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WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Surface Water Assessment

Gippsland BESS

Accent Environmental

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1 INTRODUCTION

1.1 Overview

This report details the flood study findings for a proposed battery energy storage system (BESS) development on Tramway Road, Hazelwood North, Victoria, known as Gippsland BESS. The site is located adjacent to the Jeeralang Power Station. Bennetts Creek, a tributary of Waterhole Creek draining to the Latrobe River, flows through the south-western corner of the site.

The proposed BESS site is shown in Figure 1-1, with the indicative site overview (16 December 2025) shown in Figure 1-2.

Figure 1-1 Site Locality

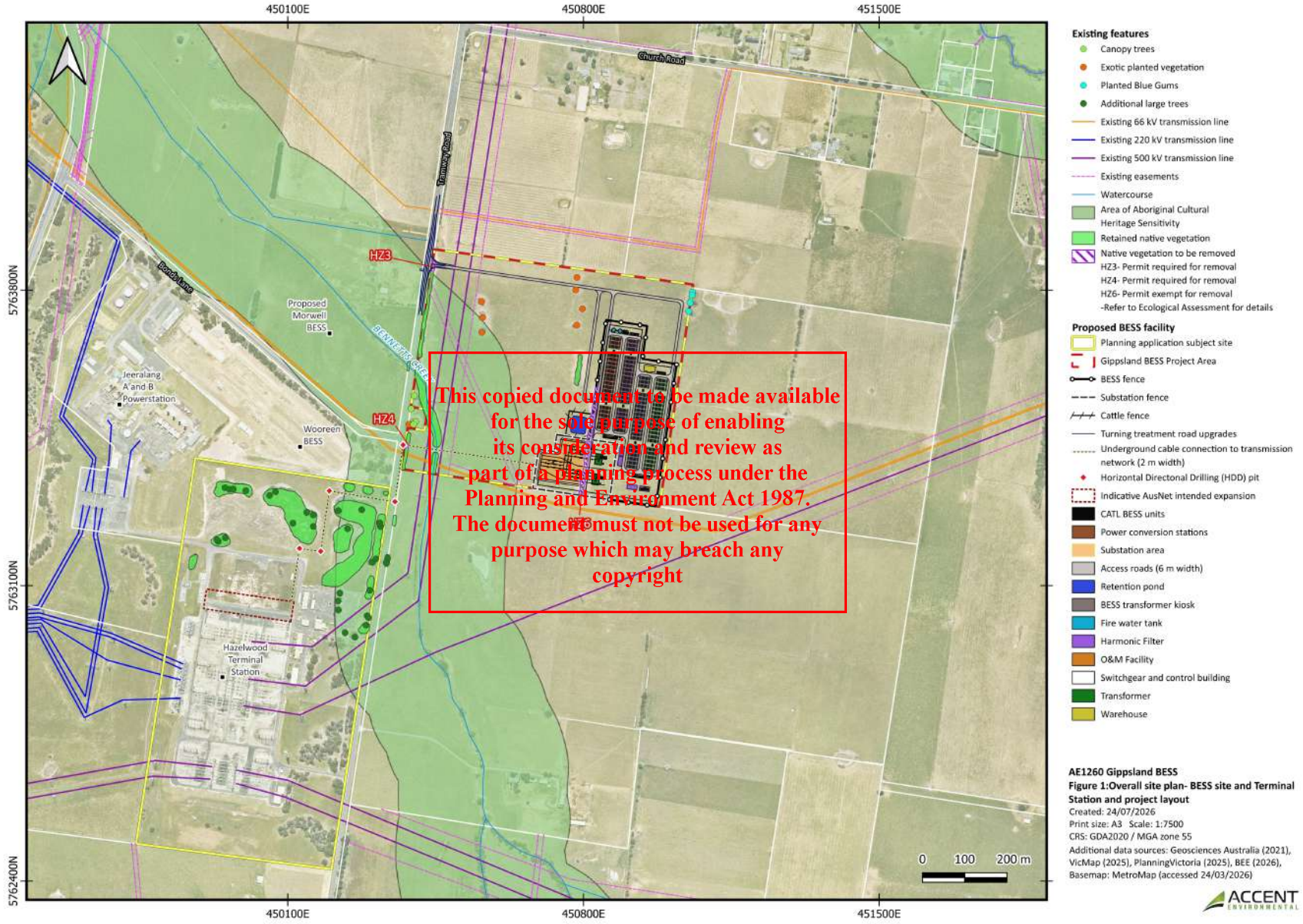

Figure 1-2 Site Locality

1.2 Methodology

The objective of this surface water impact assessment is to quantify the impact of the proposed BESS development on several elements of the surface water environment. This includes assessment of the following:

- Inundation potential – the probability for the development to be inundated by riverine flooding and/or local stormwater runoff.
- Drainage alterations – the potential for the development to affect offsite flood extents, levels, velocities and/or hazard classifications and flow rates and/or volumes.

The approach characterised the existing surface water environment, as well as the effect of the proposed BESS development in relation to it. This included:

- Establishing the existing surface water and catchment environment characteristics, including prevailing drainage functions/behaviour and water quality.
- Characterising the surface water-groundwater interaction within the area local to the subject site.
- Assessing changes to surface water behaviour resulting from the development of the proposed BESS (including impacts to water quality and, subsequently, ecological values).
- Identifying design options and/or mitigation measures which serve to eliminate or minimise any potential negative effects of the BESS construction and operation on the relevant surface water environments.

