Deniliquin East BESS

Flood Risk and Impact Assessment Report

Gransolar Group

12 May 2025

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ACKNOWLEDGEMENT OF COUNTRY

The Board and employees of Water Technology acknowledge and respect the Aboriginal and Torres Strait Islander Peoples as the Traditional Custodians of Country throughout Australia. We specifically acknowledge the Traditional Custodians of the land on which our offices reside and where we undertake our work.

We respect the knowledge, skills and lived experiences of Aboriginal and Torres Strait Islander Peoples, who we continue to learn from and collaborate with. We also extend our respect to all First Nations Peoples, their cultures and to their Elders, past and present.

Artwork by Maurice Goolagong 2023. This piece was commissioned by Water Technology and visualises the important connections we have to water, and the cultural significance of journeys taken by traditional custodians of our land to meeting places, where communities connect with each other around waterways.

The symbolism in the artwork includes:

- *Seven circles representing each of the States and Territories in Australia where we do our work*
- *Blue dots between each circle representing the waterways that connect us*
- *The animals that rely on healthy waterways for their home*
- *Black and white dots representing all the different communities that we visit in our work*
- *Hands that are for the people we help on our journey*

12 May 2025

Ben Davies
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Via email: bdavies@urbis.com.au

Dear Ben

Flood Risk and Impact Assessment Report

Please see the attached Flood Risk and Impact Assessment report for the proposed Deniliquin East BESS. This report documents the methodology and outcomes of the assessment relating to surface water flood risk and groundwater.

If you have any questions regarding this report, please get in touch.

Yours sincerely

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WATER TECHNOLOGY PTY LTD

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1 INTRODUCTION

1.1 Development Overview

This report details the findings of a risk and impact assessment for the proposed Battery Energy Storage System (BESS) at 21356 Riverina Highway, Deniliquin, NSW (the Site/Subject Site). The BESS is proposed to have a 100 MW/200MWh capacity and associated power conversion systems, switchgear, three No. 20,000 L firefighting water tanks and a control room. Gransolar has engaged Water Technology to prepare a flood risk and groundwater impact assessment.

The project site will be connected to the nearby Deniliquin Substation (Deniliquin 132/66kV TS) via a 132kV overhead transmission line crossing south over the Mulwala Canal and Riverina Highway.

1.2 Site location and layout

The Deniliquin BESS is situated within the Murray-Riverina catchment (Figure 1-1) amongst the engineered field channels and drains within existing agricultural land. The Site is located approximately 7km southeast of the Deniliquin township and Edward River, and is situated adjacent to the Riverina Highway and Mulwala Channel. The Edward River, that passes close to the Site, is an anabranch of the Murray River, rising east of Mathoura and flowing generally north-west through Deniliquin, rejoining the Murray River near Kyalite.

The Site is a 10min drive from the centre of Deniliquin and immediately north of the Riverina Highway. The Subject Site is proposed to enclose 3.5ha of leased land by ringfencing around lithium-ion battery modules, on-site substation, and other supporting infrastructure. Figure 1-2 below highlights the proposed lease area containing the key electrical infrastructure relative to the Mulwala Channel and existing Deniliquin substation.

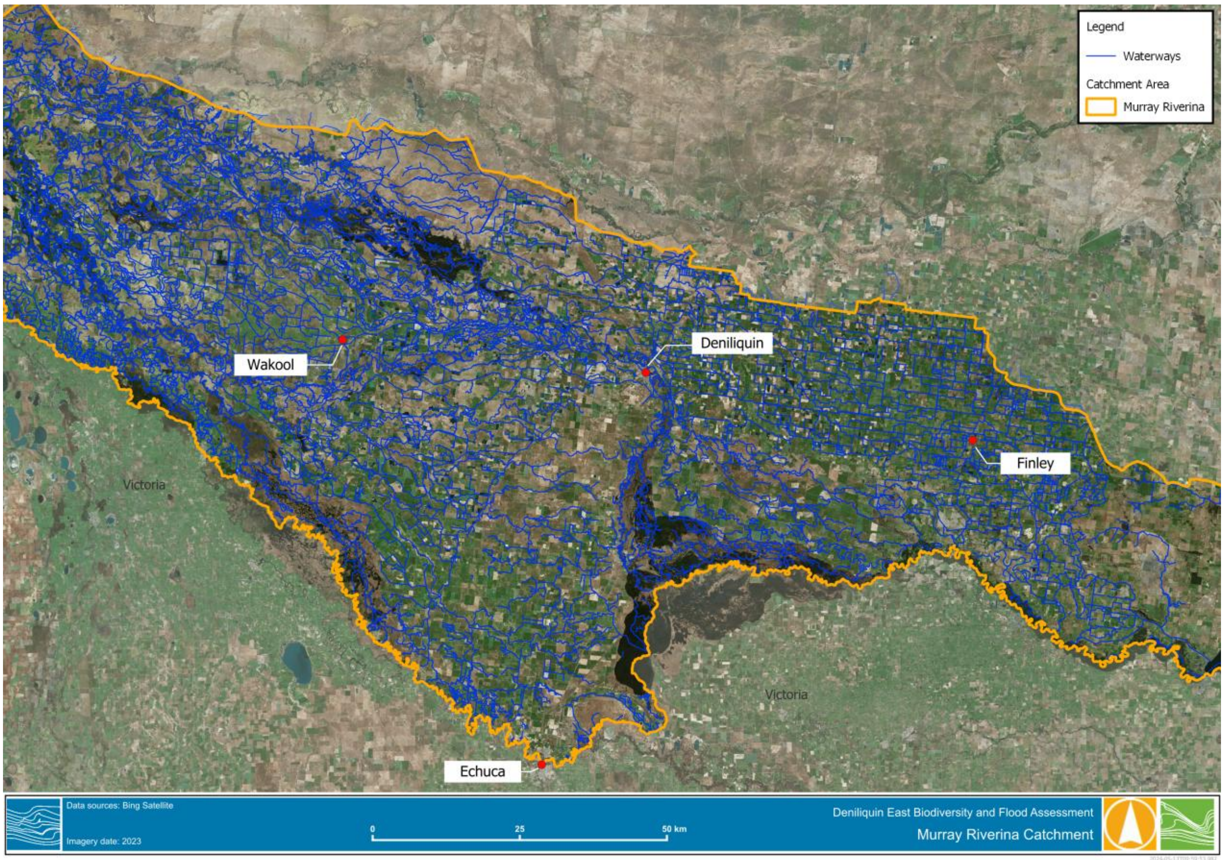

Figure 1-1 Murray Riverina catchment area

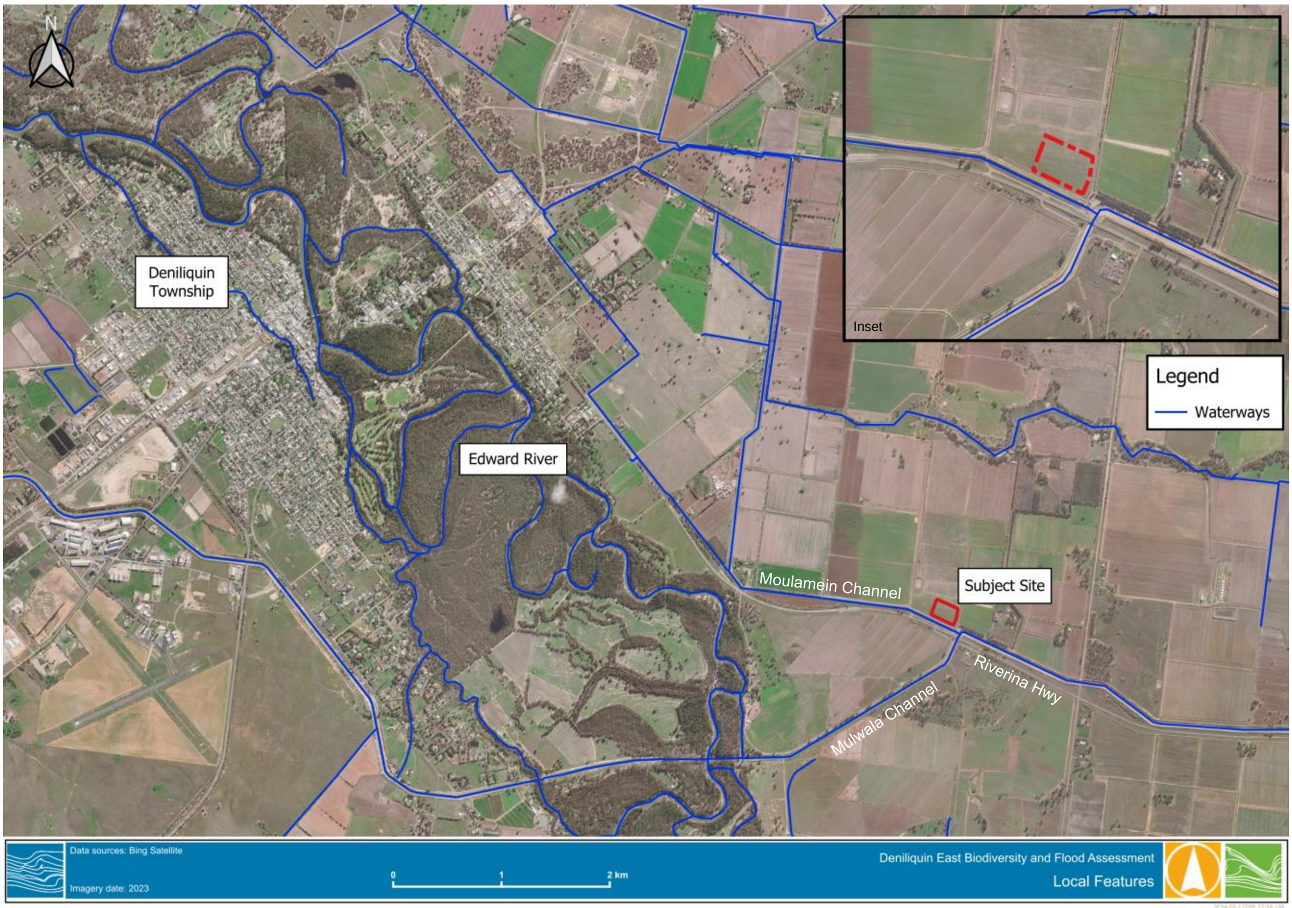

Figure 1-2 Subject Site

1.3 Scope and objective

The objective of this flood impact assessment was to assess and avoid/minimise/mitigate potential Site surface water inundation impacts. The work undertaken has involved:

- Characterisation of surface water in the project area, review of background information and topographic data.
- Review of existing groundwater information as available.
- The development of a baseline hydraulic model to reflect the flooding behaviour and mechanisms (depth, water levels and velocities).
- Identification of potential impacts of the project site on surface water; including effects on flooding (water levels, depths, velocities), and water quality.
- Preliminary hydrogeological assessment to determine groundwater level and any potential groundwater and surface water interactions at the Subject Site.
- Provision of high-level recommendations for any mitigation or design alterations which may be required to reduce potential risks associated with flooding, drainage and groundwater.

The output of the assessment is considered to provide the best currently available information on the flood risk and conceptualisation of groundwater at the Subject Site.

2 GROUNDWATER

This hydrogeological assessment considers key components of the groundwater system to develop a hydrogeological conceptual model (Section 2.2) that was used to inform a groundwater impact assessment (Section 2.3) to address general requirements detailed in DPEs Planning SEARs. Specifically, the hydrogeological conceptual model consolidates key geological and hydrogeological information at the Subject Site, including depth to and quality of the local groundwater system, as well as any seasonal variation to inform an assessment of:

- The likelihood of groundwater contamination.
- Potential impacts, if any, on the environment including groundwater-dependent ecosystems (GDEs).
- Potential impacts, if any, on and from acid sulfate soils.
- Potential cumulative impacts, if any, on the groundwater system (including impacts on nearby groundwater extraction for potable water supply or stock water supply (Water Access Licences (WALs)).

Finally, the assessment provides details on appropriate measures to avoid, minimise or mitigate the impacts, if any, from the development on the groundwater system.

The Subject Site is not located within a “groundwater vulnerable” area (NSW Department of Planning and Environment’s (DPEs) Groundwater Vulnerability mapping[2]; Deniliquin Local Environmental Plan (LEP), 2013). However, groundwater vulnerability at the Subject Site was assessed to ensure the groundwater systems are maintained and to protect resources from depletion and/or contamination due to the proposed development. Additionally, the assessment considers whether the proposed development is likely impact on groundwater salinity (Deniliquin LEP, 2013).

It is understood that during construction, the site shall have trenches excavated to maximum depths of 1.5 m below ground level (mbgl) for footings for the batteries and substations and there is a potential for sheet piles to be used for foundation supports, an oil bund to a depth of 0.9 m beneath the transformer is also expected to be constructed. For the purposes of this assessment, use of sheet piles has been considered. Further investigation may be warranted if the final construction design varies from any assumptions made herein.

2.1 Rainfall

Understanding historical rainfall seasonality and long-term trends is critical to surface water and groundwater investigations. Historical rainfall data was taken from the SILO database[3] for the grid point nearest to the study area (Latitude -35.55, Longitude 145.05). The dataset covers a 67-year period from 1957 to 2024, which is adequate to identify longer-term rainfall trends.

The mean annual rainfall is 400.2 mm/yr, with monthly average rainfall ranging between 25.1 mm in February and 40.4 mm in October (Figure 2-1). Annual rainfall is highly variable and Figure 2-2 shows periods of both above and below-average rainfall over the 67-year period. The above-average rainfall is interpreted from the cumulative deviation from the mean monthly rainfall (CDMMR) (Figure 2-2), which identifies when rainfall has trended above average (inclining line) or below average (declining line). Above-average rainfall periods were noted between approximately 1958 – 1962, 1972 – 1976, 1992 – 1994, 2010 – 2012 and 2020. Two periods between approximately 1977 – 2009 and 2013 – 2021 are noted as having a long-term below-average rainfall trend.

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[2] https://datasets.seed.nsw.gov.au/dataset/epi-groundwater-vulnerability
[3] https://www.longpaddock.qld.gov.au/silo/

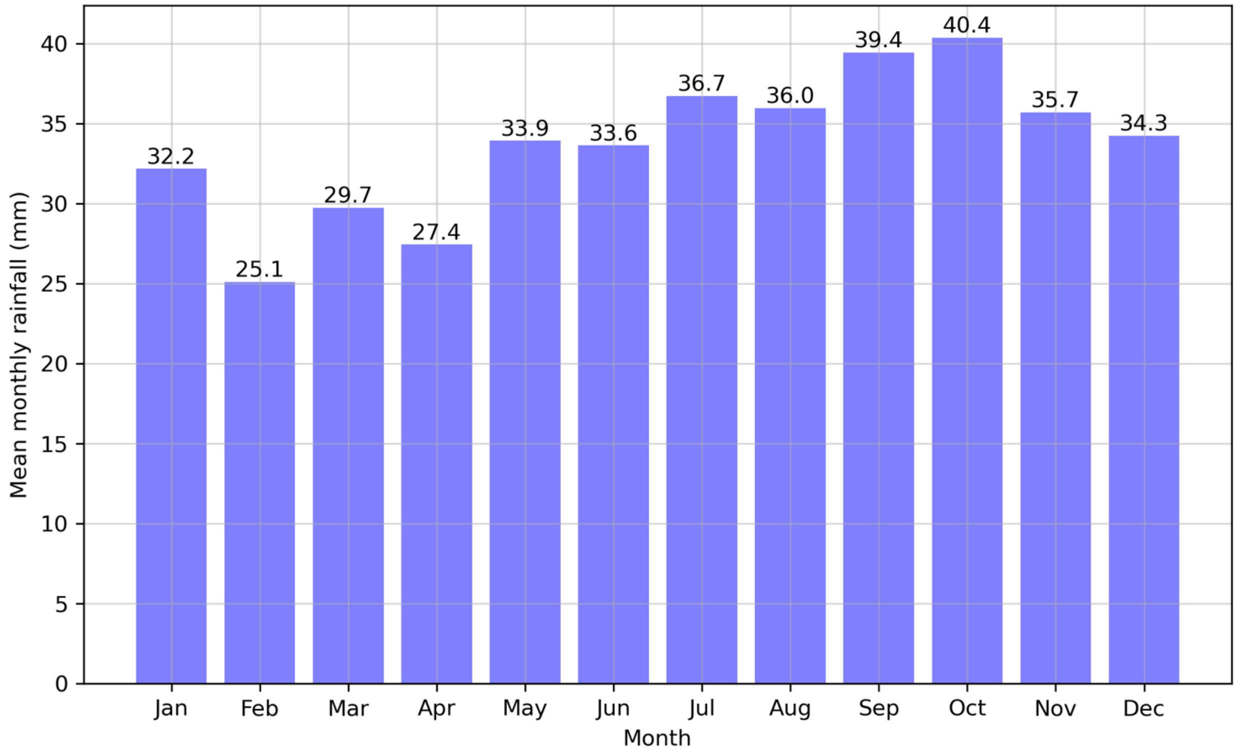

Figure 2-1 Monthly average rainfall from 1957-2024

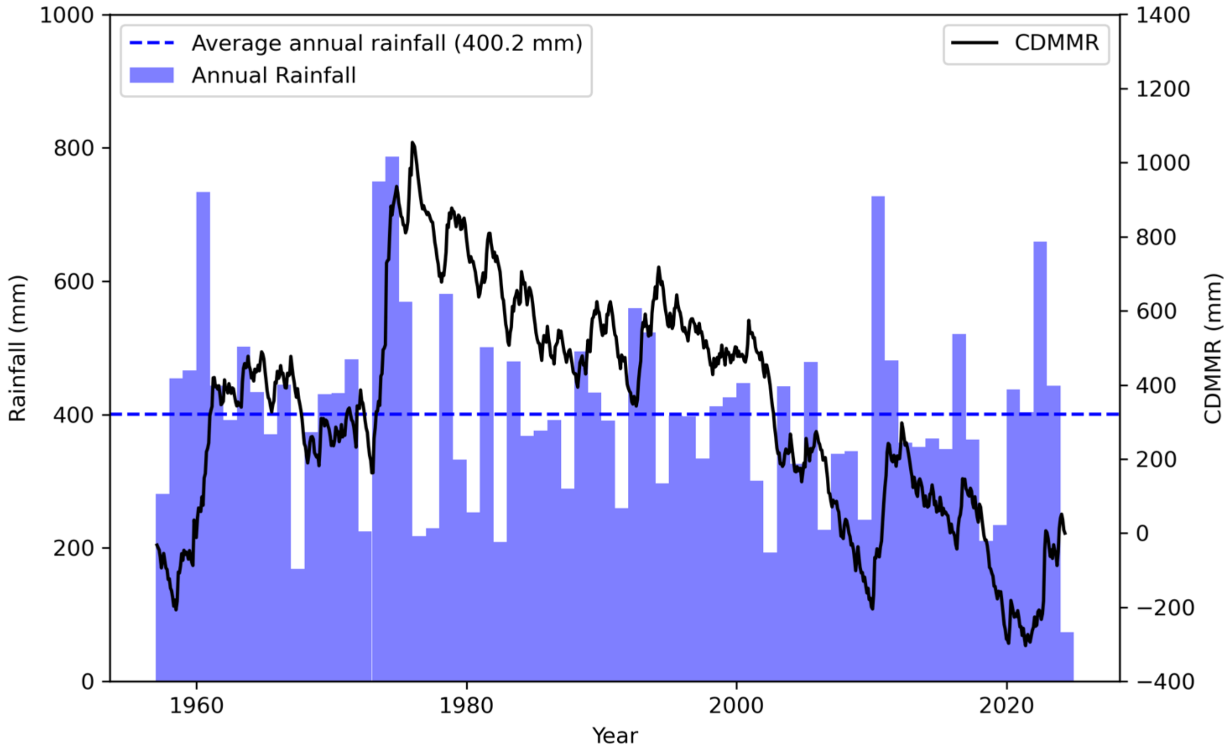

Figure 2-2 Average annual rainfall and the cumulative deviation from mean monthly rainfall (CDMMR) based on data available from 1957-2024.

2.2 Hydrogeological Conceptualisation

The Subject Site is located within an area classified as the Lower Murray Alluvium, specifically defined as the shallow alluvium (CS27a), and deep alluvium (CS27b) [Murray Alluvium Water Resource Plan GW8 (DPE, 2019)] as presented in Figure 2-3. The geology of the Lower Murray Alluvium comprises Cenozoic alluvial deposits overlying Ordovician basement rock of the Lachlan Fold Belt. Cenozoic sediments are divided into three main hydrogeological units: the shallow Shepparton Formation that DPE (2019) define as the shallow alluvium and having a maximum depth of 70 m (referred herein to as the shallow aquifer), and the underlying Calivil Formation and deeper Renmark Group that are jointly defined as the deep alluvium with a maximum depth of approximately 350 m (DPE, 2019) (referred herein to as the deep aquifer).

The shallow aquifer is composed of clay and silty clay interbedded with sand layers, which matches the alluvial floodplain deposits that are comprised of fine to medium grained quartz rich sand and clay at the Subject Site (NSW Geoscience website MinView[4]). The Calivil Formation, with typical depths between 40 – 140 m below ground level (mbgl), is mainly composed of sand and gravel beds, whereas the Renmark Group occurs at depths between 140 – 350 mbgl and consists of sand and gravel layers inter-bedded with carbonaceous clay and lignite layers. The Renmark Group is typically characterised by high transmissivity and low salinity, although areas with abundant clay and poorly sorted sands can result in reduced transmissivity (DPE, 2019). There is not necessarily a clear geological distinction or an aquitard between the shallow and deep aquifers, hence the use of the depth-based classifications. Regional groundwater flow directions are from east to west in both the shallow and deeper aquifers, with relatively low gradients between 2×10^{-4} and 5×10^{-4} (DPIE, 2019).

Groundwater bore information including geology, water levels, yields and salinity (where available) were collated within an approximate 2 km radius of the Subject Site (Bureau of Meteorology (BoM) Groundwater Explorer[5]; WaterNSW Realtime Data web portal[6]) (Table 2-1). Bore locations are shown in Figure 2-4. Lithology adjacent to the Subject Site is comprised of interbedded clays and sand to a depth of 40 m, which is interpreted shallow aquifer (DPE, 2019).

Whilst there are no bores on the Subject Site itself, and therefore, the composition of the unsaturated zone at the Subject Site is undetermined, three bores adjacent to the Subject Site report a thick layer of clay between 7 – 9 m thick in the top 10 m of the profile, which suggests that the Subject Site may have a similar unsaturated zone profile.

- GW505432 (1.1 km northeast of the Subject Site): 14 m deep and has no screen depths or water level record.
- GW500194 (1.2 km southwest of the Subject Site): screened interval from 24.0 – 27.0 mbgl and intersected nine metres of clay from the surface.
- GW505718 (2 km north of the Subject Site): screened intervals from 9 – 24 mbgl, 105-110 mbgl and 121-134 mbgl with 7 m of clay from 2 mbgl.

2.2.1 Groundwater levels and trends

Groundwater level in the shallow aquifer adjacent to the Subject Site has been recorded between 3.2 – 7.2 mbgl (2001-2010), while in the deep aquifer, a groundwater level of 20.8 mbgl (2011) recorded at GW505683 (screened interval 134 – 209 mbgl) indicates that the deep aquifer is confined at the Subject Site (Table 2-1). No current water levels were available at bores directly adjacent to the Subject Site. However, WaterNSW monitors numerous bores constructed in the Lower Murray Alluvium with three monitoring sites located between 7.5 – 12 km from the Subject Site (GW36587, GW036742 and GW088547, Figure 2-5).

[4] MinView | Regional NSW | Mining, Exploration and Geoscience
[5] http://www.bom.gov.au/water/groundwater/explorer/map.shtml
[6] https://realtimedata.waternsw.com.au/water.stm

Monitoring data GW036587 records water level in both the shallow aquifer (pipe 1) and deep aquifer (pipes 2 – 5), whilst monitoring bores GW036742 and GW088547 monitor water level in the deep aquifer only (Figure 2-6). WaterInsights[7] and WaterNSW Realtime Data web portal[5] illustrate that water level in the shallow aquifer has varied between approximately 4.28 – 8.06 (GW036587; note that the bore monitoring point is 1.3 m above ground level). Water level in the deep aquifer (slotted interval more than 40 mbgl) has varied between approximately 1.92 – 30.36 mbgl with impacts from both seasonal pumping and long-term rainfall evident (Figure 2-6).

Groundwater in the shallow aquifer may occur within 3 – 5 mbgl at the Subject Site and installation and monitoring of a shallow bore (nominal depth between 5 – 15 mbgl) may be required to confirm current and ongoing water level. Additionally, the relationship between the shallow aquifer and water flowing through Mulwala Irrigation Canal and Moulamein Channel is unknown. Although it is the anticipated that a thick clay layer may occur at the Subject Site, channels are known to leak and may interact with the shallow aquifer. Installation of a shallow monitoring bore(s) may help determine whether the surface water distribution and shallow aquifer are connected or not.

2.2.2 Groundwater Quality

Groundwater quality in the shallow aquifer varies from fresh to brackish with an average salinity of approximately 5,000 mg/L (TDS) and no obvious long-term freshening or salinisation trends (DPIE, 2019). Lower salinity groundwater is common from the deep aquifer with an average off approximately 780 mg/L, although with a trend of increasing salinity over time (Parsons Brinkerhoff, 2011; DPIE, 2019).

Adjacent the Subject Site, bore GW500194 (shallow aquifer, 1.2 km from the Subject Site) recorded a salinity of 200 mg/L (TDS); whereas bore GW505001 (shallow aquifer, 450 m east of the Subject Site) recorded a qualitative salinity of 'fair' for stock/domestic water use. Bores GW505718 and GW505683 recorded salinity in the range 800 mg/L and 1,000 mg/L (TDS), respectively.

2.2.3 Acid Sulfate Soils

The NSW DPIE webapp, eSpade[8], was accessed to determine that the Subject Site is not located within an area identified as having acid-sulfate soils. Further, as dewatering of the groundwater system is not expected during the construction or operational phase of development, no risk of acid generation is anticipated.

2.2.4 Groundwater Management and Use

Groundwater extraction from the shallow and deep aquifers across the entire Lower Murray Alluvium is shown in Table 2-2 for the period 2011 – 2023. Annual groundwater extraction ranges between 1,013 – 4,943.6 ML in the shallow aquifer and between 39,885.6 – 375,782.8 ML in the deep aquifer with higher water use years (e.g., 2018, 2019) correlating to years of below average rainfall (Figure 2-2). The deep aquifer is accessed extensively due to its good water quality and high yield. Bore yield adjacent to the Subject Site varies from 1.9 L/s in the shallow aquifer (bore GW500194, 1.2 km southwest of the Subject Site) and 306 L/s from the deep aquifer (bore GW505683, 1.6 km west of the Subject Site).

It is understood that no groundwater abstraction will occur at the Subject Site for construction or ongoing operation of the development and that all water requirements during construction (dust suppression uses only) will be taken from the Mulwala Irrigation Canal under the owner's existing licence. Potable water during construction will be trucked to the Subject Site by a commercial supplier, and rainwater will be collected for amenity use during the operational phase of the development (Enhar, 2023).

[7] WaterInsights - WaterNSW
[8] eSPADE v2.2 (nsw.gov.au)

It is anticipated that groundwater dewatering activities will not be required during the construction of shallow excavations (1.5 m maximum depth) for battery and substation footings and 0.9 m for an oil bund. However, at the time of compiling this assessment, the use of sheet piles for foundation supports, as well as the potential installation depth and configuration had not been confirmed. Thus, given that anticipated depth to water Subject Site (3 – 5 mbgl, shallow aquifer) installation of a shallow monitoring bore(s) may be warranted with consideration of the NSW Aquifer Interference Policy (DTIRIS, 2012) may be warranted.

