



Maitai River flood improvements: Area 1, Package 1

Design Report

Prepared for
Nelson City Council

Prepared by
Tonkin & Taylor Ltd

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Executive summary

This report summarises the design of the proposed flood improvements along the true left bank of the Maitai River, within Portions 1, 2 and 3 of Area 1 of the broader Maitai River flood protection project and supports the application for Resource Consent for the works. The site incorporates approximately 600 m of stopbank from Hanby Park to Clouston Bridge. These works have been prioritised for construction starting January 2026.

Residential development adjacent to the Maitai River in this area has been impacted by river flooding several times in recorded history. Existing crest levels in these portions vary between exceeding Present Day (PD) 1% Annual Exceedance Probability (AEP) flood levels to approximately 2% PD AEP flood levels. The proposed improvements increase the Level of Service (LoS) of the existing stopbanks up to a 2050 RCP8.5M 1% AEP storm event (without freeboard).

Geotechnical assessments indicate that portions of the existing stopbank do not meet typically accepted stability criteria in a number of locations. Therefore, the works have been designed to have low vulnerability to damage if shallow instability occurs on the riverside banks.

Key design elements include:

- Portion 1 – raising approximately 230 m of existing stopbank by up to 1.1 m, with realignment of a portion to protect a landscape tree.
- Portion 2 – construction of a pole floodwall (0.5 to 1.3 m high) supported by a reinforced concrete slab, designed for resilience against overtopping scour.
- Portion 3 – construction of a lower height pole floodwall (maximum 0.5 m high).

Flood modelling confirms that the proposed works will reduce flood risk to adjacent residential areas, with increases in flood levels to open space areas owned by NCC (primarily Branford Park). The design maintains public access via the Maitai River Walkway and minimises impacts on surrounding infrastructure.

Further work will include detail design, geotechnical refinement, stakeholder engagement, and preparation of resource and building consent applications.

Additionally, this project is co-funded by central government's Regional Infrastructure Fund (RIF), which requires that the project is completed by end of June 2027, within the approved co-funded budget.

Glossary of key terms

Term	Definition
Annual Exceedance Probability (AEP)	The likelihood of a flood of a certain size occurring in any given year. For example, a 1% AEP event has a 1 in 100 chance of occurring annually.
Digital Elevation Model (DEM)	A 3D representation of terrain elevations.
Factor of Safety (FoS)	A measure of structural stability. Higher values indicate greater safety margins against failure.
Freeboard	The vertical distance between the design flood and the top of a flood protection structure. Typically provided to allow a safety margin to account for modelling uncertainties or unmodelled local effects like wave action or channel change during a high flow event.
Floodwall	A vertical barrier constructed to prevent floodwaters from overtopping.
Hydraulic gradient	Term used to describe groundwater flow under stopbanks. Defined as 'head loss/length over which head loss occurs', United States Army Corps of Engineers, Engineering and Design, Seepage Control and Analysis for Dams, 30 September 1986.
High Intensity Rainfall Design System (HIRDS)	NIWA's tool for estimating rainfall intensities under current and future climate scenarios.
Improvements	Adding flood protection and/or improving resilience.
Level of Service (LoS)	The flood event magnitude that a structure is designed to withstand.
Light Detection and Ranging (LiDAR)	Remote sensing technology used to create high-resolution topographic maps for modelling.
New Zealand Society on Large Dams (NZSOLD)	Provides guidelines for dam design and safety.
Overtopping	When floodwaters exceed the crest height of a stopbank or floodwall.
PARA framework	A climate adaptation strategy: Protect, Accommodate, Retreat, Avoid.
Portions 1 – 5	Subsections of Area 1 along the Maitai River, each with distinct flood protection design elements.
Protection	Reduction in flood extents/depths.
Resilience	Reducing impacts within extents (e.g. through emergency planning, using flood resistant building materials etc).
RCP8.5M	A climate change scenario representing high greenhouse gas emissions with medium sensitivity assumptions. For this study, the effect of climate change is to increase future flows over present-day, for a given AEP.
Scour	Erosion caused by fast-moving water, which can undermine flood protection structures.
Seepage	Water movement through or beneath a stopbank, which can affect stability.
Stopbank	An embankment built to prevent river flooding of adjacent land. Also known as a levee.
TUFLOW	Hydraulic modelling software used to simulate flood scenarios and design impacts.

1 Introduction

This design report supports Consent Package 1 for flood resilience improvements along the true left bank of the Maitai River. The proposed works within this package include Portions 1, 2 and 3, which collectively span approximately 600 m of existing stopbank between the river and adjacent residential areas from Hanby Park to Clouston Bridge. These works have been prioritised for construction starting in January 2026. This report describes the detailed design process and outcomes, a high-level summary of the expected construction impacts, and assessment of flood effects for the works included in Consent Package 1. This work has been prepared in accordance with the Tonkin & Taylor Ltd (T+T) agreement with NCC signed 2 May 2025 (VO1, T+T reference: 1006675.5170, NCC Project ID 1178).

Two additional portions (Portions 4 and 5) located downstream are not included in this consent package but will be addressed in future design and consenting phases. It is not anticipated that the design or construction of Portions 4 and 5 will significantly affect the design construction impacts, or assessment of flood effects presented for Portions 1-3. Portions 4 and 5 will be assessed separately in future design and consenting packages, and any cumulative effects in combination with works covered in Consent Package 1 will also be considered.

The five portions make up Maitai Area 1, which is one of NCC's five packages of work for flood resilience/improvements along the Maitai River within the Nelson urban environment.

2 Site overview

NCC has identified five areas along the Maitai River have been identified for flood resilience/improvement works, see Figure 2.1 below.

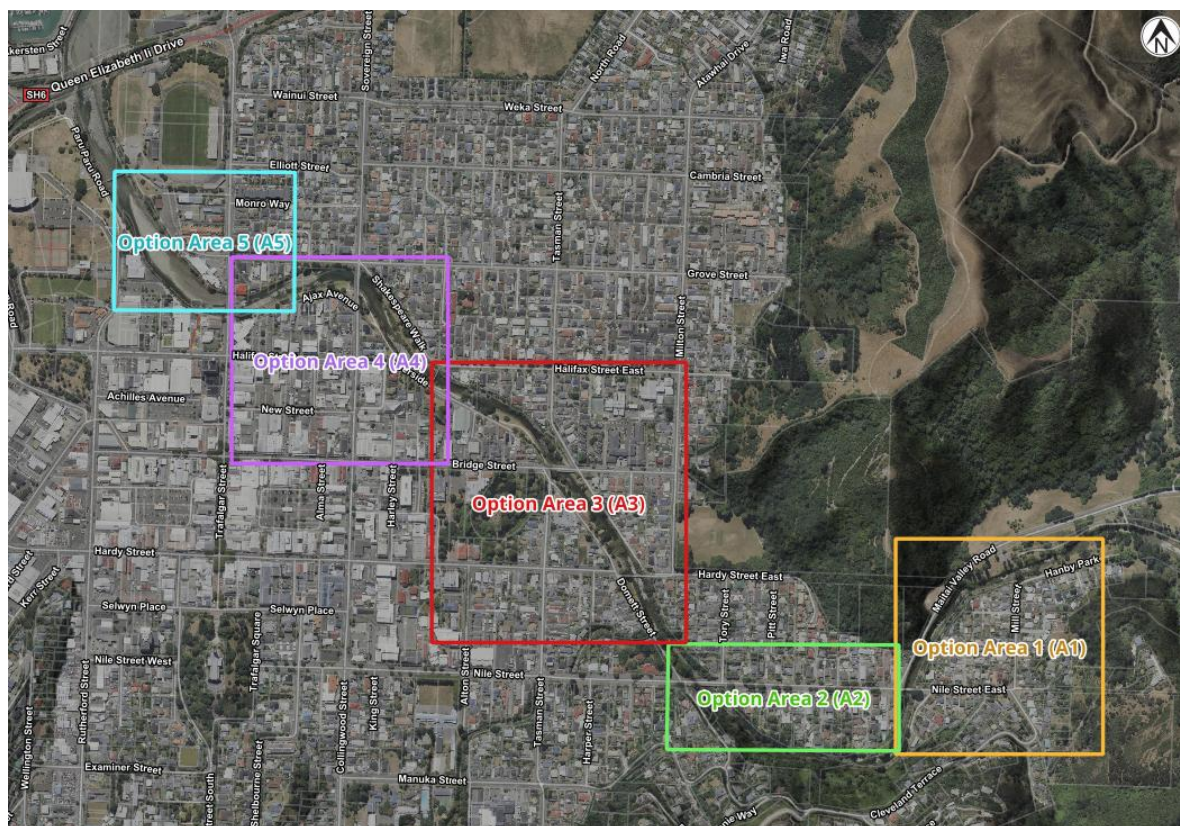


Figure 2.1: Maitai River flooding improvement works, options areas.

The general location of works for Area 1 is between Hanby Park and Clouston Terrace. Area 1 has been split into five portions as described below and shown in Figure 2.2:

- Portion 1 is comprised of the existing stopbank on the true left of the Maitai River, adjacent to Hanby Park.
- Portion 2 is located around the bend at Mill Street and is comprised of the existing stopbank on the true left of the Maitai River.
- Portion 3 is comprised of the existing stopbank on the true left, downstream of the Mill Street bend to the Clouston Bridge.
- Portion 4 is comprised of the existing stopbank on the true left of the Maitai River from upstream of the Clouston Bridge to the end of Clouston Terrace.
- Portion 5 is comprised of land on the true right of the Maitai River from upstream of Clouston Bridge to 204A Nile Street East.

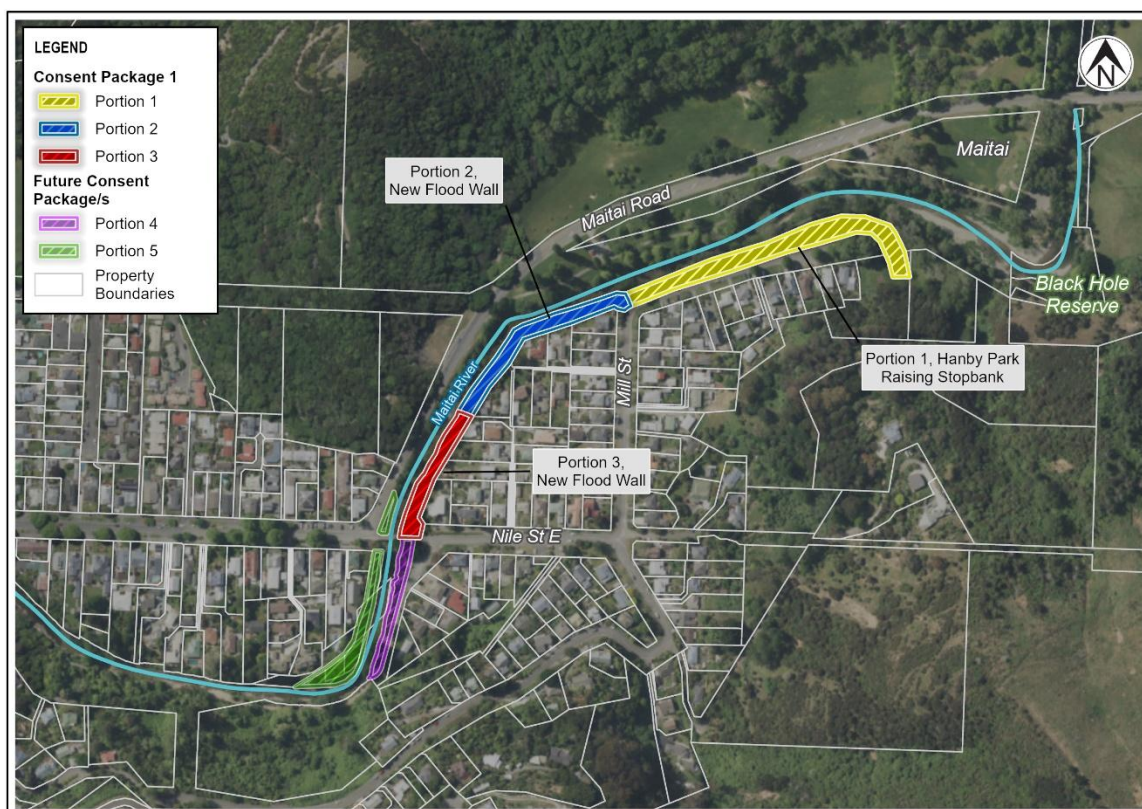


Figure 2.2: Portions of Area 1 where flood improvement work options have been assessed.

3 Background and previous work

Residential development adjacent to the Maitai River in this area has been impacted by river flooding several times in recorded history. Figure 3.1 below shows photographs¹ from selected events.



Figure 3.1: Photographs of historical flooding in the project area (Area 1).

The most recent events occurred in August 2022, May 2023, and April 2025. The August 2022 event caused widespread flooding and landslip damage throughout the Nelson region. Sections of the stopbank adjacent to Clouston Terrace (Portion 4), and in the vicinity of Mill Street (true left of

¹ Taken from [New Zealand Flood Pics \(nzfloodpics.co.nz\)](https://nzfloodpics.co.nz/)

Portion 2) overtopped in this event, shown in Figure 3.2 below. We understand from NCC that the portion adjacent to Clouston Terrace (Portion 4) also overtopped in the May 2023 event (approx. 1 in 8 to a 1 in 10-year event at Avon Terrace gauge). In the April 2025 event (approx. 1 in 5-year event at Avon Terrace gauge), river levels were within 300 mm of overtopping the stopbank.



