cumulus Engineering**

FLOOD RISK SPECIALISTS

 BESS Footprint

 Subject Lot

 Hydraulic Extent

Flood Hazard Classification

 H1 - No restrictions

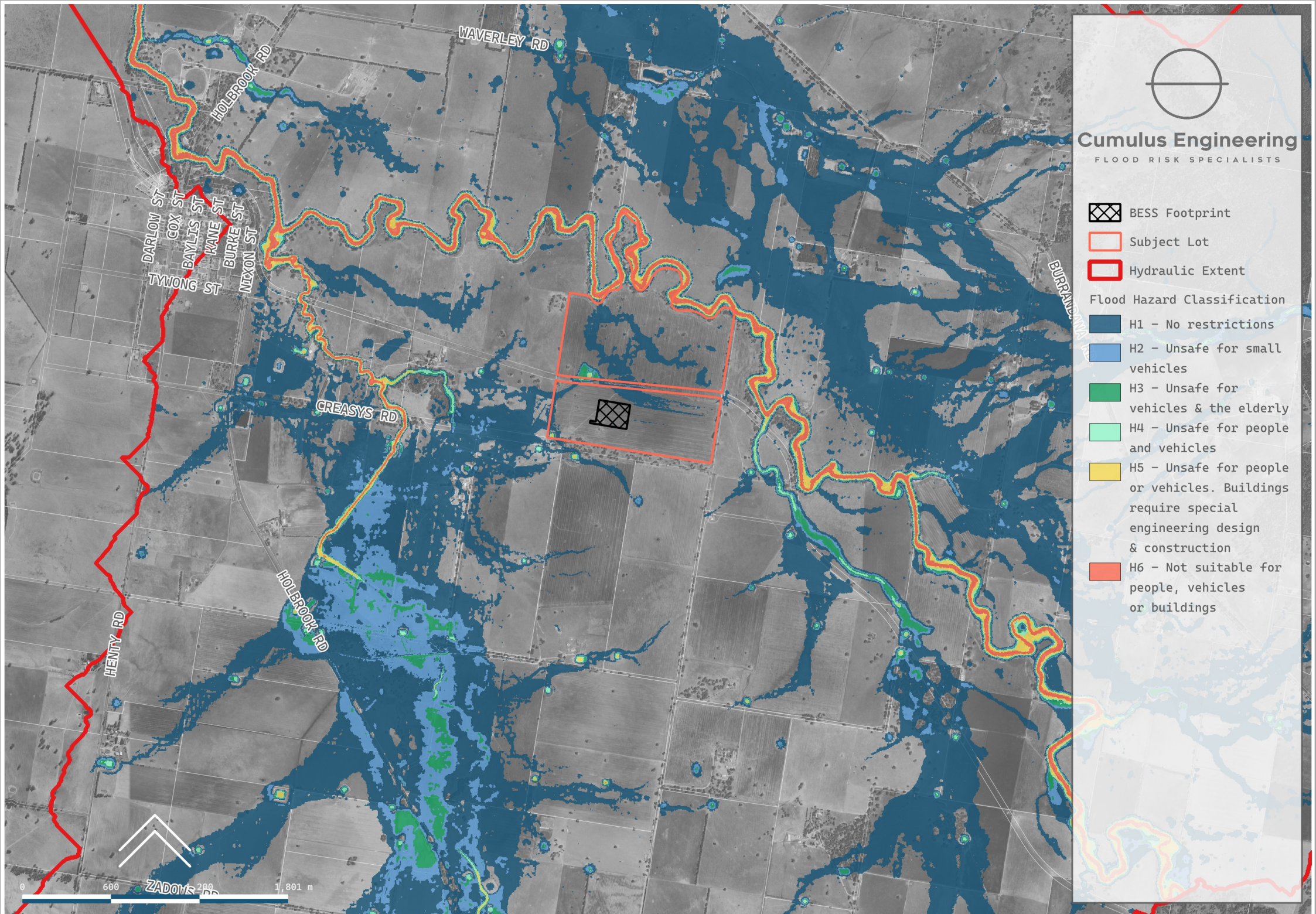
 H2 - Unsafe for small vehicles

 H3 - Unsafe for vehicles & the elderly

 H4 - Unsafe for people and vehicles

 H5 - Unsafe for people or vehicles. Buildings require special engineering design & construction

 H6 - Not suitable for people, vehicles or buildings







**Cumulus Engineering**  
FLOOD RISK SPECIALISTS



BESS Footprint



Subject Lot



Hydraulic Extent

Flood Depth (m)



<= 0.03



0.01 - 0.05



0.05 - 0.1



0.1 - 0.2



0.2 - 0.3



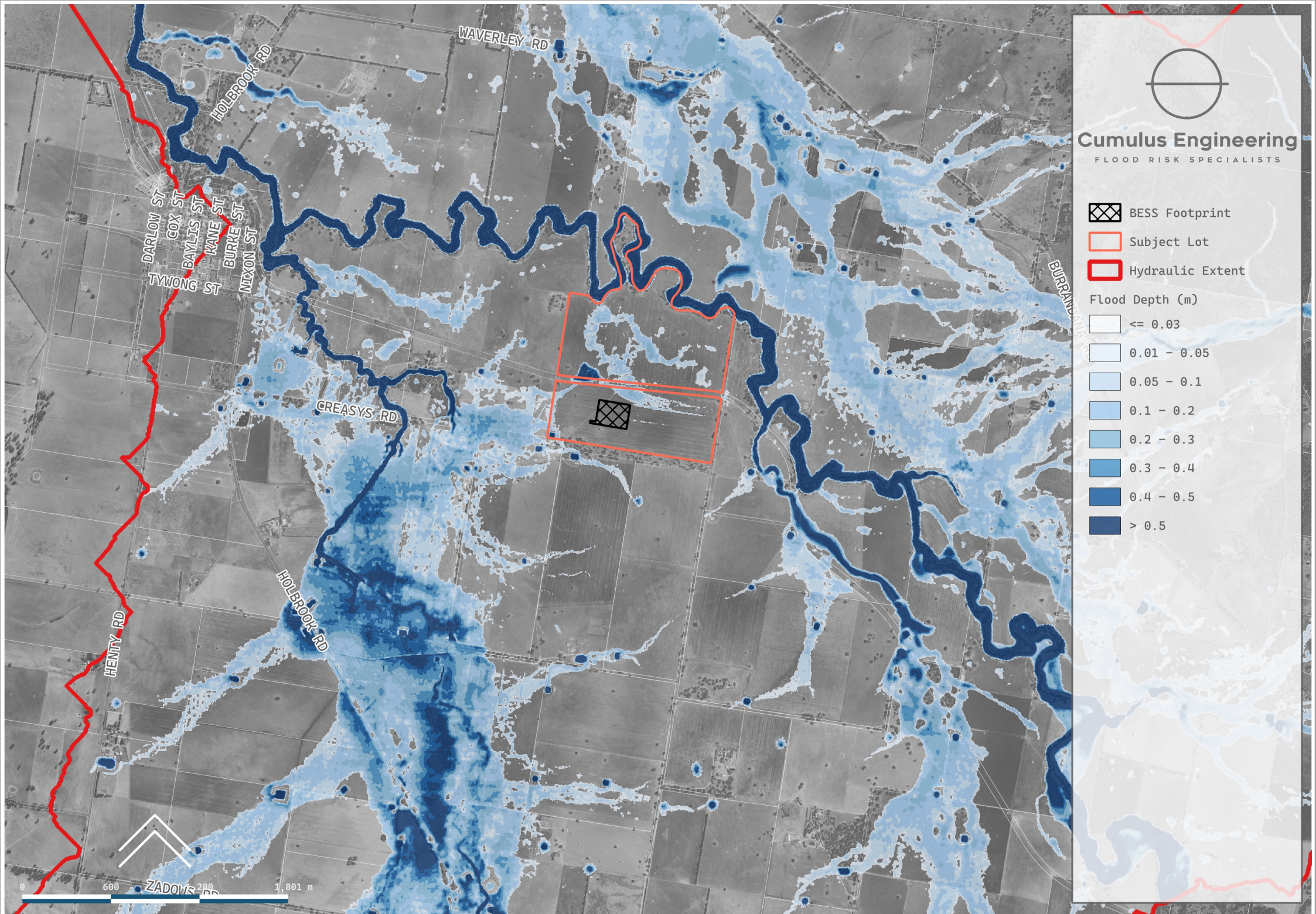
0.3 - 0.4



0.4 - 0.5



> 0.5







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

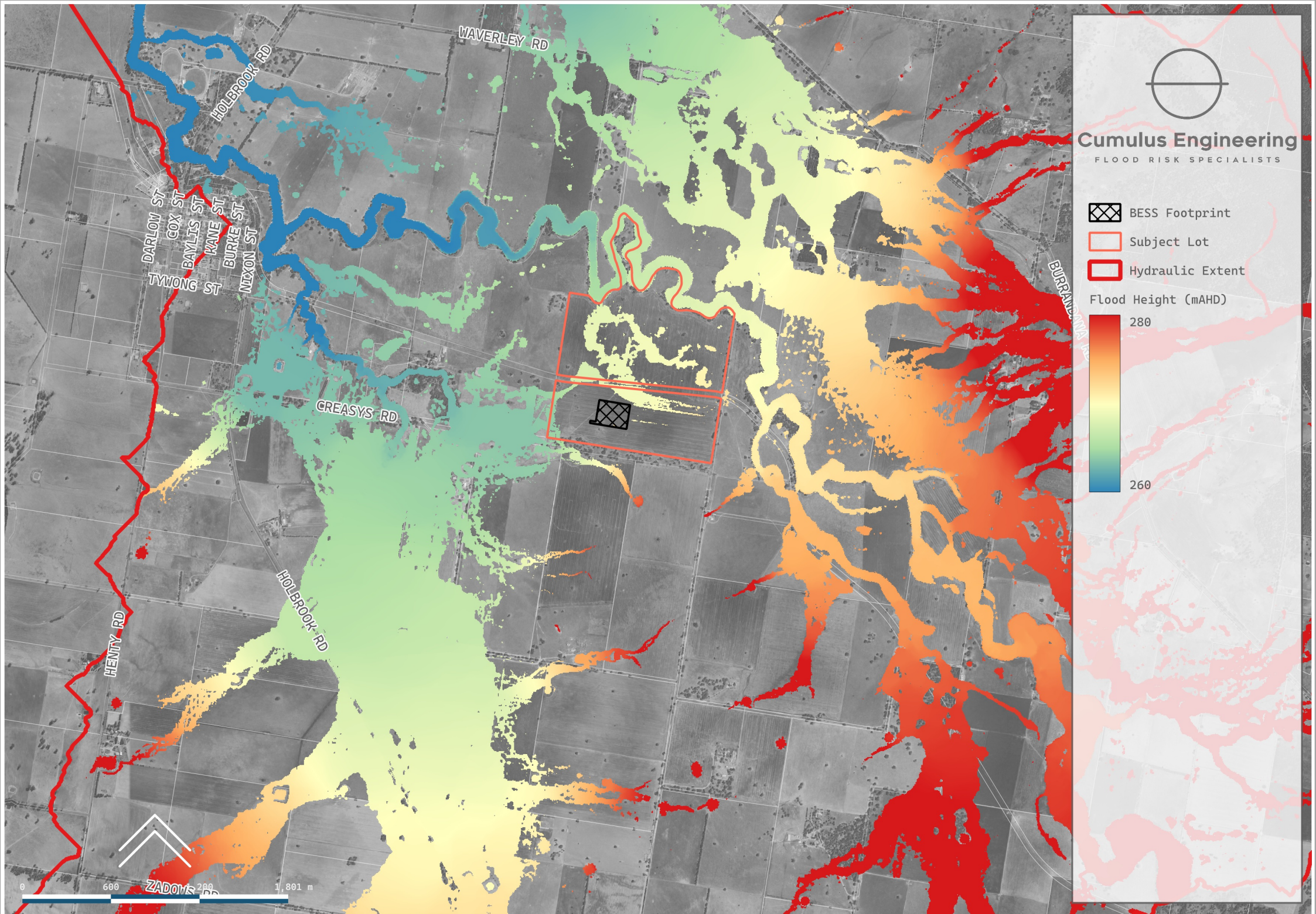


Subject Lot



Hydraulic Extent

Flood Height (mAHD)