The flood risk assessment for the subject site was based on hydrologic modelling of the Bennetts Creek catchment upstream of the BESS site and hydraulic modelling of both riverine and direct rainfall / localised catchment inundation. Outputs from the hydraulic model were used to assess flood impacts and risk, and inform decision-making in relation to the layout of the BESS infrastructure.

1.3 Site

Located on agricultural land, the subject site is situated within the Latrobe River basin in the West Gippsland Catchment Management Authority (WGCMA) management area. Bennetts Creek, a tributary of Waterhole Creek which coalesces with the Latrobe River, flows north of the site. The upstream catchment of Bennetts Creek that drains to the site is approximately 25 km^2.

The site is split by a ridge that runs north-south approximately halfway across its extent; the eastern portion of the site drains in a north-easterly direction, following the alignment of Bennetts Creek, while the western portion slopes to the west. Elevations across the site vary approximately from 99.7 to 87.1 m AHD. The local topography is depicted in Figure 1-3.

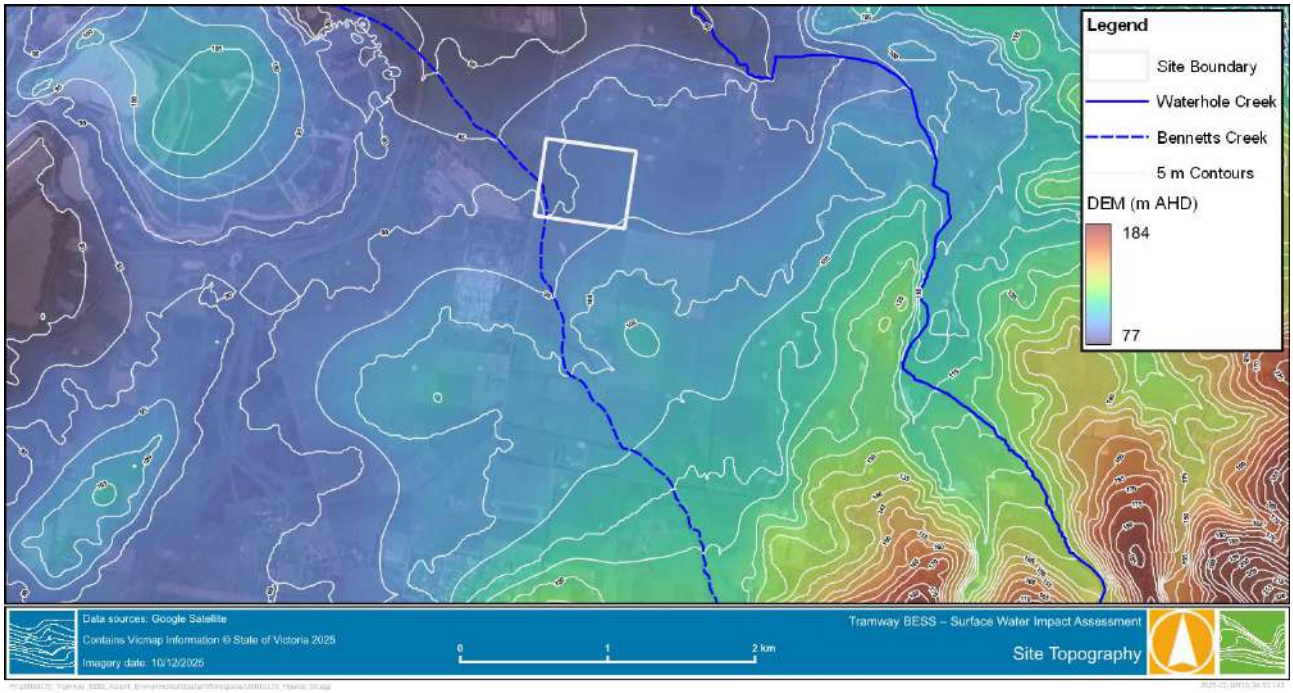

Figure 1-3 Site Topography

2 HYDROLOGIC MODELLING

2.1 Overview

Hydrological modelling of the subject site comprised of the following components:

- The hydrology of the Bennetts Creek catchment was modelled using a RORB rainfall runoff model, which produced design hydrographs for the catchment in accordance with Australian Rainfall and Runoff 2019 (ARR 2019) guidelines. Inflow hydrographs from the Bennetts Creek RORB model were incorporated into a TUFLOW hydraulic model, where the flows were routed through the site topography and surrounding area to determine the maximum flood depths, velocities and hazard classifications of the 1% annual exceedance probability (AEP) storm event.
- The local catchment hydrology was modelled using a rain-on-grid (RoG) approach, which introduces rainfall directly onto the TUFLOW hydraulic model.

2.2 Bennetts Creek Catchment Hydrology

2.2.1 Methodology

Design hydrologic modelling was completed using an ensemble approach as recommended in ARR 2019. The methodology for determining the 1% AEP design flow is outlined below:

- Delineation of the Bennetts Creek catchment upstream of the subject site.
- Designation of design inputs (e.g. rainfall, temporal patterns).
- Determination of storage parameters and rainfall losses.
- Selection of critical storm event.
- Extraction of inflow hydrographs for hydraulic model.

