

26 July 2021

Sydney Western City Planning Panel
Attn: Mellissa Felipe
Via email

Dear Mellissa,

RE: FLOODING INFORMATION FOR THE SYDNEY WESTERN CITY PLANNING PANEL – PPSSWC-2 – HAWKESBURY – DA0508/18 AT 374, 395 & 415 FREEMANS REACH ROAD, FREEMANS REACH NSW 2756

1 INTRODUCTION

Martens & Associates ('MA') have prepared this flooding information in response to the Sydney Western City Planning Panel ('Panel') 'Record of Deferral' dated Monday, 24 May 2021 in relation to a proposed sand extraction and processing facility at the above site. Additional supporting documentation has been provided and is referenced herein in response to item a) 2D modelling and item d) Anchoring. This document should be read in conjunction with the 'Flood Risk Management Plan' (Martens and Associates, April 2020). In summary this assessment has found the following:

1. The proposal will not materially alter flood behaviour under a range of flood events up to the 1% AEP.
2. The proposal will not lead to any material offsite water level impacts.
3. The proposal will not materially affect flood velocity under a range of flood conditions up to the 1% AEP.
4. The proposal will not adversely impact flood water conditions over the adjoining wetland or on the opposite river bank. No flood related physical impacts are therefore anticipated.

2 PROPOSED DEVELOPMENT

The proposed development layout and excavation details are shown in Attachment A. The proposed development comprises the following three general phases:

1. Establishment Phase
 - a. The two existing constructed inlets on the southern site boundary are proposed to be filled prior to the works commencing on the extraction pit, and will remain in place following completion of sand extraction.

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- b. The development also includes a small site office, sand processing facility, and dredging infrastructure.
- c. Sand stockpiles are to be protected by stacked sandstone block walls on their upstream (western) end to minimise the potential for scour and erosion during flood events.

2. Operational Phase

- a. Prior to operations commencing a low bund will be erected on the southern edge of the proposed extraction pit (protecting each extraction stage) to provide further protection of the pit from the Hawkesbury River. The bund will 'move' with the extraction pit stage progressively from east to west.
- b. The proposed sand extraction will be progressively excavated from east to west across four areas of the site.

3. Completed / Rehabilitation Phase

- a. The sand extraction pit will be progressively rehabilitated by backfilling.
- b. The sand extraction plant and office facilities present during works will be removed upon completion of the operational phase.
- c. The proposed final surface has been designed to maximise useable agricultural land by providing a level area, whilst ensuring there is no net fill on the floodplain.

3 HYDRAULIC MODELLING METHODOLOGY

3.1 Overview

The TUFLOW hydraulic model was used to determine flood characteristics including flood extents, levels, depths and velocities for a range of flood events for existing and proposed conditions.

3.2 Modelling Scenarios

The hydraulic model was setup to represent the following flood condition scenarios, as also illustrated in Table 1 and Table 2. Scenarios RD-1 to RD-7 represent all stages of the proposed development with rehabilitation to the design surface. Scenarios RE-1 to RE-7 represent all stages of the proposed development with rehabilitation back to existing elevations.

1. Existing condition (RD-1 / RE-1): the catchment and site in their current state.
2. Establishment phase (RD-2 / RE-2 / RE-7): the site in its establishment phase as described in Section 2.
3. Proposed condition (RD-3 / RE-3): the site in its operational phase for Area 1 as described in Section 2.
4. Proposed condition (RD-4): the site in its operational phase for Area 2 and Area 1 rehabilitated to proposed levels as described in Section 2.

5. Proposed condition (RD-5): the site in its operational phase for Area 3 and Areas 1 & 2 rehabilitated to proposed levels as described in Section 2.
6. Proposed condition (RD-6): the site in its operational phase for Area 4 and Areas 1, 2 & 3 rehabilitated to proposed levels as described in Section 2.
7. Proposed condition (RD-7): the site in the completed phase with all areas rehabilitated to proposed levels as described in Section 2.
8. Hypothetical condition (RE-4): the site in its operational phase for Area 2 as described in Section 2 and Area 1 returned to existing levels.
9. Hypothetical condition (RE-5): the site in its operational phase for Area 3 as described in Section 2 and Areas 1 & 2 returned to existing levels.
10. Hypothetical condition (RE-6): the site in its operational phase for Area 4 as described in Section 2 and Areas 1, 2 & 3 returned to existing levels.

Table 1: Flood condition modelling scenarios (return to design surface) adopted for flood modelling.

Flood Modelling Scenario	Inlets	Extraction Area 1	Extraction Area 2	Extraction Area 3	Extraction Area 4
RD-1	Existing	Existing	Existing	Existing	Existing
RD-2	Filled	Existing	Existing	Existing	Existing
RD-3	Filled	Extraction	Existing	Existing	Existing
RD-4	Filled	Design Surface	Extraction	Existing	Existing
RD-5	Filled	Design Surface	Design Surface	Extraction	Existing
RD-6	Filled	Design Surface	Design Surface	Design Surface	Extraction
RD-7	Filled	Design Surface	Design Surface	Design Surface	Design Surface

Table 2: Flood condition modelling scenarios (return to existing surface) adopted for flood modelling.

Flood Modelling Scenario	Inlets	Extraction Area 1	Extraction Area 2	Extraction Area 3	Extraction Area 4
RE-1	Existing	Existing	Existing	Existing	Existing
RE-2	Filled	Existing	Existing	Existing	Existing
RE-3	Filled	Extraction	Existing	Existing	Existing
RE-4	Filled	Return to Existing	Extraction	Existing	Existing
RE-5	Filled	Return to Existing	Return to Existing	Extraction	Existing
RE-6	Filled	Return to Existing	Return to Existing	Return to Existing	Extraction
RE-7	Filled	Return to Existing	Return to Existing	Return to Existing	Return to Existing

Note that flood modelling scenarios RD-1, RD-2 and RD-3 are identical to scenarios RE-1, RE-2 and RE-3 respectively (as there is no rehabilitation occurring in these scenarios). Additionally, scenario RE-2 is identical to scenario RE-7 (as all areas are returned to existing except for the inlets).

The hydraulic model was used to assess flooding for the following events:

1. 2 Exceedance per Year ('**EY**', or the 6 month average recurrence interval ('**ARI**')) 72 hour (critical duration) event.
2. 50% annual exceedance probability ('**AEP**') 72 hour (critical duration) event.
3. 20% AEP 72 hour (critical duration) event.
4. 10% AEP 72 hour (critical duration) event.
5. 5% AEP 72 hour (critical duration) event.
6. 2% AEP 72 hour (critical duration) event.
7. 1% AEP 72 hour (critical duration) event.

In summary, a total of 70 scenarios were modelled as part of this assessment (10 flood condition scenarios and 7 flood events each).

3.3 Terrain Data

Catchment LIDAR data available from ELVIS (2017) was merged with site survey data provided by True North Surveys (August 2018) and local bathymetry data provided by OEH (1989) to create a 3D surface for the existing conditions site and the local floodplain environment used in the TUFLOW model.

The establishment, proposed and hypothetical condition surfaces also included site design grading as shown in the earthworks grading plans and sections in MA planset P1706008PS06 (refer Attachment A).

3.4 Model Setup

3.4.1 Existing Conditions

TUFLOW model construction for existing conditions consisted of:

1. A 10 m topographic grid based on the available survey, LIDAR and bathymetry data.
2. The model domain was defined from the Hawkesbury River 2.0 km upstream of the site to Windsor Bridge 4.5 km downstream of the site and Rickabys Creek 6.5 km downstream of the site. Model boundary extents were generally placed along catchment ridgelines and / or connecting catchment high points surrounding the study area.
3. Inclusion of staged water level hydrographs at the upstream and downstream model extents. Water levels for the critical duration 20% AEP, 10% AEP, 5% AEP, 2% AEP and 1% AEP flood events were provided by WMAwater from the 'Hawkesbury Nepean Valley Regional Flood Study' (2019, '**WMAwater study**') at the upstream and downstream model extents (6 locations) to ensure replication of flood water delivery and tailwater conditions in the detailed site model.
4. Staged water level hydrographs for the critical duration 2 EY and 50% AEP flood events were extrapolated based on the data provided by WMAwater.
5. Manning's zones based on Nearmaps (2021) aerial photography of the study area, with roughness coefficients adopted as per Table 3.

- Existing dams and lakes are conservatively assumed to be full.

Table 3: Manning's roughness values for TUFLOW modelling.

Catchment Material Type	Manning's Roughness Coefficient ¹
Buildings	0.300
Bushland / Riparian	0.080
Channel (regular)	0.040
Channel (rough)	0.065
Crops	0.050
Forest	0.110
Intermediate Length Grass	0.045
Light Vegetation	0.055
Maintained Grass	0.035
Open Space	0.025
Residential / Urban Areas (low density) ²	0.150
Residential / Urban Areas (high density) ²	0.250
Roads / Concrete	0.020
Watercourse / Water Body	0.030

Notes

- Based on typical values from similar catchments.
- Based on the weighted average land use of a representative urban lot area and the adopted roughness coefficients for pervious / impervious areas.

3.4.2 Proposed and Hypothetical Conditions

The existing conditions model was modified as follows to simulate proposed and hypothetical conditions as described in Section 3.2:

- The 10 m topographic grid was updated to include the proposed site grading design for each scenario.
- Site manning's zones were updated to represent design surfaces.
- Proposed low bunds for each extraction area and stockpile walls were modelled as flow obstructions.
- Extraction areas were modelled with initial water levels at the expected groundwater level of 0.4 mAHD.

All other model construction elements remained consistent with the existing conditions model.

3.5 Results

3.5.1 Flood Results

Flood mapping results (flood levels, depths and velocities) for the critical duration 2 EY, 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP, and 1% AEP flood events in existing conditions are provided in Attachment C, with drawing references summarised in Table 4. Water level and velocity impact maps have been generated as a peak of all events and multiple scenarios

to enable ready examination of changes as a result of the proposal, rather than providing individual impact maps for each individual scenario and event.

Table 4: Flood map drawing references in Attachment C (MA mapset P1706008MS03).

Flood Condition Scenario	Critical Duration Flood Event	Water Level & Depth	Water Velocity	Peak Water Level Afflux	Peak Velocity Afflux
Existing Conditions	2 EY	Map 02	Map 03	–	–
	50% AEP	Map 04	Map 05	–	–
	20% AEP	Map 06	Map 07	–	–
	10% AEP	Map 08	Map 09	–	–
	5% AEP	Map 10	Map 11	–	–
	2% AEP	Map 12	Map 13	–	–
	1% AEP	Map 14	Map 15	–	–
Proposed Conditions ¹	All Events	–	–	Map 16	Map 17
Hypothetical Conditions ²	All Events	–	–	Map 18	Map 19

Notes

1. These results show the aggregate peak impact across all modelled AEP events for Scenarios RD-2 to RD- 7, i.e. all stages and rehabilitation to design levels (refer Section 3.2).
2. These results show the aggregate peak impact across all modelled AEP events for Scenarios RE-2 to RE-7, i.e. all stages and rehabilitation to existing levels (refer Section 3.2).

3.5.2 Validation

Comparison between WMAwater (2019) and MA peak flood levels for each modelled flood event is given in Table 5 (Attachment B). Comparison is made for the peak flood levels at the 8 locations shown in Attachment C Map 01.

The comparison shows flood levels as modelled by MA agree well with WMAwater modelling, and differences are $\leq \pm 65$ mm. MA modelled flood levels are typically slightly higher than those modelled by WMAwater across most events. The differences between modelled flood levels are likely due to differences in the modelling software used (WMAwater used RUBICON with quasi 2D modelling, MA used TUFLOW 2D modelling) and inclusion of site survey data. These changes serve to increase the accuracy of the modelled flood levels at the site.

Further, flood levels and extents throughout the MA model domain were compared to those modelled by WMAwater and were found to have close agreement. We therefore consider the MA model closely matches the Council adopted flood characteristics, slightly improving the accuracy of flood predictions at the site, and is considered adequate for the purposes of detailed site modelling.

3.6 Discussion

We note the following regarding modelled flood behaviour:

3.6.1 Existing Conditions

1. Water level, water depth and velocity maps for existing conditions are provided in Maps 02-15.

2. The primary source of site flooding is overbank flows from the Hawkesbury River. Floodwaters break the banks of the river in all modelled events.
3. Flood waters primarily flow across the site from west to east in the flow direction of the Hawkesbury River.
4. There is little variation in the peak flood levels across the site (typically < 100 mm difference) due to high tailwater levels in the Hawkesbury River.

3.6.2 Proposed Conditions

1. Proposed flooding conditions are largely unchanged from existing conditions, and the proposed site works do not materially affect local flood characteristics.
2. The main differences between proposed and existing conditions are the proposed low bunds and quarry areas, which slightly alter local flood characteristics at these locations. Outside of areas where earthworks occur, flood depths and velocities on-site are very similar to the existing condition.
3. Flood water backs up behind the low flood bunds which prevents water from entering the quarry areas in the 2 EY flood event.
4. The peak flood velocity at the low flood bunds across all modelled scenarios and flood events (including the 1% AEP) is approximately 1.8 m/s. A typically adopted threshold to prevent initiation of erosion on grassed surfaces is 1.8 m/s (Concrete Pipe Association of Australasia, 'Hydraulics of Precast Concrete Conduits' 2012), although a threshold of 2.0 m/s is also commonly applied. Typically, higher velocities of greater than 2.0 m/s are required to initiate erosion when vegetation includes shrubs and trees. Considering the design life of the project is anticipated to be 10 years, flood velocities are expected to be less than 1.8 m/s, and hence the recommended grassed bunds are unlikely to experience significant erosion or scour.
5. The peak flood velocity at the wetland area in the southeast corner of the site across all modelled flood events and scenarios is 1.73 m/s.
6. The peak flood velocity in the agricultural area across all flood events for Scenario RD-7 (the final design surface) is 1.75 m/s. Based on the adopted grass erosion threshold of 1.8 m/s, there is unlikely to be significant erosion or soil loss during flood events.

3.6.3 Offsite Flood Impacts

1. Peak water level and velocity impact plots across all modelled flood events for proposed conditions with areas rehabilitated to design levels (Scenarios RD-2 to RD-7, as described in Section 3.2) are provided in Maps 16 and 17. Peak water level and velocity impact plots across all modelled flood events for proposed conditions with areas returned to existing levels (Scenarios RE-2 to RE-7) are provided in Maps 18 and 19.
2. There are no material increases in water level or velocity at the riverbank opposite the site across all modelled events and scenarios.
3. The proposed development causes no offsite increases above 20 mm across all modelled events and scenarios, which is considered a negligible impact.

4. There are localised, minor offsite water level impacts (up to 15 mm) in some scenarios and events. The offsite flood level increases are wholly contained within the banks of the Hawkesbury River and do not affect existing adjacent properties or buildings.
5. There are minor localised offsite velocity impacts (up to 0.35 m/s) in some scenarios and events. The velocity increase affects a minor area of the properties adjacent to the site (435 and 355 Freemans Reach Road), with no affectation of the opposite bank of the Hawkesbury River.
6. Although there are minor offsite velocity impacts, the nature of these changes is temporary caused by changes in the elevation of the site and modification of the Manning's roughness of the surface throughout each of the dredging stages. In the final design surface scenario (Scenario RD-7), there are minimal offsite impacts. The peak velocity impact across all AEP events for each stage of the design is shown in Figure 1, which demonstrates their temporary nature.
7. In the areas of offsite velocity increase, the peak velocity ranges from 1.1 m/s to 1.86 m/s across all modelled events and scenarios, with only a small area (approximately 200 m²) greater than 1.8 m/s, which occurs at the boundary between the site and the adjacent downstream property (355 Freemans Reach Road). Therefore, although there is a minor temporary increase in velocities as a result of the proposal, it is unlikely to cause erosion, soil loss or any other material changes.
8. In the areas of velocity increase in the wetland area at in the southeast of the site, the peak velocity is approximately 1.73 m/s, which occurs at Stage 2 of the extraction phase. Therefore, although there is a minor temporary increase in velocities as a result of the proposal, it is unlikely to cause erosion, soil loss or any other material changes.
9. Overall, these flood impacts are of immaterial significance, particularly in the final design surface scenario (Scenario RD-7), and are considered acceptable.

