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Hawke's Bay Regional Council
Wairoa Flood Mitigation

Consequential Flooding Assessment

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Wairoa Flood Mitigation

Consequential Flooding Assessment

Hawke's Bay Regional Council

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1.0	11/08/2025	For Peer Review
2.0	13/08/2025	Final
3.0	5/09/2025	Hydraulic model update
4.0	21/11/2025	Floodway alignment update

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EXECUTIVE SUMMARY

In response to the devastating impacts of Cyclone Gabrielle in February 2023, the Hawke's Bay Regional Council (HBRC) has developed a flood mitigation scheme for Wairoa, focusing on the North Clyde and Townside areas. This report presents an assessment of the consequential flood impacts from a proposed floodway (Floodway Alignment 1C^{+}) and a stopbank, which are designed to mitigate the predicted flooding on land currently classified as Category 2C and enable its reclassification to Category 1 under New Zealand's land categorisation system.

The proposed scheme is engineered to manage a 1% Annual Exceedance Probability (AEP) flood event under current climate conditions. The floodway, approximately 1.15 km in length, bypasses 8 km of river channel and is flanked by stopbanks. The Townside stopbank, located on the true right bank of the Wairoa River, is approximately 1 km long with the purpose of mitigating the flood impacts on Category 2C land as well as mitigating some increased flow effects resulting from the floodway.

Hydraulic modelling indicates that the scheme will significantly reduce flood hazard across the Wairoa area. Key findings include:

- Approximately 859 buildings and 322 hectares of land will be protected (no longer at risk of flooding in a 1% AEP flood event).
- 4 buildings (ancillary or farm structures) will experience a minor increase in flood depth (less than 0.25 m). There are no negatively impacted dwellings (1% AEP flood event).
- Approximately 22 hectares of rural land will see increased flood depths (1% AEP flood event).
- Around 26 hectares of land will be required for the construction of the floodway, impacting 16 buildings that will be demolished/relocated.
- The floodway will be designed to withstand the modelled velocities in the floodway.

The scope of this report has been to quantify the benefits of protecting the Category 2C land and the adverse impacts on other areas. These consequences have been evaluated by considering the impacts against five criteria set out below.

Criteria	Score
Magnitude of Effect: Changes in flood depths, water velocities, and flood hazard category.	Pass
Event Scale: Differences in flood effects in different design/historic events.	**Unclear**
Property Sensitivity: Consider how the change in flood effects will affect properties; removing flood risk, still flood prone but increased/decreased risk, introducing flood risk.	Pass
Land use: Evaluate the vulnerability/resilience of the affected land to flooding.	Pass
Scale of the proposal: Considering the scale of proposed works against the accrued benefits.	Pass

Based on the flood consequences evaluation, the proposed floodway and townside stopbank passes four of the five criteria with an unclear result for the remaining criteria, showing that the benefits outweigh the adverse impacts on a community-wide scale. This would indicate that the consequences of the proposed stopbank are acceptable.

1 PROJECT BACKGROUND

1.1 INTRODUCTION

In February 2023, Te Matau a Māui Hawke's Bay faced devastation and loss from Cyclone Gabrielle – one of the biggest natural disasters in the history of Aotearoa New Zealand. The communities in Wairoa and across the region have endured significant impact to their lives, livelihoods, whānau, homes, farms and neighbourhoods.

Over the last two years HBRC has undertaken flood mitigation optioneering to determine a flood mitigation scheme that would enable re-categorisation of the Category 2A land in Wairoa to Category 1. Through shortlisting, further evaluation and property discussions, Floodway Alignment 1C+ and the Townside stopbank were deemed the most feasible flood mitigation options and have just been through concept design.

This report has been prepared for the purpose of informing a resource consent application and provides an overview of the consequential flood impact of proposed floodway and Townside stopbank. A consequential flood assessment evaluates the impacts and benefits of proposed flood mitigation scheme by quantifying the number of properties or land areas at decreased or increased flood risk/hazard as a result of the proposed works. This flood assessment will be used to inform the resource consent application.

The proposed flood scheme has been designed for the 1% annual exceedance probability (AEP) (100-year average recurrence interval (ARI)) flood event under current climate conditions, as required by HBRC.

1.2 LOCATION

Wairoa township is located on the banks on the Wairoa River a short distance upstream from where the river mouth exits into Hawke's Bay. The Wairoa River has a catchment area of 3,670 km^2.

The town is relatively low lying all the way to Frasertown, approximately 8 km north. The river slowly meanders from Frasertown through Wairoa and out to sea. This stretch of the river is also influenced by the tide.

Figure 1 shows the predicted flood extents and depth for the 100-year ARI flood event. Figure 2 shows the indictive location of key elements of the proposed flood mitigation scheme including the proposed floodway across North Clyde (purple) and stopbanks (red). As the name suggests, the proposed Townside stopbank is the extent of stopbank on the Wairoa township side of the river (south side).

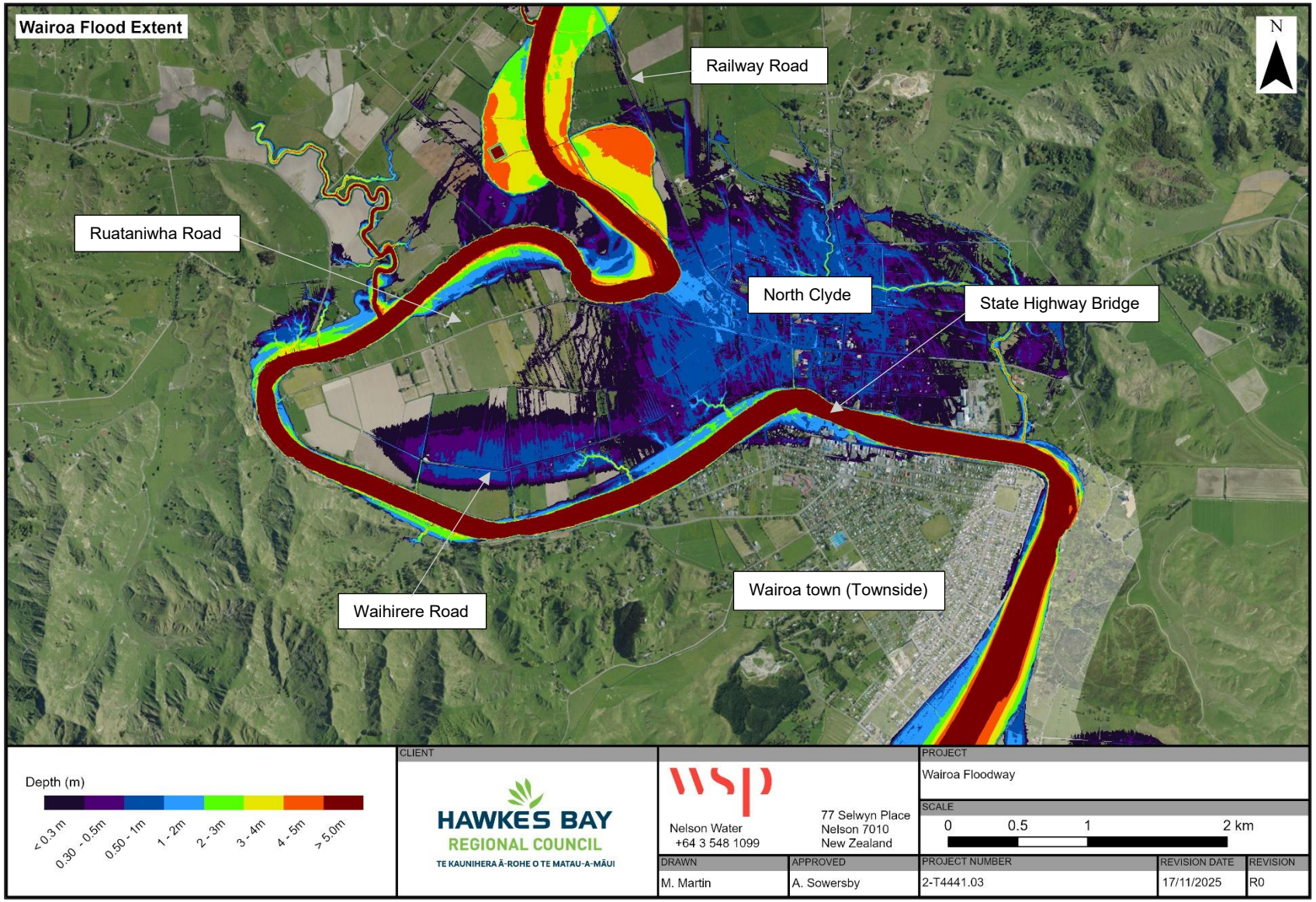

Figure 1: Predicted depth and extent of flooding in the 100-year ARI flood event (current climate) in the do-nothing scenario.