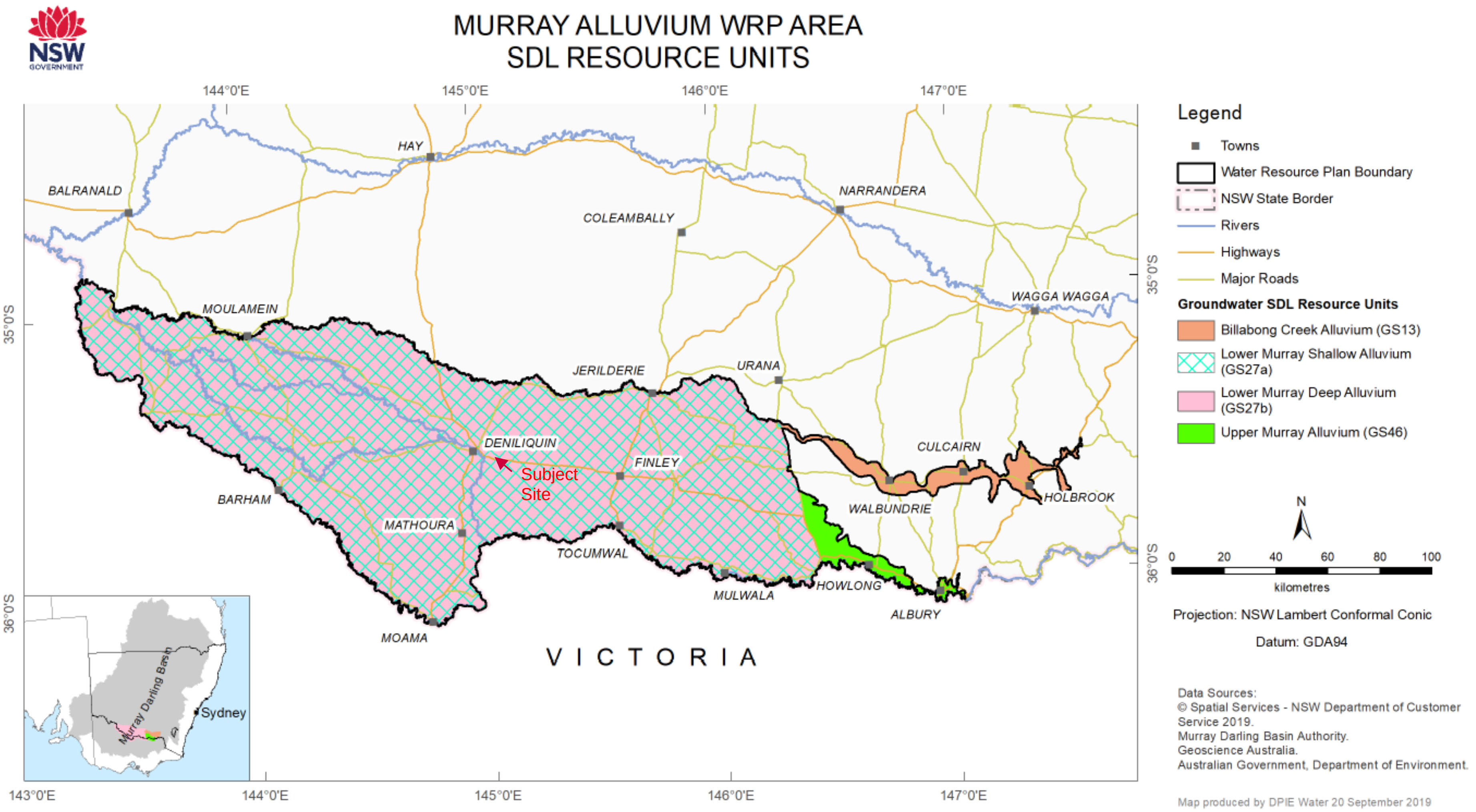

Figure 2-3 **Location of the Subject Site in relation to the extent of the Murray Alluvium Water Resource Protection Area (DPIE, 2019)**

Table 2-1 Collated bore information from bores in close proximity (approximately 2 km) of the Site

Bore ID Use Distance from Subject Site Boundary	Total depth (m)	Screen interval(s) (m)	Lithology description	Standing water level (mBGL)	Yield (L/s)	Salinity (mg/L, TDS)
GW505001 Stock/domestic 0.45 km E	20.0	No details provided				Fair
GW503030 0.45 km SE	9.1	7.10-9.10	NA	3.2 (March 2001) 5.91 (March 2010)	NA	NA
GW503031 0.9 km SE	No details provided					
GW503629 1.4 km SE	No details provided					
GW505432 Stock 1.1 km NE	14.0	NA	0.0-1.0m Topsoil 1.0-8.0m Clay 8.0-9.0m Sand 9.0-11.0m Clay 11.0-13.0m Sand 13.0-14.0m Clay	NA	NA	NA
GW505718 Stock/domestic 2.0 km N	138.0	9.0-24.0 105-110 121-134	0.0-2.0m Topsoil 2.0-9.0m Clay 9.0-138m Interbedded clay and sand	NA	NA	800
GW505479 2.2 km W	No details provided					
GW505683 1.6 km W	209	134-209	0.0-8.0m Clay 8.0-11.0m Sand 11.0-18.0m Interbedded clay and sand	20.8	306	1,000
GW500194 Stock/domestic 1.2 km SW	28.0	24.0-27.0	0.0-9.0m Clay 9.0-28.0m Interbedded clay and sand	7.2	1.9	200

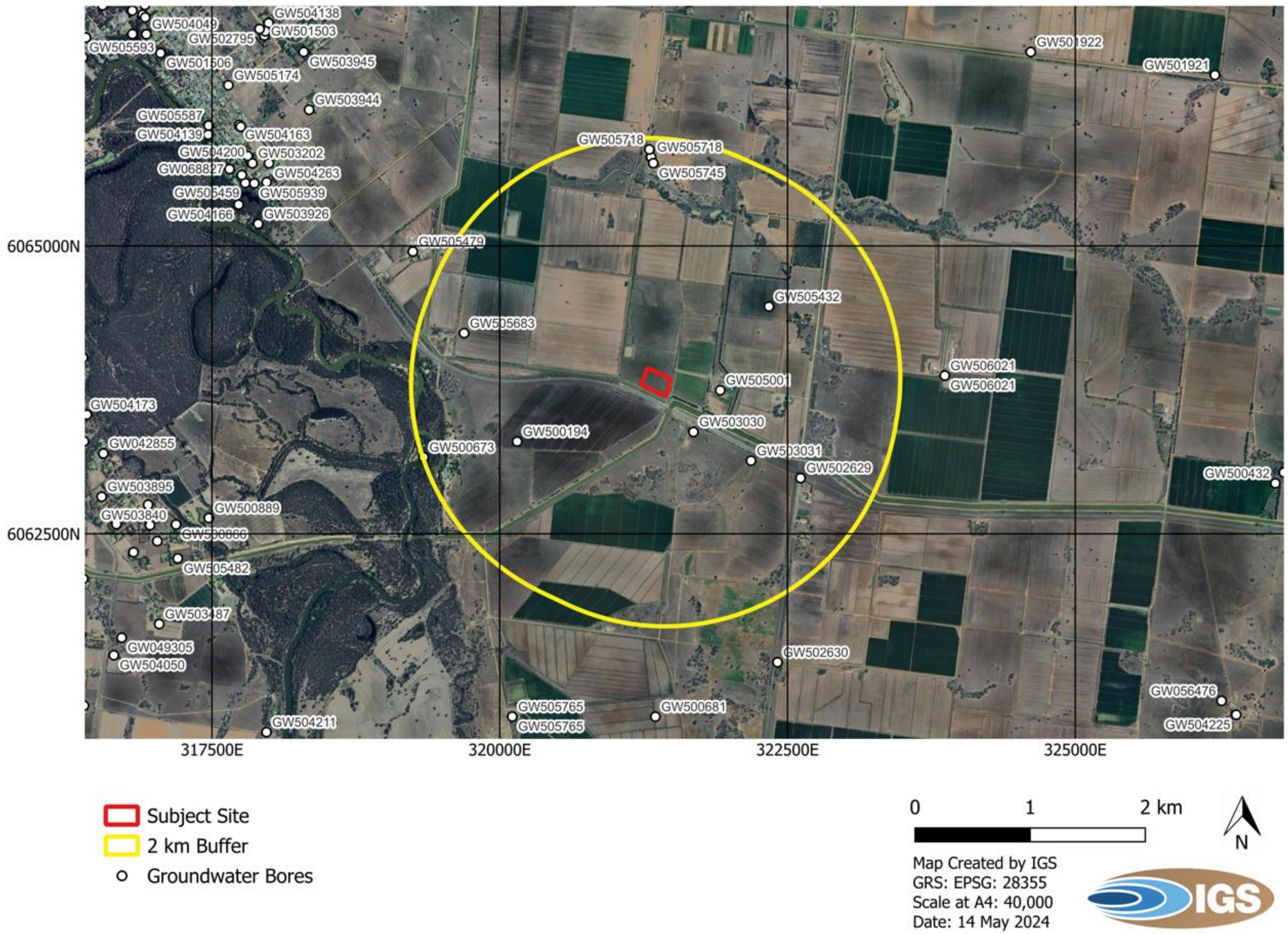

Figure 2-4 Location of groundwater bore adjacent to the Subject Site

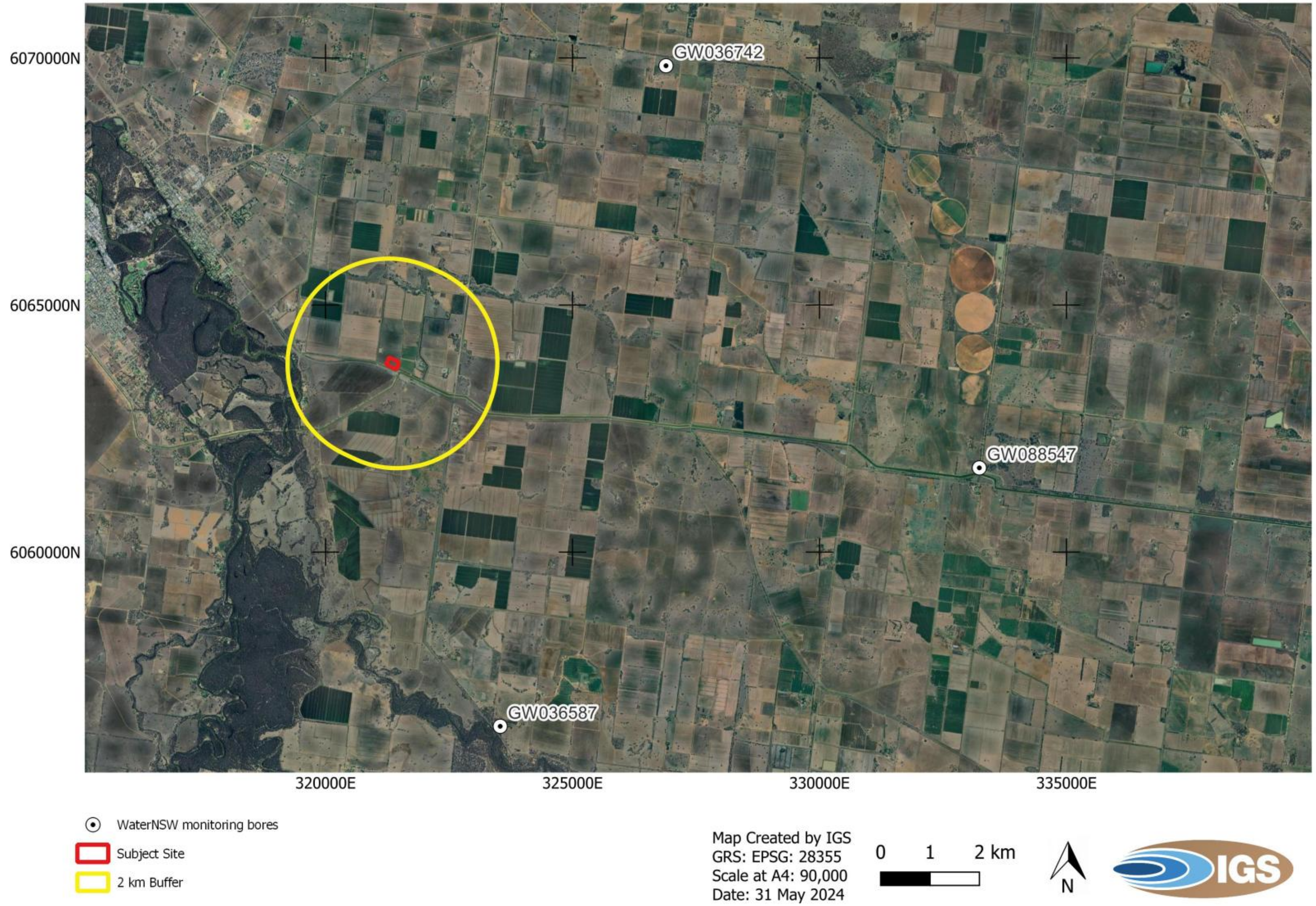

Figure 2-5 Location of Water NSW monitoring bore adjacent to the Subject Site

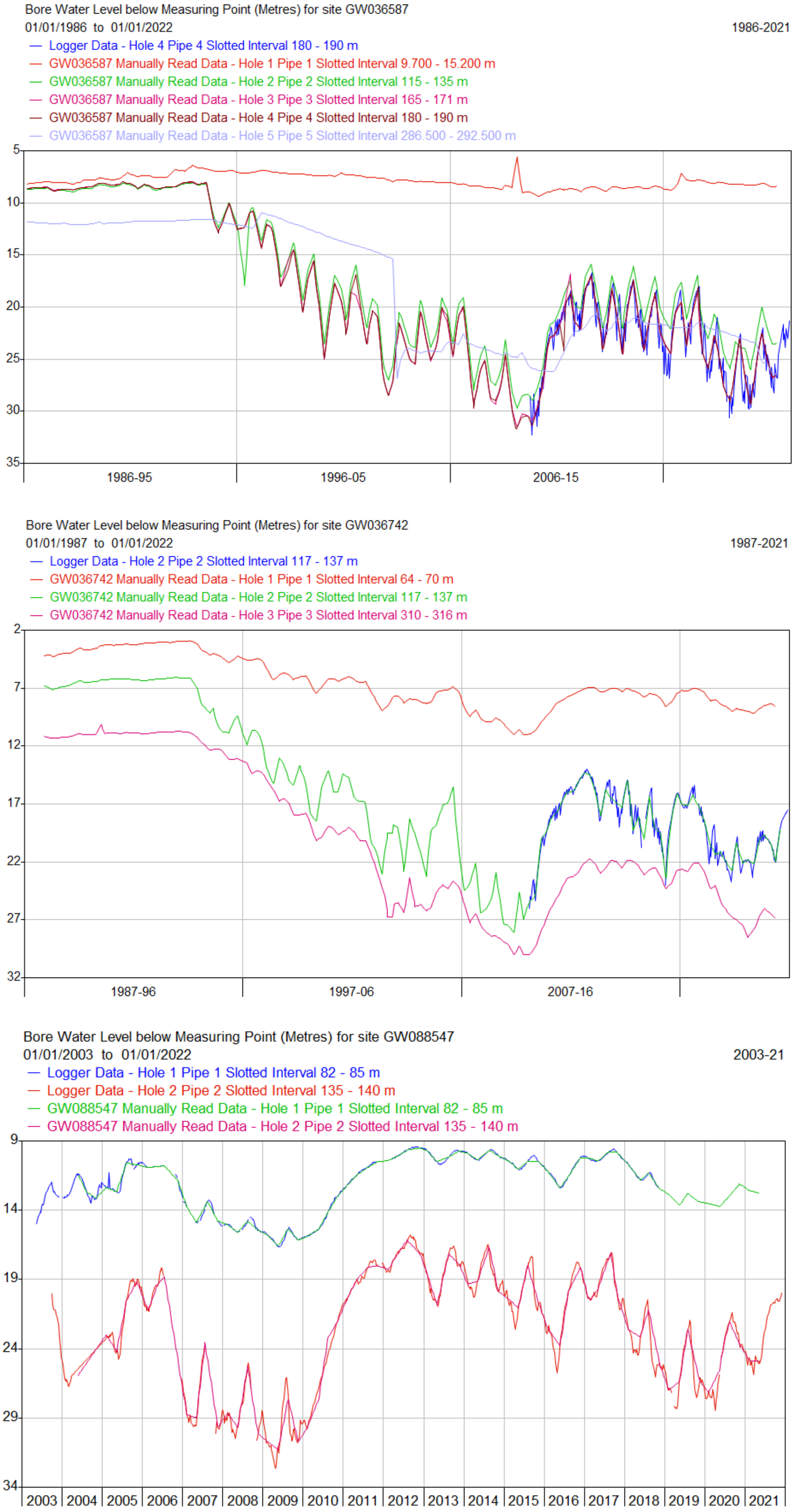

Figure 2-6 **Water level trend in the lower Murray Alluvium adjacent to the Subject Site**

Table 2-2 Annual groundwater extraction by water for the lower Murray Alluvium shallow aquifer and deep aquifer

Water year	Shallow aquifer (ML)	Deeper aquifer (ML)
2011	1013.0	39885.6
2012	1178.0	107941.5
2013	2253.2	166917.0
2014	3472.2	220898.2
2015	4151.0	294711.2
2016	3212.3	266642.5
2017	1652.6	149842.7
2018	4259.6	321016.5
2019	4943.6	375782.8
2020	3671.9	324801.6
2021	2682.4	159152.7
2022	1413.5	96059.1
2023	1016.4*	53848.6*

** NOTE DATA FOR 2023 IS INCOMPLETE.*

2.2.5 Groundwater-surface water interactions and Groundwater Dependent Ecosystems (GDEs)

Groundwater-surface water interactions at the Subject Site are likely to be limited due to the expected thickness of the underlying clay layer and the anticipated depth to groundwater of around 3 mbgl. However, connectivity between the Moulamein Channel and Mulwala Irrigation Canal and shallow aquifer may require further investigation via installation of the shallow groundwater monitoring bore(s).

The Bureau of Meteorology (BoM) GDE atlas[9] indicates the potential for terrestrial and aquatic GDEs to occur near the Subject Site (Figure 2-7). No potential GDEs are located within the Subject Site, however potential terrestrial and aquatic GDEs are located along the western boundary of the 2 km buffer around the Subject Site. These include:

- One potential aquatic GDE associated with Edward River 1.7 km west of the Subject Site is classified as having a 'high potential for groundwater interaction'.
- One potential aquatic GDE associated with the floodplain waterbody is classified as having a 'low potential for groundwater interaction.

Multiple terrestrial GDEs (River Red Gums *sp. Eucalyptus camaldulensis*) are co-located with the aquatic GDEs along Edward River and are classified as having a 'high potential for groundwater interaction' due to a watertable depth occurring between 2 – 20 mbgl (BoM GDE Atlas). River Red Gums will access both soil water (stored during seasonal rainfall and flooding) and groundwater from depths greater than 10 mbgl (Cook and Eamus, 2018).

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[9] http://www.bom.gov.au/water/groundwater/gde/

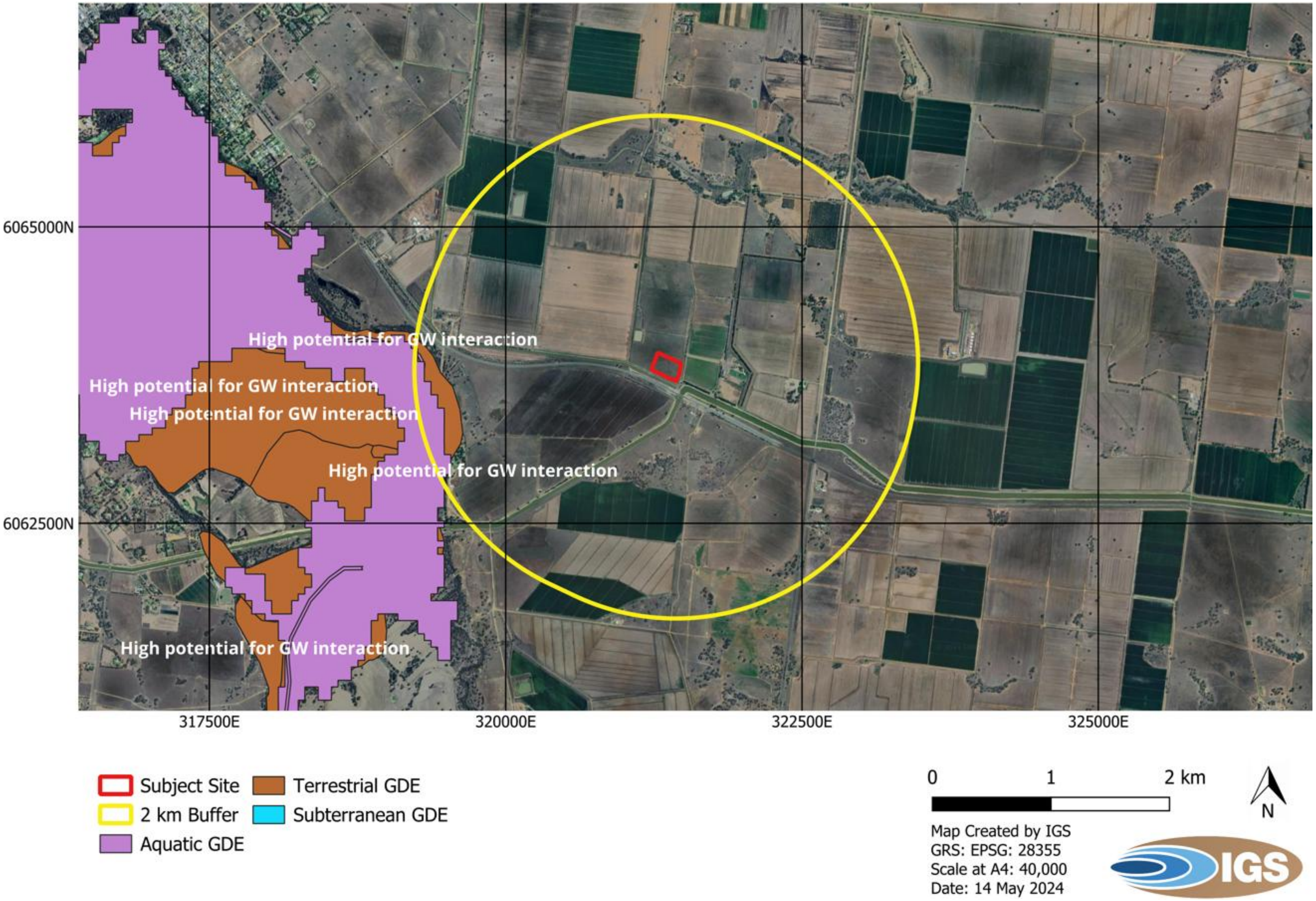

Figure 2-7 **Groundwater Dependent Ecosystems near the Subject Site (GDE ATLAS)**

2.3 Groundwater Vulnerability Assessment

2.3.1 Aquifer Interference – Minimal Impact Considerations

Based on both historic groundwater levels nearest to the Subject Site (3 – 5 mbgl, bore GW503030), as well as monitoring data (GW036587,Figure 2-6) and the anticipated battery and substation footing (maximum 1.5 mbgl) and oil bund (0.9 mbgl) depths, it is unlikely that groundwater will be impacted by these shallow excavations during construction. As there will be no groundwater abstracted during construction or operation of the development Subject Site, groundwater interaction via dewatering activities is unlikely and thus, no assessment is required under the NSW Aquifer Interference Policy (DTIRIS, 2012).

At the time of compiling this assessment, the use of sheet piles for foundation supports, as well as the potential installation depth and configuration had not been confirmed. Given the anticipated depth to water at the Subject Site (3 – 5 mbgl, shallow aquifer) consideration of the NSW Aquifer Interference Policy (DTIRIS, 2012) may be warranted if the use of sheet piles is confirmed. To inform an assessment against the NSW Aquifer Interference Policy (DTIRIS, 2012), installation of a shallow monitoring bore(s) may be required.

Although installation of sheet piles may not require dewatering of the shallow aquifer, sheet piles can impact localised groundwater flow. However, if sheet piles are required and installed to relatively shallow depths (i.e., less than 5 mbgl) as well as being laterally discontinuous, then the potential impact to the local groundwater system may be minimal. Sheet piles should not impact local groundwater quality.

2.3.2 Likelihood of contamination

It is understood that during construction, there will be no significant stored volumes of chemicals or fuels (less than 100 L) and no refuelling or washing of vehicles. Therefore, the potential risks of contamination would be from minor fuel or hydraulic hose leaks. These leaks would be managed via spill kits and mechanical removal of impacted soils until clean/non-odorous soils are observed. Therefore, due to the small volumes of potential source contaminants and thickness of clay at the Subject Site acting as a barrier to vertical migration of contaminants (7 – 9 m, based on bore within 450 m of the Subject Site), the Subject Site is considered to have a negligible risk of contaminating and/or reducing groundwater quality for any local users or GDEs associated with the local groundwater system.

Once the Subject Site is operational, it is understood that up to 100 L of fuel will be stored onsite, which is a potential source of contamination. However, standard management practices will be in place to ensure that the fuel is stored in a bunded enclosure with a minimum of 110% of the stored volume to ensure the bund can contain the entire volume of the stored fuel. Therefore, it is expected that the risk of a fuel leak will be minimal.

A 0.9 m deep oil bund will be constructed, which could be a source of contamination. However, if the bund is constructed to the current standards with regular inspection and maintenance, it is not considered to be a significant source of contamination.

Once operational, potential contaminant sources include leakage of chemicals from batteries; however, the batteries will be lithium-ion phosphate, which does not contain heavy metals and is considered the safest batteries in the industry. In the unlikely event of battery failure, the units are self-contained, with anti-leak connections, limiting any potential for contamination release. Further, as the batteries are in IP54-rated self-contained units, the opportunity for external water to interact with the internal battery and, therefore, the batteries are not considered a significant source of contamination.

Potential battery fires are expected to be contained within the individual units, as each unit has internal fire-suppression systems, including flammable gas, smoke and thermal sensors, pressure release systems and aerosol fire extinguishing systems. Therefore, the risk from small individual fires is not considered significant. However, should a larger fire occur necessitating the use of large volumes of external water and fire-fighting chemicals, then there would be a low risk to groundwater from the infiltration of fire-fighting liquids to the shallow aquifer. However, the anticipated thick clay layer beneath the Subject Site would reduce any downward migration to the underlying groundwater system and therefore, even in this scenario, the risk of contamination to groundwater is considered minimal.

IGS have been informed that no chemicals, other than what has been discussed above, will be stored on the Subject Site that would be considered a source of contamination. No dangerous goods will be stored onsite.

The risk of aquifer contamination associated with the proposed development during construction and operation is considered low due to the Subject Site only storing a small volume of bunded fuel and no other sources of contamination during operation and no stored materials or refuelling/maintenance or washdowns etc. occurring during construction and therefore having no sources onsite. Further, the locally thick clay layer will retard vertical migration through the unsaturated zone allowing time for removal of any spills to occur and be made good before contact with the groundwater at approximately 3 – 5 mbgl.

It is recommended, however, that a shallow monitoring bore(s) be installed at the Subject Site to verify the thickness of the overlying clay and depth to water in the shallow aquifer.

2.3.3 Potential adverse impacts on Groundwater Dependent Ecosystems and Groundwater Abstraction

The development is not expected to have any adverse impacts on GDEs. No mapped GDEs are within the Subject Site, therefore no GDEs will be directly damaged during construction. Terrestrial GDEs are located approximately 1.7 km west of the Subject Site and are described as having a “high potential for groundwater interaction”. However, due to the distance from the Subject Site, it is not considered likely that the terrestrial GDEs will be at risk from the development, as there is negligible risk to groundwater quality and no risk to lowering groundwater levels as no groundwater abstraction will occur from the development.

The identified aquatic GDEs are co-located with the terrestrial GDEs 1.7 km west of the Subject Site and are described as having either “high or low potential for groundwater interaction”. The GDE Atlas describes aquatic GDEs as “ecosystems that rely on surface expression of groundwater”. There will be no groundwater abstraction at the Subject Site during any phase, so there will be no change to groundwater levels related to the Subject Site. Therefore, groundwater-surface expression will not be impacted and, therefore, no risk is expected to the aquatic GDEs.

The local trees, which are not explicitly identified as GDEs, may have root systems that will penetrate the thick clays to the watertable. Therefore, there is a potential for local trees to be impacted should groundwater contamination occur. However, as discussed, it is considered unlikely that groundwater contamination would occur due to the low volumes of source chemicals and the expected thick layer of clay at the Subject Site.

There are no subterranean GDEs reported within 10 km of the Subject Site and, therefore, no risk.

2.3.4 Cumulative impact on the development on groundwater

The development is not abstracting groundwater during construction or operations and, therefore, will not have an impact on the groundwater system nor require a Water Abstraction Licence.

2.3.5 Mitigation measures

Mitigation measures are focused primarily on preventing chemical spills from reaching the groundwater system in the unlikely event of leakage. Mitigation measures include:

- Self-bunded battery storage units.
- Self-bunded fuel storage areas.

- Regular maintenance and inspection of fuel bund, oil bund and battery storage units.
- Development of site management plans detail responses to leaks such as spill kits, removal and appropriate testing and disposal of impacted soils and options for installing groundwater monitoring bores in the case of a significant fire or unexpected leak.
- Drilling of a shallow monitoring bore(s) at the Subject Site to understand the thickness of overlying clay and water level in the shallow aquifer. Should an onsite shallow monitoring bore identify an absence of clay and/or shallow water level at the Subject Site, further shallow monitoring bores may be required and further consideration of potential impacts from proposed excavations.
- Failing the above measure, measure water level in the shallow aquifer as close to the Subject Site as possible to attain current water levels and verify whether construction works may intersect the groundwater system.
- If possible, excavate during summer or autumn when water level in the shallow aquifer is likely to be lowest to further reduce the already low likelihood of intersecting groundwater when excavating for th battery and substation footing (maximum 1.5 mbgl) and oil bund (0.9 mbgl).
- If a significant contaminant release or major fire occurs, then additional shallow bores should be installed up- and downgradient of the development to determine local groundwater flow direction and verify impacts to the local groundwater system.

3 FLOODING METHODOLOGY

3.1 Overview

Assessment of the flood risk to the Site was separated into riverine and direct catchment inundation. The following sections describe the methodology for each component of the assessment.

3.2 Riverine Flooding

A desktop review was undertaken to determine existing flood risk from riverine sources to the Site. Two likely sources of riverine flooding were identified near the Site, namely the Edward River to the west and Flanagan's Channel to the north. An existing Edward River flood study was commissioned by Deniliquin Council in 2014[10] to assess riverine flood risk to the township. The results from this study highlighted the proposed BESS location remains flood free up to the 0.5% AEP design event as part of the 2014 hydraulic assessment. The Site relative to the riverine flooding from the Edward River is shown in Figure 3-1, indicating the protection provided by the Riverina Highway and Moulamein Channel embankments. Results from the Probable Maximum Flood (PMF) event suggest the Site is inundated by depths ranging from 0-0.2m.