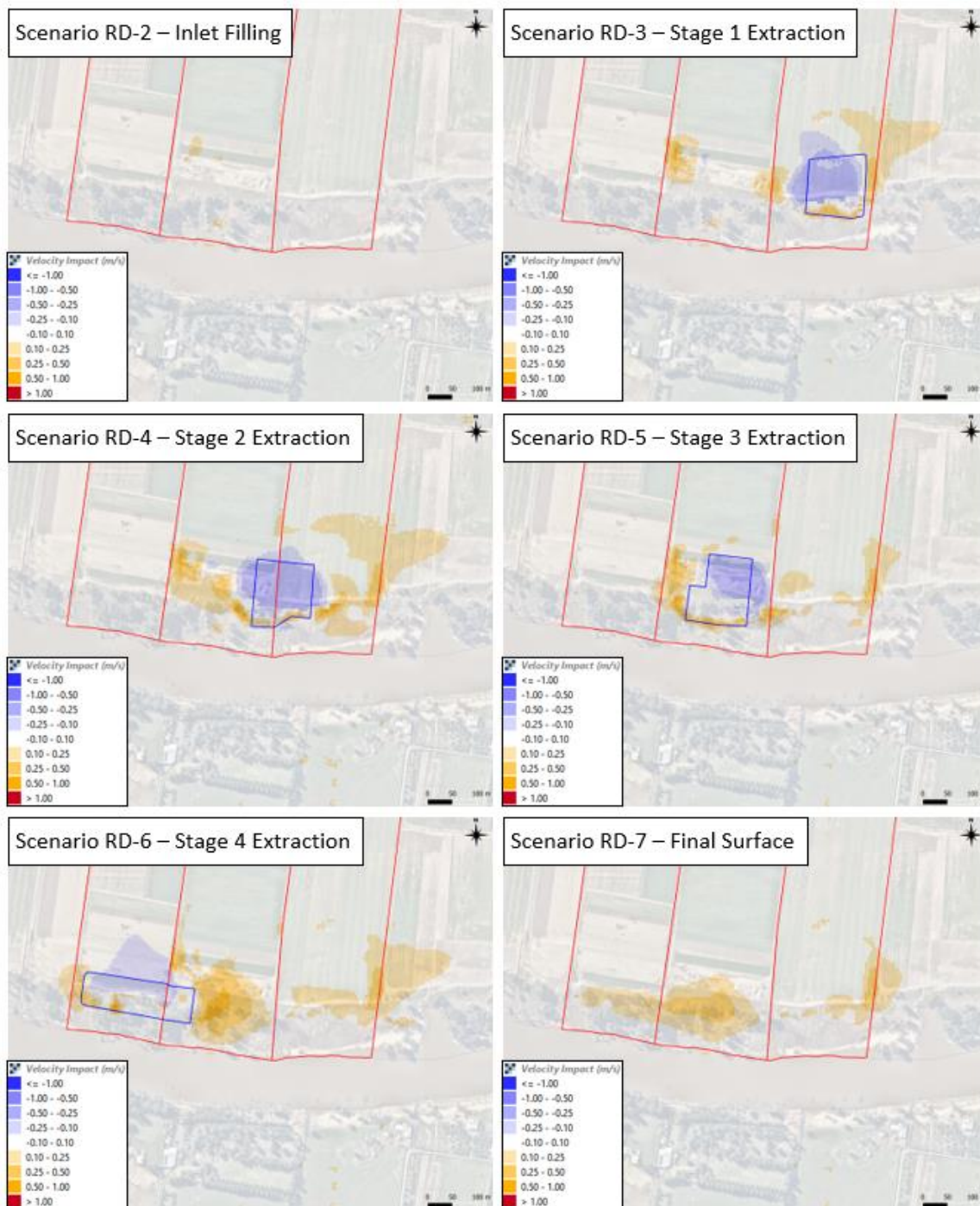


Figure 1: Peak velocity impacts across all AEP events for each scenario with rehabilitation to design levels.

4 DREDGE ANCHORING

The sand extraction dredge is required to incorporate an anchoring system to prevent displacement during a large flood event. The peak flood characteristics across the four quarry areas and the adopted design parameters are:

1. A peak water depth above surrounding ground levels of 16 m in the 1% AEP event.
2. A peak water velocity of 1.8 m/s in the 2% AEP event, noting that the 1% AEP velocity is slightly lower due to higher tailwater conditions. We recommend design for 2.0 m/s to incorporate an appropriate factor of safety.

On the basis of the above, we recommend that the anchoring system is constructed as follows:

"Prior to the issue of a Construction Certificate, an anchoring system for the sand extraction dredge shall be designed by a suitably qualified geotechnical engineer to ensure that in the event of a flood at the site, the sand extraction dredge will at all times be anchored at a minimum of three locations to withstand the hydrostatic and hydrodynamic forces associated with flood events up to and including the 1% AEP event. Subject to detailed design, this should be based on a peak flow velocity of 2.0 m/s and a peak flow depth of 20 m."

5 CONCLUSION

A detailed hydraulic model has been developed for the site consistent with Council's accepted WMAwater flood study and adding detailed site survey and proposed design elements to assess local flood characteristics. The model accurately replicates Council adopted flood characteristics.

The model was used to determine the existing and proposed flood conditions in the 2 EY, 50% AEP, 20% AEP, 10% AEP, 5% AEP, 2% AEP and 1% AEP flood events. The assessment concluded that:

1. The proposal will not materially alter flood behaviour under a range of flood events up to the 1% AEP.
2. The proposal will not lead to any material offsite water level impacts.
3. The proposal will not materially affect flood velocity under a range of flood conditions up to the 1% AEP.
4. The proposal will not adversely impact flood water conditions over the adjoining wetland or on the opposite river bank. No flood related physical impacts are therefore anticipated.

Based on the flood modelling, we recommend:

1. That the low flood bunds should be grassed prior to extraction commencing at that stage for each area to minimise the risk of erosion and scour.

This assessment has addressed the flood modelling and anchoring requirements of the Panel's 'Record of Deferral', and demonstrates the proposed sand extraction and processing facility is compatible with the local flood characteristics and can be developed as proposed.

Please contact our office if you have any further queries regarding this matter.

For and on behalf of

MARTENS & ASSOCIATES PTY LTD

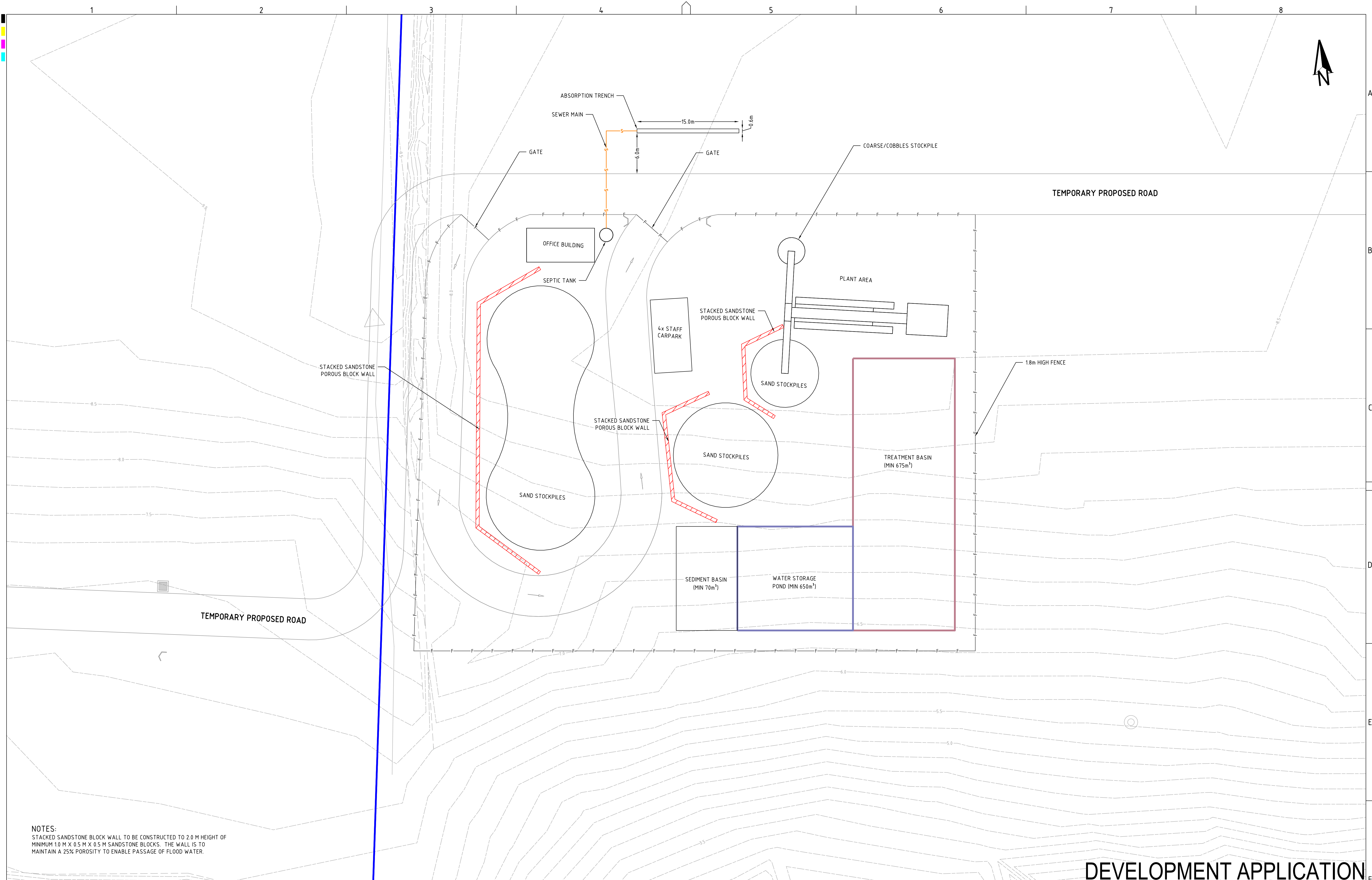


DANIEL DHIACOU

BEng (Hons1), DipEngPrac



Senior Engineer & Technical Team Leader

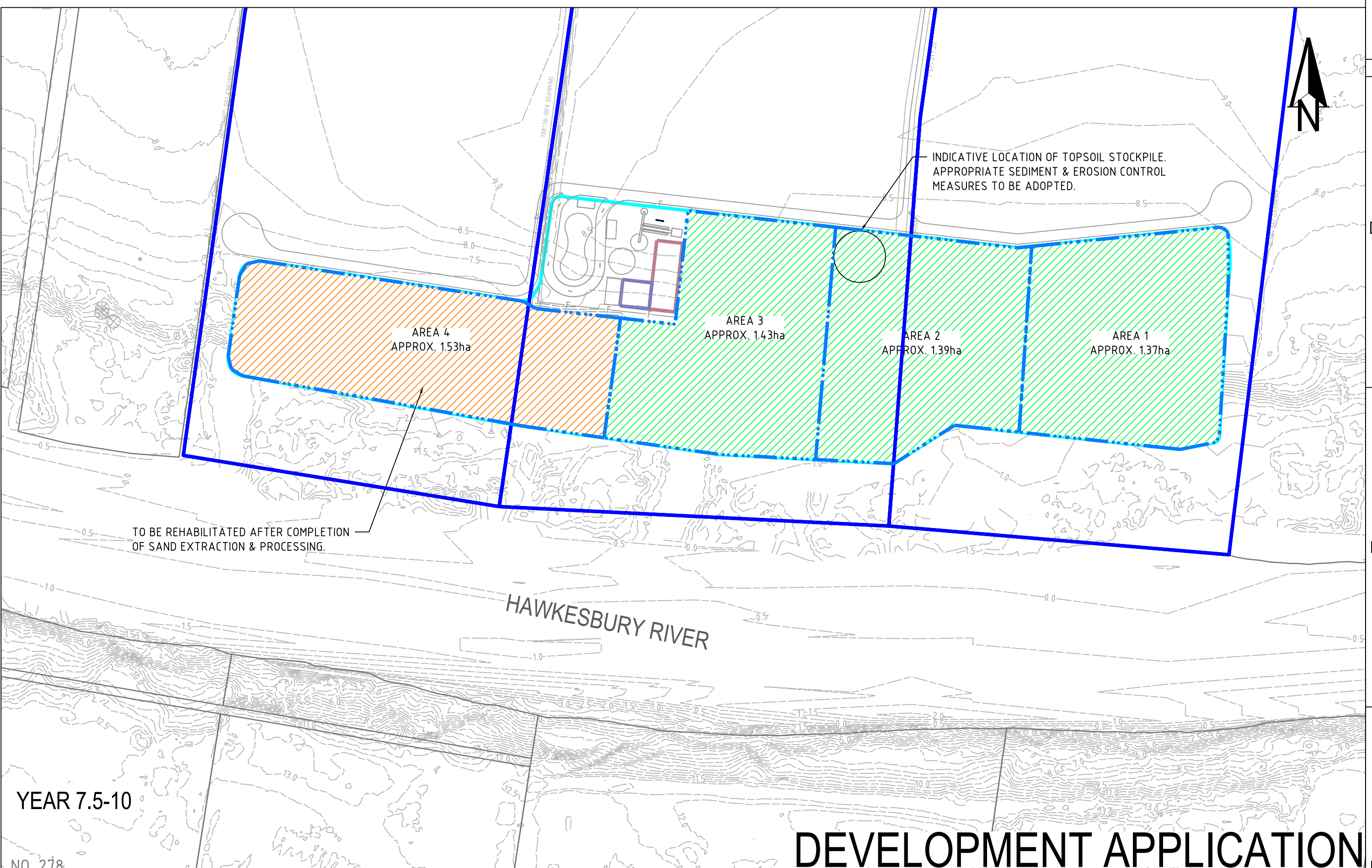
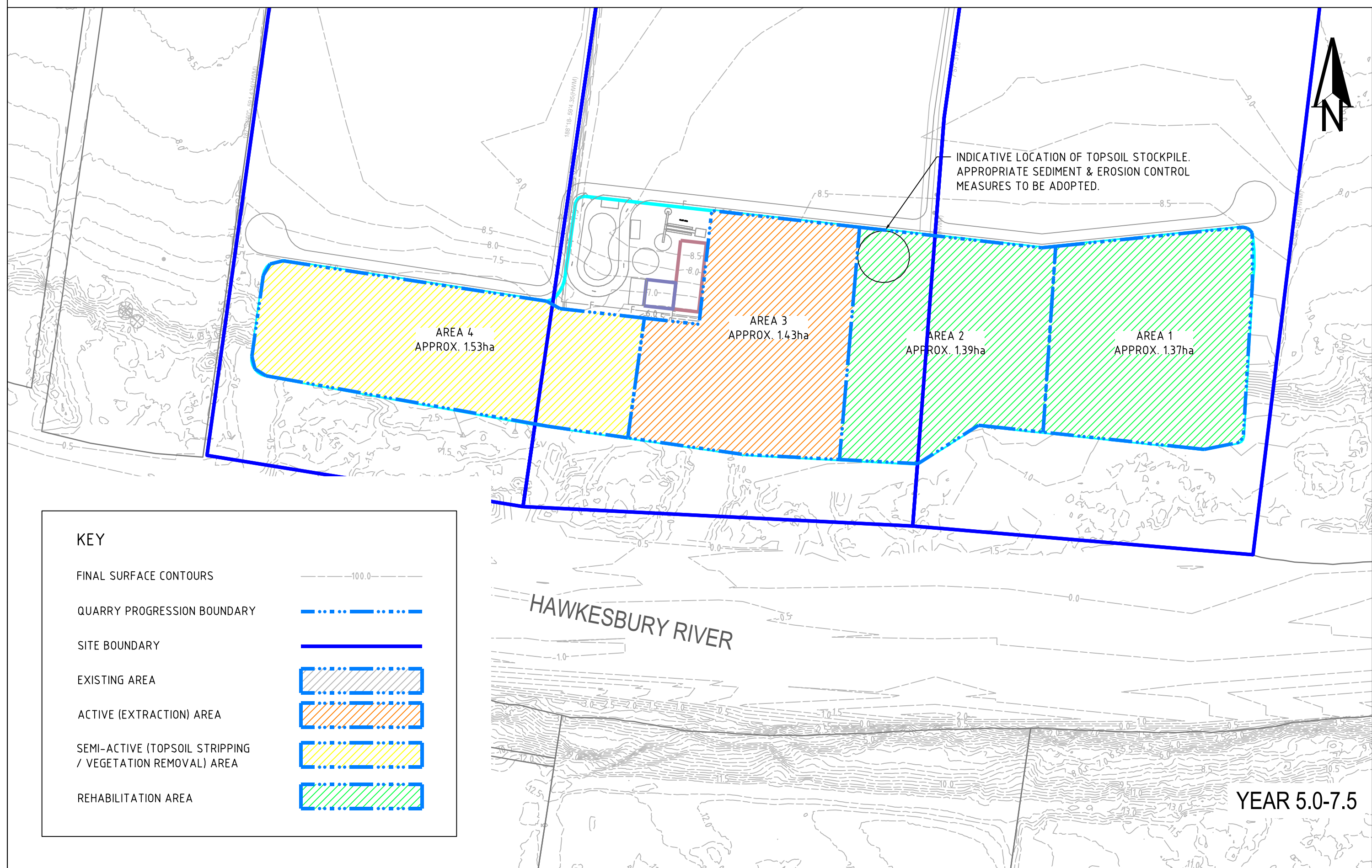
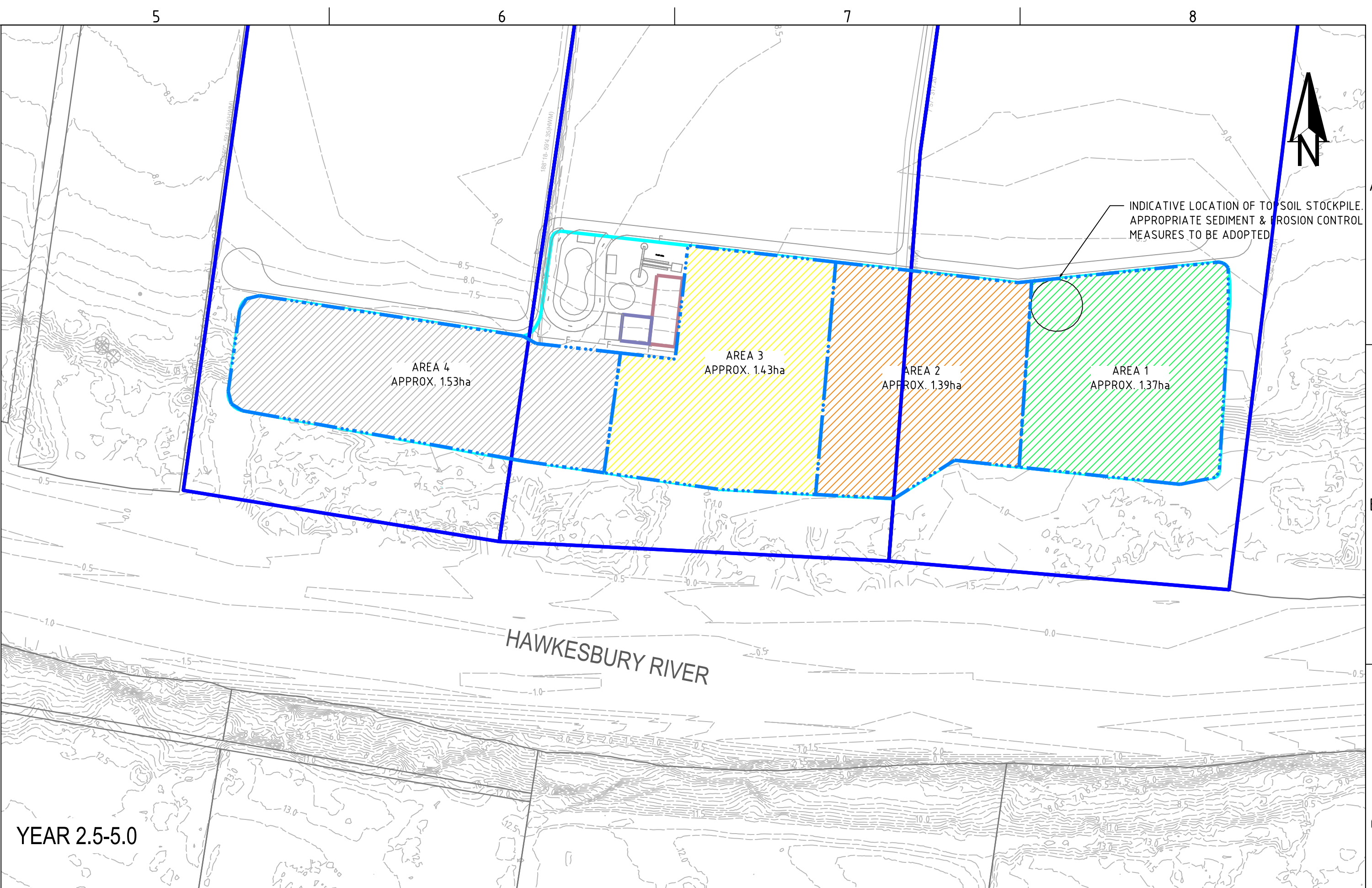
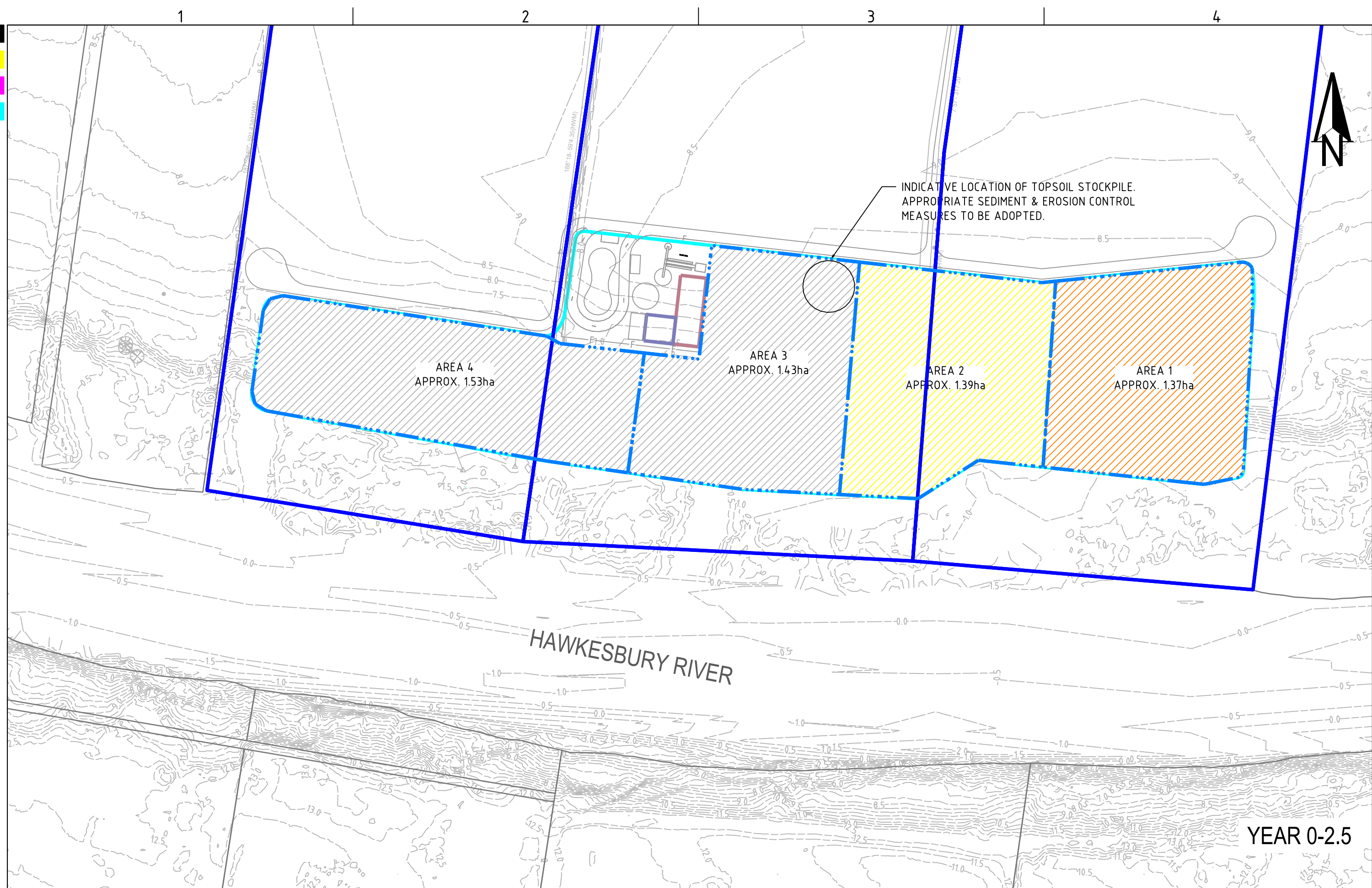
ATTACHMENT A – PROPOSED DEVELOPMENT