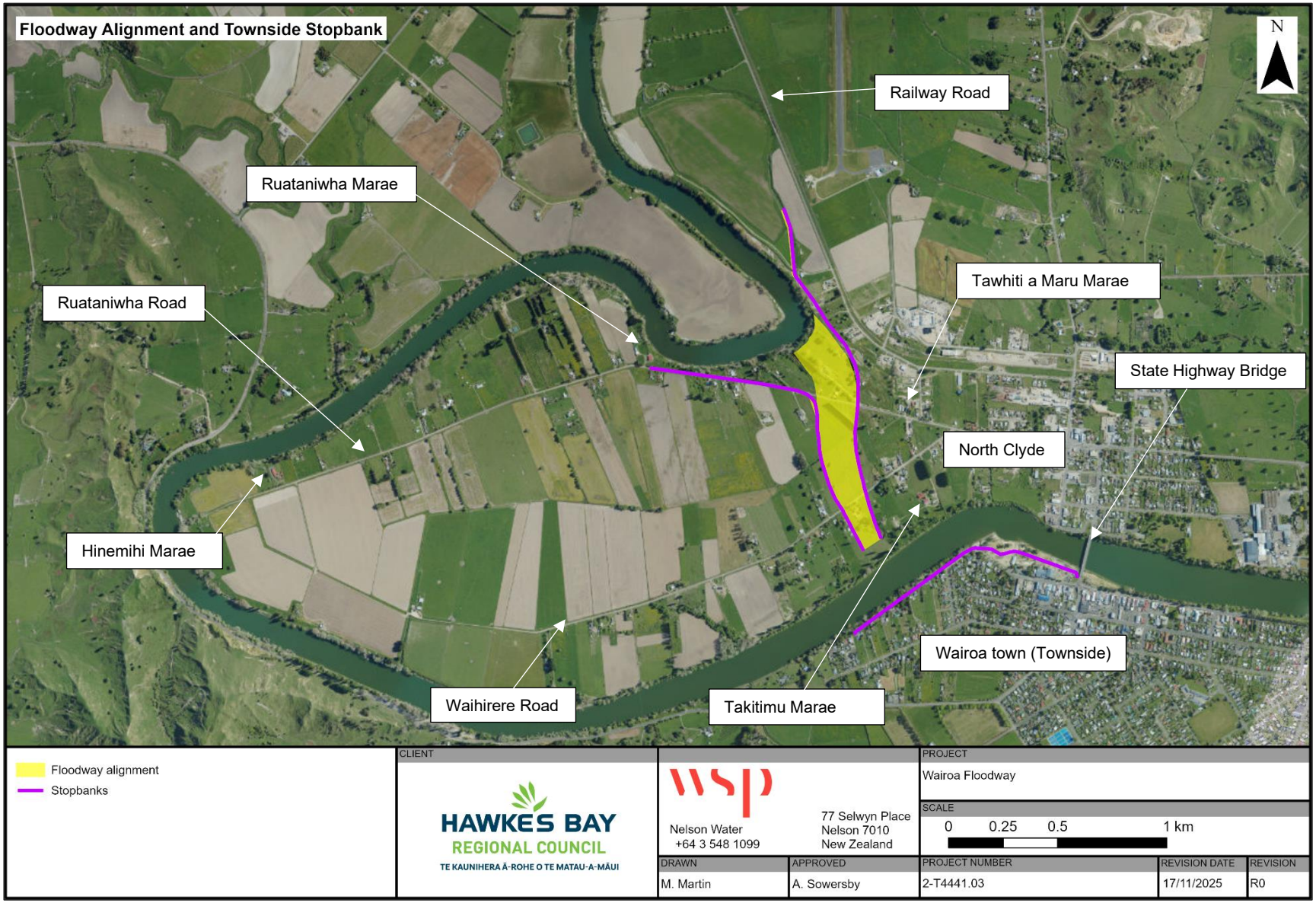

Figure 2. Location of Proposed Scheme

1.3 HISTORICAL REVIEW

1.3.1 CYCLONE GABRIELLE

Cyclone Gabrielle brought a significant amount of rainfall to the upper catchments of the Waiau and Wairoa Rivers through the night of the 13th and early morning of the 14th of February 2023. Based on the accounts of those affected in North Clyde, the Wairoa River breached its banks to the northwestern side of North Clyde between 6am and 7am and flowed across North Clyde in a north-west to south-east direction inundating homes and properties before overflowing and receding into the Wairoa River to the south of North Clyde.

The Gabrielle flood event is estimated to be smaller than a 100-year ARI event.

Figure 3 illustrates the extent of flooding following the cyclone. The left-hand image shows the Wairoa State Highway bridge crossing the Wairoa River, while the right-hand image captures the extent of floodwaters in North Clyde.

Figure 3: Images showing the extent of Wairoa flooding from Cyclone Gabrielle. (Source: Charteris Choppers footage).

1.4 CATEGORISATION OF LAND

The Future of Severely Affected Land (FOSAL) framework was developed by the New Zealand Government in response to extreme weather events like Cyclone Gabrielle, to guide decisions about the future use of land that has been severely impacted by flooding, landslides, or other natural hazards. FOSAL provided a structured land categorisation framework for affected land (Table 1). This classification system supports recovery planning, funding decisions, and long-term resilience strategies.

There is a substantial area of Wairoa that has been classified as Category 2C, as shown in Figure 4. The 2C classification area includes a large part of North Clyde (north of the State Highway bridge) and some urban properties south of the bridge. The purpose of the flood mitigation scheme is to mitigate flooding of these Category 2C properties in a 100-year ARI (current climate) event to enable reclassification to Category 1.

Table 1: Summary of New Zealand's land categorisation system (HBDC,2025).

Category	Definition	Examples / Implications
Category 1	Repair to the previous state is sufficient to manage future severe weather risk.	Minor flood damage that can be repaired without major redesign or retrofitting. Safe to remain.
Category 2A	Further assessment is needed to determine the appropriate intervention.	May later be reclassified as 1, 2C, 2P, or 3. Insufficient data currently available.
Category 2C	Community-level interventions can effectively manage future severe weather risk.	Requires upgrades to flood protection infrastructure (e.g. stopbanks) by local government.
Category 2P	Property-level interventions are needed, possibly alongside community measures.	May include raising homes, improving drainage. Costs may be significant for individual owners.
Category 3	Area is currently considered unsafe for habitation due to unacceptable future risk.	Managed retreat or land use change may be necessary. Not safe to rebuild or remain.