Details of these steps are provided in the following sections.

2.2.2 Catchment Delineation

The Bennetts Creek catchment upstream of the proposed BESS development was delineated into 53 individual sub-areas. The delineation was based on the 10 m VicMap digital elevation model (DEM). The resulting delineated sub-areas were then processed using geographic information system (GIS) mapping software to create a series of nodes and reaches, which represented the routing characteristics of the catchment, and were to be employed in the RORB model. All reaches were defined as natural channels; this definition was assumed based on expected flow characteristics owing to aerial photography, as well as prior hydrologic modelling experience. Sub-area fraction imperviousness was based on the aerial imagery and land use characteristics of the region.

The resulting RORB model encompassed a total catchment area of approximately 25 km^2, with the subject site located at the downstream end of the delineated catchment (as seen in Figure 2-1).

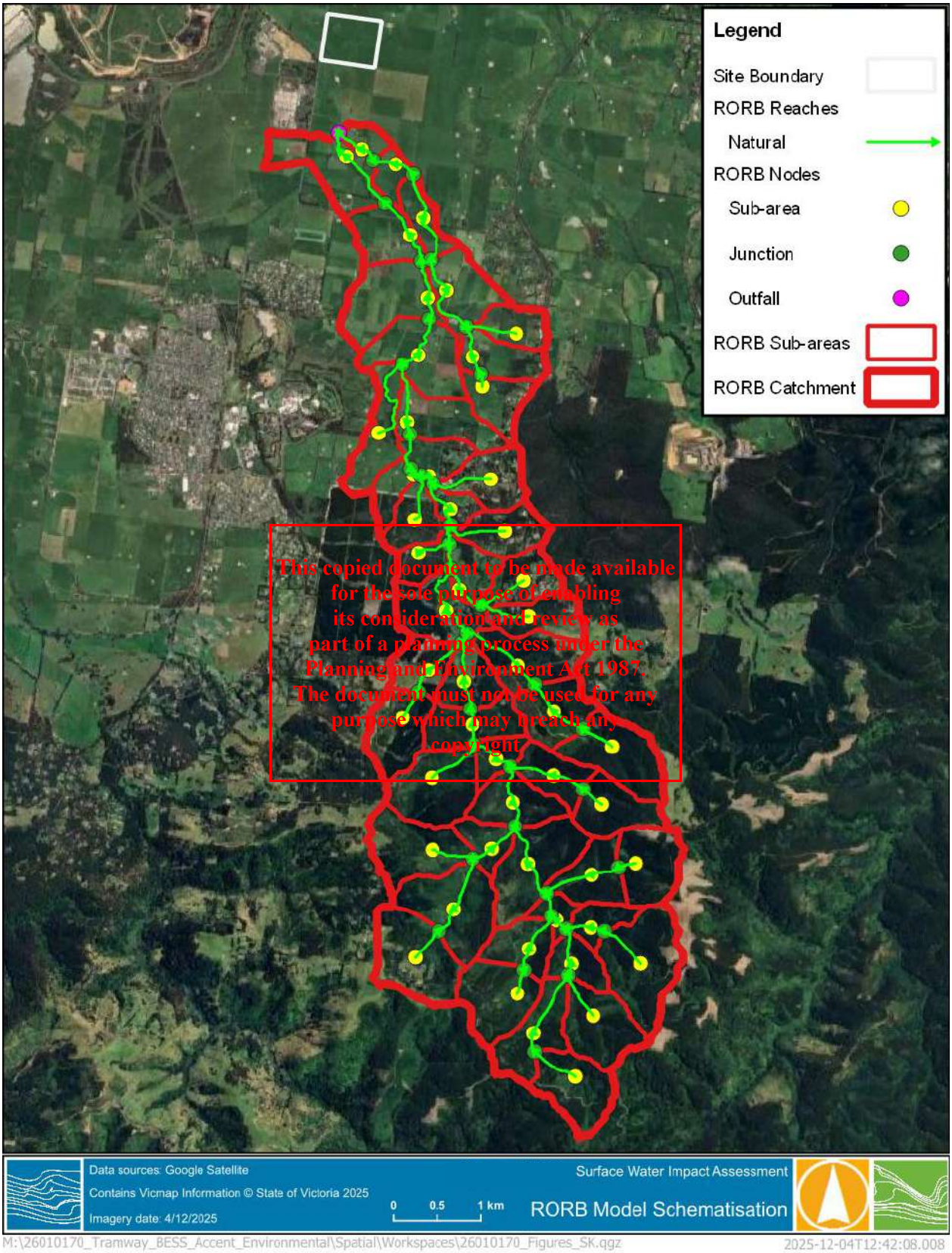

Figure 2-1 RORB Model Schematisation

2.2.3 Model Parameters

The storage parameters and rainfalls losses adopted in the RORB model for the current study are listed in Table 2-1. Selection of the parameters employed was informed by a combination of the ARR 2019 recommendations, and past hydrologic modelling experience in the local area (including work undertaken by Water Technology in relation to the Waterhole Creek Flood Study in 2007).

Table 2-1 RORB Model Parameters

Parameter	Value
Initial Loss (IL)	21 mm
Continuing Loss (CL)	1 mm/h
k_c	9.51
m	0.80

2.2.4 Design Inputs

2.2.4.1 Intensity-Frequency-Duration (IFD) Design Rainfall

Rainfall depths for the 1% AEP event were estimated for the catchment centroid using the intensity-frequency-duration (IFD) information available from the Bureau of Meteorology (BoM) website. The design rainfall estimate for the study area is shown in Table 2-2 for the critical duration.

