Gunnedah Solar Project – Phase 1 Early Works

Phase 1 - Water Management Plan

June 9, 2020

Prepared for:

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Revision	Description	Author		Quality Check		Independent Review	
0	FINAL	2020/03/26	DW	2020/03/26	BW	2020/03/26	JK
1	FINAL – Revisions per client comments	2020/04/07	DW	2020/04/07	BW	2020/04/07	PB
2	Revisions to address regulators Flooding related concerns	2020/05/24	DW	2020/05/25	BW	2020/05/24	PB
3	Revisions Per PCL Comments	2020/06/02	DW	2020/06/02	BW	2020/06/02	PB
4	Revisions Per NSW DPIE	2020/06/09	DW	2020/06/09	BW	2020/06/09	PB

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David Williams – 2020/06/09

Prepared by ____
(signature)

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Reviewed by ____
(signature)

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Peter Bright – 2020/06/09

Approved by ____
(signature)

Peter Bright, Project Manager

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LIST OF APPENDICES

1.0 INTRODUCTION

Stantec Australia Pty Ltd (Stantec) has been retained by PCL Constructors Pacific Rim Pty Ltd. (PCL) to provide engineering services for the 147 MV Gunnedah Solar Project located at 765 Orange Grove Road, Gunnedah, New South Wales (NSW) (Site). The Site is located approximately 10 km north east of Gunnedah Township, 430 km north west of Sydney.

As part of an early works program, PCL has requested to produce 90% - Issued for Construction Drawings for the portion of the site access road from Orange Grove Road to the proposed substation pad. The access road is to provide construction access for the owner of the substation, TransGrid (TG), to the ultimate location of the substation pad. Ultimately this construction access will be used as the main access road to the Site.

This report documents Phase 1 of the Water Management Plan relating to the construction of the main access road to the substation to address Schedule 3.24 and 4.3 24 of the project's Development Consent (Application Number SSD 8658).

A water management plan addressing the remaining site area portions of the solar farm will be submitted for approval at a later date.

1.1 BACKGROUND INFORMATION

A list of resources referenced when completing this preliminary water management plan has been provided below for reference:

- *Gunnedah Solar Farm – Flood Risk Assessment*, Stantec Consulting Ltd, March 2020
- *Gunnedah Solar Farm Development Consent* – Independent Planning Commission of NSW, March 12, 2019
- *Australia Rainfall and Runoff (ARR)*, Geoscience Australia, 2019
- *Gunnedah Solar Farm Environmental Impact Statement*, Pitt & Sherry Pty Ltd., April 17, 2018
- *Managing Urban Stormwater: Soils and Construction* – Landcom, 2004

In addition to the above noted reference documentation various communications with project team members from Stantec, PCL and Canadian Solar (CS) were considered.

2.0 EXISTING CONDITIONS

Under existing conditions the current land use of the site is primarily agricultural being used for row crops.

2.1 TOPOGRAPHY

The project area is relatively flat with ground slopes in the 0.5% range. Ground surface elevations range from 256 to 280 metres above sea level (masl).

2.2 HYDROLOGY

In general, runoff from the site drains as shallow overland flow towards the west. There are no significant natural drainage features across the site. The entire site is bound by irrigation channels which are approximately 5 m wide, 2-3 metres deep with a negligible longitudinal slope. During runoff events water is stored within these channels until they are pumped for irrigation or water infiltrates/evaporates. Anecdotal evidence from PCL suggests that irrigation channels infiltrate/evaporate within 3 days to a week of a rainfall event.

2.2.1 Flood Risk Assessment

An existing conditions flood risk assessment was completed by Pitt & Sherry Pty Ltd. (2018) and Stantec (2020) addressing requirements for regional and local flood modeling, respectively. These reports are available under separate cover. A summary of the local flood modeling completed for the installation of the access road (Phase 1) is included in Section 6 of this report.

2.3 SOILS AND HYDROGEOLOGY

Site soils are described in the EIS as "deep alluvial brown clays, typically comprising clay loam toposoil's (sic) over clay loam to medium clay soils" (pitt&sherry, 2018). The EIS suggests the erosion potential of the site as low to moderate hazard for rill and gully erosion

Groundwater depths range from 6.7 to 7.6 m below ground surface (bgs) in the area. The Site is not designated as groundwater vulnerable under the Gunnedah Local Environment Plan (LEP).

3.0 PROPOSED CONDITIONS

The proposed access road consists of a 1.1 km long, 5.5 m to 6.5 m wide granular access road generally built at grade.

3.1 GRADING AND DRAINAGE STRATEGY

The proposed grade of the access road generally matches existing conditions elevations on site. In areas where the access road crosses a topographical low the access road has been designed to meet the existing low point and armoured with a hardened surface and/or road sealing to promote conveyance of overland flow to downstream areas.

A portion of the proposed access road alignment (0+610 to 0+800) is in the location of an existing irrigation channel. This channel is proposed to realigned to the east (upstream) of the access road, with a culvert across the access road at station 0+799 conveying flows across the road to the existing irrigation channel to the west.

4.0 STORMWATER MANAGEMENT DESIGN

4.1 WATER QUANTITY CONTROLS

Grading design has been completed to mimic existing site drainage conditions. The increase in impervious coverage to downstream areas as a result of the installation of the proposed access road is minimal compared to the upstream drainage catchments. Therefore any increase in flows, and impact to downstream areas, as a result of the access road construction is expected to be negligible.

It is noted that there is an existing 5+ m wide irrigation channel on the adjacent property to the west, runs parallel to the entire length of the proposed access road, receiving surface runoff. The top of bank elevation for the entire length adjacent to the proposed access road is 267.5 m. It is anticipated that flows crossing the proposed access road will enter the adjacent channel and be distributed along the length of the irrigation channel prior to spilling and continuing downstream.

4.1.1 Water Quantity Monitoring Requirements

The primary concern for flooding impacts relate to the perimeter fencing and potential of increase in flooding due to blockage from flood debris. It is noted, during Phase 1, no fencing installation is proposed. In addition, impact to water levels during flooding events is proposed to be minimal as the proposed grading design maintains existing conditions drainage patterns by being constructed at/ near grade. Therefore, as no fencing is proposed and impact to water levels is expected to be negligible the monitoring requirements in the Development Consent, Schedule 4.24 (c) and (d), are not applicable or feasible for Phase 1.

4.2 WATER QUALITY CONTROLS

As mentioned above the increase in impervious coverage to downstream areas as a result of the installation of the proposed access road is minimal compared to the upstream drainage catchments.

Hardened surfaces and/or road sealing are proposed at access road low points / surface water crossings in order to mitigate erosion and transport of sediments downstream. In addition, a 20 to 50 m vegetated buffer has been provided between the access road and adjacent property to the east, providing filtration of surface water runoff.

5.0 SEDIMENT AND EROSION CONTROL (SEC) MEASURES

The various construction activities required to construction the substation access road include topsoil removal, minor grading activities, placement of granular material and general construction traffic. If left unmitigated, these activities will result in impacts ranging form disturbance of at-surface soils to potential erosion and sediment transport to downstream locations.

Erosion control will be achieved primarily by:

- Managing disturbed soils using soil conservation practices to reduce runoff and sediment transport during construction;
- Constructing barriers to filter runoff

Erosion and sediment control measures (detailed on Drawing C-200) will be implemented prior to any grading or servicing works commencing, and include, but are not necessarily limited to, the following measures:

- Perimeter sediment fencing will be installed at the downstream side of the work limits
    - Where shallow topsoil depths prevent trenching in the filter fabric, 150 mm of clear stone or pea gravel will be used to provide contact between the fabric and ground surface.
- A construction entrance feature ("shaker") will be provided at the site entrance to minimize the offsite transport of sediment via construction vehicles.
- Orange Grove Road will be inspected for and cleaned daily of any sediment (if necessary) deposited by site construction traffic.
- Stabilize topsoil stockpiles expected to be left in place longer than 10 days with vegetative cover (i.e., hydroseeding) or a rolled erosion control product in the event of unfavourable growing conditions. Topsoil stockpiles are to be surrounded by sediment fence.
- No equipment will be permitted to enter any area beyond the proposed work limits during construction.
- Water or synthetic dust suppressants will be employed to manage wind erosion and reduce dust generated from unsealed roads, stockpiles or areas of disturbed soil.
    - Dust generating activities shall be limited during periods of high velocity wind, as determined by the Construction Manager
- Re-vegetate all disturbed areas where construction is not expected for 20 days with sufficient topsoil to support re-vegetation and hydro-seeding or other stabilizing vegetation / erosion protection. If, given seasonal restriction or other revegetation limiting factors, the disturbed area should be stabilized against erosion impacts by non-vegetated means such as erosion control blankets.

- All materials and equipment used for site preparation and project construction should be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt, etc.) from migrating to offsite receivers.
    - Refueling and maintenance of construction equipment should occur in designated areas, a minimum of 100 m from a water body.
- All spills must be reported to the appropriate regulatory authority(ies).
- In the event of inclement weather or unfavourable terrain for construction, construction best practices, such as temporary rig-mats may be used to prevent disruption of surface soils and vegetative cover by construction vehicles and equipment.
- Sediment and erosion control measures are to be cleaned out when sediment reaches 1/3 of the available storage capacity.
- In the event of large or back-to-back storm events where on-site irrigation channels begin to exceed 80% capacity, irrigation channels may be pumped to provide additional containment volume. Pumped water will be discharged through a filter sock a sediment trap located on a gently sloped, vegetated area (when possible) greater than 50 m from any waterbody or downstream property.
- Silt-soxx (or approved equivalent) will be installed downstream of all proposed culvert crossings to minimize transport of sediment downstream.
- Culvert crossings will be installed with a rip-rip apron upstream and downstream of culvert entrances and exits to mitigate erosion as a result of flow concentration.

5.1 CONSTRUCTION DEWATERING

Since no significant excavation is anticipated for the construction of the Gunnedah Solar Farm substation access road, construction activities are not expected to intercept the groundwater table. However, if necessary, any required dewatering operations will be completed such that discharge rates will not adversely impact flooding or erosion conditions upstream or downstream of the Site. To mitigate the risk of sediment migration to downstream areas, dewatering discharges may be treated with a variety of measures including, but not limited to, filter socks or sediment traps at the discretion of the contractor in consultation with the owner's engineer. Dewatering measures will be directed through the sediment control measures to a gently sloped, vegetated area (when possible) greater than 30 m from any waterbody or downstream property.

5.2 CONTINGENCY PLAN

The purpose of the contingency plan is to help minimize the risk or consequence of failure of the erosion and sediment control works. Failure could result from insufficient measures, lack of maintenance, or severe weather conditions. The contingency plan includes two areas of consideration: the procedures that will be followed where a failure has occurred; and the contingency measures that will be implemented where there is potential for failure.

The Contractor shall be responsible for following the contingency plan, and will prepare the following items:

- Workers shall be on call for emergency situations for all aspects of the emergency from design to construction of emergency sediment and erosion control measures. Any associated health and safety issues are the responsibility of the Contractor.
- Heavy duty silt fence, erosion control blankets, straw bales and stakes or silt-soxx, sandbags, appropriate sized rip-rap, and clean gravel fill shall be available on-site for emergency installation.
- Heavy equipment shall be on standby for emergency works.
- Fuel spill containment supplies and equipment shall be available on-site for emergency spills of deleterious substances.
- A contact list for any further required equipment or materials shall be prepared and made available for emergency use.

5.2.1 Contingency Measures in Case of Failure

In the event of a failure, the Contractor will cease all construction related work and focus on erosion and sediment control as required to effectively stabilize the site where a failure has occurred or is imminent.

If significant long-term damage to downstream fish habitat or property is suspected, the Environmental Monitor will immediately assess and document the situation and report the incident to the appropriate regulatory agencies The Contractor will develop a restoration plan in consultation with regulatory authorities. Development of the initial restoration plan will begin within 24 hours of the discovery of sediment discharge, and will be implemented as soon as possible, following consultation and approval. The plan will address:

- Removal and disposal of sediment from outside the work limits;
- Restoration of the affected area; and
- Restoration of any areas disturbed through deposition or removal.

5.2.2 Contingency Measures where there is a High Risk of Failure

Conditions that may potentially cause failures can be identified through two methods: monitoring of the erosion and sediment control measures, and weather forecasts that anticipate severe weather conditions.

5.2.2.1 High Risk Identified Through Monitoring

Where monitoring has identified a high potential for failure, steps shall be immediately taken to reduce the risk. These measures may include repair to existing measures, modification of existing measures, and the addition of new measures.

5.2.2.2 Severe Weather Anticipated

In cases where the weather forecast indicates that significant rainfall is expected within a 24-hour period, the Contractor shall immediately complete the following:

- Verify that all erosion and sediment control measures are secure and that there is no exposed soil that could erode and be deposited downstream;
- Verify that all other measures are in good working order;
- Monitor all measures during the rainfall event, and where a potential for failure is identified, take corrective measures.

If unforeseen events cause the strategies set out in the contingency plan to be insufficient or inappropriate to meet the objective of containing sediment within the work limits, the Contractor will respond in a timely manner with all reasonable measures consistent with safety, to prevent, counteract or remedy any negative effects on the natural environment or adjacent properties.

5.3 EROSION AND SEDIMENT CONTROL MONITORING PROGRAM

To ensure the effectiveness of the various erosion and sediment control measures, a routine program should be implemented which includes the inspection of the erosion and sediment controls weekly and after each rainfall event generating runoff, and immediate repair of any deficiencies. Non-urgent repairs (i.e., no immediate risk of sediment discharges to the downstream environment) will be completed within 48 hours of identifying the deficiency, or prior to the next anticipated rainfall event, whichever is less. This program will consist of the following activities:

- Visual inspection of the SEC measures to ensure discharged flows are generally free of sediment and turbidity;
- Inspection of vegetation protection, erosion control blankets and silt fencing to ensure that they are maintained in good repair;
- Removal of construction debris that may accumulate; and
- Implementation of remedial measures including erosion stabilization, repair of damaged measures and any other remediation where required.

If the monitoring program outlined above indicates a persistent problem, then the following steps should be undertaken to determine appropriate mitigative measures (if step 1 does not resolve the issue, proceed to step 2):

1. Analysis of the monitoring information and field visits as required, to determine the cause of the problem and develop a mitigation plan to address the issue in consultation with a qualified Environmental Monitor.

   a. Implement additional mitigation measures and monitor the results.

2. Convene a meeting with the appropriate review agencies.

   a. Develop a consensus on a proposed plan of action to resolve the problem in consultation with agency staff.

   b. Implement additional mitigation measures and monitor the results.

5.4 LONG TERM EROSION AND SEDIMENT CONTROL

Approximately one (1) year after completion of construction, a site inspection will be completed to ensure that long-term erosion control measures have been effective. Seeded or replanted areas will be inspected to ensure that vegetation measures were successful and reseeding or replanting will occur where necessary.

If erosion control measures are found to be less than fully effective during this survey, reseeding or replanting of problem areas will take place. Should there be residual effects noted during post-construction monitoring, advice on contingency measures will be sought and applied.

6.0 FLOODPLAIN MAPPING

Floodplain mapping was complete to address requirements outlined in the *Floodplain Management Plan for the Upper Namoi Valley Floodplain 2019* (New South Wales, 2019) and the *Carroll to Boggabri Floodplain Management Plan* (NSW Department of Natural Resourvnces, 2006). A detailed floodplain assessment is included in the *Gunnedah Solar Farm Hydrology Report* (Stantec, 2020).

6.1 SITE FLOODPLAIN CHARACTERISTICS

During major storm events Namoi River breaks bank and drains in a westerly direction across the access road. The main access road design was completed taking into account the requirements of the *Floodplain Management Plan for the Upper Namoi Valley Floodplain 2019* to maintain flow characteristics during local and regional flood events. The vertical alignment was designed to blend with the existing ground form.

The vertical geometric alignment of the road followed the existing ground level. Cut was required at sections of the alignment and slight fill, not exceeding 0.5m was provided at sections of the road to maintain geometric design requirements.

No stormwater drainage culverts were provided along the proposed access road. Hard surface is provided to at sag point to allow runoff to drain across the road.

6.2 FLOODPLAIN MANAGEMENT

The project site is located in the Upper Namoi Management Zone BL. The Zone BL management zone is important for the conveyance of floodwaters during large flood events. The *Floodplain Management Plan for the Upper Namoi Valley Floodplain 2019* designates access road construction inside Zones BL and AID as flood works. Division 5 of the flood management plan provides rules for granting or amending flood works approvals in Upper Namoi Management Zones BL and AID. Floodplain modeling for the subject works was documented in the *Gunnedah Solar Farm Hydrology Report* (Stantec, 2020), attached.

6.2.1 Fish passage requirement

Inundation of the site occurs during the 5% AEP storm event. There is no defined watercourse along the road alignment and hence there is no permanent water feature along the access road alignment. Fish may cross the proposed road during this rare storm event. The hard pavement provided at the sag points and the road design will meet fish passage requirement as:

- The road is designed to follow the natural ground and minimizes barrier to fish crossing
- The site a prime agricultural land that has a flat regular gradient of less than 0.5%, this has resulted in flow velocities less than 0.5m/sec during major regional storm events

- There is less turbulence created at downstream end of the access road as the difference in height above natural ground surface is limited. Turbulence to flow is limited and fish passage will be maintained

6.2.2 Flood characteristics

The proposed works vertical geometry undulates following the existing ground topography. Fill height is limited along the project to limit increase in flood level upstream and redistribution of flow on adjacent landholdings.

A flood model was completed to determine the impact of the proposed road on flow characteristics during the 1% AEP storm event generated from local catchments. The study has indicated that:

- The maximum reduction in depth of flow downstream of the access road was 8 mm
  - The reduction in flood level was limited to inside the road corridor,
- The maximum increase in flood level downstream of the access road was 0.05m and the increase occurs at a ford crossing inside the project site limits
- The maximum increase in flood level upstream of the project was 90mm
  - The increase in flood level occurs inside project boundary.
- The difference in maximum flow velocity under proposed conditions 0.05m/sec

The flood level difference maps were provided as appendix to the *Gunnedah Solar Farm Hydrology Report* (Stantec, 2020), attached. The flood study has indicated that the impacts are minor and that the impacts occur within the project limits. The study has indicated that there is no impact on adjacent landholding due to the construction of the proposed access road.

6.2.3 Overall

The proposed road is designed taking into consideration the requirements of the *Floodplain Management Plan for the Upper Namoi Valley Floodplain 2019*. There are no defined watercourses along the proposed access road. Runoff occurs as a sheet flow. With the site being flat, ie a grade less than 0.5% maximum flow velocity across the proposed road is less than 0.5m/sec. With the road design blending into the existing natural terrain, there was limited increase in flood levels upstream and limited/no increase in flow redistribution for downstream property.

The proposed road was assessed against the requirements of the floodplain management plan for the upper Namoi River and it meets all the requirements.

7.0 CONCLUSION

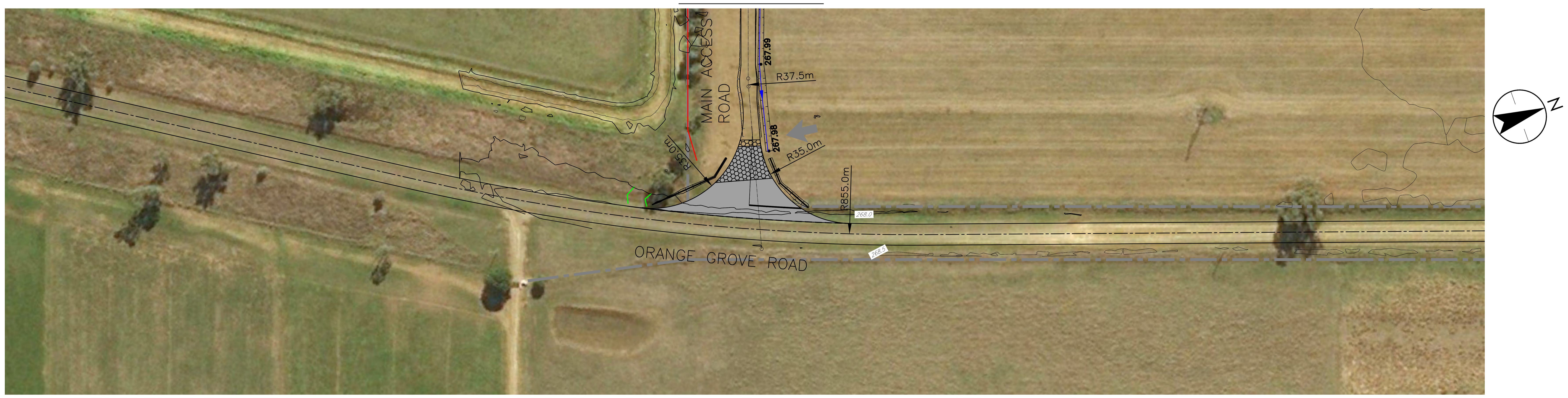
The Phase 1 Water Management Plan was developed for the proposed main access road construction as part of the Gunnedah Solar Project early works program. The phased approach has been proposed to allow for the construction of critical infrastructure concurrently with the detailed design for the remainder of the project.