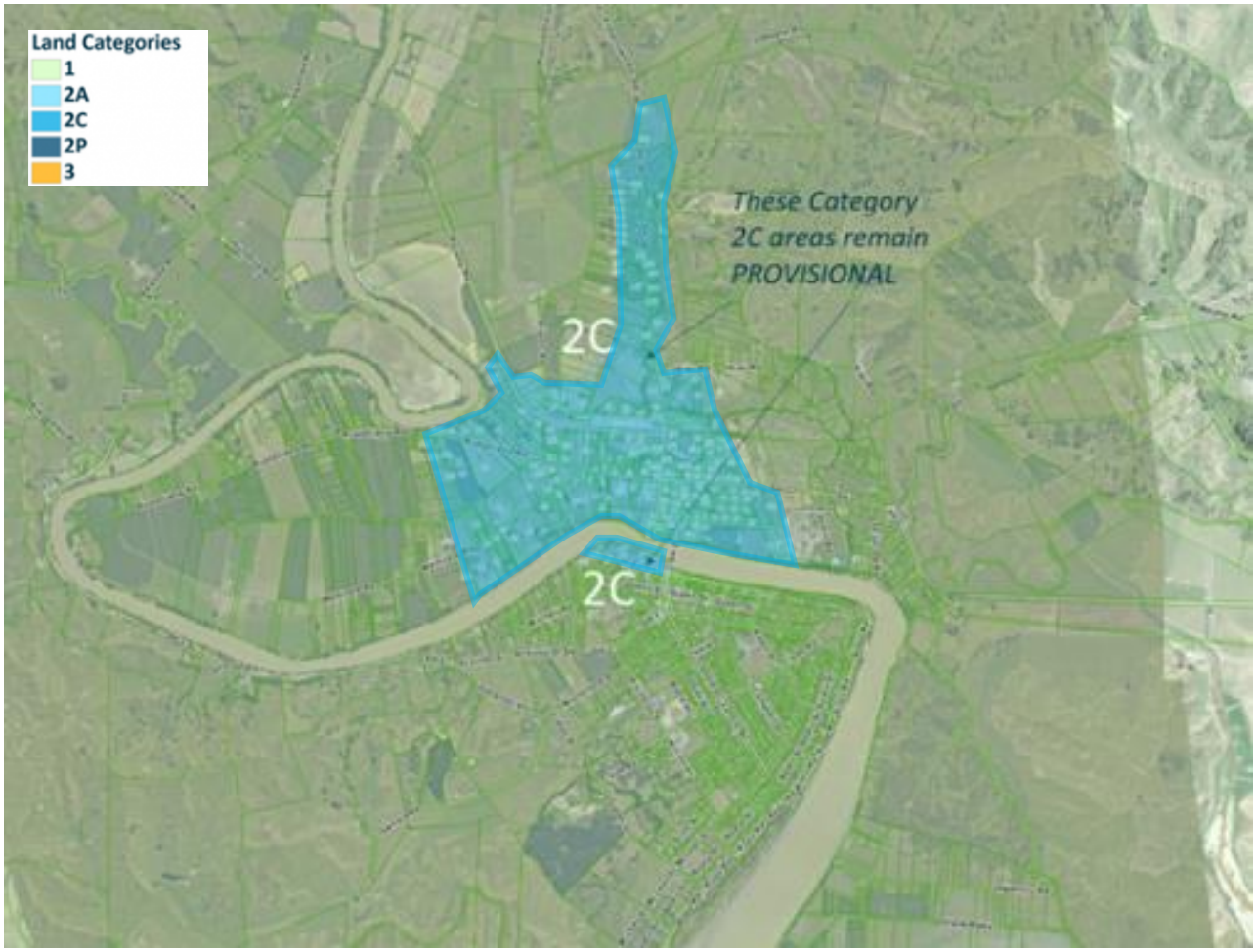

Figure 4: Map of provisional land categorisation for Wairoa (source: Hawke's Bay Regional Recovery Agency, 2025).

2 WAIROA SPILLWAY AND STOPBANK

2.1 FLOODWAY DESIGN

To manage large storm events like Cyclone Gabrielle, an engineered floodway will be constructed between two sections of the Wairoa River as shown on Figure 2. It will be flanked by eastern and western stopbanks along its entire length. The floodway is designed for a 1% AEP event, with freeboard, and will be triggered to operate when flows reach the equivalent of a 3.3% AEP flood. The definition of this operational storm event is subject to uncertainty/change and will be addressed in Detailed Design.

The floodway will shorten a large meander in the Wairoa River and is shaped to manage fluvial flow. The flow through the floodway is intended to match that which would flow through North Clyde in a design flood event so that the flow in the main river is not significantly changed. Water flowing through the floodway will flow faster and will be more confined than the predicted out of bank flows in the do-nothing scenario.

The proposed floodway alignment is approximately 1,150 m long from inlet to outlet, bypassing 8.0 km of river channel. This design provides no flood attenuation, but improves the conveyance of floodwater to protect the North Clyde Category 2C areas.

The floodway consists of an excavated channel with side stopbanks. The inlet begins on the true left of the Wairoa River, between Railway Road and Ruataniwha Road. The eastern stopbank begins near Railway Road, proceeding south to meet Ruataniwha Road, before curving east to rejoin the river. The western stopbank runs along Ruataniwha Road for roughly 600 m, then turns southeast to intersect Waihirere Road, before curving south to meet the river. (See Figure 2).

Construction will require excavating up to approximately 2 m below existing ground level. The depth of excavation required and the consequential height of the stopbanks along the edge of the excavated floodway will be determined as part of the detailed design of the floodway. The WSP hydrogeology assessment (presented in the Wairoa Flood Scheme Developed Concept Design Report, February 2025) estimates that for Floodway Option 1C, which was a previously considered floodway option to east of the proposed floodway, will result in groundwater drawdown of up to approximately 0.8 m. The hydrogeological assessment for the proposed floodway is not yet complete but there may be a similar drawdown of groundwater.

2.2 TOWNSIDE STOPBANK DESIGN

In addition to the stopbanks flanking the floodway, a new structure, referred to as the townside stopbank, is proposed upstream of the Wairoa State Highway bridge. This stopbank will be located on the true right bank of the river and opposite the outlet of the floodway and will be approximately 1 km long. See Figure 2 for the location of the stopbank. This stopbank is designed to mitigate flooding of the Category 2C land on the Wairoa town side of the river.

The stopbank is designed to manage a 1% AEP event with freeboard. The stopbank's height varies up to a maximum of approximately 2.3m.

3 CONSEQUENTIAL FLOOD RISK

While stopbanks are designed to protect certain areas from flooding, they can unintentionally redirect or pond floodwaters elsewhere. A consequential flood assessment evaluates the absolute and nett benefits of the proposed flood mitigation measures by quantifying the number of properties or land areas at decreased or increased flood risk/hazard as a result of the proposed works.

3.1 CLASSIFICATION OF FLOOD HAZARD

WSP has adopted a flood hazard classification approach based on the Australian Rainfall and Runoff Guidelines, which are widely applied in New Zealand and adapted from Smith et al. (2014). The associated classification curves are presented in Figure 5.

Flood hazard classification is determined by combining flood depth and water velocity at a given location, with hazard categories reflecting the potential risk to people, vehicles, and property. However, these classifications can be somewhat general, as they may encompass a wide range of flood depths or velocities within a single hazard class.