NOTES:
STACKED SANDSTONE BLOCK WALL TO BE CONSTRUCTED TO 2.0 M HEIGHT OF MINIMUM 1.0 M X 0.5 M X 0.5 M SANDSTONE BLOCKS. THE WALL IS TO MAINTAIN A 25% POROSITY TO ENABLE PASSAGE OF FLOOD WATER.

DEVELOPMENT APPLICATION

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD	SCALE	GRID	DATUM	PROJECT MANAGER	CLIENT	<div><div>Consulting Engineers</div><div>Environment Water Geotechnical Civil</div></div> <div>Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: www.martens.com.au</div>					
C	MINOR AMENDMENTS	28/04/2020	LL/GM	CG	MS/MK	MS	 <div>A1 (A3) 1:250 (1:500) METRES</div>	MGA	mAHD	MS	GREENER LAWN SUPPLIES PTY LTD					DRAWING TITLE CONCEPT LAYOUT SAND PROCESSING AREA	
B	MINOR AMENDMENT	01/05/2019	GM	HS/VW	MS/MK	MS		DISCLAIMER & COPYRIGHT This plan must not be used for construction unless signed as approved by principal certifying authority. All measurements in millimetres unless otherwise specified. This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd. (C) Copyright Martens & Associates Pty Ltd	PROJECT NAME/ PLANSET TITLE PROPOSED SAND EXTRACTION FACILITY PRELIMINARY CIVIL DESIGN	374, 395 & 415 FREEMANS REACH ROAD FREEMANS REACH, NSW							
A	FOR DA SUBMISSION	21/11/2018	LZ	HS/VW/MD	MS/DM	MS						PROJECT NO. P1706008		PLANSET NO. PS06	RELEASE NO. R07	DRAWING NO. PS06-A300	REVISION C



KEY

FINAL SURFACE CONTOURS

QUARRY PROGRESSION BOUNDARY

SITE BOUNDARY

EXISTING AREA

ACTIVE (EXTRACTION) AREA

SEMI-ACTIVE (TOPSOIL STRIPPING / VEGETATION REMOVAL) AREA

REHABILITATION AREA

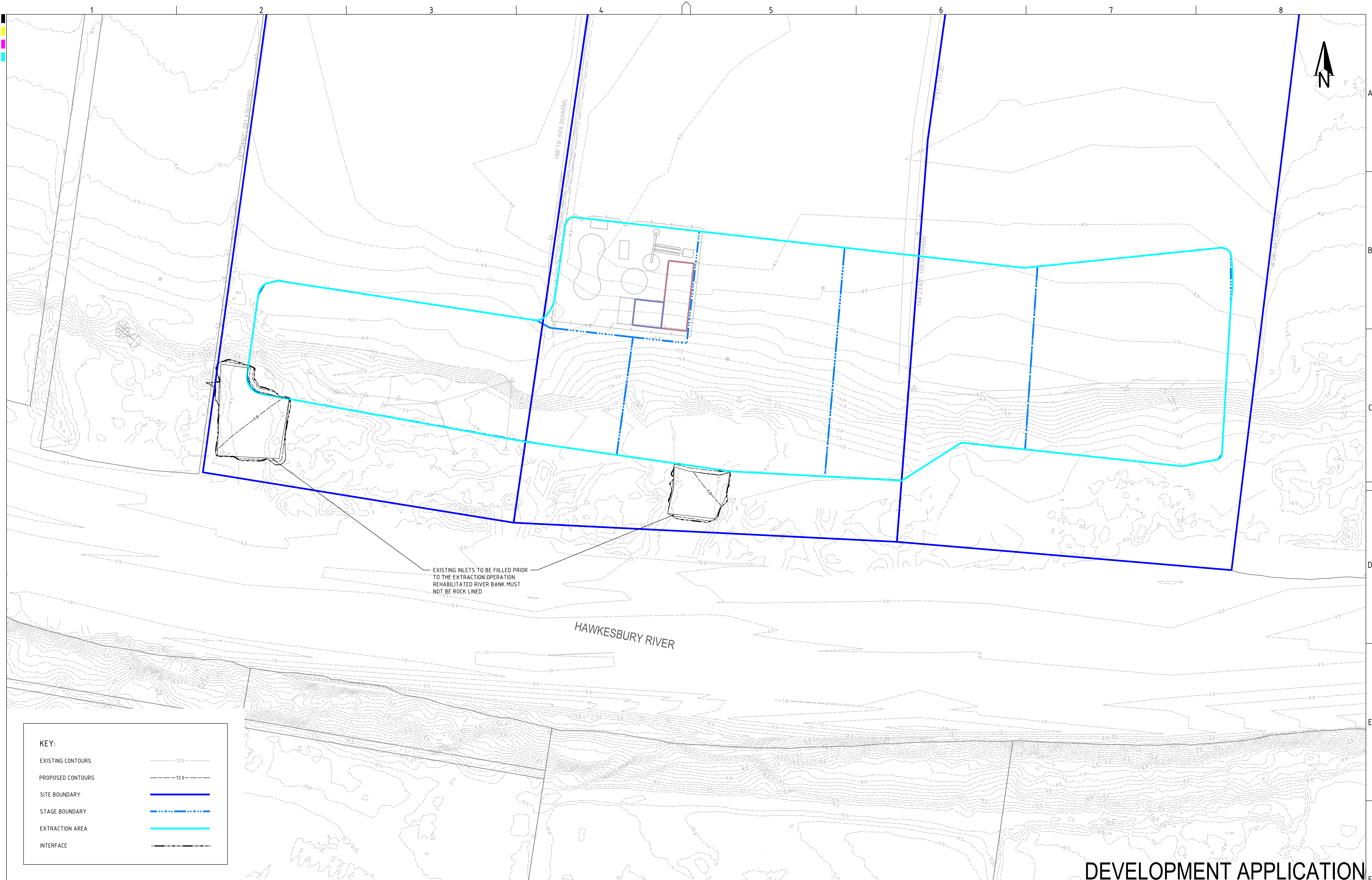
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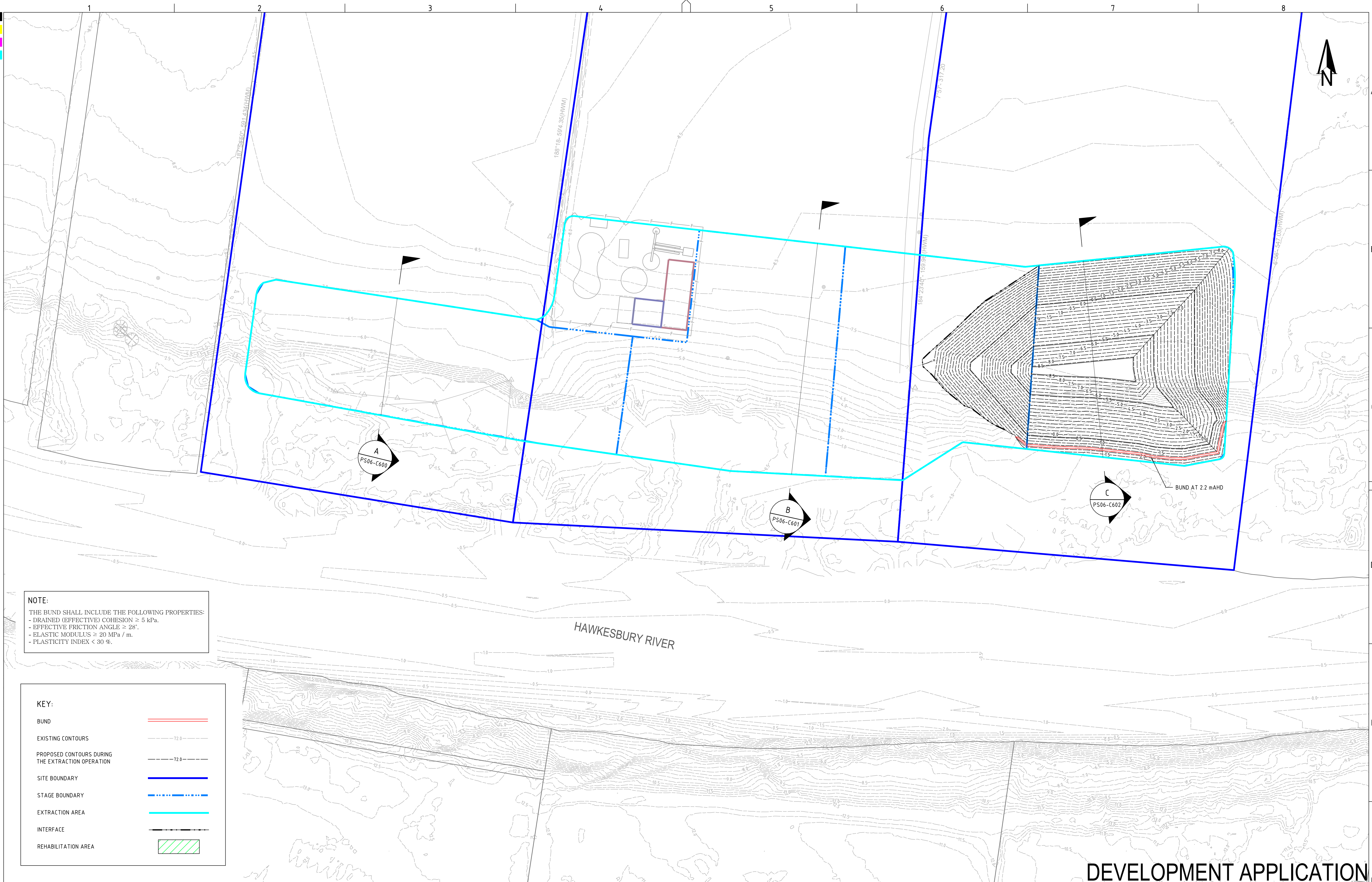
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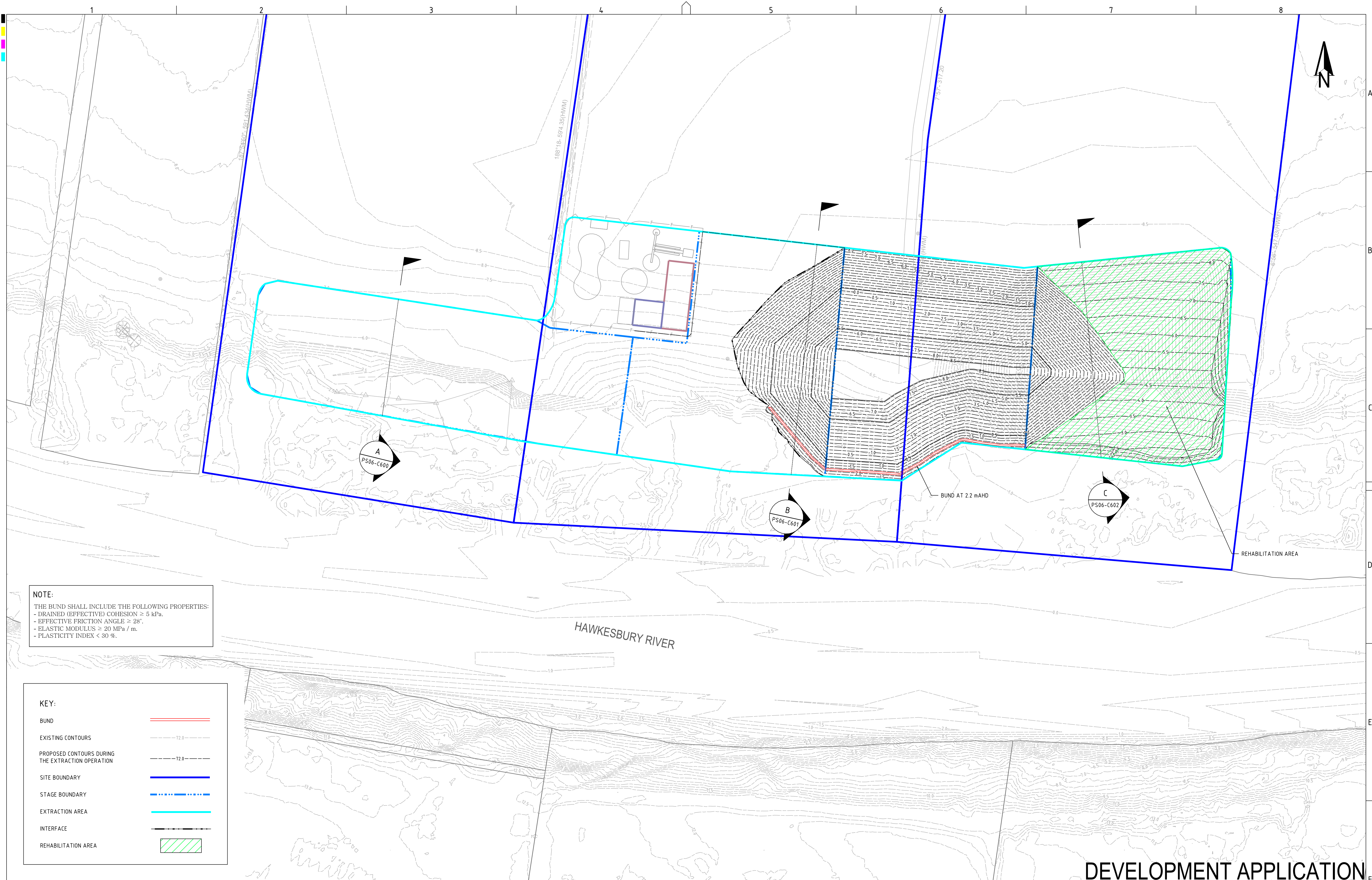


KEY:	
EXISTING CONTOURS	---
PROPOSED CONTOURS	---
SITE BOUNDARY	---
STAGE BOUNDARY	---
EXTRACTION AREA	---
INTERFACE	---

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD	SCALE	GRID	DATUM	PROJECT MANAGER	CLIENT	martens & Associates Pty Ltd		Consulting Engineers		DRAWING TITLE	
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A	FOR DA SUBMISSION	21/11/2018	LZ	HS/WW	MS/DM	MS																	
												374, 395 & 415 FREEMANS REACH ROAD FREEMANS REACH, NSW		Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: www.martens.com.au									
AT / A3 LANDSCAPE [A3]_c_v02.0.01							DISCLAIMER & COPYRIGHT This plan must not be used for construction unless signed as approved by principal certifying authority. All measurements in millimetres unless otherwise specified. This drawing must not be reproduced in whole or part without prior written consent of Martens & Associates Pty Ltd. (C) Copyright Martens & Associates Pty Ltd																



NOTE:
THE BUND SHALL INCLUDE THE FOLLOWING PROPERTIES:
- DRAINED (EFFECTIVE) COHESION ≥ 5 kPa.
- EFFECTIVE FRICTION ANGLE $\geq 28^\circ$.
- ELASTIC MODULUS ≥ 20 MPa / m.
- PLASTICITY INDEX < 30 %.