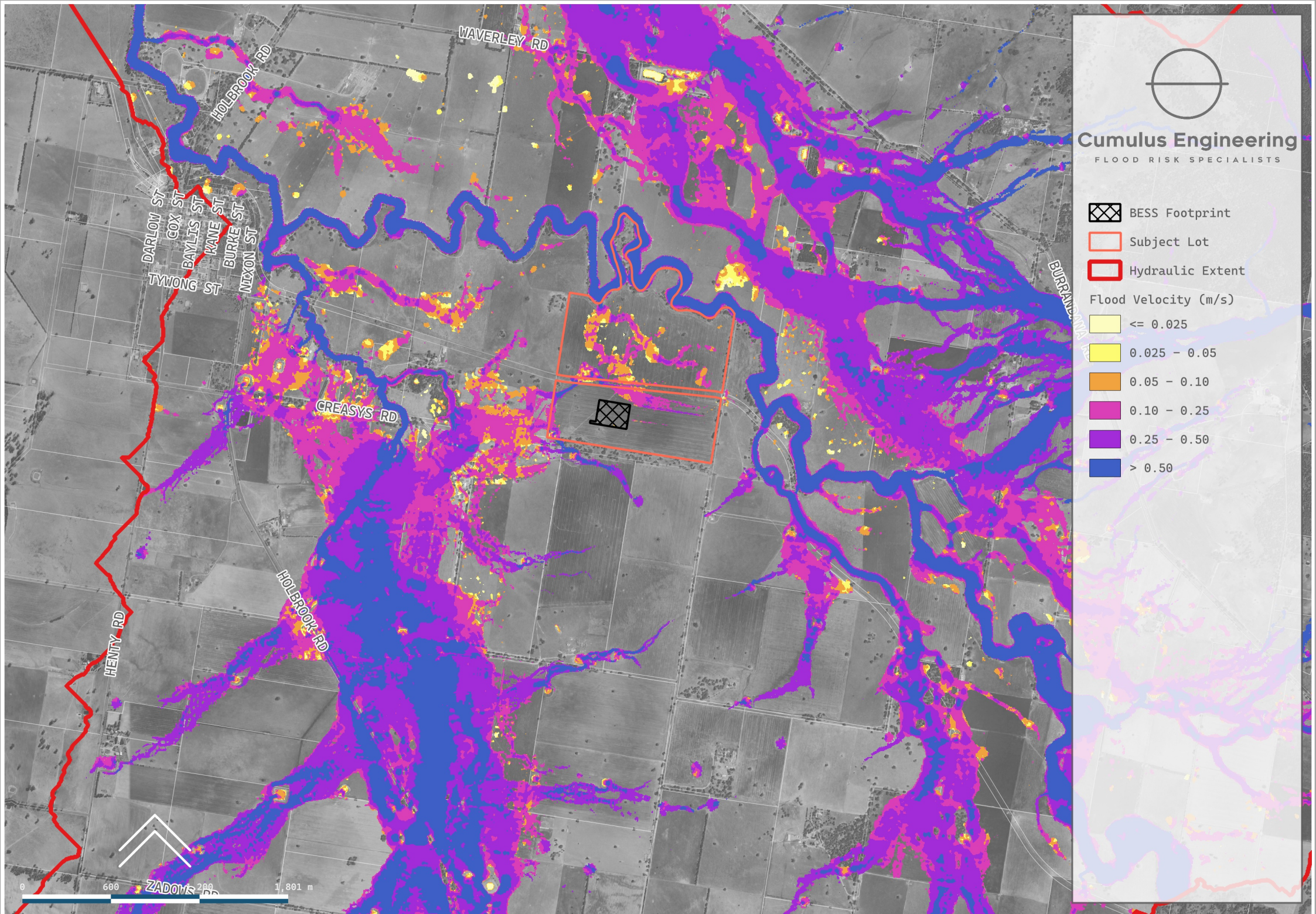


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$







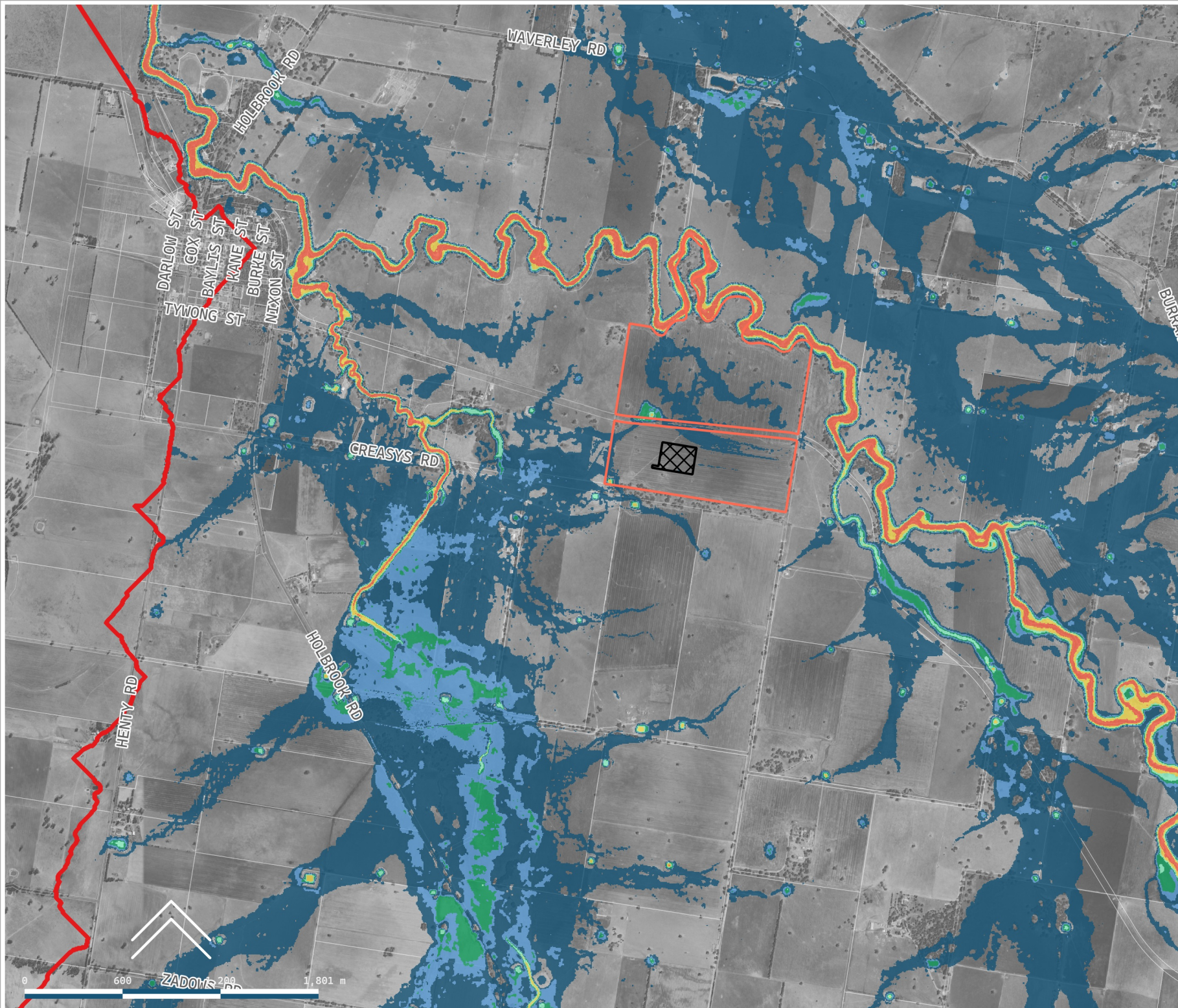
# Cumulus Engineering

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

## Flood Hazard Classification

- H1 - No restrictions
- H2 - Unsafe for small vehicles
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- H4 - Unsafe for people and vehicles
- H5 - Unsafe for people or vehicles. Buildings require special engineering design & construction
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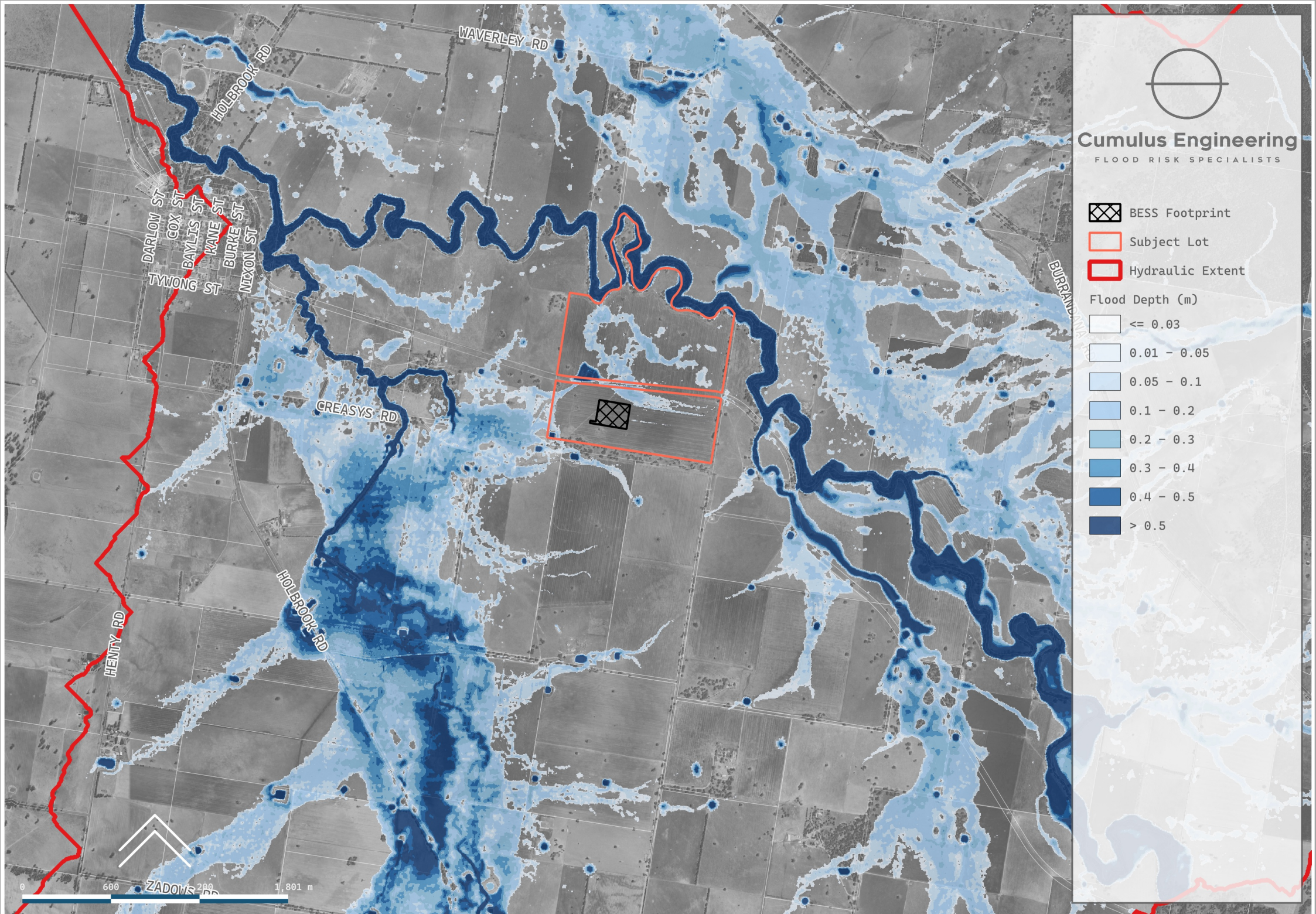


