Contact
Jeff Fulton

Our Ref
P1806743JC03V01

Pages
6 + Attachment

19 September 2022

Mitchell McCormac
Terara Shoalhaven Sand
By email

Dear Mitchell,

RE: SUPPLEMENTARY FLOOD ASSESSMENT IN RESPONSE TO SHOALHAVEN CITY COUNCIL REQUEST FOR FURTHER INFORMATION – PROPOSED EXPANSION OF SAND EXTRACTION AT PIG ISLAND, TERARA, NSW

1 Introduction

Martens and Associates (**MA**) have prepared this response on behalf of Terara Shoalhaven Sand (the **Proponent**) to address the flood related items in the Request for Further Information (**RFI**) from Shoalhaven City Council (**Council**, dated 19 April 2022, REF: RA21/1000) in relation to a proposed expansion of sand extraction at Pig Island, Terara, NSW (the **Site**).

This letter includes the following information to address the Council's RFI comments with respect to flooding:

1. Updates to hydraulic model.
2. Updated flood impact maps and discussion.
3. MA response to Council flood related RFI comments 8a) to j).

This letter should be read in conjunction with the following:

1. The MA report *Flood Assessment: Proposed Expansion of Sand Extraction Operations at Terara Sands, Terara, NSW* (2019: REF: P1806743JR04V02, the **Flood Report**); and
2. The MA letter report *Flood Assessment – Proposed Livestock Refuge Mounds, Pig Island, Terara, NSW* (2020, REF: P1404280JC01V02, the **Flood Letter**), which updated the Flood Report to include the proposed livestock fill mounds.

2 Hydraulic Modelling Updates

Full flood assessment details can be found in the Flood Report including site description, hydrologic and hydraulic model setup, flooding characteristics and compliance with Secretary's Environmental Assessment Requirements (**SEARs**). Following the hydraulic modelling of the proposed expanded extraction area, the livestock fill mounds were included as part of the proposed development, and flood impacts were assessed in the Flood Letter.

Following from these two previous flood assessments, as part of this response, the locations of the proposed livestock fill mounds have been amended slightly to satisfy the requirement to maintain a 25 m distance from the swamp oaks on Burraga Island / Pig Island. The top of mound levels have been designed to be just above the peak 1% annual exceedance probability (**AEP**) flood levels. The updated mound locations are shown in Attachment A and revised details of fill levels, areas and volumes in each lot are summarised in Table 1.

Table 1: Updated approximate levels, volumes and areas of proposed livestock fill mounds.

Parameter	Lot 2 Fill Pad	Lot 3 Fill Pad	Lot 4 Fill Pad
Top of Mound Level (mAHD)	5.8	5.6	5.6
Area (m^2)	11,300	28,400	29,800
Volume (m^3)	19,800	79,800	94,200

The mounds were included in the proposed conditions model as z-polygon modifications as outlined in the Flood Letter, and were iteratively sized and oriented within each lot to achieve acceptable offsite flood impacts. All other elements of the model setup remained consistent with the Flood Report.

3 Flood Results

Flood mapping results (flood levels, depths, velocities and provisional hazard categories) for the critical duration 10%, 1%, 0.5%, 0.2% AEP flood event and probable maximum flood (**PMF**) events in existing conditions are provided in the Flood Letter. Proposed condition water level and velocity afflux maps arising from the new mound locations are shown in Attachment A, with drawing references summarised in Table 2. The water level afflux results in Attachment A supersede those previously provided in the Flood Letter.

Table 2: Proposed condition flood map drawing references in Attachment A (MA MapSet P1806743MS02).

Critical Duration Flood Event	Water Level Afflux	Water Velocity Afflux
10% AEP	Map FL01	Map FL02
1% AEP	Map FL03	Map FL04
0.5% AEP	Map FL05	Map FL06
0.2% AEP	Map FL07	Map FL08
PMF	Map FL09	Map FL10

3.1 Water Level Offsite Impacts

We note the following regarding water level offsite impacts:

1. The proposed development has negligible offsite water level impacts in all modelled flood events up to and including the PMF.