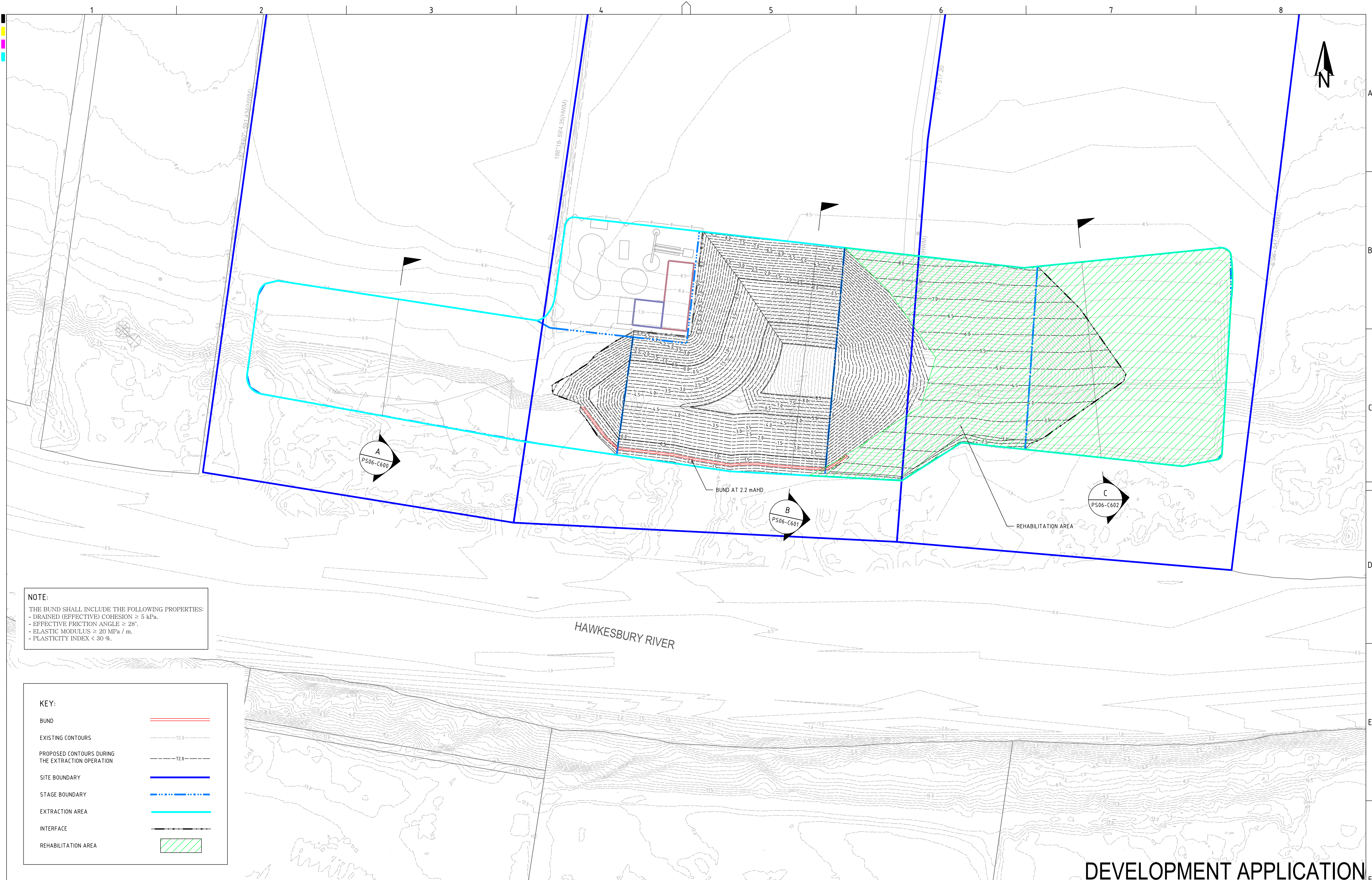
KEY:

BUND	
EXISTING CONTOURS	
PROPOSED CONTOURS DURING THE EXTRACTION OPERATION	
SITE BOUNDARY	
STAGE BOUNDARY	
EXTRACTION AREA	
INTERFACE	
REHABILITATION AREA	

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD	<div>SCALE</div> <div><div><div>0102030405060708090100</div><div>A1 (A3) 1:1,000 (1:2,000)</div><div>METRES</div></div></div>	GRID	DATUM	PROJECT MANAGER	CLIENT	<div><div><div><div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><div><div><div><div></div><div></div><div></div></div></div><di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PRINTED: 11/05/2020 11:25 AM

A1 / A3 LANDSCAPE (A1LC_v02.0.01)



NOTE:
THE BUND SHALL INCLUDE THE FOLLOWING PROPERTIES:
- DRAINED (EFFECTIVE) COHESION ≥ 5 kPa.
- EFFECTIVE FRICTION ANGLE $\geq 28^\circ$.
- ELASTIC MODULUS ≥ 20 MPa / m.
- PLASTICITY INDEX < 30 %.

- KEY:**
- BUND
 - EXISTING CONTOURS
 - PROPOSED CONTOURS DURING THE EXTRACTION OPERATION
 - SITE BOUNDARY
 - STAGE BOUNDARY
 - EXTRACTION AREA
 - INTERFACE
 - REHABILITATION AREA

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD
D	MINOR AMENDMENTS	16/07/2021	NN	CG	MS	MS
C	MINOR AMENDMENTS	28/04/2020	LL/GM	CG	MS/MK	MS
B	MINOR AMENDMENT	01/05/2019	GM	HS/WW	MS/MK	MS
A	FOR DA SUBMISSION	21/11/2018	LZ	HS/WW	MS/DM	MS

SCALE
0 10 20 30 40 50 60 70 80 90 100
A1 (A3) 1:1,000 (1:2,000) METRES

GRID	DATUM	PROJECT MANAGER	CLIENT
MGA	mAHD	MS	GREENER LAWN SUPPLIES PTY LTD
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PROJECT NAME/PLANSET TITLE
PROPOSED SAND EXTRACTION FACILITY PRELIMINARY CIVIL DESIGN 374, 395 & 415 FREEMANS REACH ROAD FREEMANS REACH, NSW



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& Associates Pty Ltd

Consulting Engineers
Environment
Water
Geotechnical
Civil

Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767
Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING TITLE				
EARTHWORKS GRADING PLAN (AREA 3)				
PROJECT NO.	PLANSET NO.	RELEASE NO.	DRAWING NO.	REVISION
P1706008	PS06	R07	PS06-C130	D


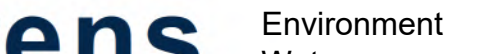
DEVELOPMENT APPLICATION



NOTE:
THE BUND SHALL INCLUDE THE FOLLOWING PROPERTIES:
- DRAINED (EFFECTIVE) COHESION ≥ 5 kPa.
- EFFECTIVE FRICTION ANGLE $\geq 28^\circ$.
- ELASTIC MODULUS ≥ 20 MPa / m.
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KEY:

- BUND
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- PROPOSED CONTOURS DURING THE EXTRACTION OPERATION
- SITE BOUNDARY
- STAGE BOUNDARY
- EXTRACTION AREA
- INTERFACE
- REHABILITATION AREA

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD	SCALE	GRID	DATUM	PROJECT MANAGER	CLIENT	 Consulting Engineers Environment Water Geotechnical Civil		DRAWING TITLE EARTHWORKS GRADING PLAN (AREA 4)									
C	MINOR AMENDMENTS	28/04/2020	LL/GM	CG	MS/MK	MS	0 10 20 30 40 50 60 70 80 90 100 A1 (A3) 1:1,000 (1:2,000) METRES	MGA	mAHD	MS	GREENER LAWN SUPPLIES PTY LTD												
B	MINOR AMENDMENT	01/05/2019	GM	HS/W/W	MS/MK	MS					PROJECT NAME/ PLANSET TITLE	 Suite 201, 20 George St, Hornsby, NSW 2077 Australia Phone: (02) 9476 9999 Fax: (02) 9476 8767 Email: mail@martens.com.au Internet: www.martens.com.au		PROJECT NO. P1706008		PLANSET NO. PS06		RELEASE NO. R07		DRAWING NO. PS06-C140		REVISION C	
A	FOR DA SUBMISSION	21/11/2018	LZ	HS/W/W	MS/DM	MS					PROPOSED SAND EXTRACTION FACILITY PRELIMINARY CIVIL DESIGN												



KEY:

EXISTING CONTOURS

72.0

FINAL SURFACE CONTOURS

72.0

SITE BOUNDARY

EXTRACTION AREA

WATERFRONT LAND
(40m FROM TOP OF BANK)

INTERFACE

REV	DESCRIPTION	DATE	DRAWN	DESIGNED	CHECKED	APPRVD	SCALE	GRID	DATUM	PROJECT MANAGER	CLIENT	<div><div><div></div><div>martens</div><div>& Associates Pty Ltd</div></div><div>Consulting Engineers Environment Water Geotechnical Civil</div></div>	DRAWING TITLE EARTHWORKS GRADING PLAN (FINAL SURFACE)		
B	MINOR AMENDMENTS	28/04/2020	LL/GM	CG	CG	MS	0 10 20 30 40 50 60 70 80 90 100 A1 (A3) 1:1,000 (1:2,000) METRES	MGA	mAHD	MS	GREENER LAWN SUPPLIES PTY LTD				
A	FINAL DESIGN SURFACE GRADING	18/10/2019	GM	CG	CG	MS					PROJECT NAME/ PLANSET TITLE PROPOSED SAND EXTRACTION FACILITY PRELIMINARY CIVIL DESIGN 374, 395 & 415 FREEMANS REACH ROAD FREEMANS REACH, NSW	PROJECT NO. P1706008			
												PLANSET NO. PS06			
												RELEASE NO. R07			
												DRAWING NO. PS06-C150			
												REVISION B			

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Email: mail@martens.com.au Internet: www.martens.com.au

DRAWING ID: P1706008-PS06-R07-C150

ATTACHMENT B – WATER LEVEL CALIBRATION

Table 5: Comparison between WMAwater (2019) and MA (2021) modelled peak water levels.

			Flood Event				
Location ¹	Parameter		20% AEP	10% AEP	5% AEP	2% AEP	1% AEP
Point A	Peak Flood Level (mAHD)	WMA ²	10.393	12.346	13.827	16.085	17.349
		MA	10.405	12.379	13.787	16.113	17.361
	Difference	(m)	0.012	0.033	-0.040	0.028	0.012
Point B	Peak Flood Level (mAHD)	WMA ²	10.307	12.291	13.816	16.082	17.348
		MA	10.322	12.287	13.768	16.103	17.351
	Difference	(m)	0.015	-0.004	-0.048	0.021	0.003
Point C	Peak Flood Level (mAHD)	WMA ²	10.275	12.259	13.810	16.080	17.346
		MA	10.297	12.254	13.761	16.099	17.346
	Difference	(m)	0.022	-0.005	-0.049	0.019	0.000
Point D	Peak Flood Level (mAHD)	WMA ²	10.256	12.230	13.803	16.077	17.343
		MA	10.276	12.226	13.755	16.097	17.344
	Difference	(m)	0.020	-0.004	-0.048	0.020	0.001
Point E	Peak Flood Level (mAHD)	WMA ²	10.217	12.168	13.788	16.070	17.338
		MA	10.241	12.183	13.747	16.091	17.339
	Difference	(m)	0.024	0.015	-0.041	0.021	0.001
Point F	Peak Flood Level (mAHD)	WMA ²	10.028	12.037	13.783	16.070	17.338
		MA	10.002	12.068	13.741	16.101	17.350
	Difference	(m)	-0.026	0.031	-0.042	0.031	0.012
Point G	Peak Flood Level (mAHD)	WMA ²	10.031	12.037	13.785	16.071	17.339
		MA	10.094	12.088	13.760	16.109	17.357
	Difference	(m)	0.063	0.050	-0.025	0.038	0.018
Point H	Peak Flood Level (mAHD)	WMA ²	9.859	11.930	13.744	16.052	17.325
		MA	9.863	11.985	13.709	16.079	17.328
	Difference	(m)	0.004	0.055	-0.035	0.027	0.003

