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Dear Elton,

Green Gold Energy (GGE) - SF and BESS, The Rock , NSW

Hydraulic Assessment

The letter summarises the outcomes of the hydraulic assessment undertaken for the proposed 6.3 MW Solar Farm and 11 MWh BESS facility at 1000 Burkes Road, The Rock NSW. This hydraulic assessment has been prepared in response to an RFI raised by Wagga Wagga City Council in relation to stormwater management at the proposed site

Existing Catchment Description

The site is located within the Burkes Creek catchment. Burkes Creek is located approximately 2 km south-west of the site, and the creek drains into the Murrumbidgee River a further 40 km downstream. The catchment area upstream of the site is approximately 54 hectares, consisting of rural agricultural land that is typical of the area. There are no defined watercourses or drainage lines upstream of through the proposed site area.

Figure 1 illustrates the site area in the context of the overall catchment. Note the extent of the upstream catchment is at the top of the hill within a few hundred metres of the northern boundary of the site, and that Burkes Creek is located approximately 2 km downstream.

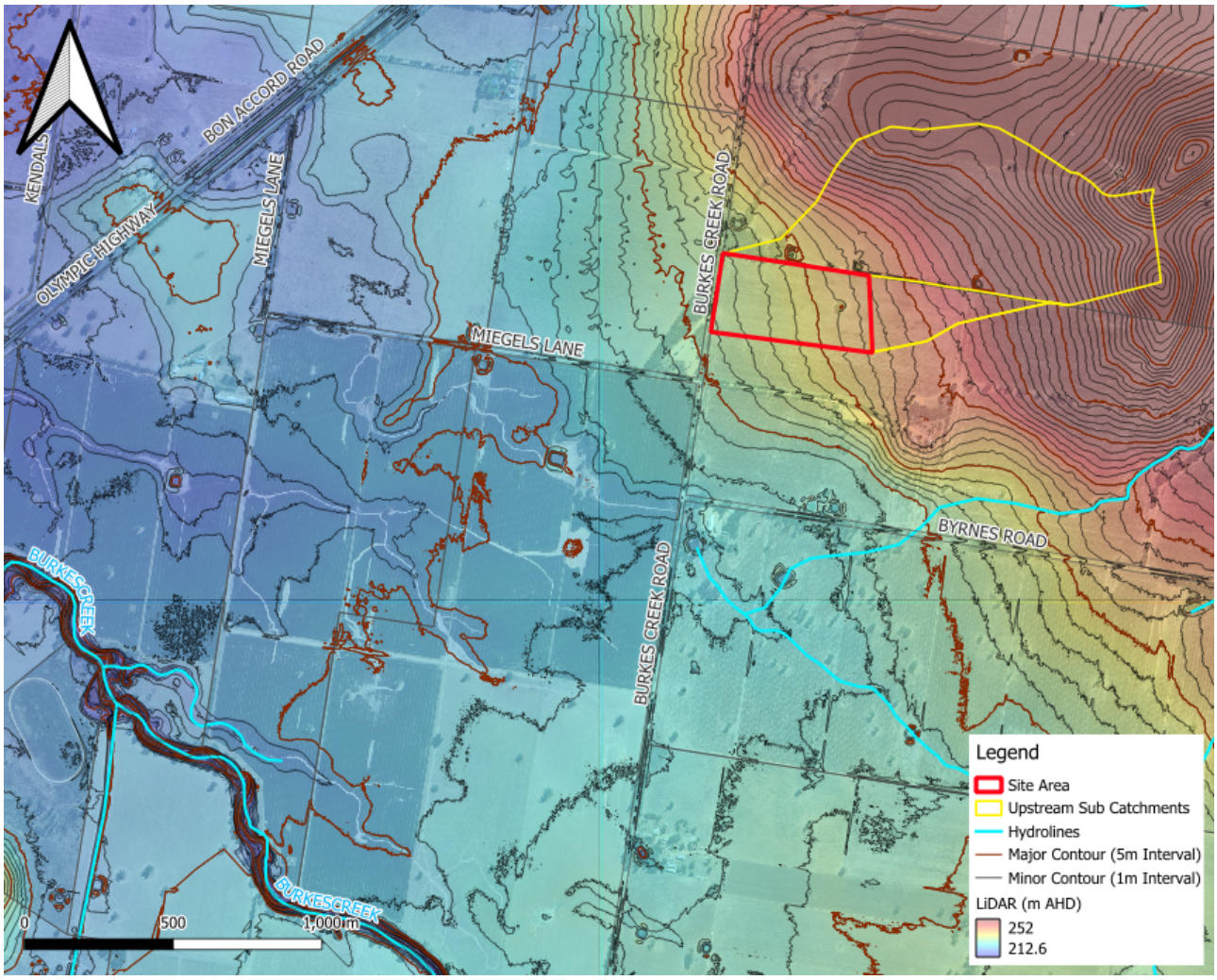

Figure 1 Overview of existing catchment

Available flooding information

Information on flooding in Burkes Creek is available in *The Rock Flood Study*, prepared for Lockhart Shire Council by WMAwater in 2014. Whilst the study primarily focuses on the township of The Rock, there is information within the report of relevance to the GGE site.

The following observations have been drawn from the flood study report:

- Analysis undertaken as part of The Rock Flood Study indicates Burkes Creek is unaffected by tailwater influences from the Murrumbidgee River where Burkes Creek passes the GGE site
- The inflow boundary to Burkes Creek at the upstream end of the model domain (located not far from the site) was reported to utilise a peak flow rate of to be 4042 m^3/s for the Probable Maximum Flood (PMF).

Utilising this flow rate, a Manning's calculation of the Burkes Creek floodplain indicated the peak flood level in the PMF would be of the order of 225.2 m AHD adjacent to the site, over five metres