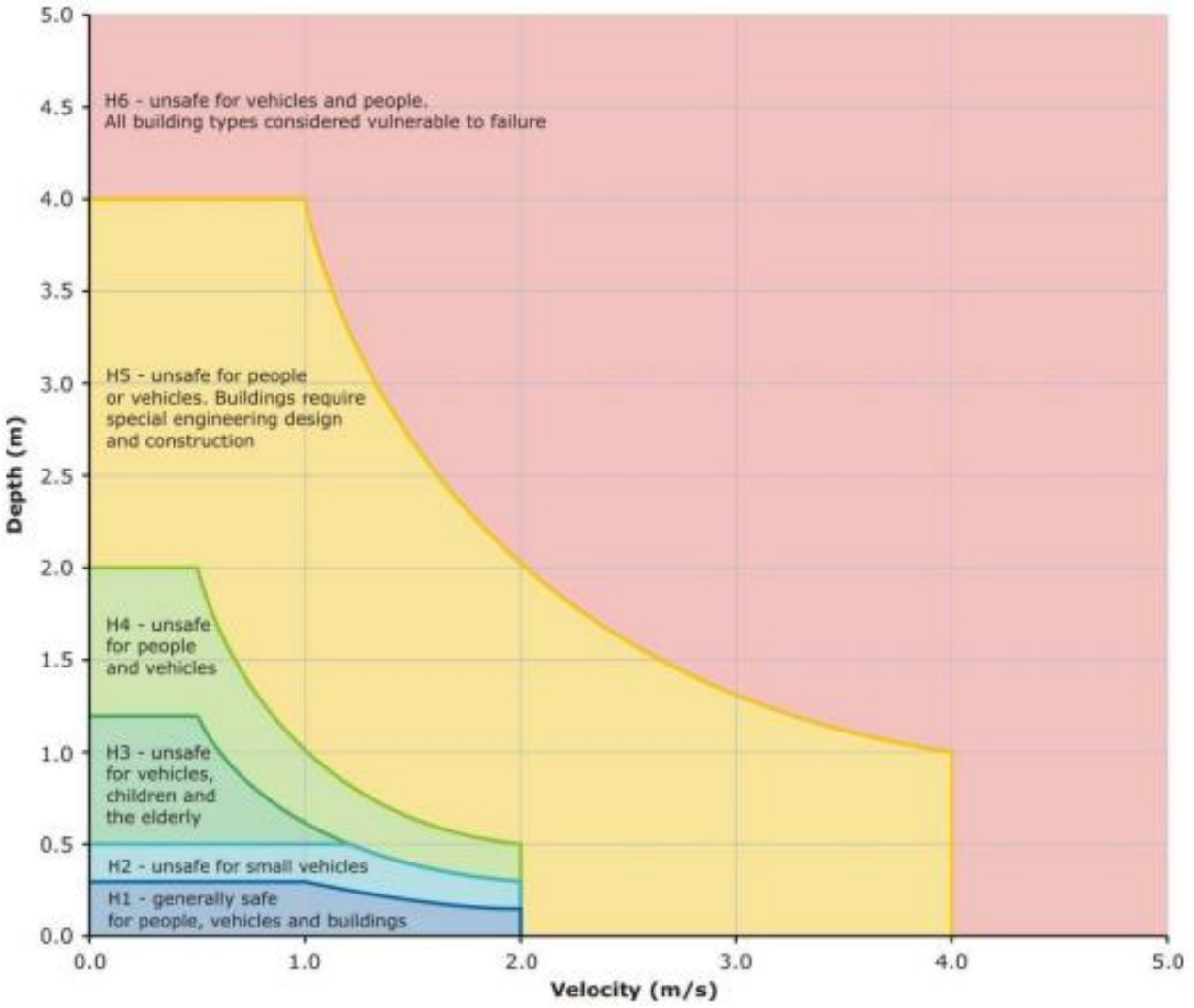

Figure 5: General flood hazard vulnerability velocity curves. (Source: Smith et al, 2014).

As PDP note in their report Assessment of Effects on Flooding for Proposed Whirinaki Stopbank (PDP, 2025), there is no formal guidance available nationally or locally which can be applied as a framework for assessing effects on flooding and flood hazard. Therefore, when considering effects on flooding, we use the following framework of five criteria (as proposed by PDP) to evaluate the effects of the proposed works. These 'PDP criteria' are outlined in Table 2.

Table 2: Framework for assessing flood risk impacts (PDP, 2025)

Category	Description
Magnitude of Effect	In this instance, the effect is quantified by changes to the flood depth/level and changes to the flood hazard classification
Event Scale	An effect for a smaller, more frequent, event is considered worse than the same effect for a larger, less frequent event.
Property Sensitivity	Properties with existing flood vulnerabilities have a lower tolerance for additional flooding compared to those with low or no flood hazard
Land use	The land use of the affected property is also a consideration. Rural land used for grazing/cropping/horticulture is considered to have a greater tolerance to flood effects when compared to residential dwellings.
Scale of the proposal	While less critical than the factors above, the size of the proposal generating the effect should be considered. A significant proposal, such as building the proposed scheme which will protect regionally significant infrastructure and 100's of residential properties, generating an effect is more acceptable than a smaller proposal (for example a stopbank protecting ten houses) generating the same effect.

3.2 HYDRAULIC MODELLING

The flood results utilised in this report are based on the Flood Model version V12. The model assumptions and parameters are set out in the Wairoa Fluvial Hydraulic Model Report (WSP, Sept 2025).

The 1% AEP referenced in this report is the current climate estimate (i.e. not including climate change).

Table 3: Design Event

Climate Event	AEP (ARI)	Flow (m^3/s)	Tide
Current Climate (2023)	1% (100yr ARI)	5400	MHWS (0.77 m)

3.3 EFFECTS ON FLOODING AND FLOOD HAZARD

3.3.1 RESULTS

As no change in flood hazard is predicted upstream of the proposed floodway, this assessment focuses on the area in which the scheme is located and downstream areas. All measurements/counts presented are for this area of interest, that being the extent shown in the results figures. The baseline scenario is presented alongside the "with scheme" scenario which includes representations of the proposed floodway and stopbanks. The following results are presented in the text and figures below:

- The maximum water depth for 1% AEP Baseline, no flood protection (Figure 7)
- The maximum water depth for 1% AEP with floodway + Townside stopbank (Figure 8)
- Flood water depth differences between no flood protection and flood protection (Figure 9)

- Australian Rainfall & Runoff Flood Hazard Classification, for 1% AEP Baseline, no flood protection (Figure 10) for 1% AEP with floodway + Townside stopbank (Figure 11).

These figures clearly show the significant decrease in flooding within the North Clyde area during the 1% AEP design event. Smaller changes in flood extent can also be seen in the Waihirere Road and Townside areas.

Whilst flooding is not eliminated in the Waihirere Road area, flood depths are reduced in this area contributing to a decrease in flood hazard. Figure 9 illustrates the difference in flood depths between the baseline and with the scheme (1% AEP flood).

Although the proposed scheme generally reduces flood hazard, the increase in flow passed downstream by the floodway and the reduction in the volume of flood water held within the floodplain is observed to have some adverse impacts on flood depth and hazard. Areas of adverse impacts are visible in the yellow to red colourway on Figure 9. The areas predicted to experience negative flood impacts are generally limited to upstream of the floodway outlet.

There is around 22 ha of mostly rural land where predicted flood depths are higher with the proposed scheme[1]. Figure 9 shows locations where this increase in flood depth is predicted to occur (yellow/orange areas). Most of the increases in flood depth occurs in the river and floodway, and the majority of the rural land impacted is on the river margins and is also predicted to flood in the do-nothing scenario. The predicted increase in flooding depth on the rural land, over and above the baseline flooding depth, is between 0.1 m and 0.25 m.

There is a small predicted increase in the flood depth on a 500 m stretch of State Highway near the Café 387, but this area also floods in the baseline scenario to approximately 2.46 m deep and the increase is only 0.11 m, bringing the flood depth to 2.57 m. Any change in the duration and velocity of the flooding on the State Highway will be very small and there will be no adverse impacts on the use of the State Highway.

There are four buildings that are predicted to experience a small rise in floodwater depth (less than 0.25 m increase) due to the floodway and Townside stopbank[2]. These buildings are ancillary (shed/garage) or farm buildings. None are dwellings.

Table 4 provides a summary of the predicted flood impacts on urupā from the implementation of the scheme. The impacts are reported in terms of the changes to the depth and velocity of floodwater compared to the do-nothing scenario (i.e. not building the scheme). Figure 6 shows the location of these cultural sites/features. In terms of depth, it is predicted that there will no longer be flooding at Waihirere Urupā, at Takitimu Marae and Te Kopua urupā, as they are now protected by the proposed flood scheme. It is predicted that there will be small reductions in flood depth at the other urupā, except Makeakea Urupā, where a small increase in flood depth is predicted. As Makeakea Urupā is already subject to flooding in the do-nothing situation to 1.22 m deep, a 0.20 m increase above this is relatively small and not likely to result in a measurable physical impact. Flood depths of this scale are unsafe for people (hazard classification around H3/H4).

In terms of velocity,

Table 5 shows the changes in velocity at these urupā which have all reduced or are no longer predicted to flood.

[1] The area calculation includes all land where the change in flood depth is at least 0.1 m

[2] Buildings are 'impacted' if they intersect an area where flood depth is predicted to increase by more than 0.1m.

