22 July 2025
Job No: 1017353.2402

Hawkes Bay Regional Council
Private Bag 6006
159 Dalton Street
Napier 4142

Attention: Mell Anderson

Dear Mell

Consequential Flood Effects of the Omāhu Stopbanks

1 Introduction, aim and purpose

Tonkin & Taylor Ltd (T+T) is currently supporting Hawkes Bay Regional Council (HBRC) with the design of two new stopbanks at Omāhu, Hawkes Bay. The project is currently in the preliminary design phase and currently adopts a 100-year Average Recurrence Interval (ARI) level of service to protect existing properties at Omāhu from flood flows of the Okawa Stream and Ngaruroro River.

This letter presents a summary on the consequential flood effect of the proposed Omāhu stopbanks to support consenting under the bespoke framework considering both the relevant Order in Council (OiC) and the RMA. This work has been undertaken in accordance with our variation request dated 26th August 2024.

This assessment utilises the previously completed Okawa Stream hydraulic flood model, which is described in the T+T report '*Okawa Stream Hydraulic Model Build*" dated July 2024[1]. For further details on the model build, uncertainties and limitations please refer to this report.

1.1 Background

The proposed stopbanks and associated road crossings are shown in Figure 1.1.

[1] Tonkin & Taylor Ltd, Okawa Stream Hydraulic Model Build, July 2024, T+T ref: 1017353.2402

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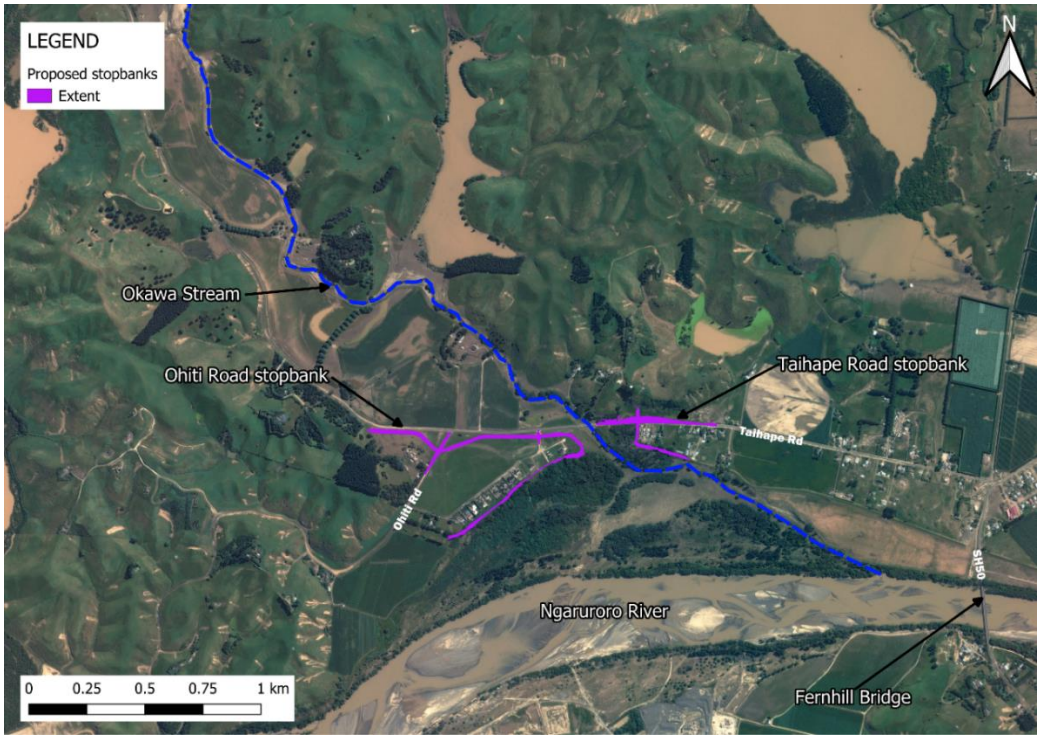


Figure 1.1: Proposed stopbank alignment.

This project, along with others in the Land Categorisation programme were originally proposed to be designed to a 100-year ARI level of service (with freeboard) plus a nominal allowance for future climate change. HBRC does not have a specific study available for potential increases in peak flows due to climate change and has instead instructed T+T to adopt the RCP8.5 2050 climate scenario to account for potential climate change impacts.

Following initial revisions of the proposed stopbank design and flood model, and as instructed by HBRC, the Omāhu stopbank design freeboard during a 100-year ARI RCP8.5 2050 climate event has been set to 700 mm.

The southern side of the Ohiti Road stopbank was designed to the Ngaruroro River model flood level. The present day 100-year ARI flood level was used with the freeboard set to 700 mm.

The Taihape Road stopbank is required as initial modelling revisions with only the Ohiti Road stopbank showed the flooding effects east of the Okawa Stream were worsened, with increased water being forced east by the proposed stopbank. Appendix C shows a flood depth map from the model build report of a design option without the Taihape Road stopbank.

2 Flood scenario overview

To assess the flood effects of the proposed stopbank preliminary design, T+T simulated different flood scenarios using a two-dimensional hydraulic model. For more information on the model, schematisation, and the events (boundary conditions), refer to the model build report[2].

In this flood consequence assessment report, we have focused on the effects of the proposed stopbanks on the broader scheme.

[2] Tonkin & Taylor Ltd, Okawa Stream Hydraulic Model Build, July 2024, T+T ref: 1017353.2402.

Two scenarios were modelled, including:

1 "Base model" schematisation.

2 "Proposed stopbank" – Includes the base model and the proposed stopbank preliminary design developed to accommodate the 100-year ARI RCP8.5 2050 climate event water level plus 700 mm freeboard from the Okawa model, and 100-year ARI water level plus 700 mm freeboard from the Ngaruroro River model.

Both scenarios were modelled for the 100-year ARI events with future climate and an estimate of the Cyclone Gabrielle event.

2.1 Model changes

Largely, the model remains unchanged from the original model build as presented in the model build report except for changes following an external peer review and with newly available information being incorporated into the model. Refer to Appendix A for these changes.

2.2 Effects of flood extent

Figure 2.1 shows the estimated maximum flood extent for the modelled scenarios during the 100-year ARI with RCP8.5 2050 climate change event. Maps showing the modelled flood depth estimates are in Appendix B.

Figure 2.1: Estimated flood extent during the 100-year ARI with RCP8.5 2050 climate change event. Where flood depth is less than 50 mm, extent not shown.

Figure 2.1 shows that in the 100-year ARI with RCP8.5 2050 climate change event, the proposed stopbanks contain the water between them and there is no overtopping of the stopbanks. The Ohiti Road stopbank protects the houses within the Ohiti Road subdivision and the Taihape Road stopbank protects the properties to the east.

There is flooding from local catchment at 18/20 Ohiti Road shown on Figure 2.1. This is addressed as part of the drainage works discussed separately[3].

Figure 2.2 shows the estimated maximum flood extent in the modelled scenarios during the estimated Cyclone Gabrielle event.

[3] Tonkin & Taylor, 2025. *18/20 Ohiti Road, Flood Protection Works, Drainage mitigation measures.*

Figure 2.2: Estimated flood extent maps in modelled Cyclone Gabrielle event. Where flood depth is less than 50 mm, extent not shown.

Figure 2.2 shows that in the estimated Cyclone Gabrielle event, the stopbank is overtopped and the properties within the Ohiti Road subdivision and to the east along Taihape Road are flooded. This outcome is expected as the peak flows during the estimated Cyclone Gabrielle event are higher than the design crest level of the stopbank. With the stopbanks in place, the extent of flooding behind them is slightly reduced. The modelling assumes that if the stopbank is overtopped it remains intact and does not breach.

Figure 2.3 and Figure 2.4 show the difference maps between the base and proposed stopbank model scenarios for the 100-year ARI RCP8.5 2050 and estimated Cyclone Gabrielle events. These are also in Appendix D for reference.

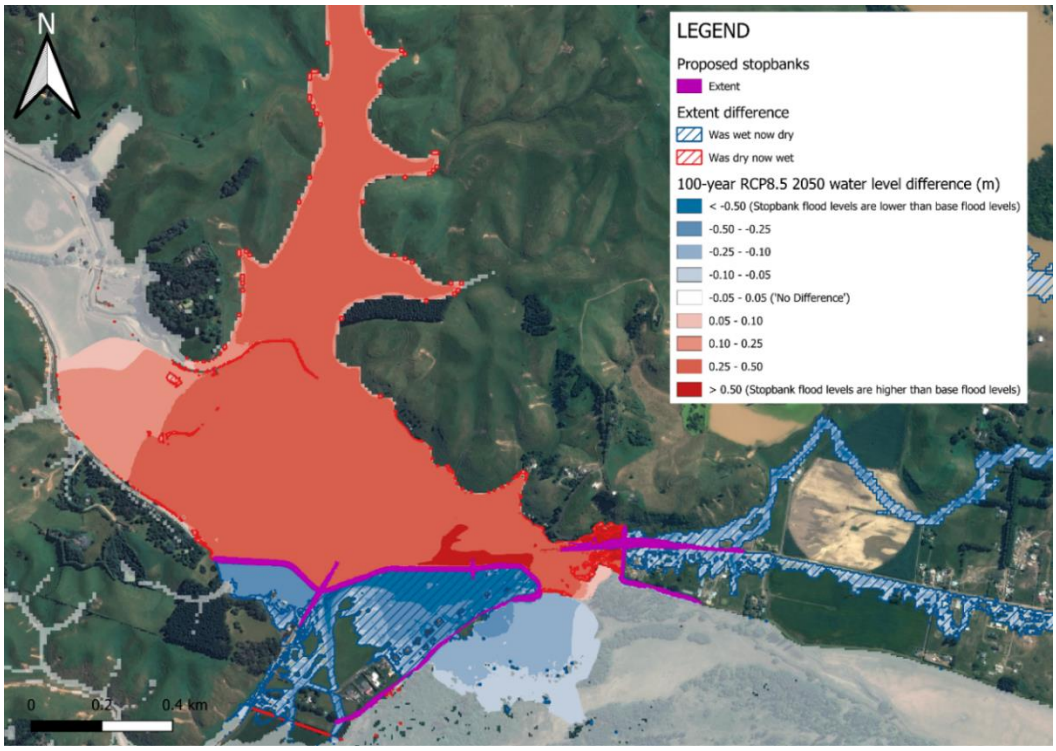


Figure 2.3: Differences in flood level estimates with the proposed stopbanks. 100-year ARI RCP8.5 2050.