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

|                                                                                     |             |
|-------------------------------------------------------------------------------------|-------------|
|  | <= 0.03     |
|  | 0.01 - 0.05 |
|  | 0.05 - 0.1  |
|  | 0.1 - 0.2   |
|  | 0.2 - 0.3   |
|  | 0.3 - 0.4   |
|  | 0.4 - 0.5   |
|  | > 0.5       |





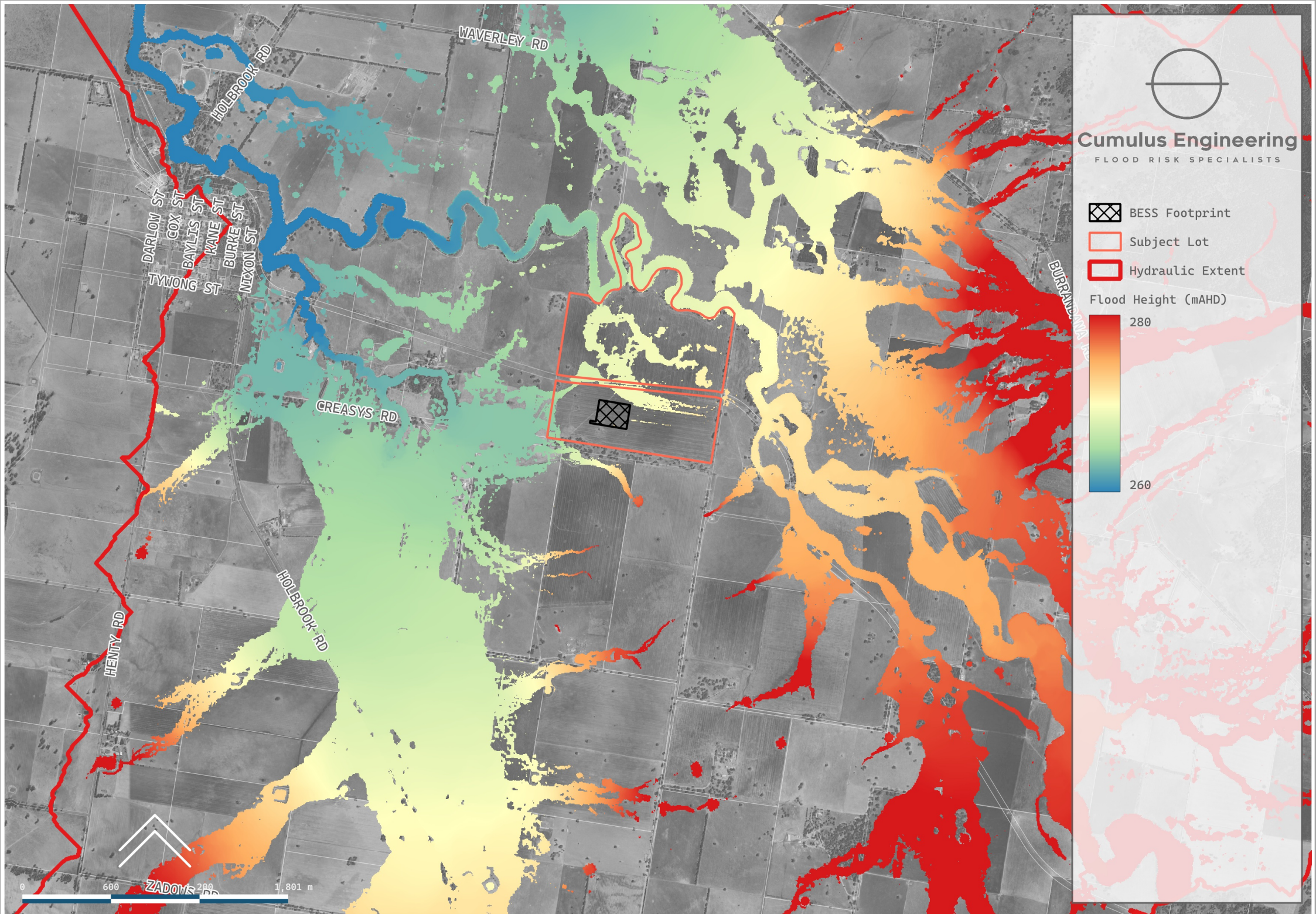
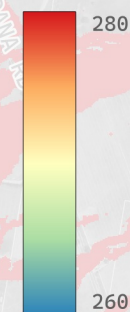


**Cumulus Engineering**

FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Height (mAHD)





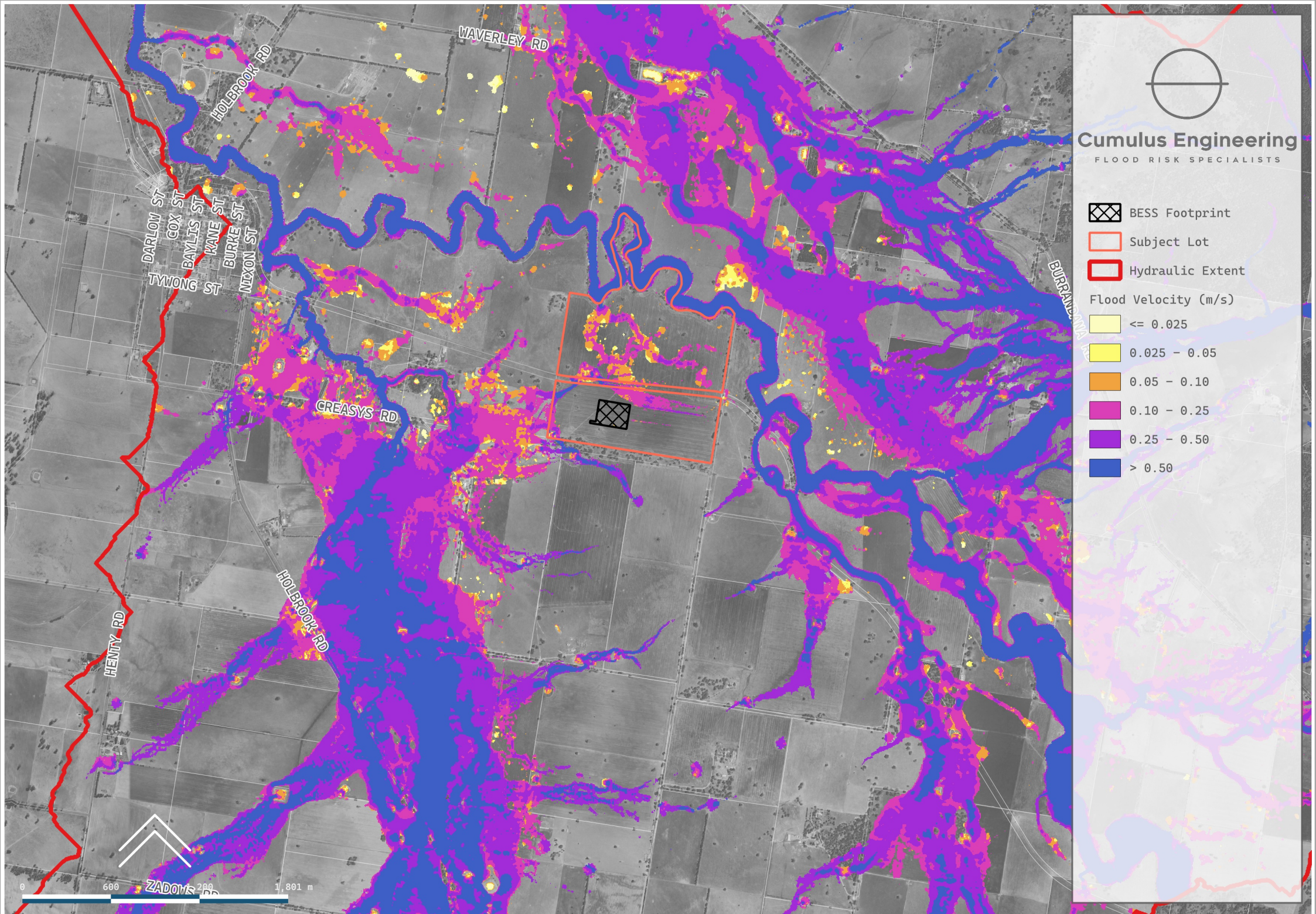


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$







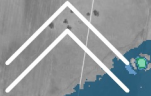
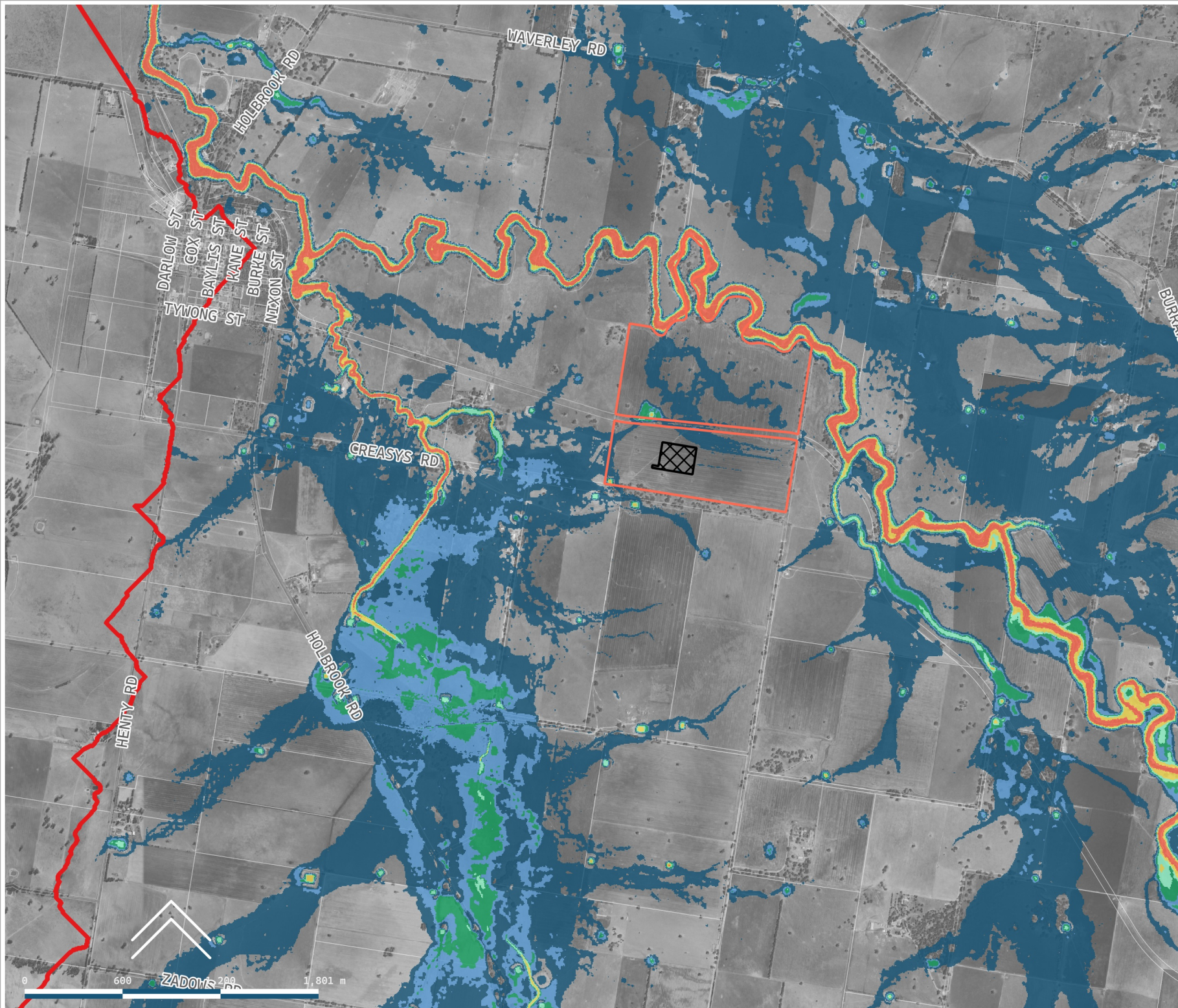
**Cumulus Engineering**