2. For the purposes of this assessment, the adopted threshold of no flood impact is 20 mm of water level increase up to and including the 1% AEP event, and 50 mm of water level increase up to and including the PMF event. This is consistent with the flood level impact thresholds adopted and approved in several recent NSW Land and Environment Court

proceedings and Section 34 mediation conferences in which MA have been involved as flood experts. It is also explicitly adopted in some DCPs (eg. Blacktown). We note there are no criteria documented for flood impacts in the Shoalhaven City Council DCP.

3. Consistent with the Flood Letter, there are no offsite impacts above 20 mm on private land for all events up to and including the 0.2% AEP event. All flood level impacts above 20 mm are fully contained within the banks of the Shoalhaven River and will not affect adjoining land holders.

4. There are areas of offsite flood level increase between 20-50 mm north and south of Pig Island in the PMF event. These impacts are immaterial considering the existing conditions flood depths in the PMF (3.7-7.9 m) and the likelihood of this event occurring being extremely rare.

5. As requested by Council, flood level afflux maps have been prepared to show a threshold of ± 5 mm. Although the proposed development causes flood levels to increase greater than 5 mm within private property in all modelled events, MA consider these impacts are acceptable. 5 mm is an insignificant change in flood level, especially in the context of the existing condition flood depths in the area, which are up to 2.1 m in the 10% AEP event and 9.2 m in the PMF event. Further, the proposed development does not cause any lots to become newly flood affected. A 5 mm water level change is also within the resolution of the model and should not be considered an actionable impact.

6. These flood level impacts are of immaterial significance and are considered acceptable.

3.2 Water Velocity Offsite Flood Impacts

We note the following regarding velocity impacts:

1. The proposed development has negligible offsite impact on water velocities in all modelled flood events up to and including the PMF event.

2. In all modelled events, flood velocity impacts are largely contained within the banks of the Shoalhaven River and do not affect private property.

3. In the 10% AEP event there are no flood velocity increases above 0.1 m/s on private property.

4. In the 1% AEP, 0.5% AEP and 0.2% AEP, there is only one private lot affected by velocity increases above 0.1 m/s. The Supagas Bomaderry processing facility north west of Pig Island is affected by velocity increases of up to 0.18 m/s in these events. This is of immaterial significance considering the existing conditions velocities on the site (up to 1.3 m/s in these events).

7. In the PMF event, several lots are affected by up to 0.10-0.20 m/s velocity increase south of Pig Island, and several lots are affected by 0.10-0.45 m/s velocity increase north of Pig Island. These impacts are immaterial considering the existing conditions flood velocities in the PMF (1.2-4.4 m/s) and the extremely rare probability of this event occurring.

5. Whilst modelling indicates some localised flow velocity increases in extreme flood events, these are primarily contained within the channel and are not aligned with significant

channel bank flow velocity increases. Modelling therefore supports the proposition that bank shear stresses will not be materially increased such that bank erosion will be initiated.

4 Response to Council Comments

Council have provided flood specific comments from 8a) to j) in their RFI letter. Table 3 provides responses to the flood specific matters raised in Council's RFI letter.

Table 3: MA response to flood specific matters raised Council RFI comments.