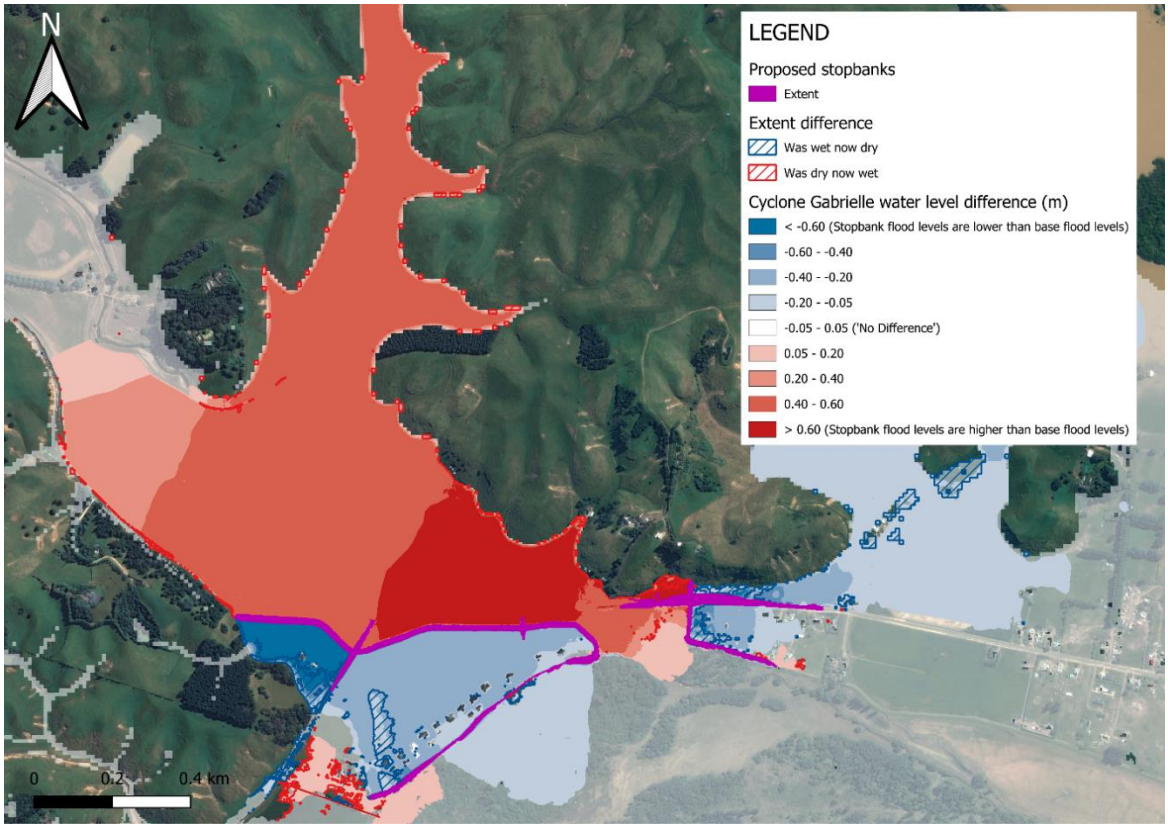


Figure 2.4: Differences in flood level estimates with the proposed stopbanks. Estimated Cyclone Gabrielle modelled event.

The difference maps show that the stopbanks eliminate flooding at the Ohiti Road subdivision and to the east along Taihape Road in the modelled 100-year ARI RCP8.5 2050 event. Although the stopbanks would be overtopped in the estimated Cyclone Gabrielle event, the stopbanks do decrease the flood level at the Ohiti Road subdivision.

As the stopbanks are constricting the flow between them, the water level upstream of the stopbanks increases by approximately 600 mm in the 100-year RCP8.5 2050 event, and approximately 700 mm in the estimated Cyclone Gabrielle event. However, in the base scenario there is already significant flooding, with flood depths generally exceeding one meter, and in some cases exceeding two metres (in the 100-year ARI RCP8.5 2050 event). These areas are largely pastoral farmland. There was a property located upstream of the stopbanks that has been removed as it was deemed Category 3 “risk to life from flooding” in the existing scenario (222 Taihape Road).

There is also a pocket of increased flooding where the Taihape Road is raised and stopbank, adjacent to the shared access road to 164-172 Taihape Road. The flooding in this area increased up to 1.5 m in the 100-year ARI RCP8.5 2050 event and 1.6 m in the Cyclone Gabrielle event.

In the estimated Cyclone Gabrielle event, there is a slight increase in flood depths on the property at 39 Ohiti Road, with depths increasing up to 200 mm. There may be some increased ponding on the property, however, the hazard at the buildings (dwelling and shed) remains unchanged – refer to Section 2.3.1.

2.3 Effects on flood hazard and velocity

An assessment of flood hazards was completed to inform the assessment of consequential effects of the proposed stopbanks. To assess flood hazard effects, we have adopted the "*Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR 2017)".* This provides an overview of various risk categories based on flood depth and velocity, see Figure 2.5.

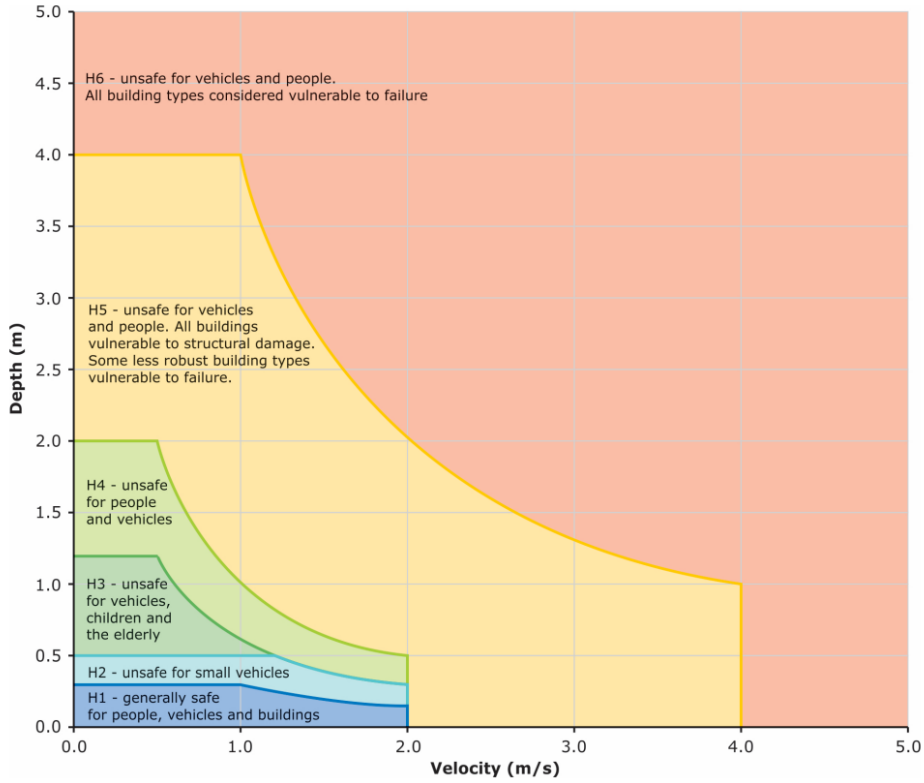


Figure 2.5: Hazard threshold defined by Smith et al (2014).

Flood hazard outputs as defined by Smith et al (2014) were generated from the model outputs and compared to estimate the effect on flood hazard caused by the proposed stopbanks. Building footprints and roads have been considered in this assessment but there may be other infrastructure within the affected area which has not been considered at this time.

Economic effect of non-structural building damage (e.g., flooding above floor level but below H5 hazard) is not included in the hazard thresholds defined by Smith et al (2014). Therefore, this has not been included in the assessment.

Risk to life (PAR/PLL) has not been explicitly assessed however this can be undertaken if HBRC require.

2.3.1 Buildings

Buildings footprints have been sourced from LINZ[4], noting the LINZ building layer does not differentiate between non-habitable, habitable or temporary buildings. The layer includes building footprints up until 12 June 2025. There were three dwellings not included in the building outlines

[4] https://data.linz.govt.nz/layer/101290-nz-building-outlines/

layer that were added to the assessment – 203, 205 and 209 Taihape Road (based on aerial imagery and our understanding of the area).

The dwelling at 222 Taihape Road have been removed as it was deemed Category 3 “risk to life from flooding” in the existing scenario. These are still shown on the aerial imagery but are not included in the LINZ layer or the assessment.

Buildings less than 50 m^2 have not been included as these are likely to be ancillary buildings like sheds. The building hazard is calculated based on the maximum water depth, velocity and depth velocity product (DxV) from within a 2 m distance around the building perimeter. The hazard rating does not consider the effects of raised floor levels on the building hazard.

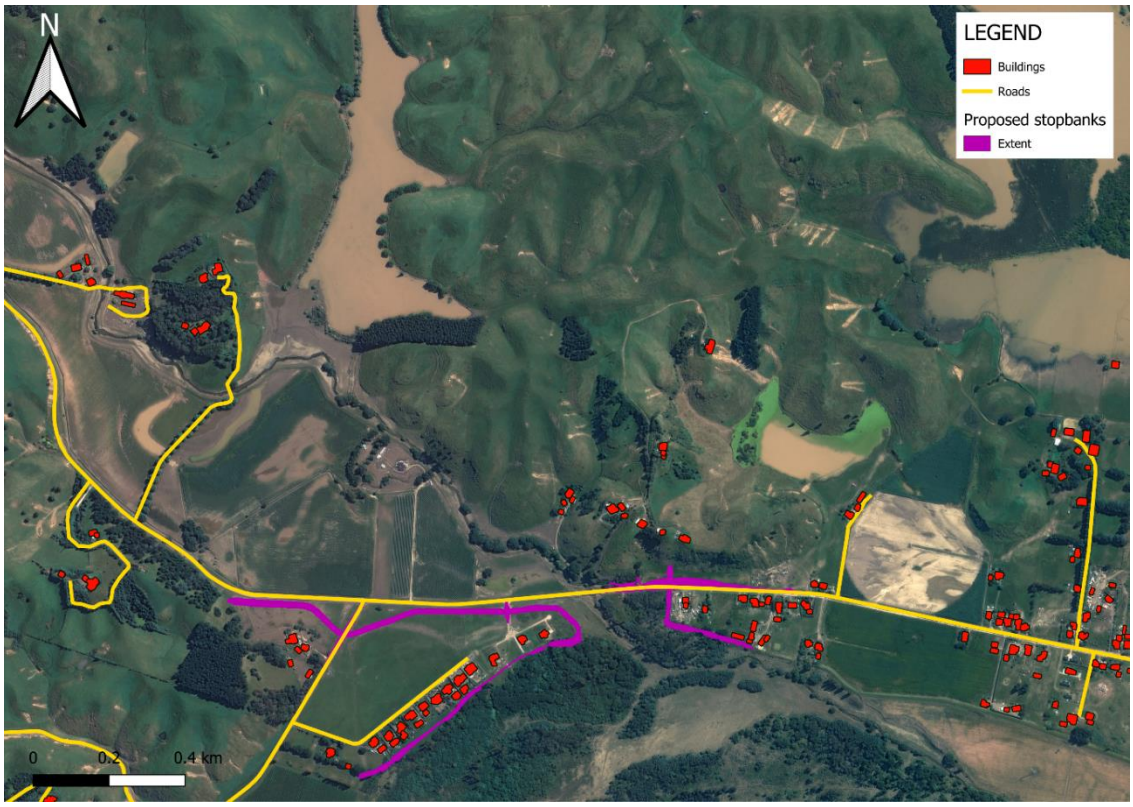


Figure 2.6: Building footprints and roads within area of interest.

The flood hazard assessment focusses on the area of interest, as shown in Figure 2.6 where the model indicates that the proposed stopbank has a potential effect on flood levels (see Figure 2.3 and Figure 2.4).

Table 2.1 shows the estimated change in the number of buildings subject to hazard between the base case and proposed stopbank scenarios. Table 2.2 provides further information on buildings which show an increase in flood hazard and the reasons for the increase.

Table 2.1: Increase and decrease in number of building footprints subject to flood hazard.

Flood event	Hazard category increase	Hazard category decrease
100-year ARI with RCP8.5 2050	2 - at 174 Taihape Road (refer to Figure 2.8).	48 - behind the stopbank at the Ohiti Road subdivision and east along Taihape Road.
Cyclone Gabrielle	12 - at 174 Taihape Road, one behind the stopbank at the Ohiti Road subdivision, at 131 Taihape Road and seven further east along Taihape Road.	28 - behind the stopbank at the subdivision and east along Taihape Road.

Table 2.1 shows that the number of building footprints subject to flood hazard reduces significantly in the 100-year ARI RCP8.5 2050 event. This is because the proposed stopbank is preventing flows from reaching buildings at the Ohiti Road subdivision and to the east along Taihape Road. There are 48 buildings which change from a higher hazard to lower or no hazard with the proposed stopbank in the 100-year ARI with RCP8.5 2050 event, as shown on Figure 2.7. There are two buildings which change from a lower or no hazard to a higher hazard, as shown on Figure 2.8.