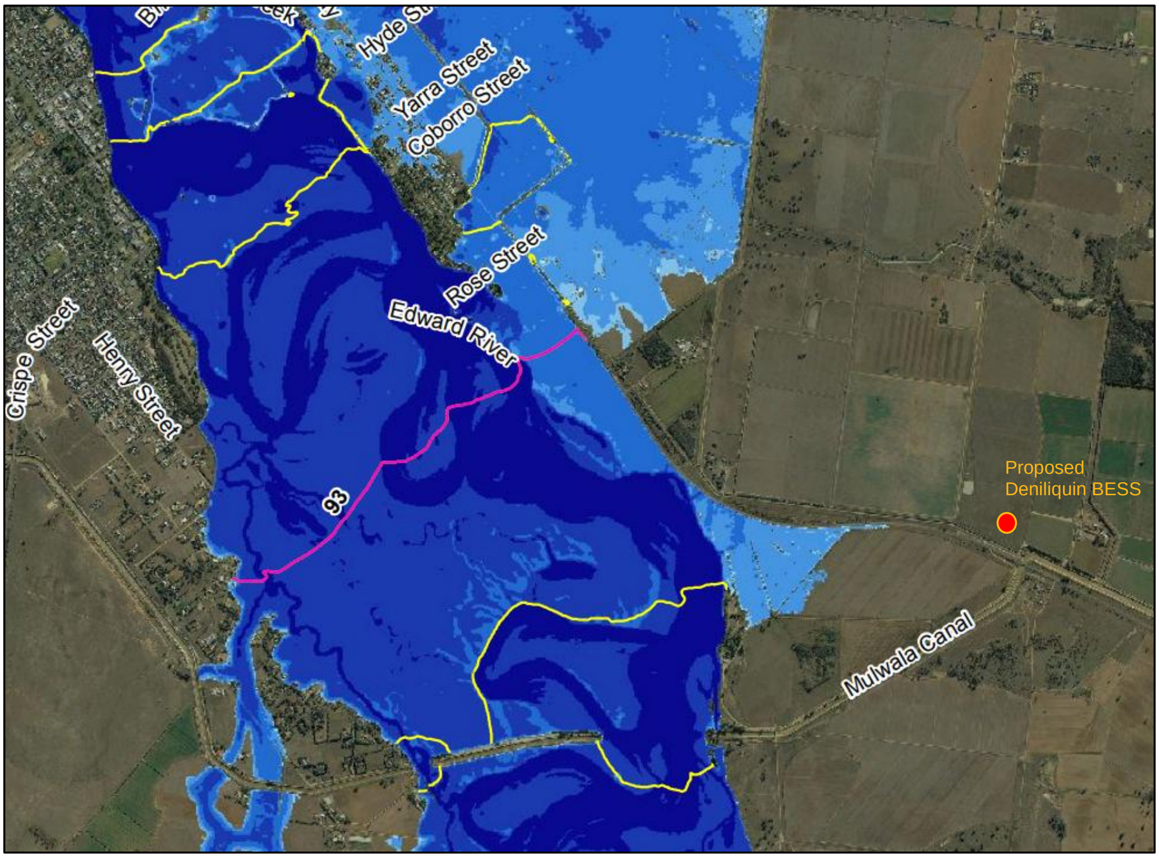

Figure 3-1 1% AEP Riverine Flood Risk from the Edward River (WMAwater 2014)

The review of the 2014 Flood Study highlighted several observations, modelling methodologies and datasets that have since become outdated or worthy of mention. Notable observations include:

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[10] WMAwater: https://flooddata.ses.nsw.gov.au/related-dataset/edward-river-at-deniliquin-flood-study-report

- The hydraulic domain digitised as part of the modelling study at the time covered the proposed BESS location. Therefore, the proposed Site was not excluded from any potential riverine inundation and the riverine assessment made as part of this flood impact assessment has reviewed the available flood mapping.
- The TUFLOW hydraulic engine used in the study was likely the 2012 build available at the time. Since then, there has been a large number of advancements in solution scheme, features and hardware.
- The LiDAR used to define the elevations with the model was sourced from a 1m resolution dataset captured in 2012. Further updates were also made using a coarse 15m resolution from 2001 and interpolated cross-sections from 1999 to represent the bathymetry.
- Alterations to the floodplain and surrounding landscape will not have been captured as part of the previous hydraulic modelling. For instance; new areas of development, deterioration of levees heights, vegetation coverage, etc.
- Since 2014, there have been several major updates to hydrological modelling as outlined within the Australian Rainfall & Runoff (2019).

The culmination of these changes and inclusion of additional climate change allowances will likely produce different design inflow hydrographs and hydraulic results on the Edward River.

No information was available on the flood risk from Flanagan’s Channel; however a review was conducted of the localised topography. Based on the elevation of the Site relative to the wider area, excessive flows within Flanagan’s Channel will preferentially continue spilling east to west downstream towards the Moulamein Channel. Likewise, the elevated embankments along Flanagan’s Channel and the field drains scattered throughout the agricultural land will inhibit out of bank flooding from reaching the Site. Inundation from Flanagan’s Channel was therefore not considered a risk to the Site.

3.3 Direct catchment runoff

3.3.1 Overview

To understand how direct catchment runoff impacts the Site hydraulic modelling was completed using a two-dimensional (2D) TUFLOW flood model. TUFLOW software is one of the most widely used hydraulic modelling software packages in Australia. The software is considered an appropriate modelling tool for modelling riverine and local overland flooding. TUFLOW allows the simulation of runoff generated from local rainfall on a grid that is representative of the site topography, known as “Rain on Grid” (RoG) modelling.

The domain of the 2D TUFLOW model extended beyond the Site boundary to cover the complete local catchment area draining to the site.

Climate change modelling used forecasting data for changes to rainfall predicted for the year 2090 and Representative Concentration Pathway (RCP) 8.5. The RCPs are used for making projections based on four different 21st century pathways of anthropogenic Greenhouse Gas (GHG) emissions and atmospheric concentrations, air pollutant emissions and land use[11]. The RCPs include a stringent mitigation scenario (RCP2.6), two intermediate scenarios (RCP4.5 and RCP6.0) and one scenario with very high GHG emissions (RCP8.5). RCPs consider the impact of atmospheric concentrations of greenhouse gases and aerosols, along with the uncertainty in possible future emissions. The use of RCP 8.5 would allow for the worst-case scenario.

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[11] https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf

3.3.2 Hydraulic Model Development

3.3.2.1 Hydraulic Model

TUFLOW HPC was selected as the numerical solver for the development of the fluvial 2D hydraulic model. The High-Performance Compute (HPC) version solves the full 2D shallow water equations including inertia and turbulence. The HPC solver also enables adaptive time-stepping in conjunction with smaller grid resolutions for greater granularity of results and topographic features. The modelling undertaken as part of this assessment has utilised the 2023-03-AC-iSP-w64 build of TUFLOW.

3.3.2.2 Topographic Data

The estimation of flood effects in engineered environments with complex flow paths can be sensitive to model grid resolution. The model domain covered an area of approximately 14.35 km² and comprised of a uniform grid of 5m resolution square cells. Sub-grid sampling was also utilised to take advantage of the 1m high resolution LiDAR to derive a non-linear storage relationship. The benefit of sub-grid sampling is defining the finer scale urban features whilst also representing reasonable simulation times with a larger cell size. The effect of cell size was examined in the sensitivity analysis in Section 4.2.3.

The topography of the site in the hydraulic model was represented by 1m resolution LiDAR captured in 2015 (Wakool2015_LiDAR1m_GDA1994_mga55). This LiDAR adequately represented the floodplain topography, allowing for accurate flood routing for out of banks and surface water 2D flow (Figure 3-2).

The following components were also added to the baseline LiDAR DTM to add more detail to the 2D domain of the flood model:

- Embankment levels along the several of the open channels were enforced to ensure the spill levels and conveyance along the channels were adequately captured.

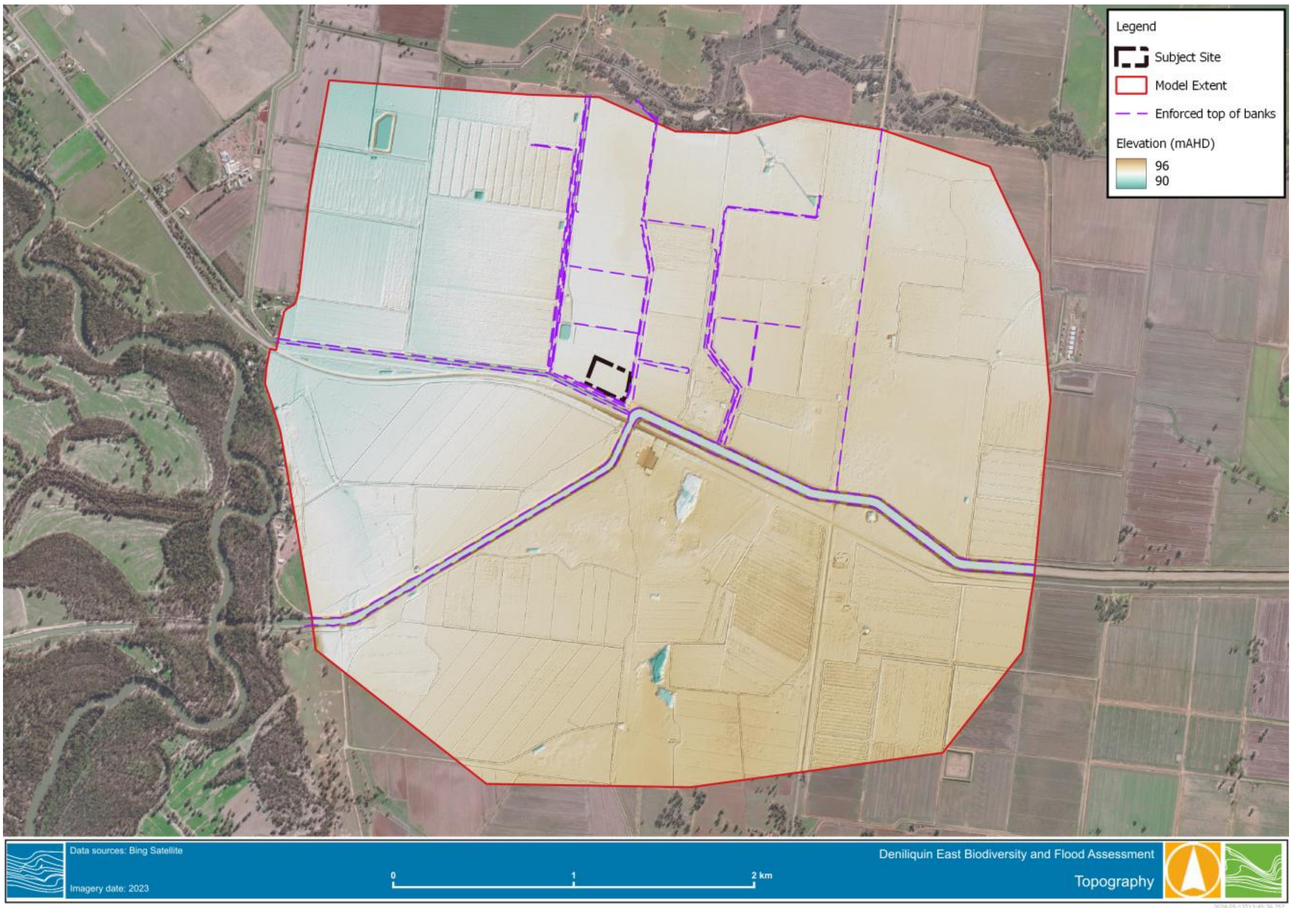

Figure 3-2 Model Extent & Topography

3.3.2.3 Hydraulic (Manning's) Roughness

The hydraulic model used Manning's 'n' to represent the hydraulic roughness to determine the restriction caused by the range of land uses within the model area. Local council planning layers were used to assign a specific Manning's 'n' roughness coefficient based on values taken from those in published texts such as Chow[12]. Each land use type was assigned a corresponding Manning's 'n' value in the TUFLOW Materials File as shown below with a set default Manning's 'n' value of 0.04 (material ID: 108).

[12] Chow, V.T., 1959. Open-channel hydraulics, McGraw-Hill, New York

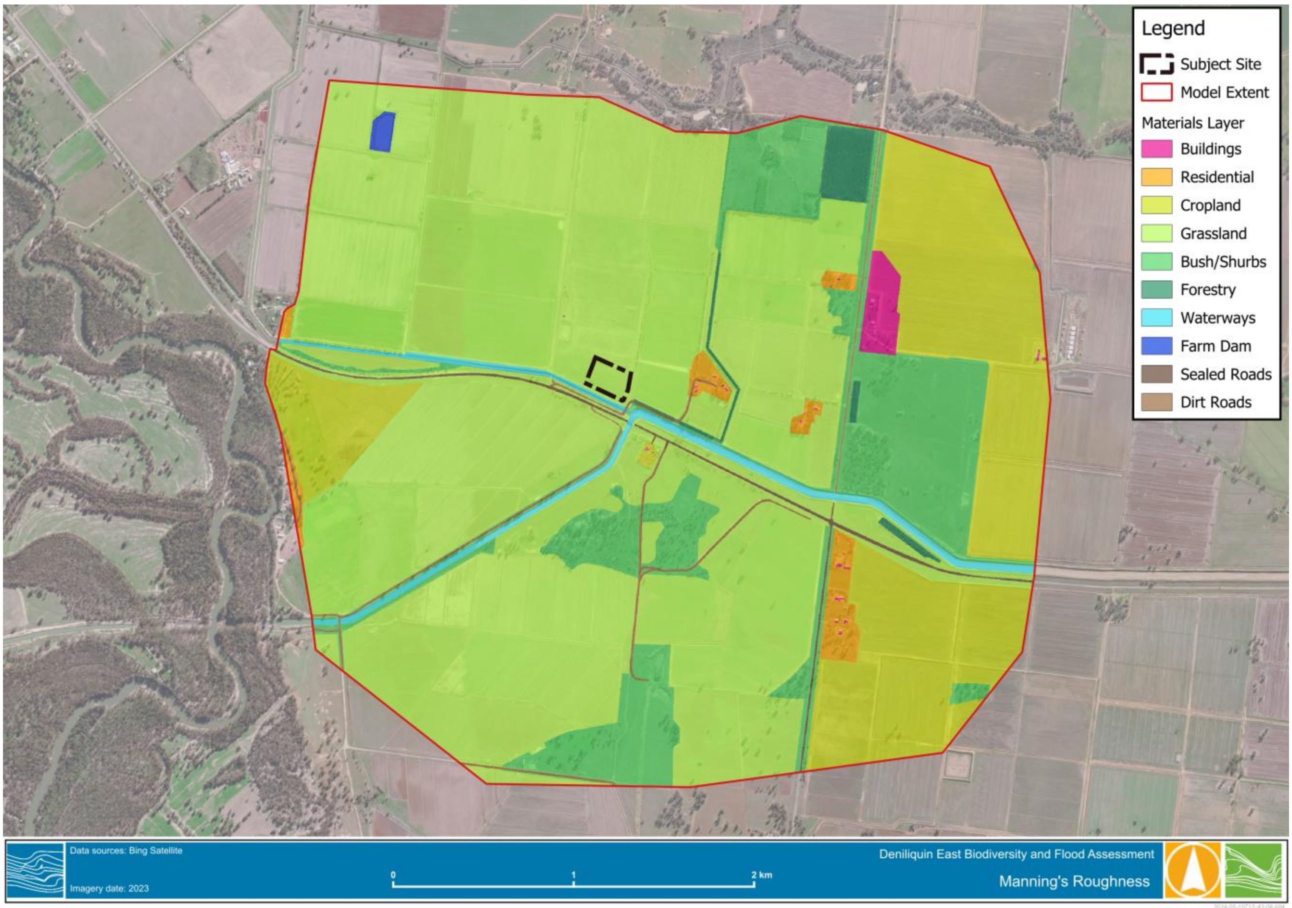

Figure 3-3 Land use

Table 3-1 Manning's 'n' Roughness Coefficients

Land Use	Manning's 'n' Roughness Coefficient
Buildings	0.5
Residential area	0.05
Cropland	0.05
Grassland	0.04
Bush/shrubs	0.06
Forestry (dense vegetation)	0.095
Waterways	0.03
Farm Dam	0.08
Sealed Roads	0.025
Dirt Roads	0.03

3.3.2.4 Hydraulic structures

Several hydraulic structures connecting the drains to Mulwala Channel were observed within the extent of model domain. No details were available for these structures; therefore, the decision was taken to exclude these from the hydraulic modelling. This approach was seen as a conservative assumption considering these structures may not be operational or blocked during a storm event.

3.3.2.5 Initial Water Levels

Initial water levels (IWLs) were set to specify the initial conditions at the start of the simulation. Both the Mulwala and Moulamein Channels were noted to maintain a regular water level managed by downstream control structures to the Edward River. For the purpose of this surface water assessment, a constant IWL driven by a Head-Time boundary on the Mulwala Channel was applied to the model. Initial water levels were approximated relative to the embankment levels to fill the storage within these channels over the course of the simulation and act as an antecedent condition.

3.3.3 Hydrologic Input

3.3.3.1 Rainfall

RoG modelling requires hydrologic inputs of rainfall and losses to be applied to the hydraulic model. The TUFLOW QGIS plugin was used to extract design rainfalls and associated data from the ARR 2019 and Bureau of Meteorology (BoM) databases for the catchment of interest (coordinates: 144.9519, -35.5325).

With the model extent being larger than the discrete catchment that the site is located within, a conservative approach was taken with no areal reduction factors being applied to the design rainfall.

Temporal patterns were selected from the Murray Basin zone. Three temporal patterns were modelled for each storm duration, consisting of front loaded, mid-loaded and rear loaded storms. Figure 3-4 showcases the temporal pattern comparison in the rainfall hyetograph for the 1% AEP 60-minute event.

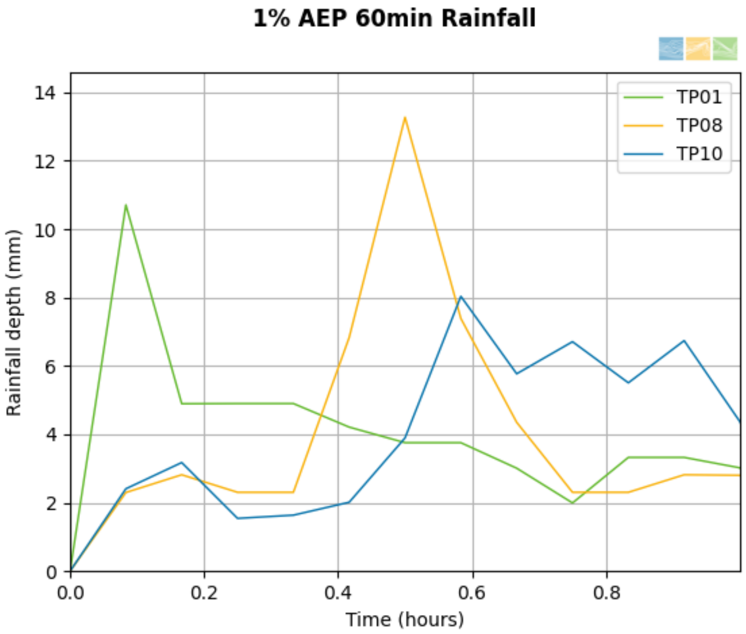

Figure 3-4 Temporal pattern comparison

The PMF rainfall depth was estimated from the Probable Maximum Precipitation (PMP) rainfall depth using a Generalise Short-Duration Method. A scale factor between the 1 in 2000-year rainfall depth and PMP was used to determine the PMF rainfall depth for each of the investigated storm durations.

3.3.3.2 Losses

Rainfall losses were accounted for using the initial loss / continuing loss method and were assigned to each land use type based on expected fraction imperviousness. Land use types were based on those identified as part of applying the Manning's roughness coefficients.

Losses were applied to the model in the hydraulic roughness database, alongside the roughness values. These losses represent the fact that not all rainfall is converted into runoff.

Starting values of 25.0 mm for initial loss (IL) and 0.0 mm/h for continuing loss (CL) were taken from the ARR datahub based on the spot location within the Murray Riverina at Deniliquin. As is recommended, these starting values were reduced based on engineering judgement and tabulated in

Further sensitivity analysis in comparison to soil infiltration is given in Section 4.2.2.

Table 3-2 Rainfall loss values

Land Use	Initial Loss	Continuing Loss
Buildings	2.5	1
Residential area	15	1
Cropland	12.5	1
Grassland	12.5	1
Bush/shrubs	12.5	1
Forestry (dense vegetation)	12.5	1
Waterways	0	0
Farm Dam	0	0
Sealed Roads	1	0.5
Dirt Roads	1	0.5

3.3.3.3 Boundary Conditions

The RoG method was used, which applies the rainfall directly onto the catchment land surface. This approach is particularly beneficial for catchment-based studies as the impact of dry and saturated ground conditions can be assessed, as well as the influence of groundwater levels. The direct rainfall is assumed to be spatially uniform across the entirety of the model extent at Deniliquin. TUFLOW converts the original rainfall hyetograph to a hydrograph to smooth the transition from one rainfall period to another.

A series of stage-discharge (HQ) curves have been applied around the perimeter of the model domain to remove surface water runoff water that flows away from the Site into neighbouring catchments. Each of these curves were automatically generated by TUFLOW and were based on a slope derived from local ground topography. To maintain a water level within the Mulwala Channel, a constant water level timeseries (HT) was applied on the western (94.7m AHD) and eastern (95.1m AHD) extent of the model domain to drive a flow through the channel system.

All external boundary conditions have been located sufficiently far enough away from the area of interest to remove the influence of boundary effects on predicted peak water levels. Figure 3-5 showcases the initial water levels and boundaries relative to the Site.

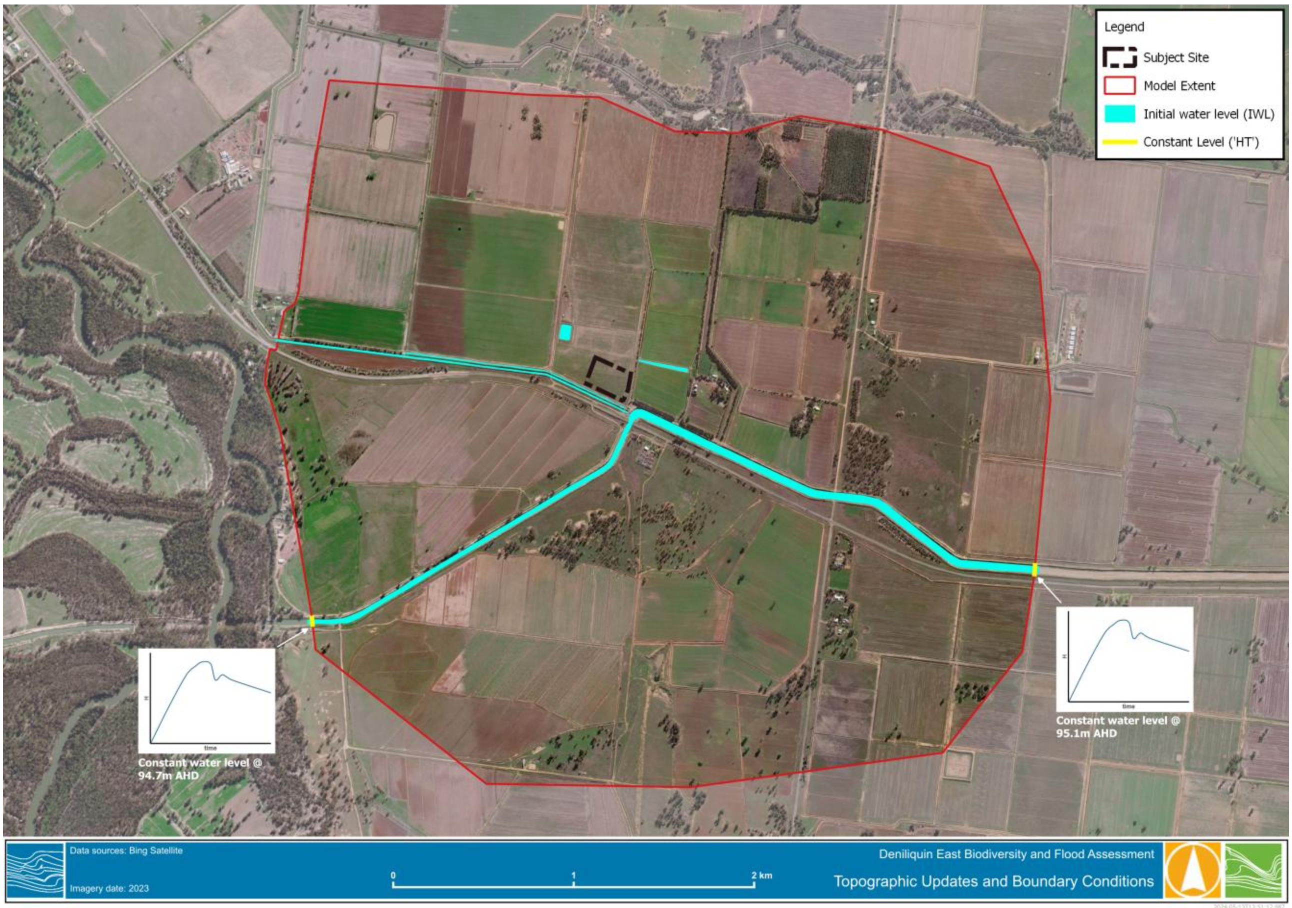

Figure 3-5 Boundary conditions and initial water level areas

3.3.4 BESS Design Updates

To account for the changes in landscape because of the BESS, the baseline RoG model included topographic and land use changes to the hydraulic model. As is seen in Figure 3-6 below, the proposed design incorporates tarmac areas and concrete pads for the battery and other infrastructure. No major earthworks are expected that would alter the flooding mechanism in or around the site. A summary of the changes made to the TUFLOW hydraulic model are noted below and in Figure 3-7:

- One road from the Riverine Highway is proposed to enable access and egress from the site – the access road was represented by a small topographic uplift over each drainage channel to the BESS lease area. The remaining roads around the site have included a 0.05m uplift to account for a raised tarmac surface;
- A series of culverts under the access road were represented to enable conveyance of channelised runoff. Each culvert size was selected to provide some level of cover from the obvert to the modelled road surface. It is expected that the culvert capacity will be assessed as part of the detailed design. The modelled culverts included:
  - 1 x 0.6m Ø circular culvert;

  - 2 x 1.2m Ø circular culvert (within the Moulamein Channel); and
  - 3 x 0.3m H x 0.6m W box culvert (through the swale).
- Each concrete pad has been represented by a small uplift in the underlying DTM by 0.15m; and
- The material land use has been adjusted to account for any crushed rock and road surface based on industry standard Manning's values.

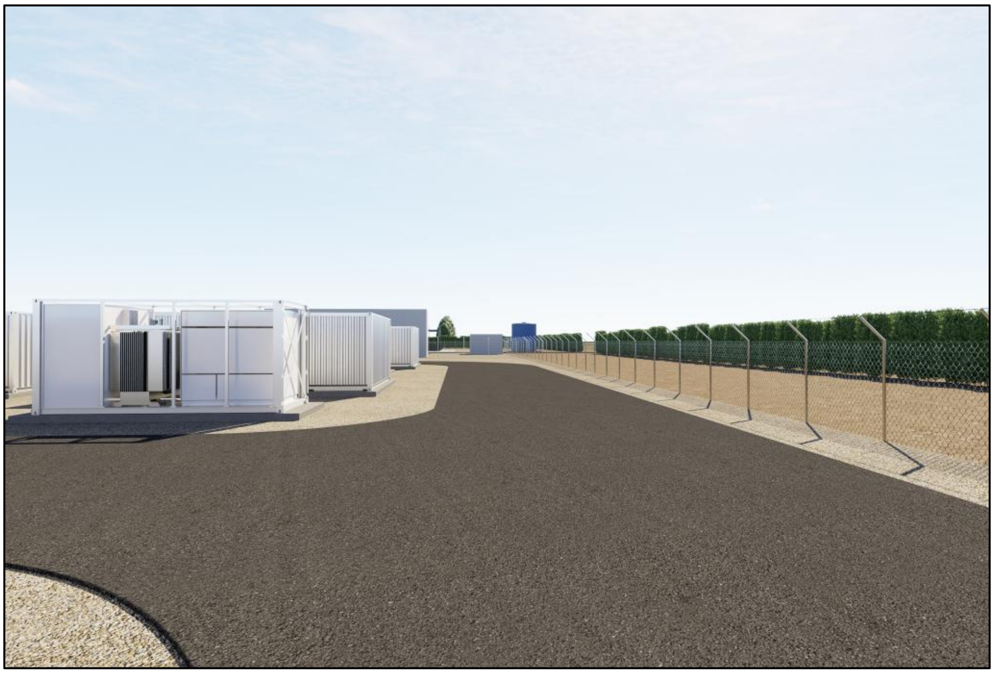

Figure 3-6 3D Render of the proposed design

Figure 3-7 Hydraulic model changes for the design scenario

4 DIRECT CATCHMENT RUNOFF MODELLING

4.1 Model verification

There are several peak flow estimation methods that can be used for broad comparison to modelled peak flows, all dependent on having a catchment which discharges to a confined flow path. Due to the lack of defined overland flow paths within the model extent, no method was found suitable for verification of the current model results.

4.2 Sensitivity Assessment

Key parameters in any hydraulic model should be varied to ensure the model is stable and to determine the sensitivity of the modelled outputs to the choice of model parameters.