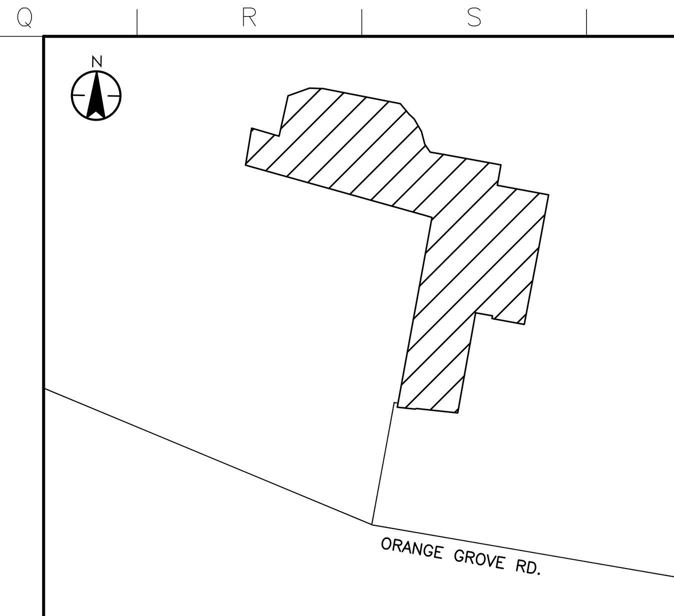
Based on the findings of this report, the following recommendations are provided.

- The proposed stormwater management measures in this report shall be constructed as designed;
- The SEC measures documented herein shall be implemented during construction;
- The monitoring and maintenance program shall be carried out during and following construction; and
- An overall site water management plan will be provided at a later date.

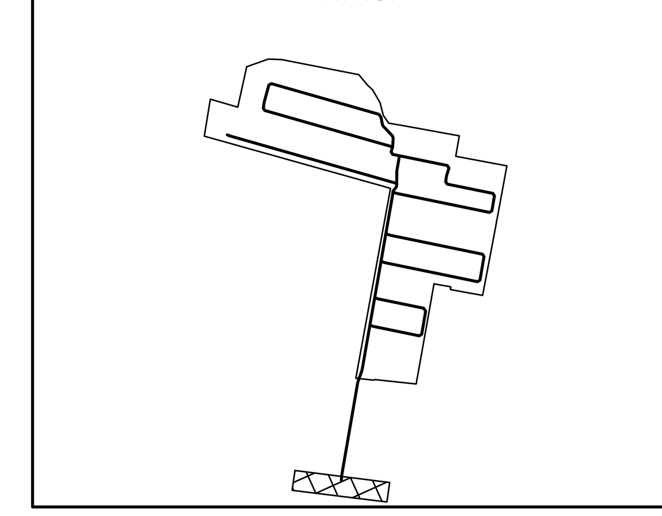
DRAWINGS

SEE SHEET 200–1B





KEY MAP
N.T.S.



KEY MAP
N.T.S.

GENERAL NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. COORDINATE CONTROL IS TO MAP GRID OF AUSTRALIA (MGA) ZONE 56. REDUCED LEVELS ARE TO AUSTRALIAN HEIGHT DATUM (AHD).
3. ALL SURVEY CONTROL MARKS, PERMANENT MARKS AND STATE SURVEY MARKS MUST BE PRESERVED. WHERE DISTURBANCE OF A SURVEY MARK OCCURS OR IS UNAVOIDABLE, ADVICE MUST BE SOUGHT FROM A SURVEYOR AUTHORISED BY THE SURVEYOR–GENERAL OR A SURVEYOR ENGAGED BY A NSW PUBLIC AUTHORITY NOTING THAT A REPLACEMENT MARK OR MARKS MAY NEED TO BE INSTALLED.
4. UTILITY ARE NOT SHOWN ON THE PLANS, THEREFORE THE PRESENCE OF A SERVICE HAS NOT BEEN ASSESSED.
5. UTITLITY INVESTIGATIONS SHOULD BE UNDERTAKEN TO DETERMINE THE PRESENCE OF A SERVICE BY DIALLING PH 1100 OR FAX 1300 652 077 (DIAL BEFORE YOU DIG). CAUTION SHOULD BE EXERCISED WHEN WORKING IN THE VICINITY OF ALL UTILITY SERVICES. THE PRESENCE OF A UTILITY SERVICE, ITS SIZE AND LOCATION SHOULD BE CONFIRMED BY CONDUCTING DIAL BEFORE YOU DIG, FIELD INSPECTION AND ASSOCAITED INVESTIGATIONS IF WARRANTED PRIOR TO THE COMMENCEMENT OF WORKS.
5. ALL MATERIALS AND WORKMANSHIP IS TO BE IN ACCORDANCE WITH THE RELEVANT PROJECT RMS &/ OR THE LOCAL COUNCIL SPECIFICATIONS FOR THE WORK.
6. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH OTHER PROVIDED REPORTS, RMS SPECIFICATIONS, MODEL DRAWINGS AND WRITTEN INSTRUCTIONS. ALWAYS REFER TO TECHNICAL SPECIFICATIONS FOR FURTHER CLARIFICATION AND DETAILS.
7. ALL LOCATIONS, ORIENTATION AND LEVELS SHALL BE VERIFIED ON SITE BEFORE COMMENCING ANY CONSTRUCTION OR FABRICATION WORK. REFER DISCREPANCIES TO THE PRINCIPAL FOR CLARIFICATION BEFORE PROCEEDING WITH WORK. DO NOT OBTAIN DIMENSIONS FROM SCALING.
8. ROAD OCCUPANCY LICENCES (ROL'S) ARE TO BE OBTAINED FROM RMS PRIOR TO IMPLEMENTATION OF ANY CLOSURE OF CURRENT LIVE TRAFFIC LANE OR ROAD REGARDLESS OF DETAILS SHOWN WITHIN THESE DRAWINGS.

DRAINAGE

9. ALL BATTERS SHALL BE TRAVERSIBLE DURING OPERATION I.E. LESS THAN OR EQUAL TO 1:4
10. THE CONTROL AND MANAGEMENT OF EXISTING STORMWATER FLOWS THROUGH AND AROUND ALL WORK SITES DURING CONSTRUCTION SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

EXISTING DRAINGE PITS AND PIPES (IF ANY)

1. THE EXISTING STORMWATER DRAINAGE PIT AND PIPE LAYOUT SHOWN ON THE DRAWINGS ARE INDICATIVE ONLY. WHERE A NEW CONNECTION OR EXTENSION IS TO BE MADE TO ANY EXISTING PIT OR PIPE, ALL LOCATIONS, ORIENTATIONS AND REDUCED LEVELS AT THE PROPOSED CONNECTION POINT SHALL BE VERIFIED ON SITE BEFORE COMMENCING ANY WORK.

GEOTECHNICAL

1. ALL EARTHWORKS SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE REQUIREMENTS OF RMS SPECIFICATION R44 AND ASSCOCIATED COUNCIL SPECIFICATIONS.
2. GEOTECHNICAL INSPECTIONS SHOULD BE CARRIED OUT BY GEOTECHNICAL ENGINEER IN ACCORDANCE WITH RMS SPECIFICATION R44 REQUIREMENTS. WHERE RECTIFICATIONS ARE REQUIRED, RE–INSPECTION SHALL BE CARRIED OUT.

TEMPORARY TRAFFIC CONTROL

1. TEMPORARY TRAFFIC CONTROL AT PUBLIC ROAD INTERFACES ETC. BE IN ACCORDANCE WITH TRAFFIC CONTROL AT WORK SITE TECHNICAL MANUAL ROADS AND MARITIME SERVICES 27 JULY, 2018

TEMPORARY DRAINAGE STRUCTURES

1. STRUCTURES HAVE BEEN DESIGNED FOR OPERATIONAL LOADS (SM1600 WHERE UNDER OR ADJACENT TO ROADWAYS) ACTING ON COMPLETED STRUCTURES. THE CONTRACTOR IS RESPONSIBLE FOR THE DESIGN AND PROVISION OF ANY TEMPORARY BRACING, PROPPING, ETC. REQUIRED DURING CONSTRUCTION. STRUCTURES SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED.
2. INADEQUATE FOUNDATION MATERIAL FOR PIPES AND STRUCTURES SHALL BE REMOVED OR IMPROVED IN ACCORDANCE WITH COUNCIL SPECIFICATIONS.
3. ALL SETOUT POINTS QUOTED FOR DRAINAGE STRUCTURES REFER RELEVANT DESIGN DRAWING, RMS MODEL DRAWING OR PRODUCT SPECIFICATION.
4. ALL CONSTRUCTION JOINTS TO BE ROUGHENED, CLEANED AND WATERED PRIOR TO POURING NEW CONCRETE.

GEOTEXTILE

1. ALL GEOTEXTILE FABRIC TO BE BIDIM A64 (OR APPROVED EQUIVALENT) UNLESS NOTED OTHERWISE.

DRAINAGE PIPES

1. ALL DRAINAGE PIPES ARE TO BE PRECAST REINFORCED CLASS 4 CONCRETE PIPES TO AS/NZS 4058 AND RUBBER RING JOINTED SPIGOT AND SOCKET TYPE UNLESS NOTED OTHERWISE.
2. CONCRETE PIPE INSTALLATION TO BE TYPE HS3 SUPPORT IN ACCORDANCE WITH RMS MD.R11.A01.B OR COUNCIL APPROVED EQUVELANT.
3. CONCRETE PIPE CLASSES HAVE BEEN DETERMINED FOR OPERATIONAL TRAFFIC LOADING ONLY (SM1600 AND HLP400 WHERE UNDER OR ADJACENT TO ROADWAYS). PIPE CLASSES ASSUME TYPE HS3 SUPPORT AND A 0.3 x O.D. POSITIVE PROJECTION TO AS/NZS 3725 AND RMS SPECIFICATION UNLESS NOTED OTHERWISE.
5. CONNECTION BETWEEN PIPES AND STRUCTURES TO BE UNDERTAKEN IN ACCORDANCE WITH RMS SPECIFICATION R11 RMS MODEL DRAWINGS UNLESS NOTED OTHERWISE.
6. CONTRACTOR IS RESPONSIBLE FOR DETERMINING OR CONFIRMING WITH THE DESIGNER THE MINIMUM COVER IS ACCORDANCE WITH THE PIPE CLASS DURING CONSTRUCTION, TO SUIT CONSTRUCTION METHODOLOGY UTILISED.

LINEMARKING

1. RAISED RETRO REFLECTIVE PAVEMENT MARKERS SHALL BE PLACED ON ALL LANE, EDGE & BARRIER LINES.
2. LINEMARKING AND SIGN POSTING TO BE IN ACCORDANCE WITH RMS DELINEATION GUIDELINES, THE RELEVANT RMS TECHNICAL DIRECTIONS, COMPLEMENTARY GUIDELINES, RMS AUSTROAD & AUSTRALIAN STANDARDS SUPPLEMENTS, AUSTRALIAN STANDARD 1742 AND RMS SPECIFICATIONS.
3. EXISTING PAVEMENT MARKS AND RRPMS CONFLICTING WITH CURRENT AND PROPOSED LINEMARKING AND PAVEMENT MARKS TO BE REMOVED USING AN RMS APPROVED METHOD.
4. WHERE BARRIERS ARE LOCATED LESS THAN OR EQUAL TO 4m FROM THE EDGE LINE, REFLECTORS ARE TO BE MOUNTED ON THE BARRIER. RED CORNER CUBE REFLECTORS TO BE PLACED ON TOP OF EVERY OTHER BARRIER UNIT (ON LEFT HAND SIDE OF THE CARRIAGEWAY) STARTING THE FIRST BARRIER.
5. LINE MARKINGS TO BE APPLIED IN ACCORDANCE WITH RMS SPECIFICATION R141 USING WATER BORNE PAINT UNO.
6. EXTENTS OF TEMPORARY LINEMARKING THAT ARE TO BE REMOVED AT THE END OF THE PROJECT WILL NEED TO BE REMOVED AND REPLACED BY MILLING AND RESHEETING WITH A 50mm AC14 (A15E) WEARING COURSE.

Stantec

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PCL
CONSTRUCTION LEADERS

Notes

1. EXISTING VEGETATION INFORMATION IS APPROXIMATE, PROVIDED FROM AERIAL IMAGERY. CONTRACTOR TO CONFIRM ALL TREE & SHRUB LOCATION ON SITE.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS IN THIS SET PREPARED BY STANTEC CONSULTING LTD.
3. THE CONTRACTOR MUST CHECK AND VERIFY DIMENSIONS; OBTAIN ALL UTILITY LOCATES AND OBTAIN ALL REQUIRED PERMITS/LICENSES AND VERIFY ELEVATIONS OF EXISTING SERVICES BEFORE PROCEEDING WITH ANY WORK.
4. ALL CONSTRUCTION WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS (LATEST EDITION).
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9. THESE DRAWINGS ARE TOO BE READ IN CONJUNCTION WITH THE Gunn_Earlyworks_WaterManagementPlan AND THE GUNNEDAH EARLY WORKS DESIGN MEMO.

Legend

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185.19	PROPOSED ELEVATION
185.19(EX)	MATCH TO EXISTING ELEVATION
	SWALE
184.5	EXISTING TOPOGRAPHIC SURVEY CONTOUR
	OVERLAND FLOW DIRECTION
2.0%	GRADE
	SLOPE (3:1 UNLESS NOTED OTHERWISE)
	HARDENED SURFACE
	CULVERT
	TEMPORARY LAYDOWN AREA (MATERIAL TO BE DETERMINED ON SITE)
	TREE LINE
	SILT FENCE SEE DETAIL ON SHEET C–500
	SILT SOXX SEE DETAIL ON SHEET C–500
	APPROXIMATE LOCATION OF PROPERTY LINES
	PROPOSED ACCESS FENCE SEE SHEET C–500 FOR DETAILS)
	PROPOSED DROP DOWN FENCE (DESIGNED BY OTHERS)

Revision		By	Appd.	YY.MM.DD
0	ISSUED FOR CONSTRUCTION	DR	JK	20.03.26

File Name: 3600727160_C_PP_MAIN.dwg	Dwn.	Chkd.	Dsgn.	YY.MM.DD
	DR	JK/SW	DR	19.12.16

Permit-Seal

Client/Project

CANADIAN SOLAR AUSTRALIA
GUNNEDAH SOLAR PROJECT

765 ORANGE GROVE ROAD
147MV GROUND MOUNT SOLAR FARM

GUNNEDAH, NEW SOUTH WALES, AUSTRALIA

Title

ORANGE GROVE ROAD
PLAN VIEW

Project No. 3600727160

Scale 1:1000 (0 10 30 50m)

Drawing No. C-200

Sheet 1A of 14

Revision 0

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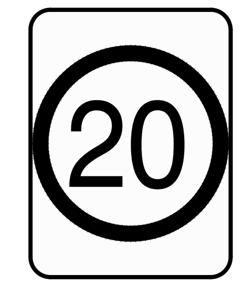
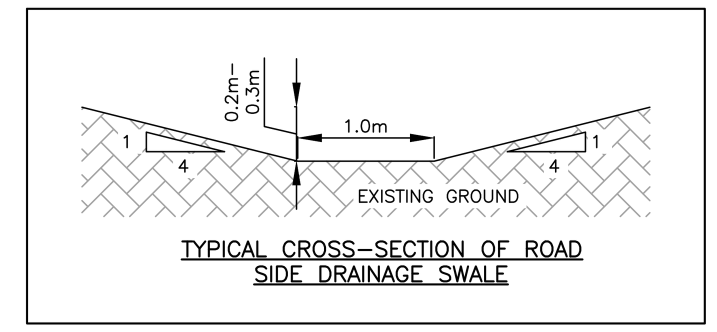
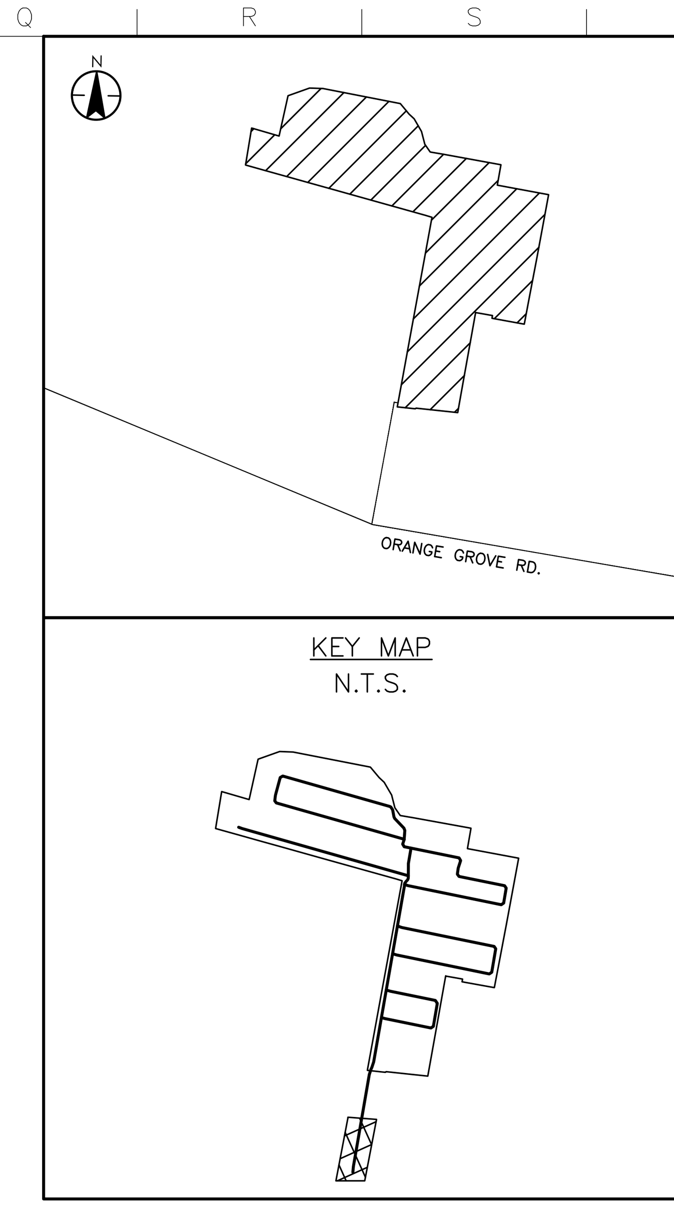
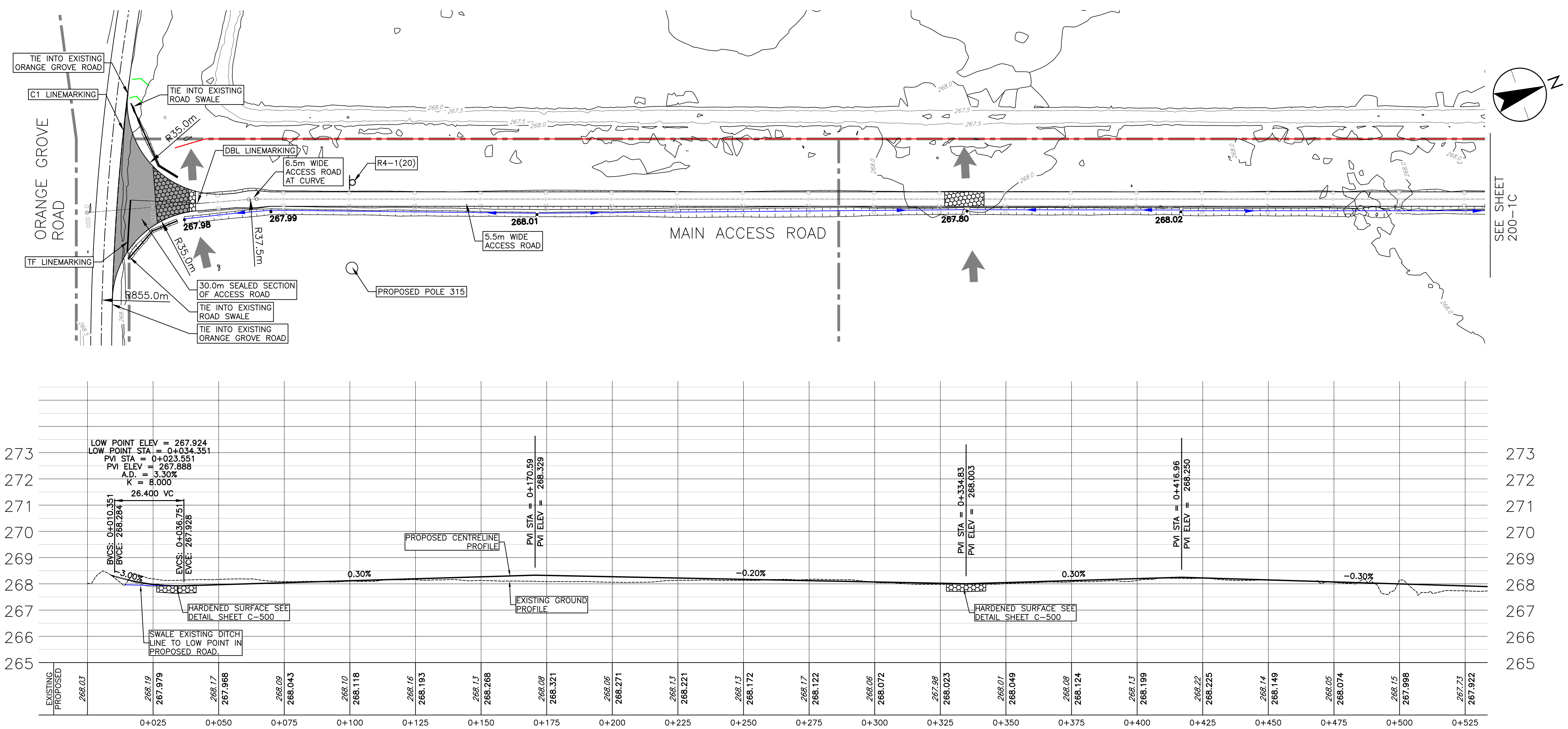
2020/03/26 7:41 PM By: Rice, Derrick