Table 2-2 IFD Design Rainfall Depth

AEP	Rainfall Depth
1%	100 mm

2.2.4.2 Temporal Patterns

Design storm temporal patterns were downloaded from the ARR 2019 Data Hub and were used to simulate the distribution of rainfall depth bursts during each storm event modelled. Point-based temporal patterns were utilised given the limited size of the catchment. Outputs owing to each of the ten temporal patterns for each event duration were compared, and the temporal pattern that resulted in the median peak flow was adopted for a particular event duration.

2.2.5 Critical Storm Events

An ensemble assessment was undertaken to determine the critical duration of the storm events affecting the subject site via riverine inundation. As mentioned previously, due to the limited size of the upstream catchment, point temporal patterns were used in the hydrologic analysis.

Table 2-3 details the 1% AEP peak flow at the Bennetts Creek hydraulic model inflow location for the critical storm duration. The assessment indicated that a 9-hour storm duration generates the highest peak flows for the 1% AEP events in relation to the riverine system.

Table 2-3 1% AEP Critical Storm Event

AEP	Peak Flow	Critical Duration	Critical Temporal Pattern
1%	57 m^3/s	9 hours	30

2.2.6 Model Validation

The 1% AEP event peak flow at the outlet of the RORB catchment model was compared to flood quantiles produced by the ARR Regional Flood Frequency Estimation (RFFE) model; the comparison of peak flow estimates is detailed in Table 2-4. The peak flow modelled in RORB as part of the current study is very similar to the flow estimate produced by the RFFE model, and is comfortably within the 90% confidence limit.

Table 2-4 1% AEP Peak Flow Estimates

Source	Discharge (m^3/s)
RORB Model	57
RFFE Model	59.2
RFFE Model 5% Confidence Limit	27
RFFE Model 95% Confidence Limit	130

2.3 Local Catchment Hydrology

As described in Section 1, a direct rainfall or rain on grid (ROG) modelling approach using TUFLOW was adopted for the simulation of local storm event inundation across the study area. TUFLOW is an industry-standard one and two-dimensional modelling package which has been used as part of numerous flood modelling projects across Australia.

The RoG approach involves directly applying rainfall to a topographic grid of the area of interest; this serves to identify flow paths through the modelling of surface water runoff, and enables mapping of flood extents, depths, velocities and hazard classifications. RoG modelling is a robust method to determine runoff volumes, peak flow rates and areas of high flood risk within regions comprised by complex topography. RoG models can identify major flow paths, depressions, and the interactions of overland flow.

The specific details of the RoG modelling undertaken in TUFLOW is discussed alongside the hydraulic modelling in Section 3.

3 HYDRAULIC MODELLING

3.1 Overview

The TUFLOW hydraulic model characterised both riverine and local catchment inundation, representing the two potential flooding mechanisms relevant to the subject site. Riverine flooding was simulated using an inflow hydrograph located along Bennetts Creek, which was taken from the RORB hydrologic model and routed through the TUFLOW DEM, while localised catchment runoff was modelled using TUFLOW's RoG functionality.

3.2 Model Extent

The model extent is shown in Figure 3-1, with flow boundaries also shown (it should be noted that for RoG modelling, rainfall was applied to the entirety of the model extent, and therefore no specific RoG boundary is shown).

Figure 3-1 TUFLOW Model Extent

3.3 Topography

The TUFLOW DEM was generated based on the 1 m Digital Twin Victoria (DTV) Balook LiDAR DEM (the TUFLOW DEM is seen in Figure 3-2).