Comment from Council RFI	MA Response
8. Flooding Afflux to Coastal Villages *Flood Assessment: Proposed Expansion of Sand Extraction Operations at Terara Sands, Terara, NSW (Martens Consulting Engineers, Feb 2019).*	
a) The report identifies that "Flood level changes are negligible in all events assessed, and increases greater than 20 mm are wholly located within the banks of the Shoalhaven River and do not extend outside the river banks". Further clarification is required as to whether exiting properties within the Lower Shoalhaven River floodplain would experience a 20mm increase in flood levels as a result of the proposed expanded dredge area. It is considered that areas with no impact should be identified with a smaller level difference such as +/- 5mm.	(1) See Attachment A Map FL01, Map FL03, Map FL05, Map FL07 & Map FL09 for the updated water level afflux in each event. As discussed in Section 3.1, MA consider any changes < 20-50 mm to be acceptable. 5 mm water level change is insignificant compared to the existing conditions water depths, and the proposed development does not cause any lots to become newly flood affected. There is no requirement in Council's LEP or DCP to comply with a water level change of < 5 mm. Further, there are no offsite impacts above 20 mm on private land for all events up to and including the 0.2% AEP event, and no offsite impacts above 50 mm on private land in the PMF. Therefore, the proposed development flood level impacts are considered acceptable.
b) Section 5.8 identifies that "Large flood events and high flood velocities can lead to erosion, scour and sedimentation. However, the proposal has a negligible effect on local flood velocities, hence there is no increased potential for land degradation. This includes the Shoalhaven River banks and levees, which modelling demonstrates will be immaterially affected by the proposal". This comment does not address Councils concerns raised with regard to the potential geomorphological impacts of the expanded dredge area on the structural integrity of the existing flood levee.	(2) In existing conditions, flood velocities at the existing flood levee on the southern bank of the Shoalhaven River range between 0.3-2.0 m/s in the 10% AEP event, and are as high as 1.4-7.3 m/s in the PMF event. In proposed conditions, velocity changes at the levee are < 0.1 m/s in all events up to and including the 0.2% AEP flood, and are 0.10-0.17 m/s in the PMF event. These changes in flood velocity are negligible compared to the existing conditions velocities, and hence there will not be any increased risk to the structural integrity of the flood levee.
c) The report identifies that the expanded dredge area would result in negligible changes to flood velocities, hazard and hydraulic categories. It is however noted that no velocity difference maps have been provided. Velocity difference maps are required for the full range of flood events modelled.	(3) See Attachment A Map FL02, Map FL04, Map FL06, Map FL08 & Map FL10 for flood velocity afflux in each event. As discussed at Section 3.2, increases above 0.5 m/s are wholly contained within the Shoalhaven River corridor in all events up to the PMF event. Although velocities in the PMF increase by up to 0.45 m/s in private property, this change is acceptable given the high velocities in the affected area (> 3.1 m/s in existing conditions) and the event's extremely low probability of occurrence.

Comment from Council RFI	MA Response
d) *This Flood Assessment does not include the proposed stock mounds on Pig Island. These stock mounds are required to be included in the modelling to demonstrate no adverse flood impacts.*	(4) This updated flood assessment includes the proposed stock mounds on Pig Island as shown in the flood maps shown in Attachment A.
Flood Assessment – Proposed Livestock Refuge Mounds, Pig Island, Terara, NSW (Martens Consulting Engineers, August 2020).	
e) *The report identifies that the proposed livestock mounds were sized and orientated within each lot to ensure acceptable offsite flood impacts (identified as less than 20mm flood level change). However the 10% AEP event water level afflux map shows a significant area with flood level increases of up to 50mm extending to be within close proximity of the Terara village. The 1% and 0.5% AEP event water level afflux maps shows a large area with flood level increases up to 50mm impacting private property on the northern bank of the Shoalhaven River. As per the previous comments, further clarification is required as to whether exiting properties within the Lower Shoalhaven River floodplain would experience a 20mm increase in flood levels as a result of the proposed expanded dredge area. It is considered that areas with no impact should be identified with a smaller level difference such as +/- 5mm. This information is required to determine if the potential flood impacts are acceptable.*	(5) See response (1). Further, see Attachment A Map FL11 which shows an overlay of all the mound locations tested in the TUFLOW model. A large number of iterations were undertaken to maximise mound area whilst minimising offsite flood impacts, and we consider the latest proposed mound locations achieve these criteria.
f) *A PMF water level afflux map has not been provided and is required.*	(6) See Attachment A Map FL09 and Map FL10 for the PMF water level and velocity afflux maps respectively.
g) *The report identifies that the proposed livestock mounds were designed to be floodfree in a 1% AEP event however the mapping shows these areas also flood-free in a 0.5% AEP event. The design event level of service and any proposed freeboard needs to be clarified.*	(7) The top of fill mound levels were designed to be just above the 1% AEP flood level with an adopted freeboard of approximately 100 mm. Based on the updated flood model that incorporates the new fill mound locations, the design event for the mounds were linearly interpolated and are as follows: - 1 in 168 year ARI for the mound in Lot 2 - 1 in 161 year ARI for the mound in Lot 3 - 1 in 221 year ARI for the mound in Lot 4 Consistent with the Flood Letter previously submitted, the proposed livestock mounds remain flood free in the 1% AEP event.
h) *The report identifies that the expanded dredge area would result in negligible changes to flood velocities, hazard and hydraulic categories. It is however noted that no velocity difference maps have been provided. Velocity difference maps are required for the full range of flood events modelled.*	(8) See Attachment A Map FL02, Map FL04, Map FL06, Map FL08 & Map FL10 for the full range of velocity afflux maps.