Stantec

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www.stantec.com

PCL
CONSTRUCTION LEADERS

Notes

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Permit-Seal

Client/Project

CANADIAN SOLAR AUSTRALIA
GUNNEDAH SOLAR PROJECT

765 ORANGE GROVE ROAD
147MV GROUND MOUNT SOLAR FARM

GUNNEDAH, NEW SOUTH WALES, AUSTRALIA

Title

MAIN ACCESS ROAD
PLAN & PROFILE
STA. 0+000 TO 0+525

Project No.	Scale
3600727160	1:1000 (0, 10, 30, 50m)

Drawing No.	Sheet	Revision
C-200	1B of 14	0

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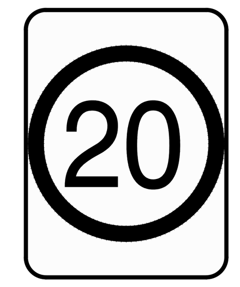

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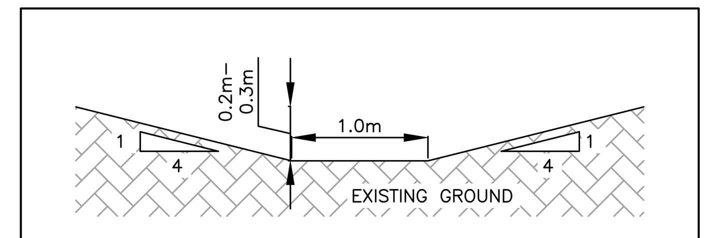
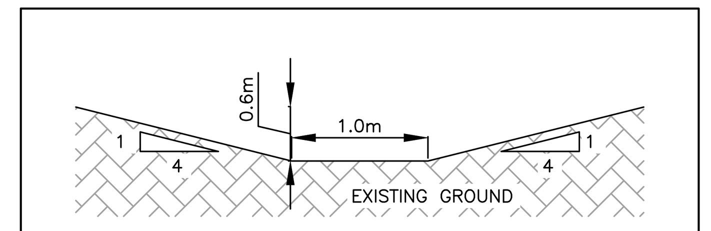
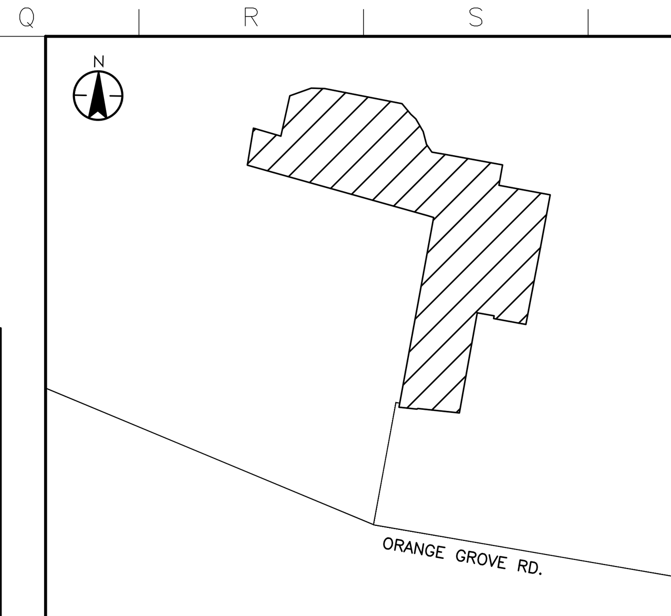


TYPICAL CROSS-SECTION OF ROAD SIDE DRAINAGE SWALE

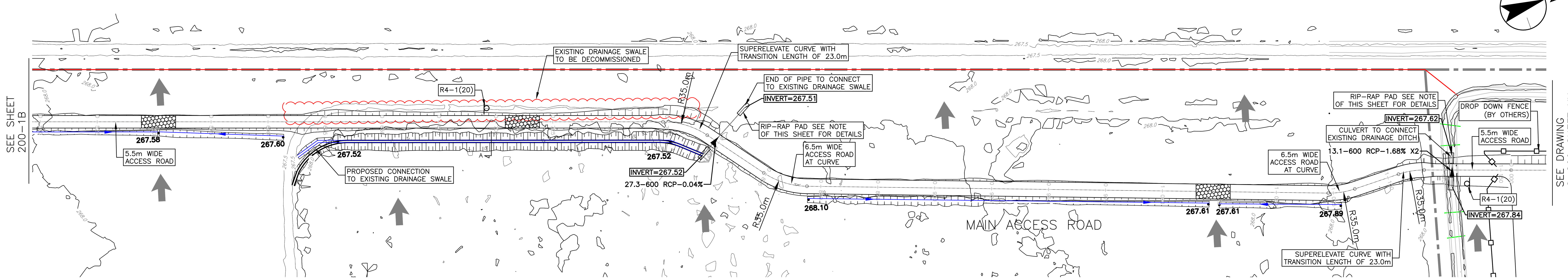


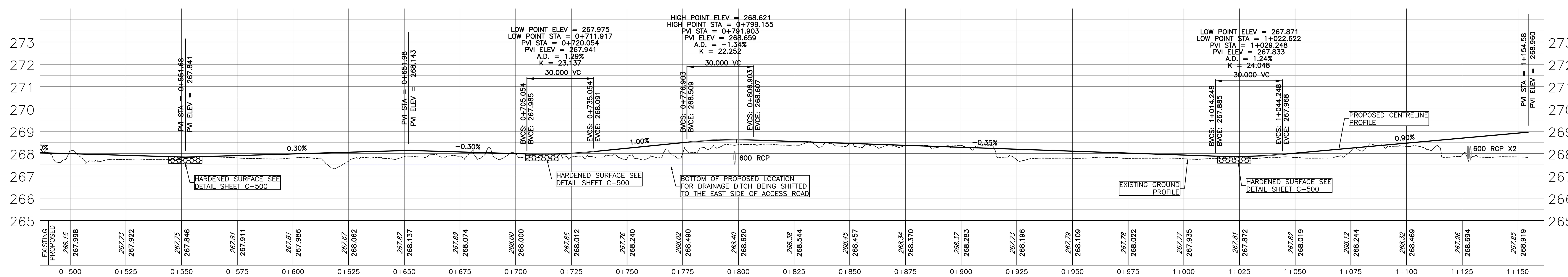
TYPICAL CROSS-SECTION IRRIGATION CHANNEL SECTION A



KEY MAP
N.T.S.

KEY MAP
N.T.S.





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PCL
CONSTRUCTION LEADERS

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Client/Project

CANADIAN SOLAR AUSTRALIA
GUNNEDAH SOLAR PROJECT

765 ORANGE GROVE ROAD
147MV GROUND MOUNT SOLAR FARM

GUNNEDAH, NEW SOUTH WALES, AUSTRALIA

Title

MAIN ACCESS ROAD
PLAN & PROFILE
STA. 0+525 TO 0+1150

Project No. 3600727160

Scale 1:1000

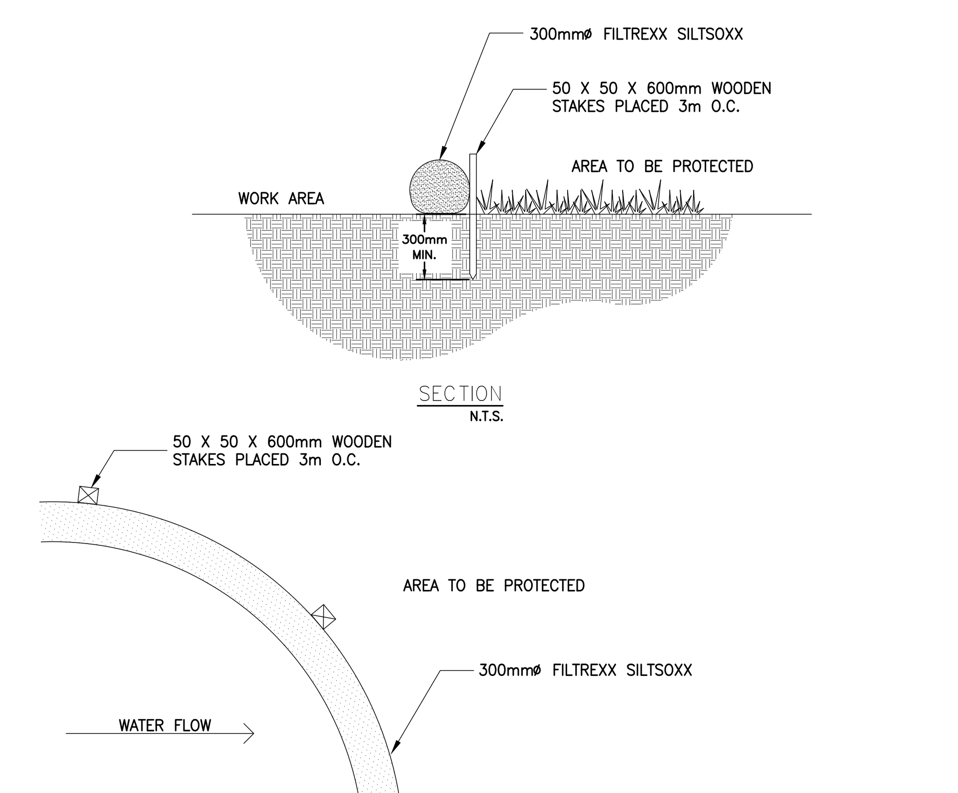
Drawing No. C-200

Sheet 1C of 14

Revision 0

ROAD CONSTRUCTION NOTES

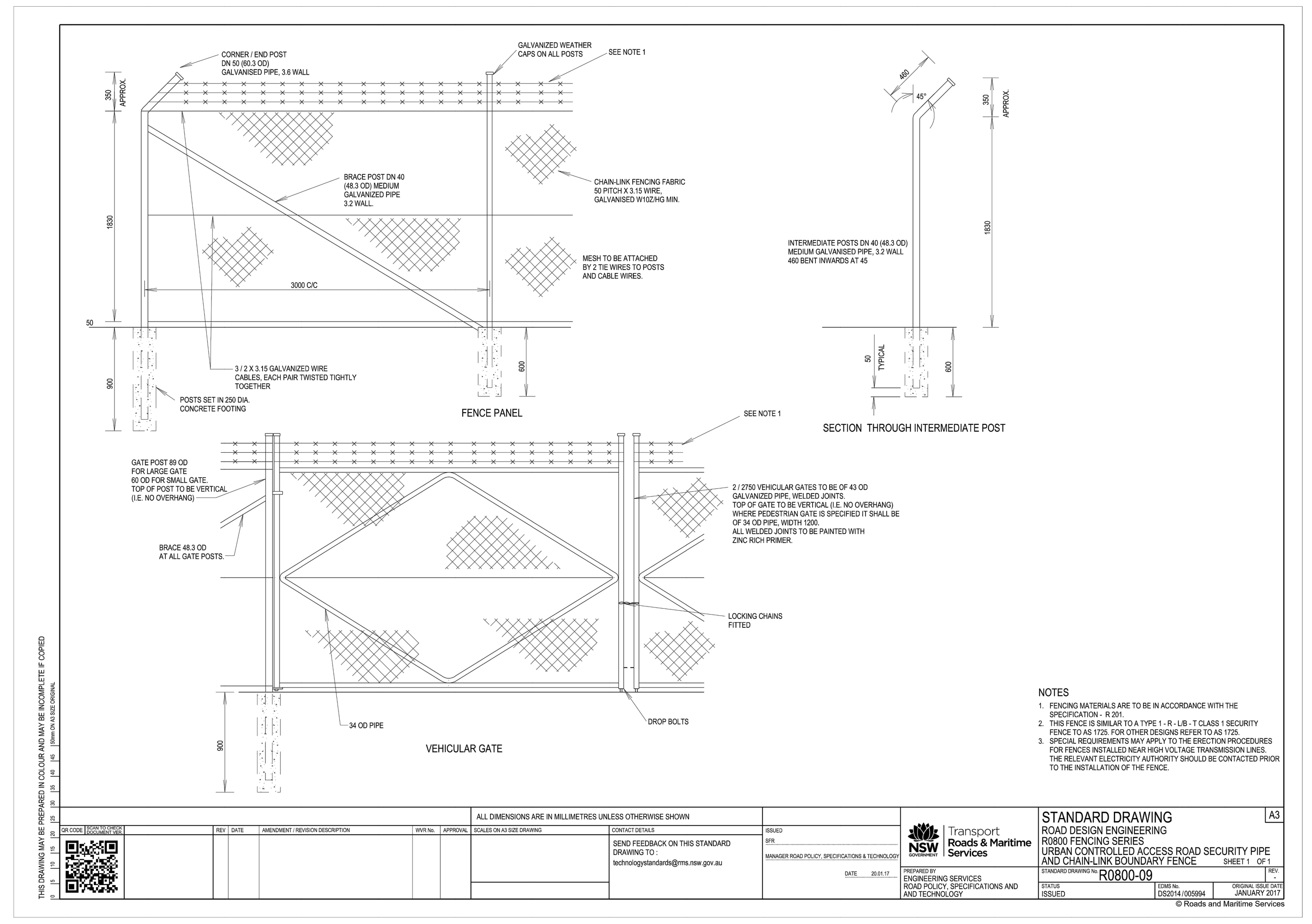
1. THE FOREGOING DESIGN ASSUMES THAT CONSTRUCTION IS CARRIED OUT DURING DRY PERIODS AND THE SUB-GRADE IS STABLE UNDER THE LOAD OF CONSTRUCTION EQUIPMENT. IF CONSTRUCTION IS CARRIED OUT DURING WET WEATHER AND HEAVING OR ROLLING OF THE SUB-GRADE IS EXPERIENCED, ADDITIONAL THICKNESS OF GRANULAR ROAD BASE MAY BE REQUIRED AND INSPECTED BY A QUALIFIED GEOTECHNICAL ENGINEER.
2. THE LONG-TERM PERFORMANCE OF THE ROAD BASE STRUCTURE IS DEPENDENT UPON THE SUB-GRADE SUPPORT CONDITIONS. STRINGENT CONSTRUCTION CONTROL PROCEDURES SHALL BE MAINTAINED TO ENSURE THAT UNIFORM SUB-GRADE MOISTURE AND DENSITY CONDITIONS ARE ACHIEVED. IF, DURING THE EXCAVATION PROCESS, NATIVE MATERIAL APPEARS SUITABLE TO BE USED AS ROAD SUB-BASE A GRAIN SIZE ANALYSIS MUST BE COMPLETED TO DETERMINE IF THE MATERIAL CAN BE LEFT IN PLACE AND WHETHER A REDUCTION IN DEPTH OF THE GRANULAR ROAD STRUCTURE IS WARRANTED. THE UNDERLYING SUB-GRADE SHALL BE FREE OF DEPRESSIONS AND IS TO BE SLOPED TO PROVIDE POSITIVE SURFACE DRAINAGE. SURFACE WATER SHALL NOT BE PERMITTED TO POND ADJACENT TO THE OUTSIDE EDGES.
3. AS PART OF THE SUB-GRADE PREPARATION, PROPOSED ROADWAYS SHALL BE STRIPPED OF TOPSOIL AND UNSUITABLE MATERIAL. FILL REQUIRED TO RAISE THE SUB-GRADE TO DESIGN ELEVATIONS SHALL BE ORGANIC-FREE AND SHALL HAVE A MOISTURE CONTENT WHICH WILL PERMIT COMPACTION TO THE DENSITIES INDICATED. THE SUB-GRADE SHALL BE SHAPED AND THEN PROOF-ROLLED IN THE PRESENCE OF A GEOTECHNICAL CONSULTANT. SOFT OR SPONGY SUB-GRADE AREAS SHALL BE SUB-EXCAVATED AND REPLACED WITH SUITABLE APPROVED BACKFILL COMPACTED TO 98 PERCENT SPMDD.