Sensitivity analysis is the study of how the variation in the output of a model (depth) can be apportioned, qualitatively or quantitatively, to different changes in the model inputs (model variables, boundary conditions and parameters). Sensitivity analysis is used to identify:

- The factors that potentially have the most influence on model outputs;
- The factors that need further investigation to improve confidence in the model; and
- Regions in space of inputs where the variation in the model output is maximum.

A summary of the key parameters tested is provided in Table 4-1.

Table 4-1 Key parameters for Sensitivity testing

Parameter	Scenario	AEP
Terrain roughness	Global ±20% change in the material roughness values	1%
Loss method	Compare the Initial Loss/Continuing Loss (IL/CL) method against the Greem-Ampt soil infiltration.	1%
Cell size	A range of cell sizes were tested with and without sub-grid sampling (SGS)	1%

4.2.1 Terrain roughness

A separate universal uplift and reduction of 20% to the Manning's 'n' roughness coefficient was applied across the entirety of the model domain. This resulted in a minor to negligible change in predicted peak flood levels at and around the Site area. The differences were generally less than 10mm from the decrease and uplift of 20% in Manning's roughness. The results of this analysis of not surprising considering the lack of upstream area. As such, this would be indicative of the model area being driven by volume rather than influences on conveyance and timing.

4.2.2 Loss method

To determine the influence of loss methods on the precited peak results, an assessment was made using the initial/continuing loss (IL/CL) and Green-Ampt methods. Initial/continuing losses were extracted from the ARR online datahub[13] and have been tabulated in Section 3.3.3.2.

Infiltration was calculated using the Green-Ampt method that varies the rate of infiltration over time based on the soil's hydraulic conductivity, suction, porosity and initial moisture content. Rainfall is applied directly onto the Deniliquin model domain, losses due to infiltration are dynamically calculated and any subsequent runoff modelled. Investigation of nearby borehole logs suggests that the localised lithology that is interacting with surface runoff is characterised as topsoil with underlying clay for several meters. For the purpose of the sensitivity testing, a 'Clay' classification was applied based on the hardcoded hydraulic conductivity properties within TUFLOW.

As a comparison, the IL/CL generally showed similar water levels and in some cases reduced drawdown of the surface water profile over time. The differences in peak water levels were often <0.01m, with the IL/CL method showing larger water levels in the longer duration simulations. As the IL/CL predicted very similar and, in some cases, higher peak water levels, the IL/CL method was used as part of the baseline and design scenario modelling.

4.2.3 Cell size convergence

Various grid sizes were tested to determine how the cell size impacts the model resolution at the Site. Two grid sizes were tested with sub-grid sampling (SGS 3m, 5m) and three grid sizes were tested without the application of sub-grid sampling (EXG 1m, 3m, 5m).

An idealised 1m grid size, that would utilise all the available underlying topography resolution, was simulated as part of the testing to compare to the other grid sizes. In general, it was found that grid sizes without sub-grid-sampling appear to both under and overestimate peak water levels and the receding limb over time. There are however, areas of the model domain where there is little difference, and this is likely a function of the small catchment with few complex flow paths. The SGS models on the other hand show a higher correlation and capture of the multiple peaks when the cell size was increased to 3m and 5m. Figure 4-1 compares a timeseries of water levels near the Site across the modelled cell sizes. The 1m non-SGS model compared better with the SGS models, however the runtime was 18x as long.

Overall, the use of SGS indicates a better correlation of the modelled result, and the 5m cell size with sub-grid sampling was selected to maintain a higher degree of precision but with more reasonable run times.

[13] https://data.arr-software.org/

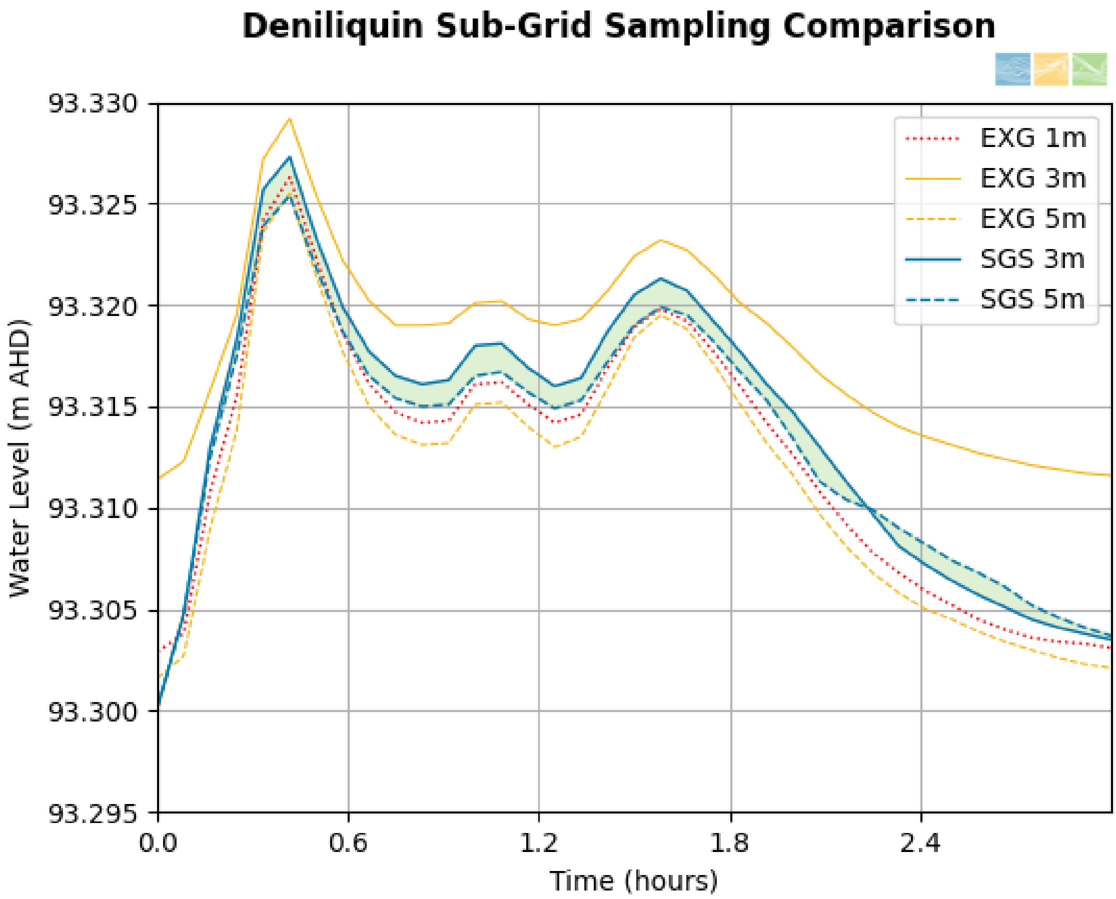

Figure 4-1 Sub-Grid Sampling Comparison

4.3 Critical Duration Selection

The critical storm duration is typically defined as the duration of rainfall which produces the greatest flood extent and flood depth. Even within a small area, the critical duration can vary due to several factors, including topography, land use, size of the upstream catchment and nature of the drainage system. As recommended in ARR (2019) the temporal pattern that produced the median was taken forward for further analysis.

All simulated AEP events were modelled with an identified back-loaded, mid-loaded and front-loaded temporal patterns for a range of events to capture the influence of short to longer duration hyetographs. The results across several durations for the 1% and 10% events are shown in Figure 4-2 and Figure 4-3. The results indicate that 1-hour is critical at the Site for those events shown, with areas surrounding dominated by longer durations. The remaining median temporal pattern AEP results are displayed in Appendix A.

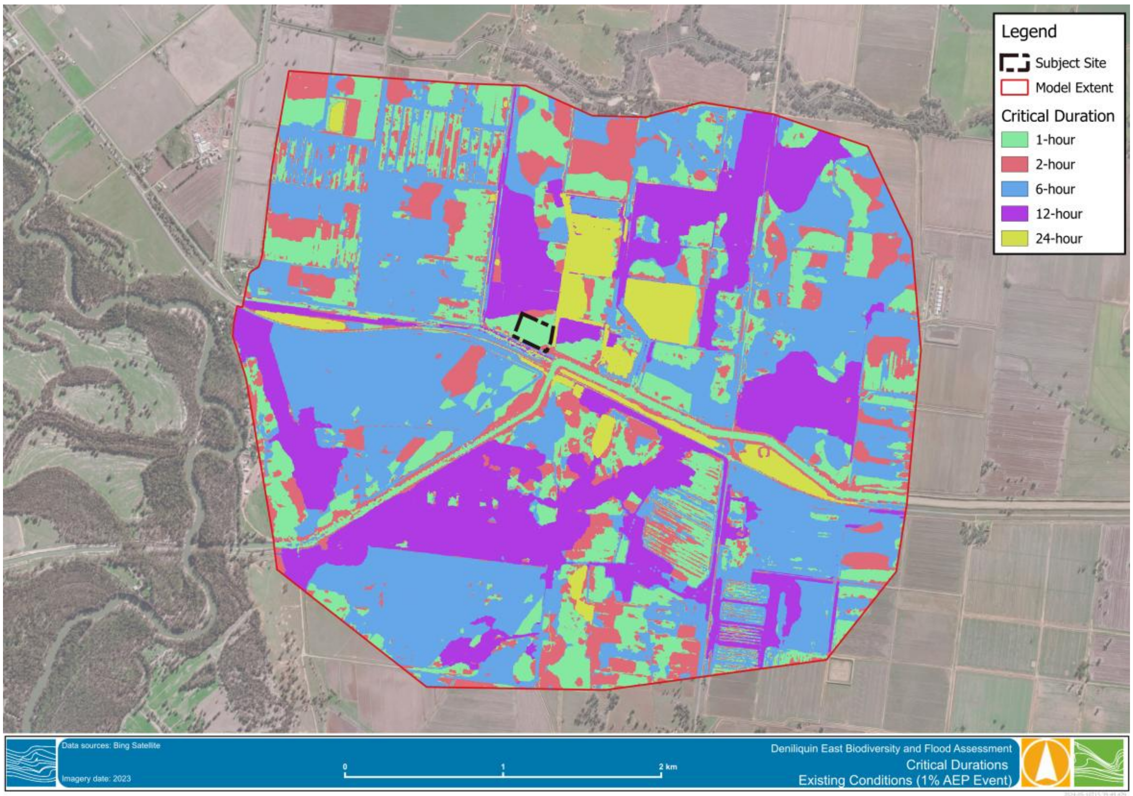

Figure 4-2 Critical Durations - Existing Conditions (1% AEP event)

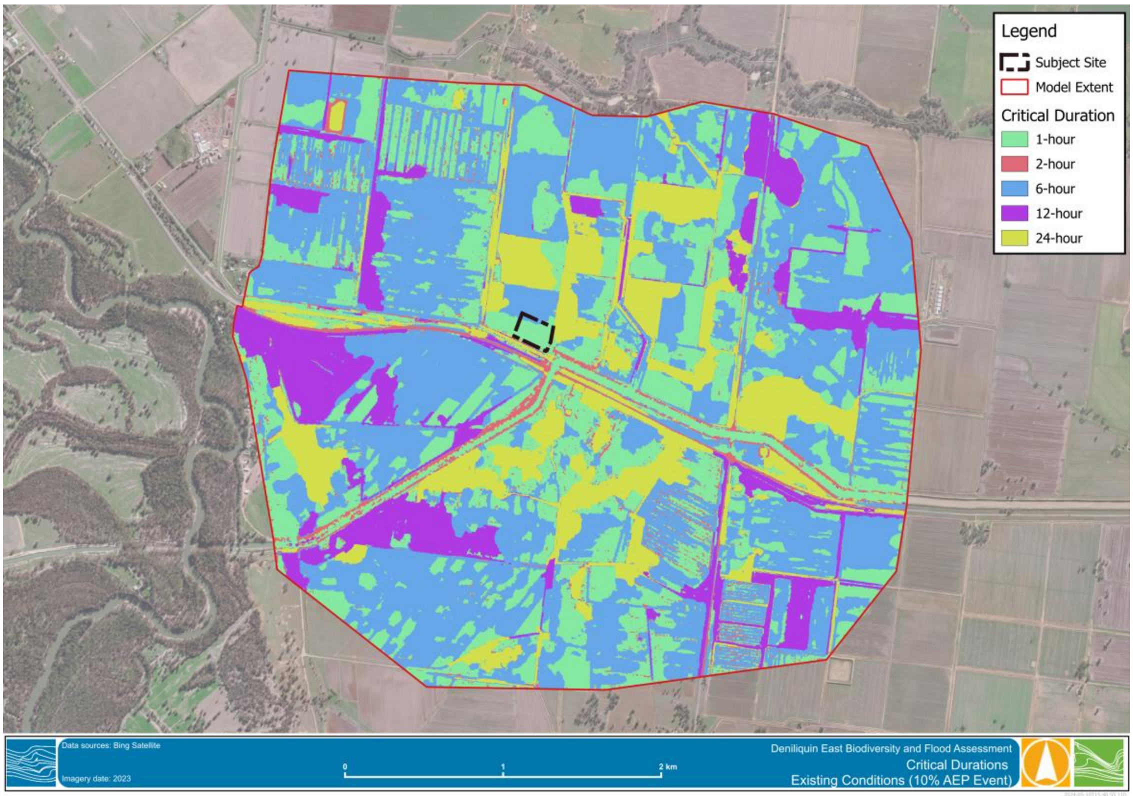

Figure 4-3 Critical Durations - Existing Conditions (10% AEP event)

4.4 Modelling Parameters

In general, standard default TUFLOW parameters were used in the modelling of the rainfall across the Deniliquin BESS model domain. Key parameters are noted below:

Table 4-2 Key model parameters

Parameter	Value
Cell wet/dry depth	0.0002
SGS sample frequency	7
SGS Approach	Method C
SGS Depth Output	Cell Average

The computation timestep is adaptive over the course of the simulation with 2D time-varying outputs generated every 10 minutes, and every 5 minutes within the plot output (PO) points/lines.

4.5 Quality Assurance

This section outlines the Quality Assurance (QA) measures undertaken in developing the Deniliquin BESS hydraulic model.

Part of the general model QA involves reviewing the TUFLOW messages generated during the model compilation stage and resolving any issues. Warnings produced by TUFLOW during the run were also investigated. Locations causing recurring warnings were identified and a solution implemented to reduce or remove the source of the issue. Model logs have also been utilised to record the key decisions made when developing the model, allowing for traceability and aid in the transfer of the models between different users. The main components of the Deniliquin BESS model build, configuration and application were recorded and have been reviewed and signed-off by a senior hydraulic modeller.

Additional review of the HPC parameters (Courant Number, Wave Speed and Momentum Diffusion) are important checks in the QA process for model health and a proxy for solution accuracy. Figure 4-4 highlights the HPC results for an example 1% AEP simulation and indicates the celerity control number (wave speed) is controlling the model with areas of deep ponding. This is not unsurprising considering the Mulwala Channel has a standing water level the entire simulation.

Further QA over the course of the model build was undertaken, those checks include:

- Material roughness was checked by importing and thematically mapping the uvpt_check file and DEM_M to ensure surface resistance was applied correctly with respect to aerial images;
- The extent of the 2D domain was reviewed to unsure it was not limiting flood extents in the larger flood events within the area of interest;
- Key topographic features were also reviewed to ensure that blockages and attenuation were captured within the grid sampling to prevent ‘leaky’ embankments; and
- Minimum dT values across the 2D domain were reviewed to highlight any troublesome areas that were slowing down overall run time.

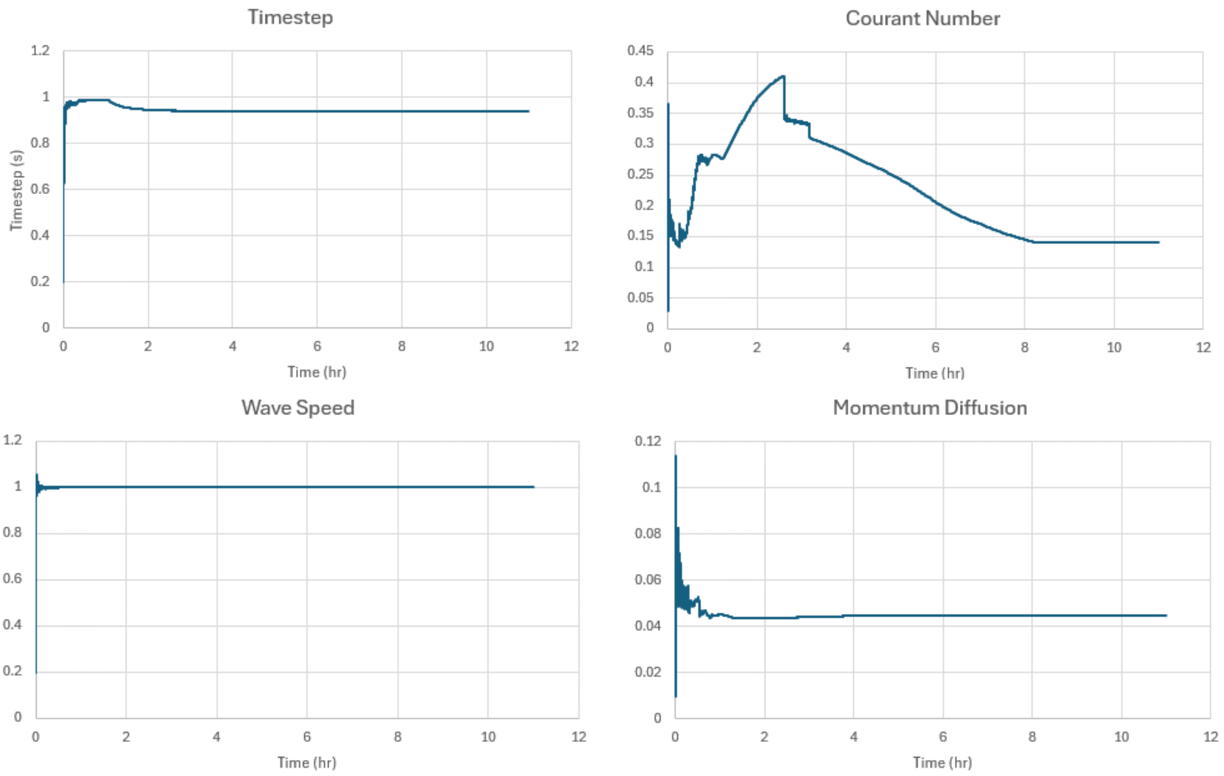

Figure 4-4 TUFLOW HPC parameters - 1% AEP, 1-hour, TP08

4.6 Model Limitations

This model has been developed to take advantage of the most accurate available data to help inform flood risk at the Site. There are however several limitations to the hydraulic model worth noting:

- No model verification was undertaken with rated upstream gauge flows or event observations.
- No hydraulic control structures have been explicitly modelled as part of this assessment. As such the connectivity between Mulwala Channel and the feeder field drains via these structures is unknown and the influence these may have on localised flood risk.

5 FLOODING RESULTS

5.1 Overview

The results of the flood modelling are presented in this section. The maximum flood level, depth, velocity and hazard for each modelled AEP was determined across the modelled event durations. Note that flood depths less than 10 mm and puddle sizes less than 0.01 ha have been filtered from all results.

In this report only the 10%, 5% and 1% AEP and PMF events are discussed under existing site conditions, with the remainder of the results provided in mapping and provided as GIS layers. Results for the 0.5% and 0.2% AEP were used for the discussion of flood levels under the climate change condition.

Floods can be hazardous, producing harm to people, damage to infrastructure and potentially loss of life. In examining the potential hazard of flooding at the site, there are several factors to be considered, as outlined in ARR 2019 (Book 6 Chapter 7)[14]. An assessment of flood hazard should consider:

- Velocity of floodwaters;
- depth of floodwaters;
- Combination of velocity and depth of floodwaters;
- Isolation during a flood;
- Effective warning time; and
- Rate of rise of floodwater.

The flood hazard of the site was assessed in accordance with ARR2019, which defines six hazard categories. The combined flood hazard curves are presented in Figure 5-1 and vulnerability thresholds classifications are tabulated in Table 5-1.

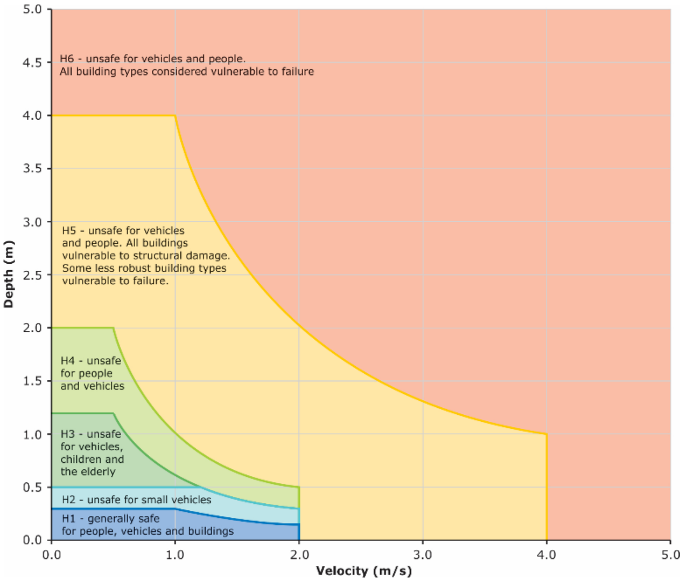

Figure 5-1 Combined flood hazard curves

Table 5-1 Hazard classification (ARR, 2016)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)	Description
H1	D*V ≤ 0.3	0.3	2.0	Generally safe for vehicles, people and buildings.
H2	D*V ≤ 0.6	0.5	2.0	Unsafe for small vehicles.
H3	D*V ≤ 0.6	1.2	2.0	Unsafe for vehicles. children and the elderly.
H4	D*V ≤ 1.0	2.0	2.0	Unsafe for vehicles and people.
H5	D*V ≤ 4.0	4.0	4.0	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	D*V > 4.0	-	-	Unsafe for vehicles and people. All building types considered vulnerable to failure.

[14] http://book.arr.org.au.s3-website-ap-southeast-2.amazonaws.com/

5.2 Existing Conditions

The 1% AEP hydraulic model results outlined in Figure 5-3 to Figure 5-5 indicate that the 1% AEP event does not produce any major external catchment flow paths through the Site. The general fall across the topography is from the bottom-right to the top-left, indicative of the accumulation of ponded water near the adjacent field dam. A long-section through the lease area (Figure 5-2; point A to point B within Figure 5-3) further confirms this, with the predicted peak water levels for the 1% AEP event overlayed onto the underlying DTM. The results highlight the shallow depths of flooding produced across the Site sheet off to the north-west and pond against the nearby channel embankments. A similar flooding mechanism is seen in all events up to the 0.2% AEP + climate change allowance.

The velocities and hazard classification follow a similar pattern, with peak velocities across the lease area site ranging from 0.03-0.1 m/s. This is quite slow and is reflective of the H1 hazard classification. Risk to people and vehicles within the Site area in existing conditions is therefore not considered a concern.

Consideration of climate change was applied to the 0.5% and 0.2% AEP events. In each case, the flooding mechanisms were identical and resulted in a shallow level of flooding across the Site. The 0.2% AEP + climate change event resulted in a peak depth of 0.08m in in the north-west corner of the lease area.

All remaining results across the modelled events can be found in Appendix B.

Note: The results presented do not account for joint inundation with riverine flooding from the Edward River in the extreme events.

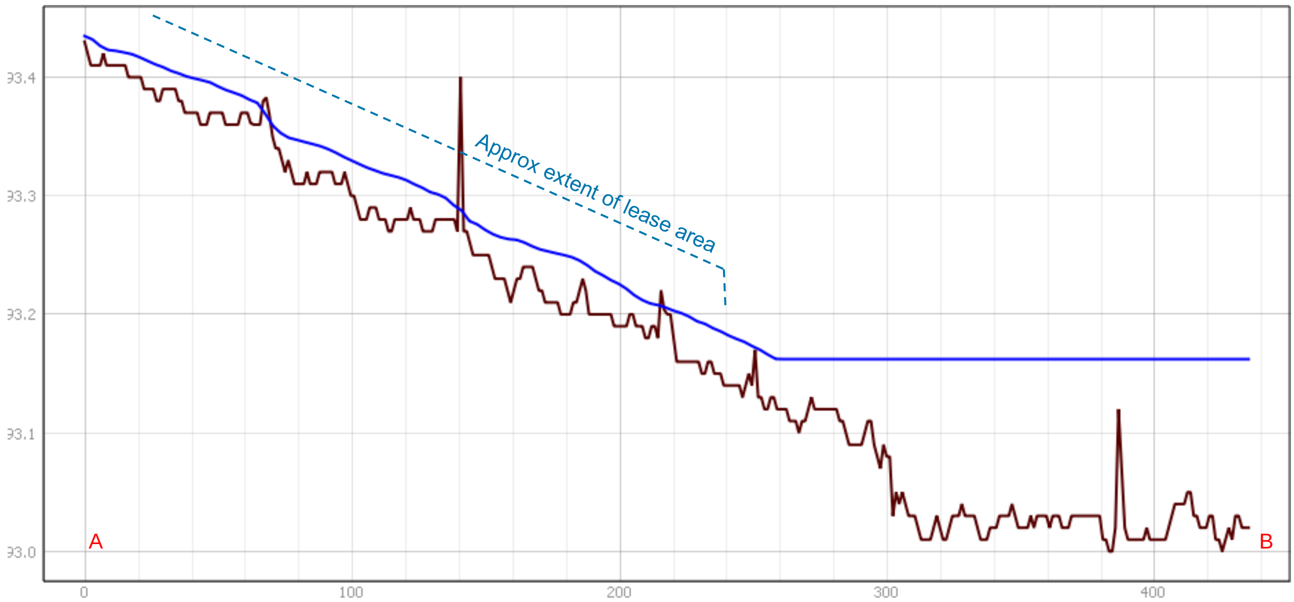

Figure 5-2 Existing Conditions – 1% AEP water level (long-section through Site)