Figure 3.2: Flooding during the August 2022 storm. Exact time of photograph unknown, peak happened a short time later according to a source.²

² Taken from [New Zealand Flood Pics \(nzfloodpics.co.nz\)](https://nzfloodpics.co.nz/)



Figure 3.3: Flooding during the August 2022 storm. Time of photograph unknown.

3.1 Draft geotechnical investigation report, June 2024

In June 2024, T+T prepared a draft geotechnical investigation report summarising site investigations and geotechnical assessments to evaluate stopbank crest height and geotechnical condition with reference to modern design standards and guidelines³. The report covered Hanby Park stopbank from the upstream end of Hanby Park to 5A Clouston Terrace. Specific assessment of the stopbank was carried out at two locations – 10 Hanby Park (Portion 1) and 5A Clouston Terrace (Portion 4). The report considered crest height and freeboard, scour protection, seepage and stability, and other risks. The report's findings are outlined below:

- Crest height and freeboard:
 - This report found that the Hanby Park portion of the stopbank, now referred to as 'Portion 1', has a crest level that provides a variable level of service up to up to 2130 RCP8.5M 1% AEP flood levels. Since this report was issued, updated modelling indicates that there is a varying LoS that generally falls between present day 1% AEP flood levels to approximately 2% AEP flood levels. No freeboard has been allowed for in this LoS.
 - The Clouston Terrace section of the stopbank has a much lower level of service. It does not meet current design criteria and is likely to be overtopped by frequent floods greater than a present day 20% AEP (approx. 1 in 5 year) event. Overtopping occurred at this location during the August 2022 and May 2023 floods, among others.
- Scour protection:
 - Several locations along the stopbank were damaged by scour in the August 2022 flood. Only one of the locations, near Clouston Terrace, involved serious damage to the stopbank. Since that report was issued, the stopbank adjacent to Clouston Terrace was heavily damaged by a slump, likely caused by scour of the toe of the riverside slope in the April 2025 flood event. A repair was undertaken in May 2025 and approximately

³ Tonkin + Taylor Ltd. (2024). Hanby Park Stopbank – Geotechnical investigation. T+T ref: 1006675.5170. Prepared for Nelson City Council.

50 m length of rock armouring was placed to stabilise the bank slope and protect the stopbank.

- Due to the velocities expected at the site during design flood events, grass is likely to only provide sufficient scour protection for short duration events. NCC could consider installing additional scour protection in high-risk areas.
- Seepage and stability:
 - The Hanby Park portion of the stopbank is generally stable and mostly meets current design criteria. However, there is a risk that during long duration floods, the integrity of the landward toe could be compromised due to the high hydraulic gradient across the Hanby Park stopbank. NCC has reported that after the stopbank was originally constructed a core cut-off trench was installed to reduce seepage through the stopbank.
 - The Clouston Terrace section of the stopbank does not meet current design requirements on the river side slope. Additionally, if the stopbank is raised, additional seepage is likely to be induced, raising the hydraulic gradient at the inland toe and negatively affecting the stability of the embankment. This adverse effect of crest raising would need to be mitigated.
- There is an additional risk of concentrated leak erosion and backward erosion at varying locations at the site. This mechanism could compound over multiple flood events and could compromise the stopbank stability in the future.
- Due to site constraints, the riverside slope of the stopbank along Portions 1, 2 and 3 were not investigated at the time of reporting.

3.2 Maitai River flood resilience improvements – Area 1, May 2025

Physical works options to improve the level of flood protection at the site, supported by preliminary flood modelling, were assessed and summarised in the T+T report titled *Maitai River flood resilience improvements – Area 1 options report* issued 16 May 2025. This report provided a long list of options ranging from ‘do nothing’ to realigning the stopbank. Twenty-four model runs with various combinations of options were tested to assess flood effects and screen the long list options. The screening resulted in an optimised option for each portion of Area 1, as follows:

- Portion 1 – raise the stopbank.
- Portion 2 – construct a floodwall along the existing stopbank on the true left and make a cut in the true right bank (Branford Park) to create a new floodway.
- Portion 3 – construct a floodwall along the existing stopbank on the true left.
- Portion 4 – lower the existing stopbank to form a floodway, raise Clouston Terrace carriageway and construct a retaining/floodwall between the floodway and carriageway. Lower the ground underneath the true left span of Clouston Bridge (may require pier strengthening).
- Portion 5 – replace the existing floodwall north of Clouston Bridge and form a floodway south of the bridge.

The report considered the feasibility of achieving LoS between present day 1% AEP and 2090 RCP8.5M 1% AEP. However, due to a range of uncertainties, particularly around the feasibility of land acquisition, it did not go as far as confirming a specific LoS for the proposed improvements. The selected level of service for Package 1 works was carried out as part of this reporting and is outlined in Section 4 below.

Subsequent to issuing the May 2025 report, analysis of the Portion 2 cut to create a new floodway along the true right of the Maitai River found that unless a significant section of the Maitai Valley

Road is realigned there is only minimal flood benefit of this floodway compared with the significant costs and other design considerations (e.g. tree removal). As such the Portion 2 cut has been removed from the project.

4 Design criteria

4.1 Level of service (LoS)

For the purposes of this report, LoS relates to the highest flood level that the scheme is designed to accommodate (as opposed to other engineering considerations, e.g. seismic failure modes). No freeboard is allowed for in the LoS. NCC holds flood modelling for the Maitai River that has been used to understand design flood flows and levels at this location.

The height and extents of the proposed improvements are dependent on the target LoS selected for each portion. Providing a higher LoS (i.e. using a future scenario and setting crest levels higher) has the potential to contain larger floods and reduce the river flooding risk further. However, accommodating higher LoS has cost and consenting implications and could also elevate other risks at the site, such as elevated risk of structural failure of the existing stopbank, as there is insufficient width to build up stable side slopes if the stopbank crest is raised, and/or increased flood levels downstream.

Design events up to a 1% AEP were considered in selecting a LoS for this site. More extreme events such as a Maitai Dam failure or a 250-year event were not included in the current scope. While consideration of such events would highlight additional flood risk, they fall outside the scope of this project.

The selected level of service provides additional time for adaptive planning in response to climate change impacts on this area. It is anticipated that NCC and the community will consider a range of responses (e.g. under the Protect, Accommodate, Retreat, and Avoid (PARA) framework) in anticipation of higher and more frequent flooding.

4.1.1 Current LoS

The current LoS of the existing stopbank along the true left bank of the Maitai River within Package 1 works varies as described below:

- The existing stopbank within Portion 1, at Hanby Park, on the true left side of the river has varying crest levels that generally exceed the present day 1% AEP flood level. At the downstream end, the LoS lowers to approximately 2% AEP levels. During the August 2022 event, localised overtopping occurred at low points at the downstream end.
- The existing stopbank within Portions 2 and 3, on the true left side of the river, provides a LoS of approximately 2-1% AEP level. Some localised overtopping occurred at low points during the August 2022 event.

4.1.2 Design LoS and indicative risk reduction at the site

The design presented in this report aims to achieve flood protection for the 1% AEP event under the 2050 RCP8.5M climate scenario. This LoS was selected to balance increasing the river flooding protection at the site, the condition of the existing stopbank, and costs. Some key considerations are described below.

4.1.2.1 Increase of river flooding protection at the site

Figure 4.1 below shows (schematically) the approximate number of existing properties on the true left of the Maitai River between Hanby Park and Clouston Terrace exposed to 1% AEP river flood hazard between now and 2130, for the current stopbanks and a range of different design LoS targets. This plot assumes that Portion 4 (not addressed in this report) has a LoS equal to present day 1% AEP flood levels.

INDICATIVE PROPERTY EXPOSURE TO RIVER FLOODING AT THE SITE

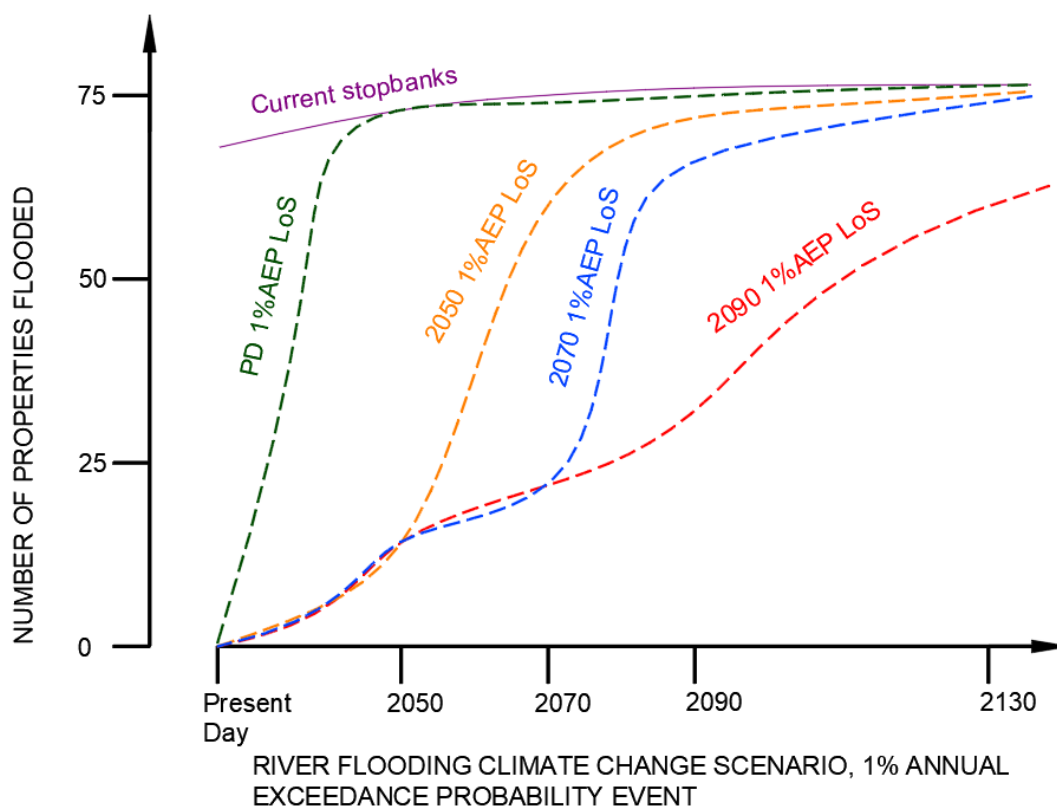


Figure 4.1: River flood risk profiles at the site for the 1% AEP flood up to 2130, considering current stopbanks and four design LoS targets (conceptual only).

Note that this figure represents the number of properties flooded once works at all five portions of the project are implemented. The maximum number of houses potentially flooded plateaus due to the steep topography surrounding the floodplain. It is worth noting that the figure only considers protection for floods up to a 1% AEP event in various climate change scenarios. For over-design events which may overtop the floodwalls and stopbanks, the increased heights may worsen flood depths and durations for some properties; however, it is beyond the scope of this report to consider events greater the 1% AEP RCP8.5 2130 event. It should be reiterated that this project and the selected LoS provides NCC with additional time for adaptive planning in response to climate change impacts on this area.

Note that while 2050 RCP8.5M 1% AEP flood levels were selected for the design of the flood improvement levels, this equates to Present Day 1% AEP flood levels plus freeboard within the project area between 150 and 390 mm.

4.1.2.2 Condition of the existing stopbank

The stopbank in Portion 1 is generally stable and mostly meets current design criteria. NCC has reported that after the stopbank was originally constructed a core cut-off trench was installed to reduce seepage through the stopbank. The performance of the stopbank has been reported to be satisfactory, with only overtopping occurring in localised areas in larger events. The nature of the proposed works within Portion 1 are such that the proposed stopbank top-up can incorporate typically stable batter angles, and/or be located away from unstable riverbanks for the majority of its

length. Therefore, works in this area are not highly sensitive to the condition of the existing stopbank.

Preliminary ground investigations and stability models for Portions 2 and 3 indicate that the existing stopbank does not meet typical stability criteria in some locations, and some localised trimming of oversteepened areas may be required to reduce the risk of instability on the river side face.

Adopting a 2050 RCP8.5M 1% AEP LoS would generally limit the required height of a floodwall to 1.3 m. We have selected flood wall locations and configurations that are not likely to be affected by limited scour, erosion or shallow slumping on the river side slope of the stopbank, potentially negating requirements for widespread stopbank strengthening, though periodic maintenance of the stopbank will likely be required to ensure that the stopbank is kept in good condition. NCC has a separate maintenance program for this.

4.2 Adopted design criteria

The following table summarises the stability criteria adopted for the design based on typical industry accepted values^{4, 5, 6}.