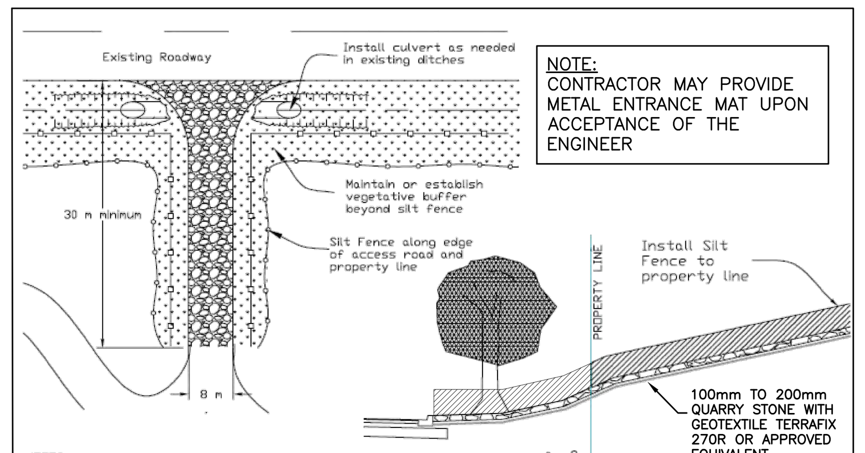


NOTES:
1. ALL MATERIAL TO MEET FILTREXX SPECIFICATIONS.
2. FILTER MEDIA FILL TO MEET APPLICATION REQUIREMENTS.
3. SEDIMENT SHOULD BE REMOVED FROM BEHIND SILTSOXX ONCE THE ACCUMULATED HEIGHT HAS REACHED ½ THE HEIGHT OF THE SILTSOXX.
4. ENDS OF SILTSOXX TO BE WRAPPED UPHILL TO PREVENT FLOW AROUND ENDS

FILTREXX SILTSOXX DETAIL OR APPROVED EQUIVALENT

NTS

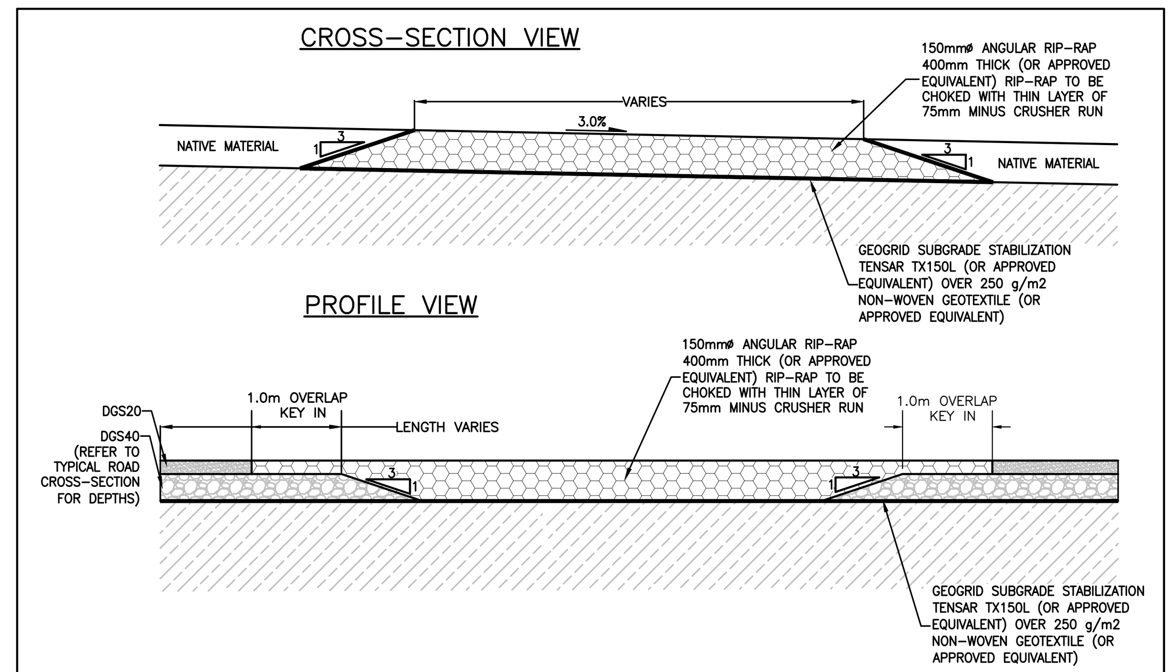




NOTE:
CONTRACTOR MAY PROVIDE METAL ENTRANCE MAT UPON ACCEPTANCE OF THE ENGINEER

NOTES:
1. Purpose of Construction Mat is to minimize transportation of sediment onto roadways.
2. Construction mat is to be installed as the first step in the site alteration process.
3. Construction mats are required where paved roads are within 300 m of the site.

CONSTRUCTION ENTRANCE MAT



HARDENED SURFACE ACCESS ROAD DETAIL

NTS

EROSION AND SEDIMENT CONTROL NOTES:
(SEE DETAILS THIS SHEET)

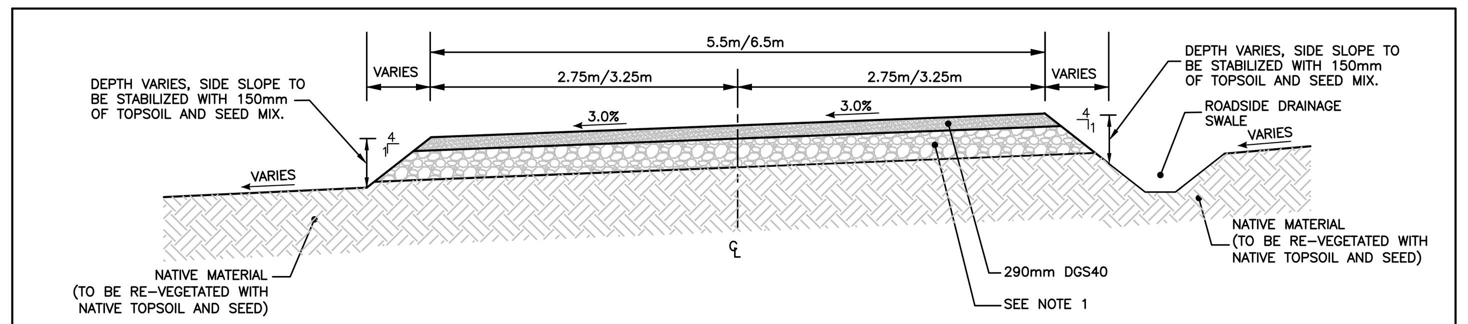
1. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM DURING CONSTRUCTION ACTIVITIES. THIS INCLUDES LIMITING THE AMOUNT AND DURATION OF EXPOSED SOIL AND INSTALLING SILT FENCES AND OTHER SEDIMENT TRAPS/FILTERS SIMILAR TO THOSE ILLUSTRATED HEREIN.
2. EROSION AND SEDIMENT CONTROL WORKS SHALL BE INSTALLED AND IN WORKING CONDITION PRIOR TO COMMENCEMENT OF CONSTRUCTION RELATED ACTIVITIES.
3. SEDIMENT CONTROL MEASURES ADJACENT TO CONSTRUCTION AREAS MAY REQUIRE REMOVAL / RELOCATION IN ORDER TO COMPLETE SPECIFIC CONSTRUCTION ACTIVITIES. THE CONTRACTOR SHALL ENSURE THAT ADEQUATE SEDIMENT CONTROL MEASURES ARE IN PLACE AT ALL TIMES.
4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO MAINTAIN AND BOLSTER EROSION AND SEDIMENT CONTROL MEASURES AS NECESSARY TO KEEP THEM EFFECTIVE AND MINIMIZE THE POTENTIAL FOR EROSION AND MIGRATION OF SEDIMENT TO THE DOWNSTREAM NATURAL ENVIRONMENT
5. AT THE DISCRETION OF THE OWNER OR OWNER'S CONSULTANT, ADDITIONAL SILT CONTROL DEVICES SHALL BE INSTALLED AT DESIGNATED LOCATIONS.
6. STOCKPILED MATERIAL IS TO BE STORED AWAY FROM WATER BODIES, WETLANDS AND OTHER SENSITIVE RECEIVERS IN A MANNER THAT PREVENTS ANY DELETERIOUS SUBSTANCE FROM ENTERING THAT FEATURE AND BE SURROUNDED BY EROSION CONTROL MEASURE WHERE MATERIAL IS TO BE LEFT IN PLACE IN EXCESS OF 10 DAYS OR PRIOR TO A RAIN EVENT, WHICHEVER OCCURS SOONER.
7. SEDIMENT THAT IS ACCUMULATED BY THE TEMPORARY SEDIMENT AND EROSION CONTROL MEASURES SHALL BE REMOVED IN A MANNER THAT AVOIDS ESCAPE OF THE SEDIMENT TO THE DOWNSTREAM SIDE OF THE CONTROL MEASURE AND AVOIDS DAMAGE TO THE CONTROL MEASURE. ALL SEDIMENT SHALL BE REMOVED AND TOPSOIL WITH SEED TO BE ADDED IF NECESSARY.
8. SILT FENCE AND EROSION CONTROL STRUCTURES TO BE CHECKED DAILY AND AFTER EACH RAINFALL (>10mm) BY A QUALIFIED INSPECTOR FOR DEFICIENCIES. SEDIMENT SHALL BE REMOVED WHEN THE LEVEL OF SEDIMENT DEPOSITION REACHES ONE THIRD OF THE WAY TO THE TOP OF THE BARRIER.
9. STOCKPILED MATERIAL IS TO BE STORED A SUFFICIENT DISTANCE FROM WATERCOURSES, TO PRECLUDE SEDIMENT INPUTS DUE TO EROSION OF STORED SOIL MATERIALS. WHERE STOCKPILED EXCAVATED NATIVE MATERIALS AND IMPORTED MATERIALS WITH A D50 LESS THAN 4.75mm ARE TO BE LEFT IN PLACE UNDISTURBED IN EXCESS OF 30 DAYS, STOCKPILES ARE TO BE COVERED WITH A ROLLED EROSION CONTROL PRODUCT (RECP) SUCH AS A TARP, SINGLE NET STRAW MAT OR DOUBLE NET STRAW MAT. IMPORTED MATERIALS WITH A D50 OF 4.75mm OR GREATER CAN REMAIN UNCOVERED. EROSION AND SEDIMENT CONTROL MONITORING RECORDS SHALL BE KEPT AND MADE AVAILABLE TO THE MINISTRY OF ENVIRONMENT AND CLIMATE CHANGE UPON REQUEST.
10. IN THE EVENT OF INCLEMENT WEATHER OR UNFAVOURABLE TERRAIN FOR CONSTRUCTION, CONSTRUCTION BEST PRACTICES, SUCH AS TEMPORARY RIG-MATS MAY BE USED TO PREVENT DISRUPTION OF SURFACE SOILS AND VEGETATIVE COVER BY CONSTRUCTION VEHICLES AND EQUIPMENT.
11. EQUIPMENT AND CONSTRUCTION MATERIAL SHALL BE STORED AWAY FROM WATER BODIES IN A MANNER THAT PREVENTS ANY DELETERIOUS SUBSTANCE FROM ENTERING THE WATER, REFUELLING OF MACHINERY AND GENERATORS SHALL NOT BE CONDUCTED WITHIN 30m OF A WATER BODY OR WETLAND AND SHALL BE COMPLETED IN A CONTROLLED MANNER WITH ADEQUATE SPILL PROTECTION ON SITE
12. PUBLIC ROADS TO BE CLEANED OF ACCUMULATED SEDIMENT CAUSED BY CONSTRUCTION AS REQUIRED.
13. IN ADDITION TO BEING RESPONSIBLE FOR ENSURING THAT THE PRESCRIBED MEASURES ARE INSTITUTED AND FUNCTIONING AS INTENDED, THE CONTRACTOR IS ALSO RESPONSIBLE FOR IMPLEMENTING ANY INTERIM OR EMERGENCY MEASURES REQUIRED, TO ENSURE THAT NO SEDIMENT IS DISCHARGED TO THE NATURAL ENVIRONMENT. THE FOLLOWING EXTRA EQUIPMENT/MATERIALS ARE TO BE KEPT ON SITE AS A CONTINGENCY, IN CASE THE PROPOSED CONTROL MEASURES ARE BREACHED.
   - SILT FENCE
   - FILTER CLOTH
   - PUMPS
   - CLEAN RIP-RAP (FREE OF FINES) FOR ROCK CHECK DAMS
   - SAND BAGS
   - ANY ADDITIONAL MATERIAL DEEMED NECESSARY TO REPAIR/ CONSTRUCT PROPOSED MEASURES OR TO ADEQUATELY DEAL WITH UNEXPECTED HIGH FLOWS

DURING AREA GRADING :

1. TOPSOIL IS TO BE STRIPPED ONLY IN AREAS REQUIRING EARTHWORKS AND PLACED IN STOCKPILES AT THE LOCATIONS SHOWN ON THE PLANS OR AS APPROVED BY THE QUALIFIED ENVIRONMENTAL SITE INSPECTOR.
2. ROADWAYS AND LAY DOWN YARDS ARE TO BE PLACED ON NATIVE GROUND AFTER TOPSOIL HAS BEEN STRIPPED
3. ALL TOPSOIL IS TO BE RE-SPREAD THROUGHOUT THE PROJECT EXTENTS.
4. NO TOPSOIL MAY BE EXPORTED FROM THE SITE.

PAVEMENT:

1. PROPOSED NEW PAVEMENTS HAVE BEEN DESIGNED BASED ON A DESIGN SUBGRADE AS SHOWN ON THE PROFILES ON DRAWING NUMBER C-500. WHERE THE EXISTING SUBGRADE IS LESS THAN DESIGN SUBGRADE, THE GEOTECHNICAL AND PAVEMENT ENGINEER SHALL BE CONSULTED
2. IF REQUIRED TRENCH AND EDGE DRAINS ARE TO BE PLACED AS INDICATED ON THE DRAWINGS AND IN ACCORDANCE WITH RMS PAVEMENT SUBSURFACE DRAINAGE DETAILS, VOLUMES 1 TO 6 (AS APPLICABLE).
3. PAVEMENT INTERFACE DRAINS TO BE PROVIDED FOR ALL INTERFACES BETWEEN DIFFERENT PERMANENT PAVEMENT TYPES, INCLUDING AT INTERFACES WITH EXISTING PAVEMENTS.

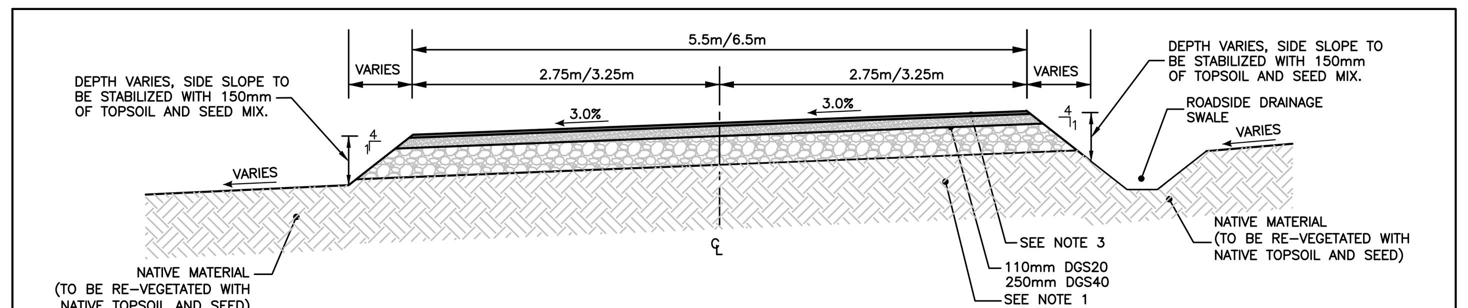


NOTE:
1 ALL TOPSOIL AND ORGANIC SOILS TO BE REMOVED FROM BELOW ANY PROPOSED STRUCTURES, ACCESS ROADS, AND PARKING AREAS. THE EXPOSED SUBGRADE TO BE PROOF-ROLLED AND INSPECTED BY A QUALIFIED GEOTECHNICAL ENGINEER. ANY LOOSE/SOFT OR WET AREAS IDENTIFIED AT THE TIME OF PROOF-ROLLING TO BE SUB-EXCAVATED AND REMOVED AND REPLACED BY COMPACTED, LOW-PLASTICITY GRANULAR FILL
2 CHANGES TO THICKNESS AND BASE MATERIAL SPECIFICATIONS TO BE MADE AT THE DISCRETION OF A QUALIFIED GEOTECHNICAL ENGINEER.
3 EXPOSED SUBGRADE MUST HAVE A MINIMUM CBR OF 4 AS PER GEOTECHNICAL REPORT COMPLETED BY CROZIER GEOTECHNICAL CONSULTANTS DATED APRIL, 2018.

COMPACTION REQUIREMENTS:
SUB-GRADE: IN ACCORDANCE WITH RMS SPECIFICATION GUIDE R44, RIP AND RECOMPACT FOUNDATION TO A MINIMUM OF 98% OF THE SOIL'S DRY DENSITY RATIO, USING THE STANDARD COMPACTION METHOD.
SUB-BASE AND BASE-COURSE LAYERS: IN ACCORDANCE WITH RMS SPECIFICATION GUIDE 71, COMPACT TO A MINIMUM OF 102% OF THE SOIL'S DRY DENSITY RATIO, USING THE STANDARD COMPACTION METHOD.
BASE-COURSE DRY-BACK REQUIREMENTS: THE FIELD MOISTURE CONTENT OF BASE-COURSE MATERIAL TO RECEIVE A BITMINOUS SEAL MUST NOT EXCEED 70% OF THE BASE MATERIAL'S OPTIMUM MOISTURE CONTENT AT THE TIME THAT THE BITUMINOUS SEAL IS APPLIED.

TYPICAL CROSS-SECTION 5.5m/6.5m WIDE UNSEALED ACCESS ROAD FROM ORANGE GROVE ROAD TO SUBSTATION DETAIL (FILL)

NTS

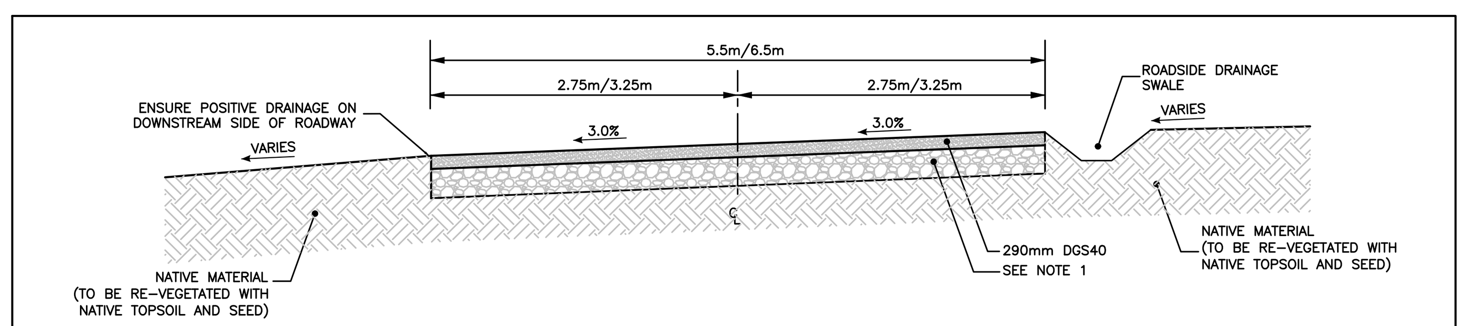


NOTE:
1 ALL TOPSOIL AND ORGANIC SOILS TO BE REMOVED FROM BELOW ANY PROPOSED STRUCTURES, ACCESS ROADS, AND PARKING AREAS. THE EXPOSED SUBGRADE TO BE PROOF-ROLLED AND INSPECTED BY A QUALIFIED GEOTECHNICAL ENGINEER. ANY LOOSE/SOFT OR WET AREAS IDENTIFIED AT THE TIME OF PROOF-ROLLING TO BE SUB-EXCAVATED AND REMOVED AND REPLACED BY COMPACTED, LOW-PLASTICITY GRANULAR FILL
2 CHANGES TO THICKNESS AND BASE MATERIAL SPECIFICATIONS TO BE MADE AT THE DISCRETION OF A QUALIFIED GEOTECHNICAL ENGINEER.
3 14/7mm DOUBLE/DOUBLE SEAL WITH A CLASS 170 OR HIGHER BINDER TYPE.
4 EXPOSED SUBGRADE MUST HAVE A MINIMUM CBR OF 4 AS PER GEOTECHNICAL REPORT COMPLETED BY CROZIER GEOTECHNICAL CONSULTANTS DATED APRIL, 2018.

COMPACTION REQUIREMENTS:
SUB-GRADE: IN ACCORDANCE WITH RMS SPECIFICATION GUIDE R44, RIP AND RECOMPACT FOUNDATION TO A MINIMUM OF 98% OF THE SOIL'S DRY DENSITY RATIO, USING THE STANDARD COMPACTION METHOD.
SUB-BASE AND BASE-COURSE LAYERS: IN ACCORDANCE WITH RMS SPECIFICATION GUIDE 71, COMPACT TO A MINIMUM OF 102% OF THE SOIL'S DRY DENSITY RATIO, USING THE STANDARD COMPACTION METHOD.
BASE-COURSE DRY-BACK REQUIREMENTS: THE FIELD MOISTURE CONTENT OF BASE-COURSE MATERIAL TO RECEIVE A BITMINOUS SEAL MUST NOT EXCEED 70% OF THE BASE MATERIAL'S OPTIMUM MOISTURE CONTENT AT THE TIME THAT THE BITUMINOUS SEAL IS APPLIED.