Notes

1. Calibration locations shown in Attachment C Map 01.
2. Peak flood levels from the WMAwater flood model results.

ATTACHMENT C – FLOODING MAPSET

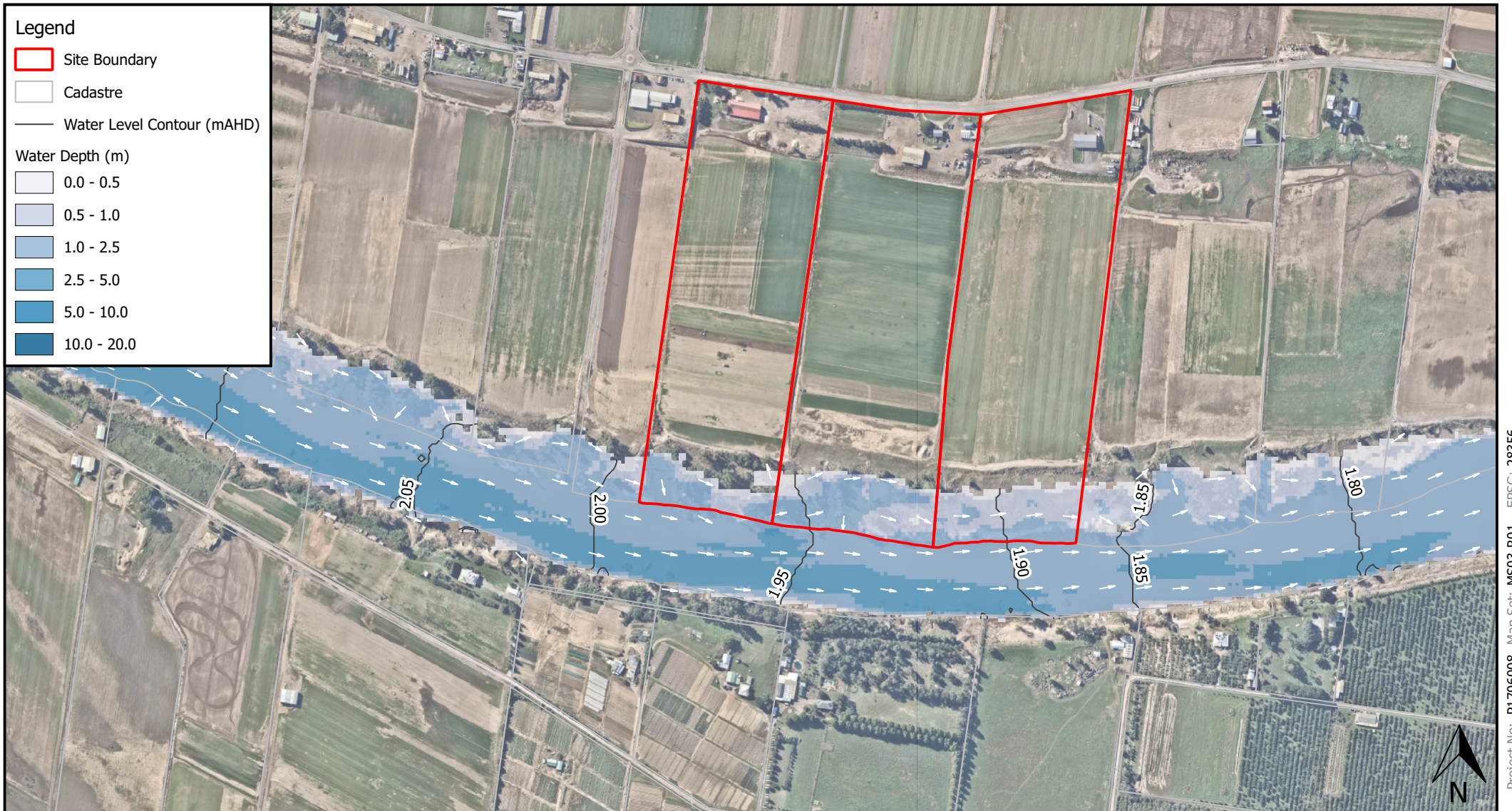


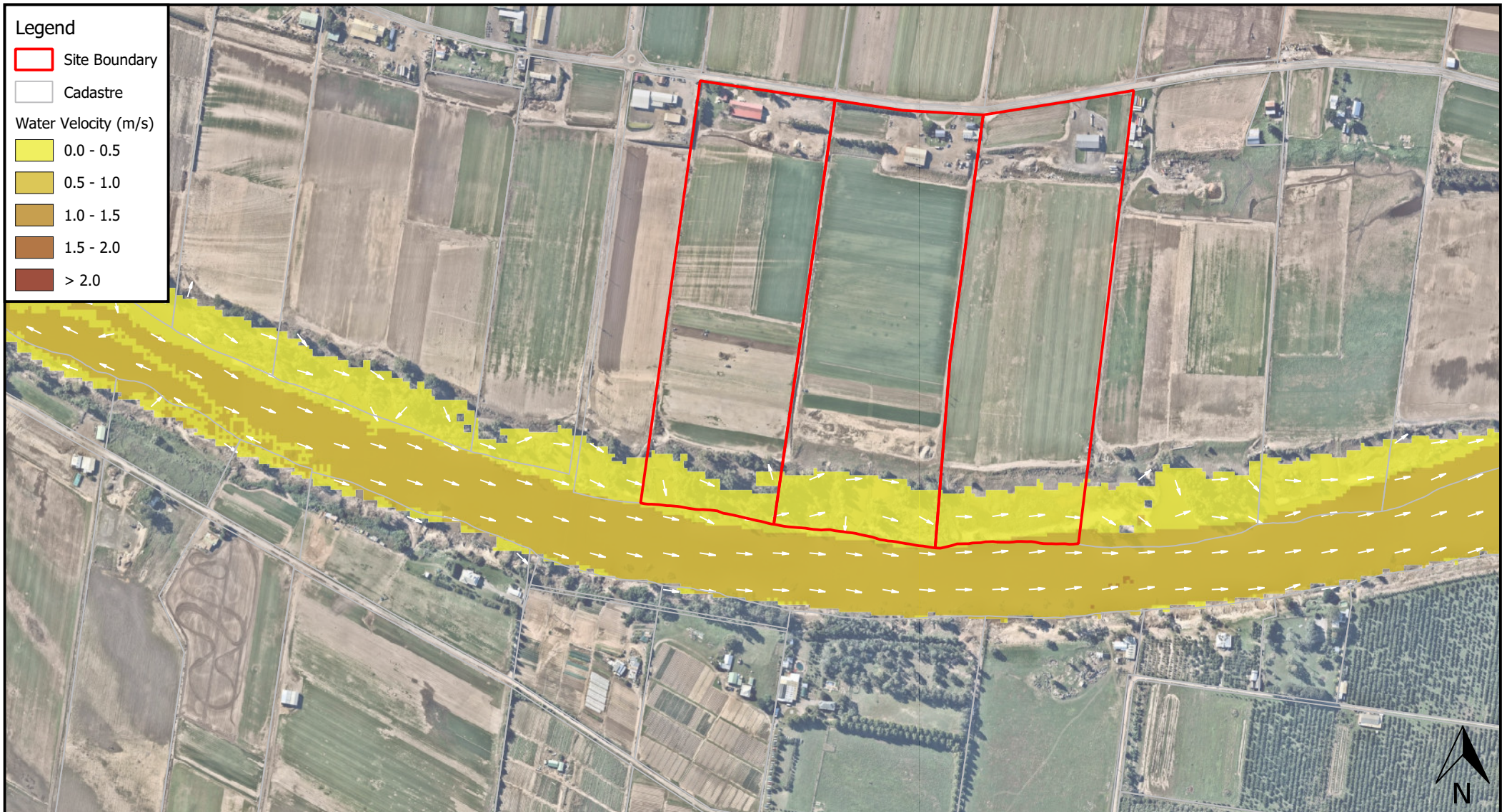
0 200 400 600 800 1000 m

1:25000 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
 Calibration Locations





0 80 160 240 320 400 m

1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**2 EY Critical Duration Storm
 Existing Condition - Water Velocity**

Map 03

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

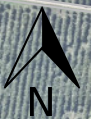
Proposed Sand Extraction Facility

Flood Assessment

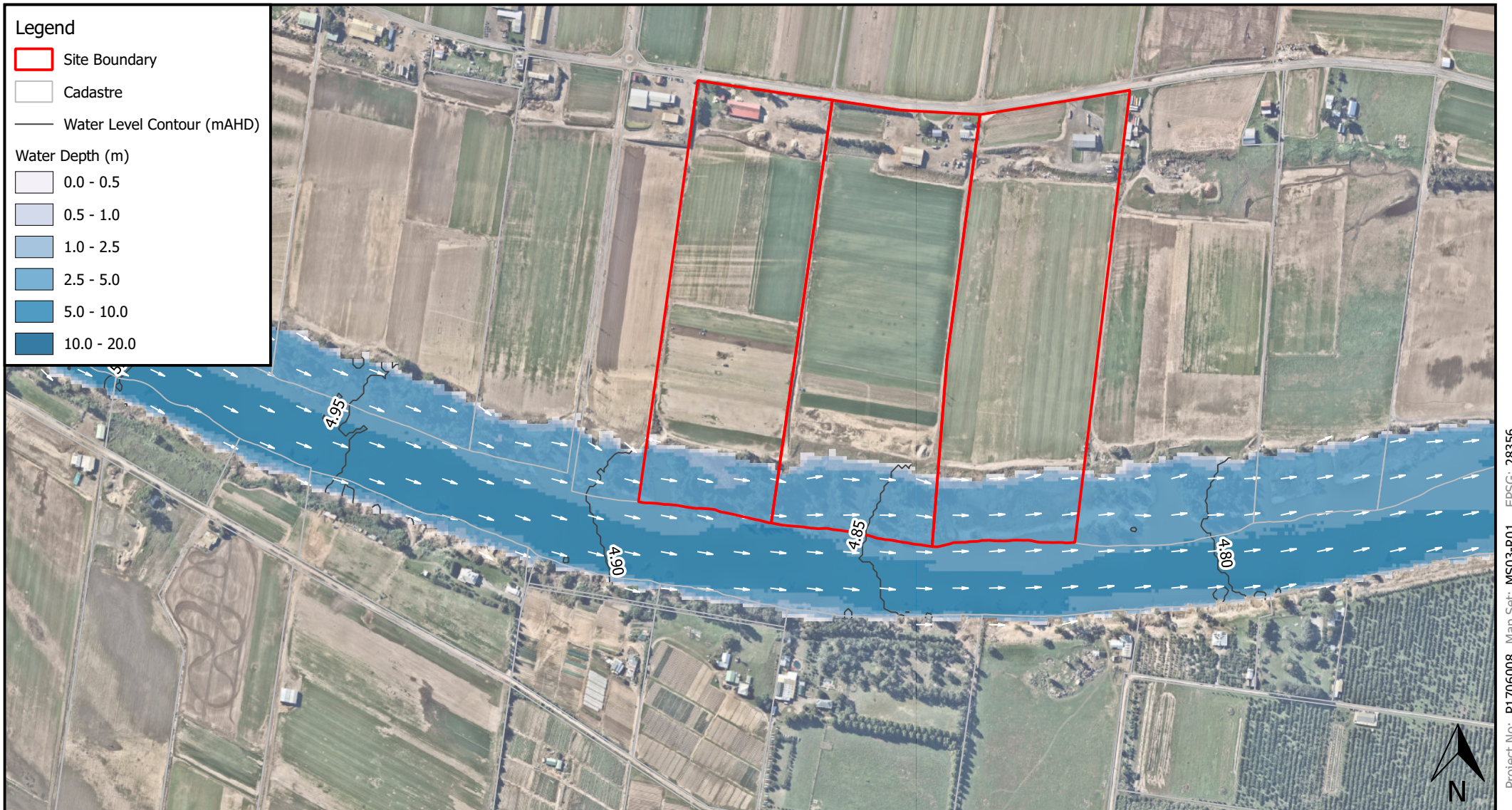
Greener Lawn Supplies Ltd

27/07/2021

Project No: P1706008 Map Set: MS03-R01 EPSG: 28356



Map
 Site
 Project
 Sub-Project
 Client
 Date



0 80 160 240 320 400 m

1:7500 @ A4

Notes:
1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**50% AEP Critical Duration Storm
Existing Condition - Water Level & Water Depth**

Map 04 Map

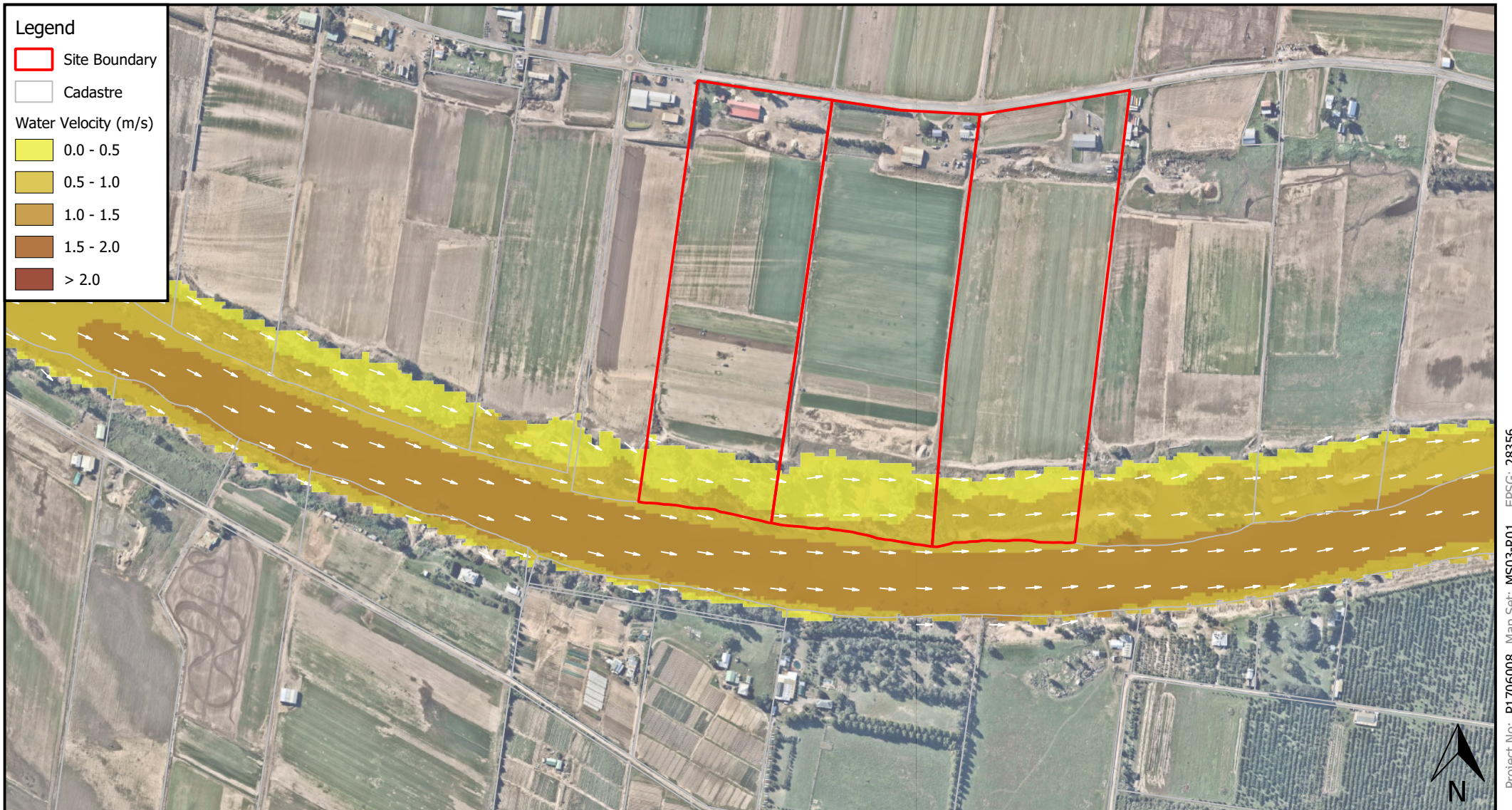
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW Site

Proposed Sand Extraction Facility Project

Flood Assessment Sub-Project

Greener Lawn Supplies Ltd Client

27/07/2021 Date



0 80 160 240 320 400 m

1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
 50% AEP Critical Duration Storm
 Existing Condition - Water Velocity

Map 05

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

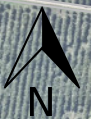
Proposed Sand Extraction Facility

Flood Assessment

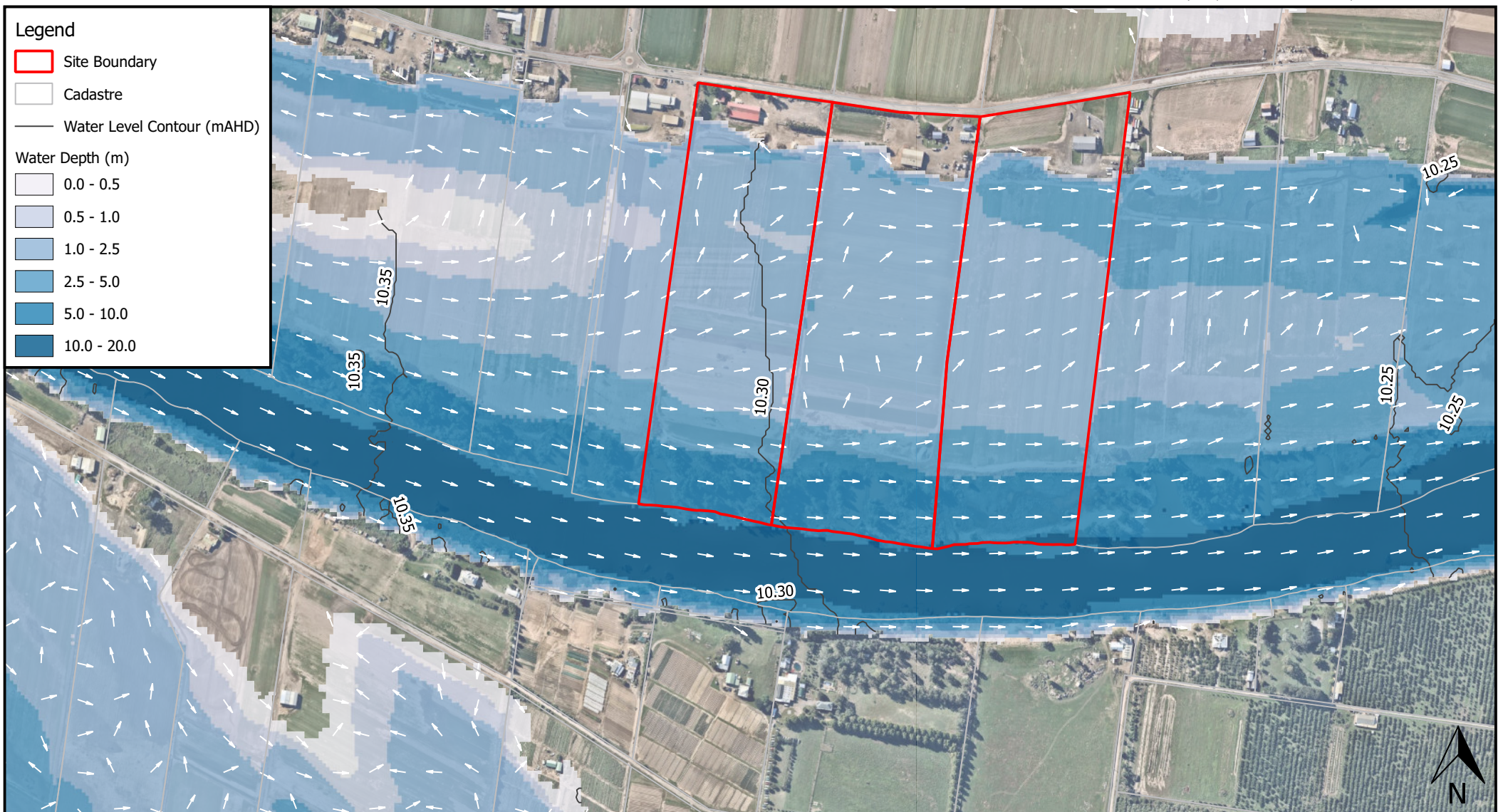
Greener Lawn Supplies Ltd

27/07/2021

Project No: P1706008 Map Set: MS03-R01 EPSG: 28356



Map
 Site
 Project
 Sub-Project
 Client
 Date



0 80 160 240 320 400 m

1:7500 @ A4

Notes:
1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**20% AEP Critical Duration Storm
Existing Condition - Water Level & Water Depth**