Table 4.1: Proposed design criteria for improvements

Parameter	Proposed criteria
Design flood flow (LoS)	2050 RCP8.5M 1% AEP flood flow for the 24-hour event, which is the critical duration for the site location and is based on NCC's existing river modelling (MaiBkYk_202103v089).
Minimum freeboard (LoS)	There are no NZ standards for stopbank freeboard requirements, and adopted values vary across the country. For this project no freeboard (i.e. 0 m) has been included above the design 2050 RCP8.5M 1% AEP flood level.
Stopbank slopes	Slope gradients are dependent on the fill material used, and other loading conditions that the embankments are likely to be subjected to, including hydraulic and earthquake loading. In some locations, maintenance requirements can govern maximum slope gradients. The following slope gradients are expected to achieve the stability criteria with the fill material planned to be used for this project: - Landward: typically 2H:1V, localised sections may need to be steeper. - Riverside: typically 2.5H:1V, localised sections may need to be steeper.
Factor of Safety (FoS) against slope instability during design water surface level	≥ 1.5 as per NZSOLD guidelines. The existing stopbank in Portions 2 and 3 may not meet this criteria, this will be assessed further and discussed with NCC during future stages of work.
FoS against slope instability during rapid drawdown conditions	≥ 1.2 to 1.3 as per NZSOLD Guidelines. The existing stopbank in Portions 2 and 3 may not meet this criteria, this will be assessed further and discussed with NCC during future stages of work.
Seismic performance	Operational Basis Earthquake (OBE), adopt 1 in 150-year, Generally FoS > 1.0. Minor deformations are acceptable provided functionality is retained, and damage is easily repairable, as per NZSOLD Guidelines.

⁴ NZSOLD Guidelines 2024

⁵ The International Levee Handbook, CIRIA C731, London 2013

⁶ U.S Army Corps of Engineers, Washington, DC 20314-1000, Engineer Manual No. 1110-2-1901, Engineering and Design, Seepage Analysis and Control for Dams, 30 April 1993

Parameter	Proposed criteria
	Safety Evaluation Earthquake (SEE), adopt 1 in 500-year, acceptable deformation, as per NZSOLD.
Hydraulic gradient under stopbank	$i \leq 0.5$
Seepage exit gradient at toe	$i \leq 0.5$

5 Design

The proposed physical works for Package 1 (Portion 1, 2 and 3) are shown in Figure 5.1. The following sections describe the design, include a sketch and discuss the expected construction impacts for each portion.

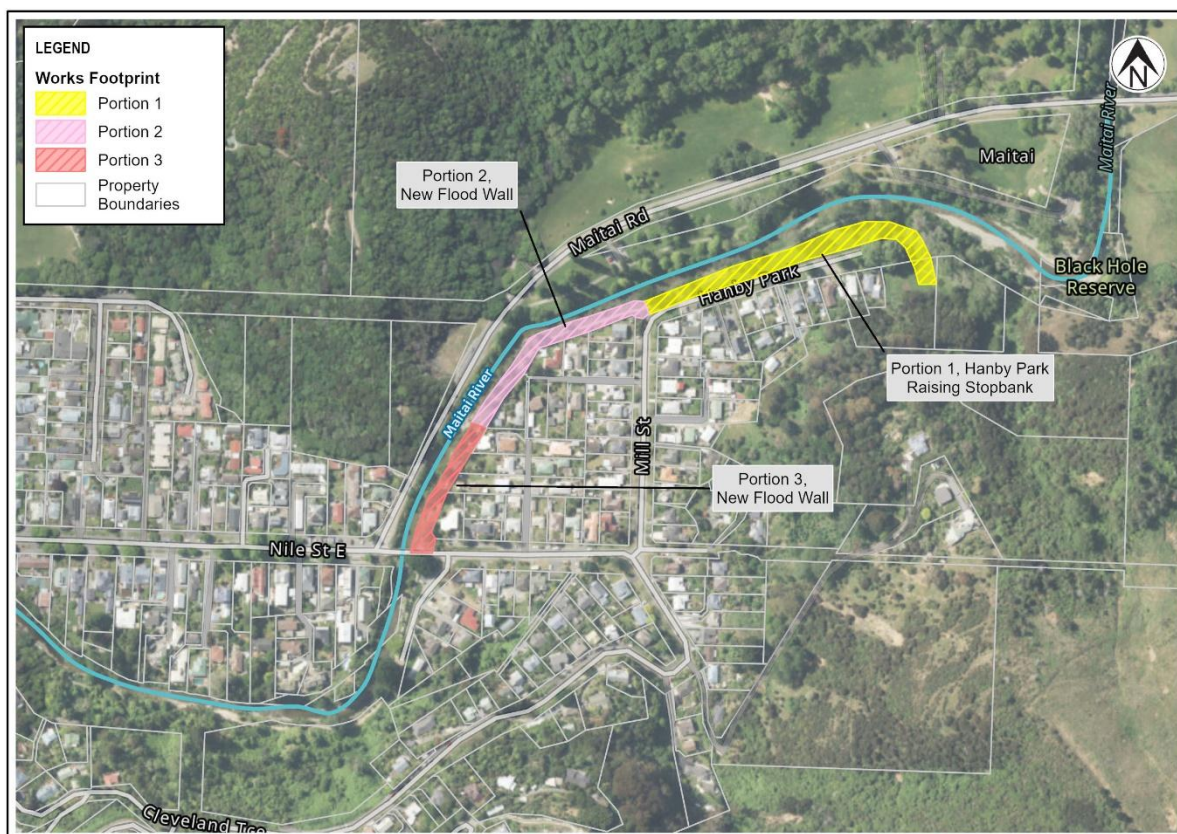


Figure 5.1: Package 1 works portions.

5.1 Portion 1 stopbank raising, Hanby Park

Portion 1 comprises approximately 300 m of existing stopbank located on the true left of the Maitai River, between the river and Hanby Park. Hanby Park is a road that provides access to 15 residences and lies on the landward side of the existing stopbank. The Maitai River Walkway runs between the river and the stopbank.

The proposed works involve raising the existing stopbank with selected compacted earth fill up to the 2050 RCP8.5M 1% AEP flood level along two areas totalling approximately 190 m length. Approx. 70 m length (of the 190 m total) will be realigned to avoid the rootzone of a protected landscape tree. Approximately 60 m of the existing stopbank already meets this LoS and will require only minor surface works to integrate with the adjacent raised sections.

A typical cross-section of the proposed design is provided in Appendix A and the extent of the stopbank raising is illustrated in Figure 5.2. The crest height increase ranges from 0 to 1.1 m, depending on existing elevations and available space. The design aims to enhance flood protection while minimising impacts on adjacent infrastructure and amenities. Note that there is a low voltage power and an NCC-owned 25 mm diameter water lateral within the footprint of the upstream portion of the stopbank alignment. We expect these services can be worked around without any major design changes, though localised works may be required to protect or divert services.



Figure 5.2: Plan showing area of stopbank raising in Portion 1, green shading.

The downstream extent of the stopbank top up will decrease in height and overlap with the Portion 2 flood wall up to the design LoS due to the limited width available between Hanby Park road and the river.

At the upstream end, two mature landscape trees are located near and within the existing stopbank footprint. A realignment of the existing stopbank is proposed to preserve these trees and reduce the risk of root-related structural compromise to the stopbank. Smaller trees impacted by works may be relocated where feasible or removed.

Construction will involve removal of the existing crest and topsoil, followed by stepped fill placement to engineering specifications. Fill materials will be selected for strength and seepage control and will be keyed in below the existing ground surface near the stopbank toe. Soil parameters used in the design are representative of typical Port Hills Gravel derived fill. This material will need to be imported from offsite. The raised stopbank has a wider footprint, so partial relocation of a short section of the Maitai River Walkway is required. Once the stopbank is raised to the design level, it will be covered in topsoil and seeded with grass. Selective planting on the landward side may be considered.

The Portion 1 works should be carried out during summer or autumn months as this is the best time to carry out earthworks of this nature.

5.2 Portions 2 and 3 flood walls, Mill Street to Clouston Bridge

Portions 2 and 3 comprise approximately 160 metres and 200 metres, respectively, of existing stopbank located on the true left bank of the Maitai River. Both sections are grassed and vegetated with trees and shrubs, and the Maitai River Walkway runs along the crest—continuously in Portion 2 and partially in Portion 3, where it descends the slope near the downstream end, close to Clouston Bridge. The waterside slope varies from approximately 1.4H:1V to 2H:1V in Portion 2, and from 1H:1V to 1.7H:1V in Portion 3.

Residential properties are located immediately landward of both portions, with property boundaries generally situated near the toe of the stopbank. Fencing and vegetation (weeds, trees, shrubs and flaxes) are present along the crest within Council-owned land.

The proposed works involve constructing a floodwall near or at the crest of the existing stopbank, with the top of the walls set to 2050 RCP8.5M 1% AEP event flood levels. Cross-sections of the proposed design are provided in Appendix A. Floodwall heights will vary, ranging from approximately 0.5 to 1.3 metres in Portion 2 and up to approximately 0.5 metres in Portion 3, depending on existing ground levels, alignment, and available space.

In selecting flood wall configurations for Portions 2 and 3, we have considered:

- The top of wall level was set to the design flood level.
- The geometry of the stopbank and the space available within NCC land.
- Ground conditions to inform stability and seepage modelling.
 - Flood walls are to be keyed into competent alluvial gravels that underly weak historical fill and buried topsoil layers. This follows a key learning from I-wall failures in New Orleans during Hurricane Katrina.
- Test augers and trenches were excavated on site in September 2025 using an 8-tonne excavator.
 - The tests generally encountered varying thicknesses of historic fill over alluvial silty gravel and cobbles.
 - Test augers were carried out using a 750 mm dia. auger. The alluvial gravels typically collapsed once the auger had advanced approx. 0.3 to 0.5 m into this layer.
 - Trial trenches could be advanced to 1.1 m penetration into alluvial gravel before collapse or very hard digging occurred.
 - No groundwater was encountered in the trials.
- Resilience of the flood wall to potential future instability and/or scour damage on the river side slope. We selected pole walls on the landward side of the stopbank crest, keyed into more stable Dense alluvial gravels below the man-made fill, which has a history of shallow failures along the river side face. Reinforced concrete slabs for added stability are included in higher areas of the wall.
- Risks associated with the wall being impacted by flood-borne debris, such as forestry logs, and a sudden breach. This was discussed with NCC and DS Project Solutions in August 2025. Key points included:
 - Following NCC's 2023 risk assessment framework, the risk of a log breaching the flood wall is:
 - o The combined likelihood of a 1% AEP flood x likelihood of entrained logs x likelihood of impacting wall, which is on the landward side of the stopbank, = Rare.
 - o The consequence of a sudden breach in the flood wall could include multiple fatalities, = Extreme.
 - o Risk = Medium.
 - We discussed that more robust materials such as steel or concrete could lessen the likelihood of a breach.
 - DS Solutions advised that:
 - o Steel or concrete construction would likely increase the construction cost of the walls by approximately 2-2.5x.
 - o Steel and concrete could have significantly higher maintenance costs over the life of the wall.
 - NCC advised that:

- o Risk could be managed by evacuating the area during large floods that are above the level of the stopbank crest.
 - o Based on the above risk management strategy, and the potential cost and maintenance implications, timber construction was preferable.
- Learnings regarding flood wall vulnerabilities from historic events such as Hurricane Katrina (2005), and the Edgumbe floodwall failure (2017).

5.2.1 Design adopted in Portion 2

The design for Portion 2 comprises a pole wall constructed on the landward side of the stopbank, supported by a reinforced concrete slab, typically up to 1.3 m high. Poles will need to be installed into a trench that is keyed into dense alluvial gravels below the historic fill and backfilled with concrete. The reinforced concrete slab provides additional stability support, and aides in sharing impact forces from floating debris. The section of wall in Portion 2 most likely to be affected by floating debris as the height above the stopbank crest is higher. Figure 5.3 below shows a sketch of the flood wall.

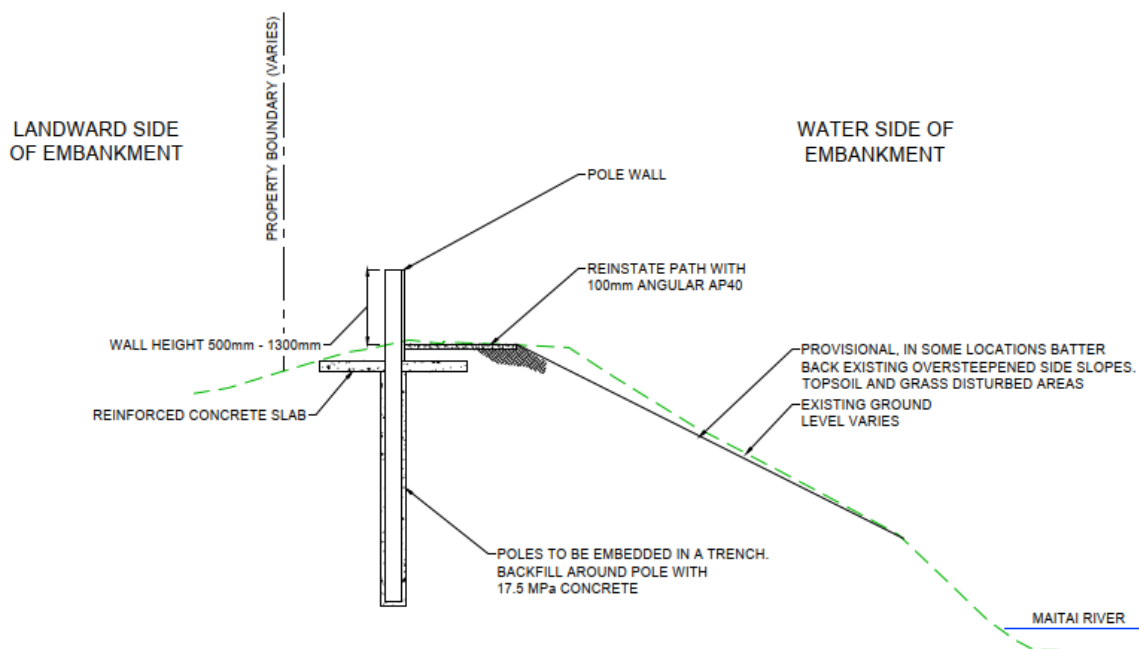


Figure 5.3: Portion 2 flood wall sketch.