We note that the two buildings at 174 Taihape Road are sheds and both structures are non-habitable buildings.

In the estimated Cyclone Gabrielle, the reduction in the number of building footprints subject to hazard diminishes compared to the 100-year ARI event as the proposed stopbank is overtopped. However, the stopbanks do provide some protection to higher depths and velocities and therefore, hazard categories. There are 28 buildings which change from a higher hazard to lower or no hazard with the proposed stopbanks in the estimated Cyclone Gabrielle event, as shown on Figure 2.9. There are twelve building footprints which are subject to a higher hazard with the proposed stopbank in the estimated Cyclone Gabrielle event, as shown on Figure 2.9.

Table 2.2: Identified buildings footprints with an increase in flood hazard

LINZ building I.D.	Location (and building description)*	Hazard increase	Primary reason for hazard increase
1748756 and 1748859	174 Taihape Rd. Two non-habitable sheds located approximately 20 m and 50 m from main dwelling.	100-year ARI RCP8.5 2050: • Shed 1: H0 to H1 • Shed 2: H2 to H3 Cyclone Gabrielle: • Shed 1: H1 to H2 • Shed 2: H3 to H4	100-year ARI RCP8.5 2050: • Shed 1: Dry to < 50 mm flood depth. • Shed 2: 400 mm increase flood depth from 250 mm to 650 mm. Cyclone Gabrielle: • Shed 1: 350 mm increase flood depth from < 50 mm to 400 mm. • Shed 2: 600 mm increase in flood depth from 600 mm to 1200 mm
1748752	27 Ohiti Rd. Dwelling.	H3 to H4 in the Cyclone Gabrielle event.	0.2 increase in Depth x Velocity from 0.4 to 0.6 as velocity increased from 0.6 m/s to 1.0 m/s in the Cyclone Gabrielle event.

LINZ building I.D.	Location (and building description)*	Hazard increase	Primary reason for hazard increase
5008319 and 5008312	131 Taihape Rd. It is unclear from aerial imagery what type of buildings these are.	H2 to H4 in the Cyclone Gabrielle event.	Depth and velocity both increase at both buildings in the Cyclone Gabrielle event. • Building 1: 70 mm depth increase from 0.32 m to 0.39 m. 0.4 m/s increase in velocity from 1.54 m/s to 1.94 m/s. DxV increases 0.17 from 0.50 to 0.67. • Building 2: 50 mm depth increase from 0.40 m to 0.45 m. 0.22 m/s velocity increase from 1.14 m/s to 1.36 m/s. 0.16 increase in DxV from 0.46 to 0.62.
1748464, 1749076, 5008334, 1749537, 1749576, 1749574 and 1749575	37 Taihape Road (dwelling), 38 Taihape Road (dwelling), 49 Taihape Rd (dwelling), 6 Hakiwai Road (dwelling), 5 Ngahiriwa Place (non-habitable shed) and 7 Ngahiriwa Place (dwelling and shed).	• H4 to H5: 37 and 38 Taihape Road. • H3 to H4: 49 Taihape Road. • H2 to H3: 6 Hakiwai Road. • H1 to H2: 5 and 7 Ngahiriwa Place.	Minimal fluctuations in flood depth and flood velocities have increased the hazard category in the Cyclone Gabrielle event. The maximum velocity increase is 0.02 m/s and the maximum depth increase is 10 mm at any of these buildings.

Note: *Interpreted from aerial imagery.

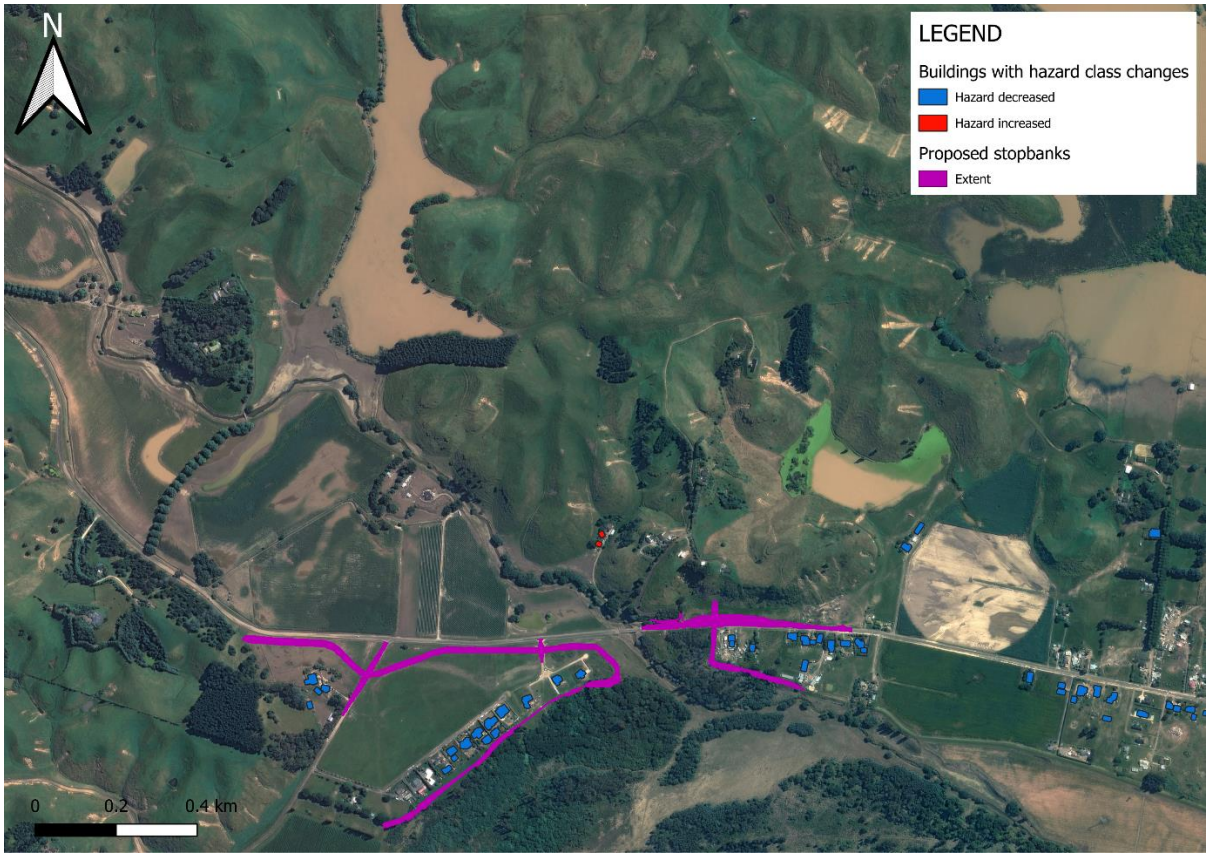


Figure 2.7: Building footprints with an increase in flood hazard in the 100-year ARI RCP8.5 2050 event.

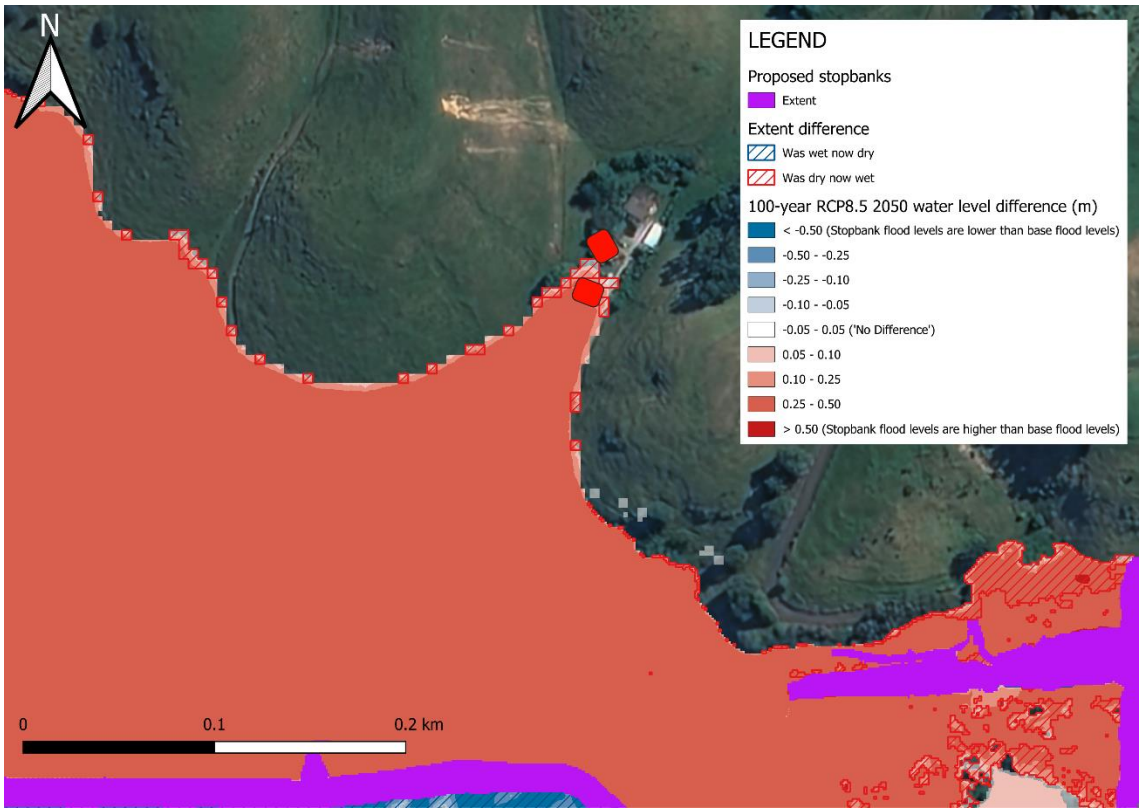


Figure 2.8: Differences in flood level estimates with the proposed stopbanks at 174 Taihape Road. 100-year ARI RCP8.5 2050.