Comment from Council RFI	MA Response
i) *The proposed location of livestock mounds in Lots 2, 3 and 4 vary in their north-south position which presents an increased overall total flow width obstruction. Clarification is required as to whether these mound locations could be adjusted to provide a reduced flow width obstruction.*	(9) See response (5).
j) *The report identifies that the proposed livestock refuge mound footprints have been maximised to avoid offsite flood level impacts, defined as afflux exceeding 20mm. The Shoalhaven River and Pig Island comprises a floodway hydraulic category. The NSW Floodplain Development Manual identifies floodways as areas that even if only partially blocked would cause a significant increase in flood levels and/or significant redistribution of flood flow, which may in turn adversely affect others. Providing fill within a High Hazard Floodway is inconsistent with the performance criteria in SDCP Chapter G9. The proposed stock mounds should be minimised as much as possible given its location within a High Hazard Floodway.*	(10) The proposed stock mounds have been iteratively designed to minimise changes to flood behaviour in all modelled events. Although the proposed development incorporates fill in a high hazard floodway, the proposed development is compatible with the flooding requirements of the Shoalhaven LEP as follows (from Clause 5.21): a. The livestock refuge mounds are compatible with the flood function and behaviour of the land. b. There are no adverse flood impacts to property or the environment, and the design has been iterated to minimise offsite flood impacts. c. There are no increased risks to people or property, and as the proposed development does not increase the number of people on site, there are no changes to evacuation capacities. d. Climate change impacts have been considered using the 0.5% AEP and 0.2% AEP flood events as proxies. Given the above, we consider the proposed development appropriately addresses the relevant flooding legislative requirements and is therefore permissible.

5 Summary

Assessment indicates that:

1. The proposed increased sand extraction area and livestock fill mounds are not likely to adversely affect local flood conditions.

2. The proposed development has acceptable offsite impacts in all modelled flood events.

3. Whilst modelling indicates some localised flow velocity increases in extreme flood events, these are primarily contained within the channel and are not aligned with significant channel bank flow velocity increases. Modelling therefore supports the proposition that bank shear stresses will not be materially increased such that bank erosion will be initiated.

4. The flood specific matters raised in Council's RFI letter have been appropriately addressed by this response.

Please contact our offices 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 – Flood Assessment MapSet

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Level Afflux (m)

- < -1.000
- -1.000 - -0.500
- -0.500 - -0.200
- -0.200 - -0.100
- -0.100 - -0.020
- -0.020 - -0.005
- -0.005 - 0.005
- 0.005 - 0.020
- 0.020 - 0.100
- 0.100 - 0.200
- 0.200 - 0.500
- 0.500 - 1.000
- > 1.000

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2022).
- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

10% AEP Critical Duration Storm - Proposed Condition Water Level Afflux

FL01	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Velocity Afflux (m/s)

- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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Map Title / Figure:

10% AEP Critical Duration Storm - Proposed Condition Water Velocity Afflux

FL02	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Level Afflux (m)