Stability modelling, using industry standard software packages Seep/W, Slope/W, and Plaxis2D, indicates that the river side of the existing stopbank does not meet current stability criteria at a number of locations. The siting of the wall on the landward side of the stopbank crest, and keying poles into Dense alluvial gravels decreases the likelihood that the new flood wall will be affected by shallow instability on the river side face.

5.2.2 Design adopted in Portion 3

The design for Portion 3 comprises a pole wall constructed on the landward side of the stopbank, typically up to 0.5 m high. Poles will need to be installed into a trench that is keyed into dense alluvial gravels below the historic fill and backfilled with concrete. Figure 5.4 below shows a sketch of the flood wall.

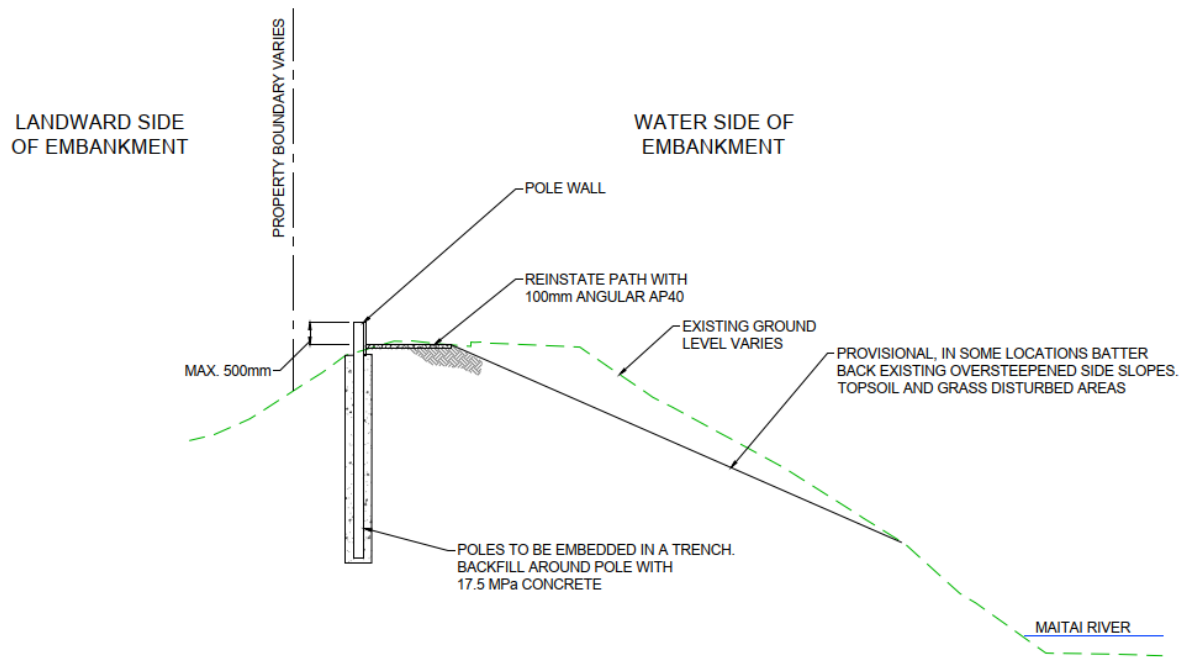


Figure 5.4: Portion 3 flood wall sketch.

Stability modelling, using industry standard software packages Seep/W, Slope/W, and Plaxis2D, indicates that the river side of the existing stopbank does not meet current stability criteria at a number of locations. The siting of the wall on the landward side of the stopbank crest, and keying poles into Dense alluvial gravels decreases the likelihood that the new flood wall will be affected by shallow instability on the river side face.

Because Portion 3 is a lower height wall than Portion 2, large debris like forestry logs are not likely to be able to get over the stopbank crest and impact the flood wall.

The downstream end of the Portion 3 flood wall will be terminated by running it into a very small (<0.2 m) low permeability earth fill top up of the existing stopbank, which will butt into the Nile St East road embankment.

5.2.3 Additional considerations

The proposed alignment of the floodwall, for both Portions, on the landward side of the stopbank leaves room for potential slope regrading or battering, in limited locations where necessary, to reduce the risk of instability and slumping on the river side slope. This work would occur no closer than 1 m from the water's edge. Requirements for improvements and locations will be confirmed during construction, in areas where weak ground is exposed.

The Maitai River Walkway path would be reinstated along the crest of the stopbank following construction. Along Portion 2, the design calls for the gravel path to be partially over the reinforced concrete slab, on the river side of the poles. Along Portion 3, the gravel path will continue along the river side of the poles.

Construction will involve clearing the crest and landward slope of topsoil, vegetation, and fencing to establish a working area. Trenching to install the poles should be carried out, poles erected, and the trench backfilled with concrete in sequential sections, to reduce the likelihood of collapse. In Portion 2, the reinforced concrete slab cast will be cast in situ around the poles. Lagging will be installed

across the poles to impound flood water. A layer of PE is included in the lagging to reduce leakage through the wall, however, some leaks are expected to occur.

5.2.4 Example of similar flood walls

A photograph of a pole flood wall from another site in the Nelson region is shown below. This wall is similar in height to the proposed Portion 2 floodwall.



Figure 5.5: Example of pole wall floodwall along waterway in the Nelson region.

6 Flood modelling

Initial optioneering was described in the T+T report titled *Maitai River flood resilience improvements – Area 1 options report* and dated 16 May 2025. This work was based on NCC's Maitai River model (version MaiBkYk_202103_v089).

To better inform concept and detailed design, a project-specific 2d-only model (MaitaiOpA1_v004) was developed in TUFLOW software to determine the flood levels for design and to assess potential offsite flood effects in the project area, as well as in upstream and downstream areas. This model uses river flows from NCC's latest river flood model (MaiBkYk_202103_v089⁷). The model has been hydraulically calibrated using flood level survey from the August 2022 event. Full details on the model are provided in Appendix B. The 2d TUFLOW model has advantages over the existing coupled 1d/2d DHI model in terms of ease of iterating through design concepts, and incorporation of 2d flow hydraulics within the river channel.

The following sections describe our assessment of the Package 1 works effects including change in river flooding depths, river flooding extents, and velocities under scenarios up to a 2130 RCP8.5M 1% AEP event.

6.1 Modelled flooding effects for Package 1 concept design

We have assessed the potential off-site flooding effects of the design described in Section 0 above using the project-specific flood model. Figure 6.1 to Figure 6.4 below present depth difference plots showing the predicted flood effects as a result of implementing the Package 1 flood improvements/resilience scheme to 2050 RCP8.5M 1% AEP flood levels.

Modelling shows that Package 1 works prevent river overflows in the Package 1 area up to the 2050 RCP8.5M 1% AEP event and reduce flooding depths in larger events, up to the modelled 2130 RCP8.5M event. The only increases in flood depths are in the Council-owned Branford Park area. There are no downstream or upstream effects above 0.05 m (the threshold used for filtering out model noise and account for effects of uncertainty (e.g. DEM resolution) so results are more meaningful and easier to interpret).

In events larger than 2050 RCP8.5M 1% AEP, such as the 2090 and 2130 scenarios, overtopping of the flood protection structures is likely. However, flood depths in residential areas remain similar to or lower than baseline and no new flood extents are introduced. Table 6.1 below summarises the general areas of increased flood depth, decreased flood depth and removed from flood extents for various flooding scenarios with Package 1 implemented.

⁷ The MaiBkYk model was previously calibrated and peer reviewed in 2021. Model version 089 is still undergoing calibration improvements at the time of this report, but the Maitai River calibration is complete and the model is considered appropriate to use for option design in Area 1.

Table 6.1: Summary of areas of increased flood depth, decreased flood depth, and removed from flood extents for PD, 2050, and 2130 1% AEP events

	Areas of increased flood depth	Areas of decreased flood depth	Areas removed from flood extents
Present day 1% AEP	Branford Park	- North end of Clouston Tce. - True right residential area north of Nile St (minor benefit).	True left residential area from Hanby Park to Nile St.
2050 RCP8.5M 1% AEP	Branford Park	- North end of Clouston Tce. - True right residential area north of Nile St.	True left residential area from Hanby Park to Nile St.
2090 RCP8.5M 1% AEP	Branford Park	- True left residential area from Hanby Park to Nile St. - True right residential area north of Nile St.	Negligible.
2130 RCP8.5M 1% AEP	Branford Park	- True left residential area from Hanby Park to Nile St. - True right residential area north of Nile St.	Negligible.

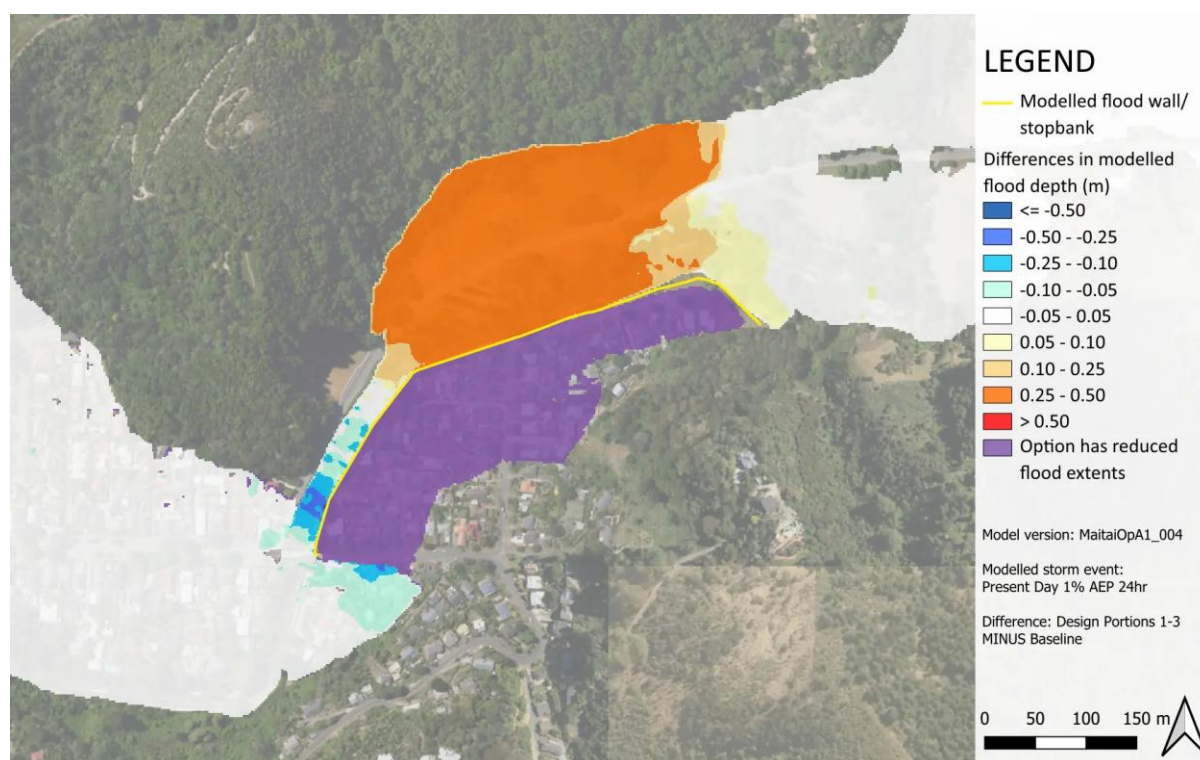


Figure 6.1: Modelled flood differences from Package 1 design during a Present Day 1% AEP event.

Figure 6.1 shows that, with the implementation of Package 1 works, compared to the baseline (no works) model, in a present day 1% AEP event:

- Branford Park experiences a river flooding depth increase of 0.25 to 0.5 m.

- The residential area along the true left of the Maitai River, north of Nile Street is no longer flooded by the river.
- There are small decreases in river flooding depths (0.05 to 0.25 m) in some areas south of Nile Street.
- The remaining area (shown in white) doesn't see a significant difference in river flooding depths from the baseline scenario (flood level difference less than 0.05 m).