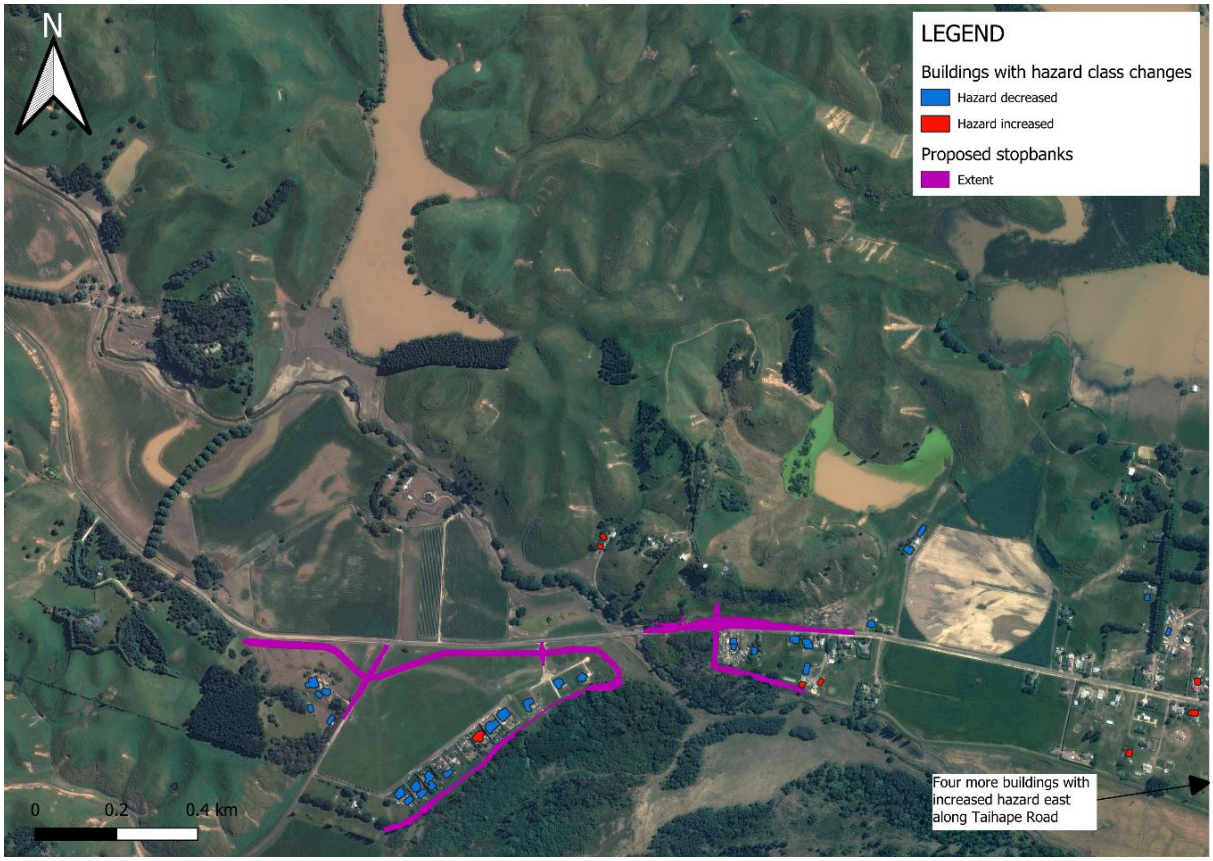


Figure 2.9: Building footprints with an increase in flood hazard in the estimated Cyclone Gabrielle event.

According to Smith et al (2014), all buildings may be vulnerable to structural damage at hazard H5, and all buildings are considered vulnerable to failure at H6. In relation to building vulnerability using these criteria, the model with the proposed stopbank indicates the following:

- There is no increase and one decrease (a dwelling at 203 Taihape Road) to the number of buildings vulnerable to structural damage in the 100-year ARI RCP8.5 2050 event.
- There are two buildings which could be more prone to structural damage in the Cyclone Gabrielle event:
  - A dwelling at 37 Taihape Road.
  - A dwelling at 38 Taihape Road.
- There are three buildings which could be less prone to structural damage in the Cyclone Gabrielle event:
  - A dwelling at 203 Taihape Road.
  - A dwelling at 205 Taihape Road.
  - A non-habitable shed at 54 Taihape Road.

In the 100-year ARI RCP8.5 2050 event, there is no reduction in the number of buildings vulnerable to damage or failure even though there are several properties (48 as shown in Table 2.1) which show a reduction in hazard. This is because in the base case event, the flood hazard for these buildings is already below the H5 hazard criteria.

There are two buildings identified in the Cyclone Gabrielle event that show a theoretical increase in potential damage or failure. However, the increase in actual flood depth or velocity is minimal at these buildings, i.e., these buildings are already at significant risk albeit. A similar situation is

observed at 54 Taihape Road, where the decrease in hazard is also marginal and sensitive to minor changes in flood depth and velocity.

The dwellings at 203 and 205 Taihape Road show a substantial reduction in flood depths and velocities due to the proposed stopbanks, indicating a meaningful decrease in flood hazard at these properties.

2.3.2 Roads

Road centrelines have been sourced from LINZ[5], noting the layer does not include private roads or other accessways.

Figure 2.10 and Figure 2.11 indicate that the for the events considered, the proposed stopbanks cause water levels to increase along Taihape Road for an approximate 2 km length from the stopbanks west and north.

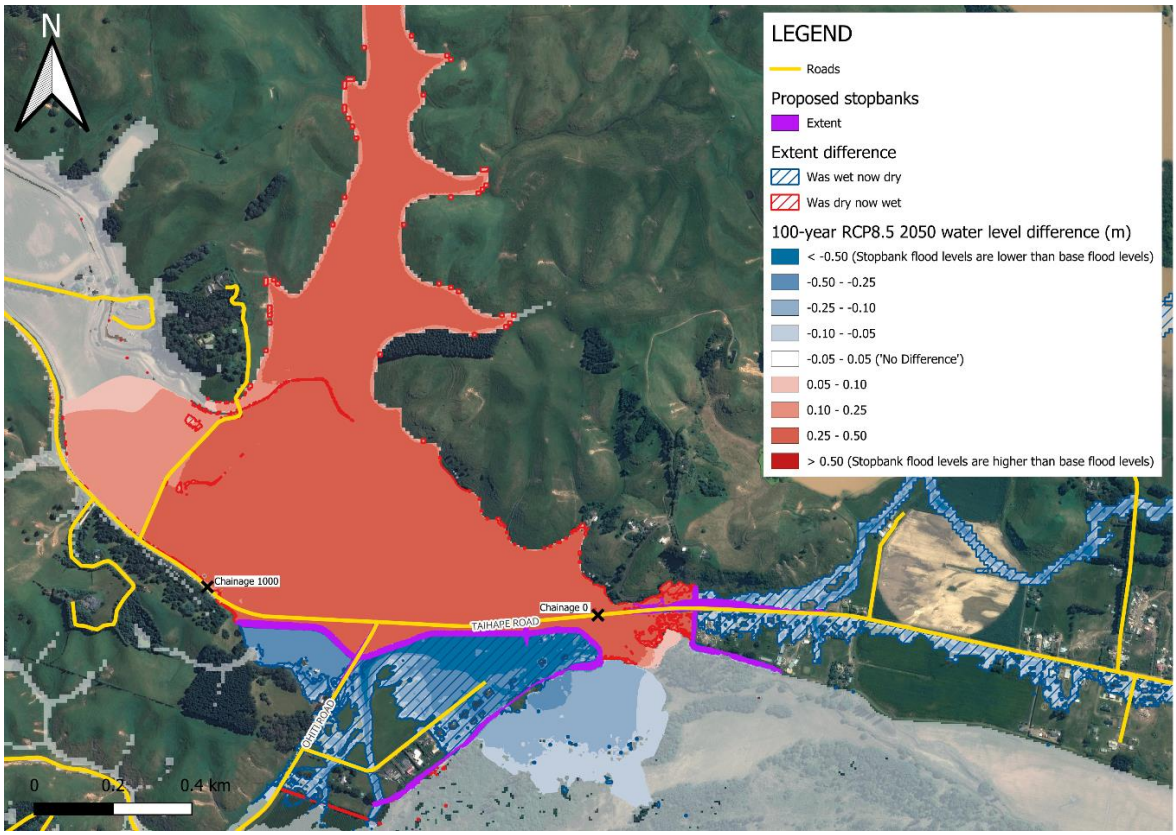


Figure 2.10: Affected roads and flood level differences with proposed stopbanks in the 100-year ARI RCP8.5 2050 climate event.

[5] https://data.linz.govt.nz/layer/50329-nz-road-centrelines-topo-150k/

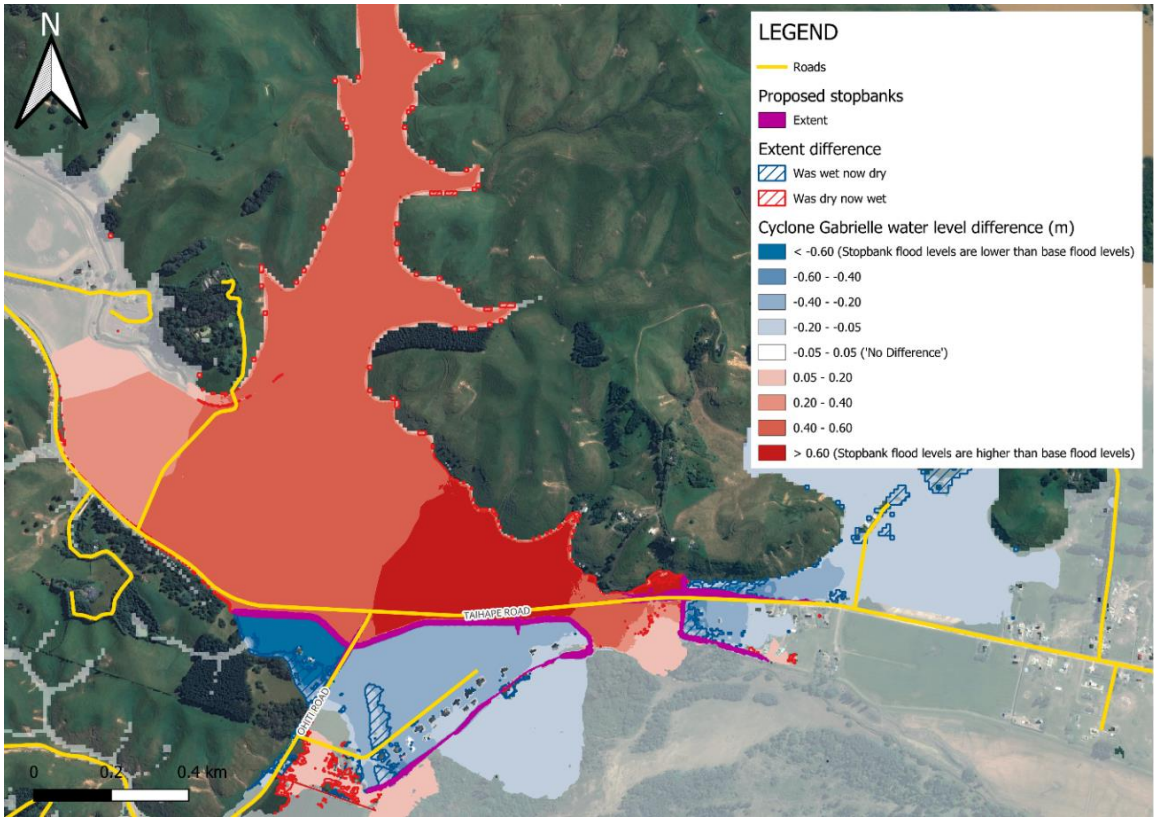


Figure 2.11: Affected roads and flood level differences with proposed stopbank in the estimated Cyclone Gabrielle modelled event

According to Smith et al (2014), all vehicles are unsafe at a hazard of H3 and higher. The model indicates that a significant section of Taihape Road is flooded with a hazard of H3 in the base case 100-year ARI RCP8.5 2050 event. Whilst the stopbank increases the flood level along the road, the hazard status for vehicles remains unchanged, that being H3 or higher which is unsafe.

Figure 2.12 shows the water level along Taihape Road in both modelled 100-year ARI RCP8.5 2050 events. The chainage reference for this plot is shown on Figure 2.10.

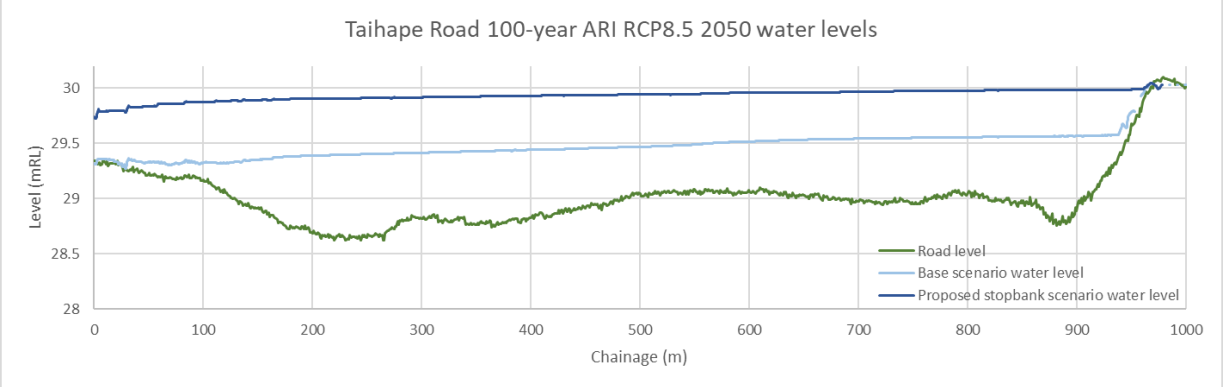


Figure 2.12: Water level along Taihape Road for the 100-year ARI RCP8.5 2050 base and design events.