TYPICAL CROSS-SECTION 5.5m/6.5m WIDE SEALED ACCESS ROAD FROM ORANGE GROVE ROAD TO SUBSTATION DETAIL (FILL)

NTS



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TYPICAL CROSS-SECTION 5.5m/6.5m WIDE UNSEALED ACCESS ROAD FROM ORANGE GROVE ROAD TO SUBSTATION DETAIL (CUT)

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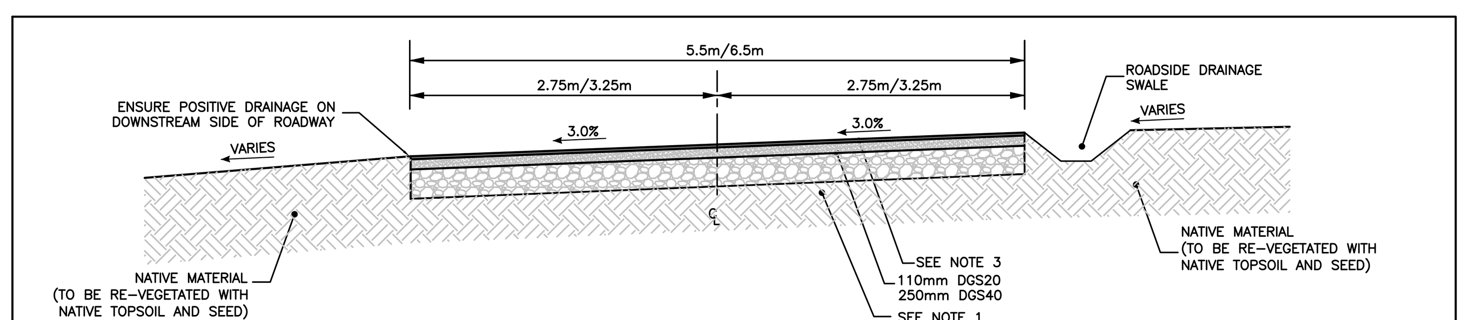

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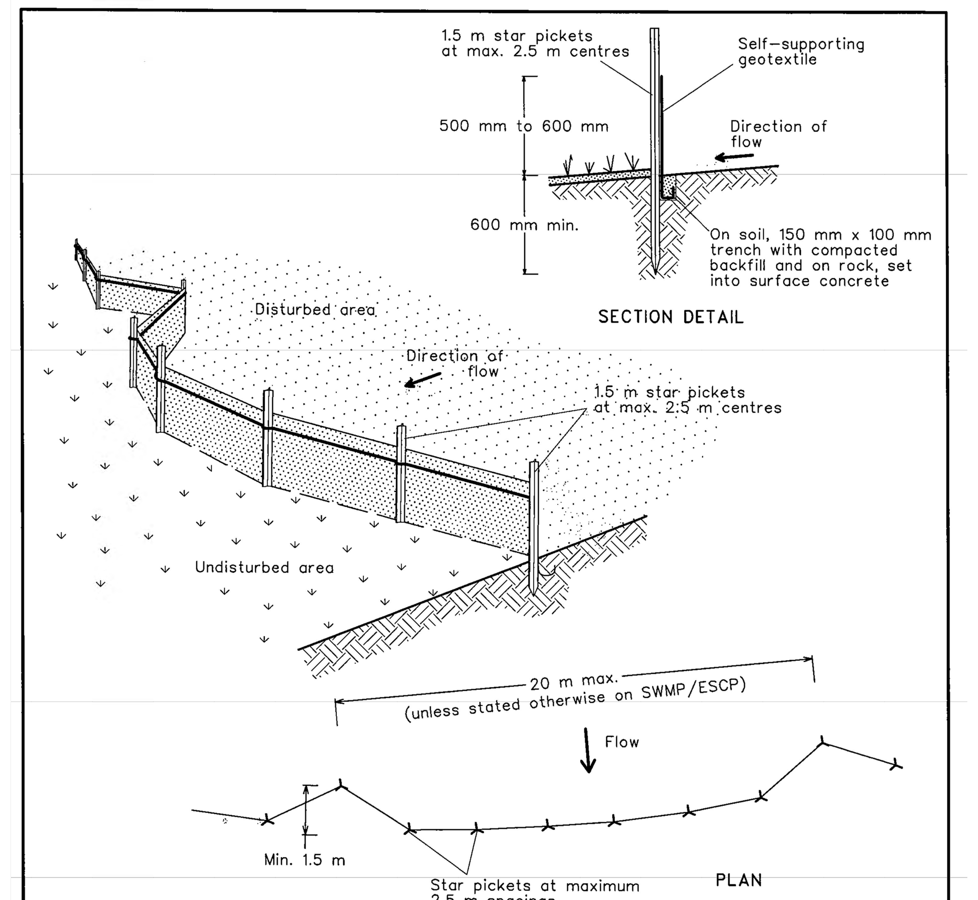

Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE **SD 6-8**

Stantec

Stantec Consulting Ltd.
300 Hagey Boulevard
Waterloo ON Canada
Tel. 519.579.4410
www.stantec.com

PCL
CONSTRUCTION LEADERS

Notes

1. EXISTING VEGETATION INFORMATION IS APPROXIMATE, PROVIDED FROM AERIAL IMAGERY. CONTRACTOR TO CONFIRM ALL TREE & SHRUB LOCATION ON SITE.
2. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS IN THIS SET PREPARED BY STANTEC CONSULTING LTD.
3. THE CONTRACTOR MUST CHECK AND VERIFY DIMENSIONS; OBTAIN ALL UTILITY LOCATES AND OBTAIN ALL REQUIRED PERMITS/LICENSES AND VERIFY ELEVATIONS OF EXISTING SERVICES BEFORE PROCEEDING WITH ANY WORK.
4. ALL CONSTRUCTION WORK SHALL BE CARRIED OUT IN ACCORDANCE WITH THE REQUIREMENTS OF THE OCCUPATIONAL HEALTH AND SAFETY ACT AND REGULATIONS FOR CONSTRUCTION PROJECTS (LATEST EDITION).
5. IF, FOR UNFORESEEN REASONS, THE OWNER AND/OR HIS/HER REPRESENTATIVE MUST ENCROACH ONTO PRIVATE LANDS TO UNDERTAKE ANY WORKS, HE/SHE MUST OBTAIN WRITTEN PERMISSION FROM THE ADJACENT PROPERTY OWNERS PRIOR TO ENTERING UPON THE PRIVATE PROPERTY TO PERFORM ANY WORKS. COPIES OF THESE LETTERS OF CONSENT MUST BE SUBMITTED TO THE OWNER AND CONTRACTOR AND A COPY IS TO BE KEPT ON FILE ON SITE PRIOR TO ANY WORK BEING PERFORMED. FAILURE TO COMPLY WITH THE ABOVE IS AT THE PROPERTY OWNERS OWN RISK.
6. THE CONTRACTOR IS RESPONSIBLE FOR RESTORATION OF ALL DAMAGED AND/OR DISTURBED PROPERTY WITHIN THE MUNICIPAL RIGHT-OF-WAY.
7. THE CONTRACTOR IS TO BE RESPONSIBLE FOR ALL DRAINAGE AND MEASURES TO CONTROL WATER. THE SITE IS TO BE FINE GRADED/LEVELED LEAVING THE SITE IN A NEAT APPEARANCE SUCH THAT POSITIVE DRAINAGE IS ACHIEVED EVERYWHERE PRIOR TO THE INSTALLATION OF SOLAR PANELS.
8. CONSTRUCTION TURNING RADIUS LIMITS IDENTIFY AREAS WHERE ADDITIONAL ROAD WIDTH IS REQUIRED TO ALLOW FOR ADEQUATE CLEARANCE FOR CONSTRUCTION VEHICLES.
9. THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE Gunn_Earlyworks_WaterManagementPlan AND THE GUNNEDAH EARLY WORKS DESIGN MEMO.

0	ISSUED FOR CONSTRUCTION	DR	JK	20.03.26
Revision		By	Appd.	YY.MM.DD

File Name: 3600727160_C-DT.dwg	DR	JK/SW	DR	19.08.13
	Dwn.	Chkd.	Dsgn.	YY.MM.DD

Permit-Seal

Client/Project

GUNNEDAH SOLAR PROJECT
147MV GROUND MOUNT SOLAR FARM
GUNNEDAH, NEW SOUTH WALES, AUSTRALIA

Title

NOTES & DETAILS

Project No.	Scale	
3600727160		
Drawing No.	Sheet	Revision
C-500	1 of 1	0

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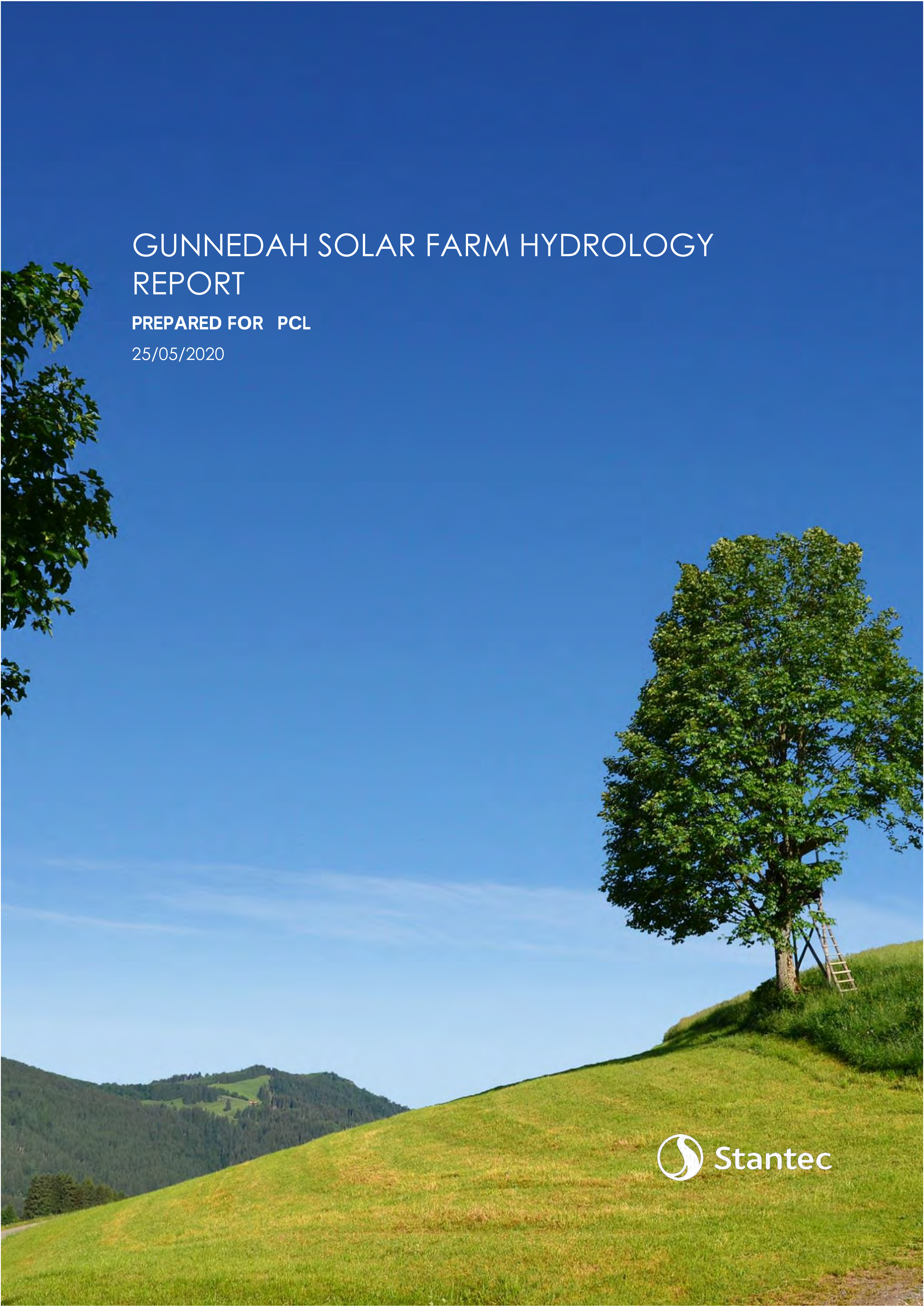
GUNNEDAH SOLAR FARM HYDROLOGY REPORT

GUNNEDAH SOLAR FARM HYDROLOGY REPORT

PREPARED FOR PCL

25/05/2020



Stantec

QUALITY STATEMENT

PROJECT MANAGER	PROJECT TECHNICAL LEAD
Darren Schreiber	Dave Williams

PREPARED BY		
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CHECKED BY		
	....	....../....../......
REVIEWED BY		
Darren Schreiber	....	....../....../......
APPROVED FOR ISSUE BY		
Peter Bright	....	....../....../......

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REVISION SCHEDULE

Rev No.	Date	Description	Signature or Typed Name (documentation on file)			
			Prepared by	Checked by	Reviewed by	Approved by
01	06/03/2020	Issued for Review	B. Wolelo	N. Keenan	D. Schreiber	P. Bright
02	18/03/2020	Issued for Client Review	B. Wolelo	D. Williams	D. Schreiber	P. Bright
03	25/05/2020	reissued to support water management plan for access road construction	B. Wolelo	D. Williams	D. Schreiber	P. Bright

Abbreviations

Terms, abbreviations and acronyms	Meaning
12d	12d Model Civil Engineering Design and Surveying software package
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AGRD	Austroads Guide to Road Design
ALS	Aerial laser survey
ARR2016	Australian Rainfall and Runoff 2016
BoM	Bureau of Meteorology
DTM	Digital Terrain Model
GIS	Geographic Information System
IFD	Intensity Frequency Duration
Lidar	Light Detection and Ranging
RFFE	Regional Flood Frequency Estimation Model
Tuflow	Tuflow Software Package
XpRafts	Xprafts software package

PCL

GUNNEDAH SOLAR FARM Hydrology Report

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1. Introduction

1.1 Purpose

This Hydrology report is prepared to document depth of inundation, flood levels, hazard and flow velocity generated while design storm occurs in the locality of the proposed Gunnedah Solar Farm (GSF) project site. A separate report that documents flow behaviour across the project site during regional flooding has been prepared by Pitt & Sherry Group. The report will inform the panel block layout plan, proposed landform design and risk of flooding during the construction and operation sitewide. The hydraulic modelling was conducted using Tuflow 1d/2d software package applying rainfall on grid hydrology. The modelling was undertaken in accordance with ARR2019. This report was updated to include finding from the post access construction modelling conducted to support water management plan during the construction of the access road.

This hydrology Report summarises the processes and procedures followed, and assumptions taken while conducting the hydrological and hydraulic assessment during the following scenarios:

- Existing catchments in a pre-development condition and
- Post the construction of the access road connecting the project site with Orange Grove Road.

1.2 References

This item lists the reference documents including reports on previous investigations, studies, consultations and data gathering processes. This includes data utilised for hydrological and hydraulic modelling.

1. A300 – Civil Engineering and construction requirements - Australia
2. Aerial Imagery, obtained from Bing Maps
3. Topographical Terrain Model Survey, undertaken by Land Survey
4. Topographical Digital Terrain Model, obtained from Airbus Website
5. 1987 & 2016 IFD data obtained from the Bureau of Meteorology Web Site
6. 2016 Ensemble temporal pattern data from Bureau of Meteorology Web Site
7. ARR Datahub, publications and guidelines
8. Drains Utility Spreadsheet
9. Gunnedah Solar Farm – Flood impact Assessment Rev 5 by Pitt & Sherry Group
10. Aerial laser survey (ALS) data, Obtained from Pitt & Sherry Hydraulic model file

2. Project Definition

2.1 Location

The GSF will be installed at 765 Orange Grove Road Gunnedah, approximately 10km north east of Gunnedah township. Gunnedah township is located 430km north west of Sydney. It is proposed to provide site access road from Orange Grove Road located east of the site. There were recorded incidences of flood waters overtopping Namoi River banks located east of Orange Grove Road and inundating the project site. The site is currently used for agriculture. Irrigation channels traverse the project site. The terrain of the site is flat. There are no distinct gullies inside the project site. Site location is shown in Figure 2-1.

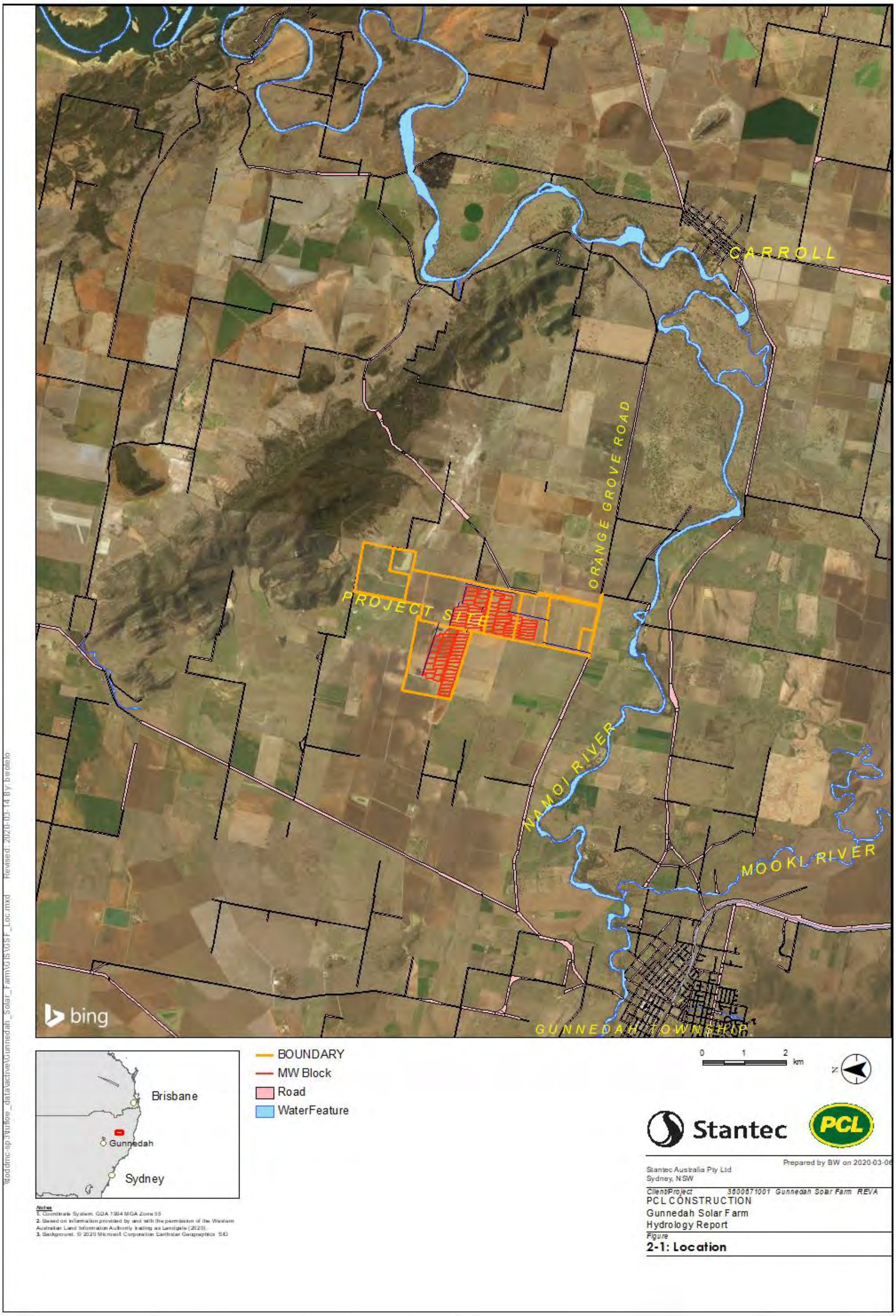

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Figure 2-1: Location

3. Hydrology

Rainfall on grid hydrology was utilised to determine flow behaviour across the project site. The hydrological model development process involved collecting rainfall depth and temporal pattern data from the Bureau of Meteorology website and collecting loss parameters from ARR Datahub. The temporal patterns that resulted in maximum intensity following initial losses were selected to be routed through the hydraulic model.