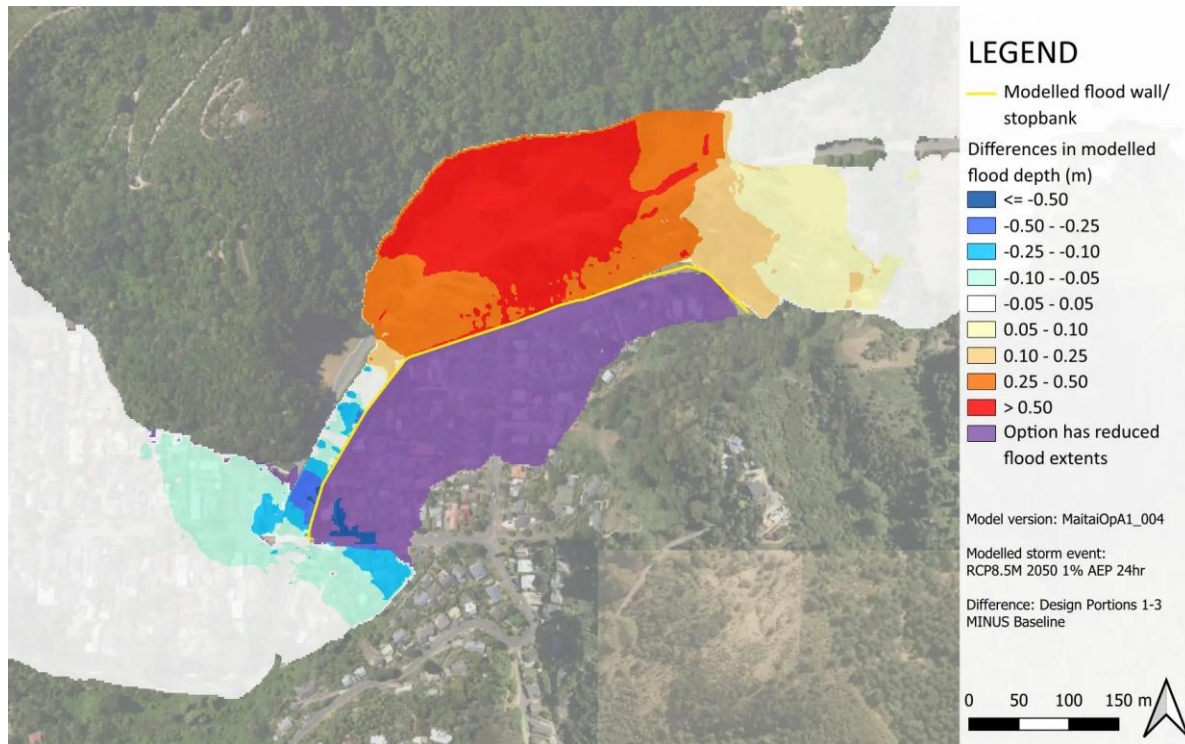


Figure 6.2: Modelled flood differences from Portion 1-3 design during a RCP8.5M 2050 1% AEP event.

Figure 6.2 shows that, with the implementation of Package 1 works, compared to the baseline (no works) model, in a 2050 RCP8.5M 1% AEP event:

- Branford Park river flood depths increase by more than 0.5 m. This results in additional storage volume detained within the park area of approximately 26,000 to 31,000 m³ relative to the baseline.
- The residential area along the true left of the Maitai River, north of Nile Street is no longer flooded by the river.
- There are small decreases in river flooding depths (0.05 to 0.25 m) in some areas south of Nile Street (on the true left) and north of Nile Street (on the true right).
- The remaining area (shown in white) doesn't see a significant difference in river flooding depths from the baseline scenario (flood level difference less than 0.05 m).

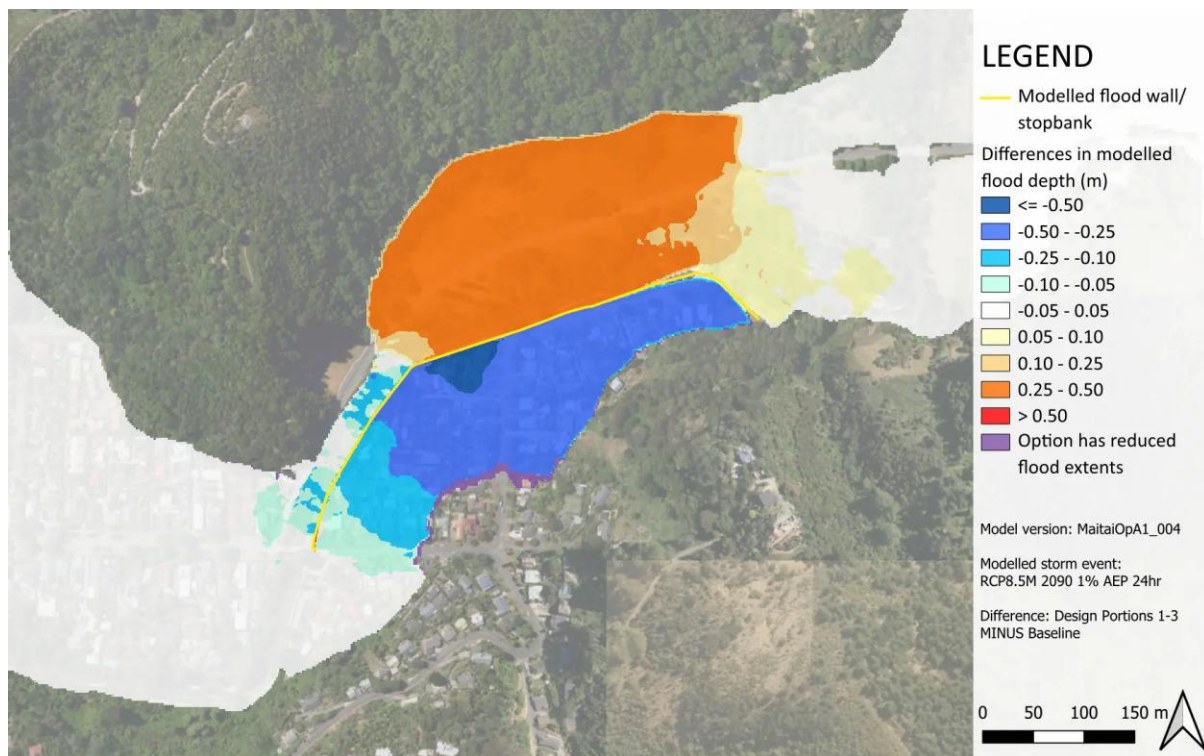


Figure 6.3: Modelled flood differences from Portion 1-3 design during a RCP8.5M 2090 1% AEP event.

Figure 6.3 shows that with the implementation of Package 1 works, compared to the baseline (no works) model, in a 2090 RCP8.5M 1% AEP event,

- Branford Park flood depths increase by 0.25 to 0.50 m.
- Flooding extents on the true left of the Maitai River, north of Nile Street sees a reduction of river flooding varying from 0.05 to >0.5 m.
- The remaining area (shown in white) doesn't see a significant difference in river flooding depths from the baseline scenario (flood level difference less than 0.05 m).

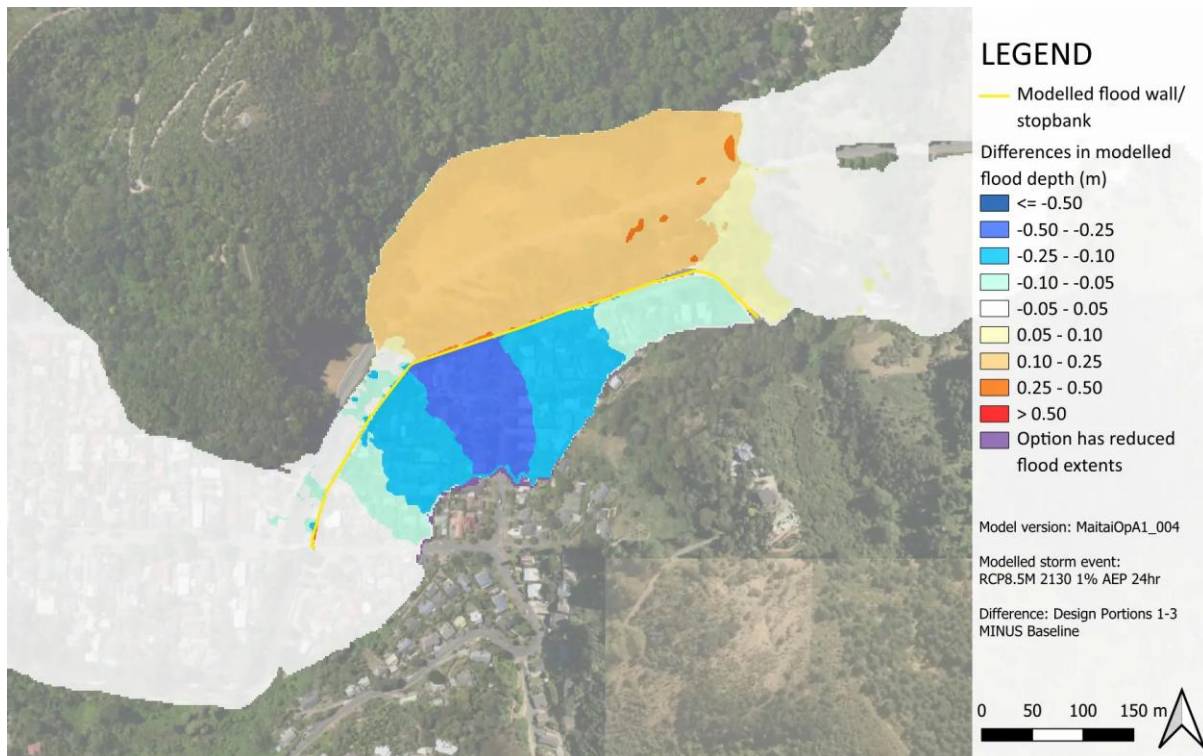


Figure 6.4: Modelled flood differences from Portion 1-3 design during a RCP8.5M 2130 1% AEP event.

Figure 6.4 shows that with the implementation of Package 1 works, compared to the baseline (no works) model, in a 2130 RCP8.5M 1% AEP event:

- Branford Park flood depths increase by 0.10 to 0.25 m.
- Flooding extents on the true left of the Maitai River, north of Nile Street sees a reduction of river flooding varying from 0.05 to 0.5 m.
- The remaining area (shown in white) doesn't see a significant difference in river flooding depths from the baseline scenario (flood level difference less than 0.05 m).

6.2 Flood profiles

Figure 6.5 shows a modelled flood profile along the river channel within the Maitai Area 1 project for the 2050 RCP8.5M 1% AEP river flood event.

Modelling shows that Package 1 works are expected to increase water levels within the Branford Park area (approx. chainage 12,300 to 12,650 m) by up to approximately 0.5 m within the river channel. Downstream of Branford Park, water levels within the channel are the same or less than the baseline model. Effects of the bridge on the water profile are observed upstream of the bridge between approximately chainage 12,750 and 12,880. The profile shows that flood levels downstream of Clouston Bridge are expected to be unaffected by Package 1 works. Figure 6.6 shows the alignment and extent of this profile along the Maitai River.

Design heights for the stopbank raising and the floodwall are based on the levels shown in Figure 6.5, without freeboard.

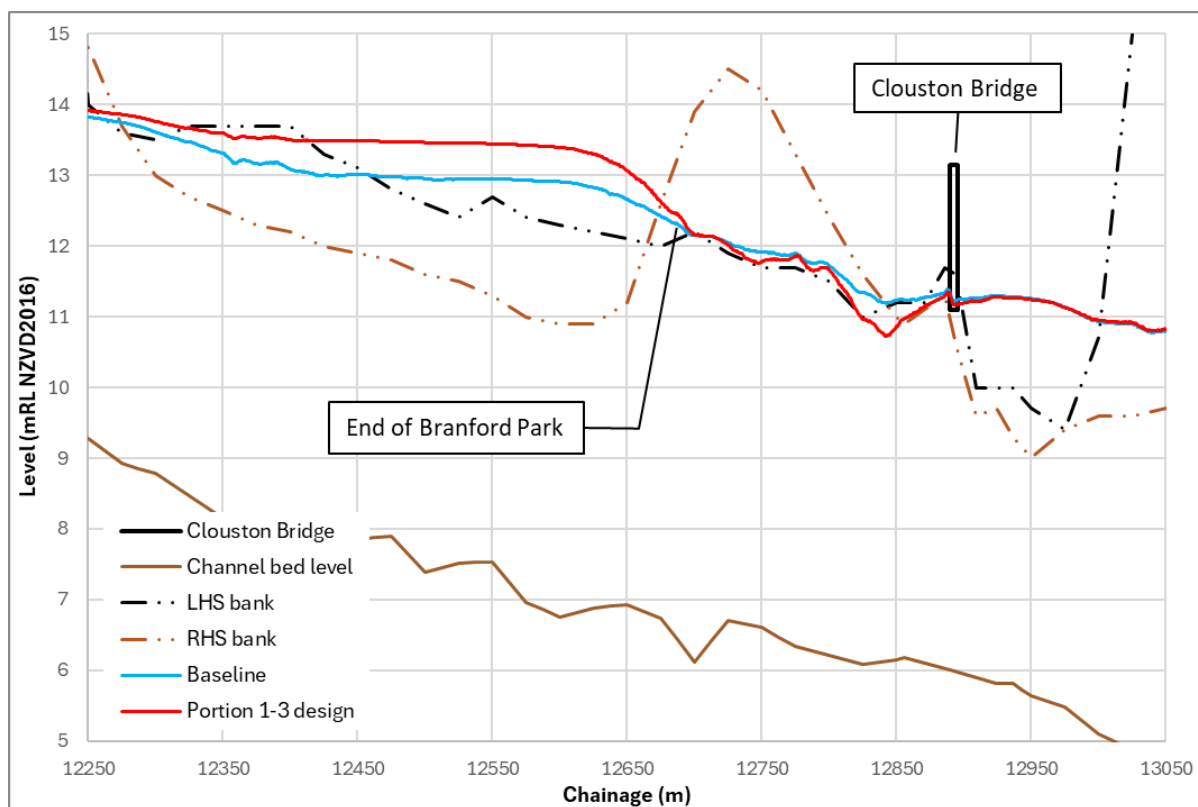


Figure 6.5: Modelled 2050 RCP8.5M 1% AEP flood profiles – baseline and post-development.