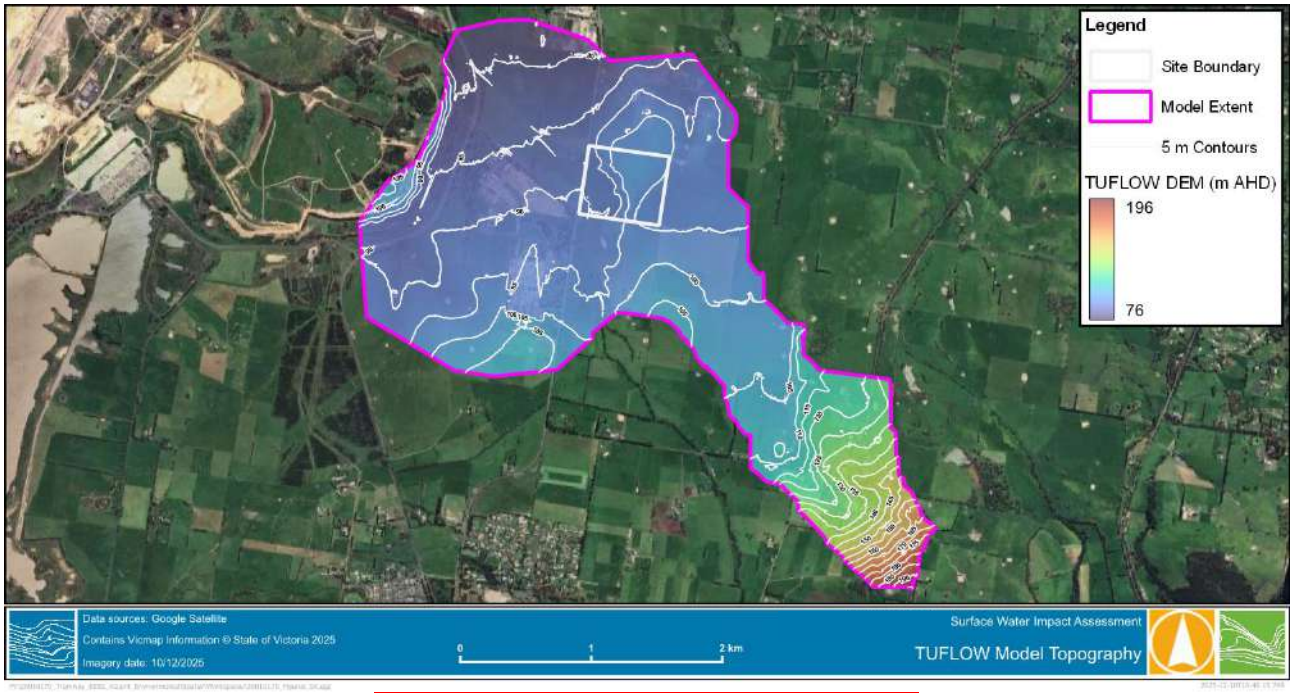

Figure 3-2 TUFLOW Model Topography

3.4 Riverine Inundation

The riverine inflow was located within Bennetts Creek approximately 810 m south of the proposed BESS. The inflow was modelled as an external discharge-time boundary referencing hydrographs derived from the Bennetts Creek catchment RORB model.

3.5 Local Catchment Inundation

Localised catchment inundation was simulated by introducing rainfall directly onto the model extent. As mentioned previously, the model extent shown in Figure 3-1 was utilised as the area for the application of direct rainfall.

Rainfall inputs for the TUFLOW model were extracted using the ARR 2019 feature in the QGIS TUFLOW plugin, which downloads the data required for RoG modelling from the ARR 2019 Data Hub and BoM websites. The 1% AEP rainfalls depths for storm events from 30 minutes to 24 hours in duration were incorporated into the hydraulic model as part of ensuring that the critical event durations could be ascertained. Based on the inundation depicted at the subject site following the modelling, it was determined that the 45-minute and two-hour events were those that were critical in relation to local catchment runoff.

3.6 Downstream Boundary

The downstream model outflow was represented using an external level-discharge boundary, with a slope corresponding to the local floodplain gradient; this allows flow to recede from the model without unduly influencing flood levels at the site.

3.7 Land Use

Land use layers were created based on aerial imagery and planning scheme zones. Hydraulic roughness coefficients (i.e. Manning's *n*) and rainfall loss values were assigned to each land use type. The values adopted

were based on recommendations from ARR 2019 and conservatively adjusted. Table 3-1 summarises the adopted land use parameters, and Figure 3-3 presents the land use layers geospatially.

Table 3-1 Land Use Parameters

		IL (mm)			CL (mm/h)		
Land Use	***n***	**9-hr**	**2-hr**	**45-min**	**9-hr**	**2-hr**	**45-min**
Utility Zone	0.35	0	3.85	7.45	2.1	2.1	2.1
Residential Zone	0.15	0	6.16	11.92	3.36	3.36	3.36
Open Space	0.08	0	7.7	14.9	4.2	4.2	4.2
Dense Vegetation	0.12	0	7.7	14.9	4.2	4.2	4.2
Waterbody	0.02	0	0	0	0	0	0
Road	0.02	0	0.3	4.47	1.26	1.26	1.26