- < -1.000
- -1.000 - -0.500
- -0.500 - -0.200
- -0.200 - -0.100
- -0.100 - -0.020
- -0.020 - -0.005
- -0.005 - 0.005
- 0.005 - 0.020
- 0.020 - 0.100
- 0.100 - 0.200
- 0.200 - 0.500
- 0.500 - 1.000
- > 1.000

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
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Map Title / Figure:

1% AEP Critical Duration Storm - Proposed Condition Water Level Afflux

FL03	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Velocity Afflux (m/s)

- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Map Title / Figure:

1% AEP Critical Duration Storm - Proposed Condition Water Velocity Afflux

FL04	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Level Afflux (m)

- < -1.000
- -1.000 - -0.500
- -0.500 - -0.200
- -0.200 - -0.100
- -0.100 - -0.020
- -0.020 - -0.005
- -0.005 - 0.005
- 0.005 - 0.020
- 0.020 - 0.100
- 0.100 - 0.200
- 0.200 - 0.500
- 0.500 - 1.000
- > 1.000

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
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Map Title / Figure:

0.5% AEP Critical Duration Storm - Proposed Condition Water Level Afflux

FL05	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Velocity Afflux (m/s)

- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
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Map Title / Figure:

0.5% AEP Critical Duration Storm - Proposed Condition Water Velocity Afflux

FL06	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Level Afflux (m)

- < -1.000
- -1.000 - -0.500
- -0.500 - -0.200
- -0.200 - -0.100
- -0.100 - -0.020
- -0.020 - -0.005
- -0.005 - 0.005
- 0.005 - 0.020
- 0.020 - 0.100
- 0.100 - 0.200
- 0.200 - 0.500
- 0.500 - 1.000
- > 1.000

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

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Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Map Title / Figure:

0.2% AEP Critical Duration Storm - Proposed Condition Water Level Afflux

FL07	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Velocity Afflux (m/s)

- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2022).
- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

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Map Title / Figure:

0.2% AEP Critical Duration Storm - Proposed Condition Water Velocity Afflux

FL08	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Level Afflux (m)

- < -1.000
- -1.000 - -0.500
- -0.500 - -0.200
- -0.200 - -0.100
- -0.100 - -0.020
- -0.020 - -0.005
- -0.005 - 0.005
- 0.005 - 0.020
- 0.020 - 0.100
- 0.100 - 0.200
- 0.200 - 0.500
- 0.500 - 1.000
- > 1.000

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water level decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water level increase.

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Map Title / Figure:

PMF Critical Duration Storm - Proposed Condition Water Level Afflux

FL09	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Proposed Mound Locations

Water Velocity Afflux (m/s)

- < -2.00
- -2.00 - -1.00
- -1.00 - -0.50
- -0.50 - -0.25
- -0.25 - -0.10
- -0.10 - 0.10
- 0.10 - 0.25
- 0.25 - 0.50
- 0.50 - 1.00
- 1.00 - 2.00
- > 2.00

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
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- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.
- Areas coloured blue represent water velocity decrease. Areas coloured white represent negligible change. Areas coloured yellow / red represent water velocity increase.

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Map Title / Figure:

PMF Critical Duration Storm - Proposed Condition Water Velocity Afflux

FL10	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356

Legend

- Cadastre
- Proposed Extraction Area
- Mound Location Iterations
- Proposed Mound Locations

N

0 100 200 300 400 500 m

1:12500 @ A3

Viewport A

Notes:
- Aerial from Nearmaps (2022).
- Cadastre from NSW Spatial Services (2020) 'Clip & Ship' SIX Maps website.

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Map Title / Figure:
Mound Location Iterations

FL11	Map
Pig Island, Terara, NSW	Site
Expansion of Sand Extraction	Project
Flood Assessment	Sub-Project
Terara Shoalhaven Sand	Client
20/09/2022	Date

Project No: P1806743 Map Set: MS02-R01 EPSG: 28356