Figure 6.6: Extents of flood profile.

6.3 Flooding duration

The design 2050 RCP8.5M 1% AEP 24 hour flood event is a single peak event that reaches maximum water elevation at around 6.5 hours into the flood at the project location. The August 2022 event had 3 distinct peaks over an approx. 72 hour period.

Seepage and stability calculations have been carried out for the design event hydrograph (river level vs time in this context) to ensure that the adopted stability criteria are met. Additionally, we have carried out checks that stability Factors of Safety are >1.2 using the 3 peak 72 hour August 2022 hydrograph.

If the works are overtopped in a larger than design event, or if flooding occurs from other sources such as overland flow from the catchment above Cleveland Terrace, flood waters are expected to drain back to the river through existing stormwater infrastructure and overland flowpaths. The area's gently sloping terrain directs surface water toward key stormwater assets such as sumps and intakes generally located within the road corridor or along the toe of the landward side of the stopbank. The Package 1 works do not obstruct or remove any of the key assets that would drain surface water. This draining relies on two key conditions: that stormwater infrastructure remains unblocked and that river levels are low enough to permit free flowing discharge through pipes and outlets.

6.4 In-channel velocities

Using the project-specific model (MaitaiOpA1_v004), average in-channel river velocities under baseline conditions (without design implementation) were extracted for present day, 2050, 2090, and 2130 RCP8.5M 1% AEP events at four locations within the project area and one location downstream of the project area, see Figure 6.7 and Table 6.2 below.



Figure 6.7: Locations for average velocity comparisons.

Table 6.2: Average river velocities (m/s) for baseline conditions and modelled storm events

Scenario	River chainage (m)				
	12,300	12,525	12,750	12,850	13,000
Present day	3.0	3.6	3.5	3.7	3.0
2050	3.0	3.7	3.6	3.8	3.0
2090	3.0	3.7	3.7	4.0	3.1
2130	3.0	3.8	3.8	4.2	3.1

Table 6.3 below summarises the average in-channel river velocities with the Package 1 design implemented and the increase from baseline for the present day, 2050, 2090 and 2130 RCP8.5M 1% AEP event.

Table 6.3: Average river velocities and increase from baseline (m/s) for design and various storm events

Scenario	River chainage (m)									
	12,300		12,525		12,750		12,850		13,000	
	Velocity	Increase	Velocity	Increase	Velocity	Increase	Velocity	Increase	Velocity	Increase
PD	3.0	0	3.6	0	3.8	0.3	4.0	0.3	3.1	0.1
2050	3.0	0	3.7	0	3.9	0.3	4.4	0.6	3.1	0.1
2090	3.0	0	3.7	0	4.0	0.3	4.5	0.5	3.1	0
2130	3.0	0	3.8	0	4.0	0.2	4.6	0.4	3.1	0

There is an increase in velocities observed in the model around the cross-sections at chainage 12,750 and 12,850 in 1% AEP events. It is important to note that:

- 1 Velocity increases are only observed during high flow events (i.e., greater than 1% events).
- 2 It is expected that there would be no change in velocities during more frequent events (i.e., below bank full conditions).

While increased velocities can be a contributing factor to scour, they do not inherently indicate an increased risk to assets and land. Intermittent rock armouring is present along both the left and right banks throughout the project area, see Figure 6.8. Banks adjacent to high-value infrastructure, such as Maitai Valley Road, are already armoured and well vegetated, providing existing protection. Additionally, NCC has reported that NCC's Transport team is planning to undertake scour protection works at the true right abutment of Clouston Bridge, improving the resilience.

As the increase in velocity is limited to rare events as defined by NCC's risk matrix, the maximum risk level that can occur is considered medium. Under current conditions, a present day 1% AEP event would result in the stopbank overtopping, exposing the same assets and property to flood induced damage, and similar or higher levels of risk. So, despite the increase in velocity, the overall risk to assets and property during rare events will be the same or less than in the current case after the implementation of Package 1 works. Given that a medium risk is generally considered tolerable, no immediate mitigation measures are recommended as part of this project.



Figure 6.8: Observed rock armouring within the project area.

6.5 Flood hazard effects

Flood hazard risk was assessed using the project-specific model (MaitaiOpA1_v004) under baseline (no design implementation) and design conditions (Package 1 implemented). Scenarios were run for present day, 2050, 2090, and 2130 RCP8.5M 1% AEP events. Flood hazard risk was assessed using the flood hazard categories based on the Australian Institute for Disaster Resilience; Flood Hazard guideline 7-3.⁸ The flood hazard is categorised using the product of the peak flood depth and velocity.

Difference plots were generated to identify areas where flood hazard risk categories increased or decreased due to the implementation of Package 1. Figure 6.9 below shows the change to flood hazard category during a 2050 1%AEP event, when comparing Package 1 works to the Baseline.

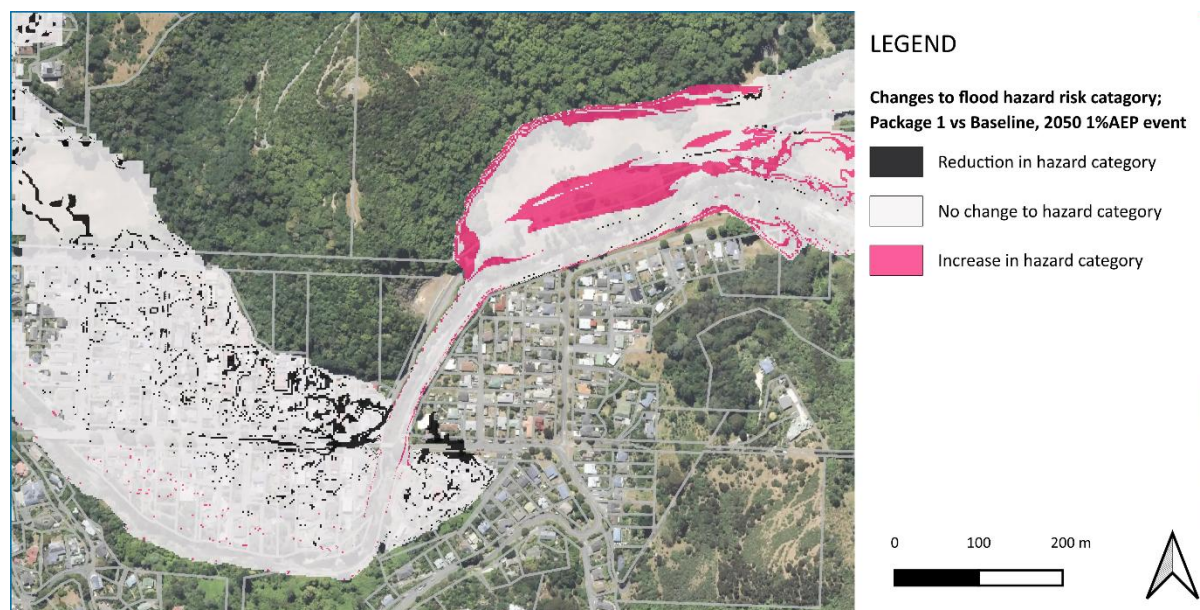


Figure 6.9: Change to flood hazard risk category.

The modelling indicates that Package 1 works do not result in increased flood hazard risk for residential properties that are already exposed to flooding (we do not consider that the ‘noise’ along the river edge and on the downstream flood plain is significant). Where increases in flood hazard risk do occur, they are limited to non-residential areas such as Branford Park. These changes are considered acceptable within the context of the overall flood risk reduction objectives of the design.

⁸ [guideline-7-3-technical-flood-risk-management.pdf](#)

7 Summary and conclusions

This report provides an overview of the design for flood improvement works and supports an application for Resource Consent (Consent Package 1) for flood resilience improvements along the true left bank of the Maitai River, as part of the broader Maitai Area 1 flood improvements project. The proposed works include Portions 1, 2, and 3, which have been prioritised for starting construction in January 2026.

Residential development adjacent to the Maitai River in this area has been impacted by river flooding several times in recorded history. Existing crest levels in these portions vary between exceeding present day 1% AEP flood levels to approximately 2-1% AEP flood levels. The proposed improvements increase the level of service of the existing stopbanks through either raising the existing stopbank or constructing a floodwall near the crest of the stopbank. We have carried out investigations, geotechnical analyses, and flood modelling to inform the design which provides protection against river flooding up to 2050 RCP8.5M 1% AEP events. The proposed works comprise:

- Portion 1 – raising two areas of stopbank totalling approx. 190 m length of existing stopbank with compacted earth fill to meet the design flood level, resulting in up to 1.1 m of additional height above the existing stopbank crest level. Approximately 70 m length of stopbank will be realigned to avoid the rootzone of a protected landscape tree. The crest of the realigned stopbank will be approximately 1.8 m above existing ground. Approximately 60 m of the stopbank already meets the required level and will require only minor surface works.
- Portion 2 – construction of a pole floodwall ranging from 0.5 m to 1.3 m in height, supported by a reinforced concrete slab, on the landward side of the existing stopbank crest. Localised battering or regrading of the river side slope of the existing stopbank may be required in some areas where weak soils are encountered, to reduce the risk of shallow slumping of the slope face.
- Portion 3 – construction of a lower-height pole floodwall (approximately 0.5 m) on the landward side of the stopbank crest. Localised battering or regrading of the river side slope of the existing stopbank may be required in some areas where weak soils are encountered, to reduce the risk of shallow slumping of the slope face.

The proposed works are designed to integrate with the existing environment, maintain public access via the Maitai River Walkway (except during construction works), and minimise encroachment on adjacent properties and infrastructure. Flood modelling confirms that the proposed improvements will reduce flood risk to residential areas within the project extent, with some increases in flood levels modelled in Council-owned open space areas such as Branford Park.

8 Applicability

This report has been prepared for the exclusive use of our client Nelson City 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 Nelson City Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd
Environmental and Engineering Consultants

Report prepared by:

Authorised for Tonkin & Taylor Ltd by:

P.P. 

Raechel Frogner
Water Engineer



Damian Velluppillai
Project Director

Technical review by Dan Andrews, Principal Geotechnical Engineer

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Appendix A Resource Consent Drawings

- **1006675.5170-001 DRAWING LIST AND LOCALITY PLAN**
- **1006675.5170-010 OVERALL SITE PLAN**
- **1006675.5170-110 PORTION 1 - PLAN**
- **1006675.5170-141 PORTION 1 – TYPICAL SECTION**
- **1006675.5170-210 PORTION 2 - PLAN**
- **1006675.5170-241 PORTION 2 – TYPICAL SECTION**
- **1006675.5170-310 PORTION 3 - PLAN**
- **1006675.5170-321 PORTION 3 – TYPICAL SECTION**

NELSON CITY COUNCIL

MAITAI FLOOD IMPROVEMENTS - AREA 1 - PACKAGE 1

PORTIONS 1, 2 AND 3

RESOURCE CONSENT ISSUE

PROJECT NO : 1006675.5170

ISSUE DATE : 23/09/2025

DRAWING REGISTER				
		DRAWING NUMBER	REV	TITLE
GENERAL				
1	✓	1006675.5170-001	B	DRAWING LIST AND LOCALITY PLAN
2	✓	1006675.5170-010	B	OVERALL SITE PLAN
PORTION SPECIFIC				
3	✓	1006675.5710-110	B	PORTION 1 - PLAN
4	✓	1006675.5710-141	B	PORTION 1 - TYPICAL SECTION
5	✓	1006675.5710-210	B	PORTION 2 - PLAN
6	✓	1006675.5710-241	B	PORTION 2 - TYPICAL SECTION
7	✓	1006675.5710-310	B	PORTION 3 - PLAN
8	✓	1006675.5710-321	B	PORTION 3 - TYPICAL SECTION
	✓	DENOTES DRAWINGS IN THIS ISSUE: 23/09/2025		