below the lowest point of the proposed Solar Farm and BESS facility (at the south-west corner near the access road entrance).

Based on the above assessment, the site is unaffected by mainstream flooding from Burkes Creek.

Existing drainage regime

The proposed solar farm/BESS site has a relatively consistent slope from east to west, with surface runoff draining through the site towards Burkes Creek Road (Figure 2). With the current grade of the site, all runoff through the site will ultimately drain into the swale drain alongside the roadway.

Inspection of available LiDAR data and aerial photography indicates the presence of a series of open channels and small dams along the property boundary immediately to the north of the GGE site. The small dams will act to capture runoff from the upstream catchment. The open channel drains towards Burkes Creek Road, where there appears to be a culvert allowing runoff to drain beneath Burkes Creek Road and into the adjacent property to the west. There is also a swale drain along the eastern side of Burkes Creek Road adjacent to the GGE site, which falls to the south.

Preliminary analysis of the open channel capacity along the northern property boundary was undertaken utilising a hydraulic model (DRAINS) indicated that the channel likely has sufficient capacity to capture the peak flow in a 1% Annual Exceedance Probability (AEP) event from the upstream catchment. This effectively prevents surface water from the property to the north of the site from draining into the proposed site area, with flows instead being conveyed along the open channel into the dams, or (if the capacity of the dams is exceeded) to the west towards Burkes Creek Road.

Based on the above, it is assumed that surface flows from the upstream catchment north of the site are captured entirely within the open channel at the northern property boundary and drained around the site to the west. No runoff from the northern property is assumed to flow into the GGE site.

Note the above assessment of the existing drainage regime is based on a desktop assessment only and should be verified by a site inspection as the design progresses.