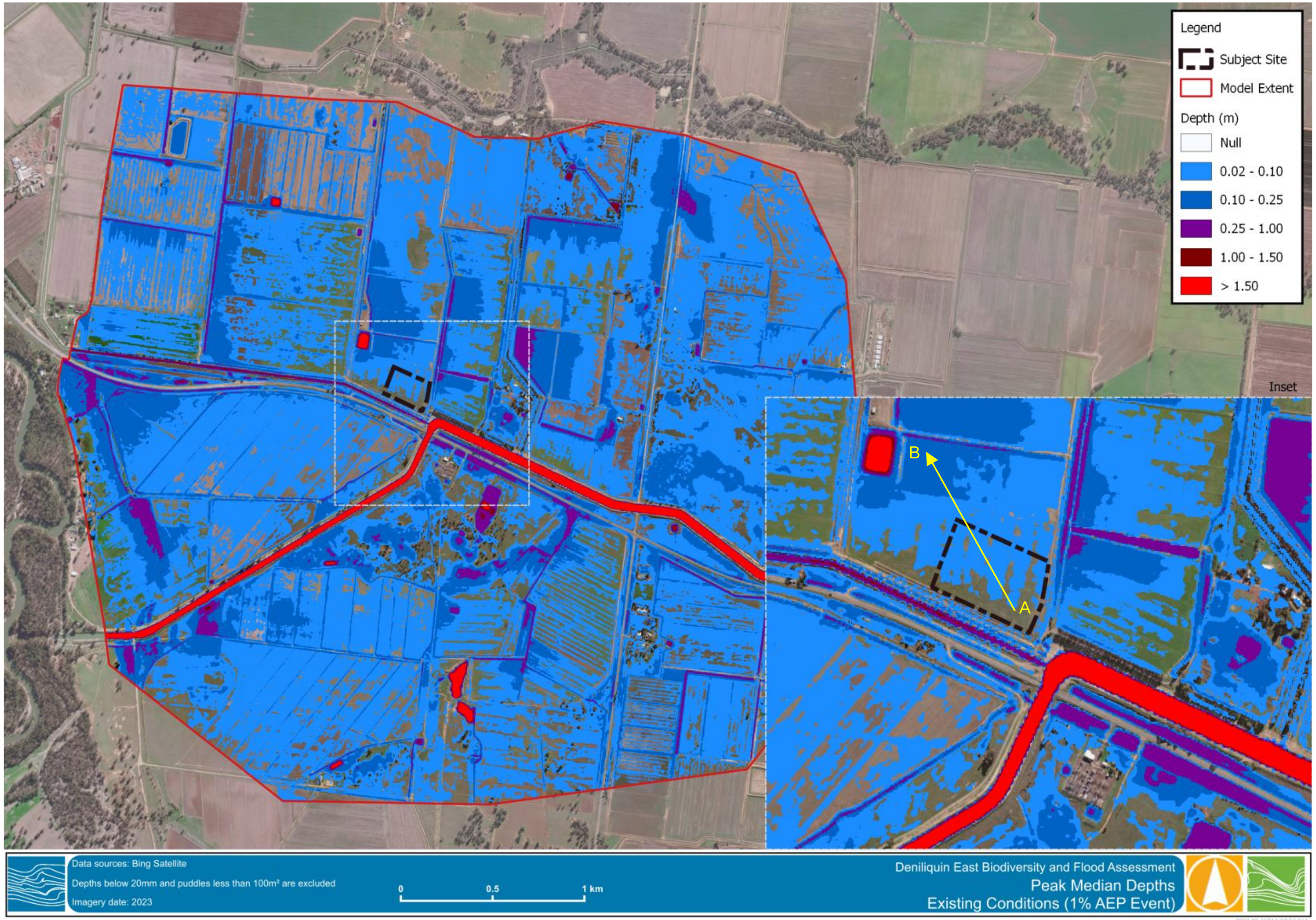

Figure 5-3 Existing Conditions – 1% AEP flood depth

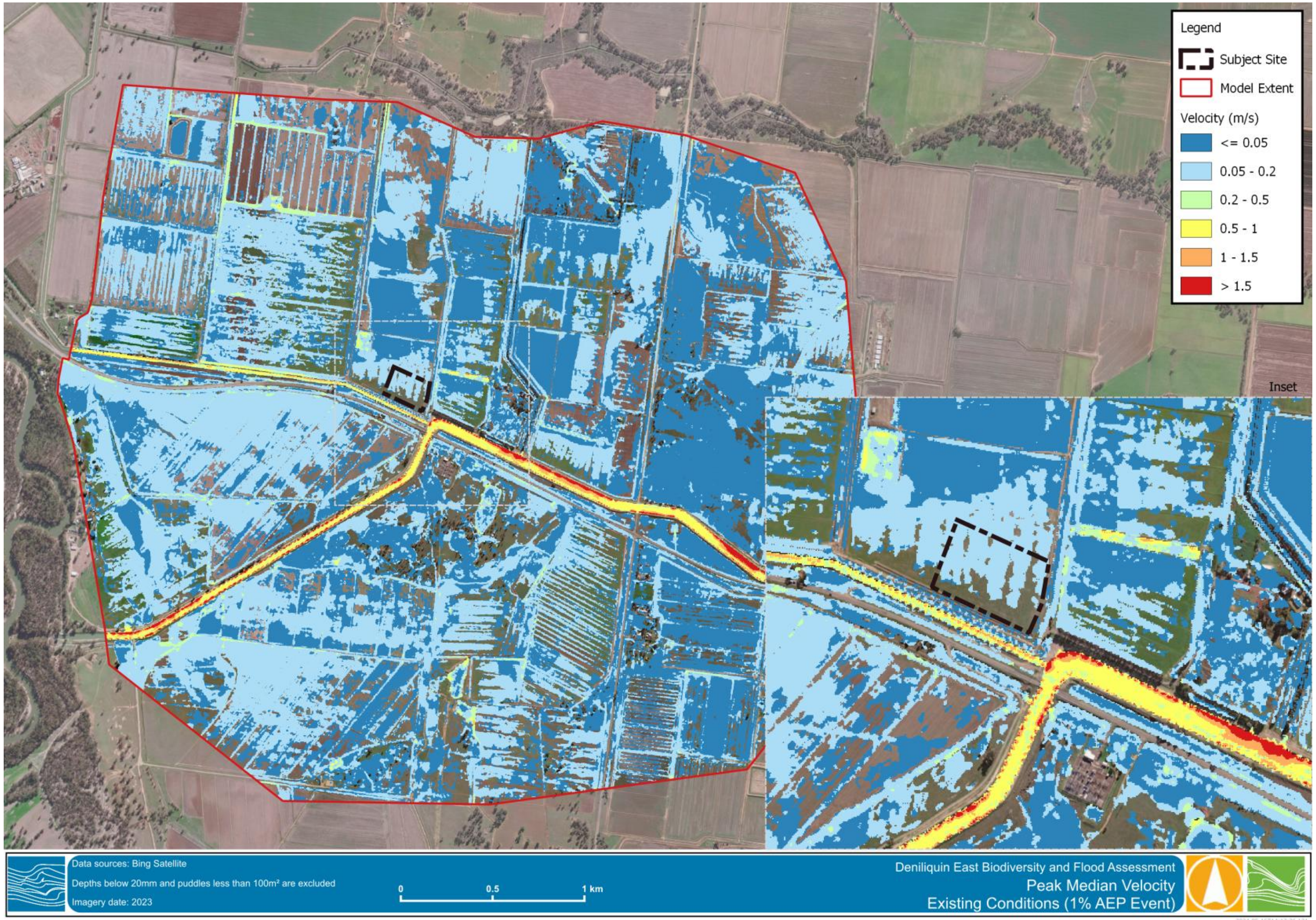

Figure 5-4 Existing Conditions – 1% AEP flood velocity

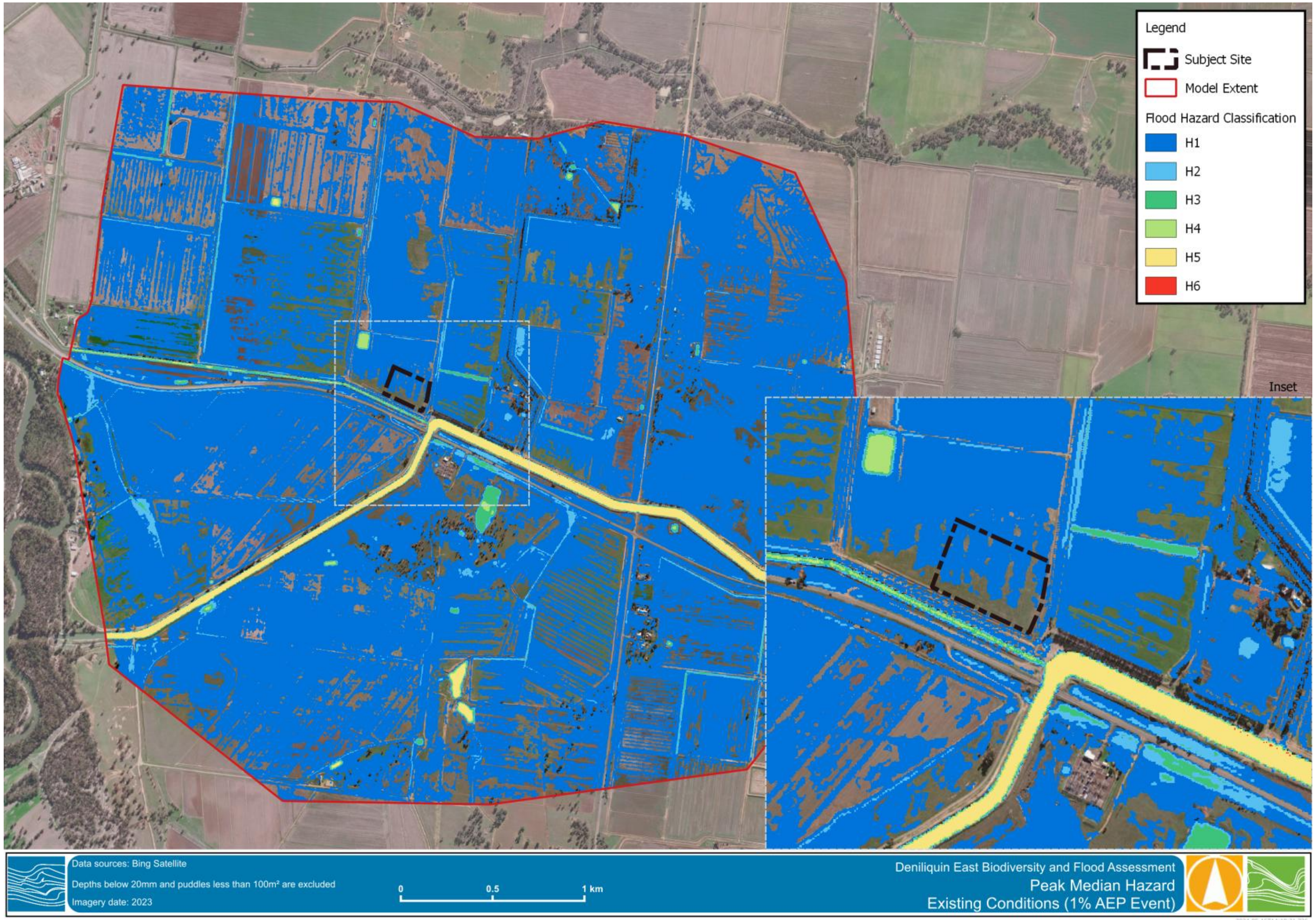

Figure 5-5 Existing Conditions – 1% AEP flood hazard

5.3 Developed Conditions

The impact of the proposed development on the flood behaviour is likely to be very low as no major changes to the land topography (cut/fill) are expected or have been assumed within the hydraulic modelling. Only those changes detailed in Section 3.3.4. To account for the installation of key assets, the baseline RoG model was modified to include raised areas for the road and project infrastructure locations.

Developed conditions output from the hydraulic model were compared to that of existing conditions to show the change in water levels and inundation extents caused by the development for a 1% AEP event. The flooding mechanisms across the AEP events display a similar behaviour and preferential flow path north-west towards the low-lying areas of the field. The inclusion of the Deniliquin BESS and adjustments to the local topography resulted in areas of increased attenuation behind the access road and elevated platform (Figure 5-6; blue and red shaded areas). The low-level runoff becomes entrapped behind the raised platform and results in upwards of 0.05m increase within the lease area (Subject Site). Off-site, small pockets of increased flood levels can be observed adjacent to the access road crossing within the field channels where peak water level differences range from 0.02 – 0.11m. The PMF depth-difference (Appendix C) displays a reduced depth across the proposed compound and access road (green shaded areas). This is due to the increased elevation of the proposed terrain and shallower predicted peak depths. Peak depths across the proposed site in the PMF event also estimated to be 200-400mm. Across the wider domain, the PMF results indicate negligible difference in the peak water levels. The inclusion of culverts within Moulamein Channel and the swale has helped reduce attenuated water in these areas by facilitating flow to the west. The only notable increase of water levels is adjacent to the Riverina Highway, with increases of 0.03 – 0.08m. In all other modelled events, impacts were not observed in this area. The predicted peak water levels in Moulamein Channel and within the vicinity of Riverina Highway are sensitive to the culvert capacity. Monitoring and maintenance of these culverts is recommended to remove potential debris and blockages.

The proposed development is not predicted to result in indirect or direct damage to the local community in the event of significant flooding. Furthermore, the implications of the BESS becoming non-operational (offline) on power supply to the local community are not considered within the scope of this assessment. No other detriment is observed that would impact other nearby receptors or emergency management within the local region.

Access and egress from the Site are not expected to be impacted by surface water flood risk up to the 1% AEP event. Looking at wider access implications, there is some curtailment of access expected along the Riverina Highway from the Deniliquin township based on the results of the Edward River Flood Study should wider riverine flooding also occur. Regarding access implications, the construction phase and resurfacing of access roads may create a bottleneck to any evacuation and emergency services. Therefore, it is recommended to not impede the movement of vehicles on the Riverina Highway more than necessary during the construction and operation of the proposed BESS. The proposed Avenis Energy BESS, situated directly east of the existing Deniliquin substation, is not predicted to be impacted by the development proposed by Gransolar. The separation by the Riverina Highway and Mulwala Channel prevents the two sites from being hydraulically linked.

Outside of surface water flood risk, the nature of the terrain falling away north-west and the application of water to manage fire risk to within the Site will likely require a tertiary containment system. The purpose of such a system will be to control and store any excess water applied to electrical infrastructure. Implementation of such a system (e.g. bunding, retarding basin) may also serve a dual function for attenuating surface water flows.

Figure 5-6 Change in 1% AEP peak depth

6 FLOOD RISK RECOMMENDATIONS

Based on the flood depth, velocity and hazard levels estimated in the flood modelling of the site, the site is generally categorised as low risk to surface water flooding. The following recommendations are proposed to be adopted at the site:

- Any sensitive infrastructure such as inverters and battery storage etc, should be located on raised fill pads with 300 mm freeboard above the maximum of the 1% AEP flood level. It is common for this type of infrastructure to be housed within shipping containers or small sheds with relatively small footprints. Given the shallow depths across the site, raising these small fill pads is highly unlikely to result in any adverse impacts offsite.
- The footings should be designed to withstand the flood velocities described in this report, which are mostly low in the lease area.
- It is recommended that the best practice principles to stormwater and sediment control be incorporated into the design, construction and operation phases of the BESS site.
- It is anticipated that vehicles can safely access and egress from the Site, however consideration should be given to not restrict the movement of emergency vehicles on the Riverina Highway with any scheduled roadworks.
- Monitoring and maintenance of any installed culverts to avoid blockage is recommended to facilitate conveyance to the west.
- Inundation from surface water in the PMF event is not predicted to significantly curtail access/egress via the Riverina Highway. The site is not expected to have permanent occupants on site during construction or operation, therefore the risk to like is considered low. As a result, there is no perceived need to develop a Flood Emergency Plan.

It is recommended that Gransolar review this report and consider its findings in conjunction with the findings of other reports related to the environment and potential constraints of the proposed site. Further progression of the site design should consider the findings of all relevant investigations.

7 ENVIRONMENTAL ASSESSMENT REQUIREMENTS

As the proposed BESS is a state significant development, the Planning Secretary's Environmental Assessment Requirements (SEARs) apply. The items of concern identified in the SEAR that have been addressed in the report. The responses for each SEARs item are found in the Table 7-1 below.

Table 7-1 SEARs items and responses

SEAR Items		Responses
Key Issue		
Land		
-	An assessment of the potential impacts of the development on existing land use and adjacent land, including flood prone land.	Flood risk and impacts are discussed in Section 5 and the maps in Appendix B
Water		
-	a detailed and consolidated site water balance and an assessment of the likely impacts of the development (including flooding) on surrounding watercourses (including their Strahler Stream Order) and groundwater resources and measures proposed to monitor, reduce and mitigate these impacts including water management issues	No water balance is required as there is no expected capture or use of surface water on site. The nearby Edward River is an anabranch of the Murray River and is 'braided' at several locations with other creeks and rivers. The Edward River therefore has a Strahler Stream Order 3 or greater depending on the reference location. Relative to the Site, the Moulamein Channel has a Strahler Stream Order of 1. Groundwater management and mitigation measures are discussed in Section 2.3.
-	details of water requirements and supply arrangements for construction and operation	Not covered in this report. Water supply and requirements will be discussed within the construction management and design report.
-	a description of the erosion and sediment control measures that would be implemented to mitigate any impacts in accordance with Managing Urban Stormwater: Soils & Construction (Landcom 2004)	The Site is relatively flat with a slight gradient towards the northwest, away from Moulamein Channel. There is no foreseeable need for continued erosion and sediment control besides those outlined in the construction management plan in accordance with industry standards.
-	assessing the impacts of the development, including any changes to flood risk and overland flows on-site or off-site	Flood risk and development impacts are discussed in Section 5 and the maps in Appendix C

SEAR Items		Responses
-	Where the project involves works within 40 metres of any river, lake or wetlands (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI Guidelines	The proposed BESS is in close proximity to irrigation channels; however these are not considered rivers, lakes or wetlands.

Input from the Biodiversity and Conservation Division (BCD) at the Department of Planning and Environment[15] also recommended further requirements as part of the flood risk assessment. These detailed requirements are tabulated below.

Table 7-2 Recommended Environmental Assessment Requirements items and responses

BCD Requirements		Responses
Items	**Flooding**	
6	The EIS must map the following features relevant to flooding including:	
a.	*Flood prone land*	Covered in Section 5 and the maps in Appendix B
b.	*Flood planning area*	The Site is situated outside of the Flood Planning level
c.	*Hydraulic categorisation*	The Site sits within a low hazard area from surface water risk due to the shallow depth and low velocity. See Section 5.2 and the maps in Appendix B
d.	*Flood hazard*	Section 5.2 and the maps in Appendix B
7	The EIS must describe flood assessment and modelling undertaken in determining the design flood levels	Section 3.3.2 details the hydraulic model and hydrology development.
8	The EIS must model the effect of the proposed development (including fill) on the flood behaviour, including:	
a.	*The 0.5% and 0.2% AEP flood events with climate change*	Covered in Section 5 and the maps in Appendix B
9	Modelling in the EIS must consider and document:	
a.	*Existing council flood studies in the area*	Section 1.1. No other studies were found on surface water flood risk in the region.
b.	*The impact on existing flood behaviour for a full range of flood events*	Covered in Section 5
c.	*Impacts of the development on flood behaviour*	Covered in Section 5 and the maps in Appendix C
d.	*Relevant provisions of the Flood Risk Management Manual*	Discussed in Section 10

[15] BCD advice on SEARs to the Department of Planning and Environment; dated 11th September 2023 (DOC23-764522)

BCD Requirements		Responses
10	The EIS must assess the impacts on the proposed development on flood behaviour, including:	
a.	*Whether there will be detrimental increases on other properties, assets or infrastructure*	Covered in Section 5.3. The maps in Appendix C showcase the relative change in flood risk as a result of the proposed Site.
b.	*Consistency with Council Floodplain Risk Management Plans*	The assessment has been conducted in accordance with relevant guidelines.
c.	*Consistency with any Rural Floodplain Management Plans*	The assessment has been conducted in accordance with relevant guidelines.
d.	*Compatibility with the flood hazard of the land.*	Covered in Section 5 and the maps in Appendix B.
e.	*Compatibility with the hydraulic functions of flow conveyance.*	The project is expected to have no/minimum changes to the hydraulic functions of watercourses and storages.
f.	*Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.*	Covered in Section 5.3. No detriment is predicted to receptors or downstream of the Site.
g.	*Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.*	There is no predicted impact on riparian vegetation due to increased flood risk as a result of the development footprint.
h.	*Any impacts the development may have upon existing community emergency management arrangements for flooding.*	Detriment is not predicted to influence local emergency management. See Section 5.3.
i.	*Whether the proposal incorporates specific measures to manage risk to life from flood*	Risk to life is not predicted at the Site as the proposed BESS sits outside of the riverine flood fringe and is only susceptible to shallow surface water flooding.
j.	*Emergency management, evacuation and access, and contingency measures*	Access and egress are assessed in Section 5.3.
k.	*Any impacts the development may have on the social and economic costs to the community as consequence of flooding.*	Considered in Section 5.3.

8 DENILIQUIN LOCAL ENVIRONMENT PLAN 2013

The proposed Site is within Deniliquin LGA and therefore it is within the area to which the Deniliquin Local Environmental Plan (LEP) 2013 applies. However, Clause 1.9.1 of the LEP states that:

> *This Plan is subject to the provisions of any State environmental planning policy that prevails over this Plan as provided by section 3.28 of the Act.*

The Site sits within the rural primary production (RU1) zoning and falls outside of the Flood Planning Map for the Deniliquin LGA. As a consideration for the consent authority, assessment against the Section 5.21 of the LEP 2013[16] provisions have been provided below. Table 8-1 outlines the flood planning controls that apply to developments within the LGA.

Table 8-1 Table identifying floodplain related controls in the Deniliquin LEP 2013

Flood planning controls		Response
5.21.2. Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development	(a) is compatible with the flood function and behaviour on the land, and	The proposed development complies with the local development controls and has been recommended to include a freeboard above the 1% AEP surface water level. The Site is situated outside of the flood planning level (Figure 8-1). **Complies.**
	(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and	The qualitative assessment undertaken as part of this flood risk report have detailed the flooding mechanisms within the proposed Site. The assessment demonstrates that the Site is mapped outside of the flood planning level, but within the fringe of the PMF for riverine flooding. Surface water flood risk has likewise indicated shallow sheet flow. Therefore, the proposed BESS will not adversely impact riverine or surface water flood behaviour on neighbouring properties. **Complies.**
	(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and	The proposed BESS project does not require permanent occupation during construction or operation and can be de-activated remotely during adverse conditions. Likewise, the predicted flood risk to the Site is low risk. Therefore, there is no perceived need to develop a Flood Emergency Plan. **Complies**
	(d) incorporates appropriate measures to manage risk to life in the event of a flood, and	The proposed development is predicted to cause minor increases in water levels around the elevated compound and access roads. Recommendations have been given to include hydraulic structures under each access road, and to elevate the BESS compound above the 1% AEP event. The predicted peak flood depths and hazards within the lease area are not anticipated to pose a risk to life in the event of a flood. **Complies.**

[16] https://legislation.nsw.gov.au/view/whole/html/inforce/current/epi-2013-0754#sec.5.21

Flood planning controls		Response
	(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.	The proposed BESS is not predicted to influence localised erosion or siltation as the Site sits on an existing managed field. The proposed access roads are expected to be constructed to industry standards to ensure trafficable areas do not compromise both the structural integrity and vegetation along the channel embankments. **Complies.**
5.21.3. In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters	(a) the impact of the development on projected changes to flood behaviour as a result of climate change,	This surface water flood risk report has qualitatively assessed the impacts of increased rainfall as a result of climate change. The shallow depth and low hazard classification will define the Site area as having no impact on broad flood behaviour on neighbouring properties in events up to and including the PMF. **Complies.**
	(b) the intended design and scale of buildings resulting from the development,	The proposed BESS site includes containerised lithium-ion battery modules, power conversion units, substation, switch-room, control room and maintenance container. The site is not expected to be in use at all times and will be situated above the 1% AEP flood level from surface water flooding. **Complies.**
	(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,	As per response to 5.21.2 (c) Due to the shallow flooding and low hazard at the Site, risk to life is not predicted from surface water flooding. **Complies**
	(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion	It will not be possible to modify, relocate or remove the proposed building as a response measure to flooding. The proposed Site is located on the upslope within the existing field and is close to the Riverina Highway to facilitate access/egress. The site is not subject to coastal erosion. **Complies.**

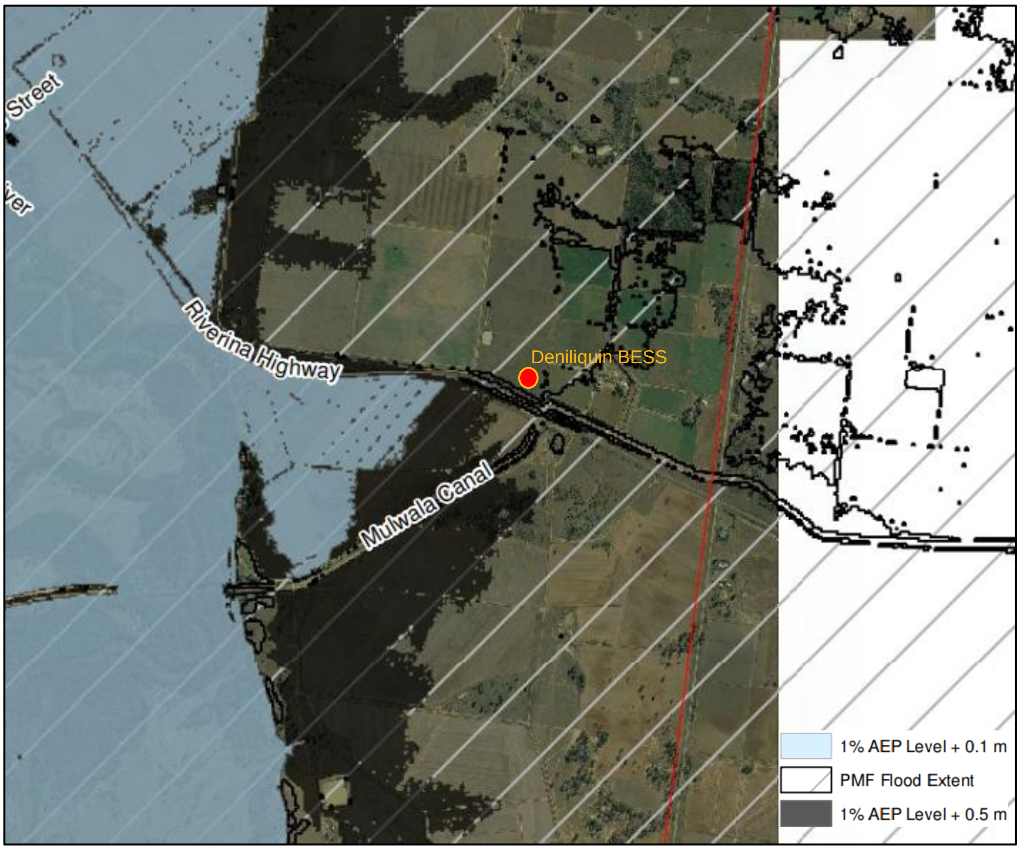

Figure 8-1 Riverine Flood Planning Level extent (Figure 32; WMAwater 2014)

9 DENILIQUIN DEVELOPMENT CONTROL PLAN 2016

The proposed Site is a State Significant Development Application (SSDA) within the Deniliquin LGA and therefore it is within the area to which the Deniliquin Development Control Plan (DCP) 2016 applies. However, Clause 2.10.1 of the State Environment Planning Policy 2021 states that:

> *Development control plans (whether made before or after the commencement of this Chapter) do not apply to: State significant development*

As good practice, consideration has been given to DCP provisions for guidance.

The Site is not located within the floodway and falls outside of the designated flood planning level from riverine flooding (1% AEP flood event + 0.1m freeboard) as indicated by Figure 32 of the 'Edward River at Deniliquin Flood Study' (WMAwater 2014). The Site is only susceptible to riverine flooding in extreme events up to the PMF. With regards to surface water flooding, the proposed Site experiences shallow sheet flow across the lease area up to the modelled climate change events. The DCP 2016 provisions therefore do not apply, however consideration is given below.

As described within *Table 10-1 (Development Controls for Flood Prone Land)* of the DCP 2016[17], the development controls for areas located within the floodplain have been assessed against the Site. Table 9-1 below in this report responds to those flood-related controls.

Table 9-1 Table identifying floodplain related controls in the Deniliquin DCP 2016

Floodplain	
Development controls for residential and rural zones	*Response*
2. The finished floor level must be in accordance with Council's Policy 5.9 Flood Planning Levels.	Although the Site is not residential, the Deniliquin Policy 5.9 states that finished floor levels located within the flood planning area must be above the 1% AEP flood event + 0.1m freeboard. A freeboard recommendation has been given above the peak 1% AEP surface water level in Section 6 of this report.
3. Safe path of travel, at the same height as the adjoining road network, must be provided for pedestrians and/or vehicles at a height that is equivalent to the adjoining road network.	Access roads into the proposed Site will be built up over the adjacent channels and connect into the existing road/track network to the Riverina Highway. These access connections are likely to be resurfaced to accommodate the loading of construction vehicles.

[17] https://www.edwardriver.nsw.gov.au/Business-Development/Planning/Deniliquin-Development-Control-Plan

10 NSW FLOOD RISK MANAGEMENT MANUAL 2023

The NSW Flood Risk Management Manual 2023 (FRMM) is a guide developed by NSW DPE and intended for local and state government on implementation of flood risk management strategies. It provides recommendations, but these are not legal requirements. The FRMM is an update of the NSW Floodplain Development Manual 2005 and includes a number of tools/guides such as the Flood Risk Management Guideline FB01 – Understanding and Managing Flood Risk, the Flood Risk Management Guideline MM01 – Flood Risk Management Measures and the Flood Risk Management Guideline EM01 – Support for Emergency Management Planning.

Merit-Based Approach

The FRMM recommends:

> *using a merit-based approach in preparing and implementing flood risk management (FRM) plans to address riverine and local overland flooding.*

This assessment has qualitatively assessed local surface water flooding and reviewed the risk from riverine sources.

Battery Storage

Battery storage is not explicitly mentioned within Table 10 in Section 2.8.3 of *Flood Risk Management Guideline FB01 - Understanding and Managing Flood Risk*. However, it is assumed that the type of use falls within the Hazardous industry with the contents being highly susceptible to flood waters.

The proposed Site is likely to be considered FPCC4 as it falls outside of floodways from the Edward River but within the extent of the PMF. Likewise, the surface water flood risk indicates the lease area displays shallow sheet flow and attenuation behind the proposed compound with a hazard classification less than H3 in the PMF. Consideration should be given to the installation of emergency response facilities in the event of an extreme flooding event.

Flood Impact and Risk Assessment

The *Flood Risk Management Guideline LU01 – Flood Impact and Risk Assessment* indicates that:

> *A FIRA may… be undertaken to support an activity … where the activity is affected by flooding.*

Given that the Site will likely experience shallow inundation by surface water flooding in events larger than the 1% AEP, the preparation of a Flood Impact and Risk Assessment (FIRA) is appropriate.

The *Guideline LU01* lists the aims of a FIRA as to identify and analyse:

- the impacts of the proposed development on the flood risk to the existing community
- the impacts and risks of flooding on the development and its users
- how these impacts can be managed to minimise the growth in risk to the community due to the development.

The Edward River Flood Study prepared by WMAwater demonstrates that the Site is likely mapped as flood fringe in the riverine PMF, which is defined by the NSW Flood Risk Manual (NSW DPE, 2023) as “areas where development will not impact on broad flood behaviour due to alteration of flow conveyance and storage”. Therefore, the proposed development will not adversely impact riverine flood behaviour on neighbouring properties in events up to and including the PMF.

This report produced for Gransolar assessed the impacts and risk of flooding from surface water and details the relative changes in peak water levels as a result of the Site within the lease area. As the proposed BESS is still under design development, the hydraulic model and analysis will likely need to be updated once a final design has been settled on to detail and assess the adopted design solutions (e.g., infrastructure/compound levels, access road crests).

The *Guideline LU01* states that:

> *All assessments need to demonstrate compatibility of the development with any existing relevant state environmental planning policies (SEPPs), local environmental plans (LEPs), DCPs or policies, as well as existing industry guidance, government guidance and reference documents.*

This flood risk report includes a discussion of the proposed development's consistency with the DCP 2016, existing industry guidance, and government guidance.

The *Guideline LU01* provides a list of issues that a flood impact assessment should provide an understanding of. It should be again noted that the FRMM and its associated Guidelines are not legal requirements.