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

Flood Hazard Classification

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0 600 1,200 1,801 m



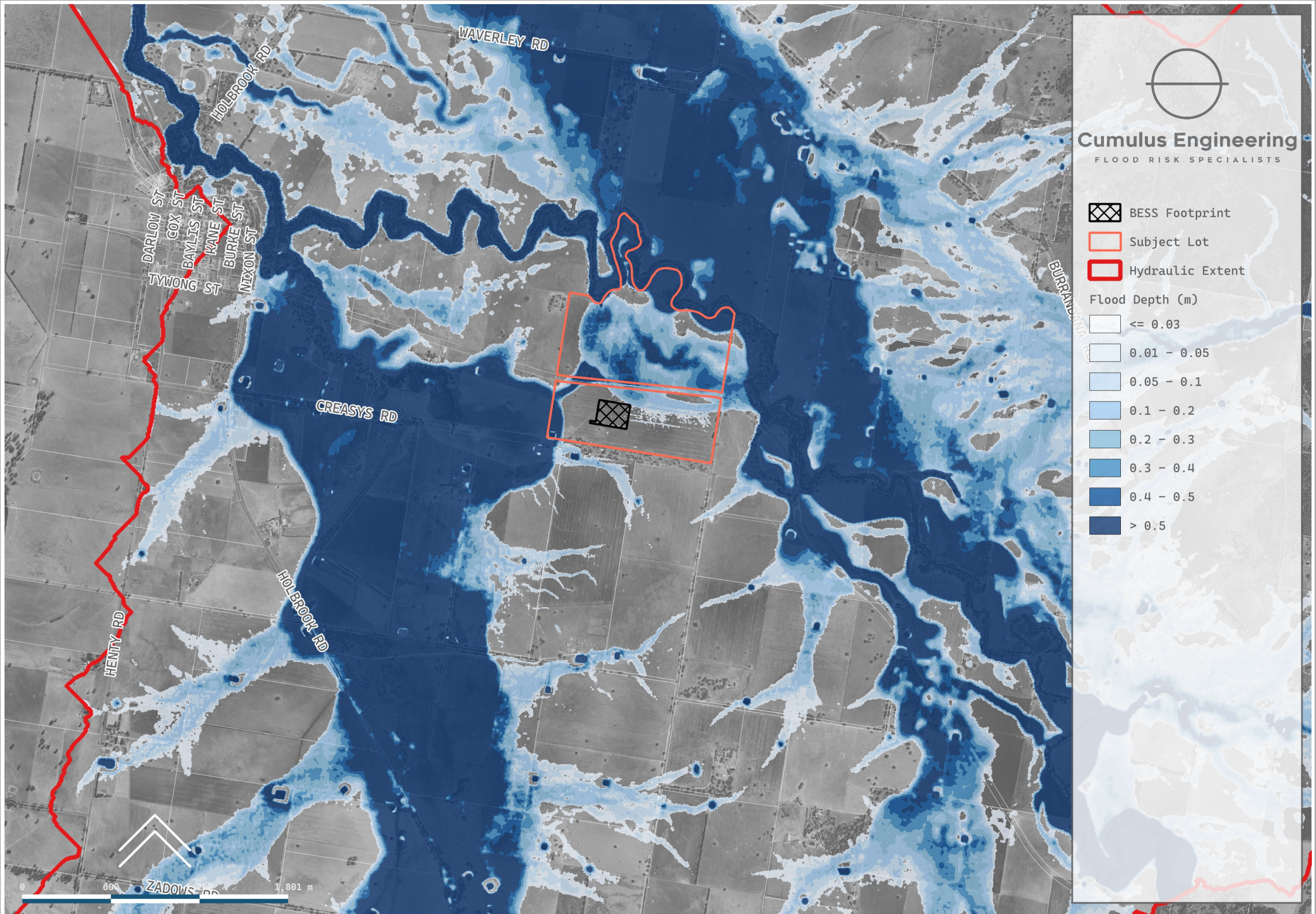


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Depth (m)

-   $\leq 0.03$
-  0.01 - 0.05
-  0.05 - 0.1
-  0.1 - 0.2
-  0.2 - 0.3
-  0.3 - 0.4
-  0.4 - 0.5
-   $> 0.5$