Table 4: Predicted change in flood depth at urupā (100-year ARI)

Urupā	Max Depth for Baseline (m)	Max Depth for Scheme (m)	Change in Max Depth (m)
Tanemitirangi Matiti Urupā	0.31	0.25	-0.06
Te Kopua Urupā	0.36	no flooding	-0.36
Ruataniwha Urupā	no flooding	no flooding	no change
Te Ha te pe Lane Urupā	0.14	0.09	-0.05
Whakapau Urupa at Hinemihi Marae	no flooding	no flooding	no change
Makeakea Urupā	1.22	1.42	0.20
Waihirere Urupa at Takitimu Marae	0.51	no flooding	-0.51

Table 5: Predicted change in velocity at urupā (100-year ARI)

Urupā	Max Velocity Baseline (m/s)	Max Velocity Scheme (m/s)	Change in Max Velocity (m/s)
Tanemitirangi Matiti urupā	1.34	1.27	-0.07
Te Kopua Urupā	0.62	no flooding	-0.62
Ruataniwha Urupā	no flooding	no flooding	no change
Te Ha te pe Lane Urupā	0.35	0.32	-0.03
Whakapau Urupā at Hinemihi Marae	no flooding	no flooding	no change
Makeakea Urupā	0.66	0.58	-0.08
Waihirere Urupā at Takitimu Marae	1.38	no flooding	-1.38

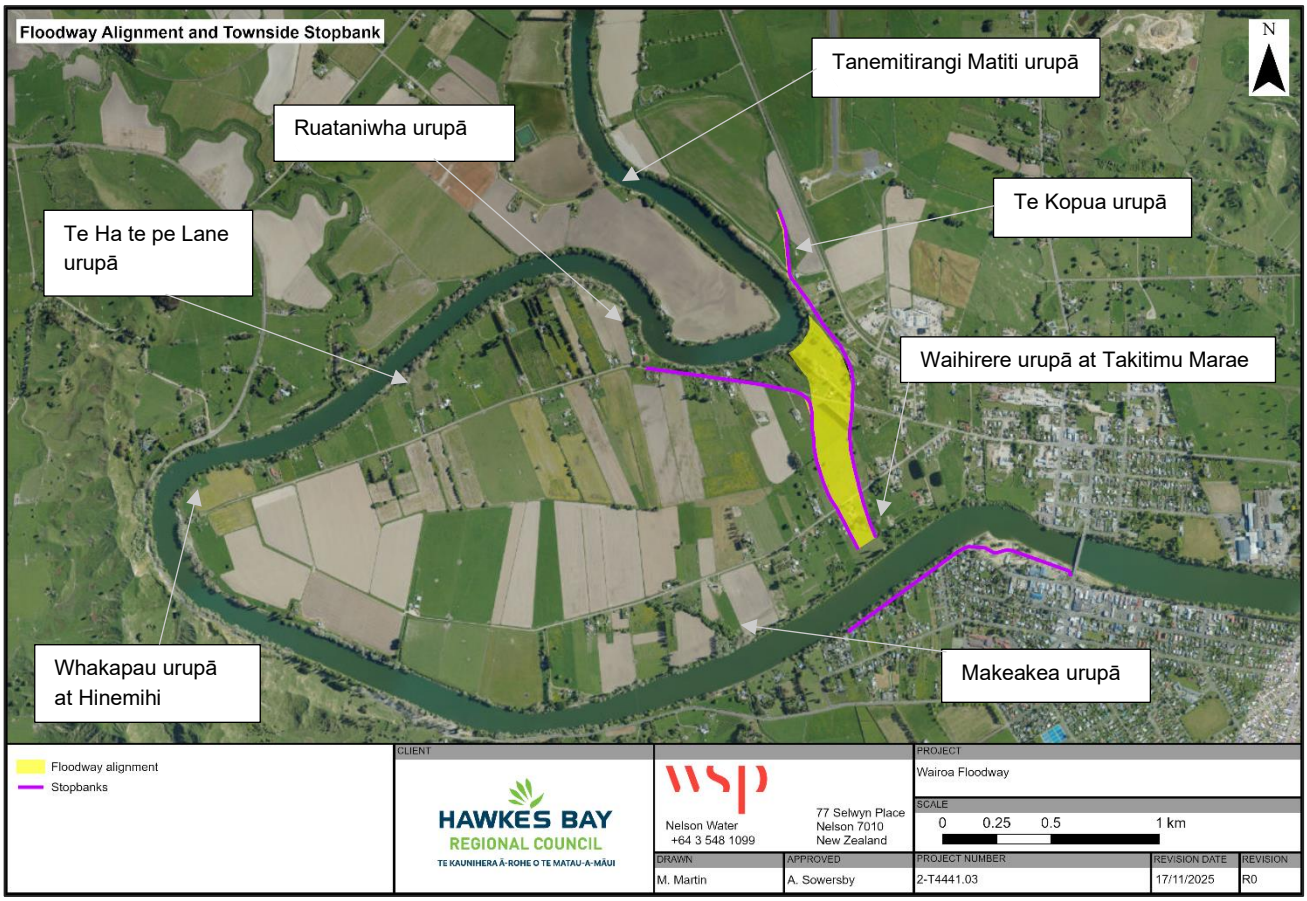

Figure 6: Location of urupā

The following sections provide details of the beneficial and adverse impacts on different receptors to flood risk within the area of interest. Table 6 shows the total area flooded and the number of buildings flooded between the two scenarios.

Table 6: Quantity of buildings and area affected by the proposed floodway and stopbanks

Modelled flood event	Area of flooding (ha)		Number of buildings in flooded area*	
	Baseline scenario	With scheme scenario	Baseline scenario	With scheme scenario
1% AEP	1,003	681	960	101

** Properties within the extent of the proposed floodway have been filtered out of both baseline and scheme results*
** Flooded areas are defined as flooding deeper than 0.1 m.*

Table 7 provides an analysis of the areas impacted and protected by the floodway and Townside stopbank.

Land protected by the scheme is any area where flood depth has reduced to no more than 0.1 m. A building is considered “protected” if floodwaters are unlikely to reach or exceed the floor level, even if water ponds on the surrounding property. As such, some buildings may be classified as protected despite being surrounded by shallow flooding.

Table 7: Estimated area of land and number of buildings protected by the proposed flood mitigation

	Within the floodway (estimated)	Protected by floodway (estimated)
Number of buildings	16	859
Number of dwellings	5	Not calculated*
Area of Māori whenua	2.4 ha	43 ha
Area of general title land	23.6 ha	279 ha
Total footprint of land	26 ha	322 ha

**Building classification data (residential, commercial, farm, ancillary etc.) is incomplete across the area of interest*

Across the modelled area of interest, the numbers of buildings and hectares in each flood hazard category, with and without the proposed floodway and stopbanks in place, have been calculated for the 1% AEP flood event.

Table 8 shows the shows the area in each hazard classification in the baseline and with scheme scenario.

Table 8: Changes in hazard classification area (ha) between baseline and flood hazard classification.

	Area (ha) of land within Flood Hazard Classification						
	H1	H2	H3	H4	H5	H6	Total
Baseline scenario	300	175	180	100	123	291	1,169
With scheme scenario	154	75	79	63	107	304	782

Table 9 shows the numbers of buildings that have moved from one hazard category to another. This shows that while there is no change in flood hazard category for 61 buildings (sum of 'diagonal grey cells'), 909 buildings move to flood hazard category H0, meaning that they are flood free. However, there are 2 buildings at increased risk, a net benefit of 907 buildings.

Table 9: Changes in hazard classification for buildings

Change in building count in each hazard category			Scheme hazard classification						
			H0	H1	H2	H3	H4	H5	H6
		Totals	909	83	25	6	3	0	0
Baseline hazard classification	H0	-	-	1	0	0	0	0	0
	H1	244	203	40	1	0	0	0	0
	H2	372	327	29	16	0	0	0	0
	H3	364	345	9	7	3	0	0	0
	H4	37	30	2	1	2	2	0	0
	H5	8	4	2	0	1	1	0	0
	H6	0	0	0	0	0	0	0	0

** Properties within the extent of the proposed floodway have been filtered out of both the baseline and scheme results*

3.3.2 ASSUMPTIONS AND LIMITATIONS

There are specific limitations with the data in Table 7, Table 8 and Table 9 due to the way depth and hazard rasters have been output from the TUFLOW model:

- "Flooded" has been defined as cells with a maximum flood depth > 0.1 m, whereas the hazard results in this report include depths between 0.05 and 0.1 m.
- All measurements/counts are constrained to the area of interest i.e. the extent shown in the results figures below.
- Buildings that have no hazard rating in the baseline scenario are not included in the hazard classification count.
- The depth raster output from TUFLOW is 2 m resolution. For Table 7, buildings have been flagged as in flooded areas if they intersect > 0.1 m depth cells. This was used as the numerous at-risk buildings along Marine Parade were not being flagged using the usual cell centre sampling, due to floor level adjustments made in the model DEM.
- The flood hazard classification raster output from TUFLOW is 4 m resolution and values have been attributed to the building footprints using cell centre sampling at 4 m resolution. This larger resolution means that some buildings have a hazard classification, but are not included in the "flooded" building/area counts.