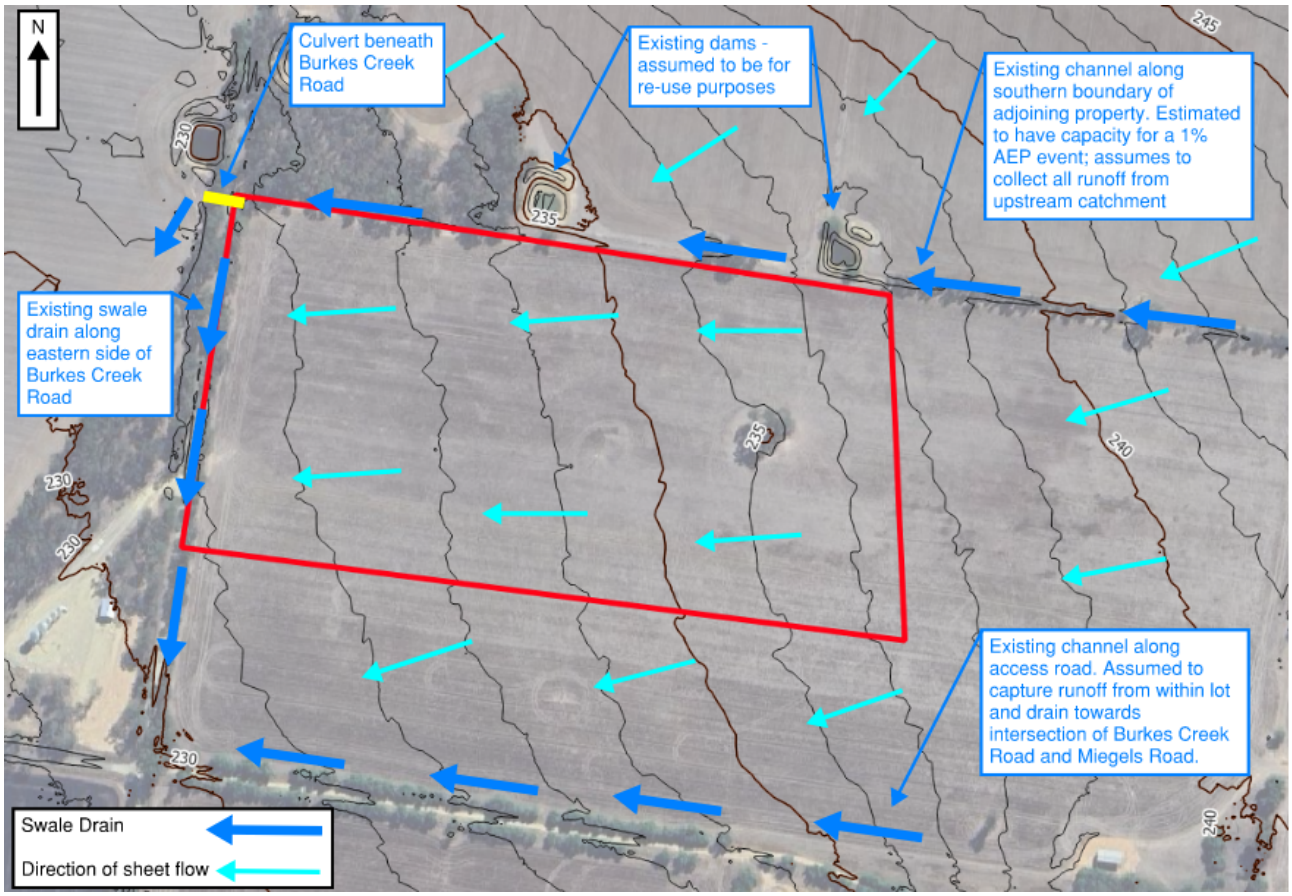

Figure 2 Existing Drainage Regime

Water Management Strategy

The layout of the proposed solar farm and BESS facility does not significantly alter the grading of the catchment. It is anticipated that runoff in the post-development scenario will largely replicate the existing conditions (that is, discharge to the western side of the site towards Burkes Creek Road). The most significant changes to the catchment will be the inclusion of the new access road and car parking areas, plus the inclusion of any fill pads associated with the new BESS facility, inverter stations and other site amenities.

Surface water is required to be drained around these features to avoid creating erosion issues to the solar farm/BESS infrastructure (including the access roads). Additionally, the discharge of runoff away from the site needs to be controlled to prevent any increase in flood risk or erosion risk further downstream in the catchment.

A high-level pre-/post flow assessment has been undertaken using the DRAINS software to inform a preliminary water management strategy for the site. Figure 3 illustrates the catchment areas schematised for the DRAINS model. Table 1 summarises the subcatchment areas and fraction impervious assumptions adopted for this assessment.

The following assumptions have been applied in the DRAINS modelling:

- Runoff from subcatchment 1 (north of the proposed site) is assumed to be entirely collected by the existing drainage swale and drained around the proposed site (that is, no runoff from subcatchment 1 is assumed to enter the proposed Solar Farm/BESS site).
- Runoff from subcatchments 2 and 4 is assumed to be unaffected by the proposed development and will discharge to the same locations as under present day conditions.
- The kinematic wave equation has been utilised in the calculation of the time of concentration (t_c) for all subcatchments
- No increase in the fraction impervious has been assumed for the solar arrays (since rainfall ultimately makes its way onto the ground surface.
- Minor increases in the fraction impervious have been assumed at subcatchments 5 and 6, to account for the proposed BESS/inverter stations and associated fill pads.
- The proposed access track is assumed to be unsealed and therefore is assumed to remain partially pervious under the post-development condition. For the purpose of this assessment, 50% of the access road has been assumed as impervious under post-development conditions.
- Fraction impervious values have been assumed based on a 2D preliminary site layout. Impervious areas will require confirmation as the design progresses.