**Cumulus Engineering**

FLOOD RISK SPECIALISTS



BESS Footprint

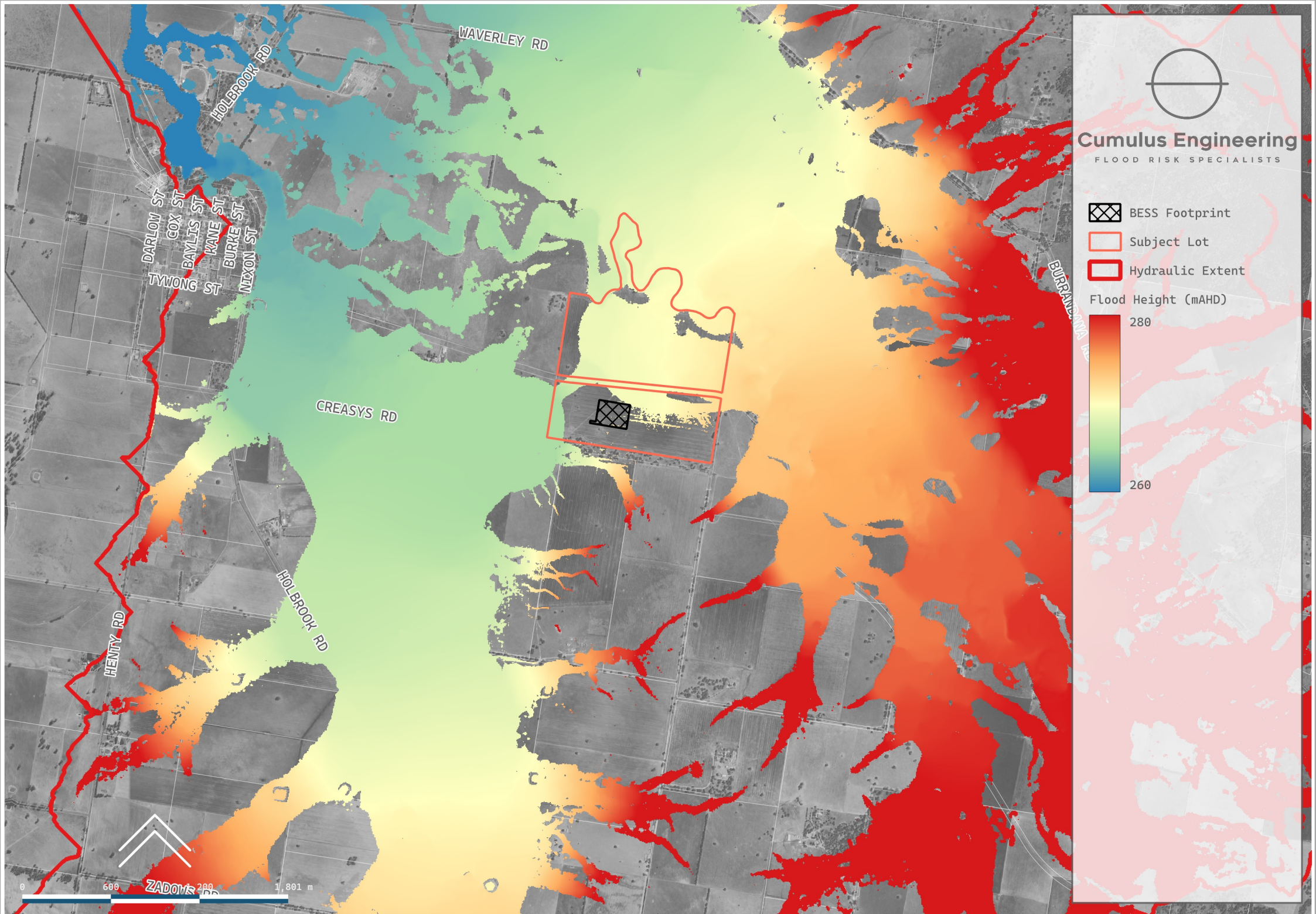


Subject Lot

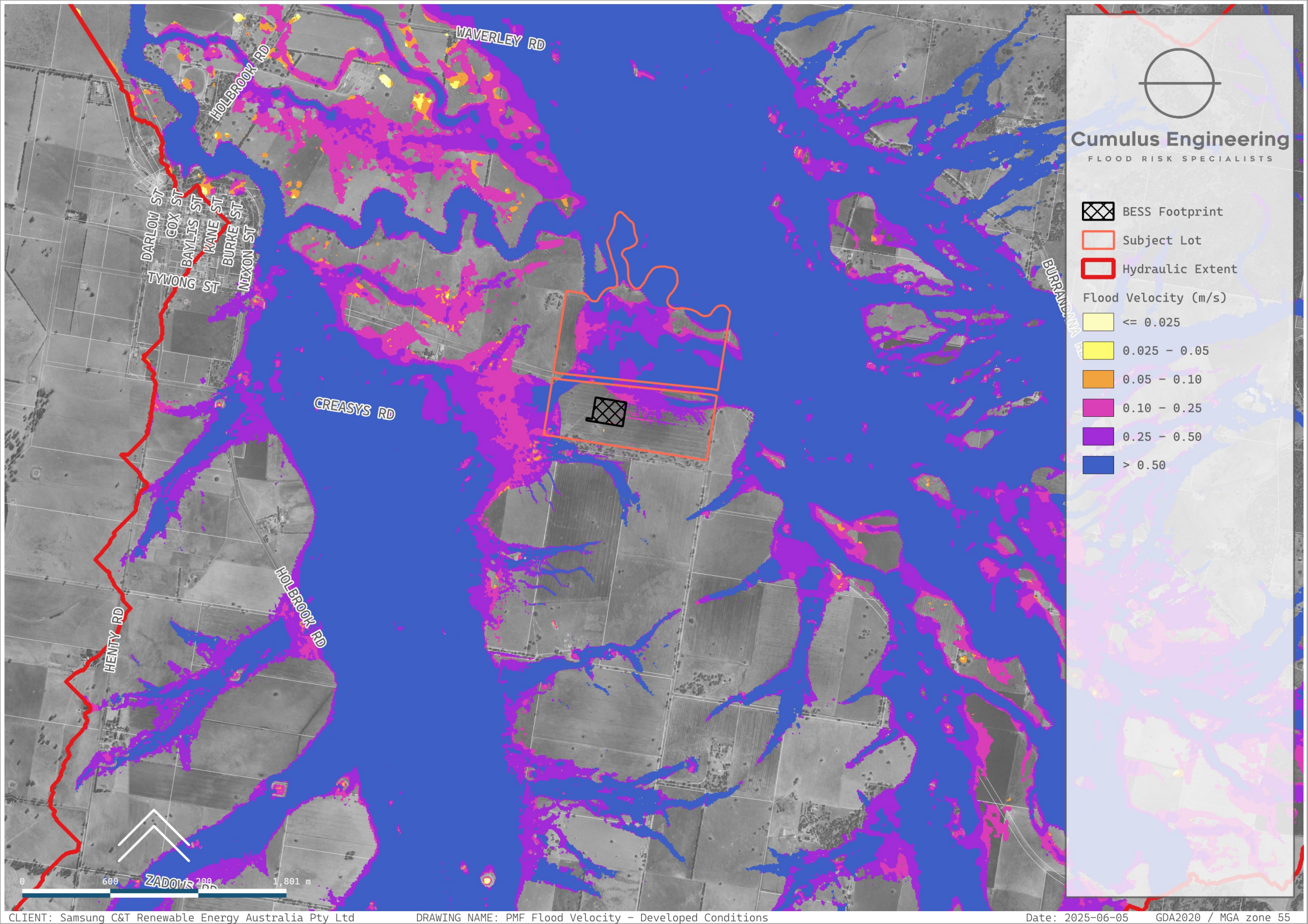


Hydraulic Extent

Flood Height (mAHD)







**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Flood Velocity (m/s)

-   $\leq 0.025$
-   $0.025 - 0.05$
-   $0.05 - 0.10$
-   $0.10 - 0.25$
-   $0.25 - 0.50$
-   $> 0.50$





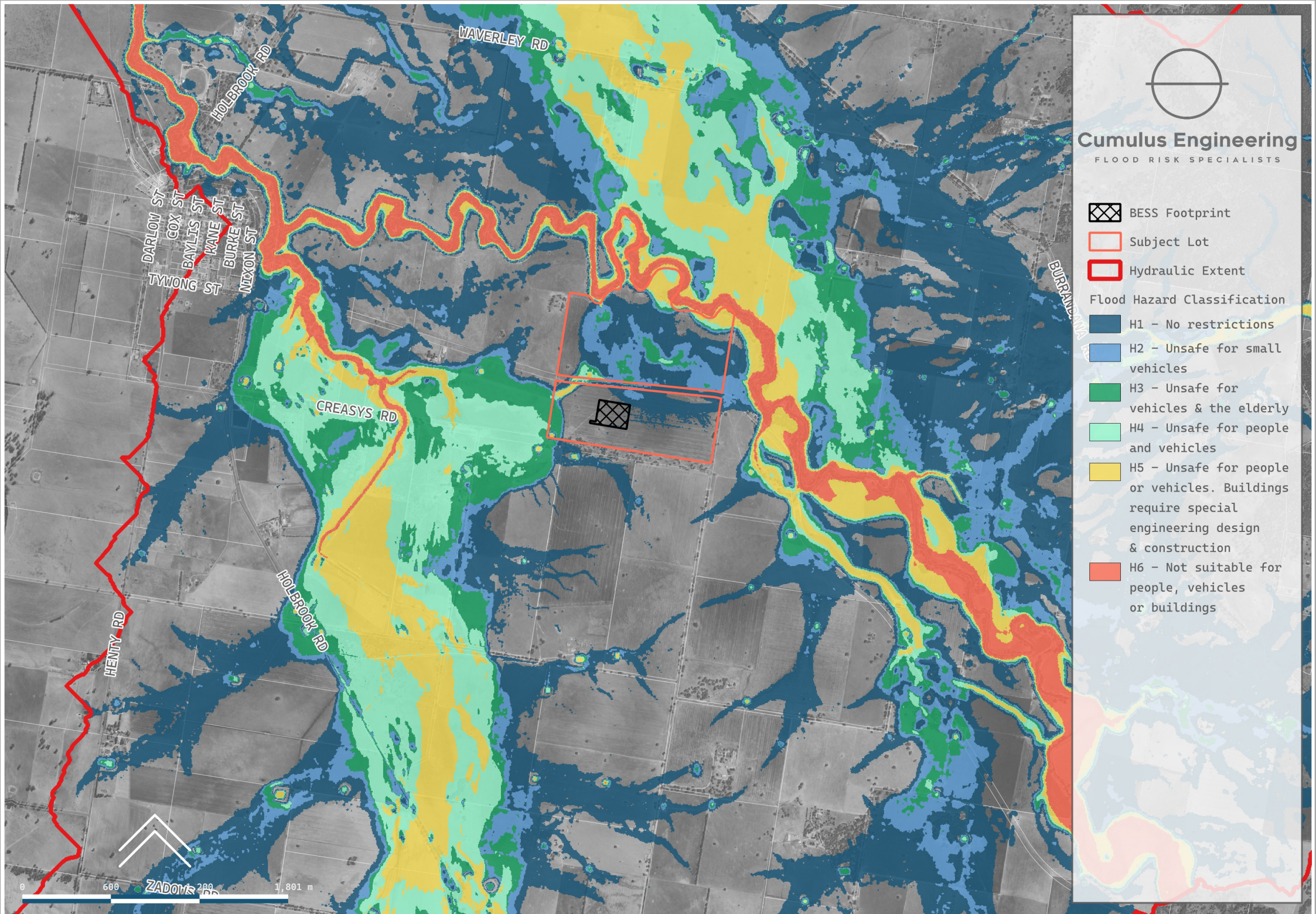
# Cumulus Engineering

FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

## Flood Hazard Classification

- H1 - No restrictions
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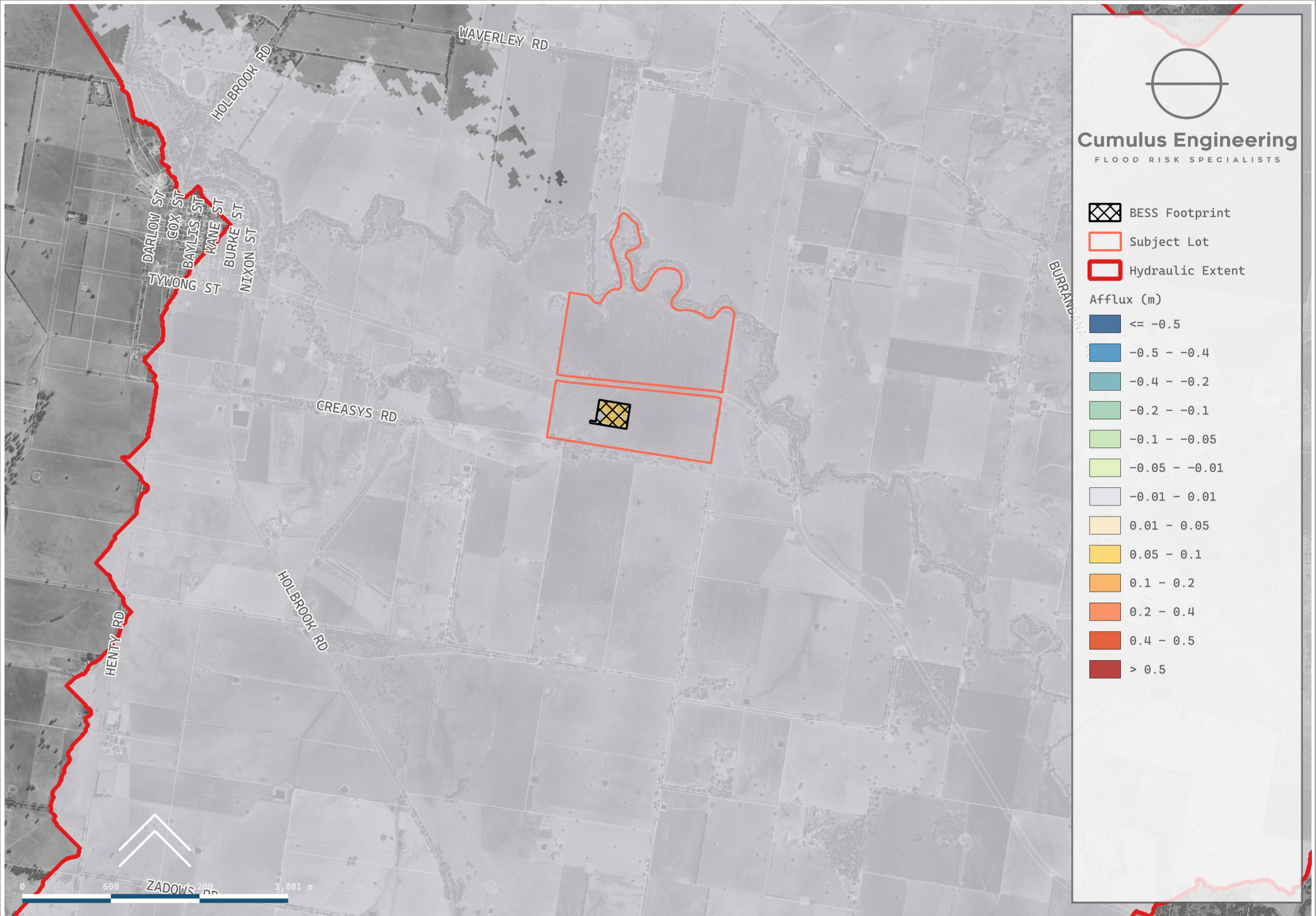


Cumulus Engineering  
FLOOD RISK SPECIALISTS

- BESS Footprint
- Subject Lot
- Hydraulic Extent

Afflux (m)

|  |               |
|--|---------------|
|  | <= -0.5       |
|  | -0.5 - -0.4   |
|  | -0.4 - -0.2   |
|  | -0.2 - -0.1   |
|  | -0.1 - -0.05  |
|  | -0.05 - -0.01 |
|  | -0.01 - 0.01  |
|  | 0.01 - 0.05   |
|  | 0.05 - 0.1    |
|  | 0.1 - 0.2     |
|  | 0.2 - 0.4     |
|  | 0.4 - 0.5     |
|  | > 0.5         |