3.1 Data Collection

Data utilised for the hydrological modelling purposes was collected from the following sources:

- Areal Imagery by Bing Maps
- Digital Terrain model from Airbus website
- Areal Laser Survey data utilised in Pitt & Sherry Regional flood model
- Unmanned Aerial vehicle (UAV) survey undertaken by Land Survey
- 2016 IFD data from the Bureau of Meteorology website
- 2016 Ensemble temporal pattern data for the Bureau of Meteorology website
- Catchment loss parameters obtained from ARR Datahub website

3.2 Terrain

A digital terrain model was developed from ground survey data utilised in the Pitt & Sherry hydraulic model, data obtained from Airbus website and UAV survey data undertaken across the project site by Land survey. Runoff collected from the hills located north of the project site are collected in farm dams provided at the bottom of the hills. The locality downstream of the dams is uniformly graded flat terrain. The elevation of the project site varies from 256m AHD to 279.7m AHD. Majority of the project site has a longitudinal less than 0.5%. Runoff in the flat section drains as sheet flow across the project site. Irrigation channels traverse the site. The Irrigation channels are up to 1m deep. A berm is provided upstream of the irrigation channels.

3.3 Rainfall Data

Rainfall data was collected from the Bureau of Meteorology (BoM) website for Station number 055023 Gunnedah (Pool) Station. The data indicates that the mean annual rainfall for the locality is 615.7mm. Precipitation occurs at the site throughout the year. However, the majority of the rainfall occurs between the months of October and March. The data could assist in selecting suitable period to undertake the construction works on site. Statistical summary of rainfall at the locality is provided in Figure 3-1.

Statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean	70.6	66.1	48.9	36.6	42	44	41.5	40.9	40.2	54.2	61.4	69.6	615.7

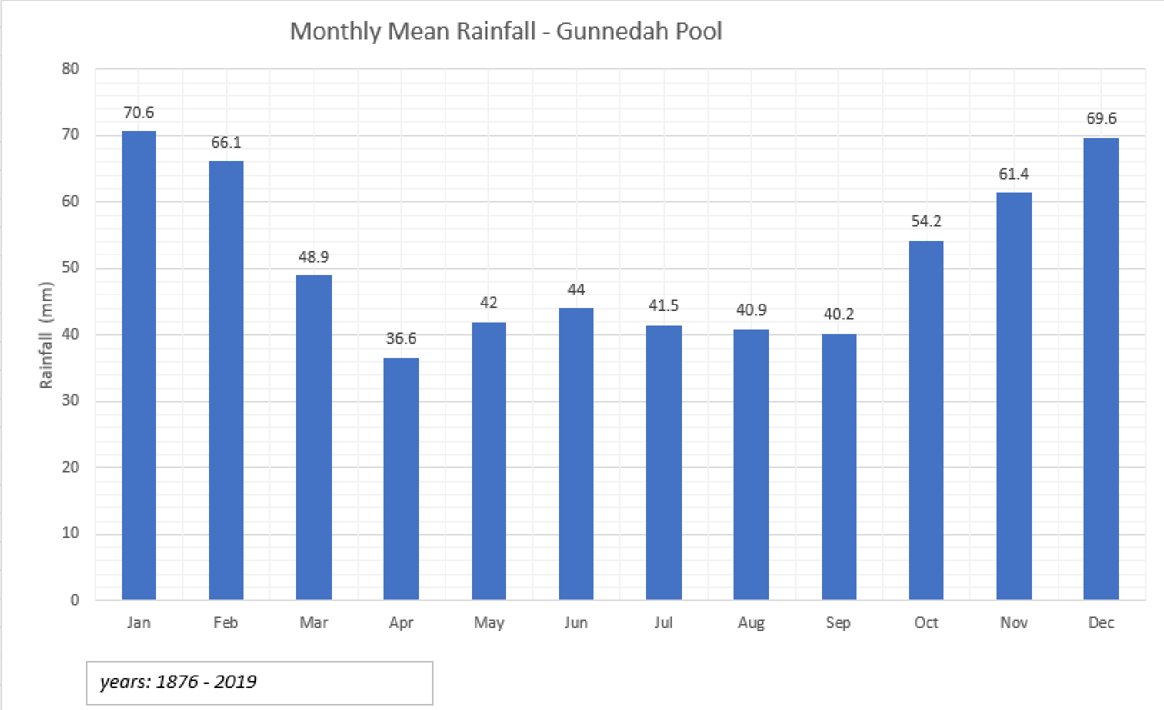

Figure 3-1: Mean Monthly Rainfall at Gunnedah Pool Station

3.4 Temperature

Temperature data collected at station number 056037 (Gunnedah Pool) in Gunnedah indicates that the mean maximum temperature varies between 21 and 41^{0}c. The mean minimum temperature varies between 11 and 29^{0}c.

The minimum temperature occurs in the winter month of July and the maximum temperature occurs in the summer month of January. Mean, lowest and highest monthly temperature data is shown in Figure 3-2.

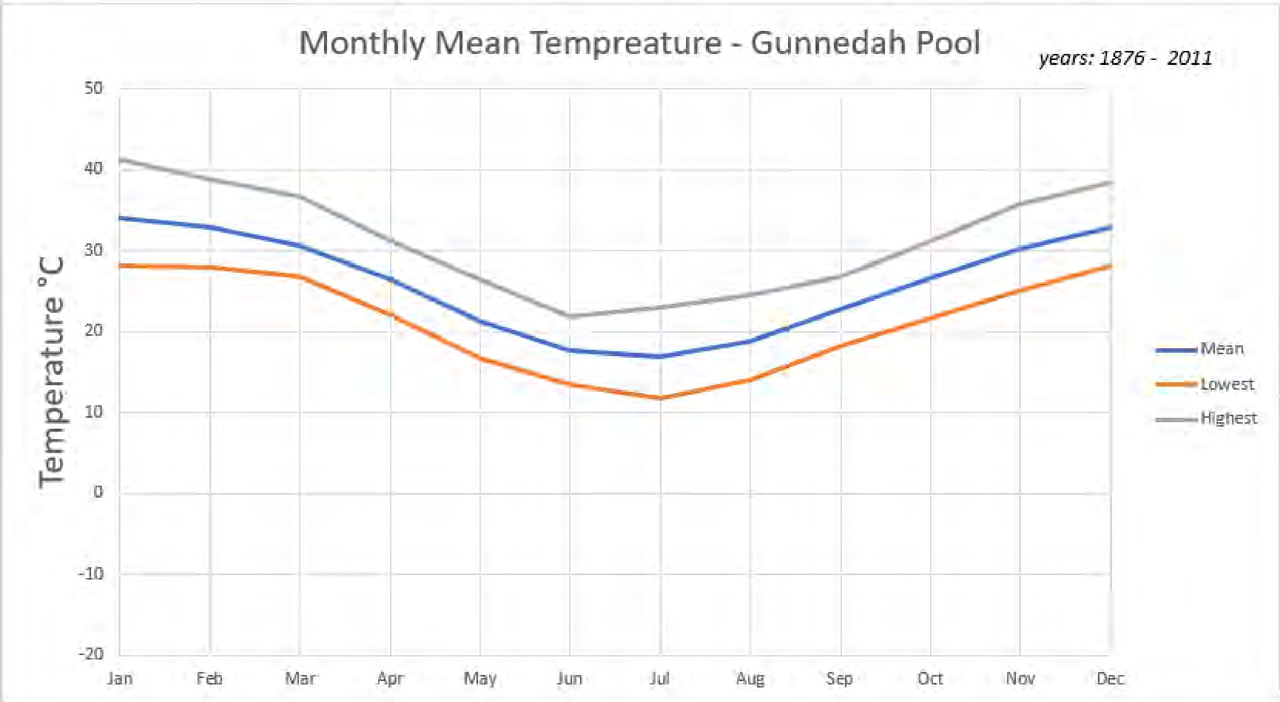

Figure 3-2: Mean Monthly Temperature at Gunnedah Pool

3.5 IFD and Temporal Pattern

The 2016 IFD data was obtained from the Bureau of Meteorology site. The IFD depth and intensity for the project site is shown in Figure 3-3. Tabular form of the data is provided in Table . The 2016 ensemble temporal data for the site was obtained from ARR Datahub website. Datahub prescribes that the east coast south temporal pattern be applied for the site.

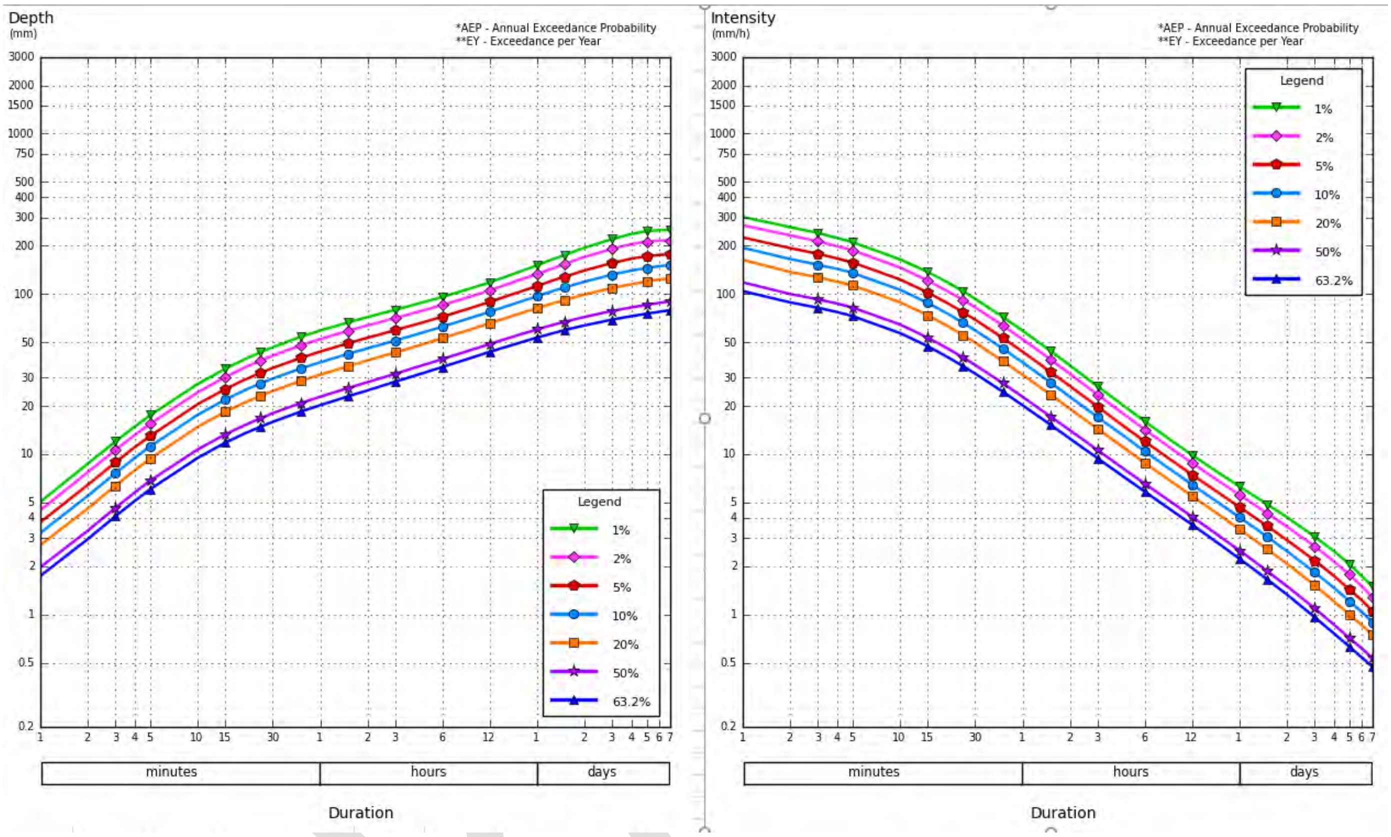

Figure 3-3: IFD Depth and Intensity data

3.5.1 Loss Parameters

Initial and continuing loss parameters were selected in accordance with the approaches prescribed in ARR 2019. Literature review has not identified a study conducted in the catchment that determined calibrated initial loss in the locality of the catchment. Where good initial loss figures are not available OEH has prescribed that hierarchical approach be utilised to determine preferred loss parameter. The catchments fits in hierarchy number five where it is preferred to utilise probability neutral initial loss figures provided in ARR Datahub. Accordingly, probability neutral burst initial figures shown in Table 3-2 where utilised while conducting the hydrological modelling.

Table 3-1 Site initial and continuing loss figures (Obtained from ARR Data hub)

ID	2264.0
Storm Initial Losses (mm)	53.0
Storm Continuing Losses (mm/h)	0.2

Table 3-2 Site Probability Neutral Burst Initial Loss (Obtained from ARR Data Hub)

min (h)\AEP(%)	50	20	10	5	2	1
60 (1.0)	22.8	26.0	21.2	21.0	21.0	20.7
90 (1.5)	25.8	27.3	22.8	22.9	22.2	21.2
120 (2.0)	28.1	24.5	21.1	21.2	21.9	21.0
180 (3.0)	31.6	24.7	21.7	21.6	21.6	19.8
360 (6.0)	39.0	25.9	22.8	21.9	20.0	16.9
720 (12.0)	47.0	31.6	28.2	27.6	21.8	15.9
1080 (18.0)	49.0	35.0	31.2	29.5	21.9	13.5
1440 (24.0)	50.3	37.5	35.0	34.2	26.3	17.4
2160 (36.0)	49.5	37.7	35.6	36.0	31.6	23.7
2880 (48.0)	53.5	43.4	42.3	43.2	40.2	32.2
4320 (72.0)	54.0	45.5	46.3	47.8	45.2	36.0

3.6 Hydrological and Hydraulic Modelling in Tuflow

2d–hydrodynamic model was developed using Tuflow software package to determine flood level, flow depth, flow velocity and hazard mapping across the project during the existing scenario. Tuflow solves depth averaged free surface flow in 1d channels or over a 2d regular grid with square cells. A hydrograph generated in other hydrological modelling packages could be applied as a boundary conduction or Tuflow can route rainfall excess across the 1d/2d model domain.

There are no significant drainage features obstructing flow at the project site. 2d hydrodynamic model could provide sufficient information on flooding across the site. Accordingly, rainfall on grid methodology was used while undertaking the flood modelling. The flood modelling process included developing existing surface digital terrain model, determining rainfall and outlet boundary conditions, determining the manning's roughness of the existing ground, preparing the Tuflow control files, debugging the model, preparing the result files and preparing the flood characteristics maps.

3.6.1 2d Model Bathymetry

Accuracy of the 2d hydraulic model result is influenced by the accuracy of model bathymetry. Model bathymetry was developed from unmanned Aerial vehicle (UAV) survey undertaken by Land Survey in the locality of the project and merged aerial survey data utilised in the Pitt & Sherry model to develop a regional flood model. Airbus DTM data was utilised in localities that were not covered by both survey data discussed. A model cell size of 2m is adopted for the study. This resolution is sufficient to determine flood characteristic across the site for the modelled events. Model domain and DTM data utilised in the study is shown in Figure 3-4.

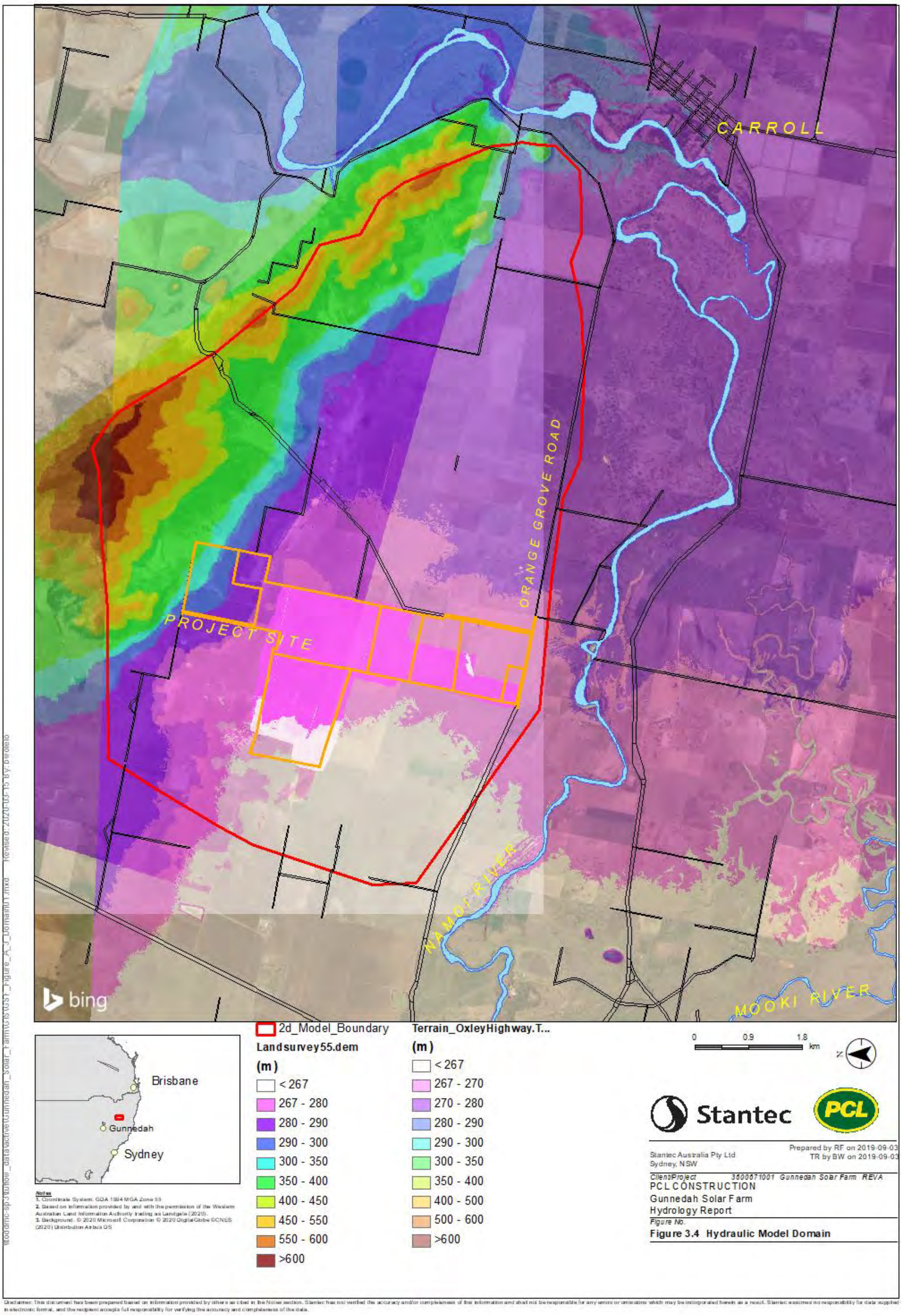

Figure 3-4: Hydraulic Model Domain

3.6.2 2d model boundary Conditions

Rainfall in excess of initial and continued loss in each cell is routed through the hydraulic model towards catchment outlet. Storm events that generate intense rainfall, post the initial losses, cause maximum flood depth, flow velocity and hazard. As the initial losses for the locality are high, an insignificant amount of runoff is generated during short duration storms including the 1% AEP, 20minute storm. The study has reduced the number of hydraulic model runs by systematically reviewing the temporal patterns and selecting storm durations and temporal patterns that have the potential to generate maximum flood characteristics. Temporal distribution patterns and storm durations that generated maximum flood characteristics during the 1% AEP storm events for storm durations ranging from 30 minutes to 270 minutes are provided in Appendix E. The temporal patterns that were selected to be routed through the hydraulic model are highlighted in yellow. The rainfall depth data is stored in the boundary condition database file and was applied across the 2d rainfall boundary layer. 2d downstream condition layers were digitised in GIS and normal depth boundary condition was applied at local catchment downstream outlet locations.