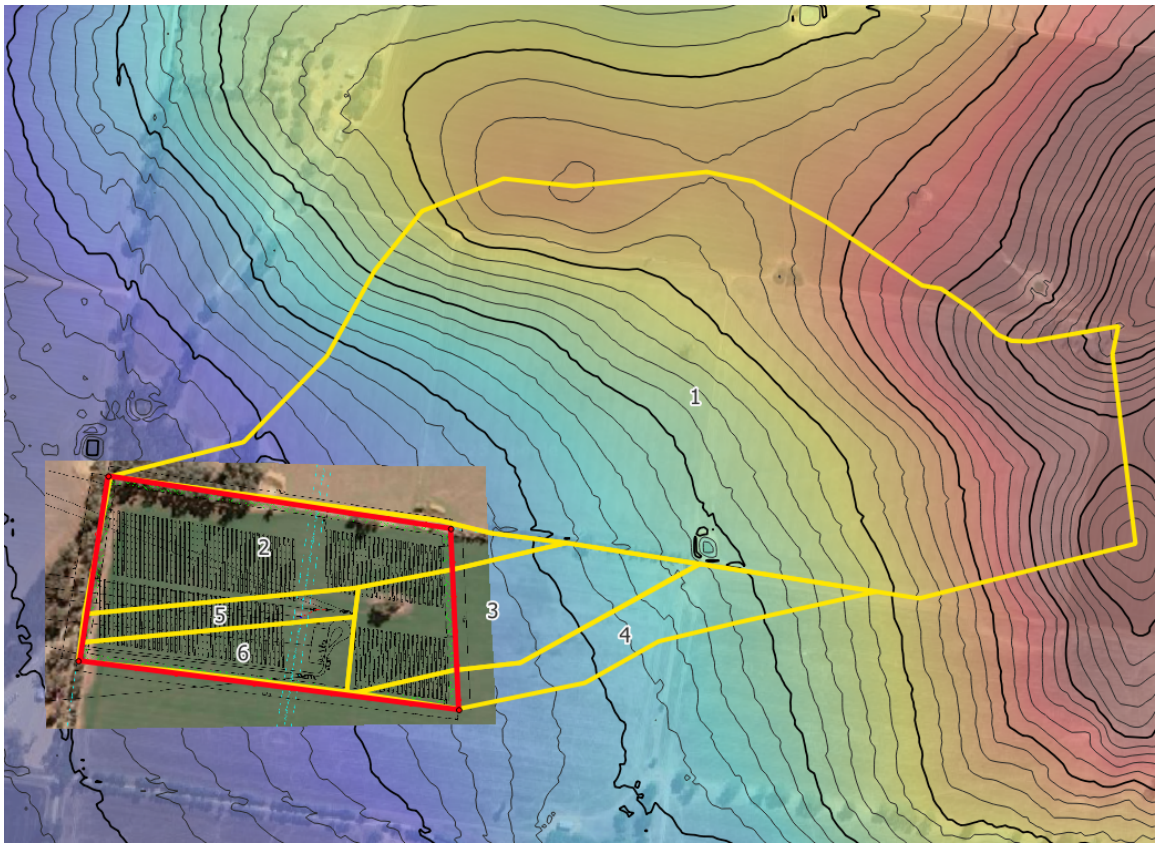

Figure 3 Subcatchment areas for DRAINS hydraulic assessment

Table 1 Subcatchment Data - DRAINS model

Subcatchment	Total Area (ha)	Fraction Impervious (Pre-Development) (%)	Fraction Impervious (Post-Development) (%)
1	54.27	5	5
2	5.71	5	5
3	5.84	5	5
4	4.06	5	5
5	1.60	5	10
6	2.56	5	12.6

Table 2 summarises the results of the DRAINS assessment for the 0.2 Exceedances per year (1 in 5 Year) and 1% AEP events.