The flood depth decreases on Ohiti Road past the stopbank crossing. The model indicates that in the 100-year ARI RCP8.5 2050 event, the hazard along Ohiti Road decreases from H2 (unsafe for small vehicles) to H1. In the modelled Cyclone Gabrielle event, the hazard is decreased from H3 to H1.

The accessway to 23-37 Ohiti Road has hazards up to H3 along it in the 100-year ARI RCP8.5 2050 event, base scenario. The stopbanks remove the hazard in the 100-year ARI RCP8.5 2050 event. In the Cyclone Gabrielle event, there is hazards up to H3 on the accessway both with the stopbanks and in the base scenario. The extent of the higher hazards is reduced with the stopbanks.

The Taihape Road stopbank decreases flood depths along Taihape Road east of the stopbank crossing. The hazard is decreased from H1 to no hazard in the 100-year ARI RCP8.5 2050 event. In the modelled Cyclone Gabrielle event, the hazard decreased from H3 to H1 with the stopbanks.

The accessway to 316 Taihape Road is subject to hazard over H3 in the base scenario in the 100-year ARI RCP8.5 2050 event. The stopbank increases the flood level on this road, but the hazard status for vehicles remains unchanged.

There are increased flood depths with the stopbanks at the beginning of the shared access road to 164-172 Taihape Road. This increases the hazard from H1 to H3 in the 100-year ARI RCP8.5 2050 event, and H2 to H4 in the estimated Cyclone Gabrielle event.

2.3.3 Bridges

The model shows that water levels and velocities increase at the Taihape Road bridge (Bridge 234) in the proposed stopbank scenario. Figure 2.13 and Figure 2.14 show the model outputs one meter upstream of the bridge in the Okawa Stream. The flood level relative to the assumed bridge deck level, and the flood velocities are shown.

The results show that in the base scenario, the flood water flows over the Taihape road bridge deck in both the 100-year ARI RCP8.5 2050 and estimated Cyclone Gabrielle events. The proposed stopbanks increase the depth and velocity of flow estimates over the bridge deck as follows:

- Maximum water depth over the bridge deck increases from 0.1 m to 0.6 m in the 100-year ARI RCP8.5 2050 event, and 0.6 m to 1.2 m in the estimated Cyclone Gabrielle event.
- The duration that water flows over the bridge deck increases from 3.7 hours to 8.7 hours in the 100-year ARI RCP8.5 2050 event, and 15.2 hours to 20.7 hours in the estimated Cyclone Gabrielle event.
- Maximum velocity of flow over the bridge increases from 0.94 m/s to 1.02 m/s in the 100-year ARI RCP8.5 2050 event, and 0.97 m/s to 1.28 m/s in the estimated Cyclone Gabrielle event.

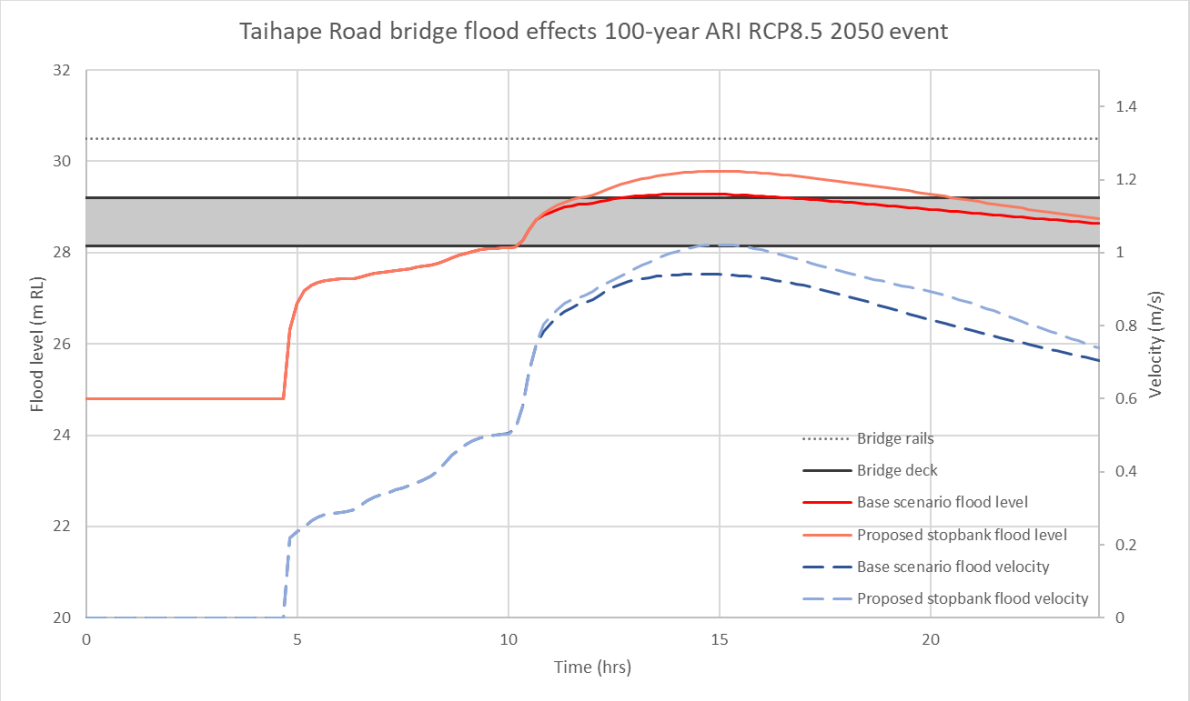


Figure 2.13: Flood level and velocity 1 m upstream from Taihape Road bridge in the 100-year ARI RCP8.5 2050 event.

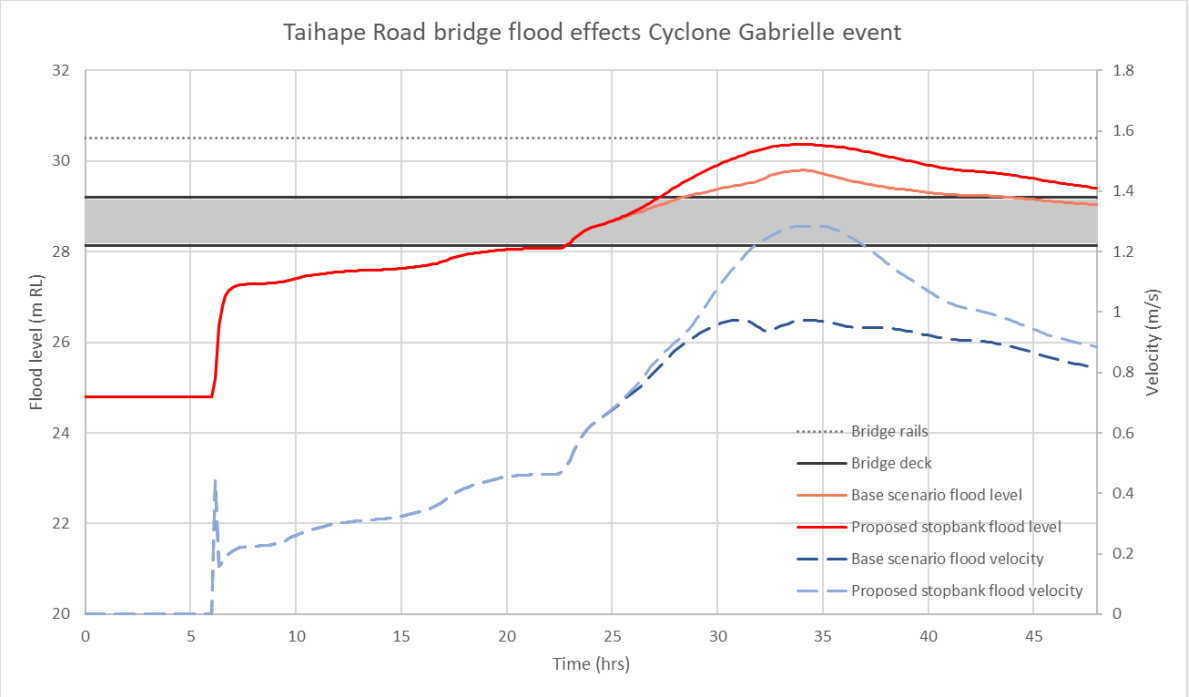


Figure 2.14: Flood level and velocity 1 m upstream from Taihape Road bridge in the estimated Cyclone Gabrielle event.

The model shows that the western bridge approach is flooded with a H3 hazard category for both the base and design scenarios in the 100-year ARI RCP8.5 2050 and Cyclone Gabrielle events. This would make the bridge unusable for driving on in these flood events anyway.

WSP were engaged by HBRC to complete a scour assessment of the bridge and abutments[6]. This provides more detail on the scour risk at the bridge.

The bridge abutments have been armoured with rip rap in March/April 2025.

2.3.4 Velocity

Figure 2.15 and Figure 2.16 show the modelled velocity in the 100-year ARI RCP8.5 2050 and estimated Cyclone Gabrielle events. In both events, and both the base and proposed stopbank scenarios, the velocities are generally limited to less than 3 m/s. There is only one small area where velocities increase above 3 m/s, at the eastern corner of the Ohiti Road stopbank in the estimated Cyclone Gabrielle event. Erosion protection will need to be considered in the stopbank detailed design stage.

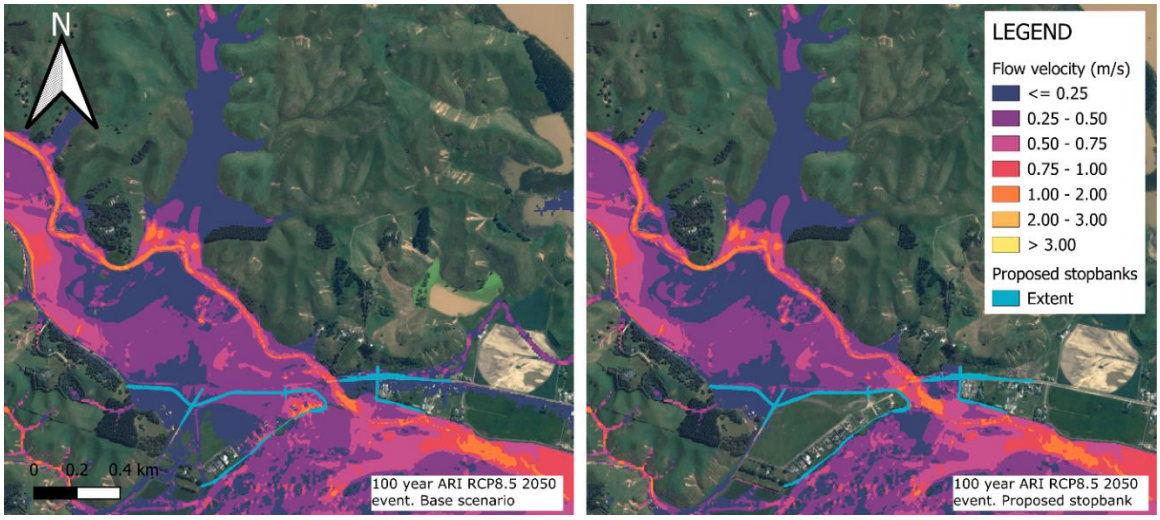


Figure 2.15: Modelled flood velocities in the 100-year ARI RCP8.5 2050 climate event.