Map 06

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

Flood Assessment

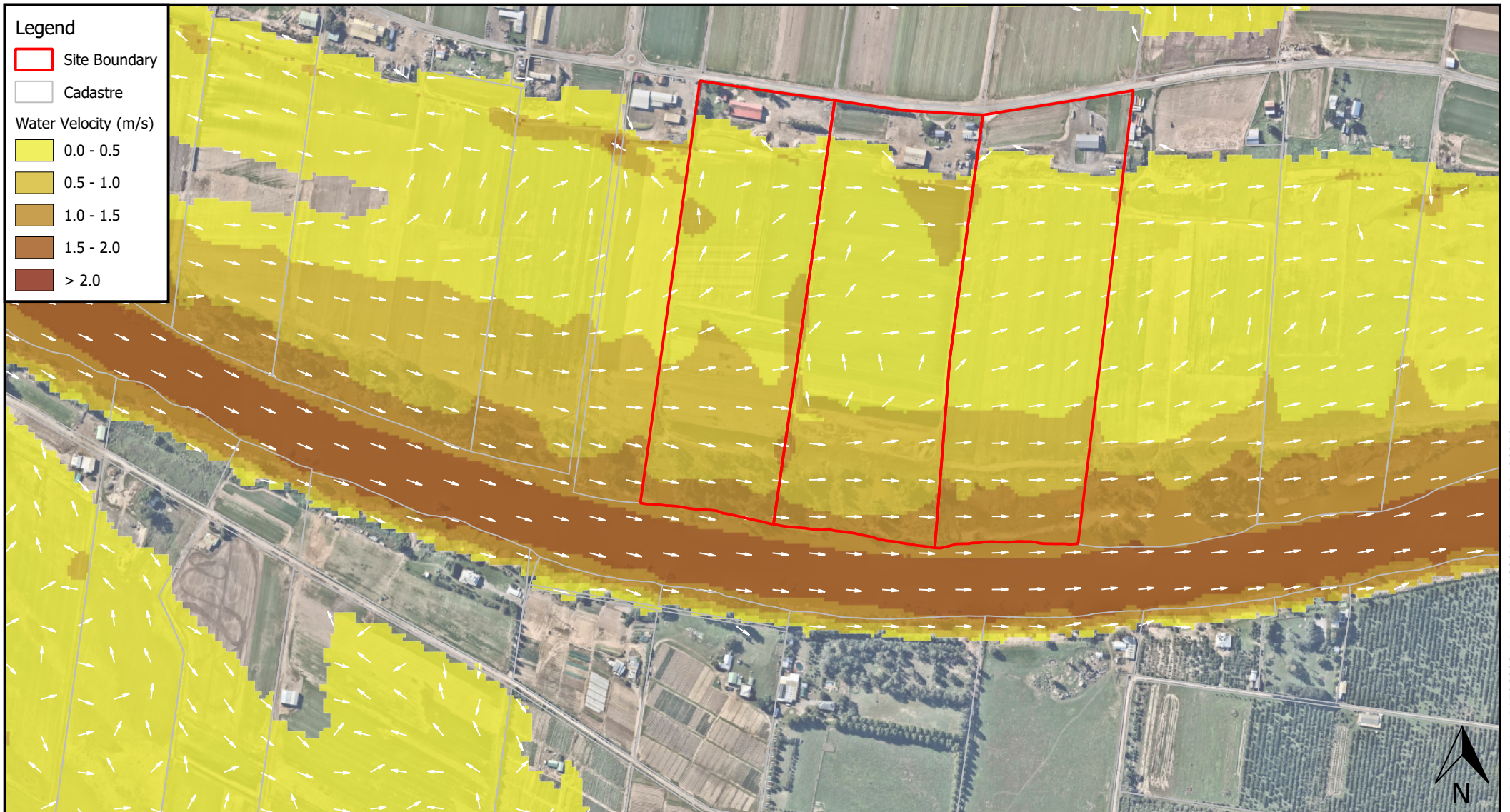
Greener Lawn Supplies Ltd

27/07/2021

Project No: P1706008 Map Set: MS03-R01 EPSG: 28356



Map
Site
Project
Sub-Project
Client
Date



1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
 20% AEP Critical Duration Storm
 Existing Condition - Water Velocity

Map 07

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

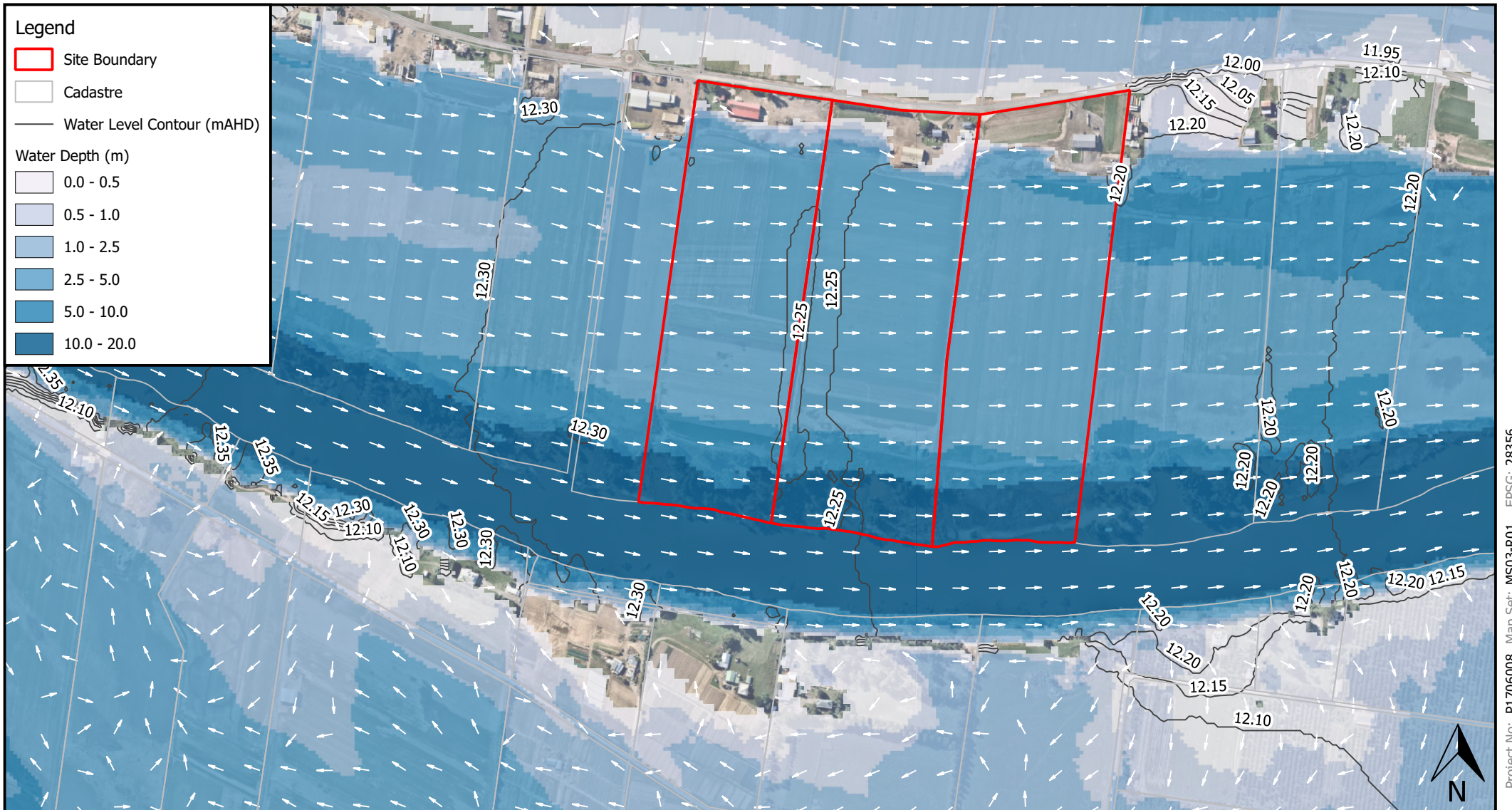
Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021

Project No: P1706008 Map Set: MS03-R01 EPSG: 28356

Map
 Site
 Project
 Sub-Project
 Client
 Date



0 80 160 240 320 400 m

1:7500 @ A4

Notes:
1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**10% AEP Critical Duration Storm
Existing Condition - Water Level & Water Depth**

Map 08

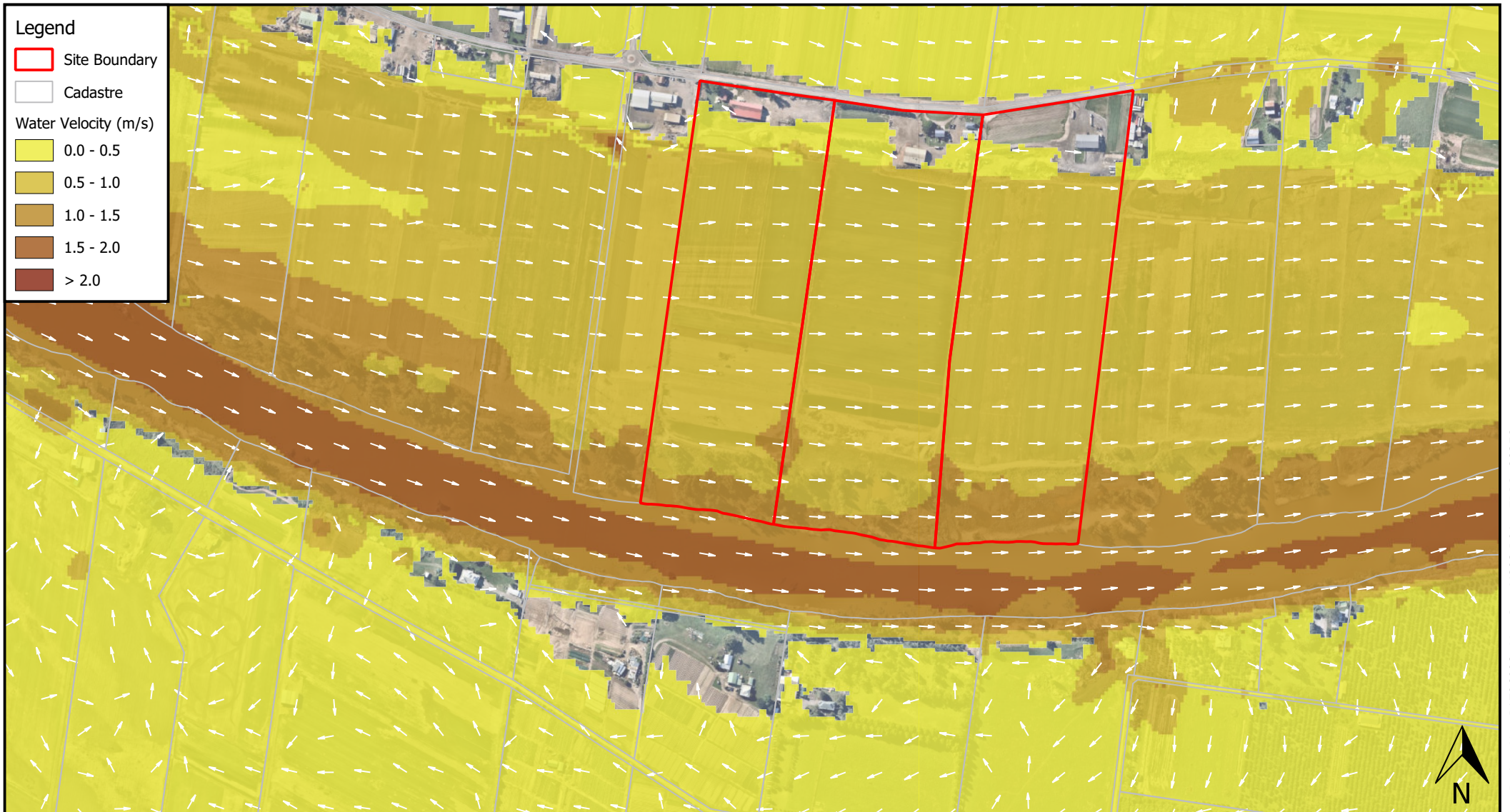
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

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1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
 10% AEP Critical Duration Storm
 Existing Condition - Water Velocity

Map 09

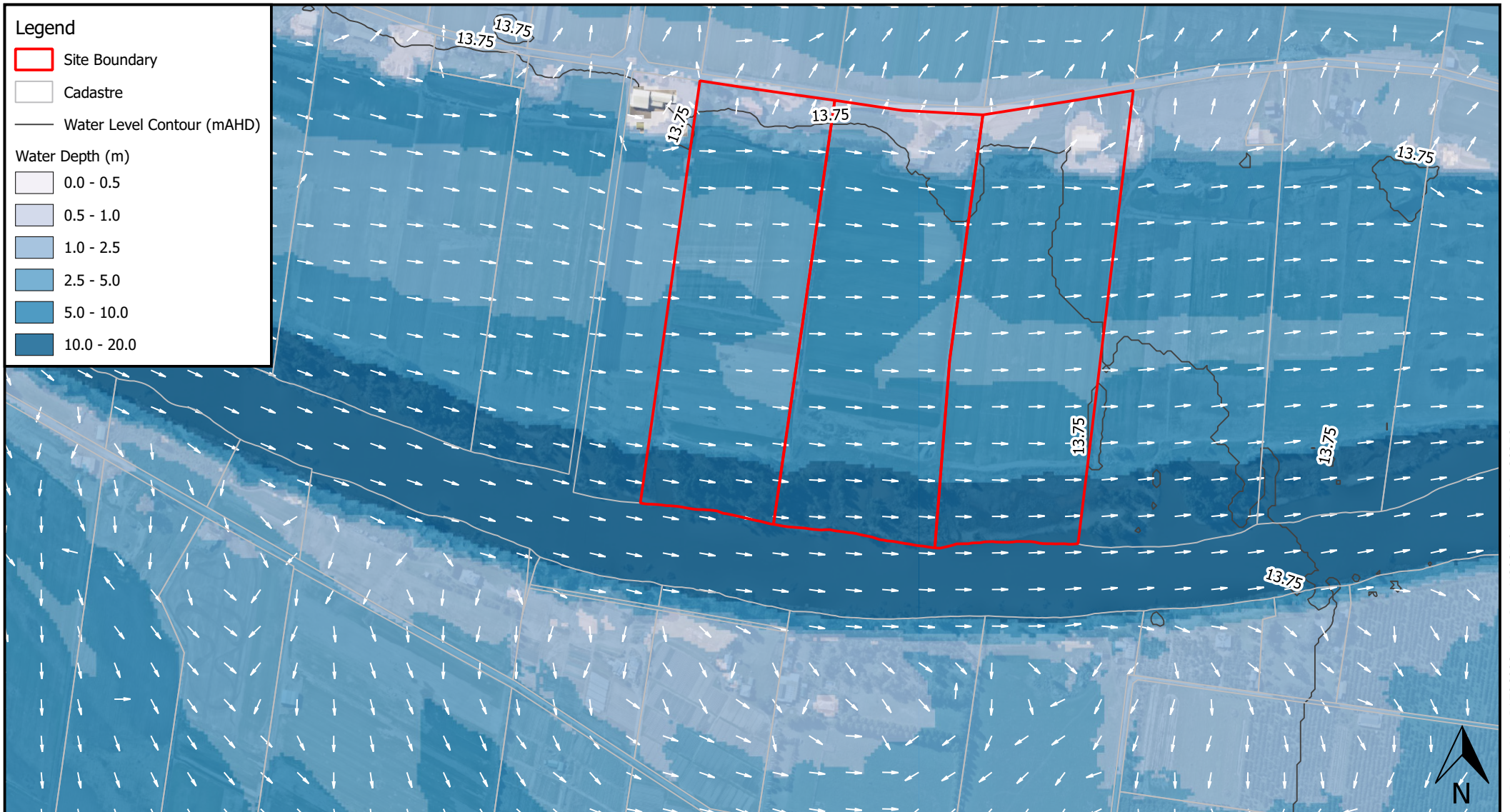
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021



0 80 160 240 320 400 m

1:7500 @ A4

Notes:
1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**5% AEP Critical Duration Storm
Existing Condition - Water Level & Water Depth**

Map 10

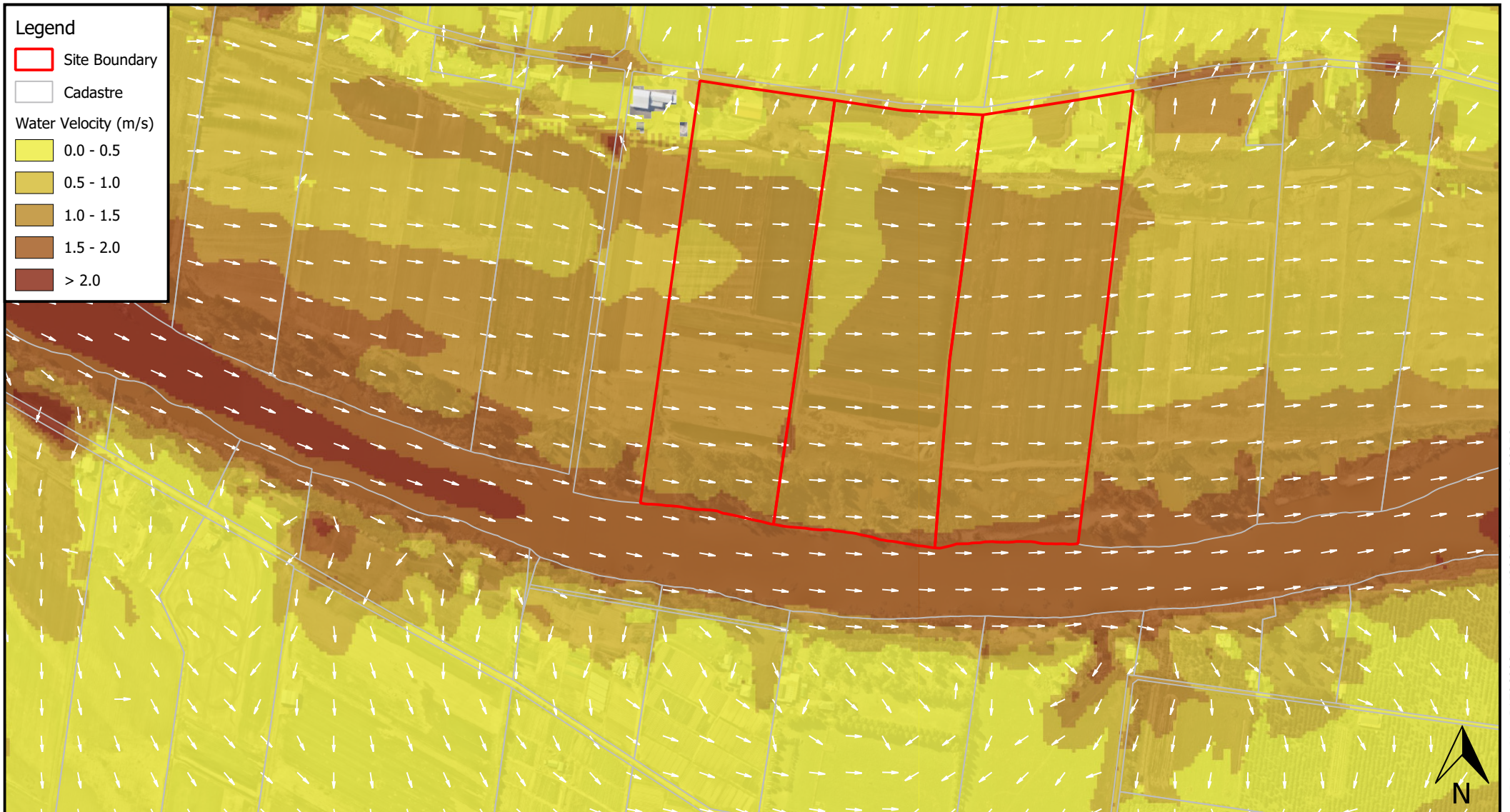
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