Table 10-1 Issues that FIRA should provide an understanding of

Issue	Advice
The full range of flood risk. To achieve this, flood behaviour would be examined for a range of events. Typical events examined may include the 10%, 5%, 1%, 0.5% or 0.2% AEP and probable maximum flood (PMF)	This flood risk report prepared for the proposed Deniliquin BESS considers the full range of flood risk for events up to and including the PMF. **Complies.**
The potential for coincidence with downstream tailwater levels or ocean inundation levels where the area is influenced by backwater flooding from downstream waterways or the ocean	A joint probability of riverine and surface water flood risk was not undertaken. As the Site falls outside of the flood planning level, the surface water assessment assumed the modelled area was not influenced by backwater flooding from downstream Edward River. **Issue does not apply.**
The constraints that flood places on the land (floodways, flood storage, flood hazard and emergency response issues) determined for a number of events, typically 5%, 1%, 0.2% or 0.5% AEP and PMF	This flood risk report prepared for the proposed development considers the constraints that flood places on the land, including flood hazard, the implications of flood fringe and discussion of emergency response issues for a range of relevant floods up to and including the PMF. **Complies.**
The appropriateness of the development or development types for the location based on the flood constraints on the land	The proposed development includes a discussion of the appropriateness of the development and location relative to the surface water flood risk surrounding the Site. **Complies.**

Issue	Advice
The adequacy of management measures and controls to: ■ effectively address these constraints to ensure the flood risks to the proposed development and its users are acceptable ■ manage flood and associated emergency management (EM) impacts to the existing community due to the development	This flood risk report prepared for the proposed development includes a discussion of potential flood risk mitigation measures and their effectiveness in addressing flood risk. This should be updated once a final design is decided on. A Flood Emergency Plan for the Deniliquin East BESS is not available that details flood emergency response procedures and actions to manage the flood risk to life. The report should be developed to include a flood evacuation capability assessment to demonstrate whether evacuation can be achieved in all circumstances, including a flood rising as fast as the riverine and surface water PMF. The assessment should also consider whether the proposed redevelopment will exceed the capacity of existing evacuation routes. **Further assessment required to comply.**
The choice of Australian Rainfall and Runoff (ARR) data version to use	The hydrological input into the hydraulic modelling utilised the latest ARR rainfall and loss methods. **Complies.**
Climate change impacts. Both existing and post-development flood behaviour needs to consider climate change impacts on flood behaviour so the robustness of decisions over time can be understood. Climate change impacts can influence outcomes and requirements for developments.	This flood risk report considers climate change impacts on the 0.5% and 0.2% AEP events using the RCP8.5 uplift on the 2090 projection. **Complies.**

11 SUMMARY

11.1 Assessment Method

Technical assessments of potential surface water impacts of the development of a BESS were undertaken to address the requirements of the SEARs.

A review of existing groundwater risk, riverine flood modelling projects and specific site based hydraulic flood modelling was conducted. Modelling of the Subject Site investigated the potential for the site to be inundated from direct (local catchment) flooding and the potential for the development to alter the hydrological regime on neighbouring properties.

11.2 Key Findings

11.2.1 Groundwater/surface water interaction

Based on the current available understanding of the local hydrogeological regime and site operations during construction and operation, it is considered that there is negligible risk to groundwater or GDEs. This conclusion is derived from:

- No significant volumes of potential contaminants will be stored on the Subject Site during construction and operation phases and any small volumes of potential contaminants shall appropriately bunded and that infrastructure maintained. Thus, there is no contamination risk on or offsite from the Subject Site.
- No groundwater will be abstracted during either construction or operation and therefore, there will be no impact on groundwater resource volumes from the development.
- Use of sheet piles may require further investigations to determine if groundwater flow will be impacted by the use of the sheet piles.
- The battery units are self-contained and will control any potential leaks. There is no opportunity for the leaching of metals due to the containment and lack of water in the battery units.
- Depth to groundwater is considered to be at least 3 mbgl (based on available data) reducing the risk of intersecting groundwater.
- The closest GDEs are located at 1.7 km west of the Subject Site and are considered at a low risk of impact from the development.
- Site management plans will provide details on the clean-up of small spills via spill kits and soil removal.

Ongoing groundwater monitoring is not considered necessary at the Subject Site unless there is a major fire where fire-fighting water or chemicals are used, or another unforeseen leak occurs that is outside of the expected small volumes of stored fuel. Should a major fire or other event occur, then groundwater monitoring bores should be located up and down-gradient of the site.

11.2.2 Requirements should groundwater be intercepted

Despite groundwater in the shallow aquifer being unlikely to be intercepted during construction, should onsite investigations determine that groundwater is shallower at the Subject Site than the available data suggests, then an assessment in accordance with the NSW Aquifer Interference Policy (2012) is required. The assessment shall determine if the aquifer interference requires mitigation measures.

Section 3.2.1 of the NSW Aquifer Interference Policy (2012) provides categories for determining if the groundwater source is ‘Highly’ or ‘Less’ productive, with a highly productive aquifer based on these criteria:

1) Groundwater has total dissolved solids less than 1,500 mg/L, and

2) Contains water supply works that can yield water at a rate greater than 5 L/s.

Based on the reported qualitative salinity and the yield rates in Table 3-1, the shallow aquifer is considered a Less productive aquifer, due to yields being less than 5 L/s, despite having a salinity that may be less than 1,500 mg/L in some areas. Once the productive status of the aquifer has been determined then an aquifer category for the groundwater source is determined from one of the following:

1) Alluvial,

2) Porous rock, or

3) Fractured rock.

Based on the geological understanding, the shallow aquifer at the Subject Site is considered a less productive alluvial groundwater source. Table 1 of the NSW Aquifer Interference Policy (2012) provides the key thresholds below which minimal impacts for less productive alluvial groundwater sources need not be considered. The three-parameter thresholds are detailed in Table 11-1.

Table 11-1 NSW Aquifer Interference Policy (2012) Threshold Values for Minimal Impact Considerations.

Less Productive Alluvial Groundwater Source	
Water Table	Less than or equal to 10% cumulative variation in the water table, allowing for typical climatic “post-water sharing plan” variations, 40 m from any: (a) high priority groundwater dependent ecosystem; or (b) high priority culturally significant site; listed in the schedule of the relevant water sharing plan; or A maximum of a 2 m decline cumulatively at any water supply work unless make good provisions should apply.
Water Pressure	At any water supply work, a cumulative pressure head decline of not more than 40% of the “post-water sharing plan” pressure head above the base of the water source to a maximum of a 2 m decline.
Water Quality	Any change in the groundwater quality should not lower the beneficial use category of the groundwater source beyond 40 m from the activity; and (b) No increase of more than 1% per activity in long-term average salinity in a highly connected surface water source at the nearest point to the activity.

Should the depth to water in the shallow aquifer be shallower than expected, and dewatering or below watertable works are deemed necessary, simple analytical modelling is required to determine if any short-term and local dewatering activities will impact the shallow aquifer depth to water 40 m from the potential GDEs identified 1.7 km from the Subject Site. It is anticipated that there will be minimal dewatering required as the excavations will mostly 1.5 mbgl or shallower. The analytical model will also be used to determine if there will be a 2 m or greater decline in water level at any water supply. However, again this is considered highly unlikely based on the current understanding of the design.

If the shallow aquifer is intercepted and dewatering is required, then to address the ‘Water quality’ consideration (Table 11-1): 1) install a shallow monitoring immediately downstream of the activity and collect baseline water quality samples (salinity) from the installed monitoring bore and other available bores as well as surface water systems (including Moulamein Channel and Mulwala Irrigation Canal) and 2) collect follow up salinity during and after dewatering to verify that there is no lowering of the beneficial use (i.e., becoming more saline).

Groundwater abstraction via dewatering will also require a Water Abstraction Licence, which should be applied for once the detailed design has been completed and dewatering volumes.

11.2.3 Riverine flooding

A qualitative review of the existing Edward River flood study and likelihood for out of bank flooding from Flanagan's Channel was undertaken relative to the location of the proposed Deniliquin East BESS. No details were available on the predicted flood risk from Flanagan's Channel; however, review of localised topography indicates any out of bank flooding will preferentially continue spilling east to west downstream towards the Moulamein Channel. Likewise, the results of the Edward River flood study indicate that the Site remains flood free up to the 0.5% AEP design event as part of the hydraulic assessment conducted in 2014.

11.2.4 Direct catchment runoff

The hydraulic flood modelling assessment indicated that neither the project area, nor the BESS layout would be impacted by significant local flooding, other than sheet flow through the Site.

Developed conditions modelling was undertaken for the proposed raised layout. This scenario showed limited potential for the development to influence regional surface water levels, with local changes to flood level observed outside of the project area. No detriment to nearby receptors is predicted as a result of this development.

12 REFERENCES

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APPENDIX A – TEMPORAL PATTERN SELECTION

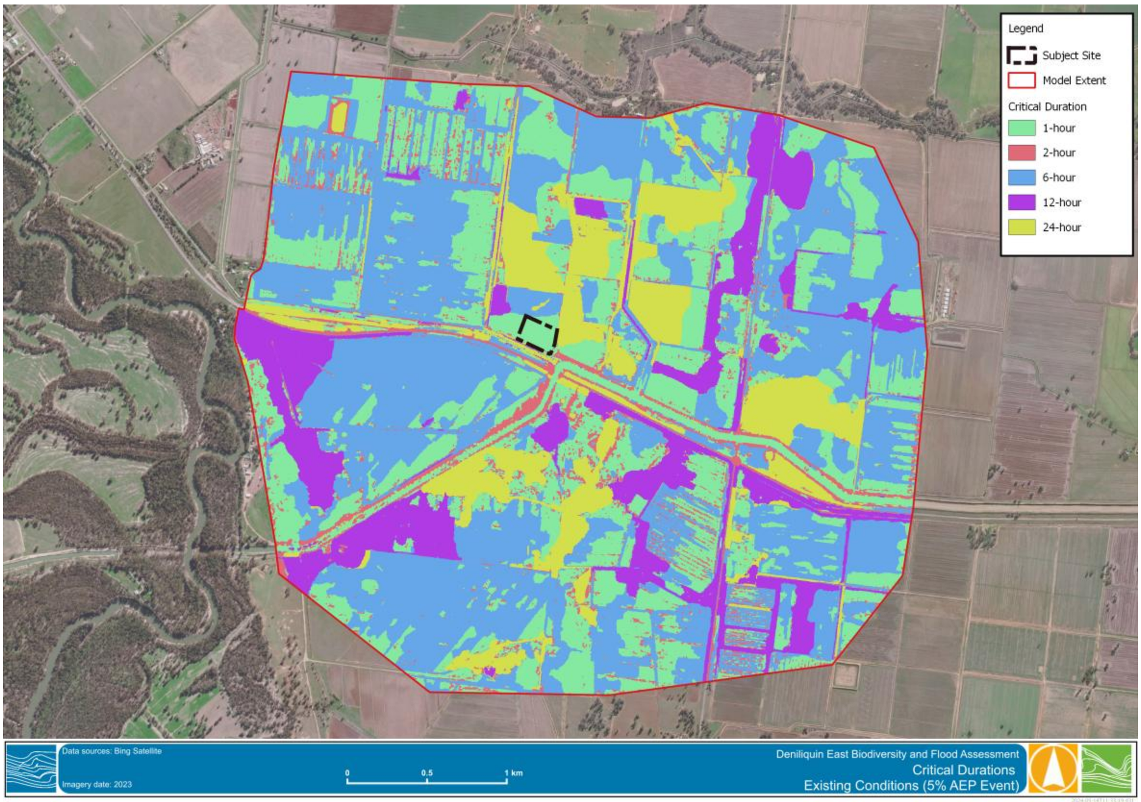

Figure A 1 Critical Duration (5% AEP)

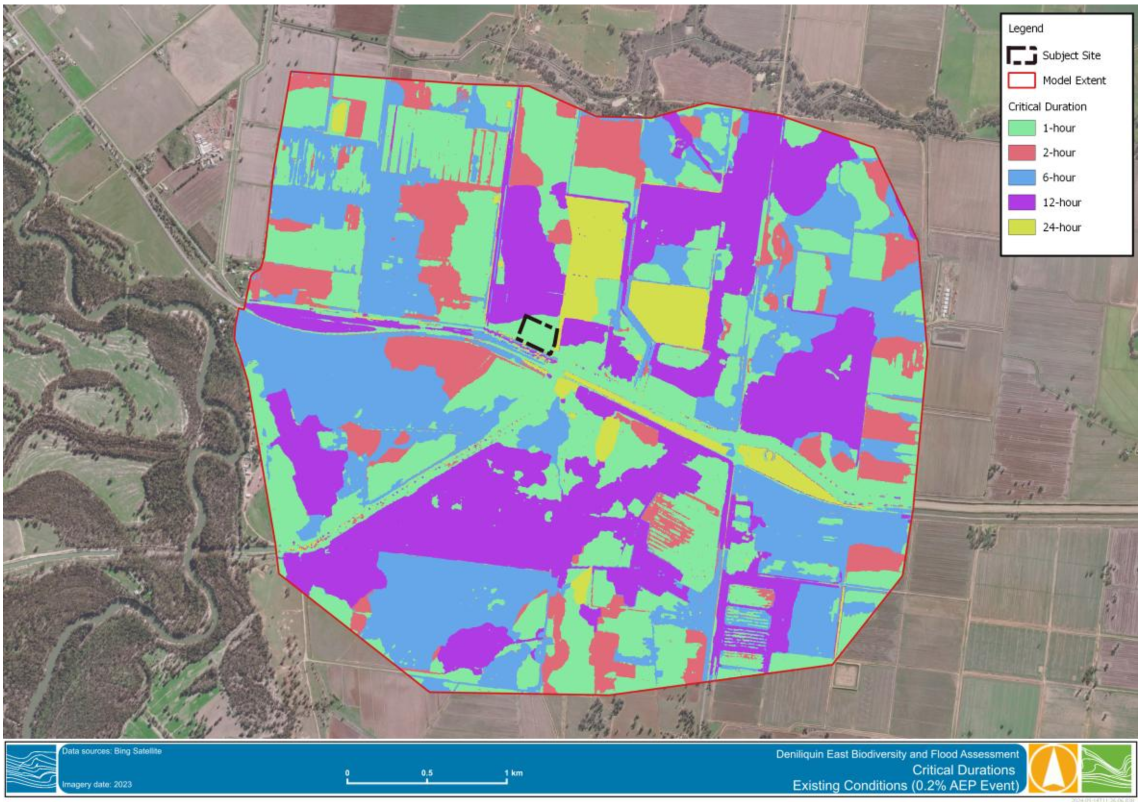

Figure A 2 Critical Duration (0.2% AEP)

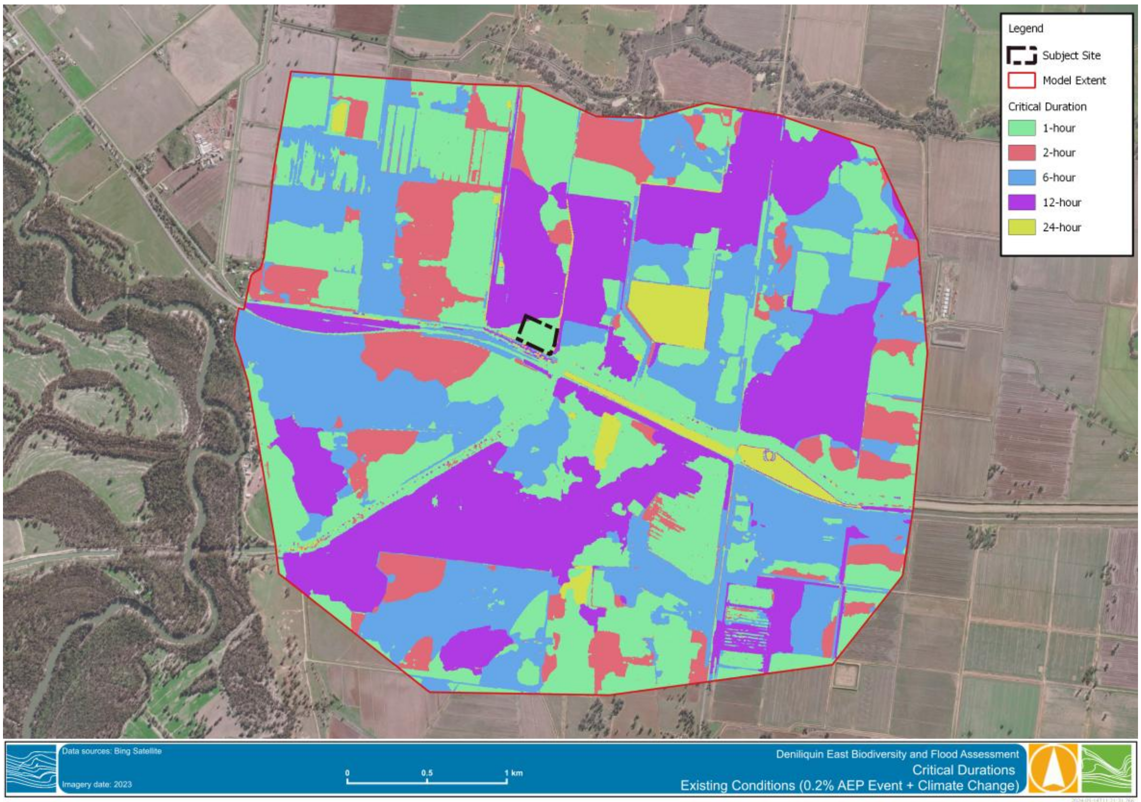

Figure A 3 Critical Duration (0.2% AEP + CC)

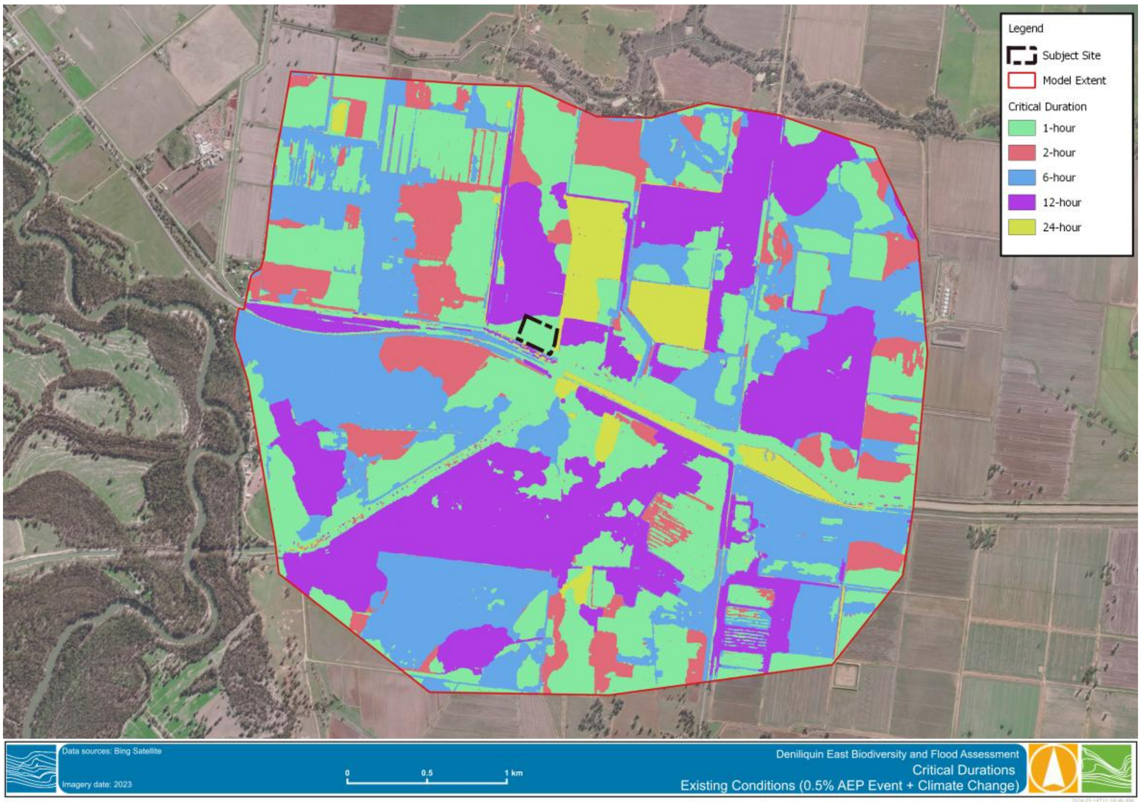

Figure A 4 Critical Duration (0.5% AEP + CC)

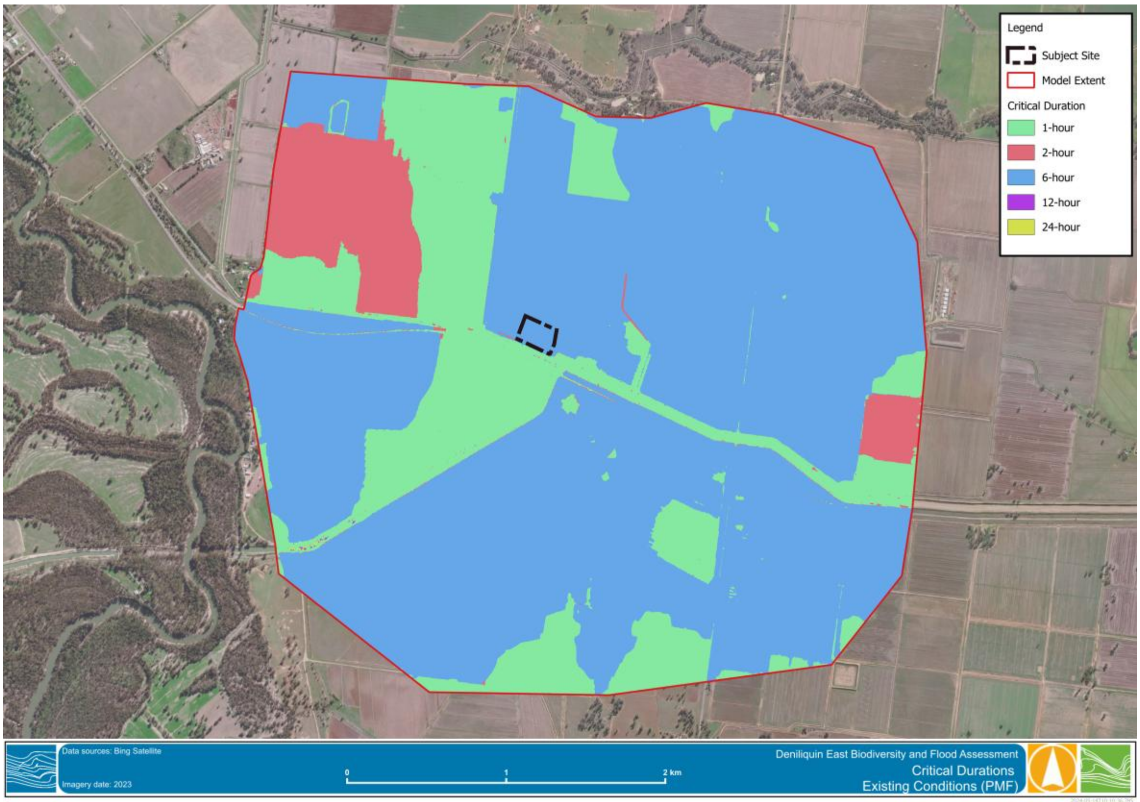

Figure A 5 Critical Duration (PMF)