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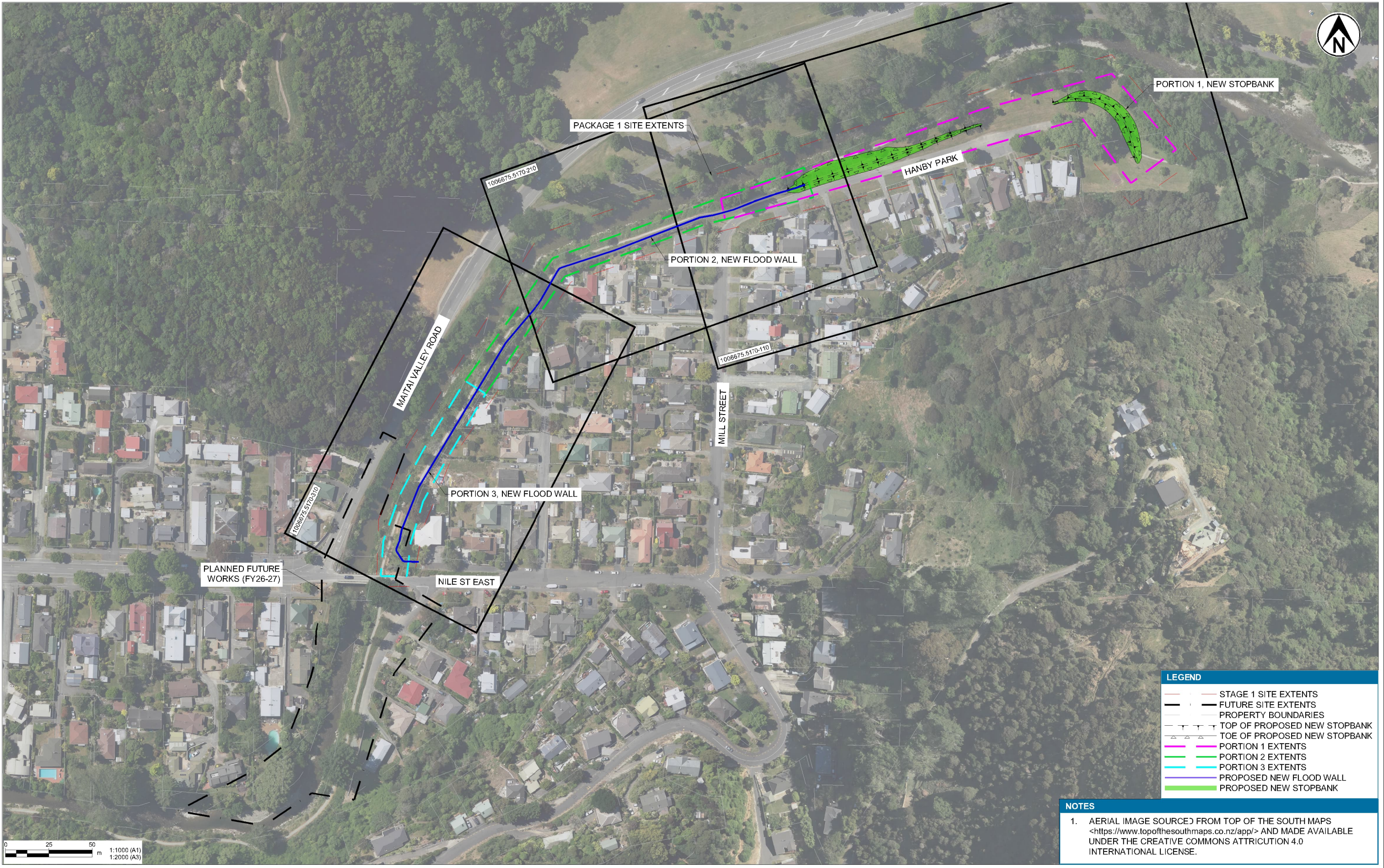
LOCALITY PLAN

SCALE (A1) N.T.S.
SCALE (A3) N.T.S.



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REV	DESCRIPTION	CAD	CHK	DATE	APPROVED	DATE		SCALE (A1) N.T.S. DWG No. 1006675.5170-001 REV B		



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TITLE	GENERAL OVERALL SITE PLAN	
SCALE (A1)	1:1000	DWG No. 1006675.5170-010
REV	B	

LEGEND

PROPERTY BOUNDARIES

25

MAJOR CONTOURS (5m INTERVALS)

MINOR CONTOURS (1m INTERVALS)

TOP OF PROPOSED NEW STOPBANK

TOE OF PROPOSED NEW STOPBANK

PROPOSED NEW FLOOD WALL

PROPOSED NEW STOPBANK

EXISTING WASTEWATER

EXISTING STORMWATER

EXISTING WATER

EXISTING FIBRE NETWORK

EXISTING CHORUS NETWORK

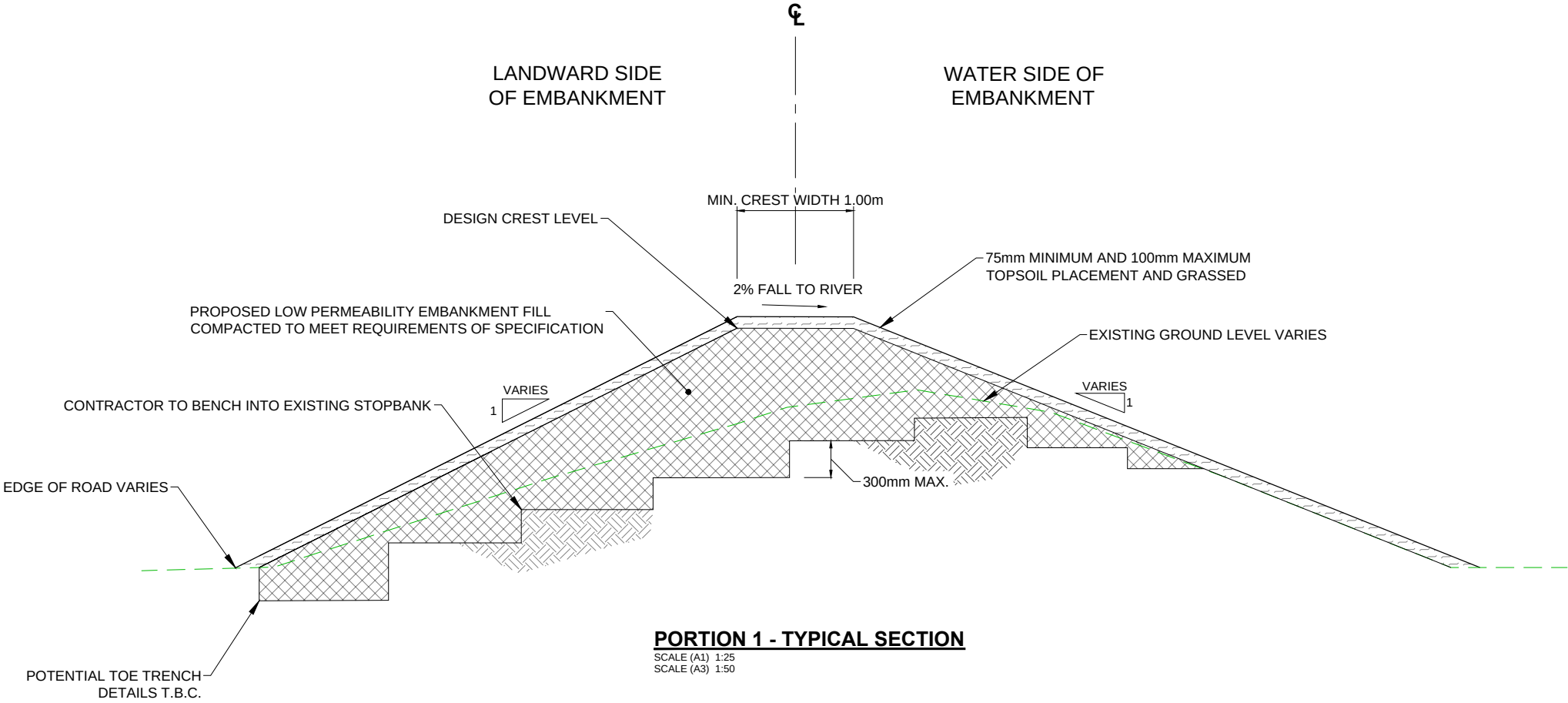
EXISTING ELECTRICAL NETWORK

EXISTING TREES

NOTES

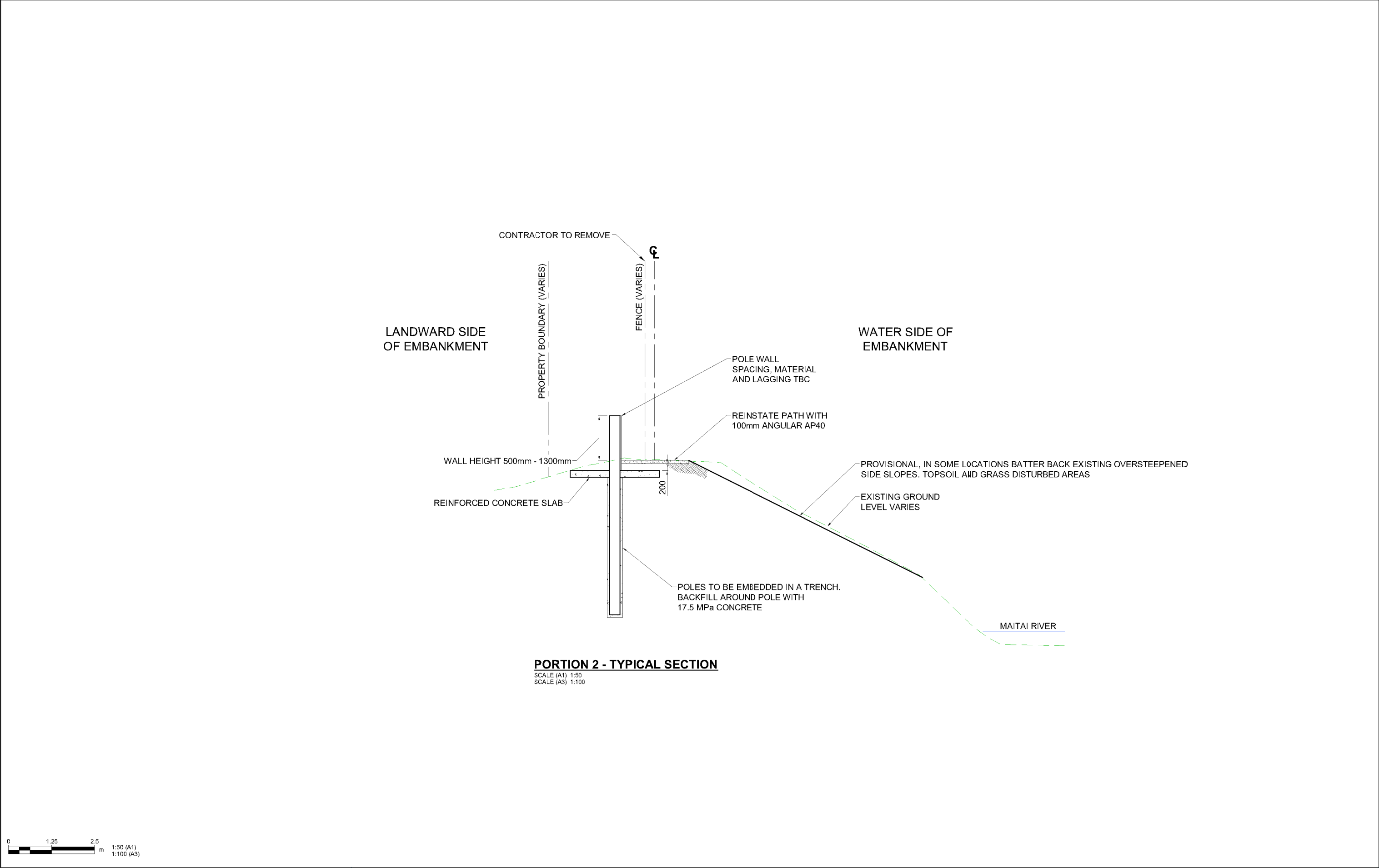
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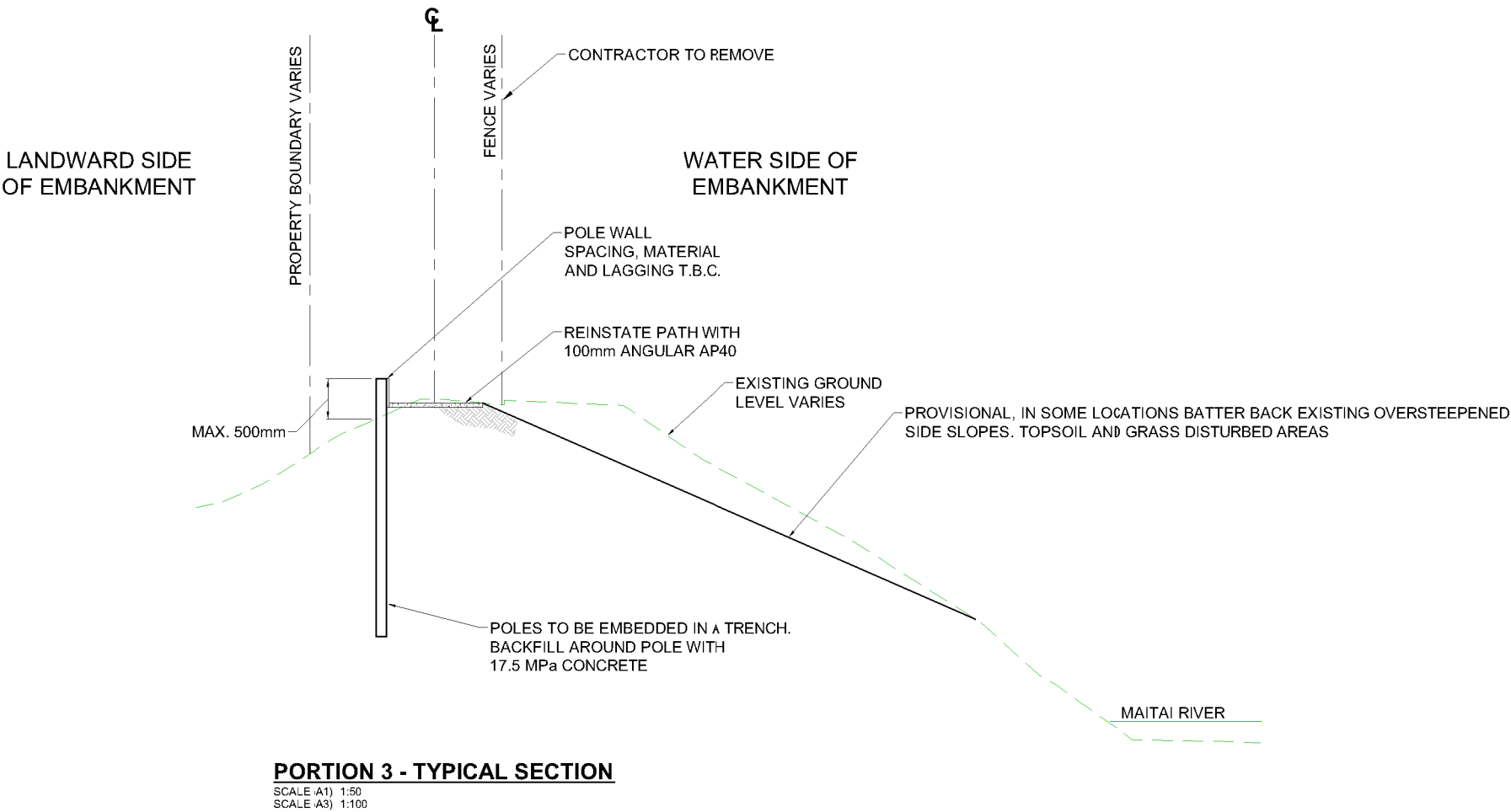
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Tonkin+Taylor www.tonkintaylor.co.nz				DESIGNED	RAFR	AUG.25	DRAWING STATUS RESOURCE CONSENT PROJECT PHASE RESOURCE CONSENT THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION PURPOSES UNLESS SIGNED AS APPROVED	CLIENT NELSON CITY COUNCIL PROJECT MAITAI FLOOD IMPROVEMENTS - AREA 1 - PKG 1 TITLE CROSS SECTION PORTION 2 - TYPICAL SECTION SCALE (A1) 1:50 DWG No. 1006675.5710-241 REV B
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					DESIGN CHECKED	DJA	OCT.25		
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Appendix B TULFOW model build details