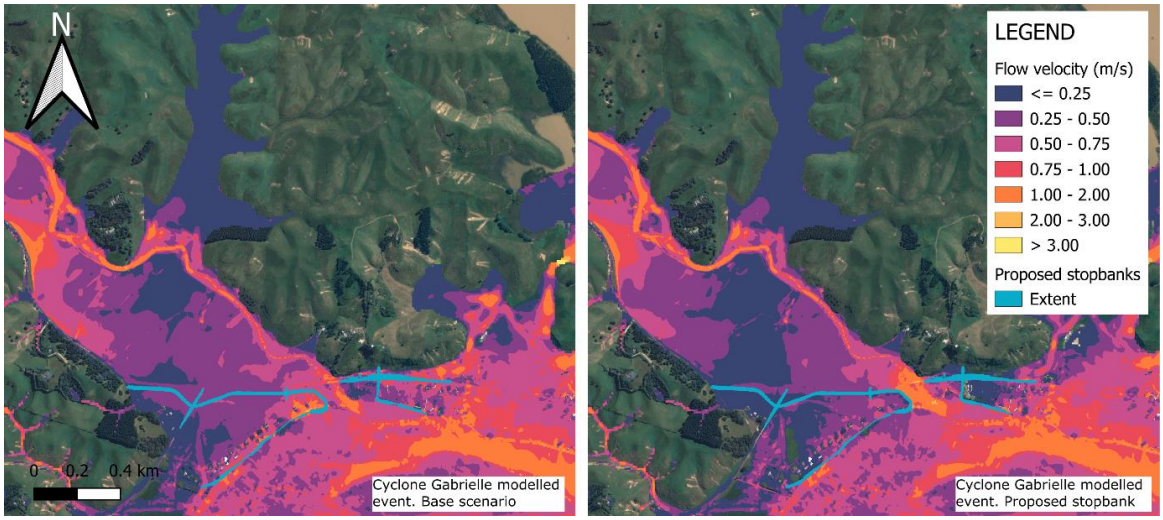


Figure 2.16: Modelled flood velocities in the estimated Cyclone Gabrielle event.

Figure 2.17 and Figure 2.18 show the velocity difference between the base and proposed stopbank scenarios. They show that the as the flow goes between the stopbanks, the velocity increases up to

[6] WSP, 15 April 2025.Okawa Stream – Summary of Peer Review and Scour Assessment.

0.8 m/s. In the proposed stopbank scenario, the maximum flow velocity within Okawa Stream is 2.2 m/s in the 100-year ARI RCP8.5 2050 event and 2.6 m/s in the Cyclone Gabrielle event.

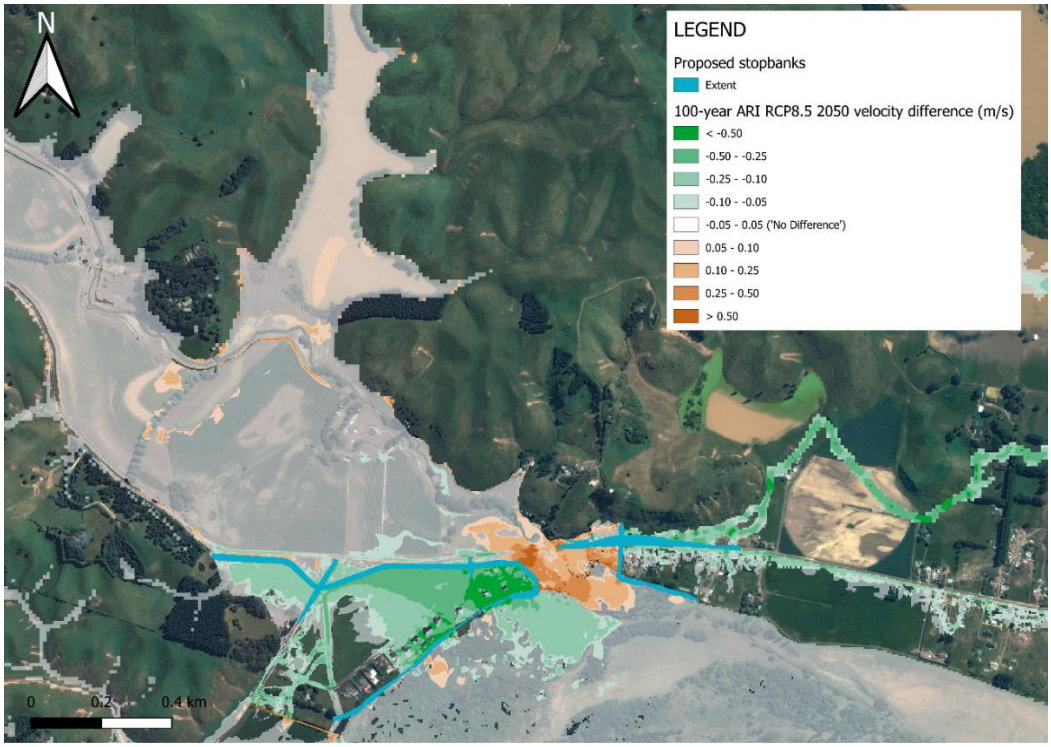


Figure 2.17: Flood velocity difference between base and proposed stopbank scenarios for the 100-year ARI RCP8.5 2050 event.

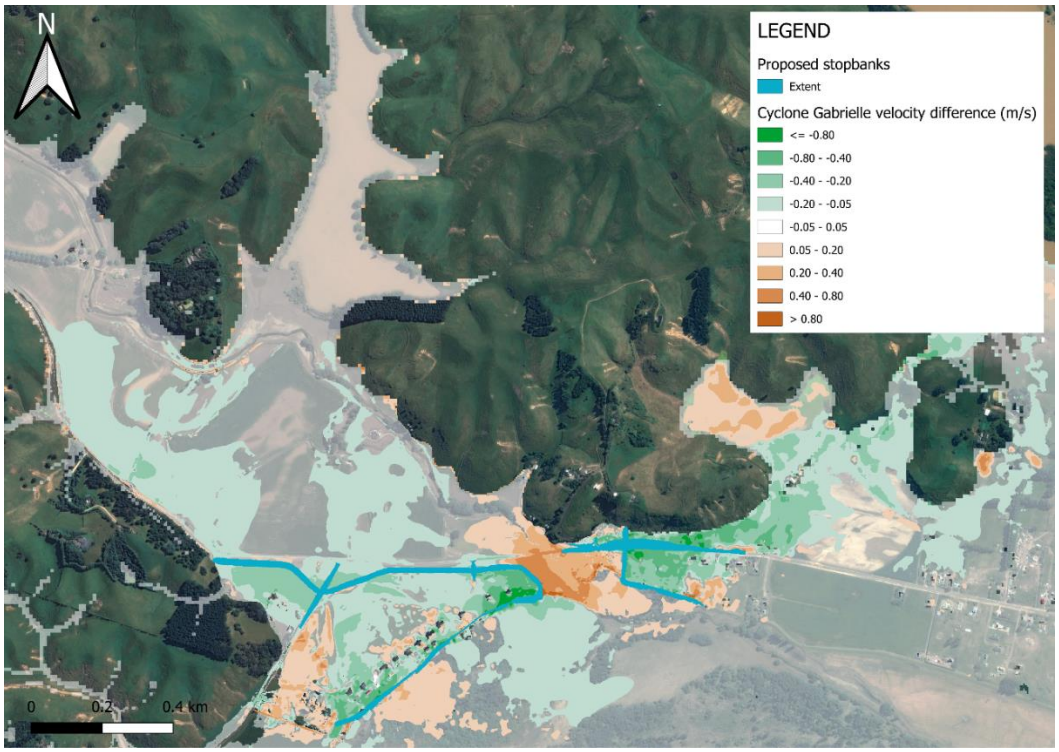


Figure 2.18: Flood velocity difference between base and proposed stopbank scenarios for the estimated Cyclone Gabrielle event.

2.3.5 Horticultural land

Figure 2.3 and Figure 2.4 show an increase in flood depth on the horticultural land upstream of the stopbanks. The modelling shows that this area was inundated in the base case for both the 100-year ARI RCP8.5 2050 event and the estimated Cyclone Gabrielle event with flood depths over 1.5 m. With the proposed stopbanks flood depths increase by up to 600 mm in the 100-year RCP8.5 2050 event, and 700 mm in the estimated Cyclone Gabrielle event. Given the land use and minor incremental effects, no further assessment has been undertaken.

2.3.6 Other infrastructure

We have not assessed any infrastructure other than what has been outlined in this report. There are overhead HV power lines within the Okawa stream floodplain, however, we understand these were not damaged by Cyclone Gabrielle.

3 Overdesign event

As shown in Figure 2.2, the stopbank is overtopped in the estimated Cyclone Gabrielle event. The effects assessment shows that the flooding at the dwellings behind the stopbank is less than the base scenario. To mitigate potential adverse impacts resulting from the construction of the stopbank, emergency response plans should be established to address such overtopping events. We understand that HBRC are also investigating the potential for stream gauging and monitoring and emergency warning systems, these are being considered by others.

The model results are shown for the stopbanks being overtopped but not breached. If breaching of the stopbanks were to occur, the flooding would be different than shown. This should be accounted for in emergency preparedness for the affected people and properties.

4 Conclusions

HBRC have engaged T+T to assess the flood effects for the proposed stopbanks at Ohiti and Taihape Road. The stopbank design currently provides protection to a 100-year ARI event with RCP8.5 2050 climate change and 700 mm of freeboard.

Flood hazard assessments have been undertaken using the Okawa Stream hydraulic model, for several model scenarios, both with and without the proposed stopbanks. The model indications that water levels increase up to 600 mm upstream of the stopbanks. Flood levels decrease within the subdivision at Ohiti Road and east along Taihape Road in both the 100-year ARI RCP8.5 2050 and estimated Cyclone Gabrielle event.

The model indicates that the number of building footprints subject to flood hazard reduces significantly in the 100-year ARI with RCP8.5 2050 climate event. In the estimated Cyclone Gabrielle event, the reduction in the number of building footprints subject to hazard diminishes as the proposed stopbank is overtopped, resulting in similar flooding to the base case scenario.

5 Applicability

This report has been prepared for the exclusive use of our client Hawkes Bay Regional Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Hawkes Bay Regional Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
	
.....	.....
Kate Hand	Tim Morris
Water Resources Engineer	Project Director

22-Jul-25
\\ttgroup.local\corporate\wellington\tt projects\1017353\1017353.2402\issueddocuments\20250722 ohiti road stopbanks effects assessment v3\20250722_ktha_ohitirdstopbanks_effectsassessment_v3.docx

Appendix A Hydraulic model changes

The hydraulic model and hydrology inputs were externally peer reviewed in March 2025[7]. Generally, the issues identified were minor in nature and did not result in significant changes to the model.

One notable update following the peer review involved the Taihape Road Bridge (Bridge 234). Newly available as-built information for the bridge resulted in changes from the original model assumptions. However, a discrepancy was identified between the as-built drawing levels and the LiDAR at the bridge. Because the rest of the model is based on the LiDAR, the bridge deck soffit level was adjusted off the LiDAR at the bridge abutments and the deck thickness.

Table Appendix A.1 outlines the changes.

Table Appendix A.1: Taihape Road Bridge hydraulic model assumptions

Parameter	Original model build assumption	As-built model assumption
Deck soffit level (m RL)	29.00	28.14
Deck depth (m)	1.50	1.06
Deck width (m)	8.50	8.50
Rail depth (m)	1.50	1.30

Another peer review issue addressed in this round of modelling was incorporating the proposed stopbanks into the hydraulic model as a 3D model instead of vertical lines.