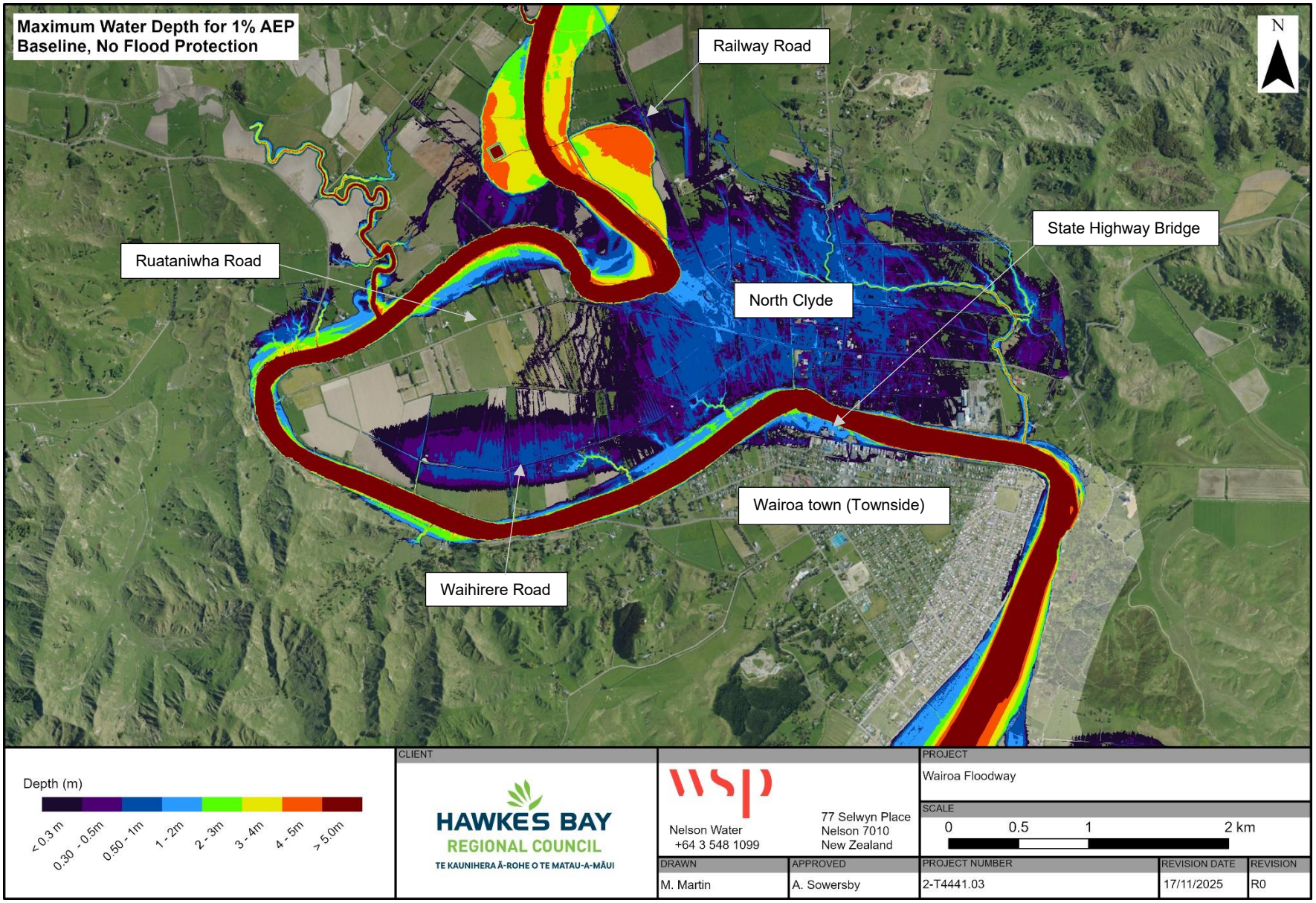

Figure 7: The maximum water depth for 100-year ARI baseline, no flood protection

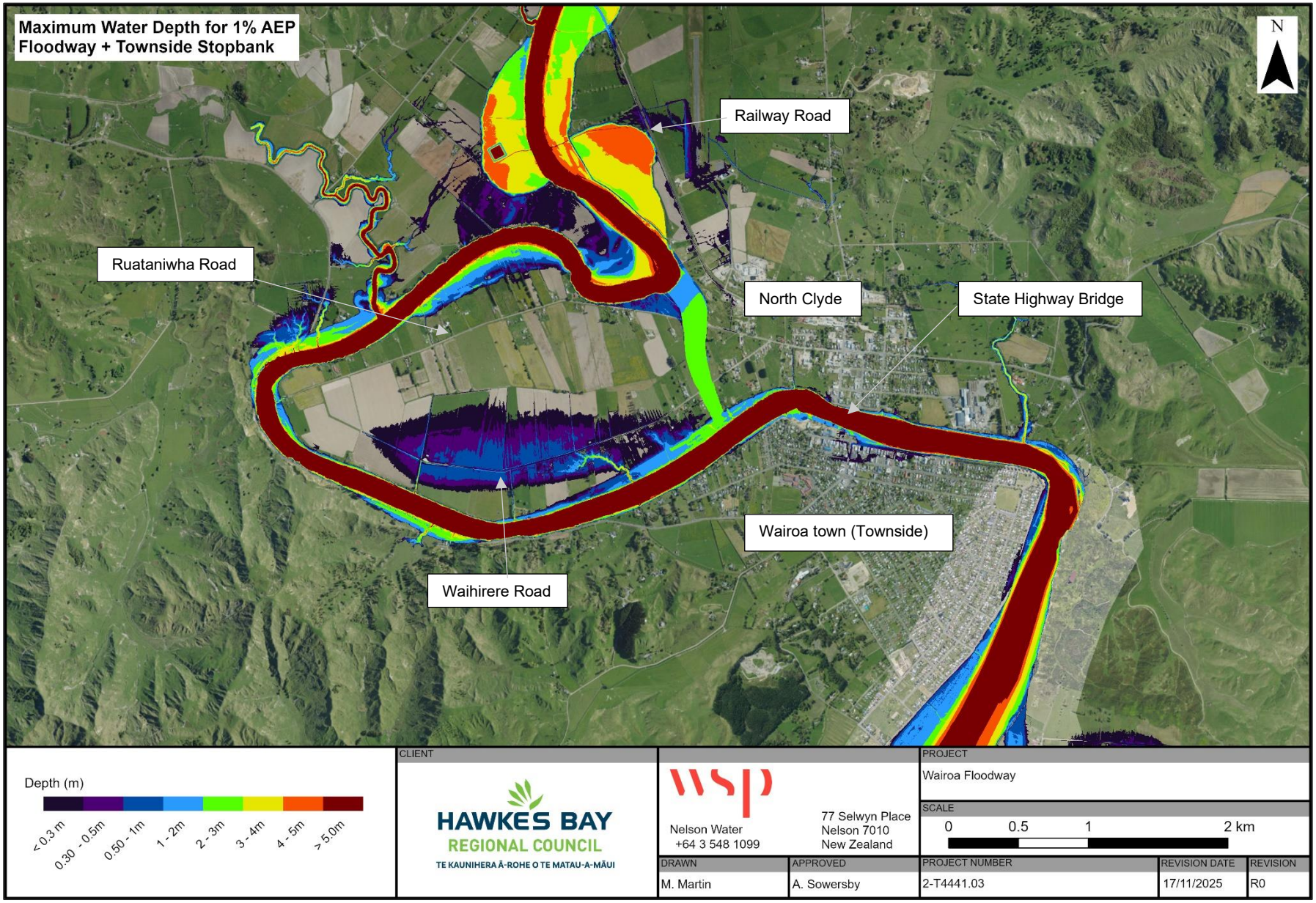

Figure 8: The maximum water depth for 100-year ARI with floodway + Townside stopbank