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0 80 160 240 320 400 m

1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
5% AEP Critical Duration Storm
Existing Condition - Water Velocity

Map 11

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

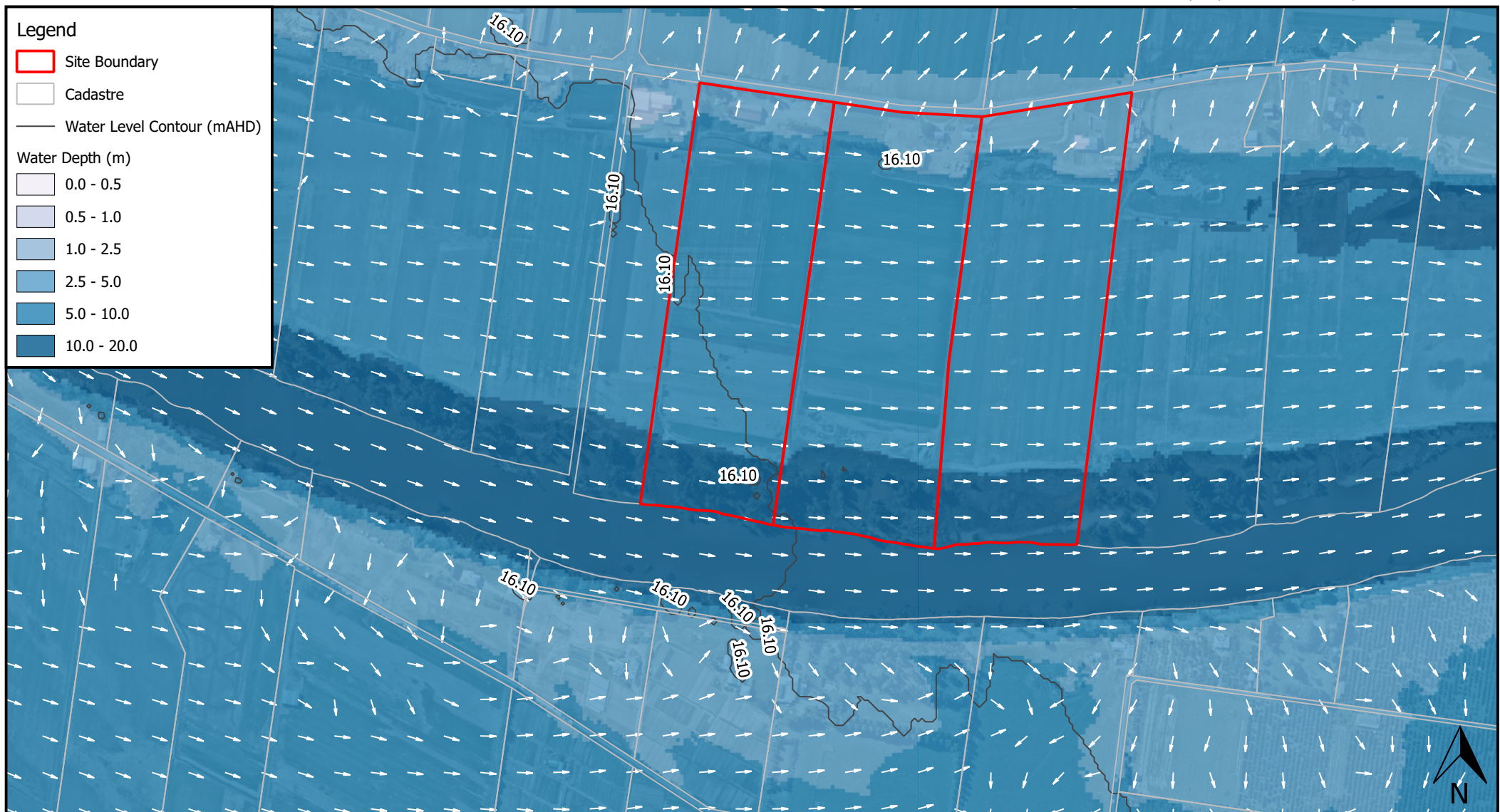
Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021





0 80 160 240 320 400 m

1:7500 @ A4

Notes:

1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**2% AEP Critical Duration Storm
Existing Condition - Water Level & Water Depth**

Map 12

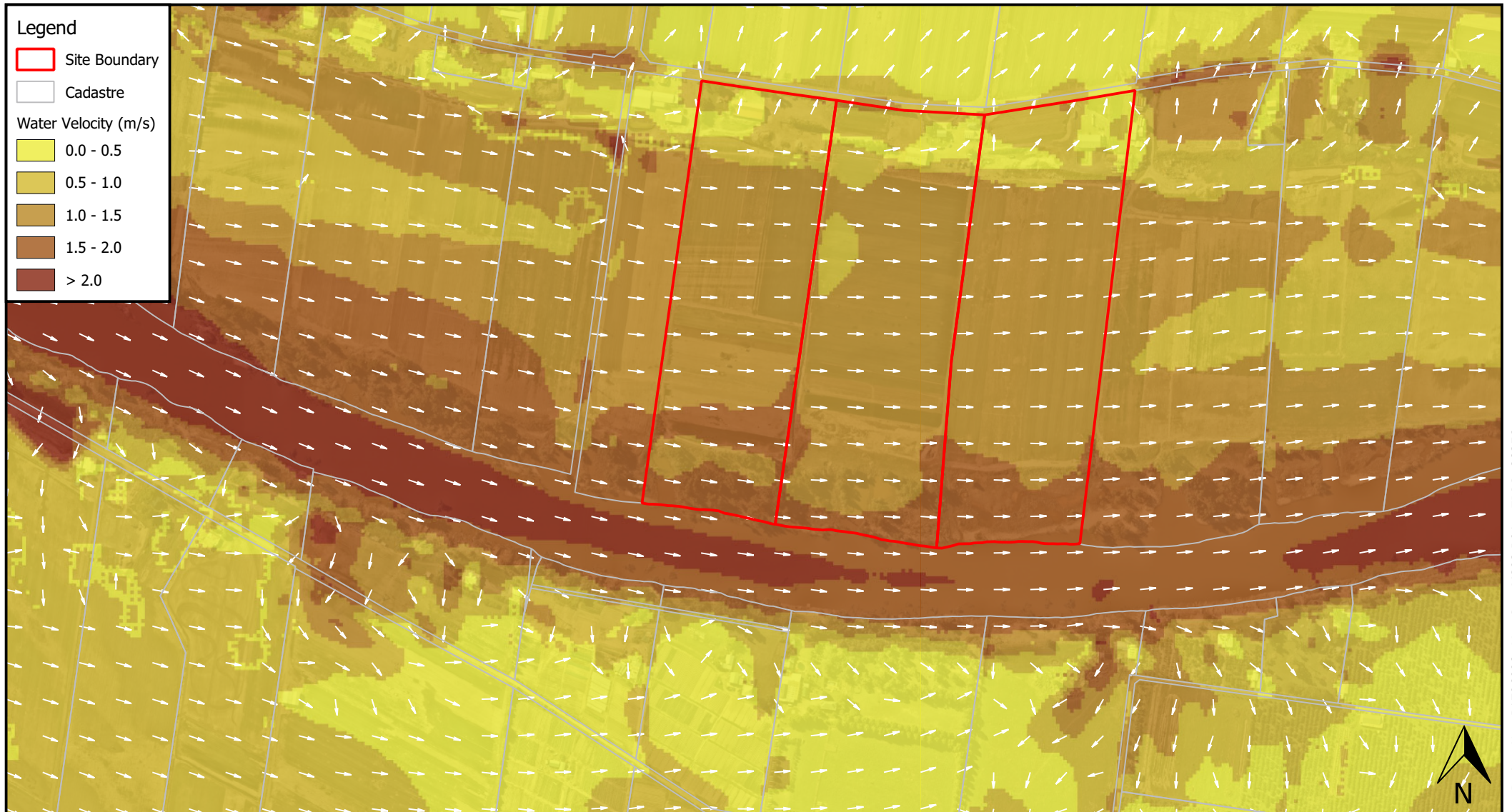
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

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0 80 160 240 320 400 m

1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**2% AEP Critical Duration Storm
 Existing Condition - Water Velocity**

Map 13

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

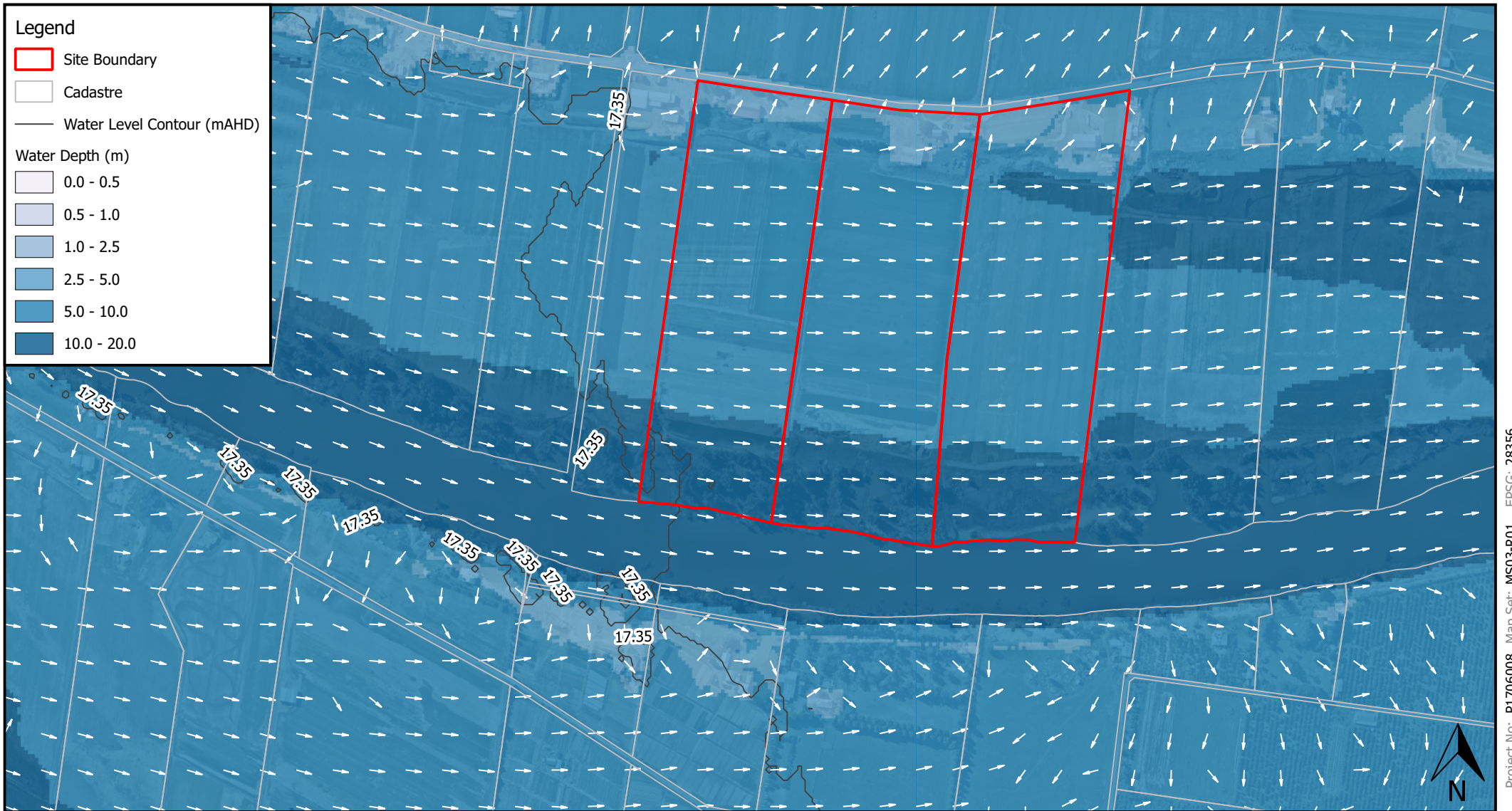
Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021





0 80 160 240 320 400 m

1:7500 @ A4

- Notes:
1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
**1% AEP Critical Duration Storm
Existing Condition - Water Level & Water Depth**

Map 14

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

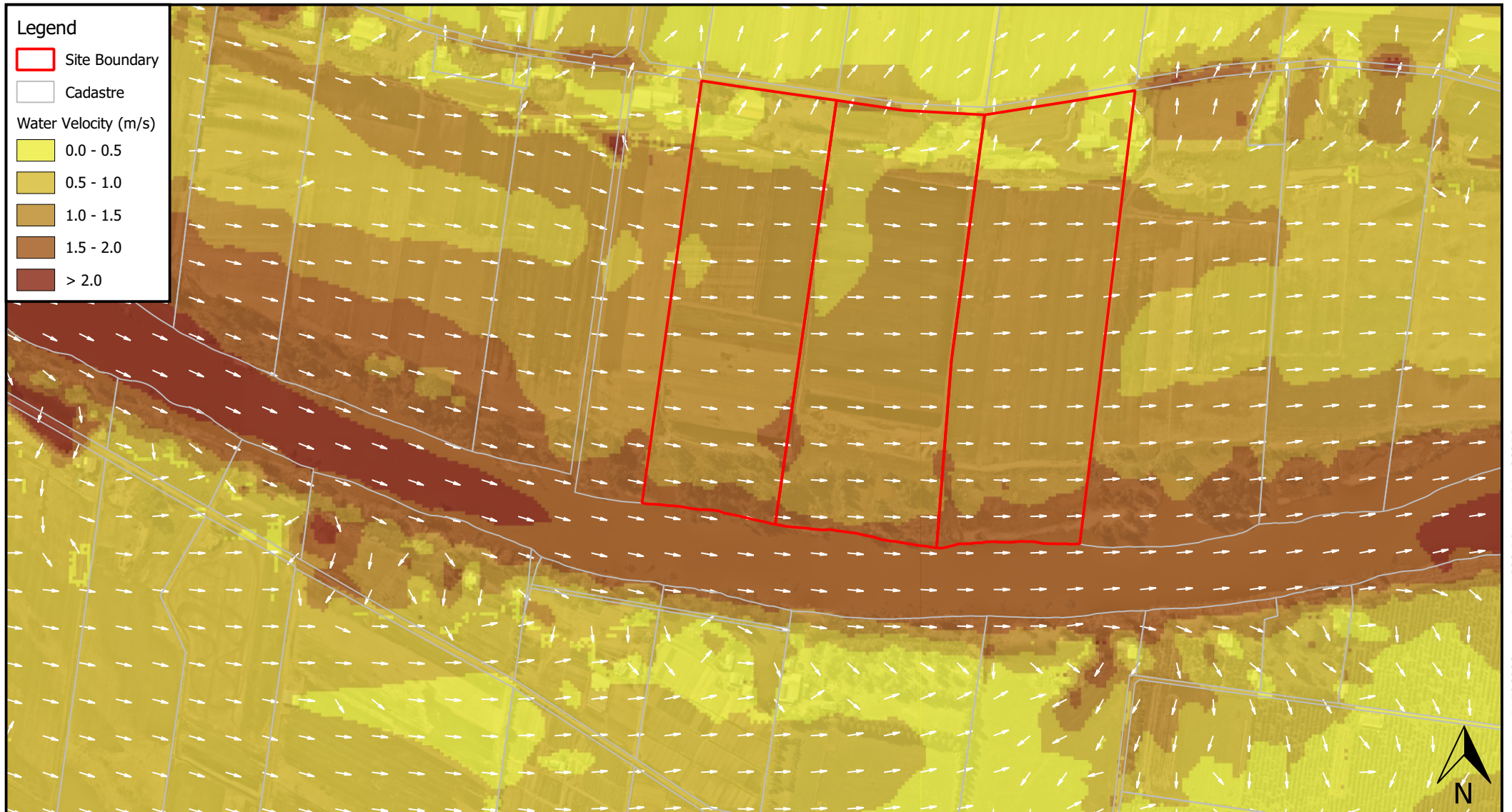
Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021





0 80 160 240 320 400 m

1:7500 @ A4

Notes:
 1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).