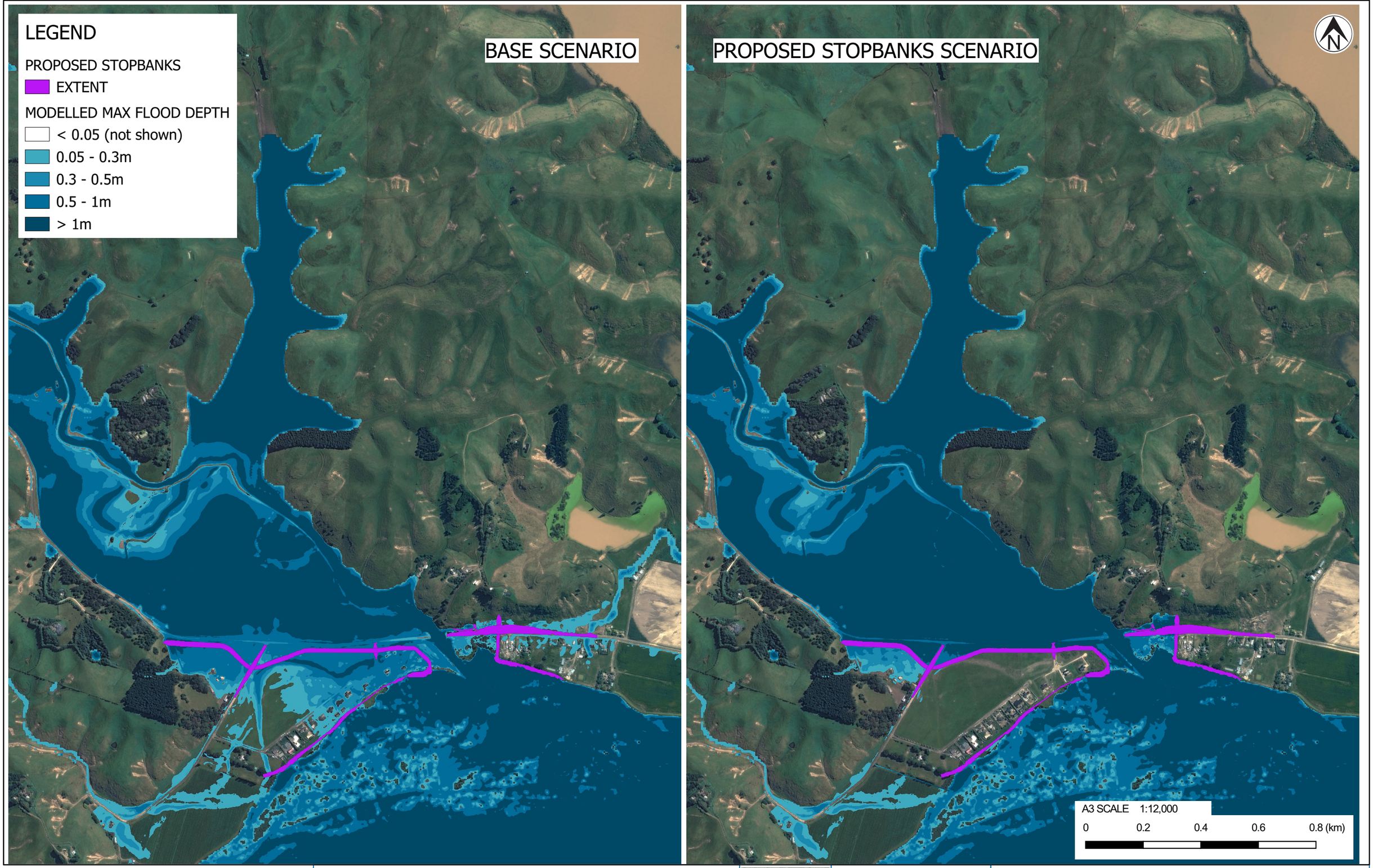
Other minor changes to the model (not an outcome of the peer review) include topography changes:

- Incorporating the finished surface for the streamworks near Bridge 234.
- Incorporating surveys undertaken of Taihape Road and Ohiti Road.

[7] WSP, Okawa Stream Hydraulic Model Build – Peer Review, 07 April 2025.

Appendix B Model flood depths

T:\Wellington\TT Projects\1017353\1017353.2402\WorkingMaterial\8 Hydraulic Modelling\QGIS\Maps\1017353.2402_OkawaStream_Reporting.qgz Layout: Appendix flood depth Drawn by KTHA



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NOTES:
Aerial imagery sourced from LINZ - Hawke's Bay 0.50m Cyclone Gabrielle Aerial Photos (2023). This map should be read in conjunction with T+T report "Consequential Flood Effects of the Ohiti Road Stopbanks".

REV	DESCRIPTION	GIS	CHK	DATE
1	First version	KTHA		14/07/25

LOCATION PLAN

PROJECT No.	1017353.2402	
DESIGNED	KTHA	JUL.25
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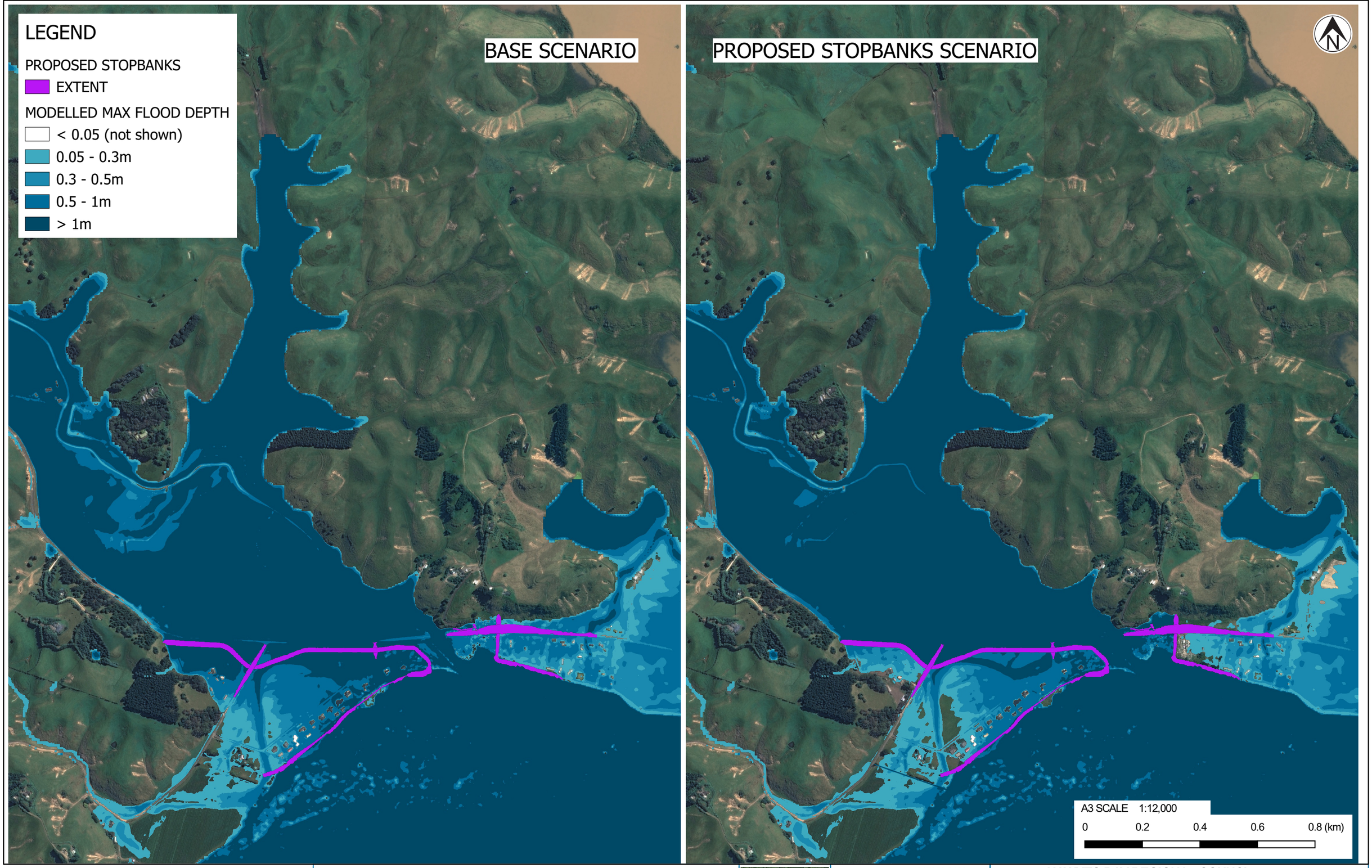
CHECKED		
APPROVED		DATE

CLIENT **HAWKES BAY REGIONAL COUNCIL**
PROJECT **OMAHU STOPBANKS**
TITLE 100-YEAR RCP8.5 2050 FLOOD DEPTH
BASE CASE AND PROPOSED STOPBANKS
SCALE (A3) 1:12,000 FIG No. 1 REV 1

T:\Wellington\TT Projects\1017353\1017353.2402\WorkingMaterial\8 Hydraulic Modelling\QGIS\Maps\1017353.2402_OkawaStream_Reporting.qgz Layout: Appendix flood depth Drawn by KTHA



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NOTES:
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1	First version	KTHA		14/07/25

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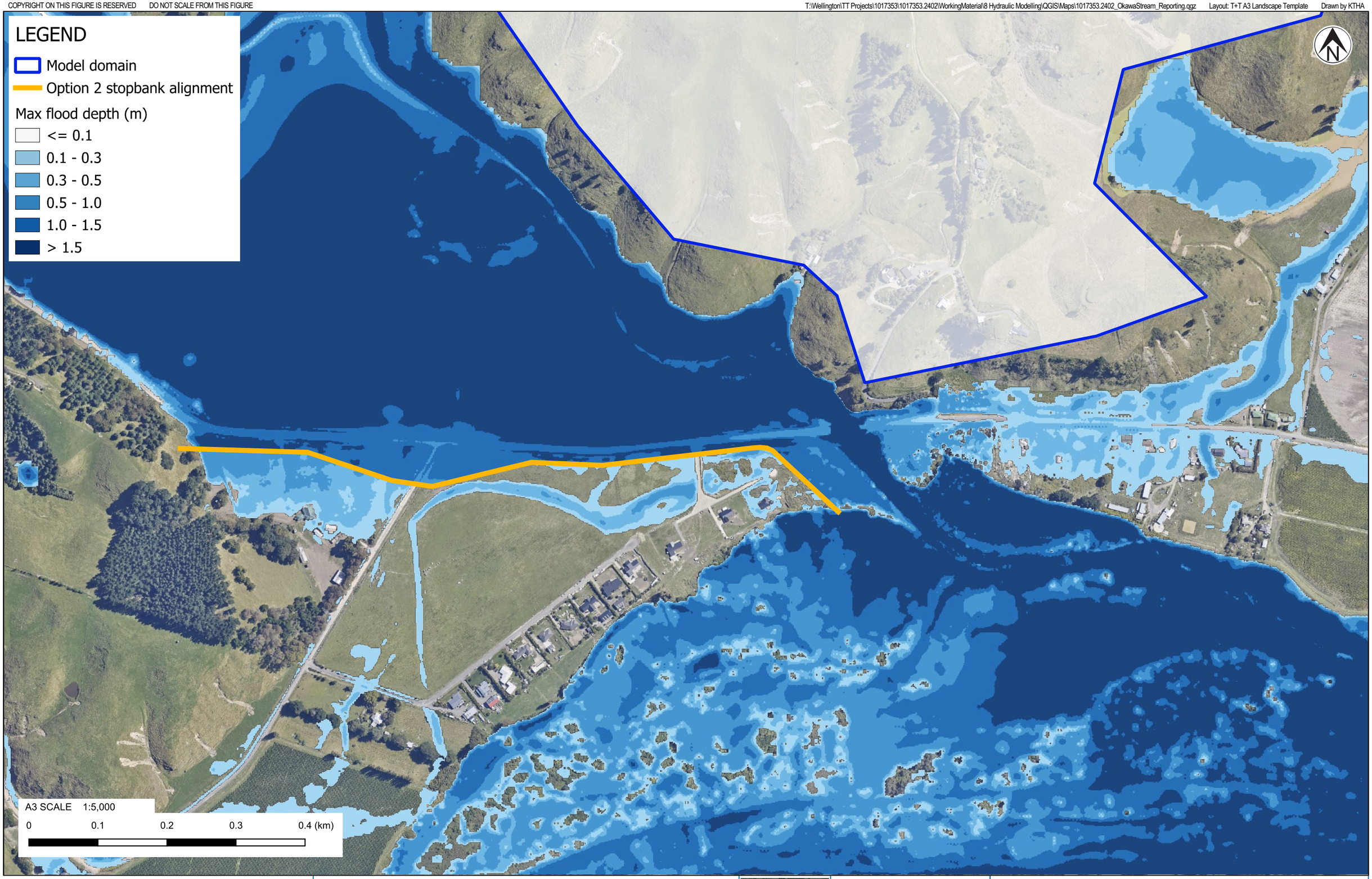
PROJECT **OMAHU STOPBANKS**
TITLE CYCLONE GABRIELLE MODELLED FLOOD DEPTH BASE CASE AND PROPOSED STOPBANKS
SCALE (A3) 1:12,000 FIG No. 1 REV 1