3.6.3 Model data

2d model extent, 2d rainfall layer, 2d boundary and 2d land use (material type) was digitised using the ArcGIS software package. Aerial imagery obtained from Bing Maps was utilised to digitise ground cover that exists within the model domain. The hydraulic roughness figures utilised for the respective ground cover inside the model domain is provided in Table 3-3.

Table 3-3 Adopted Manning's n values

Land use (Ground Cover)	Manning's n
Dense Vegetation	0.1
Farm/Pasture	0.045

3.6.4 Tuflow Model Results

Tuflow model run was conducted to determine extent of flooding, flood level, depth of flow, flow velocity and flooding hazard across the project site. Flow hydrographs were also extracted at key locations to assist with sizing of drainage structures at road crossings.

3.6.4.1 Flood Depth

The gradient of the site is flat. There are no natural drainage features that direct runoff through the site. runoff from external catchment enters the project site as a sheet flow. Runoff at the site occurs as a sheet flow and runoff from the site and upstream catchments drains away from the site as a sheet flow.

Irrigation channels traverse the project site. Bunds are provided upstream of the irrigation channels. These bunds block the sheet flow from entering the Irrigation Channels. During major storm events, runoff ponds upstream of the bunds and overtops these bunds to eventually drain towards the irrigation channels. Runoff draining towards the irrigation channel ponds in these channels and once the capacity is exceeded, it overtops the channels and drains towards downstream project boundary. Sheet flow depth is minor. Flow depth in excess of 50mm is observed only behind the bunds and inside the irrigation channels during major storm events in the local catchment. Map Showing depth of flooding generated from the 1% AEP storm event occurring across the model boundary from local catchments is shown in Appendix A.1. The map in Appendix A.2 Shows data presented in Appendix A.1 in the project locality.

3.6.4.2 Velocity

Map showing maximum flow velocity across the project site is provided in Appendix B.1. The mapping shows that maximum velocity across the site is less than 0.5m/sec.

3.6.4.3 Hazard

Depth of flow, velocity of flow or product of velocity and depth of flow could provide flooding hazard across a floodplain. MBRC hazard category pallets are utilised to generate hazard category at the project site. MBRC hazard category description is provided in Appendix C.2. Depth of flow at the site is less than 0.5m and velocity of flow is less than 0.5m/sec. Majority of the site is covered under category H1. The irrigation channels and localities abutting the irrigation channel are categorised as H2. This indicates that there is no significant hazard across the project site during major storm event in the local catchment.

3.6.4.4 PO Line Results

8 PO lines were inserted in critical localities to extract discharge and flood level across the cross sections. Tuflow sums flow across the selected cross section during each time step and provides flow hydrograph data across the line. Depending on the alignment of the PO line, the result figures could be positive or negative. A graph that shows flow hydrograph across a cross section taken parallel to the proposed access road is provided in Figure 3.5.

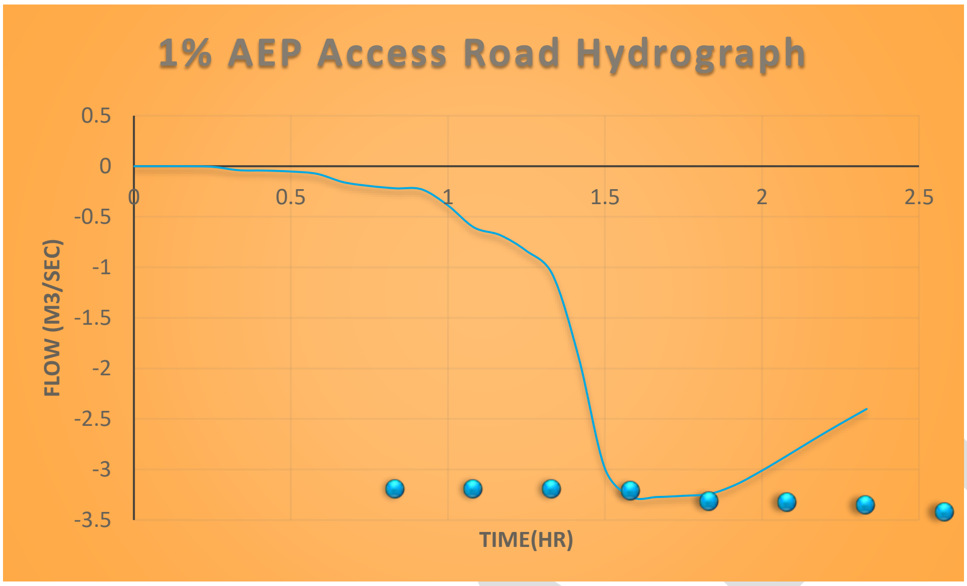

Figure 3-5: Flow Hydrographs extracted from the Hydraulic Model across the access Road

3.6.5 Key Findings

This section summarises the key observations made following the 1% AEP Storm events model run that could assist with the design development. The findings include:

- Terrain of the site is flat and uniformly graded. Runoff drains towards the project site as a sheet flow and drains out as a sheet flow.
- The landform and dams provided at the foot of the hill capture significant amount of flow and direct runoff away from the project site
- Runoff that drains towards the irrigation channels, fills the irrigation channels and drains as a sheet flow towards downstream area
- The maximum depth of flooding at site is approximately 0.5m. Runoff ponds behind the berms provided adjacent the irrigation channels.
- Flow velocity across the site is less than 0.5m/sec.

4. Access Road Model

As part of the access road water management plan, it was required to identify impacts of the proposed road on flood characteristics in the locality of the project.

A proposed scenario modelling was conducted to determine the flood levels, flow velocity, depth of flow and flow hazard post construction of the road. It was also required to understand the impacts of the proposed works.

The proposed road terrain model was included in the Tuflow model geometry control file and model run was conducted for the 1% AEP storm event. Post processing was conducted in ArcGIS to determine the flood level and maximum velocity difference across the model domain.

The modelling has indicated that:

- The increase in flood level upstream and downstream of the proposed road was minor and it occurred inside the project boundary. The maximum level increase was estimated at 100mm.
- The increase in velocity was minor. The maximum change in velocity post the construction of the proposed road was 0.05m/sec and this increase occurs inside the proposed road corridor.

The road design blends well with the existing terrain and has minor to no impact on holding downstream of the proposed road.

5. Regional Flooding

The project site is located adjacent the Namoi River. Data obtained from New South Wales Water website indicates that the catchment of Namoi River at Gunnedah (stream gauging station # 419001) is approximately 17. 100 sq.km. This station is located approximately 10km downstream of the project site. The river breaks banks and flows through the site during major storm events. Flooding occurring at the project site due to major storms occurring in the entire 17,100 sq. km is referred as the regional flooding. The regional flood modelling was conducted by Pitt & Sherry Group. Depth of flooding during the 1% AEP regional flooding event is shown in Appendix B.

The regional flooding produces worst case flow characteristics at the project site and should be utilised to determine finished floor level for essential services site wide. The impact of constructing access road and earthworks on the regional flood characteristics should be tested in the regional model.

Fencing arrangements were tested in the regional model and to ensure EIS requirements are met. Pitt and Sherry group has proposed a preferred fencing arrangements. It is proposed that the recommendation made by the group be utilised while installing perimeter fence around the site.

Appendices

Appendix A Depth of Flooding

Figure Appendix A. 1 Local overland Flow depth model wide during the 1% AEP Storm event

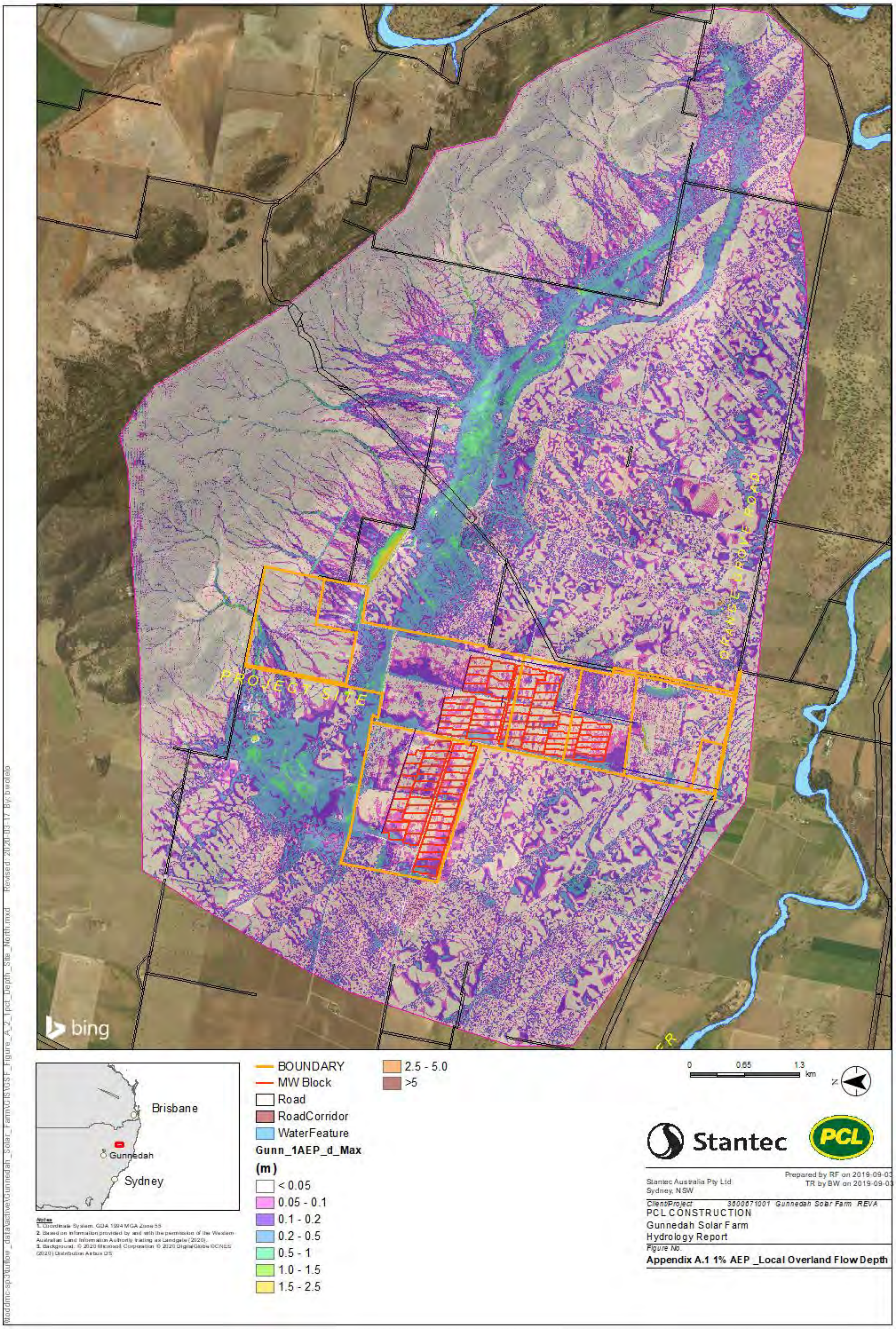

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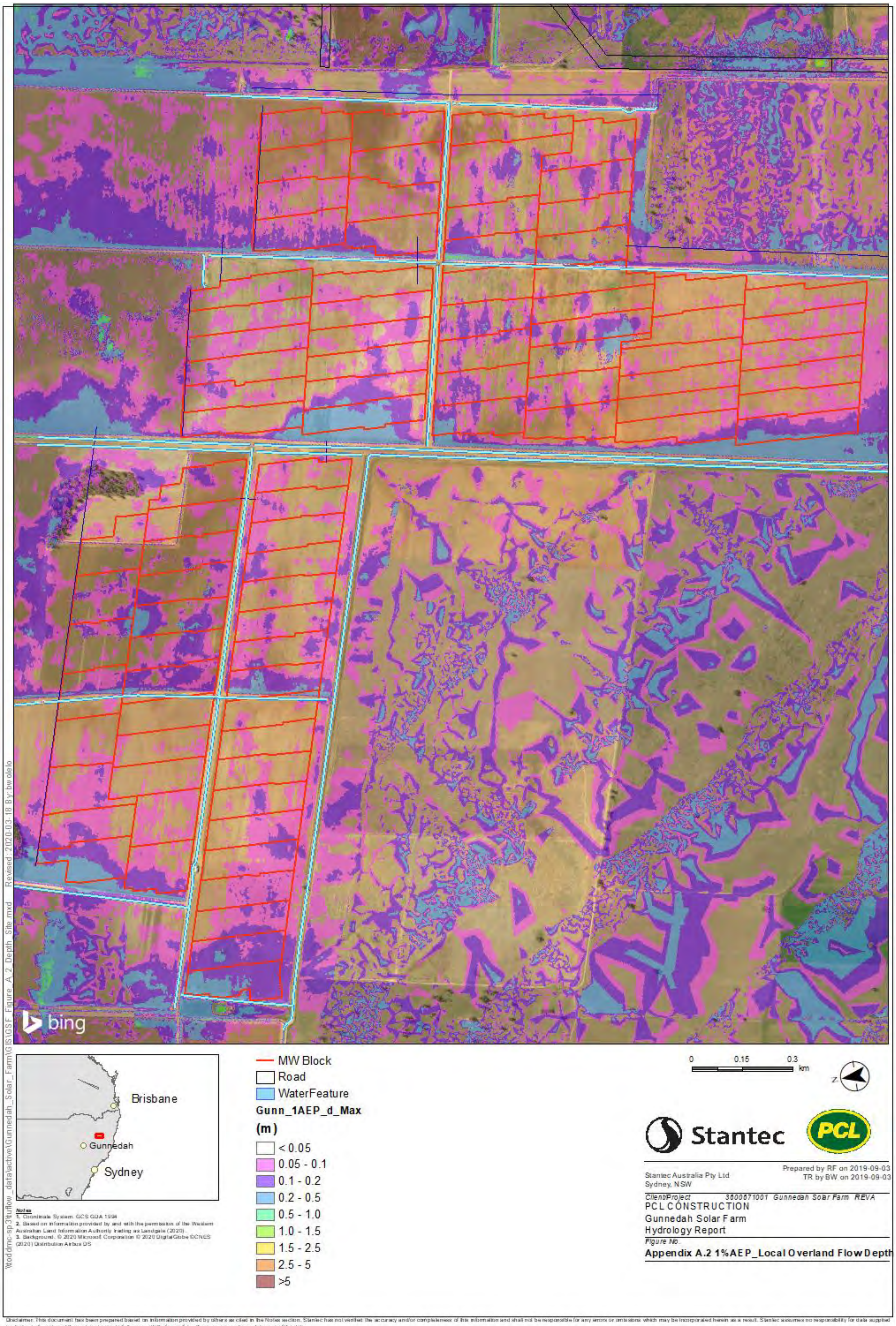
Figure Appendix A 1 Local overland Flow depth across project site during the 1% AEP Storm event



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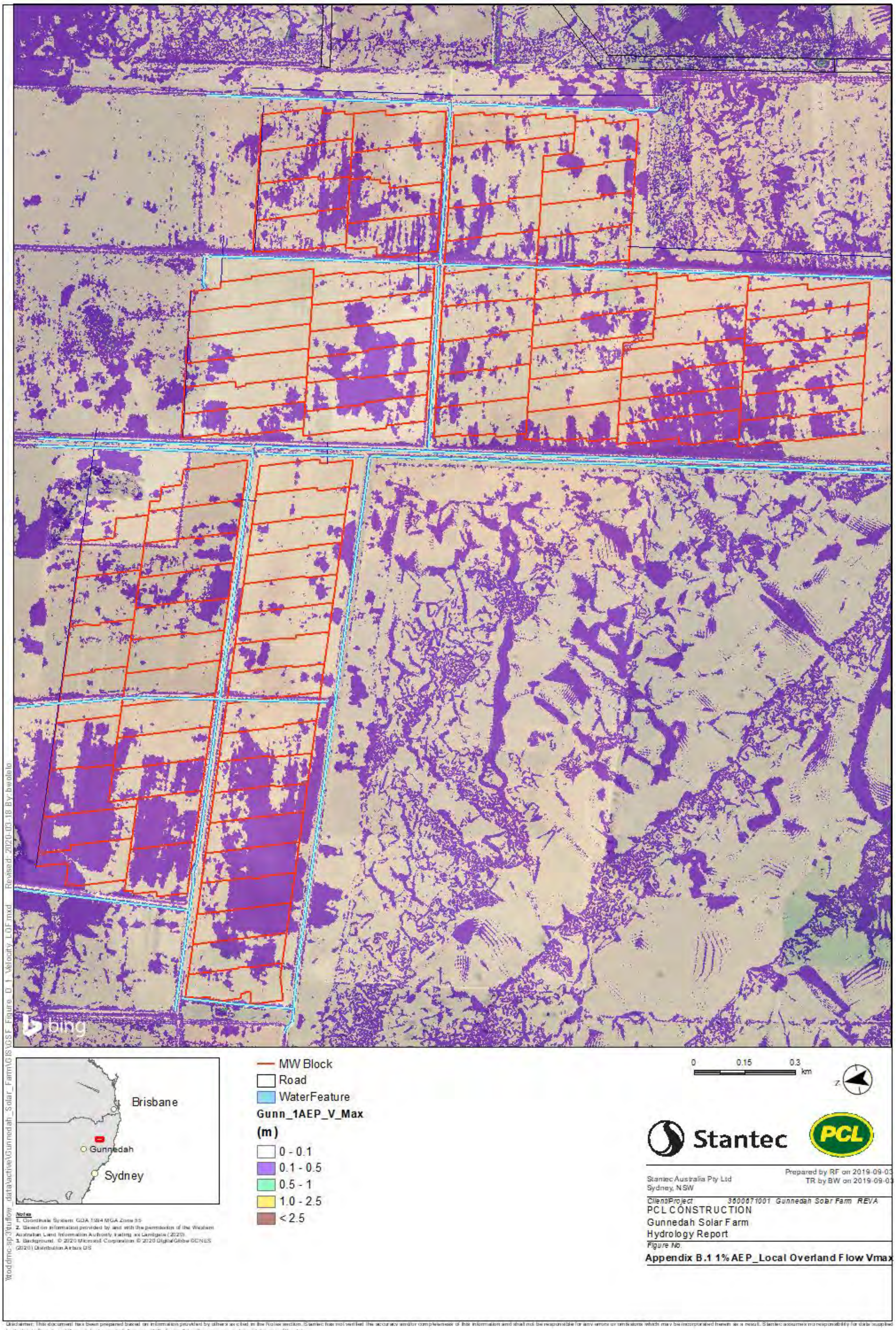
Appendix B Flow velocity

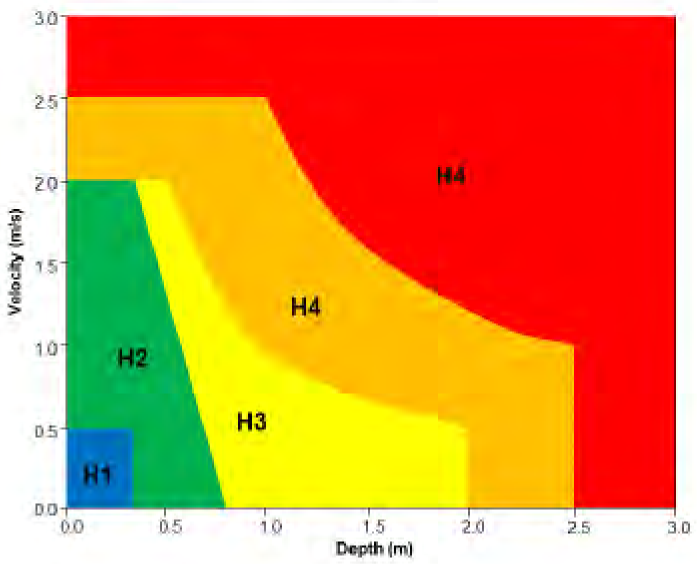
Figure Appendix B 1 Local overland Flow Velocity project site wide during the 1% AEP Storm event