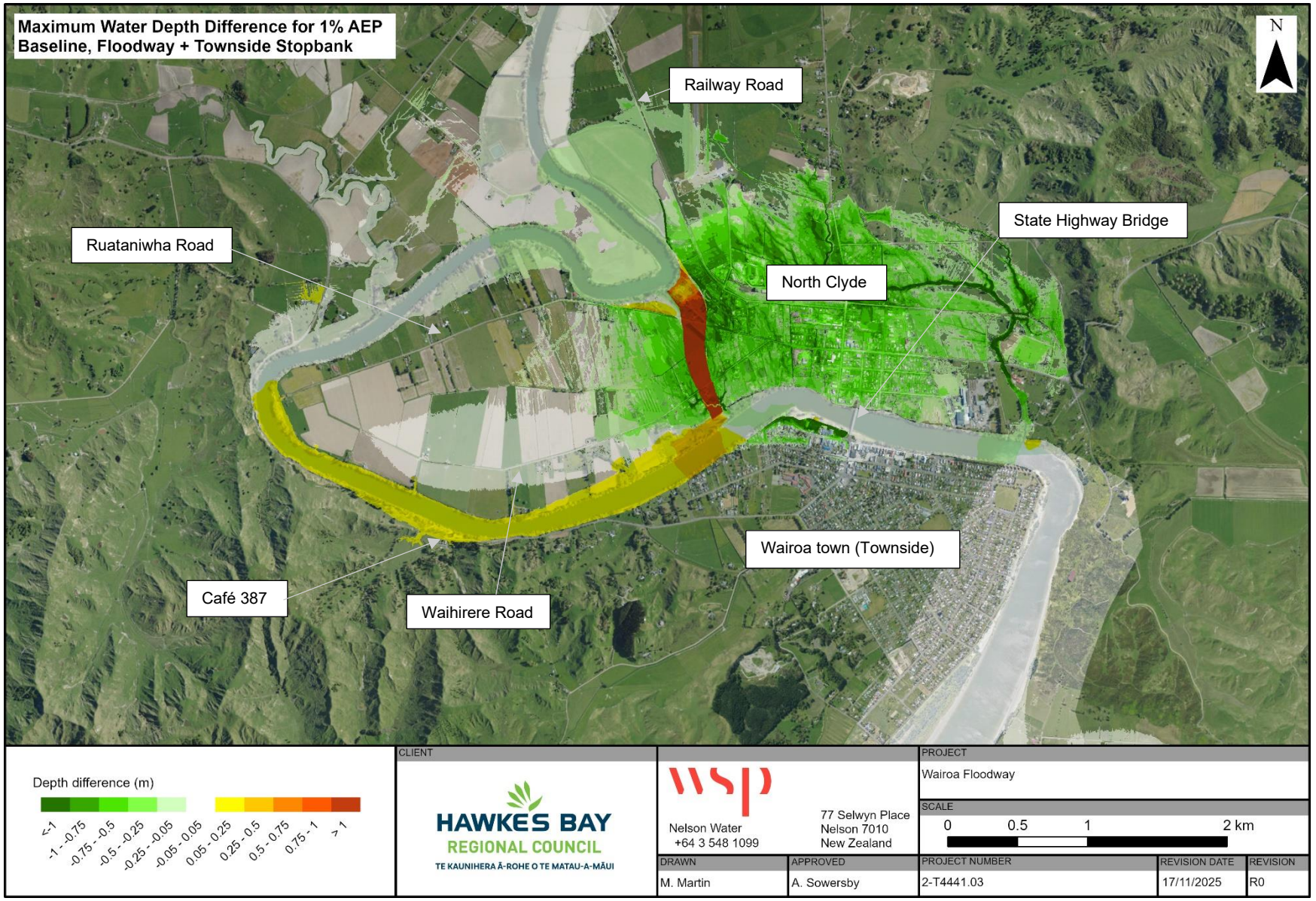

Figure 9: Flood water depth differences between no flood protection and flood protection. Green signifies a reduction in flood depth and yellow through to red signifies an increase in flood water depth. Grey is no change.

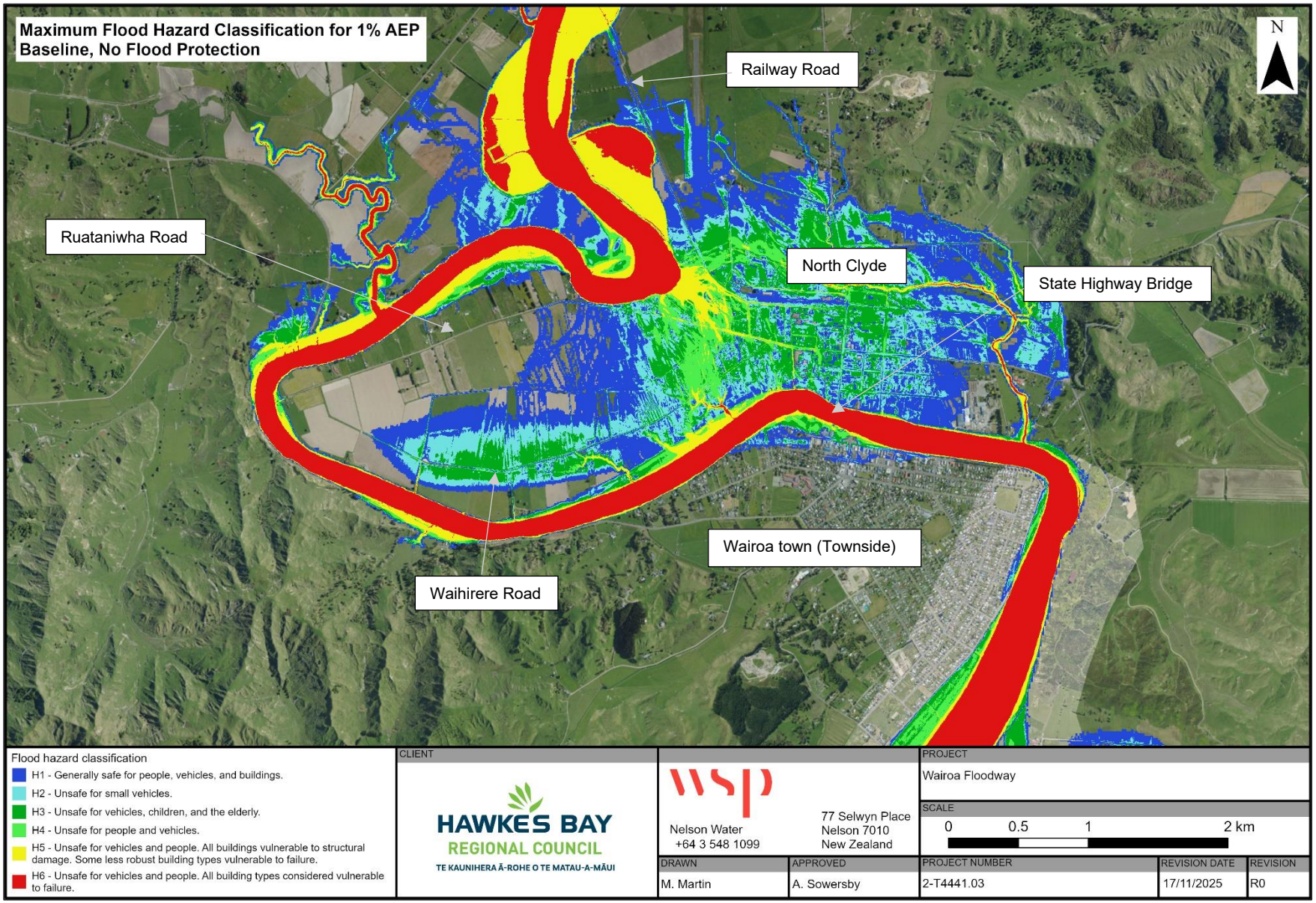

Figure 10: Australian Rainfall & Runoff Flood Hazard Classification, for 100-year ARI baseline, no flood protection.