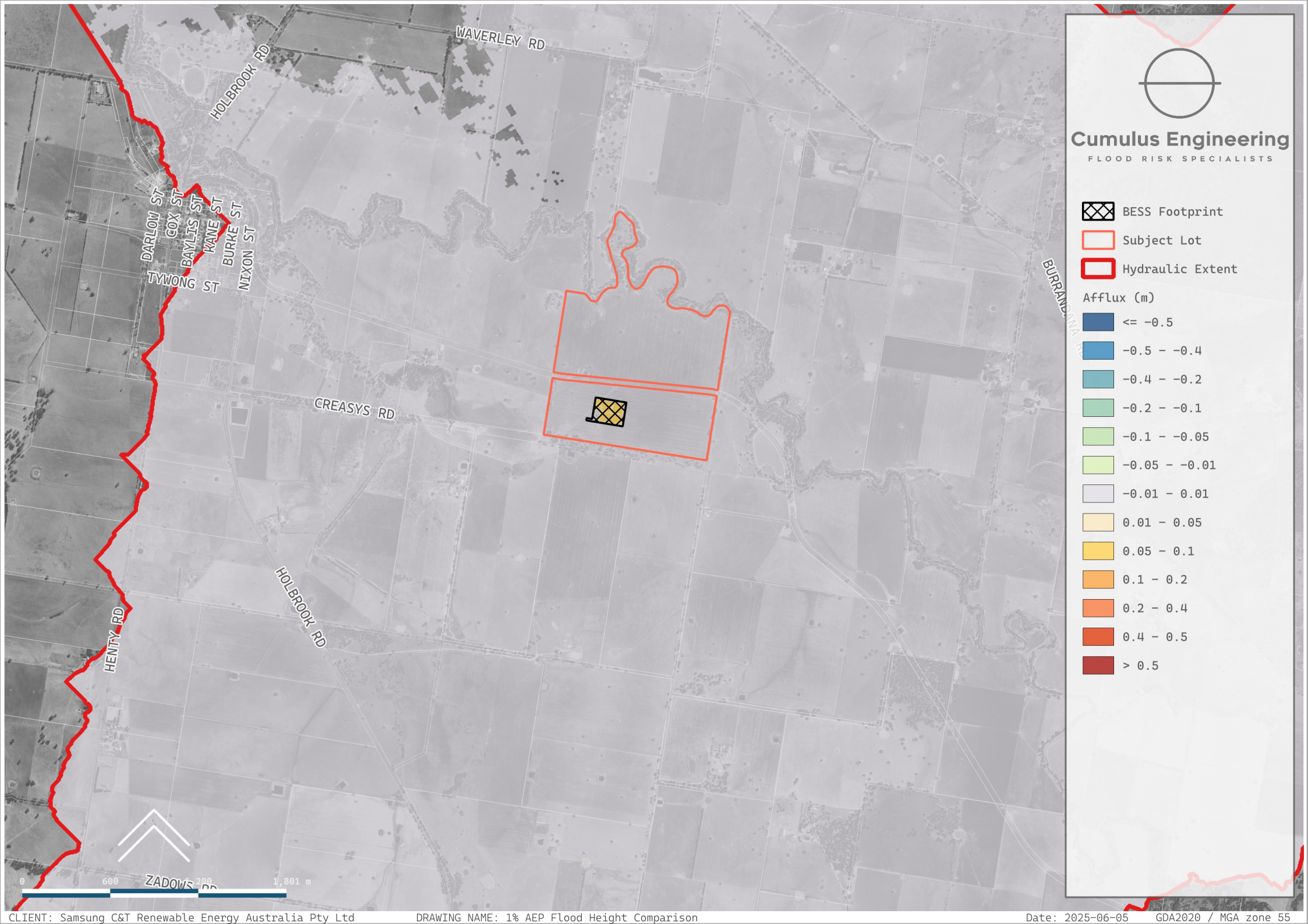


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Afflux (m)

-   $\leq -0.5$
-   $-0.5 - -0.4$
-   $-0.4 - -0.2$
-   $-0.2 - -0.1$
-   $-0.1 - -0.05$
-   $-0.05 - -0.01$
-   $-0.01 - 0.01$
-   $0.01 - 0.05$
-   $0.05 - 0.1$
-   $0.1 - 0.2$
-   $0.2 - 0.4$
-   $0.4 - 0.5$
-   $> 0.5$







**Cumulus Engineering**  
FLOOD RISK SPECIALISTS



BESS Footprint



Subject Lot



Hydraulic Extent

Afflux (m)



$\leq -0.5$



$-0.5 - -0.4$



$-0.4 - -0.2$



$-0.2 - -0.1$



$-0.1 - -0.05$



$-0.05 - -0.01$



$-0.01 - 0.01$



$0.01 - 0.05$



$0.05 - 0.1$



$0.1 - 0.2$



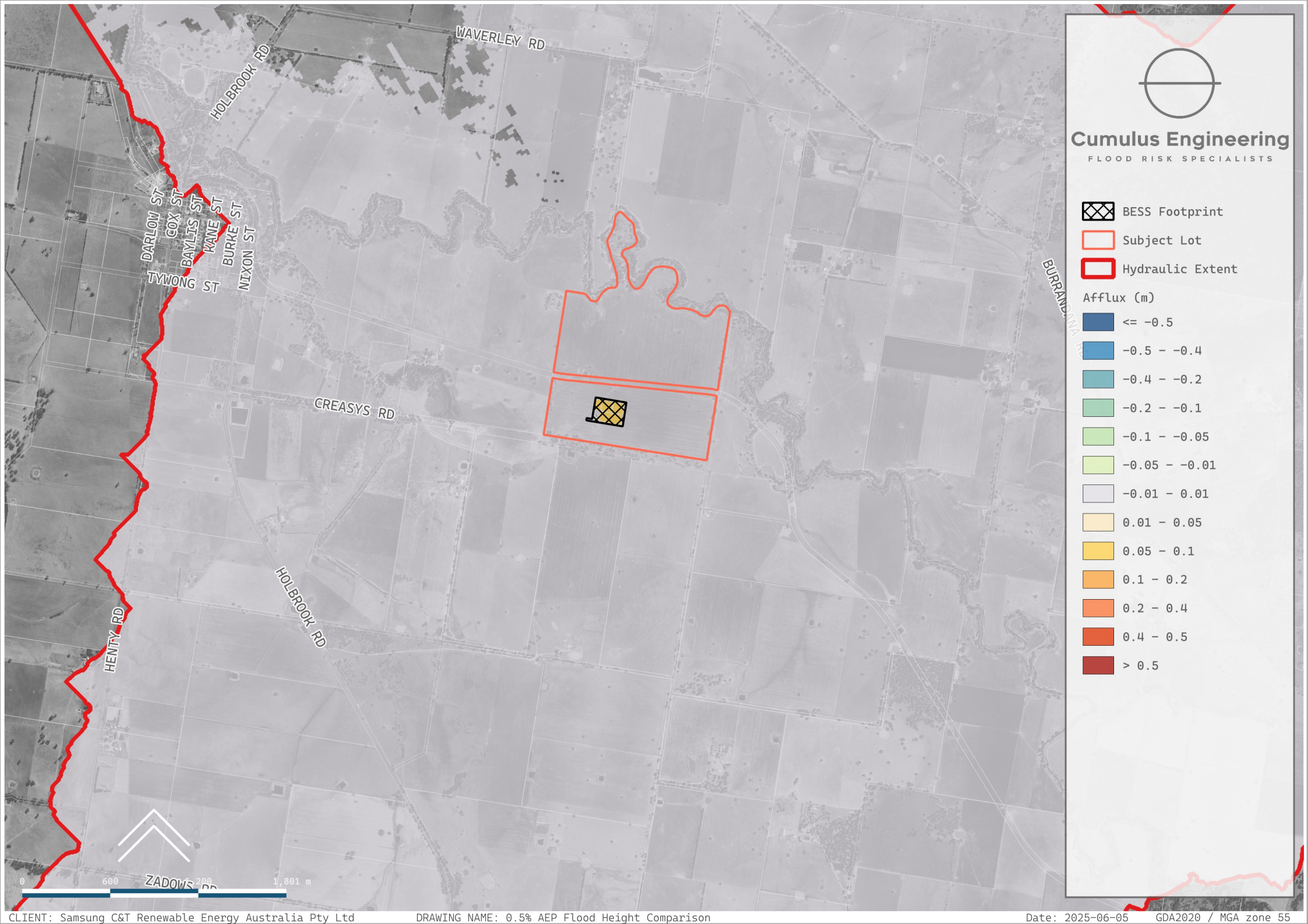
$0.2 - 0.4$



$0.4 - 0.5$



$> 0.5$





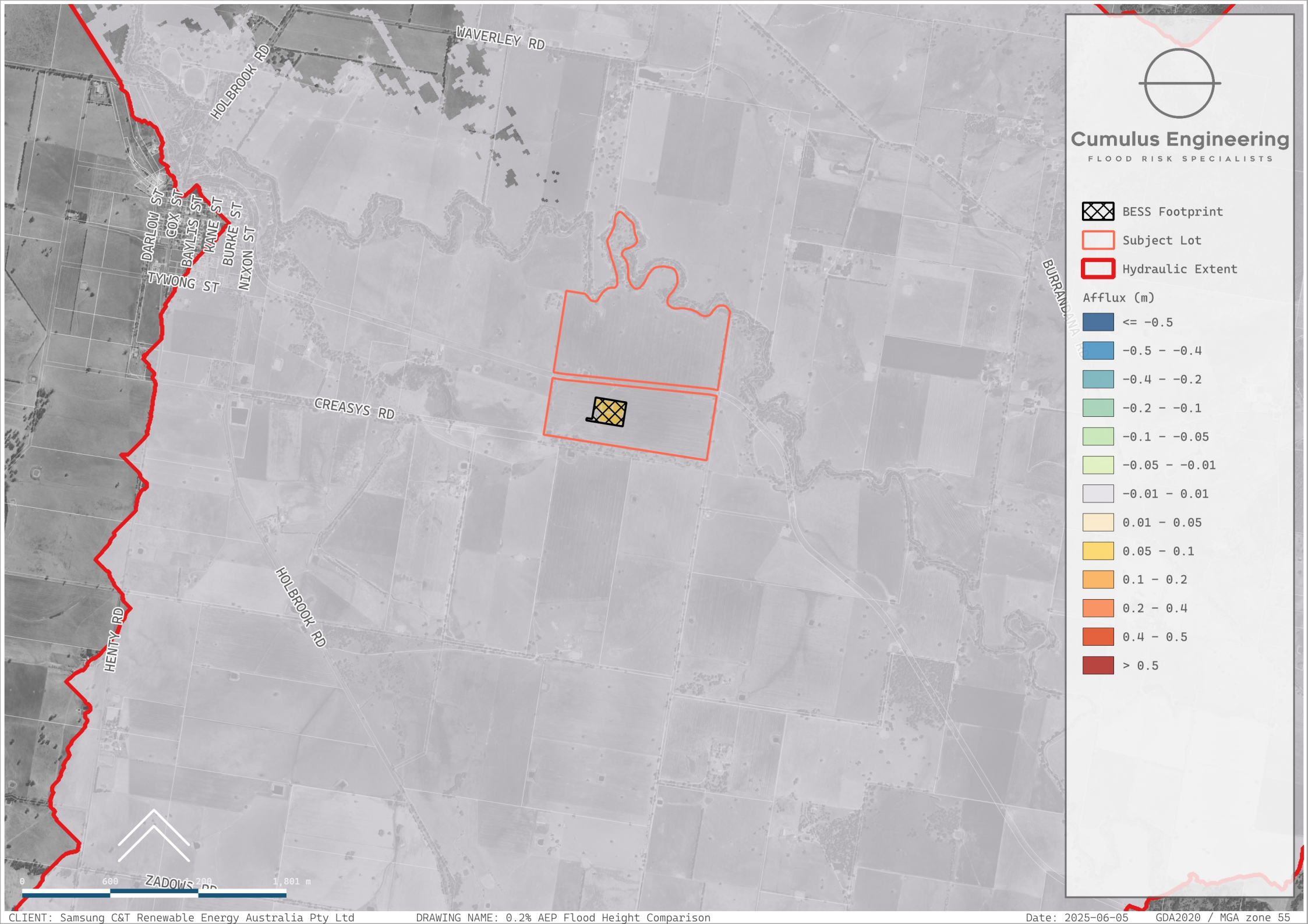


**Cumulus Engineering**  
FLOOD RISK SPECIALISTS

-  BESS Footprint
-  Subject Lot
-  Hydraulic Extent

Afflux (m)