Appendix C Flood Hazard

Figure Appendix C 1   Local overland Flow project site wide Hazard during the 1% AEP Storm event

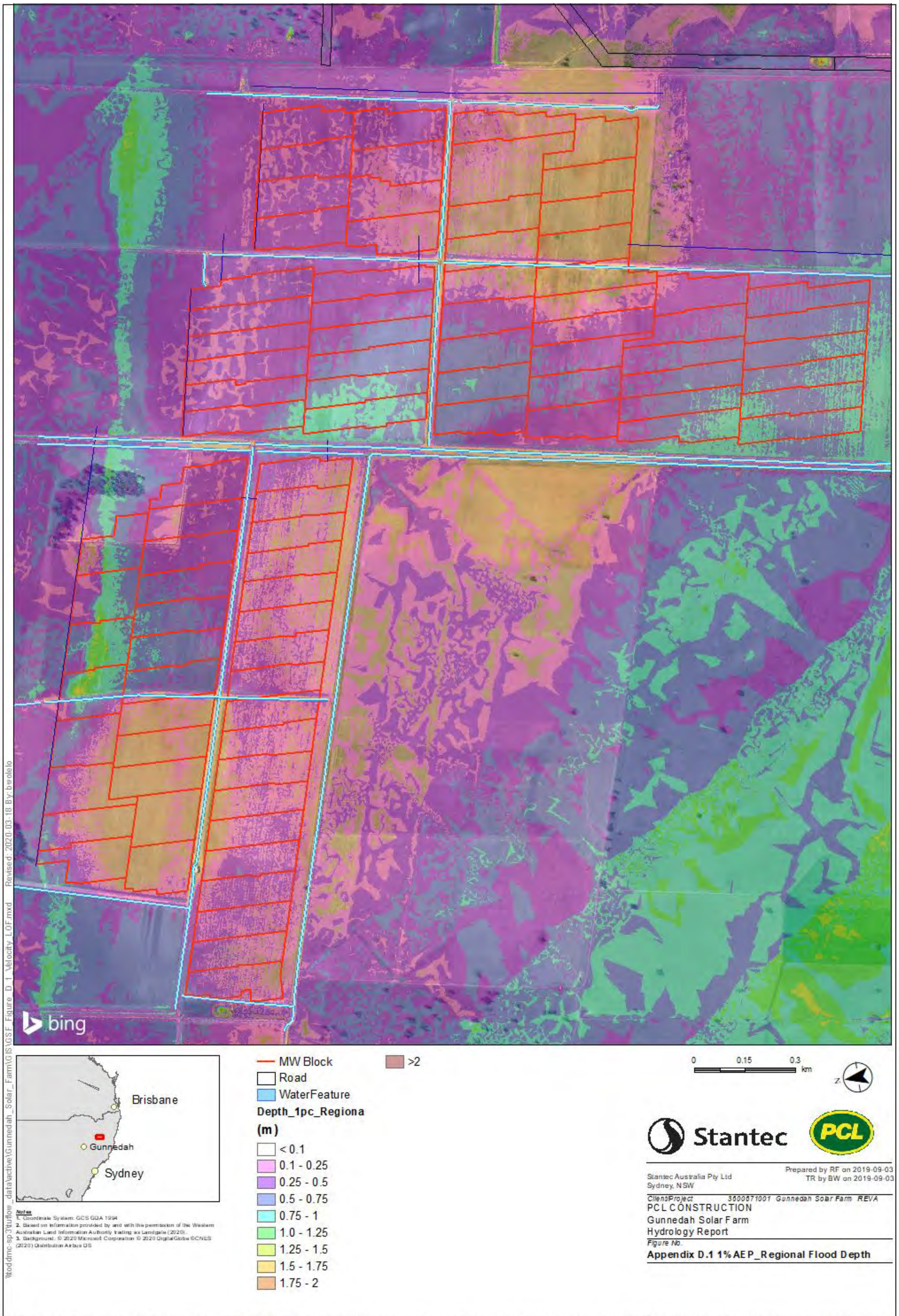
Figure Appendix C 2 MBRC Hazard Category (adopted from BMTWBM 2018)

<table>
<tr><th>Flag</th><th>Map Output Hazard Type</th><th>Supported Formats</th><th>Description</th></tr>
<tr><td>ZMBRC</td><td>ZMBRC</td><td>All formats</td><td>Flood hazard output used by Moreton Bay Regional Council.
Where:
V > 2.5 or D > 2.5 or V*D > 2.5: Category 5 (H5)
V > 2.0 or D > 2.0 or V*D > 1.0: Category 4 (H4)
V > 3.2 - 4D: Category 3 (H3)
V > 0.5 or D > 0.3: Category 2 (H2)
Otherwise Category 1 (H1)
Dry points are assigned Category 0


H1: Hydraulically suitable for parked or moving cars.
H2: Hydraulically suitable for parked or moving heavy vehicles and wading by able-bodied adults.
H3: Hydraulically suitable for light construction (e.g. Timber frame and brick veneer).
H4: Hydraulically suitable for heavy construction (e.g. steel frame and reinforced concrete).
H5: Generally unsuitable</td></tr>
</table>

Appendix D Regional Flooding

Figure Appendix D 1 Depth of Flooding during the 1% AEP Regional Storm Event



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Appendix E Depth of Flooding Difference Post Construction of Access Road

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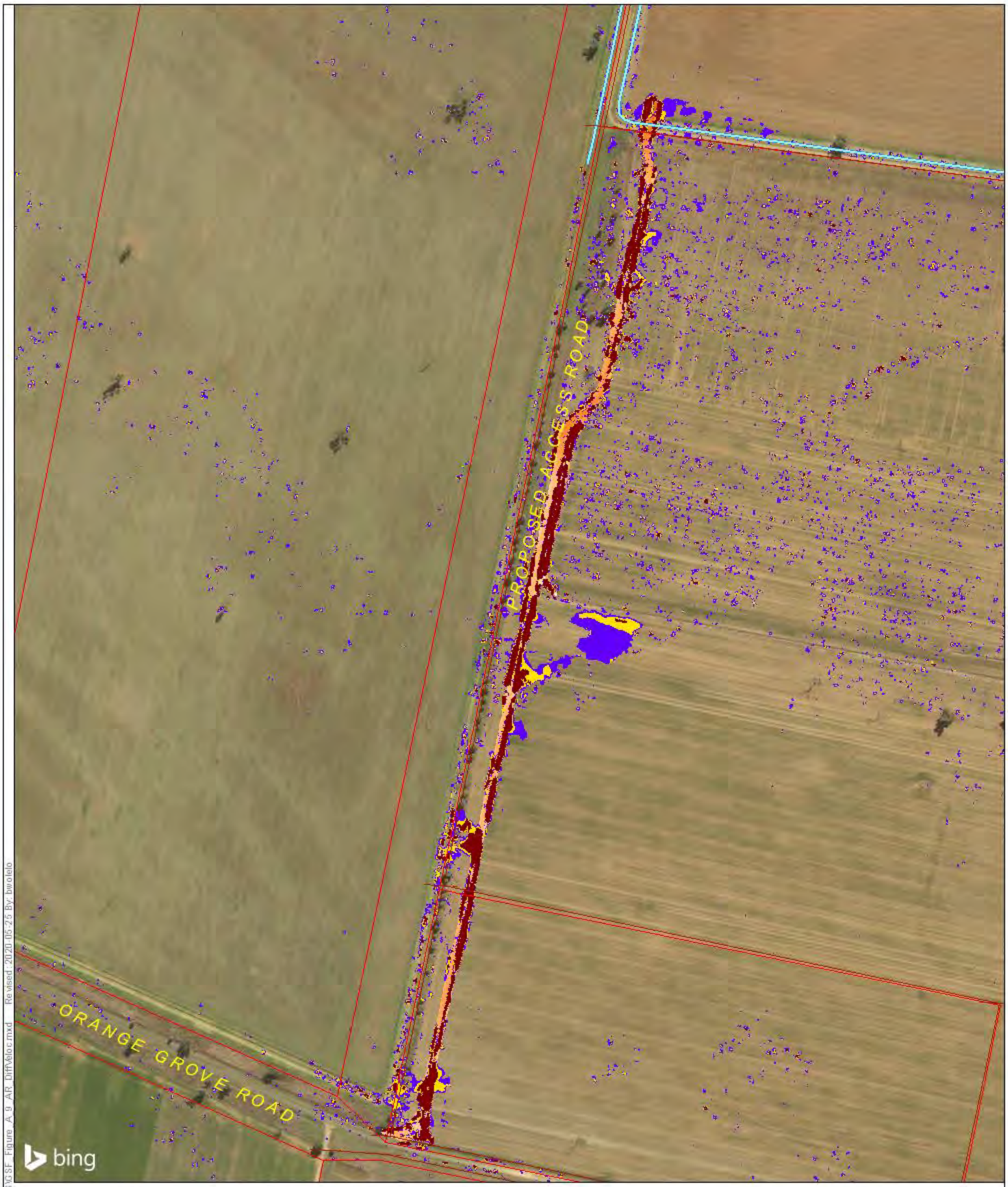
Appendix F Maximum Flow Velocity Difference Post Construction of Access Road



Notes
1. Coordinate System: GDA 1994 MGA Zone 55
2. Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2020).
3. Background: © 2020 Microsoft Corporation © 2020 DigitalGlobe ©CNES (2020) Distribution Airbus DS

MW Block
Road
RoadCorridor
WaterFeature
Lot BOUNDARY

Access_Road

(mAHD)
High : 269.027
Low : 267.325

1% AEP_Max_Velocity DIFFERNCE MAP

(m/sec)
< -0.005
0.005 - 0.02
0.02
0.02 - 0.04
0.04 - 0.06

0 0.065 0.13 km

N

Stantec

PCL

Stantec Australia Pty Ltd
Sydney, NSW

Prepared by RF on 2019-09-03
TR by BW on 2019-09-03

Client/Project *3600671001 Gunnedah Solar Farm REVA*
PCL CONSTRUCTION
Gunnedah Solar Farm
Hydrology Report

Figure No.
Appendix F.1 1% AEP Max Velocity Difference

\\Woddmc-s\Tuflow\tuflow_data\active\Gunnedah_Solar_Farm\GIS\GSF_Figure_A_9_AR_DiffVeloc.mxd Revised: 2020-05-25 By: bwoleto

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Appendix G Design Rainfall Depth and Site IFD

Table Appendix E 1 1% AEP 30minute rainfall Patterns

1% AEP, 30 Minute Rainfall Patterns										
	Duration (minutes)		30			Original Depth (mm)	46.50			
						Climate Adjusted Depth (mm)	46.50		Intensity (mm/h)	93.00
Time	**Depth** (mm) **for Pattern:**									
(minutes)	1	2	3	4	5	6	7	8	9	10
0										
5	7.82	12.27	12.21	6.31	6.18	4.06	6.17	4.16	6.29	6.13
10	7.63	7.27	10.80	12.19	15.96	4.06	6.40	8.13	8.48	5.11
15	8.19	5.68	6.58	9.94	8.41	10.38	9.73	3.11	1.88	8.17
20	8.57	6.23	7.51	1.29	5.84	9.93	9.02	10.44	3.61	8.69
25	7.81	7.58	5.87	8.90	4.63	11.74	8.07	12.49	15.08	8.69
30	6.48	7.48	3.52	7.87	5.49	6.32	7.12	8.17	11.16	9.71
Check	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50	46.50
Sum										

Table Appendix E 2 Adopted 1% AEP 1.5 hour rainfall Pattern

1% AEP, 90 Minute (1.5 Hour) Rainfall Patterns										
	Duration (minutes)		90			Original Depth (mm)	66.30			
						Climate Adjusted Depth (mm)	66.30		Intensity (mm/h)	44.20
Time	**Depth** (mm) **for Pattern:**									
(minutes)	1	2	3	4	5	6	7	8	9	10
0										
5	2.82	4.79	2.96	1.72	6.68	5.68	2.19	3.45	1.28	2.43
10	5.66	2.51	5.14	2.86	3.73	14.22	2.65	3.45	5.54	4.12
15	8.33	1.14	7.57	2.19	4.16	5.64	1.47	4.61	4.63	3.56
20	7.23	1.37	9.02	2.25	2.78	7.04	0.86	2.88	3.95	1.31
25	6.76	4.55	5.52	6.24	3.14	5.34	1.37	3.46	0.69	2.43
30	3.77	6.84	3.95	9.64	8.08	2.77	4.00	4.04	0.27	1.50
35	5.81	8.66	3.27	5.68	6.16	1.23	5.84	4.04	1.49	3.18
40	3.45	6.84	2.18	9.47	2.13	0.21	4.16	2.31	4.89	2.06
45	2.67	2.73	0.67	2.52	2.13	0.06	3.38	2.88	1.44	0.75
50	3.61	3.19	0.62	5.53	5.26	0.06	3.98	4.04	0.25	0.75
55	4.40	5.01	1.44	5.53	3.20	0.50	6.29	5.77	0.25	0.75
60	2.35	3.19	3.74	3.10	4.83	1.06	5.73	4.61	6.29	0.93
65	1.88	3.19	4.55	2.23	3.21	1.17	6.84	5.19	7.58	0.56
70	2.20	4.55	3.80	2.23	3.24	3.60	5.04	4.04	2.83	7.86
75	1.73	3.65	3.26	1.61	2.99	3.60	2.39	3.46	4.52	11.05
80	1.41	2.05	3.74	1.19	2.68	3.60	4.69	3.75	3.53	9.74
85	0.63	0.68	2.29	1.45	0.48	6.44	3.30	1.44	10.26	7.31
90	1.57	1.37	2.57	0.84	1.43	4.08	2.11	2.88	6.64	5.99
Check	66.30	66.30	66.30	66.30	66.30	66.30	66.30	66.30	66.30	66.30

Table Appendix E 3 Adopted 1% AEP 3 hour rainfall Pattern

1% AEP, 180 Minute (3 Hour) Rainfall Patterns										
	Duration (minutes)		180		Original Depth (mm)		79.50			
					Climate Adjusted Depth (mm)		79.50	Intensity (mm/h)		26.50
Time	Depth (mm) for Pattern:									
(minutes)	1	2	3	4	5	6	7	8	9	10
0										
15	3.92	16.77	2.27	2.02	11.68	6.34	9.51	13.87	2.92	3.02
30	13.75	3.59	2.21	9.29	10.02	5.28	7.36	12.00	9.60	4.68
45	4.71	1.91	6.65	7.47	16.28	7.39	9.09	12.51	5.26	4.34
60	7.26	0.02	1.26	8.07	10.53	5.72	11.50	11.30	7.78	5.76
75	14.25	0.02	1.50	8.47	11.21	2.02	9.46	7.37	7.76	4.79
90	6.03	0.02	3.82	18.36	6.11	6.33	5.41	3.60	2.78	7.04
105	4.89	0.02	12.09	10.29	2.38	14.07	9.91	1.03	10.14	13.00
120	5.75	6.82	14.64	3.83	0.08	13.72	5.41	0.52	10.81	4.45
135	5.80	10.29	10.96	0.20	1.26	1.58	4.51	6.17	5.63	9.99
150	3.66	8.09	10.20	1.42	2.08	5.10	4.21	3.77	5.90	4.52
165	4.74	15.82	8.23	4.04	7.47	7.39	2.10	1.72	2.40	4.80
180	4.76	16.11	5.66	6.05	0.41	4.57	1.05	5.65	8.52	13.11
Check Sum	79.50	79.50	79.50	79.50	79.50	79.50	79.50	79.50	79.50	79.50

Table Appendix E 4 Adopted 1% AEP 4.5 hour rainfall Pattern

1% AEP, 270 Minute (4.5 Hour) Rainfall Patterns										
	Duration (minutes)		270		Original Depth (mm)		88.50			
					Climate Adjusted Depth (mm)		88.50	Intensity (mm/h)		19.67
Time	Depth (mm) for Pattern:									
(minutes)	1	2	3	4	5	6	7	8	9	10
0										
15	5.51	1.50	4.88	1.65	18.30	11.55	0.05	6.88	2.54	2.14
30	1.33	1.78	8.87	2.82	14.18	13.56	0.05	8.83	10.02	6.50
45	3.09	5.66	16.39	3.11	3.91	8.17	8.19	3.30	4.73	1.73
60	4.03	5.24	2.51	3.46	8.97	2.79	13.44	6.80	3.31	13.70
75	4.52	6.48	2.18	3.28	1.50	5.58	7.20	1.42	6.37	6.05
90	11.30	3.00	3.03	4.24	2.96	4.19	17.29	2.08	5.58	2.52
105	8.82	7.13	7.13	2.66	0.61	6.38	7.68	4.06	3.61	0.36
120	3.58	10.31	4.71	4.12	0.00	7.18	4.81	5.89	4.04	0.58
135	2.35	11.63	5.57	3.82	0.23	4.19	0.48	6.96	3.01	0.09
150	4.55	5.33	3.94	5.06	0.00	2.99	0.70	6.50	2.93	0.03
165	1.51	4.36	1.50	4.22	0.00	2.59	0.26	5.61	7.09	2.14
180	6.48	4.04	5.96	6.19	5.15	3.19	0.96	6.02	15.90	5.43
195	2.48	7.85	7.65	11.43	7.41	2.19	3.36	6.55	6.93	3.81
210	0.68	4.48	0.93	3.91	11.05	1.80	9.12	6.60	1.78	10.82
225	0.45	4.90	4.85	8.79	9.12	2.59	1.92	2.87	0.91	9.80
240	13.20	2.42	4.24	3.98	1.12	3.39	0.96	2.60	0.73	13.97
255	10.75	1.33	2.42	4.22	1.49	2.99	7.20	2.51	0.72	8.30
270	3.86	1.06	1.76	11.53	2.50	3.19	4.81	3.01	8.29	0.51
Check Sum	88.50	88.50	88.50	88.50	88.50	88.50	88.50	88.50	88.50	88.50

Table Appendix E 5 Gunnedah Site IFD Data

	Annual Exceedance Probability (AEP)						
Duration	63.20%	50%	20%	10%	5%	2%	1%
1 min	104	118	163	194	225	268	302
2 min	88.5	99.8	137	165	193	232	261
3 min	81.9	92.5	127	152	178	213	240
4 min	76.9	86.9	119	143	166	198	223
5 min	72.6	82.1	113	135	157	187	210
10 min	56.9	64.4	88.7	106	123	146	164
15 min	47.1	53.3	73.5	87.7	102	121	137
20 min	40.4	45.7	63.1	75.3	87.5	104	118
25 min	35.5	40.2	55.4	66.2	77	91.9	104
30 min	31.8	36	49.6	59.2	69	82.4	93.1
45 min	24.5	27.7	38.1	45.6	53.1	63.5	71.8
1 hour	20.2	22.8	31.3	37.4	43.6	52.2	59
1.5 hour	15.3	17.2	23.6	28.1	32.7	39.1	44.2
2 hour	12.5	14.1	19.2	22.8	26.6	31.7	35.8
3 hour	9.42	10.6	14.4	17	19.8	23.5	26.5
4.5 hour	7.11	7.97	10.8	12.8	14.7	17.5	19.7
6 hour	5.83	6.54	8.81	10.4	12	14.2	16
9 hour	4.41	4.95	6.66	7.85	9.05	10.7	12
12 hour	3.62	4.06	5.47	6.45	7.43	8.78	9.86
18 hour	2.73	3.06	4.14	4.9	5.66	6.71	7.55
24 hour	2.22	2.5	3.4	4.03	4.67	5.56	6.28
30 hour	1.89	2.13	2.9	3.46	4.02	4.81	5.45
36 hour	1.65	1.86	2.55	3.05	3.55	4.27	4.86
48 hour	1.33	1.5	2.07	2.48	2.91	3.53	4.04
72 hour	0.96	1.09	1.52	1.83	2.17	2.66	3.06
96 hour	0.757	0.859	1.2	1.46	1.73	2.13	2.47
120 hour	0.627	0.712	0.998	1.21	1.43	1.77	2.05
144 hour	0.537	0.61	0.854	1.03	1.22	1.49	1.73
168 hour	0.471	0.535	0.746	0.897	1.05	1.28	1.49

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