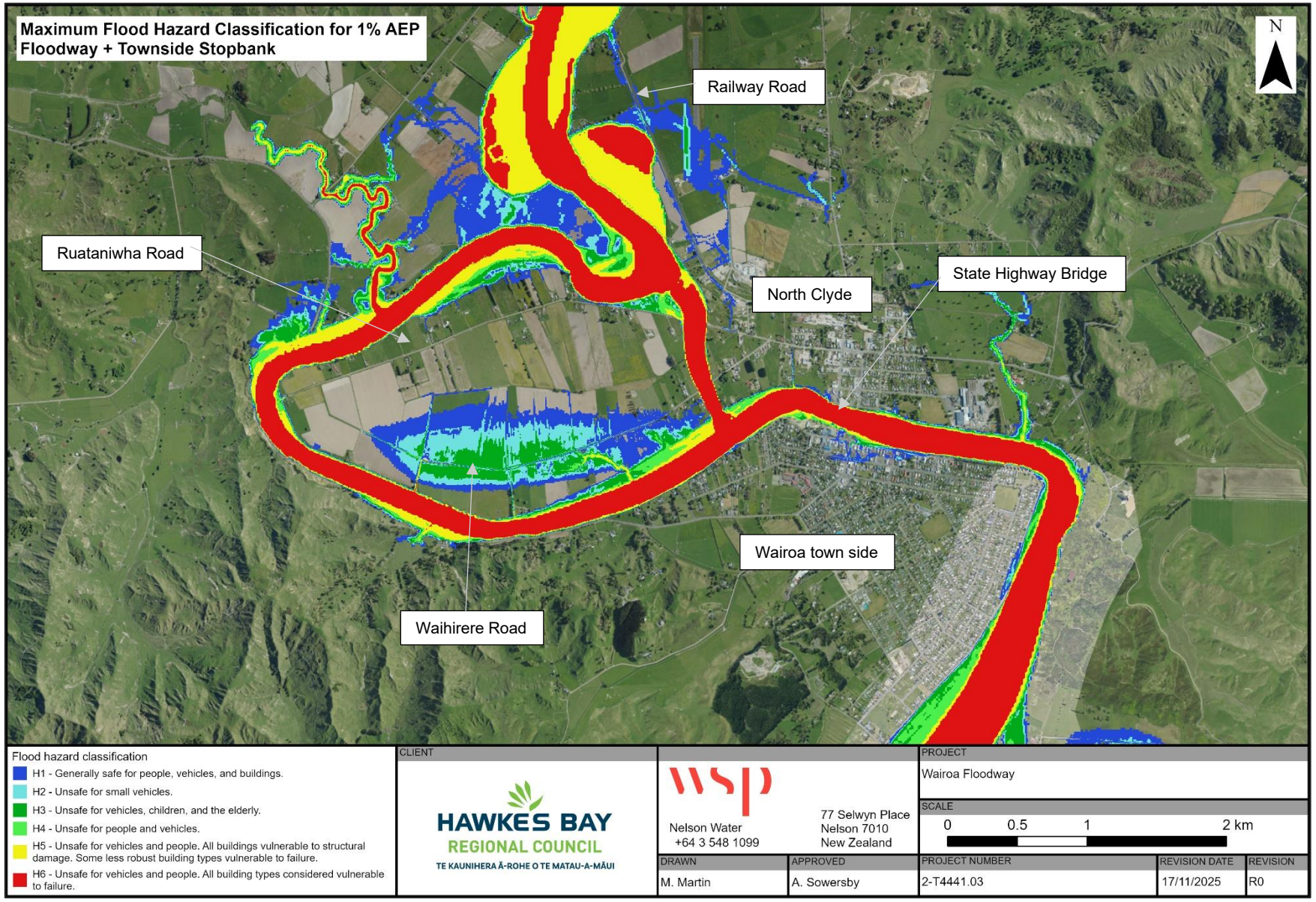

Figure 11: Australian Rainfall & Runoff Flood Hazard Classification, for 100-year ARI with floodway + Townside stopbank.

3.3.3 VELOCITY AND SCOUR

With the design of the floodway, a slight reduction in river velocity is observed upstream of the floodway outlet. Elsewhere along the river velocities remain largely unchanged compared to the baseline scenario. Flow velocity and scour potential is predicted to increase along the floodway and immediately downstream of the floodway outlet in the vicinity of the Townside stopbank. The scheme will be designed to withstand the predicted scour with a combination of grassed surfaces and engineered surfaces in high velocity locations. The townside stopbank will be set back at least 6 m from the river edge away from the areas of high predicted velocities just downstream of the outlet. As such, the consequential impacts from flood velocity and scour will be mitigated.

3.3.4 OVERDESIGN EVENTS

For this stage in the design we have not been able to model larger events as the stopbank in the flood model is ‘glass walled’ meaning that it cannot overtop. As a consequence, the results would be misrepresented for larger events.

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3.3.5 SUMMARY

A summary of the expected effects of the proposed scheme and an assessment of whether it meets each criterion (i.e. the 'PDP criteria,' see section 3.1 above) is presented in Table 10. This evaluation is based on the information presented in this Consequences Report.

Table 10: Flood Consequences Evaluation

Criteria	Effects and Consequences of the Wairoa Floodway and Townside Stopbank	Evaluation
Magnitude of Effect: Changes in flood depth and hazard classification.	Land parcels and dwellings within Wairoa's Category 2C areas benefit from flood protection up to a 1% AEP storm event, provided by the floodway and Townside stopbank. This protection covers approximately 859 buildings and 322 ha of land, reducing their flood hazard classification (in some cases from as high as H4) to none. Four buildings experience a small rise in floodwater depth (less than 0.25 m increase) due to the floodway and Townside stopbank. However, these are ancillary (shed/garage) or farm buildings; none are dwellings.	**Pass**
Event Scale: An effect from a smaller, more frequent event is considered more significant than the same effect from a larger, rarer event.	At this point in time the model is not able to model the scale of effects of the scheme with any larger overdesign events.	**Unclear**
Property Sensitivity: Properties already vulnerable to flooding have a lower tolerance for additional flood impacts than those with little or no existing hazard	There are no dwellings at risk of an increase in flood risk with the proposed floodway and Townside stopbank in place.	**Pass**
Land use: The land use of affected properties also matters — rural land used for grazing, cropping, or horticulture generally tolerates flooding better than residential dwellings.	Category 2C areas in Wairoa include a mix of urban, rural, agricultural, and Māori land. With the floodway and Townside stopbank in place, most of this land is protected during a 1% AEP event. There is around 22 ha of land that sees an increase in flooding with this scheme that is mostly rural and some greenspace between some residential properties. The Makeakea urupā is predicted to see a small increase in flood depth of around 0.20 m (above the 1.22 m predicted in the baseline).	**Pass**
Scale of the proposal: While less critical, the scale of the proposal matters—effects from a large project protecting key infrastructure and hundreds of homes are more acceptable than the same effects from a smaller project, such as a stopbank for ten houses.	The proposed floodway and Townside stopbank will protect a large area (approximately 322 ha) and about 859 commercial, residential and rural buildings are no longer predicted to flood in a 1% AEP event. There are additional buildings that see a reduction in Hazard classification. 16 buildings and 26 ha of land (including 2.4 ha Māori land) will be directly impacted due to the construction of the floodway (land purchased and buildings dismantled or relocated) and around 22 ha and four buildings (non-habitable) will see an increase in flooding.	**Pass**

4 CONCLUSIONS

WSP's modelling and analysis demonstrates that the proposed floodway and Townside stopbank under a 1% AEP (current climate) scenario significantly reduces the floodwater depth across Category 2C land surrounding the Wairoa River. This flood scheme protects approximately 322 hectares, including significant Māori land, the North Clyde area and land on the Wairoa town side.

In terms of potential adverse consequences, there are 16 properties and 26 hectares of land affected by the construction of the floodway (i.e. within the floodway itself). There are also 22 ha of land and 4 non-habitable buildings that experience a small increase in predicted flooding in a 1% AEP event due to the scheme, however, this land is predominantly rural.

While the floodway and Townside stopbank provide substantial mitigation during large storm events, they are unlikely to eliminate all flood risk to properties and infrastructure for storms larger than 1% AEP, though the effects have not been quantified to date.

This report has evaluated the benefits of implementing the proposed floodway and the Townside stopbank against its potential adverse effects. Based on the flood consequences evaluation shown in Table 1, the proposed flood mitigation measures passes four of the five criteria with an unclear result for the remaining criteria. This would indicate that **the consequences of the proposed floodway and Townside stopbank are acceptable.**

5 REFERENCES

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