APPENDIX B – EXISTING MODELLING RESULTS

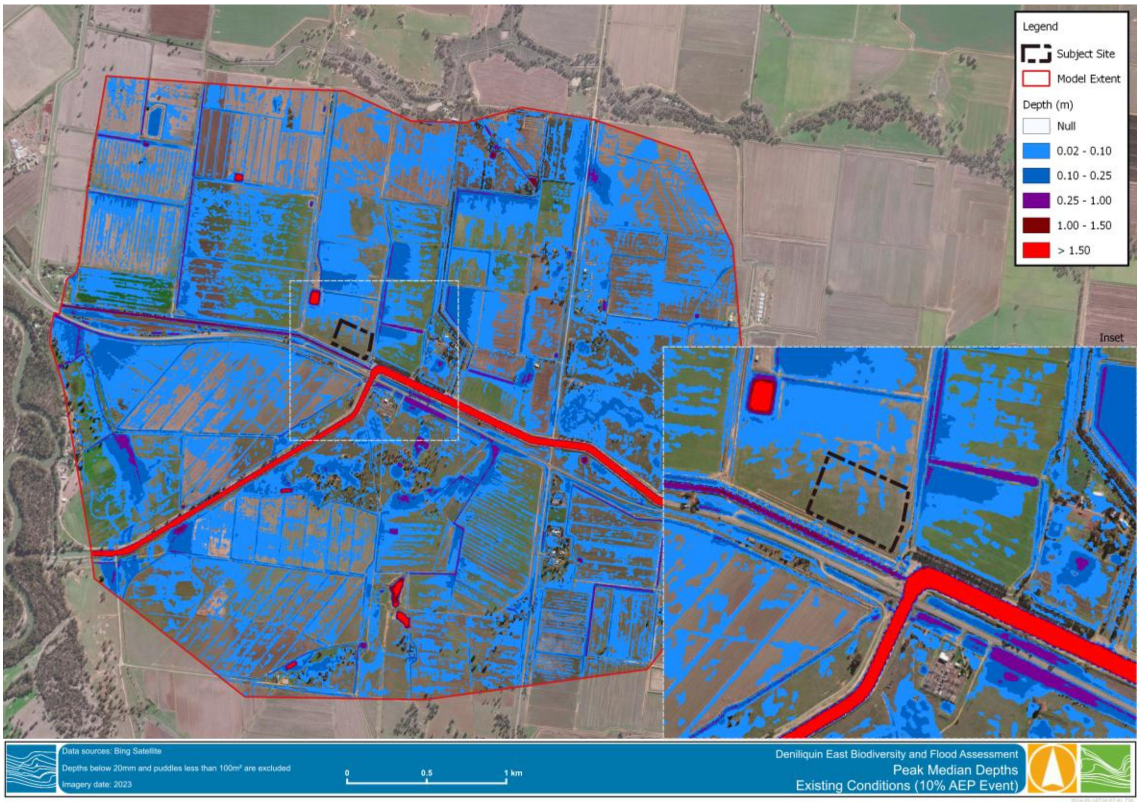

Figure B 1 Existing Conditions – 10% AEP flood depth

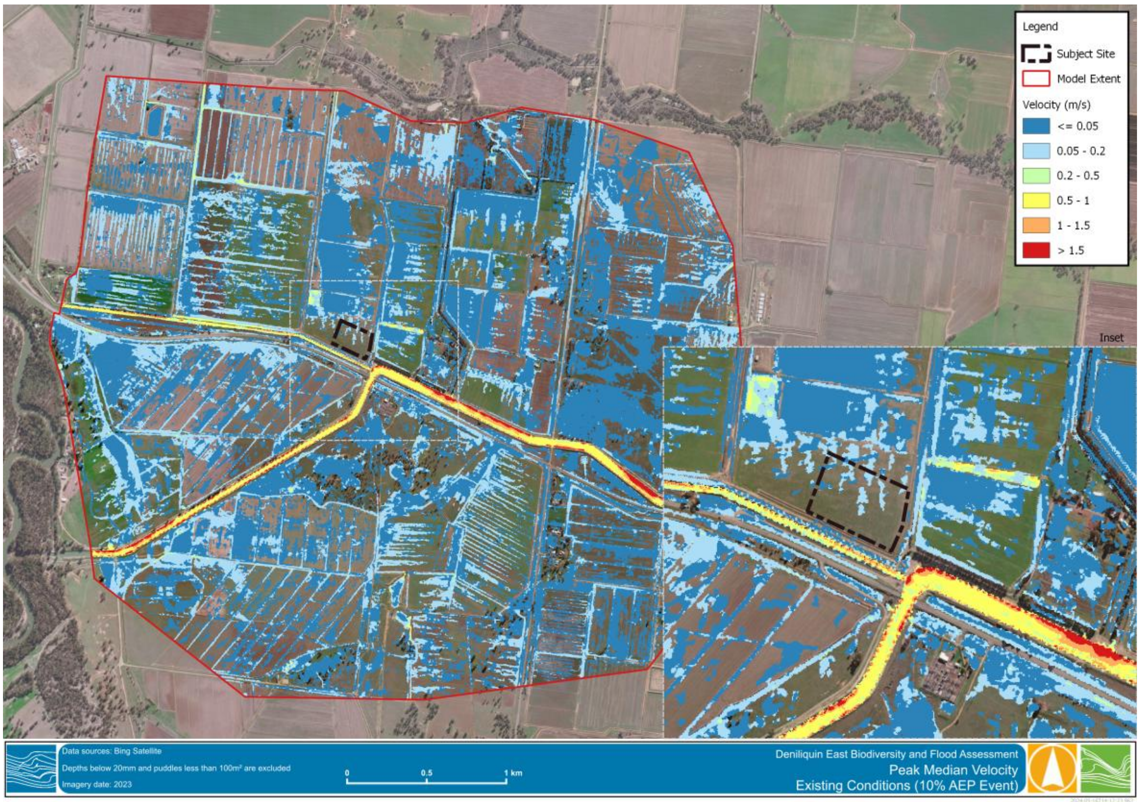

Figure B 2 Existing Conditions – 10% AEP flood velocity

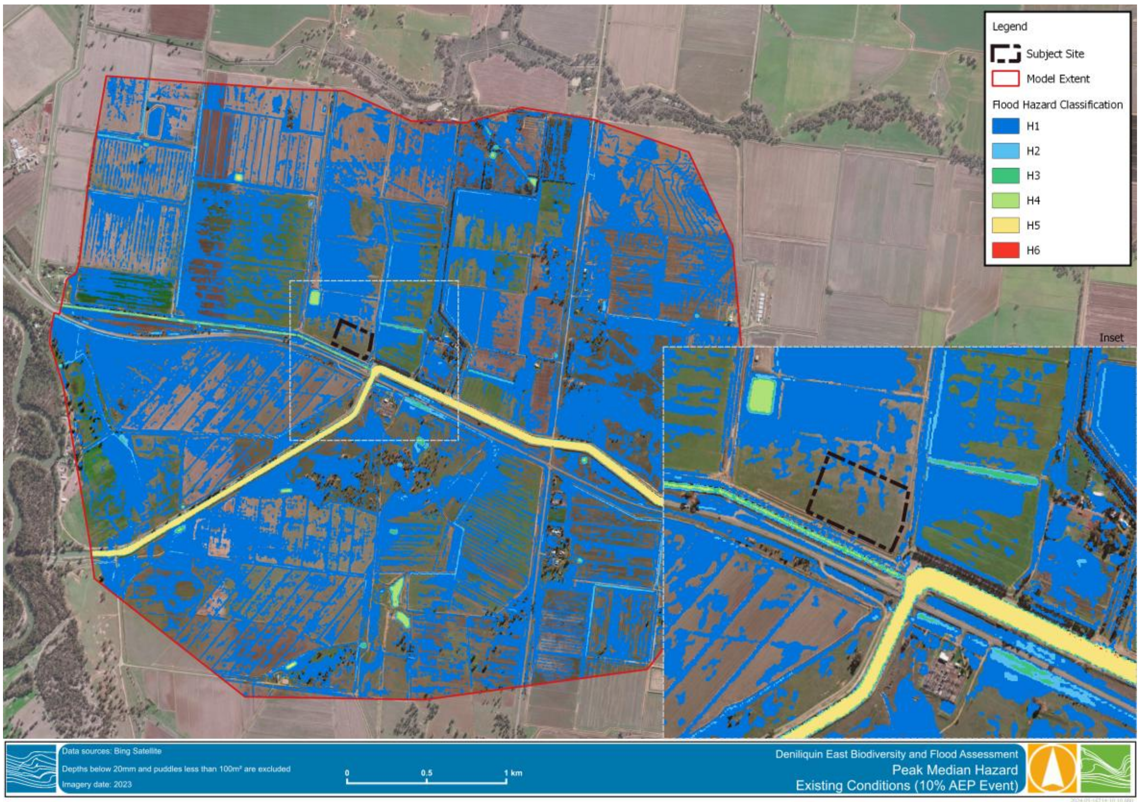

Figure B 3 Existing Conditions – 10% AEP flood hazard

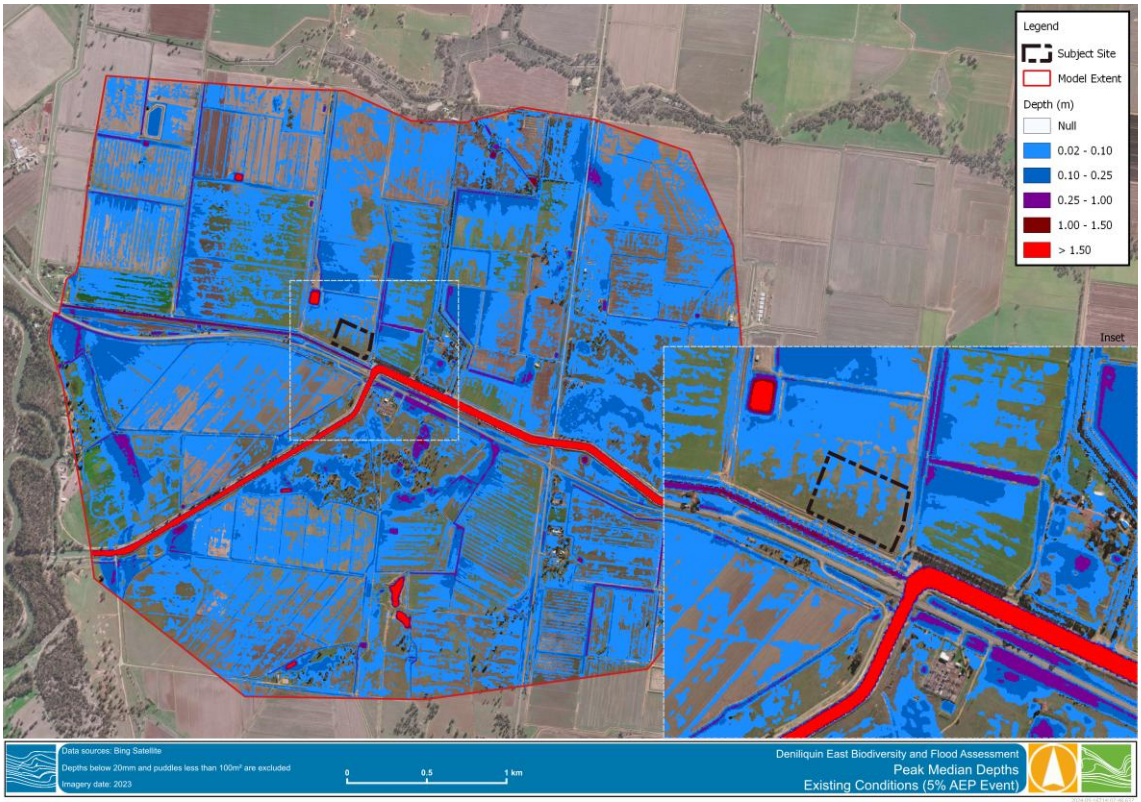

Figure B 4 Existing Conditions – 5% AEP flood depth

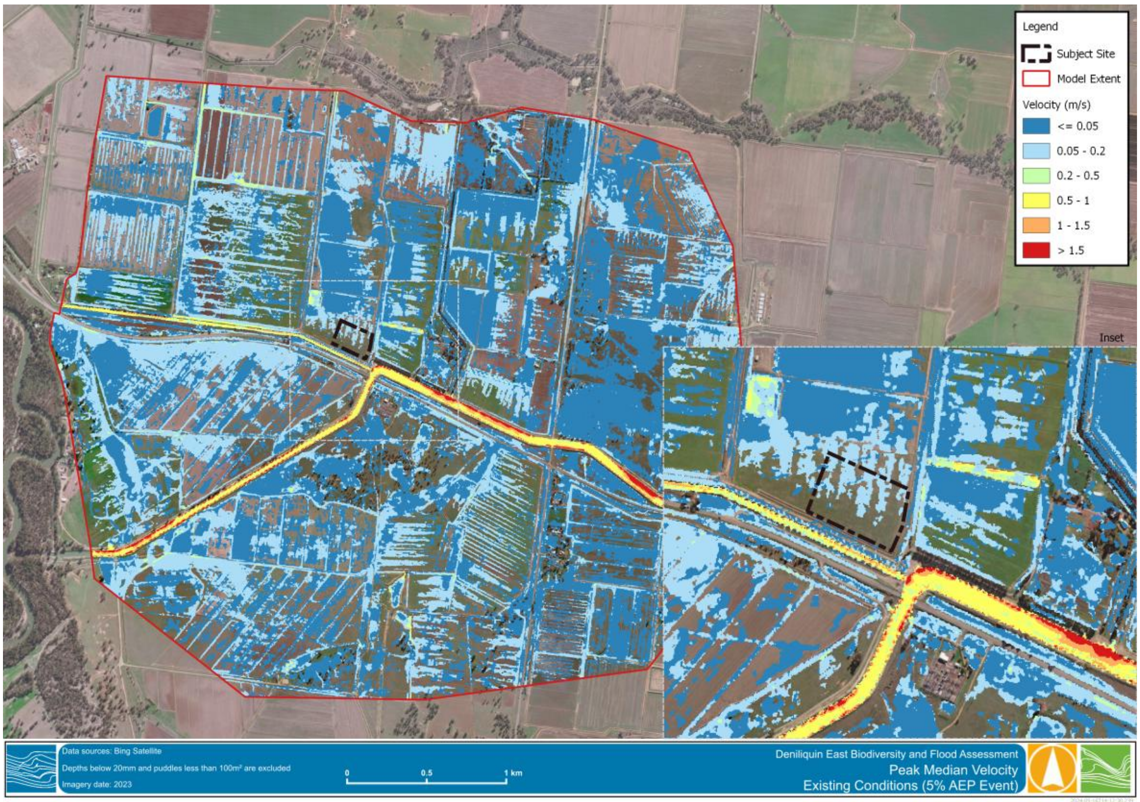

Figure B 5 Existing Conditions – 5% AEP flood velocity

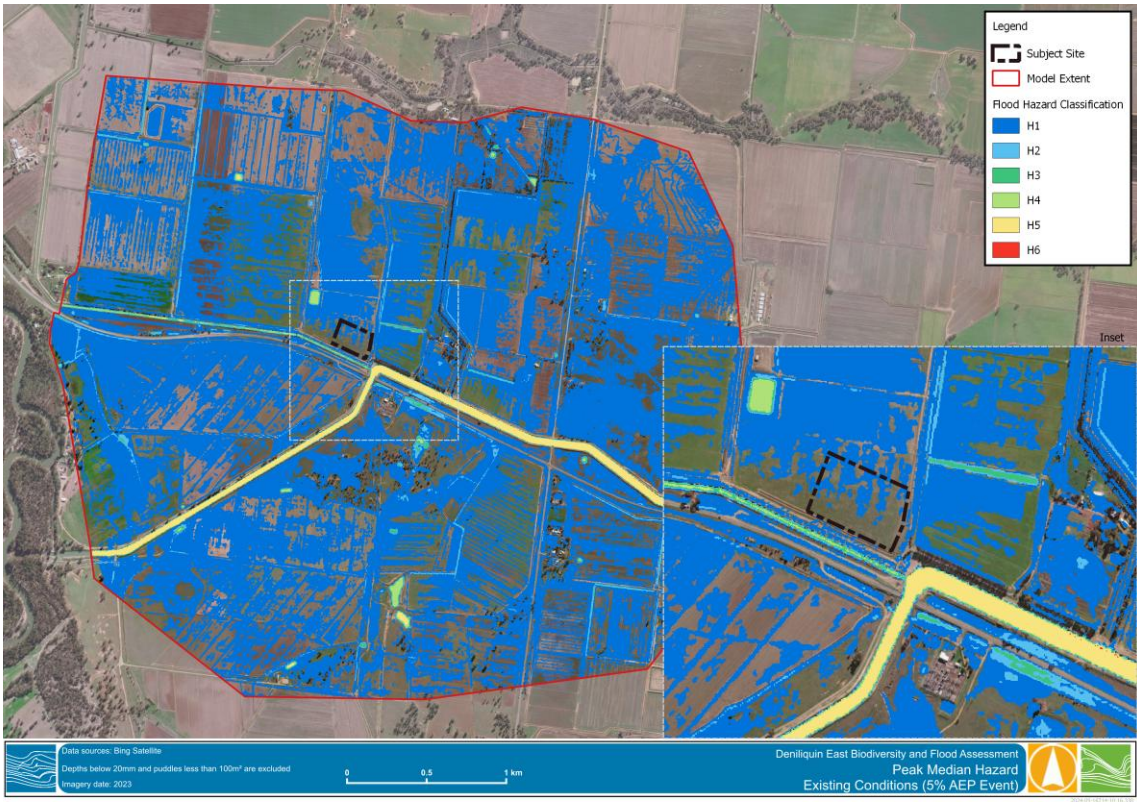

Figure B 6 Existing Conditions – 5% AEP flood hazard

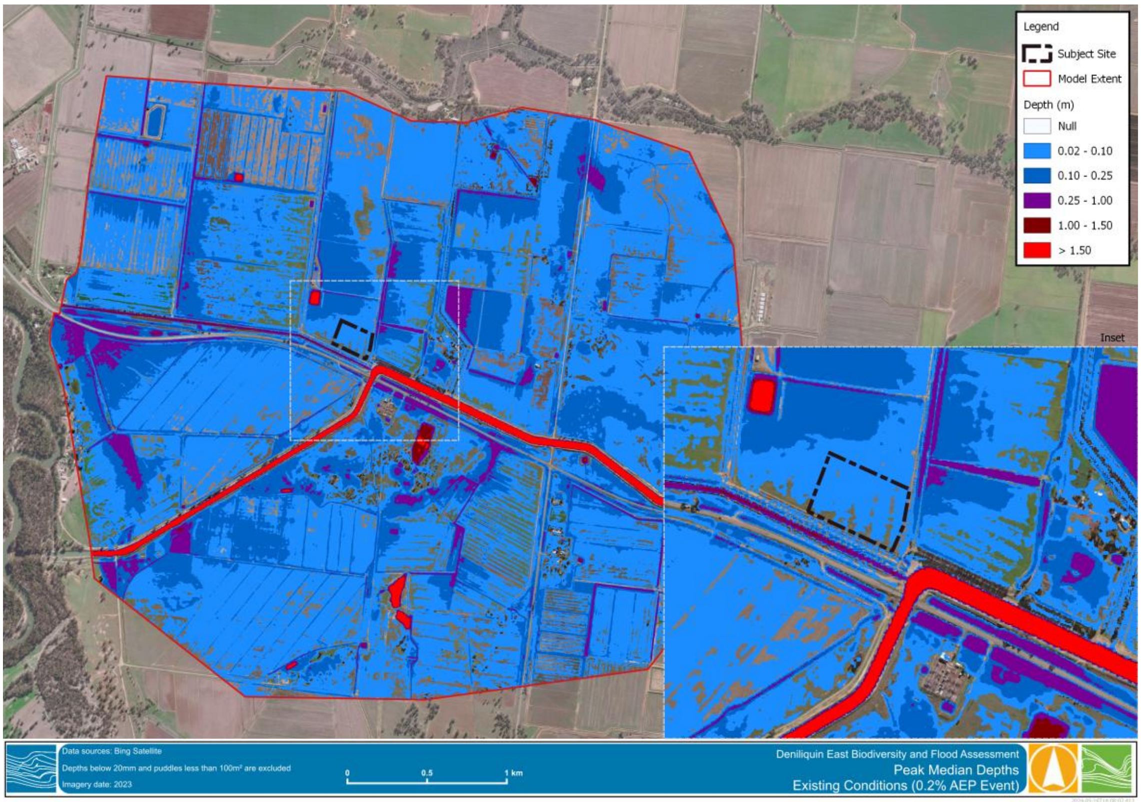

Figure B 7 Existing Conditions – 0.2% AEP flood depth

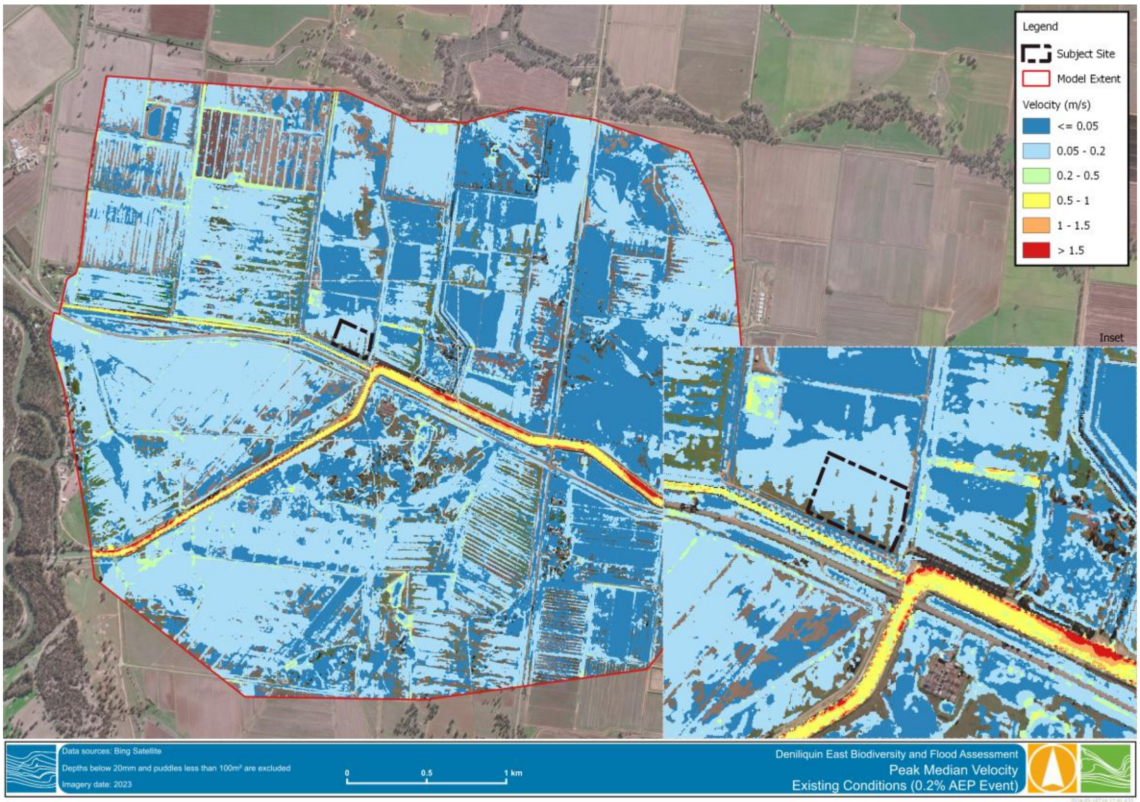

Figure B 8 Existing Conditions – 0.2% AEP flood velocity

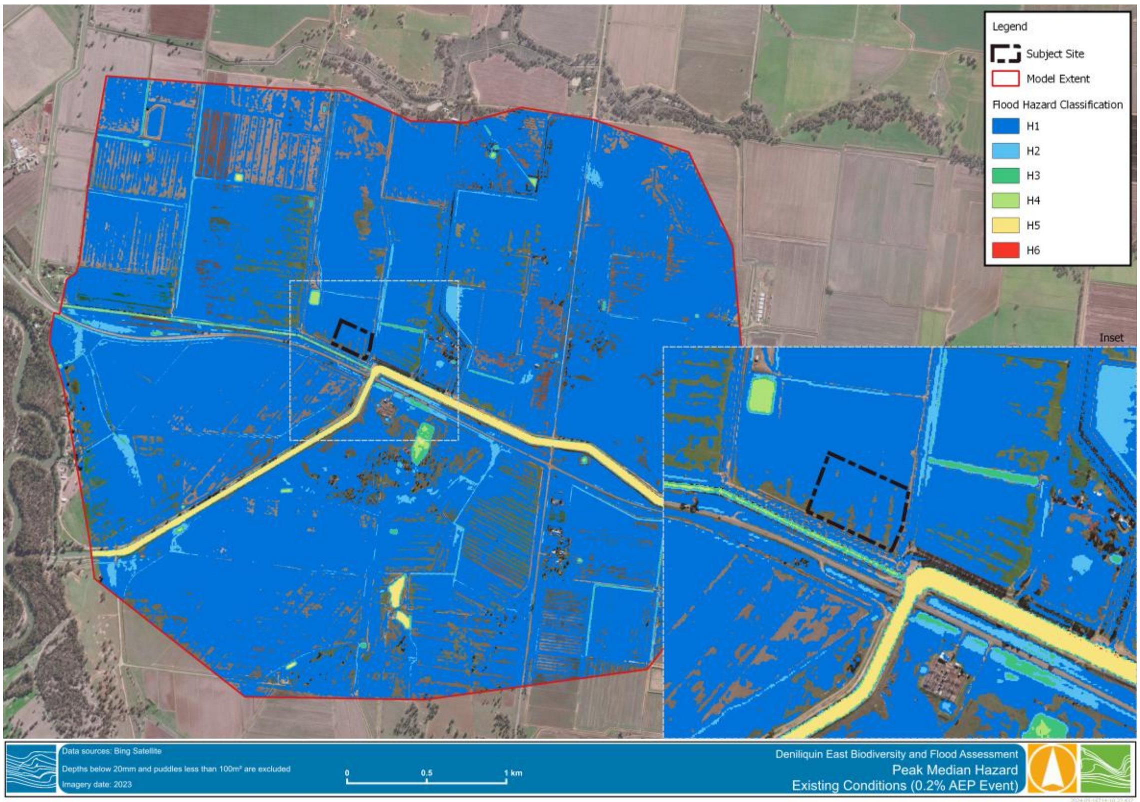

Figure B 9 Existing Conditions – 0.2% AEP flood hazard

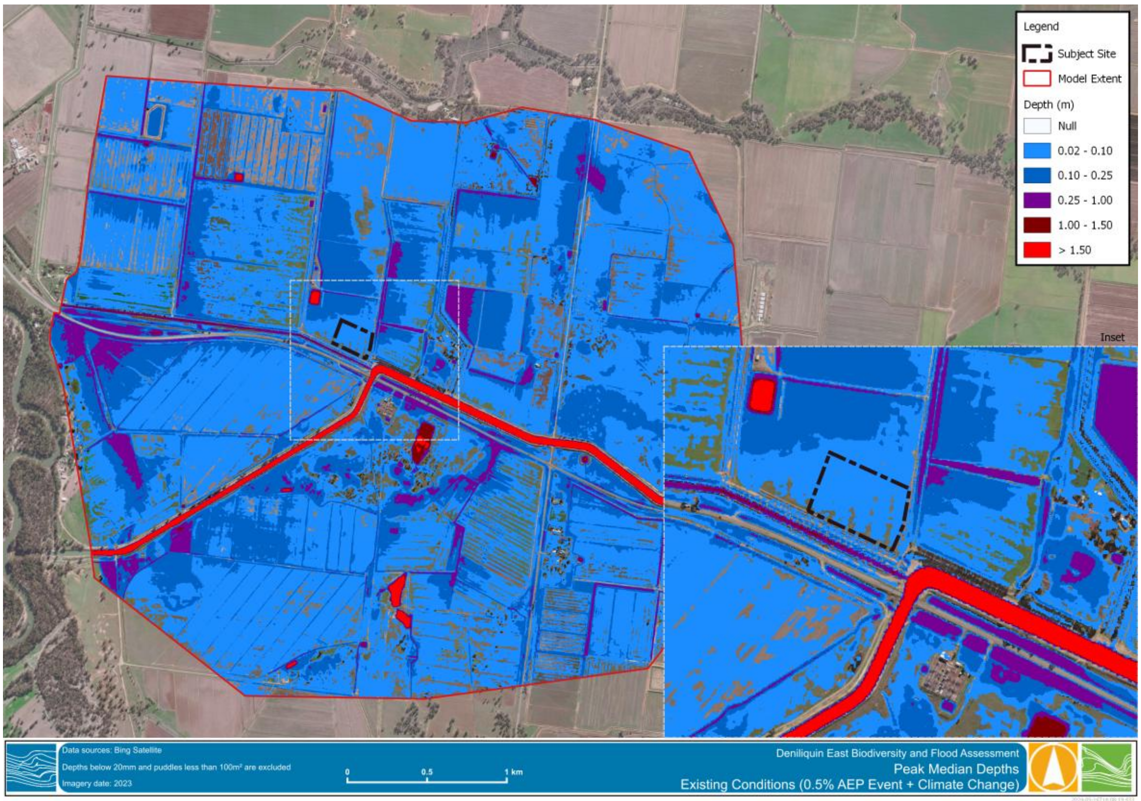

Figure B 10 Existing Conditions – 0.5% + climate change AEP flood depth

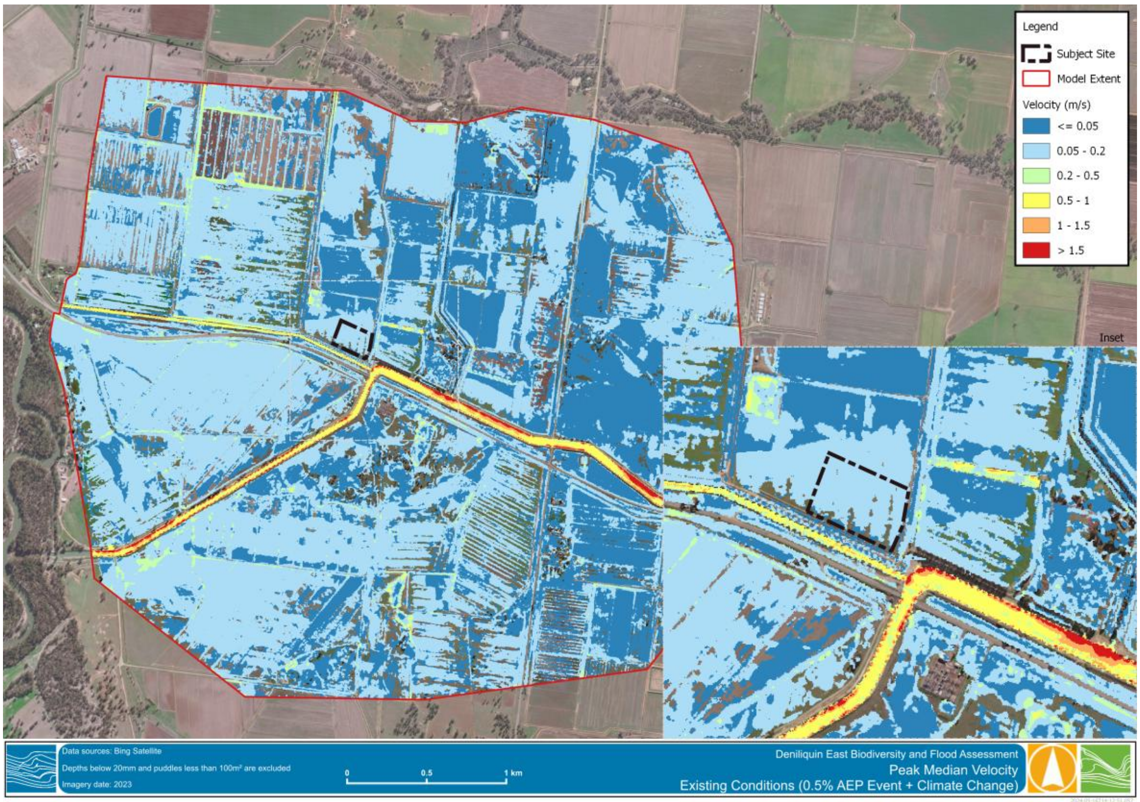

Figure B 11 Existing Conditions – 0.5% + climate change flood velocity

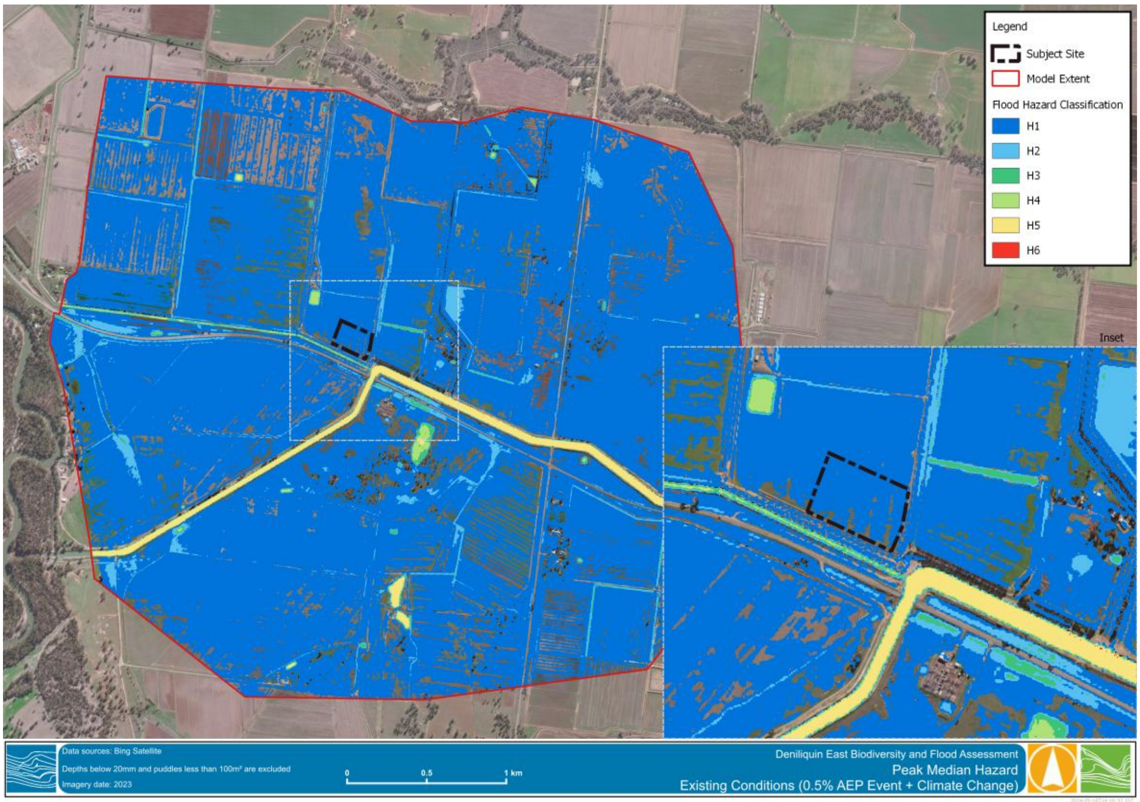

Figure B 12 Existing Conditions – 0.5% + climate change flood hazard

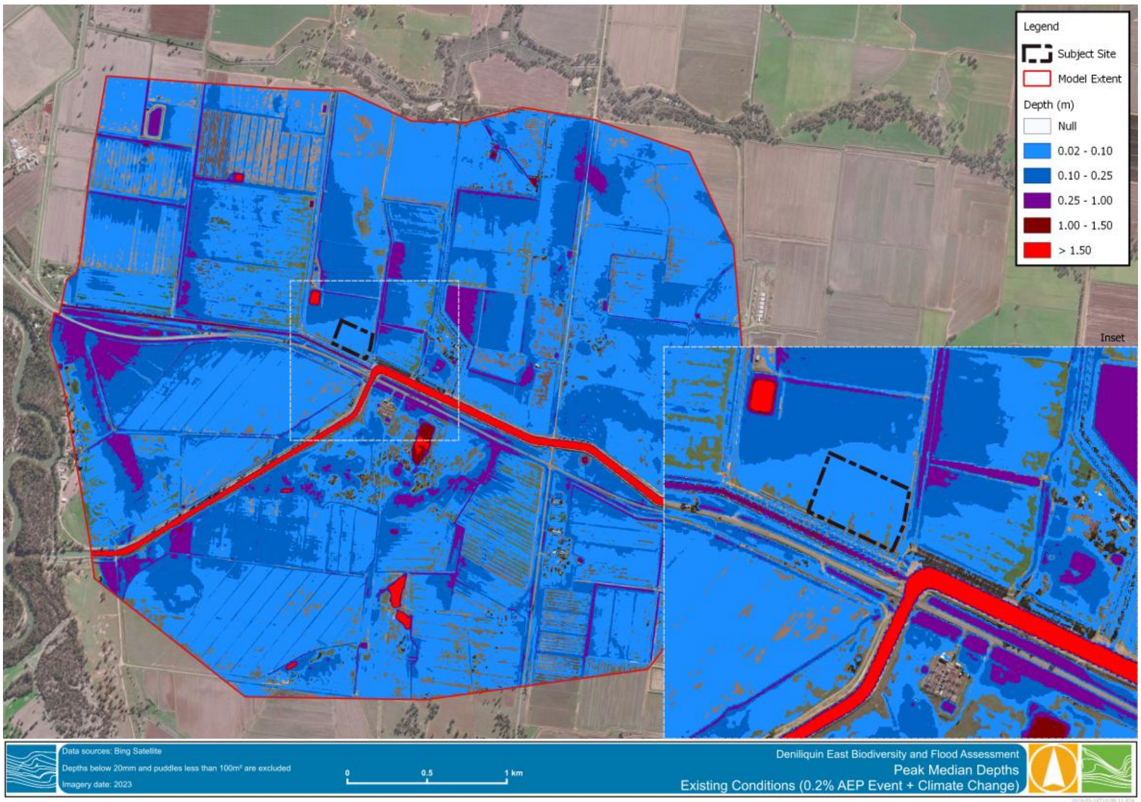

Figure B 13 Existing Conditions – 0.2% + climate change AEP flood depth