Table 2 Pre- and Post- Development Flow Comparison

	Pre-Development Peak Flow (m^3/s)		Post-Development Peak Flow (m^3/s)		Change in Peak Flow (%)	
Subcatchment	**0.2 EY**	**1% AEP**	**0.2 EY**	**1% AEP**	**0.2 EY**	**1% AEP**
1	1.21	3.75	1.21	3.75	0.0%	0.0%
2	0.22	0.68	0.22	0.68	0.0%	0.0%
3	0.24	0.74	0.24	0.74	0.0%	0.0%
4	0.13	0.40	0.13	0.40	0.0%	0.0%
5	0.06	0.19	0.06	0.19	5.0%	1.6%
6	0.10	0.30	0.11	0.32	11.3%	4.6%

The table illustrates that there are minor increases in the peak flows from subcatchments 5 and 6 under post-development conditions. Since the magnitude of the flows are relatively low (in the order of 0.3 m^3/s for subcatchment 6 in the 1% AEP event), the increase in peak resulting from the proposed development will not result in a material increase to flood risk to downstream properties. It is therefore proposed to manage the post-development flows from the BESS/access road areas by providing mitre drains with flow spreaders to adequately distribute runoff through the southern portion of the site and alleviate potential erosion issues. No detention structures are proposed to be provided for the proposed development given the relatively small increase in impervious area due to the proposed works.

Figure 4 illustrates the proposed water management strategy proposed for the site. The rationale behind the proposed scheme is summarised below:

- Drainage of the areas beneath the solar arrays will remain unaltered from existing conditions
- Runoff from the catchment area immediately to the east of the access track and site amenities area (subcatchment 3 in Figure 3) is proposed to be intercepted by a new swale drain and diverted south of the access track. Mitre drains with flow spreaders are proposed to allow runoff to be distributed through the southern portion of the lot without creating erosion issues associated with more concentrated overland flows.
- Runoff from the access road/site amenities area, plus part of the area beneath the solar arrays to the north of the access track (subcatchment 6) is proposed to be intercepted by a new swale drain along the northern side of the access road. Designated drainage crossings can be provided to allow for conveyance of surface water to the south of the access road at suitable intervals. Drainage crossings can be either pipes/culverts or dish drains depending on the design of the access track (refer to *Erosion of Sediment Control on Unsealed Roads*, NSW OEH 2012)
- Mitre drains with flow spreaders are to be provided downstream of the drainage crossings to allow for distribution of flow through the southern portion of the lot, thereby minimising erosion.

Note the proposed Solar Farm/BESS facility and associated infrastructure are not likely to adversely affect the water quality of surface runoff, and therefore no water quality treatment measures are specified in the scheme below. This will need to be confirmed once the site layout has been further developed.