-   $\leq -0.5$
-   $-0.5 - -0.4$
-   $-0.4 - -0.2$
-   $-0.2 - -0.1$
-   $-0.1 - -0.05$
-   $-0.05 - -0.01$
-   $-0.01 - 0.01$
-   $0.01 - 0.05$
-   $0.05 - 0.1$
-   $0.1 - 0.2$
-   $0.2 - 0.4$
-   $0.4 - 0.5$
-   $> 0.5$







**Cumulus Engineering**  
FLOOD RISK SPECIALISTS



BESS Footprint



Subject Lot



Hydraulic Extent

Afflux (m)



$\leq -0.5$



$-0.5 - -0.4$



$-0.4 - -0.2$



$-0.2 - -0.1$



$-0.1 - -0.05$



$-0.05 - -0.01$



$-0.01 - 0.01$



$0.01 - 0.05$



$0.05 - 0.1$



$0.1 - 0.2$



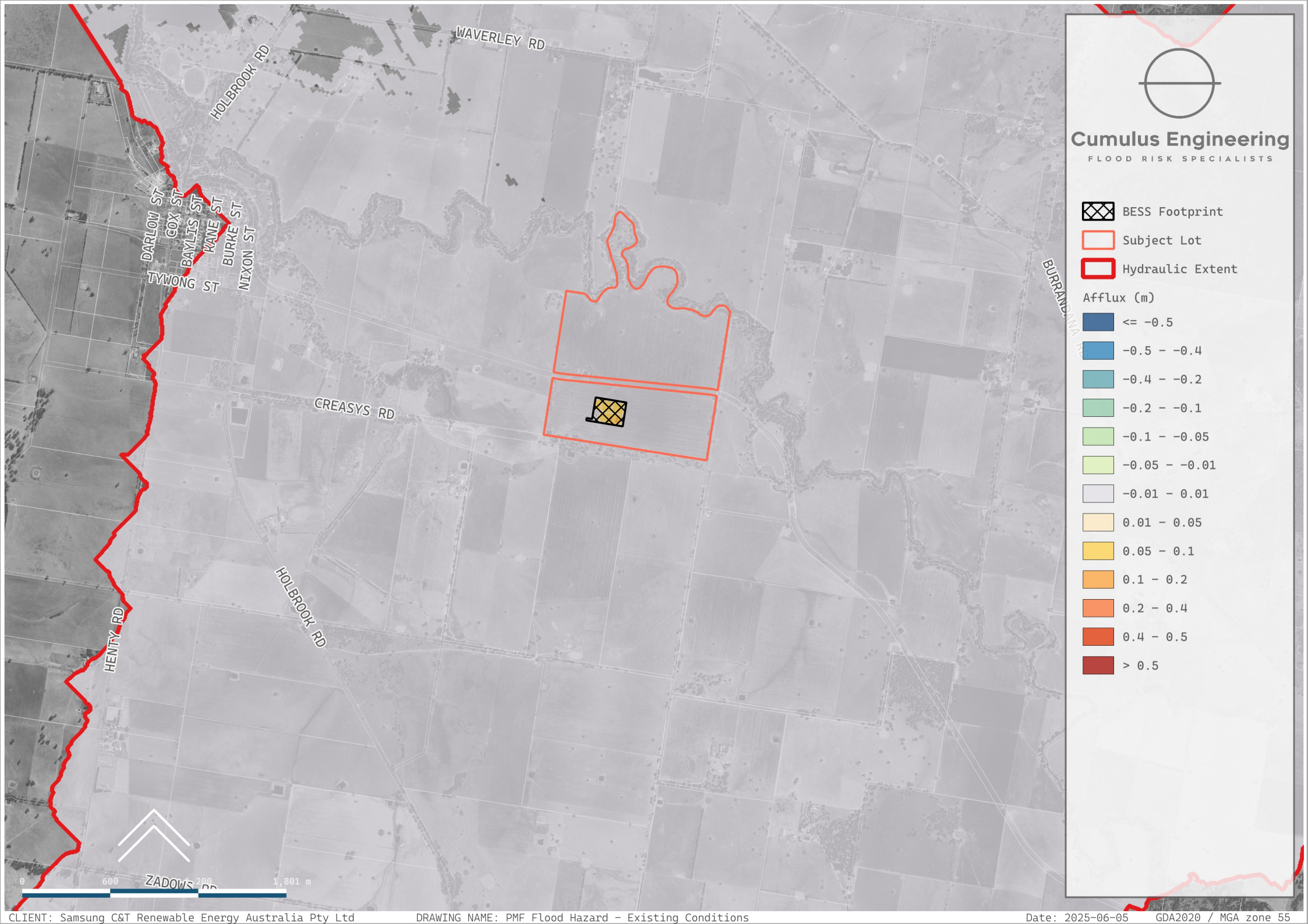
$0.2 - 0.4$



$0.4 - 0.5$



$> 0.5$

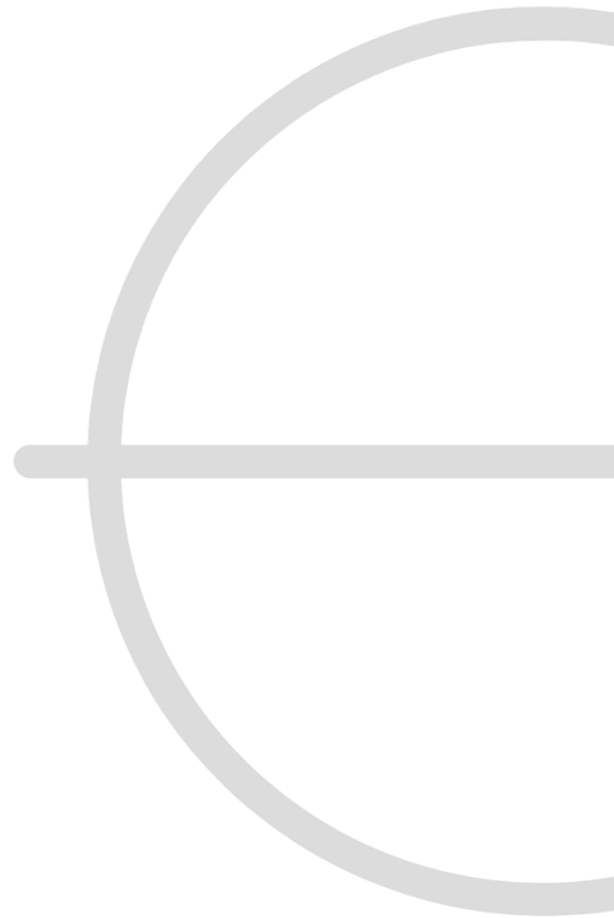


ZADOMS

1,801 m



# **Appendix C. Council & SES Consultation Meeting Minutes**





## Mangoplah BESS – Flood Assessment & Evacuation Discussion

### Meeting Minutes

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**Meeting Details:** 19/06/2025, 3:30pm, Teams Meeting

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**Attendees:**

- Andrew Mason (AM – Wagga Wagga City Council)
- Geordi Paxton (GP – Wagga Wagga City Council)
- Michael Nixon (MN – Cumulus Engineering)
- Sarah Hillis (SHi – NGH Consulting)
- Sarah Hollis (SHo – Cumulus Engineering)
- Stephan Mitchell (SM – Samsung C&T Renewable Energy Australia)
- Warren Faulkner (WM – Wagga Wagga City Council)

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#### Project Overview:

Cumulus Engineering have been engaged by NGH Consulting and the client Samsung C&T Renewable Energy Australia (SREA) to conduct a flood assessment for the proposed Mangoplah Battery Energy Storage System (BESS) facility.

The project is in the concept phase with preliminary design only. Final levels, emergency plans, and construction staging to follow development approval.

#### Topic 1 – Presentation of project and flood risk assessment

The presentation is to give an overall summary of the flood impact assessment for a proposed development in Mangoplah.

MN presented the findings from the assessment which included hydrological and hydraulic modelling, simulating flood behaviour under different flood design events (1% AEP, 5% AEP, 0.2% AEP, 0.5% AEP, as well as PMP event). The main event that was addressed regarding the flood evacuation arrangements was the 1% AEP event.

#### Flood Modelling Approach:

- Hydraulic modelling completed from the 5% AEP to PMF.
- Focus of evacuation considerations is on the 1% AEP event.
- The BESS footprint is located on a high point within the surrounding topography
- The BESS footprint is flood-free across modelled scenarios, and the development has no adverse flood impacts on neighbouring properties.
- Local rainfall is the sole source of inundation within the subject site in the 5% to 0.5% AEP events.
- Key outcomes:
  - Maximum flood depth (developed conditions): 2.6m.
  - Average flood depth: 30mm
  - Average hazard classification: H1 (no restriction)
  - Small areas of H5 hazard exist in localised low points, outside of the Development Footprint



**Flood Impact Observations:**

- Flood hazard and depth mapping show that most of the BESS site is subject to minimal inundation, up to 30 mm.  
Afflux map (change in water level pre- and post- development) shows minimal to no offsite flood impacts.  
The site is not impacted by riverine flooding in the 1% to 0.5% AEP events.

**Emergency Management:**

- Proposed Emergency Access Route follows unnamed track south from site towards Paper Forest Road, following Paper Forest Road West onto Zadows Road, providing access to Mangoplah
- Access Route provides safe access with majority of the route experiencing H1 hazard, with minor areas of H2.
- SHo commented that LiDAR used for access route likely provides conservative assessment, as the 5m DEM is unlikely to accurately pick up road crest.
- SM added context that the battery site will be operated remotely, and there will only be periodic visits from workers for maintenance and optimisation.

**Topic 2 - Discussion****Emergency Access and Maintenance Concerns**

- AM raises concerns about the accessibility of the site during flood events, particularly on Paper Forest Road, as historically this road has had issues regarding flooding. Added that Mangoplah also can become isolated in flood events.
- SHo comments that the development remains flood-free, and that operation of the site will be remote.
- SM adds that maintenance and usability of the site will be ad hoc.
- AM suggests checking recently flown 1m LiDAR of Mangoplah.

**Ownership and Maintenance of Emergency Access Roads**

- WF inquires about the ownership and maintenance of both main access track and emergency access road, noting that they are not maintained by Council
- SHi clarifies that the main access track remains private and is not proposed for regular use
- WF and SM discuss the potential need for upgrading the emergency access road needs to be flood-free and maintained.
- SHo says that emergency access routes do not need to be upgraded or maintained if they already provide safe access and egress in an extreme event.

**Action Items:**

- ▶ Cumulus Engineering to circulate the meeting minutes to all attendees.
- ▶ Cumulus Engineering to provide Council with draft report of the flood assessment.
- ▶ Cumulus Engineering to provide Council with hydrologic & hydraulic models used for assessment.
- ▶ Cumulus Engineering to investigating maintenance requirements for emergency access and egress routes.
- ▶ Wagga Wagga City Council to provide high resolution LiDAR to Cumulus Engineering.