Map Title / Figure:
 1% AEP Critical Duration Storm
 Existing Condition - Water Velocity

Map 15 Map

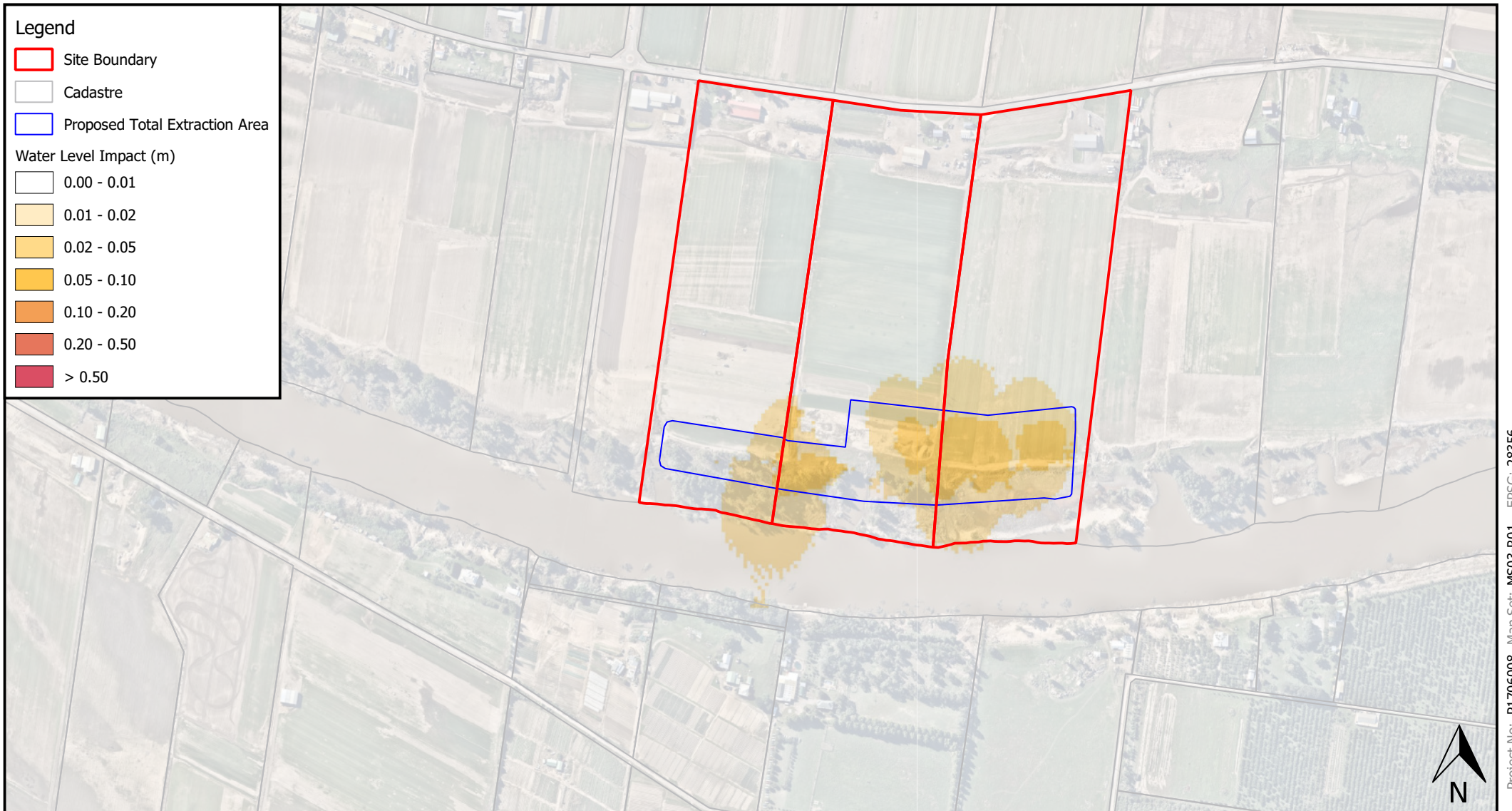
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW Site

Proposed Sand Extraction Facility Project

Flood Assessment Sub-Project

Greener Lawn Supplies Ltd Client

27/07/2021 Date



0 80 160 240 320 400 m

1:7500 @ A4

Notes:

1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).
3. Results show the peak impact across all modelled AEP events for Scenarios RD-2 to RD-7 (refer to Section 3.2 of the letter P1706008JC31V01).

Map Title / Figure:
Aggregated Peak Water Level Impacts Across all Development Stages & Flood Events
Rehabilitation is to Design Surface

Map 16

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

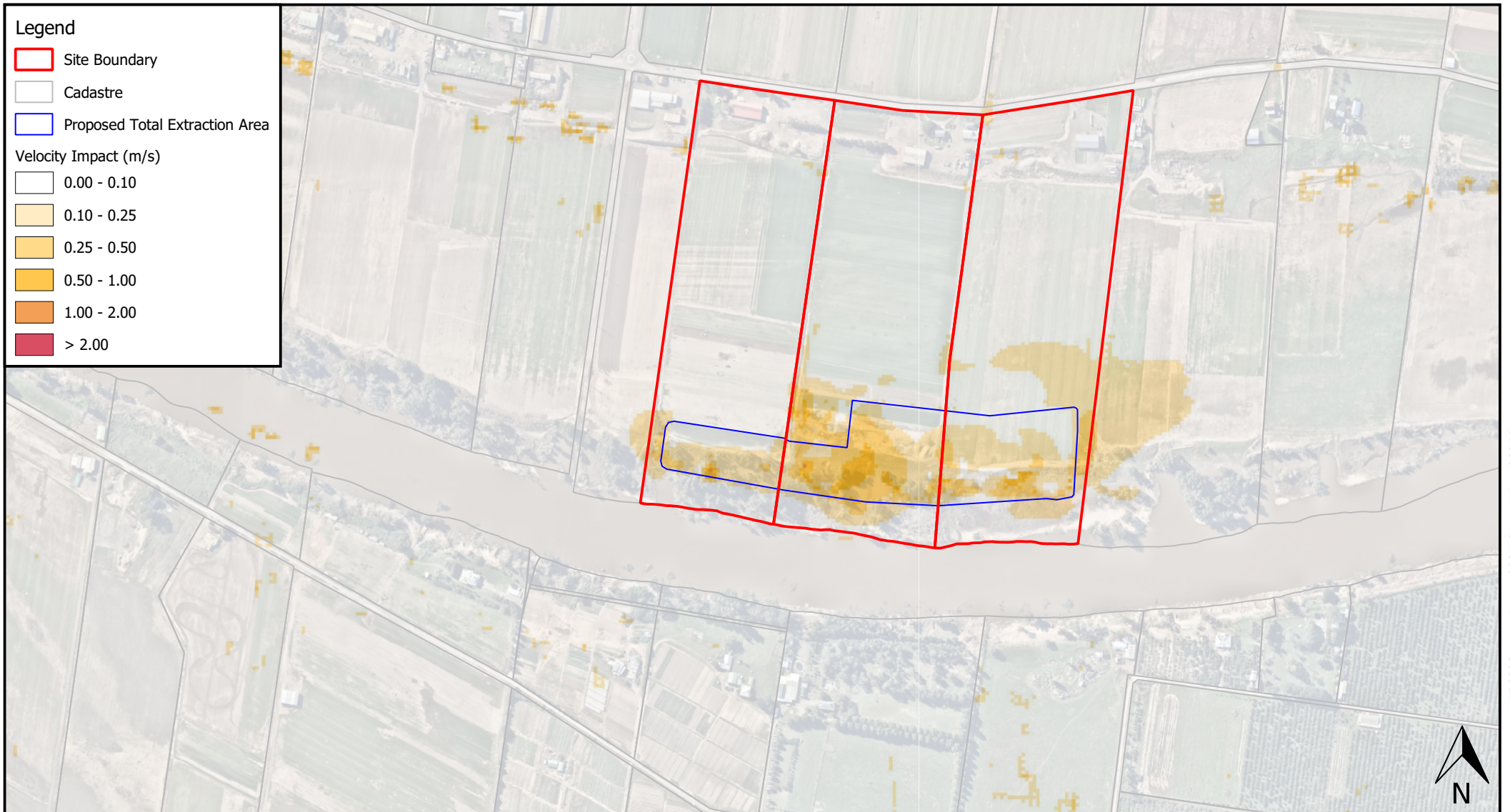
Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021





0 80 160 240 320 400 m

1:7500 @ A4

Notes:

1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).
3. Results show the peak impact across all modelled AEP events for Scenarios RD-2 to RD-7 (refer to Section 3.2 of the letter P1706008JC31V01).

Map Title / Figure:
Aggregated Peak Velocity Impacts Across all Development Stages & Flood Events
Rehabilitation is to Design Surface

Map 17

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

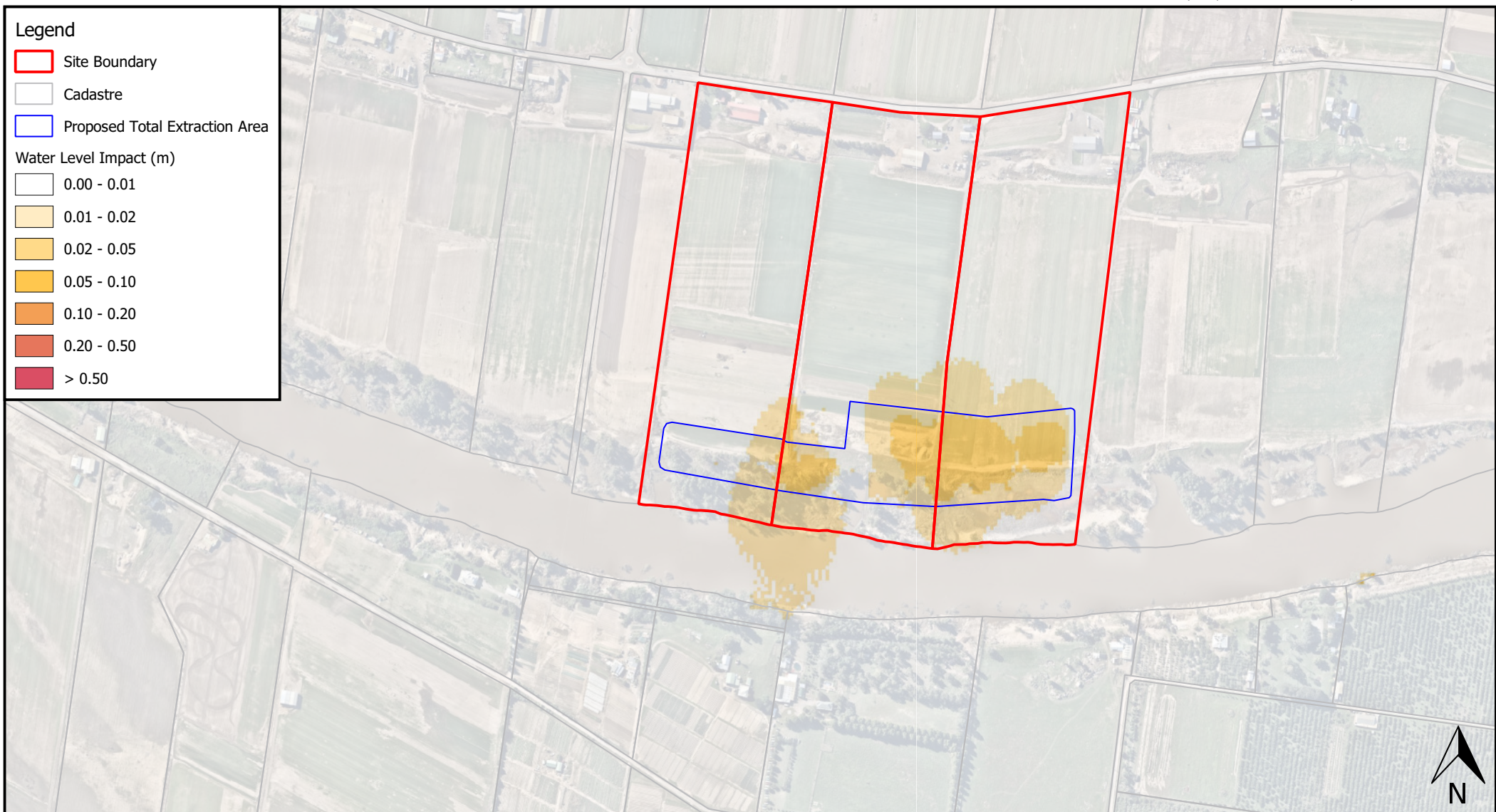
Proposed Sand Extraction Facility

Flood Assessment

Greener Lawn Supplies Ltd

27/07/2021





Legend

Site Boundary

Cadastral

Proposed Total Extraction Area

Water Level Impact (m)

0.00 - 0.01

0.01 - 0.02

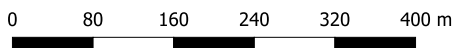
0.02 - 0.05

0.05 - 0.10

0.10 - 0.20

0.20 - 0.50

> 0.50

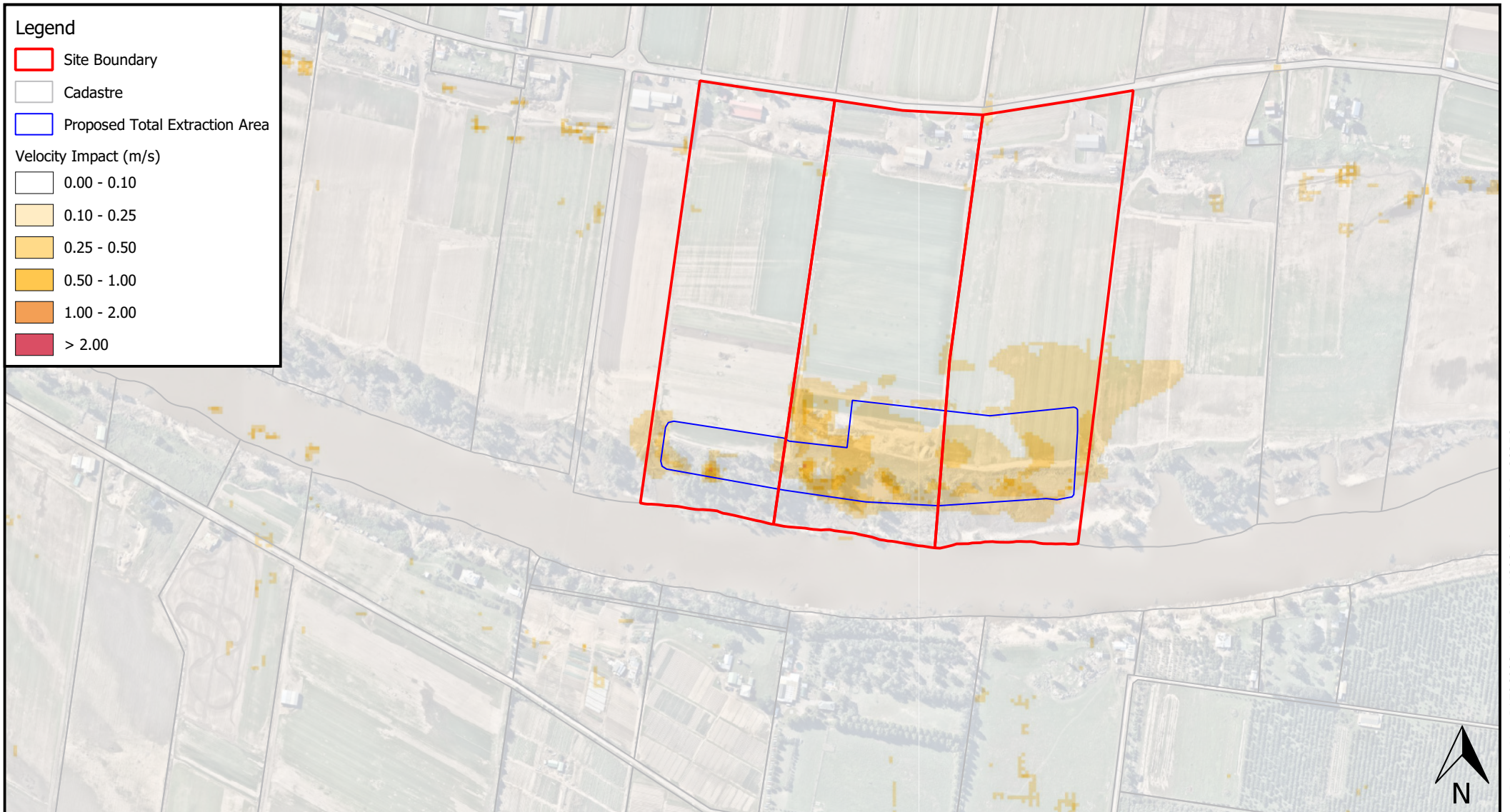


1:7500 @ A4

- Notes:
1. Aerial image from Nearmap (2021).
 2. Cadastral boundaries from SIX Maps Clip and Ship (2019).
 3. Results show the peak impact across all modelled AEP events for Scenarios RE-2 to RE-7 (refer to Section 3.2 of the letter P1706008JC31V01).

Map Title / Figure:
Aggregated Peak Water Level Impacts Across all Development Stages & Flood Events
Rehabilitation is to Existing Surface

Map 18	Map
374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW	Site
Proposed Sand Extraction Facility	Project
Flood Assessment	Sub-Project
Greener Lawn Supplies Ltd	Client
27/07/2021	Date



0 80 160 240 320 400 m

1:7500 @ A4

Notes:

1. Aerial image from Nearmap (2021).
2. Cadastral boundaries from SIX Maps Clip and Ship (2019).
3. Results show the peak impact across all modelled AEP events for Scenarios RE-2 to RE-7 (refer to Section 3.2 of the letter P1706008JC31V01).

Map Title / Figure:
Aggregated Peak Velocity Impacts Across all Development Stages & Flood Events
Rehabilitation is to Existing Surface

Map 19

374, 395 & 415 Freemans Reach Road, Freemans Reach, NSW

Proposed Sand Extraction Facility

Flood Assessment

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