Appendix C Modelled flood depth without Taihape Road stopbanks

T:\Wellington\TT Projects\1017353\1017353.2402\WorkingMaterial\8 Hydraulic Modelling\QGIS\Maps\1017353.2402_OkawaStream_Reporting.qgz Layout: T+T A3 Landscape Template Drawn by KTHA



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NOTES:

Aerial imagery sourced from LINZ - Hawke's Bay 0.10m Cyclone Gabrielle Aerial Photos (2023).
This map should be read in conjunction with T+T report "Okawa Stream Hydraulic Model Build".

REV	DESCRIPTION	GIS	CHK	DATE
1	First version	KTHA		09/07/24
2	Climate change allowance updated	KTHA		25/07/24

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DRAWN	KTHA	JUL.24	DATE
CHECKED	RIBR	JUL.24	

CLIENT **HAWKES BAY REGIONAL COUNCIL**

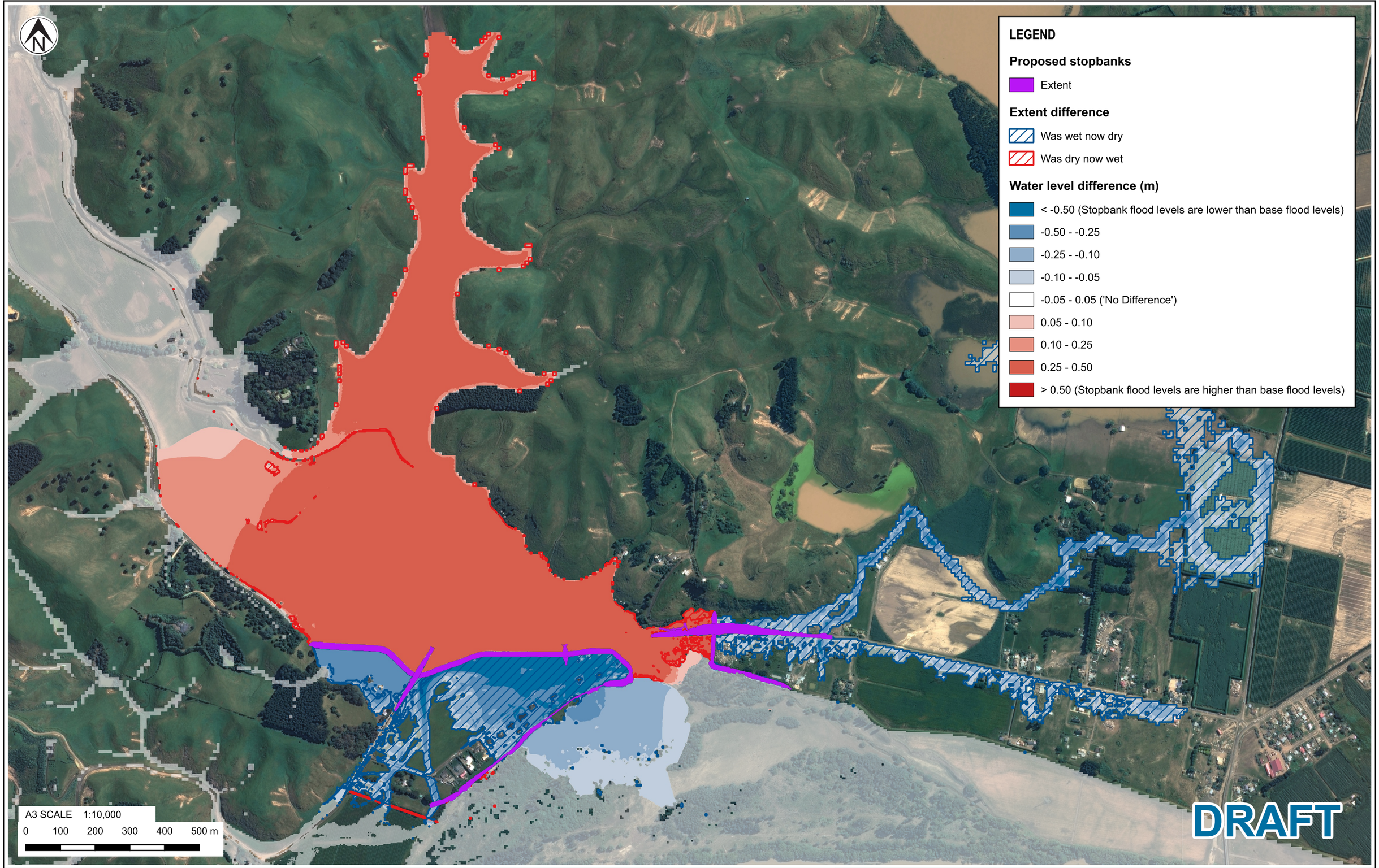
PROJECT **OKAWA STREAM FLOOD MITIGATION**

TITLE 100-YEAR RCP8.5 2075 FLOOD DEPTH OPTION 2

SCALE (A3) 1:5,000 FIG No. D3 REV 2

Appendix D Flood depth difference maps

T:\Wellington\TT Projects\1017353\1017353.2402\WorkingMaterial\8 Hydraulic Modelling\QGIS\Maps\1017353.2402_OkawaStream_Reporting.qgz Layout: Appendix flood difference Drawn by KTHA



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NOTES:
Aerial imagery sourced from LINZ - Hawke's Bay 0.50m Cyclone Gabrielle Aerial Photos (2023). This map should be read in conjunction with T+T report "Consequential Flood Effects of the Ohiti Road Stopbanks".

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1	First version	KTHA		15/07/25

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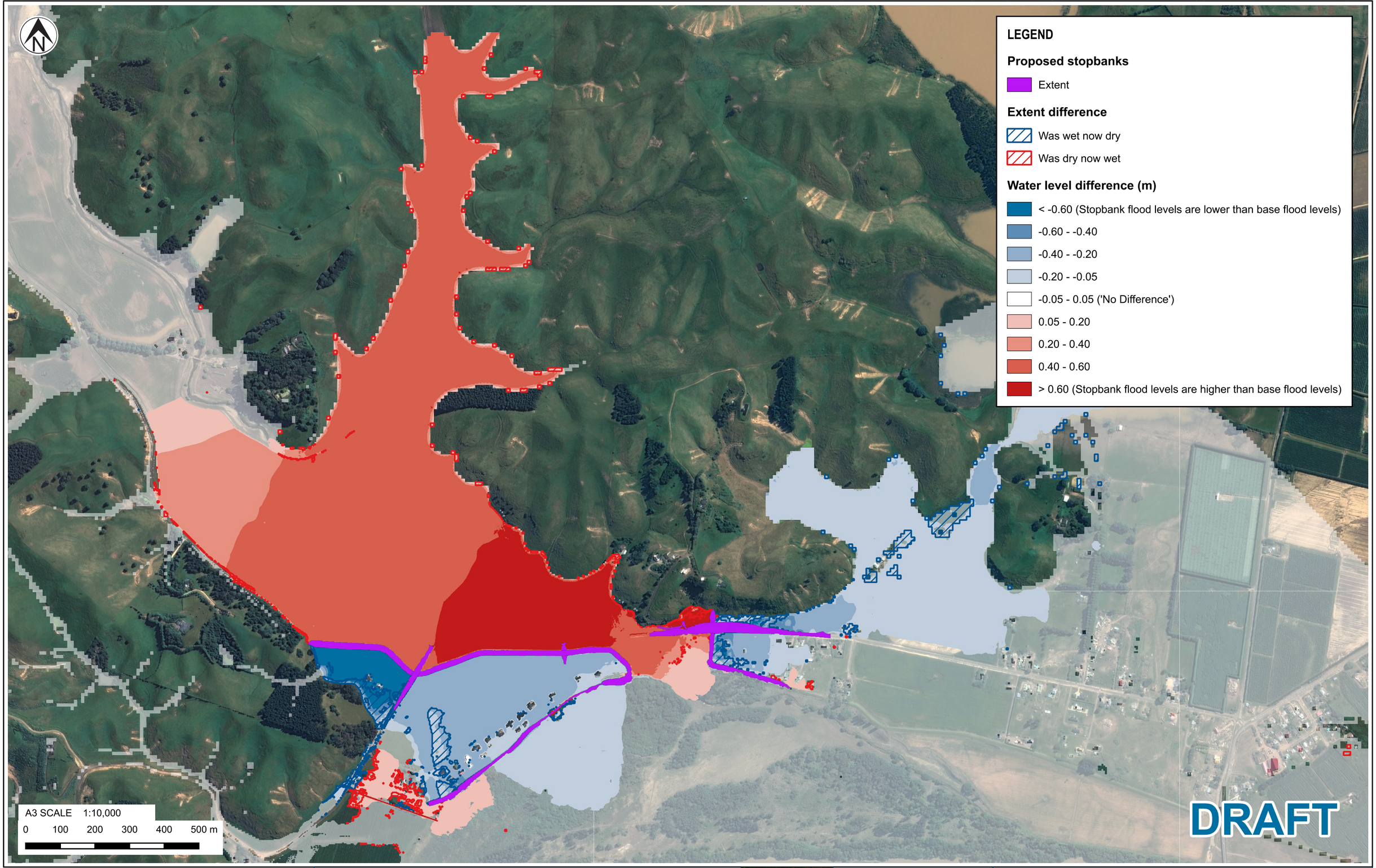
CLIENT **HAWKES BAY REGIONAL COUNCIL**
PROJECT **OMAHU STOPBANKS**
TITLE 100-YEAR ARI RCP8.5 2050 MODELLED EVENT FLOOD DEPTH DIFFERENCE
SCALE (A3) 1:10,000 FIG No. FIGURE 1. REV 0



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NOTES:
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1	First version	KTHA		15/07/25

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CLIENT **HAWKES BAY REGIONAL COUNCIL**
PROJECT **OMAHU STOPBANKS**
TITLE CYCLONE GABRIELLE ESTIMATED EVENT FLOOD DEPTH DIFFERENCE
SCALE (A3) 1:10,000 FIG No. FIGURE 1. REV 0