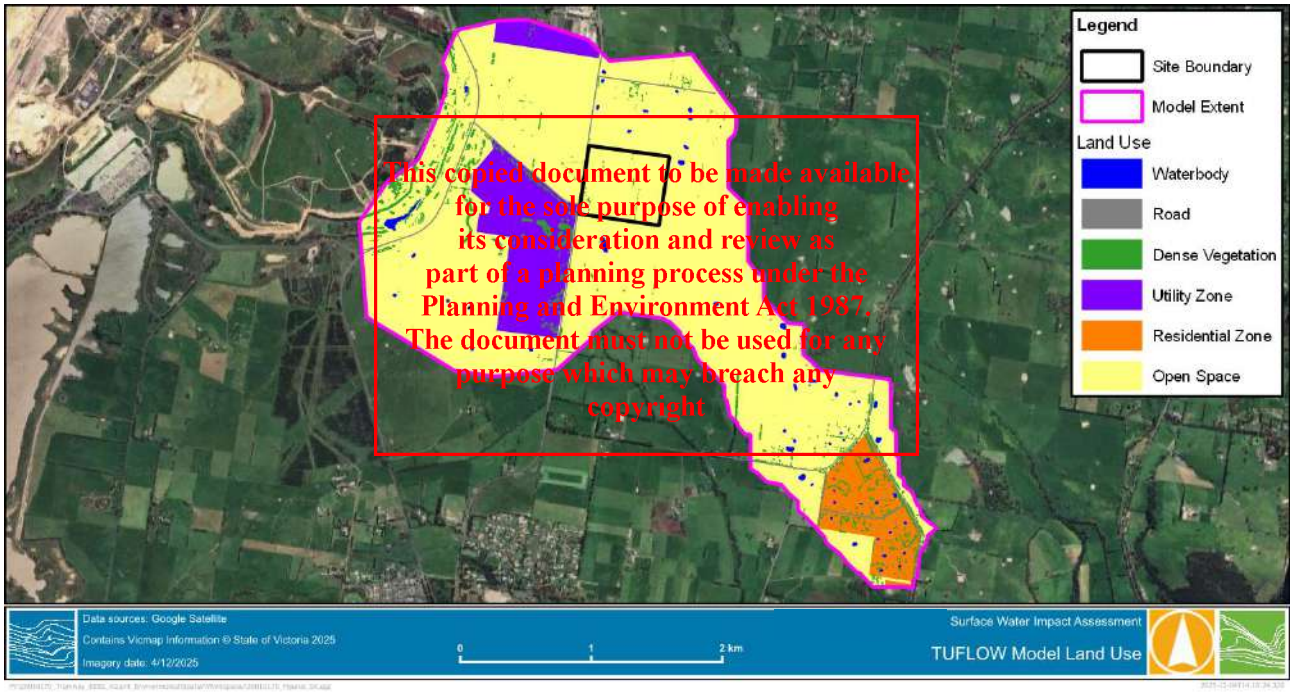

Figure 3-3 TUFLOW Model Land Use

3.8 Hydraulic Structures

Culverts along Bennetts Creek and Tramway Road were characterised within the TUFLOW model based on information and knowledge obtained from previous investigations undertaken within the region by Water Technology, and current study area imagery. The culverts were incorporated into the model as one-dimensional structures connected into the two-dimensional modelling domain at their separate ends. The location and alignment of the culverts is highlighted in Figure 3-4.

Figure 3-4 TUFLOW Model Hydraulic Structures

4 RESULTS

The 1% AEP event hydraulic modelling results under existing conditions are show in Figure 4-1 to Figure 4-6. Isolated areas of inundation less than 250 m^2 (i.e. minor puddles), and where depths were below 0.05 m, were filtered for in the results presented. The Bennetts Creek inundation extends approximately 250 m into the subject site, with most of this present along the watercourse's eastern side. The depth of this inundation is mostly within the range of 0.3 to 1 m; a limited area of flood depth greater than 1 m is seen upstream of Tramway Road from 100 to 200 m north of the Bennetts Creek culvert (the prevailing flows also serve to overtop the carriageway). There is a small section of local catchment inundation along the site's eastern boundary; flood depths within this area are not particularly deep, being almost entirely under 0.2 m.

Flood velocities across the site are almost all minor; a relatively high proportion is below 0.5 m/s, with regions along Bennetts Creek reaching a maximum of 0.8 m/s.

Flood hazard at the site is comprised of hazard classification levels ranging from H1 (the lowest level) to H5 (only seen within the Bennetts Creek channel). This range is only present along the Bennetts Creek floodplain; a maximum of hazard classification level H1 is otherwise observed across the flood extent located along the eastern boundary of the site.

As detailed in Figure 4-2, there is no inundation on the Substation, Access road or Retention pond. There is a small amount of direct runoff and associated inundation on the BESS footprint; however, this is likely to be dealt with through internal drainage. The Transmission pathway does cross a major flow path, but this is not expected to interact with the inundation given it will be directionally drilled. It should be noted earthworks will be required to enable drainage to the Retention pond, grading the topography to that location.