B1 Model build details

The model has been developed using an approach/methodology that is generally consistent with NCC's Nelson CBD stormwater model (currently under development).

Model build details are summarised below.

Appendix B Table 1: Model parameters

Parameter	Description / adopted value(s)
Model version	MaitaiOpA1_004
Model software	2025-03 TUFLOW HPC Solver.
Model overview	A 2D lumped catchment flow model.
Time step	The TUFLOW HPC model applies an adaptive time step, based on maintenance of a Courant condition.
Eddy viscosity	Default Wu viscosity coefficients for C3D and C2D (7.0, and 0.0 respectively).
Datum and projection	Vertical: New Zealand Vertical Datum 2016 (NZVD2016). Horizontal: New Zealand Transverse Mercator (NZTM) (NZGD2000).
Model extent	The model domain covers 9.5 km ² .
Model topography	A 1 m x 1 m (1 m ²) gridded DEM for ground level used in the model was sourced from Land Information New Zealand (LINZ) and is composed of data from LiDAR surveys flown in 2021.
Model cell size	Varying model cell sizes with Quadtree from 32 m (in upper catchments) down to 1 m (in areas of primary interest), with sub-grid-sampling of 1 m DEM.
Input flows	Lumped catchment input flows were taken from the results of the MaiBkYk_v089 river flow model. The MaiBkYk_v089 model uses flows based on rainfall depths estimated using data from the National Institute of Water and Atmospheric Research (NIWA) High Intensity Rainfall Design System (HIRDS) V4 values. These rainfall depths are processed using Hec-HMS to give flows for the catchments of the Maitai River and Brook and York Streams. Calibration flows are based on flow gauge data captured for the August 2022 storm event.
Downstream boundary	Sinusoidal tide boundaries using Mean Highest High Water (MHHW) peak sea level, with peak at t = 4.5 hrs. Estimated by the NIWA (2018) coastal calculator for Nelson Haven. Relative sea level rise of 1.11 m applied for RCP8.5M 2130 climate change including vertical land movement. For calibration, the downstream boundary uses tidal records of the August 2022 storm event.
Land use roughness	Land use zones defined by 2018 Landcare Research's Land Cover Database version 5. 2D manning's n roughness values, have been applied to each grid cell based on land use. Roads, rivers and building defined. A depth varying manning's n has been used to account for the changes in roughness that occur when higher water depths are reached.

Parameter	Description / adopted value(s)
	The river/stream channels use a calibrated mannings roughness of 0.03 in the riverbed, and 0.035 in the riverbanks. A lower roughness of 0.025/0.03 for the riverbed/bank has been used from Chainage 12750 to 12950 to better match August 2022 surveyed levels.

B2 August 2022 calibration

Before design modelling was carried out, the hydraulic model was calibrated against surveyed flood data from the August 2022 storm event. Calibration was done for both the extents and depths of the flooding, and a good match was achieved. The modelled August 2022 flooding extents are shown in Figure 8.1, along with the surveyed flood data locations. A long section is shown in Figure 8.2.

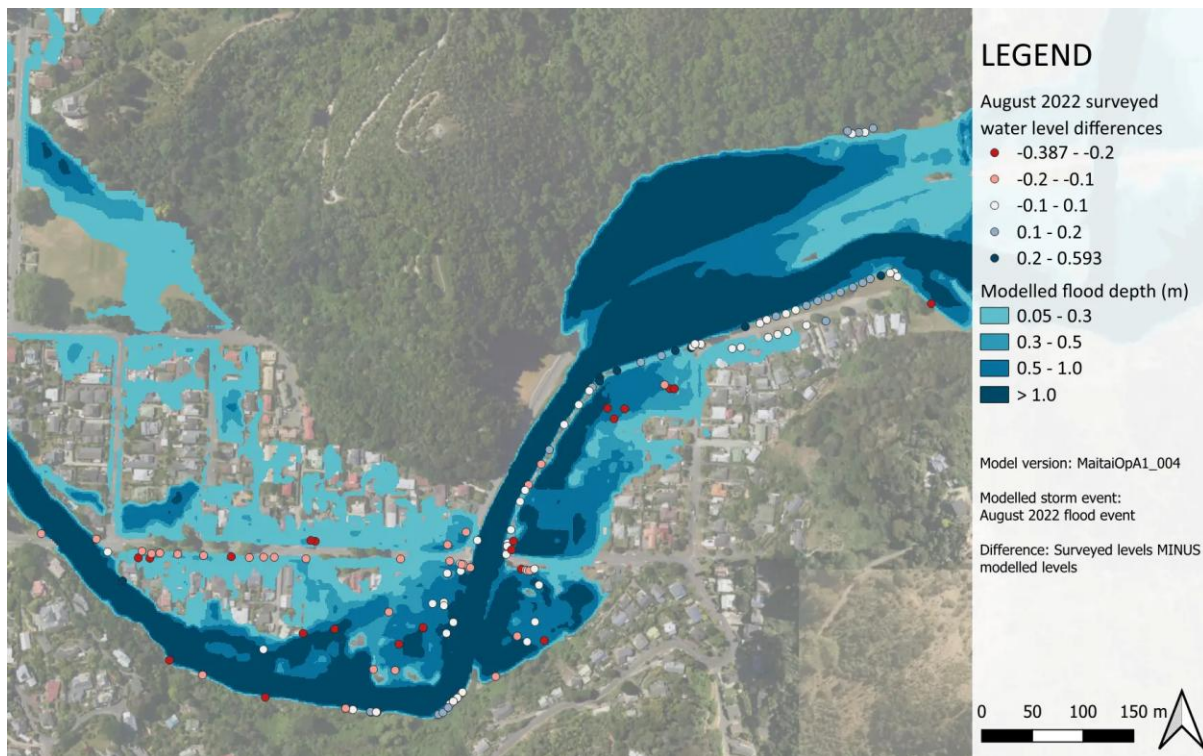


Figure 8.1: Modelled flood depths and comparison to surveyed flood levels for Hanby Park in the August 2022 storm event.

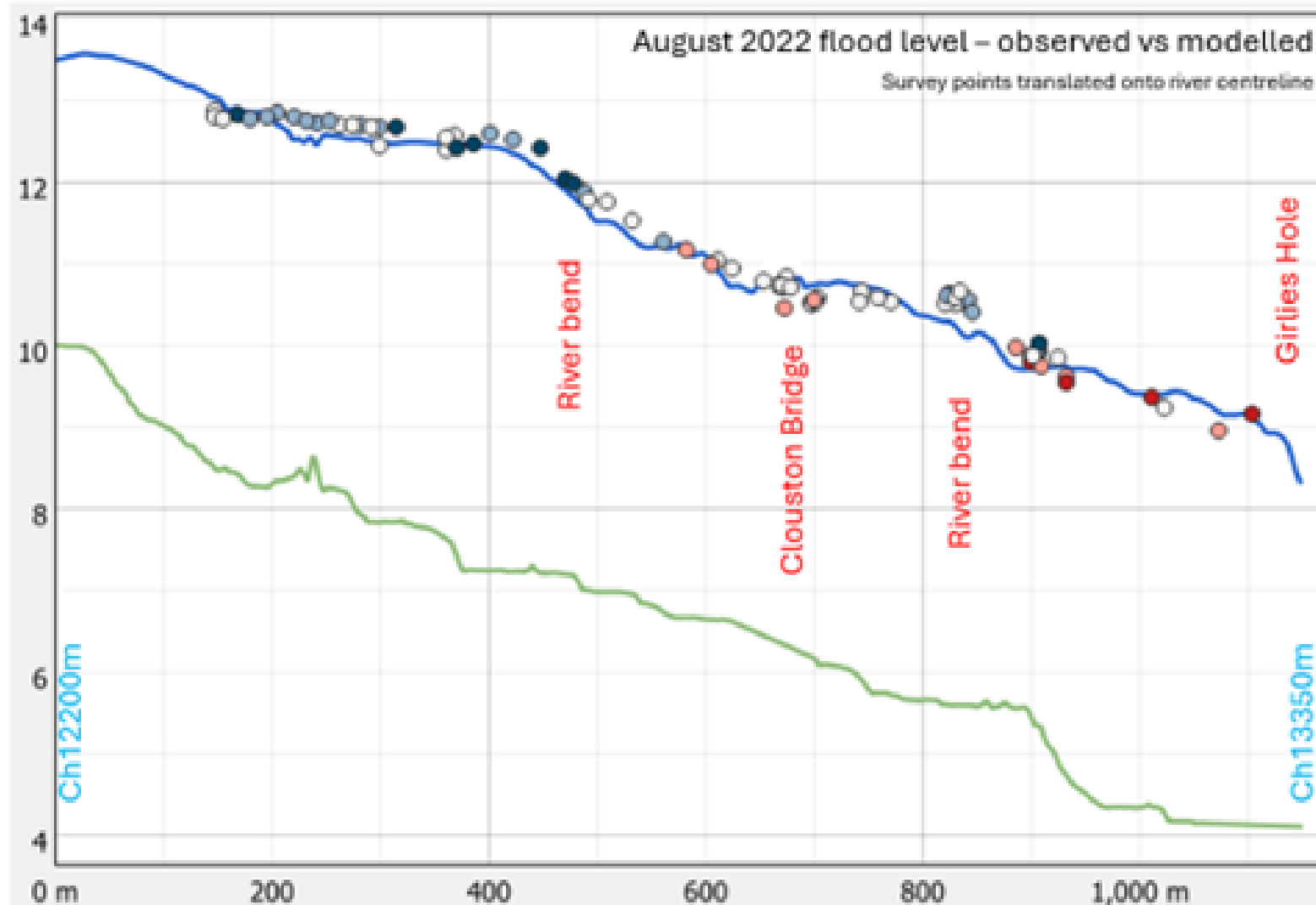


Figure 8.2: Long section of flood levels for Hanby Park in the August 2022 storm event.

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