## Mangoplah BESS – Flood Assessment & Evacuation Discussion with SES

### Meeting Minutes

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**Meeting Details:** 24/07/2025, 3:00pm, Teams Meeting

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**Attendees:** Ana Maria Chitu (AMC – NSW SES)  
Gillian Webber (GW – NSW SES)  
Julian Skipworth (JS – Cumulus Engineering)  
Maddy Shaw (MS – NGH Consulting)  
Michael Nixon (MN – Cumulus Engineering)

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#### Project Overview:

Cumulus Engineering have been engaged by NGH Consulting and the client Samsung C&T Renewable Energy Australia (SREA) to conduct a flood assessment for the proposed Mangoplah Battery Energy Storage System (BESS) facility.

The project is in the concept phase with preliminary design only. Final levels, emergency plans, and construction staging to follow development approval.

#### Topic 1 – Presentation of project and flood risk assessment (presented by MN)

The presentation is to give an overall summary of the flood impact assessment for a proposed development in Mangoplah.

MN presents the findings from the assessment which included hydrological and hydraulic modelling, simulating flood behaviour under different flood design events (1% AEP, 5% AEP, 0.2% AEP, 0.5% AEP, as well as PMP event). The main event that was addressed regarding the flood evacuation arrangements was the 1% AEP event.

#### Flood Modelling Approach:

- Hydraulic modelling completed from the 5% AEP to PMF.
- Focus of evacuation considerations is on the 1% AEP event.
- The BESS footprint is located on a high point within the surrounding topography
- The BESS footprint is flood-free across modelled scenarios, and the development has no adverse flood impacts on neighbouring properties.
- Local rainfall is the sole source of inundation within the subject site in the 5% to 0.5% AEP events.
- Key outcomes:
  - Maximum flood depth (developed conditions): 2.6m.
  - Average flood depth: 30mm
  - Average hazard classification: H1 (no restriction)
  - Small areas of H5 hazard exist in localised low points, outside of the Development Footprint

#### Flood Impact Observations:



- Flood hazard and depth mapping show that most of the BESS site is subject to minimal inundation, up to 30 mm.
- Afflux map (change in water level pre- and post- development) shows minimal to no offsite flood impacts.
- The site is not impacted by riverine flooding in the 1% to 0.5% AEP events.

#### **Emergency Management:**

- Proposed Emergency Access Route follows unnamed track south from site towards Paper Forest Road, following Paper Forest Road West onto Zadows Road, providing access to Mangoplah
- Access Route provides safe access with majority of the route experiencing H1 hazard, with minor areas of H2.
- The operation of the BESS site will be undertaken remotely, with maintenance and optimisation visits on an ad hoc basis.

#### **Topic 2 - Discussion**

- GW suggests a flood emergency management plan (FEMP) be established for the operation of the site.
- GW says NSW SES are able to review any FEMP if time and staff availability permit
- JS & GW discuss that construction, optimisation, and maintenance should be avoided in the case of severe weather warnings/conditions.
- GW enquires about whether Mangoplah would be equipped to host extra people who would be on-site in the case of an emergency event during construction. MS says that local workforces are normally employed.
- AMC & GW emphasise that the probable maximum flood should be considered when assessing safe evacuation routes.
- GW says local units will be engaged when reviewing the flood assessment for the Mangoplah BESS, and any subsequent FEMP, if available.

#### **Action Items:**

- Cumulus Engineering to circulate the meeting minutes to all attendees.



Our Ref: ID 3234  
Your Ref: SSD-77527735

31 July 2025

Michael Nixon  
Cumulus Engineering  
Via email

email: [michael.nixon@cumuluseng.com.au](mailto:michael.nixon@cumuluseng.com.au)  
CC: [pragya.mathema@planning.nsw.gov.au](mailto:pragya.mathema@planning.nsw.gov.au); [joshua.stanbury@ses.nsw.gov.au](mailto:joshua.stanbury@ses.nsw.gov.au);

Dear Michael

### **State Significant Development Application for Mangoplah Battery Energy Storage System**

Thank you for the opportunity to provide comment on the State Significant Development (SSD) Application for Mangoplah Battery Energy Storage System (BESS) at 4178 Holbrook Road, Mangoplah. It is understood that the project would involve the construction, operation and decommissioning of a Battery Energy Storage System (BESS) with a capacity of up to approximately 100 Megawatts (MW) / 400MWh (4 hours).

The NSW State Emergency Service (NSW SES) is the agency responsible for dealing with floods, storms and tsunami in NSW. This role includes planning for, responding to and coordinating the initial recovery from floods. As such, the NSW SES has an interest in the public safety aspects of the development of flood prone land, particularly the potential for changes to land use to either exacerbate existing flood risk or create new flood risk for communities in NSW.

The NSW SES recommends that consideration of flooding issues is undertaken in accordance with the requirements of NSW Government's Flood Prone Land Policy as set out in the Flood Risk Management Manual 2023 (the Manual) and supporting guidelines, including the Support for Emergency Management Planning and relevant planning directions under the *Environmental Planning and Assessment Act, 1979*. Some of the key considerations relating to emergency management are further detailed in Appendix A.

While the site is not mapped as flood prone, Paper Forest Creek and Burkes Creek cross parts of the Project Site.

#### **In summary, we:**

- **Support** that the Environmental Impact Statement (EIS) for this project includes a detailed assessment of flooding hazard on site to be undertaken in the form of a hydrology impact assessment undertaken by a suitably qualified hydrologist. For emergency management, modelling of flooding up to and including the PMF should



be considered to address any risks, including warnings and isolation, for workers and site users during flooding events.<sup>1</sup>

- **Advise** updating the Key government plans, policies and guidelines referred to in the scoping report<sup>2</sup> to the Flood Risk Management Manual 2023 (the Manual and supporting guidelines) from the superseded Floodplain Risk Management Guidelines (Department of Environment and Climate Change, 2016), and Floodplain Development Manual: The management of flood liable land (NSW Government, 2005).
- **Recommend** considering flooding impacts on the broader road network, to ensure that people are able to evacuate the site to a safe area above the PMF level, on the available the access/egress route and within the available timeframe. **Evacuation must not require people to drive or walk through flood water.**
- **Recommend** pursuing site design and stormwater management that reduces the impact of flooding and minimises any risk to the site users and community. Any improvements that can be made to reduce flood risk will benefit the community.
- **Recommend** considering flood resilience of the infrastructure, if identified that it is likely to be damaged or contaminated by flood water, to events up to and including the PMF. This could include placing any sensitive infrastructure such as battery storage, inverters, etc., above the PMF level, if feasible, to minimize risk to property and financial losses.
- **Recommend** and support the inclusion of flooding into a Business Emergency Plan, which is robust, thorough and detailed enough to address all aspects of a flood emergency, including the safety of people and mitigating damage to property. **Note** that the NSW SES does not have the statutory authority to endorse private evacuation plans nor does it have the resources to review and comment on private plans for individual businesses.
- **Recommend** considering the impacts of climate change. It is estimated that the actual probability of a 1 in 100 AEP for this catchment area is approximately a 1 in 58 AEP event for the current 2025 scenario.<sup>3</sup> For the proposed development site, this could result in more frequent inundation and/or isolation than what is currently expected based on previous modelling.

You may also find the following Guidelines available on the NSW SES website useful:

- [Reducing Vulnerability of Buildings to Flood Damage](#)
- [Managing Flood Risk Through Planning Opportunities](#)

Please feel free to contact Gillian Webber via email at [rra@ses.nsw.gov.au](mailto:rra@ses.nsw.gov.au) should you wish to discuss any of the matters raised in this correspondence. The NSW SES would also be

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<sup>1</sup> NHG, 2025. Scoping Report Mangoplah BESS page 69

<sup>2</sup> NHG, 2025. Scoping Report Mangoplah BESS page A-III and A-IV

<sup>3</sup> WMAWater. 2024. Climate Change Calculator. Retrieved 29 July 2025 from <https://ccc.wmawater.com.au/>



interested in receiving future correspondence regarding the outcome of this referral via this email address.

Yours sincerely



Elspeth O'Shannessy  
Manager Emergency Risk Assessment  
**NSW State Emergency Service**



## **ATTACHMENT A: Principles Outlined in the Support for Emergency Management Planning Guideline<sup>4</sup>**

### **Principle 1 Any proposed Emergency Management strategy should be compatible with any existing community Emergency Management strategy.**

Any proposed Emergency Management strategy for an area should be compatible with the strategies identified in the NSW State Flood Plan<sup>5</sup> and Wagga Wagga City Flood Emergency Sub Plan<sup>6</sup>, where evacuation is the primary emergency management strategy for people impacted by flooding.

Any plan developed as a part of the management strategy of the site should consider all aspects of a flood emergency including responsibilities, transportation, medical emergency, vulnerabilities, flood forecasting and warning, flood emergency response triggers, procedures, plan dissemination, testing, and review cycle. We recommend including clear and actionable triggers, for example based on Severe Weather Warnings and consider closing the site ahead of the start of the operational day if there are severe weather warnings for heavy rainfall, particularly considering the flash flooding risk in the area.

Any plan should include a review mechanism for updating the plan at regular intervals and whenever additional flood information is available or highlighted during a flood event. In addition, please note, the NSW SES does not have the statutory authority to endorse private evacuation plans.

We understand that the site-specific designs will be finalised during detailed design and construction. We recommend that the site design considers rising road access where possible for access tracks and waterway crossings (i.e., minor culvert crossings or causeways).

### **Principle 2 Decisions should be informed by understanding the full range of risks to the community.**

Decisions relating to future development should be risk-based and ensure Emergency Management risks to the community of the full range of floods are effectively understood and managed. Noting the proposal is not for residential use, site workers and visitors will need to be aware that during flood events access to the Wagga Wagga CBD area is lost with multiple access roads being cut due to riverine, creek and mainstream flooding.

Further, risk assessment should consider the full range of flooding, including events up to the Probable Maximum Flood (PMF) and not focus only on the 1% AEP flood. Climate change should also be considered.

### **Principle 3 Development of the floodplain does not impact on the ability of the existing community to safely and effectively respond to a flood.**

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<sup>4</sup> NSW Government. 2023. Principles Outlined in the Support for Emergency Management Planning Guideline

<sup>5</sup> NSW Government. 2021. NSW State Flood Plan. Section 1.6 – Key Principles. 1.6.2, page 5

<sup>6</sup> NSW SES. 2020. Wagga Wagga City Flood Emergency Sub Plan. Section 3.18 Managing Evacuation Operations, page 30



**Principle 4 Decisions on development within the floodplain does not increase risk to life from flooding.**

**Principle 5 Risks faced by the itinerant population need to be managed.**

Any Emergency Management strategy needs to consider people visiting the area or using a development.

**Principle 6 Recognise the need for effective flood warning and associated limitations.**

An effective flood warning strategy with clear and concise messaging understood by the community is key to providing the community an opportunity to respond to a flood threat in an appropriate and timely manner.

NSW SES and the Bureau of Meteorology do not have the operational capacity to provide individualised flood warnings for each business site. Therefore, it is important that business owners and operators are weather aware and act early on severe weather warnings.

Users of the site should be made aware of their flood risk, the [Hazards Near Me](#) app (a tool to receive flood warnings as part of the Australian Warning System) and the [NSW SES website](#) which contains comprehensive information for the general community about what to do before, during and after floods as well as in-language resources and HazardWatch (NSW SES interactive information and warnings site).

**Principle 7 Ongoing community awareness of flooding is critical to assist effective emergency response.**

Any flood risk at the site and actions taken to reduce risk to life should be communicated to all site users (includes increasing risk awareness, community connections, preparedness actions, appropriate signage and emergency drills) during and after the construction phase. However, it is important to note that the NSW SES is opposed to the imposition of development consent conditions requiring private flood evacuation plans rather than the application of sound land use planning and flood risk management.