Figure 4-1 1% AEP Flood Depth – Existing Conditions

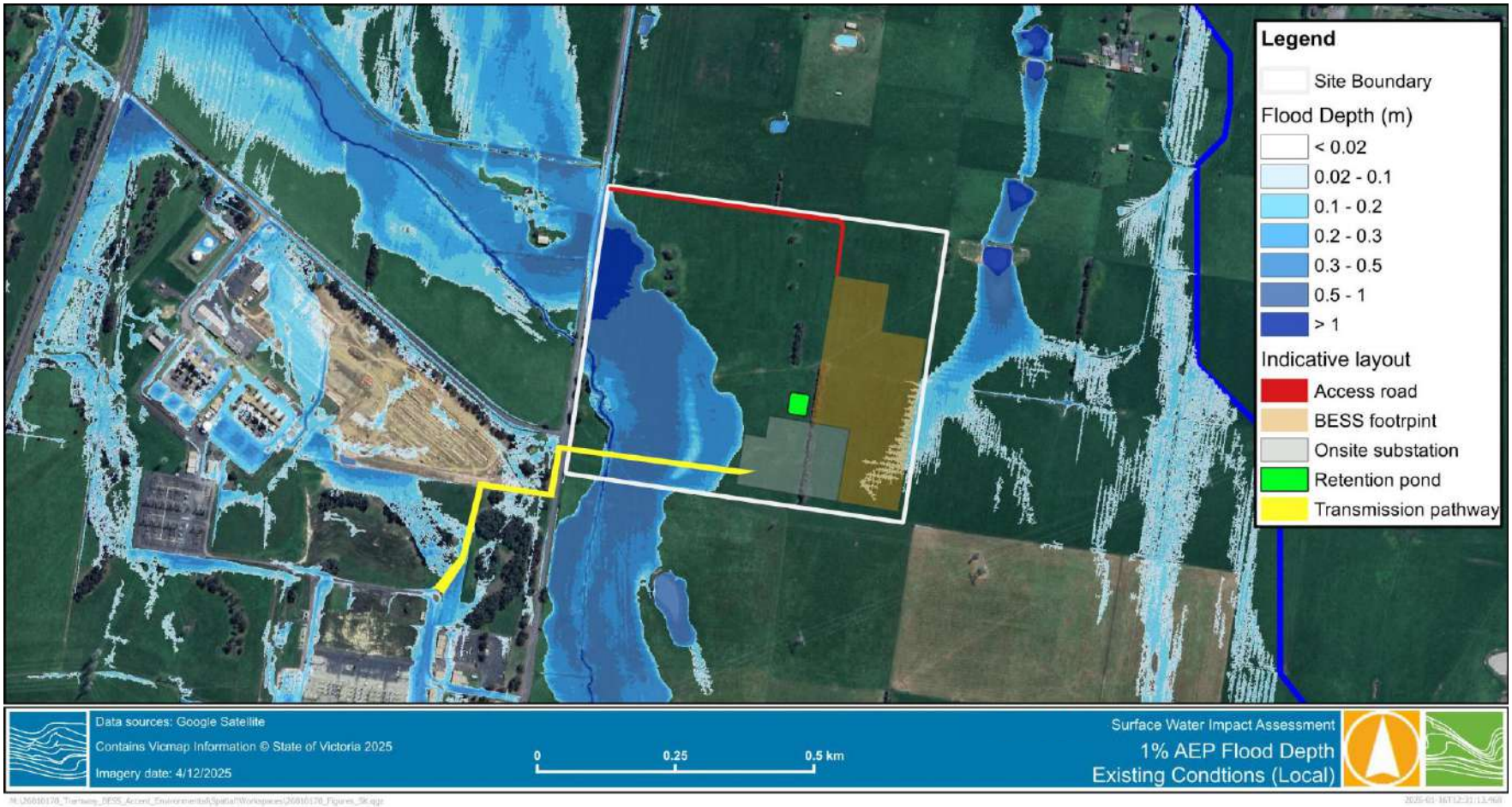

Figure 4-2 1% AEP Flood Depth – Existing Conditions (Local)