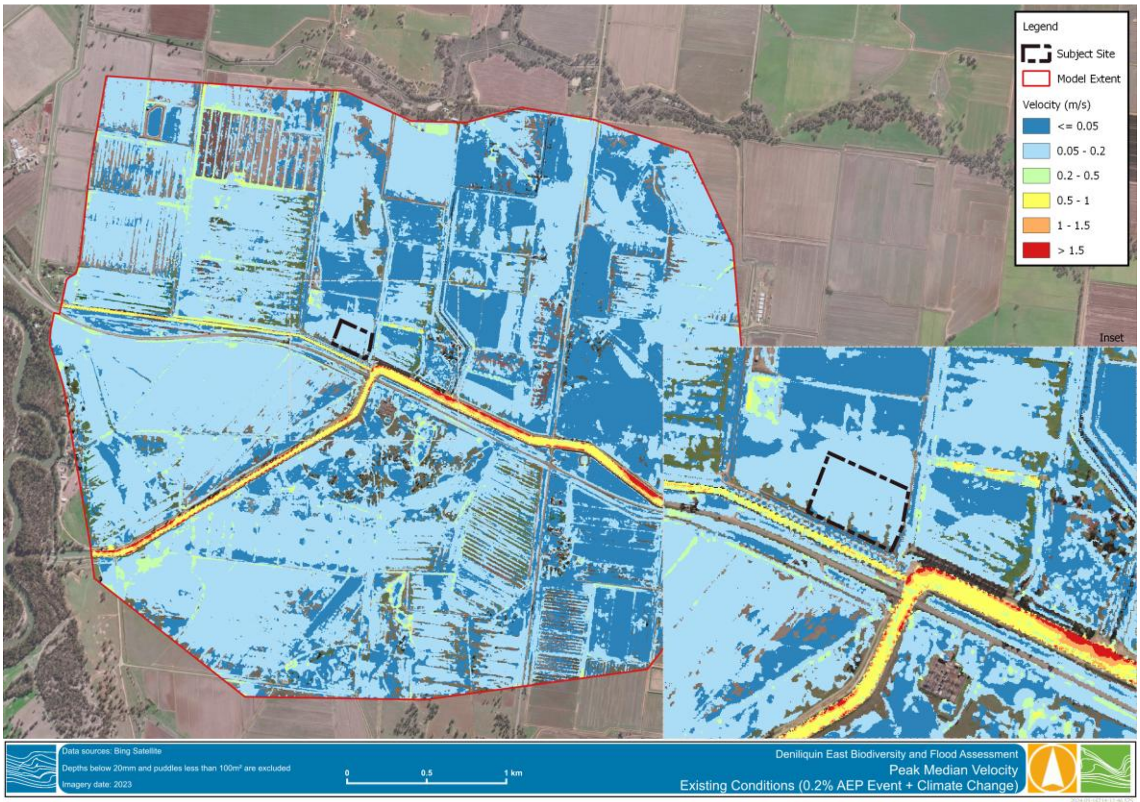

Figure B 14 Existing Conditions – 0.2% + climate change flood velocity

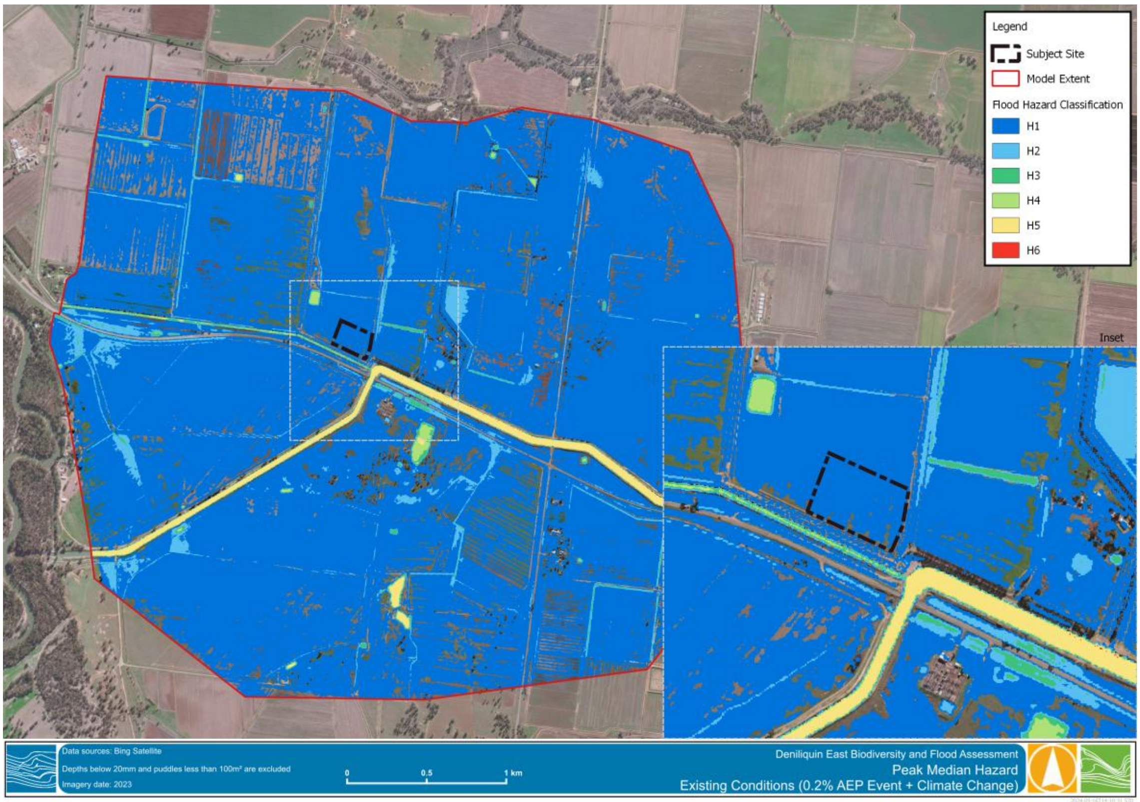

Figure B 15 Existing Conditions – 0.2% + climate change flood hazard

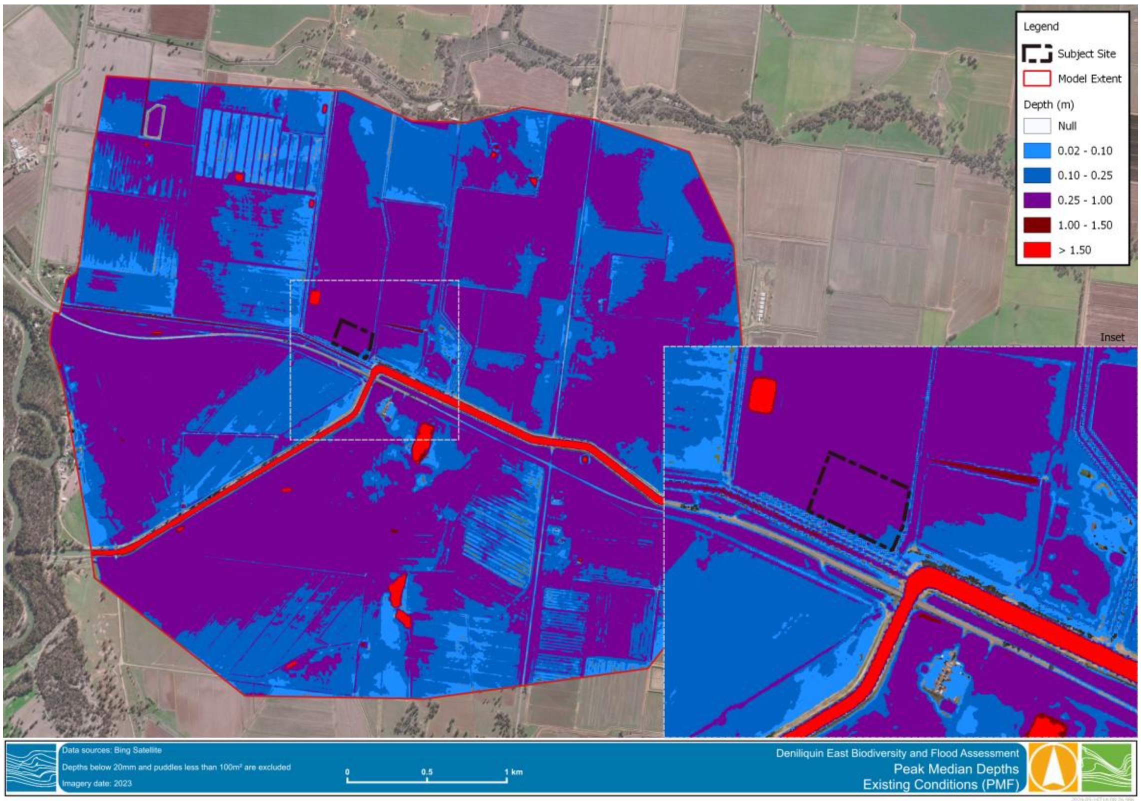

Figure B 16 Existing Conditions – PMF flood depth

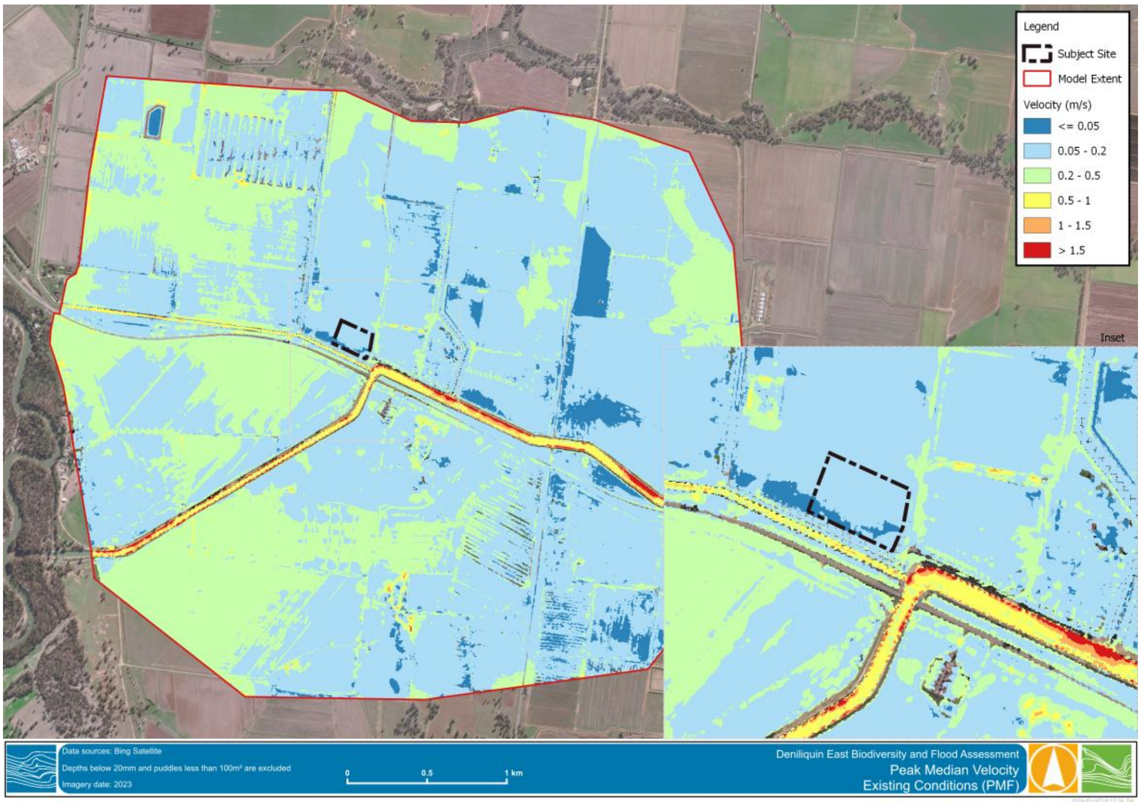

Figure B 17 Existing Conditions – PMF flood velocity

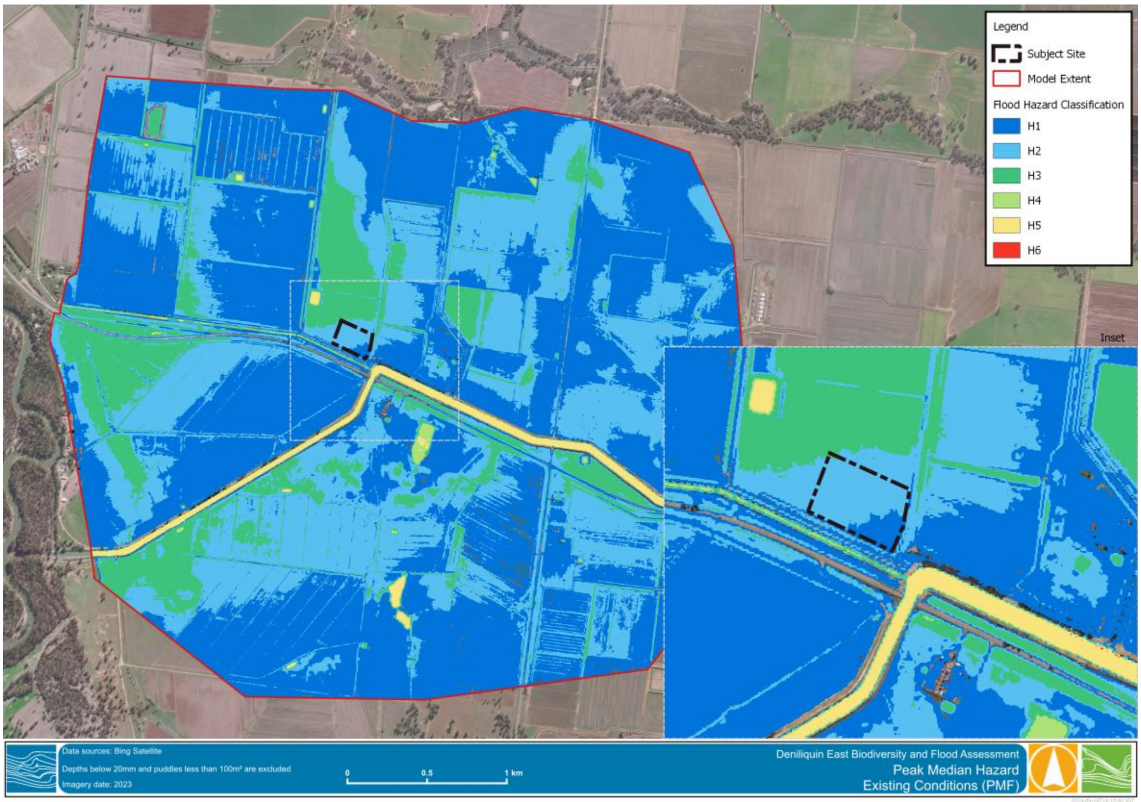

Figure B 18 Existing Conditions – PMF flood hazard

APPENDIX C – DESIGN MODELLING RESULTS

Note:
The baseline peak water level is compared against the design scenario (BESS installation) peak water level.

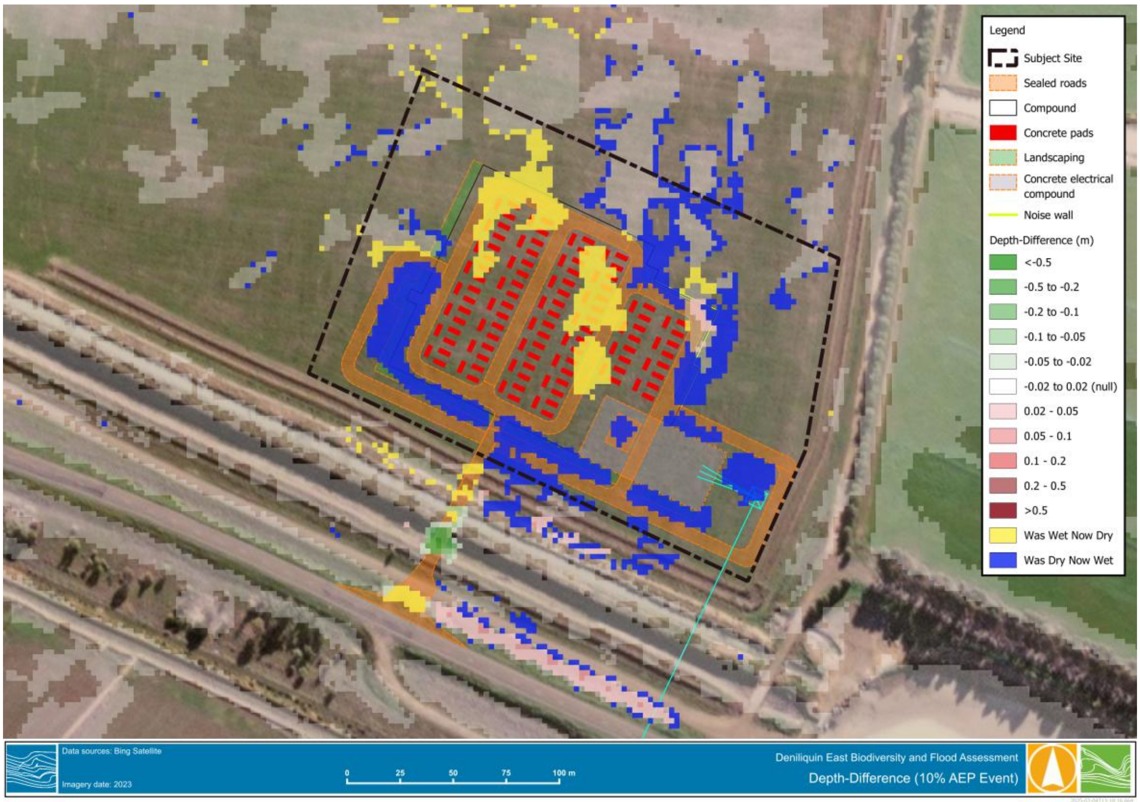

Figure C 1 Design Conditions – 10% AEP depth-difference

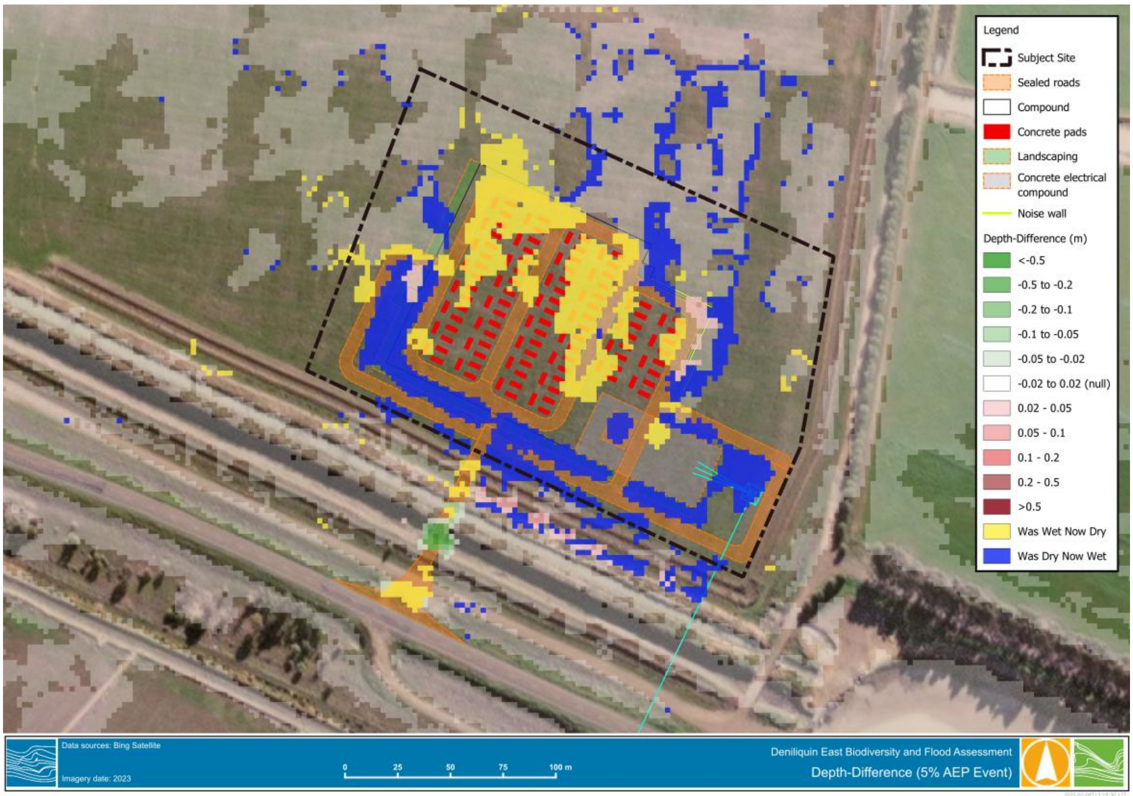

Figure C 2 Design Conditions – 5% AEP depth-difference

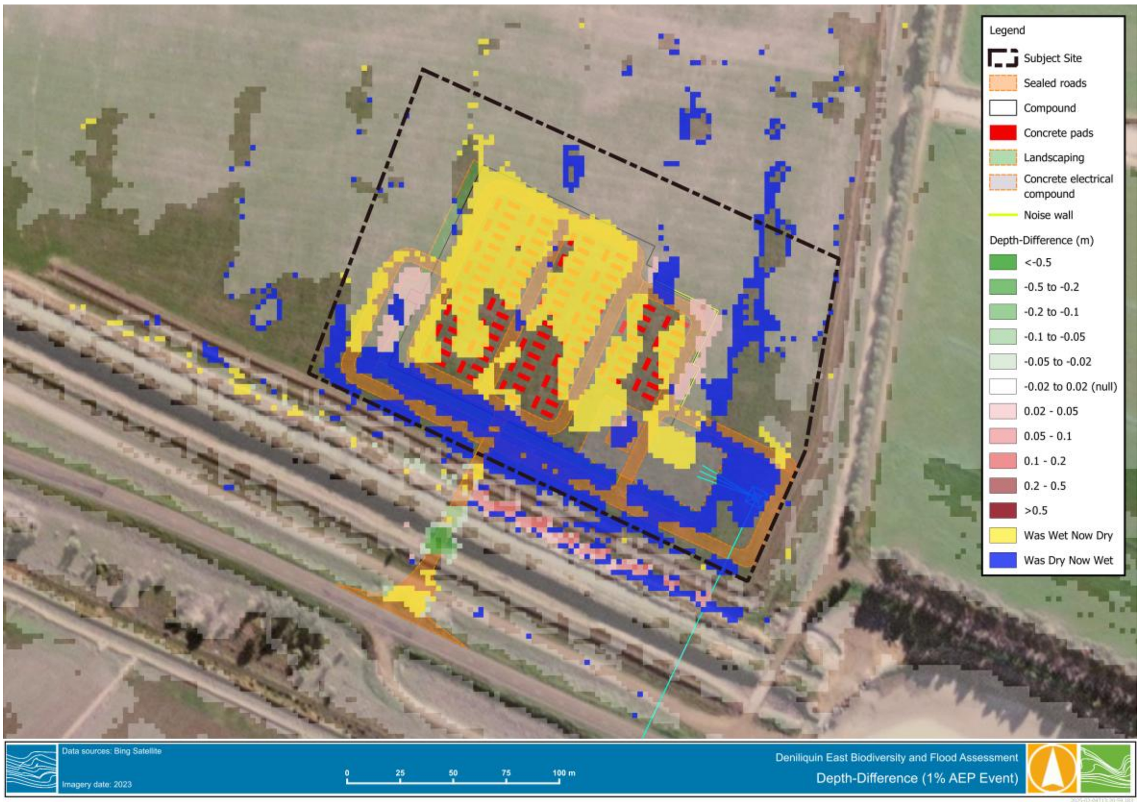

Figure C 3 Design Conditions – 1% AEP depth-difference

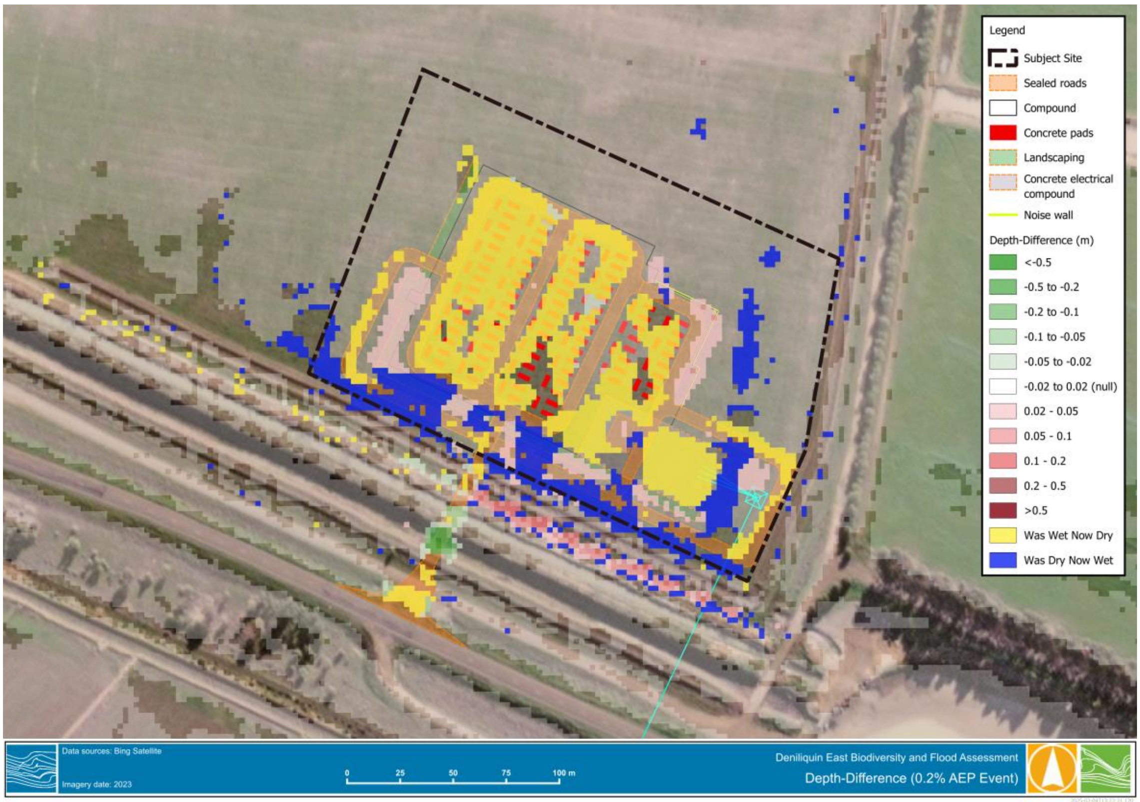

Figure C 4 Design Conditions – 0.2% AEP depth-difference

Figure C 5 Design Conditions – 0.5% + climate change AEP depth-difference

Figure C 6 Design Conditions – 0.2% + climate change AEP depth-difference

Figure C 7   Design Conditions – PMF depth-difference

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