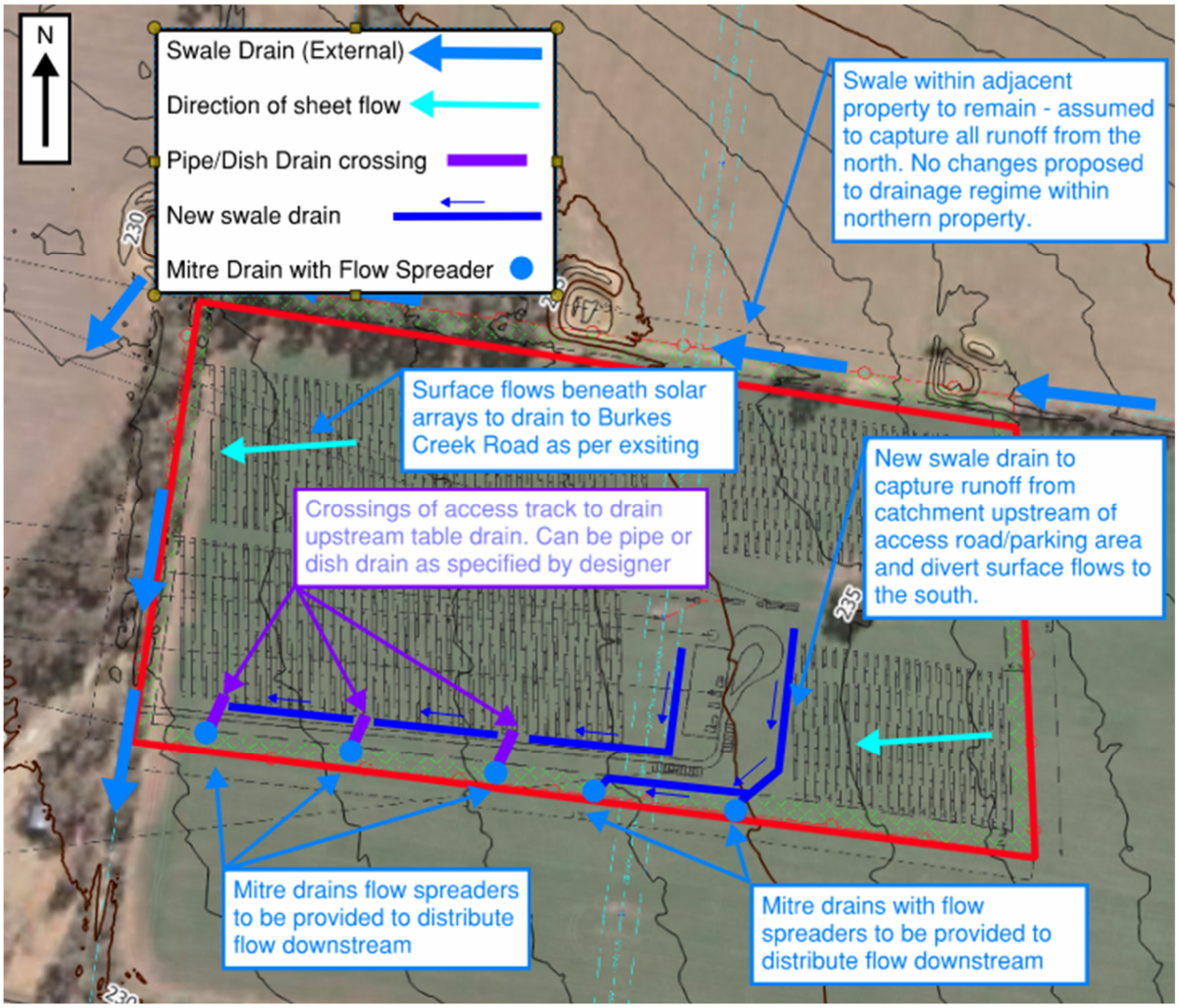

Figure 4 Water Management Strategy for Proposed Site

The water management strategy proposed effectively maintains the existing drainage regime within the site. Runoff within the site will still drain towards the western side in line with the prevailing slope of the land and be collected within the existing drainage swale along the eastern edge of Burkes Creek Road. The water management strategy is considered sufficient on the basis that:

- Peak flow volumes within the catchment area manageable (that is, can be sufficiently contained within defined drainage infrastructure) in all events up to and including the 1% AEP
- The prevailing slope of the site is moderate (between 1 – 2%) and soils within the site are not noted as being dispersive or at a high risk of erosion.

- Appropriate erosion control measures such as providing flow spreaders should be sufficient to control erosion within the site and further downstream in the catchment, effectively replicating the sheet flows which occur through the existing site. It is noted that nearby Streetview imagery indicates there are existing mitre drains close to the site area similar to those proposed for the GGE site.

Conclusions

A high-level hydraulic assessment of the proposed Solar Farm/BESS facility site has been undertaken. The site has been confirmed as not being subject to any mainstream flooding following review of the available flood studies and interrogation of available LiDAR data.

A review of the surrounding catchment has indicated that runoff from the catchment area north of the site is likely to be captured within the existing drainage channel running along the northern property boundary, and subsequently discharged to the west of the site. Runoff to be managed within the site is therefore likely to be limited to rainfall landing on the site itself, plus the relatively small catchment area to the east.

A concept water management strategy has been prepared for the site to illustrate how surface flows can be managed to both protect the proposed solar farm and BESS facility from erosion and prevent any material increase in flood risk or erosion risk to the southern portion of the lot, and to downstream receptors. The general approach of the water management strategy is to maintain the existing drainage regime as much as reasonably possible.

No detention storage is considered necessary given the predicted increases in runoff are considered small enough (in the context of the overall catchment) not to significantly impact on downstream receptors. Similarly, the impact of the Solar Farm/BESS facility on surface water quality is considered negligible.

Therefore, the management of surface water through the site can be adequately achieved through the provision of appropriate stormwater infrastructure.

Yours sincerely

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