Figure 4-3 1% AEP Flood Velocity – Existing Conditions

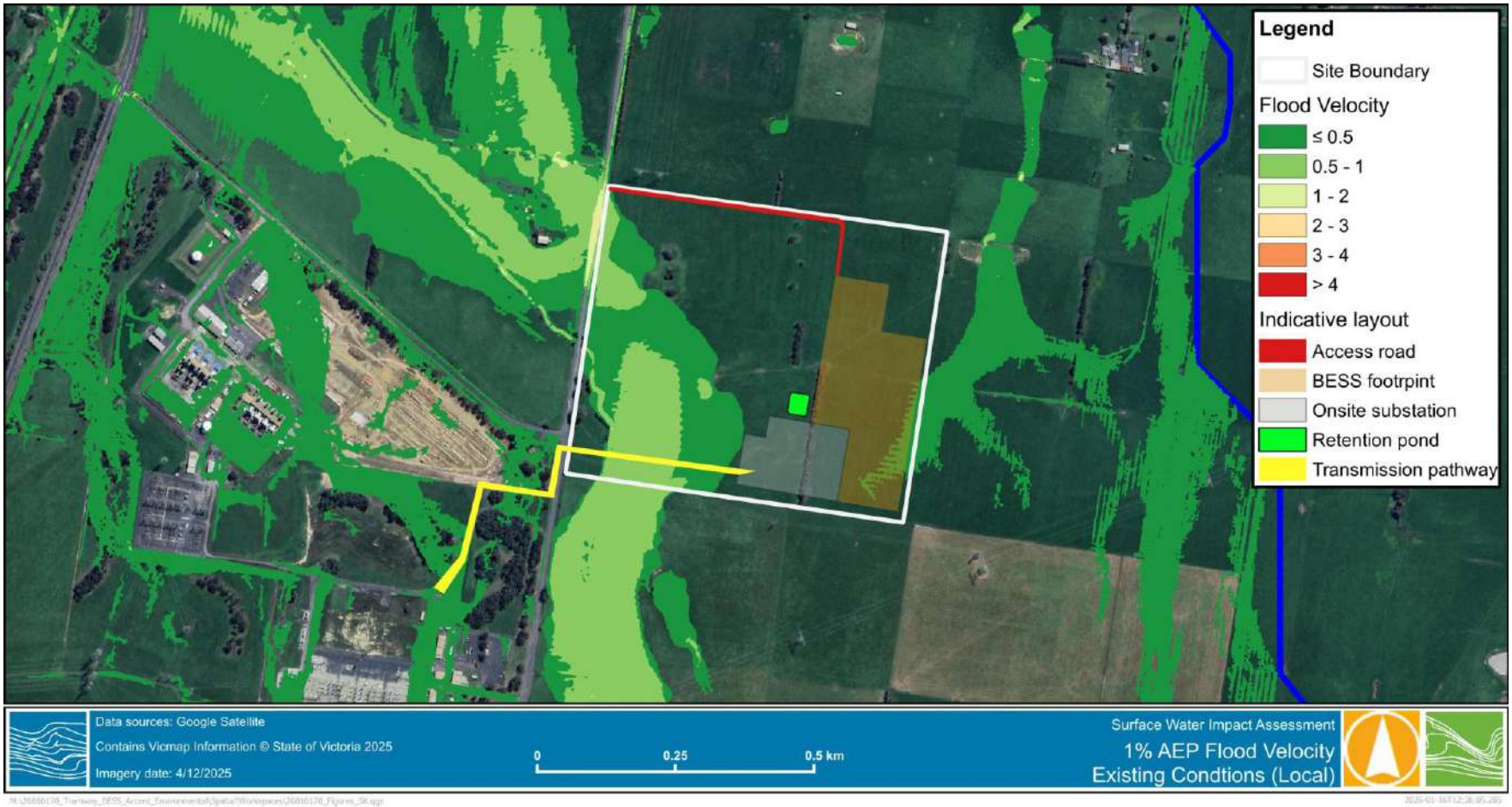

Figure 4-4 1% AEP Flood Velocity – Existing Conditions (Local)

Figure 4-5 1% AEP Flood Hazard – Existing Conditions

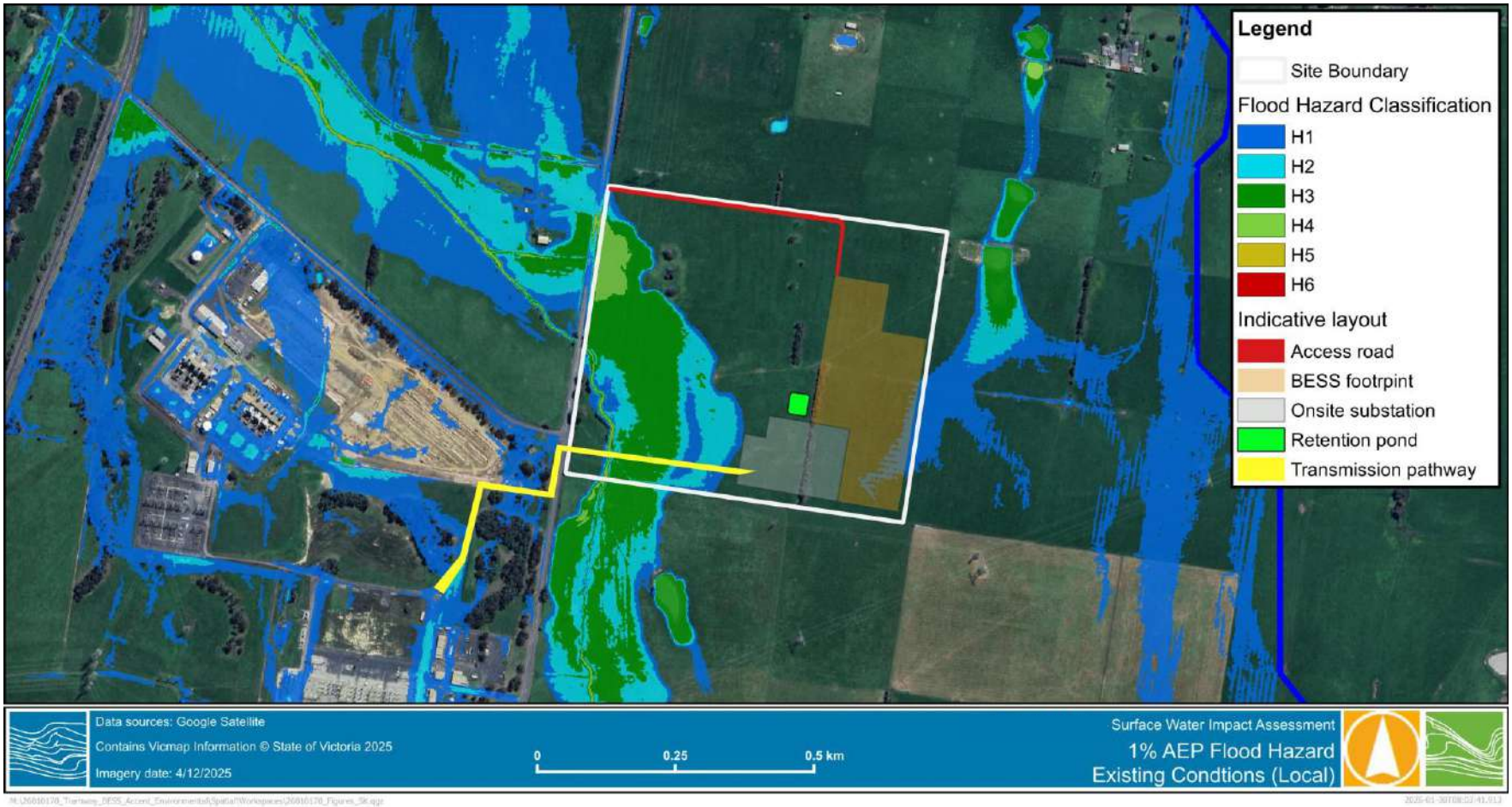

Figure 4-6 1% AEP Flood Hazard Classification – Existing Conditions (Local)

5 SUMMARY

The proposed Gippsland BESS infrastructure is largely outside the 1% AEP inundation extent, with minor inundation on the BESS footprint, driven by runoff from the footprint itself. The Transmission pathway does interact with a major flow path; however, it is expected to be directionally drilled. The location of the Retention pond will require earthworks to ensure the topography drains to that location.

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